Moving Towards a More Accurate Parcel Base

Abstract

The City of Lansing's first GIS parcel layer was inaccurate. In an effort to obtain an accurate parcel map at an economical cost, the City of Lansing partnered with the Lansing Board of Water and Light (LBWL), a publicly owned utility, to convert LBWL property data from Small World to the ESRI GIS environment. Converting the parcel data is a one-time process. However, improving and maintaining the parcel data is a continuous process. This paper will discuss the methodology of the conversion process, direction of parcel maintenance, and power of partnerships.

Introduction

Lansing, Michigan is the state capital and core central city. The city of Lansing is approximately 34 square miles in size with a population of 119,128. Lansing's MSA has a population of 447,728, which includes three counties Eaton, Clinton, and Ingham. This midsize Midwest city has an economic base of manufacturing, state government, and is near one of the nations largest public universities.

The use of GIS at the City of Lansing started to gain momentum in the mid 1990s. The City of Lansing had no standards for software or data at that time. Each department purchased their own software and developed their own data. There were three GIS software packages from ESRI, Caliper, and MapInfo in use across departments.

In 1998, Lansing made two major investments. First, Lansing's Public Service Department contracted with a consultant to produce the City's initial parcels layer based on a sewer index map and the Assessor's parcel map. Second, the City acquired digital orthophotography at 3-foot pixel resolution through a joint project with the Lansing Board of Water and Light (LBWL). These two projects were independent of each other. LBWL was in the process of developing parcels in the Small World environment using the digital orthophotography as their base.

Soon it was discovered the two projects used different coordinate systems. The parcel layer used Michigan State Plane Coordinate System NAD27 and the digital orthophotography was in Michigan State Plane Coordinate System NAD83. To resolve this problem, the parcel layer was reprojected to Michigan State Plane Coordinate System NAD83. Reprojecting the parcel layer revealed inaccuracies in the parcel layer, which got progressively worse moving from North to South. This created a situation that did not allow GIS users to use the parcel data with other data layers.

In 2002, Lansing hired a GIS Administrator to provide direction, establish standards, and eliminate redundancy. A major goal was to get an accurate parcel base in a cost effective manner.

During this period, the City of Lansing was experiencing budgetary cuts due to reduced revenue sharing funds from the state and change in the economy. Lansing had to find a way to do more with less.

Opportunity

An opportunity to address this problem came up while partnering with Lansing's Emergency Management Division and Tri-County Regional Planning Commission (TCRPC). FEMA was requiring the City of Lansing have a Hazard Mitigation Plan in place. The City was able to leverage funding from the Mitigation Plan to obtain a more accurate parcel layer. This helped analyze the potential impact a100-year flood would have on the community for the Hazard Mitigation Plan.

To obtain a more accurate parcel layer the City of Lansing also established a partnership with the Lansing Board of Water and Light (LBWL), a publicly owned utility, to convert their property layer from GE Small World to an ESRI shapefile. Upon completion of the parcel conversion, the City of Lansing would make the new parcel layer available to LBWL.

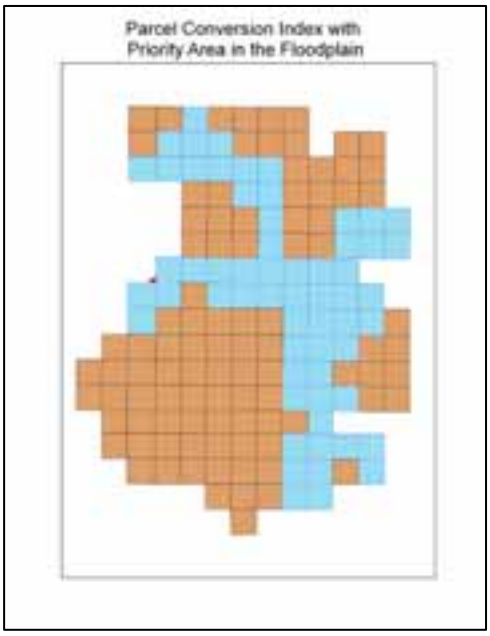
Conversion Method

LBWL's consultant converted the LBWL property layer using SafeSoft FMF software as the translation engine. Upon receiving the converted property shapefile, the City of Lansing embarked on an in-house effort to complete the conversion process. Staff involved throughout this process included the GIS Administrator, Tax Description and Mapping Specialist, Principal Residential Appraiser, Appraisers, and Interns. The objective was to develop a product that is reasonable accurate for departments to use and develop other data layers.

A parcel conversion team was created to develop a parcel conversion method. This group represented the following departments: Assessor, Emergency Management, Parks, Police, Planning and Neighborhood Development, Public Service, and Information Technology. The team created the following methodology for parcel conversion:

- Establish a workflow;
- Identify a spatial reference source;
- Verify the databases;
- Edit problems with the LBWL shapefile;
- Transfer attributes from Lansing's database into the LBWL shapefile; and
- Run the new parcel layer through a Quality Assurance process.

Workflow



A first step in identifying and resolving problems that may show up was establishing a workflow. It was determined that a parcel conversion index be made based on quarter sections to track the conversion process. Parcels in quarter section that contain the 100-year floodplain were the highest priority because the partnership between the City and TCRPC required the data to conduct analysis for the FEMA Hazard Mitigation Plan. The conversion of the remaining parcels in the workflow would be done by quarter section from West to East starting in the North part of the city.

Spatial Reference

Next, the City had to identify a base layer to be used for spatial reference. It was determined that the best source at the time was the digital orthophoto acquired though a joint project with LBWL. The digital orthophoto would be used to check the fit of LBWL's shapefile and the City's parcel layer. Staff expected a good fit between the LBWL shapefile with the digital orthophoto since it was the same one used by the LBWL to develop their property layer.

The use of a digital orthophoto was the best alternative since the City of Lansing did not have any control point to reference. A digital orthophoto is an aerial photograph that is geometrically correct. The orthorectification process will remove any inaccuracies due to displacement, distortion, aircraft movement, and camera tilt and relief. Orthophotos are good base layers for parcel mapping; providing points of reference for linear features such as sidewalks, curbs, roads, and utility lines. The City of Lansing plans on registering parcels to control points in future as control points become available.

Database Verification

The City of Lansing used Pervasive SQL and Microsoft Access to verify a one-to-one relationship between the LBWL database and the Assessor's parcel database. The only common field between the two databases that was available to compare was the address field. There were differences in the number of records in each of the databases. The City of Lansing's database contained 42,490 records, while the LBWL contained 41,160 records. LBWL only digitized property that had utility service. Therefore, missing parcels (e.g. vacant land and right-of-ways) account for some of the missing records. The other factor that attributed to missing records was LBWL did not maintain the same lot splits and combinations the City did.

LBWL data was joined to the City's parcel layer to identify problem areas. This revealed that 8,029 parcels did not contain a matching LBWL address. This represented problems with address numbering, street directions, street naming, street alias names, and street suffixes.

The database verification process helped identify problems that need to be addressed prior to populating the LBWL shapefile with Assessor's parcel data. The LBWL shapefile provided a more accurate and precise property layer, while the Assessor's database contained parcel numbers and address data that were more accurate. This problem would have to be some how addressed through editing both the LBWL shapefile and database.

Editing

The first part of the editing process was to identify problems in the LBWL shapefile by examining it closer. City staff overlaid the shapefile on the digital orthophoto and georeferenced a scanned image of Lansing's parcel map. This helped to identify problems such as geometry, lot configurations, gaps, alignment, lot splits, lot combinations, and missing parcels. After the necessary changes were made to reflect what was on the scanned Assessor's parcel map, the editor would proceed to the attribute transfer process.

Examine LBWL Property Layer

Attribute Transfer

The parcel conversion team was faced with a difficult task of determining how to transfer or add the Assessor's Parcel Number (APN) to the LBWL shapefile. Three options were considered:

1. Join the data by address;
2. Use the attribute transfer tool in ArcGIS; or
3. Use a centroid shift and transfer process.

Since there was a difference of 1,330 records between databases and 8,029 unmatched addresses, the first two options presented problems with efficiency. Option 1 would create a situation that required identifying and correcting 8,029 mismatched parcels. Option 2 required transferring each attribute from the Lansing's parcel layer to the edited LBWL shapefile.

Option 3 allowed staff to transfer the attributes from the original City parcel layer block by block to the LBWL layer. There were 2,555 block in the original parcel layer. This process was less work then correcting the 8,029 unmatched addresses, or using the attribute transfer tool to transfer the Assessor's data into 42,490 new parcels. The centroid shift and transfer process consists of the following steps:

- Create centroids with the attribute data from Lansing's parcel layer.
- Move centroids by block so the centroid falls within the lot line of the LBWL shapefile.
- Create a spatial join between the centroids and LBWL shapefile.
- Join the database from the spatially joined centroid to the LBWL shapefile by record ID.
- Export the LBWL shapefile with the joined data into new parcel shapefile.

The centroid shift and transfer process helped expedite the parcel conversion. The centroids at the block level fell within the property boundaries of LBWL shapefile after they were moved with very little adjustment. Spatial joining the two layers created a new layer containing both sets of attributes. This allowed for the use of the join function to transfer the Assessor's data from the City's initial parcel layer into the LBWL shapefile. Exporting the LBWL shapefile with the joined Assessor's data into a new parcel shapefile created a layer that was more spatially accurate than the initial City parcel layer. This new parcel layer also

contained the APN and addressing consistent with the Assessor's database. The new parcel layer would now go into the quality assurance stage.

Quality Assurance

Quality Assurance (QA) was done both visually and digitally. Data conversion from one system to another is not always exact. There are many ways for errors to produce inaccuracy in the spatial data. Therefore, the QA process checked for random and systematic errors. Random errors are components of the data such as misspelling or transposing of characters. Systematic errors are results of the conversion process. This type of error is typically a result of a technical or procedural problem.

Visual QA works in conjunction with digital QA. A check plot for each quarter section was printed at 1"=100' (1:1200) scale with the APN. The review team identified all incorrect or missing: lot lines, lot alignment, and parcel numbers. Reviewers also verified total number of parcels, overshoots and undershoots, line quality, polygon closure, overlapping polygons, gaps, and sliver polygons.

Reviewers used a light table to compare check plots with the Assessor's mylar parcel maps by overlaying it on top. Keep in mind there maybe inherent inaccuracies due to systematic errors in how the new parcel map was produced. Additionally, media can change due to humidity and temperature. Visual QA helped identify the existence and absence of data in addition to positional accuracy.

Visual QA reports were written directly on each check plot. Reviewers marked up the check plots to identify problem areas and provide comments. Reviewers also wrote their name and the date they finalized the QA process in the title block. After the visual QA, the new parcel map would go through a digital QA.

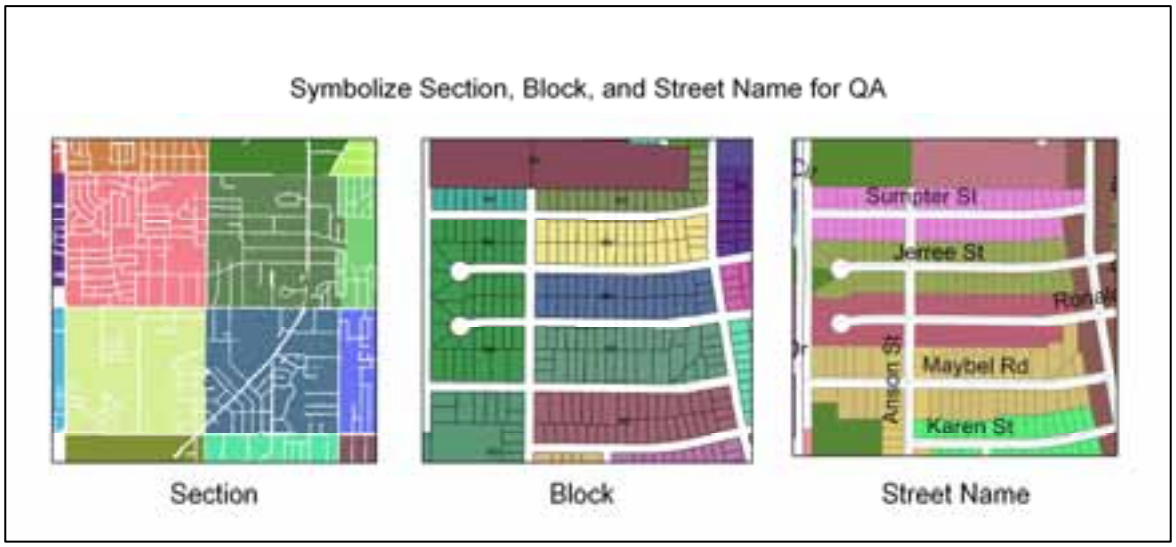
Digital QA allows for quick evaluation of a large amount of data. This process helped identify problems with the new parcel shapefile that was not visible during the Visual QA.

Lansing had limited licenses for ArcGIS 8.x, therefore both ArcView 3.x and ArcView 8.x was used in the initial QA process. ArcView 3.x with the Digitizing QA Tools developed by Jim Heald was used to check the new parcel layer for sliver polygons, overlapping polygon, and void polygons. ArcView 8.x with ET Geo Tools developed by Ianko Tchoukanski was also used to detect gaps, overlaps, delete multiple vertices, and move shared nodes.

ArcView was used to symbolize parcel data based on street name and parts of the parcel numbering system. The number system consists of a two digit county code with a dash, a two digit municipality code with a dash, a two digit geographic township code with dashes, a two digit section code with dashes, a three digit block code with dashes and a three digit individual parcel code (e.g. 33-01-16-306-001).

County	Municipality	Township	Section	Block	Parcel
Eaton=23	Lansing City=50	Delta=40 Windsor=80	25 – 36 01	3 digits	3 digits
Ingham=33	Lansing City=01	Lansing=01 Meridian=02 Delhi=05 Alaiedon=06	02-36 29 and 32 02-16 03 and 04	3 digits	3 digits

Symbolizing county, municipality, township, section, block, and street name provides a quick method to check if attribute data matched spatial data. This step helped find any attribute data that may have been missed during the visual QA.



Lansing upgraded to ArcINFO 9 later in the conversion process. This allowed staff to utilize the topology function by converting the shapefile into a personal geodatabase. Topology became part of the QA process by setting up rules for detecting gaps and overlaps to ensure data quality.

Direction of Parcel Maintenance

In 2005, the City of Lansing as member of the Mid Michigan GIS Consortium (MMGISC), which includes Clinton County, Eaton County, Ingham County, Delhi Township, Meridian Township, and Tri-County Regional Planning Commission developed a partnership to purchase new digital orthophotography for the region. This partnership allowed the City of Lansing to acquire 6-inch pixel resolution digital orthophotography at 1:1200 scale (1”=100’) at a fraction of the cost if Lansing contracted the job out individually.

Lansing has provided a copy of the new digital orthophotos to LBWL as part of our on going partnership.

The new digital orthophotos is currently being used to make corrections and adjustments to the parcel layer. Parcel maintenance is an on going process. Lot splits and combinations are updated annually. In the future, Lansing will use more accurate reference data such control points at section corner as they become available.

Power of Partnership

Lansing's parcel conversion process was the major theme though this paper. The power of partnership was an underlying theme, but just as important. The City of Lansing could not have acquired a more accurate parcel layer without the partnership of Tri-County Regional Planning Commission and the Lansing Board of Water and Light. Tri-County provided an opportunity to acquire a more accurate parcel layer with the need to complete the FEMA Mitigation Plan. LBWL provided resources such the 1998 digital orthophotos, from past partnerships, and their Small World property layer.

These initial partnerships led to other partnerships like the one with the Mid-Michigan GIS Consortium, which undertook a three county digital orthophoto flyover. This was a milestone in the history of mid-Michigan where each partner found common ground to move forward with a multi-jurisdiction regional collaborative.

Partnerships between city government, utility providers, county government, and regional planning agencies can help create opportunities to develop and share GIS resources. These opportunities enable the partnership to leverage time, resources, and talent to transform organizations. Partnerships provide new perspectives and insights to help with the advancement of all organization involved.

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