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# EXECUTIVE SUMMARY

As part of the ENHANCE 911 GIS grant project, a data development plan is being created to capture information about existing GIS data at the state and at the local jurisdictions. The data development plan is a document in progress that outlines many of the initial needs for road centerlines across the state based on results from an initial GIS survey that was undertaken in May 2011. The survey was a method to assist in determining some of the requirements that would be needed in the development of the GIS repository system and the local sub-grant program. Based on results from the survey, review of data from pilot counties, and typical 9-1-1 industry GIS needs and requirements, this section of GIS road centerline data development methodologies for the plan was written to capture some of the more common issues with 9-1-1 addressing data and options for remediation.

Many of these GIS road centerline scenarios involving road names, address ranges and other required fields outlined in the local sub-grant guidelines are some of the data remediation scenarios that local jurisdictions may be looking to undertake as part of their local sub-grant project scopes. The information in this report outlines some of the best practices and guidelines for GIS road centerline addressing and could be a resource to assist local jurisdictions in the development of their sub-grant applications. This report will not contain information on every potential addressing issue, nor will the suggested remediation scenarios apply to every local jurisdiction's situation. There can always be unique addressing scenarios within every local jurisdiction and if it applies to a GIS road centerline requirement, as outlined in the grant guidelines and eligible uses of sub-grant funds, those unique addressing scenarios should also be described within the sub-grant applications.

# 1. DATA DEVELOPMENT PLAN

## 1.1 Introduction

There are various sources of addressing information that could assist a county or PSAP in developing or verifying road centerlines for 9-1-1 purposes. To develop a road centerline layer with accurate road names and address ranges, a jurisdiction must have an existing road network that is accurate to the recommended National Emergency Number Association (NENA) standards for data collection of road centerlines, which is +/- ten feet from the center of the roadway. A road centerline layer may either already exist within a jurisdiction or one may need to be developed. Once a jurisdiction has determined a source road centerline base map that meets the spatial accuracy requirements, it will need to determine if road names and address ranges are present and the validity of any existing addressing information. A jurisdiction can start with an existing centerline file from another department or agency that is spatially accurate but might have limited road names and address ranges that will have to be verified and completed. To develop or validate existing ranges, combinations of the potential data source listed in this document can be used.

To achieve road centerlines that adhere to a baseline of NENA standards, there could be a number of factors that might need to be reviewed and remediated, within both the spatial accuracy and the attribute accuracy. This plan is an overview of many of those potential issues that might need to be reviewed:

## 1.2 What Is Required

The main component that needs to be developed for the road centerlines is a GIS dataset that is spatially accurate and whose attributes are as accurate as possible. The focus of this project will be to get all of the centerlines to a consistent baseline across the state. Based on the initial GIS survey that was conducted in the spring of 2011, there are a number of counties that consider their centerlines to have incomplete road names and/or address ranges. There will be some counties that have some spatial accuracy errors that will also need to be remediated.

During the project, the road centerlines should have the attributes appearing in Table 1 populated. These attributes are typically the required NENA addressing fields for today's wireline and wireless calls and it will be critical that at minimum these fields are complete and accurate for future call routing in Next Generation 9-1-1 (NG9-1-1).

| Field Description | Example |
|---|---|
| Prefix Street Direction | N, E, S, W, NE, NW, SE, SW |
| Street Name | MAIN, CENTER, ELMWOOD, THIRD |
| Street Type | ST, AVE, RD |
| Suffix Street Direction | N, E, S, W, NE, NW, SE, SW |
| Left From Address | 101 |
| Left To Address | 149 |
| Right From Address | 100 |
| Right To Address | 148 |
| *MSAG Community Left | GREEN TWP |
| *MSAG Community Right | GREEN TWP |
| **ESN Left | 103 |
| **ESN Right | 103 |

*MSAG—Master Street Address Guide
** ESN—Emergency Service Number representing an Emergency Service Zone

Table 1—Required Addressing Fields for NENA 1.0 Model

## 1.3 Data Development Methodologies

The first step in any GIS 9-1-1 addressing remediation is to assure spatial accuracy of the GIS datasets. Road centerlines should be within 10 feet or less from the center of the roadway 95 percent of the time[1].

### 1.3.1 GIS Road Centerline Development

Road centerlines for 9-1-1 purposes can be developed using different methodologies. In many cases, spatially accurate road centerlines might already exist through another county, state or federal department or agency. These spatially accurate roads can become the base layers for the GIS road centerline addressing information where road names, address ranges and other required fields can be applied to each road segment. In Michigan, a potential spatially accurate road centerlines source available at no cost from the Center for Shared Solutions and Technology Partnerships (CSSTP) is the GIS roads from the Michigan Geographic Framework (MGF). Leveraging this existing data infrastructure could be an effective and efficient means of acquiring an existing road centerline base to then develop the information for the required addressing fields. MGF data can be downloaded from http://www.michigan.gov/cgi/0,4548,7-158-52927_53037_12693---,00.html.

[1] NENA GIS Data Maintenance and Collection Standards, NENA 02-014 page 9.

Where there are no existing spatially accurate road centerline sources that are available, GIS data collection might be necessary to complete a road centerline base. A typical methodology for developing spatially accurate centerlines across a jurisdiction is to use an existing known accurate source of digital orthophotography that meets the accuracy standards required for the collection/digitization of road centerlines that are within 10 feet of the center of the roadway.

Global Positioning System (GPS) can be used to collect any roads that might be missing from an existing GIS road centerline source. Mapping grade GPS units can be used to collect the road geometry in the field and then downloaded back in the office to integrate with the main road centerline map and populate addressing attribute information. This becomes a typical data collection workflow methodology for long-term data maintenance.

### 1.3.2 GIS Address Structure Points

Where structure points exist, they can be used to validate against road centerlines to assure that all road names and address ranges on the road centerlines are consistent. This provides additional road name validation between the two datasets. If GIS structure points and road centerlines were developed in conjunction with one another, then road names, addresses and address ranges should match across both datasets, in most cases. Running a process to geocode the structure points addresses against the road centerlines will flag any structure points that do not match the road name or address ranges within the road centerlines. Any structure point addresses that do not fall within an existing centerline range could signify that there might be a possible range issue on the road centerlines. If a structure point address does not match any road segment, it could be due to a road name inconsistency which can be reviewed on the road centerlines.

### 1.3.3 No GIS Address Structure Points

In jurisdictions where GIS address structure points have not been developed and are not available as a source layer to validate address ranges and road names on the road centerlines, there are other potential sources of address data that could be used to validate existing road centerlines. For complete validation of addresses and address ranges, field verification is typically required in at least some capacity. Using the following sources of address information can be a starting point to validate addressing information in the office and determine areas of concern that require field verification. If a jurisdiction does not have any of the following source information available, it will be very difficult to create an accurate structure layer and verify road centerline ranges with only limited field work. Typically, complete field verification would be required, which can become quite costly.

#### 1.3.3.1 Hard Copy Addressing Maps

Some jurisdiction will have paper plots or spreadsheets of addressing information that can be referenced to help verify road centerline road names and address ranges and also aid in the development of an address structure points layer. Depending on the condition of any maps and the detail of information on those maps, they could be put through a large format scanner to create digital scans that could be georeferenced to existing digital orthophotography or GIS road centerlines layers to become a digital reference for digitizing structure address points and assigning the addresses or simply verifying the road ranges against the addresses, if existing and visible, on the scanned georeferenced image file.

#### 1.3.3.2 GIS Digital Tax Parcel Layer

In Michigan, many of the equalization departments have tax parcel data in GIS format. GIS tax parcels can be used to determine the site address for many of the site structures within a jurisdiction. By performing some basic geoprocessing routines the tax parcel polygons can be converted into parcel centroid points. The tax parcel

addresses on these points can then be used to verify road name and address range values on the road centerlines. The verification that can be performed will depend on the level of detail of the addressing information in the tax parcel data. Figure 2 depicts an example of using the tax parcel addresses and a background source layers within GIS to compare to road names and address ranges on the centerlines.

- Run a geoprocessing routine to create a centroid for each parcel polygon. The point will be created by the GIS within the center of that polygon. The points will have the same attributes that are currently within the tax parcel polygons, including parcel identification number (PIN) which is the primary database key to link to any other information within a Computer Assisted Mass Appraisal (CAMA) system data table, including current site address.

- Join the CAMA table with the site address field to the point attribute table by linking the tables on the PIN.

- Although these geoprocessing tasks require minimal effort if the PINs between the GIS attribute table and the CAMA table are standardized and match one another, there are still anomalies within the parcel data that need to be considered before any of the addressing information can be used as a validation source for road centerline address ranges

- There may not be a unique field in the CAMA system for actual site address versus mailing address. If there is a unique site field, it may not always be populated with just the actual site address. Typically the site address is populated with the mailing address which can be the same address as the site on the parcel or could be the mailing address of the owner who does not receive his mail at that location. There are instances where that address is simply a post office box or an out of town address.

- There will be parcel polygons that have multiple site structures, each with unique addresses and the parcel may only have the main site address.

Figure 1 depicts an example of parcel centroid addresses with addresses that are mailing addresses not located along this particular street.

Figure 1—Example of Parcel Centroid Addresses

### 1.3.3.3 Automatic Location Identification Database

The automatic location identification (ALI) database contains customer records for wireline installations for the telephone companies. Each record will have the 9-1-1 address of customer locations. The records can be geocoded to create a point layer representing each address within the ALI database. A road centerline layer will need to exist with address ranges in order to geocode the ALI records. A third party data source could be used for preliminary geocoding. A third party source may not have all of the correct road names or address ranges but could provide a geocoding process to get many of the ALI records plotted for a source reference. There are some limitations to geocoding the points in this manner:

- The ALI database only lists the records of wireline customers therefore will not have site addresses for all structures. Where people have discontinued their wireline service and only use cell phones as their primary, their address will not be in the database.

- The ALI database is owned by the telephone company and a telephone company will sometimes provide one free extract per year to a PSAP upon request. However, this is not always the case and a fee can be charged for an extract of the data or multiple extracts per year.

- If the ALI database is provided, it will require the recipient to sign a non-disclosure agreement as the combination of customer name, telephone number and address with the ALI database is confidential and not permitted for any unauthorized redistribution.

#### 1.3.3.4 United States Postal Service Routing Sheets

United States Postal Service (USPS) routing sheets are printed spreadsheets that show addresses in the order that the mail carrier delivers the mail. The spreadsheets typically contain resident information such as last name or a location description. These routing sheets can be obtained from the Address Management Systems (AMS) district. The routes on the routing sheets can be followed using any existing GIS data and road names and address ranges can be verified. There are some considerations that need to be made with respect to the addressing information within the routing sheets:

- The routes do not show the addresses for locations that do not receive mail delivery. For instance, if a resident has a post office box instead of mail delivery, this address will not be listed in the routing sheets.
- The routing sheets will typically show apartment and suite numbers, providing that the resident or business at the location receives mail delivery.
- A non-disclosure agreement will need to be signed as the information within the spreadsheets contains resident information.

#### 1.3.3.5 Voter Registration Database

Voter registration databases, such as the Qualified Voter File (QVF) in Michigan, are typically updated in conjunction with driver license registrations and can be used to help validate existing addresses within a jurisdiction. These addresses can be geocoded to centerlines to develop points that can be used to validate the address ranges on the centerlines. Any addresses that do not geocode can be reviewed to determine if there are road name inconsistencies or addresses that do not fall within an existing address range, possibly indicating road naming or address range issues within the road centerlines. Contact your County Clerk to inquire about the QVF.

#### 1.3.3.6 Utility Databases

Utility companies can also be another resource for addressing information. Utility companies sometimes maintain their own GIS data for customer locations. They typically have, at minimum, database records with customer locations including address information. The customer records within a specific geographic area may not contain all of the addresses within that geographic area depending on the type of utility service being provided and the number of providers in the area. It might require contacting multiple utility companies.

Although a utility database might not include all of the addresses within a geographic area, the addresses that could be provided will be an additional source that in conjunction with some of the other sources listed in this document can help to validate the information across the road centerlines

#### 1.3.3.7 Local Municipalities

Local municipalities within a PSAP jurisdiction or within a county might have existing addressing source data that could be used to validate existing addressing information on road centerlines. If a local municipality still operates as an address authority and assigns addresses for it municipality, there may be GIS data, spreadsheets or paper maps that exist that show the inventory of addresses across a municipality.

To assure that all addressing across multiple jurisdictions is consistent and complete, effective collaboration is required to validate all addressing across the existing road networks.

### 1.3.3.8 Field Verification

Once an initial determination has been made as to all of the potential source data that could be available for review against the road centerline attributes, a process of bringing that information into GIS has to be undertaken to do an initial in-office comparison and any road centerline attribute updates in-office. By setting different labeling capabilities within the GIS software, the different source data can display addressing information for a person to review the data for road segments and compare to addresses from any combination of source data listed above. For example, the road centerlines can be labeled with road name and address ranges and a parcel layer could display any address information associated with each parcel and a GIS layer from the utility company can be also labeled with addresses.

Figure 2 depicts an example of using tax parcel source information with parcel addresses labeled and road centerlines address ranges labeled to assist in validating road names and address ranges.

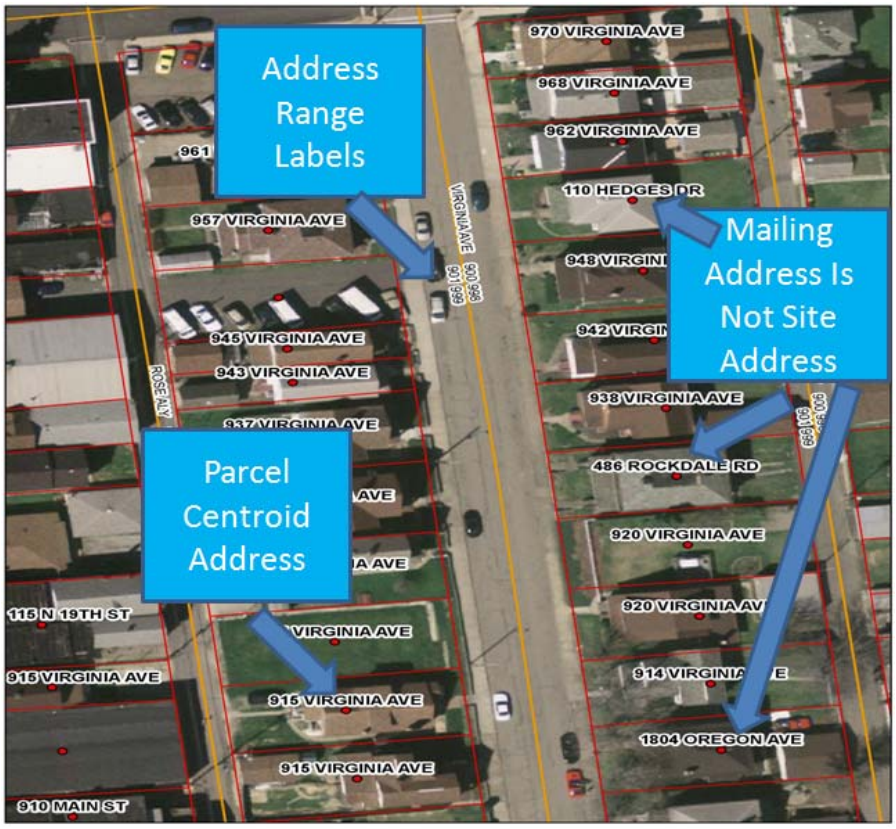



Figure 2—Example of Tax Parcel Source Information for Road Centerline Validation

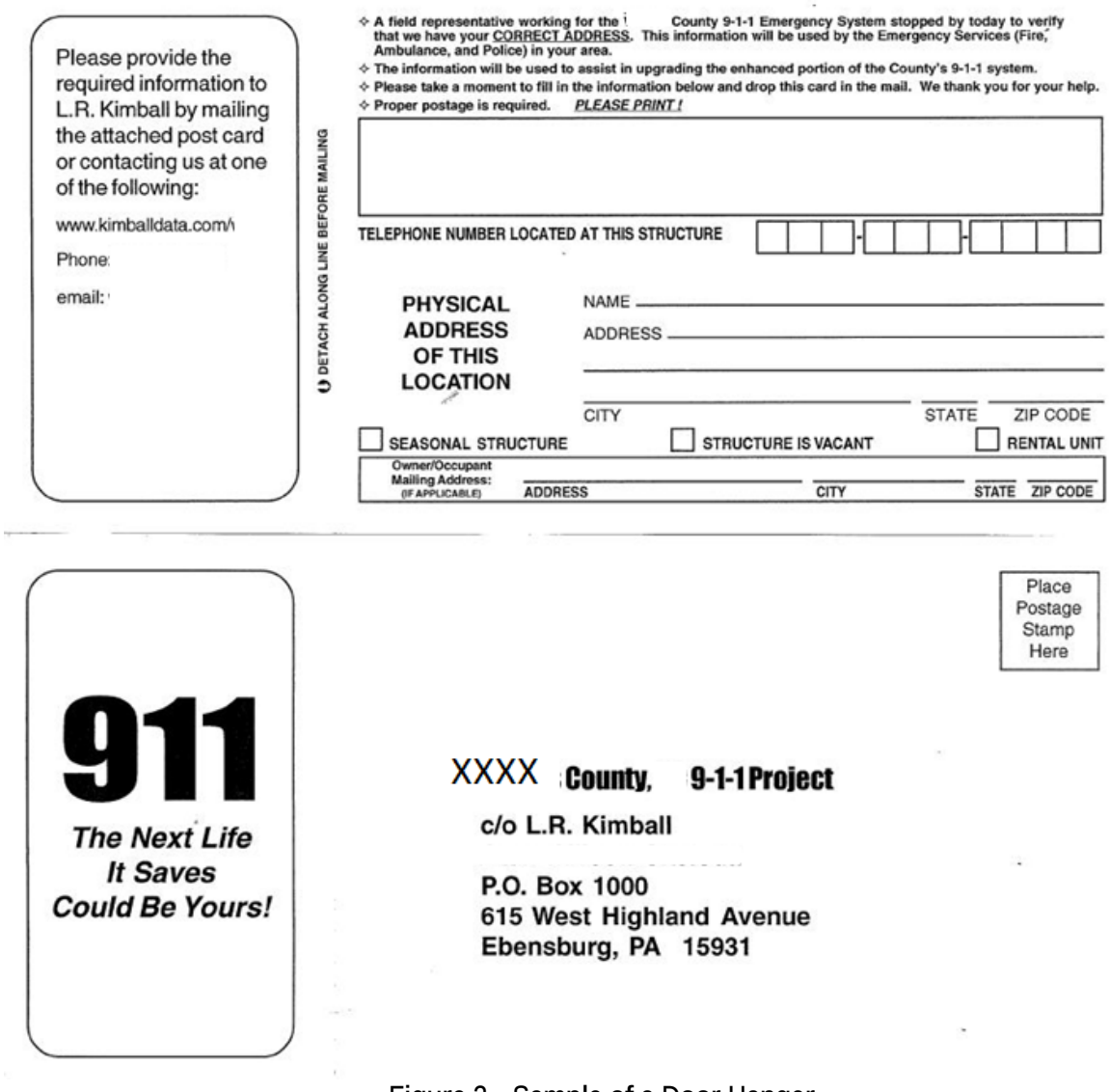
While reviewing data, if there are road segments with road names or address ranges that cannot be verified with the additional source data or the existing information that is being reviewed leads the information for a segment being questionable, those features should be flagged with a unique code in the attribute table that it needs to be field verified. By coding any features as needing field verification, once all of the data has been reviewed in the office, all of the features that have been coded for further verification can then be displayed with unique symbology. Either

plots can be developed by geographic area showing the feature that needed to be verified or the data can be loaded onto a laptop that can be taken directly into the field for verification and any required updates.

When reviewing addressing information for specific features in the field, field personnel should review the road names on the street signs and also the structure addresses along a particular street segment that is being reviewed because it was flagged in the office as a road segment with questionable accuracy. Where addresses are not visible, a door hanger should be left behind for a resident to respond back with the appropriate information. Door hangers should include space for an identification number that corresponds to the same number in the digital data (or on the paper map), as well as the resident's name, address and telephone number. The front of the card should contain a person and address of where to send the response. We have found that including a telephone number for the resident to phone their address information works equally well.

Figure 3 depicts a sample of a door hanger that can be left at a residence or business where no one is available to verify address information.

The balance of this page is intentionally left blank.



Please provide the required information to L.R. Kimball by mailing the attached post card or contacting us at one of the following:

www.kimballdata.com/

Phone:

email:

DETACH ALONG LINE BEFORE MAILING

- A field representative working for the County 9-1-1 Emergency System stopped by today to verify that we have your CORRECT ADDRESS. This information will be used by the Emergency Services (Fire, Ambulance, and Police) in your area.
- The information will be used to assist in upgrading the enhanced portion of the County's 9-1-1 system.
- Please take a moment to fill in the information below and drop this card in the mail. We thank you for your help.
- Proper postage is required. *PLEASE PRINT!*

TELEPHONE NUMBER LOCATED AT THIS STRUCTURE

PHYSICAL ADDRESS OF THIS LOCATION

NAME

ADDRESS

CITY STATE ZIP CODE

SEASONAL STRUCTURE STRUCTURE IS VACANT RENTAL UNIT

Owner/Occupant Mailing Address: (IF APPLICABLE) ADDRESS CITY STATE ZIP CODE

Place Postage Stamp Here

911

*The Next Life It Saves Could Be Yours!*

XXXX County, 9-1-1 Project
c/o L.R. Kimball

P.O. Box 1000
615 West Highland Avenue
Ebensburg, PA 15931

Figure 3—Sample of a Door Hanger

### 1.3.4 Road Centerline Field Standardization

To achieve the GIS road centerline required fields standards, some clean up of data might be required across existing road feature records. For example, if a local GIS road centerline layer only has one field for street names that includes the pre-directional, street name, street type and post-directional then to meet the required standards some of the street name components will need to be broken out into their own separate fields.

| Street Name |
|---|
| W MAIN ST |

Table 2—Example of All Street Name Components included as One Field

| PRD | STN | STS | POD |
|---|---|---|---|
| W | MAIN | ST | |

Table 3—Example of All Street Name Components Broken Out Across the Standard Street Name Fields

For systems that require the street name information to be all included in one field, the database standards provide an additional field beyond the standards street component fields listed in Table 4 to handle that scenario. This additional field combines all of the street names into one field. This field can also be very useful for labeling within a GIS environment. When records are created and updated, if you are using the full street name field, it is important that all of these fields are updated at the same time to keep the street names across the fields synchronized.

| PRD | STN | STS | POD | FULLSTN |
|---|---|---|---|---|
| W | MAIN | ST | | W MAIN ST |

Table 4—Example of Additional Field Containing the Full Street Name that can be Used for Labeling and other Systems

Road centerlines should also contain four separate fields for left and right address ranges. If a road centerline only captures a low and high range without breaking it down to the left and right, some additional data entry will be required to complete the four required fields.

| LOWRANGE | HIGHRANGE |
|---|---|
| 100 | 159 |

Table 5—Example of a Road Centerline Feature Record that only has a Low and High Range

| LLO | LHI | RLO | RHI |
|---|---|---|---|
| 101 | 159 | 100 | 158 |

Table 6—Example of a Road Centerline Feature Record that Contains all Four Standard Address Range Fields

Road centerlines should contain MSAG community and emergency service number (ESN) information to distinguish the road names and address ranges by the same communities and ESNs that are outlined in the MSAG. This also allows for better synchronization and validation between the road centerlines and the MSAG and ALI database as described in NENA Standard Document 71-501[2]. Road centerlines features should have both a left and right MSAG community fields as roads can be a boundary feature whereby address ranges on one side of the street belong to one community and the address ranges on the other side of the street belong to another community. The same left and right fields apply to the ESN information on the road centerlines.

Road centerlines should also be split at all MSAG community boundaries and emergency service zone (ESZ) boundaries. An ESZ is the geographic area representing an ESN. This allows for road names and address ranges to be split at these boundaries which will coincide with the MSAG format. It is important that all ESZ and MSAG community boundaries be topologically accurate, whereby all boundaries are snapped to each other preventing and 'gaps' or 'overlaps' between polygon boundaries. Also, all roads that share the same geometry boundary as a jurisdictionaly boundary should snap to the same topology.

Figure 4 depicts the road is split at the ESZ boundary and the ranges and ESN attribute values reflect the different geographic area.

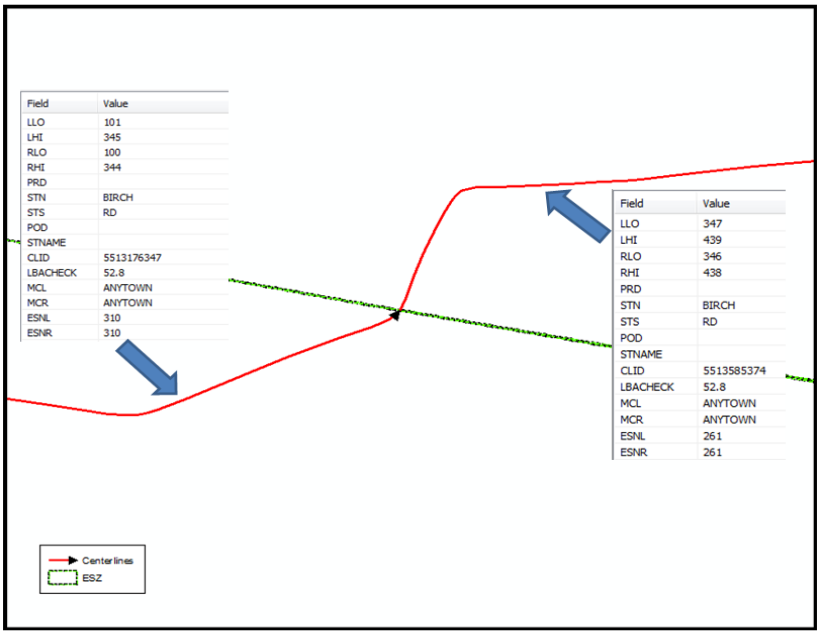



Figure 4—Road Centerline Split at ESZ boundary

[2] NENA Information Document for Synchronizing Geographic Information System databases with MSAG and ALI, NENA 71-501, Version 1.1, September 8, 2009

### 1.3.5 Addressing Standards for Road Centerlines

In the development of an accurate and standardized road centerline layer, there are a number of considerations and criteria[3] with the way the actual geometry of the road segment features are developed and how the addressing information is assigned to each road centerline segment. This section provides some basic addressing guidelines that have been introduced over the years as standard approaches to 9-1-1 addressing. Each jurisdiction will have unique circumstances for addressing and not all of these standards can be implemented or implemented across all portions of a jurisdiction and they are to be treated as guidelines. Typically, a jurisdiction will have an address ordinance depicting how the addressing should be assigned within the jurisdiction.

#### 1.3.5.1 Line Direction

As a general rule, addresses should increase from low to high. The assignment of addresses will be outlined within the local address ordinance. Some examples for the direction of addressing include: addresses increasing sequentially across a jurisdiction from south to north and west to east, addresses increasing sequentially out from a center grid point within a jurisdiction.

For dead-end streets and cul-de-sacs, addresses should increase from the intersection with the access road to the dead-end.

Figure 5 depicts an example of addresses increasing away from the start of new road. Road ranges would begin with 100 and 101.

[3] NENA Information Document for Synchronizing Geographic Information System databases with MSAG and ALI, NENA 71-501, Version 1.1, September 8, 2009, pages 17-18

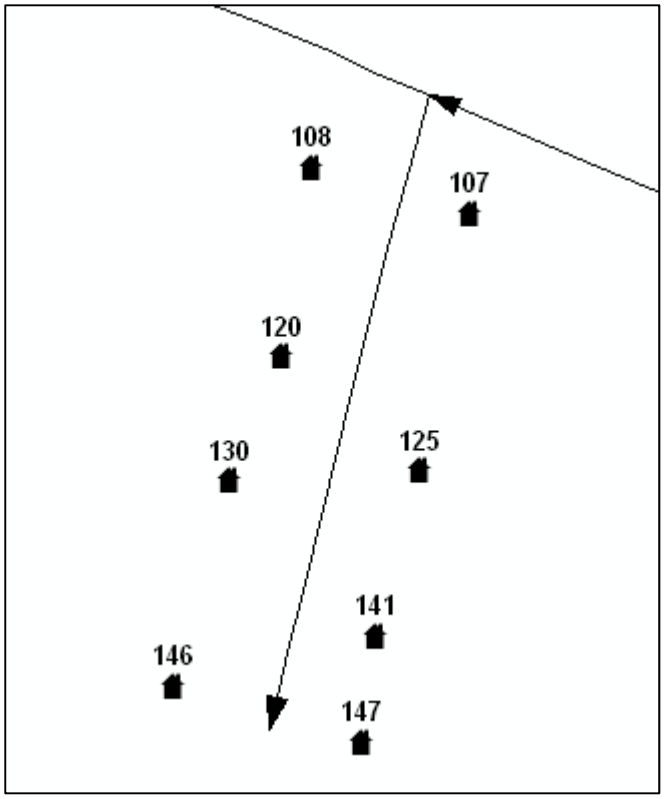



Figure 5—Example of Addresses from Start of a New Road

Odd and even addresses should be on the opposite side of the street from each other. The accepted standard is odd value addresses on the left side of the street and even value addresses on the right side of the street when standing at an intersection and facing in the direction of the increasing addresses. Although this is the recommended standard, it is not incorrect if this is not the case in all situations.

Figure 6 depicts even addresses on the right side of the road and odd addresses on the left.

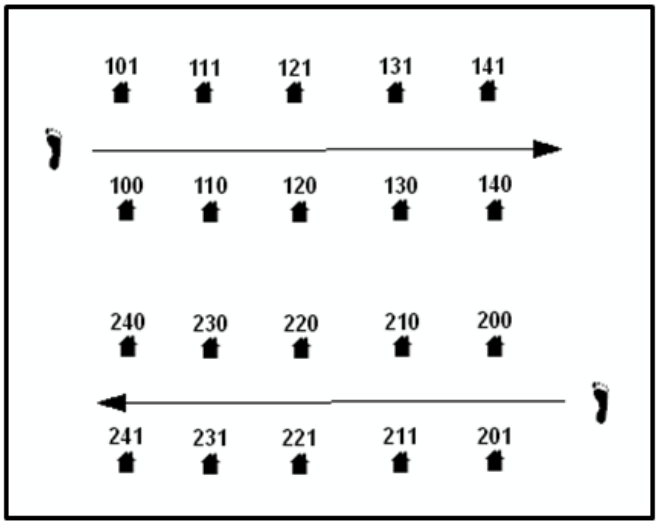



Figure 6—Road with Even and Odd Addresses

### 1.3.5.3 Driveways and Private Roads

Driveways and private roads having two or more addressable structures should be named. This is especially the case where driveways are longer than 250 feet or where the structures are not visible from the main road. These scenarios can be addresses as described in this section or as determined by addressing rules and ordinances with a local community.

Figure 7 depicts an example of a driveway with two or more addressable structures which becomes an addressable road called HIDDEN LN.

Figure 7—Example of a Driveway with Two or More Addressable Structures

### 1.3.5.4 Street Names and Address Range Development

There are a number of requirements that should be reviewed when it comes to the assignment or road names and address ranges to road centerlines. Each road segment should have at minimum a street name value in the street name field. Address ranges for a road segment should not have any overlapping range values along the same named road. Address ranges should not have all zero ranges, unless it is a unique situation such as an on-ramp, off-ramp, etc. More information on these requirements and checks are listed in the sample data assessment scorecard report posted at www.michigan.gov/911gisgrant.

Street names should be unique within a municipality and/or USPS postal zip codes. Streets having duplicate or similar-sounding names should be given new names or a unique range should be assigned to each street. This will alleviate potential issues with mail sorting, although emergency response issues may still arise. A unique street suffix (RD, CT and AVE) does not make a street name unique. The same potential issues exist for Green St. and Green Ave. within the same municipality or zip code as they would for Green St. and Green St.

Address numbers should be assigned using a consistent address interval (e.g., every 10.56, 26.4 feet or 52.8 feet). . This allows potential house numbers for future development. Address intervals could vary between urban and rural areas. Assigned address numbers should fall within the range of the road centerline segment that the driveway is accessed from. Address ranges at the beginning of a unique road should not start at 0 (zero). Typical ranges start at 1 and 2 or 100 and 101.

Divided four-lane highways should be represented with two segments, one for each direction of travel. The outside values should be assigned a range, with the inside values assigned 0 (zero). For interstate values, some computer

aided dispatch (CAD) systems accept GPS'd mile marker centroids similar to structure points. It is recommended to code the mile marker location in the Interstate centerline by splitting a small section of the centerline and assigning that segment the value of the mile marker in the outside ranges. (e.g., LLO = 160, LHI = 160, RLO = 0, RHI = 0), while being sure to include the 'N, S, E,W' designation in the post directional field for that centerline. It is permissible to leave the rest of the segments for the interstate coded with 0 (zero) ranges.

Road centerlines should be digitized in the direction that the addresses increase along a road. The addresses should be lower near the 'from' node and increasing towards the 'to' node of the road centerline segment.

Figure 8 depicts an example of incorrect and correct address information along the direction of a road. The road direction should be digitized in the direction of increasing addresses.

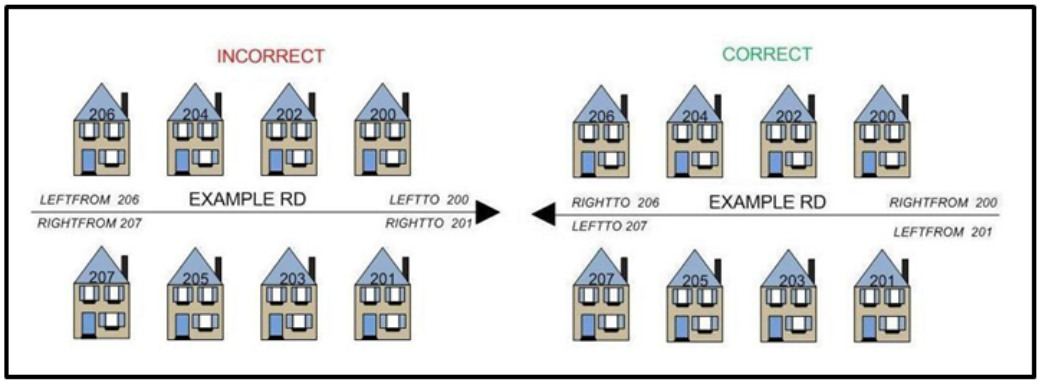



Figure 8—Example of Incorrect and Correct Address Information

Road centerline street suffixes (AVE, ST and RD) should be standardized using the USPS Publication 28 to maintain abbreviation consistency. In city 'block-style' addressing, it is recommended that ranges only allow for actual ranges rather than potential ranges. This will provide a more accurate geocode location along a road centerline.[4]

Another best practice is to enter all road values as upper case and without any leading or trailing spaces before or after values. For example, there should be no extra space after Green in the street name field. Sometimes the space bar can be mistakenly hit and there will be an extra character, 'Green_'. This makes some searches difficult because the space could cause a no match. There are some simple commands in GIS and database software to update all characters to upper case and also check and remove leading or trailing spaces.

Another recommended standard with road naming conventions is to avoid special characters and punctuation such as apostrophes, quotes, hyphen or dash, commas, periods, etc. For example, any roads such as M-35 should be

[4] NENA Information Document for Synchronizing Geographic Information System databases with MSAG and ALI, NENA 71-501, Version 1.1, September 8, 2009, page 15

data entered as M35, without the dash. Also street names should be spelled out. St. Paul Rd should be entered as Saint Paul Rd.

### 1.3.6 USPS Address Search Tools

One method to verify standard road naming conventions is to search existing address information on the USPS web site. By using the USPS address lookup at http://zip4.usps.com/zip4/welcome.jsp, an address can be entered with at minimum, address, city and state and the USPS road naming convention for that street will be returned. This will provide some additional information for any streets that fall out of the initial MSAG and GIS validations or any concerns with existing road naming within either database.

### 1.3.7 Road Centerline Topology

It is important to have the correct topology across addressing GIS datasets. Topology is defined as how point, line and polygon features in GIS share geometry such as the spatial relationships between connecting and adjacent features[5]. Topology defines and enforces data integrity such as road centerlines need to be connected together where road segments share an intersection. Another example is where polygon features such as PSAP boundaries or ESZs are adjacent to one another, there should be no gaps between the boundaries. Also, roads that are also a boundary between two jurisdictions should match the same geometry as the jurisdictional boundary.

Figure 9 depicts an example of topology dangles where roads are not 'snapped' where they should be to assure connectivity between roads that should be connected.

Figure 9—Example of Topology Dangles Where Roads are not Snapped

[5] Dictionary of GIS Terminology, 2001 ESRI Press, page 101

Figure 10 depicts an example of a road centerline that is not snapped properly at an intersection.

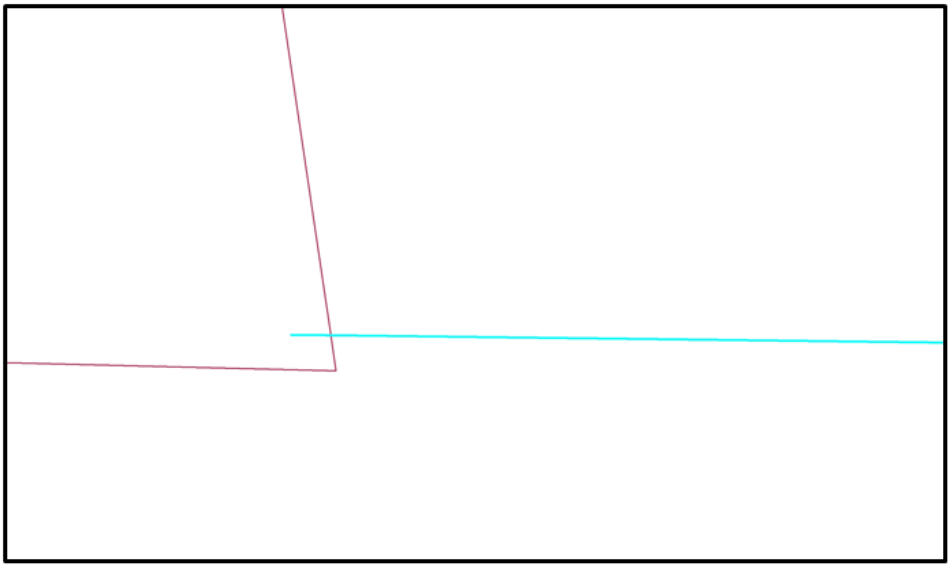


Figure 10—Road Centerline that is not Snapped Properly at an Intersection

### 1.3.8 Synchronization of GIS Data with MSAG and ALI

Synchronizing GIS addressing data with the MSAG and ALI databases will help to improve the overall accuracy and completeness of all of the datasets. If new wireline customers have been added to the telephone company customer records and the ALI database or new roads have been added to the MSAG, these database entries can be validated against the GIS data to assure that the information is represented within the GIS dataset so it can be mapped during a call. By synchronizing all of the datasets, the accuracy of all of the datasets will improve and help in locating 9-1-1 callers in today's 9-1-1 environment and is also a key step to preparing GIS data for its roles in next generation 9-1-1 (NG9-1-1).

Typically today, the ALI database and the MSAG are synchronized because it is critical in today's 9-1-1 environment for these tabular databases to validate against each other. However, it has not been a regular practice to also validate the GIS data against these tabular databases. Therefore, the first time that GIS data is synchronized against the MSAG, there can be many records that fallout because of inconsistencies in road naming conventions, standardization, community names and emergency service numbers. For an effective synchronization between the GIS data and the MSAG it is important to have left and right community names and emergency service numbers of the road centerlines.

NENA recommendations, outlined in Technical Standard 71-501, call for a 98 percent match rate[6] between the GIS road centerline and the MSAG to improve overall accuracy of the databases and in preparation for NG91-1. It is important to provide any changes or additions that are made within the MSAG or ALI database to the service provider or the 9-1-1 database administrator, who must make the necessary changes as they are presented[7].

## 1.4 Conclusion

To get to the accuracy levels required and follow the GIS road map to NG9-1-1 and to prepare GIS datasets to be 98 percent accurate, the starting point is getting current datasets standardized and attributes verified and validated. The GIS repository will play an integral part in assisting local jurisdictions in maintaining standards and accuracy levels, including tools to maintain datasets, if needed.

[6] NENA Information Document for Synchronizing Geographic Information System databases with MSAG and ALI, NENA 71-501, Version 1.1, September 8, 2009, page 17

[7] NENA Information Document for Synchronizing Geographic Information System databases with MSAG and ALI, NENA 71-501, Version 1.1, September 8, 2009, page 35