

Implementing Publication Guidelines for a Standard Representation of PLSS Fabric

Abstract

The Bureau of Land Management (BLM) is charged with coordinating cadastral information under OMB Circular A-16 in support of the National Spatial Data Infrastructure (NSDI). To help facilitate this, the BLM Cadastral Survey has issued publication guidelines for a standard portrayal of the Public Land Survey System (PLSS). In fiscal year 2005, the BLM Cadastral Survey staffs have been directed to implement the publication of standard PLSS framework data at several NSDI Data Hosts. Successful completion of the task requires the following; sound data stewardship agreements between intermingled stakeholders, collaborative participation from multiple organizations, guidelines for publication which adhere to the FGDC Cadastral Core Data Standard, and data set adaptation which accommodates current and emerging GIS technologies. The publication and maintenance of a seamless, statewide PLSS data set for the state of Utah provides a reference to illustrate the challenges encountered with implementation.

Background

The Land Ordinance of 1785, enacted by the Congress under the Confederation and subsequently codified under the Constitution by the Act of May 18, 1796, directed the creation of the Public Land Survey System (PLSS). The PLSS provided an orderly framework to segregate the Public Domain and created unambiguous and uniform parcels across the greater extent of the United States. The result, land tenure based upon the systematic plan of survey prior to the sale and registration of land. Public Domain lands were originally targeted for disposal in order to supply revenue for the young country. Today, Public Domain lands described as PLSS parcels continue to be managed and upon occasion leave federal ownership, due to legislative actions. The Bureau of Land Management (BLM) are the custodians of the federal cadastre and are legally responsible for all PLSS parcel records which includes all patent records of lands leaving federal ownership (757 DM 2.7B1). The federal cadastre historically has been a paper-based (analog) records archive of survey plats which describe the parcels and the control document index and serial register pages which together track federal land transactions. Formerly Public Domain parcels, which leave federal ownership to become private lands, constitute the senior parcels tracked by local government cadastres. While federal and local land records management act in relative independence, the PLSS parcel description provided the essential link between the federal and local cadastres.

In 1953, the Office of Management and Budget (OMB) issued the Circular A-16. The Circular provided instructions for federal agencies involved in mapping and surveying activities to coordinate together in an effort to avoid any duplication of effort. Further revisions in 1967 and again in 1990, clarified specific agency roles and expanded scope of coordination to include geographically referenced electronic (digital) data. With the 1990 revision of Circular A-16, OMB mandated the establishment of the Federal Geographic Data Committee (FGDC) as the coordinating body. The circular identified

the BLM as the coordinating lead of the Subcommittee for Cadastral Data, and instructed the BLM to enter into collaborative partnerships with tribal, state, and local governments regarding collection, maintenance and dissemination of cadastral data. The subcommittee membership is a representative microcosm of the partnerships, and the group with nationwide input, developed data standards for cadastral data. The subcommittee released the Cadastral Data Content Standard which provides, “a standard for the definition and structure for cadastral data which will facilitate data sharing at all levels of government and the private sector and will protect and enhance the investments in cadastral data at all levels of government and the private sector.”(FGDC, 2003) Currently, the Circular A-16 under the 2002 revision integrated previous circular instructions with Executive Order 12906 (Federal Register). The executive order directs the FGDC to implement the National Spatial Data Infrastructure (NSDI). The NSDI as defined in the Executive Order ,” the technology, policies, standards, and human resources necessary to acquire, process, store, distribute, and improve utilization of geospatial data.” The BLM has responsibility for implementation of the Cadastral NSDI. Effective implementation requires a collection and maintenance process and a publication process. Collection and maintenance of cadastral data from the numerous cadastral data producers, requires a coordinating repository for the data and tools for analysis in order to determine the best representation of any parcel. The publication of the cadastral data will only be populated with the identified best representation of any parcel. The concept of best representation is a valuation of data with consideration to currency of collection, positional accuracy, topological quality and richness of data elements contained. The Cadastral Subcommittee released Cadastral NSDI Reference Document (FGDC, 2006), a document describing the myriad parameters which constitute the Cadastral NSDI and specifically provides the minimum data standards required for inclusion. Such standards derived from the Cadastral Data Content Standard insure seamless cadastral data across jurisdictional boundaries, while allowing federal, tribal, state and local governments to maintain jurisdictionally specific land records management processes. Two components of the Cadastral NSDI facilitate the preceding description; a reference layer such as the PLSS in the public domain states which most parcels are derived , and a parcel layer which can accommodate jurisdictionally specific information associated with the parcels. The parcel standards not only support cadastre applications, but are organized to support the business processes which apply to parcels. The Western Governors Association (WGA, 2003) released recommendations for cadastral data which support the businesses requiring such data. The WGA grouped business applications requiring cadastral data as; titling and real estate, land use planning, energy development, and disaster management. Cadastral data support of such business practices requires that the PLSS reference layer and parcel data elements are seamless across geographic extent of interest, and that other data themes critical to the business practices can be integrated with NSDI parcel data.

BLM Cadastral Survey authored, in collaboration with the FGDC Cadastral Subcommittee, publication guidelines for Geographic Coordinate Database (GCDB). GCDB is the BLM digital portrayal of the PLSS and federal interest metes and bounds lands in the non-PLSS states, and acts as the cadastral reference layer, where collected, for the Cadastral NSDI. The Data Publication Requirements Guideline (BLM, 2005) describes the data elements and quality that customers can expect to receive from the BLM. The data requirements are derived from the FGDC Cadastral Data Content

Standard and closely mirror the minimum data standards required for inclusion within the Cadastral NSDI. This document is intended to be generalized as a publication standard for all cadastral reference data regardless of stewardship source. Current GCDB clearinghouse sites offer site specific products for the user, for example the GCDB national internet download site is hosted by Land Survey Information System (LSIS) at www.geocommunicator.gov and offers only county wide or statewide shapefiles of GCDB data through internet download. GCDB staff at specific states offer ARC/INFO coverage files of GCDB in township units and original ASCII files. Some states have made the data available by internet, but all BLM state office GCDB staff will provide the data upon request. Such arrangements result in a lack of product consistency between clearinghouse sites and those sites do not fully comply with the publication requirements. Adherence to the publication requirements by the data hosts of GCDB reference layer data will insure a consistent GCDB product for all users. Release of the publication requirements has coincided with piloting efforts by selected BLM Cadastral staff from Arizona, Colorado, Montana, and Utah with their respective state data hosts. The FGDC Cadastral Subcommittee vision for a Cadastral NSDI, centers upon utilizing data hosts representing individual states. Since the majority of parcels in the United States are private lands, fiscal cadastres predominate at the local government level. State governments have a perceived greater interest in coordinating cadastral data to support local governments within their respective geographic extent. State governments as a matter of business develop data sharing arrangements with federal agencies having parcel ownership within their states. The pilot projects have publication as an outcome, but focus on different elements of the NSDI cadastral reference layer. The cadastral reference layer contains two data components; the cadastral reference areas, which describe parcel extents and the cadastral reference points, also known as control, which provides the geographic position of the cadastral reference areas. Colorado is a pilot state for the collection, maintenance and publication of the cadastral reference layer and is concurrently piloting through another data host the collection, maintenance and publication of cadastral reference points. Arizona has piloted the publication of the cadastral reference layer. Montana BLM in partnership with the state government of Montana has been piloting both the publication of the cadastral reference layer and the collection, maintenance and publication of the cadastral reference points. All the pilot efforts are succeeding due to solid partnerships with the data hosts involved and consensus-based stewardship arrangements between the multiple cadastral data stewards within the pilot states.

The BLM Cadastral Survey is finalizing an interagency stewardship agreement with the USDA Forest Service Cadastral Survey regarding collection and maintenance of PLSS information. This agreement brings together the largest public domain land management agencies and sets forth guidelines for extent and scope of stewardship. The agreement provides recognition of the need to develop specific jurisdictional and procedural stewardship agreements at the local level in collaboration with local, state, and tribal data stewards.

In Utah the elements are in place to begin implementing the publication of a statewide seamless cadastral reference layer by BLM cadastral staff in partnership with the State of Utah, another milestone in making the Cadastral NSDI a working system.

Implementation

Current clearinghouse sites, including the national GCDB download site, which distribute Utah GCDB data, do not meet the GCDB data publication requirements. The pilot effort in Utah will produce a single standard PLSS reference layer that meets the data publication requirements. The GCDB Data Publications Requirements Guidelines as previously mentioned, identifies standards for data content, data quality, data format, and publication functionality. Regarding data content, the guidelines separate cadastral into core publication data, namely polygons and other core cadastral data, which should be available upon request. The following information must be attributions of the reference polygons; Geopolitical Areas for data query purposes, PLSS Township Identifier also known as Meridian Township Range (MTR) or TWIP, PLSS Township First Division (Sections), PLSS Township Division also known as aliquot name or lot number, and Survey System Areas which identify parcels segregated from PLSS areas such as Mineral Surveys. Data regarding PLSS corners, control points, and cadastral boundary information may be published with the core cadastral polygon, but if not, should be made available upon request. Data quality requirements for publication, addresses both geographic features and attribution. The specific quality requirements for geographic feature information are:

Positional Accuracy- Accuracy is essential to standardize on positions across jurisdictional boundaries, agency applications, and business uses. Areas of overlapping jurisdiction must have agreement to a single standardized position.

Seamless- Data sets must be seamless within stewardship regions and across stewardship boundaries. Gaps and overlaps within the data should reflect actual field survey information.

Topologically Correct – Corners, boundaries, and polygons will have correct topology rules with valid exceptions flagged.

Single representation-One version of the data will be published as the current representation.

Archived Data- Other less accurate or older representations may exist and be available upon request, but must be identified as such.

Currency- Published information to reflect the most current information available. Regular schedule of updates to the publication data set should be communicated to users.

PLSS Data Rules- The portrayal of the cadastral reference areas must follow the Manual of Surveying Instructions (BLM, 1973).

Coordinate Values as Attributes- Coordinate values of the corner need to be provided as a text or numeric value. Attribute value must be identical to mapped or spatial position of the corner.

Township Corners- The corners which represent common positions along township boundaries must be exactly the same between township data sets and must have a single unique identifier and may have additional alias identifiers.

The specific quality requirements for attribute information are:

Attribute Completeness- All of the identified attributes in the data content shall be available either by default or upon request.

Attribute Currency- Attribute currency must be the same as the geometry.

Naming Conventions- The names of files and the attributes in the files shall be clear and easily understood. This requirement addresses the non-GCDB cadastral data that is integrated into a single cadastral reference layer. The sources could be local counties and naming conventions should generalize across jurisdictions of stewardship.

Coding- Attribute fields which are based upon a domain of values should have the domain calculated in a field along with the code.

The GCDB publication guidelines identify data format parameters which must be standardized for all downloaded data. Users should be able to retrieve data from any NSDI Cadastral Data Host in a standard manner with a standard result. The standardized parameters are:

File Format- The spatial data should be delivered in geodatabase or coverage formats.

File Selections- The user data selection interface, methods and procedures must be the same regardless of the final downloaded file format.

Additional Formats- Many users of GCDB data prefer data in a DXF file format and effort should be made to accommodate such requests.

Consistent Datum and Coordinate System- The datum and the reference system need to be standardized across all published data sets, and should be clearly identified.

The guidelines for publication functionality address both user procedures of data retrieval and data stewardship activities that add to customer service. Such functionality issues are somewhat data independent, but are considered important to meeting users needs. The functionalities considered are:

The data steward shall archive data sets which are replaced by updates and shall make less current data sets available as historical data files.

A subscription service will notify users when areas of interest receive updates. Such a service can also inform users when updates are being planned or are in the process of updating. Further, all users shall be able to use data currency as a query parameter when navigating the data host.

Data retrieval selection tools shall have buffering capabilities. This user option shall direct the choice of buffering by distance or by the township unit. User shall expect and receive only those exact areas of interest selected.

The data steward should have the capability to post and integrate new data to the publication server.

The GCDB Data Publications Requirements Guidelines provides direction for user support. The publication server should have online help to assist with data selection and download procedures. Data user shall be provided with the ability to provide feedback regarding the publication server and feedback identifying specific cadastral data issues found in the publication layer.

The metadata accompanying the retrieved cadastral data must meet specified quality standards. The metadata must be accurate, complete and current. Further, projection lineage, data production procedures, and GCDB manager contact information must be contained within or accompany the metadata.

Finally, recommendations are provided for the performance of the publication server systems at the Data Host site, which include 24 hours a day, 7 days a week access, with full system functionality 99% of the time on a monthly basis.

The piloting effort in Utah is made possible by a solid partnership between the BLM and the State of Utah. The data host for serving GCDB reference areas in Utah is the State of Utah. BLM Utah currently administers an assistance agreement with the State of Utah (ESRI, 2004). The purpose of the assistance agreement is to support the creation of automated parcel data for county land record modernization. The objectives of the assistance agreement are; to integrate local control and survey data from counties into the GCDB solution of the PLSS, to facilitate a seamless interface between the PLSS controlling Federal Lands and the PLSS under local control, and to meet a critical need for 24,000 scale or better cadastral framework for the geographic extent of Utah. Currently the BLM has collected GCDB data for 2475 of the 2566 townships which cover the state, and of those townships collected, 1404 or 57% has been identified as GIS-validated. GIS-validated implies that the township is topologically correct and seamless with adjacent townships. In Utah, GCDB was collected with either PLSS Coordinate Computation System (PCCS) GCDB software or with Geographic Measurement Management (GMM) GCDB software (ESRI, 2003). Under the agreement the BLM has integrated when available local county control for townships receiving updates during scheduled GCDB operations and maintenance cycles. Rural counties have in turn accepted the updated GCDB for their cadastral reference layer. Through this process a seamless cadastral reference can be achieved across the rural county boundaries within the state. The 91 remaining townships are located principally along urban corridor of the Wasatch front, and fall within the jurisdiction of Weber, Davis, Salt Lake, and Utah county local cadastres. The BLM will likely never collect a GCDB portrayal of the aforementioned townships, but will coordinate with the urban counties. As the data stewards within their jurisdiction, the urban counties will provide the cadastral reference layer within their respective counties to infill and complete the statewide PLSS framework. Through the assistance agreement the State acts as a point of contact between the counties and other interested data stewards. To date, the State has

acquired data from the urban counties where GCDB is uncollected, but integration activities utilizing local county data to infill have yet to begin.

The PLSS layer publication pilot is receiving assistance from a contractor administered through a BLM Cadastral, Washington Office contract. The contractor, Premier Data Services (PDS) has the task of improving the existing GCDB data to meet the publication requirements and integrating the areas where GCDB is missing with alternate source data. The initial task will be to import all data into a geodatabase, which includes standardizing to a single datum and coordinate system. Once in the geodatabase, the contractor will place major focus upon merging data which currently is not seamless, both within the GCDB data and with the infilled alternate source data. Where gaps and/or overlaps occur due to multiple positions for common corners, the merging rule is; GCDB data will be snapped to local control, PCCS derived GCDB will snap to GMM derived GCDB, and Digital Line Graph (DLG) data will snap to GCDB data. In Utah, GCDB data most often is not seamless due to collection practices consistent with the rules of survey, but incompatible with the legacy GCDB software which generated GIS coverage data. Specifically, offset townships lines which are collected to controlling corners for adjustment and sixteenth corners are computed post-adjustment; such sixteenth corners are computed only in their respective townships. When GIS coverages are created slivers result. The contractor will generate a single unique corner identifier for corners found common to multiple townships and with an accompanying alias list. The creation of the single point identifier will follow the BLM rules set forth in Appendix A of the GCDB Data Publications Requirements Guidelines. The uniqueness is achieved by always utilizing the lowest six digit corner name and appending a concatenation of State, Principal Meridian, Township and Range from where it resides. The contractor will create metadata files for the alternate source PLSS data, as per publication guidelines. The DLG infill for the urban counties will require parcel generation of divisions below the Township First Division and subsequently create the attribution to identify the parcels created. If timelines allow, the contractor will integrate local control which the State of Utah has collected from the urban counties, into the DLG infill data. Upon completion of work, a geodatabase will be delivered to the data host, the State of Utah, and loaded onto the publication server.

As the data steward for GCDB data, BLM Cadastral Survey in Utah will maintain and update the federal portrayal of the PLSS. This effort will include integrating local control from other cadastral data producers which improves the PLSS parcels tracked by the BLM. The State of Utah will coordinate maintenance in the areas of the state where BLM will never collect PLSS framework. Those areas include the urban counties along the Wasatch Front. Maintenance of the statewide cadastral reference layer will initially focus upon replacing the infilled DLG with county derived cadastral reference areas.

Conclusion

The piloting effort in Utah to publish a seamless statewide PLSS reference layer suitable for mapping purposes should be complete by the end of 2006. While incomplete as to integrated local county cadastral data, at least the milestone of a complete statewide cadastral reference layer is achieved. As important is the accompanying milestone of an implemented Cadastral NSDI. To the partners involved, the implementation is a starting point. Many recommendations identified in the GCDB Data Publications Requirements

Guidelines and in the Cadastral NSDI Reference Document have not been initiated. The cadastral NSDI has both a publication component and a production component. During the piloting effort, discussions with accompanying action items have occurred to implement the production component of the Cadastral NSDI. Remote access to the publication server by the collaborating data stewards in order to update and maintain their respective stewardship responsibilities is still in a planning stage. Once implemented, this would create a coordinated production component to the cadastral reference layer. Concurrently, action items with a focus on the collection, analysis, archiving and publication of cadastral reference points occurred. The State of Utah has taken the reins of coordinating the local county control by facilitating production of local control through funding county projects with both state legislated and federally legislated dollars. The construction of a statewide repository for and publication of the local control or cadastral reference points, which were produced by federal agencies, tribal, state, and local governments and private surveyors should be finished sometime in 2007. The maintenance and update of GCDB cadastral reference data will utilize the above mentioned repository for local control to improve PLSS parcels tracked by the BLM.

References

Bureau of Land Management, GCDB Data Publication Requirements Guideline, Version Draft, <http://www.nationalcad.org/data/documents/data-rqmnts-final-draft.pdf>, (2005).

Bureau of Land Management, Manual of Surveying Instructions, U.S. Government Printing Office, Washington, D.C. (1973).

Department of Interior, Departmental Manual, 757 DM 2.7B (1), (1988).

ESRI, PLSS as a Spatial Framework: History of GCDB, ESRI International User Conference proceedings, (2003).

ESRI, Automation of Cadastral Data from Paper-based Records to Survey Fabric, ESRI International User Conference proceedings, (2004).

Executive Order 12906, Federal Register, Volume 59, Number 71, pp. 17671-17674. (1994).

Federal Geographic Data Committee Cadastral Data Subcommittee, Cadastral Data Content Standard, Version 1.3, <http://www.nationalcad.org/data/documents/CADSTAND.v.1.3.pdf>, (2003).

Federal Geographic Data Committee Cadastral Data Subcommittee, Cadastral NSDI Reference Document, <http://www.nationalcad.org/data/documents/CadastralNSDIReferenceDocumentv9.pdf> (May, 2006).

Office of Management and Budget, Circular No. A-16, Revised, (August 19, 2002).

WGA Policy resolution 05-03, Public Lands Survey System and Ownership Database, (2003).