Jane Swift, Governor

Bob Durand, Secretary

MassGIS Standard
for
Digital Parcel Files
and
Related Data Sets

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Massachusetts
Geographic
Information
System

For more information about this standard, contact either:

Christian Jacqz, Director   Neil MacGaffey, Assistant Director
MassGIS   MassGIS
617-626-1056   617-626-1057
Christian.Jaqz@state.ma.us   Neil.MacGaffey@state.ma.us

A copy of this standard may be obtained from the MassGIS web site at www.state.ma.us/mgis.

INTRODUCTION

Planning for economic development, growth management and environmental resource protection, delivering local and state government services, providing public safety and emergency response and mitigation, managing transportation infrastructure and many other government functions require information about property boundaries. Often these activities involve regions covering part or all of many towns. Property boundaries, and sometimes other legal interests in land, are depicted on assessor's property maps. These standards apply to mapping by municipalities of the boundaries of legal interests in land <u>as they appear on assessor's maps</u>. Besides fee ownership, these legal interests typically include public and private rights of way and easements. They may also include special taxing districts and other legal interests or areas with special assessment status (e.g., conservation restriction or agricultural preservation). For simplicity, all boundaries on a community's assessor's property maps are referred to in this standard as "property boundaries".

Increasingly, assessor's maps are maintained in digital form. There are numerous benefits associated with having standards for the format, quality and documentation of this mapping and associated data files. For digital parcel boundary files from multiple communities to be used together, they must all be developed according to the same digital file standard or at a minimum have common, well-defined and compatible data elements. Without such standards, making digital files from multiple communities compatible requires a prohibitive amount of work. Standardization makes it much easier and more efficient to use these files and to develop end-user applications against them. Standards for quality and for documentation provide assurance that the files can be used appropriately and in particular that information from different sources can be combined, e.g. information on hazardous waste sites, property boundaries and public water supplies can be shown in a common geographic reference and correctly interpreted.

Complying with this standard requires that each legal interest depicted in the digital parcel file or files must have its own map polygon, which may overlap or be coincident with other polygons. Having different polygons allows differentiation of the different legal interests depicted on the assessor's maps using different line symbols or area shadings. Whether these different polygons are stored in separate GIS data layer files or in a single file or, as is possible with recent GIS technology developments, in a single "relational" database, is a decision made by the custodian of the digital parcel file. If the polygons representing different legal interests are stored together in a single file or database, the type of legal interest represented by each polygon must be differentiated in the database. The mechanism for this differentiation is presented later in this standard.

PURPOSE

This standard has five purposes:

1. Providing communities a flexible specification for developing a digital parcel file suitable for use in a geographic information system (GIS). Because text labeling and the creation of a master address file are integral to extending the usefulness of a digital parcel file, portions of this standard address the creation of those datasets.
2. Making it possible to merge <u>digital</u> property information from more than one community for multi-town mapping and spatial analysis.
3. Being able to identify a single property parcel statewide based on a single unique identifier.
4. Providing various levels of documentation.

5. Assuring a minimum level of spatial accuracy.

This standard is NOT a general purpose standard for traditional printed parcel map sheets.

AUTHORITY

As the Commonwealth's Office of Geographic and Environmental Information, MassGIS has the legislatively assigned authority and mandate to "set standards for the acquisition and management of geographical and environmental data by any agency, authority or other political subdivision of the Commonwealth"(Ch. 21A, Section 4B, MGL). **Compliance with Level I of this standard will be the minimum required for any community that contracts for or otherwise arranges creation of a digital version of their assessor's maps or their equivalent under regulations currently being drafted by the Office.** This requirement should not be burdensome for most communities, as almost all digital parcel files now comply with most, if not all, parts of the Level I standard.

PROCESS FOR DEVELOPMENT OF STANDARD

This standard was drafted by MassGIS staff, drawing upon their experience with parcel map conversion and with developing GIS applications in municipal government. Standards from other states, notably Vermont and Wisconsin, were also reviewed. GIS consultants active in parcel map conversion in Massachusetts reviewed and commented on an early draft. Subsequently, GIS consultants, GIS staff at Massachusett's regional planning commissions, individuals with substantial experience working with municipal property valuation data and functions, and municipal GIS staff reviewed and commented on a subsequent more advanced draft. Many helpful comments and suggestions were received; many of them resulted in changes to the standard. These comments and the MassGIS staff response to each one are available as a companion document that is being distributed with this standard.

OVERVIEW

This standard is being issued in three parts or levels. Level I is an approach to digital parcel mapping that should be useful to any entity or individual in the Commonwealth involved in conversion of maps to digital form or maintenance of digital parcel mapping as part of a GIS database. It incorporates commonly accepted, reasonable approaches to developing digital parcel boundaries. Level I covers digital property boundary compilation and the minimal descriptive or attribute information needed to support common municipal GIS needs; it also includes some recommended practices that, when implemented, would make the digital parcel information more useful, both to the municipality and to other organizations.

Level II covers additional attribute information; it applies to any state or regional public entity which has committed resources or staff to developing parcel data, and by extension to any business or other entity that is receiving state funding for providing digital parcel information. One of the requirements for complying with Level II is that every property represented on the assessor's maps must be linked to a record in the assessor's property database. Conversely, every record in the assessor's database must be linked to a property represented on the assessor's maps. One result of this requirement is that the assessor's property database becomes an inventory of land in that city or town instead of simply an inventory of properties that receive a property tax bill.

Level III covers making the link between the assessor's database and the GIS more direct and developing a master address file. Regardless of the level at which this standard is implemented, the implicit assumptions is that it will most likely be implemented by companies or other non-municipal organizations who undertake the conversion or maintenance of the assessor's maps under contract.

Note that property boundaries compiled in accordance with Level II or III of these standards and delivered to MassGIS may, after written notification by MassGIS, be printed or distributed with the statement: *"Property boundaries automated in <year> and approved by MassGIS as conforming to Level II / III of the MassGIS Digital Parcel Mapping Standard"*.

Table I summarizes the required and recommended elements at each level of the standard.

TABLE 1: Required and recommended elements of the standard at each level.

ELEMENT IN STANDARD	STANDARD		
	LEVEL I	LEVEL II	LEVEL III
Meet Minimum compilation standards	REQ	REQ	REQ
Parcels include map_par_ID attribute	REQ	REQ	REQ
Parcels include attributes from assessor's database	REQ	REQ	REQ
North American Datum - 1983	REQ	REQ	REQ
Accurate town boundary (1)	rec	REQ	REQ
Street line network w/ street name attribute	rec	REQ	REQ
Parcels created in or export to shape file format	REQ	REQ	REQ
Metadata	REQ	REQ	REQ
Parcels include site address attributes	rec	REQ	REQ
Data layers to support text labels (2)	rec	REQ	REQ
Parcels include loc_ID attribute	no	REQ	REQ
Develop intersection table in GIS database	no	REQ	REQ
Integrate loc_ID into assessor's database	no	rec	REQ
Community develop master address file	no	rec	REQ
Deliver data files to MassGIS	rec	REQ (3)	REQ

(1) When required, this is subject to appeal
(2) For example, features created to make it possible to
    label property boundaries with their dimensions.
(3) Desirable but optional if no state funding involved.

REQ = Required; rec = recommended

DEFINITIONS

The following definitions will help in understanding this standard:

Assessor's database – This is the database of property assessment information maintained by the assessor; it is also referred to as the tax list, property list, CAMA system, CAMA database, appraisal database etc.

Attribute – A single element of non-graphic (e.g., name of owner, property area, property value) information stored in a database field and usually, in the context of this standard, associated with a single geographic feature (e.g. a property parcel on a map).

Base Map – This refers to a map portraying basic reference features on the earth's surface (both natural and cultural) onto which other, specialized, features (e.g., property boundaries, water mains) are placed. A common example is a U.S. Geological Survey topographic map.

Parcel – In this standard, this word refers to the polygon representing the boundaries of legal ownership or interest on a city or town assessor's maps.

Digital Parcel File – This refers to a computer file or files containing a graphic (vector) representation of the boundary information originally depicted and maintained on a city or town assessor's maps. Besides fee ownership boundaries that may appear in this file or files, include public and private rights of way and various different kinds of easements These files are typically created in and maintained using GIS software.

Property – In this standard, this word refers to the record in an assessor's database.

Map_Par_ID – This is a parcel identifier whose purpose is to unambiguously reference one or more polygons on the map. While the name of this database field is unique to this standard, a similar field must exist in any digital parcel file if that file is to be linked with information from an assessor's database. In digital parcel attribute files, it is usually created by "merging together" (the technical term is concatenate) various identifiers, (e.g., map number/map sub-number/parcel number/parcel sub-number, or map/block/lot or section/block/lot, that appear on assessor's maps. The various components of this identifier will vary from community to community.

If a town already has a unique identifier that serves the purpose of linking the assessor's data to identifiers on the map then they should use it. If this identifier does not exist and is being constructed from various component fields, the component parts must be separated by an underscore character ("_") to allow for parsing the concatenated fields. In either case, the field being used as a unique identifier must be named MAP_PAR_ID. If the existing field name is different, the field can be re-named, an alias field name can be assigned, or information in the existing field can be copied into a field with this name. So, for example, the parcel on a hypothetical map 14, block 6, lot 12 would be identified by in the Map_Par_ID attribute in the digital parcel file as 14_06_012. Typically each parcel polygon on an assessor's map is labeled with the lot number. The map number may only appear once on the map sheet, and the block numbers may appear as needed to differentiate the different blocks on the map sheet. For various reasons discussed under Level II of this standard, while this identifier uniquely identifies one ownership interest, it may not be a unique identifier on the assessor's maps. The key requirement for the Map_Par_ID is that it correspond to at least one parcel identifier shown on the assessor's map.

Prop_ID - This is a unique identifier for each property listed in the assessor's database. The only requirement is that it be unique for each property in the assessor's database, and that some reasonable procedure exist for generating new identifiers and ensuring that they are unique. It may be similar to the MAP_PAR_ID with the same component parts (e.g., map/block/lot, etc). When these components are concatenated, they create a unique identifier for each record in the assessor's database. Sometimes this unique identifier may already exist in a single field in an assessor's database. More often its component parts (map/block/lot, section/block/lot, etc.) are stored in separate fields in an assessor's database. When the information in these fields is concatenated together, it yields a unique identifier. However, for any given entry in an assessor's database, a Prop_ID may not be exactly the same as the MAP_PAR_ID, because not every property record in an assessor's database necessarily matches a parcel on a map. Condominiums are the most common example. Each condominium is a record in the assessor's database because each condominium owner needs to receive a property tax bill. However, condominiums cannot be uniquely identified with the same information used to identify other properties (e.g., map/block/lot, etc.), since two or more condominiums appear on one lot and they cannot each have the same lot number. A common resolution for this situation is to create a unique lot by extending the lot number. So for example the condominiums on "lot 1" have lot numbers 1A, 1B, 1C, etc. The key requirement for the Prop_ID is that it uniquely identify each property record.

Loc_ID – This identifier is specific to this standard. It is a unique identifier for parcels created from database fields containing the X and Y coordinate values (Massachusetts State Plane System, NAD83 datum, in feet) of a point that lies within the polygon, preferably at the visual center. Note that if the location of this point is derived based on the center of a bounding box, it may not satisfy the requirement that it lie within the polygon. One way to create the content for this field is to add database fields to the digital parcel file, one each for the "X" and "Y" coordinate values. The X and Y coordinate values can then be concatenated together, separated by a single underscore character ("_"), into a field called Loc_ID. This identifier has several useful properties. First, it is unique (it is a database primary key) statewide and, because it is derived from coordinates, it can be used by GIS software to locate the parcel in the absence of any other identifier. Furthermore, these coordinate values can be readily added to database fields for every map parcel using standard capabilities in most software used for spatial data development. MassGIS certification that a digital parcel file complies with either Level II or Level III of this standard will be based in part on verifying that the Loc_ID field values are correct.

Registration - In this document, registration refers to the process of finding reference points on a map/image document and assigning them coordinates from their known positions in the real-world. Once coordinates are specified for enough points on the map/image document, the entire digital document may be mathematically transformed to real-world coordinates for GIS display and analysis.

Scan - This refers to the process of making a digital image of a document (e.g., a map, text document, or photo). A scanned document can be displayed on a computer screen, but until locations on the document are assigned ("registered") to map coordinates, it cannot be overlaid with map features in a GIS database.

DIGITAL PARCEL FILE STANDARD LEVEL I

This level of the standard includes required and recommended elements. They are presented below in that order. Compliance with the required elements of this level is the minimally acceptable standard for developing a digital parcel file. Ideally, digitizing assessor's maps and linking the resulting file to information from the assessor's database will all occur as part of the same project scope. However, funding may limit this work to simply creating a digital version of the assessor's maps with (or even perhaps without) an attribute of the property identifier (Map_Par_ID) developed based on what can be determined from the map. In this scenario, no attempt is made to link the digital parcel file to information from the assessor's database. While this cannot be considered "compliance" with level I of this standard, it is certainly a worthwhile start that could be used to demonstrate the value of the digital file and, perhaps through a pilot project, of linking it to assessing information. Subsequent funding might then be used to make sure the property idenfyer (Map_Par_ID) can be used to link with information downloaded from the assessing database.

REQUIRED ELEMENTS

The following summarizes the required elements for digital parcel files at this level:

1. They must conform with the minimum compilation standards and horizontal accuracy requirements for property boundary locations,
2. They must include an identifier, the Map_Par_ID, for each polygon that is the basis for a link to the assessor's database,
3. The attributes of the parcels must include a minimum set of attributes extracted from the assessors database, and they must include an attribute that identifies the type of polygon (this attribute provides a means for identifying polygons such as ponds, traffic islands, and railroad rights-of-way that are not parcels but that exist on the map) and a look-up table to document the use of any codes for this attribute,
4. They must use the North American Datum of 1983 (NAD83) or a successor and the state plane coordinates system,
5. Metadata.

Note that the file format for the digital version of the parcel maps shall be in the software format specified by the recipient. Both the required and recommended portions of this level of the standard are presented in more detail below.

1. Boundary Compilation

Background

Assessor's maps are converted to a form useable in a GIS using one of three approaches:

a) Individual maps are scanned, registered to a geographic coordinate system, and then lines from the maps are converted to digital from, usually by "heads up" digitizing on a computer screen.
b) Individual maps are registered to a geographic coordinate system on a digitizing table and the lines are digitized.
c) Deeds for each property are examined, and the property boundaries are re-constructed and pieced together along with those of adjacent properties based on the coordinate geometry of

the boundary distances and bearings. This too results in a digital file. This method costs the most, but provides the highest accuracy result.

Sometimes a combination of the above methods may be required.

<u>Requirements</u>

Digital parcel boundary compilation MUST result in <u>one</u> of the following:

    a) A single GIS data layer or file containing a seamless depiction of a community's property boundaries and other legal interests depicted on the assessor's maps, if any.

    b) Individual GIS data layers or files, each of which contains polygons representing one of the different legal interests depicted on the assessor's maps. So fee ownership would be one data layer, easements another, and so on.

Whichever of these two approaches to structuring the data is chosen, the digital file must be as faithful as possible to the original map sources, representing the best professional judgment of the organization performing the conversion about how to reconcile discrepancies between different map sheets so that all properties are represented, no property "slivers" or gaps occur, boundaries have no gaps where they previously crossed a map sheet edge, and all polygons are closed. In some instances, it may not be possible to resolve discrepancies or errors without deed research. Whether deed research is part of developing a digital parcel file would be up to the community involved. Note that compliance with Level II of the standard may require at least some deed-based resolution.

Regardless of the compilation method used, property boundaries will be registered and/or adjusted to match apparent features on the base map. How much the property boundary locations are adjusted to "fit" the base map will depend on the compilation method, with more adjustment occurring when digitizing boundaries from the assessor's maps and less adjustment occurring when the property boundaries are based on deed research. The base map must be the 1:5000 scale MassGIS orthophotos (approximately 1 in. = 400 ft.) OR some other <u>at least as accurate</u> orthophoto or planimetric base map. Detailed information about the MassGIS orthophotos can be found on the MassGIS web site at <u>www.state.ma.us/mgis</u>.

If the compilation involves registering the property boundaries to an orthophoto base, the registration should be accomplished by matching visible features on the map to corresponding features on the orthophoto base. Roads, structures, and water bodies will be the most common such features. The minimal standards for geographic registration to and compilation on the base map are as follows:

    a. Property boundaries are often coincident with clearly defined and visible features on the base map. These include features such as the "back-of-the-sidewalk", stone walls, hedges and tree lines, etc. Therefore, within the limits of the orthophoto base map's absolute accuracy and other constraints (such as what can reasonably be interpreted from the orthophoto imagery), and when appropriate as determined by the map compiler, parcel boundaries should be registered as accurately as possible to features visible on the base map. When using the MassGIS orthophotos as a compilation base, such features should not be displaced in excess of three (3) meters relative to corresponding features on the base map. <u>Note that legal parcel boundaries may or may not be coincident with visible features, and that some features (e.g. the coastline, river banks, and pond/lake</u>

edges) can move over time. Therefore, assumptions about coincidence with visible features must be carefully reviewed, case-by-case.

b. Vector features from a road centerline GIS or CAD data set which meets National Map Accuracy Standards at 1" = 400' (the MassGIS 1:5000 scale roads coverage would be the default choice) or better, shall lie completely within the rights of way shown on the parcel map. An exception to this requirement would be if in the judgment of the organization performing the original conversion or reviewing such conversion the street was NOT in fact built within the right of way. Also, there may be "paper streets" or newly constructed roads for which no representation exists in a road centerline file.

c. As a general rule, the street rights-of-way depicted on the assessor's maps should be compiled so that they coincide with the apparent "back-of-the-sidewalk" on the orthophoto base map. However, if in locating the boundaries of the public street right of way there is an inconsistency between following visible "back of sidewalk" features and maintaining a correct and consistent width of the right of way, priority should be given to showing a correct and consistent width.

d. Where subdivision information of known survey level accuracy has been submitted to a city/town in digital form and is being incorporated into a GIS or CAD data set, the compilation procedure should respect the accuracy of those boundaries relative to the rest of the map. Subdivisions can be moved, rotated, or adjusted in their entirety, but if at all possible subdivision boundary arcs should not be adjusted relative to adjacent boundaries unless they are incorrect. Boundaries of adjacent properties should be adjusted to fit those from the sub-division. See the discussion of the optional "source" attribute in the next section.

e. Lines must be geometrically continuous and boundaries must be geometrically closed with no "undershoots" or "dangles" where boundaries intersect. The conversion process must not create "sliver polygons" (gaps or overlaps between properties) not on the assessor's maps. Polygons representing small ponds, traffic islands, or other miscellaneous areas that are not property parcels, must be correctly identified in the poly_type attribute (see discussion below).

f. No bends or other deformities in the boundary lines corresponding to seams in the original map sheet layout should be visible.

2. Required Map Identifier

Compliance with Level I of the standard makes it possible to provide selected information from the assessor's database when viewing or requesting information about the digital parcel file; this capability is essential for most local government uses of GIS.   Initially attaching information from the assessor's database (in digital form) to the digital parcel file involves linking information in a database field common to both. **This generally requires adding or using an existing identifier for the individual property records in a report or list extracted from the assessors database which will match a MAP_PAR_ID created as an attribute for each digital parcel during or subsequent to the parcel compilation process.**   Note that it may not be possible, without quite a bit of additional research and data clean up, to make this link between the assessor's list and the digital parcel map for every single parcel or property record. This level of the standard requires only an initial good-faith effort to link attribute information as completely as possible. Level II of this standard provides a mechanism for improving the degree of match.

Also note that a property record identifier being used in the assessor's database to link to the parcel mapping may or may not satisfy the uniqueness definition of the Prop_ID as defined above. This situation is also dealt with under Level II. On the other hand, if the assessors database has been set up so that there is a single property record for each parcel on the map (the ideal situation), then it will be much easier to adapt it to the linking mechanism described above. For this situation to exist, property records for condominiums would need to be stored separately or otherwise segregated and linked to the appropriate land record.

3. Attributes from Assessor's Records

Adding attributes from the assessor's database (these attributes are typically only relevant for property boundaries depicting fee ownership) is typically accomplished by obtaining a copy of the necessary assessor's information (e.g., as a comma delimited ASCII or Excel spreadsheet file), importing it to a database table in the GIS software, and joining it to the digital parcel map based on a common identifier as discussed above. As part of this process the field names in the database containing the copy of the assessor's information are defined ahead of time.

The list of required attributes from the assessor's database is below; it includes information commonly needed for GIS applications involving parcel data, both at a town and a regional level. Attribute names are required to match those listed, because using parcel data from multiple towns together requires that attribute field names match. The ability to use data from adjacent communities is relevant not only for multi-town digital parcel files but also to individual towns. For example, parcel data from adjacent communities is needed to support abutter notification mailings, "comparables" for property assessments, mapping locations of students when schools are regional, reviewing proposed developments that straddle town boundaries, and police/fire tasks such as crime mapping, mutual aid dispatch support, and lost-person searches.

Because these required attributes names can be established ahead of time, typically as a digital parcel file is developed, these attributes and their names pose little or no difficulty for a community that is developing a digital parcel file. Where a town or city has already established different attribute field names for these same attributes, these required field names would make complying with the standard difficult. Communities in these circumstances have three options: rename attributes, add alias field names, or maintain two fields with the same information.

The minimum set of attributes linked to the digital parcel file (i.e., in the polygon attribute table or shape table) from the assessor's database consists of the following (complete field definitions are in Appendix A). Note that information may not be available to populate some of these, but must be included if it is available, which distinguishes them from the optional fields listed after.

1. LAND_VAL = Current total assessed value for land (numeric field) (Note: condominiums typically have their allocation of the land value included in their "building" value.)
2. BLDG_VAL = Current total assessed value for building(s) including out-buildings (numeric field)
3. FY = Fiscal year of assessed value (character field)
4. LOT_SIZE = Deed area (numeric field, allowing for up to two decimal places)
5. LOT_UNITS = Deed area units (character field; valid values are "S" for square feet and "A" for acres)
6. LS_DATE = Last sale date (character field, not data field because dates come in too many variations but are easy to place into a character field)
7. LS_PRICE = Last sale price (numeric field)
8. LAND_USE = State use code (numeric field)

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9. Site address in the following database fields[1]: SITE_ADDR (street address, including street/house number, cardinal directions, street name, and street suffix) city (CITY), zip code (ZIP)
10. OWNER1 = Name of first owner of record (character field)
11. Owner address in the following fields: street address (OWN_ADDR), city (OWN_CITY), state (OWN_STATE), zip/mail code (OWN_ZIP), and country (OWN_CO).
12. LS_BOOK = Last sale Registry of Deeds book (character field)
13. LS_PAGE = Last sale Registry of Deeds page (character field)
14. LIV_UNITS = Number of living/dwelling units (apartments and condominiums, if available) (numeric field)
15. Building area (square feet) for commercial/industrial properties as defined by the state use codes. (if available; numeric field)
16. POLY_TYPE = Attribute to explain polygons in the file that are not legal interests (character field; valid values are RAIL ROW = railroad right-of-way, TRAFFIC ISLE = traffic islands in street right-of-way, WATER = ponds/rivers, ISLE = island in pond or river, and OTHER)
17. INTEREST = If boundaries of legal interests are being maintained in one data layer or file, then this attribute must be included; the valid values are FEE (fee ownership), MUNI_ROW (municipal right-of-way), PRIV_ROW (private right-of-way), EASE (easement), CR (conservation restriction), AR (agricultural restriction).

Note that the above are required for this standard, but nothing precludes a community from including additional information from the assessor's database as needed for GIS use. These additional items of information would, in effect, be additional "optional" attributes.

Optional attributes, which should come after the required attributes listed above, include:

1. ZONING = Zoning classification, if available in Assessor's database (character field)
2. MAP_NO = Map number of the assessor's map sheet from which the mapping of the parcel in the digital file was created (character field).
3. SOURCE = Boundary feature source (character field; valid values are ASSESS MAP, SUBDIV, SUBDIV ANR, ROAD PLAN, OTHER).
4. PLAN_ID = Identifying information for plan (e.g, subdivision or road plan) used to update the digital file (character field).
5. UPD_DATE = The data of update to the the property boundary. Should include the year and month of the update (character field).
6. RES_AREA = Total residential living area in square feet. This is a useful attribute when evaluating development proposals relative to surrounding residences, but a difficult one to create because it requires adding areas from multiple fields in the assessor's database (numeric field).
7. CI_AREA = Total building area for commercial/industrial properties in square feet. This is a very useful attribute for evaluating proposed and existing development, but it is difficult to create because it requires adding areas from multiple fields in the assessor's database (numeric field).

4. Horizontal Datum

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[1] For GIS software to reliably find locations based on property addresses ("geocoding"), the site address information listed above will need to be broken into more database fields. These additional address attributes are discussed under "Site Address" in the recommended elements section, below.

While many communities have their own horizontal survey datum, when they are building a digital mapping database they must use the North American Datum of 1983, or a successor. This will facilitate using digital data from other sources (e.g., MassGIS and the regional planning agency) and from adjacent communities. Likewise, the community must use the State Plane Coordinate reference grid with units of feet or meters. Note that Nantucket, Martha's Vineyard, and the Elizabeth Islands have their own state plane coordinate system zone, the Island Zone.

5. Metadata

It is essential to realize that the GIS data being created by or for a community are records that will exist long after those involved in creating them are gone. A GIS data development project should not be considered complete until metadata (data describing the GIS data) are also completed. This information is needed to properly understand and use any GIS data layer, now and in the future. This is particularly true with digital data because they are much easier to disseminate than the original paper or mylar maps.

Creating complete metadata should be part of creating GIS data and is good professional practice. MassGIS recommends that metadata complying either with the state standard http://www.state.ma.us/mgis/standard.htm or the Federal Geographic Data Committee's metadata standard be required from any organization that delivers or creates digital GIS data. For more information about metadata and links to web sites that provide metadata tools see the following location on the MassGIS web site: http://www.state.ma.us/mgis/munimeta.htm. The detail should include the name and version of the CAMA software from which the parcel attributes were drawn and the file format of the extract from the assessor's database.

RECOMMENDED ELEMENTS

The following are recommended elements at this level of the standard:

1. Extending parcel attributes to include a site address broken into more database fields so that it is more suitable for geocoding,
2. Developing an accurate town boundary,
3. Possible text labels (annotation).,
4. Capability for providing a copy of the digital parcel file in shape file format.

These elements will, if implemented, facilitate development of a city/town GIS in both the short and long-term.

1. Site Address

Besides the parcel identifier (MAP_PAR_ID) discussed above, the most critical piece of information for general use of GIS parcel information is the site (property location) address. The site address should be standardized and formatted into standard address elements in order to meet requirements for address matching by GIS software. Addresses separated out as described below and stored as attributes of a digital parcel file will greatly facilitate GIS use and development in a town or city. Addresses need to be stored in separate database fields as follows (complete field definitions are in Appendix A):

1. NUM1 = House number one (numeric field, no characters). Since a property may have more than one address, this is the lowest number of the two addresses or of the address range.
2. NUM2 = House number two. This is the highest number of two addresses or of the address range.
3. NUM_SFX = Alpha suffix to the house number, if it exists (character field)
4. PFX_DIR = Cardinal direction prefix to street name (one of the following single characters: *S,N,E,W*)
5. STREET = Street name (in full, as in *Commonwealth*, NOT *Comm.*; character field, use local name rather than numbered highway designation which should be listed as alternate name described below); this should not be the development name ("The Gables", "Pine Meadows")
6. ST_SFX = Street suffix type (character field, using standard abbreviation such as *ST, AVE, RD* – this standard uses the U.S. Postal Service abbreviations (see http://new.usps.com/cgi-bin/uspsbv/scripts/content.jsp?D=10090#suffix) do not use punctuation (e.g., RD not RD.)
7. SFX_DIR = Cardinal direction suffix (character field)
8. UNIT = Unit identifier or secondary building identifier (such as "rear", "basement"; character field)
9. CITY = City/Town name (character field)
10. ZIP = Zip code (this must be character field because of the leading zero in Massachusetts zip codes and it must be large enough to accommodate zip+4)

Database fields for alternate street name and suffix fields may also need to be included.

At Level I of this standard, the above address detail is recommended, but not required. Note that assessing databases are the likely source of address information, but usually do not break addresses out into these components. However, breaking addresses up into their components is a common task and one that most GIS professional staff and consultants are familiar with handling.

2. Town Boundary

If the boundary between adjacent cities or towns agrees in the digital parcel file from each community, then it will be much easier to use digital parcel information jointly or in regional GIS applications. Property boundaries at the town boundary should be based on the legislated record of each town's boundary, as recorded in Massachusetts General Laws and as recorded by the Survey Section at the Massachusetts Highway Department (MassHighway). The corner points, witness marks and accompanying maps in the Survey Section's records[2] have been entered to a database although some of the changes legislated in the past 90 years are still being added. MassGIS is working with MassHighway to produce a vector (line) version of town boundaries based on these coordinates. Contact MassGIS or the MassHighway's Survey Section with questions concerning the availability of the coordinates for a town's legal boundary. Because developing a town boundary for the digital parcel file based on the statutory boundary may involve resolving significant property boundary discrepancies, this element is not a requirement at Level I of this standard. The legal boundary should however be used if no significant property location problems are created by doing so.

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[2] The Harbor and Lands Commission Town Boundaries Survey, circa 1900

3. Annotation or Text Labels

Street Name Labels

People orient themselves on assessor's maps based on street names. Therefore, development of a digital parcel file should be accompanied by development of a GIS data layer containing a street line network. The line network should have, at a minimum, a street name attribute (address ranges can also be useful). This attribute can be used to label the street network with street names. Since MassGIS can already provide communities with a detailed street network that requires little editing and that is suitable for a large-scale municipal GIS, (1" = 400'), this approach is not more costly than alternative approaches. The street names should be taken from the assessor's maps or other authoritative source. Also see the discussion of "other text labels", below. Besides the street name labels, communities may want to consider associating additional information with their street line network such as:

- Address ranges for each street segment stored in four separate databases fields (left "from" address, left "to" address, right "from" address, and right "to" address),
- Whether a street segment is one-way
- Whether a street segment is private or public
- Whether a street segment is built or not (i.e., streets may be created as part of a subdivision, but do not exist because the subdivision is not built)

In the above context, a street segment refers to that portion of the street between two intersecting streets, between an intersecting street and where the street crosses the city/town line, or between an intersecting street and a dead-end.

Other Text Labels

Assessor's maps often include other important text-based information. These typically include labels such as lot numbers on parcels, block numbers, lot areas, lot deed area, property dimensions (length), and easement type/purpose (e.g., water/sewer/drain, vehicular access). Using GIS software capabilities for labeling property polygons based on database attributes is the best approach for labeling properties with lot numbers and areas. The importance of other text on assessor's maps will vary depending on the community.

Other text labels that may be needed include parcel boundary dimensions and easement type/purpose. One approach to creating text labels is to create an additional GIS data layer containing points or lines with the attribute needed for creating the desired text labels. So, for example, creating labels showing parcel dimensions would be achieved by creating short line segments just inside and parallel to each property boundary where a dimension needed to appear. Each of these lines would have an attribute containing the dimension of the adjacent property boundary. These dimensions could then be added displayed on a computer screen or a map by symbolizing the line feature as white or "clear", and then labeling it with text from the attribute.

Alternatively, if Arc/Info based annotation exists already, it may be possible to use ArcInfo commands to convert the annotation to a data layer containing point or line features with an attribute of the annotation text. This data layer could then be used to produce text labels as described above.

File Format

A widely used format that can be read by many different mapping software packages is ESRI's "shape file" format. This format actually results in several files with the same root name and various file type suffixes. Other possible file formats include those for GIS software from Autodesk (AutoCAD Map), Mapinfo Corporation, Caliper Corporation (Maptitude), Intergraph Corporation (GeoMedia, MGE), and others. As mentioned earlier, the file format for the digital version of the parcel maps shall be in the software format specified by the recipient. An advantage of the shape file format is that it can be imported into many other GIS software packages. It is also the preferred format for MassGIS to receive the data.

DIGITAL PARCEL FILE STANDARD LEVEL II

Compliance with this level of the standard includes compliance with all of the Level I requirements. In summary, those requirements are:

1. Meeting minimum compilation standards and horizontal accuracy requirements,
2. Adding an identifier (the Map_Par_ID)to each property in the digital parcel file to facilitate a link to the assessor's database,
3. Including a minimum set of attributes from the assessor's database,
4. Using the North American Datum of 1983 (NAD83), and
5. Metadata.

Level II has additional required elements, some of which were recommendations at Level I. **Compliance with this level of the standard is a prerequisite for receiving state funding for digital parcel file development.** A town or city's GIS project will also be supported much more effectively if the digital parcel file complies with Llevel II of this standard. The additional required elements at Level II are:

* Each parcel polygon must have a unique Loc_ID,
* Mismatches between assessor's listing and parcel mapping must be fixed and linkage enhanced by use of Loc_ID and unique property identifier or Prop_ID,
* Minimum attributes must include the site address from the assessor's database broken into its component parts as described in "Site Address" section above,
* The town boundary used must be based on the boundary coordinates recorded with the Massachusetts Highway Departments Survey Section,
* Street names associated with a single line representation of the street network must be developed, and
* The digital file is in or can be converted to ESRI shape file format and it and an accompanying street line file (and other files if they exist, for example, files created to facilitate text labeling) must be delivered to MassGIS.

These elements are described in more detail below.

UNIQUE STATEWIDE IDENTIFIER

As described in the earlier definitions section, the unique Loc_ID identifier for parcels is created by concatenating together (separated by a single underscore character, "_") the X and Y coordinate values (Mass State Plane System, NAD83 datum, in feet) of a point that lies within the parcel. The point may be generated in many software systems automatically. It should ideally be at the visual center of the parcel. It may also serve as the center or origin of a label in those cases where the size of the polygon and the desired size of the label text are compatible. The Loc_ID will provide a unique statewide identifier for parcels.

ENHANCED DATA LINKAGE

Accessing information in the assessor's database is among the most important requirements for a city/town GIS. Typically, as described under Level I, the assessor's listing for a single property parcel can be linked in a GIS to the corresponding parcel on the map using the assessor's property identifier (e.g., map/block/lot; section/block/lot, etc.) or a new identifier constructed from similar data elements. However, there is not always a one-to-one correlation between the polygons on
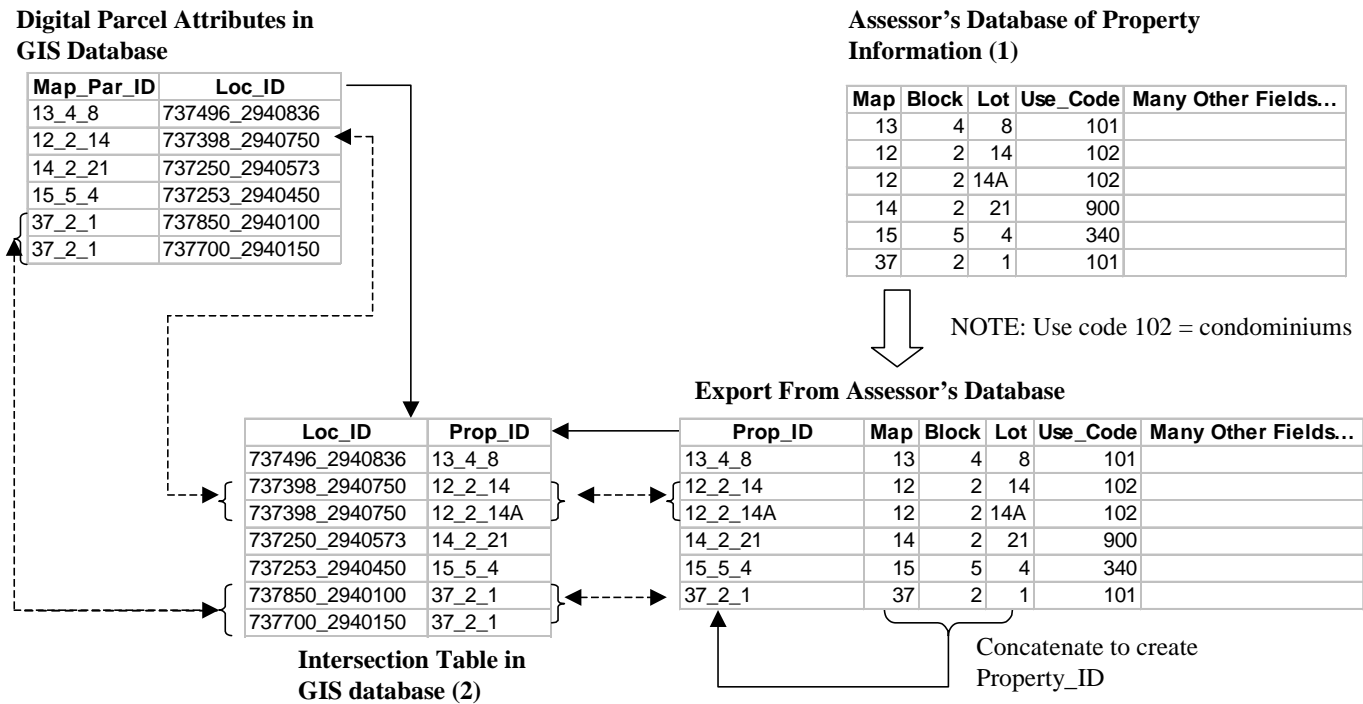
the assessor's map and the records in the assessor's database. For example, the following situations occur:

    a. Two (or more) polygons on the assessor's map may be assigned the same MAP_PAR_ID and linked to just one record in the assessor's database (commonly indicated on maps with "fish-hook" symbols linking the parcel polygons involved.) For example, a small river may separate two map polygons. By assigning a unique Loc_ID to each polygon and developing an additional database table, the "intersection table", as discussed below, this situation can be corrected .

    b. Several polygons with different MAP_PAR_IDs may have only one corresponding record in the listing, often because the assessor wishes to issue just one assessor's tax bill per owner. In this instance there are parcel identifiers on the map that may not match any records in the assessor's database.

    c. Individual units in a condominium complex will each have a record in the assessor's database, but the property identifier associated with each condominium usually cannot be linked to a parcel of land on the property map. Also, note that the common property (land and exterior of structures) of a condominium association may or may not be separately listed as a "master record" for a condominium.

    d. Parcels of land may simply be omitted from the listing because the owners are tax-exempt.

Digital parcel maps complying with level II of the standard will achieve a higher, and sometimes much higher, match between parcels shown on assessor's maps and corresponding listings in the assessor's database. This will be particularly true in communities with lots of condominiums or with frequent occurrences of multiple parcels covered by a single assessor's tax bill.

Complying with this level of the standard involves creating an intermediate database table (technically known as an "intersection" table) containing two fields, one for the Loc_ID and one for the Prop_ID. The Loc_ID field must be generated and included in the digital parcel mapping attributes. The Prop_ID field must be generated and included in the extract or report from the assessor's database as a unique identifier for each property. The intersection table is simply a means of completely specifying all possible linkages between every property and every parcel in order to deal with the data mismatches described above.   Each record in the intersection table matches only one parcel to one assessor's record, but being an independent table allows for the matching of multiple parcels to one assessor's record (case b above) or of multiple assessor's records to one parcel (case c above.) For records where there is no immediately obvious match between the two tables (e.g. condominiums), the values in the intermediate table will have to be inserted, either one at a time or in automated fashion. This may involve parsing the Prop_ID in some way or looking at the site address to determine the Loc_ID to which the Prop_ID field in the intermediate table record should match. See Figure 1.

**Figure 1: Role of Intersection Table in
Linking Parcels and Assessor's Database**

**Digital Parcel Attributes in
GIS Database**

Map_Par_ID	Loc_ID
13_4_8	737496_2940836
12_2_14	737398_2940750
14_2_21	737250_2940573
15_5_4	737253_2940450
37_2_1	737850_2940100
37_2_1	737700_2940150

**Assessor's Database of Property
Information (1)**

Map	Block	Lot	Use_Code	Many Other Fields...
13	4	8	101	
12	2	14	102	
12	2	14A	102	
14	2	21	900	
15	5	4	340	
37	2	1	101	

NOTE: Use code 102 = condominiums

Export From Assessor's Database

Prop_ID	Map	Block	Lot	Use_Code	Many Other Fields...
13_4_8	13	4	8	101	
12_2_14	12	2	14	102	
12_2_14A	12	2	14A	102	
14_2_21	14	2	21	900	
15_5_4	15	5	4	340	
37_2_1	37	2	1	101	

Concatenate to create
Property_ID

Loc_ID	Prop_ID
737496_2940836	13_4_8
737398_2940750	12_2_14
737398_2940750	12_2_14A
737250_2940573	14_2_21
737253_2940450	15_5_4
737850_2940100	37_2_1
737700_2940150	37_2_1

**Intersection Table in
GIS database (2)**

(1) Field names other than map, block, lot may be used, depending
on the community.

(2) The intersection table makes it possible to associate the two
condo units with the same polygon on the map (property identified
as 12_2_14). Similarly, the two separate map polygons identified
as 37_2_1 are inserted to the intersection table with their unique
Loc IDs.

While the approach described above may initially seem complex, it is based on standard database design principles and is not overly burdensome to implement, particularly given the long-term benefits. At a time when more and more local governments are creating GIS databases, this approach creates a sound and versatile foundation for supporting further GIS and other computer based capabilities. The key steps required for implementation are, in the intersection table, (1) assigning a Loc_ID to records in the assessor's database that do not match to a property on the assessor's maps (e.g. condominiums), and (2) assigning a Prop_ID from the assessor's database to properties from the assessor's maps that do not match a property listing in the assessor's database.

SITE ADDRESS

The attributes of the digital parcel file now include this information. For the specific database fields involved, see the discussion of site address in the "recommended elements" of Level I, above.

TOWN BOUNDARY

Property boundaries at the town boundary must be based on the legislated record of each town's boundary, as described in Massachusetts General Laws and recorded by the Survey Section at the Massachusetts Highway Department (MassHighway). The corner points, witness marks and accompanying maps in the Survey Department's records[3] are mostly automated although some recent changes are still being added. Contact MassGIS or the MassHighway Survey Section with questions concerning the availability of the coordinates for a town's legal boundary. Because developing a town boundary for the digital parcel file based on the statutory boundary may involve resolving significant property boundary discrepancies, this requirement is subject to waiver if appealed to MassGIS. A waiver <u>may</u> be granted if the survey accurate boundary causes properties to move from one town to another or there are other circumstances that would make this requirement exceptionally burdensome for a community to implement.

STREET NAMES

People orient themselves on assessor's maps based on street names. Therefore, development of a digital parcel file at Level II must be accompanied by development of a GIS data layer containing a street line network. The line network must have, <u>at a minimum</u>, a street name attribute (address ranges can also be useful). This attribute can be used to label the street network with street names. Since MassGIS can already provide communities with a detailed street network that requires little editing and that is suitable for a large-scale municipal GIS, (1" = 400' or larger scales), this approach is not more costly than alternative approaches. The street names should be taken from the assessor's maps or other authoritative source. Besides the street name labels, communities may want to consider associating additional information with their street line network such as:

- Address ranges for each street segment stored in four separate databases fields (left "from" address, left "to" address, right "from" address, and right "to" address),
- Whether a street segment is one-way
- Whether a street segment is private or public

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[3] The Harbor and Lands Commission Town Boundaries Survey, circa 1900

- Whether a street segment is built or not (i.e., streets may be created as part of a subdivision, but do not exist because the subdivision is not built)

In the above context, a street segment refers to that portion of the street between two intersecting streets, between an intersecting street and where the street crosses the city/town line, or between an intersecting street and a dead-end. <u>Also see the discussion of "other text labels", in the recommended elements for Level I.</u>

FILE FORMAT

While it is not the intent of this standard to require the use of any particular software, the ESRI shape file format represents a de facto standard in Massachusetts. It is also a published or "open" format that most commonly used GIS software can both import from and export to. Since this level requires that a copy of the digital data files be submitted to MassGIS, it must be possible to provide the file in either ESRI's ArcView (shape file) or ArcInfo export file formats. <u>This does not preclude using some other software to create and maintain the digital parcel file</u>.

DIGITAL PARCEL FILE STANDARD LEVEL III

Complying with this level of the standard includes compliance with all of the Level II requirements. Compliance with Level III is strongly recommended for communities building GIS databases. While the work required to achieve compliance is not trivial, it will provide significant benefits to the community's GIS and other computer related capabilities. Compliance will also be required as a condition for obtaining higher levels of state funding for GIS data development, should they be available.

Complying with this level of the standard has two parts:

1. Fully integrating the Loc_ID into the Assessor's database.
2. Developing a Master Address File

FULLY INTEGRATED ASSESSOR'S DATABASE

A copy of information from the assessor's database, or even a direct link to the assessor's database can most easily be accomplished if two steps are taken:

1. the intersection table described at Level II of the standard is eliminated and the Loc_ID is incorporated directly into the assessor's database,
2. Additional records are added to the assessor's database to account for situations where there is one tax record but two (usually not more) ownership interests (polygons) on the map.

This is a requirement for compliance with Level III of this standard. In essence, it requires fixing all the problems identified in achieving compliance with Level II, by ensuring that every record in the assessor's listing includes a reference to one and only one ownership interest (map polygon) in the digital parcel file. Information from the Assessor's database would still be provided to the digital parcel file by making a copy of that information and attaching it to the parcel file. However, since the Loc_ID field would be directly incorporated into the assessor's database, the intersection table would no longer be necessary.

MASTER ADDRESS FILE

Street addresses are the most common method in local government for identifying a location. Addresses are used for reporting crimes and responding to emergencies, to identify locations of repairs made by Public Works Department employees, to locate business licensees, inspections, students and in general to manage and track almost all interactions between town government and residents. GIS software typically has the capability for finding a location using an address. Because local government functions rely so heavily on street addresses, it is important that high address match rates be possible using the GIS software. However, achieving high match rates requires an accurate and complete listing of all addresses, and that each address can be linked to a known location. This location can be interpolated from address ranges associated with street line segments (this is the basis of most commercial "address matching") or it can be more accurately referenced to either a parcel or a building footprint. While addresses associated with a street network may be developed more quickly (in many areas they are available from government or commercial sources), they do not enable GIS software to identify an address location as accurately as those associated with a parcel or a building - and for emergency response or public safety purposes such errors can be costly or even fatal.

However, compiling address information for properties may be complicated by the following:

1. One parcel may have several building entrances with different house numbers for each entrance, or one building with several units having frontage on different streets (e.g., a two family house on a corner lot)
2. Non-standard addresses or additional notes about location ("rear entrance") may be entered into the address field.
3. Specific identifying information for condominium or apartment units such as unit number may be listed in with the building address.

Therefore, the best solution for communities in the long-term is developing a master address file (MAF). A MAF provides the community with a single authoritative source for all addresses in their community. Typically, the MAF is not something developed overnight, but rather incrementally, as missing addresses are discovered and as problem addresses are corrected.   It includes the Loc_ID for the parcel within which the building with that address is located and the set of standard address elements described under site address as a recommended element under Level I.

In most communities, the assessor's database can provide a good start for creating the master address file. This is true because the information collected for each property by the assessor typically includes the site address. Even more importantly, the assessor's database, through the Prop_ID, provides a means of associating this address with a location – the parcel on the assessor's map.   Additional addresses that may be associated with a parcel (e.g. additional numbers for multiple buildings on the same parcel, or building frontage on two streets) should be included in the master address file. This is done using the Loc_ID to link each address back to the appropriate parcel.

This database structure for maintaining address information allows for a proper and unambiguous linkage between the parcel mapping, the assessor's database, and a community's master address file. Note that a key part of implementing a MAF is developing a procedure for keeping it up-to-date as properties are developed or re-developed.

Finally, in an ideal implementation of GIS at the local level, communities may choose to associate addresses with buildings instead of parcels. This requires the creation and maintenance of one additional unique identifier, the "Building_ID". This identifier is similar in concept to the Loc_ID for parcels, which is used to uniquely identify the polygon of the building footprint. That identifier would then be included in the MAF, linking addresses to buildings.

APPENDIX A: ATTRIBUTE FIELD DEFINITIONS

Field Name	Type	Size	Dec. Places	Valid Values	
Required Attributes					
LAND_VAL	N	9			
BLDG_VAL	N	9			
FY	C	10			
LOT_SIZE	N	6	2		
LOT_UNITS	C	1		S (sq. ft.); A (acres)	
LS_DATE	C	10			
LS_PRICE	N	9			
LAND_USE	N	6		As set by Dept. of Revenue	
SITE_ADDR	C	36			
CITY	C	24			
ZIP	C	10			
OWNER1	C	36			
OWN_ADDR	N	6			
OWN_CITY	C	24			
OWN_STATE	C	2			
OWN_ZIP	C	10			
OWN_CO	C	18			
LS_BOOK	C	8			
LS_PAGE	C	4			
LIV_UNITS	C	10			
POLY_TYPE	C	18		RAIL ROW, TRAFFIC ISLE, WATER, ISLE, OTHER	
INTEREST	C	12		FEE, MUNI ROW, PRIV ROW, EASE, CR, AR	
Optional Attributes					
ZONING	C	8			
MAP_NO	C	4			
SOURCE	C	12		ASSESS MAP, SUBDIV, ANR, ROAD PLAN, OTHER	
PLAN_ID	C	12			
UPD_DATE	C	10			
RES_AREA	N	6			
CI_AREA	N	9			
Site Address Attributes					
NUM1	N	6			
NUM2	N	6			
NUM_SFX	C	4			
PFX_DIR	C	1		S,N,E,W	
STREET	C	24			
ST_SFX	C	4			
SFX_DIR	C	1		S,N,E,W	
UNIT	C	12			
CITY	C	24			
ZIP	C	10			