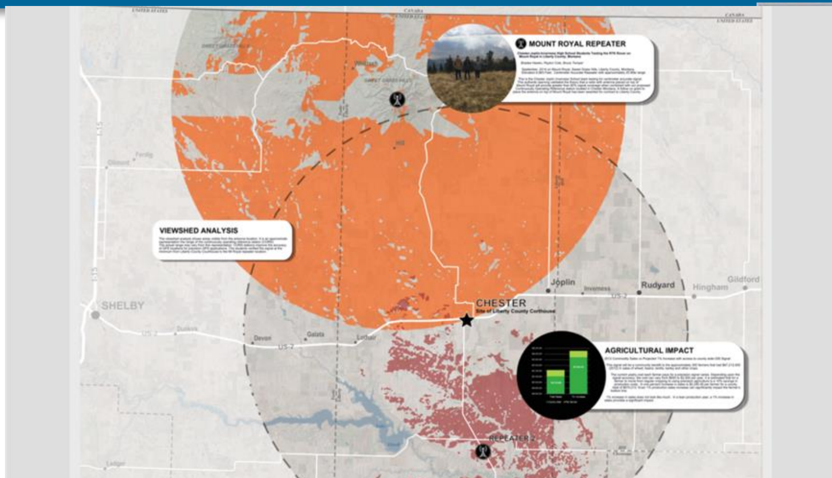
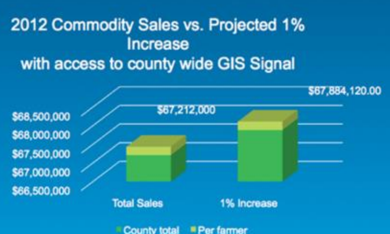
Liberty County School



Potential Precision Agriculture Impact



1 % increase is
$2,240.40 per farmer for a county total of $670,212

Swan Valley School

Student Forest Stewardship Project on the School's Property

The students designed the plan and designed wildfire reduction treatments, wildlife, wetlands and recreation enhancements with MLIA funding and GIS tools.

They arranged a contract to complete the plan in 2015 and are adding additional trails and outdoor study areas, monitoring plots for further studies.

Weed Mapping Inventory and Story Maps

Lincoln County, Montana

Lincoln County Weed District

Monitoring

Applicators are the eyes of the program. They are essential to the weed program. With each year they become more familiar with the plant and what makes it such a successful invader. This has made it possible through the work from previous years to track the progress of the program. Early detection and response in dealing with the infected areas help prevent the spread of the invaders. Monitoring the already invaded areas gives them the ability to control these sites. Measuring the progress from year to year helps them see their efforts are making a difference. The inventory of these sites provides information so they can deal with existing invasions and prevent new ones. Each year, the progress is evaluated in regards to the goals and objectives set for the year. This provides a measure to see if progress is being made and what areas need more attention.

Education

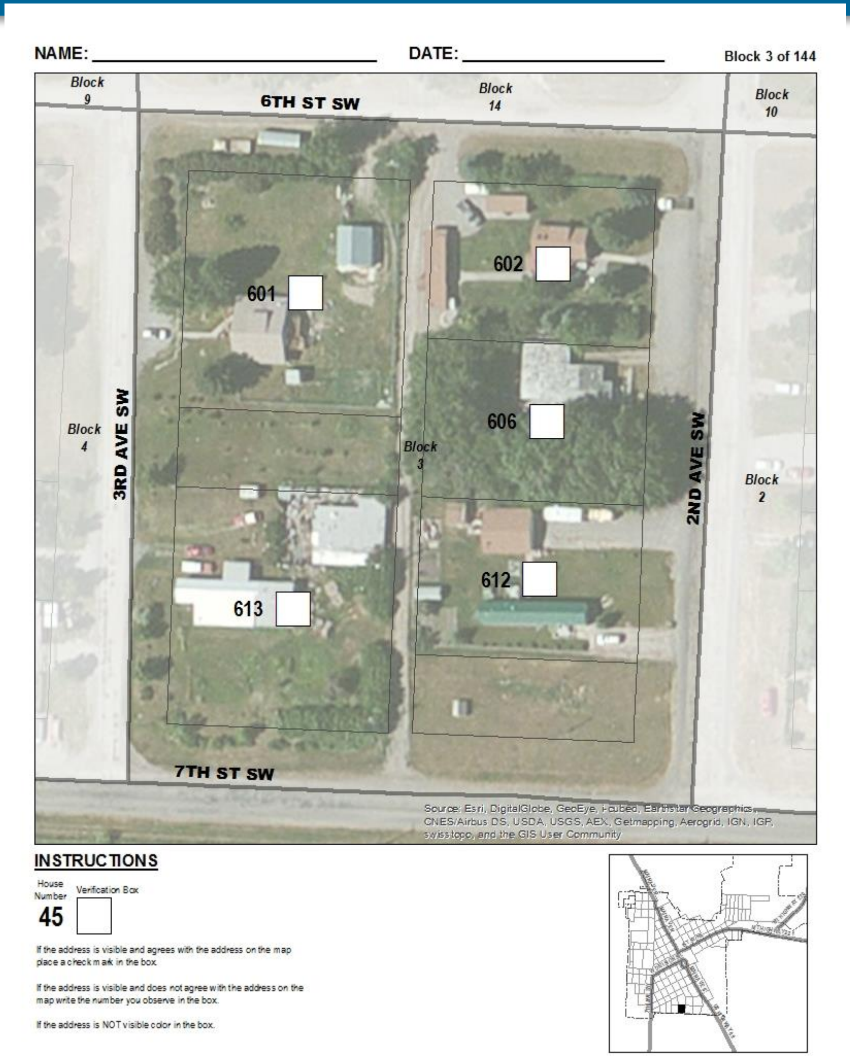
Education is one of the most important parts of the program. Without education, people in the community may have no idea what an invasive plant is, what it looks like, or why they should care. Public awareness is made through local schools, handout information, local newspapers, inviting the public to task force meetings, and electronic media. Identification of these plants by the public becomes easier, if they know what they are looking for. The new invader data base is very

Updated Roads & Infrastructure

Choteau/Teton River Floodplain

http://arcg.is/1HQWUoF

Ground Truthing Addresses in Choteau



Boy Scouts are updating and verifying addresses in the towns in Teton County

Census 2020 Voting District Project

Montana Department of Commerce

Census & Economic Information Center

State Fiscal Year 2019

MONTANA

U.S. Census 2020 Redistricting Program

Phase 1	Block Boundary Suggestions
Phase 2	Voting District Project
Phase 3	Delivery of 2020 Census Redistricting Data
Phase 4	Collection of Post-2020 Redistricting Plans
Phase 5	Evaluation of 2020 Census Redistricting

Voting District Project

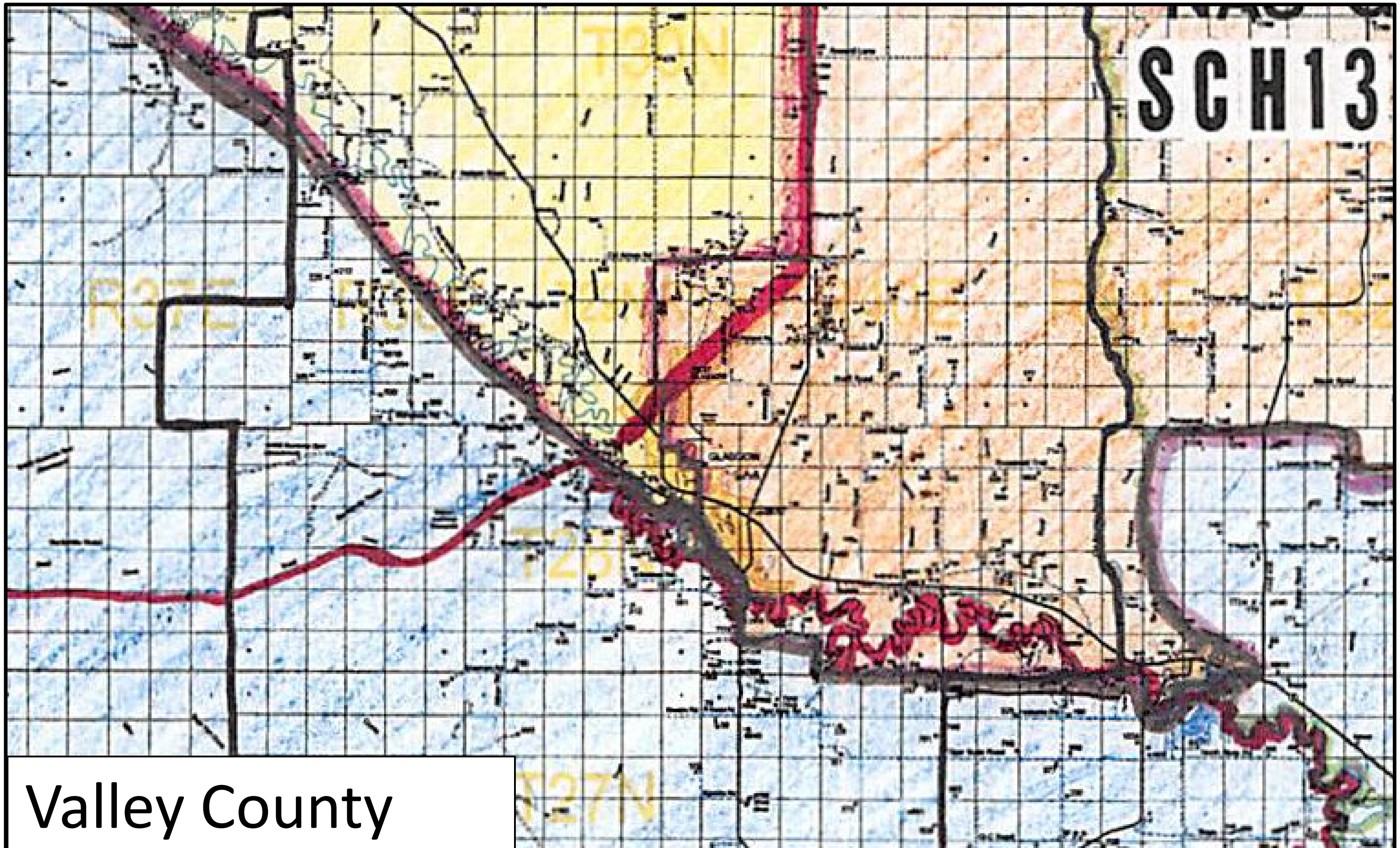
Goals & Objectives

Analyze	Analyze available voting district boundaries.
Acquire	Acquire current voting district boundaries from counties.
Compile	Compile and create GIS boundaries for all available voting districts.
Approve	Obtain county approval of final boundaries.
Submit	Submit voting district boundaries to the U.S. Census Bureau Redistricting Data program.
Publish	Publish voting district mapping application and submit report to the Montana State Library.

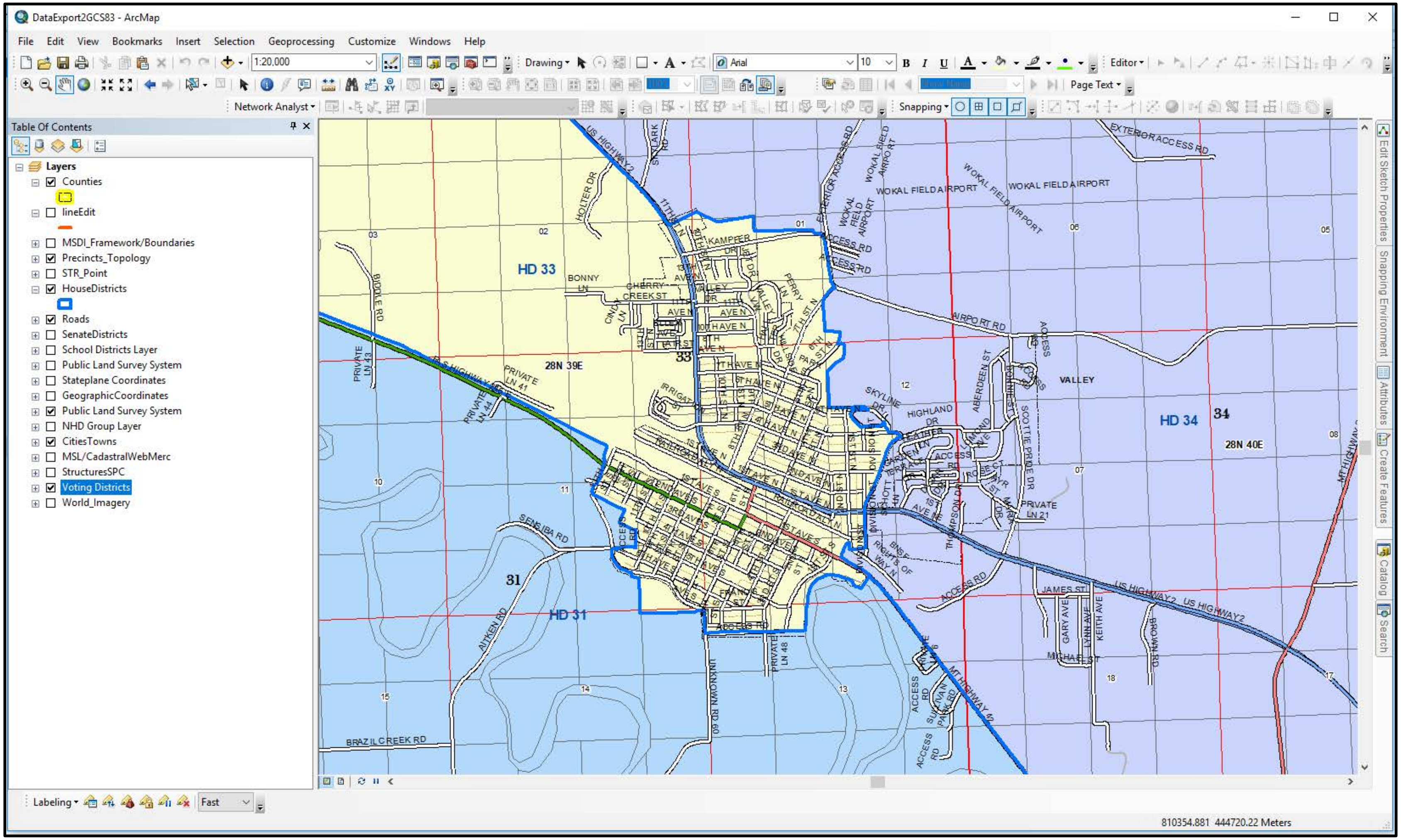
Goal 1: Analyze existing voting districts

36 of 56 counties had submitted voting districts to the U.S. Census Bureau and many were out-of-date.

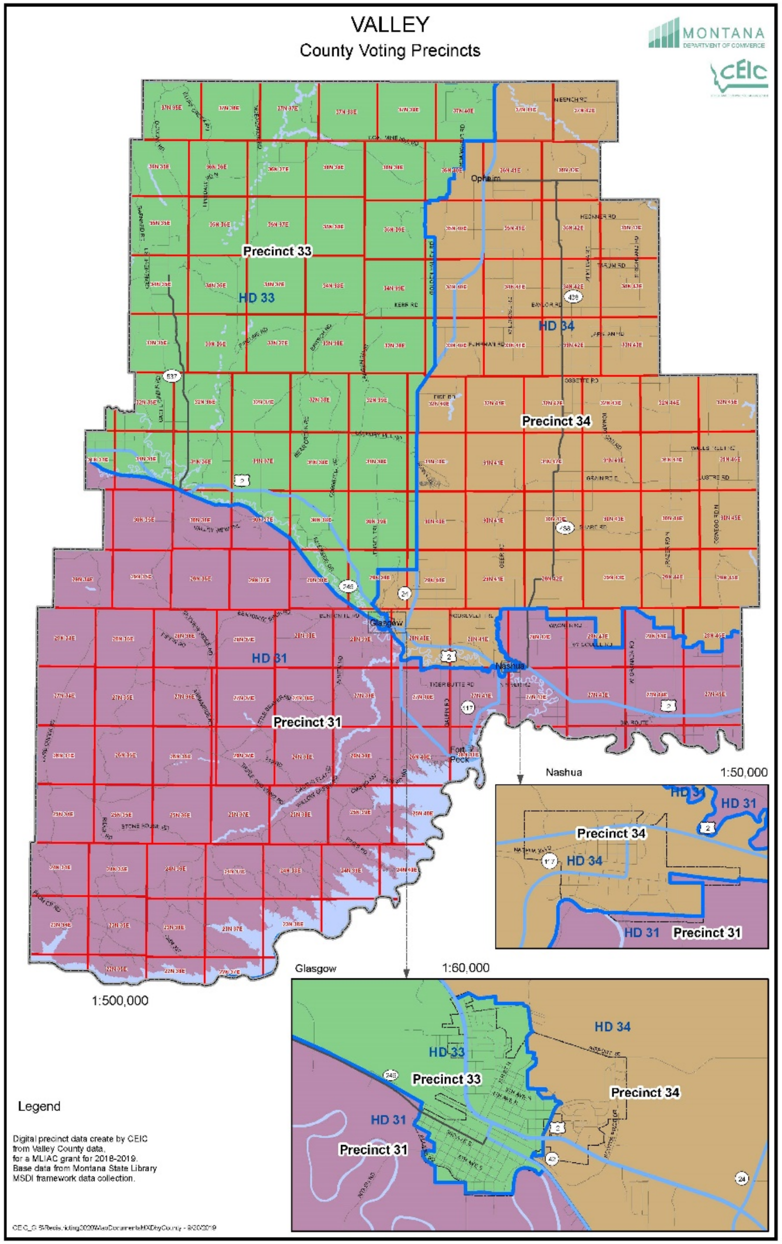
Goal 2: Acquire current voting district boundaries from counties



Goal 3: Compile and create GIS boundaries for every voting districts

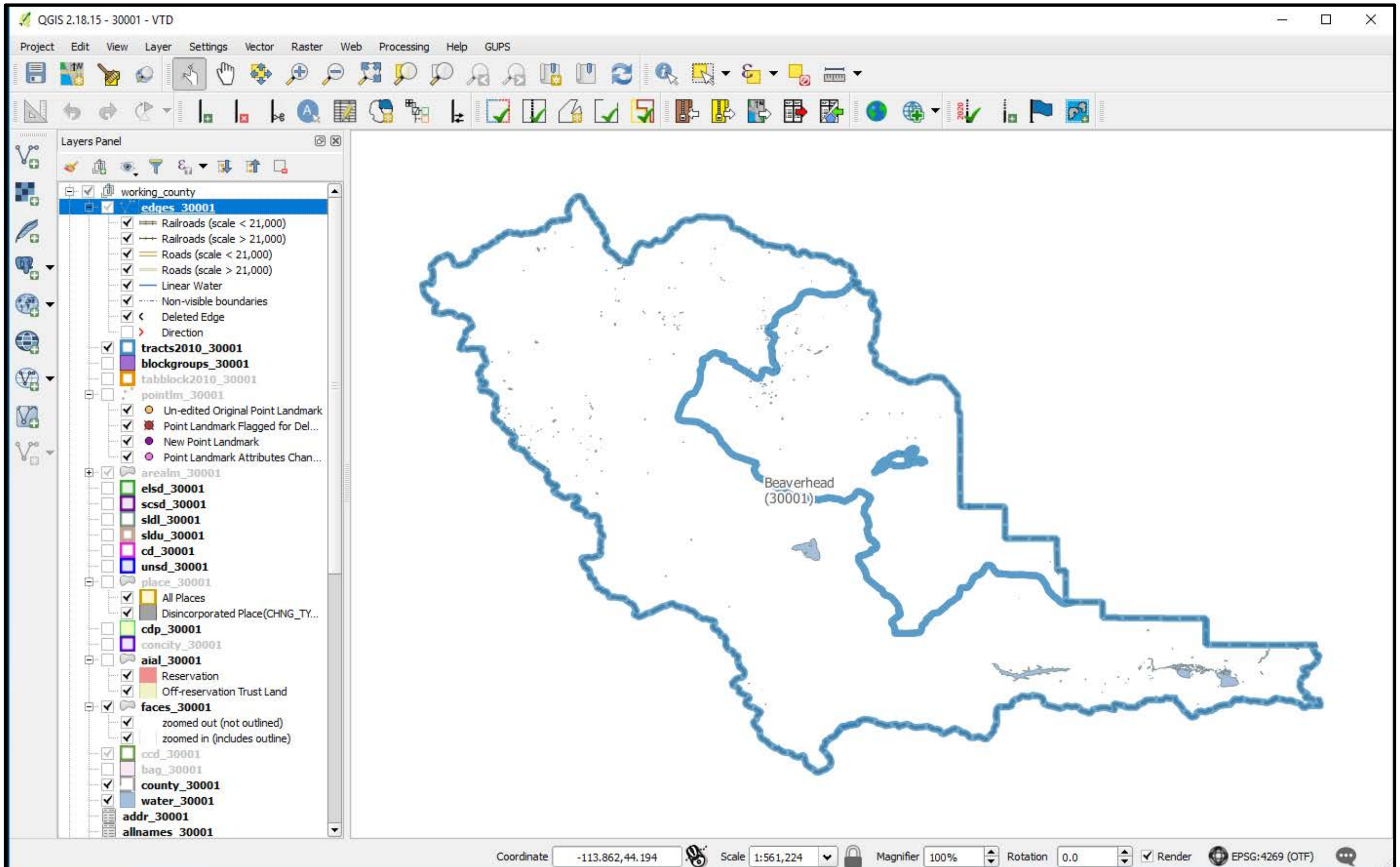


Goal 4:
Finalize voting districts and get county approval

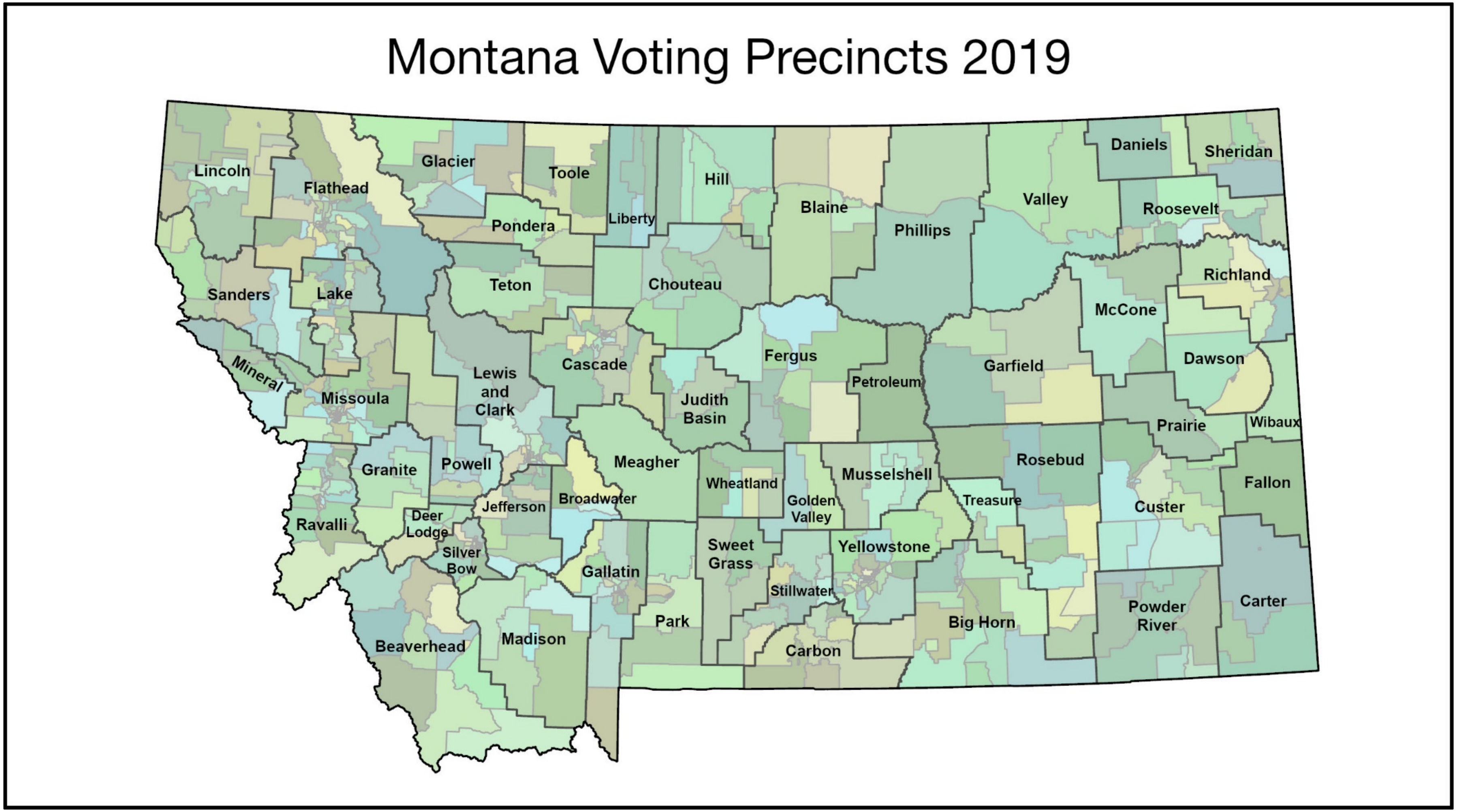


Goal 5: Provide all available voting district boundaries to the U.S. Census Bureau Redistricting Data program

VDPs submitted to U.S. Census using GUPS and SWIM in June of 2019.



Goal 6: Make voting district boundaries public and submit reports to the Montana State Library.



Next Steps

1. Montana State Library will add voting districts to the administrative boundaries in the Montana Spatial Data Infrastructure (MSDI).

2. Montana State Library and Department of Commerce will update voting districts during the Final Verification Phase between December 2019 and March 2020.

Contributors

Project Managers:

- Mary Craigle
- Tom Kaiserski

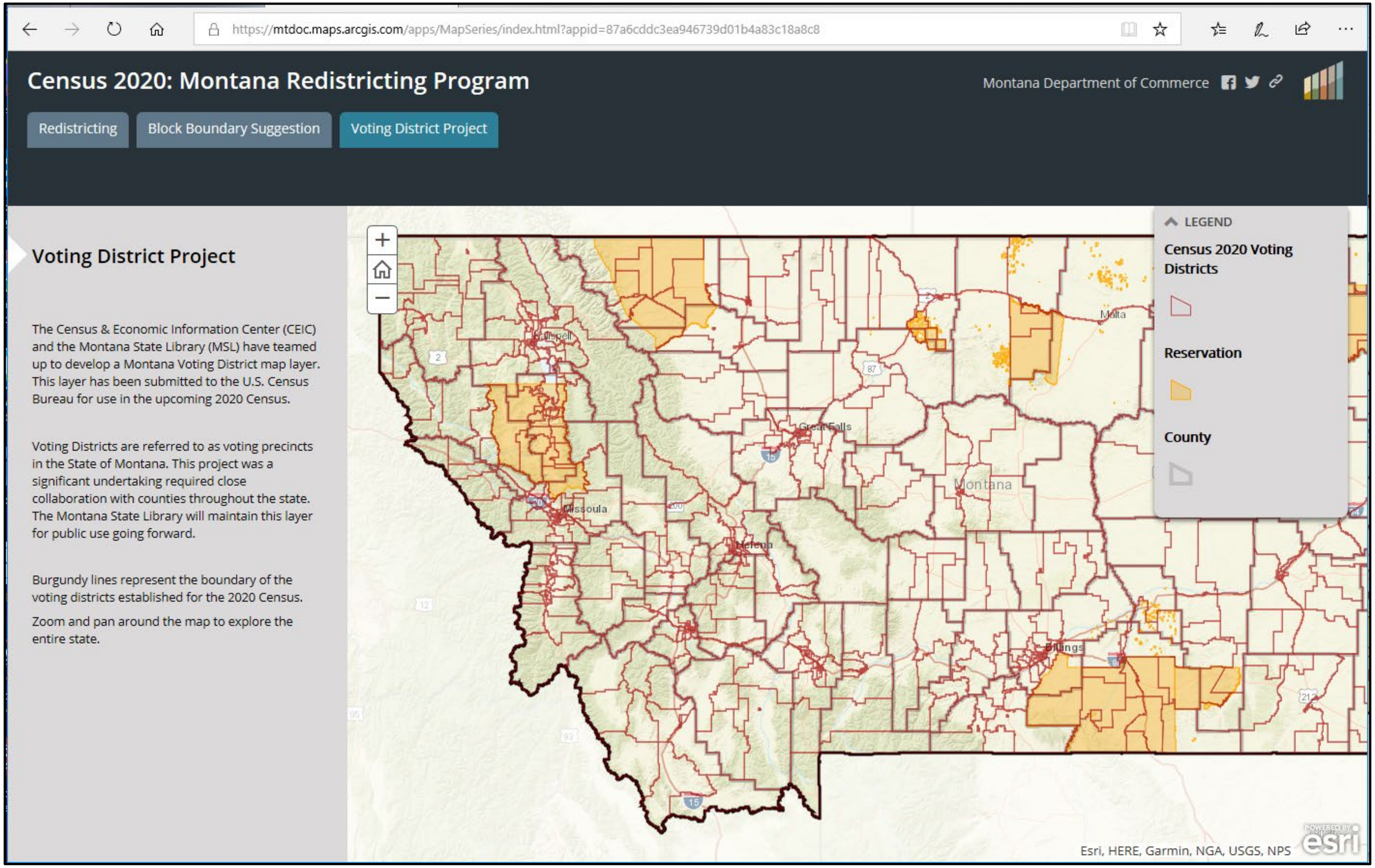
GIS Analysts:

- Leslie Zolman
- Duane Lund
- Dave Ritts

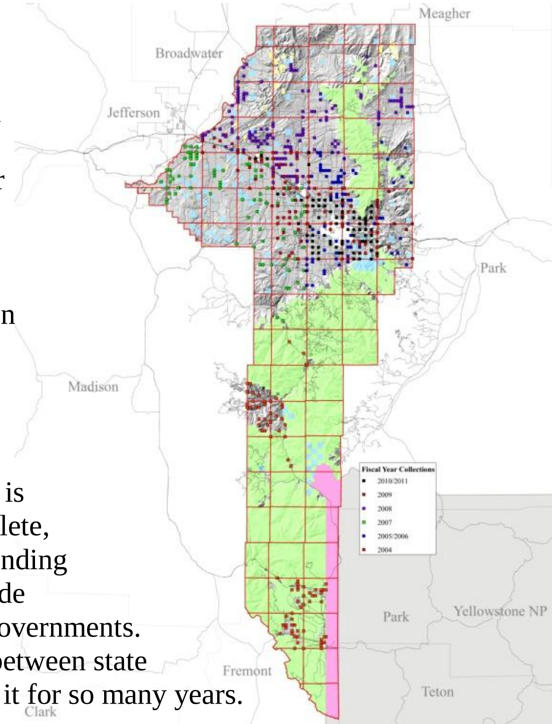
Other Contributors:

- U.S. Census Bureau staff
- County Election officials & GIS staff
- Meghan Burns - Montana State Library

Current Public Map of Voting Precincts



Gallatin County, Montana
MLIA Grant Funded Project Success



Project Summary

This successful multi-year project is an Enhancement of the Bureau of Land Management's (BLM) Geographic Coordinate Data Base (GCDB) through Control Surveys, supplementing the Geodetic Control Theme as a means for adjusting the Cadastral Theme and the Administrative Boundary Theme within Gallatin County, Montana and Southwestern Montana.

Prior to the start of this project, cadastral data was in excess of 300 feet off in numerous areas resulting in several GIS data layers that were practically unusable due to positional accuracy.

MLIA Involvement

MLIA start up funding has enabled Gallatin County to begin a program that is expected to progress steadily long after the initial joint 10 year plan is complete, thereby accomplishing the accuracy goals we have established. Available funding from the MLIA has proven to the County Commission a dedication to provide partnership assistance to strong and match-funded plans put forth by local governments. MLIA funding provided a partnership that otherwise may not have existed between state and local government resulting in project momentum and support to sustain it for so many years.

Gallatin County has developed a long-term plan that leverages MLIA funds and establishes the internal and external partnerships to enhance the Geodetic Control Theme by working with internal departments, Registered Land Surveyors, the BLM and the US Forest Service in a joint GCDB Accuracy Enhancement Process.

Expenses and Results

MLIA Fiscal Year Funding Contributions	FY2008 - $20,000
	FY2009 - $20,000
	FY2010/2011 - $20,000
	FY2012 - $10,000 (Project Underway)

Total Funds Paid to Local Registered Land Surveyors through FY2011 = $177,500

Total Project Contribution by Gallatin County through Fiscal Year 2011 = $139,572

GCDB Control Points Collected = 560   Townships Surveyed = 59

Benefits

Everyone who searches for land ownership, PLSS or administrative land information in Gallatin County benefits from this project. Registered Land Surveyors see the results of their work in partnership with our local GIS office and also jointly develop the Montana Control Point Database with the State of Montana. Additional corner records have been filed in the Clerk and Recorder's Office for future reference by the public and Surveyors/Engineers needing coordinate references.

Jurisdictional areas impacted by this project include land administered by the Gallatin National Forest, BLM, National Park Service, State of Montana and Gallatin County, as well as the Municipalities of Bozeman, Belgrade, Manhattan, Three Forks and West Yellowstone. Gallatin County data is made available through an on-line map application to all GIS and non-GIS professionals.

Submitted by: Gallatin County, Montana - Allen J. Armstrong, GIS Manager - March 29, 2012

The Small Rural School's Guide To Developing School and Community Geographical Information Systems

Swan Valley Elementary School District 33

October 2013

Prepared by John K Mercer, Trustee

Swan Valley Elementary School District
6423 Highway 83 North
Swan Valley, MT 59826

Phone: 406 754 2580
Web: http://swanvalleyelementary.org

Swan Valley Elementary School District
6423 Highway 83 North
Swan Valley, MT 59826

Mercer, John K.
The small rural school's guide to developing school and community geographical information systems

Contents

Preface

At the Swan Valley Elementary School we believe that we must prepare our children for life in the 21st century. We also believe that the school's role in increasing knowledge and learning extends to our greater community of family members and adults and that the school plays an important role in the life of the community. Information technology is an area where the Swan Valley Elementary School works hard to ensure that our children and our community doesn't end up on the wrong side of the digital divide. Toward that end the school has over the years been a leader bringing new technology into its curriculum and the community.

This booklet describes our pathway for developing a Geographical Information System (GIS) for the school and community. It offers a road map of sorts for other schools interested in this technology. It together with the companion video are available at http://swanvalleyelementary.org and are products of a Montana Land Information Advisory Council (MLIAC) grant supporting our efforts. The MLIAC grant provided the resources and incentive to undertake this journey.

John K Mercer

Acknowledgements

This story would not be possible without a grant and support from the Montana Land Information Advisory Council, and the State Library Commission. Stewart Kirkpatrick, the Montana State GIS coordinator and Jennie Stapp, State Librarian were also supportive.

There are a number of individuals and organizations essential to this project. Ken Wall of Geodata Services Inc. was our consultant. ESRI, or Environmental Systems Research Institute, provided us with software and cloud resources, and the Montana educational state site license coordinator for ESRI, Jeff Crews was invaluable.

The school board and Chris Stout our principal took a risk on this program, investing staff time and resources. Angie Williams our supervising and junior high teacher and technology coordinator was willing to learn it on the run. And the teachers and members of the GIS learning cohort had the patience and commitment to learn new technology. The students showed us how quickly they grasp this technology, and finally, most importantly the families and residents of the Swan Valley supported the school and the students in learning this new technology.

This project leverages earlier work funded by a grant from Montana FWP to the Swan Valley Community Council (SVCC) and sponsored by Missoula County Rural Initiatives to develop Swan Valley GIS data layers. This report documents our efforts as a MLIAC funded pilot project and tells the story of how we did this, so other communities can benefit.

Introduction

GIS stands for geographical information systems. It is a collection or set of tools that grew out of the computer revolution of the 70's and 80's. In the simplest terms, a GIS joins a relational database with spatial information. In a GIS almost any kind of data can be related to other data and also to physical locations either as a point, or as a collection of points in the form of lines and/or a polygon. Google Maps are an example of a GIS.

As personal computers became more powerful, GIS systems that were once the domain of high tech and big mainframe computers migrated to mini-computers and then desktops. Recently it became available through the Internet, becoming what is often called "cloud based." In this last iteration, the software resides on server farms accessible through the web browser software and the Internet. With each step, the technology has become more sophisticated, powerful and easier to use. This has profound implications for small rural schools.

Many organizations and agencies heavily use and rely on GIS tools, data and models. Schools are relative newcomers to this technology. Larger school districts use it to plan and manage bus routes and develop enrollment projections as well as building and grounds maintenance and project coordination. Students use it as a diverse tool organizing and presenting many different kinds of information with spatial context and location.

Outside of schools, GIS is a maturing tool assisting land management in much of Montana. It is becoming commonplace and prevalent throughout many work environments and applications. Geospatial technology, reasoning and information systems, sometimes collectively referred to as "GIS" is used in rural communities in a variety of ways.

For example our community is in a long narrow rural valley 75 miles South of Glacier Park, with the Swan Range and the Bob Marshall Wilderness Complex to the east and Mission Mountains Range and Wilderness to the west. Here there are at least six different federal, state and county agencies and nearly that many again private national organizations with well-developed GIS programs for the Swan River Valley, Clearwater River Valley and all the lands surrounding the Bob Marshall and Mission Mountains.

GIS is often used in developing management policy and implementing resource use decisions. For example, when seeking a building permit, GIS technology is applied extensively to both collect and present information about the proposed project as well as to model the potential impacts associated with the project. It plays a major role for counties in deciding whether land can be subdivided. It is central to federal and state natural resource planning. GIS models and data presentations often drive agency decisions about road closures, grizzly habitat, other endangered species, as well as a host of other resource decisions.

Given the prevalence of its use, our local elementary school, students, parents and community, were at a distinct disadvantage when it came to GIS information and tools. It was hard to access and use the vast amount of information available for teaching students, for local community planning efforts, and private land management. In our community and school we had very limited capability to use these tools and data in the classroom and community activities. The biggest barrier was that most people didn't "speak GIS," and if they did, there was no available infrastructure to support them or the community.

Taking on the GIS challenge

Swan Valley Elementary School recognized the need to develop GIS technology in the school and community. And we realized early on that our focus was not to introduce GIS technology as a stand-alone subject matter in the curriculum. Our goal was to see our students using GIS tools and geospatial reasoning on a regular basis across the curriculum facilitating the learning process of already established curricula. We wanted the tool to be used, not studied. With this in mind, we submitted a grant request to the Montana Land Information Advisory Council (MLIAC). We requested MLIAC support in introducing GIS data, tools and training for the Swan Valley Elementary School and Community. The school provided matching funds and in-kind support to bring the project to fruition. This project met the goals of the MLIAC by promoting the use of GIS tools and data layers within the school and community.

This project is called: *Increasing the awareness and use of Geospatial data and Technology in Small Rural Schools and Communities*, and has the following goals:

Goal 1. Develop onsite capacity to operate a geographical information system for teaching and community access.

Goal 2 – Develop capabilities of teachers, and select community members to understand and transmit knowledge about geospatial tools and data.

Goal 3 – Complete curriculum development incorporating geospatial reasoning and tools in the school and develop GIS applications to real life community problems.

Goal 4 – Provide a model prototype process and make presentations on how small rural communities can use their local schools to develop better GIS resources, access and uses within the community.

What is GIS?

Environmental Systems Research Institute (ESRI) is the leading company providing GIS products to a global market. ESRI provides us with the following definition:

> *A geographic information system (GIS) integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information.*
>
> *GIS allows us to view, understand, question, interpret, and visualize data in many ways that reveal relationships, patterns, and trends in the form of maps, globes, reports, and charts.*
>
> *A GIS helps you answer questions and solve problems by looking at your data in a way that is quickly understood and easily shared.*
> *(http://www.esri.com/what-is-gis/)*

A GIS is a powerful tool for organizing data into meaningful information about relationships with other data and locations in time and space. It allows an individual reading a map to select specific data related to a specific set of criteria. The criteria can be organized into themes with a table of contents so the user of the map can add layers of information to a real world base map. All of this can be presented interactively in real time.

For example students at SVES located all of the historical homesteader schools that ever existed in the Swan Valley. This was placed in a layer on top of a base map showing topographical features. Each school site has a specific location with historical data of the year(s) the school was operating and the name of the school. Pictures, images, and audio video clips can be attached also. From this map the students analyzed the historic data. Conclusions or theories about the schools were inferred from their location. For example, the historical schools are about a couple hours ride by horseback from each other. The inference from this is that they are close enough so that the kids can get to school and back home during daylight hours in the wintertime and do their chores.

GIS is a powerful tool that for use in any field of knowledge that deals with data located in time and space. It can integrate data from many different sources and process it, producing maps organizing and displaying the data and transforming it into information. These maps are interactive. On screen the user can scroll a map in different directions, zoom in and out to view data at different scales, click on points or polygons to reveal more information. Maps can be layered and made visible or invisible and visually combined with other layers.

This interactivity stimulates an intuitive and cognitive grasp of the information through asking "what if" questions that reveals relationship and connections between the data and its location. This is illustrated in one student project that mapped the meteor impact in Russia last year. From the map, the students noticed that the lakes in the region were similar in size and shape and began to wonder about their origin.

Thinking about things and places oriented in time and space is a basic skill. At a fundamental level it is practiced daily as we decide where to go, and how to get there. More complex questions about how things fit together require more advanced reasoning. For example students working on a school project asked how did the eruption of Mount St. Helens in 1980 change the landscape, or where did the hurricane Katrina do the most damage? Students used geospatial reasoning when developing different scenarios for managing a forest in the Swan Valley, or making a map of events in a historical novel about World War II. These are all questions that GIS can help students answer. And in fact some students in SVES have used GIS to make maps answering these and many other questions.

For more information on GIS see:
http://www.esri.com/what-is-gis/~/media/Files/Pdfs/library/bestpractices/essays-on-geography-gis.pdf

What is geographic reasoning?

ESRI offers the following thought:

> *Geography is the science of our world. Coupled with GIS, geography is helping us to better understand the earth and apply geographic knowledge to a host of human activities. The outcome is the emergence of The Geographic Approach—a new way of thinking and problem solving that integrates geographic information into how we understand and manage our planet. This approach allows us to create geographic knowledge by measuring the earth, organizing this data, and analyzing and modeling various processes and their relationships. The Geographic Approach also allows us to apply this knowledge to the way we design, plan, and change our world. (http://www.esri.com/what-is-gis/overview - geographic_panel)*

There are five basic steps in the geographic approach and geographic reasoning involves using these steps to address a problem.

1) The first step is to ask a question from a spatial or location based perspective. This means that the question is framed in the context of location and involves the use of "where" questions.

2) Once the question is stated then it is necessary to identify what is needed to answer the question. The scope and extent of the question and geographic area under consideration will help determine what data is needed and how it is tied back to location and what is the best way to collect the data.

3) Once the data is collected then it is necessary to examine it and make sure it is appropriate for answering the question.

4) The data is analyzed. Sometimes this involves "looking" at the data as displayed visually through maps or at times it may involve more sophisticated modeling using interactive GIS tools.

5) After the analysis, the information is shared through maps, narratives, story maps and other visual tools. These can be published to work groups or over the web to larger community of users.

What can GIS do?

GIS lends itself well to the classroom and students working on projects and assignments. With GIS you can map people, plants, animals and items of interest, locating them in time and space. This helps you identify places where you can find those things and see patterns of how they are located. You can map numbers or amounts, and identify places with a higher or lower density of occurrence. You can map what is inside of an area and/or find out what is outside or nearby and finally you can map changes in an area, looking at historical change or using modeling tools to project future changes.

For example, in the Swan Valley, students and teachers in SVES used GIS tools and resources for student community mapping projects throughout the 2012-13 school year. Teachers integrated GIS maps into different curricular areas such as social studies and reading.

The seventh and eighth graders built maps based on their history unit of World War II. Each student studied a different aspect of the war and put significant locations into the map. They also built maps based on books they read that were in different parts of the world. They would add descriptions of each location as it was described in the book. These students also developed GIS projects about a variety of natural disasters and presented them at open houses for the community (examples are shared in the companion video).

The fifth and sixth graders used ArcGis for Social Studies. They mapped Russia and some European countries, pinpointing important locations and adding information and pictures to the pins. They created interactive geographic quiz maps of Montana and the Swan Valley modeled after geographic quiz maps created by the National Geographic Society. These are base maps with questions about pinned locations scaled to be hidden until the user applies their local knowledge to zoom into the vicinity of the correct answer.

Outside of the school, a community member used GIS compiling data layers for the local planning committee. He said about his progress:

> *"We now have accurate and complete Cadastral information for every private land parcel and Conservation Easement in the Swan Valley Study Area. And we have accurate and complete CAMA data records for every residential dwelling in the Swan Study Area. We can tabulate, map, and visualize where and how growth has occurred over the last 100 years. This allows us to paint a picture of growth by year or other suitable time period, organized by different characteristics of the parcels/dwellings. (John Keller, Personal Communication)*

Another community member is developing a fire history data layer documenting fire control efforts along with photographs. She says*:*

> *"In 2012 I used GIS to create the first draft of an interactive fire history map in a learn-as-I-go process. I am continuing to work on my fire "History Map for the Swan Valley" as an interactive tool that allows people to easily compare conditions on the land from 1899 – present, using photos and text from the U.S. Geological Survey for the Lewis and Clark forest Reserve by H.B. Ayers (1899), 1934 aerial photography, and photos of recent fires, all overlaid on a fire history map, an ownership grid, and the most current satellite imagery for the valley. Residents can learn about the effects of wildfire over time on their private land, on adjoining public and private properties, and throughout the watershed." (Anne Dahl, Personal Communication)*

What are the components of a GIS?

GIS is not just hardware, software, data or electronic maps. It is a system with primary components that interact to produce answers to questions and products. These help solve problems or tell stories about places, things and people. It helps elucidate and illuminate relationships. The system includes hardware, software, data, and the people that use them. All four of these components are important to consider when thinking about GIS.

Hardware is the physical equipment that houses the GIS. Originally this was on large mainframe computers. Today GIS can be operated on desktops, laptops, tablets, pads, and even phones. Central to this is the computer network, including both the local area network and the Internet. Other hardware is also important and includes input devices, such as keyboards, scanners, pen tablets etc. Storage devices such as hard drives are used to store data. In the Swan Valley we have a dedicated server and onsite hardware resources, a local area net and high-speed fiber optic Internet access.

Software directs and controls the actions of the hardware. Software changes rapidly, with several updates each year and annual release of newer versions. There is a multitude of software GIS options available that will run on a variety of hardware platforms and serving differing purposes. In the Swan Valley we are using ERSI software, ArcGIS desktop 10.1, ArcGIS explorer and ArcGis online.

A GIS system is useless without data. GIS works with data that is either spatial or attribute. Spatial data is a specific location or where something occurs, while attribute data describes the what, when, who or how characteristics link to specific things or events. Data is organized, sorted, analyzed and selected through relational databases. There is a tremendous amount of data that is available for use by schools in GIS. Data can also be generated through student research and projects and entered into and used in GIS. In the Swan Valley we have data sets specific for the valley that are available as well as a plethora of information available through the Montana State Library GIS portal and other national and international data sets.

The final component required for a true GIS is the people who use it. The term "user" refers to any individual, group or organization that will use GIS to support project or program goals, or even to an entire organization that will employ GIS in support of its overall mission. In the Swan Valley we designed our GIS for use by students, teachers and community members.

How does a school develop GIS technology?

The answer to this question is it depends. The technology is changing so rapidly that in the duration of the SVES project new options for cloud based GIS became available and it is likely they will become increasingly more attractive for schools seeking GIS technology.

There are two differing approaches to bringing GIS technology into a school. One involves having the software and much of the data resident or associated with existing hardware, desktop computers, networks, servers and workstations in the school facility. SVES implemented this approach using ArcGIS Desktop 10.1 on stand alone desktops attached to a local are network and the school's server. At one point, we considered using ARCGIS Server software so that we would have greater capacity to publish maps to the school's network and the Internet.

The other approach is to use GIS through a cloud based subscription, where data is hosted on remote servers and accessed locally with desktop software or web browser software. When the cloud based ArcGIS online subscriptions was released by ESRI in the middle of the project, we began to move in this direction. The advantages of this approach allow members of an organization such as a school, the functionality of a resident desktop/server based system without the need for the supporting infrastructure to be hosted and maintained locally.

It does require web access and a reasonable bandwidth, but is not location dependent. This means that students can access both the software and their data from anywhere, at anytime and almost through any device that can access the Internet. This results in true portability and lets students and community members use, build and save maps without having to come to the school. For more information see: http://resources.arcgis.com/en/help/arcgisonline/index.html - //010q00000074000000

When weighing the pro and cons of these two different approaches the school may want to consider the following.

Lean toward on-site resident system	Lean toward offsite cloud-based system
Have server, desktops, etc.	Lacking hardware
Have tech support onsite	Lacking onsite tech support
Lacking suitable internet access	Have good internet access
Intend to teach GIS as a content area	Intend GIS as tool to support curriculum
Mostly use unique data sets	Mostly use web based data sets
Generous technology funding	Very limited technology funds
Unique map authoring and analysis	Authoring maps using base maps

For many small rural schools, it will be hard to find compelling reasons to develop a stand-alone GIS system. The problems associated with hard and software upkeep tends to outweigh any advantages that come from having the stand-alone system. Basic GIS analysis procedures are now added to ArcGIS.com map viewers, and more are being planned for upcoming software releases. Examples include buffers, overlays, geo-enrichment tools and spatial and database filters and queries. The web viewers and map templates also allow mash-ups, combining data from multiple sources. More advanced geospatial processing is available on the desktop, but elementary and middle school grade levels usually do not require these more advanced analysis.

The exception to this would be the small rural school that does not have Internet access or has very slow poor quality or unreliable access. See the following link for comparison chart of different tools.
http://edcommunity.esri.com/~/media/Files/EdCommunity/ESRI_sw_quickview_201305.pdf

Either way, the school will need the following to develop a GIS program. The first is a champion that is willing to work hard to bring GIS into the school. This can be a teacher, administrator, trustee or community volunteer. They need to be committed and if not knowledgeable, very willing to learn. If the school's GIS champion is not an advisor/expert that is knowledgeable about GIS and can answer questions and help problem solve with both hard and software as well as teach basic GIS, then the school will need to find such an individual. This person can be either a paid consultant or a community volunteer. Next the school needs a core group of teachers willing to bring GIS into their classroom. It is helpful to have community members also involved as they can help spread the word. Finally the school needs to establish a budget that supports the GIS project.

What the Swan Valley Elementary School did

At the Swan Valley Elementary School we implemented our GIS program through four key steps.

1) We developed onsite capacity to operate a geographical information system for teaching and community access (Goal #1).

This required upgrades and additions to our current computer systems. SVES had 20 computers linked through an Ethernet network to a server and to the Internet with a high speed DSL through Blackfoot Co-op. In addition, we added four SMART Boards, which are linked to each teacher's computer. To develop the capacity to operate a GIS using ESRI software we needed to increase the RAM in our student systems, build two additional workstations and add a new server. We acquired ESRI ArcGIS Desktop 10 software, ESRI ArcGIS for Server, ArcGis Explorer and MS Server 2008 and 2008 Server Client Access Licenses. The server uses a RAID for data redundancy and security. Additionally, it is backed up monthly on a third stand-alone drive and stored off site.

For data, we have a set of 31 SVCC data layers developed by GeoData Services Inc. for the Swan Valley Community Council. These layers are an important resource for the school and community. They are designed to accompany the Swan Valley Growth Planning Committee's Swan Valley and Community Profile and support the community envisioning process http://www.co.missoula.mt.us/rural/communitycouncils/SwanValley.htm. These were produced through a grant from MT FWP sponsored by Missoula Rural Initiatives and provided to the community council. A number of these layers have unique data. An important purpose of this grant was to make these layers available to the students, the community, SVCC, the planning committee and agencies. These data layers also form the basis for future work with community and county organizations.

2) We developed capabilities of teachers, and select community members to understand and transmit knowledge about geospatial tools and data (Goal #2). This required a core group of teachers and influential community members who became our first GIS learners and ambassadors of geospatial reasoning and information systems. These individuals needed instruction in fundamental GIS concepts, how and when to use GIS tools, and workflow design. They received an introduction to the SVCC data layers, and how to use them in the training sessions. Training was a combination of in-class course work as designed by ESRI, and additional instruction via online courses, WebEx, group and individual coaching. In addition to training, we provided each learner with a copy of ArcGIS for Home Use. Training services, coaching, and project design oversight was provided by Ken Wall of GeoData Services, Inc. and delivered in Missoula at the School of Forestry GIS training lab and/or onsite at SVES.

3) Our next step was completing curriculum development incorporating geospatial reasoning and tools in the school and developing GIS applications to real life community problems (Goal #3).

We provided coaching and directed support for our GIS learners about project design and implementation. During this time, teachers developed GIS lesson plans and resources. For grades 5-8 they developed lesson plans in multiple subject areas using Spatial Reasoning and GIS resources as adjunct teaching tools supporting the school's curriculum. Community learners used GIS to address specific community problem such as developing a fire history map or completing data layers and generating maps for the planning committee to display important information relevant to community concerns and issues generated through the visioning process.

4) Our next step was articulating our prototype process and making presentations on how the school developed and used GIS resources building awareness and support of the GIS program.

We held open houses for the community, showcasing the student projects. We documented the project and its steps and wrote *The small rural school's guide for developing school and community geographical information systems.* We develop a video webinar/podcast to accompany the booklet. These are available on line at http://swanvalleyelementary.org

We presented this information at conferences, and submitted articles to local newspapers. This information is available electronically for the many small communities like the Swan Valley found all over the state with names like Bynum, Cardwell, Paradise, Lustre, and Helmville. They stand to benefit from developing GIS knowledge and tools in many of the ways we do in the Swan Valley.

Conclusions

Developing a GIS system was challenging and was a risk in the sense that it required an investment in time and resources for the school district. But it was also rewarding and stimulating for the school, the teachers, students and the community as a whole. For a small rural community like the Swan Valley, it opens up doors to a much larger and greater world encouraging our students to learn in ways that they did not have before. This next year we will be using the GIS across the general curriculum as well as for specific projects, including developing an experimental school forest with permanent research plots. We will produce a second volume to this booklet and video after we have had a full year of using the GIS that describes in more detail the outcomes and benefits of using GIS in a small rural school.

In closing, we encourage educators, administrators, and trustees to work with their schools to acquire this technology. We invite schools and educators to come and visit and see the GIS program in action and please contact us if you have questions.

Resources

There are a tremendous amount of GIS resources available online through ESRI. The gateway to these resources is http://www.esri.com

http://www.esri.com/industries/education is a link dedicated to education and education resources.

http://www.esri.com/industries/k-12 Resources specific to k-12 education

http://edcommunity.esri.com this is the link to the online education community. This is a great place to become familiar with the community maps and projects sponsored by schools using GIS.

http://edcommunity.esri.com/Resources/ArcLessons A link to lesson plans for a variety of grade levels and subjects using GIS tools. These are complete fully developed out of the box plans that teachers can implement.

http://edcommunity.esri.com/Resources/Webinars This is a link to a variety of instructional "how to" sessions designed for teachers. These can be downloaded for free and viewed at your convenience. We recommend that any educator interested in GIS view *Where Do You Start with GIS in Education?* Featuring Charlie Fitzpatrick of the ESRI Education team for a good introduction and overview introducing the technology.

http://edcommunity.esri.com/Resources/ebooks This link lists a number of white papers or ebooks that can be downloaded. We recommend *What is GIS?* This is a useful collection of essays for schools to have introducing GIS.

http://edcommunity.esri.com/software-and-data is a link to the page that describes the different GIS platforms and their advantages and disadvantages for schools, including ArcGIS for Desktop, ArcGIS Explorer and ArcGIS Online. http://edcommunity.esri.com/~/media/Files/EdCommunity/ESRI_sw_quickview_201305.pdf is a chart that compares the different options.

http://www.esri.com/~/media/Files/Pdfs/industries/university/academic_programs/pdf/site-license-overview.pdf Describes the educational Site license program through ESRI. This can provide schools with ArcGIS software at no cost through the State Site License Program. The State Site License Coordinator is Jeff Crews who can be reached at jeff@spatialsci.com The Site License link for Montana is http://www.spatialsci.com/index.php/sID/aa017b03/fuseaction/programs.cms.htm

http://training.esri.com/gateway/index.cfm This link is to the training resources offered through ESRI. Many are available online and some may be offered free to educators through the school's site license.

http://www.magip.org This is the link to Montana Association of Geographic Information Professionals. This is a good resource to locate a GIS consultant or expert to help with the implementation of GIS in the school. It is also a good resource for information about various GIS conferences, training sessions etc.

http://about.montanastatelibrary.org/commission_councils/mliac/ This is the link to the Montana Land Information Advisory Council. Stewart Kirkpatrick is the State GIS Coordinator and can be reached at: mailto:SKirkpatrick@mt.gov

This is the link to the Montana Cadastral that has tremendous amount of data about land ownership, tax information and developments http://svc.mt.gov/msl/mtcadastral/

http://nris.mt.gov/gis/default.asp This is the link to the Montana Geographic Information Clearinghouse that is the "Most comprehensive collection of geospatial data for Montana." http://geoinfo.montanastatelibrary.org is the link to the new upgraded web portal to geospatial information hosted by the Montana State Library. This is a good data source for schools seeking to develop local community maps.

http://nris.mt.gov This is the link to the Montana Natural Resource Information System (NRIS). This is a good data source for schools seeking to develop community maps about local natural resources.

http://fwp.mt.gov/doingBusiness/reference/gisData/dataDownload.html This is the link to the Montana Fish Wildlife and Parks GIS data.

http://www.geodataservicesinc.com/Pages/default.aspx This is the link to the company that contracted with SVES. Ken Wall is very knowledgeable about GIS and can answer technical questions about the implementation of the SVES GIS program. He can be contacted at mailto:kwall@geodataservicesinc.com

This is the link to the web maps developed specifically for the Swan Valley http://geodataservices.maps.arcgis.com

http://swanvalleyelementary.org This is the link for the Swan Valley Elementary School.

mailto:jkmercer@mac.com This is the contact link for John K Mercer, the trustee who championed the GIS project for Swan Valley Elementary School.

mailto:awilliams@swanvalleyelementaryschool.com This is the contact link for Angie Williams, the Supervising and Junior High Teacher who championed the GIS project for Swan Valley Elementary School. She is also the Technology Coordinator for the school.

The City and County of Butte-Silver Bow has been the recipient of two (2) Montana Land Information Act (MLIA) grant awards in recent years. The first project was to update and improve the attribute and spatial accuracy of our land ownership (cadastral) database, and the current project (in progress) will allow us to modernize the methods of managing, and strengthening our capabilities to maintain the digital representation of our Sanitary Sewer System. The ultimate goal of our efforts has been to provide the most complete, accessible, maintainable and accurate Geographic Information System (GIS) databases to support various City-County, State, Federal and private sector applications and mapping projects.

The results of our partnership with MLIA have provided an organized structure and environment in which to concentrate our efforts of providing the long-term compilation, preservation and utilization of GIS data. The grant opportunities have allowed us to focus efforts on enhancing the data integrity and functionality of existing datasets for all facets of community development, including public health, emergency response services, economic development, land use planning, sensitive resource protection and physical infrastructure improvements. The resulting capability to deliver the most current and reliable data has generated a marked increase in use by various Butte-Silver Bow Departments as well as the private sector businesses.

For example, the Sanitary Sewer Improvement project includes point features representing all associated manholes, a standard attribute of the infrastructure. In addition, the updated dataset will also include an attribute referred to as "cross connections," which are troublesome locations where the sanitary sewer main is conjoined with the Storm Water System. The enhanced, more accurate database is now used by public works personnel in the field to identify and then eliminate these potential points of untreated sewage discharge into Silver Bow Creek, at the headwaters of the Upper Clark Fork River.

Considerable resources have been expended to update other Butte-Silver Bow databases: the Storm Water System (Fall 2008 and Spring 2009); the Cadastral Data was upgraded and realigned to the Geographic Coordinate Database (2009); the availability of current aerial photography from the Montana Base Map Service Center has facilitated improvements to the E911 Street Centerline and the Building Footprint databases.

The integration of all available resources, including the timely MLIA grants and the developing partnerships that promote data and technology sharing, has been instrumental in addressing and resolving core business issues here at Butte-Silver Bow. These results are encouraging departments to identify more GIS applications that can assist them in their ongoing work to manage assets and deliver services in the best interests of the community.

terraGo TECHNOLOGIES

Case Study Draft

Carbon County, Montana Improves Public Safety with TerraGo® GeoPDF® Maps and Imagery

Carbon County, Montana, located in the south central part of the state covers more than 2,000 square miles- nearly double the size of Rhode Island. Encompassing the Custer National Forest and the northeast entrance to Yellowstone National Park, the scenic, rural county is home to approximately 10,000 citizens.

In 2004, Carbon County implemented a new standardized addressing system to help first responders react more quickly to emergency situations and prepare for enhanced 911 (E-911) phone service.

However, the new system was initially met with confusion. The county was too big for dispatchers to know all areas by heart and not all stakeholders had sufficient computer resources or training. In addition, a number of county locations had multiple addresses for a single site and it was a challenge to provide the new address system to both public safety personnel and the public in a way that was economically feasible.

County seat Red Lodge Fire Dept. volunteer Tom Kohley understood these challenges well and, as a GIS consultant, knew that publishing geospatial data was the key to overcoming these obstacles. Working with Carbon County's Disaster and Emergency Services (DES), he helped secure a grant to implement the Carbon County GeoAtlas project.

"The fact that we had to accommodate a wide range of end users was a big challenge," said Kohley. "We have some departments that are very sophisticated like Red Lodge, but others with volunteer forces and few computer facilities. We needed an end product to serve both, and one that was extremely easy to create and distribute in both digital and printed versions."

Kohley and the DES started with base map files from the U.S. Geological Survey (USGS). From the base maps, the team used Esri ArcGIS 10 software to prepare map files. Next, using TerraGo® Publisher™ for ArcGIS, the team produced interactive, portable and intelligent GeoPDF® maps and imagery that allow users who do not have access to sophisticated GIS or advanced training to access, dynamically update and share compact geospatial information.

The GeoPDF maps were then compiled into the GeoAtlas, a detailed road/address 400-page atlas covering all of Carbon County. The GeoAtlas was uploaded to www.carbongeoatlas.com where the atlas pages can be viewed and downloaded by public safety professionals as well as the public. GeoAtlas GeoPDF maps can also be distributed on paper printouts, USB flash drives or DVDs for offline users in the field.

To view the electronic GeoAtlas maps, users need only to download TerraGo Toolbar™, a no-cost software application that enables anyone, anywhere to access and interact with GeoPDF maps and imagery produced by TerraGo Publisher and Composer™ software. Toolbar also enables users in the field to make updates to the GeoPDF maps using georeferenced notes, photos, video or other information and then return the updates to the ArcGIS managed database.

"I was really surprised how easily we could imbed hyperlinks into pages and jump rapidly to just the right coordinates, click and go," said Kohley. "The multi-layer aspect of TerraGo GeoPDF maps helps greatly.

terraGo TECHNOLOGIES

Case Study Draft

But above all, it made things incredibly easy to distribute and for end users to put the data to work for public safety. So many other organizations need this information as well – I've had inquiries from power companies, UPS and Realtors."

TerraGo solutions used by Carbon County:

- TerraGoPublisher for ArcGIS
- TerraGo GeoPDF maps and imagery
- Implementation consulting <TerraGo Professional Services?>

By utilizing TerraGo PDF maps and imagery, Carbon County achieved the following benefits:

- Finalized the implementation of county E-911 system
- Launched a Web-based GeoAtlas as a free resource for public safety officials and the community
- Economically produced more than 150 (and counting) first responder maps containing over 400 pages of accurate maps covering the entire county
- Product can now be dynamically updated; information is no longer static

For more information on the Carbon County GeoAtlas project, please visit http://www.carbongeoatlas.com/

Sidebar DRAFT:

Challenge: Carbon County, Montana initially implemented a new rural addressing system, which was met by confusion among first responders and the public. To support an E-911 services implementation that would shorten emergency response times and save lives, the county needed an accurate, centralized database of new addresses that could be easily accessed by non-GIS trained public safety public.

Solution: Using TerraGo Publisher for ArcGIS to produce TerraGo GeoPDF maps, Carbon County DES successfully produced detailed maps that could be accessed and shared in digital and print formats.

Result: Carbon County now has a comprehensive, online digital map atlas and new rural addressing system enabling it to successfully support an enhanced 911 system that has reduced emergency response time and helped save lives. The county map atlas also has become an indispensable tool for public safety first responders as well as the public and businesses which can access up-to-date, free geospatial information without the need for special training or software.

Teton County Planning Department
P.O. Box 1312
Choteau, Mt. 59422
406 466-2155
noxweed@3rivers.net

I have been asked to provide a summary of the MLIA grant received for the Rocky Mountain Front GIS/local planning Cooperative. As the part time planner for Teton County, this grant has helped bring Teton County into to 21st century with GIS training and technology. The timing of the grant was very good, with a part time GIS person just starting his new position.

There has been much change in Teton County since the end of the grant period. A new industry has moved in just north of Choteau with the expectation of 50-500 new jobs. Oil and gas exploration has begun along the Front with several test well locations having been drilled. These two changes have brought up questions about the county's infrastructure and can it provide for these changes. City water and sewer, County and City roads and rental housing are all being tested. Emergency services may also be asked to keep pace with a potential rapid change.

The MLIA grant has provided the Board of County Commissioners with some very important baseline data that would not have been secured without this help. The training and hardware will allow Teton County to make good local decisions as the future unfolds. Zoning in the county may become a topic of conversation and Teton County will be better prepared for this possibility.

Ongoing land use changes along the Front include US Fish and Wildlife conservation easements and the proposed Rocky Mountain Front Heritage act. An easement layer has been developed that can be updated and provide a quick look at lands under easements. This is but one example of the positives of this MLIA grant.

Paul Wick/Teton County Weed and Planning

The Ravalli County Cadastral Project

The Purpose

The Ravalli County Cadastral Project was an endeavor to construct and maintain a cadastral database necessary to support a multipurpose land information system. The criteria for this database were accuracy, completeness, currency, and maintainability. The accuracy and completeness portions of the criteria stipulated that extra effort be given to field GPS measurements and research of county source documents. Given our small department and existing workload, this meant finding a way of putting more people and equipment to the task.

In 2008, the Ravalli County GIS department applied for and received a grant under the Montana Land Information Act (MLIA). The purpose of the MLIA grant was to help fund the additional personnel and consultation required to implement and complete the anticipated three-year project.

The Opportunity

Since its establishment in 2005, the Ravalli County GIS department has operated on a very miniscule budget to deal with its daily responsibilities and work toward its future goals. Allocating resources to an endeavor such as this project, which was understood by only a few, was next to impossible. The opportunity provided by the MLIA funding has allowed us to build a cadastral database that helps to enhance the productivity and efficiency of those who serve the public. The grant award has demonstrated to our local policy makers that what we are working toward is beneficial and worthy of the effort. Furthermore, the process itself has given us the opportunity to educate people regarding the importance and benefit of making accurate and thorough cadastral data readily accessible.

The Outcome and Benefit

Many people in the Ravalli County offices remember what it was like when they actually had to open file cabinets and hunt for paper documents every time they needed map information. Some will even talk about the lengthy process involved in simply finding a drawing of a particular land parcel, only to spend more time in determining its associated physical address, permit information, and survey history. The new cadastral database has given us the means to accurately store much of that information in a single integrated location, which is accessible on many of the county's desktop computers. We can now look at and more thoroughly understand parcel data as it relates to aerial photography, structure points, septic system points, roads, and other GIS data.

Our new cadastral database can be considered a work in progress. Land information is constantly changing and the historical goings on regarding parcel ownership seems endless. The cadastral database allows us store newly retrieved information (whether it is new changes or historic data) with the confidence that it is mapped in its correct location. Compared to those days past, life is good.

MLIA Grant Story – Lewis & Clark County, 2009

1. Brief summary of grant purpose

MLIA_2009_10 Grant – Enhancement of the BLM GCDB, to support the Geodetic Control Theme and adjust the Cadastal Theme within Lewis & Clark County.

This grant targeted seven specific townships for GCDB enhancement. Those townships include the communities of Lincoln and area (T14NR09W, T14NR08W); Wolf Creek and Craig area (T14NR04W, T14NR03W, T15NR04W, T15NR03W); and Augusta area (T20NR06W).

The project objectives for this grant were to leverage MLIA grant funds with a partnership of funding comprised of the Montana Department of Administration – GIS Bureau utilization of BLM Assistance funds and already approved County funds to target the higher populated areas in Lewis & Clark County for GCDB enhancement. Lewis & Clark County had successfully partnered in the past with the state to enhance the GCDB in various locations, in particular, the heavily populated Helena Valley. This project continued that successful partnership of data sharing and enhancement to GCDB and the Cadastral framework. In addition, the survey work completed for the GCDB enhancement was beneficial to the Geodetic Control framework and to the Montana Control Point Database.

2. Brief summary of outcome (include any efficiencies gained or any funds saved)

Deliverables from this project were two-fold:

- Survey Control reported to the Montana Control Point Database – Supporting the Geodetic Control Framework
- GCDB positional enhancement resulting in Cadastral Framework positional enhancement.

3. What MLIA funding allowed you to do that otherwise you couldn't have accomplished?

Without either the local share of MLIA funds or the leveraged funds from Federal and State MLIA this project may not have been accomplished. The local MLIA funds the County keeps greatly improved the chances of taking on this and other related projects.

4. How did the project improve the quality of life form Montana citizens (the old "put a face on it" idea)

With an ever-increasing availability of more accurate digital data (ortho-imagery, GPS defined roads, FEMA flood zones, etc…) there are examples where the cadastral and the more accurate data are not aligned. As a reference tool the current GCDB derived cadastral is an invaluable tool. But when referenced to this high accuracy data it brings to light the limitations, as well as the ‘faith’ in the cadastral. This GCDB enhancement project resulted in the improvement of the cadastral within Lewis & Clark County, and subsequent 'faith' in that cadastral.

With the deliverables noted above, the cadastral framework was greatly improved in the affected areas. In the town of Cascade alone the road right-of-way, as depicted by the cadastral, now aligns with actual roads on the ground. Something, that prior to this project was not the case.

Project Area