



National Park Service  
U.S. Department of the Interior

Natural Resource Stewardship and Science

# NPS I&M Standard Operating Procedure: Processing TIGER Road Source Data for Landscape Dynamics

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## Summary

Steps for obtaining and processing source TIGER Line Road data from the U.S. Census Bureau, for use with Landscape Dynamics.

| Version History      |                  |         |         |        |                     |
|----------------------|------------------|---------|---------|--------|---------------------|
| Previous Version No. | Date of Revision | Changes | Made by | Reason | Updated Version No. |
| xx.xx                | YYYYMMDD         | What    | Who     | Why    | xx.xx               |
|                      |                  |         |         |        |                     |
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|                      |                  |         |         |        |                     |

1. Version numbers increase incrementally by tenths (e.g., version 1.1, version 1.2, ...etc) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0 ...). Record the previous version number, date of revision, author of the revision, identify paragraphs and pages where changes are made, and the reason for making the changes along with the new version number.

2. Post new versions on the internet and forward copies to all individuals with a previous version of the SOP.

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## Overview

TIGER Line Road data comes from the United States Census Bureau and is updated continually throughout the year, having been released yearly since 2007. Data exists before 2007 but is stored in ASCII format. Since 2007 the data has been available in FTP via shapefile by county, or GBD by state/national level. TIGER Line Road attributes as released now, were standardized in 2002(MTFCC). While GBD is desired, other uses may determine shapefile to be sufficient. TIGER road data exists for United States' states and territories and islands and counties. Through the use of scripting, and general data preparation, the data will be broken into various NPS-relevant geographies for use in analysis or visualization of those geographies; this includes Alaska, Continental US (CONUS, including Puerto Rico and the US Virgin Islands), Hawaii, Guam, Commonwealth of the Northern Mariana Islands, and American Samoa.

In addition to other NPS mission driven analyses, TIGER road source data is used in Landscape Dynamics to create road density summary statistics for various IMD parks and their related AOAs. If road data for areas extending into Canada or Mexico is required, custom road data will need to be sourced. Please see SOP\_LD\_Custom\_Source\_Data\_DRAFT.docx for more information on requirements for submitting custom road source data.

## Requirements

ESRI ArcMap 10.2 or greater

Match existing standards for Landscape Dynamics analytical input as outlined in this SOP pertaining to source for road data, attributes desired, SRS (Spatial Reference System) and naming conventions.

Based on geographical location, standard spatial reference for output data is as follows:

|                |                                                                                               |
|----------------|-----------------------------------------------------------------------------------------------|
| Alaska         | Alaska Albers Equal Area Conic (NAD83)                                                        |
| CONUS          | USA Contiguous Albers Equal Area Conic USGS (NAD83; Puerto Rico and US Virgin Islands (USVI)) |
| Hawaii         | UTM Zone 5N NAD83                                                                             |
| American Samoa | NAD_1983_HARN_UTM_Zone_2S (WGS_1984_(ITRF00)_To_NAD_1983 + WGS_1984_(ITRF00)_To_NAD1983_HARN) |
| Guam           | WGS_1984_UTM_Zone_55N (WGS_1984_(ITRF00)_To_NAD_1983))                                        |
| CNMI           | WGS_1984_UTM_Zone_55N (WGS_1984_(ITRF00)_To_NAD_1983))                                        |

## Pre-Processing

### Obtain Source data

Collect source data via the U.S. Census Bureau. The data is provided in shapefile and GDB format. GDB format is advised due to its high efficiency storage, ability to run processes, and since a single file contains all data across U.S. states, and territories. However, some releases are only Shapefile, in which case, use Shapefile and process. Begin by understanding ones end-product; nation-based or custom. For datasets encompassing the entire country, and territories, it is advised to use a Boundary Dataset. These are referenced at the end of the pre-processing section. The U.S. Census Bureau site contains links to nearly every GDB release, as well as break downs of the shapefiles available. If running a custom AOA, shapefiles will suffice, however, if preparing large country wide datasets, it is highly advised to use GDB versions where available.

Datasets released, per year, will match. The releases per county are the same as the state release, which are also the same as the country wide release. When analyzing items to include and download, remember to locate the territories and confirm that these exist correctly in the desired dataset/format. The territories have FIPS codes, but are occasionally sequestered to a territory section on the FTP. Items can be downloaded from the website or the FTP, whichever suits ones needs better.

1. Shapefile format:
  - a. <https://www.census.gov/geo/maps-data/data/tiger-line.html>
2. Geodatabase format:
  - a. <https://www.census.gov/geo/maps-data/data/tiger-geodatabases.html>
3. TIGER FTP address (all Years)
  - a. <ftp://ftp2.census.gov/geo/tiger>

### **2015 SPECIFIC STEPS:**

1. Accessing the ftp directly is the quickest way to collect data.
2. FTP
  - a. By county:
    - i. <ftp://ftp2.census.gov/geo/tiger/TIGER2015/ROADS/>
  - b. National Level:
    - i. <ftp://ftp2.census.gov/geo/tiger/TIGR2015/>
3. Steps to download data:
  - a. Locate FTP TIGER Roads most recent release. Data is released yearly, and updated throughout the year. However, you can only collect data on a per-year basis.
    - i. Click link and download in GDB format.
    - ii. [ftp://ftp2.census.gov/geo/tiger/TIGR2015/tl\\_2015\\_us\\_roads.gdb.zip](ftp://ftp2.census.gov/geo/tiger/TIGR2015/tl_2015_us_roads.gdb.zip)
  - b. Locate Primary Roads dataset (if desired)
    - i. Primary roads data is a subset of the Roads dataset containing Interstates, Highways, and State Highways.
    - ii. Primary roads dataset is released as a shapefile.
    - iii. [ftp://ftp2.census.gov/geo/tiger/TIGER2015/PRIMARYROADS/tl\\_2015\\_us\\_primaryroads.zip](ftp://ftp2.census.gov/geo/tiger/TIGER2015/PRIMARYROADS/tl_2015_us_primaryroads.zip)
  - c. Locate Precise Roads (if desired)
    - i. Precise roads is a subset of the Roads dataset that includes primary roads as well as county highways, major highways, and other state roadways.
    - ii. State based dataset, commonly released as a shapefile.
    - iii. <ftp://ftp2.census.gov/geo/tiger/TIGER2015/PRISEROADS>

### Boundary Datasets

The following are overview files used for general understanding of boundaries and *Geographic Extents*. (known as ProcessRegions in scripts and Python toolboxes). This may include the number of counties and states and territories currently available or available in the past, and how they relate to the road data as it exists on the Census FTP. Census products are named based on FIPS codes at the time of collection, boundary datasets are thus useful to isolate changes, and file counts. Overview files are used for quality control, and can be referenced throughout data collection. For example the state FIPS code is used as entry into the 2010 TIGER extract script to create a set of ~56 feature classes. They can be referenced for quality control when processing and collecting data across ~3000+ counties and territories. They are available on the U.S. Census Bureau FTP or on the website directly. All items are organized on the FTP according to year released.

Files used to collect data based on specific geographic extents (ProcessRegions OR geographic extent used interchangeable throughout) include the following. All items are organized on the FTP according to year released. See above section for FTP and website links.

1. 2015
  - a. tl\_2015\_us\_state
  - b. cb\_2014\_us\_state\_500k
2. 2010
  - a. tl\_2010\_us\_county10
  - b. tl\_2010\_us\_state10
3. 2007
  - a. fe\_2007\_us\_county
  - b. fe\_2007\_us\_state

## **Processing & Procedures**

### **TIGER 2015 Processing Steps**

Data processed for 2015 was processed manually, while data processed for 2010, and 2007 was scripted. It depends on the amount of data, and year released which method will suffice. It is highly advised to work locally, not on the network, when processing data. Once a dataset has met the standards set for final QC, place this dataset in the scratch folder. 2015 was processed based on ProcessRegions and the Boundary Dataset listed above. ProcessRegions as follows Alaska, CONUS, GuamSaipan, Hawaii, Samoa.

Below is the *ProcessRegion* name, followed by the associated states or territories.

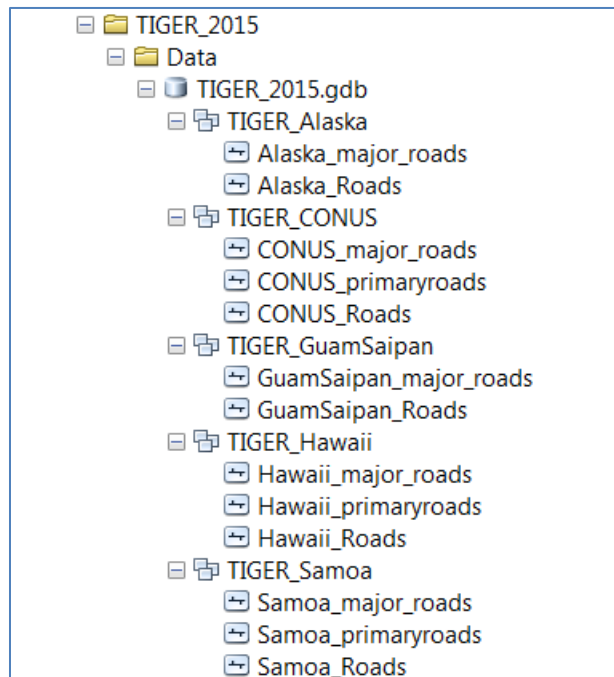
- *Alaska* includes Alaska (AK) only
- *CONUS* includes the contiguous United States, Puerto Rico (PR) and the U.S. Virgin Islands (USVI)
- *GuamSaipan* includes Guam (GU) and the Commonwealth Northern Mariana Islands (CNMI)
- *Hawaii* includes Hawaii (HI) only
- *Samoa* includes American Samoa (AS) only

### **2015 SPECIFIC STEPS:**

1. Select roads based on ProcessRegion from Boundary Dataset listed above. Create Layer based on selected features, and export. Repeat this step for each ProcessRegion.
2. Run Project on each new file created and output to necessary SRS as referenced in the **Requirements** section, and in Example 2.

3. Run Definition Query on the output of the Project tool to create each subsequent dataset.
  - a. MFTCC = 'S1100' (Query for primary roads)
  - b. MFTCC = 'S1100' AND MFTCC = 'S1200' (Query for major roads or precise roads)
  - c. MFTCC Like 'S%' (Query for all Roads, hint all features should be returned)
4. Working directory/GDB should now contain 15 datasets.
  - a. Datasets only exist *IF* the query returns <true>
5. Begin building final GDB.
6. Create 5 Feature Datasets
  - a. Table below has FeatureDataset names in **BOLD**. (Example 2)
    - i. SET Projection to desired projection upon feature dataset creation.
    - b. Each item below the **BOLD** heading is the FeatureClass name.
7. Import each 3 ProcessRegion, re-projected, query based, exported Feature Classes; into each Feature Dataset.

Example 1: Standard naming conventions as applied to TIGER Line 2015 GDB, Feature Datasets, Feature Classes as viewed in an ESRI file geodatabase structure.



Example 2: Standard naming conventions as applied to Feature Datasets, Feature Classes, and ESRI Projection string.

- a. **TIGER\_Alaska** = NAD\_1983\_Alaska\_Albers (Alaska Albers Equal Area Conic).
  - i. Alaska\_Roads
  - ii. Alaska\_primaryroads
  - iii. Alaska\_major\_roads
- b. **TIGER\_CONUS** = USA\_Contiguous\_Albers\_Equal\_Area\_Conic\_USGS\_version
  - i. CONUS\_Roads
  - ii. CONUS\_Primaryroads
  - iii. CONUS\_major\_roads
- c. **TIGER\_GuamSaipan** = WGS\_1984\_UTM\_Zone\_55N
  1. Specific transformations listed below (most accurate NAD83 to WGS84)
  - i. GuamSaipan\_Roads

- ii. GuamSaipan\_primaryroads
  - iii. GuamSaipan\_major\_roads
- d. **TIGER\_Hawaii** = NAD\_1983\_UTM\_Zone\_5N
  - i. Hawaii\_Roads
  - ii. Hawaii\_primaryroads
  - iii. Hawaii\_major\_roads
- e. **TIGER\_Samoa** = NAD\_1983\_HARN\_UTM\_Zone\_2S
  - 1. Specific transformations listed below (specific to NAD83 to HARN)
  - ii. Samoa\_Roads
  - iii. Samoa\_primaryroads
  - iv. Samoa\_major\_roads

Transformations applied:

**starting to ending projection**

followed by the transformation name

#### **NAD 1983 to NAD HARN**

WGS\_1984\_(ITRF00)\_To\_NAD\_1983 + WGS\_1984\_(ITRF00)\_To\_NAD1983\_HARN

#### **NAD 1983 to WGS 1984**

WGS\_1984\_(ITRF00)\_To\_NAD\_1983

The Following is a short summary of collection and processing steps for previous years' data.

#### **2010 SPECIFIC STEPS:**

1. FTP
  - a. Data is available as FIPS based shapefile, zipped, with only "Roads" in the dataset
    - i. Roads implies [MTFCC] like 'S%'
  - b. <ftp://ftp2.census.gov/geo/tiger/TIGER2010/ROADS/>
    - i. Download shapes in efficient manner, ie one state at a time, alphabetical...etc
    - ii. Data must be downloaded on a per state, and per county basis.
2. Run script below see **Appendix 2** for more information.
  - a. Script 1 extracts shapefiles from .zip, imports into a feature class for efficiency, builds a single road dataset per state FIPS code.
    - i. "X:\ProjectData\NPSCAPE\DATA\Scratch\TIGER\_Roads\TIGER\_2010\Products\Scripts\extract\_from\_shape\_roads\_2010.py"
  - b. Script 2 projects FIPS based roads to standardized SRS, builds 3 new road datasets based on road type, appends final products to 2010 Tiger GDB road datasets.
    - i. "X:\ProjectData\NPSCAPE\DATA\Scratch\TIGER\_Roads\TIGER\_2010\Products\Scripts\build\_roads\_2010\_GDB.py"
  - c. Follow steps to match 2015 data projection, separation, names, format, etc for further processing. (Script based)

#### **2007 SPECIFIC STEPS:**

1. FTP
  - a. Data is available only as FIPS based shapefile, zipped, as "edges" dataset
    - i. The edges dataset is not separated, it includes all "lines" on a per county basis
    - ii. The edges dataset needs further processing to separate out only Roads.
  - b. <ftp://ftp2.census.gov/geo/tiger/TIGER2007FE/>
    - iii. Data must be downloaded on a per state, and per county basis.
    - iv. The following query can be used within an FTP application: ( \*\_edges.zip )
2. Run script below, see **Appendix 3** for more information.
  - c. "X:\ProjectData\NPSCAPE\DATA\Scratch\TIGER\_Roads\TIGER\_2007\Products\Scripts\extract\_and\_build\_roads\_2007\_GDB.py"

- d. Follow steps to match 2015 data projection, separation, names, format, etc for further processing.
  - i. Hawaii – Island of Oahu delivered with no projection, metadata lists projection as same as contiguous U.S., AK, PR, and VI. Set projection to GCS NAD83.
  - ii. Ref: Appendix 3, Section B) for more information.

See **Appendices** for specific steps to create datasets, and/or useful scripts.

## Post-Processing

Scratch folder can be used for holding, and acceptance:  
 X:\ProjectData\NPSCAPE\DATA\Scratch\TIGER\_Roads

Move final GDB\_products to respective network directory:

X:\ProjectData\NPSCAPE\DATA\SourceData\USData\Transportation\TIGER\_2015  
 X:\ProjectData\NPSCAPE\DATA\SourceData\USData\Transportation\TIGER\_2010  
 X:\ProjectData\NPSCAPE\DATA\SourceData\USData\Transportation\TIGER\_2007  
 ...etc

## EDIT Metadata:

Import metadata from other files, such as a source file, if metadata needs to be updated.

Ref:

"X:\ProjectData\NPSCAPE\Products\SOP\NEW\_SOPs\SOP\_Update\_Metadata\_on\_SDE\_SOP\_DRAFT.docx"

"X:\ProjectData\NPSCAPE\DATA\Scratch\TIGER\_Roads\TIGER\_Roads\_SOP\_Draft.docx"

## Literature Cited

Trainor, Timothy F. *The MAF/TIGER Enhancement Program: The Mechanics and Maintenance of Large-scale National Spatial Database*. Whitepaper.MAF\_TIGER\_update\_whitepaper1.pdf

*United States National Map Accuracy Standards*. By the U.S. Bureau of the Budget. 1947.  
 NatMAP\_Standards\_647.PDF

2015 TIGER/Line Shapefiles (machine-readable data files)/ prepared by the U.S. Census Bureau, 2015.

2015 TIGER/Line Shapefiles *Technical Documentation*/prepared by the U.S. Census Bureau, 2015.  
 TIGER2015\_TechDoc.pdf  
 FunctionalStatusCodes.pdf  
 MAF\_TIGER\_CODES\_mtfccs.pdf  
 RouteTypeCode.pdf  
 TIGER2015\_GDB\_Record\_Layouts.pdf

2010 TIGER /Line Shapefiles [machine-readable data files]/prepared by the U.S. Census Bureau, 2012.

2010 TIGER/Line Shapefiles *Technical Documentation*/prepared by the U.S. Census Bureau, 2012.  
 TIGER\_2010\_TechDoc.pdf

2007 TIGER/Line Shapefiles [machine-readable data files]/prepared by the U.S. Census Bureau, 2008.

2007 TIGER/Line Shapefiles *Technical Documentation*/prepared by the U.S. Census Bureau, 2008.  
 TIGER\_Line\_2007\_FE\_TechDoc.pdf

## Appendices

### Appendix 1: Additional TIGER 2015 Road Data Information

Dataset Properties, 2015: (new datasets will match 2015 going forward)

1. Roads (Definition Query)(MTFCC LIKE 'S%')
  - a. Attributes available:
    - i. RTTYP - Route Type Code
    - ii. MTFCC - MAF/TIGER feature class code
    - iii. PREQUAL - Prefix qualifier
    - iv. PREDIR - Prefix direction description component
    - v. PRETYP - prefix type code description component of the feature name
    - vi. SUFTYP - suffix type code description component of the feature name
    - vii. SUFDIR - suffix direction code component of the feature name
    - viii. SUFQUAL - suffix qualifier code component of the feature name
  - b. Most useful attribute:
    - i. MTFCC (MAF/TIGER feature class code)
    - ii. Use this PDF to identify various codes that can be excluded from analysis.
    - iii. "X:\ProjectData\NPScene\DATA\Scratch\TIGER\_Roads\metadata\MAF\_TIGER\_CODES\_mtfccs.pdf"
2. tl\_2015\_us\_primaryroads (Definition Query) (MTFCC = 'S1100')
  - a. Dataset placed in national gdb
  - b. Subset of Roads that includes:
    - i. Interstates
    - ii. Highways
    - iii. Expressways
    - iv. State HWYs
  - c. Attributes available:
    - i. LINEARID - Linear feature identifier
    - ii. FULLNAME - Concatenation of expanded text for prefix qualifier, prefix direction, prefix type, base name, suffix type, suffix direction, and suffix qualifier (as available) with a space between each expanded text field; display name.
    - iii. RTTYP - Route type code
    - iv. MTFCC - MAF/TIGER feature class code
3. major\_roads AKA precise\_roads (Definition Query) (MTFCC = 'S1200' and MTFCC = 'S1100')
  - a. Dataset available depending on year.
  - b. If not available, process as MTFCC codes S1200 and S1100.
  - c. Combination of Primary and Secondary Road classifications.
  - d. Attributes available:
    - i. LINEARID - Linear feature identifier
    - ii. FULLNAME - Concatenation of expanded text for prefix qualifier, prefix direction, prefix type, base name, suffix type, suffix direction, and suffix qualifier (as available) with a space between each expanded text field; display name.
    - iii. RTTYP - Route type code
    - iv. MTFCC - MAF/TIGER feature class code

## Appendix 2: TIGER 2010 Processing Steps

Run script:

"X:\ProjectData\NPSCape\DATA\Scratch\TIGER\_Roads\TIGER\_2010\Products\Scripts\extract\_from\_shape\_roads\_2010.py" builds road dataset based on state from shapefiles.

Inputs as follows:

- a. FIPS number (per state)
- b. Shapes (per state)
- c. Working directory

Run script:

"X:\ProjectData\NPSCape\DATA\Scratch\TIGER\_Roads\TIGER\_2010\Products\Scripts\build\_roads\_2010\_GDB.py" run project, final merge, and standardize naming properties to match TIGER2015.

Inputs as follows:

- a. Working directory
- b. Region (ProcessRegion OR Geography), number explained in description.
- c. Text file as input for feature datasets based on Region

2010 Script Logic as follows:

Download roads by state, first, manually, and in some organizational structure.

1. Import each road by state dataset into a working GDB in source projection (Script 1)
  - a. Import shape into FeatureClass GDB, this was scripted for ease and efficiency but is not necessary. Space is saved by doing this per state, then deleting the .zip files, and repeat.
  - b. Output based on FIPS code.
2. Build working GDBs (Script 2)
  - a. data\_wrk
  - b. data\_prj
  - c. data\_primary
  - d. data\_precise
3. Re-project roads by state to new projection and export (Project tool)
4. Separate out primary roads and export
5. Add precise roads to primary roads and export
6. Build final GDB, and append files based on ProcessRegions
  - a. Create new product \*Region\*\_roads
  - b. Create new product \*Region\*\_primaryroads
  - c. Create new product \*Region\*\_major\_roads
  - d. Append all.

Properties and attributes very closely match new releases for TIGER Line GDB.

## Appendix 3: TIGER 2007 Processing Steps

Section: A).

Run script: "X:\ProjectData\NPSCape\DATA\Scratch\TIGER\_Roads\TIGER\_2007\Products\Scripts\extract\_and\_build\_roads\_2007\_GDB.py" to build 2007 roads based on county download, create final merged product, and check attributes.

Inputs as follows:

- a. Working directory
- b. Output directory
- c. Region
- d. Text file as input (zips of edge shapefiles, such as per state, Region specific)

2007 Script Logic as follows:

1. Download \*\_edges.zip per county, per state
2. Script extracts the zip to a directory and imports the shapefiles into a GDB
3. Begin processing by selecting out only Roads
  - a. MTFCC LIKE 'S%'
4. Re-project newly selected Roads
  - a. Select out only primaryroads per county
  - b. Select out only major\_roads per county
5. Build final GDB, append final products based on Region
  - a. Create new product \*Region\*\_roads
  - b. Create new product \*Region\*\_primaryroads
  - c. Create new product \*Region\*\_major\_roads
  - d. Append all.

Additional attributes are available in the 2007 dataset. These attributes pre-date the standardization that occurred in 2010 through 2013.

1. Most common attribute remains un-changed
  - a. MTFCC – MAF/TIGER feature class code
  - b. FULLNAME – Concatenation of expanded text for Prefix Qualifier, Prefix Direction, Prefix Type, Base Name, Suffix Type, Suffix Direction, and Suffix Qualifier (as available) with a space between each expanded text field
2. Additional attributes available:
  - a. TLID – Permanent edge ID
  - b. STATEFP – Current State FIPS code
  - c. COUNTYFP – Current county FIPS code
  - d. ROADFLG – Flag for road feature, Y or N

Section: B).

Additional comments on source projections from 2007FE metadata as follows and accounted for in script processing and transformations. The following is extracted from the metadata delivered via XML with the shapefiles from the U.S. Census Bureau. The 2007 source data covering the Pacific Islands per island has localized Datums. Local datums of the Pacific Islands will cause errors unless verified and/or corrected. Local datums are accounted for in the scripting, however, some files are delivered un-projected. For example, the Island of Oahu, Hawaii is delivered with no projection, metadata lists projection as same as contiguous U.S., AK, PR, and VI. Set projection to GCS NAD83.

North American Datum of 1983:

48 contiguous states,  
District of Columbia,  
Alaska,  
Hawaii (only Oahu Island within Honolulu County, HI (15003)),  
Puerto Rico, and the  
U.S. Virgin Islands.

Regional datums are used in the Pacific Island Areas

The datums used in the remainder of Hawaii are as follows:

Hawaii County, HI (15001), Old Hawaiian Datum;  
Honolulu County, HI (15003), local astronomic datums for all islands northwest of 161 degrees west longitude;  
Kalawao County, HI (15005), Old Hawaiian Datum;

Kauai County, HI (15007), Old Hawaiian Datum for Kauai Island and local astronomic datum for Kaula Rock;  
Maui County, HI (15009), Old Hawaiian Datum.

The datums used in American Samoa are as follows:

Eastern District, AS (60010), American Samoa Datum of 1962;

Manu'a District, AS (60020), American Samoa Datum of 1962;

Rose Island, AS (60030), local astronomic datum;

Swains Island, AS (60040), local astronomic datum 1939;

Western District, AS (60050), American Samoa Datum of 1962.

The Guam Datum of 1963 is used in Guam (66010).

The datums used in the Commonwealth of the Northern Mariana Islands are as follows:

Northern Islands Municipality (69085),

Guam Datum of 1963 (Agrihan, Alamagan, Anatahan, Gupan, Medinilla, Pagan, and Sarigan Islands)  
and local astronomic datums (Asuncion, Maug, and Farallon De Pajaros Islands);

Rota Municipality (69100), Guam Datum of 1963;

Saipan Municipality (69110), Guam Datum of 1963;

Tinian Municipality (69120), Guam Datum of 1963.

#### **Appendix 4: U.S. Census Bureau Geographic Terms**

FIPS – Federal Information Processing Standards, a set of standards related to federal, state, and local government agencies and Information Technology. Related to TIGER data, the data is classified according to county and state FIPS codes.

LSAD – Legal/Statistical Area Description codes related to the U.S. Census bureau, the data they release, and collect related to census demographics.

MTFCC – MAF/TIGER Feature Class Codes used to classify items physical, man-made or other, across years, and decades by the U.S. Census Bureau. Codes are standardized, and were adopted in 2002. The U.S. Census Bureau continues to use this code system. (Item1)

- MAF – Master Address File
- TIGER – Topologically Integrated Geographic Encoding and Referencing