NENA Information Document for Development of Site/Structure Address Point GIS Data for 9-1-1

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Prepared by:
National Emergency Number Association (NENA) Core Services Committee, NG Data Management Sub-Committee, and Site/Structure Address Points (SSAP) Workgroup

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NENA's Committees have developed this document. Recommendations for change to this document may be submitted to:

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Table of Contents

1 Executive Overview

This document is an informational tool chest, not a listing of instructions and requirements. The reader will find a great deal of practical information on address point placement methodologies, based on real world experience. Reading the entire document will provide the greatest understanding of address point placement options and be the most beneficial to the reader.

Consulting **Section 2.12 Acronyms/Abbreviations** will provide the reader specific terminology and definitions used by each point placement methodology. **Section 3.6 Best Practices** and **Table 3-1 Methodology Usage Matrix**, emphasizes the necessary issues to keep in mind while reading the methodologies sections, and provides additional information necessary when examining each address point placement methodology. The reader should examine the address point placement methodologies to determine which suits their particular situation best. The reader will also find references to other NENA documents that will lead to more information.

1.1 Purpose and Scope

This document has been designed to serve as a guide for those developing site/structure address point data in a Geographic Information System (GIS) for use in 9-1-1 and Next Generation 9-1-1 (NG9-1-1). Site/structure address points represent addresses assigned by the local addressing authority, which may not reflect the addresses used in commercial or United States Postal Service (USPS) databases. Identifying when or how addresses need to be assigned, labeled or symbolized is not the intent or within the scope of these guidelines. Rather, the intent is to provide guidelines for site/structure address point GIS data development to support the needs of public safety applications, including:

- NG9-1-1 Location Validation
- NG9-1-1 Call Routing
- 9-1-1 Map Display
- Computer Aided Dispatch (CAD)
- Vehicle Routing
- Emergency Notification

This document is meant to provide Public Safety Answering Point (PSAP) management, vendors, and other interested parties guidelines for the development of a site/structure GIS layer, including subaddress level attribute fields. Subaddress level attribute fields are already defined within NENA-STA-006, 'NENA Standard for NG9-1-1 GIS Data Model'. The NG9-1-1 GIS Data Model outlines the recommended table structure for this type of 9-1-1 GIS layer but does not define the placement or spatial representation criteria for site/structure address points. This document provides guidance on site/structure address point placement criteria and subaddress data development needs for the following scenarios:

a) Single structure on single property – one address
b) Multiple structures on single property – one address
c) Multiple structures on single property – multiple addresses
d) Duplex (taking into account different entrance types)

e) Multifamily residence (single or multi-storied)
f) Mixed use structure (businesses and residences located in same building; home based business within family residence)
g) Mobile home parks
h) Apartment complexes
i) Business Parks
j) Strip malls/ shopping malls
k) Multistory office buildings
l) Campgrounds
m) Marina slips
n) Vacant lots
o) Landmarks (e.g., monuments, statues, traffic circles, bridges)
p) Recreational areas without structures present (e.g., boat launch, picnic areas)
q) Phone Booths, roadside phones
r) Utility Nodes (e.g., phone poles, substations, etc.)
s) Oil wells, gas wells, mines, borrow pits, etc.
t) Wind turbines
u) Cell towers
v) Temporary addresses (e.g., construction trailers for transportation projects, ice fishing houses, vegetable stands, firework stands, kiosks with static addresses with different users throughout the year)
w) Other (e.g., addresses assigned by local authorities for cemetery plots, airfields, railroad crossings, phones at gates, train control boxes, etc.)

These guidelines are intended to identify the spatial location(s) in a 9-1-1 GIS layer to use for existing addresses. This document takes into account the Next Generation 9-1-1 (NG9-1-1) functionality within the Emergency Call Routing Function/Location Validation Function (ECRF/LVF). Therefore, site/structure address points that follow these recommended guidelines can be used in current 9-1-1 systems and future NG9-1-1 systems. Suggested alternatives are also provided for cases where current software may not support the recommended guidelines.

The primary reasons to implement these guidelines are to:

- Provide for consistent, standardized spatial placement of site/structure address points.
- Provide for consistent, standardized use and spatial placement of site/structure subaddress points.
- Provide for consistent, standardized use and spatial placement of supplemental site/structure routing points.
- Provide the level of detail needed for each of the public safety applications listed above as to when a single point may be needed and when multiple points may be needed.

1.2 Benefits

This document benefits users and providers of GIS data by:

- Providing guidelines for data to be used in current 9-1-1 systems, future NG9-1-1 systems, and as a GIS data layer in other public safety GIS applications.
- Providing standards across multiple databases.
- Providing guidance on:
    - If/when a driveway access point needed
    - If/when should more than one driveway access point be represented
    - If/when should more than one structure access point, regardless if subaddresses are present, be represented
    - When an Emergency Services Boundary (e.g., Fire, Law or Emergency Medical Service) intersects a parcel, site, or structure
    - A hierarchical addressing system when moving from a primary address point to different levels of subaddresses (e.g., complexes with multiple buildings each containing multiple subunits, all having the same principal address)
    - Data Quality considerations for site/structure address point placement

2 Introduction

2.1 Operations Impacts Summary

This document is intended to provide address point placement guidance only, and does not require PSAPs or 9-1-1 Authorities to adopt or follow the methodologies provided. The level of impact on Operations is related to the degree to which address point data are used. It is worth noting that use of address point data benefits 9-1-1 services by increasing address location precision (not necessarily spatial accuracy), both in the PSAP and in an NG9-1-1 i3 routing environment.

Use of address point data will have impacts on both 9-1-1 Authorities and PSAPs. Today, 9-1-1 Authorities are not necessarily responsible for provision of address point data for PSAP GIS. In the future however, similar to MSAG responsibility today, 9-1-1 Authorities will be responsible for provision of maintained GIS address data to their NG9-1-1 network. Should 9-1-1 Authorities elect to provide address point data, the point methodologies chosen for creation and maintenance directly impact resources required, as well as the data's accuracy and usefulness for the NG9-1-1 network, PSAP GIS, and 9-1-1 emergency notification. Further, maintenance of address point data per NENA NG9-1-1 GIS Data Model (NENA-STA-006) may have additional impacts, including "... to meet local, regional, and other organizational needs...."

The methodologies used for address point creation and maintenance may impact PSAP operations' map-based decisions for resource allocation, vehicle routing, and emergency notifications. Additional impacts may be realized in an NG9-1-1 i3 environment, including fewer call transfers as a result of more accurate GIS-based call routing.

2.2 Technical Impacts Summary

The focus of this document is limited to spatial placement of address points. The technical impacts of this document on Customer Premise Equipment (CPE) and network hardware are negligible.

In terms of software impacts, the methodologies used for address point placement, and the resulting placement precision, may impact the accuracy of the networks' geospatial routing decisions. Additionally, spatial placement of address points may impact CAD software assignment of resources and vehicle routing.

2.3 Security Impacts Summary

Security concerns regarding address point placement are minimal.

Although address point attributes are not the subject of this document, it is worth noting that an Address Point dataset as a whole (the combination of the geographic point and related attributes) may contain confidential, proprietary and/or sensitive information that must not be introduced into the public domain. Certain data are confidential under many state laws. Such information is considered confidential when included in databases and on maps used by entities in the provision of emergency services. Such information may also be considered proprietary. Sensitive information implies a loss of security when disclosed to others. Such information may include wireless cell tower locations, military bases, refining facilities, airports, water treatment and distribution facilities, law enforcement facilities, federal offices, emergency management information and resources, and power generation / distribution facilities.

More information about data, information, and guidelines for data and physical security can be found in the NENA Security for Next-Generation 9-1-1 Standard (NG-SEC), NENA Standard 75-001.

2.4 Document Terminology

The terms "shall", "must", "mandatory", and "required" are used throughout this document to indicate normative requirements and to differentiate from those parameters that are recommendations. Recommendations are identified by the words "should", "may", "desirable" or "preferable".

2.5 Reason for Issue/Reissue

NENA reserves the right to modify this document. Upon revision, the reason(s) will be provided in the table below.

Doc #	Approval Date	Reason For Changes
NENA-INF-014.1-2015	09/18/2015	Initial Document

2.6 Recommendation for Additional Development Work

2.6.1 Multipoints

It is recommended that the use of multipoints as an allowable method for representing Site/Structure Address Points be considered by the NENA Standard for NG9-1-1 GIS Data Model Workgroup or another appropriate NENA Workgroup.

A multipoint is a single feature in a GIS, consisting of a collection of one or more individual point locations, stored as coordinate pairs (these are referred to in some software packages as "parts" of the feature.) A multipoint feature has a single record in the database – this reflects the fact that the collection of point locations has a single identity. For example, a set of building centroids representing a condo development where all the buildings have the same numbered address might be represented as a multipoint.

In a data production environment, that includes requirements from outside the 911 center, multipoints can resolve a dilemma associated with developing an address point data set using commonly available resources: aerial imagery, structure footprints and parcel maps. The dilemma is that on the one hand, associating simple (single-part) point geometries with address records is intuitively understood as the "correct" methodology and is more compatible with many software packages currently in use. On the other hand, it is very common to have multiple structures at a site with just one address, any of which might be the source of a call or the location of an incident, so a collection of points is really a more accurate representation of reality.

Not every structure can be separately addressed, but it is still desirable to assign an address to every structure. Multipoints allow the user to do this while avoiding an ambiguous, many-to-one relationship between the geometry and the address record. The user can disaggregate or "explode" the multipoint and add address detail where necessary to support call routing, dispatch or any other 9-1-1 function. If necessary, single points (feature centroids) can be generated from multipoints to provide compatibility with software and display requirements. Further standards development is needed to support the potential use of multipoints.

2.6.2 Point Placement Type

There currently is no way to distinguish which placement methodology was used to place a point (i.e. based on a Structure, Site, Parcel, Property Access, Geocoding). This information would be very useful to a data user as it provides valuable information about the point placement. This Site/Structure Address Point GIS Data for 9-1-1 informational document discusses these five placement methods and users of the data would benefit from having the placement method included as an attribute in the data, particularly when there are multiple placement methodologies used in the same dataset.

2.6.3 Elevation

The elevation of a 9-1-1 caller is particularly relevant when the caller is located in a multi-story building. The Federal Communications Commission (FCC) in its January 29th, 2015 Order (Report and Order (FCC 15-9)), acknowledged the importance of this issue, especially for wireless callers. As the technology becomes defined and deployed, this document should be updated.

2.7 Anticipated Timeline

The time to implement these guidelines will be contingent upon the resources applied by a local government or other entity to develop, manage and or provide this Site/Structure Address Point data. Any development timeframe will also be impacted by the placement methodology selected from those included in **Section 3.4 Address Point Placement Methodologies**, as point placement methods will range in speed of application.

2.8 Costs Factors

Following the methodologies for Site/Structure Address Point placement outlined in this document can have both financial and human resource cost implications when developing this type of GIS data. The amount of resources required to follow placement guidelines noted in this document may range from significant, if existing data needs to be modified to follow any guidelines listed herein, to minimal if new site/structure address point data is being created using a calculated method only.

For those with existing address point data, implementing one or more of these placement guidelines will involve reevaluating current point locations. This could potentially be a manual, labor intensive and time-consuming effort.

For those considering how to build address points from scratch, these guidelines should have a negligible cost impact beyond those resources planned for developing this type of data.

2.9 Cost Recovery Considerations

Collaborating, coordinating and sharing the cost of data development and maintenance with neighboring 9-1-1 entities and other stakeholders outside of 9-1-1 may offset the cost of collecting and maintaining high quality, current Site/Structure Address Point data. Other stakeholders include local and state planning departments, engineering, taxing authorities, and public / private partnerships with utilities, development permitting organizations, and other organizations. Consistent addressing, data scrubbing, and data maintenance will benefit all stakeholders.

2.10 Additional Impacts (non-cost related)

These guidelines are expected to have additional impacts that may include:

- Better performance of some 9-1-1 applications
- Reduced probability of misrouted calls
- Better information available for Public Safety
- Improved response time
- Improved communication of response location
- More efficient use of limited resources

2.11 Intellectual Property Rights Policy

NOTE – The user's attention is called to the possibility that compliance with this document may require use of an invention covered by patent rights. By publication of this document, NENA takes no position with respect to the validity of any such claim(s) or of any patent rights in connection therewith. If a patent holder has filed a statement of willingness to grant a license under these

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Please address the information to:

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2.12 Acronyms/Abbreviations

See NENA-ADM-000, NENA Master Glossary of 9-1-1 Terminology, located on the NENA web site for a complete listing of terms used in NENA documents. All acronyms used in this document are listed below, along with any new or updated terms and definitions.

Acronym (Term)	**Definition / Description**	****New (N) / Update (U)**
9-1-1 Map Display	The part of the Human Machine Interface (HMI) that displays emergency event location and calling device location information on a map.	N
Access	The means or way (route) to approach a location.	N
Address	An address specifies a location by reference to a thoroughfare or a landmark; or it specifies a point of postal delivery. [from FGDC standard]	N
Address Range-Actual	The range of addresses from the lowest valid assigned address on each side of the road centerline segment to the highest valid assigned address (e.g., 133–167, 136-170).	N
Address Range-Potential	The range of addresses from the lowest possible address on the road centerline segment to the highest possible address (e.g., 100-198, 101-199). Also known as buffered, continuous, exhaustive, hypothetical, padded, theoretical, and city-style (e.g., 100 block) address ranging.	N
Building	A manmade enclosed structure (with exterior walls and a roof) in the real world.	N
Centroid	A point within and at the center of the physical extent of a real world object, as represented in a GIS.	N
CAD (Computer Aided Dispatch)	A computer based system, which aids PSAP Telecommunicators by automating selected dispatching and record keeping activities.	
ECRF (Emergency Call	A functional element in an ESInet which is a LoST protocol server where location information (either civic address or geo-coordinates)	

Acronym (Term)	Definition / Description	**New (N) / Update (U)
Routing Function)	and a Service URN serve as input to a mapping function that returns a URI used to route an emergency call toward the appropriate PSAP for the caller's location or towards a responder agency.	
Emergency Notification	General category for any systems used to notify persons or devices of an emergency. May include changeable message signs, sirens, telephone and other media.	U
Entrance	A representation of a means or way to enter a property, structure, or site.	N
Geocoding	Conversion of location information from one form into another, typically a civic address (address number and street name) into at least latitude and longitude coordinates.	U
GIS (Geographic Information System)	A system for capturing, storing, displaying, analyzing and managing data and associated attributes which are spatially referenced.	
GIS Feature	Representation of a real world object in a GIS as a single geometric object.	N
HMI (Human Machine Interface)	The means through which a person interacts with an automated system/machine. A vehicle or an installation is sometimes referred to as the human-machine interface (HMI).	N
LiDAR (Light Detection And Ranging)	LiDAR (Light Detection And Ranging) is an airborne, spaceborne or ground-based laser-ranging technique commonly used for acquiring high-resolution topographic data. www.usgs.gov	N
LVF (Location Validation Function)	A functional element in an ESInet that is a LoST protocol server where civic location information is validated against the authoritative GIS database information. A civic address is considered valid if it can be located within the database uniquely, is suitable to provide an accurate route for an emergency call and adequate and specific enough to direct responders to the right location.	
Multipart GIS Feature	A GIS feature that has multiple geographically discrete parts (for example, multipoint or multipolygon), but is considered as a whole and is related to a single database table record.	N
NENA *(National Emergency Number Association)*	The National Emergency Number Association is a not-for-profit corporation established in 1982 to further the goal of "One Nation-One Number." NENA is a networking source and promotes research, planning and training. NENA strives to educate, set standards and provide certification programs, legislative representation and technical assistance for implementing and managing 9-1-1 systems.	
NISO *(National Information Standards*	NISO, the National Information Standards Organization, a non-profit association accredited by the American National Standards Institute (ANSI), identifies, develops, maintains, and publishes technical	N

Acronym (Term)	Definition / Description	**New (N) / Update (U)
Organization)	standards to manage information in our changing and ever-more digital environment. NISO standards apply both traditional and new technologies to the full range of information-related needs, including retrieval, re-purposing, storage, metadata, and preservation. http://www.niso.org	
NG9-1-1 (*Next Generation 9-1-1)*	NG9-1-1 is an Internet Protocol (IP)- based system comprised of managed Emergency Services IP networks (ESInets), functional elements (applications), and databases that replicate traditional E9-1-1 features and functions and provides additional capabilities. NG9-1-1 is designed to provide access to emergency services from all connected communications sources, and provide multimedia data capabilities for Public Safety Answering Points (PSAPs) and other emergency service organizations. www.nena.org/resource/resmgr/ng9-1- 1_project/whatisng911.pdf NOTE: It is recognized that there will be a multi-year transition to NG9-1-1 beginning as early as 2010. See the NENA list of FAQs related to NG9-1-1 for more details.	
Parity	Refers to odd and even street address numbers. Odd numbers are located on one side of a street and even on the other, without integrating odd and even numbers on the same side of a street.	N
Parcel	A representation of the boundaries of legal ownership of a single tract or plot of land or real property. It may or may not be spatially accurate.	N
Point-in-Polygon selection	The process of identifying spatial coincidence between points and polygons by overlaying a point onto a polygon to determine if the point is contained within the polygon.	N
Property	A representation of land by either a parcel, group of parcels or site footprint.	N
PSAP *(Public Safety Answering Point)*	Public Safety Answering Point (PSAP): An entity responsible for receiving 9-1-1 calls and processing those calls according to a specific operational policy.	
Site	An identified, described, or recognized location that may not have a defined boundary or a structure (e.g., campsite, ball field, park, etc.).	N
Structure	A constructed item (e.g., building, tower, etc.) that can have an address assigned to it.	N
Subaddress	A component of an address that provides differentiation between features having a common street name and address number.	N
Unit	A group or suite of rooms within a building that are under common ownership or tenancy, typically having a common primary entrance.	N
Vehicle Routing	The automated process that calculates a path for a vehicle from one location to another.	N

3 Operational or Technical Description

3.1 Site/Structure Address Point Usage in Public Safety Applications

The public safety applications considered in this document are:

- ***NG9-1-1 Location Validation:*** The action of ensuring a provisioned location is properly formatted, contains required data elements, and is within the jurisdiction of LVF being queried. An address point may be used to validate address-based location information, against an authoritative 9-1-1 approved database, to verify that it is valid for 9-1-1 use.
- ***NG9-1-1 Call Routing:*** The capability to route the 9-1-1 call to the appropriate PSAP. An address point is spatially compared to the emergency service boundaries to determine the appropriate PSAP to receive the 9-1-1 call.
- ***9-1-1 Map Display:*** The part of the Human Machine Interface (HMI) that displays emergency event location and calling device location information on a map. An address point may be used to display the location of the actual calling device or emergency event. Address points can help give context to an emergency callers location and may provide useful information to call takers that allow them to provide additional directions to emergency responders beyond what is available from automated Vehicle Routing
- ***Computer Aided Dispatch (CAD):*** A computer based system, which aids PSAP Telecommunicators by automating selected dispatching and record keeping activities. An address point may be used to aid in the identification, dispatching, and/or routing of emergency service vehicles to the location of an incident or emergency.
- ***Vehicle Routing:*** The automated process that calculates a path for a vehicle from one location to another. Address points may be used for the starting point, ending point, or both for vehicle routing in order to determine the best route.
- ***Emergency Notification:*** General category for any systems used to notify persons or devices of an emergency. May include changeable message signs, sirens, telephone and other media. Address points may be used to determine which persons, devices, or both need to be notified of an event based on their proximity to the event.

3.2 Address Points vs. Access Points

The distinction between address points and access points is a common source of confusion, particularly considering that in many cases a single point can be interpreted as both an access and address point. Mapping applications used by call takers and dispatchers have traditionally relied upon not only the location of an address point on a map, but also on the point of access to it, such as a driveway, gate, or other entrance. The access point is a critical feature for directing emergency responders to an address, either by visual cue, or for use in Computer Aided Dispatch system routing. While this document is primarily concerned with the placement of address points, their relationship to associated access points should also be considered in the address point placement process. In many cases both an address point AND an access point may be useful. Additionally other access-related features may need to be considered, such as driveways, gates, multiple building entrances, etc.

3.3 Address Point Placement Guidelines

The methodologies outlined below are recommended guidelines for creating and placing new address points or redefining existing address points for use in 9-1-1. These methodologies should not be considered all inclusive, as local addressing practices, which may differ from the techniques described below, will likely take precedence. Some methodologies may be used for the interim placement of an address point, particularly if detailed information about a site or structure is not readily available when the point is being created (e.g., unavailability of a site/structure building plan or subaddress information).

Identifying when or how addresses need to be assigned, labeled or symbolized is not within the intent or scope of these guidelines. For the purposes of this guideline document, the elevation placement of an address point is not considered. The placement examples provided in these guidelines solely illustrate two-dimensional address point locations. While there are secondary uses for this data, address point placement must meet 9-1-1 needs. Specific factors affecting point placement accuracy are covered in detail in **Section 3.7 Data Quality Considerations**.

Point placement requires consideration of location relative to other known locations such as a thoroughfare, landmark, or other agreed upon reference points. Address point placement necessitates that the address information be sufficient to allow points to be accurately located. The degree of point placement precision will vary based on an application's needs, but should be adequate to deliver first responders rapidly and efficiently to the correct location. Point placement in relationship to emergency responder and other agency boundaries is particularly important. For example, in a NG9-1-1 call routing system an address point should be located within the Emergency Services Boundary of the agency that is intended to respond to the call for service. Location within the correct political subdivision is an important, but secondary consideration (e.g., region, county, parish, city, parcel).Functionality requirements for efficient emergency response may override some specifics of these guidelines but should otherwise be applied consistently.

3.4 Address Point Placement Methodologies

The methodologies described in this section reflect the primary ways address points are created for use in public safety applications. With regard to subaddresses, please see **Section 3.5 Address Point Placement for Subaddresses**.

Five address point placement methodologies described in this section are:

- Section 3.4.1 Placement of an Address Point Based on Geocoding off of Road Centerlines
- Section 3.4.2 Placement of an Address Point Based on a Parcel
- Section 3.4.3 Placement of an Address Point Based on a Site
- Section 3.4.4 Placement of an Address Point Based on a Structure(s)
- Section 3.4.5 Placement of an Address Point Based on Property Access

3.4.1 Placement of an Address Point Based on Geocoding off of Road Centerlines

Placement of an address point to represent an address along a road segment based on the high and low numbers assigned to the road segment using geocoding techniques. Geocoding based on road centerlines is the use of technology and geographic reference data to return a geographic coordinate

that approximates the location of an address, based on linear interpolation between the high and low numbers assigned to a road segment. The location of the address point should be offset to be located on one side of the road or the other. Generally, this method is used when aerial imagery or other spatial data is not available. For more information see **Section 3.6 Best Practices**.

3.4.1.1 Calculated Placement

Description – Point location is automatically calculated along a road segment based on the low and high address numbers assigned to the road segment, typically performed in a GIS by geocoding a list of addresses.

3.4.1.1.1 **Default –** Next to the road the address references, offset a specified distance

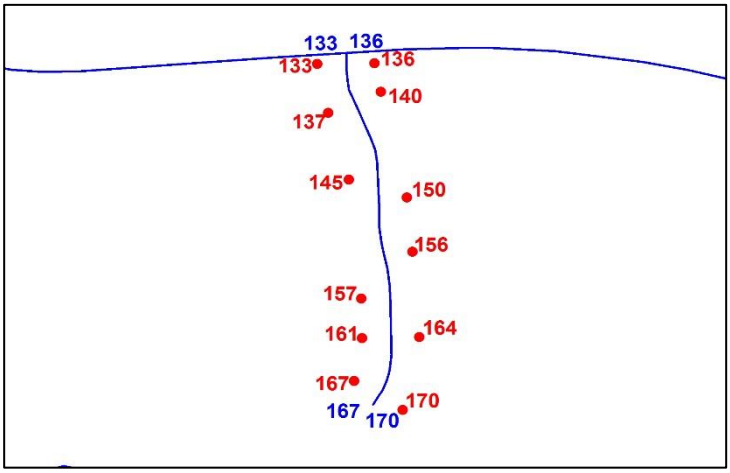
The location along a road segment where address points are automatically placed depends upon the type of address ranges assigned to road centerlines, 'actual' or 'potential', when geocoding.

An "actual" address range is the range of addresses from the lowest valid assigned address on each side of the road centerline segment to the highest valid assigned address. Placement using "actual" address ranges will result in a point with the lowest valid assigned address being created and placed at the beginning of the road segment and a point with the highest valid assigned address being created and placed at the end of the road segment. The remaining validly assigned addresses will be placed based on linear interpolation between the high and low numbers assigned to the road segment.

A "potential" address range is the range of addresses from the lowest possible address on the road centerline segment to the highest possible address. Potential address ranges typically reflect the address numbering standard established by the local addressing authority (e.g., potential address assignment every 52.8 feet; every 50 feet; every 5.28 feet). Placement using "potential" address ranges will result in points being placed based on linear interpolation between the high and low numbers assigned to the road segment.

Placement based on these different types of road centerline address ranges are shown in Figure 3-1 and Figure 3-2:

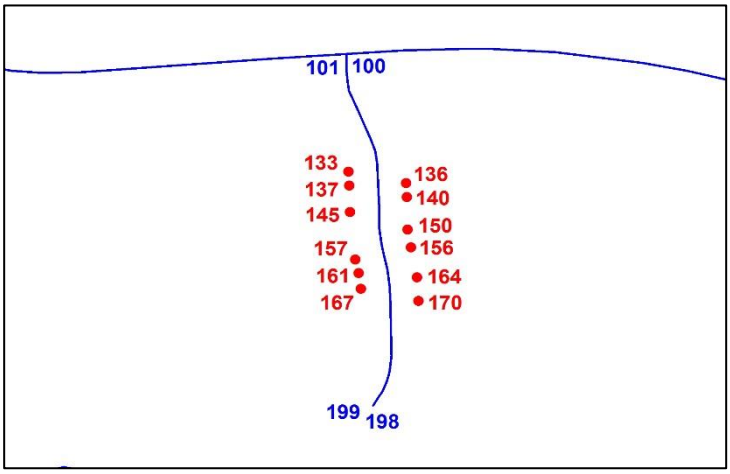
Figure 3-1 Address Ranges-Actual



Advantages:
- easy way to create address point placement in an automated fashion
- allows for quick mass address point creation
- parity is automatically set to match road centerlines

Disadvantages:
- can result in spatial locations far from where the actual address exists
- geocoded parity may not reflect reality

Figure 3-2 Address Range-Potential



Advantages:
- easy way to create address point placement in an automated fashion
- allows for quick mass address point creation
- parity is automatically set to match road centerlines

Disadvantages:
- can result in spatial locations far from where the actual address exists
- geocoded parity may not reflect reality

Notes:

- An offset from a road centerline is included to place an address point within a boundary polygon.
- While geocoding may allow for quick mass address point creation, it does not necessarily provide accurate point placement.

3.4.1.2 Manual Placement (Not Applicable)

3.4.2 Placement of an Address Point Based on a Parcel

Placement of an address point to represent an address associated with a parcel. The location of the address point must be located within the parcel and often reflects the center of the parcel. Generally this method is used when aerial imagery or other spatial data is not available. For more information see **Section 3.6 Best Practices**.

3.4.2.1 Calculated Placement

Description – Point location is automatically calculated at the center of a parcel polygon using an automated centroid creation process, typically performed in a GIS.

3.4.2.1.1 **Default -** In the center of the parcel

Figure 3-3

Advantages:
- can be automated & consistent
- can be spatially joined to corresponding parcel by point-in-polygon

Disadvantages:
- may not identify the location of a specific structure, e which is especially significant in a rural environment
- may not place well on multiple addresses in the same parcel

Notes:

- Address point must be located within the addressed parcel boundary. In some situations (e.g., L or U-shaped polygons) this may require manual adjustment or setting the GIS software's setting/configuration to always place the point inside the polygon.
- May not visually indicate the road segment that has been assigned as the structure's address

3.4.2.2 Manual Placement

Description - Point location should reflect the center of a parcel polygon, near the road referenced in the address, or where the majority of development resides.

3.4.2.2.1 **Option 1 -** In the visual center of the parcel

Figure 3-4

Advantages:
- can be spatially joined to corresponding parcel by point-in-polygon
- may be able to closely tie to nearest named road segment

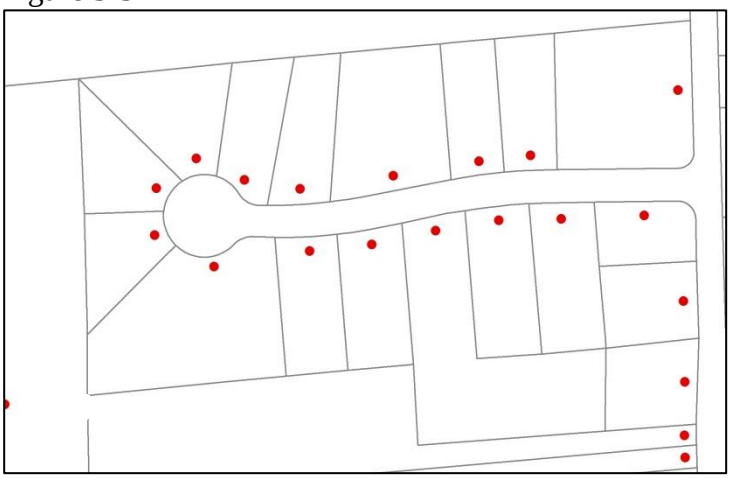
Disadvantages:
- may not identify the location of a specific structure, which is especially significant in a rural environment
- may not place well on multiple addresses in the same parcel

Notes:

- This method may be rarely used.
- May not visually indicate the road segment that has been assigned as the structure's address

3.4.2.2.2 Option 2 – Next to the road that the address references, generally at the center of the parcel frontage

Figure 3-5



Advantages:
- can be spatially joined to corresponding parcel by point-in-polygon
-able to closely tie to nearest named road segment

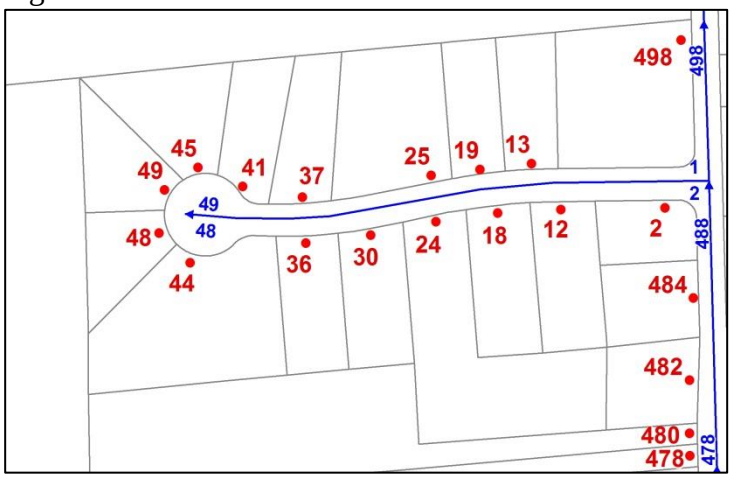
Disadvantages:
- may not identify the location of a specific structure, which is especially significant in a rural environment
- may not place well on multiple addresses in the same parcel

Notes:

- None

3.4.2.2.3 Option 3 – Next to the road that the address references, using address ranges to guide placement

Figure 3-6



Advantages:
- can be spatially joined to corresponding parcel by point-in-polygon
- able to closely tie to nearest named road segment

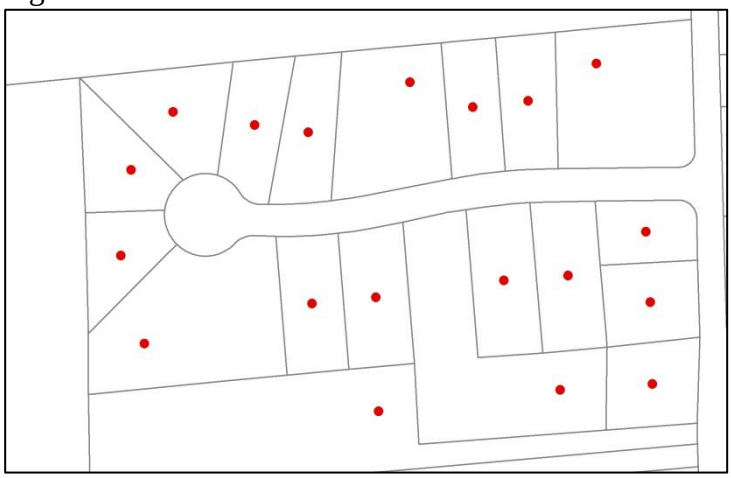
Disadvantages:
- may not identify the location of a specific structure, which is especially significant in a rural environment
- may not place well on multiple addresses in the same parcel

Notes:

- If road centerlines with actual (not potential) address ranges are available, then in Option 2B point placement is further refined to reflect the representative ranges.

3.4.2.2.4 Option 4 - On area of use or development, using additional knowledge (e.g., site plan, personal knowledge, etc.) to guide placement

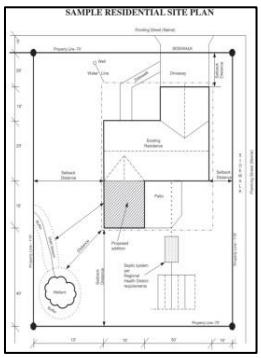
Figure 3-7



Advantages:
- can be spatially joined to corresponding parcel by point-in-polygon
- can place well on multiple addresses in the same parcel

Disadvantages:
- may not be close enough to as-built structure(s)
- may deviate from ingress based upon point placement
- may deviate from nearest corresponding named road segment address based upon point placement

Site Map



Notes:

- Placement of the point using a site plan or other document is only an approximation.
- A proposed structure location may be used where an actual one does not yet exist.
- Reference material could be digital, paper, or both when no imagery is available.

3.4.2.2.5 **Special Case 1 –** Multipart GIS Feature (Polygons)

Figure 3-8 shows one parcel comprised of two polygons representing one database feature.

Figure 3-8

Notes:

- Automated placement of points inside multipart polygons may not produce desirable results and may require manual review (see gray area above in diagram).
- Where multiple polygons represent a location that will be provisioned with a single address, users will need to determine where the address point should be placed in relation to associated features.

3.4.2.2.6 **Special Case 2 –** Multiple addresses within one parcel

Figure 3-9 and Figure 3-10 illustrate how multiple address points within a single parcel can be placed as either distributed (Figure 3-9) or stacked (Figure 3-10).

Figure 3-9 Manual Placement

Figure 3-10 Automated Placement (3 Stacked Points)

Notes:

- Numerous points can be placed within any polygon. Using an automated placement process, multiple points typically will be stacked upon each other, such as with a spatial join with a database that supports many-to-one relationships. Multiple stacked points may require further manual placement editing or representations such as unique symbology, to indicate stacked points.

3.4.3 Placement of an Address Point Based on a Site

Placement of an address point to represent an identified, described, or recognized location that may not have a defined boundary or a structure (e.g., campsite, ball field, picnic area, etc.). The location of the address point should be located within the site. For more information see **Section 3.6 Best Practices**.

3.4.3.1 Calculated Placement

Description – Point location is automatically calculated at the center of a site boundary polygon using an automated centroid creation process, typically performed in a GIS.

3.4.3.1.1 **Default –** In the center of the site boundary polygon

Figure 3-11

Advantages:
- can be automated

Disadvantages:
- may not identify the location of anything other than the approximate center of the site.
- not representative of an actual accessible place within a potentially large area.

Notes:

- This method requires a polygon boundary layer, with appropriate address information, to perform a calculated placement.
- Address point must be located within the site boundary. In some situations (e.g., L or U-shaped polygons) this may require manual adjustment or setting the GIS software's setting/configuration to always place the point inside the polygon.

3.4.3.2 Manual Placement

Description – Point location should reflect the center of a site boundary polygon, the visual center of the site when a defined boundary does not exist, or the location of the entrance to or the likely concentration of activity within the site.

3.4.3.2.1 **Option 1 –** In the visual center of the site boundary polygon

Figure 3-12

Advantages:
- provides location of site with no specific sub location information (ball parks, picnic shelters)

Disadvantages:
- may not identify the location of anything other than the approximate center of the site.
- not representative of an actual accessible place within a potentially large area

Notes:

- None

3.4.3.2.2 Option 2 – Single point at a primary entrance to the site, using one of the placement options documented in **Section 3.4.5 Placement of an Address Point Based on Property Access**, whether or not a boundary exists

Figure 3-13

Advantages:
- able to closely tie to nearest named road segment

Disadvantages:
- not representative of an actual accessible place within a potentially large area
- may not identify the location of a specific site, which is especially significant in a rural environment
- may not place well if multiple addresses share same ingress

Notes:

- When a site has more than one entrance from the named road, and it is not clear which access is considered the primary access, there is no preference for point placement.
- When a site has entrances from more than one named road, each entrance may need its own unique address. This issue should be brought to the attention of the local addressing authority as it cannot be resolved by GIS. For more information see **Section 3.6 Best Practices** and **Section 3.7 Data Quality Considerations**.

- If structures are located on the site, then the placement options documented in **Section 3.4.4 Placement of an Address Point Based on a Structure(s)** should be considered.

3.4.3.2.3 Option 3 – Single point created on primary area of use / activity, using additional knowledge (e.g., site plan, personal knowledge, imagery, etc.) to guide placement, whether or not a boundary exists

Figure 3-14

Advantages:
- will identify the location of a specific site
- may suggest a more-probable event location within a larger area

Disadvantages:
- may not be best location in all seasons (e.g., ball field versus sliding hill)

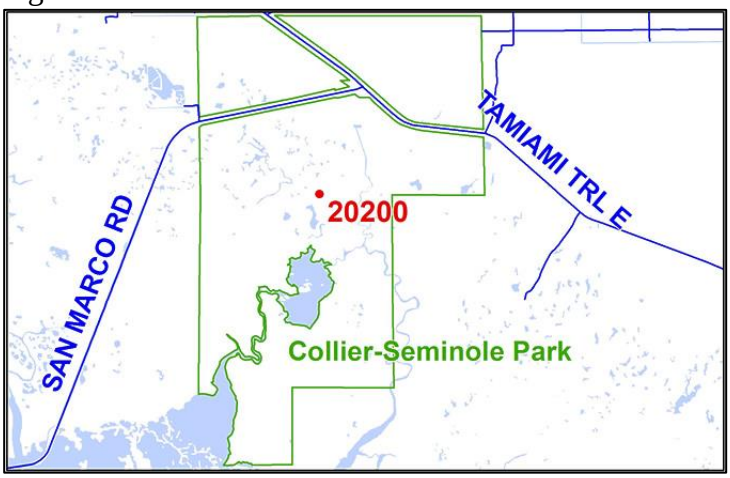
Notes:

- When a site has more than one primary area of use / activity, and it is not clear which area is most utilized, there is no preference for point placement.
- When a site has more than one primary area of use / activity, each area may need its own unique address. This issue should be brought to the attention of the local addressing authority as it cannot be resolved by GIS. For more information see **Section 3.5 Address Point Placement for Subaddresses** and **Section 3.6 Best Practices**.
- If structures are located on the site, then the placement options documented in **Section 3.4.4 Placement of an Address Point Based on a Structure(s)** should be considered.

3.4.3.2.4 Special Case 1 – A site composed of a Multipart GIS Feature (Polygons)

Figure 3-15 shows one large park comprised of three polygons representing one database feature.

Figure 3-15



Notes:

- Automated placement of points inside multipart polygons may not produce desirable results and may require manual review.
- Where multiple polygons represent a location that will be provisioned with a single address, users will need to determine where the address point should be placed in relation to associated features.

3.4.4 Placement of an Address Point Based on a Structure(s)

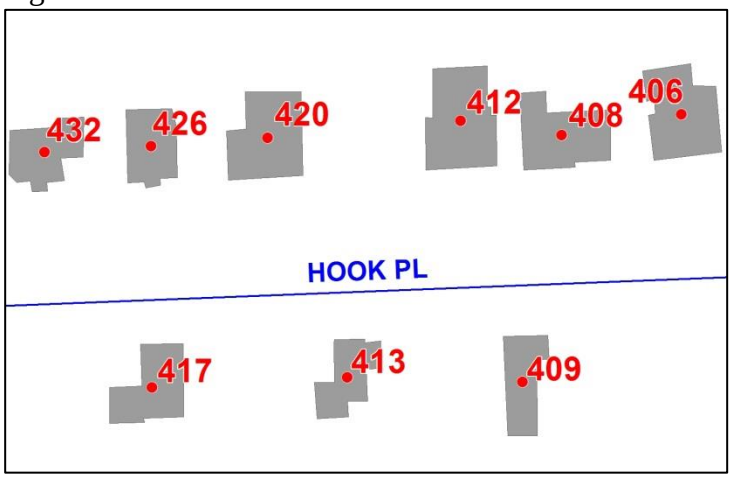
Placement of an address point to represent an address associated with a structure. The location of the address point should be located within the structure(s) location or footprint. For more information see **Section 3.6 Best Practices**.

3.4.4.1 Calculated Placement

Description – Point location is automatically calculated at the center of the addressed structure polygon using an automated centroid creation process, typically performed in a GIS. In this situation there is only one numbered address per structure and only one structure per numbered address.

3.4.4.1.1 Default – In the center of the addressed structure polygon

Figure 3-16



Advantages:
- can be automated & consistent
- can be spatially joined to corresponding structure polygon by point-in-polygon

Disadvantages:
- none noted

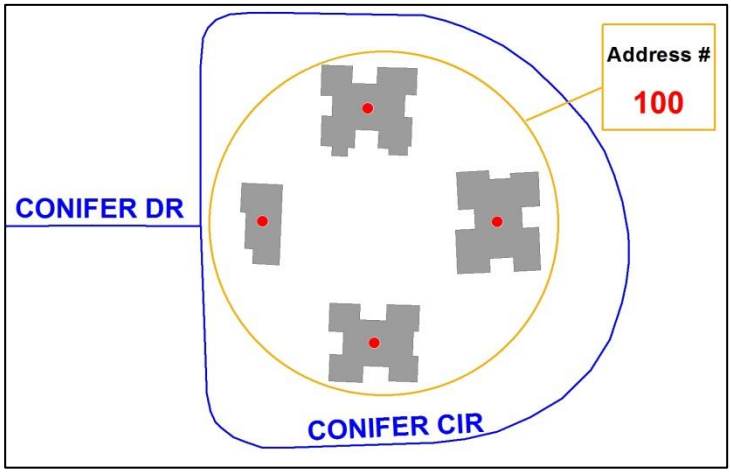
Notes:

- Address point must be located within the addressed structure polygon. In some situations (e.g., L or U-shaped polygons) this may require manual adjustment or setting the GIS software's setting/configuration to always place the point inside the polygon.
- May not visually indicate the road segment that has been assigned as the structure's address
- A point location within a structure polygon footprint would allow for attribute transfer.

3.4.4.1.2 Special Case 1– Where a group of addressed structure polygons share a single address number and subaddress information is not known, provided, or assigned. This type of scenario is common in the following situations: Apartment Complexes, Business Parks, Mobile Home Parks, University/College Campuses and Large Multipart Farms.

Two different placement methods are shown in Figure 3-17 and Figure 3-18 (see also additional examples at the end of **Section 3.4.4.2.6 Placement of an Address Point Based on a Structure(s) - Special Case 3**):

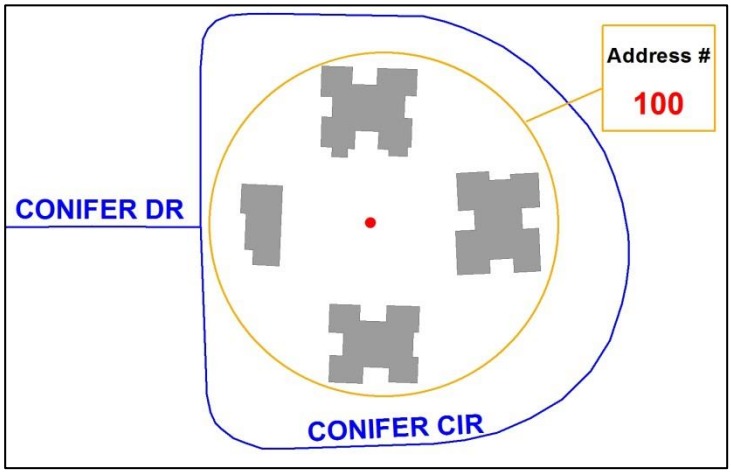
Figure 3-17 In the center of each addressed structure polygon



Notes:

- This will cause multiple address points, with the same attributes, to be created. Some 9-1-1 applications may have problems with multiple address points that have identical attributes. For these applications, every address should be represented by a single unique address point.
- Depending on the specific circumstance, one address for multiple structures may be appropriate; in other cases it may not. This issue should be brought to the attention of the local addressing authority as it cannot be resolved by GIS. For more information see **Section 3.5 Address Point Placement for Subaddresses** and **Section 3.6 Best Practices**.

Figure 3-18 In the center of a group of addressed structure polygons



Notes:

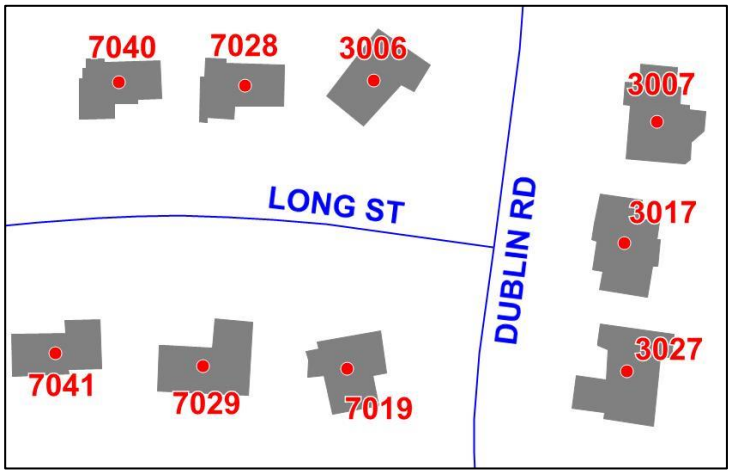
- This represents the centroid of a multipart GIS feature automatically generated by a GIS application.
- This may create an issue for some public safety applications and users of them since there is no clear association between the address point and the multiple structure polygons sharing the same address (e.g., interpretation of which structure should be referenced for a call).
- Depending on the specific circumstance, one address for multiple structures may be appropriate; in other cases it may not. This issue should be brought to the attention of the local addressing authority as it cannot be resolved by GIS. For more information see **Section 3.5 Address Point Placement for Subaddresses** and **Section 3.6 Best Practices**.

3.4.4.2 Manual Placement

Description - Point location should reflect the center of or entrance to the addressed structure. Visual guides, such as structure polygons, aerial imagery or other resources can be used to manually place address points. For more information see **Section 3.6 Best Practices** and **Section 3.7 Data Quality Considerations**.

3.4.4.2.1 **Option 1** – In the visual center of the addressed structure polygon

Figure 3-19



Advantages:
- can be spatially joined to corresponding structure polygon by point-in-polygon

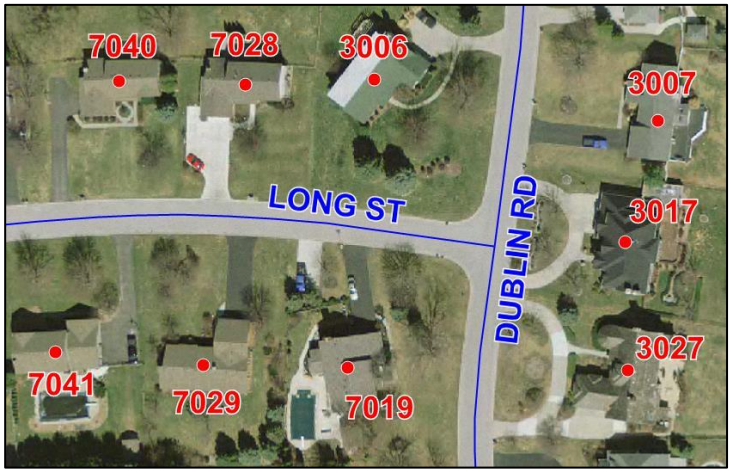
Disadvantages:
- none noted

Notes:

- May not visually indicate the road segment that has been assigned as the structure's address.
- A point location within a structure polygon footprint would allow for attribute transfer.

3.4.4.2.2 **Option 2 –** In the visual center of the addressed structure shown in imagery

Figure 3-20



Advantages:
- will identify the location of a specific structure
- could work for multiple addresses sharing a structure

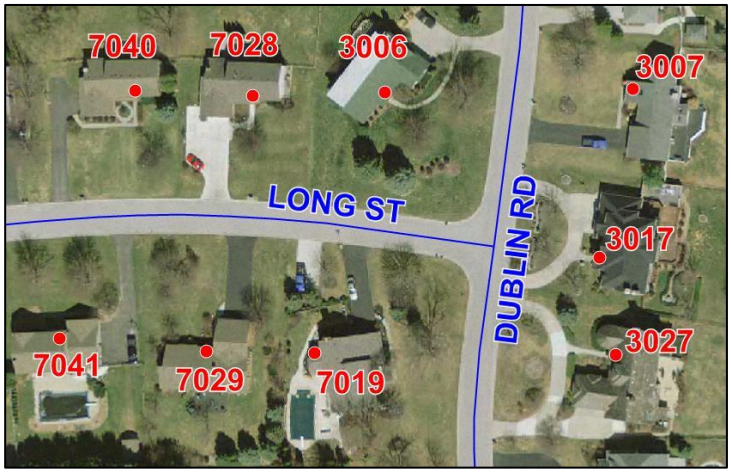
Disadvantages:
- visual determination of the center of a structure, based on imagery, may be imprecise depending on size/shape

Notes:

- May not visually indicate the road segment that has been assigned as the structure's address.

3.4.4.2.3 **Option 3 –** At a primary entrance to an addressed structure

Figure 3-21



Advantages:
- provides more detail for larger and more complex structures,
- helps differentiate location for multiple addresses within a single structure
- may provide value for tactical response and courtesy

Disadvantages:
- doors/ entries may be changed over time
- method is resource intensive to implement and maintain

Notes:

- Placement should be verified.
- Given the resources required, users may want to consider limiting use of this methodology only to situations where it is useful to geographically distinguish entrances/exits.

3.4.4.2.4 Special Case 1 – Where a structure has multiple units, each with its own address and its own primary entrance

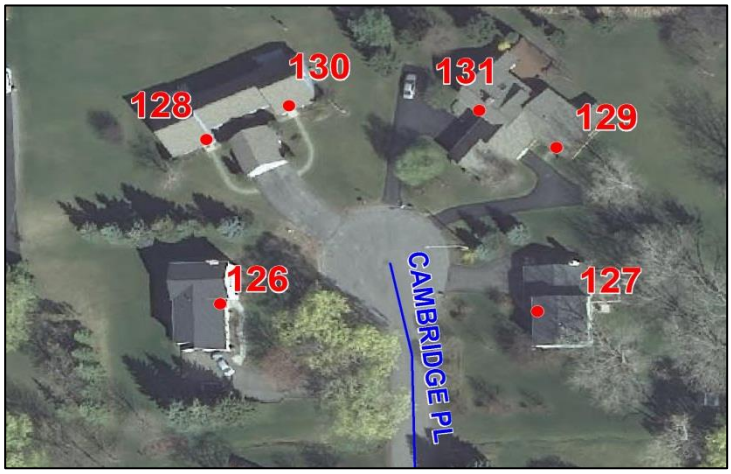
Two different placement methods are shown in Figure 3-22 and Figure 3-23 (see additional example at the end of this section):

Figure 3-22 In the visual center of each addressed unit

Notes:

- Placement of points should be located within the footprint of the tenancy.
- Points should be placed to take into account close proximity of addresses so as to clearly convey each address's location (for example vertically stacked addresses reflecting multiple residences or businesses above each other).

Figure 3-23 At a primary entrance to each addressed unit



Notes:

- Placement should be verified.
- Given the resources required, users may want to consider limiting use of this methodology only to situations where it is useful to geographically distinguish entrances/exits.

Additional Example of Special Case 1

In Figure 3-24 and Figure 3-25, two methods of address point placement are shown: In the visual center of each addressed unit (Figure 3-24) and at a primary entrance to each addressed unit (Figure 3.25).

Shopping Center

Figure 3-24

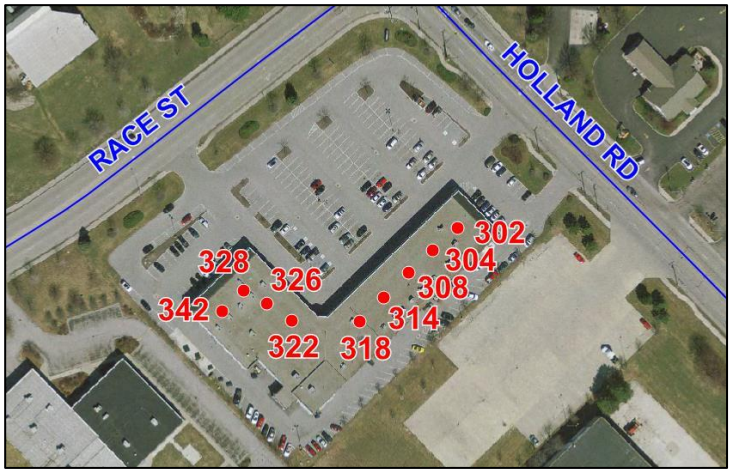
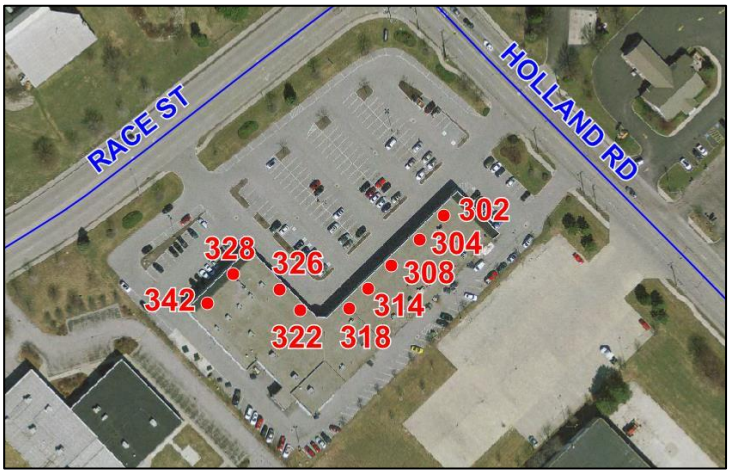
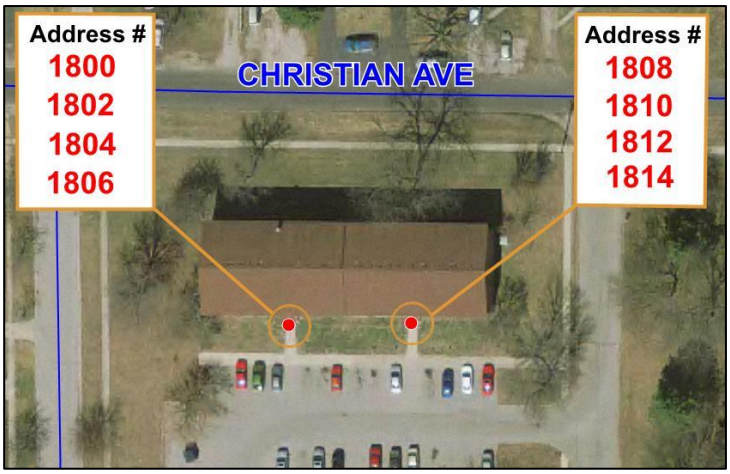


Figure 3-25



3.4.4.2.5 Special Case 2 – Where a structure has multiple units, each with its own address, that share a primary entrance. Points are stacked one on top of the other at the entrance.

Figure 3-26



Notes:

- None

3.4.4.2.6 Special Case 3 – Where a group of addressed structure polygons share a single address number and subaddress information is not known, provided, or assigned. This type of scenario is common in the following situations: Apartment Complexes, Business Parks, Mobile Home Parks, University/College Campuses and Large Multipart Farms.

Two placement methods are shown in Figure 3-27 through Figure 3-30 (see additional examples at the end of this section):

Figure 3-27 In the visual center of each addressed structure polygon

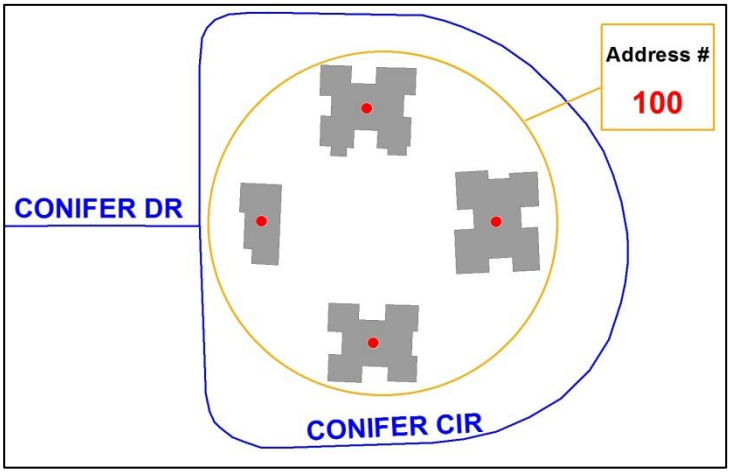
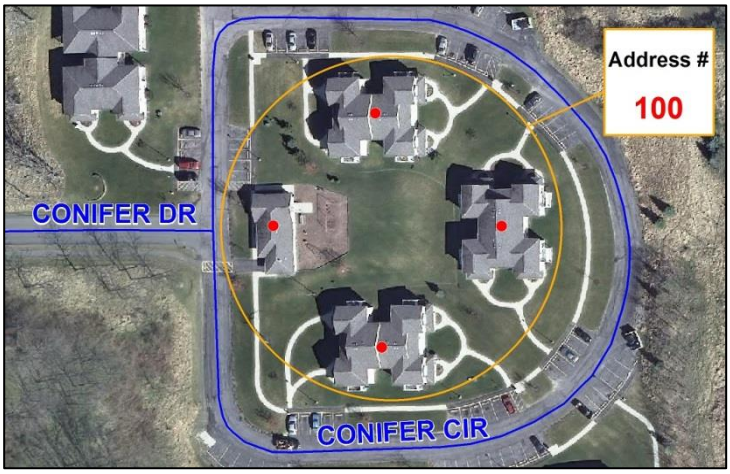


Figure 3-28 In the visual center of each addressed structure as shown in imagery



Notes:

- This will cause multiple address points, with the same attributes, to be created. Some 9-1-1 applications may have problems with multiple address points that have identical attributes. For these applications, every address should be represented by a single unique address point.
- Depending on the specific circumstance, one address for multiple structures may be appropriate; in other cases it may not. This issue should be brought to the attention of the local addressing authority as it cannot be resolved by GIS. For more information see **Section 3.6 Best Practices** and **Section 3.7 Data Quality Considerations**.

Figure 3-29 In the visual center of a group of addressed structure polygons

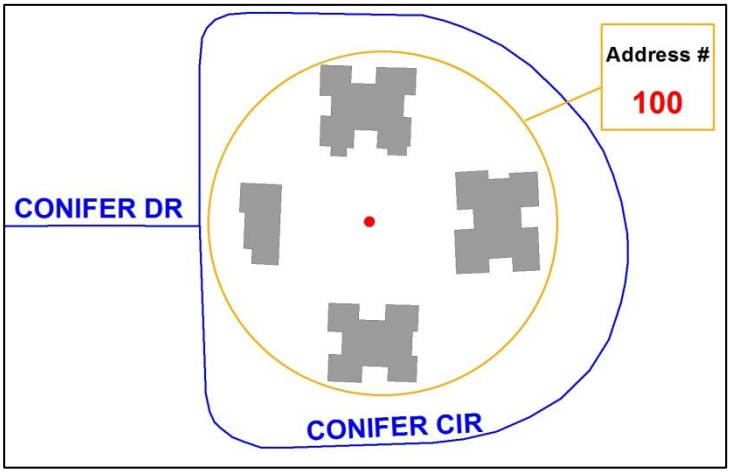
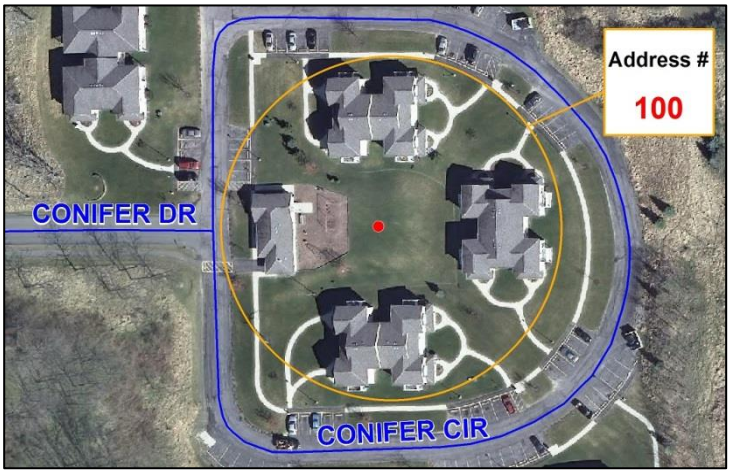


Figure 3-30 In the visual center of a group of addressed structures as shown in imagery



Notes:

- This may create an issue for some public safety applications and users of them since there is no clear association between the address point and the multiple structure polygons sharing the same address (e.g., interpretation of which structure should be referenced for a call).
- If there is an administrative building and that location is known, the point could be placed on the administrative building.
- Depending on the specific circumstance, one address for multiple structures may be appropriate; in other cases it may not. This issue should be brought to the attention of the local addressing authority as it cannot be resolved by GIS. For more information see **Section 3.5 Address Point Placement for Subaddresses** and **Section 3.6 Best Practices**.

Additional Examples of Special Case 3

In Figure 3-31 through Figure 3-40, two methods of address point placement are shown: In the visual center of each addressed structure polygon (or each addressed structure as shown in imagery) and in the visual center of a group of addressed structure polygons (or a group of addressed structures as shown in imagery).

Business

Figure 3-31

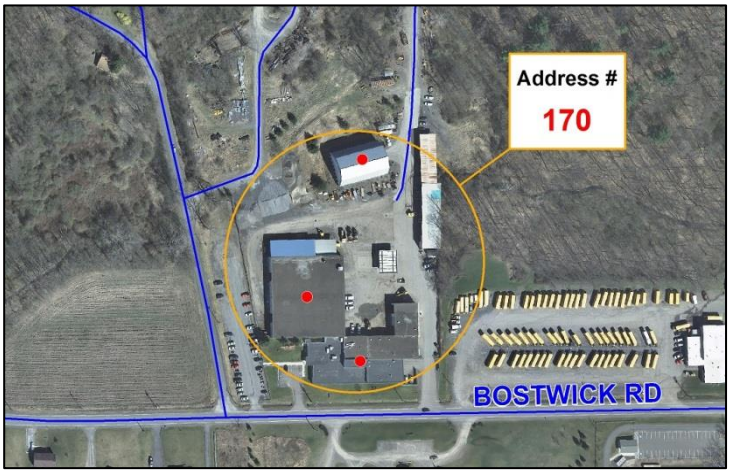
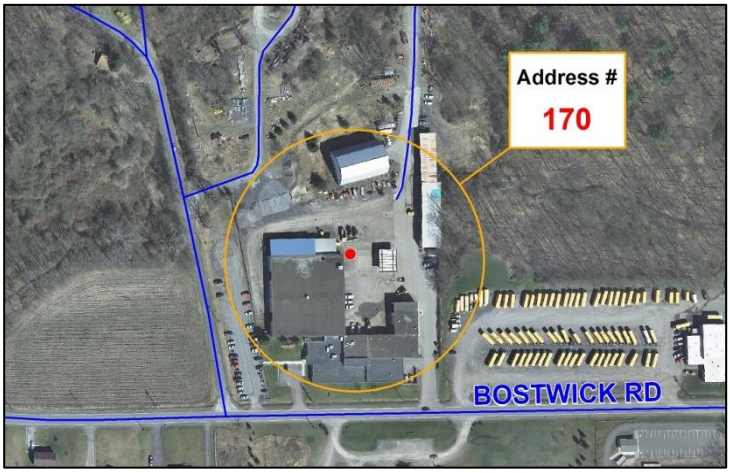


Figure 3-32



Mobile Home Park

Figure 3-33

Figure 3-34

Apartment complex

Figure 3-35

Figure 3-36

Business Park

Figure 3-37

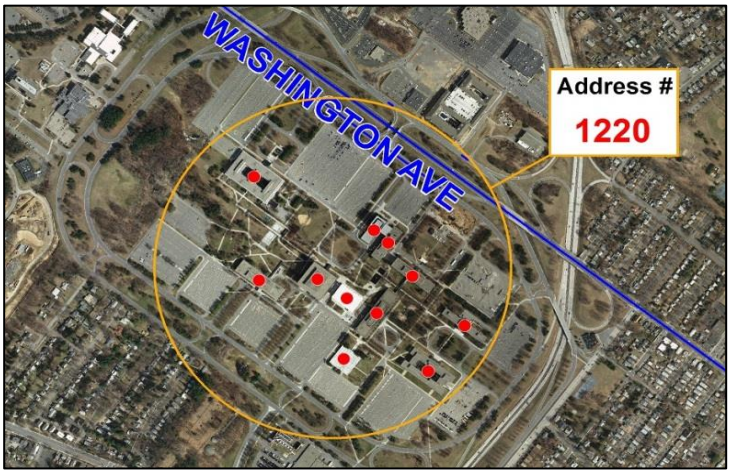


Figure 3-38

University/College Campus

Figure 3-39

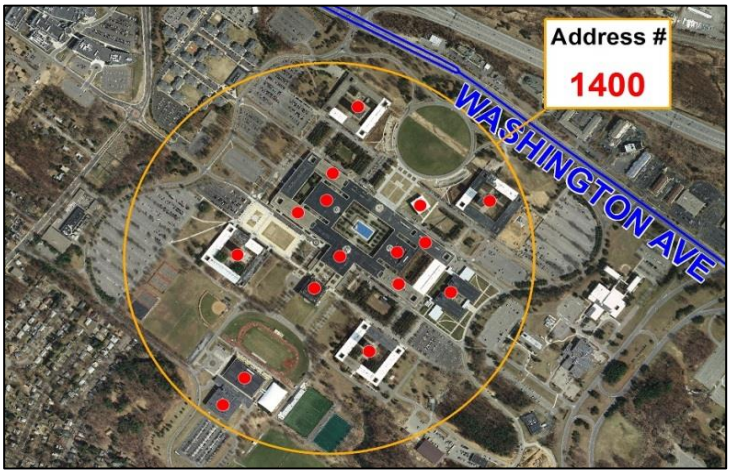
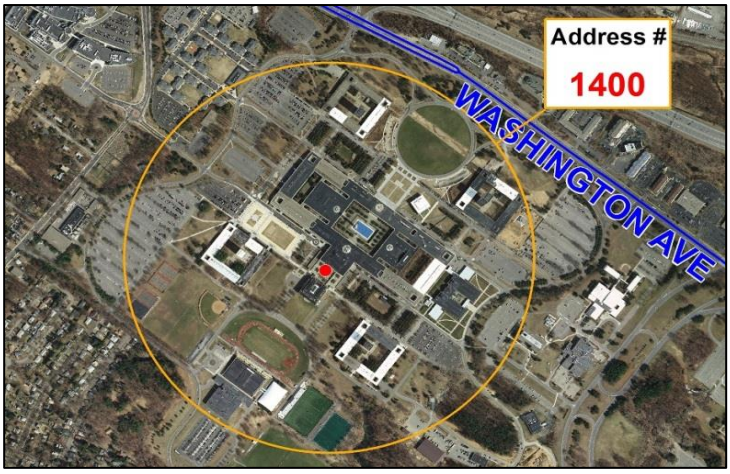


Figure 3-40



3.4.5 Placement of an Address Point Based on Property Access

Placement of an address point to represent an address based on the location of the primary access to a given property. The location of the address point would typically represent where a driveway, access road, or other primary entrance to a piece of property meets the named or mapped road. It is most likely near the named road that is part of the full address. It is less preferred to place address points directly on or near the road centerline, as this may cause issues with alignment of polygons used for NG9-1-1 call routing, as well as require additional Quality Assurance/Quality Control procedures for address points. Note that there can be more than one access to a property, so it is recommended that the address point be placed at the center of the property's primary access route. For more information see **Section 3.6 Best Practices**.

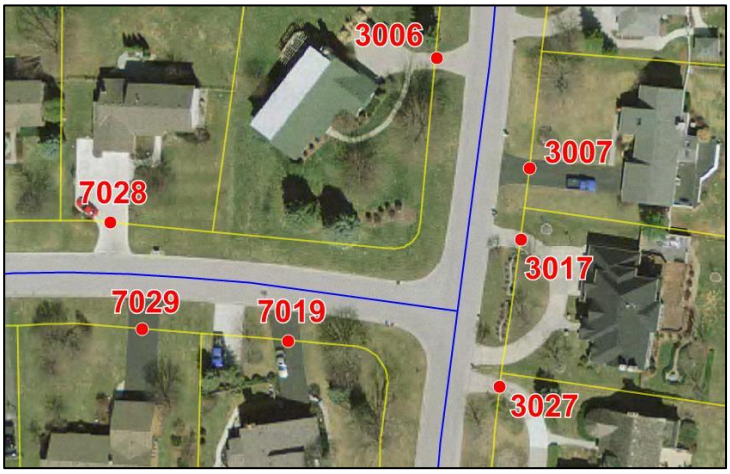
3.4.5.1 Calculated Placement (Not Applicable)

3.4.5.2 Manual Placement

Description - Visual guides, such as aerial imagery, site plans or other graphical resources are used to manually place address points on the centerline of the driveway, access road, or other primary entrance to a piece of property, near where it meets the named road. For more information see **Section 3.6 Best Practices** and **Section 3.7 Data Quality Considerations**.

3.4.5.2.1 Option 1– On the property right-of-way line

Figure 3-41



Advantages:
- can be placed to intersect property ingress
- can be spatially joined to corresponding parcel by point-in-polygon
-able to closely tie to nearest named road segment

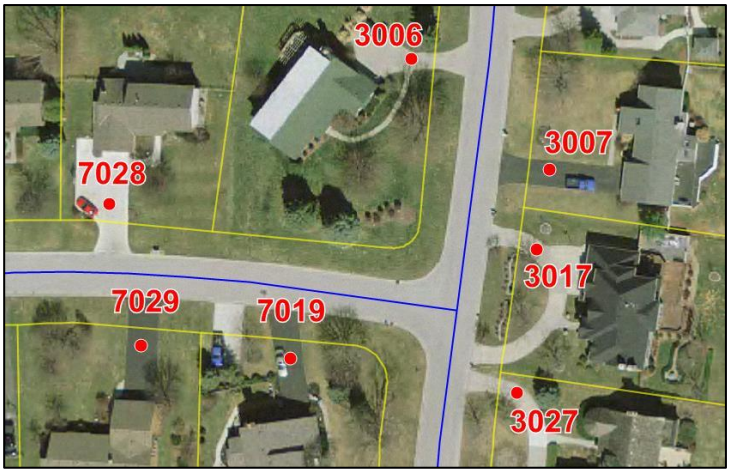
Disadvantages:
- may not identify the location of a specific structure, which is especially significant in a rural environment
- may not place well if multiple addresses share same ingress
- may not closely tie to interior parcels far from a road segment

Notes:

- When a property has more than one access route from the named road, and it is not clear which access is considered the primary access (as with the horseshoe shaped drive shown above), there is no preference for point placement.

3.4.5.2.2 Option 2 – Offset a distance from the named road into the property

Figure 3-42



Advantages:
- can be placed to intersect property ingress
- can be spatially joined to corresponding parcel by point-in-polygon
-able to closely tie to nearest named road segment

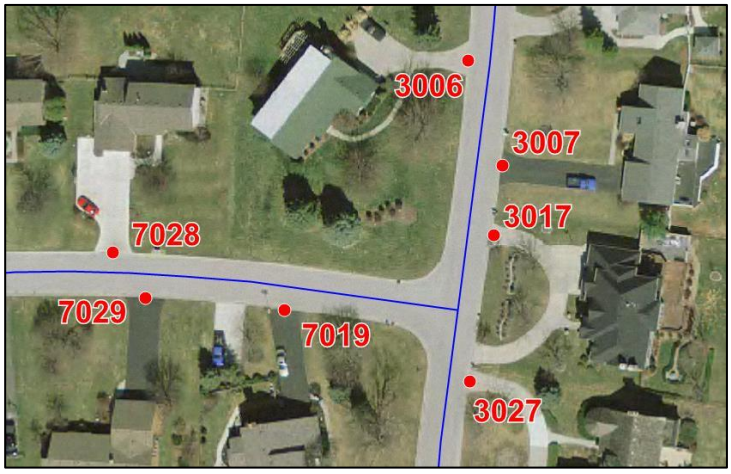
Disadvantages:
- may not identify the location of a specific structure, which is especially significant in a rural environment
- may not place well if multiple addresses share same ingress
- may not closely tie to interior parcels far from a road segment

Notes:

- Address point should be located within a parcel boundary, when applicable, for spatial relationships with other GIS data layers.
- The offset distance into the property, which should be consistent, is at the discretion of the local addressing authority.
- Care should be taken in setting a default offset distance as it could impact call routing.

3.4.5.2.3 Option 3 – Where the driveway meets the visible named road

Figure 3-43



Advantages:
- can be placed to intersect property ingress
- can be spatially joined to corresponding parcel by point-in-polygon
-able to closely tie to nearest named road segment

Disadvantages:
- may not identify the location of a specific structure, which is especially significant in a rural environment
- may not place well if multiple addresses share same ingress
- may not closely tie to interior parcels far from a road segment

Notes:

- None

3.4.5.2.4 Special Case 1 – Where the primary access to a property is on a different named road than the road that the address is assigned off of

Figure 3-44

Notes:

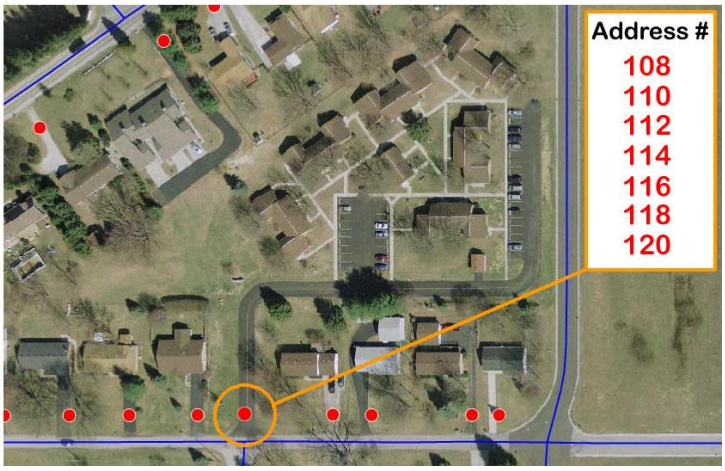
- Does not intuitively reflect the named road that is part of the structure's address, which, for example, could affect vehicle routing.

3.4.5.2.5 **Special Case 2 –** Where multiple properties share the same driveway, access road, or other primary entrance to their properties at the named road

NENA's Addressing Systems - A Training Guide for 9-1-1 (Second edition, chapter 3, page 47) recommends that driveways with 2 or more residences be named. However, this does not mean that a shared driveway needs to become a public road, but is simply a named private road.

Four different placement methods are shown in Figure 3-45 through Figure 3-48:

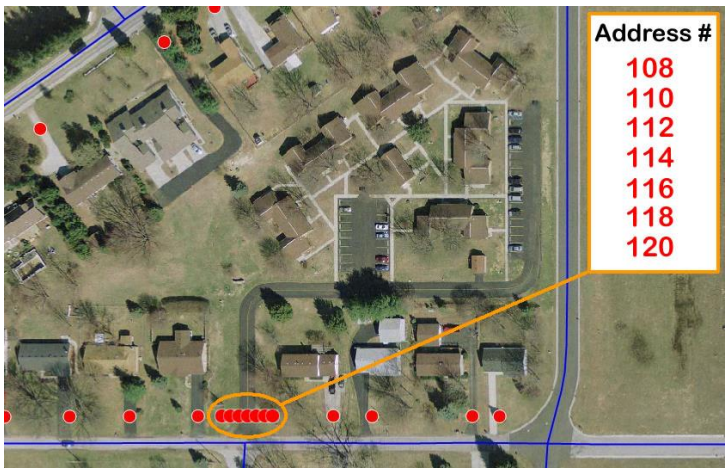
Figure 3-45 Stacked one on top of the other at the named road



Notes:

- Can be placed sufficiently close to the named road centerline to meet routing requirements for responding units
- Not useful for indicating in which sequence the addresses will be encountered as responding unit moves along the shared driveway (if that information is available)

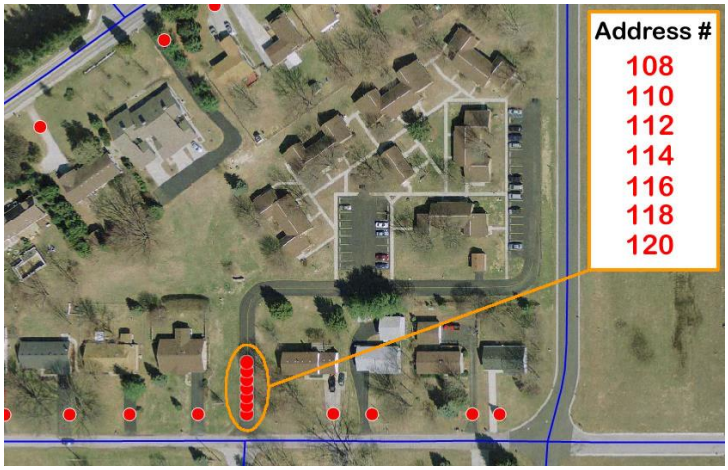
Figure 3-46 Along the named road



Notes:

- Can be placed sufficiently close to the named road centerline to meet routing requirements for responding units
- Not useful for indicating in which sequence the addresses will be encountered as responding unit moves along the shared driveway (if that information is available)
- May be insufficient space to place points without overlapping them, especially if the number of addresses along the shared driveway is large due to multi-unit structures

Figure 3-47 Along the shared driveway leading to structures

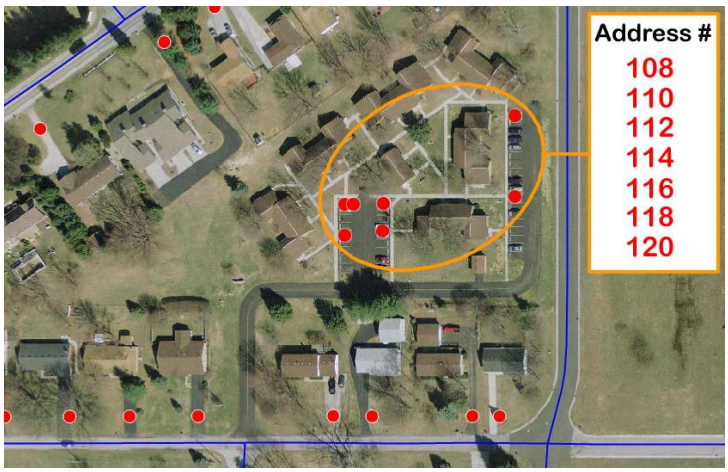


Notes:

- May be useful for indicating in which sequence the addresses will be encountered as responding unit moves along the shared driveway (if that information is available)
- May be insufficient space to place points without overlapping them, especially if the number of addresses along the shared driveway is large due to multi-unit structures

- May not be sufficiently close to the named road centerline to meet routing requirements for responding units or may be too close to a road centerline with a different name

Figure 3-48 At each structure's separate driveway or parking area



Notes:

- Useful when each structure has a separate driveway
- May not be sufficiently close to the named road centerline to meet routing requirements for responding units or may be too close to a road centerline with a different name
- May not clearly indicate which structure a point is referencing

3.5 Address Point Placement for Subaddresses

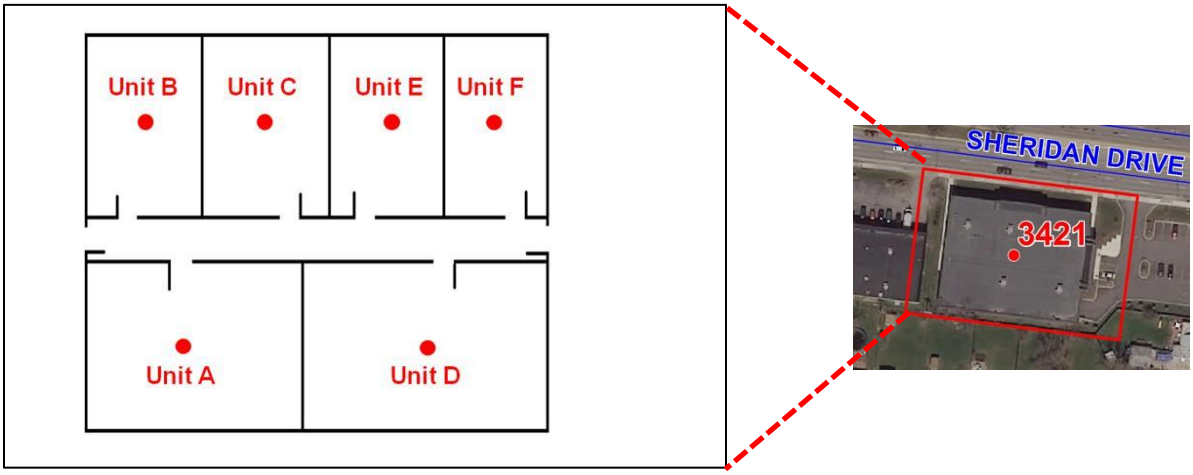
Subaddresses are elements of addresses used to identify specific locations, within structures/sites or within a group of structures/sites, to differentiate them from each other. Subaddresses may also be used to reflect commonly used names such as an area in a park (15000 Livingston Rd, Softball Field). Point placement considerations should encompass use of the NG9-1-1 GIS Data Model structure (NENA-STA-006) and the six subaddress elements (Building, Floor, Unit, Room, Seat, and Additional Location Information) described in the Civic Location Data Exchange Format standard (NENA-STA-004). Those placing points will need to consider how much (or to what level) detail will be used to place an address point. For example, a single address point for an apartment complex may be sufficient. Alternatively, address points that are placed on each building, or each unit, assist in identifying the location or routing the call.

Note: Graphic labels in Figure 3-49 through Figure 3-52 are meant to clarify placement and are for illustration purposes in this document only.

3.5.1 Common Uses of Subaddresses

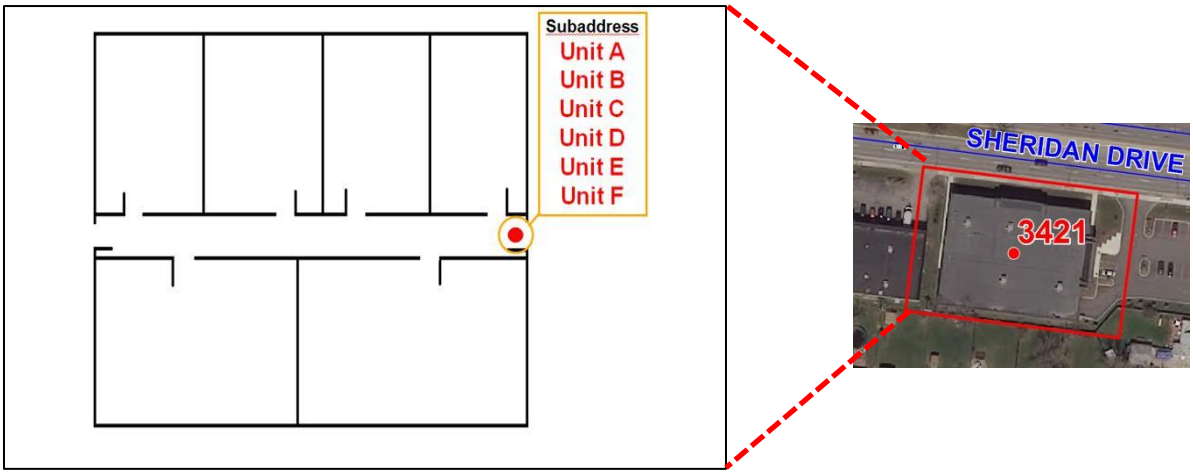
1. Subaddresses are used to differentiate units with shared entrances into the same building (e.g., office building, apartment building). Another use of subaddresses is to differentiate units with separate exterior entrances and should be handled the same way as described in **Section 3.4.4.2.4 Placement of an Address Point Based on a Structure(s), Special Case 1**.

Figure 3-49



In this example, a point is placed in the center of each addressed unit within the building located at 3421 Sheridan Drive. Alternatively, points could be placed at the entrance to each individual unit within the building.

Figure 3-50



In this example, a point is placed at the external entrance of the building located at 3421 Sheridan Drive with points stacked on top of each other. Alternatively, points could be stacked at the center of the building. This is a common technique when subaddress assignments are known although their exact location within a structure is not available.

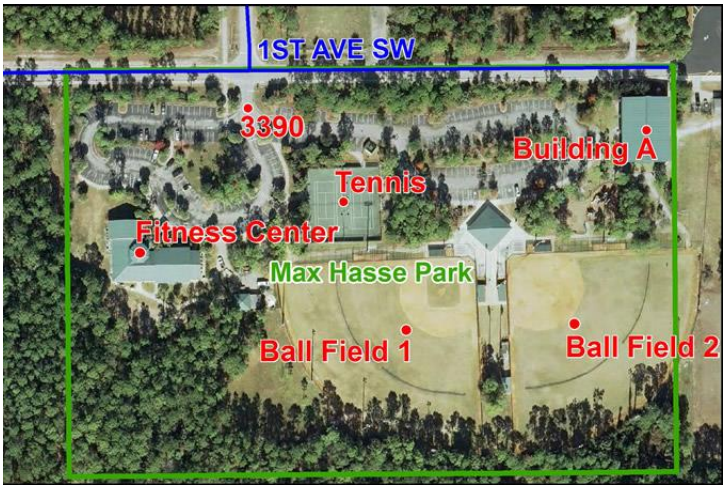
2. Subaddresses are used to differentiate separate buildings that are on a site, all having the same address number and street name (e.g., mobile home park, school campus)

Figure 3-51

In this example, a point is placed on each mobile home, all of which are located at 550 North 19th Street.

3. Subaddresses are used to differentiate locations within a site, all having the same address number and street name (e.g., a park containing separate areas for ball fields, soccer fields, playgrounds, picnic areas, etc.)

Figure 3-52



In this example, a point is placed in the center of each addressed location within Max Hasse Park, all of which are located at 3390 1st Avenue Southwest.

3.5.2 Subaddress Considerations

- A balance will have to be struck for the level of subaddress detail needed (e.g., one point for an entire building vs. one point for each unit within a building), dependent upon the application use. Often, the level of detail associated with subaddress information is not needed for routing a call but may be helpful for identifying the location for responders.

The level of location detail needed will vary between applications and on a case by case basis.

- The level of detail required usually begins with a relatively low level of subaddress information being provided and increasing in granularity as needs and time permit.
- Generally the greater the level of subaddress detail the greater the cost in initially creating the address points and the greater the long term maintenance costs.
- A decision will have to be made on whether to utilize the Room, Seat, Additional Location and Complete Landmark Name fields in the data model (see NENA-STA-006, NENA Standards for NG9-1-1 GIS Data Model) as often this information may not be initially supplied by the local addressing authority. However, some applications may already have mechanisms to deliver this same information without necessitating its inclusion in the address point data (e.g., Common Places in CAD systems, floor plans in mapping systems).
- Subaddress data could be maintained in a related table structure (for example, 'child' tables that are related to the 'parent' address point tables), if the application is capable of supporting these relationships.
- More generally, maintaining address records with unit level information in a related table allows for linking a single point to multiple address records and thus eliminates the need to "stack" points in the production database. Since stacked points may be difficult to edit and manage, this can be a significant advantage. The "flat file" or stacked version of the address points can always be created and exported from a spatial view to support routing functionality and for use in systems that cannot manage related tables. In creating address points, it is helpful to keep different applications in mind and to distinguish between what address point attribution is useful for display in a 911 application (a text field used for labeling, for example, listing a range of units accessed from a particular entrance) versus the one-to-one attribution required for call validation and routing.
- Placing multiple address points with subaddress information on multistory structures (especially those with a single main entrance) may not be an efficient strategy. A single point with no subaddress information may work better in some applications. In a three dimensional environment placing individual points to represent subaddresses at elevation may be more valuable and needed.

3.6 Best Practices

3.6.1 General Best Practices and Recommendations

Each unique address should be represented by one and only one address point. Some 9-1-1 applications may have problems with multiple address points that have identical attributes. For these applications, every address should be represented by a single unique address point. Programs developing address point data for 9-1-1 users should establish criteria or 'Best Practices' for which sites/structures need to have unique addresses. Five general considerations should be covered by these criteria:

- Address point placement should be based on an authoritative list of addresses and current, accurate geographic information (imagery, parcel data, etc.) with reliable attribution. Information from addressing authorities may need to be verified against other record sets and observations in order to create a complete and current address listing for any given jurisdiction. The quality of both address listings and geographic information should be validated and documented.
- It is strongly recommended to develop and implement a feedback process between emergency response staff and the addressing authorities within their jurisdictions to ensure that all appropriate structures receive an appropriately positioned address point, and that the relationship between a complete address repository and the Site/Structure Address Point data layer be regularly maintained.
- The goals and purposes of an address point layer, as well as the resources available for development, should be carefully considered and incorporated into a strategy for ongoing maintenance before beginning to create the layer. If a data maintenance strategy is not considered early in the planning process, further development and maintenance of the layer could become difficult and expensive. For example, a process requiring considerable field verification could add significantly to the resources required to place future points.
- A good strategy will enable use of the best available data for any given situation, and multiple address point placement methodologies may potentially be used within the same layer. For instance, a rooftop address point may provide adequate precision for a single family structure, whereas a large commercial development or school may benefit from more precise entry point location.
- For a number of applications, address point locations should be located within the correct PSAP or emergency services boundaries. The placement of address points may reveal issues with the mapping of jurisdiction or service boundaries that require these boundaries to be reviewed and corrected with the cooperation of the responsible agencies.

3.6.2 Methodology Issues and Best Practices

Address point placement methodologies described in this section are listed in the same order as the methodologies in **Section 3.4 Address Point Placement Methodologies**.

3.6.2.1 Placement of an Address Point Based on Geocoding off of Road Centerlines

Basic Requirement: address point to be placed a calculated distance along a road segment and offset to the correct side of the road. Linear geocoding will only work for civic-style addresses which include an address number and street name.

Issues/Best Practices

This method can only yield an approximation of how far along the road segment that a given address is located and cannot indicate how far the structure(s) are from the road.

When structures are irregularly spaced and there are long stretches without any addresses, interpolation can produce very misleading results.

Many geocoding engines cannot handle mixed parity on a given side of the road or road centerlines with different jurisdictions on left and right sides. These situations may require special adjustments to the geocoding process, the related data, or both, to achieve acceptable results.

Landmarks cannot be geocoded against road centerlines unless they are associated with a civic-style address which includes an address number and street name.

This method might be used to create a preliminary address point layer which could subsequently be refined, or to help validate point locations created using another method. However, in general other point location methods using more precise data are a better practice.

Point placement based on geocoding road centerlines is not well suited to distinguish discrete subaddress locations.

3.6.2.2 Placement of an Address Point Based on a Parcel

Basic Requirements: address point must be placed within the correct parcel.

The accuracy and completeness of address lists provided by the assessor or other source should be verified.

Issues/Best Practices

With either automated or manual placement, special care should be taken when placing points to ensure they are located within the correct PSAP and emergency services boundaries. Placement should be checked against authoritative references for service area assignment and accurate boundary mapping either manually or using GIS overlay operations.

Point placement based on parcels is not well suited to distinguish discrete subaddress locations.

Automated Placement

Automatically creating centroids, or address points, from an existing parcel layer with associated address information is a quick way to represent address information that already exists within the parcel database and assign it to a point feature that can be used to represent an address. However, using the center point of the parcel may be less than optimal if it is far removed from the developed portion of the parcel. Subsequent review of generated points to ensure that they meet the requirements of any specific application is strongly recommended.

At a minimum, automated point placement needs to ensure that the address point is located within the parcel. Simply using the default centroid calculation in the GIS software may produce points that are located outside the parcel polygons, and a special setting in the GIS

software may be needed to correct this situation. This is particularly an issue for multipart, non-contiguous parcels.

Automated placement may not be appropriate if there are multiple, distinct addresses associated with the parcel leading to the production of address points stacked in the center of the parcel, without any reference to where they are located on the property.

Manual Placement

Manually placing the address point on the center of the parcel may not offer much improvement over the automatically generated parcel centroid. For most applications, if additional resources such as aerial and oblique imagery, road networks, and site plans are available to guide point placement, points should be placed on the area of use or development. If there are multiple addresses within the parcel that are not all addressed from the same road, a different methodology that ensures that each point aligns with the roadway from which that point is addressed would be preferable.

3.6.2.3 Placement of an Address Point Based on a Site

This methodology would typically be used to supplement other methods, for example, to deal with locations where there are no structures or clearly identifiable access.

Basic Requirement: address point to be placed within the correct site area

Issues/Best Practices

Address points placed based on an identified site such as a park will be a subset of the overall address point layer and may be developed using a different methodology than for other points. Such differences in methodology should be documented and clearly understood by the end user. Issues with calculated versus manual placement are similar to those for parcels. For large sites the point should be placed near the area of use or development. Some sites may not have a civic-style numbered address, which may cause difficulties with some software. At a minimum, only points with a valid NENA format address should be placed in the address point data set.

If structures or access roads can be viewed in a GIS environment, and particularly if site boundaries are not well defined, these additional features may provide guidance for the placement of address points.

However, site address records for campsites, trailer locations or other situations where there are many small sites on a given parcel may provide too much detail (“subaddress” information) for efficient use in some applications. For example, some dispatch applications may require selection of the specific address record from a long list.

3.6.2.4 Placement of an Address Point Based on a Structure(s)

Basic Requirement: address point to be placed within the correct structure polygon(s) or on the correct image object(s)

Issues/Best Practices

Calculated placement requires a GIS dataset that includes structure polygons. Ideally, the source dataset should provide distinct addresses for each structure. Calculated placement on

a structure's primary entrance is not practicable in most instances. Data developers should be cognizant of address point placement in relation to the needs of an emergency response. One solution is the placement of an address point to represent the entrance to a structure.

If multiple structures share the same address, it should be brought to the attention of the local addressing authority to determine if additional addresses are needed.

It may be hard to identify the primary structure on a site or the primary entrance to a structure. Photo-interpretation to identify the "correct" or "primary" structure or primary entrance of a structure is not recommended as the exact use of each structure/entrance may not be apparent in aerial imagery. Address points should not be arbitrarily placed on one structure to the exclusion of others on the same site unless there is confirmation that only the one structure carries that address. Similarly, address points should not be arbitrarily placed on one entrance to the exclusion of others unless there is confirmation that it is the only entrance. Local knowledge, or field work, will be required to make that determination. If structures cannot be differentiated by address, and a single address point is desired, it may be preferable to place address points manually at the visual center of a cluster of buildings to indicate the approximate location of that address.

If points are manually placed on the rooftops of tall buildings, they may be significantly displaced from their "true" ground location, such that they are located outside of structure footprint or even in extreme cases land outside a parcel boundary. This should be manually corrected if necessary to avoid misleading locations and erroneous transfer of attributes.

3.6.2.5 Placement of an Address Point Based on Property Access

Basic Requirement: address point to be placed on the correct driveway or access road

Issues/Best Practices

If parcel data are available, placement just within the parcel boundary where the driveway meets the named road is preferred to facilitate comparison or transfer of address data from parcels. The placement of the point at a fixed distance from the road centerline may not support this requirement, if the "offset distance" from the centerline leaves the point within the right-of-way polygon. The preferred methodology will be application specific.

For larger parcels or multi-structure developments, mapping a single point of access may not provide sufficient information about the location of the address within the parcel or area of development. If there are multiple points of access, each address point should be associated with the correct access for that address.

Point placement based on property access is not well suited to distinguish discrete subaddress locations.

3.6.3 Application Recommendations/Notes

The matrix in Table 3-1 is intended to provide a quick reference guide as to the suitability of each address point placement methodology for use in the most common public safety/9-1-1 applications (see **Section 3.1 Site/Structure Address Point Usage in Public Safety Applications**). One asterisk

represents a least recommended method and three asterisks represent the most recommended method. Point placement methods are listed from low to high resources required for data development and maintenance.

Table 3-1 Methodology Usage Matrix

	Public Safety Application				
Point Placement Method	NG9-1-1 Location Validation / Call Routing	9-1-1 Map Display	Computer Aided Dispatch	Vehicle Routing	Emergency Notification
Geocoding	*	*	*	**	*
Parcel	**	**	**	*	**
Site	**	**	**	*	**
Structure	***	***	***	*	***
Property Access	*	**	**	***	**

NOTE: NG9-1-1 Location Validation & NG9-1-1 Call Routing are displayed in a single column, since both the ECRF and LVF use the same LoST protocols as noted in NENA 08-003 v1.

Assumptions in determining relative cost in resources:

- Calculated placement (even when used as just a starting point) takes less time and therefore is less costly
- Greater precision of placement requires more time in gathering and collating data and is therefore more costly

Note: Generally if a methodology is more costly to develop it will also be more costly to maintain

3.6.3.1 NG9-1-1 Location Validation and Call Routing

All known addresses within a given jurisdiction need to have an address point location, derived from an appropriate placement methodology(s), in order to be validated and determine call routing.

Geocoding Placement Method: The use of road centerlines with address range attribution requires careful planning. Point locations along the road centerline must be offset by some distance to ensure that they are located within a PSAP polygon (rather than on its edge). Road centerlines may need to be split and centerline segment address ranges adjusted to ensure that points are located within the correct PSAP boundaries.

Parcel Placement Method: One advantage of this method is that parcel boundaries often define jurisdiction and associated response. Where PSAP boundaries cross a parcel, the placement of the address point will need to be checked to ensure that it is associated with the correct PSAP.

Site Placement: If a PSAP boundary crosses a site, then consideration should be given to placing a point within each PSAP boundary with additional description (e.g., west side of site).

Structure Placement Method: Placement of a point based on a structure, or on that structure's primary entrance, is less likely to result in routing a 9-1-1 call to the wrong PSAP. However in some cases PSAP boundaries may cross building footprints and therefore points may need to be placed manually.

3.6.3.2 9-1-1 Map Display

9-1-1 Map Display requirements will vary by jurisdiction, but at a minimum every known address needs to have a valid address point location. Consideration must be given to the intended use of the map display, as well as other map layers contained in the map display (e.g., road centerlines, building footprints, aerial imagery), in order to help determine the most appropriate placement methodology to use. Whichever methodology is used, the end-user should be made aware of what the address points represent (e.g., center of parcel or structure entrance). This is especially important if multiple methodologies were used to create the address point layer. Including the map layers used for point placement in the map display can assist in making what the address points represent self-evident.

Geocoding Placement Method: Display of address points, based on geocoding off of a road centerline, can be misleading and therefore this method is not recommended.

Parcel Placement Method: Address locations derived from parcel centroids may be a starting point, but in many situations a more detailed and accurate placement will be needed to achieve useful presentation of information.

Site Placement Method: Address locations derived from site centroids may be a starting point, but in many situations a more detailed and accurate placement will be needed to achieve useful presentation of information.

Structure Placement Method: Placing an address point within a structure's footprint or near its primary entrance may be the most useful placement methodology. For a 9-1-1 map it may be helpful to distinguish locations at the level of subaddress.

Property Access Placement Method: This methodology has limitations in situations where the primary use or activity is far from the property access, for example on larger parcels or complexes with multiple accesses, such as school campuses.

3.6.3.3 Computer Aided Dispatch (CAD)

Address points should be located within the correct response boundary in order to support CAD dispatch. Manual review or GIS overlay using accurate response boundaries is needed to validate point placement.

Geocoding Placement Method: Geocoded points should be located within the correct response boundaries to support CAD dispatch. This will often mean that road centerlines need to be split and segments recoded. This method offers little advantage where road centerlines are already being used for dispatch.

Parcel Placement Method: If response by police, fire or emergency medical service is determined by property address, then parcel based placement may be an appropriate way to determine the correct responding unit. However, as with call routing, the response areas may not align with parcel boundaries.

Site Placement Method: If response by police, fire or emergency medical service is determined by site address, then site based placement may be an appropriate way to determine the correct responding unit. However, as with call routing, the response areas may not align with parcel boundaries.

Structure Placement Method: If the boundaries associated with responding units are consistent with the structure mapping, then any methodology based on structures or the structure's primary entrance would be appropriate.

Property Access Placement Method: Placement of a point based solely on property access may result in the wrong assignment of responder to the point – as noted above, placement within the parcel boundary may be helpful.

3.6.3.4 Vehicle Routing

Address points may be useful to facilitate responding units being directed to incidents. However, a separate Access Point layer could be a more suitable layer to support the needs of vehicle routing. Specifically, the function of an Access Point is to reflect the location of roadway access to an address along the road network, supplying the necessary information critical to vehicle routing. Note that the requirements of vehicle routing may conflict with the requirements of Site/Structure Address Points needed for other public safety applications (see **Section 3.2 Address Points vs. Access Points**).

Geocoding Placement Method: The use of road centerlines and geocoded points may be appropriate for vehicle routing, particularly where ranges have been validated for each segment.

Parcel Placement Method: Since in many cases the location of the parcel centroid may bear little or no relation to the road centerline or access to the property, manual adjustment of the point will likely be required.

Site Placement Method: Since in many cases the location of the site centroid may bear little or no relation to the road centerline or access to the property, manual adjustment of the point will likely be required.

Structure Placement Method: This methodology may not work well for vehicle routing because of the varying distance of the structure, or the structure's primary entrance, from the road centerline. This may be mitigated if there is an associated "network" of driveways and access roads which connects the structures to the named roads. Also be aware that, taking the point of access to be the nearest point on a named road may lead to routing errors.

Property Access Placement Method: Where address points are being used for vehicle routing, this methodology is appropriate. Placing the point a specific offset distance from the road centerline may be the best option for such systems.

3.6.3.5 Emergency Notification

Site / Structure Address Points can facilitate emergency notification of incidents. Emergency notifications and messaging are often based on areas that are created by buffering an incident location (e.g., address points, building footprints, parcel boundaries, transportation segments, or a utility network) by a specified distance. These buffered features (points, lines or polygons) define notification areas, which can then be used to select nearby address points for notification or other analyses.

In general an address point placement based on a structure or the structure's primary entrance will usually work better than other methods as structures usually provide the focal point of human activity with an area.

3.7 Data Quality Considerations

Every map (digital or printed) is a representation of reality, and the accuracy of that representation depends on several factors, including the purpose for which the data are collected. There are five categories of data quality for geographic information to consider when building an address point data layer: completeness, logical consistency, positional accuracy, temporal quality, and thematic accuracy.

Completeness – the degree to which all addresses are represented as points and attributes within a data layer without redundancy.

Logical consistency – a description of an address point location in the context of other features (i.e., is the address point correctly positioned relative to other address points, road centerlines, emergency service zones, etc.?).

Positional accuracy – how closely the stored location of an address point represents its real location on the earth's surface, consistent with the intent of the placement.

Temporal quality – how well the information in the database reflects the current state of the address points being captured. Both the location of an address point and its attributes have aspects of temporal quality that must be considered. For example, the amount of time between when source data was last observed or collected (e.g., date of flight for imagery) and when the data is being used is especially important.

Thematic accuracy – the consistency of the types of data in a data set (e.g., only address points are contained in the address point data layer) and whether the address point attribute values are correct.

It is essential to know the data sources and to understand the methodologies, used to create address point positions. The accuracy of an address point data layer is only as good as the least accurate data or collection device that was used to create it. Creating address points by referencing data of unknown accuracy will result in address points of unknown reliability.

Some source data factors in inaccurate address point placement are as follows:

Imagery – low resolution, camera orientation (tall building lean), poor image rectification (i.e., the conversion to a common projection and coordinate system), date the image was captured, etc.

Structures – these might be auto-traced from imagery or Light Detection And Ranging (LiDAR) data, or could be heads-up digitized. Sun shadows, dense vegetation, changes in elevation, irregularly spaced LiDAR measurements, etc., can cause issues in producing accurate footprints, and therefore accurate point placements within the footprint.

Road centerlines – the definition of "center" of the road may be suspect, the position of an address along a road centerline is only an approximation, the distance of an address from the centerline is usually unknown, etc.

Parcels – imprecise historical deed descriptions, interpolation points rather than surveyed points, accuracy can vary within parcel layer itself (rural property values will not support as high a positional accuracy requirement as urban properties), etc.

The degree of positional accuracy that is needed will vary with the point placement method that is selected. In general terms, the smaller the object you are trying to represent (e.g., a structure's doorway as opposed to the center point of a parcel), the greater the level of positional accuracy that is required. The minimum positional accuracy for address points can be considered by location type as follows:

Table 3-2

Location Type	Expected Accuracy
Geocoding	Interpolation along the correct road centerline segment
Parcel	Within the correct parcel
Site	Within the area, boundary, or on the correct image object
Structure	Within the correct structure polygon, on the correct image object, or on the correct doorway
Property Access	On the correct driveway or access road

Keep in mind that relative positional accuracy - spatial relationships between address points and related features - may be more important than absolute accuracy.

3.8 Metadata

The National Information Standards Organization (NISO) defines metadata as "structured information that describes, explains, locates, or otherwise makes it easier to retrieve, use, or manage an information resource[1]".

Metadata for geographic information should include data identification**,** lineage, constraints, distribution, maintenance, reference system and the feature catalog**.** Metadata may also include the quality, application, representation and portrayal, as well as additional content information associated with the data being described.

The methods of placement used to create address point locations, including the methods described in this guidance document, should be provided in layer-level or feature-level metadata. Metadata aids users in determining whether the data is suitable for their intended uses and producers in maintaining the quality of the data.

Layer-level metadata typically represents all features within a single data layer. Feature-level metadata typically refers to metadata for one or more features. If address points in a data layer have differing metadata, i.e. differing placement methods, then feature-level metadata should be considered.

Finally, metadata associated with address point data should be provided and discoverable to those who want to use it.

4 Recommended Reading and References

[1] National Emergency Number Association. "NENA Next Generation 9-1-1 (NG9-1-1) United States Civic Location Data Exchange Format (CLDXF) Standard". NENA-STA-004.1.

Posted at http://www.nena.org/?NG911CLDXF

[2] National Emergency Number Association. "NENA Standard for NG9-1-1 GIS Data Model." NENA-STA-006.

[3] National Emergency Number Association. "NENA GIS Data Collection and Maintenance Standards". Version 1. NENA 02-014.
Posted at http://www.nena.org/general/custom.asp?page=gisdatacollection

[4] National Emergency Number Association. "NENA Information Document for Geographic Information System Databases with MSAG & ALI." Version 1.1. NENA 71-501.

Posted at http://www.nena.org/general/custom.asp?page=synch_gis_msag_ali

[5] National Emergency Number Association. "NENA Master Glossary of 9-1-1 Terminology." NENA ADM-000.18-2014.

[1] National Information Standards Organization (NISO). *Understanding Metadata* [Internet]. Bethesda: NISO Press, c2004. Available from: http://www.niso.org/publications/press/UnderstandingMetadata.pdf

Posted at: http://www.nena.org/?page=Glossary

[6] National Emergency Number Association. “Addressing Systems: A Training Guide for 9-1-1” by Marc Berryman. Copyright 2008. NENA ISBN 1-883119-18-9

[7] National Emergency Number Association. “NENA Security for Next-Generation 9-1-1 (NG-SEC) Standard”. Version 1. NENA 75-001.

Posted at http://www.nena.org/general/custom.asp?page=NG911_Security

[8] U.S. Federal Geographic Data Committee. "United States Thoroughfare, Landmark, and Postal Address Data Standard." February 2011. FGDC-STD-016-2011.

Posted at: http://www.fgdc.gov/standards/projects/FGDC-standards-projects/street-address

[9] National Information Standards Organization (NISO). “Understanding Metadata.” Copyright 2004. NISO ISBN: 1-880124-62-9

Posted at: http://www.niso.org/publications/press/UnderstandingMetadata.pdf

[10] International Standards Organization. “ISO 19115-1:2014 Geographic information -- Metadata -- Part 1: Fundamentals”. Copyright 2014.

Regarding Multi-Line Telephone Systems (MLTS), documentation on the best practices for locating a telephone device associated with a Private Branch Exchange (PBX) can be found in:

[11] National Emergency Number Association. “Industry Common Mechanisms for MLTS E9-1-1 Caller Location Discovery and Reporting Technical Information Documents (TID)”. Version 1. NENA 06-502.

Posted at: http://www.nena.org/?page=MLTS_Location

[12] National Emergency Number Association. “NENA Technical Requirements Document on Model Legislation E9-1-1 for Multi-Line Telephone Systems”. Version 3. NENA 06-750.

Posted at: http://www.nena.org/?page=MLTS_Legislation

5 Previous Acknowledgments

None. This is the initial document.