Standard on Manual Cadastral Maps and Parcel Identifiers

July 2016

International Association of Assessing Officers

This standard replaces the August 2004 *Standard on Manual Cadastral Maps and Parcel Identifiers*. IAAO assessment standards represent a consensus in the assessing profession and have been adopted by the Executive Board of the International Association of Assessing Officers (IAAO). The objective of the IAAO standards is to provide a systematic means for assessing officers to improve and standardize the operation of their offices. IAAO standards are advisory in nature and the use of, or compliance with, such standards is voluntary. If any portion of these standards is found to be in conflict with national, state, or provincial laws, such laws shall govern. Requirements found in the *Uniform Standards of Professional Appraisal Practice* (*USPAP*) also have precedence over technical standards.

Acknowledgments

At the time of the 2016 revision (approved July 2016) the Technical Standards Subcommittee was composed of Alan Dornfest, AAS, Subcommittee Chair, Josh Myers, Carol Neihardt (associate member); Wayne Forde, August Dettbarn, Bill Marchand, and Chris Bennett, staff liaison. The chair of the Research and Standards Committee was Doug Warr. The project leader for the revision was past committee member, subject matter expert, and ad hoc committee participant Michael Prestridge.

Revision Notes

The 2016 updates are primarily derived from revisions to the *Standard on Digital Cadastral Maps and Parcel Identifiers* that were then applied as appropriate to this standard.

The previous revision of the *Standard on Manual Cadastral Maps and Parcel Identifiers* was approved in August 2004.

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1. Scope

This standard provides recommendations on the development and maintenance of cadastral maps and parcel identifiers for the purpose of assessing real property, using manual methods. It describes the components of a basic mapping system, cadastral data, content, design, preparation, materials, security and maintenance. It also discusses requirements for an effective parcel identification system as a common index to all property records.

2. Introduction—Responsibility and Role of the Assessor

The principal responsibility of the assessor is to locate, inventory, and appraise all property within the jurisdiction. Cadastral maps for the entire jurisdiction, regardless of taxable status or ownership, are essential to perform assessment functions. Cadastral maps enable the assessor to determine the location of property, indicate the size and shape of each parcel and reveal geographic relationships that affect property value. Maps and map data are important not only for assessors, but also for other governmental agencies, the public at large, the private business sector, and the land information community (realtors, title companies, and surveyors).

The assessor may assume many different roles in the management, maintenance, and stewardship of a jurisdiction's cadastral mapping program. The assessor, or authorized agent, should be the data steward for parcel and assessment data and possess the ultimate authority to inventory, create and define all parcels and other cadastral information. The assessor should maintain parcel identifiers for assessment purposes. The assessor may be involved in creating and maintaining data related to the parcel map such as zoning, and soils information. In contrast, the role of the assessor may be limited to maintaining all cadastral information and parcel identifiers; leaving responsibility for other non-cadastral data to other offices.

The assessor should track current ownership of all parcels via the recording of deeds and other documents conveying title so that the responsible party can receive assessment and tax notices. The function of processing title documents may be performed by cadastral mappers. In larger jurisdictions this function may be performed by a separate department. Regardless, deed processing and cadastral mapping are functionally related through the review of ownership and the interpretation of property descriptions and should be organizationally linked in the assessor's office.

The assessor should address policy-level matters, such as how the overall mapping program is integrated in a multipurpose data-sharing environment. Policies for program financing, stewardship or ownership of data, communication frequency, and sharing and transferring of data, for example, should be documented.

3. Core Components of a Manual Cadastral Mapping System

A mapping system for assessment purposes includes the maps, accompanying records, and resources to support mapping. It should contain the following core components.

- A geodetic control network based in a mathematical coordinate projection
- A current, accurate, base map (ideally, photogrammetrically derived and tied to the geodetic control network)
  - A cadastral parcel overlay delineating the boundaries of real property in the jurisdiction
  - A unique parcel identifier assigned to each parcel
  - Other cadastral information related directly to the parcel such as subdivision, lot and block, tract, and grant boundaries
- Additional overlays of interest to the assessor such as municipal boundaries, zoning, and flood plains
- A series of parcel data files containing parcel identifiers, ownership and assessment data

3.1 Geodetic Network

A geodetic network consists of monument points whose locations on the surface of the earth are defined with certainty. For the purpose of creating cadastral maps, these points are typically monument survey points such as a U.S. Public Land Survey System (PLSS) corner, or subdivision/plat corner. These points may be described in terms of latitude and longitude, but are more commonly used when projected to a coordinate system, such as state plane coordinates. Density and placement of control points should be related to map scale, population density, property value, accuracy specifications, and anticipated product lifespan. Professional land surveyors use Global Navigation Satellite Systems (GNSS) and Real Time Kinematic (RTK) satellite navigation to locate\points with accuracy in the sub-centimeter range.

The assessor and cadastralist should work closely with other professionals such as engineers, and surveyors, or with contract professionals if necessary, to assess the quality and completeness of data points which may already exist in a geodetic network and which relate to the creation of the cadastral map. If necessary, geodetic coordinates may need to be collected on additional data points to ensure densification of the network sufficient for the creation of cadastral information. The geodetic network, and data points consisting of monument corners contained therein, must be associated with the cadastral elements being mapped. In other words, corners collected as part of the network should correspond directly to a cadastral corner; a PLSS corner, a subdivision monument or a specific parcel corner. The assessor and cadastralist should be aware that many monuments on the ground have no relationship to land ownership. If new geodetic coordinates are being collected, it is critical for both the assessor and the data collector to have an understanding of the points which will serve the creation of the cadastral data.

3.2 Imagery and Base Maps

Vertical aerial photographs have long been an essential imagery product for development of the cadastral map. Imagery has greater value when all distortions have been removed; it is tied to a geodetic control network, can serve as a base map, and meets the measurement tolerances required for use with cadastral maps or as a base for the construction of the cadastre. Such images are called orthophotos, orthorectified images, or "orthos". Orthophotos are most commonly provided in a digital form either in black and white or color. Digital color orthophotos are the standard imagery product of most assessment agencies. At a minimum, jurisdictions should acquire new imagery of urban areas every five years and of rural areas every ten years. Jurisdictions experiencing rapid or slow growth, or without construction permitting requirements, should adjust this timetable. Partnering with other agencies that also derive a benefit from aerial imagery such as law enforcement, fire rescue, emergency management, public works, engineering, utilities, planning, economic development, and aviation authorities may allow for acquisition on a shorter timetable (annually in some cases), reduced costs, and a higher image resolution.

In a manual mapping program, orthoimagery can serve as a base or "Base Map" for the construction of cadastral and non-cadastral map overlays. Any imagery used as a base for the construction of cadastral map overlays should be tied to a geodetic network. Traditional Base Maps locate major physical features of the landscape such as roads, water features, elevation contours, fence lines, and building footprints. In some jurisdictions, they contain the fundamental information from which the cadastral maps are prepared. Base maps can be in the form of line maps (generated manually or by computer) or photographic maps. Regardless of the form, base maps are usually created from aerial photographs. Aerial photographs provide an efficient and economical means for preparing the base maps. Base maps are typically prepared by professional photogrammetry firms using photogrammetric methods and may include attributed: lines (roads, edge of pavement, curbs, ditches, and fences, etc.); polygons (elevation contours, water bodies, building footprints, etc.); and points (power poles, fire hydrants, etc.). This traditional form of base map production can be costly solely for purposes of the assessor. Due to rapid advancements in the quality, resolution, and production of digital color orthophotos, few assessors still contract for the traditional base map containing photogrammetrically derived features.

In more rural and remote areas, base map needs may be met by a national mapping program's digital topographic maps or orthophotoquads, or by other orthoimages. Examples are the U.S. Geological Survey's Digital Raster Graphics (DRG's) or Digital Line Graphs (DLGs), the National Aerial Photography Program (NAPP), and the National Agricultural Imagery Program (NAIP).

3.3 Core Cadastral Map Information

The cadastral maps should be viewed as overlays to the base maps. There should exist cadastral maps for the entire assessing jurisdiction showing the size and position of each parcel in relation to other properties, bodies of water, roads, and other major geographic features. The maps should be produced at an appropriate scale and display all boundary lines, dimensions, or areas; identifying parcel numbers; and other pertinent legal and descriptive information. The maps provide a physical framework upon which non-physical parcel information can be displayed, such as assessing comparisons, land appraisals and market or other statistical data.

At a minimum, cadastral maps should contain the following core cadastral information that relates directly to the ownership and description of property.

- A Public Land Survey System (PLSS) layer, if geographically applicable
- Subdivision, plat, and condominium boundaries (and name if scale permits) as recorded or filed
- Block and lot boundaries and numbers as recorded or filed
- Parcel boundaries; platted and unplatted, both taxable and nontaxable

Cadastral maps should include other basic map information including a map number, date map was prepared, scale, revision block, legend, map key, north arrow, and key to adjoining maps. Cadastral maps may include information containing data referenced

in property descriptions and related to property ownership boundaries. Examples include; PLSS Section, Township and Range lines Government Lot lines; Government Grant lines, road right of way ownership, easements, street centerlines, railroad right of way ownership, hydrography, and normal high water lines.

3.4 Parcel Identifiers

A unique identification number should be assigned to each parcel or code that links the parcel with files containing data such as ownership, value, use, and zoning. Parcel identifiers provide a common index for all property records. They provide a means of referencing legal descriptions in a uniform and more manageable way. Parcel identifiers make possible an efficient property record system for office and field use.

3.5 Additional Map Overlays

The assessor may maintain a variety of additional map overlays which support the work of the assessor and other users such as municipalities or taxing authorities and school districts. Examples include:

- Parcel identifiers
- Location and names of streets, highways, alleys, railroads, rivers, lakes, etc.
- Parcel dimensions (and areas if not stored in a tabular database)
- Political boundaries
- Jurisdictional boundaries
- Taxing districts
- School districts
- Appraisal neighborhoods and market areas
- Sales data
- Zoning, Future Land Use
- Soil types, flood plains
- Situs addresses
- Assessed values
- Locations of improvements
- Monumentation network coordinate listing
- Special districts (for example, voting)
- Sewer and water lines
- Waterways and county drains
- Topological and topographical information
- Deed and survey reference information
- Points of interest such as locations of fire and police, public buildings, parks, schools, and hospitals

3.6 Index Map

An index map should show the location and boundaries of the individual cadastral map sheets in relation to the major features within the jurisdiction, such as roads, railroads, streets, rivers, lakes and political boundaries (see Appendix, figure 1).

3.7 Subdivision Index

The subdivision index should list all recorded subdivision plats. The index should contain a map reference for each subdivision with named subdivisions in alphabetical order and numbered subdivisions in numerical order.

3.8 Program Management

Responsibility for mapping program management should be clearly assigned. Management personnel should be well trained in performing any or all of the following duties.

- producing new cadastral and associated map information
- maintaining existing overlays and ownership records
- controlling quality of production and maintenance
- contracting for mapping services and aerial imagery
- sharing and selling maps and data
- meeting with the land information community and the public on parcel descriptions in problem areas
- purchasing equipment, hardware and software
- creating and maintaining procedure manuals
- training personnel
- budgeting

Managers must first ensure that their map products meet appraisal needs, and then coordinate their efforts with other agencies and entities. They should also be aware of national standards for cadastral and other map data.

3.9 Staff and Training

A cadastral mapping program requires trained staff to administer the cadastral mapping function. When determining sufficient staffing levels, the following should be taken into consideration.

- Functions and tasks
- Efficiency of mapping processes, and workflows
- Economies of scale
- Quantity of vertical parcels (e.g. condominiums, mineral rights) and land parcels

- Volume and complexity of deeds and plats filed that require mapping action
- Use of contracted mapping services
- Creation and maintenance of overlays for non-assessment purposes
- Interaction with other agencies and or users of the data

All mapping personnel should receive training in procedures that are appropriate to their tasks and job descriptions. At a minimum, mapping and deed-processing staff should understand the engineering basis of highway and railroad rights-of-way, the surveying basis of boundary creation and description throughout the history of the jurisdiction and appropriate legal principles of boundary and title law; survey bearings and angles, correction angles, closure error, and closure tolerances.

4. Preparation for a Mapping Program

Preparation is essential before undertaking a mapping program. The jurisdiction should evaluate the mapping needs of the assessor; other local, state, and federal agencies that will be using the final product, and external business users to determine the type of finished product and the accuracy required. The assessor should evaluate existing and needed personnel, facilities, data processing, and technical administrative support; investigate and determine the funding available; and, establish preliminary schedules and completion dates.

4.1 Program Management

Mapping may be carried out in a variety of ways, depending on the scope and magnitude of the mapping project. Regardless of how the mapping function is performed, responsibility for its management should be specifically assigned and a project plan developed as to serve as the organization's blueprint for both the process of mapping and for the content and format of the final product.

Managers can expect to deal with contracts for photography, equipment and production; daily map production; personnel training; budgeting; quality control; and external standards.

4.2 Contracting for Mapping Services

When a mapping program or a major updating and remapping program is undertaken, consideration should be given to whether the project will be conducted in-house or contracted to an appropriate vendor. Many assessors' offices do not have the experienced personnel necessary to produce and maintain cadastral maps, and few have the specialized equipment and expertise needed to produce orthophoto base maps. In some states or provinces the property tax supervisory agency provides maps for the assessor. Occasionally mapping is the responsibility of another governmental agency, such as the engineering or public works department. In many cases, however, the jurisdiction must contract with a professional mapping firm for the production of maps. The jurisdiction or assessor should become familiar with accepted contracting procedures. See *Standard on Contracting for Assessment Purposes* (IAAO 2002).

4.2.1 Technical Specifications

The jurisdiction must prepare a set of technical specifications that clearly defines the aerial photography or mapping services to be performed. The specifications should address the technical aspects of the project and specify the quality and quantity of the products to be delivered.

The technical specifications should include such items as the following.

- geographic areas to be mapped
- preliminary activities to be performed (for example, the establishment of horizontal and vertical control)
- types of maps to be produced
- data to be displayed on the maps (for example, dimensions, political boundaries, geographic features, street names, and other labels)
- sources of data
- scale, size and layout of the maps
- labeling
- deed records
- all other technical and accuracy requirements

In developing technical specifications, any state- or province-mandated aerial photography and mapping standards must be used. In the absence of such standards, research should be carried out to determine which published mapping specifications best fulfill the needs of the individual jurisdiction.

4.2.2 Evaluating Mapping Firms

A high level of technical expertise is required to evaluate mapping professionals and contract proposals. If the expertise is not readily available, consultants should be retained to assist in the effort. See *Standard on Contracting for Assessment Services* (IAAO 2002).

4.2.3 Requests for Proposals and Contractor Selection

When contracting for the development of mapping services, it is recommended that the jurisdiction de-

velop a request for proposals (RFP) that embodies the technical specifications set forth in 6.2.1. See *Standard on Contracting for Assessment Services* (IAAO 2002).

5. Ownership and Map Production and Maintenance

An assessor's cadastral maps represent a substantial capital investment. Assessors must manage and maintain this investment to maintain its relevance. Cadastral maps and ownership databases should be maintained and published in a timely manner and on a continual basis as part of the assessment roll production cycle and should be fully integrated into the sales review, exemption review, and assessment review and analysis functions of the assessor's office through workflow processes.

Map maintenance involves recording description changes, making map corrections, and notifying map users of the changes on a regular basis. Maintenance also includes the constant correction and improvement of the maps from new and more accurate survey data, documenting all records used in preparing the maps and in describing the locations of property corners and monuments shown on the maps, maintaining indexes to facilitate access to those records, and maintaining work records keyed to the parcel identifiers and indexed in map sheet order.

There should also be a plan for re-mapping areas at as large a scale as necessary, to more clearly depict new subdivisions and areas of rapid development and growth.

5.1 Ownership Maintenance

The current owner and parties of interest should be identified for each parcel. In addition, the basis of ownership (recorded deed, contract, court decree, and so on) should be documented; should cite an instrument number, record book, page, volume, etc. of the source document, and should be linked to the cadastral parcel via a unique parcel identifier. A record of prior ownership (ownership history) should be maintained. Deeds and other ownership documents should be processed within two weeks of recording (National Research Council [NRC] 1983, 56). Ownership information should then be published. Procedures manuals should provide detailed step by step instruction. At a minimum, maintenance of ownership databases involves the following:

- Collecting all relevant deeds, trusts, judgments, contracts, plats, court cases, owner requests, and other muniments of title
- Identifying the parcels these documents affect
- Determining the effect of the documents through an interpretation of the property description; such as, a simple ownership change or a change affecting parcel boundaries through splits, combinations, property line adjustments, new subdivisions, right of takings, or other map edits
- Interacting with property owners, surveyors, attorneys, title insurance companies, and other land information professionals to resolve problems when necessary
- Entering changes in the appropriate databases
- Controlling the quality of the data

5.2 Base Map Preparation

Cadastral maps should be prepared using base maps (for example, planimetric maps, topographic maps, or orthophoto maps) that have been produced photogrammetrically from aerial photography. At a minimum, rectified aerial photographs should be used as the base for cadastral maps. Aerial photographs must be current, taken with a calibrated precision mapping camera, and must meet prescribed specifications for scale, overlap, tilt, time of day, and other requirements.

Aerial photographs and base maps should be prepared in accordance with established industry and governmental standards, such as those adopted by the American Society for Photogrammetry and Remote Sensing; the Surveys and Mapping Branch of the Canadian Department of Energy, Mines, and Resources; the U.S. Geological Survey; or the British Air Survey Association. Aerial Photography/base mapping specifications prescribed by the U.S. Geological Survey are contained in *Large-Scale Mapping Guidelines, USGS Open-File Report 86-005* (1986). Review and link

5.3 Cadastral Map Production and Maintenance

A procedure manual should be developed and kept current to ensure the work is accomplished in a timely and uniform manner. Procedures manuals should provide detailed a step by step instruction of deed processing, production and maintenance of cadastral overlays, drafting accuracy, control, boundaries, text sizes, symbols, scale, maintenance and stewardship of non-cadastral information or overlays, data schema diagrams, workflows, and procedures of obtaining, referencing and retaining records in accordance with applicable statutes and ordinances; at a minimum, maintenance of the cadastral map involves the following:

- Obtaining all relevant documents
- Editing the map to effect changes of parcel lines, identifiers, and associated cadastral data
- Editing any additional non-cadastral data for which the assessor may possess stewardship
- Performing quality control measures

- Distributing or publishing map data
- Correction and improvement of the cadastre when new and more accurate data become available

The compilation and plotting of the parcels should be accomplished through the use of any existing source maps and the descriptions as contained in the vesting instruments or assessment records; in conjunction with the delineation of the parcel's boundaries and limits, as distinguishable from the physical and cultural features of a photographic basemap. If descriptions are unavailable, field checks and discussions with owners to establish agreed upon boundaries are appropriate.

In the event a parcel ownership boundary cannot be delineated or determined through the use of existing source maps, vesting instrument descriptions, assessment record descriptions, filed or recorded plans or plats of subdivisions, recorded surveys of plats, road and railroad right of way maps, the following priorities of calls shall be utilized:

1. Natural boundaries
2. Man-made boundaries
3. Contiguous owners
4. Distance
5. Course (bearing or direction)
6. Area

5.3.1 Parcel Discrepancies

It is common for cadastral overlays (subdivision, lot, block, parcel) to have individual parcels or groups of parcels to have gaps, overlaps, closure errors, or nonconformity compared to ground occupation. Decisions on addressing discrepancies should be based on the following:

- Mapping and boundary law, such as principles of junior and senior rights, priority of 'calls' in a property description, latent error verses patent error, water boundaries, and adverse possession
- Surveying techniques and technology, such as the need to rotate descriptions to a common basis of bearing
- Land division systems affecting the jurisdiction, such as the evolving PLSS and/or Spanish, French, Dutch, or English colonial practices (Price 1995) in North America.
- Intent of the description
- Good judgment and common sense

The goal should be to produce a seamless final cadastral map product. Most gaps or overlaps between parcels should not be displayed. Parcel polygons should not overlap creating a double assessment, either real or perceived, and no gaps should exist between jurisdictions creating a situation whereby land escapes assessment.

The assessor or mapper should bring significant parcel discrepancies to the attention of the property owner, the attorney or title company, or other party involved in the property conveyance, private surveyors, and if necessary, the county surveyor for resolution.

Discrepancies should be documented and include recommendations form the cadastralist on how to address the issues and reasons for the visual display the parcels to the public. Documentation may include annotation attached to lines or areas on the map. Full documentation of the discrepancy should exist in a paper or database file.

5.3.2 Map Security

As insurance against loss or damage, and as assurance of an adequate historical record of ownership, at a minimum, at least one reproducible set of maps, or microfilmed copy plus any related computerized map data should be stored in a safe, secure, dry, fireproof environment at a location different from the place where the originals are created, stored or used. A copy should be made for these purposes at least once a year, or as often as ownership parcels are used for a certified assessment roll or tax roll.

6. Essentials of Design

Manual cadastral map design should conform to the following standards.

6.1 Map Sheet Size

A uniform size for map sheets facilitates handling and storage of maps. The final map size will depend on the scale and coverage of the maps; however, intended use of the maps, supply, storage and mode of reproduction must also be considered. The use of readily available precut material is desirable. The following are commonly used map sizes: 11" x 17", 20" x 30" 24" x 36", 30" x 30", 30" x 36" and 36" x 36".

6.2 Map Scales

A map scale that covers the largest possible area while showing necessary detail should be selected. Parcel size and the complexity of parcel descriptions in the area to be covered by a single map are the major determining factors in choosing map scales. In general, larger-scale maps should be used for urban and suburban areas and smaller-scale maps for rural areas. Map scales should be expressed as ratios, allowing for easy conversion from the imperial system to the metric system (for example 1:1,000 can be read as "one unit on the map equals 1,000 units on the ground"). The following are commonly used mapping scales:

- Urban areas: 1:1200 (1" = 100')
- Suburban areas: 1:2400 (1" = 200')
- Rural areas: 1:4800 (1" = 400') and 1:9600 (1" = 800')

6.3 Map Material

All photographic enlargements and final detailed maps, whether generated manually or by computer, should be on stable base film of at least 0.004" thickness. Double-matte finish is preferred for maps. Overlays should have a single-matte finish. Among the advantages of film over paper are:

- Map and photograph reproduction using standard diazo process is easier and more economical.
- Map information can be changed without physically damaging the master maps.
- The dimensional stability of maps and photographs is increased.
- The durability and permanence of the maps and photographs are greatly increased.

6.4 Symbols

Standard symbols should be employed on the maps. Examples of standard mapping symbols and cartographic specifications are shown in figure 2 of the Appendix.

6.5 Line Work

Throughout the finished maps, the line widths should be standardized and drawn in non-etching ink produced specifically for use on films. Line weights should be specified by technical pen sizes, for example, 00, 0, 1 and 2, or the metric equivalents, .30, .35, .50 and .60.

6.6 Lettering

All lettering on finished cadastral maps should be produced mechanically and specified by the template size or character height, line weight and orientation.

6.7 Map Layouts

Throughout the finished maps the layout should be standardized, containing a title block, revision block, legend, map key, north arrow and keys to adjoining maps. A title block identifies the map, the date it was prepared and the scale. A revision block is used to record any revisions made to the maps and the date of revision.

7. Parcel Identifiers

Parcels in a manual cadastral map must be linked to assessment data. The key link between parcels and tabular data is the parcel identifier (also referred to as the PIN (Parcel Identification Number) or the PID (Parcel ID (Identification)). A PIN or PID can consist of numbers, alpha characters, code(s) or combination thereof to identify one parcel. For the purpose of this standard, PIN shall be used.

The PIN should be defined and recognized as the official reference to all documents or data for each parcel. All jurisdictions in a state or province should use the same primary system of parcel identification. Various secondary identifiers also may be used to index parcel data; however, all of the secondary identifiers must be cross-indexed to the PIN.

7.1 Desirable Characteristics

Many formats of parcel identifiers are in use. A PIN whether in use or proposed, should be judged based on six attributes: compliance with standards, uniqueness, permanence, simplicity and ease of use, ease of maintenance, and flexibility.

7.1.1 Compliance with Standards

If a state, regional, or local parcel identifier format has been adopted, a jurisdiction should follow it. In addition, various national PIN formats have been proposed (PRIA 2003), but not yet mandated.

In the United States, at the Federal level, the National Academy of Science, suggests a 'national parcel number' could simply add an appropriate Federal Information Processing Standards (FIPS) code, developed by the National Institute of Standards and Technology, to the front of each jurisdiction's existing PINs (National Academy of Science 2007). In 1995, The Federal Geographic Data Committee (FGDC) Cadastral Subcommittee developed a *Cadastral Data Content Standard* (2008) that identifies core parcel data useful to many stakeholders and suggests that this information be captured and maintained by assessors. The core data elements are described in Appendix A.

7.1.2 Uniqueness

Uniqueness is the most important attribute of a PIN. Ideally, there should be a one-to-one relationship between a parcel and its identifier. This relationship may not be achievable because of assessment limitations 'caps', taxing district boundaries, tax increment financing areas (TIFs), and physically divided single use properties, among other situations.

7.1.3 Permanence

Parcel identifiers should be permanent and change only when absolutely necessary, such as when the boundaries of a parcel change.

7.1.4 Simplicity and Ease of Use

Parcel identifiers should be easy to use and understand with as few digits as possible. A parcel identifier that is uncomplicated and easily understood helps to reduce errors in its use.

7.1.5 Ease of Maintenance

The parcel identification system should be easy to maintain and should efficiently accommodate changes, such as subdivision or consolidation of parcels.

7.1.6 Flexibility

The parcel identification system should be reasonably flexible. It should be capable of serving a variety of uses: not just land parcels, but multi-story condominiums, subsurface rights, air-rights, easements, leases, and so on.

7.2 Kinds of Parcel Identifiers

There are five basic types of parcel identifiers, described as follows. The first two types, which incorporate clues to a parcel's geographic location, are recommended for assessment purposes.

7.2.1 Geographic Coordinate System Identifiers

The geographic coordinate system is a method of locating a point on the Earth's surface based on its distance from each of two intersecting grid lines known as *x* and *y* axes. These grid lines can be based on latitude and longitude, the Universal Transverse Mercator (UTM) system, or state plane coordinates. Parcel identifiers using this system are composed of the coordinates for a single point, usually the parcel centroid.

Parcel identifier systems based on geographic coordinates are easy to maintain, because new numbers are quickly assigned by picking parcel centroids. They are easy to use in the field, because the PIN can help locate the parcel when using a GPS.

These PINs meet the desired characteristic of uniqueness. However, geographic coordinate-based PIN's may not meet the criteria of simplicity because a complete parcel identifier could be a lengthy numeric character string containing *x, y,* and *z* coordinates. The *z* coordinate is required for multi-story condominiums and apartments, where parcels at different levels could have the same x-y centroid. The elevation problem could also extend to sub-surface parcels, such as underground parking or mineral rights. Additionally, the desired characteristic of permanence can also be problematic. Assessors should be aware that minor map edits, corrections, or adjustments can alter the parcel centroid's x, y, and possibly z coordinate thereby breaking the link with the number stored in tabular databases and undermining the 'permanence' aspect. An alternative to the centroid may be the use of coordinates associated with a separate 'point' or 'label' within each parcel polygon. Points or labels are less likely to have their x and y locations altered due to minor edits of the parcel polygon.

7.2.2 Rectangular Survey System Identifiers

This system of parcel numbering is based on section/township/range systems such as the United States PLSS. Parcel identifiers based on a rectangular survey system are developed by using the section/township/range, quarter-section, and quarter-quarter-section numbers; along with individual parcel identifiers assigned to each tract or subdivided lot and block. This kind of PIN provides an approximate geographic location of each parcel that is easy to understand and maintain, and meets the criteria of uniqueness and permanence; however, it is not applicable in geographic locations not subject to the PLSS.

7.2.3 Map-based System Identifiers

This system is based on the incorporation of the cadastral map into the parcel identifier. This PIN consists of a map (or page) number, block (or group) number, and parcel location as numbered within a block or group of parcels. For example, a PIN of 32–02–16, indicates 32 represents the map on which the parcel is found, 02 is the block on the map, and 16 identifies the parcel location within the block. Map-based identifiers may reference a geographic area and are convenient for use with printed maps in the field. However, they have limited usefulness when transferred to a digital cadastral mapping environment where the map exists in a seamless environment rather than as individual map sheets.

7.2.4 Name-related Identifiers

Name-related identifiers use the names of individuals claiming an interest to a parcel as the parcel identifier. A common example of this is the use of name codes in the grantor–grantee index. Use of such identifiers is discouraged because they do not meet the criteria of permanence reference to geographic location, and ease of use.

7.3 Assignment and Maintenance of Parcel Identifiers

Parcel identifier numbers (PINs) established in accordance with the guidance in this section should be assigned to all parcels during the initial phase of a cadastral mapping program. These PINs should be considered provisional until the mapping program has been completed and all maps have been formally approved.

The assessor should maintain parcel identifiers, ownership information, and property descriptions as new parcels are created. Two methods exist for the process of maintaining "parent" and "child" parcels when dividing (splitting) or combining (joining) existing parcels. One method is to retire or delete the PIN of the existing parent parcel which has been divided or split

into two or more child parcels. The other method is to retain the original PIN of the parent parcel and assign a new PIN to each new child parcel. Both methods exist because of system configurations, workflows, and other processes that may be tied to the PIN. Such other processes include researching the history of a PIN, retaining assessment limitations or 'caps', or 'base-values' in the case of Tax Increment Financing Areas (TIFs). Both methods are acceptable when applied consistently. However, once a PIN has been retired it should not be reused unless absolutely required due to the parcel numbering schema limitations. Notations should exist in the parcel record regarding its reuse. A review of the records should be performed to ensure no outstanding taxes or liens exist on the retired PIN before its reuse.

Parcel identifiers should change only when the geometry of the parcel changes due to the subdivision of the parcel, the consolidation of two or more parcels, the recordation of a plat affecting the parcel, or other governmental actions affecting parcels or the property descriptions of parcels, such as the vacating of a recorded plat. The assessor should notify the property owner(s) when a change occurs to a PIN. This is especially important given the Dodd-Frank Wall Street Reform and Consumer Protection Act, which addresses the listing of a parcel identification number on mortgage documents in which real property is being pledged. Documentation of the change should be maintained in the assessor's notes.

8. Digital Cadastral Mapping

Digital cadastral maps provide tremendous value to the assessor and numerous other users in a parcel data sharing environment. Digital maps are an integral part of a comprehensive assessment system, without which, a complete picture of the interests and value of the land and improvements to the land is not possible.

Assessors engaged in a manual mapping program should examine a transition of their mapping program and a conversion of their manual maps into a digital mapping environment. Manual maps can be converted to a digital form and given intelligence quickly and cheaply with methods which create a Geospatial PDF; or conversions can be more extensive with the creation of a data model and the re-engineering of the core cadastral data layers in a digital environment with a densified geodetic control network. Assessors with limited funds may explore free open-source Geographic Information System (GIS) software; however, regardless of resources, assessors should explore conversion options with both short term and long range needs and benefits considered. *See Standard on Digital Cadastral Maps and Parcel Identifiers (IAAO 2015).*

Appendix

FIGURE 1. Example of an Index Map

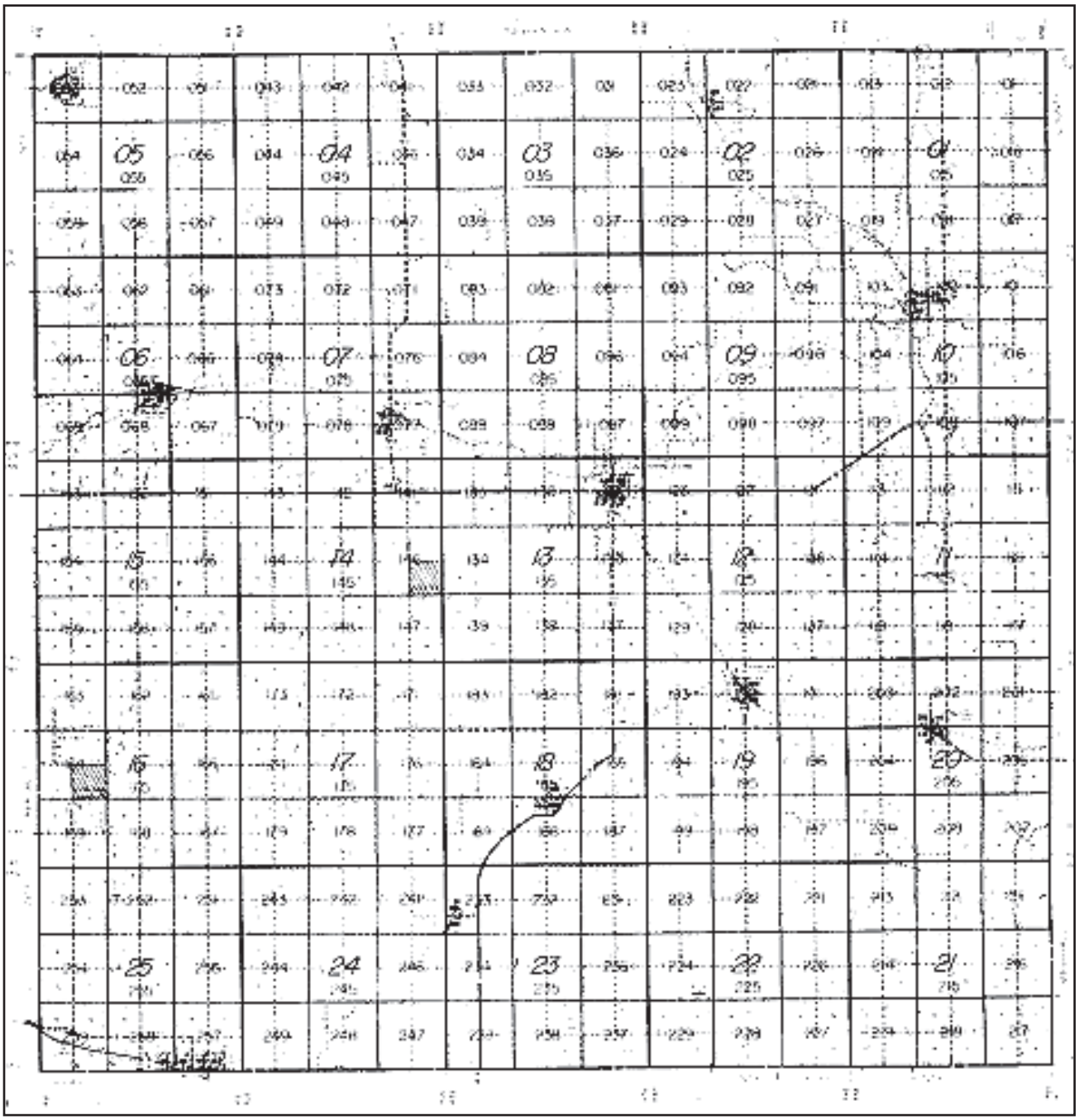

FIGURE 2. Examples of Standard Mapping Symbols

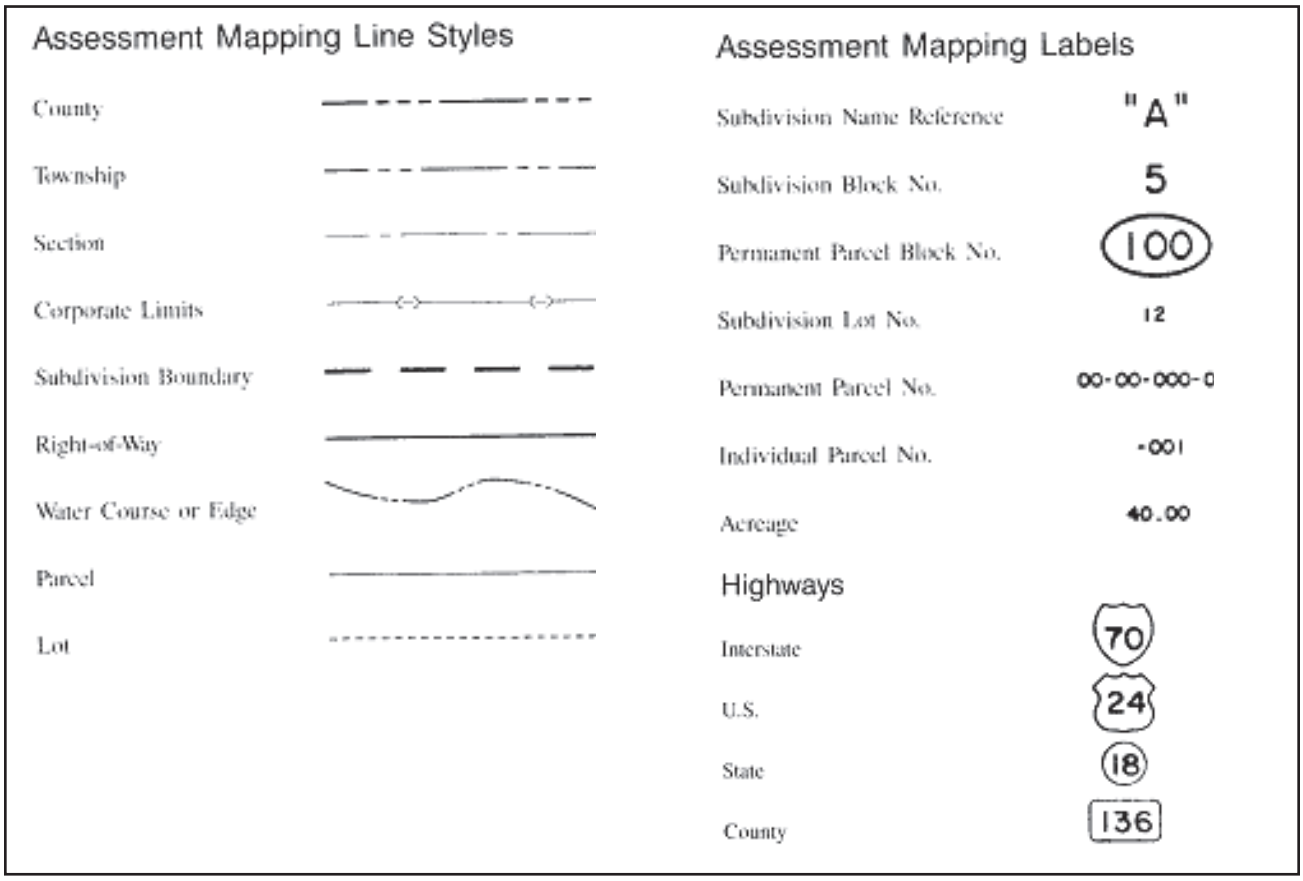

FIGURE 2. Examples of Standard Mapping Symbols (*continued*)

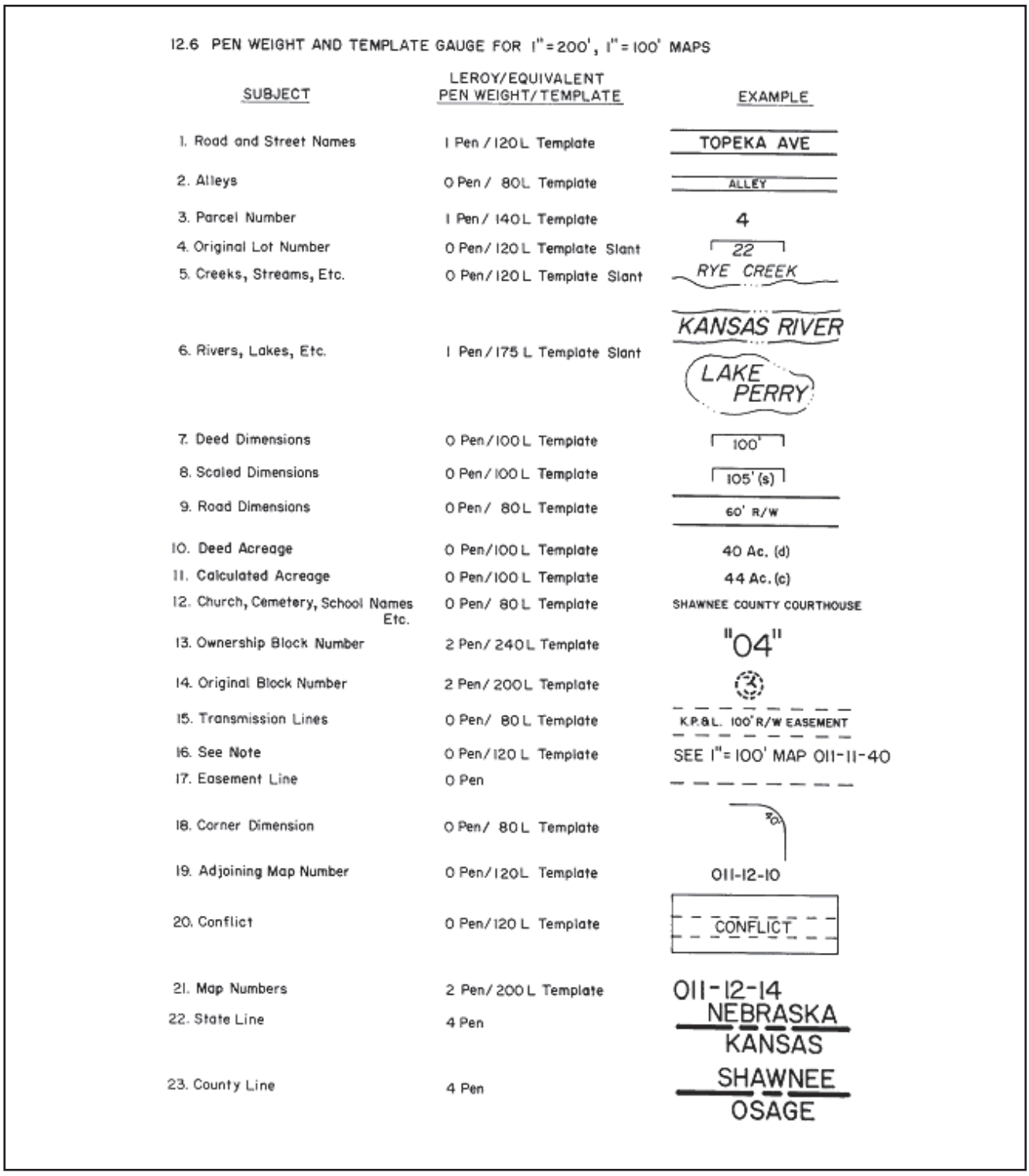

FIGURE 2. Examples of Standard Mapping Symbols (*continued*)

12.6 CONTINUED 1"=200', 1"=100' MAPS

SUBJECT	LEROY/EQUIVALENT PEN WEIGHT/TEMPLATE	EXAMPLE
24. Township and Range Lines	4 Pen	
25. Section Lines	3 Pen	
26. Quarter Section Lines	1 Pen	
27. Corporate Limit Lines		TOPEKA CITY LIMITS
28. Railroad R/W	1 Pen	A.T. & S.F. R.R. 100' R/W
29. Highway R/W	1 Pen	50' R/W
30. Property Boundary Lines	1 Pen	P/L P/L
31. Original Lot Lines	0 Pen	
32. Water	0 Pen	
33. Land Hooks	0 Pen	
34. Transmission Lines	0 Pen	
35. State Name	2 Pen/200 L Template	KANSAS
36. County Name	2 Pen/200 L Template	SHAWNEE COUNTY
37. Township and Range Number	1 Pen/140 L Template	T-22 S R-2W / T-23 S R-3W
38. Section Number	1 Pen/140 L Template	2 1 / 11 12
39. Corporation Name	1 Pen/140 L Template	TOPEKA CITY LIMITS
40. Railroad Name	0 Pen/120 L Template Slant	BURLINGTON N. R.R.
41. Interstate Highway	0 Pen/140 L Template	70
42. U.S. Highway	0 Pen/140 L Template	24
43. State Highway	0 Pen/140 L Template	18
44. County Highway	0 Pen/140 L Template	136
45. S/D Limits	1 Pen	
45-A S/D Limit Number	0 Pen/80 L Template	2
46. Vacated Street	0 Pen	
47. Leasehold Imp. Boundary Lines	0 Pen	
48. Leasehold Improvement	1 Pen/140 L Template	13.01 L. I.
49. Mineral Rights	1 Pen/140 L Template	12 / 320 Ac. / M. R.

FIGURE 2. Examples of Standard Mapping Symbols (*continued*)

12.7 PEN WEIGHT AND TEMPLATE GAUGE FOR 1" = 400' MAPS

SUBJECT	LEROY/EQUIVALENT PEN WEIGHT/TEMPLATE	EXAMPLE
1. State Line	4 Pen	
2. County Line	4 Pen	
3. Township and Range Lines	4 Pen	
4. Section Lines	3 Pen	
5. Corporation Lines	3 Pen	
6. Railroad R/W	0 Pen	A.T. & S.F. R.R.
7. Highway R/W	1 Pen	60' R/W
8. Property Boundary Lines	1 Pen	
9. Original Lot Lines	0 Pen	P/L P/L
10. Water Line	0 Pen	
11. Land Hooks	0 Pen	
12. S/D Limits	1 Pen	
12-A S/D Limit Number	0 Pen/ 80L Template	2
13. Transmission Lines	0 Pen	
14. State Name	2 Pen/ 200L Template	KANSAS
15. County Name	2 Pen/ 200L Template	SHAWNEE COUNTY
16. Township and Range Number	1 Pen/ 140L Template	T-14S R-2E / T-15S R-2E
17. Section Number	1 Pen/ 140L Template	6 5 / 7 8
18. Corporation Name	1 Pen/ 140L Template	TOPEKA CITY LIMITS
19. Railroad Name	0 Pen/ 80L Template Slant	BURLINGTON NORTHERN R.R.
20. Interstate Highway	0 Pen/ 140L Template	70
21. U.S. Highway	0 Pen/ 140L Template	40
22. State Highway	0 Pen/ 140L Template	6
23. County Highway	0 Pen/ 140L Template	127

FIGURE 2. Examples of Standard Mapping Symbols (*continued*)

12.7 CONTINUED 1"= 400' MAPS

SUBJECT	LEROY/EQUIVALENT PEN WEIGHT/ TEMPLATE	EXAMPLE
24. Road and Street Names	1 Pen/ 120 L Template	COUNTY ROAD
25. Alleys	0 Pen/ 80 L Template	ALLEY
26. Parcel Number	1 Pen/ 140 L Template	2
27. Original Lot Number	0 Pen/ 120 L Template Slant	20 | 21 | 22
28. Creeks, Streams Names	0 Pen/ 120 L Template Slant	DRAGOON CREEK
29. Rivers, Lakes Names	1 Pen/ 175 L Template Slant	CLINTON LAKE
30. Water Acreage	0 Pen/ 80 L Template Slant	35 AC. (c)
31. Deed Dimensions	0 Pen/ 80 L Template	175'
32. Scaled Dimensions	0 Pen/ 80 L Template	180' (s)
33. Deed Acreage	0 Pen/ 120 L Template	120 Ac. (d)
34. Calculated Acrege	0 Pen/ 120 L Template	127 Ac. (c)
35. Church, Cemetery, School, Etc.	0 Pen/ 80 L Template	SHILOH CEMETERY
36. Transmission Lines	0 Pen/ 80 L Template	K.P.&L. 100' R/W EASEMENT
37. Adjacent Map Reference	0 Pen/ 120 L Template	012
38. Easement Line	0 Pen	
39. Map Number	2 Pen/ 200 L Template	012-04-10
40. Conflict	0 Pen/ 120 L Template	CONFLICT
41. Road Dimensions	0 Pen/ 80 L Template	60' R/W
42. Vacated Street	0 Pen	
43. Leasehold Imp. Boundary Lines	0 Pen	
44. Leasehold Improvement	1 Pen/ 140 L Template	13.01 L. I.
45. Mineral Rights	1 Pen/ 140 L Template	12 320 Ac. M.R.

Glossary

This glossary defines mapping terms used in this standard and its appendices and other commonly used mapping expressions. Many of these definitions were compiled from the textbook, *Definitions of Surveying and Associated Terms* (1978), and are used with permission of the publisher (American Society of Civil Engineers).

abandonment. An action involving relinquishment of rights in real property, by an owner, for the sole purpose of permanently terminating his ownership. The act of abandonment must be voluntary and intentional

abstract of title. A compilation of abstracts of deeds and other pertinent data, which affect the title to a piece of real property, all bound together in chronological order. It is a form of title evidence made for the purpose of title examination.

access rights. The right of ingress to and egress from a property which abuts upon an existing street or highway. It is an easement in the street, which is appurtenant to abutting property, and is a private, not public, right.

accretion. The process by which new soil is accumulated. The imperceptible addition of land to the shore of the ocean or bay, or to the banks of a river.

adverse possession. The actual, exclusive, open, notorious, and continuous possession and occupation of real property under an event claim of right or title.

assessment map. (See *cadastral map.*)

assumed plane coordinates. A local plane coordinate system set up at the convenience of the user. (See also *coordinates.*)

avulsion. The sudden and perceptible tearing away or separation of land by violent action of water. The land so removed remains property of the original owner.

bearing. Direction of a line measured from north or south to east or west, not exceeding 900 . Examples: N 300 W or S 870 E.

cadastral map. A map showing the boundaries of subdivisions of land, usually with the bearing and lengths thereof and the areas of the individual tracts, for the purposes of describing and recording ownership. A cadastral map may also show culture, drainage, and other features relating to the value and use of the land.

chain. A land surveyor's measure, 66 feet or 100 links

chain of title. A chronological list of documents which comprise the recorded history of title of a specific piece of real estate.

compilation. (1) Cartography: The production of a new or revised map or chart, or portion thereof, from existing maps, aerial photographs, surveys, new data and other sources (see delineation). (2) Photogrammetry: The production of a map or chart, or portion thereof, from aerial photographs and geodetic control data, by means of photogrammetric instruments, also called stereocompilation.

contour map. A topographic map that portrays relief by means of contour lines.

coordinates. Linear or angular quantities that designate the position of a point in a given reference frame or system. Also used as a general term to designate the particular kind of reference frame or system, such as plane rectangular coordinates or spherical coordinates. (See also *assumed plane coordinates, geodetic coordinates, geographic coordinates, plane rectangular coordinates,* and *state plane coordinate systems.*)

culture. Features of the terrain that has been constructed by man.

delineation. The visual selection and distinguishing of map worthy features on various possible source materials by outlining the features on the source material, or on a map manuscript (as when operating a steroplotting instrument); also, a preliminary step in compilation.

diazo process. A means of reproduction using a coating of a diazo compound that is decomposed by exposure to light.

dimensional stability. Ability to maintain size; resistance to dimensional changes in moisture content and temperature.

double matte finish. (See *matte finish.*)

easement. An interest in land created by grant or agreement, which confers a right upon owners to some profit, benefit, dominion, or lawful use of or over the estate or another; it is distinct from ownership of land.

geocode. A code (usually numerical) used to locate or identify a point, such as the center of a parcel.

geodetic coordinates. The quantities of geodetic latitude and longitude that defines the position of a point on the surface of the earth with respect to the reference spheroid. (See also *coordinates.*)

geographic coordinates. A system of spherical coordinates for defining the positions of points on the earth. The declinations and polar bearings in this system are the geographic latitudes and longitudes respectively. (See also *coordinates.*)

government lots. Lots established, measured, and computed by the U.S. Government's survey of the pubic lands. The term is often used synonymously with "fractional lots" or "lots" (¼ sections irregularly shaped and more, or less than 40 acres). Some government lots are regular in shape and are 40 acres in area.

government surveys (U.S. Rectangular Land Survey). In 1785, the U.S. Congress authorized the first land survey of the United States. It specified that surveyed townships were to be 6 miles square. The townships are surveyed from an east-west base line and from north-south

principal meridians. Townships are laid off from these base lines and meridians.

horizontal control. Control stations whose grid coordinates have been computed on plane surveys; known points can be converted to coordinate values.

index map. (1) A map of smaller scale on which are depicted the locations (with accompanying designations) of specific data, such as larger-scale topographic quadrangles or geodetic control. (2) Photography: A map showing the location and numbers of flight strips and photographs.

latitude (geodetic use). The angular distance north or south of the equator. The horizontal element of the geodetic coordinate system.

link. A one-hundredth of a surveyor's chain, a linear measure of 66 hundredths of a foot or 7.92 inches.

longitude (geodetic use). The angular distance east or west of the prime meridian, never exceeding 1800. The vertical element of the geodetic coordinate system.

lot. A plot of land, generally a subdivision of a city, town, or village block, or some other distinct tract, represented and identified by a recorded plat.

map. A representation (usually on a flat medium) of all or a portion of the earth or other celestial body, showing relative size and position of features to some given scale or projection. A map may emphasize, generalize or omit the representation of certain features to satisfy specific requirements.

map scale (fractional). A fractional scale is the ratio that any small distance on the map bears to the corresponding distance on the earth. It may be written in the form of a fraction (1/100,000) or as a proportion (1:10,000). Fractional scales are representative in any linear units.

manuscript map. The original drawing of a map as compiled or constructed from various data, such as ground surveys or photographs (See *compilation*)

matte print. Print made on photographic paper with a dull finish; more suitable for pencil or ink annotations than a glossy print but less suitable for interpretation than a semimatte print.

matte finish. A coating or texture on the surface of polyester film. Commonly used with cadastral maps because of dimensional stability, ink adherence, erasing quality, translucence, and strength.

meridian. A north-south line from which longitudes or departures, and azimuths are reckoned.

metes and bounds. Measurement of angles and distances; a description of a parcel of land accomplished by beginning at a know reference point, proceeding to a point on the perimeter of the property being described, and then tracing the boundaries until one returns to the first point on the perimeter, usually a corner. The angles are described by reference to points of the compass, and the distances are described in feet or chains; curves are treated as arcs on a circle.

monument. A permanent physical structure marking the location of a survey point or boundary line. Common types of monuments are inscribed metal tablets set in concrete post, solid rock or parts of buildings; distinctive tone posts; and metal rods driven in the ground.

national map accuracy standards (NMAS). For horizontal accuracy, maps at publication scales larger that 1:20,000, 90% of all well-defined features, with the exception of those unavoidably displaced by exaggerated symbolization, with be located within 1/30 inch (85 mm) of their geographic positions as referred to the map projection; for maps at publication scales of 1:20,000 or smaller, 1/50 inch (50 mm). For vertical accuracy, 90% of all contours and elevations interpolated from contours will be accurate within one-half of the basic contour interval. Discrepancies in the accuracy of contours and elevations beyond this tolerance may be decreased by assuming a horizontal displacement within 1/50 inch.

original plat. Used to distinguish the first plat from the subsequent addition. Original Town or Original Townsite are employed in the same manner.

orthophotograph. A photograph having the properties of an orthographic projection. It is derived from a conventional perspective photograph by simple or differential rectification so that image displacements caused by camera tilt and relief of terrain are removed.

overlay. Mapping: A record on a transparent medium to be superimposed on another record; for example, maps showing original land grants (or patents) prepared as tracing cloth overlays so that they can be correlated with maps showing the present ownership. Also, any of the several overlays that may be prepared in compiling a manuscript map; usually described by name, for example, lettering overlay.

parcel. A contiguous area of land described in a single description or as one of a number of lots on a plat; separately owned, either publicly or privately, and capable of being separately conveyed and assessed.

photodelineation. The delineation of features on a photograph.

photogrammetry. The art, science and technology of obtaining reliable information about physical objects and the environment through processes of recording, measuring and interpreting images and patterns of electromagnetic radiant energy and other phenomena.

plane rectangular coordinates. Called plane coordinates. A system of coordinates in a horizontal plane used to describe the positions of points with respect to an arbitrary origin by means of two distances perpendicular to each other. (See also *coordinates.*)

planimeter. A mechanical device used for measuring the area of a parcel on a map.

planimetric map. A map that presents only the horizontal positions for the features represented; distinguished from a topographic map by the omission of relief in measurable form.

plat. A diagram drawn to scale showing all essential data pertaining to the boundaries and subdivisions of a tract of land, as determined by survey or protraction.

public land survey system (PLSS). A rectangular survey system established in the United States by the Land Ordinance of 1785. The basic survey unit is the six-square-mile township. Townships are located by baselines and meridians parallel to latitude and longitude lines; they are defined by range lines running parallel (north-south) to meridians and township lines running parallel (east-west) to baselines.

rectification. The process of projecting the image of a tilted aerial photograph onto a horizontal reference plane to eliminate the image displacement caused by tile of the aerial camera at the time of exposure.

single matte finish. (See *matte print*.)

state plane coordinate systems. A series of grid coordinate systems prepared y the U.S. Coast and Geodetic Survey for the entire United States, with a separate system for each state. Each state system consists of one or more zones. The grid coordinates for each zone are based on, and mathematically adjusted to, a map projection. (See also *coordinates*.)

topographic map. A map that presents the horizontal and vertical positions of the features represented; diminished from the planimetric map by the addition of relief in measurable form.

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Guide to Assessment Standards

Standard on Assessment Appeal

Standard on Automated Valuation Models

Standard on Contracting for Assessment Services

Standard on Digital Cadastral Maps and Parcel Identifiers

Standard on Manual Cadastral Maps and Parcel Identifiers

Standard on Mass Appraisal of Real Property

Standard on Oversight Agency Responsibilities

Standard on Professional Development

Standard on Property Tax Policy

Standard on Public Relations

Standard on Ratio Studies

Standard on Valuation of Personal Property

Standard on Valuation of Property Affected by Environmental Contamination

Standard on Verification and Adjustment of Sales

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