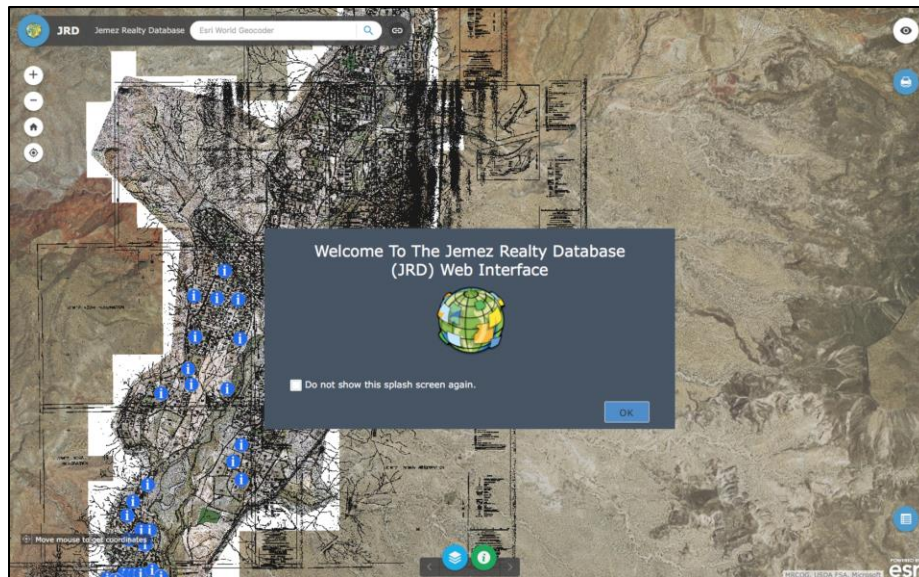44-CXP-A164

Facilitating Resolution of Land Disputes:
Applying Information Technology to Store and Access Historical Land Assignment Records

An Interactive Qualifying Project Report

Submitted to the faculty of Worcester Polytechnic Institute in partial fulfillment for the degree of Bachelor of Science

Sponsoring Agency: Pueblo of Jemez

Submitted to:

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i

Abstract

The lack of a reliable system to store and easily access historical documents regarding land assignments has led to many land disputes within the Jemez Pueblo of New Mexico. In this project we designed and developed an automated system, sensitive to the unique culture of the Pueblo, to facilitate resolution of these land disputes.

Acknowledgements

Authorship

Andrew Boynton - Andrew contributed to all of the main chapters of this report, especially the Abstract, Introduction, and Conclusions & Recommendations chapters. He also wrote Appendices A, C, and F. Along with Rachel, he participated in contacting members of the Jemez Pueblo outside of scheduled meetings to gain more information or keep individuals updated on the group's progress. Andrew and Rachel also developed the initial sections of the user's guide.

Emerson "Wyatt" Henke - Wyatt developed components to all the main chapters of this report, specifically focusing on the Methodology and Results & Analysis chapters. He also wrote Appendix B, which outlined the interviews conducted by the team. Wyatt took charge of researching what technical platforms the Jemez Pueblo should use for their Jemez Realty Database (JRD), creating Appendix E: Platform Comparison Chart, and working with the IT Department of the Jemez Pueblo to get the platform of the database running. He also helped develop the user's guide. Finally, Wyatt worked with Billy to input all the information compiled throughout the project into the final JRD platform that was created.

Rachel Rynazewski - Rachel wrote parts of all the main chapters of this report, focusing on the Introduction and Background chapters. She also headed up compiling all citations into the References. She also wrote the main draft of Appendices G, H, and I. Rachel was the main proofreader for all drafts, performing final small edits before compiling them into the paper. In addition, she worked with Billy to create the Excel Assignee Index component of the JRD. She served as a communications coordinator between the group and the sponsor/liaison. She also worked to develop most of the sections of the user guide.

Billy Sullivan - Billy created sections for all of the main chapters of this report, particularly the Executive Summary and Background. He also compiled potentially unknown words from the report into Appendix D. Billy set up and populated the file structure for organizing storage of digitized records, and linked this file structure to the JRD. He helped organize communications with departments of the Jemez Pueblo and assisted Wyatt in researching potential technical platforms for the JRD. Billy also developed sections of the user's guide. He worked with Rachel to create the Assignee Index component of the JRD, and with Wyatt to input information into the final system platform. He also created the web application.

Table of Contents

Table of Figures

Glossary

Assignment: Similar to an owner, however there is no actual legal ownership of the land. Tribal land is communal, thus the tribal government will assign tracts of land to individuals of the tribe. As a result, the federal government has no records of the tribal land being split between individuals.

Encryption: The process of encoding messages or information in such a way that only authorized parties can read it.

ESRI: The company that makes ArcGIS, one of the pieces of software we used in our project.

Georeference: The process of taking information that does not include any geographic information and placing reference points to place that piece of information on the map where it is supposed to go.

GIS: Geographic Information System, a system that allows the user to store and edit geographic data.

Hyperlinking: Connecting a digital document or file in a computer to another location in a computer via a simple linkage.

Land Survey: Record of the location of the land, total acreage, use, and control.

Plat: A plat in the United States (plan or cadastral map) is a map, drawn to scale, showing the divisions of a piece of land.

RAID: Redundant Array of Independent Disks, a data storage virtualization technology that combines multiple physical disk drive components into a single logical unit for the purposes of data redundancy, performance improvement, or both.

Tract: An individual parcel of land.

Executive Summary

For most people, the concept of land ownership is thousands of years old, but it is a much more recent concept for many Native American tribes. The Southwest Region of the United States has a long history of complex land control problems. Initially, the area was under Native American control, but that changed when the Spanish conquered the area. Eventually, the United States of America gained control of the region and transformed it into the Southwest states we know today, granting the indigenous tribes of the area individual reservations for their nations. The focus of this project was on the Jemez Pueblo, a Native American pueblo located southwest of Santa Fe, New Mexico. The Jemez Pueblo is an independent sovereign nation with its own government and judicial systems. Recently, a lack of organized land records within the Jemez Pueblo has led to land disputes, several of which are still unresolved.

The goal of this project was to establish a framework by which information regarding tribal members' land assignment and use can be recorded and stored for future reference. The first step in this process was to determine what information would be stored in a land ownership database. We worked with the Pueblo's Natural Resources Department, Tribal Realty Department, and other tribal members to identify available records that could be used for constructing a more complete history of the tribe's land assignments. We then identified all of the information that needed to be recorded and saved and established a way for additional information to be added to the database by others in the future.

We met our objectives through interviewing tribal members, archival research, and reviewing historical maps. By interviewing members of the different tribal government departments, we established what different users would need from the database and were directed towards relevant sources of information. Archival research of the tribe's documents

unearthed historical information of the Pueblo's land and its assignees. Using the information that we obtained as a guide, we planned out our system including how information would be entered, stored, and used. Finally, we put the system to use and used the historical information we gained in conjunction with historical maps to fill our database with proper geographical information and supporting documents.

      To determine how land disputes between tribal members could be addressed most successfully, we asked current Governors, Lt. Governors, tribal officials and the tribal council members how disputes have been settled in the past and how land ownership has changed historically. These discussions with various tribal members has allowed us to identify major components of land disputes and create a system that would support resolving these disputes. Our final report and the database we established should help resolve conflicts within the Pueblo, while simultaneously providing the Pueblo with a history of their land and how it has been used.

1   Introduction

Land ownership might seem straightforward, but often, there are many factors that make figuring out who owns what land a lot more difficult. This is especially the case when dealing with Native American tribes for whom land ownership was a foreign concept imposed upon them by an invading or colonial power (D. Martin, personal communication, April 15, 2016). Massasoit Ousamequin of the Native American Wampanoag Confederacy was quoted as saying, "What is this you call property? It cannot be the earth, for the land is our mother, nourishing all her children, beasts, birds, fish and all men. The woods, the streams, everything on it belongs to everybody and is for the use of all. How can one man say it belongs only to him?" (Anti-Defamation League, 2005, para. 3). For Native Americans, all land has been shared among everyone in the tribe, so the idea of one person or group having exclusive rights to some land has been a foreign idea.

Modern Native Americans have adopted a modified version of the US concept of land ownership in the form of land assignments. The federal government has given a tribal nation a reservation of land, and the tribe splits that land up for individuals to use (D. Yepa, personal communication, August 24, 2016). However, because the entire Indian nation owns the reservation, individuals cannot "own" property, thus they are "assigned" individual plots of land within the tribal land by their leaders. Sometimes, tribal governments do not have sufficient organization of their documents to clearly describe the land assignments that they have given out. There have been undocumented land transfers because land has been passed through a family without formally registering those transfers with the tribe's Realty Department (H. Sando, personal communication, September 13, 2016). This has created some disputes because land assignment information is not easily accessible or is missing. The Jemez Pueblo of New Mexico

is one such tribe where land disputes exist due to scattered knowledge and documentation about land assignments and boundaries, and the tribal government is looking for ways to solve these disputes fairly.

A system that can provide organized land ownership history as well as provide visual aids is critical when dealing with land disputes (Hoffman, 2015). Geographic Information Systems (GIS) have often been utilized for the purpose of organizing development and infrastructure data, thus it has become a standard software used for storing land boundary and ownership information (Dempsey, 2012). Maintaining accurate land usage and assignment information is not a problem faced only by the Jemez Pueblo. Other Native American tribes, such as the Isleta Pueblo located in New Mexico, have also been challenged with maintaining historical land assignment and land usage information (F. Candelaria, N. Thompson, E. Salazar, personal communication, August 26, 2016). The Isleta Pueblo approached their problem by establishing a GIS database in which historical maps and land transfer documents could be stored and organized digitally for easy viewing.

The Jemez Pueblo has recognized the need to collect and store land boundary and assignment information. They have most of the information needed to help solve land disputes and clear up confusion about assignments, but there is no central location where all this information can be found. The Jemez Tribal Council recognized the need for a single database that includes all information related to individual plots of land. They believe that storing this information in an automated system will provide easy access to this information and help facilitate resolution of ongoing and future disputes. So far this database has not been set up, however.

The goal of this project about was to provide the Jemez Pueblo with a computerized storage tool, the Jemez Realty Database (JRD), in which current and historical boundary maps, as well as assignment information of Pueblo land, could be stored and referenced. This system needed to be created so that the Jemez Pueblo could transition from the use of somewhat incomplete paper records to an automated system that can be used to settle land disputes amongst tribal members efficiently. In order to provide the Pueblo with the required database, our objectives included: identifying the categories of information to be used and representative samples for each category, identifying (and collecting) all sources of information in a digital format, determining what use cases to develop for security purposes, identifying and recommending an appropriate database platform, determining permissions for the users of the JRD, and determining a way to sustain the system. We accomplished these objectives through human-based research processes, such as interviews and interactive presentations, archival research, technical information, and human-based research processes. We presented the tribe with a usable electronic realty database that can be referenced and updated as more information regarding reservation land is found. We hope that this will facilitate fair and efficient resolution of Jemez Pueblo land disputes.

2   Background

Currently, the Jemez Pueblo is experiencing internal land disputes among its members living on the reservation. In order to understand why these disputes are occurring, we will highlight the critical information necessary to present the problem more clearly. This chapter will discuss the difference between land ownership and land assignment, the history of the Jemez Pueblo as well as its governmental structure and land use patterns. We also discussed Geographic Information Systems (GIS) and its use as a way to keep track of land use and land related information. In discussing GIS, we discuss a real-life application of its use as an example of a tool that may be applicable for use by the Jemez Tribe.

2.1   Land Ownership vs. Land Assignment

The idea of land being owned by individuals compared to the idea of land being a communal asset has been a fundamental difference between Western societies and the indigenous people of North America for hundreds of years (H. Sando, personal communication, September 13, 2016). European countries have long valued the concept that one individual can own and control a piece of land. Owning land represents wealth and power (Powell, 1996). One of the main populations who settled in North America were the English, who followed the European model of land ownership. John Locke, an English philosopher of the 17ᵗʰ century, outlined three essential rights all men should have. These rights were, life, liberty, and property, and obtaining property was considered the final process in securing individual freedom. During the 16ᵗʰ and 17ᵗʰ century English settlers as well as those from other European countries began to emigrate to North America in hopes of attaining the rights John Locke preached. The values and principles of the Europeans were introduced to the Americas through the colonies that were settled in the New World. The settlers greatly valued the land of America because it represented

a new beginning. Once settlers had established farms and homesteads, they needed a way to show that a certain parcel of land was theirs (Alexander, 2007). The document that legally verified the claim of the settler was a land deed. Deeds were recognized by Common Law, practiced in England since the Middle Ages. Within Common Law, property law was defined as the "law, principles, policies and rules by which disputes over property are to be resolved and by which property transactions may be structured" (para. 1). The structure of recording who owned the land was shown through land deeds. Deeds properly indicated who owned the land, the amount of land and other essential information. The written records were very important because the following generations of those first settlers could access these documents, providing a history of the land, including changes of boundaries and ownership.

In contrast, owning land was not practiced by Native Americans. Instead, they believed that they were connected to the land and all things that grew on or utilized it (Arnold, 2016). The Native Americans lived off the land, but land ownership was not a cultural concept in their societies. There were many tribes in North America, but territories were established by the tribes themselves based on control and power as well as geographical locations. Within the territories, the land was considered communal, and the people in the tribe shared what was available. Not until European immigrants arrived were the Natives introduced to the idea of land ownership. When these immigrants gained control of the land, they tried to force their customs and values upon the Natives. From the time when Europeans first settled the United States of America until the mid-20th century, land was taken away from Native Americans and controlled by the government (Indian Civil Rights Act, 1968). Currently, the Native Americans have been restricted to reservations, land designated by the U.S. government for the Native Americans to live on. The reservations are sovereign nations under the Indian Civil Rights Act of 1968. As

sovereign nations, the Native Americans are separate from the U.S. government and can follow their own laws and customs on the reservations (but not elsewhere). Because Native Americans shared the land among all members of the tribe, on many reservations, the land was separated and assigned to various members by either the leader of the tribe or a tribal council (H. Sando, personal communication, September 13th, 2016). The tribal members assigned to a piece of land can then pass it down to family members. Oral histories were used as the records by which families were able to continue to use the land and pass it down from generation to generation. In the next section, we provide an overview of the history of the Jemez Pueblo in order to illustrate how their culture and land values have affected their society.

2.2   History of Jemez

The Jemez people have a deep history in the American Southwest, fighting for their land and migrating through what is now New Mexico before settling in their current home at Walatowa (Jemez Pueblo, 2016b). The Jemez Nation originally developed in an area named "Hua-na-tota" in the four corners region of New Mexico (Village of Jemez Springs, 2016). In the 13th century, the nation moved down to the "Cañon de San Diego Region" where they lived until the Spanish arrived in 1541. However, the Spanish who visited the area attempted to conquer the native nations, eventually resulting in the Great Pueblo Revolt of 1680. The Great Pueblo Revolt was comprised of multiple Puebloan nations uniting together to get rid of the Spanish, and it was the only successful revolution in the United States where the invading people (the Spanish) were driven out. Unfortunately, the Spanish were not done yet. They returned to the area to reconquer it in 1688, this time for good. The war between the Puebloan nations and Spain continued for many years until all of the Santa Fe region was under Spanish control in 1692 except for the Jemez Nation. The Jemez went on fighting until they were finally defeated by the Spanish in the

Battle of Guadalupe Mesa in 1696, after which they fled to their current home in the Village of Walatowa. The now lost sacred lands of the Jemez Nation are no longer physically accessible to them but are still remembered through cultural traditions and ceremonies held in Walatowa.

2.2.1 Jemez Tribal Government Structure

Native American nations can work with the Bureau of Indian Affairs (BIA) to govern themselves; however, some nations, like the Jemez, practice self-determination. This means that they are self-governing tribes that work separately from the BIA (American Indian Relief Council, 2016). This latter approach grants nations more control over their communities, but it also means that they receive less funding from the federal government because they do not utilize the US government's services. As defined by the Jemez Pueblo (2016b) and Joe S. Sando (1982), the Jemez government is constructed of many groups of people. There is the Governor, who is the leader of the tribe, and under him are two Lieutenant Governors, who are in charge of areas like law enforcement and fiscal matters. There are also numerous departments in charge of community services. The Governor and his Lt. Governors, as well as all past Governors of the Jemez nation, form what is called the Tribal Council. This group also serves as the Tribal Council Court for the Jemez. They have the exclusive jurisdiction to hear and settle all land disputes within the Pueblo. There is also the traditional government, which includes the War Captain and Lt. War Captain, who are religious leaders of the tribe.

Within the Pueblo's Government, there is some outdated technology and information that needs to be improved to solve problems like land and water disputes (D. Yepa, personal communication, April 11, 2016). According to Sando (1978; 1982), the Jemez pass on a lot of their extensive history and traditions by word of mouth. Oral history is a rich part of the Jemez culture, especially due to their use of the strictly oral "Towa" language. This means that a lot of

detailed information cannot be found by looking for traditional written forms of documentation. The land disputes in the Pueblo cannot be solved easily due to this lack of written data. Thus the Pueblo's leadership believes that updated technologies, like GIS, are needed to hold historical images and maps of the area to capture the information that has so far not been saved.

2.2.2 Land in the Jemez Pueblo

The Jemez have always valued agriculture as a base for their economy, and it is an integral component of the Jemez' existence (Tiller, 1987). Their religion, government, and more is connected to agriculture. Without agricultural land or related business, the Jemez's way of life would be forced to change.

Since land was most likely viewed as communal land, people used what they felt they needed and did not worry about boundaries, plots, or ownership of specific sections of land (D. Martin, personal communications, April 15, 2016). Today, the Jemez have a region of land that the federal government has granted them as a whole, but the distribution of land within the pueblo is an internal process separate from the federal government. In 2007, the Jemez Pueblo (2016a) established their realty office that assigns individual tracts to people in the community, which is the current system by which individuals gain rights to a piece of tribal land. There have been numerous land disputes in the Pueblo that were filed in the late 1990s and early 2000s (D. Yepa, personal communication, April 11, 2016). The lack of a tribal realty office at the time may help explain why the disputes happened and have yet to be resolved (Jemez Pueblo, 2016a).

These disputes have also not been resolved due to a lack of formally written documentation and a lack of organization of land records in the tribal government (D. Yepa, personal communication, April 11, 2016). These disputes sometimes revolve around inherited land with multiple relatives who believe they are the rightful heir, or different people thinking

that they own the same land because of miscommunications between their parents or grandparents (H. Sando, personal communication, September 13, 2016). These disputes usually would not come up until transfer documents have already been started for one of the potential heirs, slowing down the process and forcing the Realty Department to halt the work they are currently doing. This has discouraged Harold Sando, the realty officer for the Jemez Pueblo, from processing the normal request in a timely manner out of fear that a dispute will come up and stop the process. A lot of the issues like this can be solved by having a record of assignment transfers that were approved by the tribal Governor so that the government can look back to the previous, government approved, assignee to find connections to possible recipients of land. Along with that record trail, consolidating them into an easy to navigate database can make accessing this information easier.

The Jemez Pueblo has also been in litigation with the federal government over water rights since the 1980s, which is what led to the creation of hydrographic survey maps in 1985 (H. Sando, personal communication, September 13, 2016). In the Jemez Pueblo, farmlands get their water from irrigation ditches located throughout the reservation; however, if fewer people are farming, the federal government could conclude that the reservation needs less water to run through those ditches. Unfortunately, fewer agricultural land assignees are actually using their plots to farm, and many fields are left untouched. The tribal government is trying to encourage more people to plant crops in their fields, but a large portion of farm land has remained unused.

Another issue that occurs in the Jemez Pueblo is that sometimes assignees of agricultural land want to build homes on their agricultural plot, which is prohibited by the tribal government, but it has happened despite this prohibition (H. Sando, personal communication, September 13, 2016). One problem with using agricultural land for home sites is that if people want electricity

in these homes, they need to get the power lines extended to the area on which the field is located. This costs money that either has to come out of the individual's pocket or the tribal government's pocket. Some people still build homes regardless and never inform the Realty Department. The Realty Department is thus kept uninformed and becomes unhelpful to those community members. The Realty Department is currently in charge of making sure people have land assignments, homes, and utilities; this leaves the sole member of the Realty Department, Harold Sando, with more work than he can handle. Not informing Mr. Sando before transferring land or building homes only hurts the department and the community. Therefore, the tribal leaders want to require tribal members to contact the Realty Department before taking any action that could alter their assigned land or its use.

2.3   Managing Land with GIS

For thousands of years, geographical information has been recorded in maps and census information documents. Prior to the 1970's much of this information was in paper form, which often made it difficult to make direct comparisons at different points in time (ESRI, 2016). Even comparing information between maps was a cumbersome task as the scales of the maps were often different and required maps to be resized and plotted on a transparent overlay. However, this all changed during the 1970s as computers became capable of automating these processes.

Physical maps and census information could now be digitized and stored on magnetic tape (ESRI, 2016). The information on the tape could then be viewed and combined with additional information on the same land so that it could be analyzed. The combination of these processes formed what is known as a Geographical Information System. A Geographical Information System, or GIS, is a way for maps and information unique to a specific location to

be digitally stored and viewed. GIS works by organizing information about each location in layers.
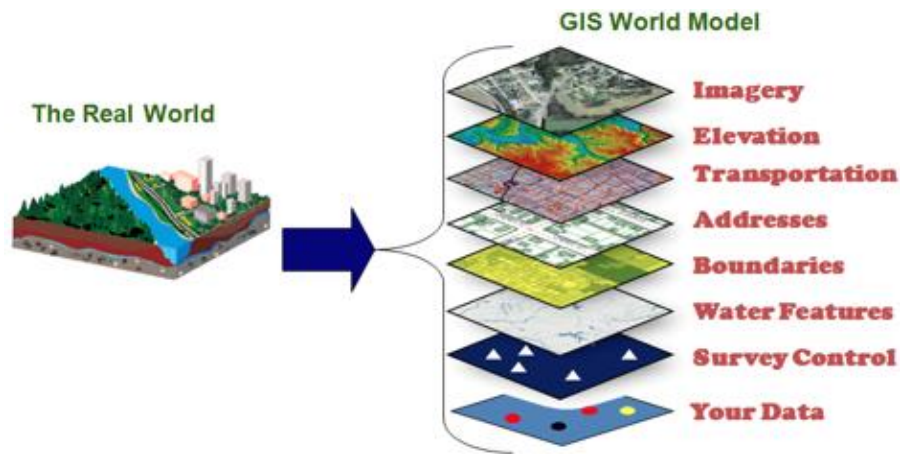

Figure 2-1: GIS Representation of the Real World
(Henrico County, 2016, para, 5)

This multi-layered organization of information by geographical location, depicted in Figure 2-1, allows for a complete representation of the real world (Henrico County, 2016, para, 5). Since the information is organized by location, information contained in different layers can be compared at each location on the map. This means that if census information is stored in one layer and natural resources are stored in another layer, an analysis can be made comparing where people live in relationship to where natural resources are located.

2.3.1 Modern GIS

Although the technology used today to digitize and store geographical, census and other types of information has dramatically changed since the 1970s, the concept and use of GIS has seen little change (ESRI, 2016b). Information is still imported into the system, which can then be viewed and used for analysis. However, the system no longer consists of rooms of computers or punch card programs. Modern GIS is in the form of software and can run on most modern personal computers (ESRI, 2016a). In fact, GIS has improved so much that the software can

perform its own analysis of who owns what land and provide the user with its findings. With modern GIS software handling everything in its database, the challenge becomes getting the information into the database efficiently and correctly.

2.3.2 Existing ArcGIS System at Isleta Pueblo

The Isleta Pueblo, located southeast of Albuquerque, recently moved to an electronic method of keeping track of land assignment and other land details (E. Salazar, F. Candelaria, N. Thompson, personal communication, August 26, 2016). Previously, they had run into problems such as when a document might get lost or where proper documentation did not exist. They moved to an electronic system to solve these problems. The system they came up with has three main parts: An Excel spreadsheet, a file structure full of scanned documents, and a hyperlinked layer in GIS.

The Excel spreadsheet is used to keep track of land ownership information so that it is easy to find the current status of a piece of land (E. Salazar, F. Candelaria, N. Thompson, personal communication, August 26, 2016). The spreadsheet lists, for each tract of land, the current owner, the previous owner, how the land was acquired, and other essential pieces of information. The spreadsheet also points to where the documents are stored within the file structure, so that, if needed, the source of the information could be accessed. An important thing to note about this spreadsheet is that only one person has permission to edit this file. This was done to prevent people from accidentally altering the data, as it would take a long time to recreate. This spreadsheet is used if one already knows which tract of land one is looking at, but if that is not known, then the hyperlinked GIS layer can be used to determine what land is being shown.

The hyperlinked GIS layer contains a bunch of points placed on a map, with each point representing a tract of land (E. Salazar, F. Candelaria, N. Thompson, personal communication, August 26, 2016). Each of these points is placed on the tract of land it is referring to, so once one finds the tract one is looking for, one can simply click on the point to get to the relevant information. These hyperlinks go to the file directory containing all the scanned documentation for that tract. For example, if someone clicked on a hyperlinked point, a folder would open up containing any transfer documentation, plats, survey information, and any other documentation pertaining to that tract. This layer also contains an attribute table with much the same data as the Excel spreadsheet, to easily look up the information for that particular tract of land.

The file structure containing the scanned documents is the main part of the Isleta Pueblo's system, as both the Excel spreadsheet and the hyperlinked GIS layer serve as access points to this file structure (E. Salazar, F. Candelaria, N. Thompson, personal communication, August 26, 2016). Neither the GIS layer nor the spreadsheet has any legal standing, only the documents do, so when someone needs proof of a land transaction or other information, they would need to access the file structure. Having all the documentation in electronic form makes it very difficult for a document to go missing, as long as proper precautions are taken. It also allows multiple people to access the same document at the same time. This saves everyone time and keeps the information secure for future generations.

The Isleta Pueblo's land ownership information system was designed to solve problems very similar to what the Jemez Pueblo is trying to solve. However, one thing that was missing from the Isleta Pueblo's system was fine-tuned permissions for data access as well as a simplified user interface for some users who don't need the advanced interface.

2.4 Summary

Although the Jemez have been able to develop into the modern society they are today, there are still advancements that need to happen. Land disputes have caused conflicts in the Pueblo that have been unresolved for years. However, developments in mapping technology have provided the Jemez with a solution to their issues in tracking land data. Digital mapping software will help provide the required information to settle land disputes and resolve conflicts between tribal members in a civil and fair manner both now and in the future. In the next chapter, we will discuss how we went about solving these issues.

3 Methodology

In the Jemez Pueblo, undocumented boundary changes and a lack of land assignment records have been a large contributor to land disputes within the Pueblo. Most of these disputes have been between tribal members over land boundaries and assignment of the agricultural and residential lands. The goal of our project was to provide the Jemez Pueblo with an automated storage tool in which current and historical boundary maps, as well as assignment information about Pueblo land, can be safely stored and accessed when needed by tribal officials.

In order to create a successful system, we followed the workflow diagram below:
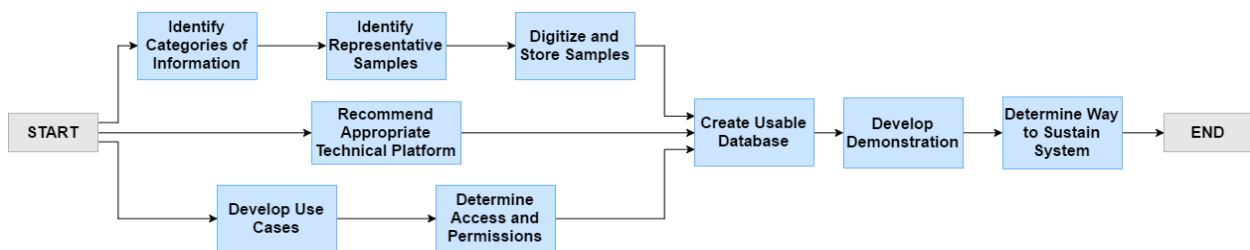
Figure 3-1: Methodology Block Diagram

As this diagram in Figure 3-1 shows, the process of completing this project started with identifying the categories of information for the Jemez Realty Database (JRD), selecting representative samples, obtaining digital sources, developing use cases, recommending an appropriate technical platform, determining usage permissions for JRD, determining how to import digital records into the JRD, developing a demonstration, and determining a way to sustain the JRD.

3.1 Identify the Categories of Information to be Stored in the JRD

Before we could select the technical platform and design and build the JRD, we needed to identify and organize all of the types of information that would be stored in and retrieved from the database to support the needs of the tribe. In addition to the type of information to be stored, we needed to determine the specific data elements from each category that would be extracted

and stored. Each data category had a different process in collection of the data, so it was critical for us as a group to determine how many categories we would be evaluating. In addition, each category had different information, and we needed to determine what information we needed for the JRD. To identify what information was available and where the Pueblo stored it, we interviewed Mr. David Yepa, the Governor of the Pueblo, and Mr. TJ Loretto, the Pueblo's GIS mapping specialist (reference Appendix B: Interview Protocols & Summaries, Interview with Governor & GIS Specialist). During the interview, Governor Yepa and Mr. Loretto referred us to Mr. Sando, the head of the Pueblo's Realty Department to see if there were more potential data categories that should be used in the JRD. We conducted a separate interview with Mr. Sando. Before we could narrow the scope of the types of sources of land information, we had a meeting with Mr. Faron Candelaria, Mr. Nick Thompson and Mr. Ernie Salazar of the Surveying and Mapping Department of the Isleta Pueblo. The Isleta Pueblo was in the process of creating a database system that incorporated several maps showing land boundaries, with data from sources they had analyzed. This prepared us for the potential sources of information we would encounter in the Jemez Pueblo. Based on their recommendations, we looked for any available information from land maps, land surveys, and realty documents on the history of the land and its assignees. The specific sources of information we looked into and decided on are described in detail in the results and analysis chapter of this report. Once we developed the categories where data would be extracted from, we were then able to go through the various sources and gather samples for the JRD.

3.2 Identify Representative Samples for Each Category of Information

After identifying the different data categories to be entered into the JRD, we collected examples of each category from the Jemez Pueblo sources. We gathered assignment documents

from the Realty Department; such as documents that recorded when tracts were transferred from one assignee to the next or when the tribal government granted someone a piece of land. We also gathered documents from the Natural Resources Department about boundaries and physical properties of the land. After collecting documents from the Realty and Natural Resources Departments, we linked that information to the associated tracts of land. We focused on finding a few representative examples of each data category as opposed to gathering all the data. We also selected a small but representative area of the reservation map to show all GIS layers and categories from diverse regions in the reservation. We determined which examples to use by picking approximately 90 tracts from different locations around the reservation mostly from agricultural land, but also some residential land as well. We picked these tracts based on whether the Jemez Pueblo had multiple records pertaining to that tract on file or not. This ensured that we had diverse regions to demonstrate to our sponsor how the JRD would work with tracts from all over the reservation and that we did not focus on land that did not have a lot of information to input into the JRD.

3.3   Determine How to Store Digital Representative Samples

In order for the Pueblo's documents to be stored in the JRD, they needed to be digitized. We collected representative examples of each category of land document. Some of the physical documents were of a larger scale, so we had to find a large scale scanner with the ability to properly scan multiple sizes. We then scanned the individual documents and saved them onto a hard drive. The hard drive was used as a source to move the digital records onto a shared drive for the Governor and Natural Resource and Realty Departments to access. The shared drive was setup on a server located within the Pueblo. The server was allocated for our project by the IT department. This was very important because we scanned a variety of documents that required a

large amount of storage. However, some of the information from these documents was retyped for particular parts of the JRD. Those pieces of information were from the previously scanned and digitized documents. Once the data was compiled, we could then begin the process of establishing what information the groups of people using JRD would need access to when operating the system.

3.4   Develop Use Cases to Show How the JRD Operates

Use cases are organized descriptions that define what an operator of a system needs to be able to do within the system. We cane up with the use cases for our system, the JRD, on order to ensure that all users would be able to do what that needed to be able to do within the JRD. The use cases were determined by a "test run" on a sample GIS map, Excel sheet, and file structure, that showed us what steps were necessary to properly operate the JRD. The action steps we completed in the "test run" were evaluated and then divided into groups. The actions steps were put into a specific group based on who and why they would perform each step. Developing action steps for the use cases heavily relied on selecting the platform for the users of the Pueblo.

3.5   Identify the Most Appropriate Technical Platform

In order to solve the current land disputes and help prevent more in the future, the Jemez Pueblo needed a system to store land boundary and assignment information. The JRD needed to be simple in order to make it easy to add new information to the database and to get information from it. The JRD needed to support hyperlinking digital scans of land records with the other GIS data for easy record management. In order to pick the software to use, we first interviewed the GIS specialist at the Jemez Pueblo, TJ Loretto. He told us that he uses ArcGIS for his GIS and mapping needs. We then interviewed three members of the surveying and mapping department at the Isleta Pueblo. They gave us an overview of the system that the Isleta Pueblo used for their

land management and assignment information. They used ArcGIS for their system as well, and

they showed us how all of the Jemez Pueblo's needs could be met through ArcGIS.

ArcGIS covered the software side of the JRD platform, but we still needed to decide on

the hardware to run the software. To do that, we looked at the ESRI website, the company that

makes ArcGIS software, to see what options they sold. We then looked at the system

requirements for various options and developed some potential ways the Jemez Pueblo could

host an ArcGIS database. We then came up with criteria to compare the options. To compare the

options, we looked at what software the Pueblo would be using, how much the software cost,

how much the hardware cost, how many people could access the JRD and with what

permissions, any dependencies for the JRD, how much data one could store, how secure the data

would be, how protected from failures the data would be, and how the user could access the JRD.

We then presented these options to the Governor, Tribal Council, and the GIS specialist along

with our recommendation.

3.6 Determine Access and Permissions for Usage of the JRD

Developing the use cases for the mapping system directly correlated with the specific

platform chosen. The platforms we analyzed had different operating techniques while working

the system. Creating the use cases for multiple platforms would not have been reasonable

because it would have required someone to learn how to operate different systems. After

choosing one single platform in which the JRD would be created, our group then needed to

discuss with the Governor of the Jemez Pueblo which individuals or groups from the Pueblo

should have access to the JRD. It was very important to know who exactly would be using the

JRD because we had to factor in what each type of user would be using the database for when

designing the different interfaces associated with those accounts. With the platform in place and the use cases formed, we then were able to import the records we analyzed into the JRD.

3.7   Create a Usable Database

Once we had decided we were going to use ArcGIS, we had to actually create the JRD. To do this we took an aerial map created in 2015 and made it the base GIS layer. This meant that the rest of the mapping information and boundaries would be laid over that map. Once that was imported into ArcGIS, we took scanned copies of other maps and pieced them together in a layer on top of the base layer. We had to georeference different locations that had not changed between the creation of these two maps in order to make sure they were accurately placed on top of each other.

With those two components completed we moved on to creating groups in ArcGIS for all of our categories. After all the groups had been created, we inputted records into those groups in ArcGIS. In order to link Realty Department records to maps, we created points within each tract in the JRD and hyperlinked all records regarding that tract to that point. This allows people to navigate the area visually and access all information regarding a tract just through locating it on the map. We chose a smaller sample of tracts, pulling random tracts from each of the 1985 maps, and inputted all information for those tracts for every category into ArcGIS. This allowed us to show the depth of the JRD to those who would be using it, and also prevented us from trying to accomplish too much in the time frame we had for completing this project. Once we had finished inputting the information, we spent time polishing the appearance of the JRD so that it was pleasing to the eye and easy to follow for people of different levels of confidence and experience using technology such as ArcGIS.

In addition to ArcGIS, we also created an Excel file index containing details about assignments for each tract of land in the reservation. The same documents that were hyperlinked to tracts in ArcGIS were hyperlinked to entries in this Excel file. The Excel and GIS are meant to be separate systems used by different people though they contain similar information.

3.8 Determine a Way to Sustain the JRD

After populating the database, we moved on to creating resources for the Jemez Pueblo to use in order to continue use of the system after this project ended. The expectation is that JRD would be used for many years. To help new users understand how the JRD works and all of its features we created a user guide.

We also needed to demonstrate how the stored information could be used, and the capabilities it could provide the Jemez Pueblo. Using our use cases as a guide, we determined which aspects of the JRD should be shown and to whom they should be shown. Once we decided what topics we wanted to present, we took the information laid out in our user guide and turned them into a demonstration. We created the demo and presented it to our sponsors and advisors. Afterward, we took feedback given to us and made appropriate changes to complete the JRD to their liking.

3.9 Summary

When we first began working on our project, we had to determine what the Jemez Pueblo already had in terms of land ownership documentation and how their existing system worked. This was accomplished through interviews and by looking at land ownership documentation. From there, we found out what information the pueblo wanted to store. We then needed to determine how people would access the system, which we accomplished through interviews. We made a recommendation as to what platform the pueblo could use for their database and decided

how we would sample the data. We knew from previous interviews that the pueblo wanted to focus on agricultural land, which we kept in mind when we picked our samples, but we also wanted to make sure to show residential land as well. We scanned the relevant documents and pulled the relevant information into the spreadsheet. Lastly, we prepared the users to continue using the JRD in the future. Next, we will discuss the details of the results gathered through performing these methods and achieving these objectives.

4 Results & Analysis

The goal of this project was to provide the Jemez Pueblo with a digital storage tool, the Jemez Realty Database (JRD), where current and historical boundary maps and assignment information for reservation land could be stored and referenced. Our Methodology chapter explained the process we followed in completing this project. This chapter explains the details of the results we came up with and how they came together to form the JRD.

4.1 Identify the Categories of Information to be Stored in the JRD

Based on the advice from Governor Yepa and TJ Loretto, the head of the Department of Natural Resources and the Isleta Pueblos Surveying and Mapping Department to identify the categories of Jemez Pueblo information from which we would be drawing data for the JRD. After the joint interview, (see Appendix B: Interview Protocols & Summaries, Interview with Governor and GIS Specialist), we determined that the categories the Pueblo have are land maps and realty documents.

There were 3 sub-categories within land maps. The first sub-category we analyzed was a hydrographic land survey from 1985, provided by the BIA to the Jemez Department of Natural Resources. There were nine sheets that made up the hydrographic land survey. These sheets included land boundaries, tract numbers, and acreage of the tracts of land. In this map, the total area was broken into smaller maps, each one with its own tracts. See Figure 4-1 for reference.
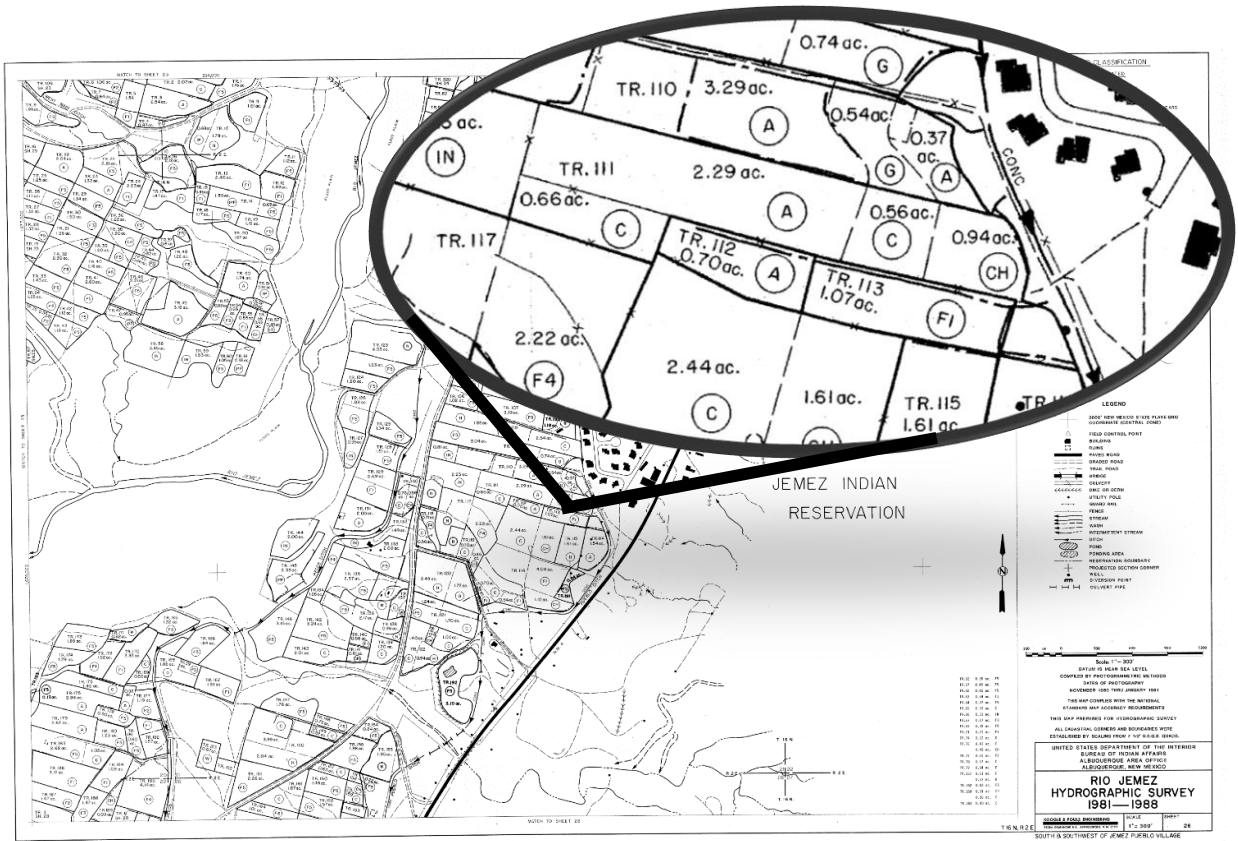
Figure 4-1: 1985 Hydrographic Map

Figure 4-1 represents one of the nine 1985 hydrographic sheets. We chose the 1985 hydrographic land survey as the starting point for the JRD as it was the first completed survey of the Pueblo's land. Future land surveys can be added as other layers to document the history of the land. The second sub-subcategory that was provided was a 2015 aerial photographic land map of the Jemez Pueblo. Unlike the 1985 map, this map did not include land boundaries, tract numbers or the number of the tracts. The 2015 aerial survey map was used to create another layer within the database. Figure 4-2 is an example of the 2015 aerial photography as a single layer. Figure 4-3 shows one of the 1985 maps laid over the 2015 aerial photography.

Figure 4-2: 2015 Aerial Photography

Figure 4-3: Overlay

The final sub-category of land maps, included in the JRD, was a highway easement map. We chose to incorporate this map in our database because there is one main highway, highway 4, that runs along the outer boundary of the pueblo. The map connects the agricultural and residential land, located in the center of the pueblo land to the outer boundaries. Figure 4-4 is the highway easement map. The red/orange line represents Highway 4.
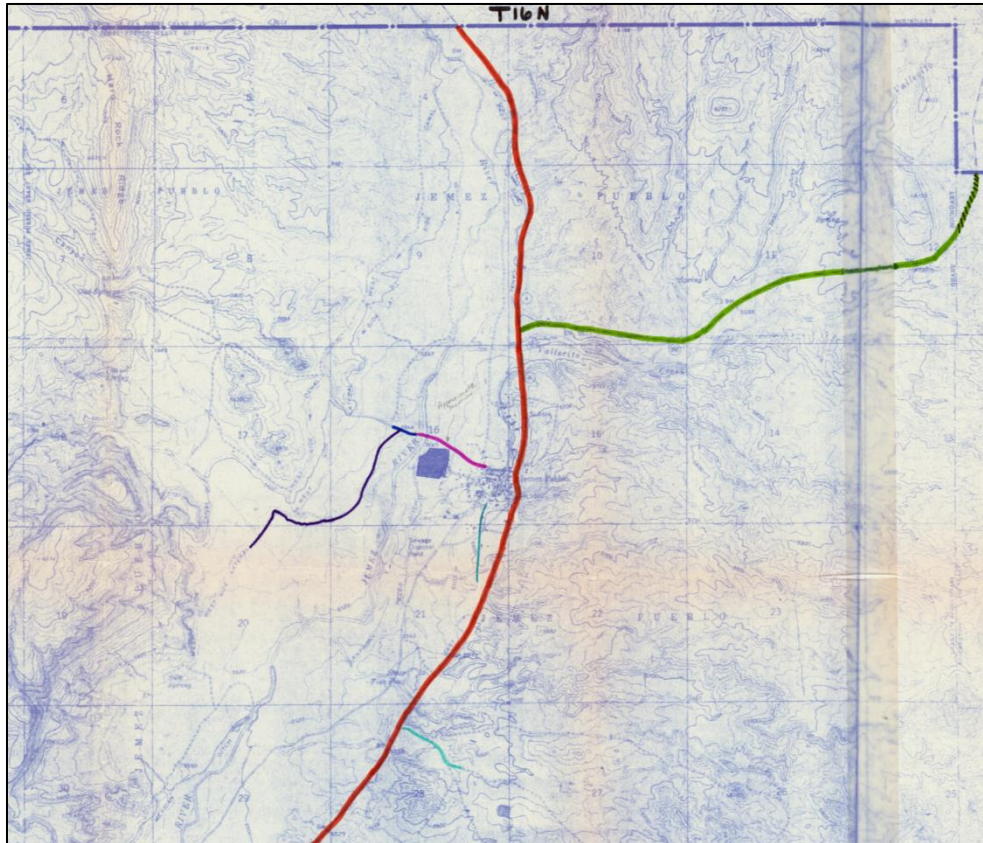
Figure 4-4: Highway Easement Map

The second category for the JRD, were realty documents. One of the sub-categories of realty documents was a 1985 assignee index, in connection to the 1985 hydrographic land survey map. The index included the map and tract number, assignee/owner's name, land usage, the surveyor's information, and the date each individual tract was recorded. The index was very important because it connected all assignees of that time to the 1985 hydrographic land survey map. An example of the 1985 land survey index is shown in Figure 4-5 below.

```
HYDROGRAPHIC SURVEY DATA              JEMEZ RIVER BASIN


Map   21    Tract    1
Owner's Name:  ████████          Indian: ██  Non-Indian: ██
Address:                JEMEZ  , NM    Tribal Assoc:  JEMEZ
Location of Land(Including legal description as available)




------------------------------------------------------------

LAND USE(S)
              Irrigation


CROPS/ACREAGE
              Fallow 1 year(s)    2.09 acre(s)

------------------------------------------------------------

WATER SOURCE DATA

Source of Water:  SURFACE
  A.  (SURFACE WATER)  Ditch System:
      (1) Point of Diversion:  N 1,696,260    E  354,125
      (2) Name of Ditch:  WEST MAIN DITCH
  B.  (GROUND(well)WATER)
      (1) Location of Well:  1/4,    1/4,    1/4, S , T , R
          X=              , Y=
      (2) Depth of Well:
      (3) Water Level:
      (4) Size Casing:
      (5) Gallons per Minute(GPM)Pump:
      (6) Power:
  C.  State Engineer File Number:


------------------------------------------------------------
```

Figure 4-5: 1985 Index

We identified land transaction agreements as another sub-category. The assignment

records provided us with a history of the assignees of a particular piece of land. The agreement

form illustrated how the different tracts were passed down within the family as well as

transferred to other tribal members. Figure 4-6 is part of a blank Land Transaction Agreement

Form, used by the Realty Department. A full version of this form can be found in Appendix F.

Figure 4-6: Land Transaction Agreement Form

In total, there were 21 completed land transactions that were we able to view. The

majority of the completed land transactions were for private houses and not agricultural land,

which was meant to be the central focus for the project. It was still crucial to evaluate this sub-

category because we were able to see what information was required from the tribal members in

order to complete the transaction. The final realty document sub-category we identified were

BIA land plats. These documents included an illustration of the land, coordinates of the land's

location and the assignee of the land. The survey dates of the plats ranged from 1970's to 2015.

However, we were unable to connect these plats to specific tracts in the reservation. We discuss

in section 4.2 of the specifics why we decided not to include them in the JRD for now.

In conclusion, we identified two categories that would be used for the JRD. The

categories were land maps and realty documents. The sub-categories were the 1985 hydrographic

land survey, 2015 BIA aerial land survey, highway easement map, 1985 land assignee index,

land transaction agreement form and the BIA land plats. Figure 4-7 shows how all these

categories and sub-categories fit together.
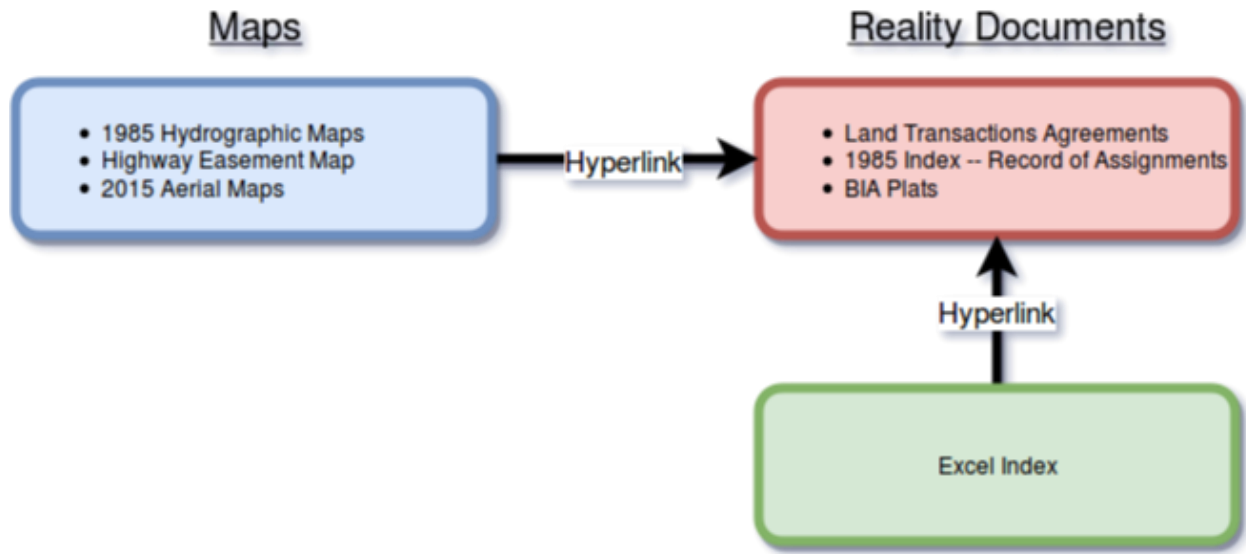
Figure 4-7: Outline of Categories

4.2 Identify Representative Samples for Each Category of Information

After deciding what categories of data to include in the JRD, we gathered samples for each of these categories. We had to collect a sample opposed to importing all of the data because of the amount of information available compared to the time we had to complete this project. It was more important to show the depth of the JRD than it was to input all of the information at this time. If we focused on including all of the data, we would not have had enough time to complete other major components of the system. However, we still wanted to ensure that we used examples of all the different categories and sources available to us. We wanted to make sure we include at least one of each type of map and realty document. The rest of this section will go into depth about how we chose our samples for each of these categories.

After discussing the best approach with Governor Yepa, it was decided that the 2015 aerial photography from the BIA land survey would become the base layer of the GIS component of the JRD. This is because it was a full survey of the entire reservation and had a connected index detailing the names of all assignees at that time. We also decided to overlay all

nine of the hydrographic maps created in 1985 onto the 2015 photography by creating an additional layer in the GIS database. This is to show how the land, specifically tract boundaries, have changed over 30 years. Lastly, we also incorporated a highway easement map to serve as an example that the JRD can support realty information beyond just personal land assignments.

For the realty documents, we chose a relatively small sample of tracts and incorporated their respective records into the map component of the JRD. The 1985 hydrographic survey index included every tract (over 1000 tracts) within the reservation. However, because we wanted to show the depth of the JRD over breadth, we chose to limit the information that we included from this source and leave the rest of it to be inputted by the Jemez Pueblo in the future. We chose 10 tracts from the middle region of each map in order to create an even distribution throughout the reservation. In addition to the 1985 index, we also received 21 Land Transaction Agreement Forms [the form used to identify a transfer of land from one assignee to another that is signed by the Governor and a notarized (see Appendix F: Land Transaction Agreement Form)] from the Realty Department. We analyzed these documents to identify where they were located and find the respective Map-Tract number, but was only able to identify the exact location of about 10, and only 3 of those were within the agricultural land that we focused on for this project. We stored those 3 Land Transaction Agreement Forms into the correct location within our file structure, which will be discussed in more depth in the next section. Between these two sources, there were approximately 100 tracts dispersed throughout the Jemez reservation land included into the map component of the JRD.

The BIA provided approximately 450 plats made for tracts in the Jemez Pueblo; these plats identified the location using the Public Land Survey System (PLSS) of Central New Mexico. The PLSS divided land into townships and ranges, a 6 square mile region, and then

further divided the land into sections, 1 square mile regions, within those townships and ranges (see Appendix H: Public Land Survey System). Plats normally use this system to identify the general region a tract is located in, but it can only relate land to within a quarter-mile radius at best. Usually one would then use provided coordinates to locate the exact location of a piece of land from a section corner; however, the coordinates used in these plats were in 10000, 10000. A 10000, 10000 coordinate system uses an arbitrary origin point as opposed to a standardized origin (e.g., Latitude, Longitude, or State Plane coordinates). These plats usually used a PLSS section corner as the origin point, but unless you know the exact location of the origin point it is very difficult to locate a tract of land. This made it impossible to georeference into ArcGIS because ArcGIS is not compatible with 10000, 10000 coordinates, and the Jemez Natural Resources Department uses State Plane coordinates for all of their work. We contacted TJ Loretto, the GIS specialist for the Jemez Pueblo, to help us identify the exact locations of some of the plats and potential put them into State Plane coordinates. However, because of the time restrictions of the project, we excluded the BIA plats from the JRD with the intention that in the future they would be included when there was more time to identify their exact locations.

Finally, we decided that for our purposes we would rely on the 1985 index as our main source regarding assignee information. In the future, there would be room for expansion, but it will require the Realty Department to complete more assignment transaction paperwork first.

4.3 Determine How to Store Digital Representative Samples

To get the necessary information into the JRD in a format that supported its intended use we needed to digitize all of the physical records. Once the samples were digitized we organized them into the JRD database. The file structure of the shared drive, as seen in Figure 4-8, gave each individual tract its own folder which contained all documents related specifically that tract.

This included the 1985 index sheet for that tract and the Land Transaction Agreement Form for that tract, if the land had ever been transferred.
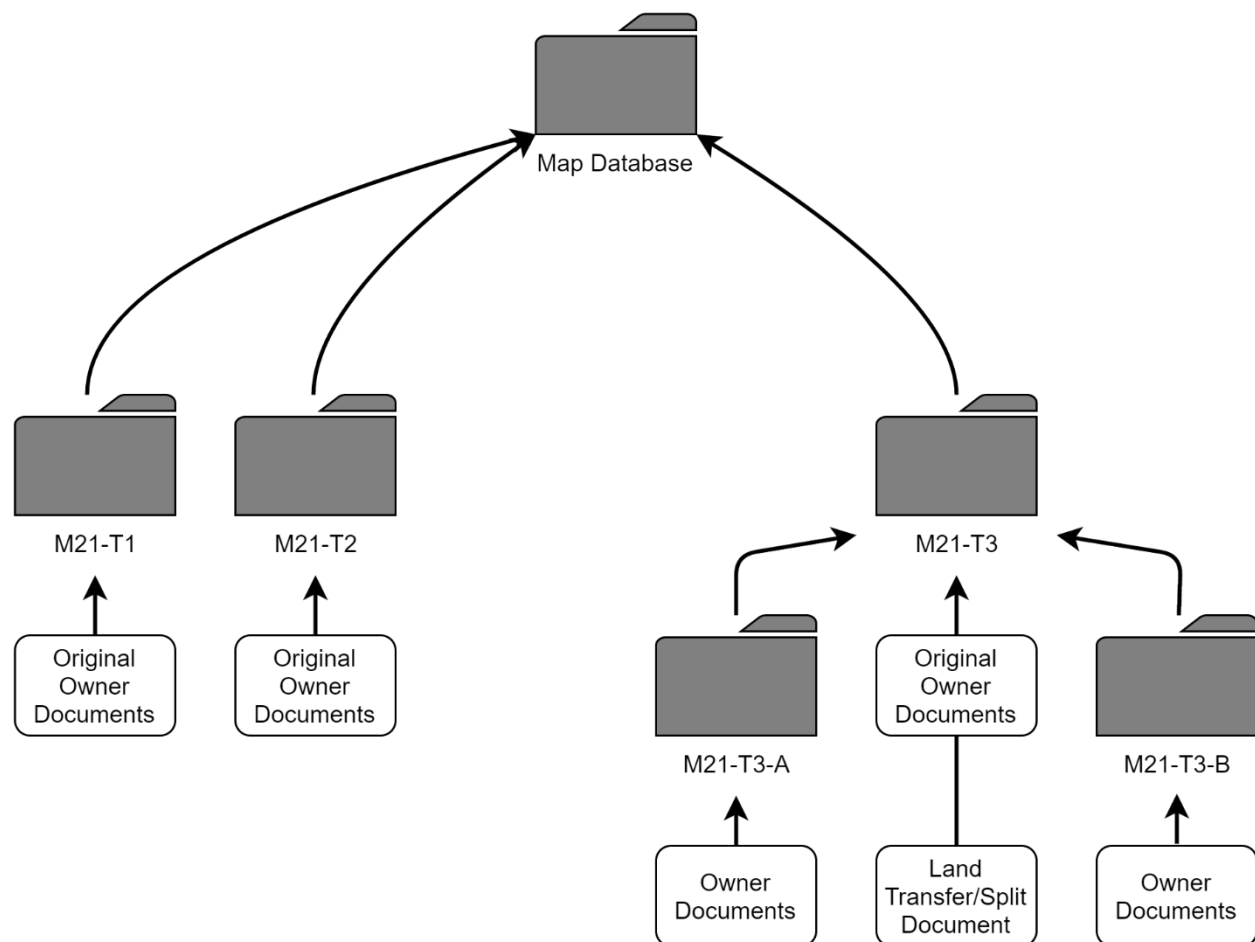
Figure 4-8: Shared Drive File Structure

Because there were nine maps that made up the entirety of the 1985 hydrographic land survey, we created folders for each map. Then the digitized 1985 index PDF files were placed into the corresponding tract number.

Additionally, the information that we wanted to include in the database from the 1985 land assignee index had to be manually typed into an Excel file. We were not able to electronically draw the information from the 1985 index sheets. To facilitate the entering of the data we created a form that appears when you open up the Excel file. This Excel file contained a macro that would open up a popup form when you used the keyboard shortcut, Ctrl+Shift+I, that

allowed you to fill out the information for each field in the sheet and auto-sort the entries in order

of tract number once the popup form was filled out and closed. This allowed for data entry to be

simple compared to scrolling through over a thousand entries to find where a new entry is

supposed to go and inserting a new row, potentially corrupting the formatting of the file.

Figure 4-9: Excel Entry Form

On the form, seen in Figure 4-9, we highlighted critical information from the 1985 index

that the Realty Department deemed necessary for each tract. One feature of the form is that once

you input the information to the sections and submit, the data will be entered in chronological

order. The order is based on the 1985 hydrographic land survey number and the number of the

tract on those maps. For example, map 21 and its respective tracts would be before map 22 tracts.

We spent six hours filling out an individual form for every one of the 1985 index sheets. Also,

realty documents were added to the database to provide a history of each particular tract to show

changes, if any, of the assignee, boundaries, and acreage. The records we digitized were saved on

a hard drive so they could be transferred to a final Excel table once it was constructed. This

allowed us to organize them in a common place. When we successfully determined how we

would store all of the relevant information, we then needed to develop procedures for how these

data would be entered, maintained and reported in support of the objectives of this project. To

do this we developed use cases of specific real-life applications.

4.4   Develop Use Cases to Show How the JRD Operates

Due to the increase in land disputes within the pueblo, we wanted to find a more efficient

way to store all the land and other related records. This way all the individuals who might need

access to them could find the records in one place instead of being stored in different locations in

the Pueblo. According to Governor Yepa, only Tribal Council members, the Realty Department,

and the Natural Resources Department would be using and have access to the JRD. Use cases are

organized descriptions that define what an operator of a system needs to be able to do within the

system. In Figure 4-10 below, we show the basic functions each user would be able to perform in

the JRD. We have outlined the tasks the three groups would use within the JRD in more detail in

Appendix C.
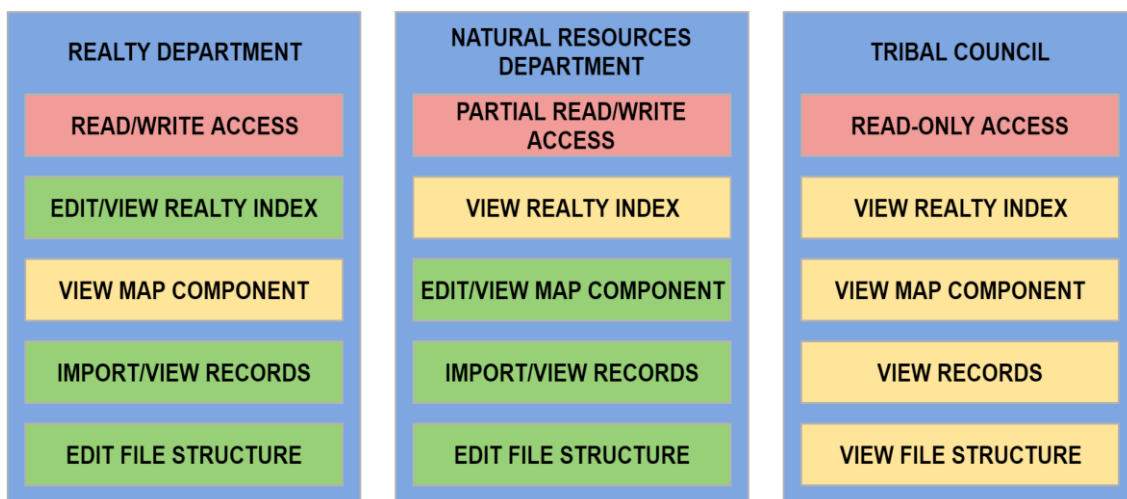
Figure 4-10: Use Case Breakdown

34

In the above chart, we have outlined the three user groups and the permissions they have within the JRD. The Realty Department has read and write permissions on the shared drive, meaning they can edit and view both the realty index and the file structure. The Natural Resources Department has read and partial write permissions on the shared drive, meaning they can edit the file structure, but only view the realty index. The Tribal Council only has read access to the shared drive, meaning they can only view the information within the JRD, not change it. In addition to the permissions on the shared drive, only the Natural Resources Department has permission to edit the map component.

4.5   Identify the Most Appropriate Technical Platform

Once we were satisfied with the finalized the use cases, we determined a technical platform that would be able to support what we wanted to do. We also wanted to keep in mind compatibility with the data the Pueblo already had, so we decided to also use ArcGIS when creating our land inventory database (see Appendix D: Platform Comparison Chart). In addition, we decided to create an Excel spreadsheet and folder structure to store additional data. We chose Excel over other spreadsheet options because we wanted to use a system that people were familiar with and to ensure compatibility with other things in the Pueblo. For our folder structure, we decided to store files in the PDF format, as this would ensure compatibility with many different systems and ensure that the documents would look the same on any computer.

We came up with a few different options for the Pueblo. The first option is to store everything on one computer. This has the advantages of speed and simplicity, as the data are already resident on the computer trying to access it, so there is no slowdown of data access. The data would be secure as someone would need to physically access the machine to access the data. In addition, this is the cheapest option, as the Pueblo would only need to maintain one system, as

opposed to several. However, the drawbacks of this method include lack of data redundancy and

lack of access. Only one person could access the data at a time, and that person would need to go

to where the computer is physically located in order to access the data. In addition, if the one

computer suffered a failure of some kind, the data might be lost. This could be mitigated through

local backups onto different drives, but there is still the risk of the whole computer being

destroyed, such as in a fire. Remote backups take protecting the data a step further; however, this

adds complexity to the system and makes data security a bit harder, as you would need to ensure

the security of the backups as well.

The second option we came up with for the Pueblo is storing the data in a shared folder

on a network, which is what the Isleta Pueblo uses. This would allow multiple people to access

the data while also keeping the data secure by only allowing certain people to access it.

Compared to the previous option, there might be a bit of a speed bottleneck as the data would

have to be moved across the network to anyone trying to access it, but not by much. In terms of

physical security, the servers are all stored in the main administrative building, which is the most

secure place on the Pueblo. The physical machine could still be destroyed by natural disasters, so

off-site backups would be an important aspect of this option. In addition, there should be some

type of data redundancy setup for this option, such as a RAID (Redundant Array of Independent

Drives), which would allow for the failure of a hard drive without the loss of data. Financially,

this option has the potential to be cheaper than the first option, but everyone who needs access to

the database will need a computer with the specifications to handle the database, which could

increase the cost.

The third option for the pueblo would be to use Arc Server with Portal, hosted locally at

the Pueblo. This would allow multiple people to access the information, but they would not be

restricted if they did not have a powerful computer system, as they could access the information through a web-based interface. This would also allow a custom interface to be designed for the different groups or individuals who would use the system. While this is a more expensive option than the previous two options, it would allow the greatest number of features to be available to the Pueblo. In terms of hardware, this would mean having a dedicated server system to run the application, just like the previous option. The hardware requirement for this option is the same as the previous option, and this system would also have to be maintained, just as the previous system.

The fourth option for the pueblo would be to get a subscription for ArcGIS cloud from ESRI, the company that makes ArcGIS. This is the most expensive option presented here, but it has the fewest requirements. The only hardware requirements for the Pueblo would be to have internet capable devices to access the web-based interface. In addition, the Pueblo would not be responsible for maintaining the system, as that would be taken care of by ESRI. In terms of data security, ESRI uses enterprise-grade encryption of all data and the data would only be accessed by authorized users that the Pueblo would designate. As ESRI maintains the system, they are also responsible for data redundancy and have many systems in place to ensure data do not get lost.

We presented these options to the Pueblo, along with our recommendation of going with option three, Arc Server with Portal. We thought that this option would best support the varied use cases as well as keep the data secure but still accessible. The Pueblo decided to go with our recommendation, and got a license for Arc Server with Portal from the BIA. They were able to do this at no additional cost to the Pueblo as they have a license agreement with the BIA for software such as this.

The final JRD had two components, GIS and Excel, and they contained common information in separate platforms so that different departments can use the system that works best for them. The Realty Department would use the Excel component, the natural resources department would use GIS, and the Tribal Council would use both. Both of these components are backed up by the folder structure we designed, and it is used by all groups using the system.

The system we put together follows the architecture chart below (Figure 4-11). We used two servers which were connected to each other many different ways. Server 1, named ARCGIS, was the main server, as it hosted ArcGIS server as well as the shared folder. The other programs installed on that server were necessary for those programs to function. ArcGIS Server requires the installation of ArcGIS Web adapter, which comes with ArcGIS server, so no additional licenses had to be purchased. ArcGIS Web adapter requires Internet Information Systems, or IIS, to be installed. IIS is made by Microsoft, and is available for free if you are running Windows Server as the computer's Operating System. Also installed on ARCGIS is ArcGIS Datastore, which, while not required, allows the user to host feature layers on ArcGIS Server more easily than if ArcGIS DataStore was not installed. ARCGIS also hosts the shared folder, which in turn contains the Excel Sheet and the Document Directory.
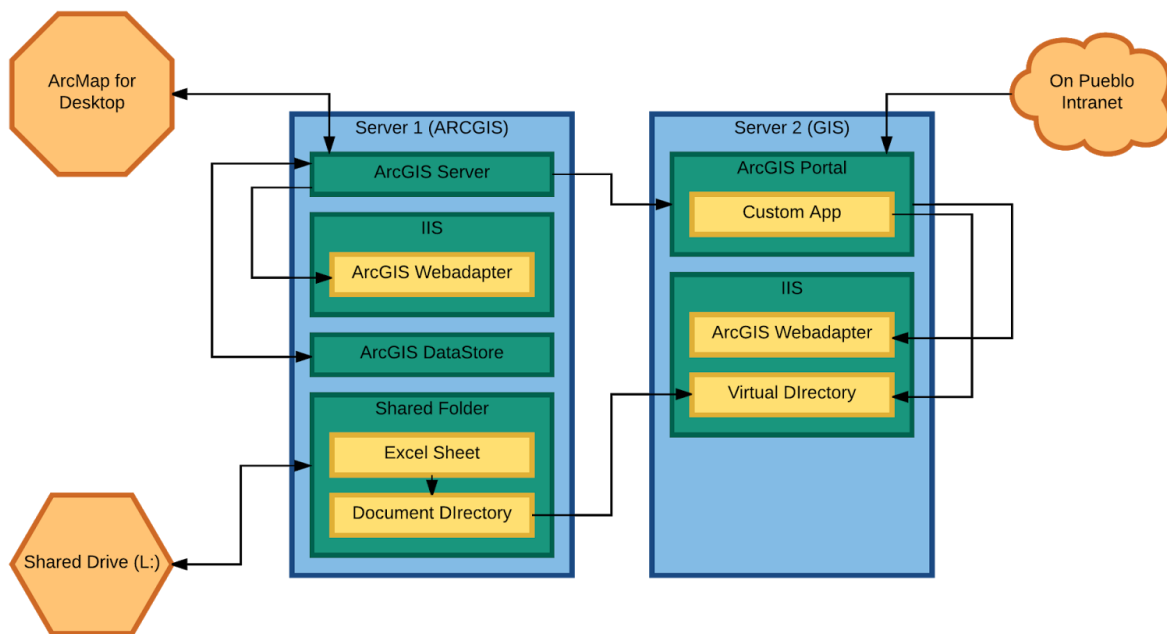
Figure 4-11: Platform Architecture Chart

Server 2, named GIS, hosts ArcGIS Portal, which is what allows web based access to the

JRD through a custom app that we developed. Just like ArcGIS server, ArcGIS Portal requires

ArcGIS Web adapter, which in turn requires IIS. On this server, we also hosted a Virtual

Directory through IIS which allows users, after logging in to the system, access to the folder

structure through a web browser. ArcGIS Portal was then connected to ArcGIS Server, which is

necessary to share maps from ArcGIS Server to ArcGIS Portal.

4.6 Determine Access and Permissions for Usage of the JRD

As previously discussed, JRD is intended to be used by only the Tribal Council, Realty

Department and Department of Natural Resources. A key aspect of this system was the

establishment of the permissions each group had within the system. In our inaugural meeting

with the Governor, he explained that the Tribal Council makes the final decision when dealing

with land disputes. Therefore, JRD would provide view-only access to all of the maps and

searches available in the system to the Tribal Council. The Department of Natural Resources will need to be able to upload new survey data into the system, as well as upload new maps and other GIS resources, but they will not need to be able to edit the Excel sheet. Therefore, the JRD would provide partial read/write access to the Department of Natural Resources. This system will allow them to upload new documents into the file structure and add information to the GIS system, but not allow them to edit the Excel sheet. The Realty Department will be responsible for entering and maintaining all of the data within JRD, so they would need to edit both the files in the document storage structure, as well as editing capabilities of the Excel sheet. Therefore, the JRD would provide read/write access to the Realty Department.

4.7   Create & Test Usable Database

Once we had finalized the GIS platform selection and had the IT department help us get the system running in the Pueblo, we needed to get all of the information we had digitized and organized and import them into the appropriate elements of the JRD. We imported the 2015 photography and the 1985 maps into ArcGIS. We georeferenced the 1985 maps to the 2015 map so that they were aligned on top of the 2015 map accurately to see the changes in the land over 30 years.

We used ArcGIS' hyperlinking function to link each tract to the appropriate folder in the dedicated shared drive in the server. We used a virtual directory, seen in Figure 4-12, because the web-adapter that Arc Server with Portal uses would not allow direct linkage to local files. This virtual directory allowed for reading, but uploading and editing of files still had to be performed in the local shared drive. This allowed users to navigate to any tract in ArcGIS and simply click on it to view all records about that piece of land. Hyperlinking allowed users to view the land in

the maps and view the paper trail of records about land and other infrastructure in the reservation if they want to without cluttering the interface of the maps.
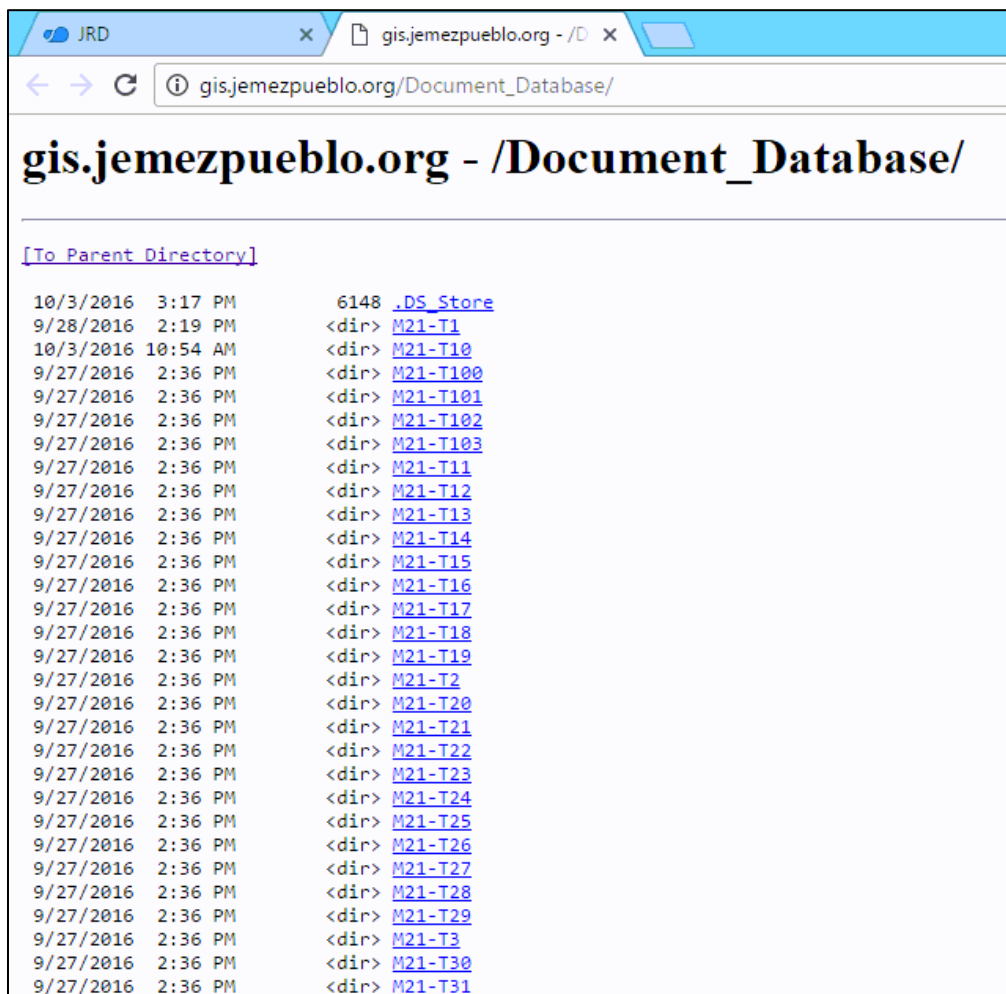
Figure 4-12: Virtual Directory

The other component of the JRD was the Excel Realty Index containing assignment information for each tract of land. This was filled with all assignments documented by the 1985 index, and contained fields such as acreage, assignee name, how was the land acquired, and more (see Appendix H: Assignee Index). The Excel file contained a column that has hyperlinked each entry to the same folder for that tract that the map component of the JRD was hyperlinked to. This allowed users of both the map component and the Excel component to access to the records for each tract of land. Though the two components of the JRD were linked to the same file

structure, they were not linked directly to each other. ArcGIS was only compatible with linking a singular row from an Excel sheet, and we found this would be ineffective because of the frequency rows changing with new data entries in the Realty Index. We also decided it was not to link them because if it only linked one row at a time, it would not allow users to see the transfer history (which spans multiple rows) with a single linkage.

We tested the JRD to finalize aesthetics, formatting, permissions, and organization. We verified the JRD was operating properly for each user level by logging in as the three different users and attempting to use the database and file structure as they would. With these components completed to the level outlined in this section, we presented the JRD to our sponsor, with the intention that the Tribal government staff would continue to fill more data into the JRD in the future.

4.8 Determine a Way to Sustain the JRD

In order to maintain a healthy system, it is important to document how the system works and how it to use it. To document this information, we have created a user manual and live demonstration presentation.

The first supplemental document we created was the user manual. From our use cases, we determined that certain actions should be explained (see Appendix C: Use Cases). We created a user guide for each of the different user groups and highlighted the use of both the Excel and GIS components of the JRD. The user guides are composed of a set of instructions which we wrote as we configured and maintained the system, as well as a set of screenshots providing visual aides to go with the written instructions. As we were working on the system, we encountered some errors that needed to be resolved. In case these errors were to reoccur we created a

troubleshooting guide with instructions on how to resolve the issue. The complete user manuals and troubleshooting guide can be referenced in Appendix I: User's Guide.

Taken from what we felt were the most important topics in the user guide, we created demonstrations that were presented before a live audience. We showed the governor and the Tribal Council how to view the Pueblo's entire land area, both present and past, view property data (acreage, use, etc.), view land assignments and transfer history, how to search for tract by owner or tract number, and how to access PDF files through the GIS maps.

After planning which features should be demonstrated we began creating the demo. We first selected an area on the map that contains information from every category. By ensuring that the area we chose has information entered for every category, we were sure that the area we demoed would serve as an accurate model of the final project. We showed how the land has changed over the years and any available records for each tract. This information was accessible by clicking on points within the map or Excel index to bring up the hyperlinked files contained in the shared drive We also demonstrated how to view and hide layers in the GIS component of the JRD, and how to search for information in either GIS' data field or Excel's search function.

Once we had completed the preparations for the demo, we presented the demo to our sponsors and advisors. In this demo, we showed how different users could navigate and perform desired tasks in the database. The demo was used both for us to show the work we had accomplished and for the sponsor to understand how the system we created for them works.

4.9 Summary

The first major accomplishment we made in this project was identifying categories of data to include in the JRD. These categories were:

- The 1985 hydrographic survey maps

- The 1985 hydrographic survey index
- The 2015 land survey aerial photography
- The Realty Department's Land Transaction Agreement forms
- The Highway 4 easement maps and legends

Second, we identified what technical platform to use for the JRD:

- ArcGIS for Server for data storage
- Portal for ArcGIS to provide an online interface for the JRD

Third, we identified the users of the JRD, who are:

- The Realty Department, who will have full "Read/Write" access
- The Natural Resources Department, who will have "Partial Read/Write" access
- The Tribal Council, who will have "Read-Only" access

Lastly, we created documentation to help the Jemez Pueblo sustain the JRD. This was in the

form of a user guide and a live demonstration for our sponsor and other tribal members.

5   Conclusions

As a group we were able to set up an interactive system for the Jemez Pueblo. This system included land maps, land surveys and a file structure that holds documents and records showing the history of the land. We provided the Jemez with a starting point for their transition in using a computerized mapping database compared to oral history and written record analysis when solving land disputes. The Jemez Pueblo will benefit from this project because we have created a system that has the ability to store information in one location. Documents will no longer be scattered amongst departments. GIS mapping is a very powerful system, and the Jemez Pueblo now have tools to take advantage of the capabilities of the JRD.

5.1   Recommendations

After completing the development of the Jemez Realty Database, we identified recommendations several recommendations related to the operation and enhancement of the system. As explained in previous sections, since 1985 was the first year the BIA completed a full survey of the Jemez land, this was designated as the base year of the database. The Natural Resources Department informed us that a full land survey was completed in 2015. Our first recommendation is to upload the 2015 land survey information once all of the documentation is received from the BIA. The purpose of the database is to be a common storage station for all relevant information dealing with agricultural land and the other land within the Jemez Pueblo. Uploading the 2015 land survey will connect the 1985 base layer to the current land. This will show any boundary changes and new developments, subsequently assisting the pueblo in settling land disputes because a history of each land parcel would then be present in the database. Additionally, every year a complete land survey is provided to the pueblo it should be uploaded into the database.

During interviews with the Realty Department, the main issue surrounding land disputes was a lack of documentation. We were informed that many tribal members involved in land disputes rely on oral history as evidence for their claims. This burdens the Realty Department because they then have to conduct several interviews in order to piece together evidence for the Tribal Council to use in making the final decision on the case. Some of the cases we analyzed had not been solved for over a year We recommend a comprehensive legal form be developed that includes: acquisition or transfer information of the specific land, multiple non–family witnesses and an approval statement from the governor who is in office at that time. A major component of the legal form is non-family member witnesses. This form should be required for the transfer of all land from this point forward.

In the future, we recommend the Jemez Pueblo increase the number of staff members in the Realty and Natural Resources departments. The installation of the JRD required data analysis, data entry and software installation. Hiring staff members with experience with those tasks will be very beneficial to maintaining the JRD. We also recommend hiring temporary employees, either from within the Pueblo or from local universities to work on the data entry that was not completed by this project team. The majority of work was devoted to entering the 1985 land index information into the realty index. We estimated that it required 45 minutes to enter 100 individual assignees. For 1,044 assignees, it required 8 hours for all of the data to be entered. In regards to scanned documents, the Pueblo has an automatic scan feeder, so a future employee only needs to organize the documents and put them into the feeder. This will take minimal time. Temporary employees may be the best option because land surveys and indexes are usually completed once a year. This means the majority of the data entry work will come periodically. The Pueblo may not need to hire a full-time employee unless there is other work to be done.

During our first week of the project, the Isleta Pueblo showed us their mapping database as well as the Excel sheet that contains information of each assignee. We used that input as the basis for the design of JRD. We created a form that allowed us to input information based on the categories of data we wanted to show in the spreadsheet. When you submit the input form it automatically sorts the data based on the numerical value of the 1985 hydrographic land survey map number and separate tract numbers of the parcels of land on that map. We recommend looking through Excel tutorials to create a form that one can use instead of manually inserting data by selecting each column. We will provide the code we used for our form as an example in return for the generosity they graciously showed us. Through our research and contact with ESRI, the company that provides the systems, we were able to determine that the BIA can provide and upgrade the Isleta to Arc Server and ArcPortal for free. Currently, the Isleta Pueblo is using a local network to run their mapping system. However, Arc Server and ArcPortal have more capabilities within their systems.

Our final recommendations for the Jemez regard their relationship with the BIA. BIA has a unique number for all the tracts of land within the Jemez Pueblo, and keeping that number documented in addition to their own naming convention will help communications with the BIA. When the BIA needs to be consulted, knowing what they refer to a tract of land as will help clarify what specific land is being referred to. We recommend adding a column to the Realty Index for this number to be documented. Also, the BIA uses the PLSS when creating plats for tracts within the Jemez reservation, so we suggest that a PLSS layer be added to the map component of the JRD to ease the process of identifying the exact location of a tract documented in a plat. This imagery is not difficult to find and can easily be added in the future.

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Appendix A: Sponsor Description

The Jemez Pueblo (2016a) is an independent sovereign nation located in southwest United States, about 40 miles northwest of Santa Fe, New Mexico. The Jemez Pueblo is a tribal nation, which means it maintains a separate government and tribal court dissociated from the United States Federal Government. There are around 3,400 total tribal members and 58% live within the boundaries of the reservation. According to a 2010 census, the Jemez Pueblo is home to about 1,788 people in 467 households (U.S. Census Bureau, 2010). Within the Pueblo's government there is a hierarchy of positions, which include the Tribal Council, the Governor, two Lt. Governors, two Fiscales, and a sheriff. David R. Yepa, one of our project liaisons, is the Governor of the Jemez Pueblo. As governor, he summons the Tribal Council meetings and carries out the Council's orders, and at the end of his one-year term, he becomes a members of the Tribal Council for life.

The term "pueblo" can refer to more than just the nation as a whole; it is actually Spanish for town or village (Merriam Webster, 2016). Within the Pueblo there are adobe homes constructed from clay and other, more modern, subsidized housing (Jemez Pueblo, 2016b). The traditional clay houses used early in history were able to stay cool inside despite the desert conditions of the Southwest. Presently, more of the members of the Jemez Pueblo tribe live in a modern complex that is constructed around the tribal center. These homes are fitted with modern utilities like electricity, plumbing, gas, Internet, etc.

The mission of the Jemez Pueblo (2016b) is to care for the individual members of the tribe, so the nation has its own established government and agencies that oversee everyday life. Currently the Pueblo is serving the people by trying to solve land ownership and boundary disputes amongst the tribal members. The agricultural land inside the boundaries of the

reservation are limited and the tribal council has determined who has the legal rights to which plots.

The Jemez Pueblo is funded partially by the BIA; however, the Jemez exercise self-determination and thus have departments and services provided and funded by their own independent government as well (Sando, 1982). The Jemez' economy is based on tourism, art, and handicrafts. The Jemez people are well renowned pottery and jewelry makers. However, the Jemez have always had an agricultural base to their economy, and that is still the case to this day (Jemez Pueblo, 2016b).

Appendix B: Interview Protocols & Summaries

Interview with Realty Department

- Interview was conducted in person at the realty department located in the Jemez Tribal Administration Building
- Our group had already met with the Realty Department before, so we did not have to introduce ourselves again
- Every member had the chance to ask questions, but one member, (Billy) was in charge to make sure the meeting progressed
- One group member (Rachel) took notes
- The interview was in question-answer-discussion format

Interviewees

Harold Sando (Realty Officer, Realty Department, Jemez Tribal Administration)

Interviewer

Billy Sullivan

Date: September 13, 2016
Time: 10:00AM
Location: Realty Department, Jemez Tribal Administration Building

Topics

- What is the current process/flow of documents when people come to the realty department for assignments?
  - Who do tribal members need to talk to first?

- What are the important forms that you currently use as the "final" documents?

- What are some big issues that the realty department currently faces?
  - Where do most land disputes stem from?

- How can we help/alter what we've been working on to suit your needs more?
  - Can we edit the realty documents that were presented to us further to fit the current trends in the pueblo?
    - Are there any additional documents that you need but don't have?

- What input do you have on our Excel index thus far?

- Open up for other discussion topics.

Minutes

What is the current process/flow of documents when people come to the realty department for assignments?

- People have to first come in and have some written verification of the land being passed to them
  - A will is the best form of documentation (as most of these are inheritance cases)
  - Basically a written document from the "original" owner claiming that the land is being given to the person who is trying to claim it
  - If people do not have a document, then Harold will usually perform an interview with that person to get the proper information/a statement from them about the land and how they were granted the land from the deceased previous owner
    - This is an issue because it becomes a conflict of interest for Harold when he helps the individuals like this
- After they provide verification of them gaining this land, they have to fill out the Land Transaction Agreement Form (this is usually the final document as it is what goes through the Governor and the Notary)
- The form will be turned into Governor for review
  - After it is approved it is signed by Governor and Notary and returned to realty department
- Once it is returned to the realty department, they send a survey request to the BIA for them to come out and survey the property, put in the stakes at the corners, and create a plat for the realty department to keep on file for that property

What are the important forms that you currently use as the "final" documents?

- The Land Transaction Agreement Form
  - This is the biggest one
- The Verification of Assignment Form
- The Assignment Record Form

Big issues that the Realty Department currently faces

- Parents telling all their kids that they can have the same piece of land.
  - This results in them arguing, and no one can have the land because they cannot come to an agreement.
- Things are not taken to the realty department until there is controversy
  - They may come to get a survey done, declare subdivisions (maybe), or they want to build a home site.
- They do not have a probate code for the tribe; they cannot probate.
- People can lose wills and other verification records, then they have no proof.
- Harold has started to just let things sit for a little because he doesn't want to start the process just to have a family member come in and claim the same land and halt the process again at the Governor level.

<u>How can we help/alter what we've been working on to suit his needs more?</u>

- He has been numbering his files as 2016-1, 2016-2 and so on in order of which ones he reviews/fills out.
- He could use some set documents that can be used as a will but just for the land that he can give to people for them to fill out before they pass so that it is documented.
  - Also create a document for those interviews to be more official if a will cannot be found.
    - Basically a deceased person's will document that can be standardized as opposed to the 10-page document he references when he needs to do interviews.
- Rewording the Land Transaction Agreement Form so that a deceased person can be the previous assignee of the land.
  - There is a current issue, where if Harold puts "deceased" the governor will turn it away because a deceased person cannot transfer land.
    - Harold appreciates that Gov. Yepa was an attorney, because he is helping Harold realize the need for tighter legality in his department.
- He would like a guide for how to use the system and the procedures needed to complete necessary steps to filing these requests through the realty department because there is no system right now. He wants standardization to make things simpler.
- He would also like a section in our Excel index where he can put what verification document that was used next to how the land was acquired.

Interview with IT Department

- Interview was conducted in person at the IT department at the Jemez Pueblo
- Group members introduced themselves and gave a brief background to what they are studying at WPI.
- The interview was led by Wyatt, while Rachel took notes. All group members had the opportunity to ask questions
- The interview began with us giving a brief overview of what the project was and what we thought we needed from the IT department.

Interviewees

Wilson Barrow, IT Director
Shawn Larson, IT Systems Specialist

Interviewer

Wyatt Henke

Date: 9/15/2016
Time: 10:45 AM
Location: IT Office, Jemez Pueblo

Topics

- What software do you use?

- What are your storage options?
    - Show file structure to get input

- What kind of protection do you have against data loss?
    - How often do they backup and where to?

- What do you need from us to get us a server?
    - What about a shared drive for storage?

- Open up to other discussion points.

Minutes

What software do you use?

- They use VMware
- They use Windows servers

What are your storage options?

- They can do a couple hundred GB for us

- o We decided to start with 200GB
- They will create a dedicated share drive for this system
- They want us to run our file structure by TJ and Harold to see if it works for them

What kind of protection do you have against data loss?

- They perform daily backups of their servers
    - o Servers are in the tribal administration office
    - o They do not have any fire safety systems in place in the server room
    - o The backup is in the IT office, and then copied to tape
    - o There is a disaster recovery in implementation phase
- They are getting ready to buy servers for duplication/redundancy

What do you need from us to get us a server?

- They need system requirements from us
    - o What is going to be on this drive, and how much space it will take up
    - o ESRI gives a general description of the system requirements; we sent this to Shawn
- We would have an operator and a data partition
- Our project group can receive access to the server/shared drive.
- They cannot provide an answer to us about making the shared drive the data drive.

Interview with Governor & GIS Specialist

- Interview was conducted in person at the Tribal Administration Conference Room at the Jemez Pueblo
- Group member introduced themselves and gave a brief background to what they are studying at WPI and what the IQP project is
- The interview was led by Rachel, while Billy took notes. All group members had the opportunity to ask questions
- The Interview began with our group discussing what we believed the project goals were and we got feedback from the tribal administration. We then discussed the logistics and specifics for the upcoming weeks

Interviewees

David Yepa (Governor)
TJ Loretto (GIS/Mapping person)
Benny Shendo (Tribal Administrator)
Hilario Arimjo (Lieutenant Governor)

Interviewer

Rachel Rynazewski

Date: August 24, 2016
Time: 9:00am
Location: Tribal Administration Conference Room, Jemez Pueblo

Topics

- What are your goals for the JRD?
    - We think that the goal is to have a skeleton with a sample of information inputted into it that can be completed easily by just plugging information into it after we leave, is this correct?

- What resources can we use?
    - Are there people we can contact?
    - Are there departments we can get information from?

- What is your vision for the system?
    - Consider the time restriction.

- Future Plans
    - When are we going to be scheduled to work on site at the Jemez Pueblo?
    - When do we want to have weekly update meetings?
    - Where can we work when we are on site?
    - What is the first thing we can get started on?

- Open up to other discussion topics.

Minutes

What are your goals for the JRD?

- Creating a database for compiling all information on land in pueblo
- Track ownership (assignment) change
- We want to accomplish the skeleton of a database with some maps that can easily be added too after this project is completed
    - Ideally we will be able to put some of the ownership information in the database as well before our 7 weeks are up

What resources can we use?

- TJ is part of the natural resources department
    - Main point of contact
    - Will allow us to utilize his office and computer if need be
    - Is a very busy person, so planning with him ahead of time is key
- Mabel Waquie - Tribe member working for the BIA
    - On site Tuesdays and Thursdays
    - Available for technical assistance for computer mapping
- Herald Sando - Currently the only member of the realty department, worked on assigning ownership to plots during the hydrographic survey
- Information is in all various forms, paper, oral, digital
    - Unfortunately, this has led to hearsay and disputes
- Obtain information from BIA
- The Realty Department has hydrographic maps from the water litigation in 1980 consisting of the 27 different maps covering the entire river basin
    - These list acreages
- There are maps from the 1930s that include who was assigned each plot.
- Other tribes use various tracking systems
    - Isleta Realty Department have a good example. Visiting on Friday with TJ Loretto at 9:30 to see more.
- Public Works may have some maps/other resources
- Realty department has owners of plots and possibly maps as well
- Google Maps has historical maps dating back to 1996
- University of New Mexico may have some resources that we can utilize as well
- Realty department has large scanner
- 1985 mapping index of land assignments by plot
- They have satellite image maps from the last 20 years

What is your vision for the system?

- The main purpose of the database is for the Reality Department
    - Establish base for up to date assignment of agricultural land
- Given time restrictions start base with maps dated back to 1980s
- Look into storing information in the cloud
- Possible first map to use

- o 1985 to present, multiple versions
- o List plots, not owners
- o 1930's map has names associated with land plots
- Store (explain) how information was obtained
- Look into what computer systems the tribal administrators are using and determine how to setup our database to meet those system requirements/restrictions

Future Plans

- Tuesdays and Thursday are concrete on site days, Starting Aug 30
  - o Aug 30th we will have our inaugural meeting with our advisors and the Tribal Council at 2pm at the Tribal Administration conference room
- Determine available information and set up a roadmap for our project
  - o Completed during inaugural meeting on Tuesday
- Have weekly report meetings Thursday afternoons to discuss accomplishments from last week and plan the work for the following week
- Write weekly reports? (possibility)
- The headquarters that we will be working out of is an office space next to the Housing Department with the ability to drive to TJ Loretto's office and the Governor's office
- We will be starting to scan physical maps on Tuesday morning before our inaugural meeting that afternoon

General Pueblo Info

- The agricultural land is very important to the Jemez people because throughout history agriculture drove society
- Agricultural land may become or have already become home sites
- Population 3,700
- The pueblo is growing
- Land is assigned, not owned individually
- Water rights dispute since 1800s
- This project will actually have a significant impact on the Jemez Pueblo
  - o Chance for them to restore value of their agricultural land

Interview with Isleta Pueblo Surveying and Mapping Division

- Interview was conducted in person at the Isleta Pueblo
- Group members introduced themselves and gave a brief background as to what they are studying and why, as well as what an IQP is

Interviewees

Ernie Salazar (Land Surveyor, Isleta Pueblo)
Faron Candelaria (Surveying and Mapping Division Manager, Isleta Pueblo)
Nick Thompson (GIS Specialist, Isleta Pueblo)

Interviewer

Andrew Boynton

Date: 8/26/2016
Time: 9:30 am
Location: Conference Room B, Administration Building, Isleta Pueblo

Topics

- How did you register the land when creating your system?
    - What kind of documents were used?

- Where did you get land information from?
    - Documents?
    - People?

- What Software did you use?
    - What type of GIS software as well as any other programs needed to create the data that can be put into the GIS?

- What kind of categories and data fields did you use?

- What were your goals for your GIS database?
    - Was it to help disputes or to just get organized? Or both?

- Are there any potential issues with using this type of system?

- Background about the Isleta Pueblo.
    - What departments use this system?
    - Is there any relevant information about the Isleta Pueblo in general that can help us understand the implications of this GIS database?

- Open up to other discussion topics.

Minutes

How did you register the land when creating your system?

- Hand draw boundaries of plots on sat maps
  - Tract Map
- Number the plot
  - Unique id
  - Helpful to include information in the number, including tract/year
- Registration slip
  - Puts names to plots
  - Includes how the land came to the person
  - Signed by the governor

Where did you get land information from?

- Tribal members might have records of land transfers
- Plats
- Land assignments
- Surveys
- Tract maps

What Software did you use?

- Autocad
  - Used to make the geometry for the plats
- Carlston Survey
  - Plugin for Autocad
- Autocad Civil
- ArcMap
  - GIS
- ArcGIS
  - GIS
- Excel
  - Database
- Access
  - Database

What are the data fields that you used in your Excel sheet?

- New owner
- Previous owner
- Date
- Tract #
- Acreage
- Reason for change
- Transaction #

- Unique ID for land
- Original owner
- Paper References (hyperlink)

What were your goals for your GIS?

- Realty Record Log (excel)
- Plats
- Tract Map
- Defined fields (database)
- Surveys
- Link to scans of original documents

Potential Issues

- Individual room ownership
- Dividing up land
  - Access to roads and water are important for each plot

Isleta Background

- 290,000 Acres in Isleta Pueblo
- Isleta Realty Division
  - Established in 1980
- Realty Division created "Tract" map
  - Showed property
  - Hand drawn on aerial map
  - Registration slip asked questions on how land was required, acreage etc.
- Meets and Bound mapping terminology = Bearing and Distance
- Around 1980, individuals began to not trust word of mouth for land exchange/passing down so disputes became more common
- Isleta Realty Department uses an Excel spreadsheet to track land
  - Tracking number of land
  - Person I number
  - Who has owned the land before and after
  - Was is purchased
  - Was it inherited
  - What is the total acreage?
- Example of Track in the Excel file
  - 12-002; where 12 identifies the number of the particular track map and 2 is the parcel
- Isleta stores mapping information on shared drive
- Agriculture land boundaries can be tracked by water ditches that run around land

Terms

- Plat
  - Map showing boundaries

- How it was obtained
- Legal description
- Easements
- Right of way
- Older plats might use relative relationships to bound the property
  - Ditches
  - Roads
  - Other property
- IHS
- State Plane coordinates
  - Standard for the area
- 10000 10000
  - Relative coordinates
- UTMS
  - Universal Standard
- MRGCD
  - Middle Rio Grande Culture Ditch
- Geo-reference
  - Putting information (scans, surveys) into its place on a map

Lessons Learned

- Need for Standards
  - Naming
    - Including the tribal members as some members might have the same name
  - Fonts
  - Coordinates
- Lots of sources of information
  - All need to be pipelined into the system
- Paper trail
  - Used for legal decisions
  - Members might want copies of paper sources
  - Older documents trump newer documents in case of conflict
- User friendly vs complete information
  - Talking with users
- Survey records
- User Access

TJ's Input

- 89,000 Acres in Jemez Pueblo
- Jemez Pueblo has 4 ditches
  - 2 controlled by the Governor and 2 controlled by the Fiscales in the East portion of the Pueblo
- Jemez Agricultural plots are generally small acreage, 5 acres is the maximum plot size
- BIA surveyed whole Jemez Pueblo, but there are no names attached to the plots of land
  - Need to compare to 1985 map

- System that is being developed must be user friendly for Tribal Council members
- Agricultural land recently mapped, great place to start for student group

Appendix C: Use Cases

Realty Department:
- Open the JRD
- Access the excel file
- Import assignment information to excel
- View PDF records from the excel sheet
- Search for tract by assignee name in excel
- Access PDF files through the GIS maps
    - One-Click Capabilities
- Access to import PDF files
- View entirety of Pueblo
- Turn layers of map on/off

Tribal Council
- Open the JRD
- Access the excel file
- View PDF records from the excel sheet
- Access PDF files through the GIS maps
    - One-Click Capabilities
- View entirety of Pueblo
- Turn layers of map on/off

Natural Resource Department
- Open the JRD
- Access the excel file
- View PDF records from the excel sheet
- Search for tract by assignee name in excel
- Access PDF files through the GIS maps
    - One-Click Capabilities
- Access to import PDF files
- View entirety of Pueblo
- Turn layers of map on/off
- Import new survey/mapping data to ArcMap

Appendix D: Platform Comparison Chart

	Local Computer	Local Network Drive	ArcGIS Local Server	ArcGIS Cloud
Software	**ArcGIS for Desktop**	**ArcGIS for Desktop**	**ArcGIS for Server**	**ArcGIS Online**
License Cost	ELA eligible (free)	ELA eligible (free)	ELA eligible (free)	$2500 (5 users) to $40,000(200+ users) per year
Hardware Cost	$800-900 (per computer)	Up to $1000 (new server) $800-900 (per computer to access the information)	Up to $1500 (new server) Possibility of using existing server	N/A
Accessibility	Single User	Anyone with access to network drive	Customizable, anyone with an internet connected device and a login	Customizable, anyone with an internet connected device and a login
Dependency	None	Network access	Network or Internet	Internet
Storage Space	Hard Drive Dependent	Hard Drive Dependent	Hard Drive Dependent	500GB (Can pay for more)
Data Security	Local (Single user), encryption, physical security	Password (restricted to specific users), encryption, physical security	Password access (restricted to specific users), encryption, physical security	Password access (restricted to specific users), encryption
Data Redundancy	Off site backups, backups to shared folder, RAID array	Off site backups, RAID array	Off site backups, RAID array	Off site backups, RAID array
User Access	ArcMap (full access)	ArcMap (full access)	Custom APP (per user permissions), ArcMap (full access)	Custom APP (per user permissions), ArcMap (full access)

69

Specs for New Computer:

CPU: Intel Core i5-6600K 3.5GHz Quad-Core Processor ($227.99 @ SuperBiiz)
CPU Cooler: Cooler Master Hyper 212 EVO 82.9 CFM Sleeve Bearing CPU Cooler ($24.88 @ OutletPC)
Motherboard: Asus Z170-A ATX LGA1151 Motherboard ($150.88 @ OutletPC)
Memory: G.Skill Ripjaws V Series 16GB (2 x 8GB) DDR4-2400 Memory ($69.88 @ OutletPC)
Storage: Samsung 850 EVO-Series 250GB 2.5" Solid State Drive ($94.00 @ B&H)
Storage: Seagate Barracuda 2TB 3.5" 7200RPM Internal Hard Drive ($74.99 @ Newegg)
Storage: Seagate Barracuda 2TB 3.5" 7200RPM Internal Hard Drive ($67.99 @ SuperBiiz)
Video Card: XFX Radeon HD 5450 1GB Video Card ($27.99 @ SuperBiiz)
Case: Corsair 200R ATX Mid Tower Case ($49.99 @ Newegg)
Power Supply: Corsair Builder 600W 80+ Bronze Certified ATX Power Supply ($36.99 @ Newegg)

Total: $815.58
Prices include shipping, taxes, and discounts when available
Generated by PCPartPicker 2016-09-07 12:59 EDT-0400

Appendix E: Job Descriptions

GIS Mapping Job Description

Below is an overview of the basic skills a GIS mapping specialist must have to successfully operate the system (Study.com, 2015a).

Requirements:
- GIS technicians typically earn a Bachelor of Science degree in geography, computer science or engineering
- Take courses or be familiar with the material of GIS, geography, geosystems, historical geography, and computer architecture
- Experience in the field

Skills:
- Computer literate
- Attention to detail
- Communications skills to present data, maps etc.

Responsibilities:
- Develop, maintain and update Geographic Information System (GIS) databases
- Gather data from city, state, federal and private sources
- Receive and review maps
    - Land parcel records and engineering documents
- Analyze GIS information and convert data into different GIS formats
- Data entry into databases
- Update GIS layers and databases
- Create maps and GIS related documents

Realty Department Employee Job Description

Below is an overview of the basic skills a reality department employee must possess to successfully carry out duties (Study.com, 2015b).

Requirements:
- A bachelor's or master's degree in a business-related field
- Experience working in field
    - Ex. BIA records department, surveying

Skills:
- Computer literate
- Communication skill
- Proficient in Excel and Word
- Surveying land
- Can interpret types map

Responsibilities:
- Sit down and assist individuals who have an issue or question concerning their land
- Analyze land claims by looking through records
- Data entry
- Survey land when a dispute arises
- Keep records

Contact BIA for additional records or assistance

Appendix F: Land Transaction Agreement Form

LAND TRANSACTION AGREEMENT   #2016- _____

This Agreement is made at Jemez Pueblo, New Mexico, on _____ 2016 ____

By _____ of Jemez Pueblo whose address is _____

And _____ of Jemez Pueblo whose address is _____

1. _____ are/is the owner(s) of the lot parcel situated in the Pueblo of Jemez Indian

Reservation, County of Sandoval, State of New Mexico, and wish to exchange lands described as follows:
(give legal/general description of property)

_____

_____

_____ desires to receive the exchanged property described in paragraph 1

_____ transfers all rights to _____

This agreement shall bind all parties as a final agreement. In witness whereof, the parties have executed this agreement.

_____		_____	
Signature of Original Assignee	Date	Signature of New Assignee	Date

WITNESSES

(witnesses are the family members of the land assignee who are transferring assignment and witnesses of new assignee)

_____		_____	
Name	Date	Name	Date
_____		_____	
Name	Date	Name	Date

ATTEST

_____
Governor   Date

_____	_____
1st Lieutenant Governor Date	2nd Lieutenant Governor Date

NOTARY PUBLIC:
SUBSCRIBED AND SWORN BEFORE ME THIS _ DAY OF _____, 20____.

_____   _____
My Commission Expires   Notary Public
(Notary must be present when this form is completed. Form completed without a Notary signature will not be accepted and returned to the sender)

Appendix G: Public Land Survey System

The Public Land Survey System (PLSS) is a system in the United States which divides federal land into what are known as "townships" and "ranges" (U.S. Department of the Interior, 2016b). Townships are 6-mile sections that run from north to south, while ranges are 6 mile sections that run east to west. The origin point is the intersection between the Meridian (the origin for range) and the Baseline (the origin for township).
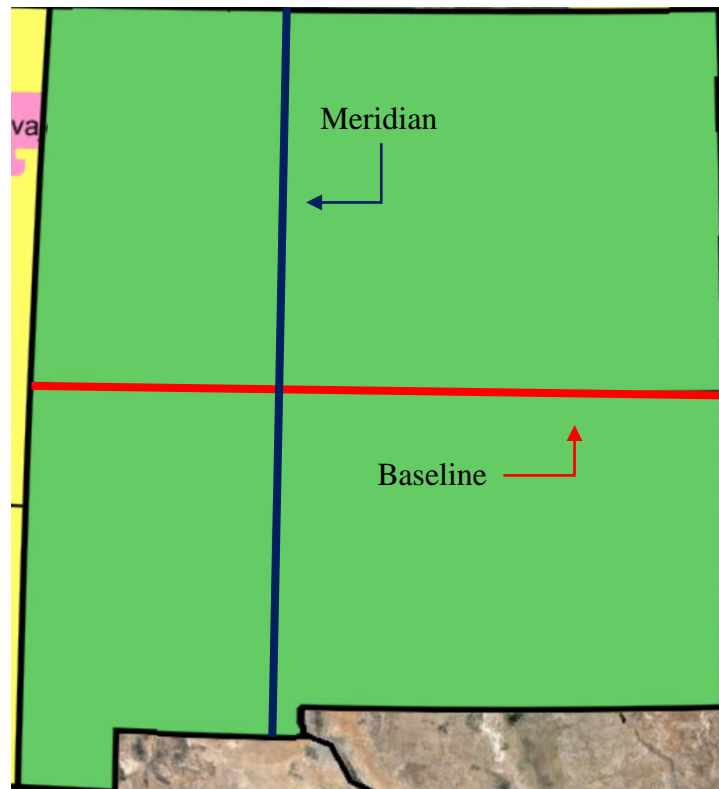
Figure 5-1: Meridian-Baseline Map
(Google Inc., 2016)

The 6-mile by 6-mile area created by the intersections of townships and ranges are also referred to as "townships" for the sake of simplicity.
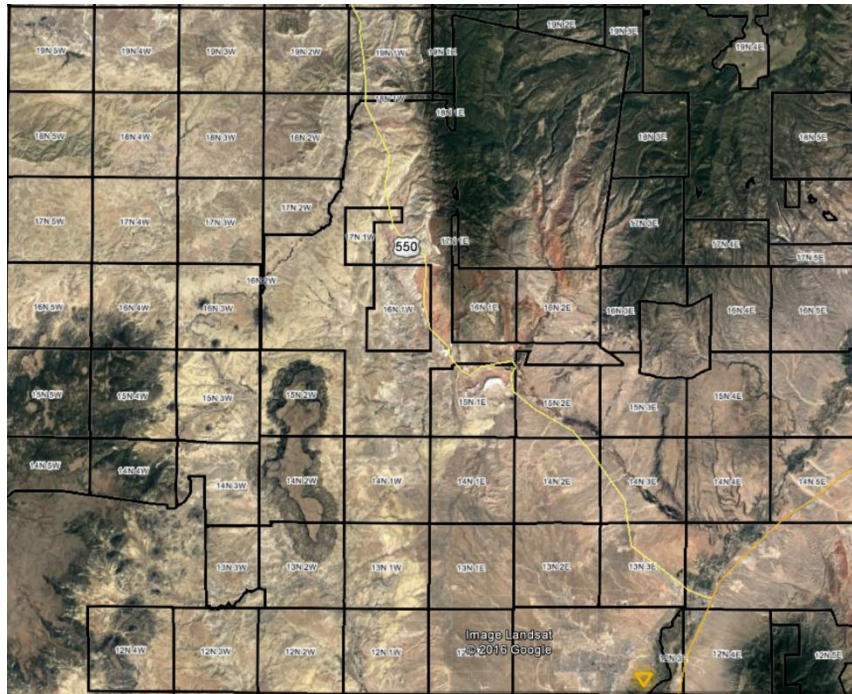
Figure 5-2: Township and Range Map
(Google Inc., 2016)

Townships are then broken up into 36 1-mile by 1-mile regions known as "sections" that start in

North East corner and snake across and down, as seen below.

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36
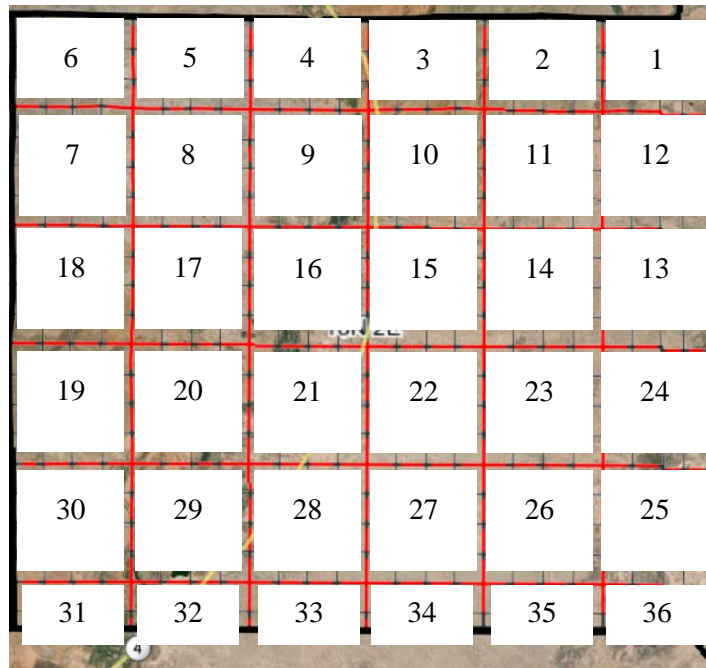
Figure 5-3: Section Map
(Google Inc., 2016)

These sections can then be divided up into quarters or eighths. This is done by stating a quarter with cardinal directs, such as the NW ¼. To signify an eighth of a section you just specify another cardinal direction before stating the location of the quarter, such as the NE ¼ NW ¼, which specifies the NE quarter of the NW quarter.
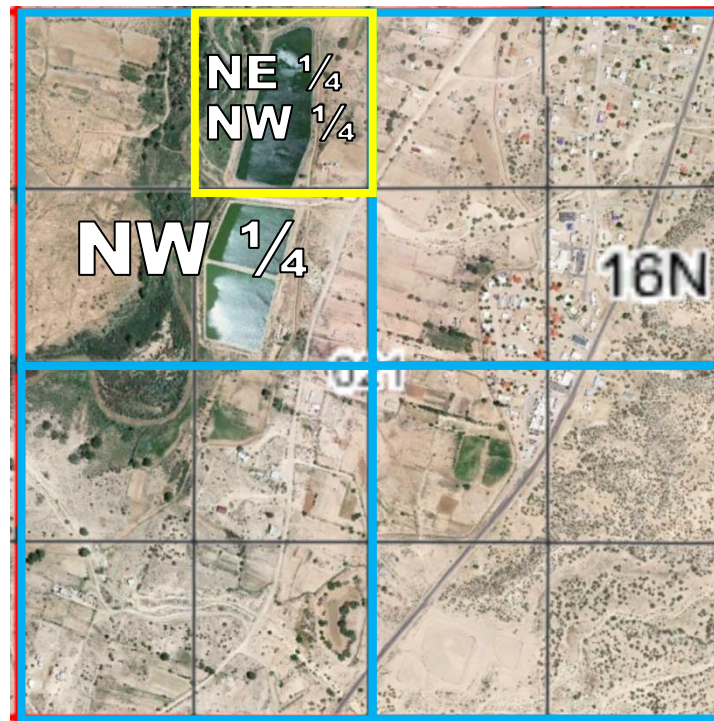
Figure 5-4: Section Quarters Map

(Google Inc., 2016)

The plats for Jemez land that were provided to us listed this identifying information in the following order: Section quarter, Section number, Township, Range. For example, NW ¼ Sec. 28, T.16N., R.2E., N.M.P.M. In this example, N.M.P.M stands for New Mexico Principal Meridian, meaning that the origin for the township listed is the New Mexico Principal Meridian, pictured in Figure 11. This type of description can be as detailed as anyone wants it to be by just adding more quadrants to the description; however, the plats provided to us never went past the first quadrant in description.

Assignee Index Formatting

The index is in numeric order by tract name and has columns for each of the following fields:

- "Original Sheet" (based on the hydrographic survey maps)
- "Original Tract" (based on the hydrographic survey map)
- "Tract #" (the current name for that unique tract)
- "Lot" (if a tract has been subdivided)
- "Property Assignee"
- "CIB#" (their tribal census number)
- "2nd Assignee" (if two people have land together)
- "Date" (of the assignment/transfer)
- "Acquired How?" (how did this person gain this land)
- "Verification Document" (i.e. will, letter, etc.)
- "Acreage"
- "File Location" (which is where the hyperlinks will be)

Original Sheet	Original Tract	Tract #	Lot	Property Assignee	CIB #	2nd Assignee	CIB #	Date	Aquired How?	Verification Document	Acreage	File
21	1	M21-T1		Joe Tosa							2.09	
21	2	M21-T2		Audamita Chiwiwi							1.45	
21	3	M21-T3		Joe Toso							0.72	
21	4	M21-T4		Juan Louis Pecos							1.38	
21	5	M21-T5		Joe Pecos							1.3	
21	6	M21-T6		Juan Toledo							3.18	
21	7	M21-T7		Juan L. Pecos							1.57	
21	8	M21-T8		Allen Toya							0.95	
21	9	M21-T9		Leo Sando							0.74	
21	10	M21-T10		Earnest Shendo							1.01	
21	11	M21-T11		Mrs. Juan Toya							0.91	
21	11	M21-T11		Mrs. Juan Toya							0.91	
21	12	M21-T12		Sam Chinena							0.81	
21	12	M21-T12		Sam Chinena							0.81	
21	13	M21-T13		Jose Lucero							2.31	
21	14	M21-T14		Joe Tosa							2.42	
21	15	M21-T15		Manuel Tosa							1.24	
21	16	M21-T16		Randolph Padilla							0.6	
21	17	M21-T17		Mrs. Alfred Toe							5.1	
21	17	M21-T17		Franklin Casiquito							0.87	
21	18	M21-T18		Frank Fragua							2.85	
21	19	M21-T19		Cirano Toya							0.99	
21	20	M21-T20		Pete Toya							0.79	
21	21	M21-T21		Frank Madalena							0.76	
21	22	M21-T22		Pedro Chinana							0.91	
21	23	M21-T23		John Cajero							1.65	
21	24	M21-T24		Mrs. Frank Waquie							1.16	
21	25	M21-T25		Rey San Juan							1.55	

Figure 6-1: Excel Index Format

Figure 15 above depicts the layout of the Assignee Index, from this you can see how it follows numeric order by tract number and has fields for relevant information about each tract to be filled in by the Jemez Realty Department.

Entry Form Popup

Figure 6-2: Entry Form

This dialogue box allows users to input a new entry without having to scroll through the entire Excel sheet. It also has a function that auto-sorts the new entries after the dialogue box is closed. This allows for simple and quick data entry.

Appendix I: User's Guide

Jemez Realty Database

Interactive User Guide
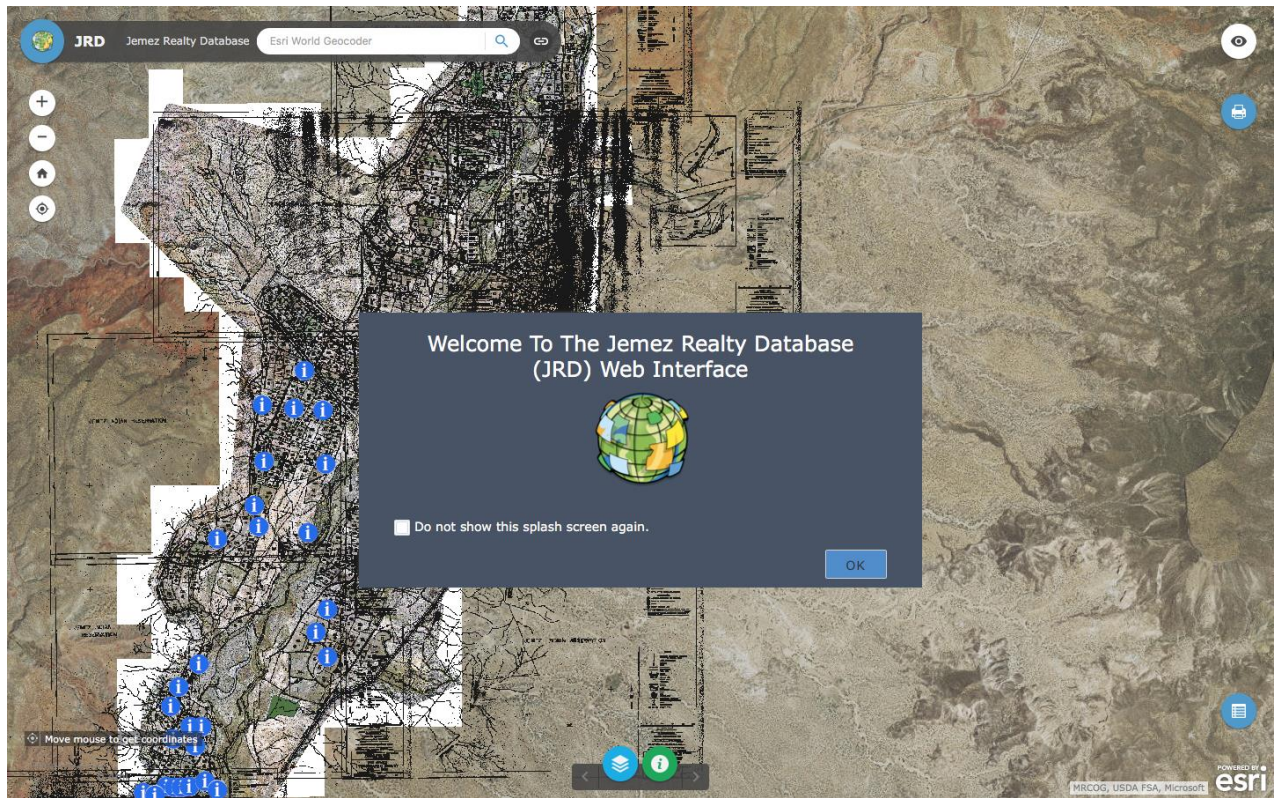
Authors:

Andrew Boynton

Wyatt Henke

Billy Sullivan

Rachel Rynazewski

Table of Content[1]

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[1] Note: these page numbers correspond to what was delivered to our sponsor, they are inaccurate to the page numbers in this report.

How to Access Records from File Structure

1. Open File Explorer

2. Select Computer

3. Open the L Drive by double clicking "docdb (\\arcgis) (L:)"
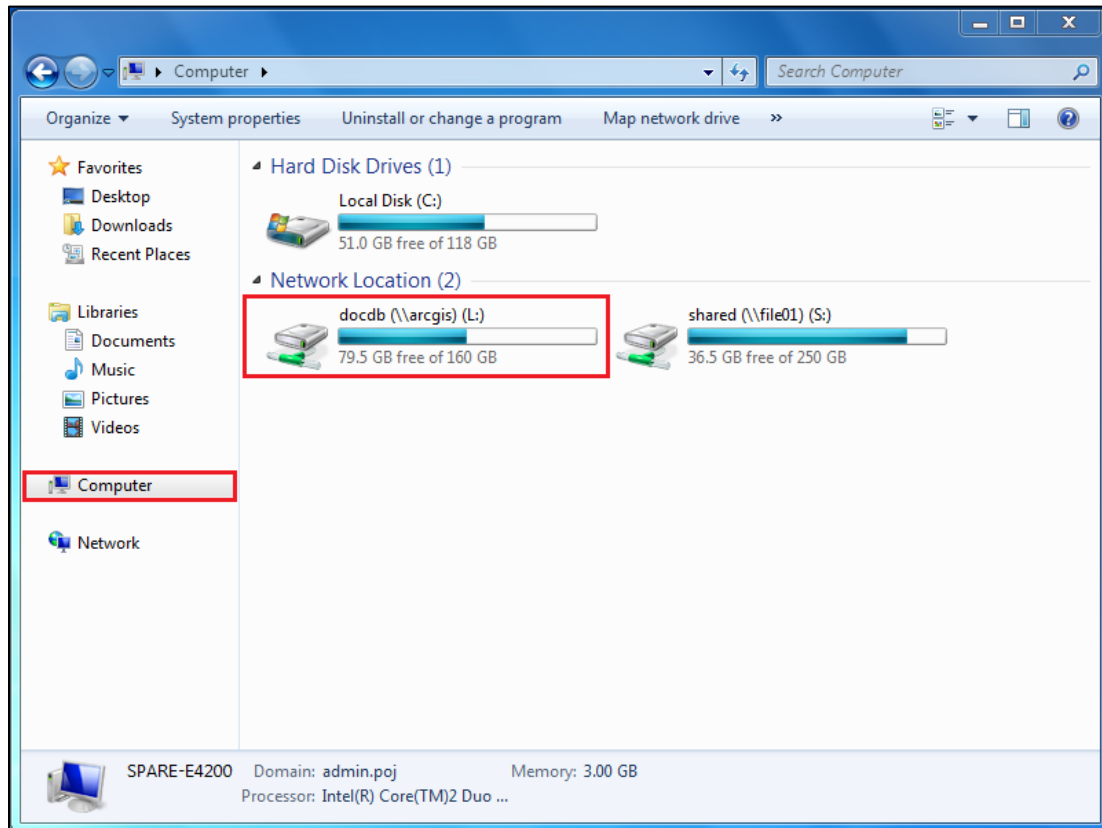
4. Double click "Map-Tract"
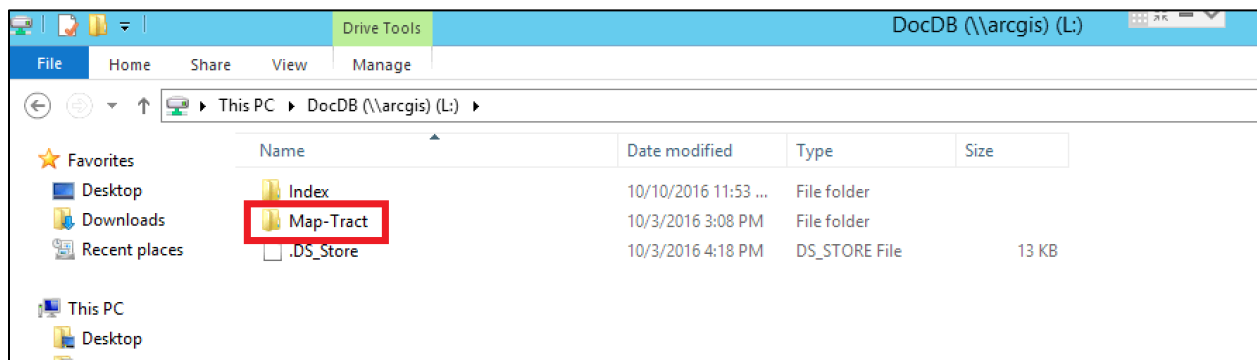
5. Double click any of the folders within the list to view the records for that specific tract
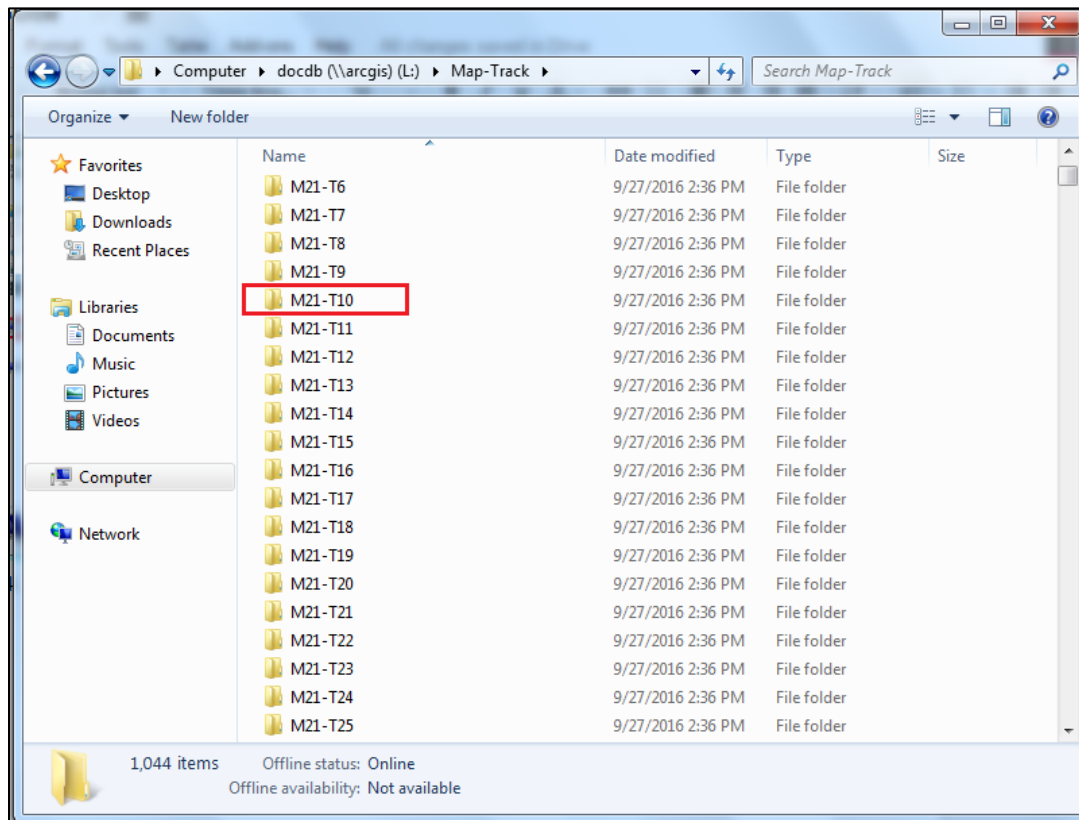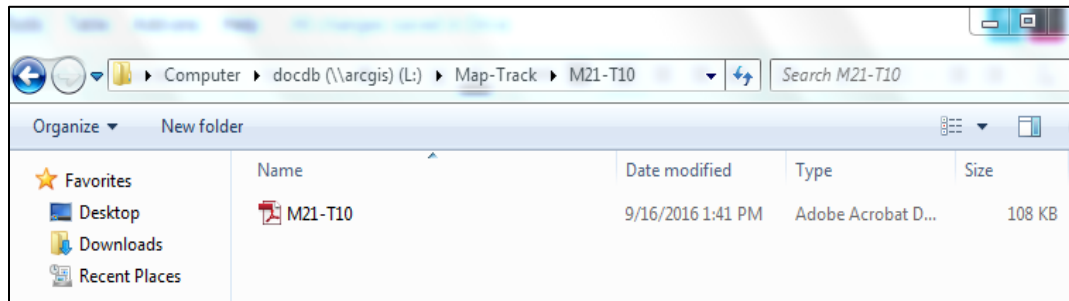
How to Add Records to File Structure

1. Locate the file you want to add to the shared drive

2. Right click on the file and select "Copy"
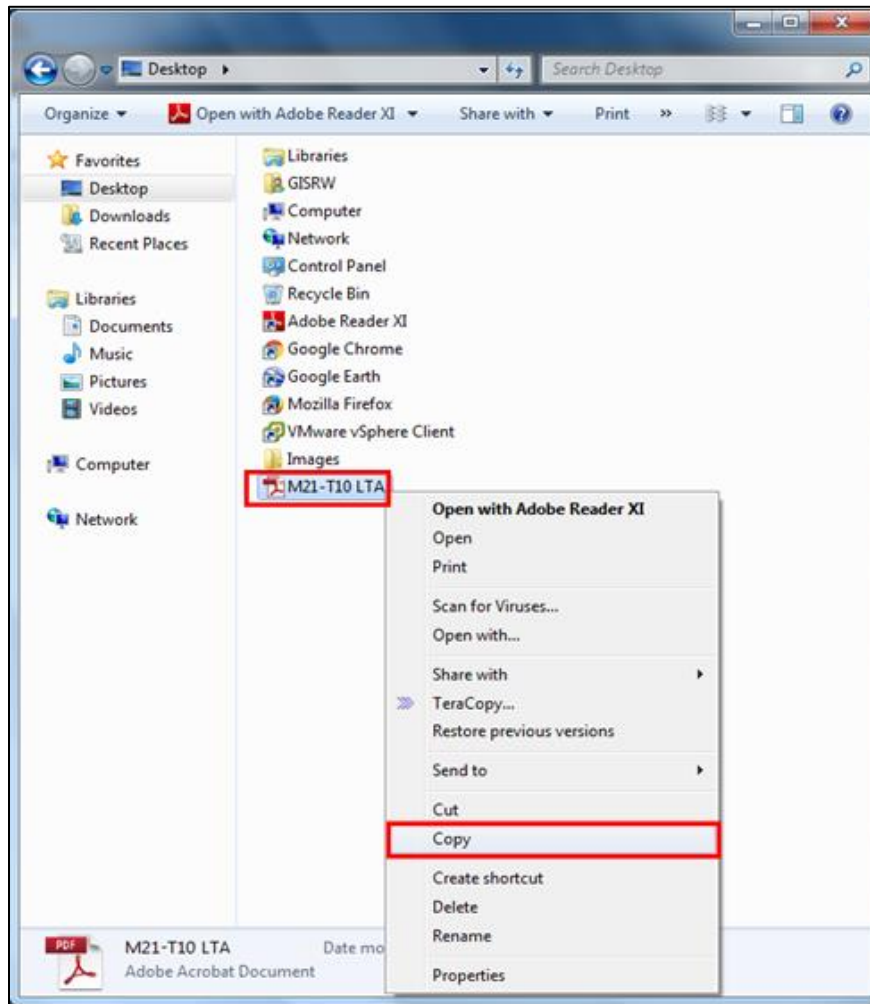
3. Navigate to the desired folder in the shared L Drive

4. Right click on any blank space inside of the desired folder and select "Paste"
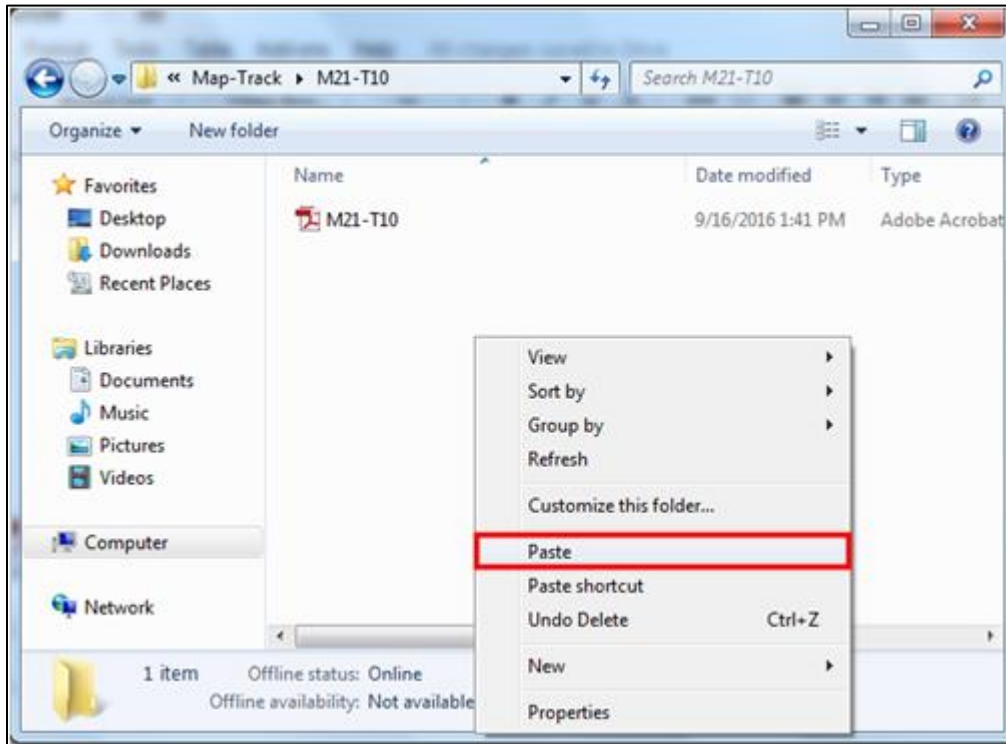
5. The file should now be located in that folder
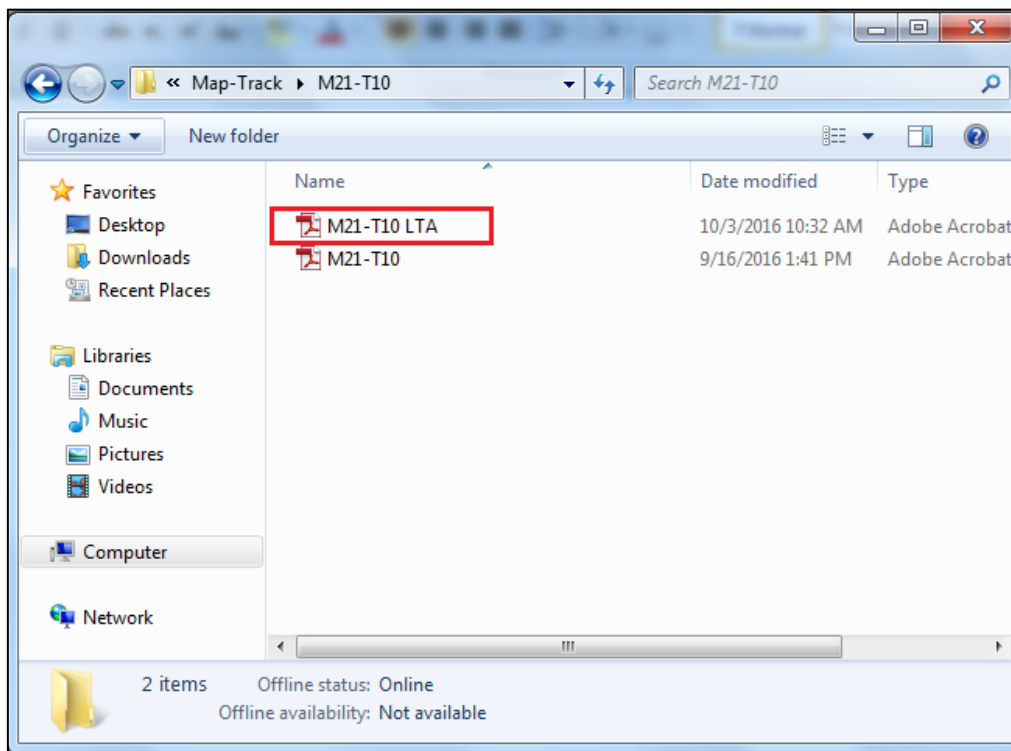
6. Alternatively, you can use the keyboard shortcuts:

    a. Copy: Control + C

    b. Paste: Control + V

6. You can also insert a new record into the file structure by originally saving it to the proper location. Select "Save As"
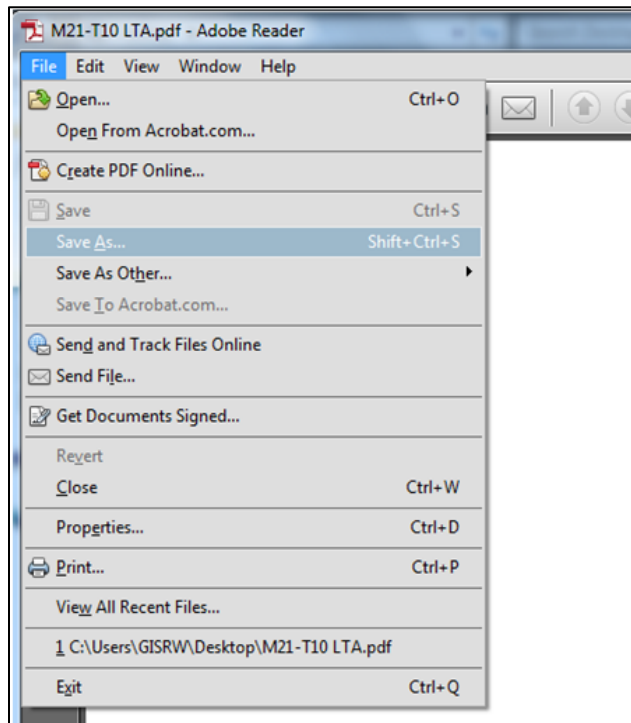
7. Navigate to the proper folder in the shared drive that the file needs to be saved to

8. Click "Save" to save the file to that location

How to access/open the JRD

Map Component

1. Open Web Browser

    a. We recommend using Google Chrome or Mozilla Firefox

2. Go to http://gis.jemezpueblo.org
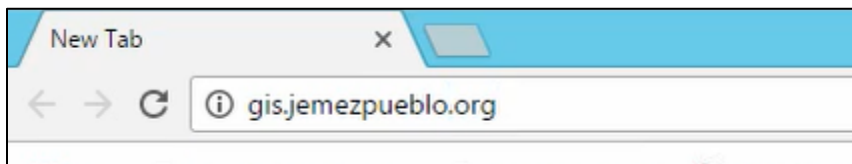
3. This will bring you to the username and password information

4. Input username and password and click "Sign In"

    a. If you do not know your login information, contact Shawn Larson in the IT

    Department. He can reset your password.

5. This will take you to the application

Excel Realty Index Component

Note: You will only be able to edit this document if you have the proper permissions. If you do

not have the proper permission, the document will not allow you to save. If you believe you have

the wrong permissions, contact Shawn Larson in the IT Department.

1. Navigate to the File Explorer on your computer

2. Select "Computer"

3. Open the L Drive by selecting "docdb (\\arcgis) (L:)"
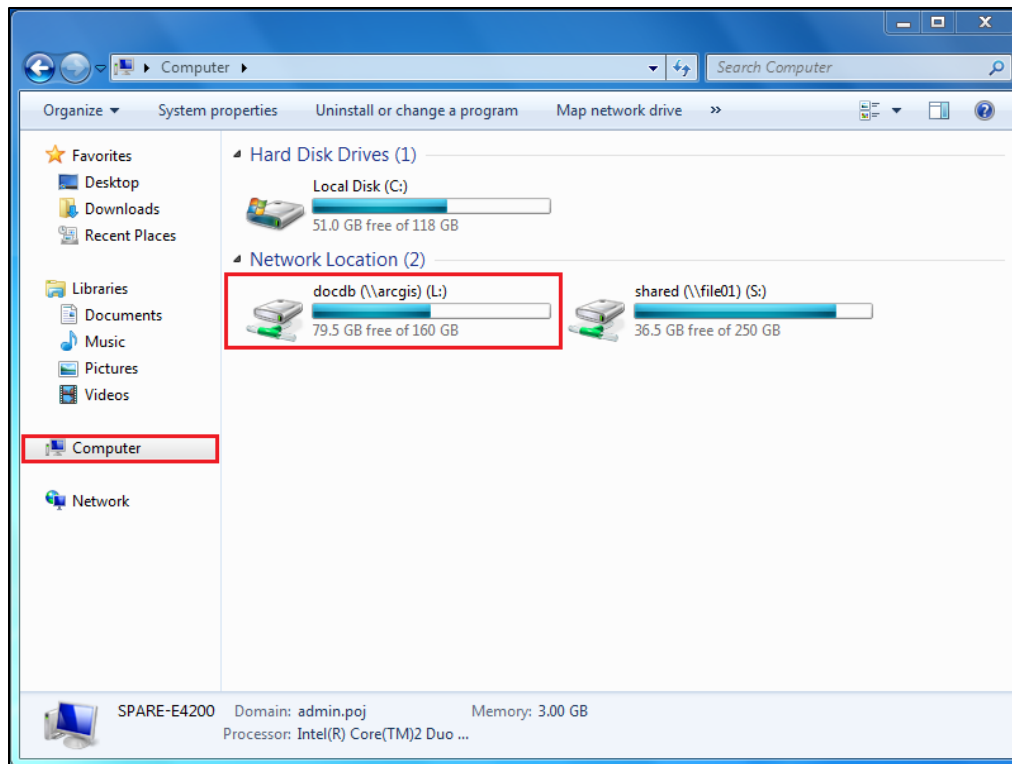
4. Double click the folder named "Index"
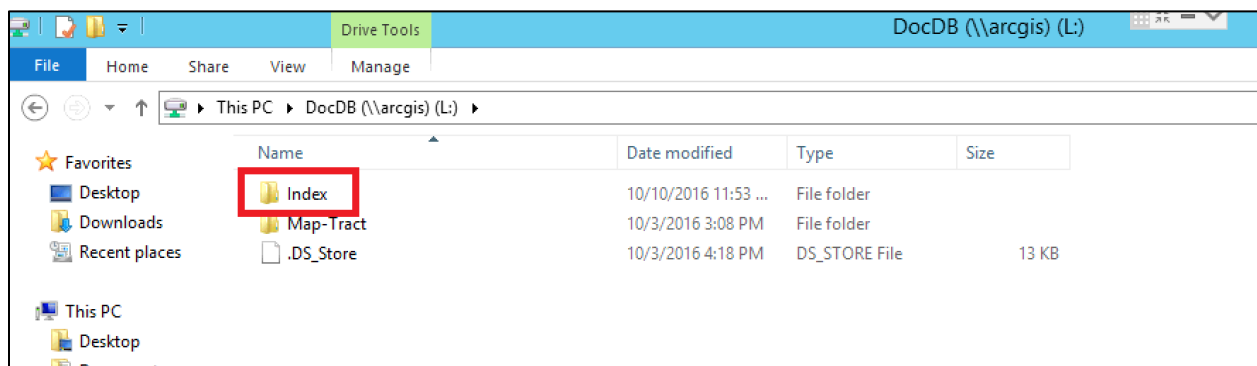
5. Double click the "RealtyIndex" Excel document located in this folder
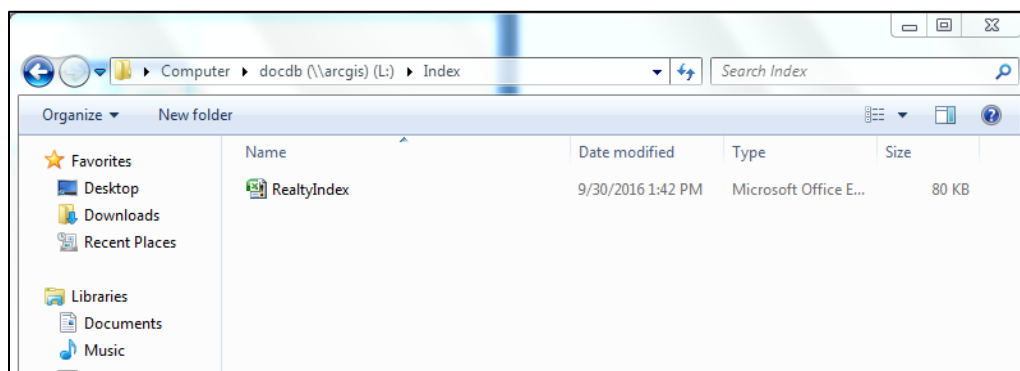
How to Import Assignment Information to Excel Realty Index

1. Open the "RealtyIndex" Excel document

2. A popup window will automatically appear telling you the keyboard shortcut to use to access the data input form. This shortcut is "Control + Shift + I"

   a. If the popup does not open automatically, click "Enable Content" in the ribbon at the top of the sheet

   b. If there is a ribbon with an option to "Enable Editing", also click that button
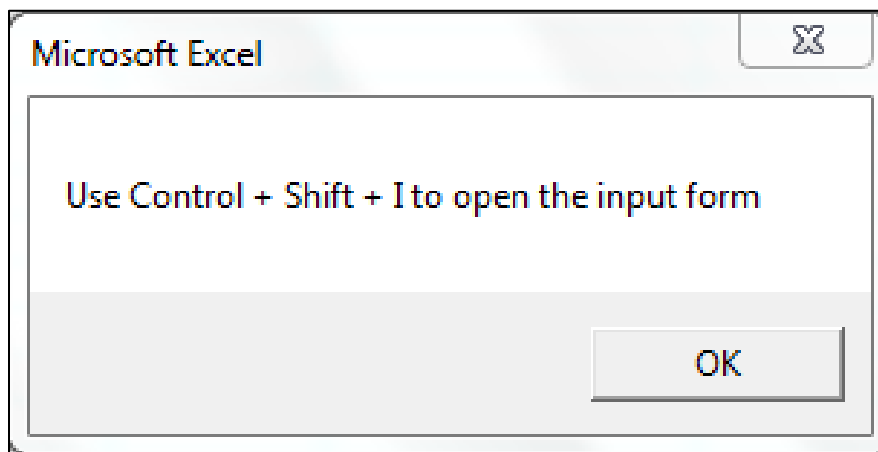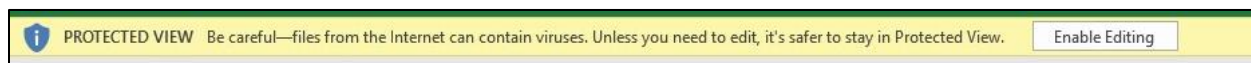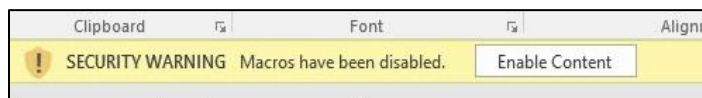
3. Click "OK" in order to view the Realty Index

4. Use the keyboard shortcut "Control + Shift + I" that you were told about upon opening the file in order to open up the data input form. It should look like this:

Property Owner

Field	
Original Sheet:	
Original Tract:	
Tract Split:	
Tract #:	
Property Assignee:	
CIB #:	
2nd Assignee:	
CIB #:	
Date:	
Aguired How?:	
Verification Document:	
Acreage:	
File:	

New Record

New

Delete

Restore

Find Prev

Find Next

Criteria

Close

5. This form takes the columns from the Excel worksheet and turns them into a simple form to fill out. Click "New" to input a new entry.

6. Fill in all the fields that you have information for, the fields are described below:

    a. "Original Sheet": What was the map sheet was this tract of land located on according to the 1985 hydrographic survey map?

    b. "Original Tract": What was the tract number for this tract of land according to the 1985 hydrographic survey map?

    c. "Tract Split": If the property has been subdivided, what subdivision within the tract is this? (A, B, C, etc.)

    d. "Tract #": This is automated based on the information filled in before it.

i. If you input "Original Map" as 26 and "Original Tract" as 15 it generates "M26-T15". If it is a split tract, it will include the letter afterwards, like "M26-T15-A"

e. "Property Assignee": What is the full name of the assignee of this land?

   i. Note: If you are inputting information from past transfers/assignments, input the name of the assignee according to the record you are gathering this data from.

f. "CIB#": What is this person's tribal census number?

g. "2nd Assignee": If the land is co-assigned with another individual, what is their full name?

h. "CIB#": What is this person's (the 2nd assignee) tribal census number?

i. "Date": What was the date of the transfer or assignment?

j. "Acquired How?": How was this land acquired by this individual? Was it a direct assignment, transfer, inheritance, etc.?

k. "Verification Document": What document was used to verify that both parties agree to this transfer? (i.e. a will, signed letter, or other legally accepted document)

l. "Acreage": What is the acreage of this tract of land?

m. "File": What is the number of the final document the realty department has regarding this specific land transaction?

   i. Note: If the document does not have an associated file number, you can either leave it blank or put the name of the file that someone could search

for to see this official transaction. (i.e. the "Land Transaction Agreement" form, the "Verification of Assignment" form, etc.)

Property Owner		?	✕
Original Sheet:	29	▲	1045 of 1045
Original Tract:	30		New
Tract Split:			Delete
Tract #:	M29-T30		Restore
Property Assignee:	John Doe		
CIB #:	111111		Find Prev
2nd Assignee:	Jane Doe		Find Next
CIB #:	222222		Criteria
Date:	9/27/2016		Close
Aquired How?:	Inheritance		
Verification Document:	Will		
Acreage:	1.64		
File:	2016-8	▼	

Property Owner		?	✕
Original Sheet:	28	▲	1036 of 1045
Original Tract:	26		New
Tract Split:			Delete
Tract #:	M28-T26		Restore
Property Assignee:	Bob Smith		
CIB #:	333333		Find Prev
2nd Assignee:			Find Next
CIB #:			Criteria
Date:	9/15/2016		Close
Aquired How?:	Transfer		
Verification Document:	Written Agreement		
Acreage:	0.56		
File:	2016-9	▼	

7. Once you have finished inputting all the information, you can either click "New" to fill in another entry (if you have multiple to input in a row) or you can click "Close" to close the pop-up and view the Excel sheet again

8. Upon closing that pop-up, you will see that the sheet has automatically sorted the new entries into the appropriate location based on the Map-Tract number to maintain numeric order throughout the index.

Original Sheet	Original Tract	Tract Split	Tract #	Property Assignee	CIB #	2nd Assignee	CIB #	Date	Aquired How?	Verification Document	Acreage	File
28	19		M28-T19	Jose A. Toya							3	
28	20		M28-T20	Frank Toya							3.97	
28	21		M28-T21	Alonzo Yepa							10.41	
28	22		M28-T22	Frank Toya							1.63	
28	23		M28-T23	Alonzo Yepa							0.83	
28	24		M28-T24	Frank Fragua							7.05	
28	25		M28-T25	Abel Sando							3.53	
28	26		M28-T26	Bob Smith	333333			9/15/2016	Transfer	Written Agreement	0.56	2016-9
29	1		M29-T1	Joe A. Sando							4.19	
29	2		M29-T2	Sammy Chinana							1.55	
29	3		M29-T3	Joe Lucero							4.38	
29	4		M29-T4	Joe A. Sando							2.27	
29	5		M29-T5	Johnny Baca							1.49	
29	6		M29-T6	Diego Pecos							2.29	
29	7		M29-T7	Joe A. Sando							7.31	
29	8		M29-T8	Joe A. Sando							1.92	
29	30		M29-T30	John Doe	111111	Jane Doe	222222	9/27/2016	Inheritance	Will	1.64	2016-8

How to View Records from the Excel Realty Index

1. Open the Realty Index

2. Click on the "Tract #" you want to view information for

Original Sheet	Original Tract	Tract Split	Tract #	Property Assignee
21	1		M21-T1	Joe Tosa
21	2		M21-T2	Jualamita Chiwhwi
21	3		M21-T3	Joe Tosa
21	4		M21-T4	Juan Louis Pecos
21	5		M21-T5	Joe Pecos
21	6		M21-T6	Juan Toledo
21	7		M21-T7	Juan L. Pecos
21	8		M21-T8	Allen Toya
21	9		M21-T9	Leo Sando
21	10		M21-T10	Earnest Shendo
21	11		M21-T11	Mrs. Juan Toya
21	11		M21-T11	Mrs. Juan Toya
21	12		M21-T12	Sam Chinena
21	12		M21-T12	Sam Chinena

3. This will open up a File Explorer window open to the folder for this tract number located in the network shared drive. This folder contains all the scanned records regarding this tract number.
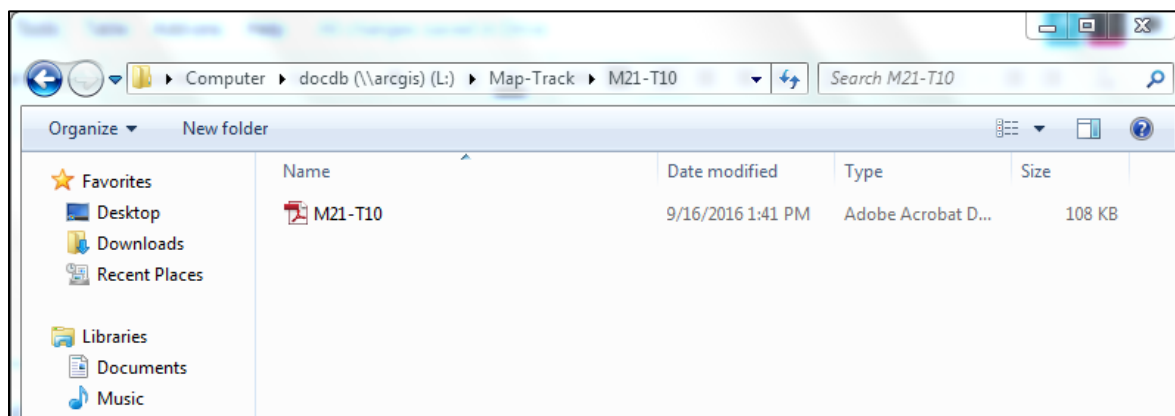
How to Search for Tract by Assignee Name in Excel Realty Index

1. Open "RealtyIndex" Excel sheet

2. Under "Home", click "Find & Select", and in the dropdown choose "Find"

    a. Alternatively, you can use the keyboard shortcut: Control + F
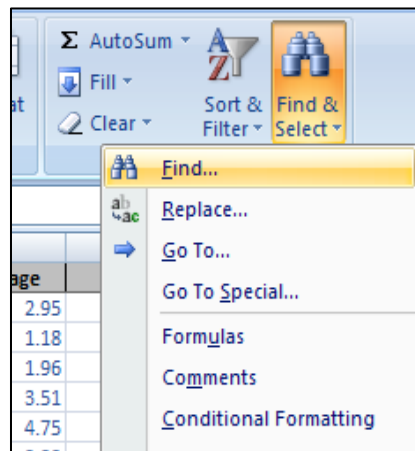
3. You can type in the name you want to search for in the "Find what" box:
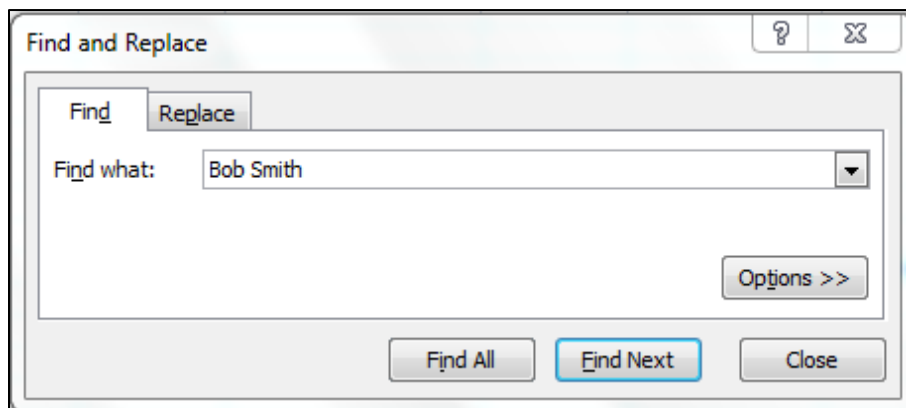
4. Select "Find Next" or "Find All" to find either the next occurrence of that name or all occurrences of that name respectively.
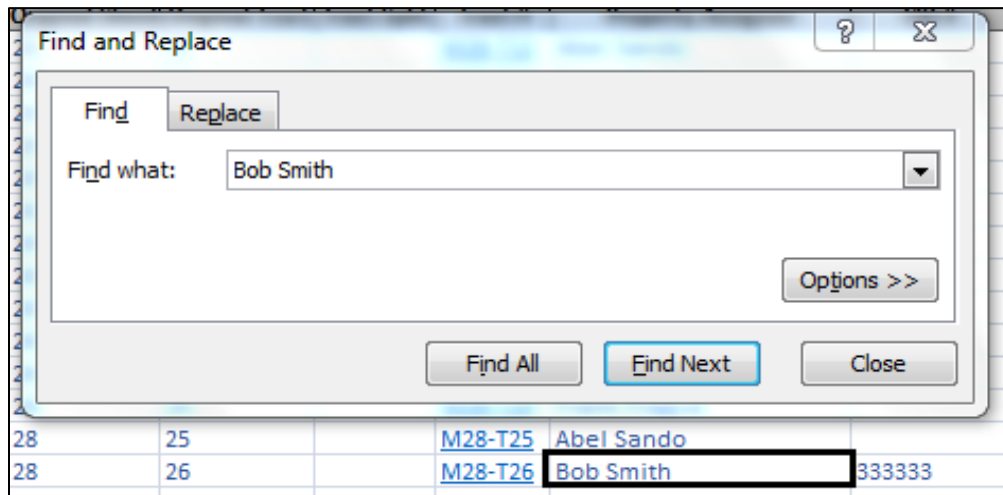
How to Turn Category Layers On and Off in Map Component of JRD

1. Open up the GIS web-application

2. Select "Layer List" Icon at the bottom of the screen
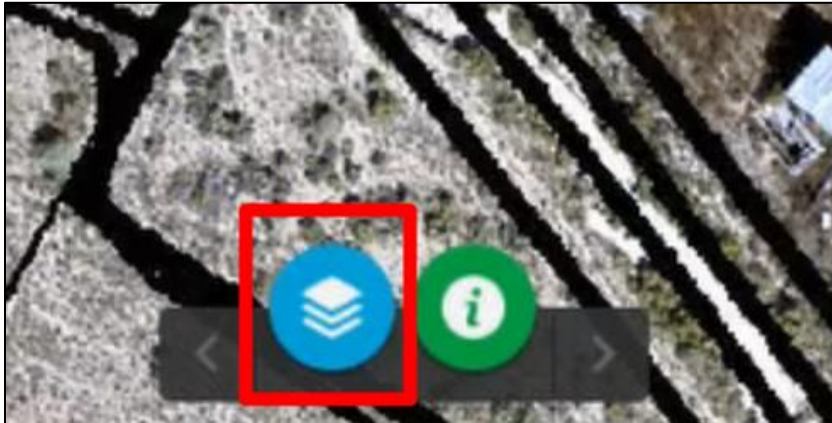
   a. This opens the "Layer List" popup
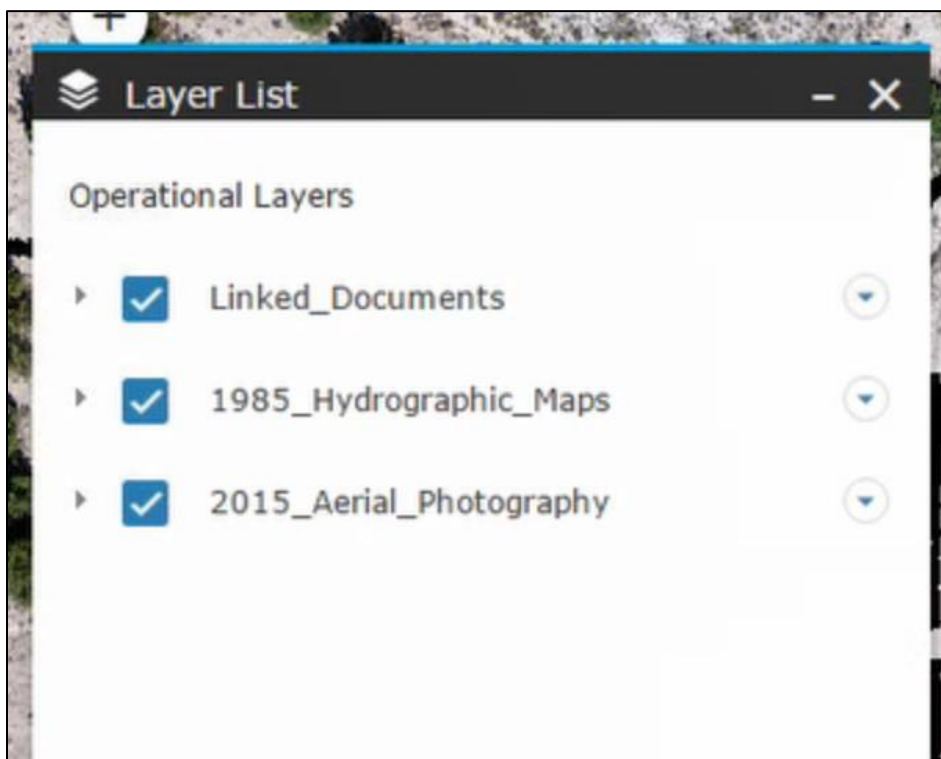
3. Click the checkbox to turn on or off layers. The layer is on if the checkbox is filled in with a checkmark and blue.
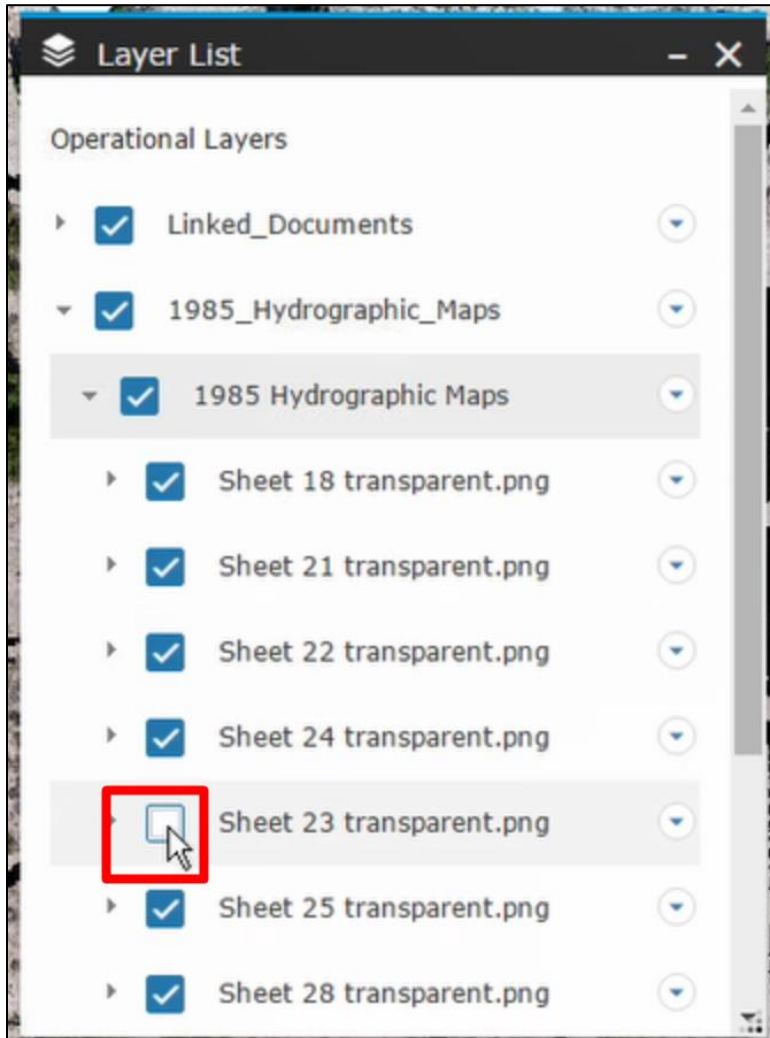
4. If there is a little arrow next to a layer, click on it to view a dropdown list of the individual sections of that layer. Click on those checkboxes to turn on and off individual sections of a layer.
   a. i.e. each sheet of the 1985 hydrographic survey map can be turned on and off this way
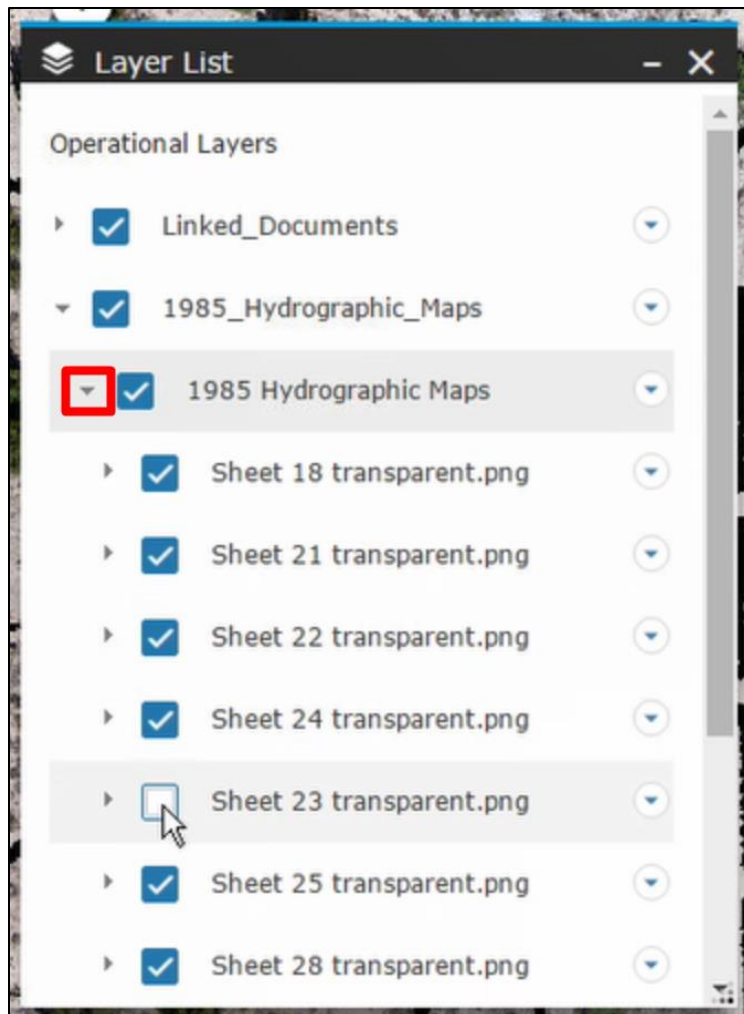
5. You can safely press the "X" in the top right-hand corner of this popup to close the popup while keeping the layers on or off as you had selected
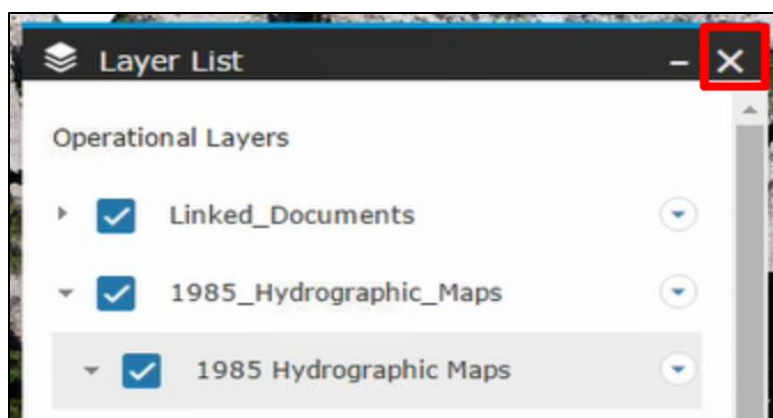
How to Import & Publish New Survey/Mapping Data into Map Component of JRD

1. Open ArcMap for Desktop
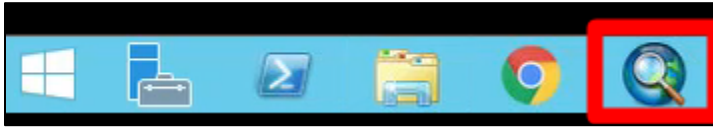
2. Hit "Cancel" in the "Getting Started" window

3. Select "File"

4. Select "New"
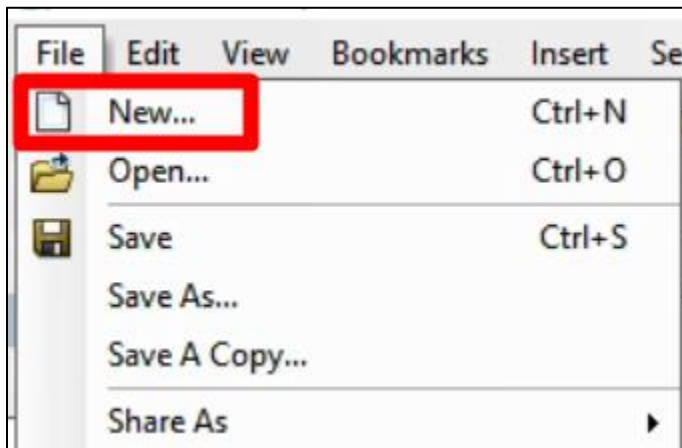
5. Ensure that "Blank Map" is selected in the "New Document" window

   a. If it is not selected, click "My Templates" located under "My Maps" and select

   "Blank Map"

6. Click "OK"
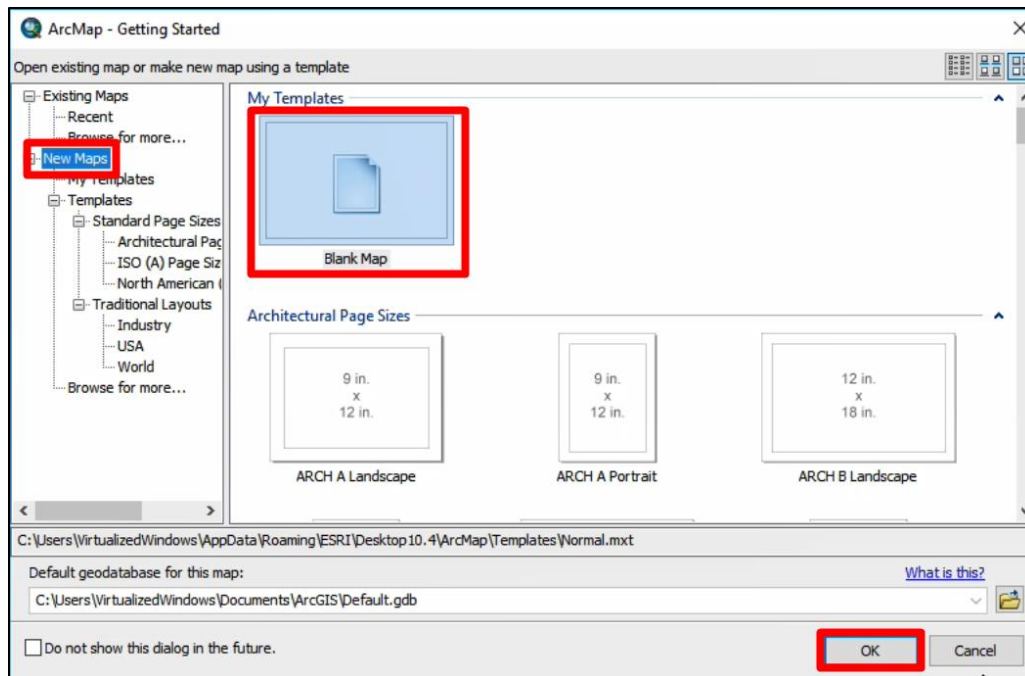
7. Select "File"

8. Select "Add Data" and "Add Data"
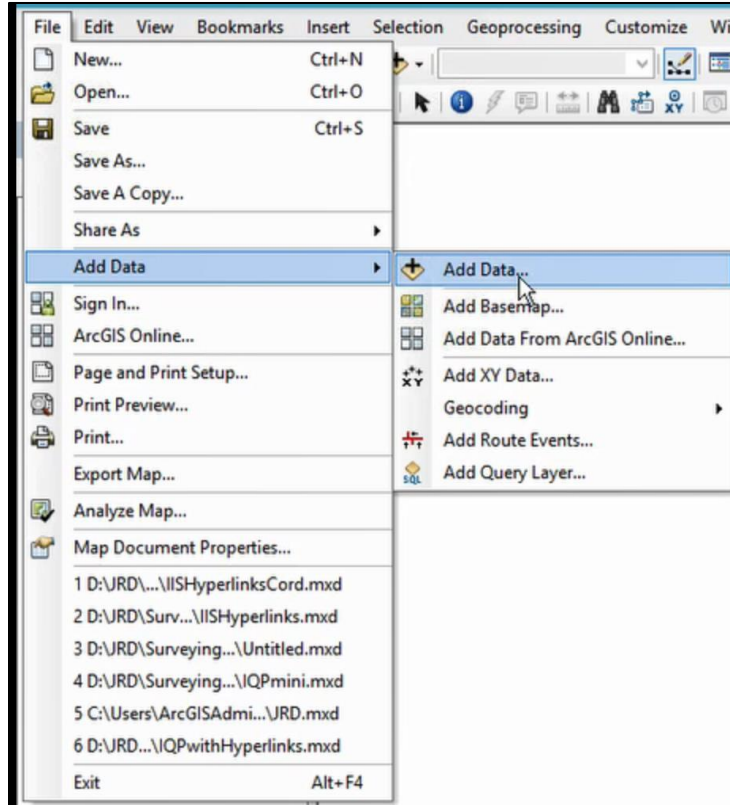
9. In the window that opens, navigate to the data you want to share, click it and select "Add"

10. Select "File"

11. Select "Share as"

12. Select "Service..."
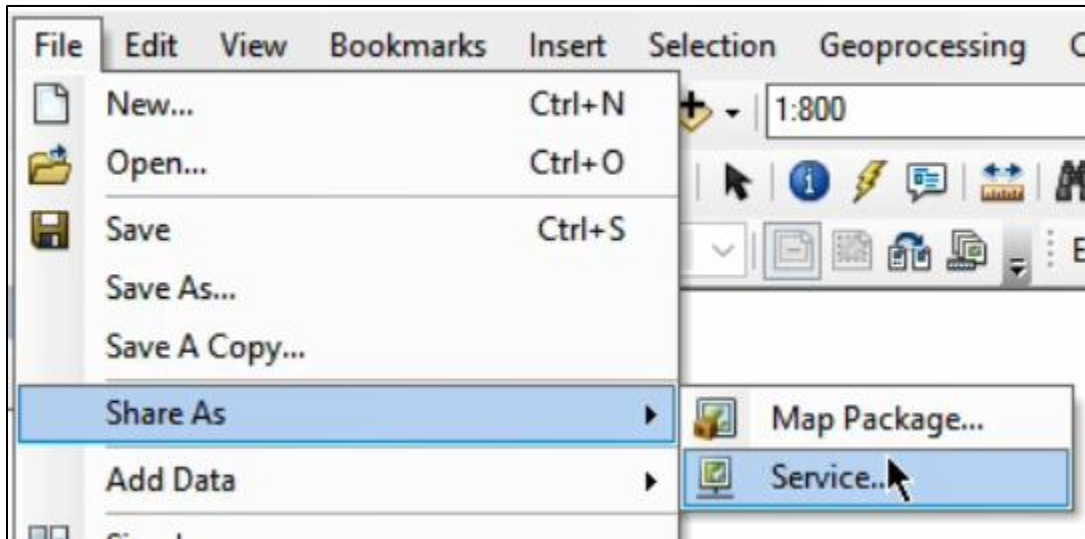
13. Select "Publish a Service" in the window that appears if you are putting new data onto the server.

14. Select "Next"
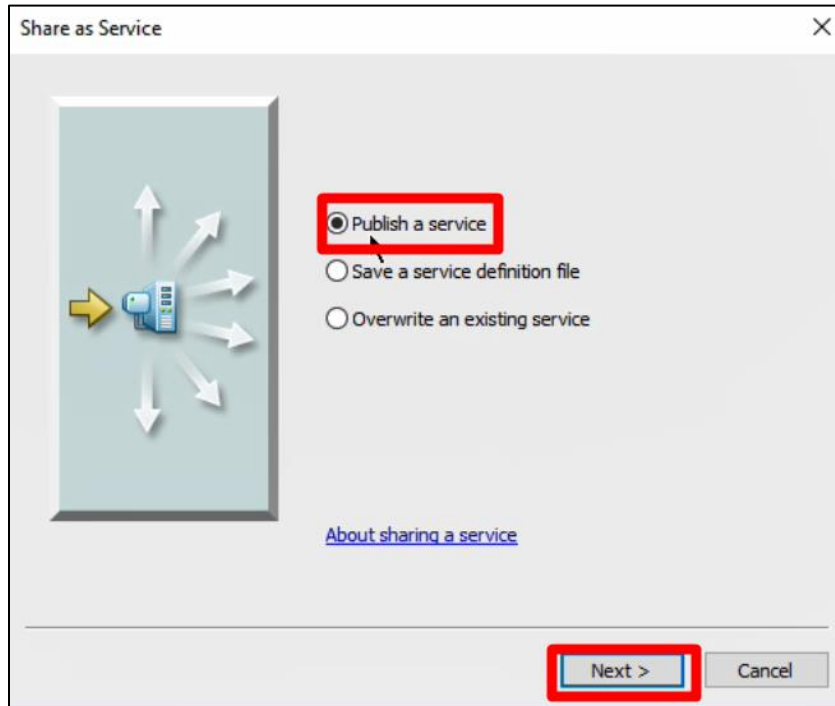
15. Ensure that the correct server is selected in the "Choose a Connection" dropdown

16. Give this data a name in the "Service Name" box

17. Select "Next"
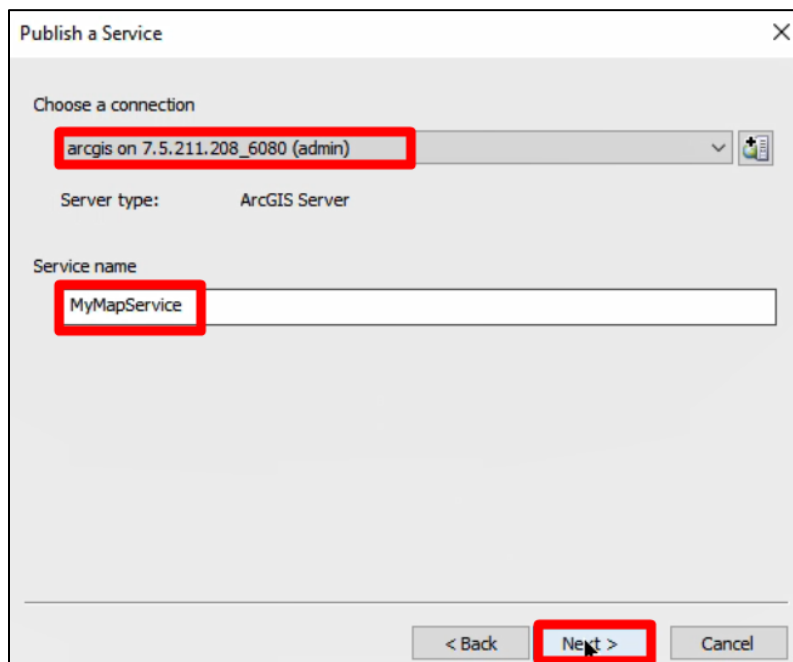
18. Ensure that "Use Existing Folder" is selected and "[root]" in the respective dropdown

19. Select "Continue"
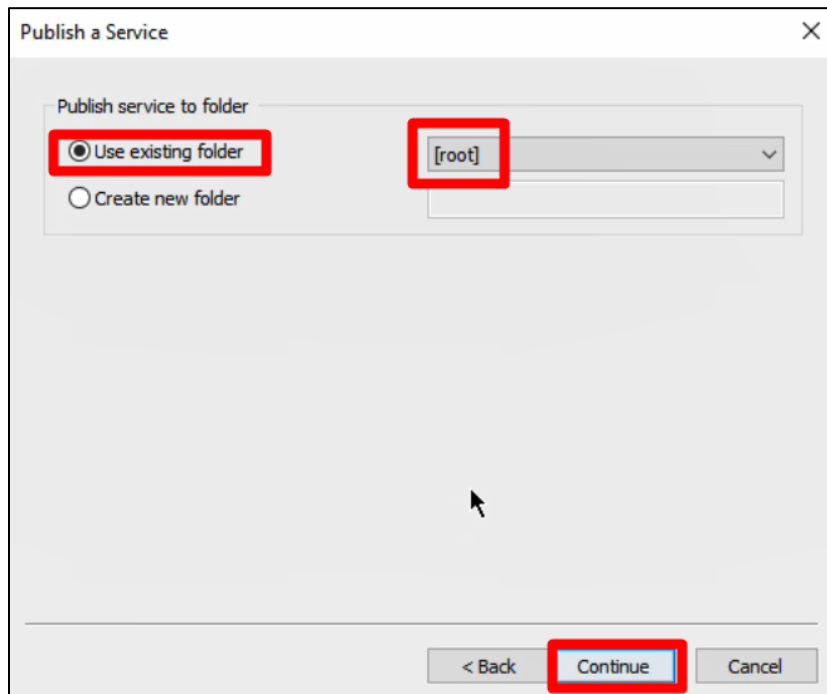
20. Select the "Capabilities" tab
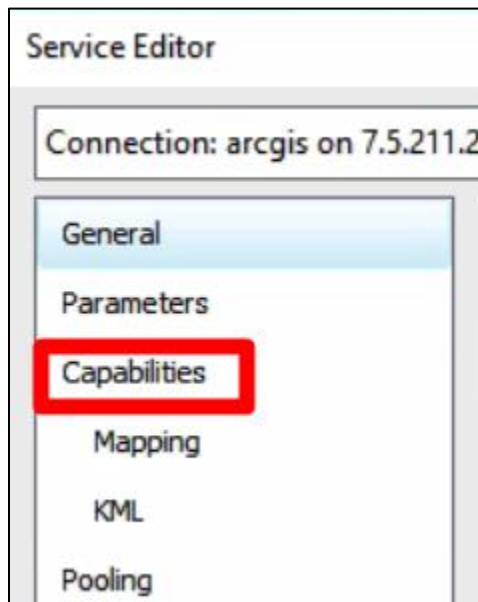
21. If you are uploading a Feature Class, ensure that "Feature Access" is checked
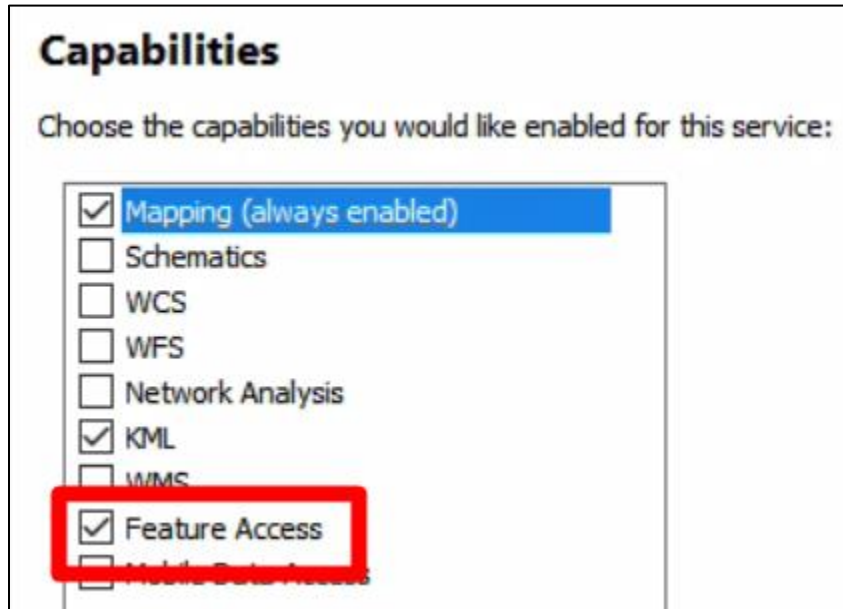
22. Select "Analyze" at the top of the window
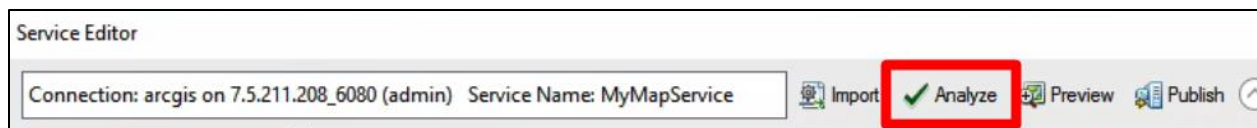
      a.   If there are any errors, then resolve those errors

            i.   For help, you can right click on an error for more information

23. Select "Publish"

24. If the "Copying Data to Server" window appears, Select "OK"

25. You know it has successfully published if a popup appears stating that "The service has been published successfully"
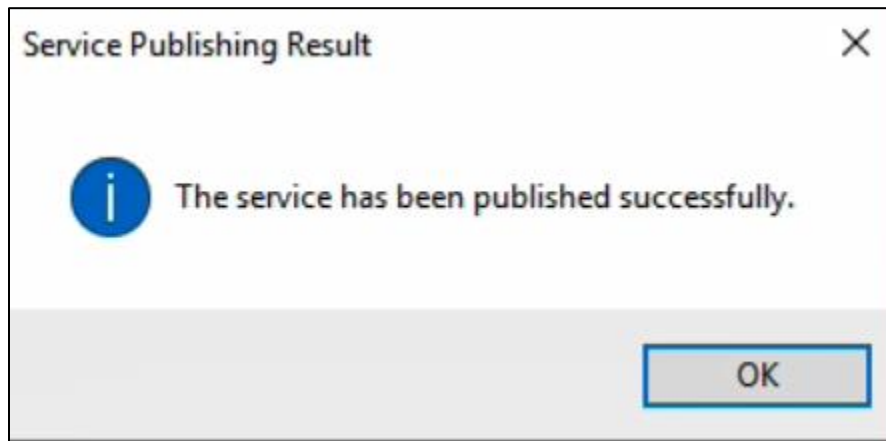
a. Click "OK" on this popup

How to Overwrite & Publish Existing Survey/Mapping Data into Map Component of JRD

1. Open ArcMap for Desktop
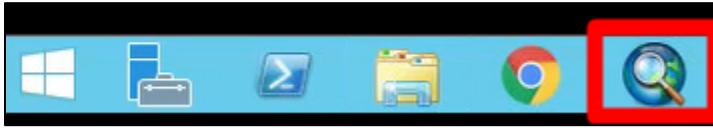
2. Hit "Cancel" in the "Getting Started" window

3. Select "File"

4. Click "Open"
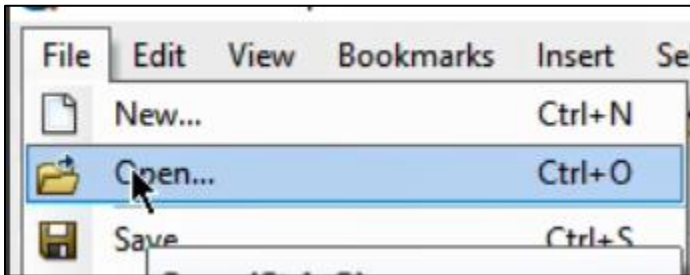
5. Navigate to a previously saved files and select it

6. Click "Open"
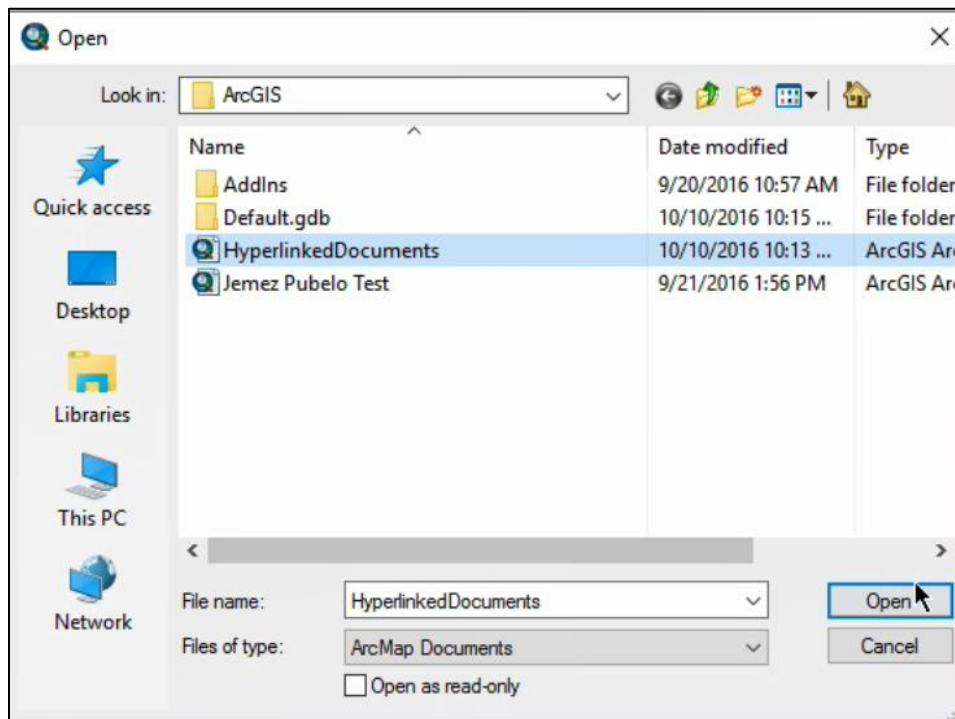
7. Select "File"

8. Select "Share as"

9. Select "Service..."
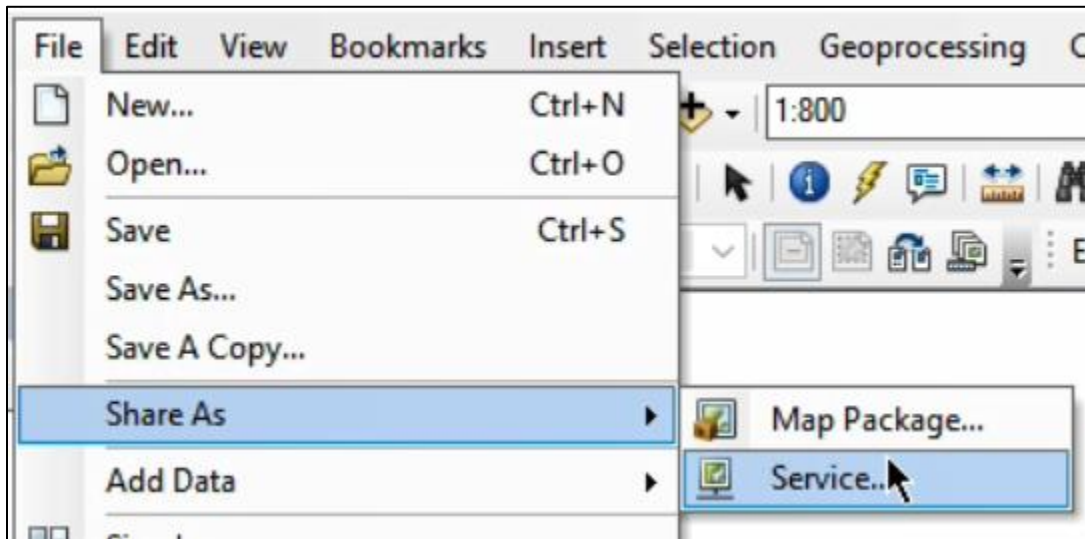
10. Select "Overwrite an Existing Service" if you are editing existing data for the server.

11. Click "Next"
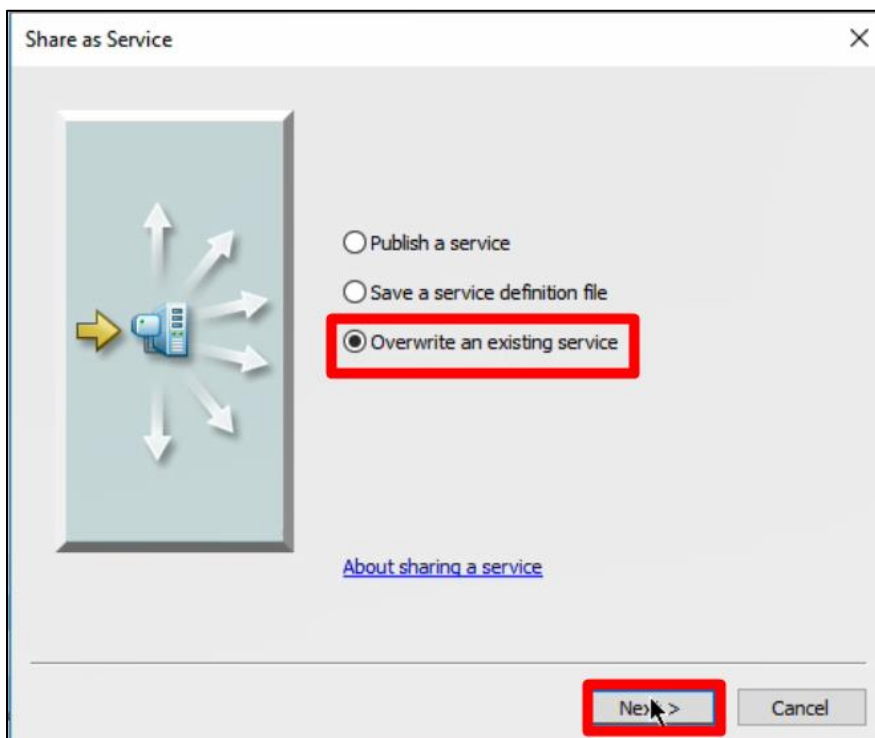
12. Ensure that the correct server is selected in the "Choose a Server" drop-down box

13. Select the service you wish to overwrite in the list below

14. Select "Continue"
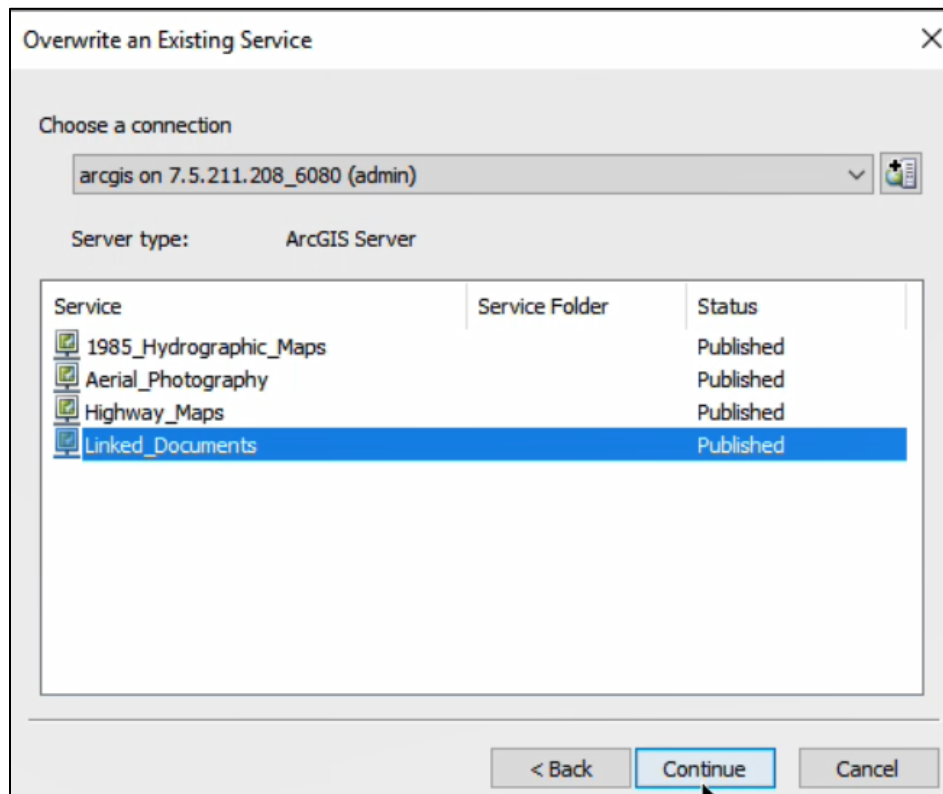
15. Select the "Capabilities" tab
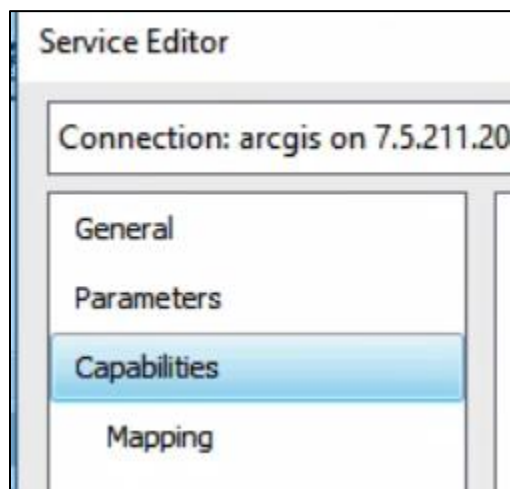
16. If you are uploading a Feature Class, ensure that "Feature Access" is checked
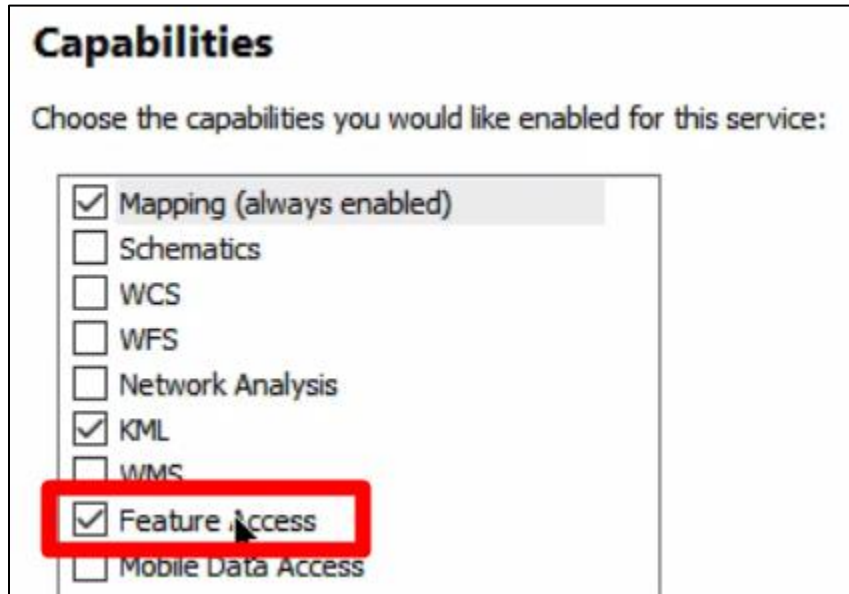
17. Select "Analyze" at the top of the window

    a.   If there are any errors, then resolve those errors

         i.   For help, you can right click on an error for more information

18. Select "Publish"
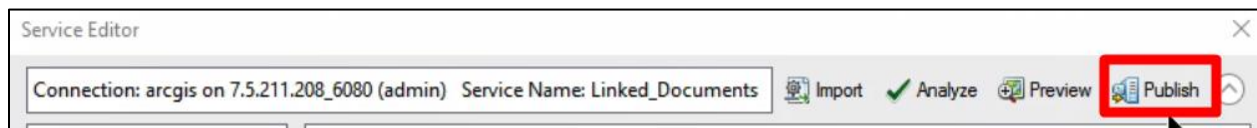
    a.   If the "Copying Data to Server" window appears, Select "OK"

19. You know it has successfully published if a popup appears stating that "The service has been published successfully"
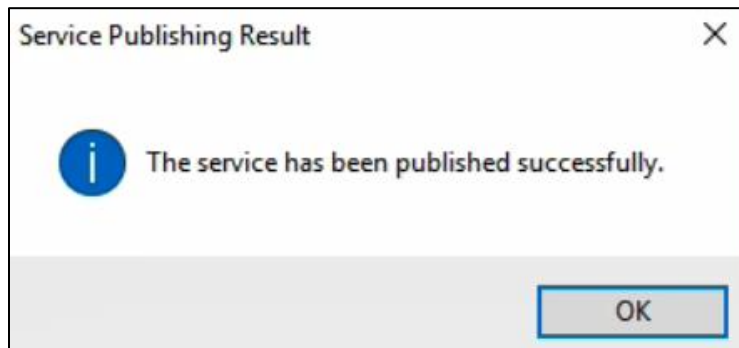
a. Click "OK" on this popup

How to Insert Hyperlinked Points into Map Component of JRD

1. Open ArcMap for Desktop
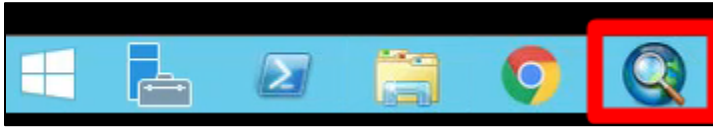
2. Select "New Maps"

3. Select "Blank Map"

4. Click "OK"
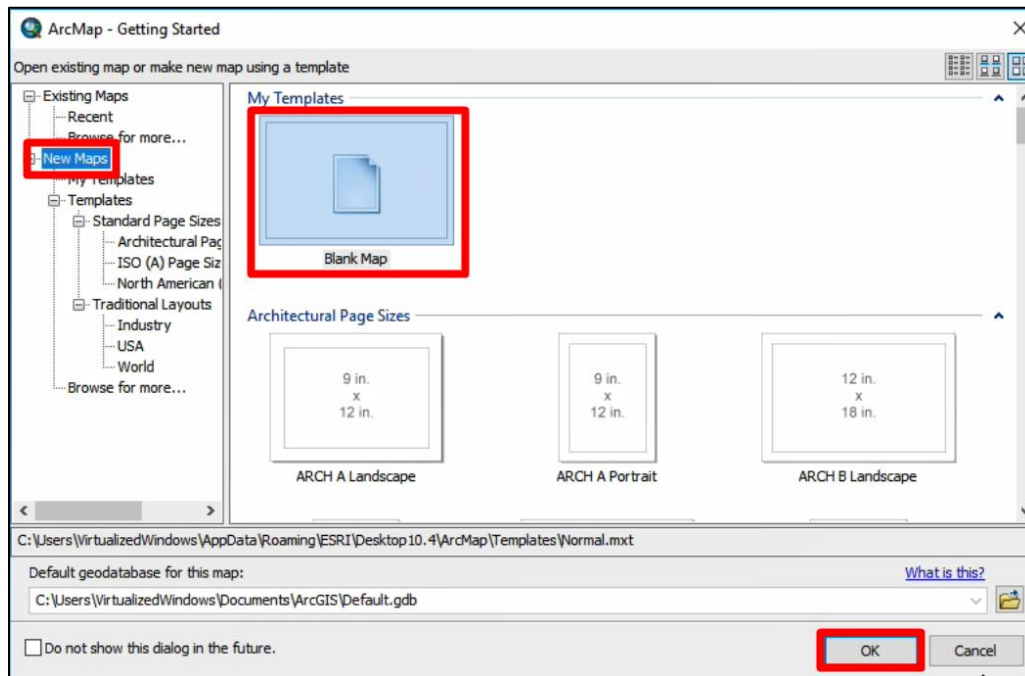
5. Open "Catalog"

6. Click the plus sign next to "Home"

7. Right click on "Default.GDB"

8. Select "New" and "Feature Class" from the dropdown
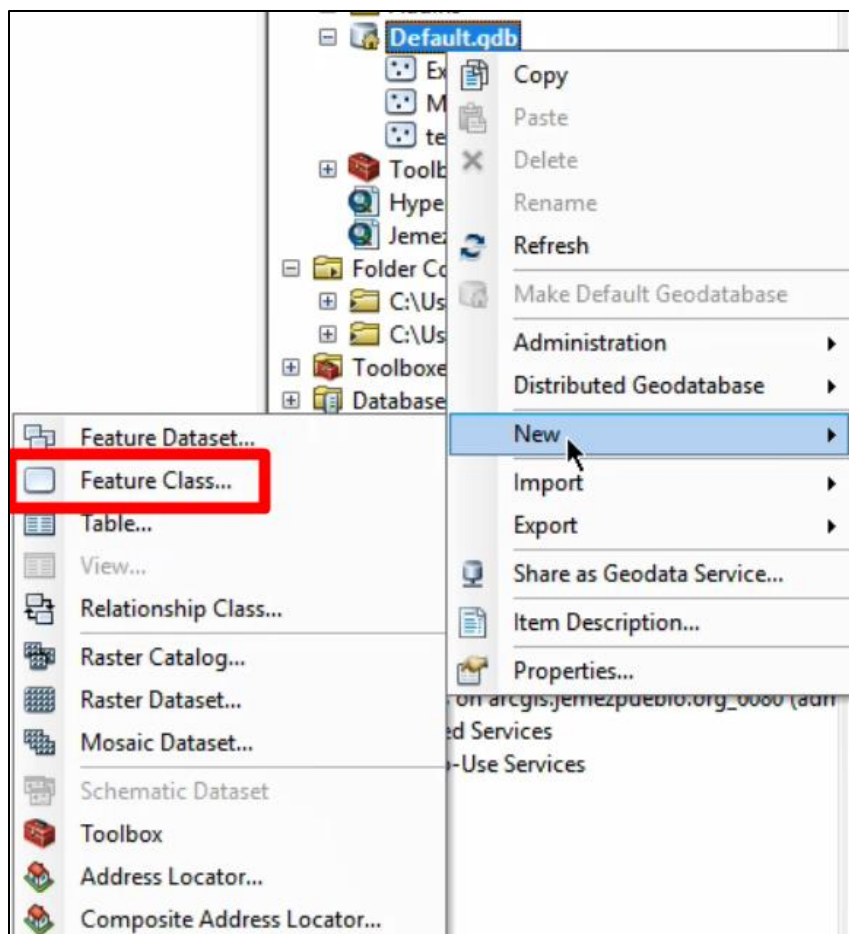
9. Give your new table a name with a matching alias

10. Select "Point Features" from the dropdown menu

11. Click "Next"

12. Search and Select "NAD_1983_StatePlane_New_Mexico_Central_FIPS_3002_Feet" using the search feature

13. Click "Next"
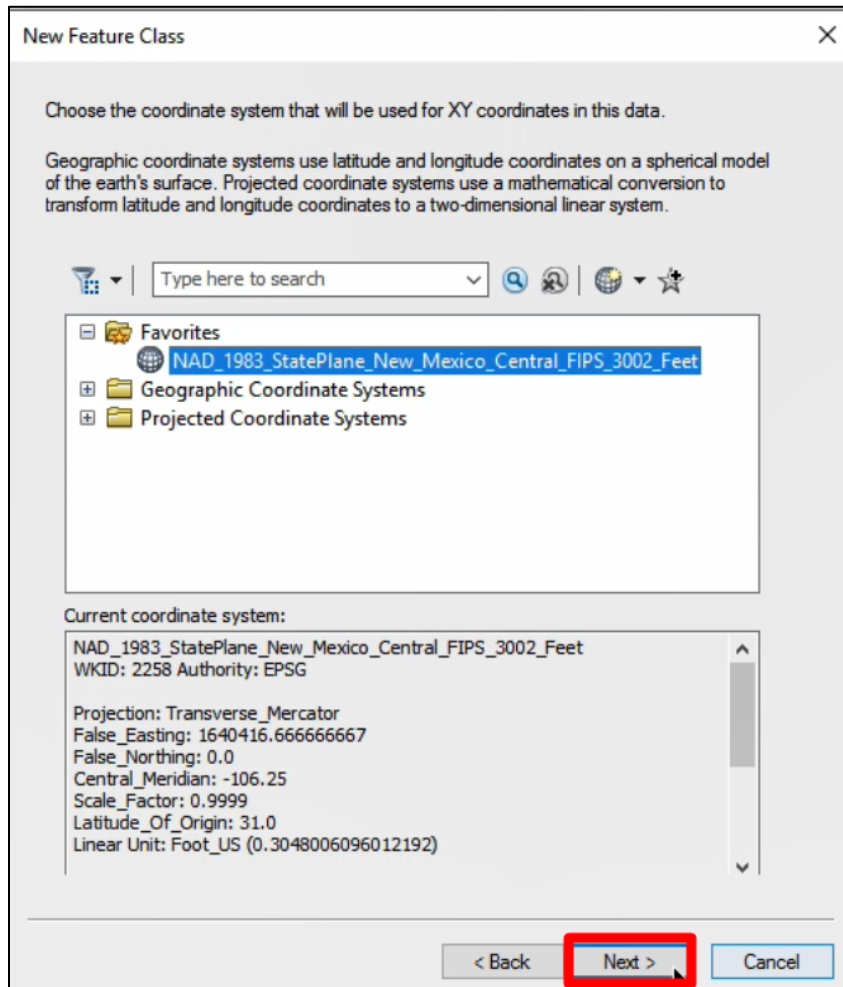
14. Click "Next" again

15. Click "Next" again

16. Add fields that you would like to include within the table and select their data type(s)

17. Change the "Length" to 200

18. Click "Finish"

19. Right click on the name of the table you created under "Layers"

20. Click "Open Attribute Table"
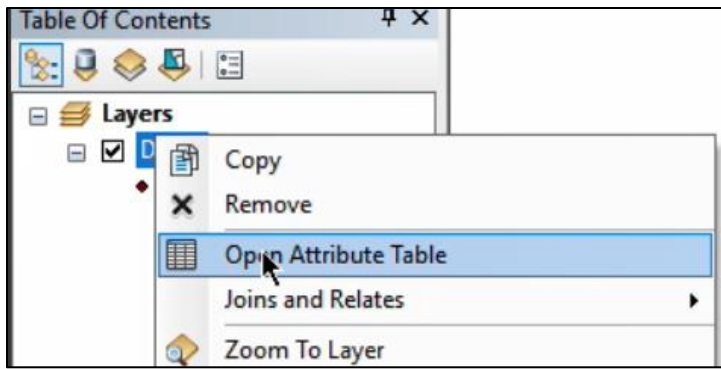
       a.   Or you can use the shortcut Control + T to open the attribute table

21. Navigate to the "Editor" toolbar

22. Click "Start Editing"
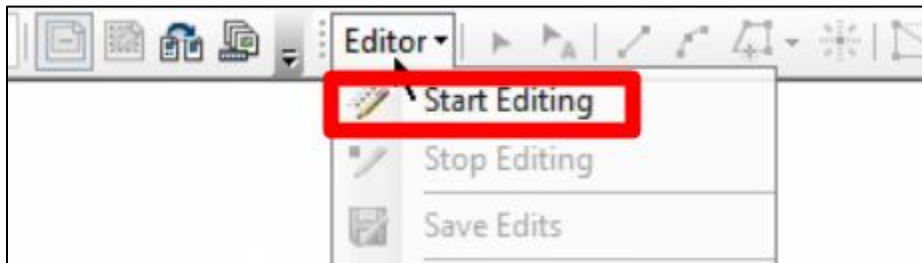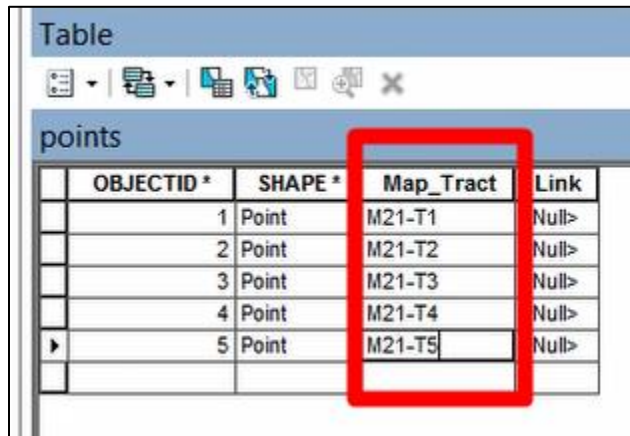
23. Go to the "Feature Class" window and select the name you provided for the table
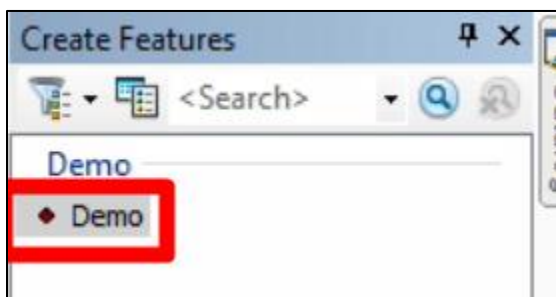
24. Click the map to add a point

25. Edit the fields in the Attribute Table for each point added to the map
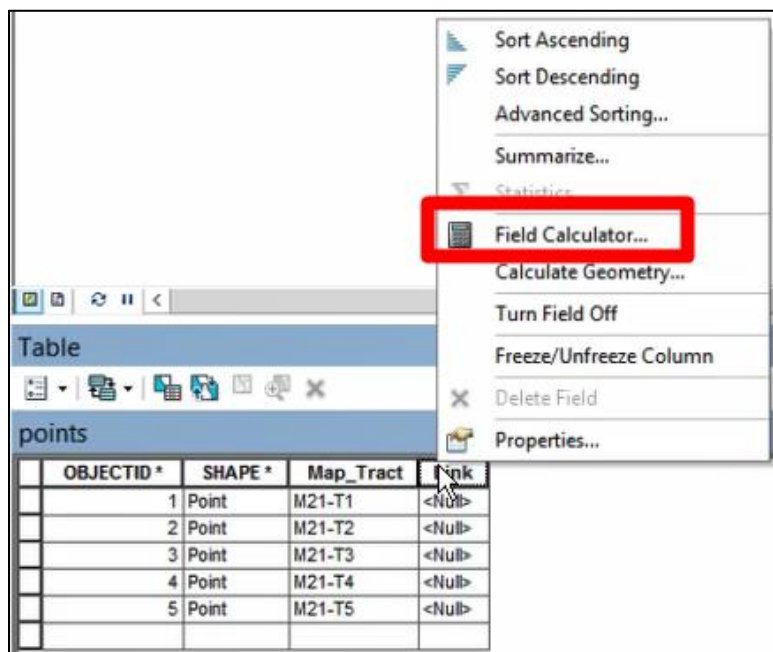
    a. For the "Map-Tract" column, input the map-tract number that correlates to that

       point

    b. Right click on the "Link" column in the attribute table and select "Field

       Calculator"

i. Paste the following into the textbox

"http://gis.jemezpueblo.org/Document_Database/" & [Map_Tract]

ii. Click "OK"

Field Calculator

Parser
- ● VB Script   ○ Python

Fields:
- OBJECTID
- SHAPE
- Map_Tract
- Link

Type:
- ● Number
- ○ String
- ○ Date

Functions:
- Abs ( )
- Atn ( )
- Cos ( )
- Exp ( )
- Fix ( )
- Int ( )
- Log ( )
- Sin ( )
- Sqr ( )
- Tan ( )

☐ Show Codeblock

| * | / | & | + | - | = |

Link =

"http://gis.jemezpueblo.org/Document_Database/" & [Map_Tract]

About calculating fields

Clear   Load...   Save...

OK   Cancel
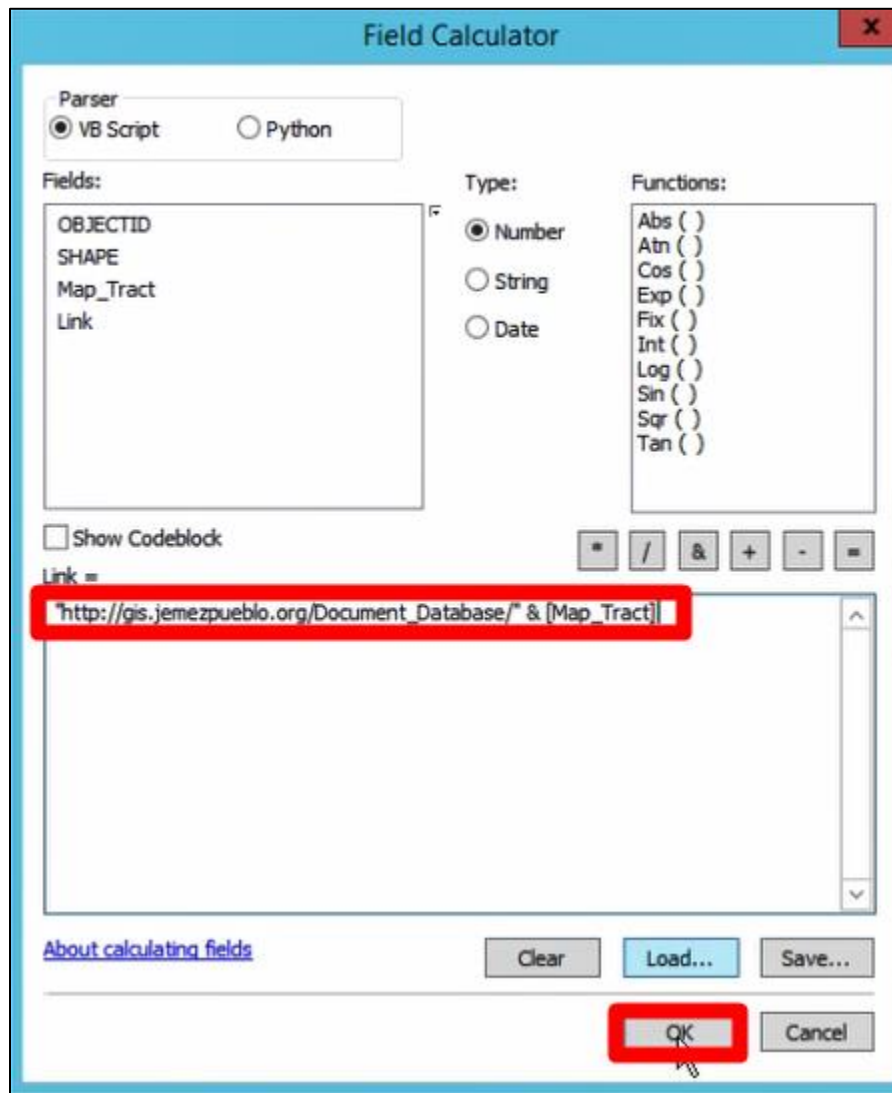
How to View Records from Map Component of JRD

1. Open up the map component of the JRD

2. Close the popup window

3. Zoom to the tract you want to view

4. Click on the blue icon on that tract
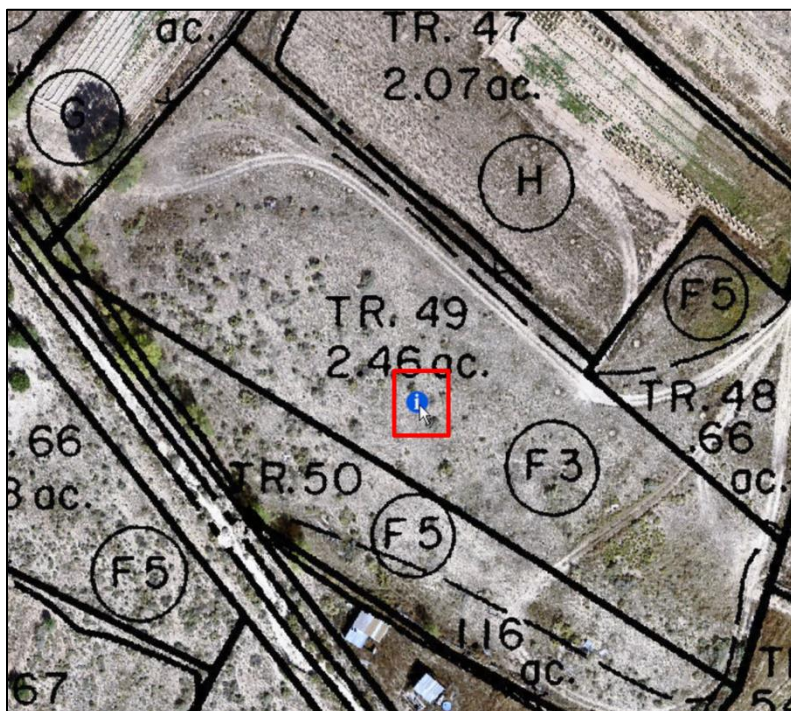
5. Select "More Info" link
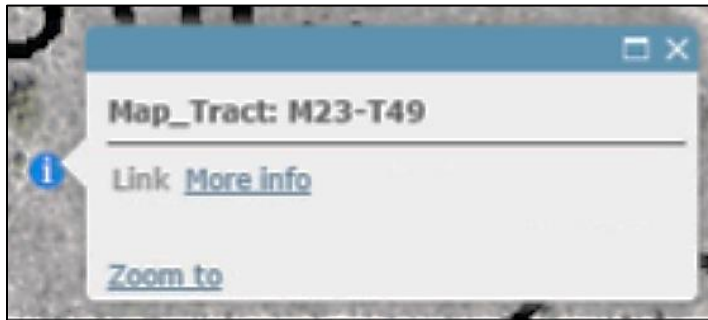
6. Login with your username and password

7. Select the record you wish to view from the list

8. It should open the document in a new tab on your browser

How to Share Service from ArcServer to ArcPortal

1. Open a web browser

2. Go to http://arcgis.jemezpueblo.org/arcgis/manager
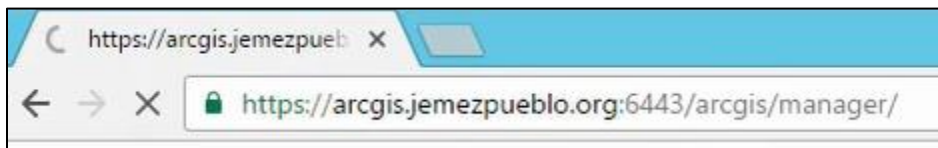
3. Login

4. Select the share icon
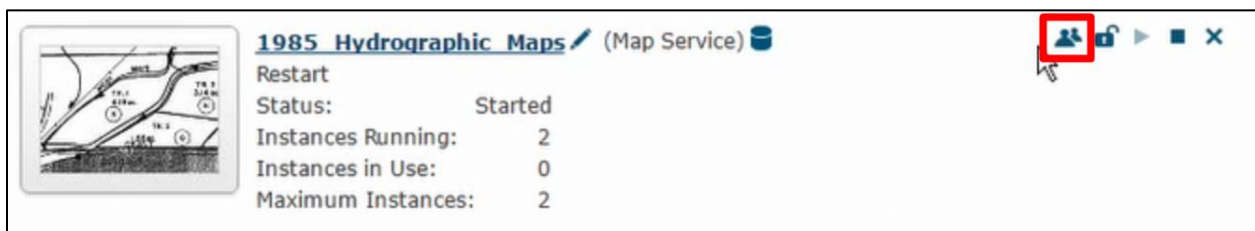
5. Check the box next to "Portal for ArcGIS"
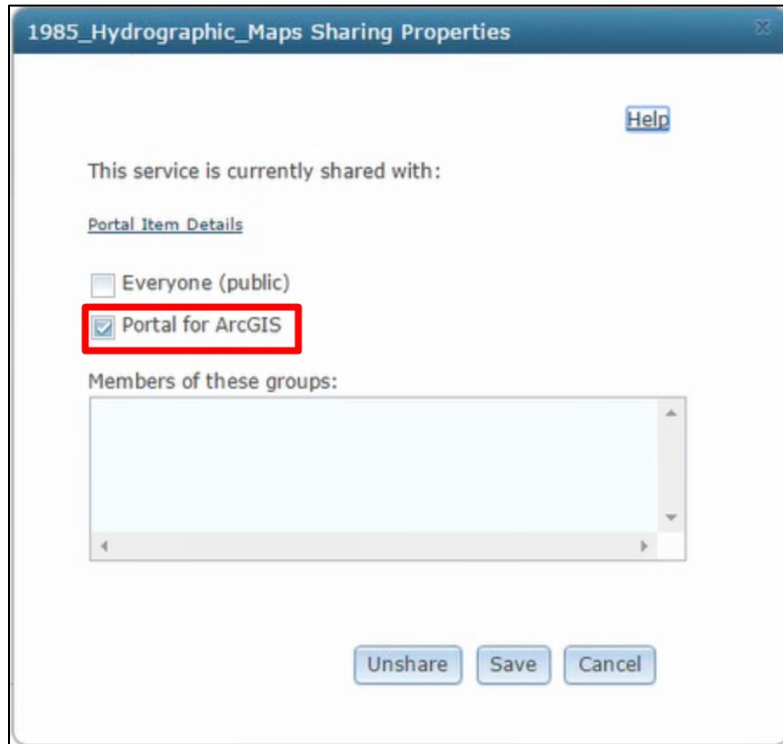
6. Select "Save"

How to Manage Items in ArcPortal

Change Owner

Note: You need to be an administrator in order to perform this task

1. Follow steps 1-5 from "Open the Map Component of the JRD"

2. Select "My Organization"

3. Select the gear icon next to the original owner

4. Select "Manage Items"

5. Select the checkbox next to the item you want to change the owner of
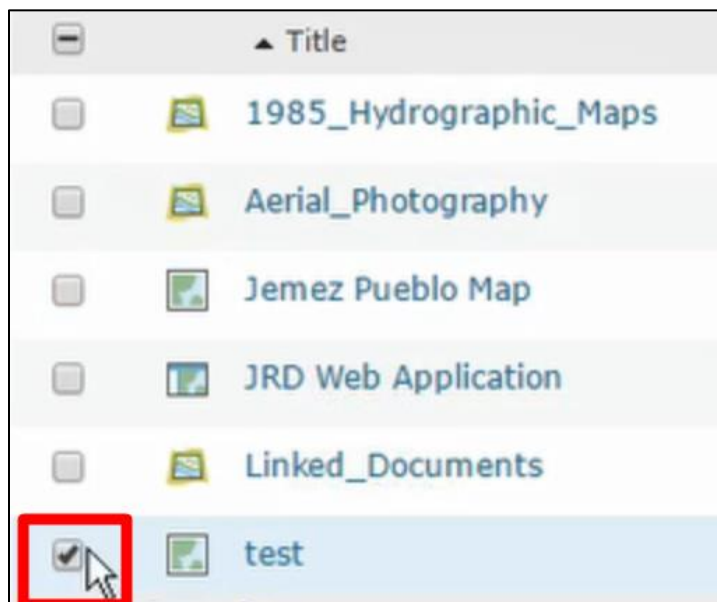
6. Select "Change Owner"

7. In the "Move To" window, select the new owner from the dropdown box
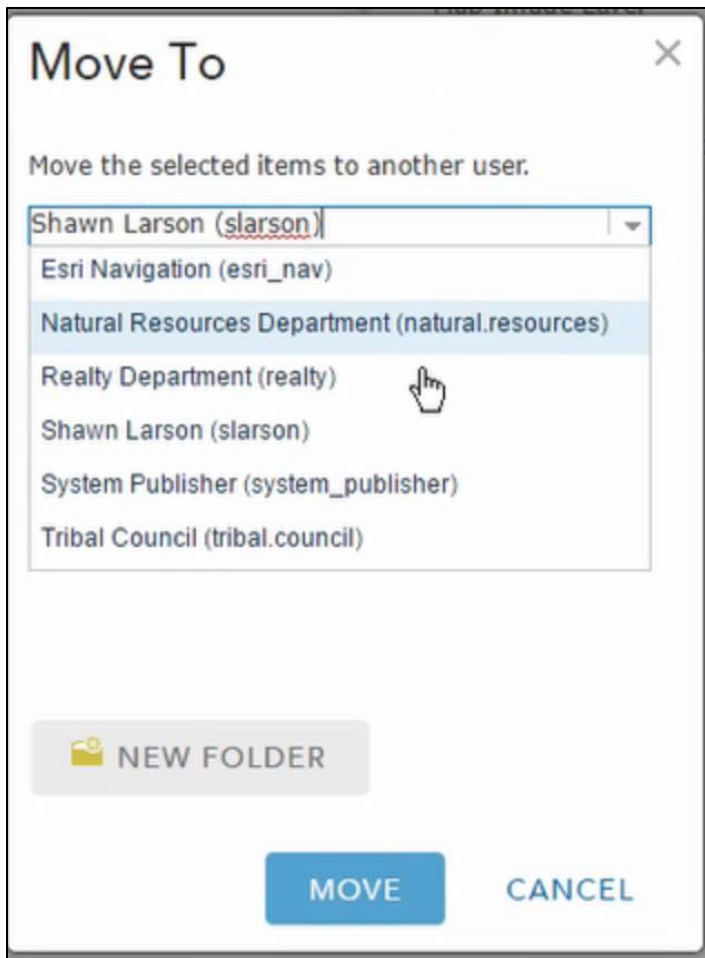
8. Select the folder you wish the item to be located in

9. Select "Move"

Change Sharing Settings

1. Follow steps 1-5 from "Open the Map Component of the JRD"

2. Select "My Content"
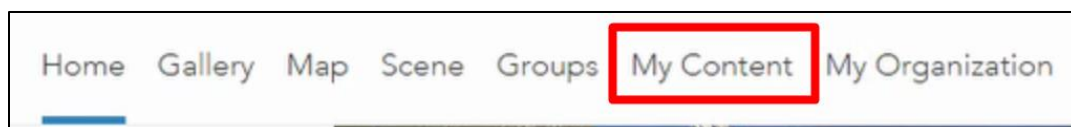
3. Click on the item you wish to change the sharing setting for
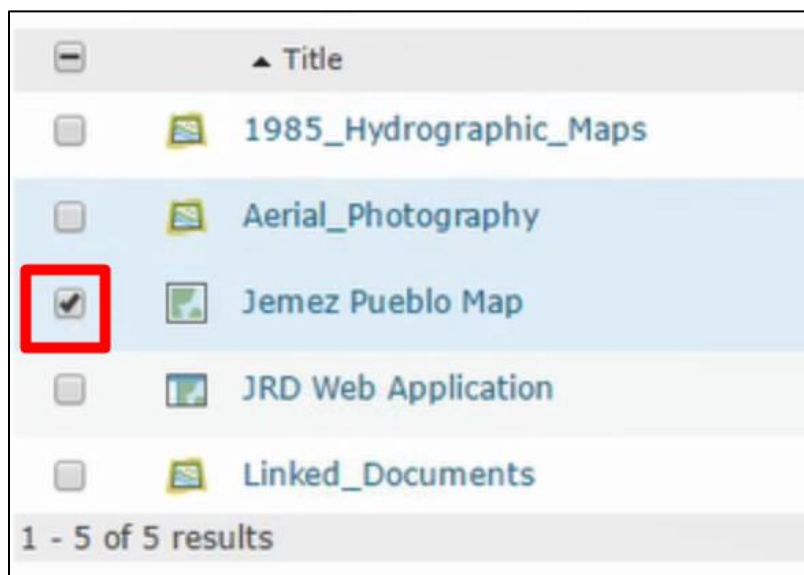
4. Click the "Share" button
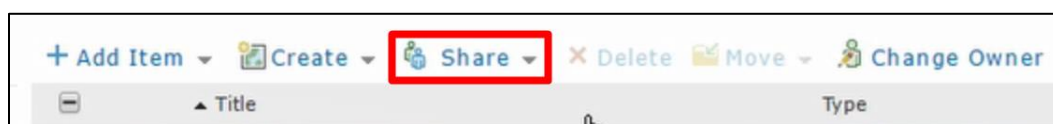
5. Click "access and update capabilities"
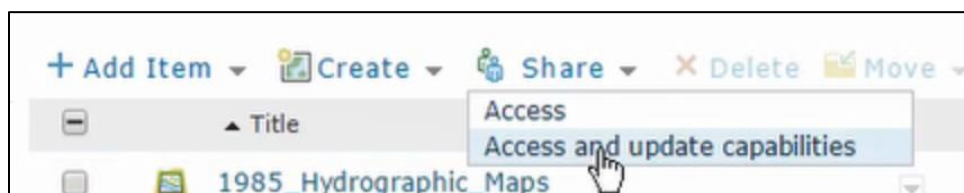
6. Click the checkboxes next to the group you want to share with

7. Click "OK"
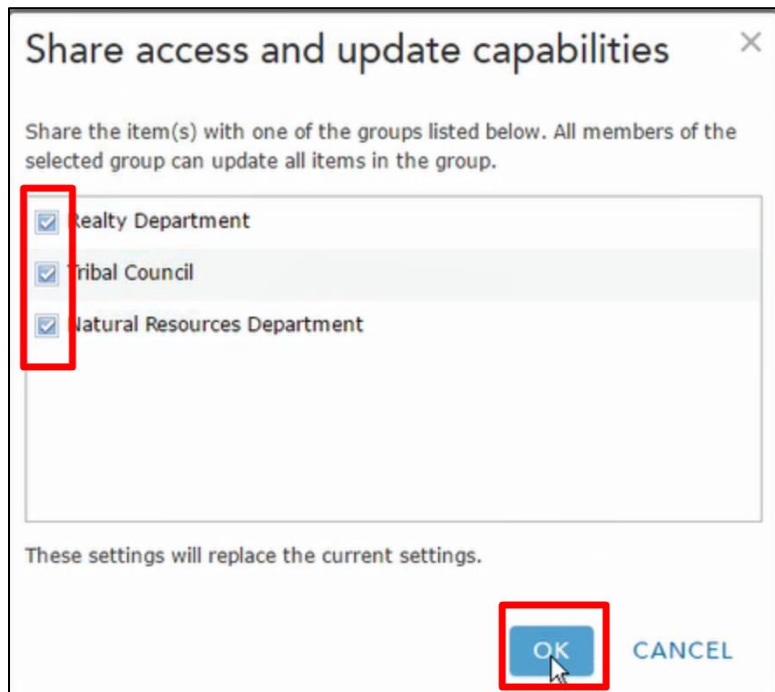
How to Delete Services

1. Open web browser

2. Go to http://arcgis.jemezpueblo.org/arcgis/manager
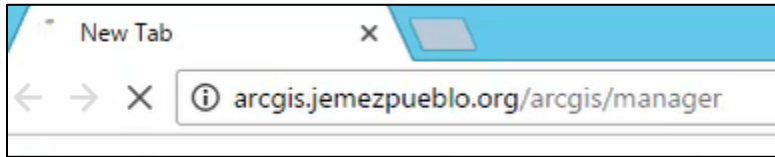
3. Login

4. Select the "X" next to the service you wish to delete
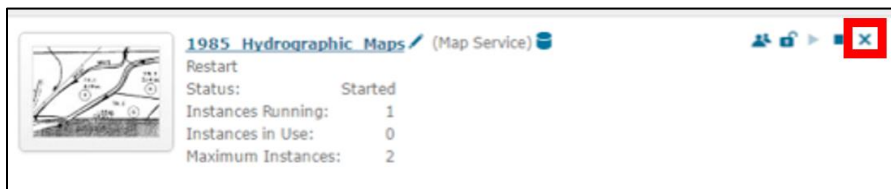
5. Select "OK" in the confirm box

How to Add a Tract Split into the File Structure

1. Follow steps 1-3 of "How to Access Records from File Structure"

2. Open the "Map-Tract" folder
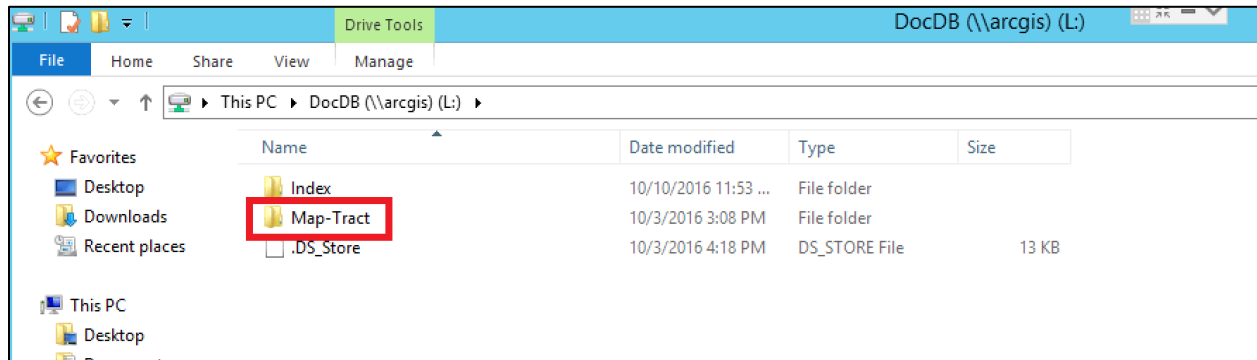
3. Navigate to the folder of the tract that is being split
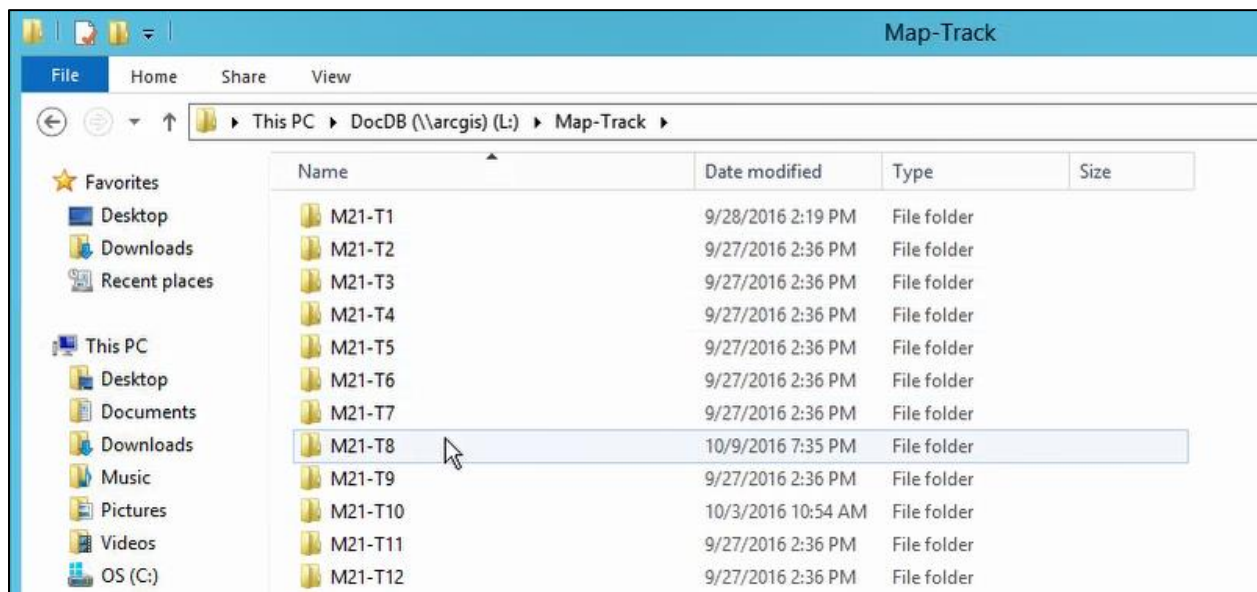
4. Open that tract's folder

5. Right-click on an empty area within that folder

6. Select "New"

7. Select "Folder"
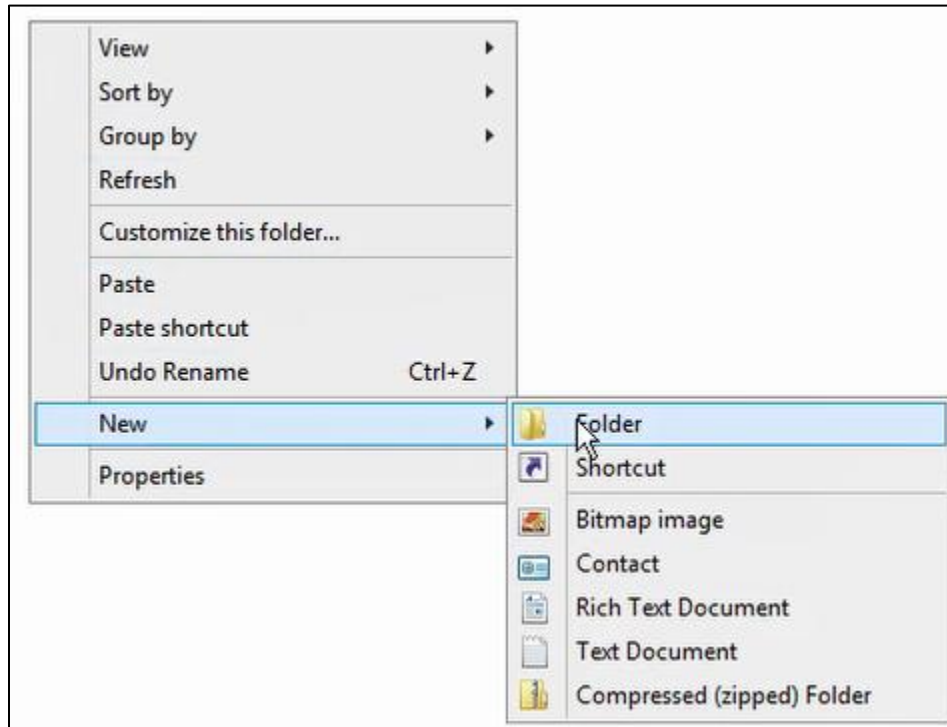
8. Follow this naming convention for all subdivisions of the tract: "M#-T#-A"

    a. The letter added to the end is dependent upon which subdivision you are creating

        a folder for
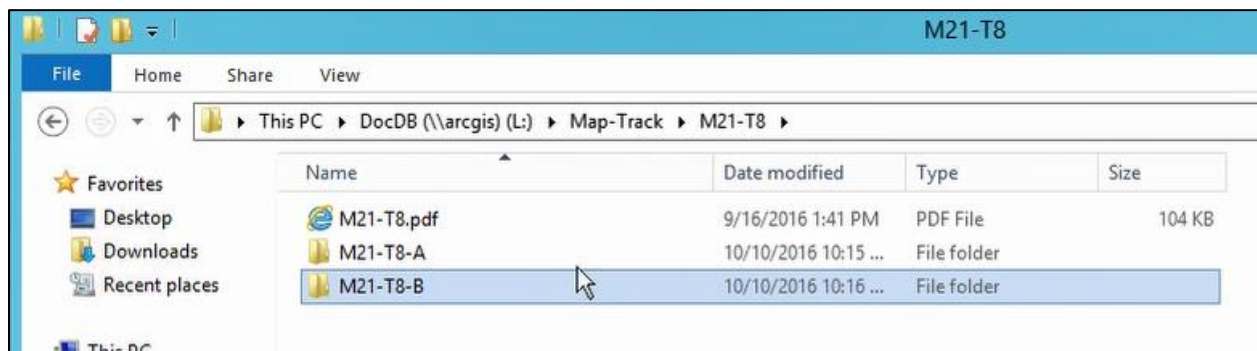
9. Add the relevant documents for this tract split in this new folder
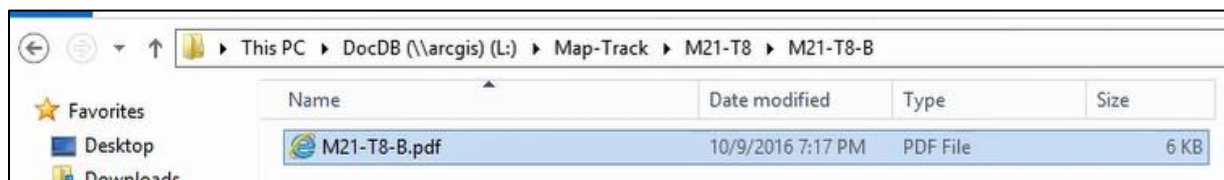
How to Renew an SSL Certificate

For ArcServer

1. Open a web browser

2. Go to http://arcgis.jemezpueblo.org/arcgis/admin

3. Login

4. Select "Machines"

5. Select "ARCGIS.ADMIN.POJ"

Registered Machines

Machines:

- ARCGIS.ADMIN.POJ

Supported Operations: register   rename

Supported Interfaces: REST

6. Select "SSL Certificates"

Machine - ARCGIS.ADMIN.POJ

Server Machine Properties

Name:	ARCGIS.ADMIN.POJ
Admin URL:	https://ARCGIS.ADMIN.POJ:6443/arcgis/admin
Platform:	Windows Server 2012 R2-amd64-6.3
Server Start Time:	2016-10-04T14:59:23,873
Web server maximum heap size (in MB):	-1
Web server SSL Enabled :	true
Web server SSL Certificate:	arcgiscert
App server maximum heap size (in MB):	256
SOC maximum heap size (in MB):	64
Synchronize:	false

+Ports

Resources: status   sslcertificates

Supported Operations: edit   start   stop   unregister

Supported Interfaces: REST

7. Select "arcgiscert"

8. Scroll to the bottom

9. Select "Generate CSR"

10. Submit all the text in the box labeled "CSR:" to your certificate authority

11. When you get your certificate back from your certificate authority, go back to "arcgiscert" and scroll to the bottom
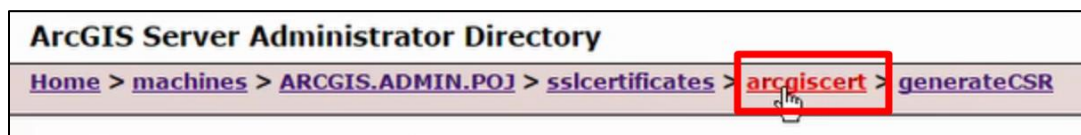
12. Select "Import Signed Certificate"

```
#4: ObjectId: 2.5.29.14 Criticality=false
SubjectKeyIdentifier [
KeyIdentifier [
0000: 03 DE 50 35 56 D1 4C BB   66 F0 A3 E2 1B 1B C3 97  ..P5V.L.f.......
0010: B2 3D D1 55                                  .=.U
]
]
```

Supported Operations: generateCSR export delete importSignedCertificate
Supported Interfaces: REST

13. Select "Choose File"

Import Signed Certificate For : arcgiscert

Import CA Certificate
Signed Certificate: Choose File No file chosen

14. Navigate to the certificate and select it

15. Click "Open"

All Files

Open ▼   Cancel
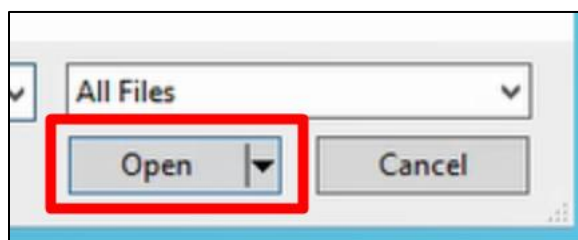
16. Click "Submit"

Import Signed Certificate For : arcgiscert

Import CA Certificate
Signed Certificate: Choose File No file chosen

Format: HTML ▾

Submit

For ArcPortal
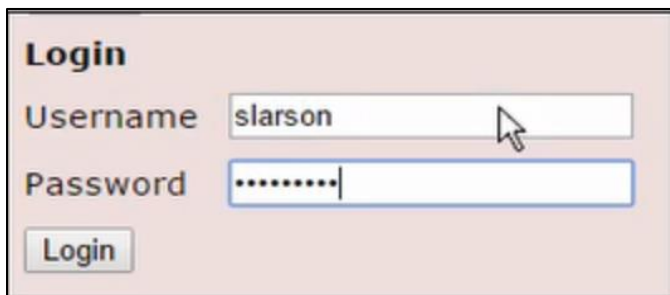
1. Open a web browser
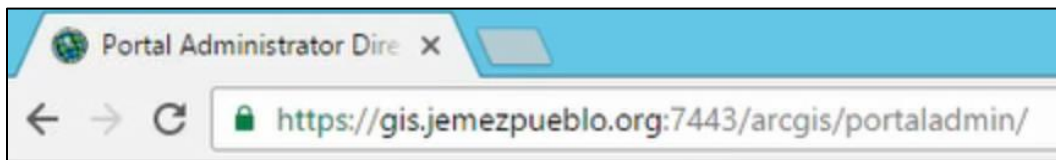
2. Go to https://arcgis.jemezpueblo.org:7443/arcgis/portaladmin

3. Login

4. Select "Security"

5. Select "SSL Certificates"

6. Select "giscert"

7. Scroll to the bottom

8. Select "Generate CSR"
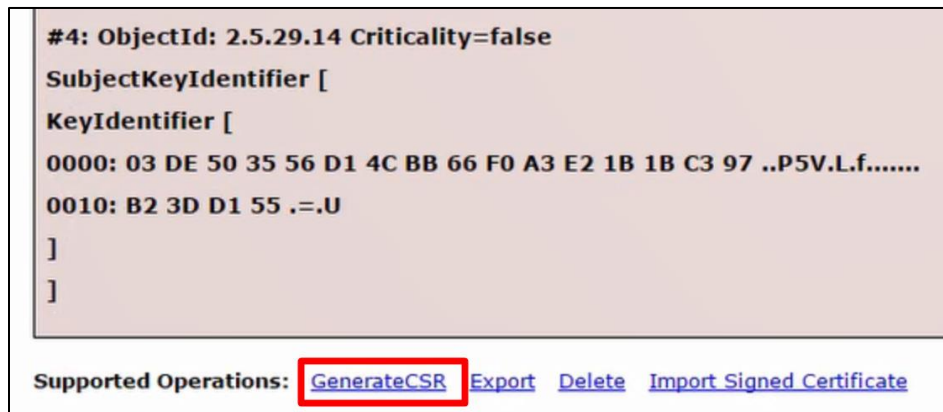
9. Submit all the text in the box labeled "CSR:" to your certificate authority

10. When you get your certificate back from your certificate authority, go back to "giscert"

and scroll to the bottom

Portal Administrator Directory

Home > Security > SSLCertificates > giscert > Generate CSR

Generate CSR

11. Select "Import Signed Certificate"

#4: ObjectId: 2.5.29.14 Criticality=false

SubjectKeyIdentifier [

KeyIdentifier [

0000: 03 DE 50 35 56 D1 4C BB 66 F0 A3 E2 1B 1B C3 97 ..P5V.L.f.......

0010: B2 3D D1 55 .=.U

]

]

Supported Operations: GenerateCSR Export Delete Import Signed Certificate

12. Select "Choose File"

Import Signed Certificate

File * Choose File No file chosen
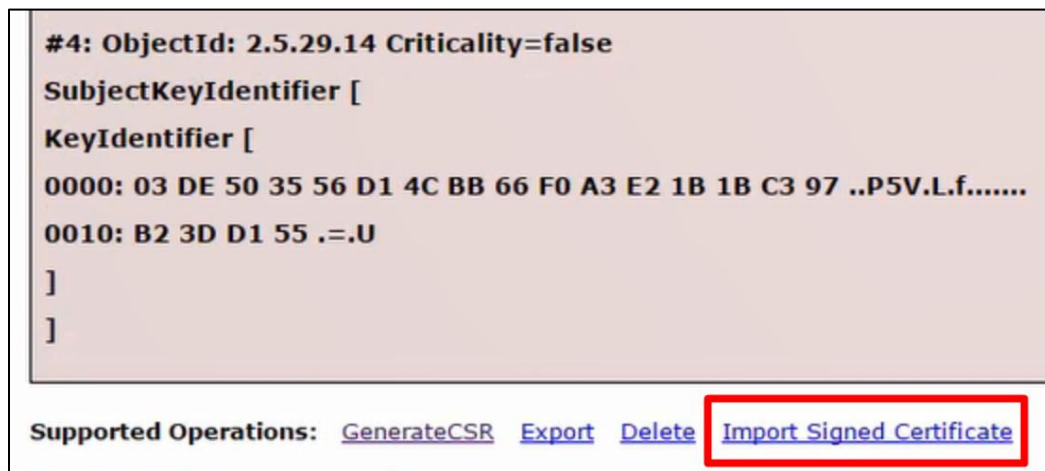
Import

13. Navigate to the certificate and select it

14. Click "Open"
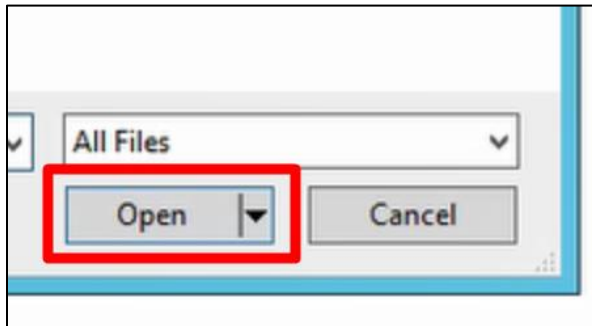
15. Click "Import"

For IIS

1. Open remote desktop client

2. Connect to "gis.admin.poj"

3. Open "Internet Information Services Manager"

   a. You can find this by searching for it in your start menu
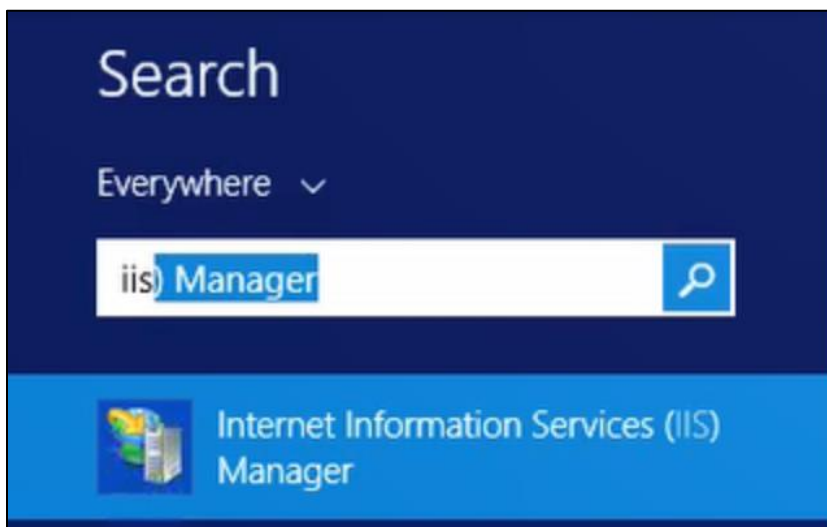
4. In the "Connections" list, select "GIS (ADMIN\ArcGISAdmin)"

5. Open "Server Certificates"
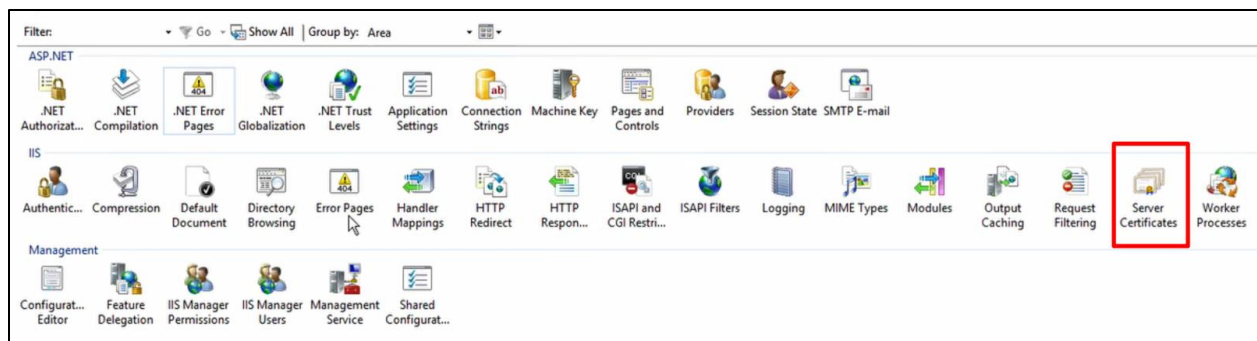
6. Right click the certificate named "GIS"

7. Click "Renew"
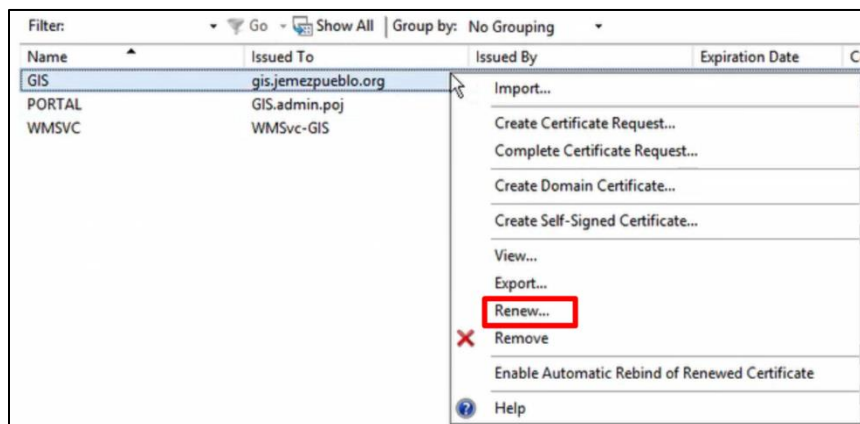
8. Select "Create a renewal certificate request"

9. Click "Next"
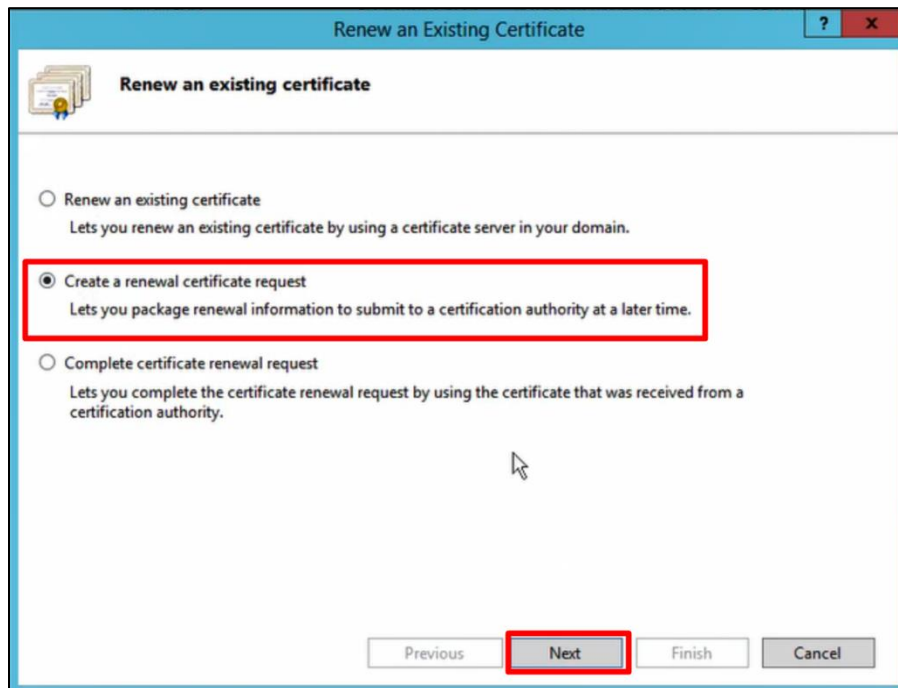
10. Click the "..." box
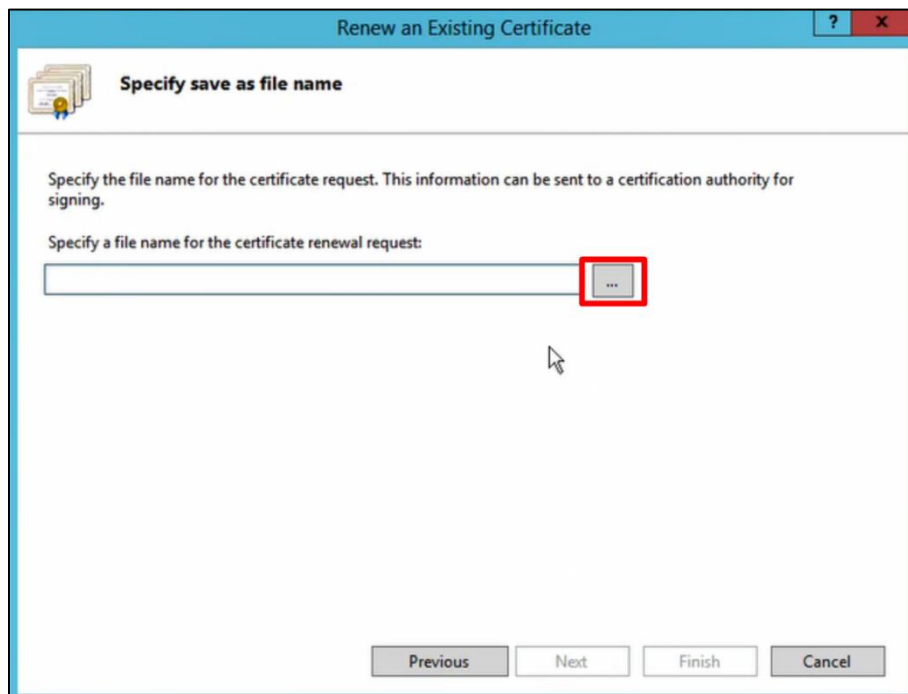
11. Navigate to where you want to store your request

12. Give it a name you understand and will remember

13. Select "Open"
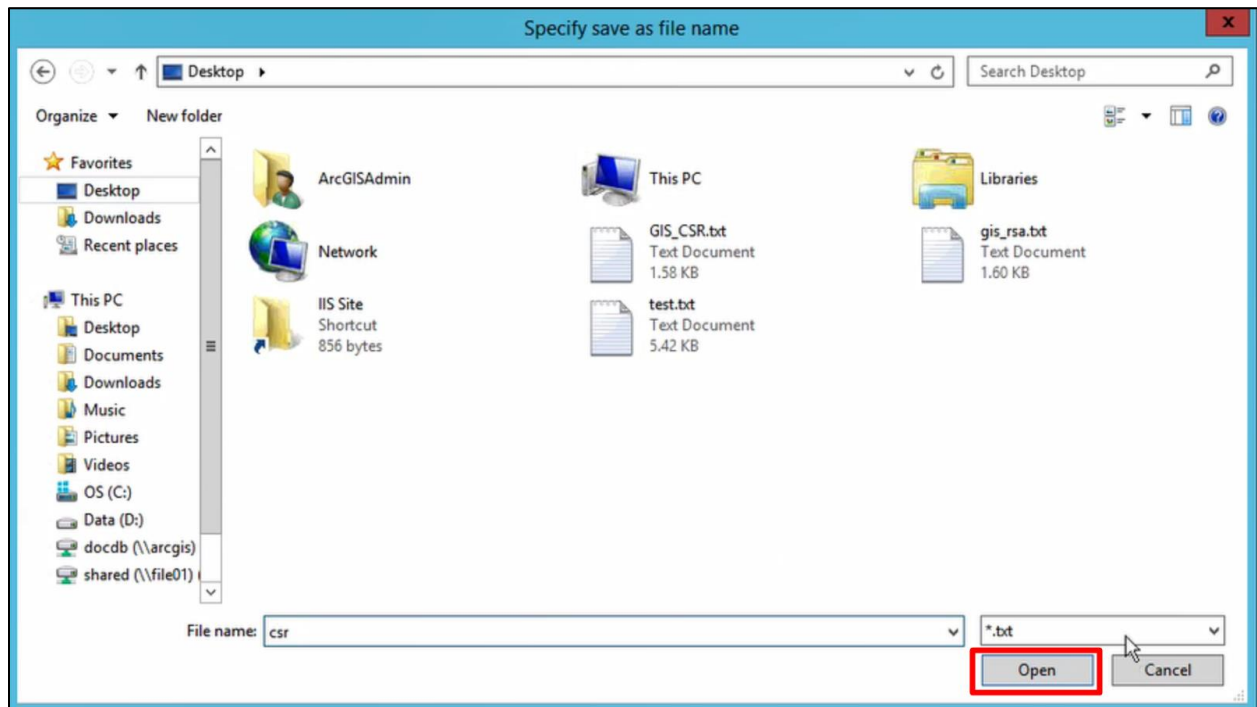
14. Select "Finish"
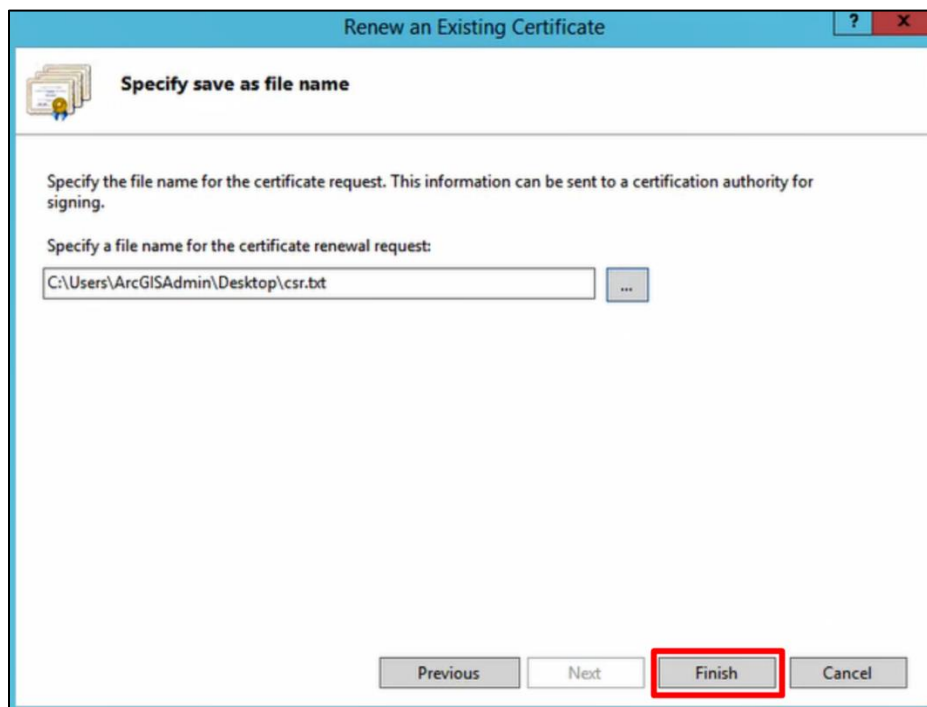
15. Submit the text of the file you created to your certificate authority

16. When you get your certificate back from your certificate authority, go back to the "Server Certificates" in the "IIS Manager"

17. Right click the certificate named GIS

18. Click "Renew"

19. Select "Complete certificate renewal request"

20. Select "Next"
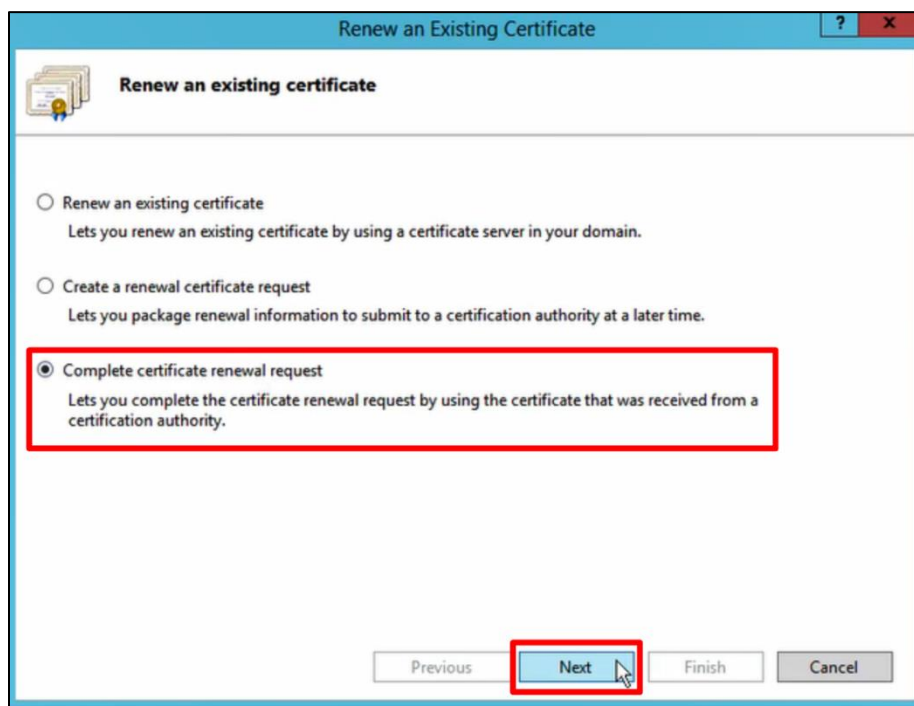
21. Click the "..." box
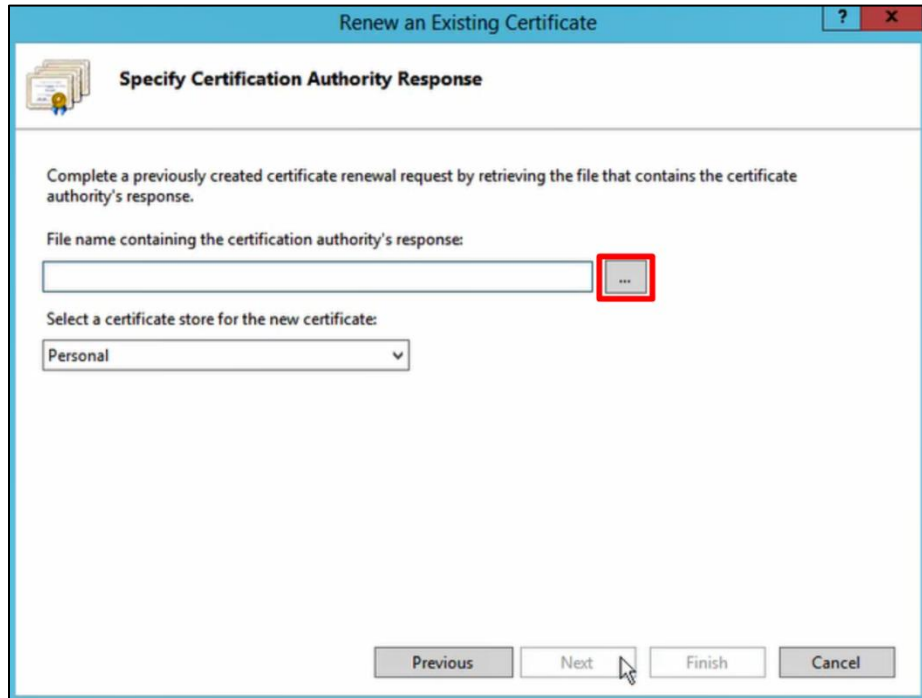
22. Navigate to where the certificate you got from the certificate authority is stored

23. Select it

24. Click "Open"
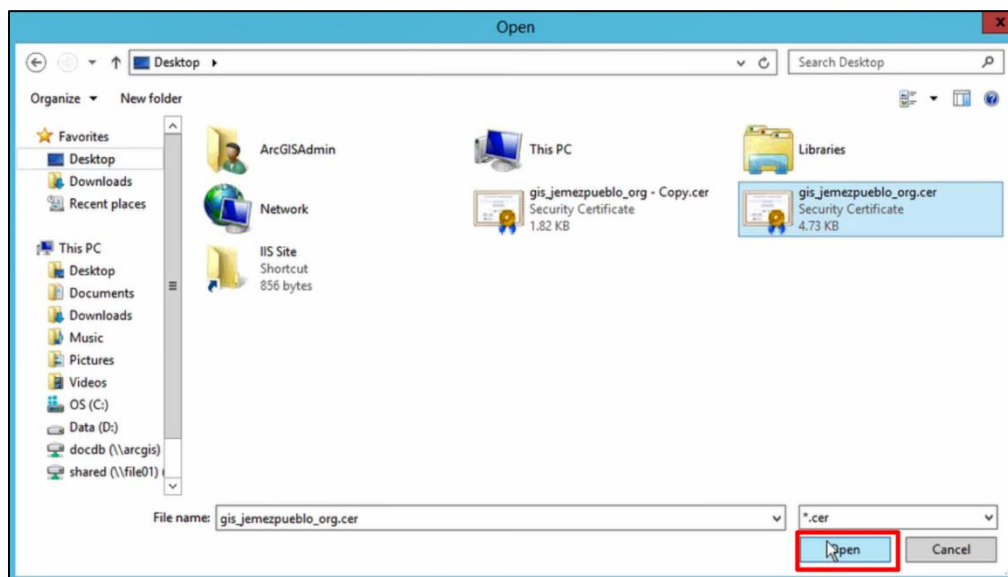
25. Click "Finish"

Renew an Existing Certificate

Specify Certification Authority Response

Complete a previously created certificate renewal request by retrieving the file that contains the certificate authority's response.

File name containing the certification authority's response:

C:\Users\ArcGISAdmin\Desktop\gis_jemezpueblo_org.cer

Select a certificate store for the new certificate:

Personal

Previous | Next | Finish | Cancel

How to Georeference

1. Open ArcMap for Desktop
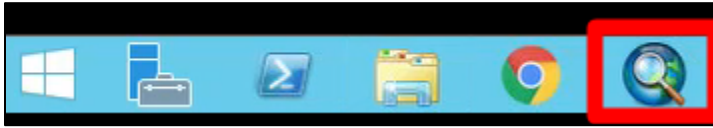
2. Open a blank document

3. Navigate to "File" and "Add Data"

4. Select "Add Data" from the dropdown
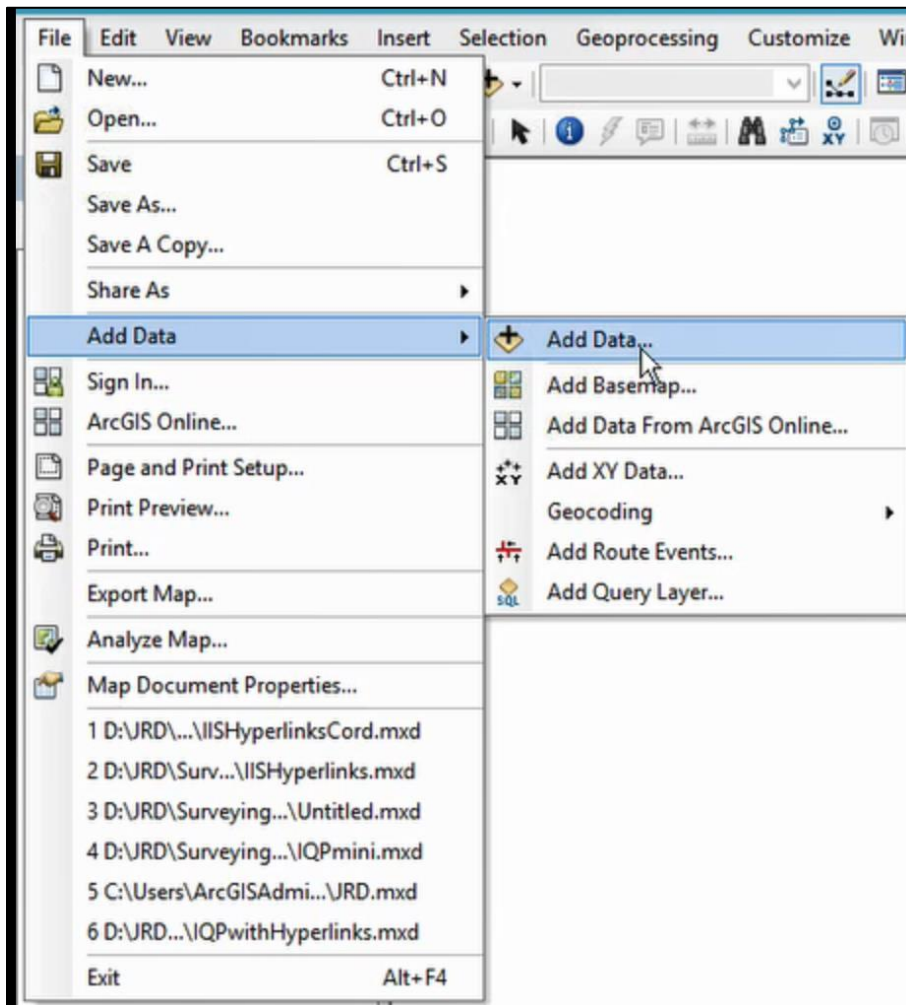
5. In the dialogue box that opens, navigate to the document you want to georeferenced and click "Add"
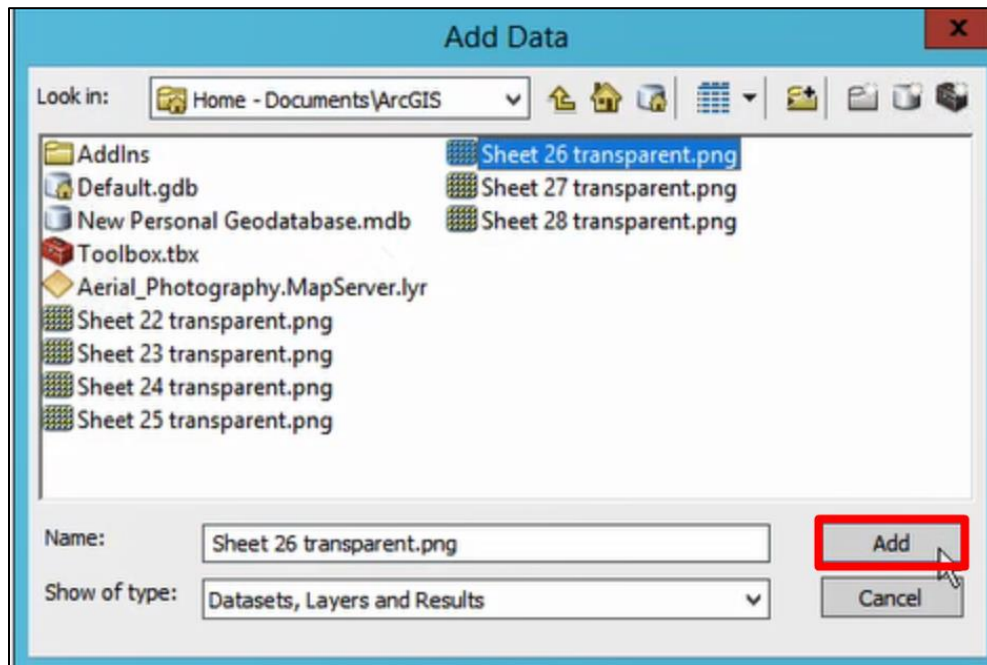
6. Repeat these steps for the data you are georeferencing to, that way they are both added to the document

7. Right click on the blank space next to your toolbars
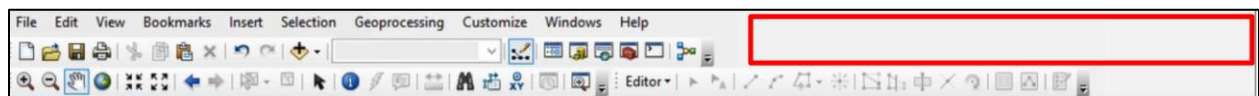
8. Click "Georeferencing"
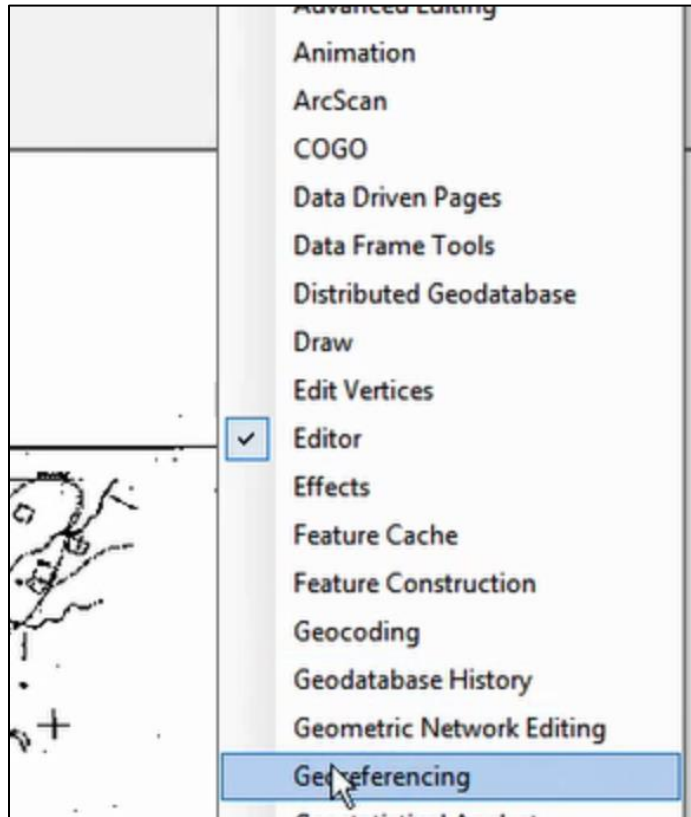
9. Make sure the proper layer is selected in the dropdown box in the "Georeferencing" toolbar

10. Click "Georeferencing" and ensure that "Auto Adjust" is not selected
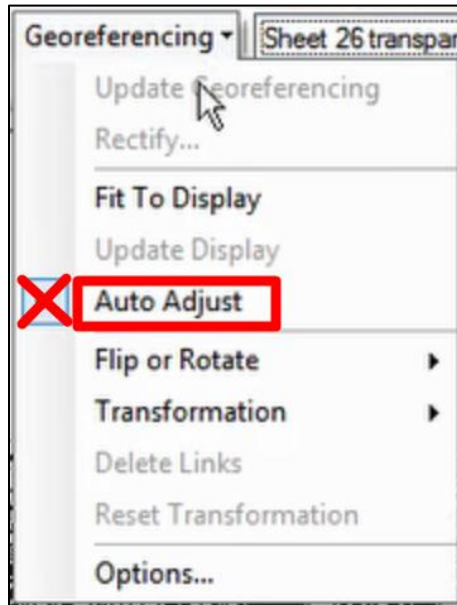
11. Click the "Add Control Points" icon

12. Navigate to layer you want to georeference in the map view

13. Click a point that you can find on the layer you are georeferencing too

    a. Road intersections, buildings, and other prominent landmarks are good points to use
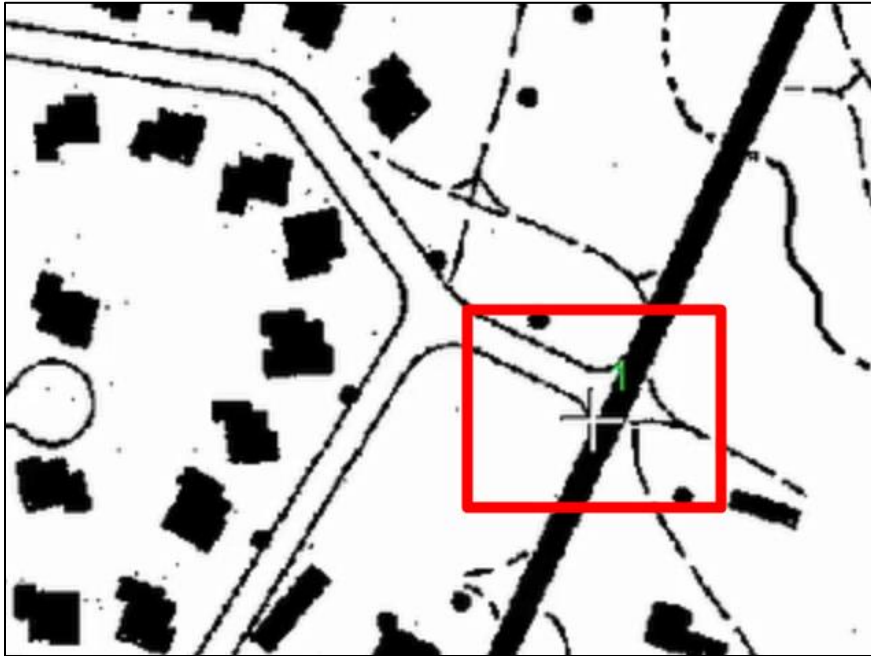
14. Navigate to the layer you are georeferencing to in the map view
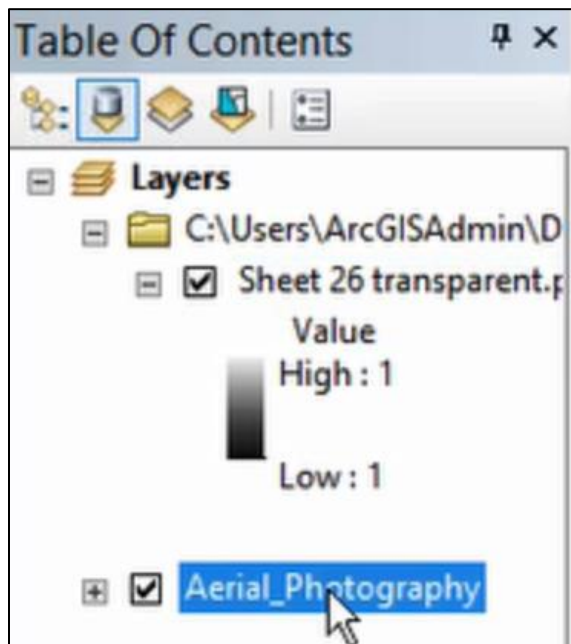
15. Select that same landmark point in this layer

16. Repeat at least once more to georeference the two layers, however you should have

multiple point in order to have an accurate georeference

17. Once you have at least 2 points, you can turn "Auto Adjust" on to see the changes made

as you make more points

18. When you finish placing points, click "Georeferencing" again

19. Click "Update Georeferencing"
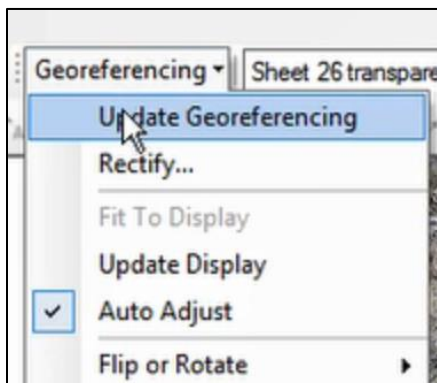
<u>Troubleshooting</u>

Manage Users/Reset Passwords

Note: Only Admin can perform this task

1. Open the map component of the JRD

2. Click "My Organization"

3. Click the gear icon next to the user you are managing

4. Click "Reset Password"

5. In the popup, click "OK"
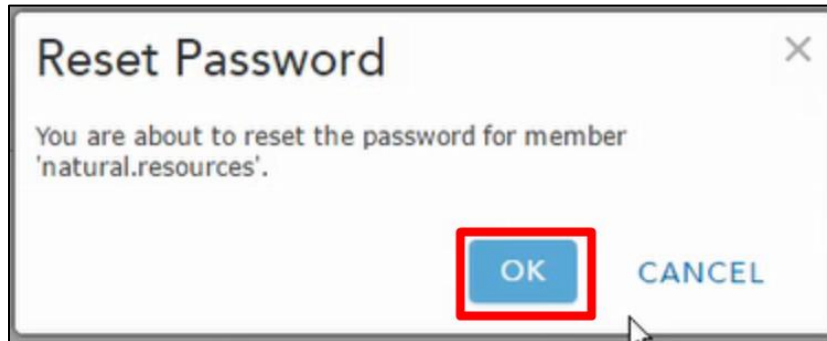
6. The user's new password will be displayed, click "OK" once you have notified the user
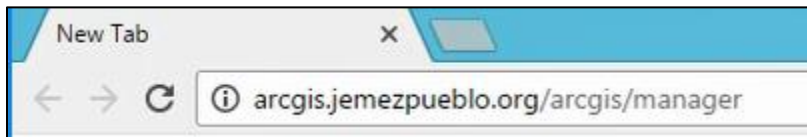
of their new password
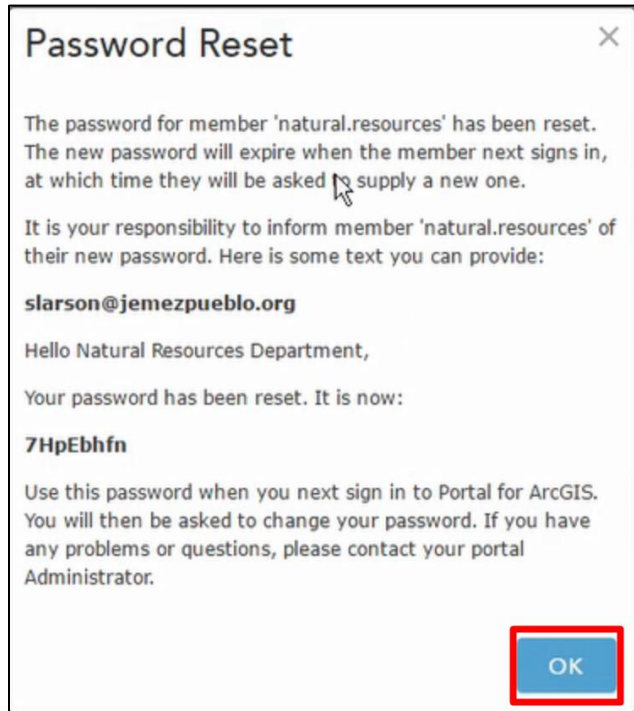
a. The user will be prompted to update their password to something they choose

when they login next

Reconnect ArcServer to ArcPortal

Note: We do not have screenshots for this section yet, will be completed Monday morning, but we wanted to submit this tonight.

1. Go to the server manager: http://arcgis.jemezpueblo.org/arcgis/manager

2. Login

3. Click "Sharing"

4. Click "Sign In"

5. Login

Broken Hyperlinks

A broken hyperlink is likely due to improper naming to a new point in ArcMap. To solve this issue, you must open ArcMap for Desktop, select the points layer and revisit that added point to confirm the name is correct. If an issue still arises, contact your IT Department, as it may be an issue with the folder in the L: Drive and they will have administrator access to alter those folders.

A broken hyperlink in the Realty Index is a result of a broken formula, the formula for all entries into the "Tract#" column should be:

=HYPERLINK(CONCATENATE("\\ARCGIS\DocDB\Map-Tract\",
CONCATENATE("M",A2,"-","T",B2)),CONCATENATE("M",A2,"-
","T",B2,IF(C2="","",CONCATENATE("-",C2))))

If the formula appears to be correct, contact your IT Department, as it may be an issue with the folder in the L: Drive and they will have administrator access to alter those folders.
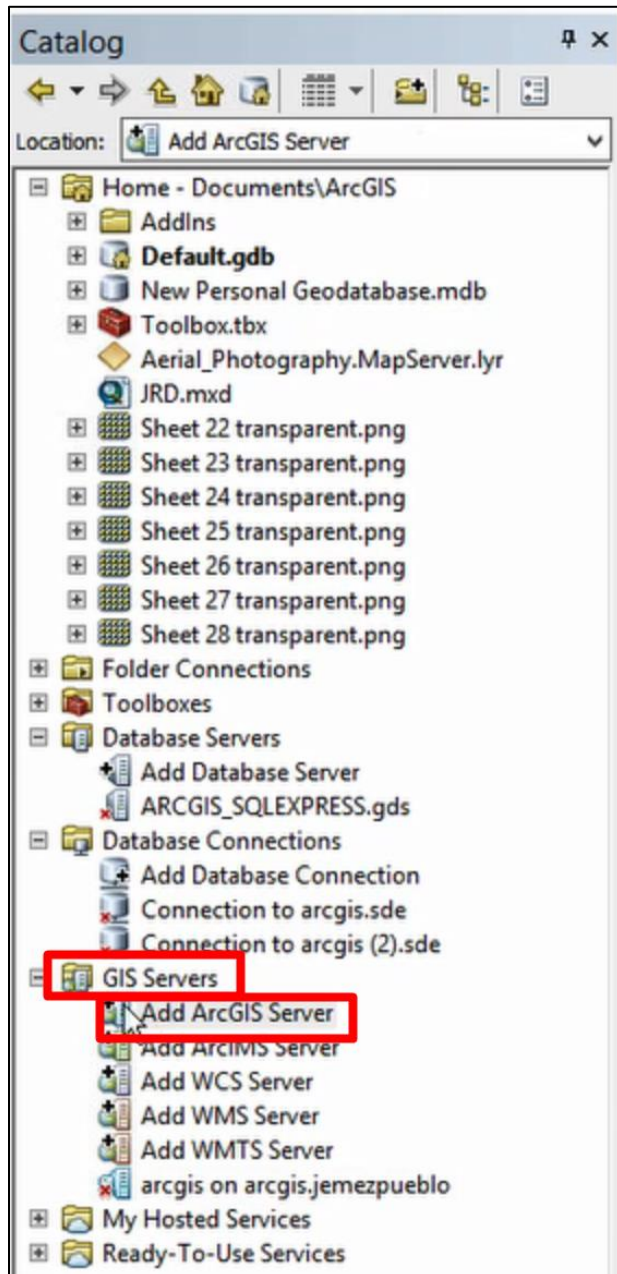
Reconnect ArcGIS for Desktop to Arc Server
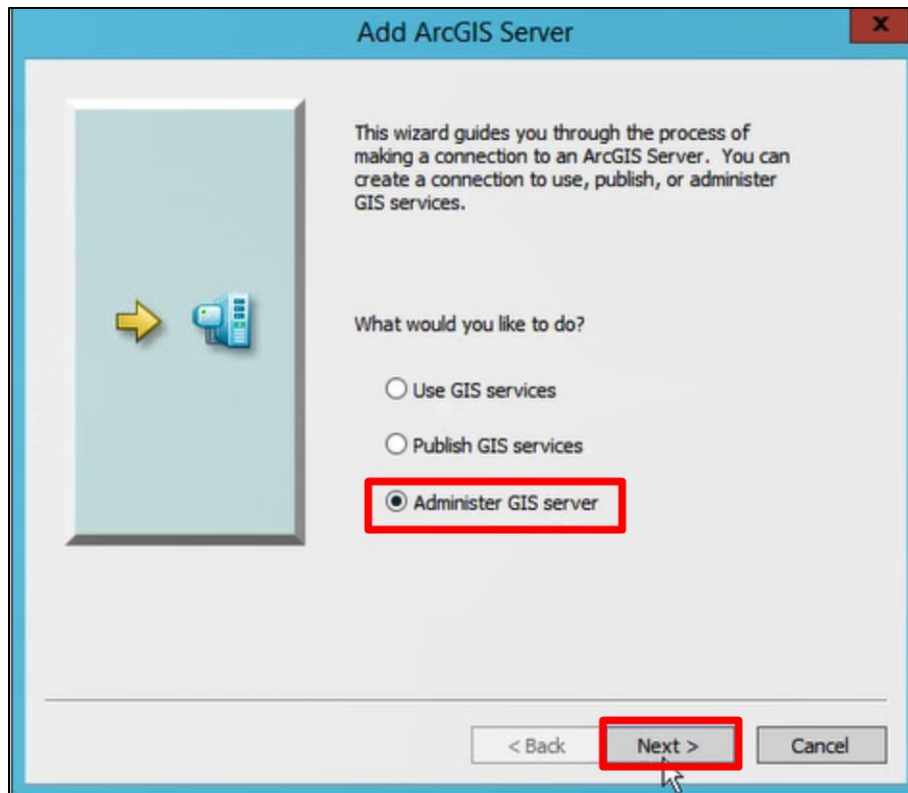
1. Open ArcMap for Desktop
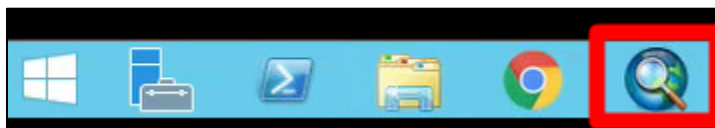
2. Open any document

3. On the right-hand side, click "Catalogue"

4. Click the plus sign next to "GIS Servers"

5. Double click "Add ArcGIS Server"

6. Select "Administer GIS Server"

7. Click "Next"

8. In the next dialogue box, fill in the appropriate information

    a. Server URL is https://arcgis.jemezpueblo.org:6443/arcgis/admin

    b. Server Type is ArcGIS Server

    c. Checkbox labeled "Use ArcGIS Desktop's staging folder" is selected

    d. The login information is filled in

9. Click "Finish"

How to fix Realty Index Entry Form

In the case that the Excel Macro ever stops working properly, the functioning code has been provided below:

```
Sub InputAndSort()
'
' AutoSort Macro
'


'
'Range("A1", ActiveCell.End(xlDown).End(xlToRight)).Select
Columns("A:AI").Select
ActiveSheet.ShowDataForm
    Columns("A:AI").Select
    ActiveWorkbook.Worksheets("Property Owner").Sort.SortFields.Clear
    ActiveWorkbook.Worksheets("Property Owner").Sort.SortFields.Add Key:=Range( _
        "A1:A10000"), SortOn:=xlSortOnValues, Order:=xlAscending, DataOption:= _
        xlSortNormal
    ActiveWorkbook.Worksheets("Property Owner").Sort.SortFields.Add Key:=Range( _
        "B1:B10000"), SortOn:=xlSortOnValues, Order:=xlAscending, DataOption:= _
        xlSortNormal
    ActiveWorkbook.Worksheets("Property Owner").Sort.SortFields.Add Key:=Range( _
        "C1:C10000"), SortOn:=xlSortOnValues, Order:=xlAscending, DataOption:= _
```
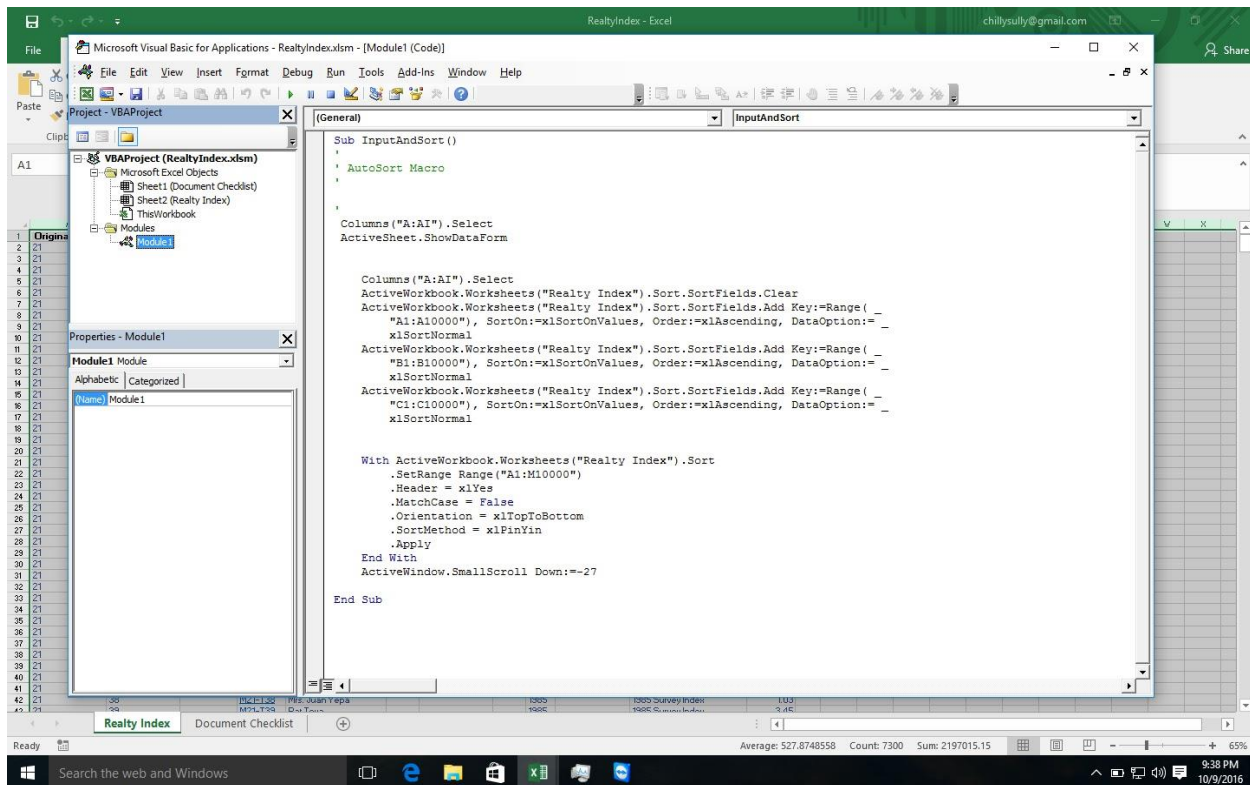
```
        xlSortNormal


    With ActiveWorkbook.Worksheets("Property Owner").Sort
        .SetRange Range("A1:M10000")
        .Header = xlYes
        .MatchCase = False
        .Orientation = xlTopToBottom
        .SortMethod = xlPinYin
        .Apply
    End With
    ActiveWindow.SmallScroll Down:=-27


End Sub
```

The code should be inserted into the macro editor which can be accessed with the keyboard

shortcut Alt + F11.

Once inserted, save the changes and close the window.

If the problem persists, contact your IT administrator