

Building National Parcel Data in the United States: One State at a Time

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Editor's Note: IAAO has published a series of articles on standardizing parcel data at the state level. One article summarized the results of a study from the U.S. Department of Housing and Urban Development (HUD) on efforts to collect data from local governments nationally (F&E, April 2013, p. 3), and three other articles summarized statewide parcel standardization and aggregation efforts in New Hampshire (F&E, February 2013, p. 3), Idaho (F&E May 2013, p. 3), and New Mexico (F&E, June 2013, p. 3). This article continues that discussion, summarizing the results of a recent investigation into the practices in 12 states related to building standardized parcel data sets and an inventory of the status of parcel automation and standardization across the United States. There will be a follow-on presentation and discussion on national parcel data standardization by states at the IAAO Conference in Grand Rapids, Michigan, in August 2013.

The aggregation and standardization of locally generated land records geographic information system (GIS) data sets has always been a challenging task. With each local government autonomously managing its local programs, finding the common standard base across so many competing interests is not easy. Two efforts that approach solutions to this challenge for local and state agencies are described in this article: the data standards and data stewardship concepts from the Federal Geographic Data Committee (FGDC) Cadastral Subcommittee and a review of best practices related to parcel data in 12 states. These approaches are focused on public-sector or publicly available solutions.

Many private vendors have aggregated and standardized parcel data across the nation. As with other publically

available national data sets, such as street centerlines and Census information, there is always a role for the private sector to enhance and add value, enabling new applications and capabilities.

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The efforts of the Cadastral Subcommittee to build standards and provide stewardship and planning guidance describe a starting target for state-based programs and standardized parcel data. A core data standard that includes a standard for cadastral reference data as well as parcel data has been completed and is freely available at the subcommittee's outreach Web site (<http://nationalcad.org>). The core data standard presents an essential list of elements that can be expanded or limited depending on the business needs driving a state implementation. The subcommittee has also developed draft business plans for statewide cadastral programs and guidance on levels of data stewardship.

Cadastral Subcommittee Data Standards and Stewardship

The Office of Management and Budget *Circular A-16* (http://www.whitehouse.gov/omb/circulars_a016_rev) charges the Bureau of Land Management (BLM) to lead

the FGDC Cadastral Subcommittee and to coordinate the development of national data standards and facilitation of the preparation of data sets complying with those standards. *Circular A-16* does not state that the subcommittee or the BLM is responsible for collecting or developing a national database, only for providing the standards and assisting with the facilitation.

The subcommittee has developed a data content standard for cadastral data (<http://nationalcad.org/download/cadastral-data-content-standard-ver-1-4/>), which defines and describes cadastral data and the relationships of various features within a cadastral data set. However complete it may be, a content standard does not provide sufficient guidance for implementation. To support the implementation of standardized data set collections, the subcommittee developed a data publication guideline that conforms to the content standard and provides more specific guidance on the physical implementation of the content standard. The publication standard or guidance has two components: the cadastral reference data and parcel data (<http://nationalcad.org/download/cadnsdi-publication-standard-version-2/>).

The publication standard of interest is the parcel component, which provides a set of essential or core data elements to support emergency response, navigation and discovery, and other basic business needs. Many applications that rely on parcel data need much more information than the core or essential elements, such as tracking mortgages and sales and verifying grant-in-aid applications after emergencies. The publication standard is defined so the more detailed information required to meet these other needs can be identified from the core data. Which attributes are essential depends on which business applications are to be addressed. As the number and depth of the needs increase, the number of attributes likewise increases.

In addition to the data standards, the subcommittee has developed guidance for state cadastral business plans and defined levels of cadastral data stewardship for state-wide data implementation. The plan templates and levels of stewardship provide pathways for the development of statewide standardized cadastral data, addressing not only the data itself but also organization, data access, and state-level coordination needs.

The levels of state data stewardship define the degree to which the parcel data from the various producers in the state have been combined and have the ability to be reconciled into a single data set.

For the lower levels of state stewardship, the data have been assembled into one place with a single point of contact, eliminating the need for those who require parcel

information to contact each county or parcel producer separately. The benefits of having disparately maintained data content converted to a standard set of attributes with the ability to be combined into a single data set are achieved in the higher levels of stewardship.

The subcommittee recognizes that the state stewardship will evolve and develop over time as parcel data sets are completed, partnerships with local parcel data producers (data managers) are established, and data management capabilities at state agencies develop. Some of the key characteristics of the spatial and attribute data at each level are summarized in Table 1.

Table 1. Levels of state stewardship for parcel data

Level	Inventory/Distribution/Access/Standardization
1	<p>Inventoried</p> <p>Data inventory is complete, county contacts are established, and the state has begun implementing its strategy to create a sustainable parcel stewardship program.</p> <ul style="list-style-type: none"> • Counties have identified contacts for the parcel data. • State is maintaining county contact inventory. • Implementation in progress to compile and integrate parcel data.
2	<p>Assembled</p> <p>Data producers (counties) provide data sets to the state on a yearly basis, and the states aggregates or assembles the local data but does not change or modify the local data.</p> <ul style="list-style-type: none"> • Geometry is not spatially reconciled. • Attribute content is not reconciled to a standard set of field names and types. • Attribute content may be less than the complete core data set.
3	<p>State Standardized</p> <p>Data producers provide data sets to the state, and the state standardizes the local data cross-walking local attribution to a state standard.</p> <ul style="list-style-type: none"> • Geometry is not spatially reconciled. • Attribute content is reconciled to a standard set of field names and types. • Attribute content may be less than the complete core data set.
4	<p>Local Standardized</p> <p>Data producers provide data sets to the state with a standardized set of parcel attributes connected to the parcel geometry.</p> <ul style="list-style-type: none"> • Attribute content is reconciled to a standard set of field names and types prepared by the data producer in standardized formats. • Attribute content may be less than the complete core data set. • The data producers have "bought in" to the program and are active participants supporting the submission of standardized data.
5	<p>Reconciled</p> <p>Data producers provide complete data sets to the state with a standardized set of parcel attributes connected to the parcel geometry. The geometry is reconciled and tied to a common cadastral reference with no overlap or gap between jurisdictional boundaries.</p> <ul style="list-style-type: none"> • Geometry is spatially reconciled and registered to a commonly agreed-upon cadastral reference reducing the effort to reconcile the geometry between boundaries. • Attribute content is reconciled to a standard set of field names and types prepared by the data producer in standardized formats. • Attribute content includes the complete core data set. • Data producers have "bought in" to reconcile their parcel geometry to match an agreed-upon reconciled boundaries between jurisdictions.

Attribute standardization means attributes from the various data producers have been processed or converted to a single common state attribute standard including attribute name, field length, and type.

Geometry reconciliation means differences in geometry at county or other data producer boundaries are resolved. To accomplish this, the parcel data have to be tied to a common spatial reference so the county boundaries and parcels are seamless and continuous.

The most recent review of state level parcel data programs and state level stewardship is shown in Figure 1.

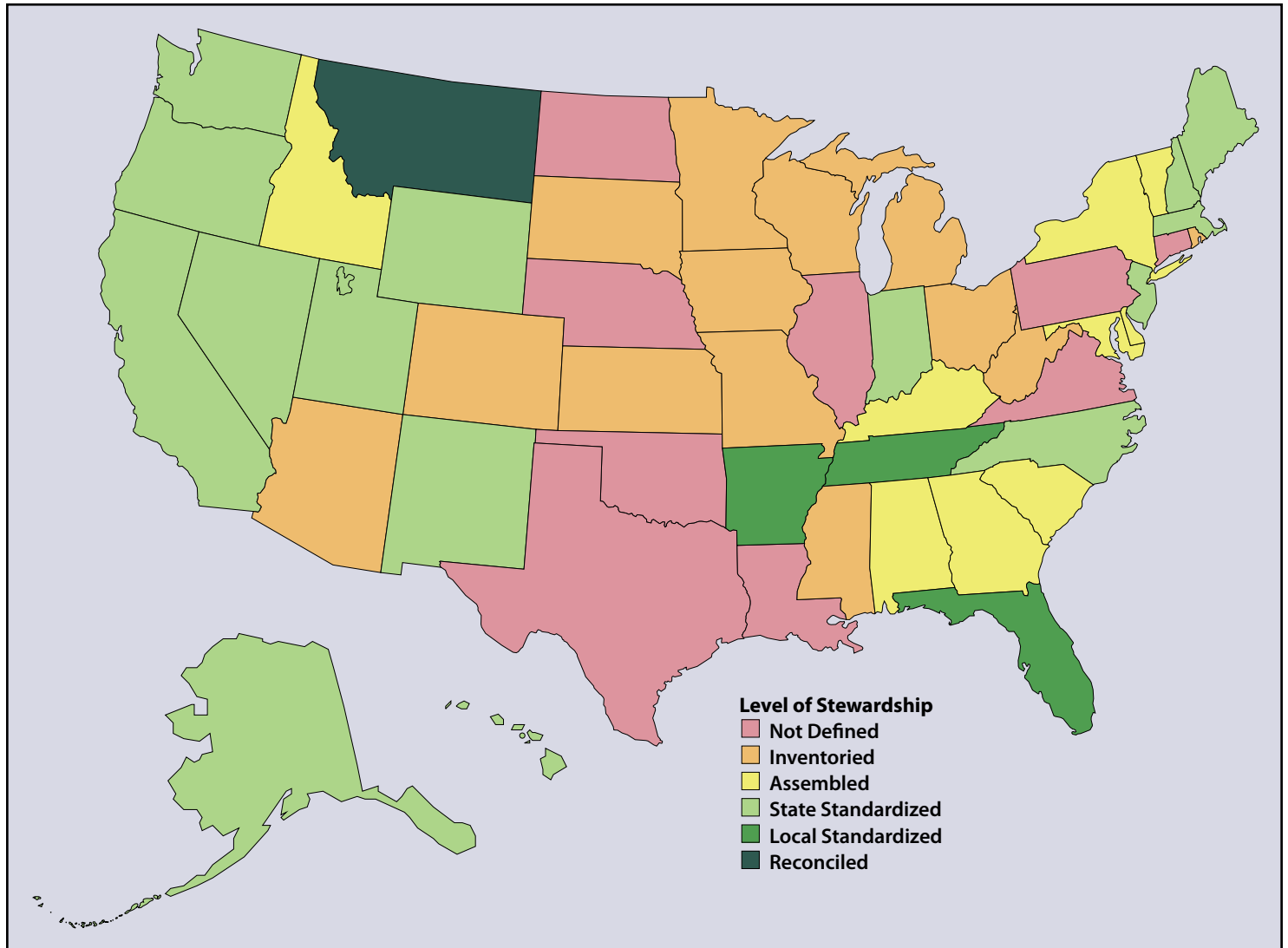
State stewardship is important because this is the mechanism or program that can standardize parcel data statewide without disrupting local operation and maintenance. State-hosted Web sites or Web services minimize the complexity for federal and regional agencies to gain access to parcel information for decision support. Instead of having

to contact more than 4,000 entities, the user can gather information from 51 access points.

The benefits to the counties, the state, emergency responders, and citizens increase as the levels increase. For example, at Level 1, a single state contact is identified and that state contact has a pulse on the status of parcel data in the state. This single contact helps emergency responders and other essential government business functions to more quickly identify what data may be available in a state. At Level 2, the state contact has at least annual copies of the parcel data that can be provided through a single contact. Any agreements on use and methods of distribution will be harmonized for the state.

Montana is an example of a state that has reached Level 5 and is providing free access to regularly maintained statewide coverage of parcel data through a single portal. Related data sets can also be accessed, and these data have been resolved to the parcel information. Other states, such

Figure 1. Levels of stewardship in the United States



as Florida, have achieved Level 4, and the attributes and geometry from each county can be combined into a single database. Several state agencies have been able to reap the benefits of regional and statewide multi-jurisdictional parcel data sets with their in-house databases. Reaching Level 4 has another added benefit—the local data producers can provide more current data in the standardized format if needed.

Full state coverage is essential to realize full benefits. Several states (Washington and Kansas as examples) have nearly full digital parcel data coverage, but not entirely. This lack of completeness reduces the ability to experience the full benefits and application uses.

Ongoing Best Practices

In 2012, the California Strategic Growth Council (CSG) through the University of California, Davis (UCDavis) funded a study to examine the best practices for statewide parcels, land use, and address-related data in other states either with conditions similar to or adjoining California. The results of the study, when combined with an analysis of the conditions in California, assisted the CSG in defining future sustainable locally maintained and state aggregated parcel-based data sets that would serve statewide goals. Initially the impetus for this study was to provide standardized data sets for response to wildland fires. The CSG and many California state agencies quickly realized the value of standardized statewide parcel data for supporting many programs across the state. When coupled with other statewide data sets such as address information and land use, they form a valuable decision support data set.

The states selected for review are a sampling of best practices and do not constitute an identification of all best practices, nor are the states in this study the only ones with best practices. The goal was to find states that are similar in size, local conditions, and goals as well as states in which the department of revenue or equivalent agencies play an active role with the parcel data aggregation.

The 12 states in the inventory are Arkansas, Florida, Idaho, Indiana, Montana, New Mexico, Nevada, North Carolina, Ohio, Oregon, Utah, and Washington. The complete report can be found at http://downloads.ice.ucdavis.edu/sgc_parcel/Statewide_Best_Practices_final.pdf.

In general, this study found that aggregating and standardizing locally maintained parcel data is manageable and doable. These locally sourced data provide the most current and most accurate representation of land ownership and real estate values for the state. Impediments related to data sharing, data availability, and the storage and hosting of these relatively large data sets are easily

overcome when there is a defined business need and state leadership. In most cases, once the parcel data from local governments have been standardized and aggregated, many more business applications for the data emerge.

The most commonly occurring business drivers for statewide GIS programs for land records are related to property tax system management and public safety. In many cases the business driver is reflected in legislative or executive action. This action tends to also create an office and/or position as the focus of statewide coordination or technology deployment efforts and often identifies funding sources.

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Business Drivers

The most common business drivers are as follows:

- *Property Tax Administration, Oversight, or Improvement.* These business drivers tend to focus on the quality and procedures for local governments and state-mandated reporting requirements. A cadastral or parcel standard or guideline and reporting standard formats are often included in these types of programs.
- *Public Safety.* The public safety-driven programs typically describe a set of statewide data sets (orthoimagery, road centerlines, address points, parcels), guidelines for collection, quality assurance of these data, and update frequency. Emergency response, such as wildland fire, tornadoes, hurricane, and flooding, are included in the public safety business drivers.
- *Broadband Access.* This business driver arose almost uniformly from the Federal Communications Commission (FCC) Broadband Initiatives, which include grant support for identifying the level of broadband service available in any location in the state.
- *Public Lands.* This business driver arises from the need to coordinate the state records of land ownership with federal land ownership and the record of state and federal land ownership on the local tax rolls. The consistent and accurate management of the use of public lands is a common application accompanying this business driver. The two most common drivers

for understanding public land status are pressure on public resources, such as energy development (wind, fossil fuel, oil shale), and asset inventory.

Other business drivers include support of specific state programs, such as agriculture or commodity land management, improved management of state-owned property, natural resource protection, population forecasting, regional planning, destination sales tax determination, healthcare service delivery applications, corridor location and impact analysis, statewide addressing, improved geocoding, voting, public transportation planning, improved public data access, parks and recreation access, and economic development. Many political and administrative boundaries are coincident with parcel boundaries, including boundaries of school districts, incorporated limits, and zoning districts. A consistent, statewide parcel data set that is maintained and kept current can reduce administrative errors.

In effect the business driver influences the granularity, attribution, currency, and accuracy of the data sets. Knowing what business need drives the data aggregation and standardization is important for understanding the fitness for use. For example, parcel data aggregated and standardized from local real estate records for use in property tax equalization across the state may not be suitable for a statewide planning application if the publically managed lands, which typically are not included in local real estate records, are needed for statewide planning. There are other business needs in each state, but these are the primary business drivers for parcel-related data. The nuances and influences of each of these business drivers can be seen in how the state develops its statewide data sets and applications.

There are hard costs for not having aggregated statewide parcels, for example, duplicate efforts collecting data for specific projects for transportation infrastructure, economic development, and after-the-fact emergency management.

Locally Generated Parcel Data

All the states in this study had completed or were in the process of completing statewide aggregation of locally generated parcel data. Each state had developed a standard content for the statewide parcel data, and many of these standards were based on the national guidelines for core parcel data developed by the FGDC Cadastral Subcommittee. One interesting observation is that only a few states had tackled the issue of a seamless, edge-matched statewide parcel data set. Resolving the differences among counties and registering all parcel data to a statewide common base is still an emerging concept, except in Montana, where parcels are seamless statewide. In Florida, where parcel

data by county have been freely available for download and standardized for many years, no business need for seamless parcels has been identified. Parcel data business applications are highly localized, and the additional effort to edge-match the county parcels is not justified. Arkansas and North Carolina encourage edge-matching at county boundaries where the data are defined well enough to support that edge-match. However, the state data aggregation efforts will not adjust or move the county-generated data. The edge-match must occur at the local level so it can be maintained and reflect the legal record information.

Each state has a unique culture, and finding the keys to successful management and implementation varies with each state. The common thread is a community of mutual trust and respect, regardless of whether this is gained through mandates, incentives, or voluntary participation.

Standardizing the attribute content and providing the spatial data as generated by the local jurisdictions is the most common approach to delivering statewide parcel data. New Mexico is developing a statewide point data set for parcels that will accommodate those counties without automated parcel mapping. Florida has found that having standardized, consistent parcel attributes across the state is one of the most significant benefits and also increases the use of the parcel data.

Statewide Coordination

The programs reviewed in the best practices sample all have some level of statewide coordination. In many cases the coordination comes from the line-of-business functions in the state such as the state department of revenue or board of equalization or its equivalent. Most of the states also have a geographic information office that provides broader coordination and is housed within a state agency (often the state information technology department or agency).

The question of whether state-granted authority is needed to complete statewide parcel data standardization or a volunteered or acknowledged authority is sufficient was not answered. Both authority styles had equal success in the states studied. In some states, depending on the relationship between the state and the local governments and the organizational culture in the state, there is a need for mandates and incentives to achieve a sustainable system. Some states, for example, Indiana, have a paid incentive. Florida has state authority through the department of revenue but

also had funding in the early stages and gradually built the program establishing trust and standards incrementally. In parallel with granted authority, the motivation and persistence of the individual coordinator to lead and coordinate the building of a GIS community is a critical component. Each state has a unique culture, and finding the keys to successful management and implementation varies with each state. The common thread is a community of mutual trust and respect, regardless of whether this is gained through mandates, incentives, or voluntary participation.

There are some commonalities among the states examined for best practices. All the states have an active coordination council or similar entity for the participation of local governments in the development of standards and guidelines. These forums also provide a means for feedback, outreach, and education. Increasing the participation and sense of ownership in the program from the local data producers was often cited as an underlying goal for these forums.

State offices with GIS technology skills are another common element in each of the states. These GIS skills include the ability to support local governments with GIS data automation, data hosting, server management, and Internet publishing. Many states also have on-staff application development and programming skills. Skill levels and GIS capabilities of state agencies have grown rapidly in the past few years. This trend is expected to continue.

In some states university support provides intellectual capital for developing new methods and approaches, and in some cases the university serves as a politically neutral setting for data hosting, data aggregation, or data analysis.

Benefits

Quite a few states have completed formalized rate of return (ROI) or benefits analysis of statewide GIS services. These studies have all found positive ROI and have documented benefits in three different ways:

- Cost avoidance, such as economy-of-scale purchases
- Anecdotal, such as increased efficiency in assembling data for projects
- Expanded use of GIS in public agencies and the private sector.

Other identified benefits are the ability to use data across local jurisdictional boundaries in response to emergencies, consistent data sets for economic development, and complete coverage of data for understanding and managing broadband access.

Another observed benefit is that states with a strong state coordination and state GIS presence appear to

attract more grant-funding and cost-sharing opportunities. For example, states with a strong state GIS coordination presence were able to leverage broadband services grants within the state and expand GIS use and benefits. This is also true for the next-generation E911 funding and for hydrography and floodplain mapping programs.

Challenges

Technology was not identified as a challenge or hindrance to statewide GIS programs. This is important to note since technology concerns may have been an issue in early statewide system development. The technology infrastructure, including servers and server management, Web publishing tools, and bandwidth, are all issues that plagued early statewide data publishing. Modern technology infrastructure is much less challenging because of its ability to access cloud-based services for data storage and access, Web-friendly cartography built into GIS development tools, and network bandwidth everywhere—well, almost everywhere.

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Coordination, education, and sustainable funding are the three most common challenges facing the statewide programs that were reviewed. Coordinating data aggregation, standardization, and publication among many diverse local government data producers is at the top of most states' list of challenges. Some states have overcome this with cost sharing or local government grants; some with centralized services providing access to technology to local governments at a reduced cost; some with state regulations and compliance requirements coupled with incentives; and others by defining statewide essential business needs that are readily understood and needed by local governments. Whatever the solution, successful programs have engaged and convinced local government data producers to participate in developing and maintaining statewide standardized GIS data.

Establishing sustainable local programs with skilled staff who can provide locally sourced data sets is another challenge many states have to overcome. But, as with the coordination, each successful state has found ways to provide technology, data collection and maintenance standards, education, or funding incentives to overcome these issues.

Privacy is a continuing concern for any data publishing. Information that was public since 1776 but was locked away

in dusty volumes was protected because of the challenge of access. When that same public information is scanned, spatially enabled, and published on the Web, available to the world with minimal effort, the public nature of the information seems to change. Individual county and state privacy and public access policies will have to settle these challenges. Sometimes hidden behind privacy is cost recovery. Should the data be freely available? Should there be an access charge? Should access be limited to viewing only? These are just some of the other policy questions every jurisdiction faces. The nationwide inventory of land records indicates that in general, data are being made available for viewing and for government-to-government data sharing. Going forward, the data may also be available through Web services.

There is no one best approach to overcoming challenges or delivering benefits. The best approaches will be influenced by and will learn from local and state government relationships in areas beyond GIS, the state's overall policy and approach to public access to data, and the general knowledge and acceptance of the usefulness of GIS (perhaps thought of as "the GIS Culture" or overall GIS understanding) in the state.

Momentum and Metrics

The Cadastral Subcommittee began an inventory on the status of land records data sets across the country in 2000. In 2003 the subcommittee completed the first estimate on the status of parcel data automation and state program participation. Two more inventories were conducted in 2005 and in 2009. In 2012 another summary was performed based on a county-by-county review nationwide. Table 2 illustrates some of the essential parcel data trends. Note that the percentages may be slightly affected by improved parcel counts per county in the last two inventories and changes in population numbers and distribution from 2000 to 2010.

Table 2. Essential parcel data trends

Metric	2003	2005	2009	2013
Number of parcels	141.3 million	144.3 million	148 million	149.5 million
Percentage of parcels automated	61%	72%	82%	92%
Percentage of counties automated	30%	35%	50%	76%
Percentage of population	60%	65%	93%	97%
Number of states with parcel programs	8	13	37	40

The trend is undeniable; the number of local governments with digital parcel data is steadily increasing and is nearly complete, and the percentage of the population in an area with digital parcels has made impressive gains. In the earlier inventories the parcel counts were estimated

based on population and parcel density, and as parcel automation has been completed, the parcel counts have improved. Also, the 2000 Census population numbers were used in the first three inventories and the 2010 Census was used for the last inventory. But even with these adjustments, the trend is clear.

There are many publications and articles that stress the need for national parcel data. In the decade since the subcommittee has been tracking progress, the completion rate for digital parcel data has been very rapid. Remaining are the mostly rural, lower population counties that do not have automated parcel data; these counties may need a state or regionally sponsored approach to reach automation.

Almost 80 percent of the counties with digital data provide some level of unrestricted parcel-by-parcel viewing of the data, with a smaller percentage providing countywide viewing. However, only 19 percent provide the ability to download countywide parcel data sets, and less than 1 percent provide Web service access.

The availability and accessibility of these digital data is another issue. Almost 80 percent of the counties with digital data provide some level of unrestricted parcel-by-parcel viewing of the data, with a smaller percentage providing countywide viewing. However, only 19 percent provide the ability to download countywide parcel data sets, and less than 1 percent provide Web service access.

Initially the inventory focused on the degree of parcel data automation and rate of completion, but soon it evolved to track contacts and Web sites. In 2005, the land records inventory, which was developed to support the nationwide status of parcel data, was migrated to the national GIS Inventory database (<http://www.gisinventory.net/>). The contacts and Web links are maintained in the nationalcad component of the GIS Inventory on a voluntary basis.

In 2012, an FGDC Cooperative Agreements Program (CAP) Grant was secured by the Appalachian Ohio Geospatial Data Partnership (AOGDP) to complete an inventory of GIS data resources for the state of Ohio. The Ohio inventory update led to a spatially driven viewer for the national inventory, which can be accessed at <http://www.bhgis.org/inventory/>. This inventory, which is updated quarterly, is based on user feedback, and provides a visual metric on the progress toward a publicly available

standardized parcel data sets database. This inventory includes links to Wikipedia, Census quick facts, and county viewing and data download sites, if they are available.

A National Driver with Individual Benefits

A major cause of the financial crisis was the inability of lending institutions and investors to understand exactly what real estate was represented by mortgage securities. These securities comprised bundles of mortgages split, combined, and packaged such that the only way to assess creditworthiness was to rely on a rating organization that also had no clear way to assess the quality of the security. In mapping terms, lending institutions and investors were unable to put the “mortgage on the map.” Having the ability to put a mortgage on a map, specifically a parcel map, would allow the lending agencies, investors, regulators, citizens, and homeowners to overlay demographic data such as median home values and household incomes. This overlay could be used to evaluate trends in lending, identify neighborhoods or regions in which loan value was out of line with income, and help individual citizens evaluate their home purchase choices and options. Coupling these data with foreclosures, recent sales, and assessments provides better information for decision and analysis.

In response to the financial crisis, the Dodd-Frank legislation set up the Consumer Financial Protection Bureau (CFPB) (<http://www.consumerfinance.gov/>). The CFPB’s mission is to help protect borrowers, whether for mortgages, credit cards, student loans, or other financial products. CFPB is working to understand and publish metrics that help regulators and business with the debt capacity and ability to repay. The bureau has identified a need to

be able to place a mortgage on the map—by address, by parcel identifiers (PIN), or by another unique identifier. Because addresses are generally unsuitable for unambiguous, unique data keys, PINs are preferred. A nationwide parcel map with unique PINs would deliver CFPB this capability.

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Build It and They Will Come

The outcomes of building data and technology are unpredictable; 99.99 percent (or more) of the current users of the Global Positioning System (GPS) were not even considered when the original system was designed and built. In 2000, President Clinton disabled selective availability, which enabled accurate, dependable worldwide positioning. A whole new industry was created, and many couldn’t imagine not having GPS navigational devices. The U.S. Census Bureau developed and published TIGER (Topologically Integrated Geographic Encoding and Referencing) data, which became the basis of national street center-line data sets. Combined with the U.S. Geological Survey topographic maps, TIGER put substantial national data sets in the hands of individuals and businesses, spawning new GIS capabilities and industries. If statewide parcel data sets are available and aggregated nationally, new applications, businesses, and capabilities will be available to all.



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