Implementing a Geographic Information System (GIS) for the Case Management Process with the Code Compliance Division at Coconino County

By Andrew C. Gillette

A Practicum
Submitted in Partial Fulfillment
of the Requirements for the Degree of
Master of Science
in Applied Geospatial Sciences

Department of Geography, Planning and Recreation
Northern Arizona University
May 2011

Approved:

_____

R. Dawn Hawley, Ph.D.

_____

Alan A. Lew, Ph.D.

_____

Kristopher Estes, IT Director/GIS Manager,

Coconino County

Table of Contents **Page**

List of Figures **Page**

COCONINO COUNTY
GEOGRAPHIC INFORMATION SYSTEMS

121 E. Birch Ave. Suite 200
Flagstaff, AZ 86001
☎: (928) 679-7800
FAX: (928) 679-7849

Kris Estes
GIS Director
121 E. Birch Ave. Suite 200
Flagstaff, AZ, 86001

Dr. Dawn Hawley
Department of Geography, Planning and Recreation
Northern Arizona University, Box 15016
Flagstaff, Arizona 86011-5016

Dear Dr. Hawley:

This letter is to commend Andrew Gillette for his significant contribution to Coconino County through the application of GIS to enhance our public services. Andrew was tasked with several project initiatives over the last 9 months which focused on advancing GIS use within our Community Development department.

Andrew worked diligently to assist the County GIS division to improve our digital zoning layer and introduce GIS as an alternative to traditional paper maps. His efforts have paved the way to revolutionize the future technical platform utilized by Community Development department to make data driven planning decisions. Andrew's ability to engage with Community development staff and understand their business needs has greatly improved the ability for GIS to structure effective solutions for the future.

Andrew's greatest contribution has related to the County's Code enforcement division. Working closely with the County's new code enforcement manager, Andrew was able to interpret the business needs of the division and design a GIS centric solution which enabled the division to visualize the back logged records of code violations. This has been extremely meaningful for the County to reveal spatial relationships and better logistically plan for daily inspection duties. Andrew was required to develop several database automation procedures across multiple database platforms which he incorporated advance computer modeling and programming skill sets. Andrew also enabled this utility by creating a mobile field application which now allows our field inspectors to access case information while in the field. In a County the size of Coconino, this has been a tremendous asset. He continues to work towards utilizing the system to demonstrate statistical data relationships to support effective use of staff resources. This will provide a great assistance to the department and improve code enforcement protocols and planning initiatives.

Andrew has been an asset to the Coconino County GIS division. He has been instrumental in advancing the utilization of GIS to improve our local government. I look forward to seeing his continued progress in the field of GIS

Sincerely,
Kris Estes
IT Director/GIS Manager

Acknowledgements

I would like to give a special thanks to my Mother Julie Gillette, Sister Kimberly Gillette, Father George Gillette and Stepmother Susan Gillette for helping me and supporting me during my pursuit of earning a master's degree. A very sincere thank you is for my advisor Dr. Dawn Hawley for pushing me through the phases of a master's degree, we did it! I would have not attempted a master's study without the encouragement from my former GIS manager at the Town of Buckeye, Thank you Don Homan, Jr. The practicum project would have not been as easy to accomplish without the help from the Coconino County GIS folks. The records extraction process was successful with the help from Duane Marshall, thank you Duane for teaching me the server language for speaking to database servers. Thank you Stan Wickham for helping me with VBA programming language for the customized code records button in ArcMap. A special thank you is given to Kris Estes my GIS manager at the county for supporting my quest of a practicum project at the county. This project was a success in the fact that Steven Brown the code compliance manager wanted to utilize GIS technologies, thank you Steven.

Abstract

Government agencies are responsible for managing land record information of their specific jurisdictions. With the increasing use of computer systems in work environments, land records are able to be managed in digital spaces, eliminating the dependence of paper processes and increasing its accessibility. Coconino County is considering the use of geographic information systems (GIS) to manage land records with its Code Compliance division. Using ESRI's ArcGIS for GIS with the Code Compliance division, an interactive mapping application is provided for interacting with code enforcement cases that are spatially linked to geographic locations. The process for converting code enforcement cases to spatial features involves extracting case records into comma separated value files that are compatible with GIS. Using comma separated files; GIS develops record tables for holding case information and to create point spatial features connected to geographic locations displayed in mapping applications. A customized mapping application specific to code enforcement is created for code enforcement officers uses in the field and office. With a code enforcement GIS, officers can interact and manage code enforcement cases by visualizing cases on digital or paper maps. The unique tool of GIS assists code enforcement officers to increase the effectiveness of their work and reference any code enforcement case from a mapping environment.

Introduction

Managing land record information is important for towns, cities, counties and states, as land based information is critical for development, long range planning, emergency management, administrative and economic purposes. Public knowledge and accessibility also has to be considered by public agencies. Coconino County is considering methods to improve, manage and expand land information and its availability. Maps, a common method of storing land information, give visual representation of areas, showing travel, weather, geography and land records. Advances in computer software and hardware have made digital cartographic information more accessible than traditional paper maps. An advantage of digital information is that it can be stored in databases allowing multiple users with network connections to access and view information. While updating paper maps is a time consuming process and limits user viewings because of stored location issues. Digital data with proper geographic information system (GIS) software and network connections, can provide interactive base maps for creating and viewing land record information by anyone with a computer and access. Managing spatial records is a cost effective process, but can be difficult to implement because of inertia around traditional methods used in local government. Changing traditional methods requires proper computer technologies but also personnel be trained in managing spatial records, so agency buy-in is essential. The result can be a system that allows users to manage spatial records and view land use information in a digital environment, better efficiency and enhanced customer service.

The Coconino County Community Development Department currently uses a paper based system with some digital software. Paper county map books are stored at the Community Development Department where they are manually referenced and updated. These maps show land uses of parcels, easements, encumbrances, permit records, code cases, township and range sections and the road rights of ways of the 18,661 square miles in Coconino County. County map books have been used for decades to reflect planning land uses changes. Changes to the maps are done manually by drawing in parcel splits or cutting and pasting paper notes to show changes. This process makes the maps look cluttered and worn. To view these map books individuals need to be at the department's building. The code enforcement division under community development relies on these maps for verifying land information. The map books are not backed up in any form and if an accident or damage were to occur, all information with books pertaining to the county land uses would be lost.

Background

To get a better understanding of code enforcement, an interview with Steven Brown (Brown, Steven. What is Zoning Code Enforcement? Interview. 04 November 2010), the county Zoning Code Enforcement manager, was conducted. With this interview and careful review of the Coconino County Zoning Ordinance (August 3, 1981), Section 7: Enforcement, a clearer understanding was obtained for what Zoning Code Enforcement is within County Government. The ability to enact zoning ordinances that contain enforcement authorities and directions is derived from the police powers delegated to local and county jurisdictions by the state, through enabling legislation. For the state of Arizona, that authority comes to the County from Title 11-Section 11-807: Version 2 which reads:

> *"A specific zoning plan may be adopted or amended after notice and hearings before the commission and board as provided in section 11-813. If the board adopts a specific zoning plan,* ***it shall establish administrative rules and procedures for the application and enforcement of the*** *plan and may assign or delegate administrative functions, powers and duties for the plan to county officers and officials".* (*Arizona Revised Statutes Title 11- Section 11-807; Version 2*)

It is important to note that all zoning plans (ordinances) in order to be held valid must be consistent with and conform to the County's adopted comprehensive plan. The purpose of the Coconino County Zoning Ordinance is stated as:

> *"For the purpose of implementing the goals, objectives and policies of the Coconino County Comprehensive General Plan, to promote and protect the public health, safety and welfare of the people of the County of Coconino, to safeguard and enhance the appearance and quality of development of Coconino County, and to provide for the social, physical and economic advantages resulting from comprehensive and orderly planned use of land resources, a Zoning Ordinance establishing classifications of zones, and regulations within those zones hereby is established and adopted by the Board of Supervisors."* *(Coconino County Zoning Ordinance - Section 1 – August 3, 1981)*

It is unlawful, and considered a public nuisance per se, to make use of any lot, parcel, or piece of property in such a way as to conflict with the provisions of the Zoning Ordinance. A violation of the Zoning Ordinance would be to erect, construct, reconstruct, alter or use a

building or any other structure that does not conform to the criteria set forth in the Ordinance. The Board of Supervisors, Director of Community Development, County Attorney, County Sheriff, County Clerk, and all officials charged with the issuance of licenses or permits enforce the provisions of the Ordinance. Any permit, certificate, or license issued in conflict with the provisions of the Ordinance is void. To provide for the enforcement of the Zoning Ordinance, the County may withhold all building permits and zoning permits for properties on which a use of the property, building or any other structure exists that does not meet the standards of the Ordinance.

A zoning enforcement officer as an agent for the Community Development Director, investigates, and reports on all notices of zoning violations. The Board of Supervisors has appointed a hearing officer to hear and determine zoning violations. Individuals determined by the hearing officer to be violating any provision of this Ordinance will be charged with a zoning violation which is punishable by a civil sanction not to exceed the equivalent of a maximum fine of a Class 2 misdemeanor for each violation. The zoning enforcement officer who is carrying out his/her responsibilities in Coconino County is compelled to initiate enforcement actions only upon receipt of a complaint. That complaint can emanate from the public, other staff, or in some instances where the violation is particularly egregious, can be initiated by the zoning enforcement officers themselves.

The enforcement actions that flow from the complaint provide for multiple opportunities for the respondent to comply and avoid further action. Zoning violations that are not corrected during this process are brought to a Hearing Officer and a judgment is sought compelling compliance. If compliance is not obtained by a certain date contained in the judgment, fines accrue, and at a point the case is remanded to the County Attorney for litigation before the Superior Court, seeking a judgment from that body and the resolution of fines and court costs through the imposition of a lien against the property that is the site of violations. It is only when the property changes hands through a sale or repossession that the lien is settled and the County paid. The fines realized can then be used to effect the correction of the violations.

The current code enforcement case management process does not support viewing cases in mapping applications. Interlocking computer software is used now to log and manage code violation cases, but it doesn't update county land spatial data for maps. Coconino County has an

ESRI ArcGIS enterprise system using a Microsoft SQL server relational database management system (RDBMS) to support multiple users in the sharing and using of land based spatial information, including web applications. The developing and managing of spatial land information pertaining to code enforcement cases is done after a case has been recorded. Code enforcement cases are recorded using interlocking software and are only visible as tables in the database, similar to Microsoft Excel. Interlocking software stores records in an Oracle RDBMS. Code staff is not able to view their cases on a map. The county GIS department and code compliance manager would like to utilize GIS capabilities being used with code enforcement cases.

Practicum Purpose

This applied research practicum is focused on creating a geographic information system (GIS) to help with managing the code enforcement cases that are first started by a complaint and then investigated by a zoning officer to create a case. Coconino County has an enterprise GIS system that is integrated throughout the entire organization. This allows a large number of users to manage, share, and view spatial data. Accurate spatial data can be used to address a variety of needs, creation, modification, visualization, analysis, and dissemination. This project is using a GIS to develop code enforcement case spatial features from exported code enforcement records tables developed by code enforcement officers using interlocking software. Each code record has an Assessor's Parcel number (APN) which will be the primary key link for developing spatial case records from the established counties parcel infrastructure. The software used for the GIS is ESRI ArcGIS which is an interactive mapping application. With this being a cross department project all data developing and customizing of the applications for the users to use while working with spatial data will be done by trained GIS staff. Database managing will also be done by staff of the GIS department. Code enforcement personnel will be trained by GIS staff in how to operate ArcGIS software and how to use global positioning system (GPS) units with ArcGIS in the field. This project is an attempt and provides an example for how to expand GIS services and technologies to other divisions and personnel within an organization.

The process of spatially enabling code cases starts with developing a database to database separate server connection. With this project, a connection will be made with the code compliance object-relational database management system known as oracle (ORDBMS) and the

GIS Microsoft SQL server which is a relational database management system (RDBMS). Both of these database systems use the Structured Query Language (SQL). This language is designed for managing various forms of data in relational databases. After creating this connection a comma separated file with case records was created to be used with GIS to create code case spatial features.

By creating spatial data with code cases, accurate maps with code cases can be viewed in either printed maps or by interactive mapping applications on computers. Spatial code enforcement cases allow officers, when in the field to see cases around them when their computers are connected to a GPS unit and the mapping application. The use of ESRI ArcGIS software allows this process to take place, making all code case records available in digital form, spatially enabling code enforcement cases for visualizing.

Objectives

The following process objectives were identified:

1) Meet with code enforcement staff to discuss why GIS would benefit their work. Demo the interactive mapping application of ESRI ArcGIS. Explain the Geodatabase and point spatial features.
2) Extract case record information out of an Oracle server as comma separated files (.csv), to be placed in a Microsoft SQL server in a geodatabase as tables for use in ESRI ArcGIS.
3) Use tables to develop case record point spatial features. Create a localized Field GIS deployment folder that contains all data so the application can run off a computer's hard drive and not need a network connection. Ensure computers using this data have the appropriate software ESRI ArcGIS.
4) Deploy the data on code enforcement computers, feedback, error handling and training sessions.
5) Results: Evaluating the process after a period of use for workloads, backlog upkeep and effectiveness.

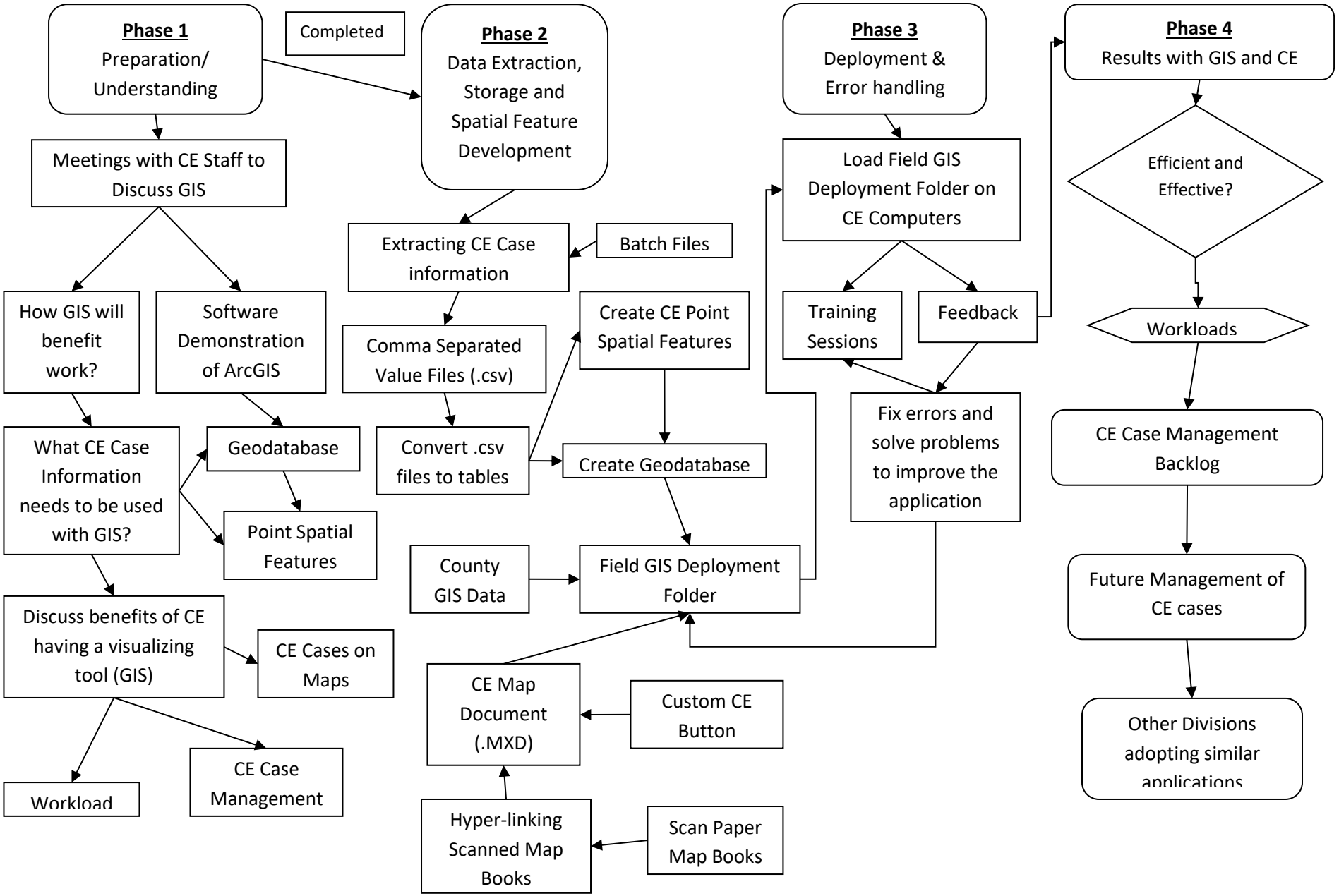

Figure 1. Flowchart for using GIS with the Code Enforcement (CE) Case Management Process

Scope

This practicum project focuses on creating a visual representation of code enforcement cases. The project will be using GIS for viewing and interacting with code enforcement case records. GIS will be used to create code enforcement spatial features that are referenced to geographic locations and for user interaction with spatial features. Coconino County's code enforcement division will be using ESRI ArcGIS products. Staff of the code enforcement division will be using mobile and desktop computers installed with GIS software (ESRI ArcGIS) that allows for them to view spatial code cases at specific locations, along with other GIS data. It is very important to note that code enforcement staff will be trained in how to operate ESRI ArcGIS. The training will take place in sessions before and after staff have used the software. When in the field with mobile computers code officers will be using global positioning systems (GPS). GPS units when attached to the mobile computers can display that officer's location on the screen. With the officer able to see where they are located they will also be able to see all code cases in the area too.

Justification

This project provides a guide for how GIS technologies can be intergraded with divisions of an organization. Records created by a division for its purposes can be developed into spatial features with GIS and viewed on maps. This project is working with the Coconino County Code Compliance division to enable them to use GIS technologies in the office and field with spatial features of their code enforcement cases. GIS is a tool to assist the division with mapping the location of its code violations, the application could be used as a management tool for a variety of goals such as:

- Identify the best areas to focus enforcement efforts
- Develop efficient officer enforcement workloads and area coverage
- Focus workloads on specified geographic areas
- Determining the locations of concentrations of certain types of violations in the County
- Identify the number and type of each violation in a geographic area
- Analyzing the distribution of code violations by type, number, and geographic extent
- Comparing the distribution of code violations by area within a specified time frame
- Identifying the location of all code violations within the County boundary
- Trend Analysis with population densities

Literature Review

Many municipalities from around the world have implemented GIS to improve existing processes, increase efficiency, improve productivity and increase service delivery. The use of an enterprise GIS system to help with these processes and workflows has proven to be beneficial from case studies and reports written by various government agencies. Mesa, Arizona, was experiencing delayed data updates. Mesa implemented an ESRI enterprise GIS system to increase the frequency of data updates and created easy to use applications for data management. The mapping applications allow for employees in both the office and the field to have access to spatial data. Spatial data can be used by many users at different locations where paper maps are more restrictive (Accessed 27 February 2010, http://www.esri.com/showcase/case-studies/index.html#city_of_mesa_arizona_panel).

Foshan, China is the third largest city in China's Guangdong province with a population of 5.4 million covering 3,800 square kilometers located on the Pearl River Delta. The City of Foshan implemented a GIS system to give them a citywide GIS platform and to improve urban planning. Foshan uses ESRI's ArcGIS server for data management and to improve city planners' decision making. Ruixin Chen, Director of the Information Technology Centre, Foshan Bureau of Planning, said "As Foshan's communities grow, we need a GIS solution to provide a solid platform for the maintenance, exchange, update and sharing of geographic information." With a GIS system in place, Foshan can increase real time spatial data to the public and third parties while at the same time strengthening the planning and land management processes (Accessed 14 March 2010, http://news.gislounge.com/2009/08/city-of-foshan-china-selects-esri%E2%80%99s-gis-solution-to-improve-urban-planning/).

The State of Vermont implemented an enterprise GIS system to enhance the capabilities and efficiency of the state's geographic information systems. The purpose for developing a state wide enterprise system was to have uniform spatial data that could be used at every agency level as agencies would not have to implement their own GIS system and create spatial data layers. The enterprise GIS system is used by all state agencies, divisions and departments that use GIS. In the years leading up to this report the state has seen GIS become an intricate part of local, regional and state governments. They all use the same data layers and when changes are made to

a specific layer it is reflected in the enterprises geodatabase system used state wide (Accessed 14 March 2010, www.vcgi.org/about_vcgi/projects/egis/EGT_ParticipantDirectory.pdf).

Tippecanoe County, Indiana is home to Purdue University, high-tech and manufacturing companies and the City of Lafayette. With increased use of GIS by county departments and the City of Lafayette, new software solutions were being discussed to manage spatial data. Tippecanoe County utilized ESRI's ArcIMS to improve providing and displaying of cadastral layers through the web. GIS and computer –aided design (CAD) were being used to manage the county's cadastral layers. By using GIS and CAD to develop the parcel layer, the county found information was not being deployed effectively and it was taking more time to develop. The county solution was to use ESRI enterprise system to create an enterprise geodatabase with ArcSDE and use Sidwell's Parcel Builder software which is supported by ArcGIS. The enterprise geodatabase solved the backlog issues, provided better GIS services to the community and use of GIS data in its GIS web sites. The county was able to improve its parcel management productivity and provide GIS data to all users (Accessed 27 February, http://www.esri.com/showcase/case-studies/index.html#tippecanoe_county_indiana_panel).

The City of Riverside, California ensures that its citizens live a good quality of life. The City's Code Compliance division enforces the codes that disallow nuisances like illegally parked cars, illegal structures on properties and the accumulation of trash. The database system used to store these code violations is in need of improvement. Riverside has looked at implementing a GIS system to help manage the database with code cases. A GIS system would in addition to the database structure help with managing the workflows of Code officers and provide mapping of code cases. Existing GIS layers could be linked to code information to better show the displacement of where violations are occurring and give possible insight to reasons of why. The maps developed using code information could give good visualization tools that would be used for city council and intergovernmental meetings. A GIS system is now used with the city's code compliance division. (Accessed 18 June, www.esri.com/news/arcuser/0401/codeview.html)

With the advances in computer technology over the past 30 years, more information is being stored in various data formats. The different types of database systems allow for a wide range of information to be stored digitally. The connections that can be developed between these databases to cross reference information raises a question of organization to decide what

hardware and software is the best fit for their needs. GIS is one of the many types of software with the ability to create, maintain, edit and manage information. If the use of GIS increases with the organization, further decisions are needed on how to handle it. This involves selecting the correct software and the addition of software packages available beyond the standard marketed type. The use in the office or in the field with the appropriate personnel is considered. (Accessed 25 July, http://www.colorado.edu/geography/gcraft/notes/atwork/evolving.html)

The reason for developing a GIS system for an organization is best understood when analyzing an organization that has not used GIS. The City of Buffalo, New York implemented a GIS system in part to help transition and change the current processes of using and relying on paper based systems. The development process for GIS begins with understanding that GIS is not only a technical issue but that of the institutional, organizational, procedural, and information quality aspects of the municipal government. After understanding the issues, an informative GIS strategic plan was developed. This plan decided who and where in the organization GIS is most important to. The formation of a steering committee was developed to help with GIS during the implementation phases; these members were the decision makers of the organization. Technical working groups were needed to help with training and managing of the various data layers and work processes. This group also helped with the integration of GIS into the organization and managing of data along with the conversion of data from CAD files to GIS. Lastly the appropriate applications of GIS with specific tools were developed and provided to the managers of divisions for their specific needs and uses. (Accessed 10 April, http://www.gisdevelopment.net/magazine/africa/2006/july-sep/18_1.htm)

A GIS system can be used in an organization to manage and display various types of data. A GIS coordinator not only is tasked with managing a GIS system but also to expand this service to other divisions and staff. This is completed by providing the proper hardware tools like computers and GIS software and internet connections from workstations to the databases where data is stored. This is ideal for the office environment but to further expand the use of GIS, field operations need to be considered for how they can utilize GIS. GIS mobile by ESRI is designed around allowing field staff to have this tool at any location outside of the office. Mobile GIS allows for GIS data to be accessed, created and worked with in the field when conducting business. Code compliance divisions could benefit greatly from being able to have

this service. Code offices conduct most of their work in the field and providing them with a mobile GIS service would be a solution to improving their case management. (Accessed 18 September, http://proceedings.esri.com/library/userconf/serug10/papers/abstracts/pap27.html)

Methodology

This project is designed around using GIS to develop, display and interact with spatial data. Other projects were attempted at Coconino County to spatially enable land record information before this project with the code enforcement division. However, as these projects were delayed, the techniques and methods developed from these delayed projects were modified for use in this code enforcement project.

Previous Created Data Projects

A previous attempt was made to enhance Coconino County's community development capabilities using spatial data. To manage spatial permitting records county map books needed to be scanned into digital formats and Zoning Analyst software was to be used. Zoning Analyst software is separate from ESRI ArcGIS but creates and uses the same type of spatial data and can access the databases where this spatial data is stored. The software also tracks the permit application process, showing permit meeting dates and faster processes for developing the permit notifications. After going through training sessions with the Zoning Analyst vendor and feedback from Community Development staff who would be using the software, it was determined that the county's enterprise GIS system with another software application already in use, the interlocking software currently logging permit case information, could instead be used to manage spatial records. Zoning Analyst and interlocking would require a double entry of permit information. Zoning Analyst was canceled and a customized development of ArcGIS for land use planning started.

The county map books that were scanned into a pdf digital format previously could still be used and the scanned map books would be hyperlinked to the parcel layer for referencing when working with spatial records in ArcGIS. An analysis was performed of how community development staff manages the current process and how those processes would be used to better customize ArcGIS software. It was determined that managing of permitting records with the Planning and Zoning division in ArcGIS was not efficient and the project was halted. Soon after this halt in spatial enabling land record information, it was proposed and decided that the code

compliance division would utilize GIS technologies in the office and the field with spatially enabled code enforcement case records.

Code Enforcement Project

With the code compliance division willing to utilize GIS technologies, meetings were first held to discuss the needs, wants, capabilities and utilization purposes of GIS with code enforcement. Demonstration and training sessions were also held to show how to operate ESRI ArcGIS, specifically ArcMap which is the application for interacting with spatial data. A total of three meetings were held and two demonstration sessions from August to December 2010. A special emphasis was focused on using global positioning system (GPS) units in the field with ArcMap. The GIS software application used for data interaction is ESRI ArcMap which opens map document files (.mxd) that display spatial data in an interactive mapping environment. The spatial data in an .mxd can be turned on or off for viewers' preferences. ESRI ArcMap is the application used for user interaction with spatial data and gives users various tools for data interaction. Most tools are standard with the application but depending on tasks to be completed, customized tools can and will be developed from analyzing the current code enforcement processes and spatial data layer. These tools can be designed to change spatial features or allow for referencing other digital files. The code enforcement spatial data will be represented by using the vector model, as this model is best used to represent features on the earth's surface. There are three different types of features in vector data: points, lines and polygons. These features have high location accuracy and contain attribute tables where specific code enforcement case information can be stored. Code enforcement case records are represented with vector point features.

Extracting Code Enforcement Case Information

The code enforcement division uses interlocking software to create a record (case) of a complaint that is a violation of the county's zoning ordinance. These records are stored in an oracle server. The records are extracted from this server in several comma separated value files (.csv), which allows the files to be stored in the GIS Divisions Microsoft SQL server and then to be used to create code enforcement spatial features. The code enforcement information included in this extraction process was decided on during the initial meetings.

Extracting these records in .csv files started with creating batch files that communicate to the oracle server using structure query language (SQL) with oracle sequel plus. Oracle sequel plus is run from the Widows command line through code entered in the batch files, and communicates with the oracle server. There were two batch files involved. One is a Windows NT command script (CEwork.cmd) that runs with the Windows command line. The .cmd file calls the second batch file containing the SQL code (CEwork.sql) for using Oracle sequel plus. After running these files and communicating with the Oracle server, five different .csv files were created containing record information specific to code enforcement cases. A folder was created to store the batch and .csv files. The batch files can be run unlimited times resulting in new .csv files. The five .csv files created are:

- **CE_Main** – Contains all cases and includes fields with case numbers, parcel APN's, case statues and enforcement officer assigned. (5,761 records)
- **CE_Action** – Contains case number, Action taken and statues of the action. (21,752 records)
- **CE_Contact** – Contains the case number, contact information specifically being the name of the person and their relationship to the location being owner and violator. (3,577 records)
- **CE_Parcel** – Contains the case number, APN, Owner and site address. (5,158 records)
- **CE_Violation** – Contains the case number and type of violation that occurred. (7,633 records)

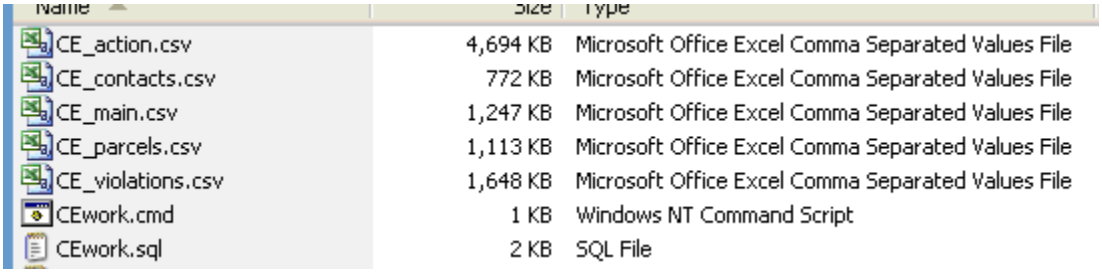

Figure 2. Code Enforcement Folder

These five .csv files were used with the code spatial features for displaying case information in ArcMap. The main.csv file was used to create spatial features with the county's parcel layer, and the four other .csv files will be used with relationship classes, as explained later.

Creating a Geodatabase

With the code enforcement information contained in .csv files, development began on creating a geodatabase for storing code enforcement information. A geodatabase is a database that stores and manages spatial data used with GIS. ESRI emphasizes the use of geodatabases and has developed three different types of geodatabase for working with spatial data and interacting spatial data with its applications. This project will use a personnel geodatabase. A personnel geodatabase is the simplest of the geodatabases and uses a database filing system like that of Microsoft Access. This means that you can work with table (.csv) data information in ESRI applications or Microsoft Access. Access doesn't allow for interaction with spatial data used with GIS.

Using Microsoft Access, a database was created to load all the code files. Access allowed for the .csv files to be loaded into tables that had all field types in a text (string) format. (Errors would occur with the field types being in other formats like integer.) With the Access database containing all the .csv files, now recognized as tables, a personal geodatabase was created with ESRI's ArcCatalog application. ArcCatalog specifically allows for users to manage spatial data used in GIS applications like ArcMap. The name of the personal geodatabase is Vector_Code.gdb. An import table process was conducted between the access database and the Vector_Code.gdb to load all tables in the Vector_Code.gdb.

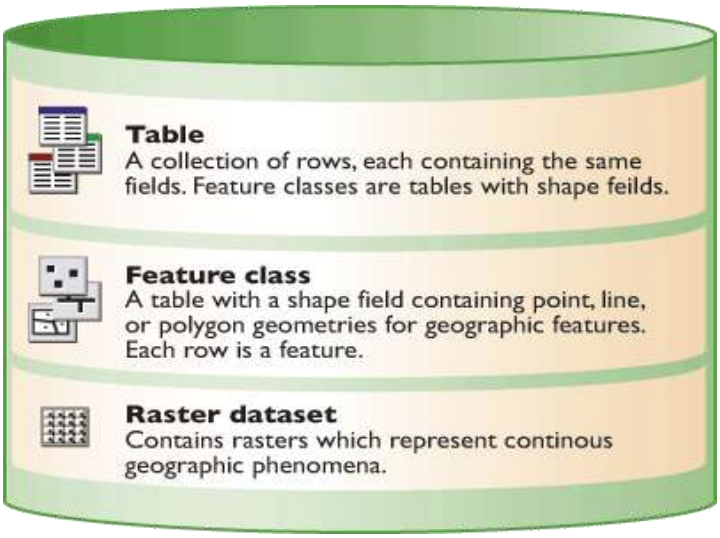

Figure 3. Geodatabase (.gdb) (Accessed 30 March http://webhelp.esri.com/arcgisdesktop/9.2/index.cfm?TopicName=An_overview_of_the_Geodatabase)

Spatial Data (Features Class) development for Code Cases

With a geodatabase created specifically for code enforcement data, development could occur now to develop spatial features for each code case. What occurred is a feature class representing code cases as points being located in the Vector_Code.gdb with the code tables. A feature class is a file format in a geodatabase that represents one of the three different types of vector features, it represents features place on the earth's surface and also contains an attribute table where information pertaining to the features is stored. With this project a point feature class was used.

To create this code case feature class an existing county's parcel feature class was used, that represents all the parcels in Coconino County. The county's parcel feature class uses polygons and they needed to be converted to point features for this project. Using tools in ArcToolbox (polygons to points) of ArcMap, the polygon feature class is converted to a point feature class and placed in the Vector_code.gdb. To create the code enforcement case features the CE_Main table and point parcel feature class will be used. To process these two data formats into a code records feature class an arcscript from ESRI support site was used. The arcscript is called "Table to Feature Class Spatial Merger". (Accessed 24 January http://arcscripts.esri.com/details.asp?dbid=16772)
Specifically, for this table to feature class spatial merger to work, fields located in the CE_Main table and point parcel feature class needed to be used. The fields in both data formats needed to contain the same information. The two fields used are the Assessor's Parcel Number (APN). After running the arcscript with the feature class and table a point code_records feature class is created. The CE_Main table contained 5,761 records, after running this arcscript 4,948 records were created. The reason for this record difference is that code enforcement records associated with APNs no longer active with the current county's parcel layer were discarded.

The code_records feature class represents all code enforcement cases and has an attribute table that contains fields from both data formats. After the creation of this code_records feature class, fields that are not relevant to the feature class were removed.

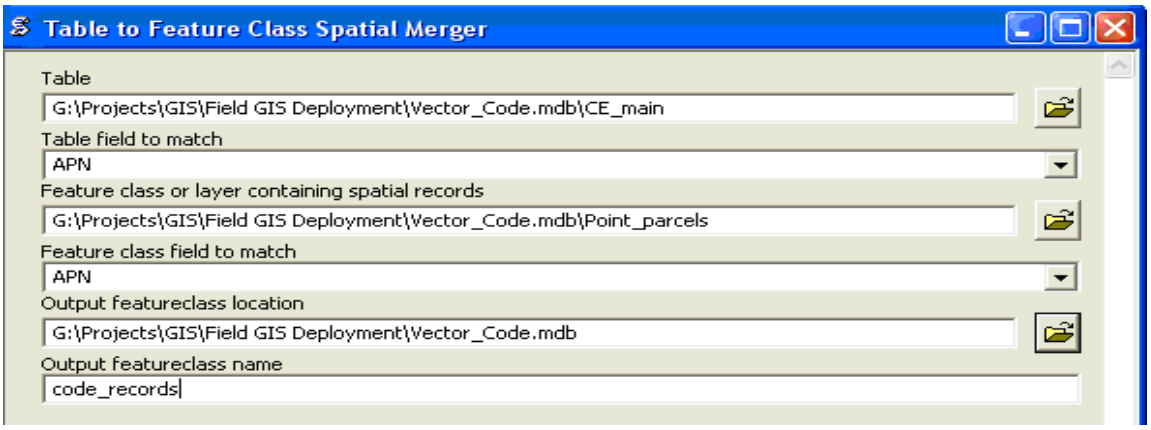

Figure 4. Table Feature Class Spatial Merger

Set up of GIS for Code Enforcement

Prior to this project the county's GIS division created a field deployment folder that contained all GIS information for ESRI applications, specifically ArcMap. The vector_code.mdb was loaded into this folder. This field GIS deployment folder is loaded on all of the code enforcement officer's computers for use in the office or field with ArcMap. Contained in this folder is an .mxd that when opened with ArcMap, displays all the spatial data for mapping interaction. The .mxd maintains path connections with spatial data layers located in folders and geodatabases in the field deployment folder.

For the code enforcement division, a specific .mxd is created for the officers to use, this called: CCGIS_CODE_FIELD.mxd. This .mxd contains the code_records feature class and other spatial data layers representing information in Coconino County.

With a feature class of code enforcement cases that only contains fields in its attribute table that were kept from the spatial merger, other information in the four code enforcement tables needed to be available for viewing in ArcMap. To enable information in these other tables to be viewed with the code_records feature class, a relationship class is created in the vector_code.mdb. There are a total of four relationship classes, one for each table not including CE_Main. A relationship class is a connection between features and tables. A relationship class can only be created in a geodatabase. What is unique about a relationship classes is when a feature in the code_records feature class is selected, the corresponding values related to that code case in the other tables is selected, too. To create this kind of connection fields between the feature class and tables have identical fields. When the feature class was created the APN field

was used because it was in both data formats. For the relationship classes, the Complaint ID field is used. All tables that were exported contained this field, especially for creating connections between the features and tables.

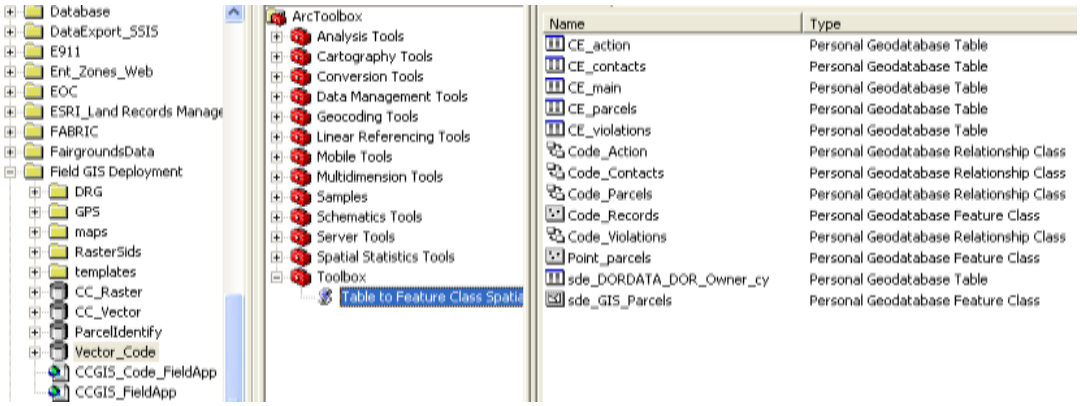

Figure 5. Vector_Code.gdb in Field GIS Deployment Folder

With relationship classes established between the code_records feature class and the various code enforcement tables, users can view all information of code enforcement cases in an ArcMap session.

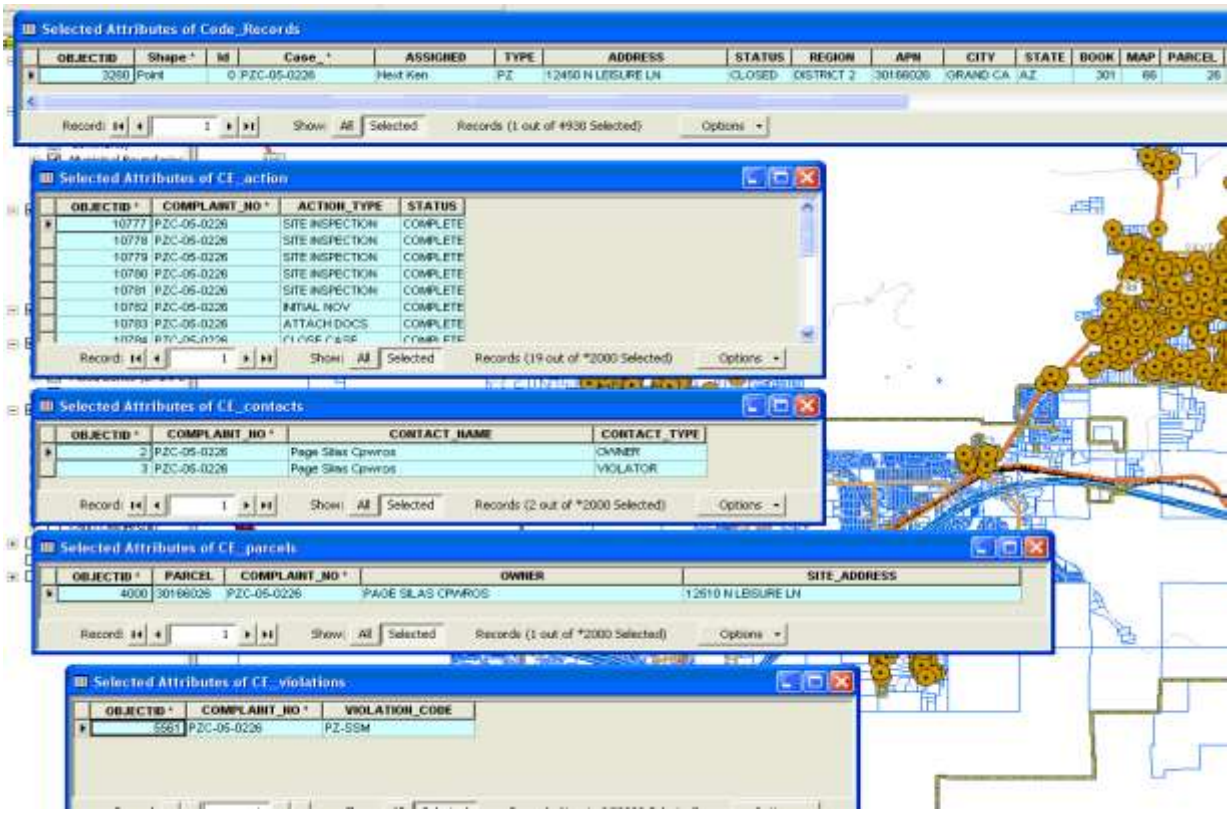

Figure 6. Selected Case with Relationship class Tables

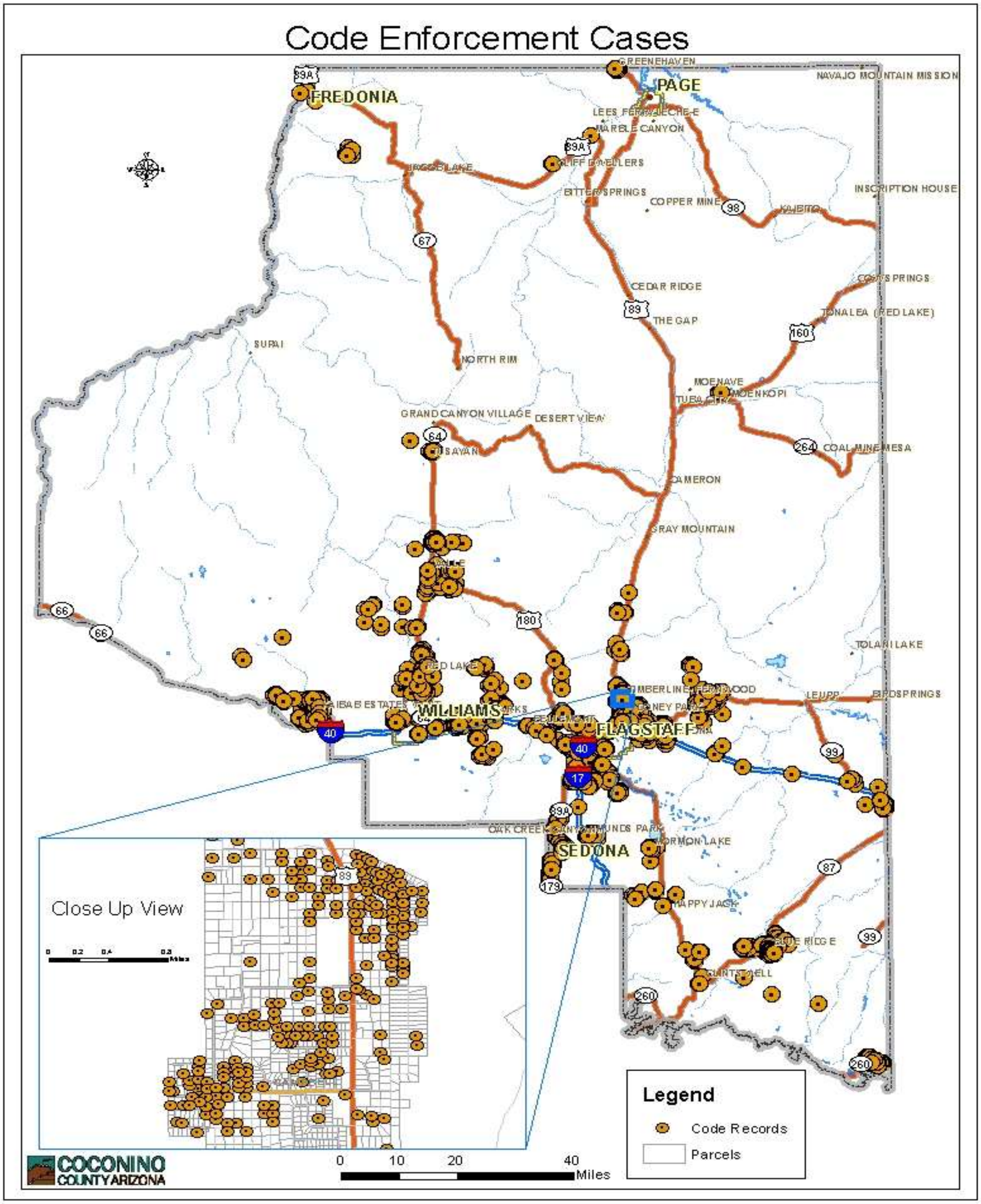

Figure 7. Map of Coconino County with Code Enforcment Cases

Customizing GIS for Code Enforcement

After seeing that each relationship class required its own table on the computer screen, it was decided to program a button using ESRI ArcObjects that presented a form that displayed all the appropriate code enforcement table information for a selected feature. ArcObjects uses Microsoft Visual Basic for Applications (VBA) which allows for ArcGIS applications to be developed further than their base packages. Using the customize mode and VBA editor in the ArcMap application a button and form is designed and programmed. The button when used will call and display a form that presents code enforcement information. The form contains controls that are used to represent different fields of information located in the different code enforcement tables.

Code Records button

Using ArcMap's customize mode a UItoolcontrol button called Code Records was created. This button, when clicked, only interacts with features contained in the code_records feature class and displays a form created in VBA editor that displays code enforcement table information. This button was added to the toolbar in ArcMap that contained seven other customized tools for interacting with spatial data. These seven other tools were created by staff of Coconino County GIS division prior to this project.

Figure 8. Customized Buttons in ArcMap

Code Records Form

Using VBA editor, programming code was entered to give function to the button when used. When the button is clicked on in the toolbar and then used to select a code case feature, a form appears on the screen displaying information. This form is created in VBA editor and contains the following controls: five labels, four list boxes and two buttons.

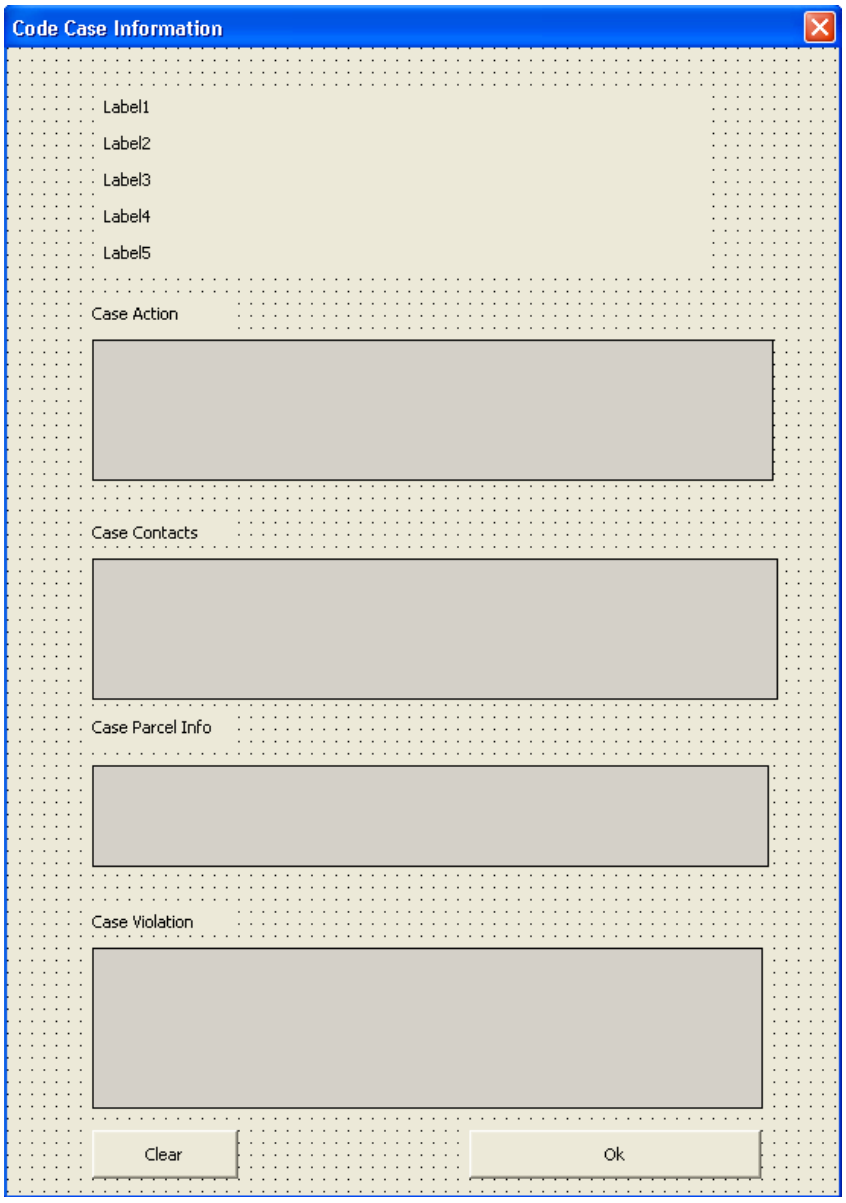

Figure 9. Code Form (Development Stage)

With the form created, programming code can be entered to each control in the form. To add code to the controls, two coded modules are coded. One is (Code_Feat.GetCASE) used for selecting code enforcement case features. This module drives the selecting procedures of the button when clicked by a user and then used on case features. The second module contains two functions that:

1) (CodeDataRetrieval.GetCode_tables) retrieves code enforcement tables from the code geodatabase.

2) (CodeDataRetrieval.Load_tables) loads the code enforcement table information into the labels and list boxes.

When a code case feature is selected the complaints ID number is used to gather all information from the corresponding tables that are related to the ID number. The two buttons (clear, Ok) used with this form clear displayed information and close it. The clear button only clears all information presented in the forms controls. The ok button closes the form.

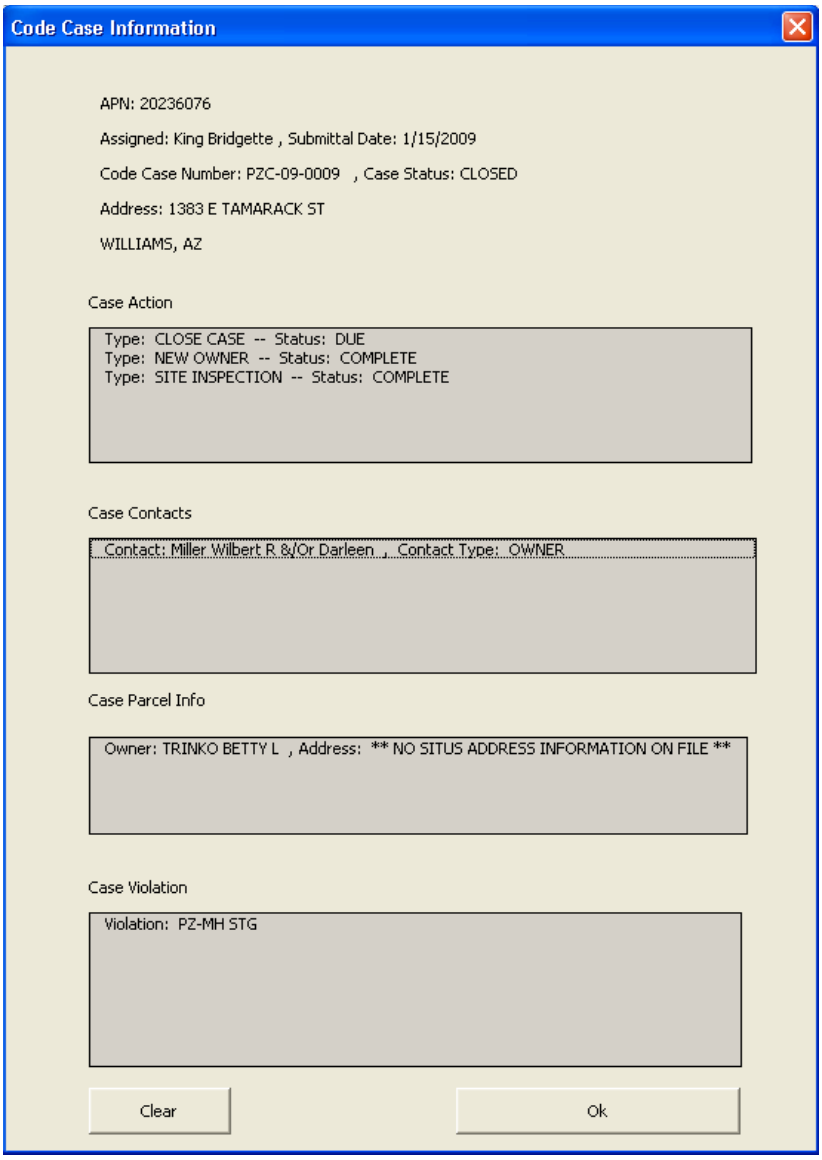

Figure 10. Code Form in Use

Results

Coconino County code compliance division was looking at options to be able to view their code enforcement cases. By using GIS applications code enforcement cases were created into spatial features used with interactive mapping applications, like that of ESRI ArcMap. Specifically, this project developed spatial features with GIS from code enforcement violation case records that were created using interlocking software, based on a request by the staff of the code compliance division to have code enforcement cases available for visualizing when in the field by using their laptops. This would give officers a knowledgeable tool for referencing cases. The processes involved in this development were extracting case information from an oracle server as .csv files, conversion to tables for spatial feature development in a Microsoft SQL server and storage in a geodatabase.

With spatial features developed from code enforcement cases, code enforcement officers can view cases and the information related to each case with ArcMap in the field or office. The previous method of looking at cases in a column and row filing setting was replaced. An added ability of the ArcMap application was how a GPS unit could be connected, showing the current location in the application. With a case records feature class and a GPS unit attached to ArcMap, officers could see their location and all cases in the specified view extent on the screen. With the customize button officers could select cases for reviewing. This project provided a GIS tool that could improve the divisions work abilities.

Another use from the development of spatial features is with the code enforcement case management process. Interlocking software was the only tool code enforcement staff had to use for managing code cases. The code enforcement division had a caseload backlog which needed to be addressed. Spatial features were created with a use for managing this caseload backlog, but not enough time has passed for monitoring the case management process from deployment to this written document. Spatial features and GIS would provide another tool for working with code enforcement cases and managing their information. With techniques learned from managing the backlog, procedures could be developed for future management of the code enforcement cases. Code enforcement officers had access to all code enforcement cases in a mapping environment effectively increasing their case management.

Error Handling

After the deployment of the GIS application for code enforcement an emphasis was focused on error handling. Error handling would be conducted by receiving feedback from code officer's uses and the problems they encountered while using GIS. These problems were evaluated and resolved to increase the effectiveness of using this application. The two most significant problems were using the GPS unit with the application and the customized button.

One problem encountered after the deployment was using the GIS application and GPS units. GPS units were not always cooperating with the application. Every time the application was launched a connection needed to be reestablished with the application. This was resolved by first troubleshooting the problem with the GIS master application and then conducting a training class of the application and use with GPS units.

Another problem involved the use of the customized button for selecting and viewing case information. One parcel could contain multiple cases and the feature development process caused case points to be stacked on top of each other. The button would only select the top case in the stack of cases. The programming for the button was altered to allow users to drag a box around cases with the mouse pointer, resulting in all cases within the drag box being selected. A message box was programmed to tell the user how many cases were selected. After the user clicks ok and clears the case number selected message box a form appears with the complaint identification numbers of the selected cases. The user can then select the complaint number click the "Get Case Information" button and the code case information form appears with that cases information.

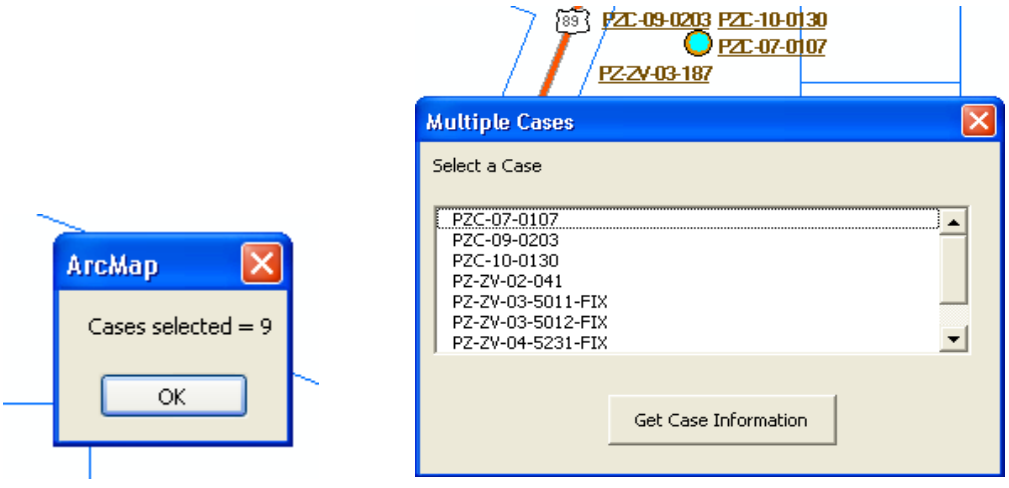

Figure 11. Total Selected Case Message Box and Case select form

Conclusion

Spatial features are a part of GIS technologies, and can increase access to land information. This project has provided a process for taking record information from one of Coconino County's divisions and spatially enabling the records. With the use of ArcMap in the code compliance division and spatial features of code enforcement cases, code enforcement officers had the ability to use a unique skill of GIS in the workplace. A GIS benefits the effectiveness and efficiency of code enforcement employee's abilities by utilizing mapping tools to interact with code violation cases. This project provided a method for how to expand GIS technologies to other divisions at Coconino County. As a result of this project other divisions at Coconino County have expressed interest in using GIS technologies. With this project in its infancy some ideas have already been discussed for its future. Some future possibilities discussed are to use GIS only to create code enforcement cases, utilize mapping applications for managing and working with land record information.

Since the deployment of this project, code enforcement officers enjoyed using the application. They had expressed their positive desires for viewing cases on maps, interacting with cases was easier. Officers were looking forward to the day when GIS was the only software used for managing code enforcement records. With this project being utilized with current work practices, a case records spatial feature update was scheduled once every one to two months. Code enforcement cases will continue to be created and they need to be reflected in the current mapping application now being used.

References Cited

ESRI. 2005. Enterprise GIS Improves Workflow and Data Management. ESRI, http://www.esri.com/showcase/case-studies/index.html#city_of_mesa_arizona_panel, accessed 27 February 2010.

GIS Lounge. 2009. City of Foshan, China Selects ESRI's GIS Solution To Improve Urban Planning. GHIS Lounge, http://news.gislounge.com/2009/08/city-of-foshan-china-selects-esri%E2%80%99s-gis-solution-to-improve-urban-planning/, accessed 14 March 2010.

State GIS Coordinating Team. 2006. Vermont Enterprise GIS Initiative. State GIS Coordinating Team, www.vcgi.org/about_vcgi/projects/egis/EGT_ParticipantDirectory.pdf, accessed 14 March 2010.

ESRI. 2008. Parcel Maintenance Backlog Cleared with Enterprise GIS. ESRI, http://www.esri.com/showcase/case-studies/index.html#tippecanoe_county_indiana_panel, accessed 27 February 2010.

ESRI. 2001. Improving Code Enforcement Services with GIS. ESRI ArcUser, http://www.esri.com/news/arcuser/0401/codeview.html, accessed 18 June 2010.

University of Colorado at Boulder. 2000. The evolving GIS workplace. By Larry Daniel Vice President, Research & Information Systems, http://www.colorado.edu/geography/gcraft/notes/atwork/evolving.html, accessed 25 July 2010.

GIS Development. 2006. Implementing a Sustainable GIS in a Local Authority. GIS Development, http://www.gisdevelopment.net/magazine/africa/2006/july-sep/18_1.htm, accessed 10 April 2010.

ESRI. 2010. Mobil GIS for Code Enforcement. ESRI, http://proceedings.esri.com/library/userconf/serug10/papers/abstracts/pap27.html, accessed 18 September 2010.

Arizona State Legislature. Arizona Revised Statutes. 2010 ED. Title 11, Sec. 11-807; Version 2, http://www.azleg.gov/FormatDocument.asp?inDoc=/ars/11/00807.01.htm&Title=11&DocType=ARS, accessed 4 September 2010

Coconino County. Coconino County Zoning Ordinance. 1981 ED. Sec 1, P. 1 ,http://www.coconino.az.gov/comdev.aspx?id=144, accessed 4 September 2010.

Brown, Steven. What is Zoning Code Enforcement? Interview. 04 November 2010