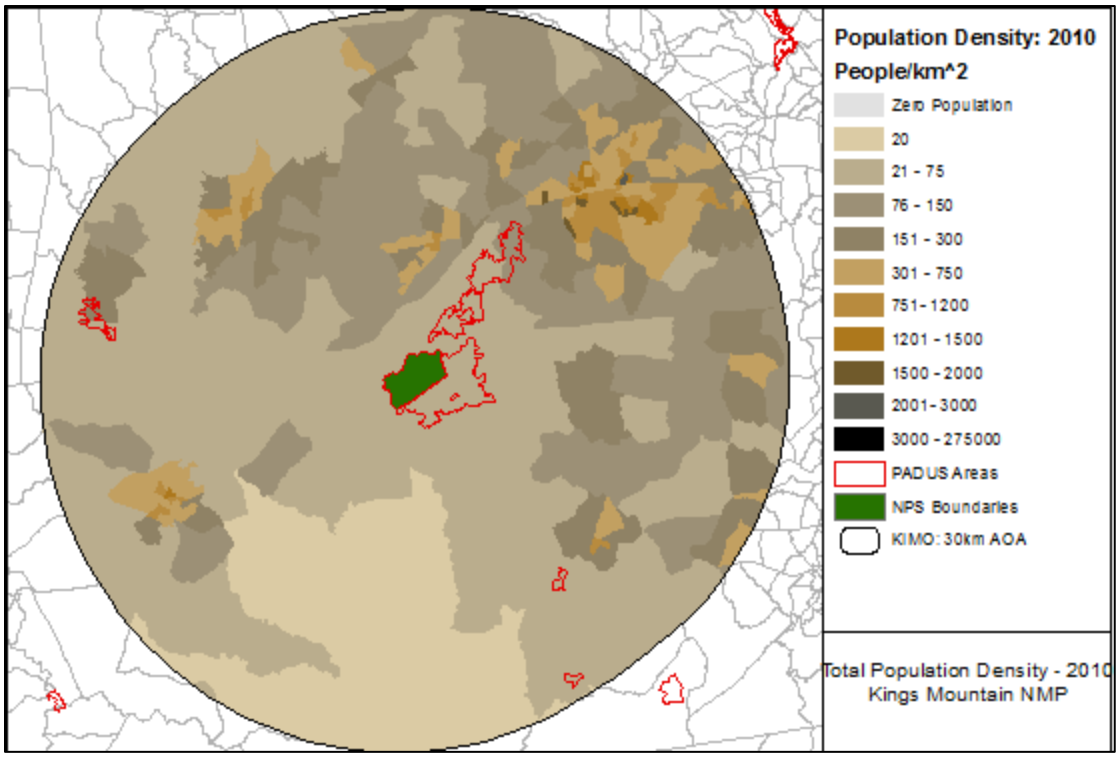
National Park Service
U.S. Department of the Interior
Natural Resource Stewardship and Science

NOTE: There may be revised processes and documentation available, check the NPScape methods webpage for the most current version
http://science.nature.nps.gov/im/monitor/npscape/methods_sops.cfm

NPScape Standard Operating Procedure: Population Measure – Current Density and Total



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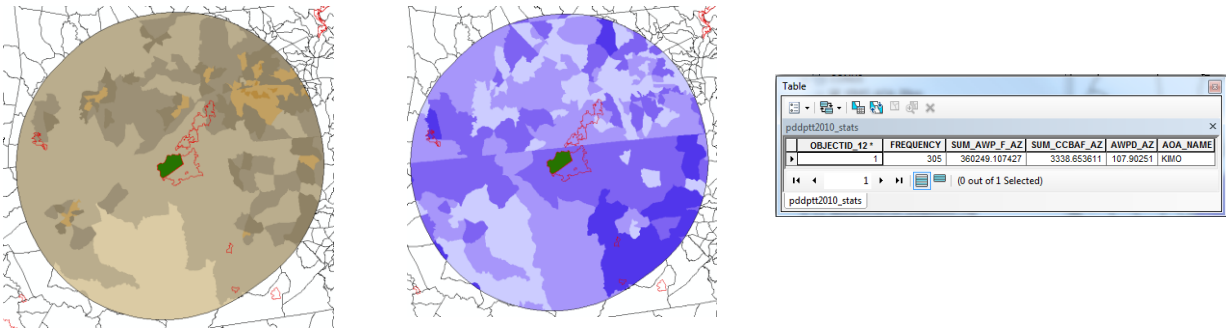
Version History		
Version	**Update Date**	**Changes**
20130214	20130214	Updated to expose other demographic metrics from US Census, such as age and race; generalized to allow users to specify own erase features; processing logic extended to utilize water area estimates provided by Census
20130315	20130315	Note added regarding an issue in Geoprocessing Options between ArcMap 10.0 and 10.1 that could cause a script to fail in 10.1
20131219	20131219	Tool optimized for ArcMap 10.1, and tested for use with 10.2
20140305	20140305	Updated to change script logic to prevent negative population densities when both census water and erased features are used.
20140522	20140522	Fixed an issue with processing extent that caused AOAs too close together (or singlepart AOAs that are close together) to produce outputs that extend into adjacent AOAs.

Overview

NPScape is a landscape dynamics monitoring project that provides landscape-level data, tools, and evaluations for natural resource management, planning, and interpretation (NPS 2013). This standard operating procedure (SOP) provides guidance on how to generate NPScape metrics of current human population density and total by US Census block-group (available for 1990, 2000 and 2010). Download the tool(s) and a copy of this SOP here: http://science.nature.nps.gov/im/monitor/npscape/methods.cfm

The purpose of this SOP is threefold. First, because these directions were followed in the processing of the NPS datasets, it provides detailed documentation on the methodology used by NPScape to calculate density and total metrics for the Population measure. Second, this SOP provides any user with the ability to replicate the creation of these data for custom areas of analysis. Finally, if an I&M park or network has a need to analyze human population data other than US Census, this SOP provides a processing template for recalculating focal metrics associated with the Population measure.

- File Geodatabase (ESRI® format) with four or more feature classes and a statistics table [YYYY = year or decade]:
    - pddYYYY, pddYYYY_Clip, pttYYYY, and pttYYYY_Clip polygon feature classes
    - pddpttYYYY_stats
    - optionally, pddYYYY_AllErased, pttYYYY_AllErased, pddYYYY_Clip_AllErased, and pttYYYY_Clip_AllErased polygon feature classes if an erase layer is used in the analysis



Example pdd2010_Clip and ptt2010_Clip feature classes (density and total) and pddptt2010_stats statistics table for at Kings Mountain NM

Using an ArcGIS™ toolbox, processing steps include extracting pre-processed U.S. Census block group polygons (the tool input dataset) for an area of analysis (AOA), calculating population total for a selected Census attribute, calculating total and clipped polygon areas (km^2) and area-weighted population totals and area-weighted population density (people/km^2). Optionally, area totals and weighted densities can be modified by erasing user-provided polygons and/or accounting for Census-derived water area. Any AOA polygon can be used as long as its spatial reference matches that of the tool input dataset.

This SOP is dependent on pre-processed US Census data as the tool input (U.S. Census Bureau 1991, 2001, 2011). Specific Census attributes are required for correct processing.

For ecological guidance on using and interpreting these metrics, see the NPScape Interpretive Guide (Monahan et al. 2012).

Software Requirements

ArcGIS software is required to generate the metric outputs. The data sources and tools used are assumed to be in ESRI ArcGIS™ format, version 10.1 Service Pack 1.

Data Requirements

Pre-processed U.S. Census Block Group polygons

Data required to run the tool: Population_CensusYYYY.gdb\CensusBlockGroups_YYYY

Follow the link from: https://irma.nps.gov/App/Reference/Profile/2184561/?Inv=true, to download Census Block Data for 1990, 2000, or 2010 (CONUS, AK, HI), and 2000 or 2010 for PR; or for Guam, American Samoa, or Commonwealth Northern Mariana Islands, Census Block Data 2010.

The pre-processed Census tool input datasets are created from Census block group features and tables. These source data are posted by county and the pre-processing steps standardize the block group polygons and merge the spatial and tabular data. See Appendices 4, 6, and 7 for details. Additionally, these data contain multiple population attributes, which may be used to calculate density and total metrics. These attributes vary by Census year. See Table 1 for attribute details by decade.

Each Census dataset contains an attribute for the area of water within each Block Group. Optionally, this attribute can be used to adjust the calculated Block Group area and resulting density. For 1990, this attribute is in km^2, for 2000 and 2010 units are m^2. The processing script accounts for this difference in units.

If you are a NPS user, you can contact the NPScape team to request a custom clipped extent if desired: mailto:NRSS_NRPC_NPScape@nps.gov

Area of Analysis polygon

AOA polygons for boundaries and 3 km and 30 km buffers of parks, CEC ecoregions, FWS LCC polygons, and upstream watersheds (for selected parks) are available as NPScape datasets http://science.nature.nps.gov/im/monitor/npscape/methods.cfm

Alternatively, user-defined AOA polygons can be used if they conform to the input spatial reference.

Erase polygon(s) (optional)

Optionally, areas can be erased from the input Census Block Group polygons to adjust calculated densities for locations where people are unlikely to live (e.g. parks, business zones, malls, wilderness areas, etc.).

NPScape suggests using the 2012 U.S. Protected Areas Database (PADUS) 1.3 GAP Status feature class which can be used as an erase source.

http://gapanalysis.usgs.gov/padus/data/download/

This dataset provides the most complete, up-to-date, national source of protected areas data. See details below for how NPScape has used it as an erase mask when computing population metrics. *Note: PADUS1.3 data acquired from the GAP Analysis program MUST be repaired before using in the NPScape tool,* **be sure to use the ArcGIS Repair Geometry tool to correct spatial errors in the PADUS1_3Combined feature class.**

Alternatively, any user-defined erase polygons can be used if they conform to the input spatial reference.

See the Frequently Asked Questions section for other data access options.

Input data spatial reference

The NPScape project uses USA Contiguous Albers Equal Area Conic USGS as its standard spatial reference. A local (i.e. custom, non-NPScape sourced) area of analysis polygon may be used if its spatial reference matches the NPScape-provided tool input raster or vector data. In this scenario, re-project your local AOA data (if necessary) and run repair geometry on it before running the tool(s). See the Frequently Asked Questions section for more details on re-projecting tool outputs or inputs.

Input Data Pre-Processing

Determine AOA polygon and (optionally) choose Erase polygons

If using an NPScape-sourced AOA, download the appropriate AOA geodatabase from the link in the Data Requirements section.

If using PADUS 1.3 GAP Status as the erase source, download it from the PADUS web site (linked above). NPScape has traditionally used PAD_US 1.3 GAP Status categories 1 and 2 only as the erase mask when computing population metrics. You can recreate that mask by subsetting (*select by attribute*) the same categories from the PADUS feature class.

Re-project user-defined input datasets (if needed)

All user-defined, custom, non-NPScape sourced tool inputs (e.g. AOA polygon) must be in the USA Contiguous Albers Equal Area Conic USGS spatial reference to be used with NPScape-sourced tool inputs.

1. Open ArcCatalog or ArcMap. Click the search button and search for 'Project'. Open the Project tool and re-project your data to USA Contiguous Albers Equal Area Conic USGS.
2. Search for 'Repair Geometry' and run that tool on your re-projected dataset.
3. See the Frequently Asked Questions section for more details.

Download tool input data

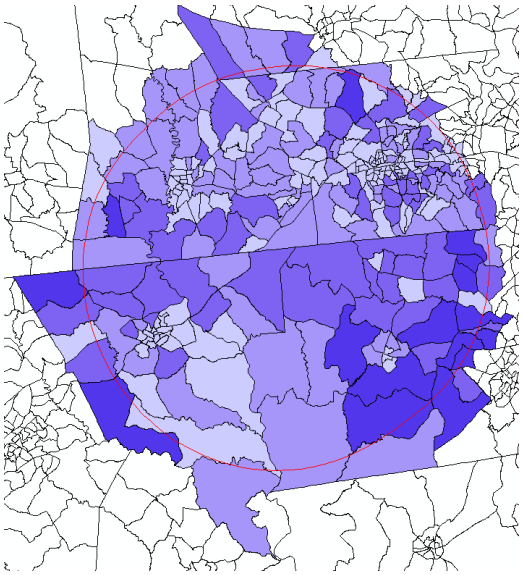
Download the Census Block Group dataset for the desired years from IRMA, https://irma.nps.gov/App/Reference/Profile/2184561/?Inv=true. These datasets are seamless across the maximum, consistent extent possible from the US Census data (Alaska, CONUS, Hawaii, and Puerto Rico). **LOOK FOR DATASETS MARKED "TOOL INPUT".**

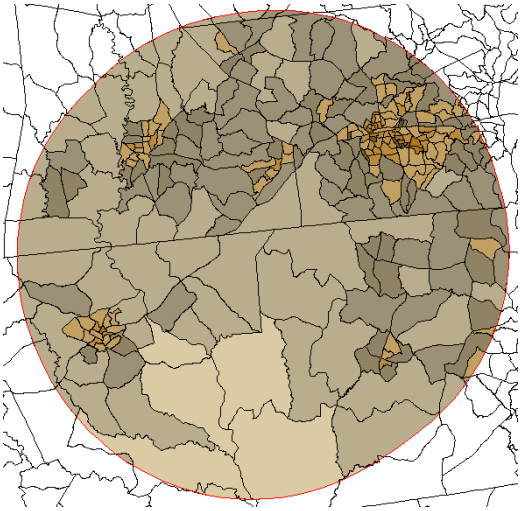
Also available are Census Block Group datasets for Guam, American Samoa, and Northern Mariana Islands.

Run NPScape Population Tools – Population Density and Total

The NPScape Population Tools toolbox contains one tool which outputs two date-stamped combined population density and total feature classes for an AOA: one with block group polygons clipped to the AOA and one with unclipped block group polygons. Also, a summary statistics table for the AOA:

- pddpttYYYY and pddpttYYYY_Clip: polygon feature classes with density and total values by Census block group and, for pddpttYYYY_Clip, clipped to the source AOA
- pddpttYYYY_stats: a table reporting summary statistics for density and total over the entire source AOA
- optionally, if the erase option is used: pddYYYY_AllErased and pttYYYY_Clip_AllErased, polygon feature classes with density and total values by Census block group and, for pddYYYY_Clip_AllErased and pttYYYY_Clip_AllErased, clipped to the source AOA

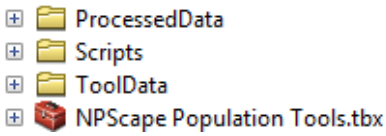




Example unclipped population density and clipped population total feature classes for an AOA at Kings Mountain NMP.

Add and access toolbox to ArcMap

1. Check Geoprocessing Options settings: Geoprocessing → Geoprocessing Options → 'Overwrite the Outputs of Geoprocessing Operations' should be checked. This addresses an issue in ArcGIS 10.1 Service Pack 1 when using feature layers.
2. In Windows Explorer, extract the tools zip file downloaded from the methods link in the Overview section above.
3. Open ArcMap and use the Catalog pop-out window to navigate to the folder where the tool was extracted. The following folder structure should be present:



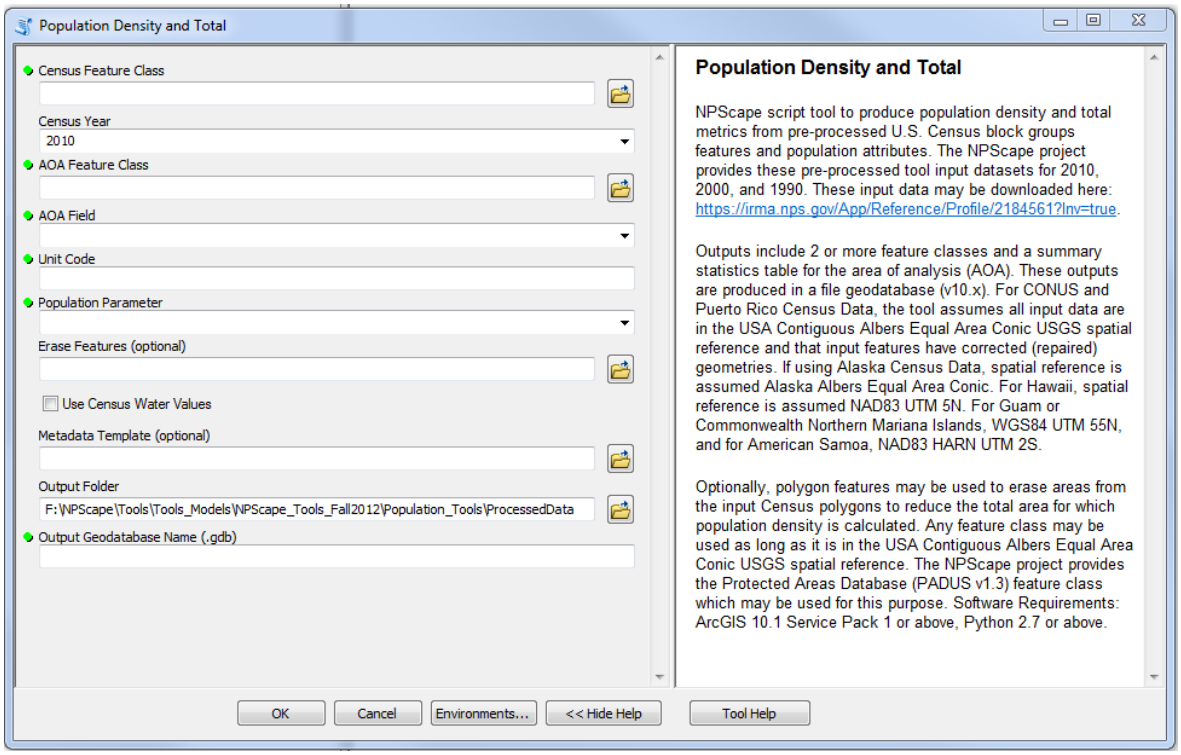
ProcessedData contains ArcMap layer files and is the default tool output folder. *Scripts* contains the base Python code used by the NPScape Population Tools.tbx toolbox tool. The toolbox and associated tools can only be accessed and run successfully from ArcMap.

4. Expand the NPScape Population Tools.tbx and double-click on the Population Density and Total tool to open it.

Run the Population Density and Total Tool

1. Add input data to the map:
   - Area of analysis feature class; if this is a multi-part feature class, summary area will be the total of all parts, unless one or more individual parts is selected
   - Tool input data: NPScape Census block group feature class
     Population_CensusYYYY.gdb\CensusBlockGroups_YYYY
   - Erase feature class (optional). *If using PAD_US 1.3 GAP Status, as recommended by NPScape, use Select by Attributes to choose only GAP status categories 1 and 2 (areas offering the highest level of conservation protection). If you do not do this, ALL PAD_US polygons will be erased. Remember: PADUS 1.3 data acquired from the GAP Analysis program* ***MUST*** *have a geometry repair operation run before using in the NPScape tool.*

2. Populate values for each of the parameters in the tool:



Census Feature Class: Population_CensusYYYY.gdb\CensusBlockGroups_YYYY
Census Year: select appropriate 4-digit year of Census data (2010, 2000, or 1990 if using standard NPScape tool input data)
AOA Feature Class: feature class used as area of analysis
AOA Field: Text format attribute from Area of Analysis Polygon. Used to label output feature classes and tables for multi-feature AOAs. ***NOTE*:** This field CANNOT contain any special characters (hyphens, commas, etc).
Unit Code: park unit code (or other AOA label); becomes the AOA_Name value in outputs
Population Parameter: Census parameter to use for total and density calculations (see Table 1 below). Select a count-based parameter to generate density and total values.
Erase Features (optional): Erase feature class to use for reducing calculated area
Use Census Water Values: if marked, calculated areas will be reduced (subtracted) by Census-reported water area inside block groups; *for 1990 block groups, this attribute is in km^2, for 2000 and 2010 units are m^2. The processing script accounts for this difference in units. Water attribute used varies by Census year: 1990 - AREAWAT, 2000 - AREAWATR, 2010 - AWATER10*
Metadata Template (optional): XML file used as metadata template for output feature classes and table
Output Folder: can be changed, default is ProcessedData subfolder
Output Geodatabase Name: File name for output file geodatabase (v10.x); must end in '.gdb'

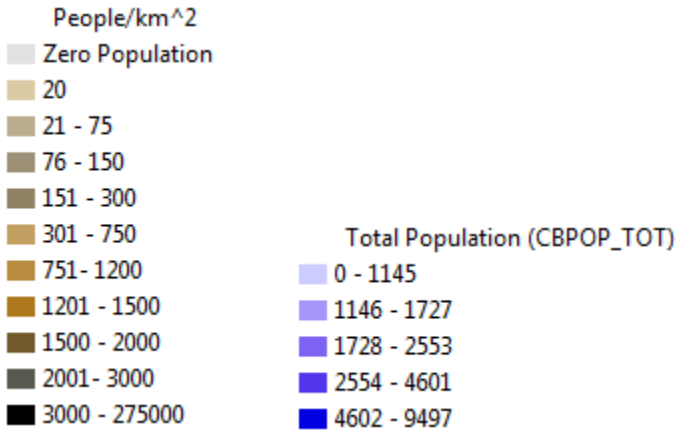
***Note**: if the geodatabase already exists, all feature classes and the output stats table will be overwritten*

3. Depending on the extent of the AOA feature class, the tool may take several minutes or possibly longer to run. Processing status will display in ArcMap as a popup. The full tool summary is found in the ArcMap → Geoprocessing → Results popup, including error messages.
4. The clipped and unclipped density and total feature classes (pddYYYY_Clip and pttYYYY_Clip, pddYYYY and pttYYYY) and summary statistics table (pddpttYYYY_stats) are added

automatically to the map. If a single-part feature class with multiple features was used as the AOA, only outputs for the last feature processed will be added automatically to the map. Additional output feature classes for a single-part feature class can be added manually and symbolized with *.lyr files in the ProcessedData subfolder.

From the ProcessedData folder, the clipped PDD feature class is symbolized by the pdd2010_AWPD_F_AOA.lyr file, and the unclipped PDD feature class is symbolized by the pdd2010_AWPD_F.lyr file. Default density symbology is a standard categorical breakdown of the area-weighted population density attribute (AWPD_F_AOA) for the AOA (adjusted for Census water area, if used).

From the ProcessedData folder, the clipped and unclipped PTT feature classes are symbolized by the ptt2010.lyr file located in the ProcessedData subfolder. Default total symbology is a feature class-specific categorical breakdown of the total population (CBPOP_TOT) attribute. *See Table 1 below in this section for a complete description of attribute fields provided in the tool input feature classes. Table 3 in the Interpretation Tips section contains the same information for the summary statistics outputs table.*



5. If the Erase Features parameter was used either alone or in addition to the Census Water, four additional feature classes will be produced as outputs: pdd_YYYY_AllErased, ptt_YYYY_AllErased, pdd_YYYY_AllErased_Clipped and ptt_YYYY_AllErased_Clipped. Add these manually to the map, using the pdd2010_AWPD_F.lyr for symbolizing population density and ptt2010.lyr for symbolizing population total.
6. Running the tool again: open Geoprocessing → Results. Open the Current Session node. Double-click on the Population Density and Total tool name to open the tool dialog. *Change the output geodatabase name if you don't want all of your original output over-written.* Change other parameters as needed.

Table 1: Census Population Parameter Values for 1990-2010

All parameters represent counts of persons per block group except as noted. Note that 1990 Census attributes are somewhat different from 2000 and 2010; for temporal comparisons, some grouping of attributes may be required (e.g., grouping of 2000 and 2010 age categories to match those used in the 1990 Census). Also, the 1990 Census contains additional attributes. Only count-based parameters will generate density and total values when used in the Population Density and Total tool.

	Parameter Name		
Census Category and Definition	**1990**	**2000**	**2010**
Population Total			
Total population	POP100	P010001	P0010001
Total urban and rural	-	P020001	P0020001
Total urban	PC_URBAN (est. percentage)	P002002	P0020002
Total urban, inside urbanized areas	-	P002003	P0020003
Total urban, inside urban clusters	-	P002004	P0020004
Total rural	PC_RURAL (est. percentage)	P002005	P0020005
Not defined	-	P002006	P0020006
Race			
Total population, race	-	P003001	P0030001
Total population, one race	-	P003002	-
White alone	WHITE (total) PC_WHITE (percent)	P003003	P0030002
Black/African American alone	BLACK (total) PC_BLACK (percent)	P003004	P0030003
Am Indian and AK Native alone	INDIAN	P003005	P0030004
Asian alone	ASIAN	P003006	P0030005
Native HI and other Pacific islander alone	-	P003007	P0030006
Some other race alone	OTHER	P003008	P0030007
Two or more races	-	-	P0030008
Minority, number of persons of non-White or Hispanic origin	MINORITY	-	-
Minority, percent of total population who are non-White or Hispanic origin	PC_MINORITY	-	-
Hispanic or Latino Origin			
Total population	-	P004001	P0040001
Not Hispanic or Latino	-	P004003	P0040002
Hispanic or Latino (count)	HISPANIC	P004002	P0040003
Sex by Age			
Total, sex by age	-	P012001	P0120001
Male, all ages	-	P012002	P0120002
Male, under 5 years	-	P012003	P0120003
Male, 5 to 9 years	-	P012004	P0120004
Male, 10 to 14 years	-	P012005	P0120005
Male, 15 to 17 years	-	P012006	P0120006

		P012007	P0120007
Male, 18 to 19 years	-		
		P012008	P0120008
Male, 20 years	-		
		P012009	P0120009
Male, 21 years	-		
		P012010	P0120010
Male, 22 to 24 years	-		
		P012011	P0120011
Male, 25 to 29 years	-		
		P012012	P0120012
Male, 30 to 34 years	-		
		P012013	P0120013
Male, 35 to 39 years	-		
		P012014	P0120014
Male, 40 to 44 years	-		
		P012015	P0120015
Male, 45 to 49 years	-		
		P0120116	P0120016
Male, 50 to 54 years	-		
		P012017	P0120017
Male, 55 to 59 years	-		
		P012018	P0120018
Male, 60 to 61 years	-		
		P012019	P0120019
Male, 62 to 64 years	-		
		P012020	P0120020
Male, 65 to 66 years	-		
		P012021	P0120021
Male, 67 to 69 years	-		
		P012022	P0120022
Male, 70 to 74 years	-		
Male, 75 to 79 years	-	P012023	P0120023
		P012024	P0120024
Male, 80 to 84 years	-		
		P012025	P0120025
Male, 85+ years	-		
		P012026	P0120026
Female, all ages	-		
		P012027	P0120027
Female, under 5 years	-		
		P012028	P0120028
Female, 5 to 9 years	-		
		P012029	P0120029
Female, 10 to 14 years	-		
		P012030	P0120030
Female, 15 to 17 years	-		
Female, 18 to 19 years	-	P012031	P0120031
Female, 20 years	-	P012032	P0120032
Female, 21 years	-	P012033	P0120033
Female, 22 to 24 years	-	P012034	P0120034
Female, 25 to 29 years	-	P012035	P0120035
Female, 30 to 34 years	-	P012036	P0120036
Female, 35 to 39 years	-	P012037	P0120037
Female, 40 to 44 years	-	P012038	P0120038

Female, 45 to 49 years	-	P012039	P0120039
Female, 50 to 54 years	-	P012040	P0120040
Female, 55 to 59 years	-	P012041	P0120041
Female, 60 to 61 years	-	P012042	P0120042
Female, 62 to 64 years	-	P012043	P0120043
Female, 65 to 66 years	-	P012044	P0120044
Female, 67 to 69 years	-	P012045	P0120045
Female, 70 to 74 years	-	P012046	P0120046
Female, 75 to 79 years	-	P012047	P0120047
Female, 80 to 84 years	-	P012048	P0120048
Female, 85+ years	-	P012049	P0120049
Median Age by Sex **			
Both Sexes (all)	-	P013001	P0130001
Male	-	P013002	P0130002
Female	-	P013003	P0130003
Age			
0-4 years (count)	AGE_0_4 (total) PC_0_4 (percent)	-	-
5-9 years	AGE_5_9 (total) PC_5_9 (percent)	-	-
10-19 years	AGE_10_19 (total) PC_10_19 (percent)	-	-
20-49 years	AGE_20_49 (total) PC_20_49 (percent)	-	-
50-64 years	AGE_50_64 (total) PC_50_64 (percent)	-	-
65+ years	AGE_65_UP (total) PC_65_UP (percent)	-	-
Education			
School enrollment, estimate of persons 3 years or older enrolled in elementary through high school	SCH_ENROLL	-	-
Estimated percentage of persons 18 or older who graduated from high school	PC_HIGHSCH	-	-
Estimated percentage of persons 18 or older that have a Bachelor's Degree	PC_BACHDEG	-	-
Families			
Count of families	FAMILIES	-	-
Income			
Median household income estimate **	INCOME	-	-
Estimate of persons living below poverty level	POVERTY	-	-
Estimated percentage of persons living below poverty level **	PC_POVERTY	-	-
Housing/Occupancy			
Owner-occupied households (count)	OWNER_OCC	-	-
Renter-occupied households (count)	RENTER_OCC	-	-
Owner occupied, percent **	PC_OWNER (percent)	-	-
Renter occupied, percent **	PC_RENTER (percent)	-	-

Estimated percentage of owner-occupied households where shelter costs are 30% or more of income **	HIGHMORTG	-	-
Estimated percentage of renter-occupied households where shelter costs are 30% or more of income **	HIGHRENT	-	-
Percentage of population 5 years or older that lived in the same house in 1985 **	SAMEHOUSE	-	-
Estimated median year built **	MEDYRBUILT	-	-
Number of Households, total	HOUSEHOLDS	-	-

** Values other than counts of persons per block group.

Quality Control

Verify dataset outputs

1. **If Erase is used**, add pddYYYY_AllErased, pttYYYY_AllErased, pddYYYY_Clip_AllErased and pttYYYY_Clip_AllErased feature classes to the map. Symbolize as described above to compare differences in density values between the erased and un-erased feature classes *Note: in some places the default symbol categories may not have small enough ranges to display visual differences between polygons*.
2. View the standard population density symbology for the AOA. Look for zero population polygons (light gray color). If any are present, select them and open the attribute table to verify the value of the population attribute selected in step 2 above is actually 0. These polygons are identified as special landuse areas by Census (parks, business zones, malls, wilderness areas, etc.) and are assigned 0 values by default.
3. **If a multi-feature singlepart AOA polygon was used**, there will be an output feature class and a statistics table for each AOA feature, named with the tool-assigned value of the AOA Field attribute. However, only outputs for the final feature processed will be added to the map automatically. Add the additional output feature classes and statistics tables. Use the *.lyr files in the ProcessedData subfolder to symbolize the features for either population density (PDD) or total (PTT), as described above.
4. Open the attribute table and sort CBPOP_TOT, CBA_TOT, AWPD_F (or AWPD_F_AOA), looking for zero or negative values. There should be none, and if any exist please contact the NPScape team immediately regarding the issue, mailto:NRSS_NRPC_NPScape@nps.gov
5. Right-click on each of the following attributes and select Statistics:
   CBPOP_TOT, AWPD_F (or AWPD_F_AOA), AWPD_P (or AWPD_P_AOA)
   CCBA* and AWP_*
   The statistical distribution and range should show no significant outliers or odd values
6. Spot check and manually calculate the density calculations for a few polygons:
   AWPD_F = CBPOP_TOT / CCBAF_TOT
   AWPD_F_AOA = (CBPOP_TOT * (CCBAF_AOA / CCBAF_TOT)) / CCBAF_AOA

Verify statistics output

1. Open the pddptt_YYYY_stats table and verify (hand check) the calculations of the total area-weighted population density for the AOA:
   AWPD_AOA = SUM_AWP_F_AOA / SUM_CCBAF_AOA

   Note: the FREQUENCY field in the table is the number of polygons used to calculate the summary values. See Table 2 for details.

Interpretation Tips

Table 2: Summary statistics table attributes

*A summary table (**pddpttYYYY_stats**) is produced for each Census date processed. This tabulates the AOA-level population, corrected block group area, and population density for the entire AOA. The stats table is created from pddYYYY_Clip, or pddYYYY_Clip_AllErased if the optional erase layer is utilized.*

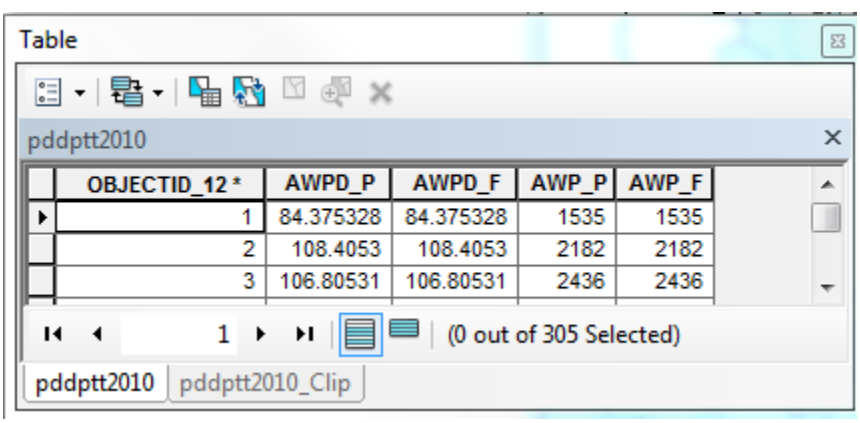
pddpttYYYY_stats

Attribute	Description
FREQUENCY	Number of polygons used in calculating sums
SUM_AWP_F_AOA	Sum of area-weighed population (total) calculated from selected population parameter for AOA
SUM_CCBAF_AOA	Sum of corrected Census block group areas for AOA (km^2); reduced by clipping to AOA and, optionally, by erasing features and/or by subtracting Census water area
AWPD_AOA	Area-weighted population density for the entire AOA: = SUM_AWP_F_AOA / SUM_CCBAF_AOA
AOA_NAME	AOA name from AOA Identifier tool parameter concatenated with AOA Field value

Comparing Attributes for Erased and Un-erased Feature Classes

See Table 3 for details on the various attributes for each feature class.

All feature classes include total area (i.e. unclipped) density (AWPD_*) and area-weighted population total attributes (AWP_*). These values do not change in any of the subsequent feature classes:



OBJECTID_12 *	AWPD_P	AWPD_F	AWP_P	AWP_F
1	84.375328	84.375328	1535	1535
2	108.4053	108.4053	2182	2182
3	106.80531	106.80531	2436	2436

In addition, clipped feature classes (*_Clip, *_Clip_AllErased) include area of analysis-specific attributes (*_AOA) for corrected area (CCBA*_AOA), density (AWPD_*_AOA) and area-weighted population totals (AWP_*_AOA):

Table

pdd2010_KIMO_Clip

CBA_TOT_AOA	CCBAP_AOA	CCBAF_AOA	AWPD_P_AOA	AWPD_F_AOA	AWP_P_AOA	AWP_F_AOA
6.962388	6.962388	6.962388	84.37533	84.37533	587.4537	587.4537
9.031689	9.031689	9.031689	108.4053	108.4053	979.0829	979.0829
1.954146	1.954146	1.954146	106.8053	106.8053	208.7131	208.7131

0 (3 out of 305 Selected)

pdd2010_KIMO_Clip

- In feature classes (clipped or unclipped) <u>not erased</u> and with <u>no census water subtraction</u>, CBA_TOT(_AOA), CCBAP_(TOT/AOA) and CCBAF_(TOT/AOA) attributes will be equivalent.
- Erased feature classes will display differences in CBA_* and CCBAP_* values (for block group polygons with erased areas only).
- If the Census water area reduction is applied, the CCBAF_* values will differ from CCBAP_* (for polygons where Census reported a water area only). Census water area fields: CBA_W, CBA_W_AOA. (See Table 3 and Appendix 8)
- Erased <u>and</u> Census water area-adjusted feature classes will contain different AWPD_P*, AWPD_F*, AWP_P*, and AWP_F* values in those block group polygons that were erased and/or whose total areas were adjusted by the Census-reported water area (see Table 3).

Census water subtraction AND erased output feature class table. Note the various field values:

Table

pddptt2010_AllErased

OBJECTID_12 *	CBA_TOT	CCBAP_TOT	CCBAF_TOT	CBA_W	AWPD_P	AWPD_F	AWP_P	AWP_F
16	0.557634	0.557634	0.556255	0.001379	1113.6331	1113.6331	621	621
17	0.693564	0.693564	0.693564	0	801.65643	801.65643	556	556
18	6.550327	6.434311	6.410086	0.024225	127.47456	127.47456	835	835
19	7.365168	7.331725	7.269934	0.061791	254.4409	254.4409	1874	1874

1 (1 out of 305 Selected)

pddptt2010_AllErased

<u>Symbolizing Density Differences</u>

The default classified category symbology used in the pddtpttYYYY layer may not adequately reveal differences in population densities when visually comparing un-erased and erased features or when comparing densities across multiple Census dates. To rectify this, right-click the density layer, choose Properties –-> Symbology and update the symbology classes, either by adding more or changing the breakpoints between the existing classes.

<u>Table 3: Attributes in Output Feature Classes</u>

Description and distinctions between feature attributes depending on the tool processing options used. Feature classes clipped to the AOA (pddpttYYYY_Clip) will have modified total areas, modified corrected block group area, and modified population density values (in polygons that intersect the AOA boundary). Erased feature classes (pddpttYYYY_*_AllErased) will have modified corrected Census block group area*

values and modified population density values (in polygons where the erase feature overlaps). See the above section (Comparing Attributes for Erased and Un-erased Feature Classes) for some example values.

PLEASE SEE ALSO APPENDIX 8, pages 45-48

ATTRIBUTE	DESCRIPTION	FEATURE CLASS(ES)
CBPOP_TOT	Population total of Census Block	pddpttYYYY, pddpttYYYY_Clip, pddpttYYYY_AllErased, pddpttYYYY_Clip_AllErased
CBA_TOT	Calculated total area of census block group polygon (km^2) – no adjustments made	pddpttYYYY, pddpttYYYY_Clip, pddpttYYYY_AllErased, pddpttYYYY_Clip_AllErased
CCBAP_TOT	Corrected block group area (km^2); *area reduced by optional erase process*	pddpttYYYY, pddpttYYYY_Clip, *pddpttYYYY_AllErased,* *pddpttYYYY_Clip_AllErased*
CCBAF_TOT**	(CCBAP_TOT – CBA_W) Corrected block group area (km^2); *area reduced by optional erase process* *area reduced by optional Census water area subtraction	pddpttYYYY*, pddpttYYYY_Clip*, *pddpttYYYY_AllErased*,* *pddpttYYYY_Clip_AllErased**
AWPD_P	(CBPOP_TOT / CCBAP_TOT) area-weighted population density for corrected block group area; *area reduced by optional erase process*	pddpttYYYY, *pddpttYYYY_AllErased*
AWPD_F	(CBPOP_TOT / CCBAF_TOT) area-weighted population density for corrected block group area *area reduced by optional erase process* *area reduced by optional water area subtraction	pddpttYYYY*, *pddpttYYYY_AllErased**
AWP_P	(CBPOP_TOT * (CCBAP / CBA_TOT)) area-weighted population for corrected block group area; *area reduced by optional erase process*	pddpttYYYY, *pddpttYYYY_AllErased*
AWP_F	(CBPOP_TOT * (CCBAF / CBA_TOT)) area-weighted population for corrected block group area; *area reduced by optional erase process* *area reduced by optional water area subtraction	pddpttYYYY*, *pddpttYYYY_AllErased**
CBA_TOT_AOA	Calculated total area of block group polygon within AOA (km^2)	pddpttYYYY_Clip, pddpttYYYY_Clip_AllErased
CCBAP_AOA	Corrected block group area within AOA (km^2); *area reduced by optional erase process*	pddpttYYYY_Clip, *pddpttYYYY_Clip_AllErased*
CCBAF_AOA**	(CCBAP_AOA – CBA_W_AOA) Corrected block group area within AOA (km^2); *area reduced by optional erase process* *optional Census water area subtraction	pddpttYYYY_Clip*, *pddpttYYYY_Clip_AllErased**
AWPD_P_AOA	((CBPOP_TOT * (CCBAP_AOA / CCBAP_TOT)) / CCBAP_AOA) area-weighted population density for corrected block group area within AOA; *area reduced by optional erase process*	pddpttYYYY_Clip, *pddpttYYYY_Clip_AllErased*
AWPD_F_AOA	((CBPOP_TOT * (CCBAF_AOA / CCBAF_TOT)) / CCBAP_AOA) area-weighted population density for corrected block group area within AOA; *area reduced by optional erase process* *optional water area subtraction	pddpttYYYY_Clip*, *pddpttYYYY_Clip_AllErased**

AWP_P_AOA	(CBPOP_TOT * (CCBAP_AOA / CCBAP_TOT)) area-weighted population for corrected block group area within AOA; *area reduced by optional erase process*	pddpttYYYY_Clip, *pddpttYYYY_Clip_AllErased*
AWP_F_AOA	(CBPOP_TOT * (CCBAF_AOA / CCBAF_TOT)) area-weighted population for corrected block group area within AOA; *area reduced by optional erase process* and/or *optional water area subtraction	pddpttYYYY_Clip*, *pddpttYYYY_Clip_AllErased**
CBA_W	Census-reported area of water in block group (km^2)	pddpttYYYY, pddpttYYYY_Clip, pddpttYYYY_AllErased, pddpttYYYY_Clip_AllErased
CBA_W_AOA	(CBA_W * (CBA_TOT_AOA / CBA_TOT)) Census-reported area of water in block group (km^2); adjusted for area within AOA	pddpttYYYY_Clip, pddpttYYYY_Clip_AllErased

**In some census blocks, Census Water area can be larger than the census block land area (CBA_W > CBA_TOT/CCBAP_TOT). In these cases, the tool will produce negative area values which then result in negative population densities. To prevent this from occurring, in those areas where "CCBAP_TOT - CBA_W" results in a negative CCBAF_TOT value, the negative CCBAF_TOT value is automatically replaced by the CCBAP_TOT value. This method does slightly inflate population density results, but removes the negative population densities (which aren't possible in reality).

Frequently Asked Questions

Can/should I use a different spatial reference?

Any NPScape spatial output can be re-projected to a 'final' local spatial reference; care should be taken to use a local spatial reference with minimal area distortion. For vector outputs, Repair Geometry should be run after re-projection. This approach should be noted in explanatory or interpretive documentation to avoid misleading the user; re-projection of an output dataset will have no effect on area attributes in the summary table generated by the NPScape script.

All NPScape tools generate area calculations from input data. If tool input data must be re-projected prior to running the tools, care should be taken to use a local spatial reference that distorts area minimally, such as an equal-area projection. For CONUS tool input datasets, NPScape uses USA Contiguous Albers Equal Area Conic USGS (NAD_83) as the spatial reference. Alaska-specific tool input datasets are in Alaska Albers Equal Area Conic (NAD_83) while Hawaii-specific datasets use UTM Zone 5N (NAD_83). UTM WGS84 Zone 55N is used for Commonwealth Northern Mariana Islands and Guam, and UTM NAD83 (HARN) Zone 2S is used for American Samoa.

<u>Re-projecting vector input data</u>:
NPScape tool input vector data can be re-projected prior to use as a tool input. The source dataset should be clipped to an extent larger than the intended area of analysis. Then, after clipping, Repair Geometry must be run to correct geometric errors. Finally, the clipped input can be re-projected to the local spatial reference, followed with another Repair Geometry operation.

<u>Re-projecting raster input data</u>:
Re-projection to match a local spatial reference is not recommended for raster format NPScape tool input datasets. If re-projection must be done, the source tool input raster should be clipped to an area of analysis rectangular extent first. Then Processing Extent → Snap Raster environment setting in ArcGIS should be populated with the source input tool raster. Warping will occur but should be less than it would be without the Snap Raster setting.

Alternatively, the AOA extent could be re-projected to the same spatial reference as the NPScape input raster followed by a repair geometry operation. Then, this polygon could be rasterized to a temporary raster dataset with a cell size matching the input raster, setting the snap raster to the input raster to minimize warping. Then, this temporary raster could be used to extract an area from the NPScape tool

input raster. Finally, this extracted raster could be re-projected to the desired local spatial reference as described above.

I'm having trouble downloading the tool input dataset. Is there another way to get it?

Many tool input datasets are very large. Please contact the NPScape team to request a custom delivery and/or a custom clipped extent: mailto:NRSS_NRPC_NPScape@nps.gov

My outputs don't show up in my map. What can I do?

The tools use ArcGIS display layers to visualize the metric outputs. If you see a red **!** by the layer name in the map, the layer can't find the feature class to which it is linked. The most common reason is that the Output Geodatabase Name parameter differed from what the tool script expected. Fix the problem by clicking the red **!** and navigating to the output geodatabase. Then, select the correct feature class or raster.

If a multi-feature singlepart AOA polygon was used, there will be an output raster or feature class and statistics table for each AOA feature, named with the value of the AOA Field attribute. However, only outputs for the last feature processed will be added to the map automatically. Add the remaining output rasters/feature classes and statistics tables. Use the *.lyr files in the ProcessedData subfolder to symbolize the features.

Literature Cited

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National Park Service. 2013. NPScape: monitoring landscape dynamics of US National Parks. Natural Resource Stewardship and Science, Inventory and Monitoring Division. Fort Collins, Colorado. http://science.nature.nps.gov/im/monitor/npscape/ (Accessed 20130219).

Appendices

Appendix 1: Known issues

Data availability

Tool input data exists for the continental U.S., Puerto Rico, Alaska, Hawaii, and the other Pacific Islands.

The Virgin Islands Census data has not been processed at this time.

Additional issues

- Area calculations for block groups along Census defined shorelines or other boundaries (Canada, Mexico) may not be coincident with the respective boundaries obtained from other sources.

- In 2010 Census (possibly others), census data were either not produced or the data exist with population total values equal to zero; examples include some NWR's not being covered by Census block-group features, or some block-groups containing correctional facilities but had population totals set to zero. These cases were not observed to be consistent across states.

- Use of census water areas vs. other hydrological information; when census water area is used, the census-reported water area value is subtracted from the calculated area of each block group (where water is reported) and no part of the input census data is removed; whereas, if a hydrological layer is used for the Erase layer, the extent of those hydrological features will be erased (removed) from the respective census block group and the resulting area calculated.

- Using an erase feature layer (not hydrological) AND subtracting census water area could potentially cause some areas to be removed from calculations twice (over-estimating, or "double counting", removed area values from the statistical processes). The best way to combat this issue is to use a different water layer for "erase", and if need be, merge it with any additional erase layers for use so no area is doubly removed)

- Attribute difference between Census dates – see Table 1

Appendix 2: Using custom AOAs and/or local input data

Custom AOAs

The AOA feature class should include a text attribute with a name value for the AOA feature(s). The feature class can contain single or multi-part polygons. If single-part polygons are used, an output raster and statistics table will be produced for each feature, named with the attribute value selected in the AOA_Field parameter.

Local input data

This SOP is dependent on U.S. Census Block data as the tool input (U.S. Census Bureau, 1991; 2001; 2011). Specific Census attributes are required for correct processing.

Appendix 3: Tool scripts

See Scripts subfolder for Python scripts used by the metric tool(s). No edits to any of these scripts are needed to run the tool.

Appendix 4: Tool input data processing details

To create the 1990, 2000, and 2010 population metric tool input data, state-level tabular and spatial data were downloaded from the U.S. Census FTP site and processed into a seamless nationwide tool input feature class.

2010 Source data: State-by-State Tabular and Spatial Data from U.S. Census

State-by-state delimited text 2010 summary files (tabular 'Summary File 1' source) are available here:

ftp://ftp.census.gov/census_2010/04-Summary_File_1/

An Access 2003 template for 2010 tabular summary files available:
ftp://ftp.census.gov/census_2010/04-Summary_File_1/SF1_Access2003.mdb

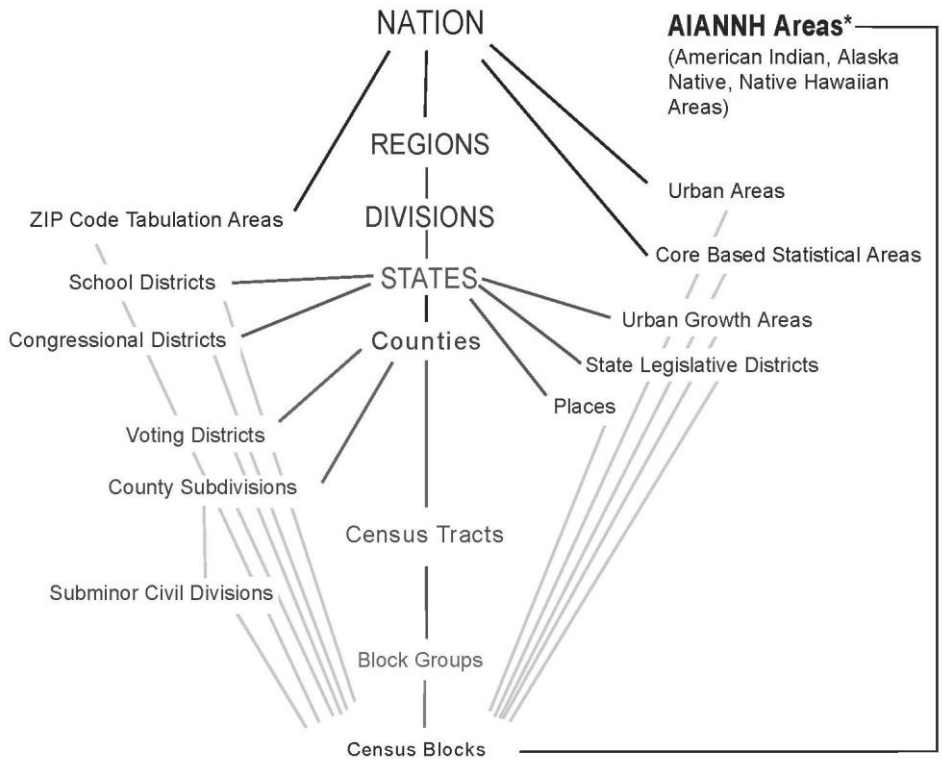
2010 spatial data (state-by-state block group shapefile polygons from TIGER) titled with state FIPS codes are here:
ftp://ftp.census.gov/geo/tiger/TIGER2010/BG/2010

U.S. Census documentation is available for download:

2010 Census of Population and Housing Summary File 1 Technical Documentation
Complete and detailed description of the tabular Summary File 1 content and format.

2010 File Structure for Summary File 1
Description of SF1 file structure.

Geographic Hierarchy for Census Data (from 2010 Census Summary File 1— Technical Documentation)



* Refer to the "Hierarchy of American Indian, Alaska Native, and Native Hawaiian Areas"

2010 Processing steps - Summary

Data loading:

1. For each state, selected Summary File 1 and GEO_Header_SF1 delimited text files were imported into tables in a state-specific copy of a customized Access 2003 template using import specifications (see SF1_00001-04 tables, GEO_Header_SF1 table).
2. For each state, the block group shapefile polygons were corrected for geometric errors (if needed) and imported into the state-specific customized Access 2003 database as the 'BlockGroup2010' feature class.
3. An Access SQL query was used to create a block group-level summary table (tblBG2010_Pop_Race_Age).
4. A Python script was used to automate these data loading steps (Census2010_ReProcess.py).

Joining block group polygons to census attribute data and quality control:

1. The BlockGroup2010 feature class was joined to the summary table (tblBG2010_Pop_Race_Age) to create a state-specific feature class (<state abbreviation>_PopRaceAge_Geo.shp). This feature class was projected into the USA Contiguous Albers Equal Area Conic USGS spatial reference and its geometry was repaired. A Python script was used to automate this step (Census2010_ReProcess.py).
2. The total population Census attribute value (P0010001) was verified visually in ArcMap and compared against a master Census landuse lookup spreadsheet (special_landuse_bgs_2010.xls). Finally, county summaries of total population were calculated and compared to values posted on the Census QuickFacts website.
3. To allow for more accurate area calculations, polygons in feature classes for states with shorelines (ocean and lake) were corrected by removing the buffered area Census adds to the features adjacent to shorelines. Geometry was re-built for affected feature classes.

Creating nationwide merged feature class:

1. State-level feature classes with shorelines were clipped with Terrestrial Area boundaries (GADM database of Global Administrative Areas). The clip is necessary to eliminate remaining slight buffers and mis-registration of block group features along shorelines. All coastal states (particularly Alaska) and states with lakeshore features are affected by this problem.
2. State-level feature classes were merged into a file geodatabase feature class (name). This is the NPScape tool input dataset for Census 2010.
3. A Python script was used to automate these steps (Census2010_Merge.py).

2000 Source data: State-by-State Tabular and Spatial Data from U.S. Census

State-by-state delimited text 2000 summary files (tabular 'Summary File 1' source) are available here:
ftp://ftp2.census.gov/census_2000/datasets/Summary_File_1

An Access 2003 template for tabular summary files available:
http://www.census.gov/support/2000/SF1/Access97.zip

2000 spatial data (state-by-state block group shapefile polygons) titled with state FIPS codes are here:
http://www.census.gov/geo/www/cob/bg2000.html

U.S. Census documentation is available for download:

2000 Census of Population and Housing Summary File 1 Technical Documentation
Complete and detailed description of the tabular Summary File 1 content and format.

Description of 2000 SF1 file structure
http://www.census.gov/prod/cen2000/doc/sf1.pdf

2000 Processing steps - Summary

Data loading:

1. For each state, selected Summary File 1 and SF1GEO delimited text files were imported into tables in a state-specific copy of a customized Access 2003 template using import specifications (see SF1_00001-04 tables, SF1GEO table).
2. For each state, the block group shapefile polygons were corrected for geometric errors (if needed) and imported into the state-specific customized Access 2003 database as the 'BlockGroupShape' feature class.
3. An Access SQL query was used to create a block group-level summary table (tblBG_PopAreaRaceAge).
4. A Python script was used to automate these data loading steps (Census2000_ReProcess.py).

Joining block group polygons to census attribute data and quality control:

1. The BlockGroup2000 feature class was joined to the summary table (tblBG_PopAreaRaceAge) to create a state-specific feature class (<state abbreviation>_PopAreaRaceAge_Geo.shp). This feature class was projected into the USA Contiguous Albers Equal Area Conic USGS spatial reference and its geometry was repaired. A Python script was used to automate this step (Census2000_ReProcess.py).
2. The total population Census attribute value (P010001) was verified visually in ArcMap. Finally, county summaries of total population were calculated and compared to values posted on the Census QuickFacts website.

Creating nationwide merged feature class:

1. State-level feature classes with shorelines were clipped with Terrestrial Area boundaries (GADM database of Global Administrative Areas). The clip is necessary to eliminate remaining slight buffers and mis-registration of block group features along shorelines. All coastal states (particularly Alaska) and states with lakeshore features are affected by this problem.
2. State-level feature classes were merged into a file geodatabase feature class (name). This is the NPScape tool input dataset for Census 2000.
3. A Python script was used to automate these steps (Census2000_Merge.py).

1990 Source data: State-by-State Tabular and Spatial Data from U.S. Census

State-by-state DBF-format text summary files (tabular 'Summary File 1' source) are available here:
http://www2.census.gov/census_1990/1990STF1.html

Spatial data (state-by-state block group shapefile polygons) titled with state FIPS codes are here:
http://www.census.gov/geo/www/cob/bg1990.html

U.S. Census documentation is available for download:

1990 Census of Population and Housing Summary File 1 Technical Documentation
Complete and detailed description of the tabular Summary File 1 content and format.

1990 Summary File 1 Census Data - Quick Reference Table
Additional description of SF1 file structure.

1990 Processing steps - Summary

Data loading:

1. For each state, selected Summary File 1 and SF1GEO delimited text files were imported into tables in a state-specific copy of a customized Access 2003 template using import specifications (see SF1_00001-04 tables, SF1GEO table).
2. For each state, the block group shapefile polygons were corrected for geometric errors (if needed) and imported into the state-specific customized Access 2003 database as the 'BlockGroupShape' feature class.
3. An Access SQL query was used to create a block group-level summary table (tblBG_PopAreaRaceAge).
4. A Python script was used to automate these data loading steps (Census1990_ReProcess.py).

Joining block group polygons to census attribute data and quality control:

1. The BlockGroup1990 feature class was joined to the summary table (tblBG_PopAreaRaceAge) to create a state-specific feature class (<state abbreviation>_PopAreaRaceAge_Geo.shp). This feature class was projected into the USA Contiguous Albers Equal Area Conic USGS spatial reference and its geometry was repaired. A Python script was used to automate this step (Census1990_ReProcess.py).
2. The total population Census attribute value (P010001) was verified visually in ArcMap. Finally, county summaries of total population were calculated and compared to values posted on the Census QuickFacts website.

Creating nationwide merged feature class:

1. State-level feature classes with shorelines were clipped with Terrestrial Area boundaries (GADM database of Global Administrative Areas). The clip is necessary to eliminate remaining slight buffers and mis-registration of block group features along shorelines. All coastal states (particularly Alaska) and states with lakeshore features are affected by this problem.
2. State-level feature classes were merged into a file geodatabase feature class (name). This is the NPScape tool input dataset for Census 1990.
3. A Python script was used to automate these steps (Census1990_Merge.py).

Update schedule

The U.S. Census bureau updates census information every 10 years. Interim corrections/updates are published to the American Fact Finder website at the state, county, tract, or block group level.

Until decadal release, none planned for CONUS, AK, HI, PR and VI areas. Census may release data for Guam and American Samoa in late 2012. If available, these data will be processed into input and metric layers for population total and density.

Appendix 5: Metric data processing details

Metric data for all Census dates (2010, 2000, 1990) and all full geographic extents were processed using the following logic.

Source data

Seamless (merged) input datasets produced from steps in Appendix 4 were used as processing targets.

Processing steps

The Population Script Tool was used to create the CONUS, AK, HI, and PR Density and Total Seamless feature class using a dissolved version of the same feature class as the extent for processing.

- Census Water Area subtracted
- PADUS v1.3 Gap Status 1 and 2, erased from input

Update schedule

None planned for CONUS, AK, HI, PR and the other Pacific Islands areas until the next census update circa-2021, dependent upon data availability. The US Virgin Islands has not been processed as of this time, but may still be.

Appendix 6: 2000 Census - legacy data processing details

From legacy SOP: National Park Service. 2010. NPScape population measure – phase 1 data processing SOP: Acquiring and processing 2000 census data at the block group level – detailed instructions for Access 2007. Natural Resource Report NPS/NRPC/IMD/NRR—2010/249. National Park Service, Fort Collins, Colorado.

This process documents the original (legacy) NPScape process used to acquire and process 2000 Census data. Specifically, it documents the processing of Block Group (i.e., Summary Level 150) statistics for Total Population, Universe Total (P001001). **This entire process is now automated as described in Appendix 4 above.**

Acquire Background Files

Starting page for documentation of data is at http://www.census.gov/support/SF1ASCII.html

- For any work, the following files should be downloaded:
  The File Documentation PDF provides an essential, although difficult to grasp, description of the dataset. This is found at: http://www.census.gov/prod/cen2000/doc/sf1.pdf. It will help the user determine which files to download from the FTP site. Section 7.3 (i.e., Table (Matrix) Section) indicates which files to download. For instance, if one were interested in Total Population, they would need to download File 01 and get the data from the column named P001001

- In the \Data\Population\2000Census\OriginalStateData folder is a state template (aa_StateTEMPLATE.mdb) for importing the information. This template is a slightly modified version of the original Census Access template, named SF1.mdb, for importing all of the data (http://www.census.gov/support/2000/SF1/Access97.zip)

Acquire State Data Tables and Shapefiles

To process the data at the block group level, it will be necessary to get the state-level data. For each state, you will need to get at least three files:

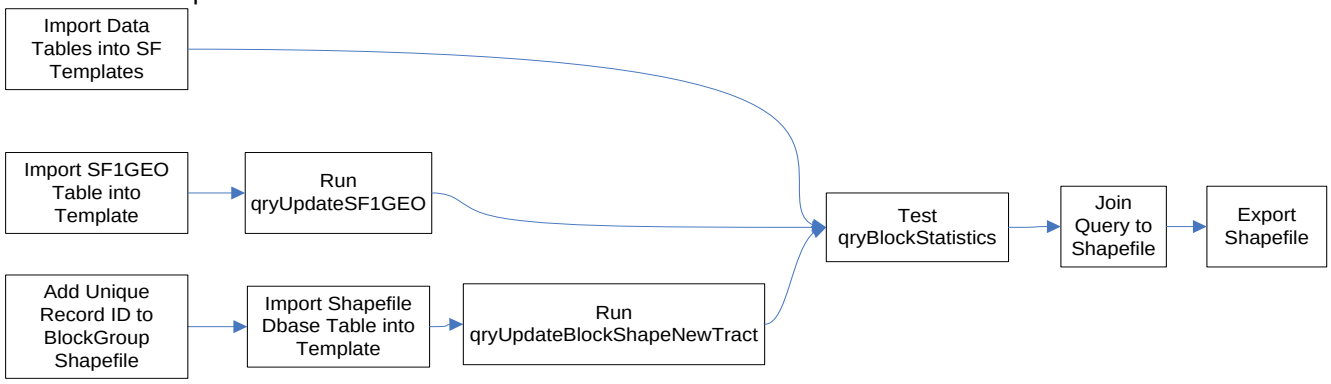
- State Block Group Shapefile (bg<*>_d00_shp.zip) – Contains all of the block group boundaries. Located at: http://www.census.gov/geo/www/cob/bg2000.html
- State Data Table(s) – One or more of the 39 data tables (<*>00001_uf1.zip and/or <*>00037_uf1.zip). The <*>00001_uf1.zip archive contains data tables for population while the <*>00037_uf1.zip archive contains data tables for housing. For this analysis, only <*>00001_uf1.zip needs to be downloaded. These archives are located at: ftp://ftp2.census.gov/census_2000/datasets/Summary_File_1 (Chapter 7 (TABLE (MATRIX) SECTION – Page 7-25) of the File Documentation PDF provides an index of information on each of the 39 tables.)
- State GeoBoundary Table (<*>geo_uf1.zip) – Enables a crosswalk between the tabular information and the block group shapefile. This is also known as the SF1GEO table. Located at: ftp://ftp2.census.gov/census_2000/datasets/Summary_File_1

1. Create a subfolder under for 2000Census: ProcessedStateData
2. Using WinZip or the Windows Extract utility, unzip the data table (<*>00001_uf1.zip and <*>geo_uf1.zip) and shapefile (bg<*>_d00_shp.zip) archives into the \ProcessedStateData folder.
3. Re-name the state data tables by changing the <*>.uf1 extension to a <*>.txt extension. For instance, in the case of processing Alaska, ak00001.af1 should be renamed to ak00001.txt.

4. Re-name the state geoboundary (SF1GEO) table by changing the <*>.af1 extension to a <*>.txt extension. For instance, in the case of processing Alaska, akgeo.af1 should be renamed to akgeo.txt.
5. Copy the state shapefile zip archive (bg<*>_d00_shp.zip) into the \ProcessedStateData folder. Unzip it. Note: The shapefile zip archives are not named using the state code. See Appendix 1 for a list of state shapefile zip archive names

Processing Data Overview

For this task, we recommend processing each state individually in Access 2003 or Access 2007. If Access 2007 is used, be sure to set the output format to Access 2003: click the Office Button and select Access Options. Set the default file format to Access 2002-2003.



Many of these steps are automated in the state template Access geodatabase (aa_StateGDBTEMPLATE.mdb). Specifically, it contains the following:

- SF10001 template population table: includes defined field names and lengths
- SF1GEO template geoboundary table: includes defined field names and lengths
- qryUpdateSF1GEO<*> queries: populate new fields (SF1GEO.NewTract and
- SF1GEO.GEOID)
- qryUpdateBlockGroupShape<*> queries: populate new fields
- (BlockGroupShape.NewTract and BlockGroupShape.GEOID)
- qryMake_tblBG_Pop: creates table (tblBG_Pop) of block-group level population statistics

Import SF1GEO table into State template geodatabase

The state data SF1GEO table (<*>geo.txt) is fixed-width delimited and should be imported to the exact field lengths of the template in Access. It"s OK to use Access 2007, just be sure to save the database in Access 2003 format.

1. Copy the template geodatabase from aa_StateGDBTEMPLATE.mdb to the \ProcessedStateData folder. Rename it using the two-character state code: <*>_StateGDB.mdb (for example: AK_StateGDB.mdb for Alaska).

2. Open <*>_StateGDB.MDB in MSAccess 2007. Click the Security Warnings Options button and select the Enable this Content radio button. Click OK.

3. Activate the Tables tab. Select External Data → Text File from the Import toolbar. Enable the Append Records to table radio button and select the SF1GEO table. Navigate to the \ProcessedStateData and select the state data SF1GEO table (<*>geo.txt). Click 'OK'.

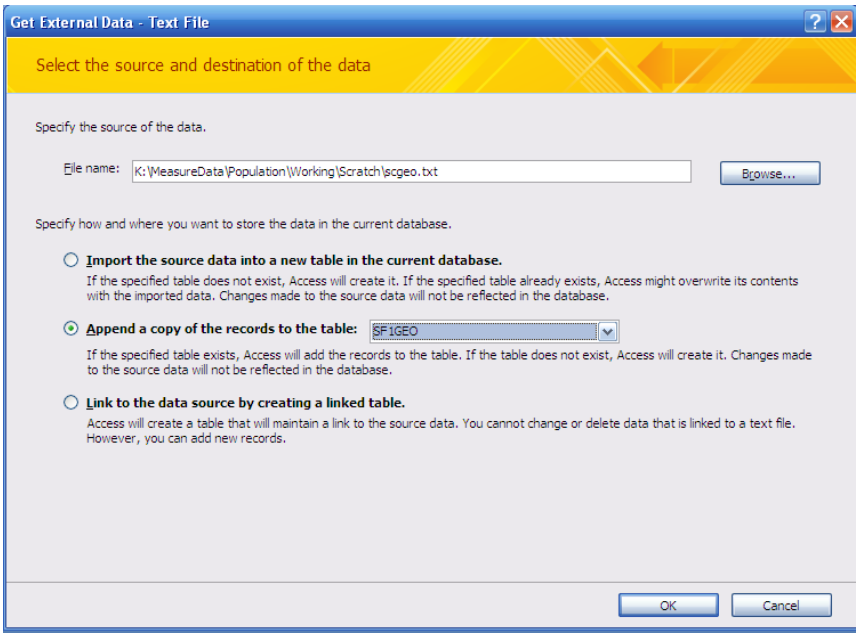


Figure 3. Append Records to SF1GEO Table

4. On the Import Text Wizard pop-up, click the 'Advanced' button. Click the 'Specs' button and scroll to select the 'SF1GEO Import Specification'. Make sure the remainder of the controls are populated as shown in Figure 4:

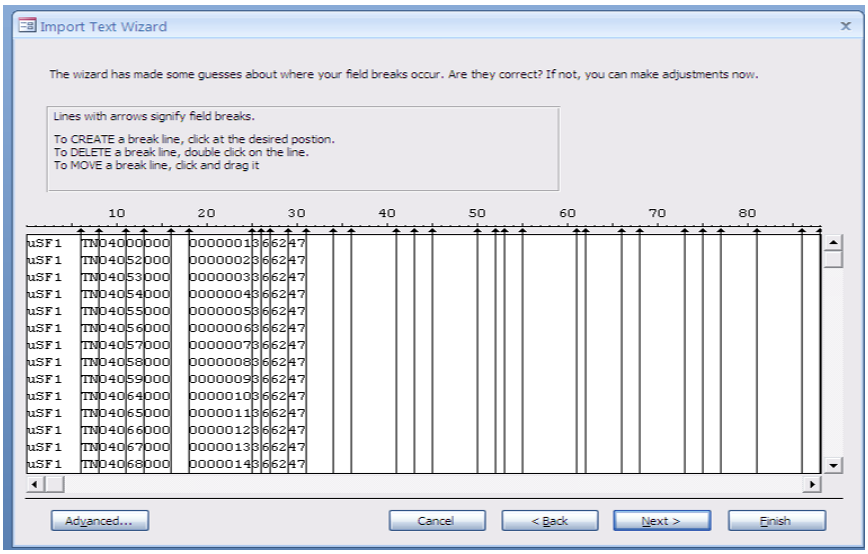


Figure 4. Import Specifications for SF1GEO Table

Click the Next>> button and confirm the delimiting as shown in Figure 5:

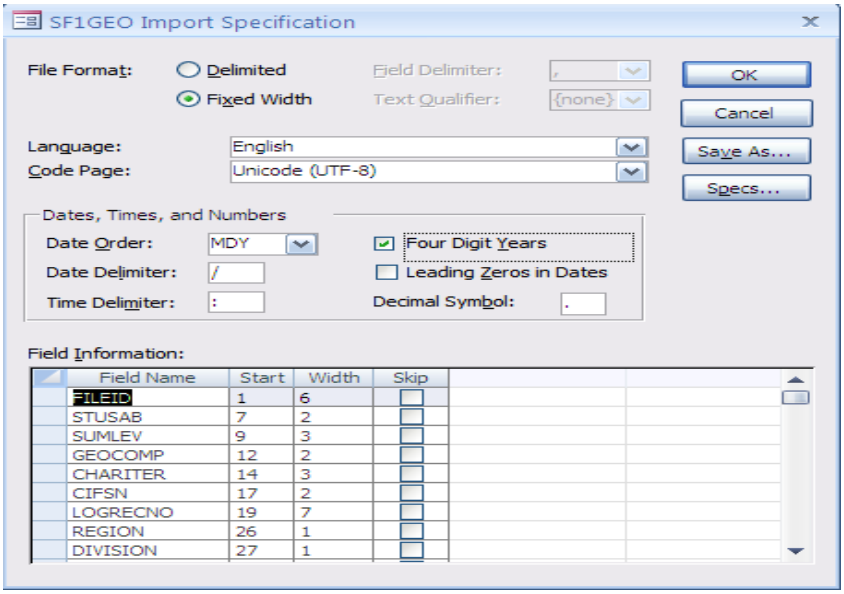


Figure 5. Delimiting for SF1GEO Table

5. Confirm that the SF1GEO table is the storage target for the imported records and click Finish. Click 'Yes' if prompted to save the specifications. It may take several minutes to complete the import.

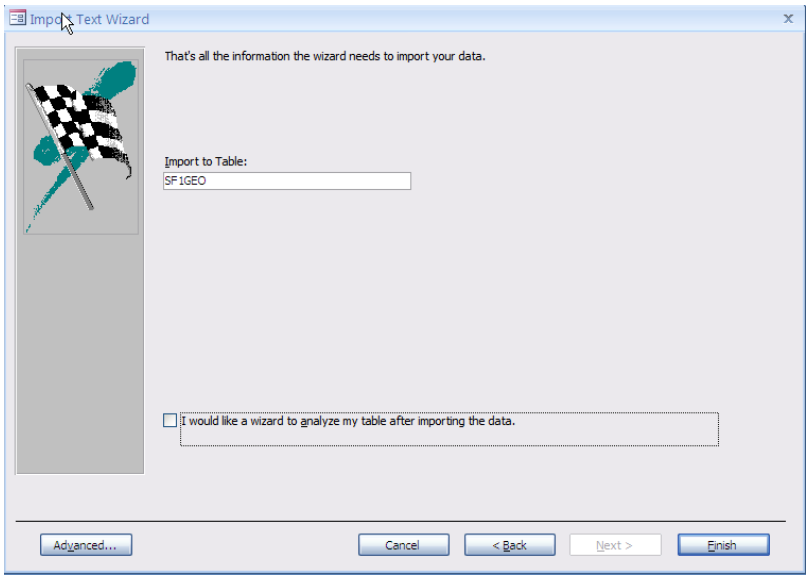


Figure 6. Target table for SF1GEO Table

Open the SF1GEO table and verify the records loaded correctly.

<u>Import SF00001 table into State template geodatabase</u>
In Access 2007, import the SF00001 state table (<*>00001_uf1.txt) as a comma-delimited text table and append its records to the SF10001 table.

1. Select External Data → Text File from the Import toolbar. Enable the Append Records to table radio button and select the SF00001 table. Navigate to the \ProcessedStateData and select the state data SF00001 table (<*>00001_uf1.txt). Click 'OK'.

2. On the Import Text Wizard pop-up, click the 'Advanced' button. Click the 'Specs' button and select the 'SF10001 Import Specification'. Make sure the remainder of the controls are populated as shown in Figure 7:

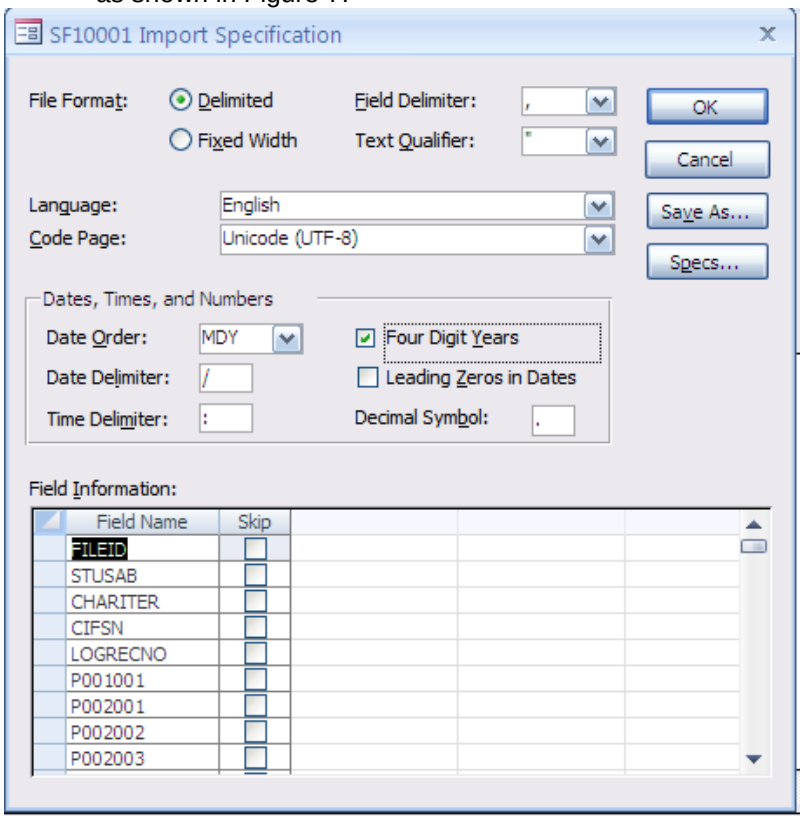
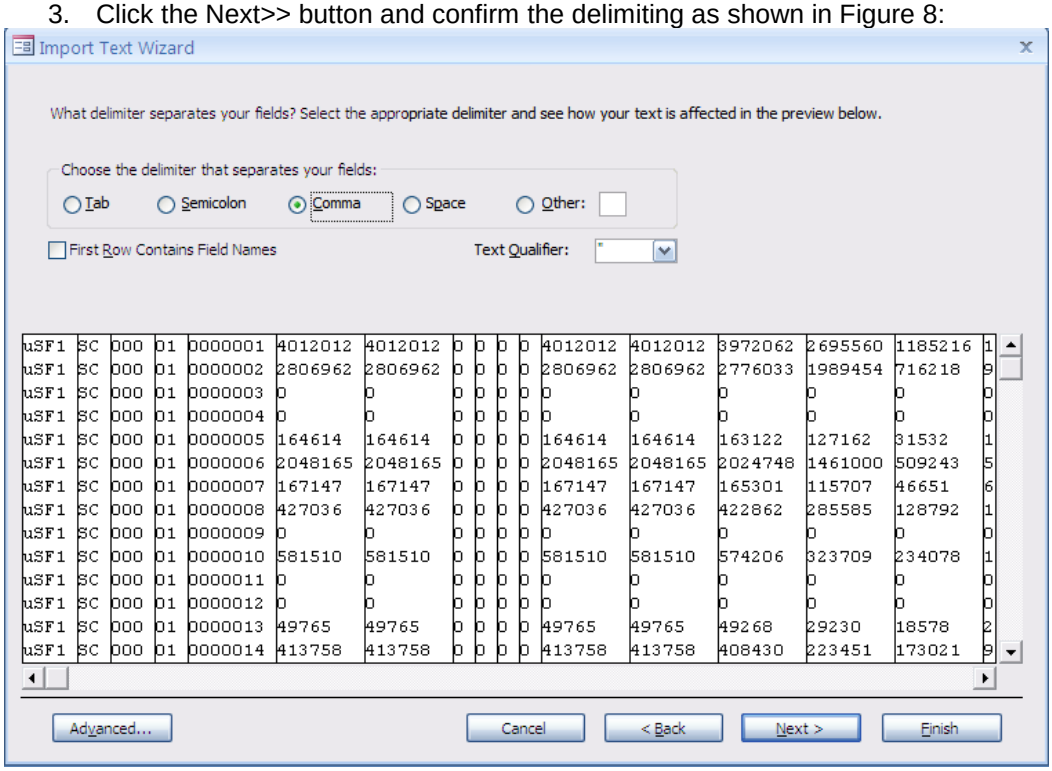


Figure 7. Import Specifications for SF00001 Table

3. Click the Next>> button and confirm the delimiting as shown in Figure 8:



uSF1	SC	000	01	0000001	4012012	4012012	0	0	0	0	4012012	4012012	3972062	2695560	1185216	1
uSF1	SC	000	01	0000002	2806962	2806962	0	0	0	0	2806962	2806962	2776033	1989454	716218	9
uSF1	SC	000	01	0000003	0	0	0	0	0	0	0	0	0	0	0	0
uSF1	SC	000	01	0000004	0	0	0	0	0	0	0	0	0	0	0	0
uSF1	SC	000	01	0000005	164614	164614	0	0	0	0	164614	164614	163122	127162	31532	1
uSF1	SC	000	01	0000006	2048165	2048165	0	0	0	0	2048165	2048165	2024748	1461000	509243	5
uSF1	SC	000	01	0000007	167147	167147	0	0	0	0	167147	167147	165301	115707	46651	6
uSF1	SC	000	01	0000008	427036	427036	0	0	0	0	427036	427036	422862	285585	128792	1
uSF1	SC	000	01	0000009	0	0	0	0	0	0	0	0	0	0	0	0
uSF1	SC	000	01	0000010	581510	581510	0	0	0	0	581510	581510	574206	323709	234078	1
uSF1	SC	000	01	0000011	0	0	0	0	0	0	0	0	0	0	0	0
uSF1	SC	000	01	0000012	0	0	0	0	0	0	0	0	0	0	0	0
uSF1	SC	000	01	0000013	49765	49765	0	0	0	0	49765	49765	49268	29230	18578	2
uSF1	SC	000	01	0000014	413758	413758	0	0	0	0	413758	413758	408430	223451	173021	9

Figure 8. Delimiting for SF00001 Table

4. Select the SF10001 table as the storage target for the imported records:

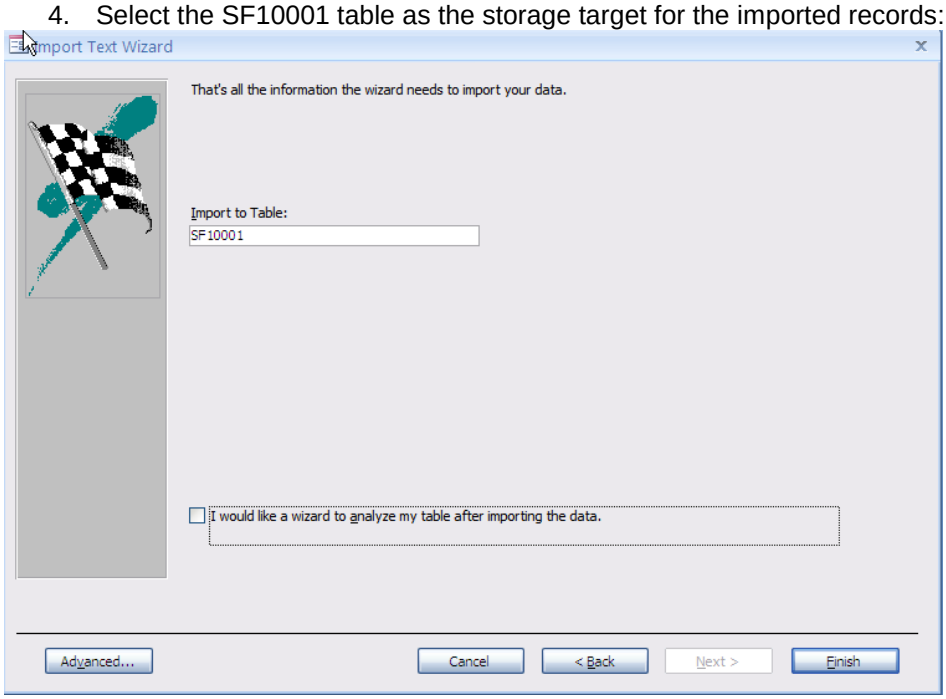


Figure 9. Table Confirmation for SF00001 Table

5. Click 'Finish' to start the import. Click 'Yes' if prompted to save the specifications. It may take several minutes to complete.
6. Open the SF10001 table and verify the records loaded correctly.

Correct feature errors in block group shapefile

Occasionally, the state block group shapefile may contain errors in block group feature geometry. Block group polygons with zero area are not uncommon and single-part polygons for block groups may exist. These incorrect features must be removed since they will result in inflated population calculations.

1. Open ArcMap 9.3 and add the bg<*>_d00.shp state shapefile to a new empty map.
2. Open the Select by Attributes tool from the Selection menu. Enter the following expression and click 'OK'.

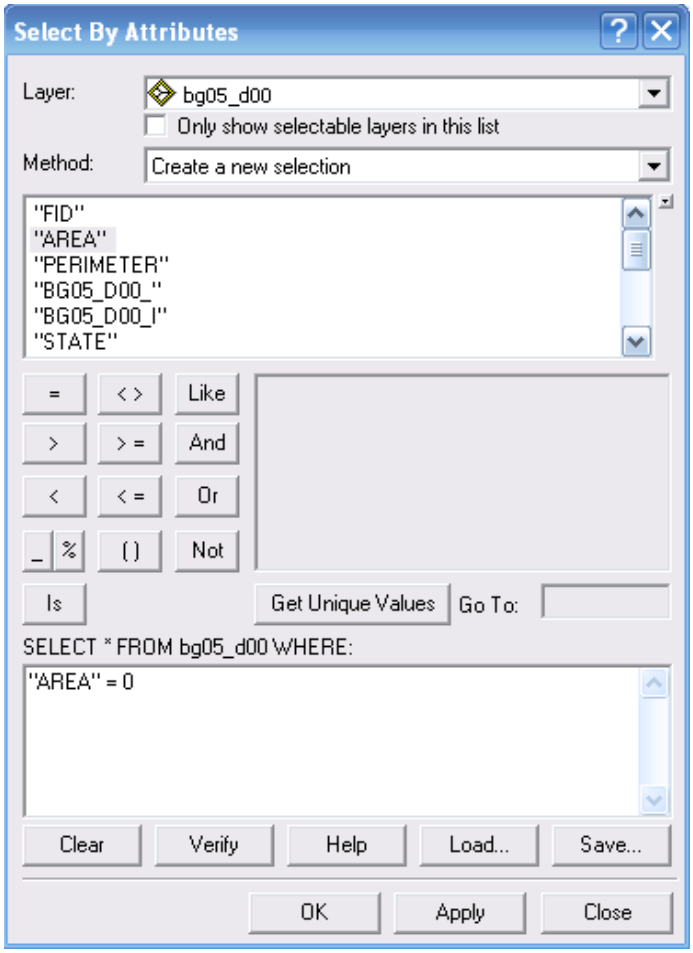


Figure 10. Select Block Group by Attribute

3. Right-click the shapefile in the table of contents and choose 'Open Attribute Table'. Click the 'Selected' button to filter the selected records.
4. **Do this step ONLY if one or more features are selected:** open the Data Management Tools → Generalization → Eliminate tool from ArcToolbox. Populate the form as shown, being sure to change the name of the output feature class and that the 'Eliminate polygons by border' is checked. Click 'Ok' to remove the zero-area polygons.

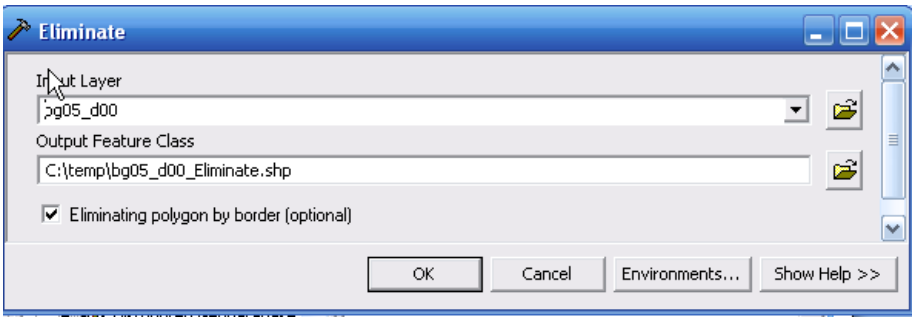


Figure 11. Eliminate Polygons by Border

5. Clear selected features (even if none were selected in Step 3) by choosing 'Clear Selected Features' from the Selection menu.
6. Some single-part polygon features may still be present in the shapefile. Remove them by running the Data Management → Generalization → Dissolve tool on the shapefile produced in step 4. *If you didn't need to run step 5, do the Dissolve using the bg<*>_d00.shp shapefile.* The dissolve output will be a feature class in the <*>_StateGDB.mdb geodatabase. Name the output feature class: BlockGroupShape. Click the 'Select All' button under the Dissolve Fields list. Then, <u>un-select the following fields</u>:

   FID, AREA, PERIMETER, BG<*>_D00_, BG<*>_D00_I

Make sure the Dissolve tool options match those shown in this figure:

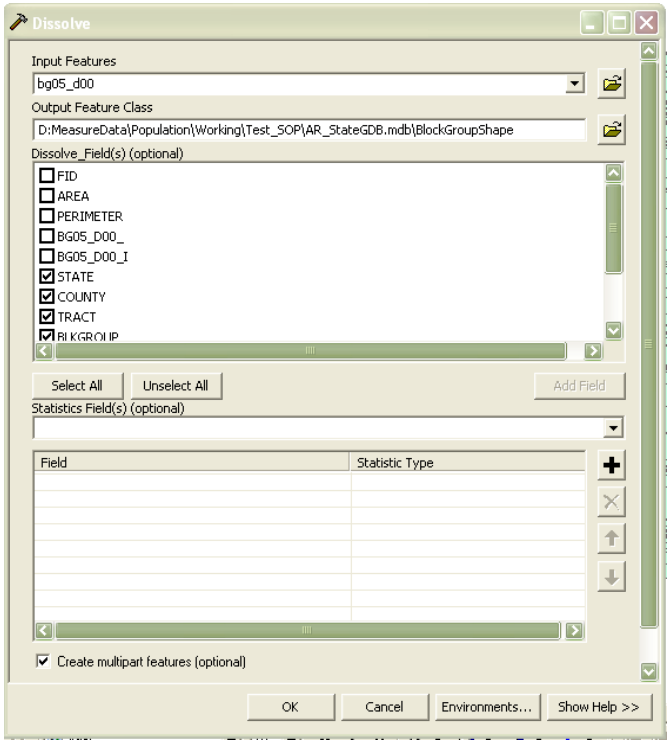


Figure 12. Dissolve Single-Part Polygon Features

<u>Run queries to populate BlockGroupShape values</u>

In the source spatial data from Census, the values in the TRACTS field are inconsistently represented with either four or six digits. To remove the ambiguity and enable tables can be joined, it is necessary to format all tracts in the BlockGroupShape table as a six-digit code.

The unique ID, GEOID, is populated from the updated NewTract values, plus other fields in the table.

1. Navigate to the Queries tab. Run the query called ***qryUpdateBlockGroupShape_NewTract*** to update this field using the TRACT values of BlockGroupShape.
2. Now, run the query called ***qryUpdateBlockGroupShape_NewTract_Padding.*** Open the BlockGroupShape table and verify that the NewTract values are populated correctly.
3. Navigate back to the Queries tab. Run the qryUpdateBlockGroupShape_GEOID query to update the GEOID field. Open the table and verify the GEOID values are populated.

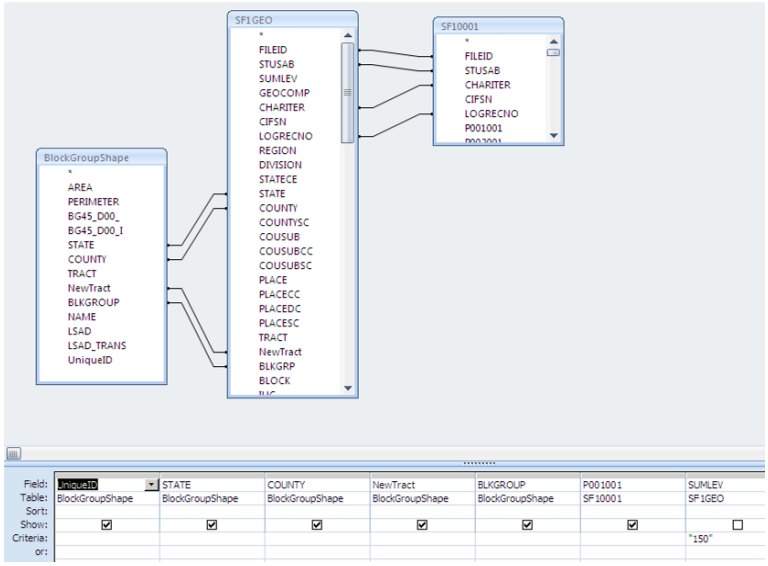
<u>Add NewTract and GEOID field to BlockGroupShape table</u>

In the SF1GEO table from Census, the values in the TRACTS field are inconsistently represented with either four or six digits. To remove the ambiguity and enable tables to be joined, it is necessary to format all tracts as a four-digit code.

1. Using Access 2007, open the design view of the SF1GEO table . Add a new text field (field size of 6) to the SF1GEO table and title it "NewTract." Add another new text field (field size of 30) and title it 'GEOID'. Close the table, saving the changes.
2. Run the query titled **q*ryUpdateSF1GEO_NewTract*** to update the NewTract field using the TRACT values of SF1GEO. Then, run the **q*ryUpdateSF1GEO_NewTract_Padding*** query to standardize the length of the field values. (*Note: for some states, this query may not update any rows. In these cases, the NewTract values are already 6 digits in length.)* Open the SF1GEO table and verify that the NewTract values are populated correctly.
3. Navigate back to the Queries tab. Run the ***qryUpdateSF1GEO_GEOID*** query to update the GEOID field. Open the table and verify the GEOID values are populated.

<u>Run Make Table Queries</u>

Figure 15 shows how the tables need to be joined, filtered and grouped to get a correct statistic for the block groups. The critical criteria is SUMLEV=150. This will summarize the population totals at the block



group level in the resulting tblBG_Pop table.

Figure 15. Query Logic to Create the tblBG_Pop Table

This query logic is contained in the query titled ***qryMake_tblBG_Pop***. Running this query will produce the table **tblBG_Pop**, which can be joined in ArcGIS.

In Access, run the ***qryMake_tblBG_Pop*** query to create the tblBG_Pop table. Open the tblBG_Pop table to verify that it contains records.

Note: If this query takes more than 10 minutes to execute, upsizing the data to SQL Server Express first will dramatically increase performance time (to just a few seconds). To do this, see the Upsizing to SQL Express section below and then run the query using the SQL Server tables.

Join data table to geodatabase feature class

1. In ArcMap, open the <*>_StateGDB.mdb geodatabase and add the dissolved, updated feature class, BlockGroupShape, to a new empty map. Then, add the ***tblBG_Pop*** table***.*** Switch back to the 'Display' tab.
2. Right-click the BlockGroupShape feature class and select 'Joins and Relates'. Click 'Join' and create the joins to the tblBG_Pop table using the GEOID fields shown below.

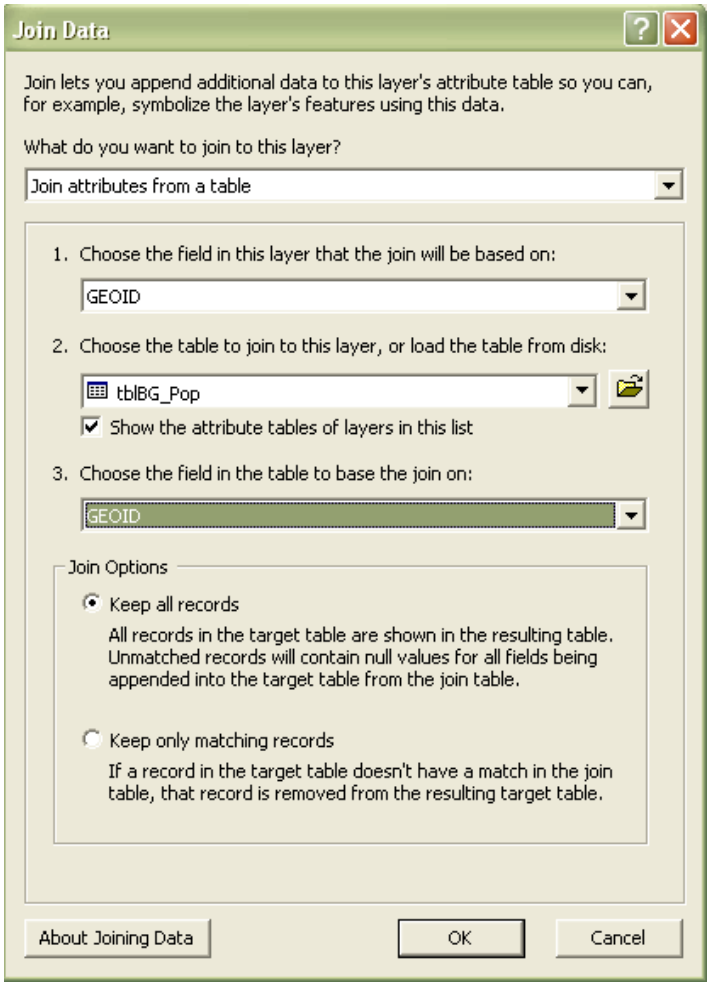


Figure 16. Adding Joins in ArcGIS

Export Shapefile and Repair Geometry

When the join completes, export the joined feature class to create a new shapefile.

1. Right-click the BlockGroupShape feature class in the ArcMap table of contents and select 'Export Data'. Change the format the Shapefile and the export name to <*>_Pop.shp where * is the two-letter state acronym.
2. Add the new shapefile to the map and verify the features and the attributes exist. Open the attribute table and make sure the BLKGROUP_1 and P001001 fields are populated.
3. To fully verify the attributes, right-click the shapefile and select 'Properties'. Choose the Symbology tab and select Quanties as the show type. Choose P001001 as the value field and select a coloramp. Apply the symbology and verify that all polygons have a P001001 value (no white polygons should be visible).
4. Define the spatial reference for the shapefile. Open the Data Management → Projections and Transformations → Define Projection tool in ArcToolbox. Select the <*>_Pop.shp shapefile. Define the projection as shown in Figure 17 (Select → Geographic Coordinate Systems → North America → North American 1983.prj:

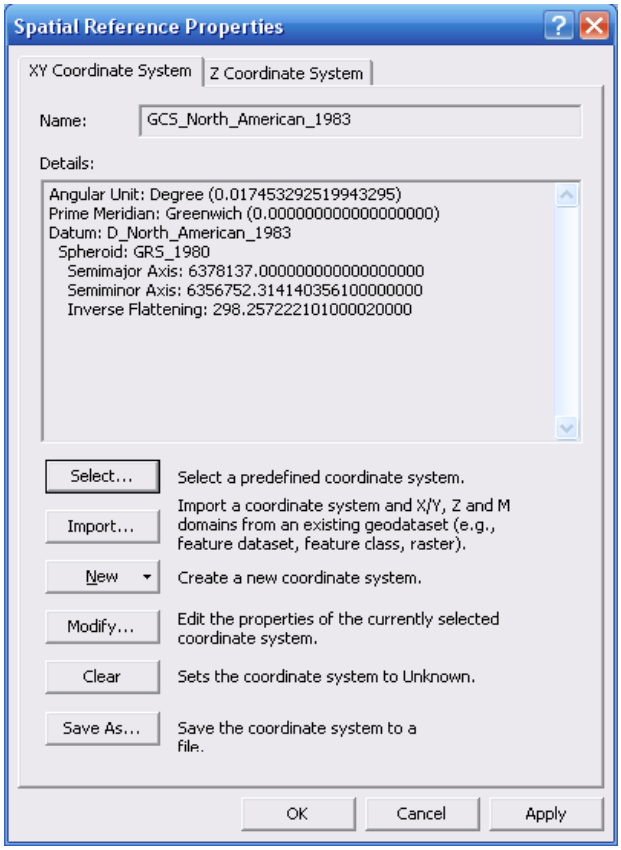


Figure 17. Defining the Projection

5. In ArcToolbox, open the Data Management → Features → Repair Geometry tool. Select the <*>_Pop.shp shapefile, keep 'Delete Features with Null Geometry' checked and click 'OK' to run the repair.
6. Add the following files to a zip file archive (named <*>_2000Data.zip, where * is the two-character state code) and copy it to the \ProcessedStateData folder:

<*>_Pop.shp
<*>_Pop.shx
<*>_Pop.sbn
<*>_Pop.sbx
<*>_Pop.dbf
<*>_Pop.prj

<*>_Pop.xml
<*>_StateTEMPLATE.mdb

Aggregating Multiple States

This section addresses those cases where shapefiles from multiple states need to be aggregated. Using ArcToolbox, run the Merge tool from Data Management Tools → General.

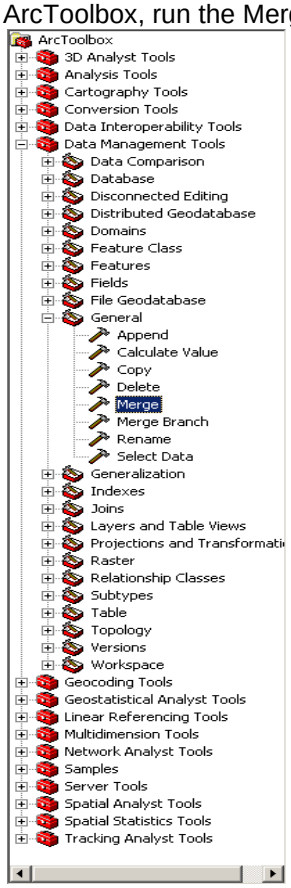


Figure 18. The Merge Tool in ArcToolbox

Quality Control

1. Verify All Block Groups Have a Value

When tblBG_Pop table is successfully joined to the block group shapefile (using the UniqueID fields), each block group feature (polygon) should have a census statistic (P010001). Note: Section 3.10 Step 3 above suffices for this QC check.

2. Aggregate Numbers to the County Level and Compare with Official Census Figures

To ensure the P010001 population calculations are correct, cross-reference the <*>_Pop.shp attribute data to the calculated Census values.

a. Spot-check the data by navigating to http://quickfacts.census.gov/qfd/index.html and selecting a county. Find the Populations Estimate Base, 2000 value and the county FIPS code. (The county FIPS code is listed at the bottom of the State and County Quick Facts table on this webpage.) This FIPS code is the same as the COUNTY attribute of the <*>_Pop.shp shapefile.
b. In ArcMap, select the Census block groups in the county by selecting the COUNTY attribute matching the FIPS code.

c. Open the attribute table and display only the selected records. Right-click the P010001 attribute and select 'Statistics'. Compare the sum to the Populations Estimate Base, 2000 value on the web page.

Extracting Information Beyond Block Group Total Population

There may be cases where users wish to extract other information from SF0001 table. To extract other information, make a copy of query qryBlockGroupPop. Then, in the Design View of the copied query, add or modify the fields. For instance, any other field could substitute for P001001. Likewise, it is possible to add extra fields beyond the SUMLEV field.

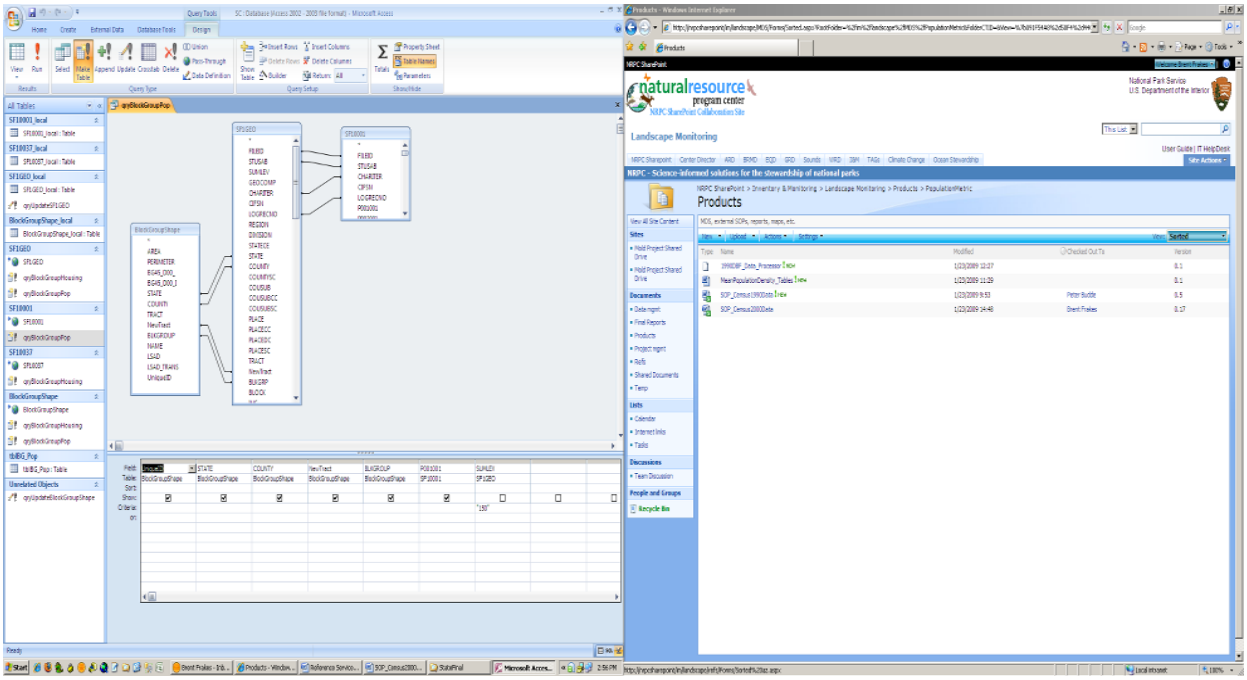


Figure 19. Query Logic to Extract the Total Block Group Population

Appendix 7: 1990 Census - legacy data processing details

From legacy SOP: NPS-IMD. 2009. NPS Landscape Dynamics Project: Population Metrics Processing SOP. 1990 Census Data Processing SOP. Inventory and Monitoring Division. National Park Service, Fort Collins, Colorado.

This process documents the original (legacy) NPScape process used to acquire and process 1990 Census data. Specifically, it documents the processing of Block Group (i.e., Summary Level 150) statistics for Total Population, Universe Total (P001001). **This entire process is now automated as described in Appendix 4 above.**

Overview

This SOP provides guidance on how to acquire and process 1990 Census data. Specifically, it documents the processing of Block Group geographies and associated Census variables contained in Summary Tape File 1 (STF1).

The processing steps describe the procedures required to prepare 1990 Census block group data on a state-by-state basis. If your project demands you work in a multi-state area, you can

replicate the process and subsequently merge your results into a larger "regional" framework.

Data Acquisition

For any work, the following files should be downloaded:

- The File Documentation PDF provides an essential description of the dataset. This is found at: http://factfinder.census.gov/metadoc/1990stf1td.pdf. It will help the user determine which files to download from the FTP site.
- An additional useful reference from the University of Washington Libraries details the Census field names and their content (see http://wagda.lib.washington.edu/data/type/census/geodb/metadata/STF1qkRef.pdf).

Acquire State Tables and Shapefile

To process the data at the block group level, it will be necessary to get the state-level data. For each state, one will need to get two different files:

- State Block Group Shapefile – Contains all of the block group boundaries. Located at http://www.census.gov/geo/www/cob/bg1990.html#shp .
- State Table(s) – One or more of the nine DBF data tables (e.g., stf1a1-9[state_abbrev].dbf) needs to be downloaded from the 1990 Census ftp site (http://www2.census.gov/census_1990/1990STF1.html). An ASCII readme file is in each of the regional directories that describes the range of Census variables in the respective nine stf1 files to guide your selection.

Once downloaded, all the shapefiles will need to be unzipped from their archives; there are a few remaining processing steps (see below) necessary to prepare them so they can be merged into regional or national layers and utilized in population studies. The DBF files are already unzipped and will be processed further to calculate required linking fields and remove unnecessary attribute information (see detailed processing below).

Data Processing

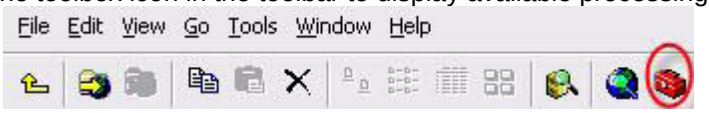
These necessary processing tasks will be conducted in Access and ArcGIS; the DBF preprocessing is accomplished with a custom Access utility that works in both Access2003 and 2007 and the remaining steps using a current version of ArcGIS (either v9.2 or v9.3).

Define Shapefile Parameters

The shapefiles you downloaded and unzipped earlier still require a few minor pre-processing steps to define the original projection parameters.

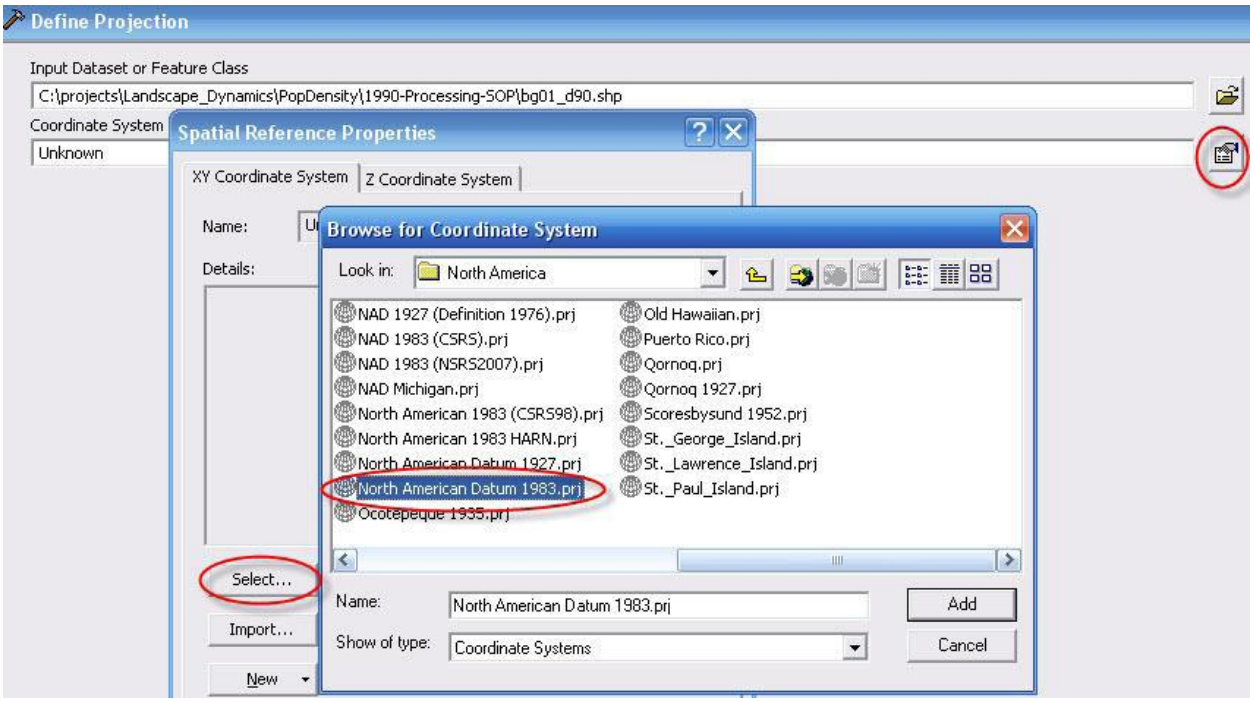
The Census block group cartography files you downloaded are missing projection definitions. You'll need to add the appropriate geographic (Lat/Long) and datum (NAD83) projection parameters to they can be appropriately georeferenced and merged with other state files in ArcGIS.

In ArcCatalog, navigate to the directory containing the unzipped shapefiles. If the ArcToolbox is not already open, click on the toolbox icon in the toolbar to display available processing tools.



Once the toolbox is displayed, click to open the Data Management Tools > Projections and Transformations Tools, and finally the Define Projection tool.

With the define projection tool open, first specify the shapefile for which you want to define projection information. Then, click on the icon to the far-right of the menu on the Coordinate System button to specify your spatial preference properties.



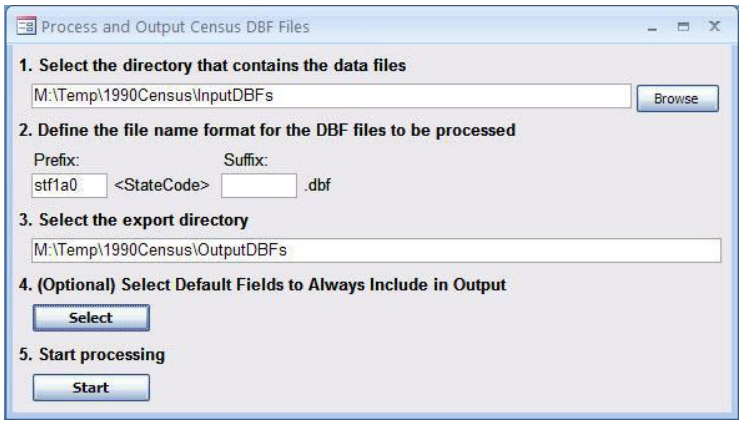
From the Spatial Reference Properties menu, click on Select, then Geographic Coordinate Systems, then North America, and finally North American Datum 1983.prj. Click Add from the Coordinate System screen and OK from the Spatial Reference Properties screen. Lastly, click OK from the Define Projection tool and the appropriate Geographic NAD83 projection parameters will be applied to the specified shapefile.

<u>Pre-process SF1 Data Tables with Access Utility</u>

Once you‘ve downloaded all the desired SF1 DBF data tables into a single directory you need to pre-process the content so it can subsequently be —related‖ to the Census block group geographies (contained in the ShapeFiles). The basic functionality of the Access utility consists of: generating a required 12-character GeoID field, zero-filling the TRACTBNA field so it contains the required six-characters, populating the GeoID field by concantenating four fields (STATEFP, CNTY, TRACTBNA, and BLCKGR), and allowing you to select the order and field contents of the output DBF file.

Download the Access 2007 utility (1990DBF_Data_Processor.mdb) from the NPScape Sharepoint site (in the Population Measures folder) onto your local system. Double-click on the mdb in Windows Explorer to open the mdb. (If you receive any security warnings, please allow macros to run or enable the content to run—depending on your version of Access).

For example, select Enable this content in Access2007 as shown above.
In the dialog box, you‘ll need to specify just a few parameters to initiate the process: specify the directory where you downloaded the STF DBF files to, identify the *.stf prefix (stf1a0-9), and the desired output directory. Optionally, you can specify the order and content of fields in the output DBF file.



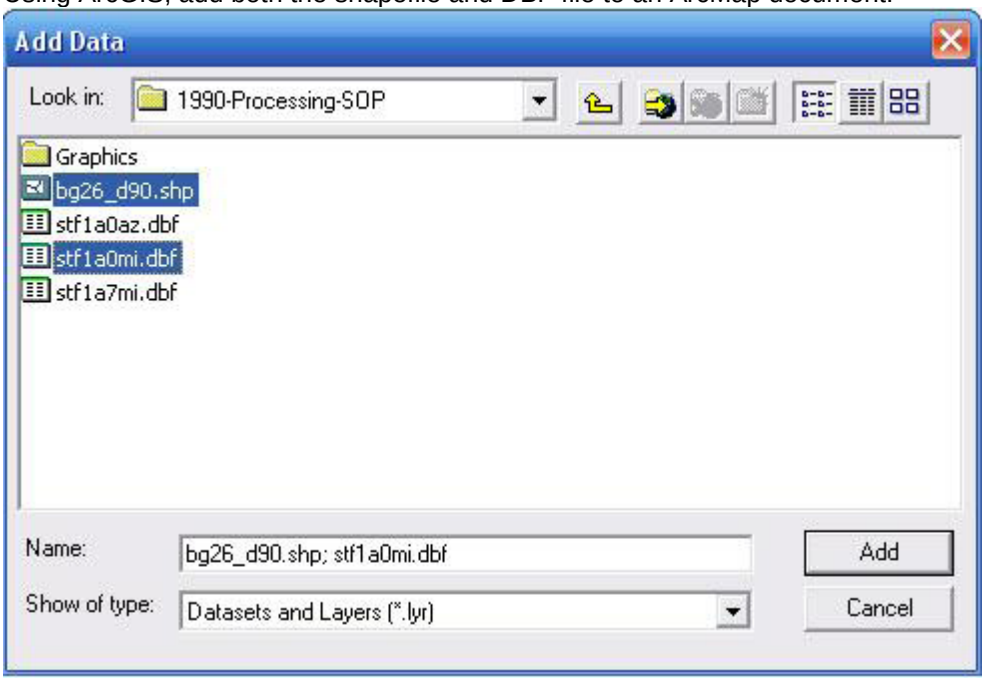
Click Start to initate the pre-processing. You'll be presented with a list of fields contained in the input DBF files and you can optionally select additional variables you'd like added to the output, specify new output field names, and control the desired order variables will be written to the output file.

Click Submit and the input files will processed and output files generated according to your specifications. File name prefixes will be with appended with the date (YYYYMMDD) so you can track results. Once the process is complete you'll receive an informational pop-up message.

Press OK to dismiss the message and optionally close the utility.

<u>Add State BlockGroup Shapefile and SF1 DBF file</u>

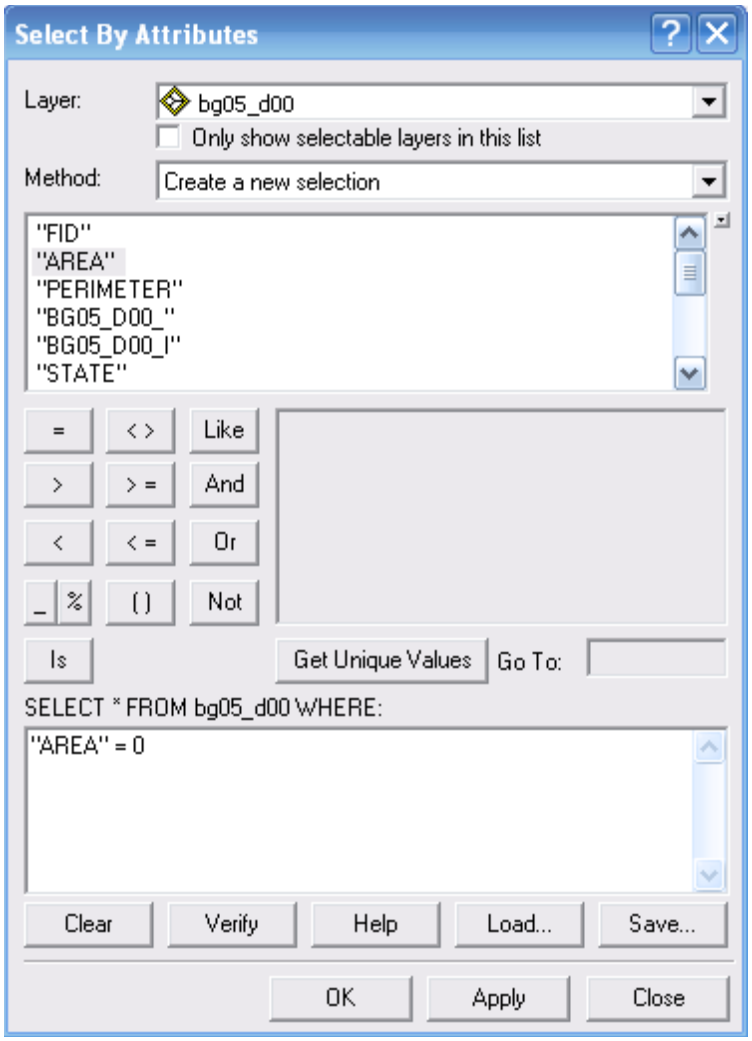
Using ArcGIS, add both the shapefile and DBF file to an ArcMap document.



Correct BlockGroup Shapefile Geometry Errors

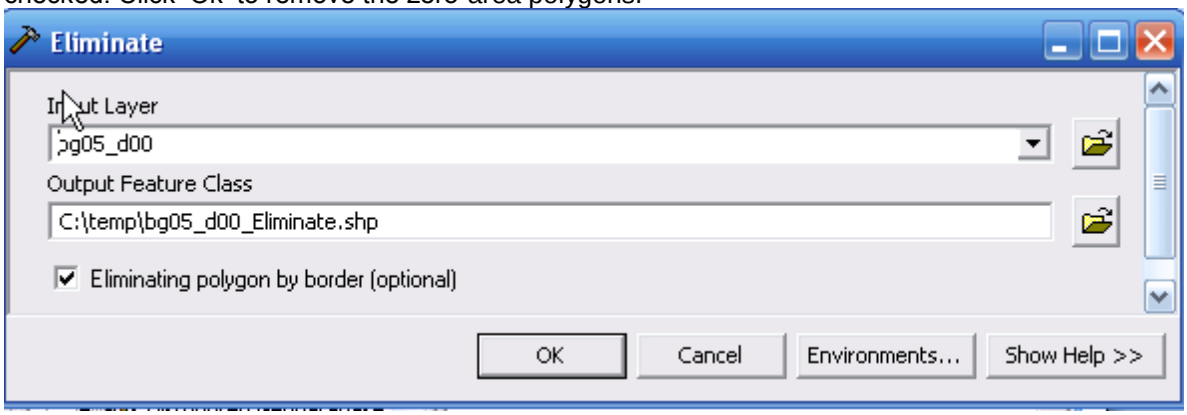
Occasionally, the state block group shapefile may contain errors in block group feature geometry. Block group polygons with zero area are not uncommon and single-part polygons for block groups may exist. These incorrect features must be removed since they will result in inflated population calculations.

1. Open the Select by Attributes tool from the Selection menu. Enter the following expression and click _OK‘.



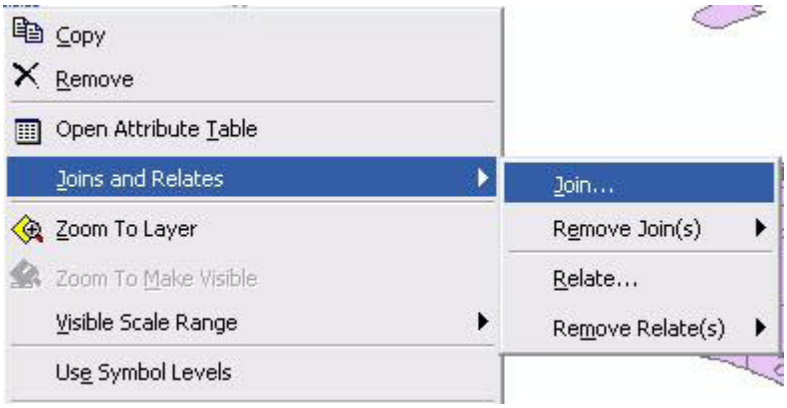
Right-click the shapefile in the table of contents and choose _Open Attribute Table‘. Click the _Selected‘ button to filter the selected records.

2. Do this step ONLY if one or more features are selected: open the Data Management Tools Generalization Eliminate tool from ArcToolbox. Populate the form as shown, being sure to change the name of the output feature class and that the _Eliminate polygons by border‘ is checked. Click ‘Ok‘ to remove the zero-area polygons.

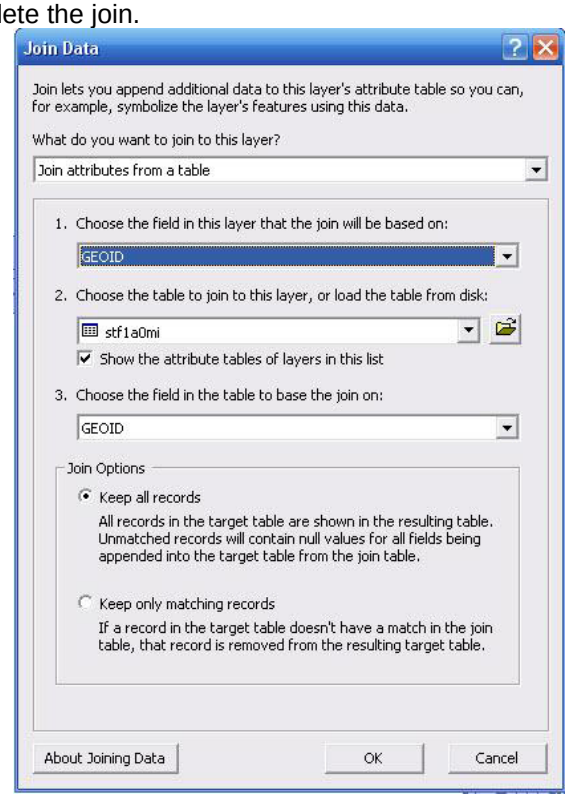


3. Clear selected features (even if none were selected in Step 3) by choosing _Clear Selected Features' from the Selection menu.
4. Some single-part polygon features may still be present in the shapefile. Remove them by running the Data Management → Generalization → Dissolve tool on the shapefile produced in step 4. *If you didn't need to run step 5, do the Dissolve using the bg<*>_d00.shp shapefile.* Name the output feature class: BlockGroupShape. Click the _Select All' button under the Dissolve Fields list. Then, un-select the following fields:
   FID, AREA, PERIMETER, BG<*>_D00_, BG<*>_D00_I

<u>Join SF1 Dbase content to Corrected Shapefile Dbase Table</u>
In ArcGIS, right-click on the corrected shapefile name in the table of contents and select Join and Relates > Join



In the Join Data form, specify the name of field in the shapefile the join will be based on (GEOID), the table to join to the layer (the desired stf1* DBF), and the field in the table to base the join on (again GEOID). Select OK to complete the join.

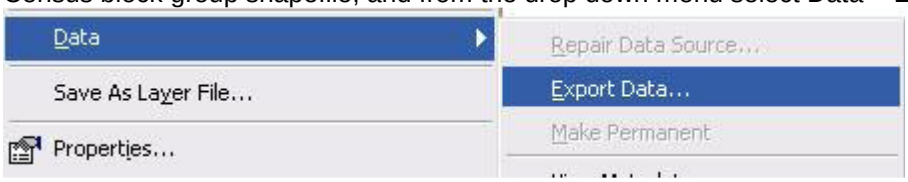


Verify the results of the join by reviewing the shapefile attribute table to see if the additional fields were appended to the end of the table.

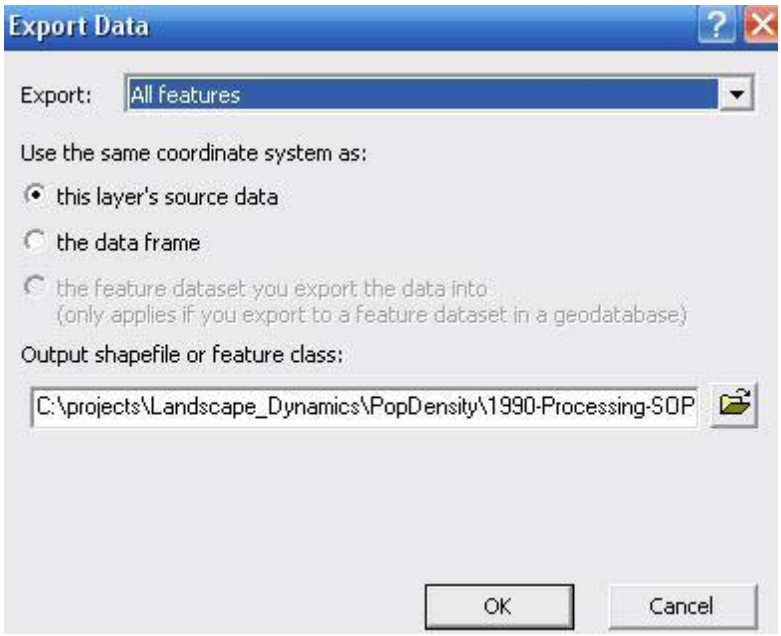
NOTE: You can replicate this process to append additional Census attributes to the shapefile by adding further stf1a# DBF files to your ArcMap project and repeating the Join Data steps described above.

Export Shapefile

To make the joined table —permanentll, export the joined shapefile to create a new shapefile titled "SS_Pop90.shp" where SS is the state acronym. In the table of contents, right-click on the downloaded Census block group shapefile, and from the drop down menu select Data > Export Map.



In the Export Data menu, specify that you want to export all the features, retain the original coordinate system parameters of the source shapefile, and specify the output directory and file name (ss_Pop90.shp). Select OK to complete the export.



Confirm that you would like to add the exported data to the map as a layer by clicking Yes on the confirmation pop-up.

Drop extra fields from shapefile attribute table

A number of extra, duplicate fields get added to the attribute table when the shapefile and Census variables are joined. You'll want to remove the duplicate fields to minimize file sizes and eliminate any confusion when others look at your data.

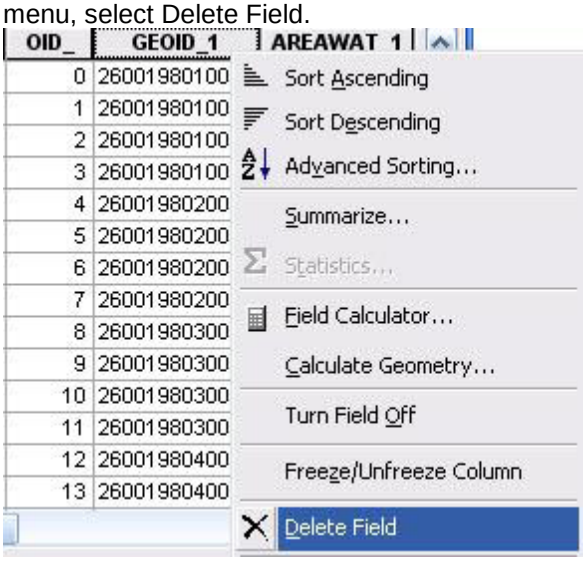
First open the attribute table by right-clicking on the new shapefile (ss_pop90.shp) and select open attribute table.

Locate the two duplicate fields in the attribute table; if the process worked properly you should only have OID_ and GEOID_1 that need to be removed.

Attributes of mi_pop90

SUBCLASS_	RINGS_OK	RINGS_NOK	ST	CO	TRACT	BG	GEOID	AREALAND	AREAWAT	AREATOT	NAME	OID_	GEOID_1
661	1	0	26	001	980100	1	260019801001	114.885	2.521	117.406	BG 1	0	260019801001
679	1	0	26	001	980100	2	260019801002	55.562	0.002	55.564	BG 2	1	260019801002
756	1	0	26	001	980100	3	260019801003	13.575	0.024	13.599	BG 3	2	260019801003
778	1	0	26	001	980100	4	260019801004	20.14	0.067	20.207	BG 4	3	260019801004
656	1	0	26	001	980200	1	260019802001	87.451	9.651	97.102	BG 1	4	260019802001
657	1	0	26	001	980200	2	260019802002	2.347	11.94	14.287	BG 2	5	260019802002
674	1	0	26	001	980200	3	260019802003	2.412	7.469	9.881	BG 3	6	260019802003
681	1	0	26	001	980200	4	260019802004	35.228	0.873	36.101	BG 4	7	260019802004

Right click on the field name for one of the attributes in the shapefile attribute table. From the drop down menu, select Delete Field.



Confirm the deletion by clicking on Yes when the pop-up message appears. Repeat the process to remove other duplicate fields as needed.

<u>Quality Control</u>

Verify All Block Groups Have a Value

Open the shapefile attribute table and make sure all the records have Census variables added.

Aggregate Numbers to the County Level and Compare with Official Census Figures
To ensure the calculations are correct, navigate to http://quickfacts.census.gov/qfd/index.html and determine the census calculated values.

Appendix 8: Polygon value comparisons

Attributes in Output Feature Classes

Description and distinctions between feature attributes depending on the tool processing options used. Feature classes clipped to the AOA (pddYYYY_Clip) will have modified total areas, modified corrected block group area, and modified population density values in polygons that intersect the AOA boundary. Erased feature classes (pddYYYY_*_AllErased) will have modified corrected Census block group area values and modified population density values (**see also Figure 8A below**).*

Attribute	Description	pddYYYY^	pddYYYY_Clip^^	pddYYYY_AllErased^§	pddYYYY_Clip_AllErased^^§
CBPOP_TOT	Total population calculated from selected population parameter	Original Census Block population value	Original Census Block population value	Original Census Block population value	Original Census Block population value
CBA_TOT	Calculated total area of block group polygon (km^2)	Original census block area calculation	Original census block area calculation	Original census block area calculation	Original census block area calculation
CCBAP_TOT	Corrected block group area total (km^2); *may be reduced by optional erase process*	*EQUAL* to CBA_TOT	**CAN BE:** *LESS* than CBA_TOT **OR** *EQUAL* to CBA_TOT	*LESS* than CBA_TOT *in erased polygons* *EQUAL* to CBA_TOT *in polygons with no erased features*	*LESS* than CBA_TOT *for polygons with erased features*
CCBAF_TOT*	Corrected block group area (km^2)*; reduced by optional erase process and/or optional Census water area subtraction*	*LESS* than CCBAP_TOT *for polygons reduced by Census water area*	*Whether reduced by census water area subtraction or not,* **CAN BE:** *LESS* than CCBAP_TOT **OR** *EQUAL* to CCBAP_TOT	*LESS* than CCBAP_TOT *for polygons reduced by Census water area and also erased* *EQUAL* to CCBAP_TOT *for polygons with no Census water area reduction or erased features*	*LESS* than CCBAP_TOT *for polygons with census water reduction;* *EQUAL* to CCBAP_TOT *for polygons with no census water present, or if census water not used*
AWPD_P	area-weighted population density for corrected block group area (partially adjusted); *area reduced by optional erase process*	LESS than AWPD_F if *Census water area is subtracted*	N/A	*EQUAL* to AWPD_F *if Census water area is not used* *LESS* than AWPD_F *if Census water area IS used*	N/A
AWPD_F**	area-weighted population density for corrected block group area (fully adjusted); *area reduced by*	*MORE* than *AWPD_P for polygons reduced by Census water area (area decreases)*	N/A	*EQUAL* to AWPD_P *if Census water area is not used;*	N/A

	optional erase process and increased by optional water area subtraction			*MORE* than AWPD_P *if Census water area IS used (area decreases)*	
AWP_P	area-weighted population for corrected block group area; *area reduced by optional erase process*	*EQUAL* to CBPOP_TOT	N/A	*LESS* than CBPOP_TOT *when reduced by erase process*	N/A
AWP_F***	area-weighted population for corrected block group area; *area reduced by optional erase process and optional water area subtraction*	**CAN BE:** *EQUAL* to AWP_P *if Census water area is not used or not present;* **OR** *LESS* than AWP_P *for polygons reduced by Census water area*	N/A	*LESS* than AWP_P *When reduced by erase process and/or reduced by Census water area* *EQUAL* to AWP_P *if Census water area not used or not present*	N/A
CBA_TOT_AOA	Calculated total area of block group polygon within AOA (km^2)	N/A	**CAN BE:** *LESS* than CBA_TOT *if polygon clipped to AOA boundary* **OR** *EQUAL* to CBA_TOT *if polygon not clipped to AOA boundary*	N/A	**CAN BE:** *LESS* than CBA_TOT *for polygons clipped to AOA boundary* **OR** *EQUAL* to CBA_TOT *for polygons not clipped to AOA boundary*
CCBAP_AOA	Corrected block group area within AOA (km^2); *reduced by optional erase process*	N/A	*EQUAL* to CBA_TOT_AOA	N/A	*LESS* than CBA_TOT_AOA *if reduced by Census water area* *EQUAL* to CBA_TOT_AOA *if Census water area not used or not present*
CCBAF_AOA *	Corrected block group area within AOA (km^2); *reduced by optional erase process and optional Census water area subtraction*	N/A	*LESS* than CCBAP_AOA *if reduced by Census water area* *EQUAL* to CCBAP_AOA *if no Census water area used or present*	N/A	*LESS* than CCBAP_AOA *if reduced by Census water area* *EQUAL* to CCBAP_AOA *if Census water not used or not present*
AWPD_P_AOA	area-weighted population density for corrected block group area within AOA; *area reduced by optional erase process*	N/A	*LESS* than AWPD_F_AOA *in clipped polygons* *EQUAL* to AWPD_F_AOA *in unclipped polygons*	N/A	*LESS* than AWPD_F_AOA *in clipped polygons* *EQUAL* to AWPD_F_AOA *in unclipped polygons*

AWPD_F_AOA**	area-weighted population density for corrected block group area within AOA; *area reduced by optional erase process and optional water area subtraction*	N/A	*MORE* than AWPD_P_AOA *for clipped polygons reduced by Census water area* *EQUAL* to AWPD_P_AOA *for unclipped polygons*	N/A	*MORE* than AWPD_P_AOA *if reduced by Census water area* *EQUAL* to AWPD_P_AOA *if Census water not used or not present*
AWP_P_AOA	area-weighted population for corrected block group area within AOA; *area reduced by optional erase process*	N/A	*EQUAL* to AWP_F_AOA *if Census water area is not used;*	N/A	*LESS* than AWP_F_AOA *if reduced by Census water area* *EQUAL* to AWP_F_AOA *if Census water area not used or not present*
AWP_F_AOA***	area-weighted population for corrected block group area within AOA; *area reduced by optional erase process and optional water area subtraction*	N/A	*EQUAL* to AWP_P_AOA *if Census water area is not used;* *LESS* than AWP_P_AOA *for polygons reduced by Census water area*	N/A	*EQUAL* to AWP_P_AOA *if Census water area is not used;* *MORE* than AWP_P_AOA *for polygons reduced by Census water area;* *LESS* than AWP_P_AOA *if reduced by Census water area* ***and*** *erase features are present*
CBA_W	Census-reported area of water in block group (km^2)	If Census water area subtraction is used	If Census water area subtraction is used	If Census water area subtraction is used	If Census water area subtraction is used
CBA_W_AOA	Census-reported area of water in block group (km^2); adjusted for area within AOA	N/A	If Census water area subtraction is used	N/A	If Census water area subtraction is used

^ All Census Blocks that intersect the boundary of the AOA of interest
^^ All Census Blocks that intersect the boundary of the AOA of interest and clipped to the boundary of the AOA; final output when no erase process is used
^§ All Census Blocks that intersect the boundary of the AOA of interest with erase features removed
^^§ All Census Blocks that intersect the boundary of the AOA of interest and clipped to the boundary of the AOA and erased features removed; final output when an erase process is used
***** Census water area adjustment results in CCBAF_TOT being **LESS** than CCBAP_TOT or CCBAF_AOA being **LESS** than CCBAP_AOA
****** Census water area adjustment results in AWPD_F_AOA being less than AWPD_F
******* Census water area adjustment results in AWP_F_AOA being less than AWP_F
NOTE: *When Census Water is subtracted, and an Erase layer is used, there is a chance CCBAF_TOT could result in a negative value. The script runs a check and if that occurs, the script automatically replaces the negative CCBAF_TOT value with the positive CCBAP_TOT so as to prevent a negative population density value.*

***Figure 8A**: Comparison of values in the four features classes, when Census water is subtracted, and an erase feature is used. Highlighted row in each feature class is the same block group polygon and illustrates the various differences. Note that CBPOP_TOT and CBA_TOT remain the same in all four feature classes.*

pdd1990_REDW

PC_HIGHSCH	PC_BACHDEG	SAMEHOUSE	BUILT_1939	MEDYRBUILT	HIGHMORTG	HIGHRENT	Shape_Length	Shape_Area	CBPOP_TOT	CBA_TOT	CCBAP_TOT	CCBAF_TOT	CBA_W	AWPD_P	AWPD_F	AWP_P	AWP_F	AOA_NAME
73.4	10.9	40.4	99	1966	15.3	47.6	253940.79868	1483200971.917023	1160	1483.201	1483.201	1482.955	0.246	0.782092	0.782222	1160	1159.808	redw - REDW
84.7	15.3	58.6	32	1973	14.4	22.1	175127.644735	928172391.894159	685	928.1724	928.1724	928.1254	0.047	0.738009	0.738047	685	684.9653	redw - REDW
73.5	10.9	41.1	22	1970	14.7	14.9	102317.500629	173349502.917897	1209	173.3495	173.3495	126.4115	46.938	6.974349	9.564003	1209	881.638	redw - REDW
55.1	3.2	57.9	59	1972	9.8	24.8	17891.749967	9224233.148112	816	9.224233	9.224233	9.224233	0	88.46265	88.46265	816	816	redw - REDW
71.9	6.8	48.8	91	1974	14	40.7	65610.582663	64221367.524732	1253	64.22137	64.22137	64.22137	157.02	19.51064	19.51064	1253	1253	redw - REDW
70.3	9.4	29.5	25	1968	36.4	8.5	256946.560148	1812190212.699743	719	1812.19	1812.19	1809.789	2.401	0.396757	0.397284	719	718.0474	redw - REDW
84.7	28.1	60.6	49	1969	12.1	0	248592.161693	650523524.757893	752	650.5235	650.5235	525.0235	125.5	1.155992	1.432317	752	606.923	redw - REDW

2 (1 out of 75 Selected)

pdd1990_REDW

pdd1990_REDW_Clip

HIGHMORTG	HIGHRENT	CBPOP_TOT	CBA_TOT	CCBAP_TOT	CCBAF_TOT	CBA_W	Shape_Length	Shape_Area	CBA_TOT_AOA	CCBAP_AOA	CCBAF_AOA	CBA_W_AOA	AWPD_P_AOA	AWPD_F_AOA	AWP_P_AOA	AWP_F_AOA	AOA_NAME
15.3	47.6	1160	1483.201	1483.201	1482.955	0.246	24463.484033	14894182.928086	14.89418	14.89418	14.89171	0.00247	0.782092	0.782222	11.64863	11.64863	redw - REDW
14.4	22.1	685	928.1724	928.1724	928.1254	0.047	141005.345869	705416803.385334	705.4168	705.4168	705.3811	0.03572	0.738009	0.738047	520.6043	520.6043	redw - REDW
14.7	14.9	1209	173.3495	173.3495	126.4115	46.938	102317.500629	173349502.917897	173.3495	173.3495	126.4115	46.938	6.974349	9.564003	1209	1209	redw - REDW
9.8	24.8	816	9.224233	9.224233	9.224233	0	17891.749967	9224233.148112	9.224233	9.224233	9.224233	0	88.46265	88.46265	816	816	redw - REDW
14	40.7	1253	64.22137	64.22137	64.22137	157.02	65610.582663	64221367.524732	64.22137	64.22137	64.22137	157.02	19.51064	19.51064	1253	1253	redw - REDW
36.4	8.5	719	1812.19	1812.19	1809.789	2.401	50311.12493	28093460.033983	28.09346	28.09346	28.05624	0.037221	0.396757	0.397284	11.14629	11.14629	redw - REDW
12.1	0	752	650.5235	650.5235	525.0235	125.5	243387.229422	644253669.009714	644.2537	644.2537	519.9633	124.2904	1.155992	1.432317	744.7521	744.7521	redw - REDW

2 (1 out of 75 Selected)

pdd1990_REDW_Clip

pdd1990_REDW_AllErased

PC_HIGHSCH	PC_BACHDEG	SAMEHOUSE	BUILT_1939	MEDYRBUILT	HIGHMORTG	HIGHRENT	CBPOP_TOT	CBA_TOT	CCBAP_TOT	CCBAF_TOT	CBA_W	Shape_Length	Shape_Area	AWPD_P	AWPD_F	AWP_P	AWP_F	AOA_NAME
73.4	10.9	40.4	99	1966	15.3	47.6	1160	1483.201	1483.201	1483.201	<Null>	284605.15861	1269342642.233158	<Null>	<Null>	<Null>	<Null>	<Null>
84.7	15.3	58.6	32	1973	14.4	22.1	685	928.1724	879.4628	879.4158	0.047	197650.837003	879462859.108474	0.778884	0.778926	649.0519	649.0172	redw - REDW
73.5	10.9	41.1	22	1970	14.7	14.9	1209	173.3495	169.8845	122.9465	46.938	112654.713508	169884463.409303	7.116601	9.833549	1184.834	857.4716	redw - REDW
55.1	3.2	57.9	59	1972	9.8	24.8	816	9.224233	9.224233	9.224233	0	17891.749967	9224233.148112	88.46265	88.46265	816	816	redw - REDW
71.9	6.8	48.8	91	1974	14	40.7	1253	64.22137	41.51108	41.51108	157.02	99547.770195	41511080.004242	30.18471	30.18471	809.9078	809.9078	redw - REDW
70.3	9.4	29.5	25	1968	36.4	8.5	719	1812.19	1671.404	1669.003	2.401	411699.878786	1671404470.702796	0.430177	0.430796	663.1422	662.1896	redw - REDW
84.7	28.1	60.6	49	1969	12.1	0	752	650.5235	369.1446	243.6446	125.5	243654.211897	369144580.551629	2.037142	3.086463	426.7282	281.6512	redw - REDW

2 (1 out of 75 Selected)

pdd1990_REDW_AllErased

pdd1990_REDW_Clip_AllErased

HIGHMORTG	HIGHRENT	CBPOP_TOT	CBA_TOT	CCBAP_TOT	CCBAF_TOT	CBA_W	Shape_Length	Shape_Area	CBA_TOT_AOA	CCBAP_AOA	CCBAF_AOA	CBA_W_AOA	AWPD_P_AOA	AWPD_F_AOA	AWP_P_AOA	AWP_F_AOA	AOA_NAME
14.4	22.1	685	928.1724	879.4628	879.4158	0.047	154499.652351	670497282.880392	705.4168	670.4973	670.4615	0.03572	0.778884	0.778926	522.2399	522.2401	redw - REDW
14.7	14.9	1209	173.3495	169.8845	122.9465	46.938	112654.713508	169884463.409303	173.3495	169.8845	122.9465	46.938	7.116601	9.833549	1209	1209	redw - REDW
9.8	24.8	816	9.224233	9.224233	9.224233	0	17891.749967	9224233.148112	9.224233	9.224233	9.224233	0	88.46265	88.46265	816	816	redw - REDW
14	40.7	1253	64.22137	41.51108	41.51108	157.02	99547.770195	41511080.004242	64.22137	41.51108	41.51108	157.02	30.18471	30.18471	1253	1253	redw - REDW
36.4	8.5	719	1812.19	1671.404	1669.003	2.401	28383.731827	21596543.741999	28.09346	21.59654	21.55932	0.037221	0.430177	0.430796	9.29034	9.28767	redw - REDW
12.1	0	752	650.5235	369.1446	243.6446	125.5	241313.722484	368636540.948554	644.2537	368.6365	244.3461	124.2904	2.037142	3.086463	750.965	754.1653	redw - REDW
17.6	48.7	3522	14.69958	13.22927	13.22927	0	22419.139996	13229269.470477	14.69958	13.22927	13.22927	0	266.2279	266.2279	3522	3522	redw - REDW

1 (1 out of 74 Selected)

pdd1990_REDW_Clip_AllErased