

SYSTEM TECHNICAL DOCUMENT

D-R-A-F-T

SAMS-II

September 18, 2017

This document describes technical specifications of the new Statewide Address Management System



WV GIS Technical Center
Dept. of Geology and Geography
West Virginia University

Kevin Kuhn
GIS Analyst
Kevin.kuhn@mail.wvu.edu

Kurt Donaldson
Manager
Kdonalds@wvu.edu

Table of Contents

Overview 1

Server Hardware Configuration 2

Microsoft SQL Server Database 3

 Enterprise Database 3

 Backup and Recovery 3

ArcGIS Server Configuration 3

 ArcGIS Server and ArcSDE 3

 Types of Services 4

 Map Services 4

 Feature Services (aka: Feature Access Capability) 4

 Geoprocessing Services 4

 Geocode Service 4

 Geometry Services 5

 Spatial Reference 5

 Map Caching 5

User Management System 6

 Online Editing 7

Addressing Web Application 8

 Application Domain Names 8

 User Interface 8

 Map Scales or Zoom Levels 10

Data Specifications 11

 Data Model 11

 Data Dictionary 11

 Data Formats 13

Import and Export Utilities 13

 Data Imported from Oracle-Based SAMS-I 13

Data Import Utility 17

 Data Export Utility 18

Other SAMS-II Tools 19

Formatted: Normal

Citizen Feedback tool.....	19
Identify Address Information tool	20
SAMS-II Address Editing Report tool	21
User Preference tool.....	22
Address Search tool.....	23
Addressing Standards	24
SAMS Workflows.....	24
Addressing Coordinators and Users	24
Workflows and Processes	25
Address Data Layers	25

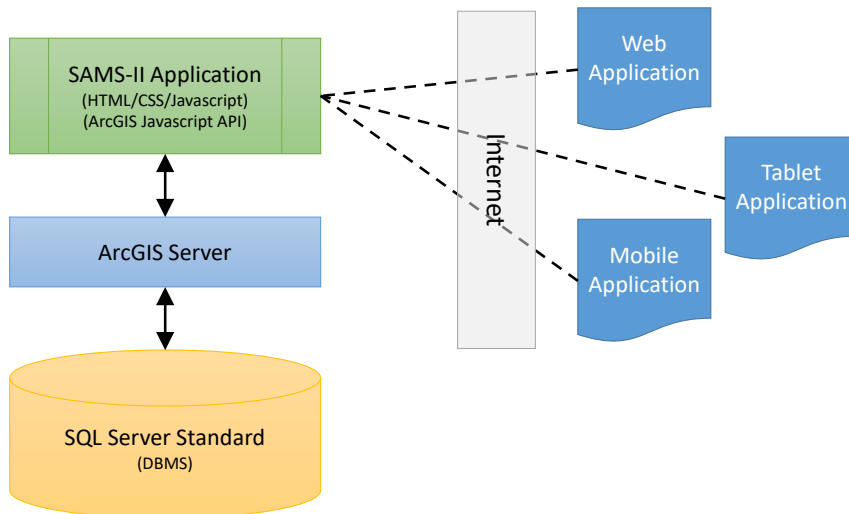
Overview

This document describes technical specifications for the replacement application for the Statewide Addressing and Mapping System maintained by the WV Division of Homeland Security and Emergency Management (WV DHSEM) that primarily supports statewide 911 emergency management operations. The new system named SAMS-II utilizes ESRI ArcGIS Server and Microsoft SQL Server database software for collecting, storing and maintaining the statewide addresses. The SAMS-II is primarily a web application developed using the ArcGIS JavaScript API, which allows address coordinators to view and edit the addressing data.

The SAMS-II web application provides web tools primarily for addressing coordinators to view and maintain their addressing data, and serve as a central repository of statewide addressing data in West Virginia. In addition, SAMS-II provides utilities for importing and exporting addressing data from SAMS-II. SAMS-II has a login for authorized users who need to edit addressing layers.

SAMS-II utilizes the ESRI Local Government Information Model that includes a series of operational and reference layers that support addressing. The new system provides access to the best available background layers and the performance speed of the map viewing and editing functions has improved.

The SAMS II server is a virtual server that is housed on two physical servers. Those two servers are using Microsoft's Hyper-V virtualization environment, an industry standard virtualization environment. Using two server in redundancy mode, Hyper-V provides a failover fault tolerance for the virtual machine running on the two servers.

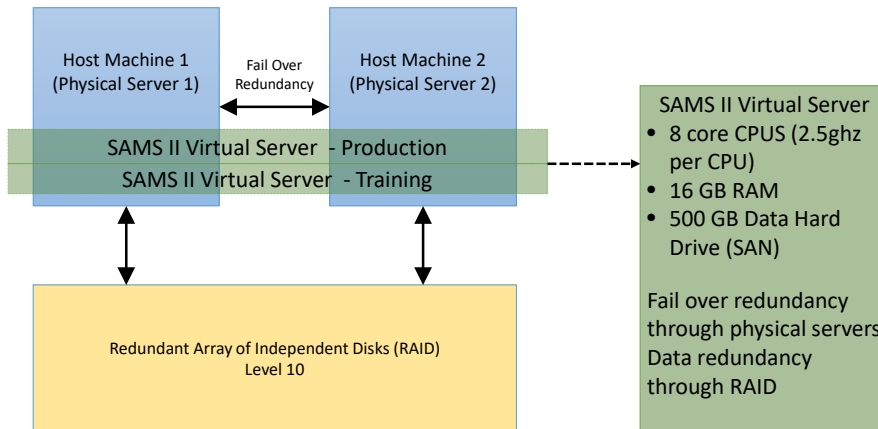


Server Hardware Configuration

The SAMS-II applications are housed on virtual servers built on two physical servers (host machines). The host machines are using Microsoft's Hyper-V virtualization environment, an industry standard virtualization environment. Using two host machines provides for capacity and redundancy. Hyper-V provides a failover fault tolerance for the virtual machine running on the two host machines. Each acts as a real time backup for the other such that if any one of them fails, the other takes over the tasks of the first in under three seconds. The physical servers are connected via fiber channel to a Storage Area Network (SAN). The SAN provides RAID redundancy and speed using RAID level 10. RAID level 10 combines the speed benefits of striping of drives with the natural 100% redundancy of mirrored drives. In effect, the SAN at RAID 10 level provides a mirror of the stripes within the storage array. This provides a degree of redundancy that is highly resilient to any hardware failures within the SAN. This protects both software configurations on the virtual servers and the data stored on them.

Each virtual machine is configured as a Windows 2012 R2 server with 4 CPUs, each running at 2.5 ghz. The virtual machine has 16 gigabytes of RAM memory for handling a large number of ArcGIS REST services. Data is stored in Microsoft's SQL Server Standard edition. The database itself will be stored on a 500 gigabyte data drive located on the SAN. SQL Server provides the ability to import and export the data to offsite data storage, such as external drives, which creates yet more resilience in the system.

SAMS II Server Configuration and Setup



Microsoft SQL Server Database

Enterprise Database

The SAMS-II enterprise geodatabase is housed in a Microsoft SQL Server 2012 Standard edition database. This database supports high performance data access, automation of various processes through the use of triggers, and an automated backup process.

Backup and Recovery

Full database backups are automatically performed weekly and incremental backups are automatically performed daily. Backups are performed using scheduled SQL Server Agent jobs that run database maintenance plans. The schedules and plans are authored and managed using Microsoft SQL Server Management Studio. The purpose of the backups will allow the data to be restored to its end-of-day state for any selected date. Data restoration is a manual process and generally considered to be a recovery from catastrophic loss of data. This type of backup is not intended to restore individual features. All backups are maintained for one year. Database administration such as scheduling backups etc. is performed using the *Microsoft SQL Server Management Studio* application. Database access permissions are based on the use of Windows Authentication; that is Windows network domain logins.

ArcGIS Server Configuration

ArcGIS Server and ArcSDE

Initial SAMS-II development was performed using ESRI's ArcGIS Server 10.3.1 and Microsoft's SQL Server 2012. WVGISTC upgraded the ArcGIS Server platform to ArcGIS Server 10.5 during the 1st quarter of 2017, the latest release of software available at the close of the performance period. WVGISTC uses the ArcGIS Desktop suite for various GIS tasks, such as publishing services, validating service operations, data editing, etc. SAMS-II uses an enterprise geodatabase built on the Microsoft SQL Server database - stores all the data while ArcSDE is used to bridge between ArcGIS Desktop and the geodatabase. While ArcGIS Desktop, i.e., ArcMap, can save data to the geodatabase server directly, ArcGIS Desktop is also used to compose SAMS-II related maps and data. ArcGIS Server can publish the resources, primarily maps and data, which are from ArcGIS Desktop, as REST web map service and/or feature service. SAMS-II client can display maps for viewing by using web map services and editable data online by using feature services. The communications between different components can be seen at Figure 1.

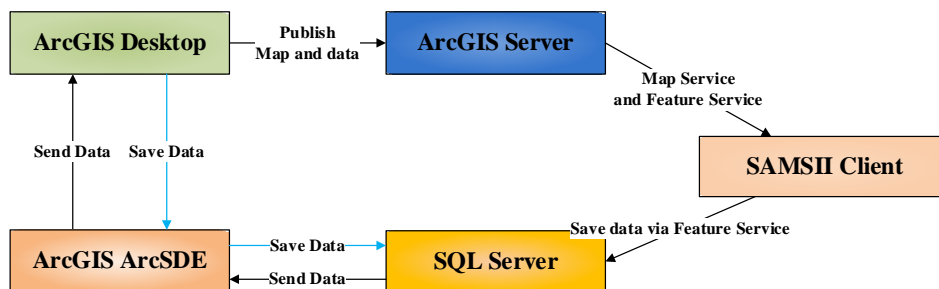


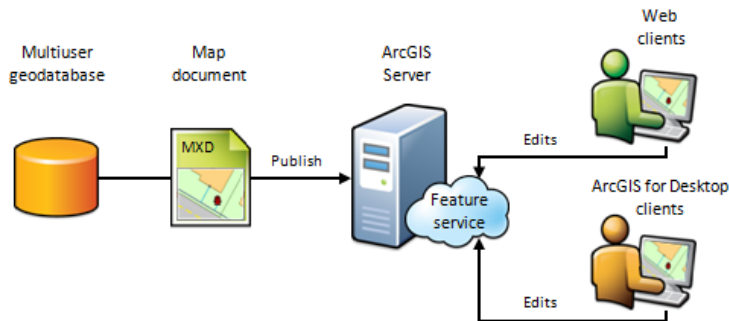
Figure 1: Communications between different components

Types of Services

Map Services. Map service makes maps, features, and attribute data available in the application. It includes the viewing only SAMS operational layers, reference layers, and basemap layers.

Shared Services: The SAMS Addressing application consumes GIS data and map services from many agencies. It includes commercial web map services such as Bing Maps or Esri Streets or West Virginia data services hosted by the WV GIS Technical Center, WV DEP, and WV DOT. The shared data and services allow the application to be more robust in the breadth of capabilities offered to users. In addition, most map layers are cached to distribute online maps faster.

Feature Services (aka: Feature Access Capability). Feature Access capability is embedded on a map service, and it provides accesses to vector data that are served by an enterprise-level relational database management system (RDMS). To implement this capability, an enterprise level of RDMS-based ArcSDE is required. The Feature Access capability not only allows users to edit features by using thin clients, such as the application developed by using ArcGIS JavaScript API, but also allows users to edit features by using fat clients, such as ArcMap Desktop. The following figure illustrates the general idea of feature editing behind of Feature Access capability.



Geoprocessing Services. A geoprocessing service exposes powerful GIS analytic tool(s) to the world-wide web so that users can access such tools in a web context. The SAMS-II Addressing application employs geoprocessing services for printing and other utility tools.

Geocode Service. Geocode service allows users to locate address on a map. A geocode service uses site and street addresses from SAMS along with a commercial service to locate addresses. More information about WV Address Locator Services can be found at this link:

<http://wvgis.wvu.edu/data/dataset.php?ID=411>.

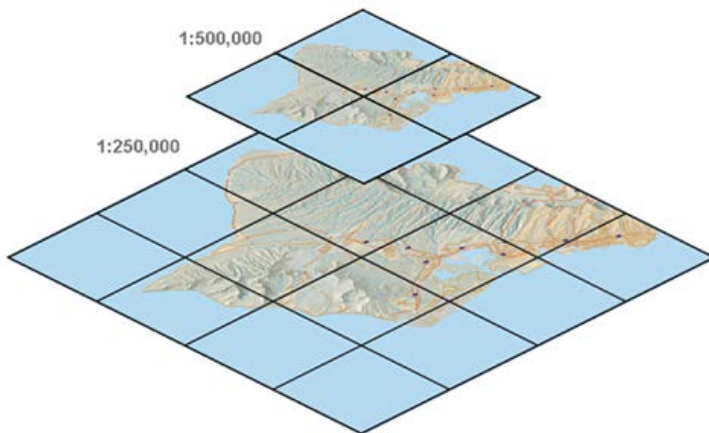
Geometry Services. The geometry service helps applications do geometric calculations such as buffering, simplifying, calculating areas and lengths, and projecting. For the SAMS Addressing application, the geometry service is also used to create and modify feature geometries during web editing. Reprojecting features is not a problem since positional accuracy is preserved when projecting between Web Mercator and other coordinate systems like UTM Zone 17.

Spatial Reference

The map layers in the SQL Server Database are projected to UTM Zone 17. The map projection of the map services of the application reprojected to Web Mercator (Auxiliary Sphere) EPSG: 3857. Length and area calculations are performed in UTM Zone 17 for positional accuracy reasons.

Map Caching

Map caching is a very effective way to distribute online maps faster. When you create a map cache, the server draws the entire map at several different scales, and stores copies of the map images as tiles. The server can then distribute these tiled images whenever someone asks for a map. It's much quicker for a map server to hand out a cached image than to draw the map each time someone requests it. Another benefit of caching is that the amount of detail in the image doesn't noticeably affect how quickly the server can distribute the copy.



User Management System

The user management component is based on both ArcGIS Server and Microsoft SQL Server. ArcGIS Server serves the users' login information, including username, password and the services that a user has access. SQL Server stores the users' detailed information, such as contact information and their authorized county list.

The workflow is as follows. A user first attempts to login into the system. If the login information can't be confirmed, that user needs to find the right login information. Otherwise, if the authentication is correct, then a token is generated for that user that corresponds to the assigned services for the confirmed login. A further request for users' detailed information will be sent to SQL Server. After receiving the user information, this user can do online editing which will be discussed the next section. Or the user will be redirected to the login component if no user information can be retrieved from the server. Figure 2 illustrates the workflow described above.

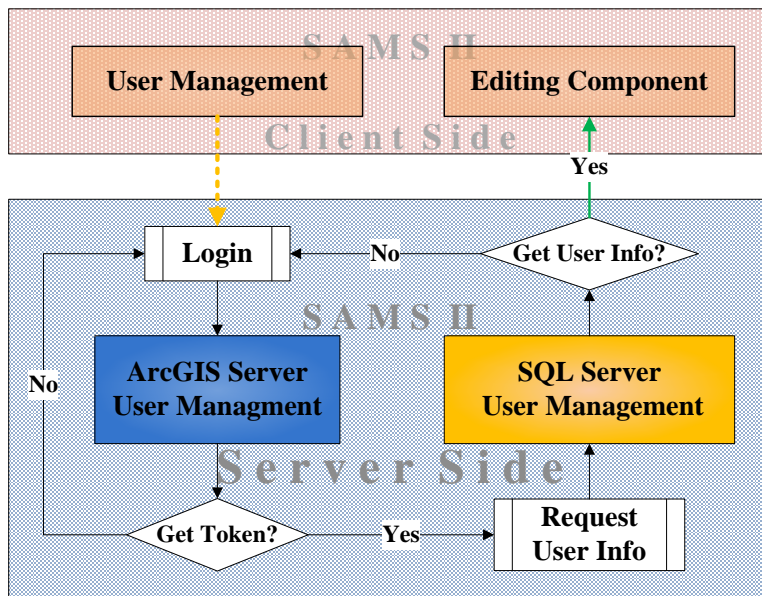
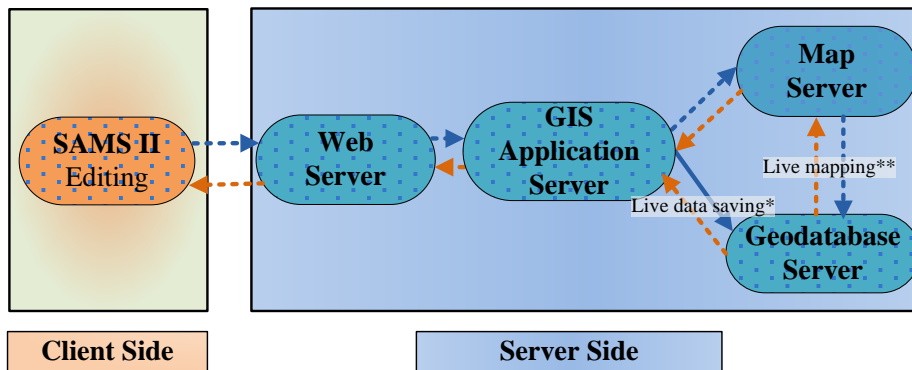


Figure 2: SAMS-II user management implementation

Online Editing

Online editing is based on ArcGIS Server's Feature Service which is only available when the data is powered by a workgroup level or enterprise level relational database management system. In SAMS-II, data is stored in an enterprise geodatabase geospatial data is served stored in by Microsoft SQL Server and online data is accessed through ArcGIS Server via GIS Data Services through ArcSDE. By using Symbology, scale dependency and attribution is controlled via an ArcMap document, the data served by SQL Server are used to create map document. The map document is published as a GIS map services; and feature service by using ArcGIS Server. While the data view-only layers are published as is through the map services, editable data layers are published as the data editing is through the feature services. The workflow can be described as follows: After the client executes editing, the saving requests are sent to the server side. On the server side, the Web Server receives the data saving request first. It forwards the request to ArcGIS Server. ArcGIS Server first writes the editing to the Geodatabase Server. At the same time, ArcGIS Server requests map from the Map Server, which requests data from the Geodatabase server. ArcGIS Server will return maps and data to the client through the Web Server. Figure 3 demonstrates the workflow.



*: the live editing is done through ArcGIS Server's Feature Service

**.: the live mapping is realized by using ArcGIS Server's Map Service which is based on the same dataset as the Feature Service

Figure 3: SAMS-II online editing

Commented [KK1]:

Commented [KK2]: What is powered ? The license, the database?

Addressing Web Application

The application user interface provides multiple views for viewing or editing address layers. A login is required to edit addressing layers [and view detailed attribute information](#). The Web application utilizes ArcGIS Server JavaScript API which allows online applications to be viewed by tablet and mobile phone devices that use touch screen controls.

Application Domain Names

The application will be accessed with the following domain names *sams.mapwv.org* or *sams.mapwv.com* on the particular server and redirected to alias names of *mapwv.org/SAMS* or *mapwv.org/address*

User Interface

The user interface of the application is divided into the following components:

Views	<ul style="list-style-type: none">• Default View:<ul style="list-style-type: none">○ Only viewing of address layers○ No editing capabilities○ Better speed performance for navigating to area of interest or for changing between different reference layers or base maps• Edit View:<ul style="list-style-type: none">○ Must be authorized user to login○ Allows editing of address layers○ Permits exporting and importing of address layers
Navigation Tools	<ul style="list-style-type: none">• Scale Slider Bar• Zoom in and out, zoom to statewide extent, zoom to geographic location• Pan in any direction• Hold down on the shift key and left-click the mouse to draw a box to zoom to a specific area
Other Tools	<ul style="list-style-type: none">• Measure: Measure distances and areas• Markup: Add notes to a point marker• Eraser: Erase markups or queries• Bookmark: Create bookmarks on your computer• Share: Create link to current map view• Citizen Feedback• Print• Identify Address Information• SAMS-II Address Editing Report tool• Data Import Utility• Data Export Utility• User Preference

Search By	<ul style="list-style-type: none"> • Address (redesigned for SAMS-II only) • Parcel Map (enabled for SAMS – II) • Map Coordinates • Geographic Place Name (GNIS) • City County USGS Topo Quad.
SAMS Layers	<ul style="list-style-type: none"> • Labels (Addresses & Streets) • Sites • Streets • Validation Layers • Status Layers • SAMS Viewing Layers • SAMS – II Training Report Maps, including: <ul style="list-style-type: none"> ○ Imported ○ Site Address Point ○ Road Centerline ○ Entrance Point ○ Address Point ○ Site Line ○ Summary
Reference	<ul style="list-style-type: none"> • Roads/streams/geographic place names • WV DOT Streets (Web Map Service) • MSAG Zone • Postal LLC Zone • Emergency Zone • Parcels • Trails • Watersheds • Political Boundary
Basemaps	Chose from multiple base maps including street maps or aerial imagery
Edit Panel Tools (Streets)	<p>Toolbar functions to create or edit street features</p> <ul style="list-style-type: none"> • Selection (use shift button and left mouse button to select multiple features) <ul style="list-style-type: none"> ○ New Selection (geometry selection) ○ New Selection (attribute selection) ○ Add to selection ○ Subtract from selection ○ Clear Selection • Draw or Delete Street Polyline • Flip Street Polyline • Cut Polyline • Union/Merge Polyline • Undo and Redo • Save or Delete Attributes

Edit Panel Tools (Sites)	<p>Toolbar functions to create or edit site features</p> <ul style="list-style-type: none"> • Selection (use shift button and left mouse button to select multiple features) <ul style="list-style-type: none"> ○ New Selection (geometry selection) ○ New Selection (attribute selection) ○ Add to selection ○ Subtract from selection ○ Clear Selection • Draw or Delete Site Point • Cut Polyline • Undo and Redo • Save or Delete Attributes • Other tools <ul style="list-style-type: none"> ○ Link Site ○ Link Address
MSAG	<p>Tools for viewing and editing Master Street Address Guide database</p> <p>Redesigned Search results window</p>

Map Layers: The SAMS addressing layers are scale dependent and specific layers have opacity slider bars. The reference layers may include trails and railroads in the future. Future plans are to create a better leaf-off mosaic of 2010-12 Sheriff's imagery and county acquired imagery.

Map Scales or Zoom Levels

As you zoom in (or out) of the online maps you see, the user sees a series of different maps with slightly different information displayed at each zoom level. Zoom level is indicated and controlled on the SAMS application by a vertical zoom slider and zoom navigation tools. Whenever the zoom level is changed, a different map is shown.

ArcGIS maps use the Web Mercator Auxiliary Sphere tiling scheme (WKID 102100), which is the same tiling scheme that ArcGIS Online, Google Maps, and Bing Maps use. ArcGIS maps use the same coordinate system, map DPI, and tile size. Cached levels of detail for each map and layer match; however, not all maps and layers contain all levels of detail.

Levels	Map Scale	1" = how many ft	Default View	Editor View	Largest Scale for commercial map services in West Virginia	
1	1:4,622,324	385,193.7 ft	County Status	County Status		
2	1:2,311,162	192,596.8	County Status	County Status		<i>Smallest scale Cache begins</i>
3	1:1,155,581	96,298.4	County Status	County Status		
4	1:577,791	48,149.3	County Status	County Status		
5	1:288,895	24,074.6	County Status	County Status		
6	1:144,448	12,037.3	Streets	Streets		

7	1:72,224	6,018.7	Streets	Streets		
8	1:36,112	3,009.3	Sites/Streets	Sites/Streets		
9	1:18,056	1,504.7	Sites/Streets	Sites/Streets	USA Topo, ESRI Topo aka Community Map	
10	1:9,028	752.3	Sites/Streets	Edit	ESRI Streets	
11	1:4,514	376.2	View Only	Edit	ESRI Imagery	
12	1:2,257	188.1	View Only	Edit	Bing Imagery	
13	1:1,128	94.0 ft	View Only	Edit	Bing Streets (Cache ESRI streets); Sheriff Association 12"	
14 (4")	1:564		N/A	N/A		
15 (4")	1:282		N/A	N/A	Sheriff Association 4"	<i>Largest scale</i>

Data Specifications

Data Model

The ArcGIS Local Government Information Model was adapted to meet the user requirements of the address layers. More information about the Local Government Information Model can be found on the Esri website <http://solutions.arcgis.com/local-government/help/local-government-information-model>.

The SAM-II model queries records using a primary ID generated from the county FIPS code. More documentation will follow about the SAMS-II data model including a data dictionary. The data dictionary will include a description of the contents, format, and structure of SAMS-II data model and the relationship between its elements.

Data Dictionary

The following data layers and tables are utilized to meet the minimum addressing requirement. The Data Element presents the name of the feature class, description, and feature type. Detailed descriptions and details are presented below.

Feature Class	Description	Feature Type
Address	This Feature Dataset contains features related to address data management.	Feature Dataset
SiteAddressPoint	Site address points represent the location of site or service delivery addresses assigned by local governments.	Point Featureclass
AddressPoint	Address points represent the location of the site address point, of the address along the parent road.	Point Featureclass
AddressEntrancePoints	Address entrance points represent the location where the public, or a service provider, would gain access to the specific site or service delivery address. In downtowns or other urban settings, many times the most direct access	Point Featureclass

Feature Class	Description	Feature Type
	to an address may not be coincident with the location in which the address was assigned. In rural areas, the address entrance point could represent an entrance to a long or shared driveway.	
SiteLine	This Featureclass represents drop lines, or driveways associated directly with an address site point,	Line Featureclass
AdministrativeArea	This dataset contains municipal, school and other related administrative or jurisdictional boundaries.	Feature Dataset
CountyBoundary	This feature dataset represents WV counties and the border counties for surrounding states.	Polygon Featureclass
Reference		Feature Dataset
RoadCenterline	This featureclass represents the road network, containing all named roads within a county. This dataset is attributed with address ranges and can be used for a geocoding services.	Line Featureclass
UnRoads	This featureclass represents all un-named road and trail segments not used for addressing sites, but may be necessary for emergency services, or denote important trails.	Line Featureclass
Standalone Featureclasses and Tables		
Emergency Zone Number	This featureclass represents the emergency zone number boundary.	Polygon Featureclass
Emergency Service Number		Polygon Featureclass
MSAG	This database view is compiled from the road centerline, and MasterStreetName table.	Database View
MasterStreetName	A table used to store a master list of valid street names. This master list of names is used to populate address information in the road centerline and site address feature classes.	Database Table
Site_Attach	This table contains the old and new SiteID, as well as alternate/old address data.	Database Table
Road_Attach	This table contains the old and new SiteID, as well as alternate/old address data.	Database Table

A more complete data dictionary will be assembled in the near future.

Data Formats

All GIS data layers must be delivered as ESRI shapefiles (file geodatabase preferred) according to the database design in this specification. Database tables must be delivered in a standard database format. Database field names must be capitalized and consist of no more than 10 characters to be shapefile compatible.

Import and Export Utilities

Data Imported from Oracle-Based SAMS-I

Data from the Oracle based SAMS system is imported into SAMS-II using a combination of ArcGIS tools and Transact-SQL scripts. The original source data are in individual sets of ESRI shapefiles (.shp) containing point, polygon, and line information along with Dbase (.dbf) format data files containing lookup data. There is one set of data files per county. The shapefiles and data files are created by DOT using export tools that extract data from the Oracle SAMS system. The following is a list of the files that are imported.

Shapefiles:

- Drop_Line.shp
- Emergency_Zone.shp
- <CountyName>_Site.shp
- <CountyName>_Street.shp
- Unnamed_Road

Data files:

- Agency.dbf
- MSAG_LLC.dbf
- Old_Address.dbf
- Street_Name.dbf
- Street_Name_Join.dbf
- Unit.dbf

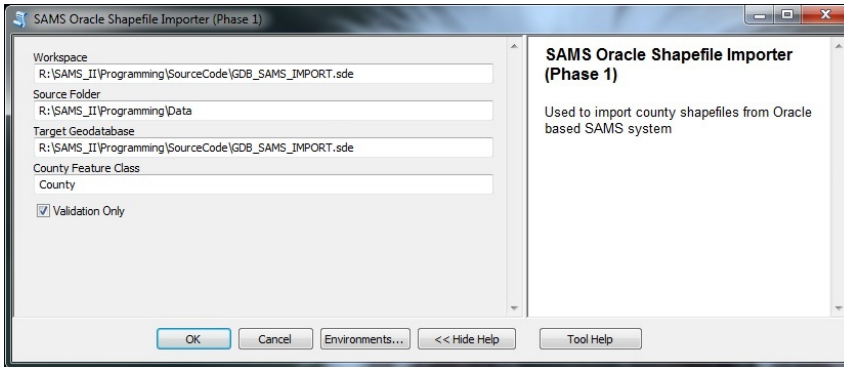
The data are ingested into the SAMS-II system in 4 phases:

- 1) Import into a consolidated enterprise geodatabase
- 2) Conversion to the SAMS-II geodatabase format
- 3) Route categorization and Domain data normalization
- 4) Creation of a master street name table (MSAG)

Phase 1 is accomplished using the ArcGIS Python script "OracleImporter.pyt". The script is in the format of an ArcGIS tool with user controlled processing parameters. A "Validation Only" option is available in the tool that allows the source data to be validated prior to loading. This tool imports the individual shapefiles and data files directly into a consolidated enterprise geodatabase where the data from all of the counties is merged. During the load process an attribute is added to each feature class and table to

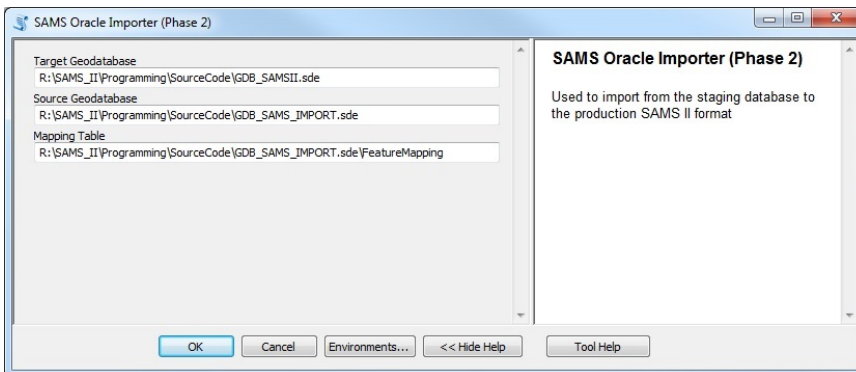
hold the county FIPS codes. The FIPS code is then assigned by the Python tool as part of the import process. The source for the FIPS codes is a pre-defined County table created by WVGIS Tech Center staff.

The following is a screenshot of the “OracleImporter.pyt” user interface.



Phase 2 is accomplished using ArcGIS Python scripts implemented as an ArcGIS tool named “OracleImporterStep2.pyt”. This tool moves the previously loaded data into the final production format based on a table of field mappings. This mapping information specifies the source and target data tables and fields. The actual mapping specifications are given in Table 1. Upon completion of the automated process, the data files listed above are manually copied to the production SAMS-II database using built-in ArcGIS copy functionality. These tables are only used for the initial data loading process and are retained for reference only.

The following is a screenshot of the “OracleImporterStep2.pyt” user interface.



Phase 3 involves the manipulation of individual feature attributes to match the SAMS-II data model based on feature specific values. The new model supports the distinction between local, state, and federal route

types by placing the route name in corresponding fields. Additionally, the domain values used in the Oracle based system must be migrated to the new values. Table 2 contains the mapping that is used to support this migration. These processes are accomplished using Transact-SQL scripts that are run manually after the completion of phases 1 and 2.

The **phase 4** Master Street Addressing Guide (MSAG) capability is supported through the use of a SQL Server database view that dynamically generates unique street data based on the individual street segments defined in the RoadCenterLine table. This allows the system to automatically adjust MSAG information in real-time as edits are performed on the individual segments. The database view used to enable this functionality is named “vwMasterStreetName”. The MSAG records are derived from the unique combination of the following fields in the RoadCenterline table:

- STCOFIPS - County FIPS code
- FULLNAME - Full Street name
- FEDROUTE - Federal route identifier
- CTYROUTE - County route identifier
- MSAGLEFT - Left side MSAG area
- MSAGRIGHT - Right side MSAG area
- ESNLEFT - Left side emergency service area
- ESNRIGHT - Right side emergency service area
- FromAddress - Minimum Value
- ToAddress - Maximum value

Table 1: Field Mappings

SourceFeatureClass	TargetFeature Class	SourceField	SourceData Type	TargetField	TargetData Type
CountyData\Street	RoadCenterline	STREET_ID	Text	CENTERLINEID	Text
CountyData\Street	RoadCenterline	STREET_TYP	Text	STRTETYPE	Text
CountyData\Street	RoadCenterline	LABEL	Text	FULLNAME	Text
CountyData\Street	RoadCenterline	LABEL_ID	Text		Text
CountyData\Street	RoadCenterline	ROUTE_NUMB	Text	STROUTE	Text
CountyData\Street	RoadCenterline	ROUTE_SUBN	Text		Text
CountyData\Street	RoadCenterline	SURFACE_TY	Text	SurfTYPE	Text
CountyData\Street	RoadCenterline	L_FROM_ADD	Text	FROMLEFT	Text
CountyData\Street	RoadCenterline	L_TO_ADD	Text	TOLEFT	Text
CountyData\Street	RoadCenterline	L_POST_ID	Text	MSAGLEFT	Text
CountyData\Street	RoadCenterline	L_CNTY_ID	Text	LCntyID	Text
CountyData\Street	RoadCenterline	L_ZIP	Text	ZIPLEFT	Text
CountyData\Street	RoadCenterline	L_STATE	Text	LState	Text
CountyData\Street	RoadCenterline	L_ESN	Text	ESNLEFT	Text
CountyData\Street	RoadCenterline	L_FROM_ADD	Text	FROMRIGHT	Text
CountyData\Street	RoadCenterline	R_TO_ADD	Text	TORIGHT	Text
CountyData\Street	RoadCenterline	R_POST_ID	Text	MSAGRIGHT	Text
CountyData\Street	RoadCenterline	R_CNTY_ID	Text	RCntyID	Text
CountyData\Street	RoadCenterline	R_ZIP	Text	ZIPRIGHT	Text
CountyData\Street	RoadCenterline	R_STATE	Text	RState	Text
CountyData\Street	RoadCenterline	R_ESN	Text	ESNRIGHT	Text
CountyData\Street	RoadCenterline	UPDATED	Text	LASTUPDATE	Text
CountyData\Street	RoadCenterline	COMMENTS	Text	Comment	Text
CountyData\Street	RoadCenterline	MSAG_LLS	Text		Text
CountyData\Street	RoadCenterline	LEFT_IS_OD	Text	Left_Odd	Text
CountyData\Street	RoadCenterline	SHAPE@	Text	SHAPE@	Text
CountyData\Street	RoadCenterline	STCOFIPS	Text	STCOFIPS	Text
CountyData\Site	SiteAddressPoint	SITE_ID	Text	SITEADDID	Text
CountyData\Site	SiteAddressPoint	SITE_TYPE	Text	UNITTYPE	Text
CountyData\Site	SiteAddressPoint	STREET_ID	Text		Text

SourceFeatureClass	TargetFeature Class	SourceField	SourceData Type	TargetField	TargetData Type
CountyData\Site	SiteAddressPoint	SIDE	Text	SIDE	Text
CountyData\Site	SiteAddressPoint	ESN	Text	ESN	Text
CountyData\Site	SiteAddressPoint	ADDR_LABEL	Text	PREADDRNUM	Text
CountyData\Site	SiteAddressPoint	ADDRESS_NU	Text	ADDRNUM	Text
CountyData\Site	SiteAddressPoint	POST_ID	Text		Text
CountyData\Site	SiteAddressPoint	CNTY_ID	Text	STCOFIPS	Text
CountyData\Site	SiteAddressPoint	STATE	Text	State	Text
CountyData\Site	SiteAddressPoint	ZIP	Text	Zip	Text
CountyData\Site	SiteAddressPoint	ZIPP4	Text		Text
CountyData\Site	SiteAddressPoint	PARCEL_NUM	Text		Text
CountyData\Site	SiteAddressPoint	COMMENTS	Text	Comment	Text
CountyData\Site	SiteAddressPoint	MSAG_LLC	Text	MSAG	Text
CountyData\Site	SiteAddressPoint	SHAPE@	Text	SHAPE@	Text
CountyData\Drop_Line	SiteLine		Text	LAYER	Text
CountyData\Drop_Line	SiteLine		Text	FeaCode	Text
CountyData\Drop_Line	SiteLine		Text	FULLADDR	Text
CountyData\Drop_Line	SiteLine	SHAPE@	Text	SHAPE@	Text
CountyData\Drop_Line	SiteLine	STCOFIPS	Text	STCOFIPS	Text
CountyData\Drop_Line	SiteLine	Site_ID	Text	SiteAddKey	Text
CountyData\Drop_Line	SiteLine		Text	AddressPtKey	Text
CountyData\Drop_Line	SiteLine	STCOFIPS	Text	STCOFIPS	Text
CountyData\Unnamed_Road	UnnamedRoad	SHAPE@	Text	SHAPE@	Text
CountyData\Unnamed_Road	UnnamedRoad	UNROAD_ID	Text	UNROAD_ID	Text
CountyData\Unnamed_Road	UnnamedRoad	UNROAD_TYP	Text	UNROAD_TYP	Text
CountyData\Unnamed_Road	UnnamedRoad	STCOFIPS	Text	STCOFIPS	Text
CountyData\Site	SiteAddressPoint	STCOFIPS	Text	STCOFIPS	Text
CountyData\Street	RoadCenterline	STREET_ID	Text	OriginalID	Text
CountyData\Site	SiteAddressPoint	SITE_ID	Text	OriginalID	Text
CountyData\Drop_Line	SiteLine	Site_ID	Text	OriginalID	Text
CountyData\Unnamed_Road	UnnamedRoad	UNROAD_ID	Text	OriginalID	Text

Data Import Utility

Data Import Utility allows counties to integrate their data into the statewide database (see Figure 4).

First, the Import utility allows users to upload their address data (county-wise) into SAMS-II statewide database. The uploaded file should be in zip file format, and could include 5 or fewer types of address data: road centerline, site line, site address point, entrance point, and address point. The Drag-N-Drop component allows users easily drag the targeted zipfile to drag-n-drop zone and the zipfile will be automatically uploaded to a temporary location on the server. After users let the server to process, the uploaded zipped file is unzipped and stored in a staging database, which means the address data is uploaded, but is not integrated into the statewide database yet. Users need to finish the steps introduced in the next paragraph.

Secondly, once the address data is uploaded, users need to finish the follow-up steps to complete the entire process of address data import. While the first step upload data into the staging database, this step is actually integrate data into statewide dataset. To accomplish this goal, users need to work through the next 4 steps (the 1st step is Data upload, as indicated as "1: Data" in Figure 4). The 2nd step ("2: Layer" in Figure 4) is to specify address layer name. After the layer name is correctly set, the next step - the 3rd step ("3: Fields" in Figure 4) - is to match the uploaded data fields with the statewide data fields. For the fields that have domain set, the next step - the 4th step ("4. Domain" in Figure 4) - is for domain mapping. After the previous steps are successfully achieved, which indicates data is fully ready for integration, the last step - the 5th step ("5: Publish" in Figure 4) - is to publish the uploaded data into SAMS-II database. For every step, if it is failed or it can't be validated, the Utility will notify users the errors, and users can check out the detailed error message in the "Log Info" area.

One thing about the Utility: if a county has uploaded the address data into the staging database, users can work on Step 2 through Step 5 many times or until the data is successfully integrated. The work principal is like this: once users specify a county, the system will detect whether that county has pre-loaded data or not. If preloaded data exists, users do not have to reload data but directly work on the steps that have not been finished yet. If for any reason, users reload data and the data is different from last time, users need to redo the whole data import routine as a brand new process. If the system identify the specified county does not pre-exist, users need to follow the routine that is introduced above.



Figure 4: Data Import Utility (Note: the county list is based on users' login)

Data Export Utility

Data Export Utility allows users to download their data from the statewide database for offline uses. If a user has multiple counties, he/she can choose one from the list. If a user has only one county, that county is displayed. After the county is specified, users click on the Set button to start the data export process. The exported data will be available in zipfile format for downloading.

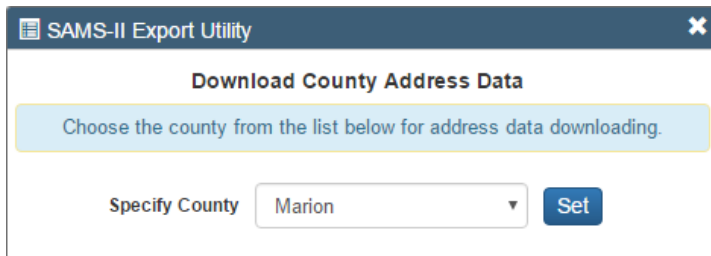


Figure 5: Data Export Utility (Note: the county list is based on users' login)

Other SAMS-II Tools

In the User Interface segment, several SAMS-II specific tools have been listed. Those tools include User Feedback tool, Identify Address Information tool, SAMS-II Address Editing Report tool, and User Preference tool.

Citizen Feedback tool

This tool allows the general public to report the address issues to the corresponding county coordinator. General public need to have their information filled out, and identify the location that has issued, and fill in their comment on the issue. Users need to use the orange button to identify the location. Once the location is identified, the corresponding coordinator's information, which is not editable for users, will be auto-populated.

Citizen Feedback

Click button on the left, and then click on map for a location. [Help](#)

Your Name

Your Email

Your Phone

Request Type

County Name

Contact Name

Email

Phone #

Comments

Figure 6: Citizen Feedback tool (for public users)

Identify Address Information tool

This tool allows login users to find address information without starting edit mode or to look up address information that is not in his/her editing territories, e.g., the neighbor counties. The tool work on mouse click and it returns address information of the mouse click. The blue-colored tabs (labelled as layer name) indicate that address information in those layers exist at the location of mouse click. On the other hand, the greyed out layers have no address data available at the mouse click location.

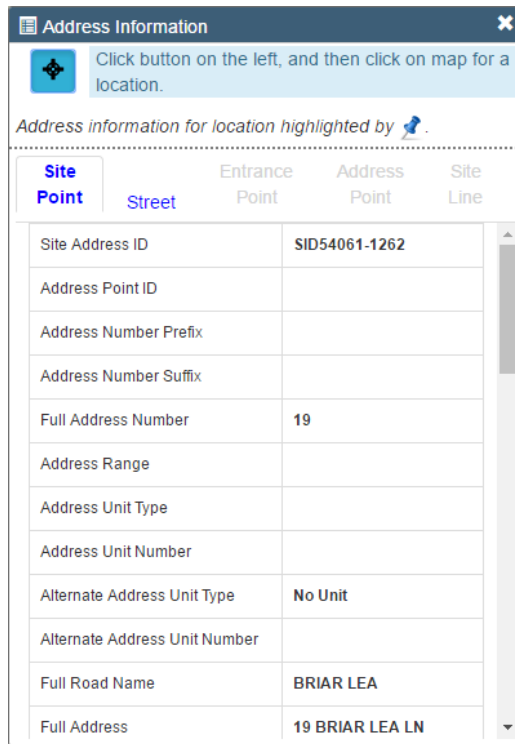


Figure 7: Identify Address Information tool

SAMS-II Address Editing Report tool

This tool is a combination of three components. First, it includes the control on the report layers (see Figure 8). Every layer is based on county geometry. There are seven maps. The Imported map tells which counties have data imported and on which day the import was successfully accomplished. For the five address maps, i.e., Site Address Point, Road Centerline, Entrance Point, Address Point, and Site Line, every layer shows the latest updating time and how many features (roughly) has been created/updated. The Summary map is also used for identification purpose. That is the second function for address editing report: the mouse-click info-window.

The mouse-click info-window component works for the visible Summary map only. If the Summary map is invisible, there will be no summary info-window popup. When the maps is visible, users can click on a county to retrieve the summary editing information as seeing in Figure 9.

The third component is to let logged-in users to view the summary reports: County Feature Summary which lists the total feature count by county, broken down per layer; Feature Creation Summary which

lists the total number of features as created by individual users, organized by county; and User Feature Creation Summary which lists total number of features created by user.

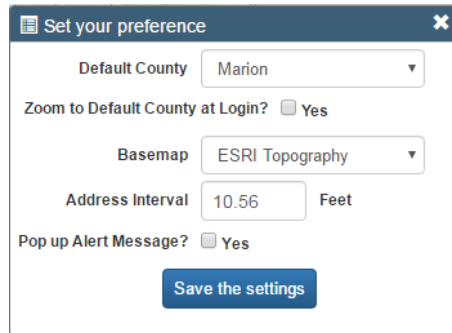
The image shows two screenshots from the SAMS-II system. The left screenshot, titled "SAMS-II Training Report Maps", displays a list of report types with checkboxes and progress indicators: Imported, Site Address Point, Road Centerline, Entrance Point, Address Point, Site Line, and Summary. Below this is a caption "(Figure 8: Report maps control)".

The right screenshot, titled "SAMS-II Editing Report", shows a summary of report data for Harrison County (54033). The contact is Greg Skidmore (304.623.6559) with email gskidmore@harrco911.org. The report includes statistics for Road Centerlines (18966 total, last created <n/a>, last edit 5/3/2016), Site Points (45309 total, last created <n/a>, last edit 6/1/2016), and Address Points (0 total, last created <n/a>, last edit <n/a>). It also lists Entrance Points (0 total, last created <n/a>, last edit <n/a>) and Site Lines (725 total, last created <n/a>, last edit <n/a>). A "Zoom to" link is visible at the bottom. Below this is a caption "(Figure 9: Report Summary Info-Window)".

Below the "SAMS-II Training Report Maps" control is a screenshot of the "Reports" window, titled "Access Reports". It contains a text box explaining that there are three types of reports available for download as MS Excel tables: County Feature Summary, Feature Creation Summary, and User Feature Creation Summary. A link "Open the report link" is provided at the bottom. Below this is a caption "(Figure 10: Access Reports)".

User Preference tool

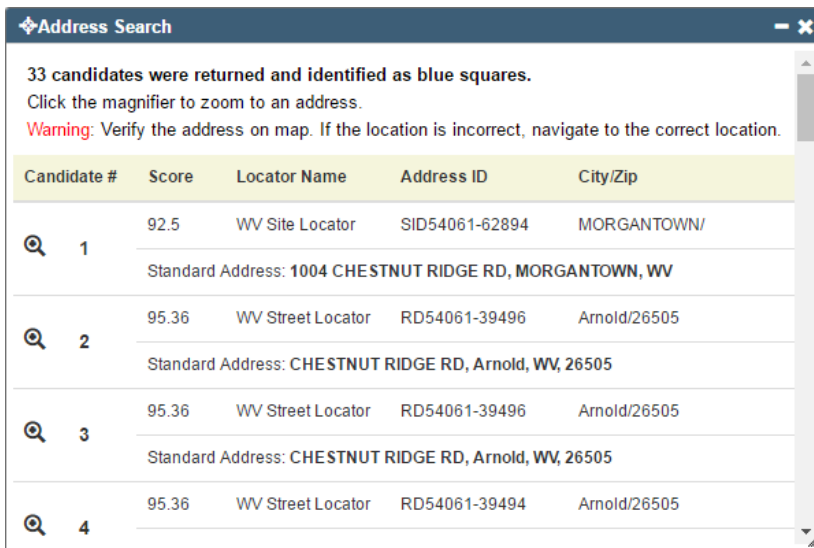
The User Preference tool (Figure 10) lets users specify their preferences in using SAMS-II online editing system. The preferences include the default county (if a user has several counties), whether zoom to the default county or not, the default basemap, the address interval, and whether to pop up the alert message or not. Users' preferences take effect right away after the "Save the settings" button is clicked.



(Figure 10: User Preference tool)

Address Search tool

Address search tool (Figure 11) lists all the candidates address for a user’s input address. For every candidate address, the information include its score in the corresponding locator, the locator name, the address id if the candidate is from WV GIS Technical Center’s geocoding service, the candidate’s city/zip, and the standard address. The magnifier to the left of the tool help users zoom into a candidate address.



(Figure 11: Address Search tool)

Addressing Standards

Addressing standards are listed on the WV Statewide Addressing and Mapping website located at <http://www.dhsem.wv.gov/Operations/Pages/Statewide-Addressing-and-Mapping.aspx>

Resources include:

- WV E-911 Reference Guide Version 2.1 (September 2008)
- Data Specification Guide for County Coordinators (September 2008)
- Data Specification Guide for County Coordinators

SAMS Workflows

Presently addressing coordinators that participate with the SAMS have two distinct workflows. Approximately 19 counties use the SAMS maintenance tools for direct data editing, accessed through the online web client. The other addressing coordinators use local software for independent data maintenance and participate by submitting their data for manual integration.

Addressing Coordinators and Users

The primary target audience of the SAMS system is the county and local addressing data stewards, the group of people responsible for creating and maintaining addressing data for 911 emergency services in their jurisdiction. Address data stewards of the current SAMS system are classified as online users and offline users. There are approximately 19 counties using the online SAMS web application to maintain their county's addressing data; while there are approximately 25 offline address stewards that store and maintain their own data locally. The offline stewards often use off-the-shelf hardware and software to maintain their data which is then forwarded to WVDHSEM for integration into the statewide addressing database.

The WVDHSEM staff administrates the current SAMS and provides data integration and technical assistance to the 911 data stewards. The public benefits from the statewide addressing system through geocoding and web map services.

- 1) Administrators – Users who may work at the state level, such as WVDHSEM, perform administrative tasks related to SAMS maintenance, address data coordination, technical support and data validation.
- 2) Online Data Stewards – Users utilize the SAMS web application to perform tasks related to creating and maintaining addressing data. These tasks are access-restricted to the address stewards' county boundaries and requires a login to access the statewide addressing and mapping database.
- 3) Offline Data Stewards – Users utilize local hardware and software for tasks related to creating, maintaining and storing addressing datasets. These users may also participate in the SAMS system

through coordinated data exchanges. Offline address data is uploaded to the SAMS by WVDHSEM staff.

- 4) Third party addressing stewards – Users such as contractors or vendors that perform tasks related to creating, maintaining, or providing web data services. These users may develop online or offline addressing tools and services.
- 5) Address Data Public Consumers – The public or non-data stewards of addressing data, such as citizens that can use addressing locator services or provide feedback (such as identifying an incorrect address or street name) through a web application.

Workflows and Processes

Some workflows create and edit addressing data, while other processes validate information through automated scripts or field verification. *For the new system design the WVDHSEM should document all workflows and interactions at the county and state levels.*

Creating New Data – Processes used to enter in new address information. This process may involve creating a new site point or street centerline. New information can be gathered through a variety of methods: submitted design or construction plans, lot plats, GPS coordinates, aerial imagery, etc. Creating new data involves both spatial (geographic information) and non-spatial (attribute information) data.

Editing Existing Data – Processes used to edit geographic and attribute information for both site locations and street centerlines. Editing geographic information may relate to adjusting the location of a road centerline or site address points based upon new aerial imagery. Editing workflows can also include tasks such as splitting, copying, or deleting features; renaming streets, or correcting missing data.

Re-Addressing Data – Workflows that involve re-addressing data en-masse may include corrections to site addresses, for example.

Data Validation – These tasks verify the addressing data follows local ordinance rules. Examples of address validation may look for address number order, even/odd side or valid range. Validation tasks can be either manual or semi-automated.

Data Field Verification – Field verification programs validate and confirm physical locations. These tasks can include the collection of GPS coordinates or other physical measurements such as photos of structures.

Address Data Layers

Addressing data layers primarily consist of Site Address Points and a Street Centerlines. Each dataset contains a core set of attributes that describe the address location using known NENA and USPS standards. The address data steward workflows may reflect creating, editing, removing or other processes that alter site address points or road centerlines.

Site Address Point -- a point dataset that represents the physical location of the structure. This point may represent a single structure, such as a single family detached home, or may represent a commercial

building containing many addresses. Key attributes of this dataset includes a unique site identifier, complete address information, such as number, street name, city, zip, and other information such as Emergency Service Zone, structure type and others.

Street Centerline -- a line (polyline) dataset that represents the physical location of the center line of the road network within the area. The topology (geometry) of the centerline dataset reflects the addressing data attributes, primarily the address range. Key attributes for the centerline dataset includes a unique centerline identifier, primary and secondary names, route numbers, valid address ranges.

Secondary Operational Datasets -- these operational datasets directly support addressing functions, such as emergency service zone boundaries, stand-alone tables that contain postal codes, old-address tables (crosswalk information), site multi-address tables, road name tables and other information.

Reference and Basemap Datasets -- is often used in conjunction with and to support the addressing data. Reference datasets may often include data such as aerial imagery, building footprints, census data, hydrography, cadastral data, flood data, etc. These datasets are often held by other parties such as other government agencies or commercial interests.