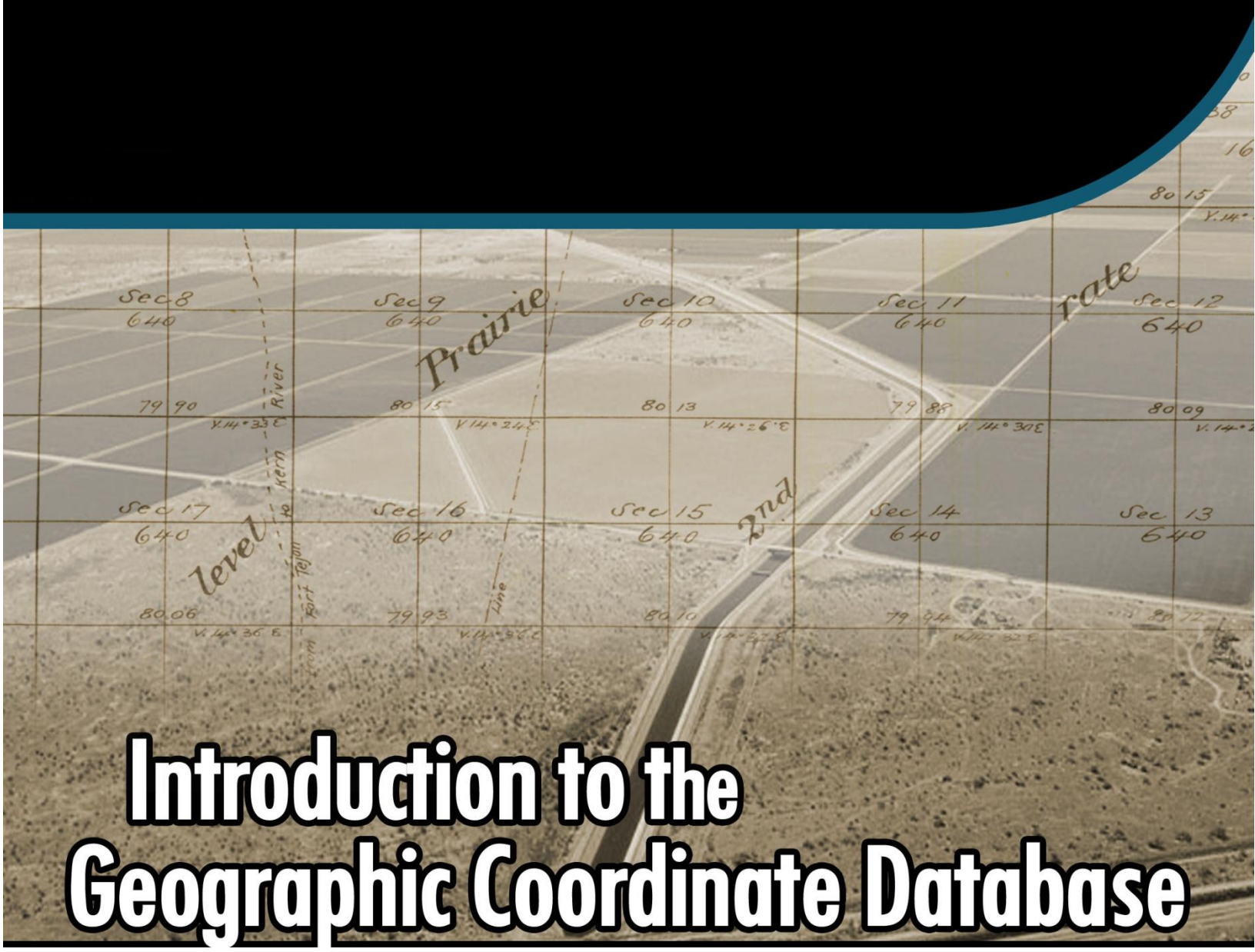

Introduction to the Geographic Coordinate Database

v.1 2008

STUDY GUIDE

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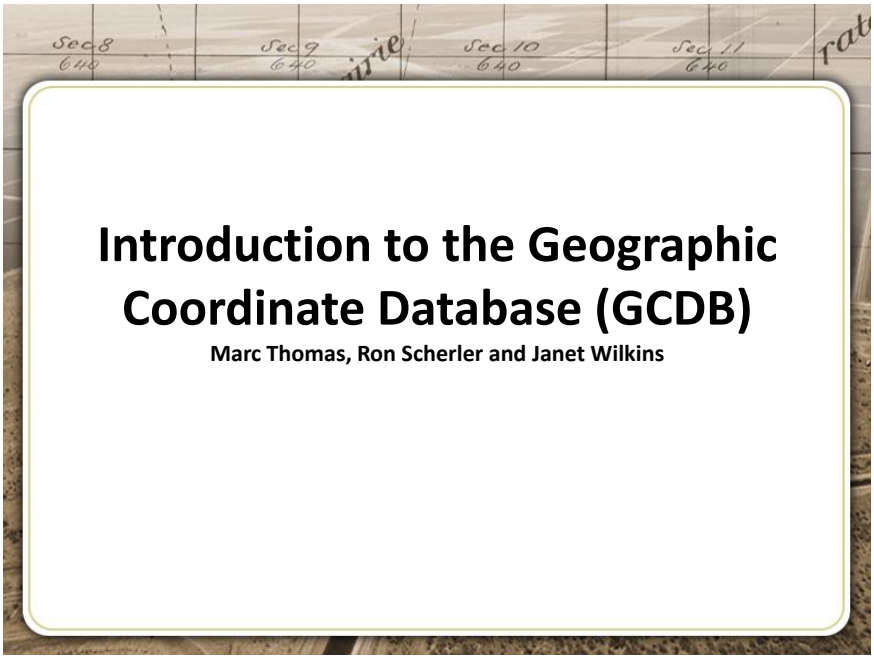
Introduction to the Geographic Coordinate Database

Hi, I am Ron Scherler and I am here with Marc Thomas. This is Introduction to the Geographic Coordinate Database. Marc, tell us a little about yourself.

What is your involvement in the geographic coordinate database?

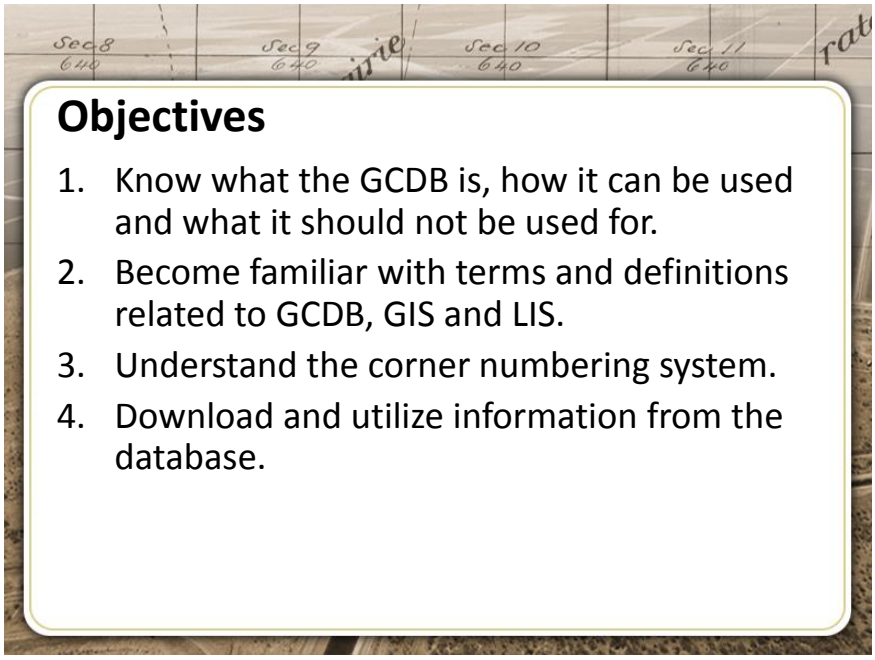


My name is Marc Thomas. I began my federal career in 1970 and about 1987 I got involved with GIS and producing a digital portrayal of the PLSS for the Western Oregon Digital Database (WODDB). This was BLM's first landscape wide approach at building a resource management plan that was required every decade. In 1989, I was selected as the GCDB manager for Oregon and Washington where I held that post until 2006 when I retired.

Objectives

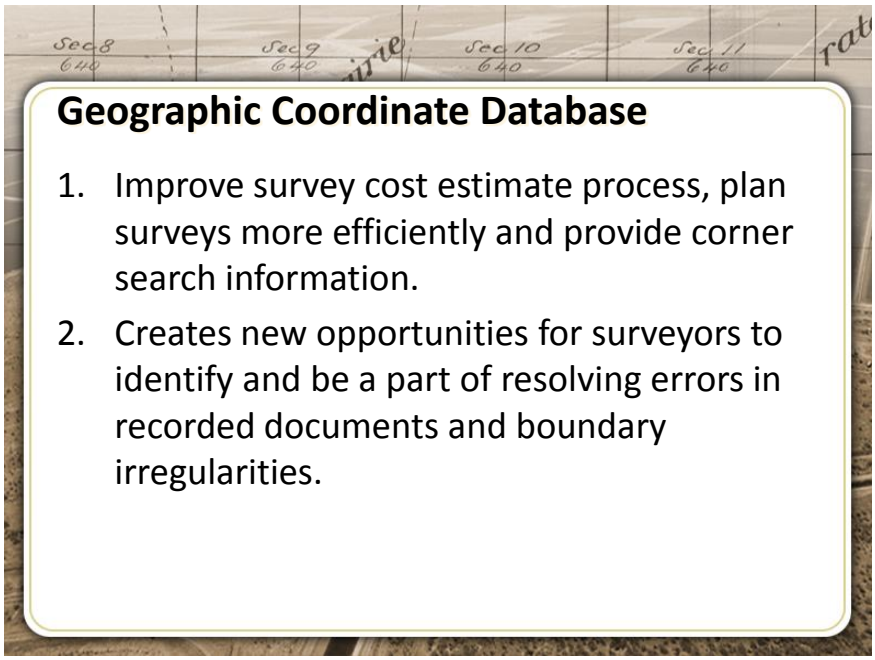
Let us just take a minute and look at the objectives. This is what we expect you to get out of this course. First, we want you to know what the geographic coordinate database is and how it can be used and what it should not be used for. Second, we want you to become familiar with terms and definitions related to GCDB, GIS and LIS. Third, understand the

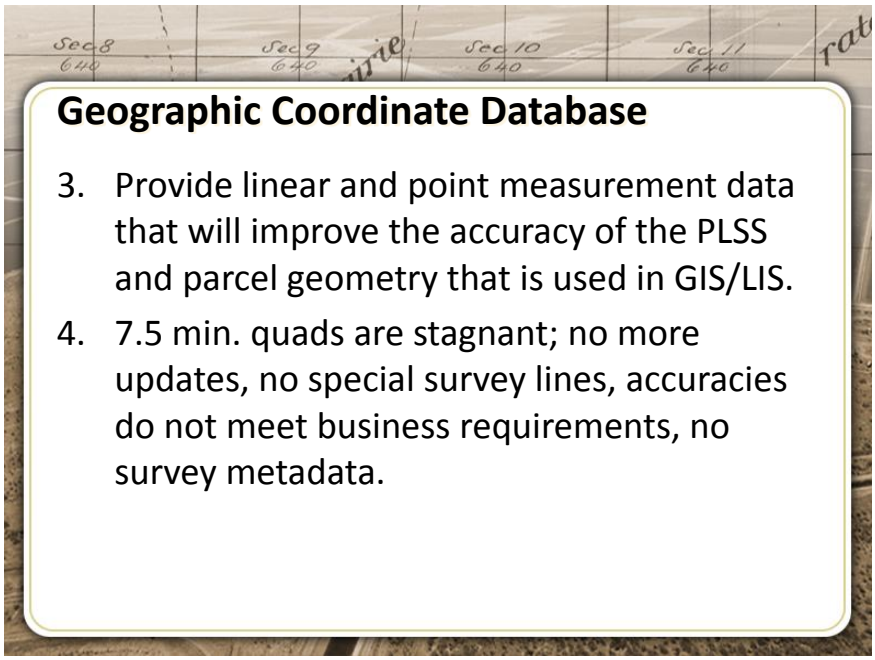
unique corner numbering system. Finally, we want you to understand how to download and utilize information from the database in your day-to-day work.



Overview of GCDB

Using the GCDB Coordinate Database will allow you to improve your cost estimate process and your ability to perform corner searches when you are in the field. It also creates new opportunities for you, the surveyor, to provide information that goes into the GCDB to make it better. Using the records that are recorded at both BLM and the counties, you are portraying what the records say. Surveyors are necessary to help resolve the discrepancies that appear based on these records. Therefore, this means work for you. You are the ideal people to work at fixing that information.





The GCDB also provides linear and point measurement data that will improve the accuracy of the PLSS and the parcel geometry that exists in your counties.

GIS and LIS – What's the Difference

The GIS is the geographic information system that is used now to create maps and do planning at virtually all levels of government. The LIS or land information system really is a spatial portrayal of what the records are. Many of the land records documents are based on the PLSS. They are then followed up with the parcels that the counties use to create their tax lot parcels and assessor's maps.

Both of these systems use the same base information, which makes the two compatible so we can bring them together. They are using the same parcel information and the PLSS is the base for the parcels in many cases. Sometimes it will diverge, but it is important that where they are common they are displayed as common. So really, the LIS is the record keeping portion and the GIS is the mapping or planning part.

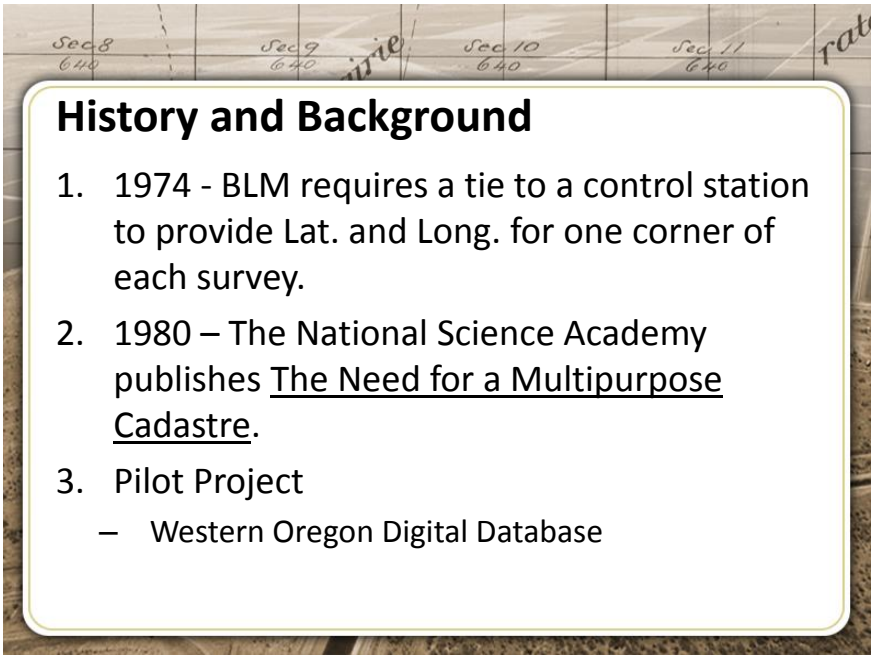
You can perform analysis with the GIS that cannot be done with the land information system. In addition, the other benefit of using GCDB is that the USGS quadrangles are no longer being updated by the USGS. Today when you use GIS tools and datasets, you can bring the GCDB data in and overlay it on digital imagery to see new roads or other human actions on the landscape that will not show on the old quads.

I can remember in field using a quad that was 20 years old and they could not continually keep those updated. The data is not always up to date but, the new systems allow us to continually update the documents and maps we the themes that we need. Sometimes the imagery that is available flown at the statewide level, or at the county level, is gathered by flying very low flights to obtain high accuracy imagery. You can then overlay this sort of information on a map to help you plan your surveys.

History and Background of GCDB

In the late 70's the National Resource Council had been charged with trying to come up with modernizing the land information systems in the United States. Many of the old methods that we had used even as far back as the GLO were still in place. Drawing plats by hand, assessors' maps and stamping documents and recording them at the county. Creating a lot of space for paper records. The National Resource Council published this book in 1980, the "Need for a Multi-Purpose Cadastre" and laid out a process for all levels of government to automate their systems, their land information systems. Coincidently, on that panel was a land surveyor from BLM, so that is how we got our foot in the door.

I remember reading this book sometime in the 80's and as I see what's happened with GCDB, GIS and LIS, it's amazing to me what an accurate and well thought out plan is in that book. One of the things that our surveyor on the panel did put into place was, the requirement to tie to a horizontal control station for each survey that we perform thereby providing a geodetic tie to the earth's surface for this spatial component.

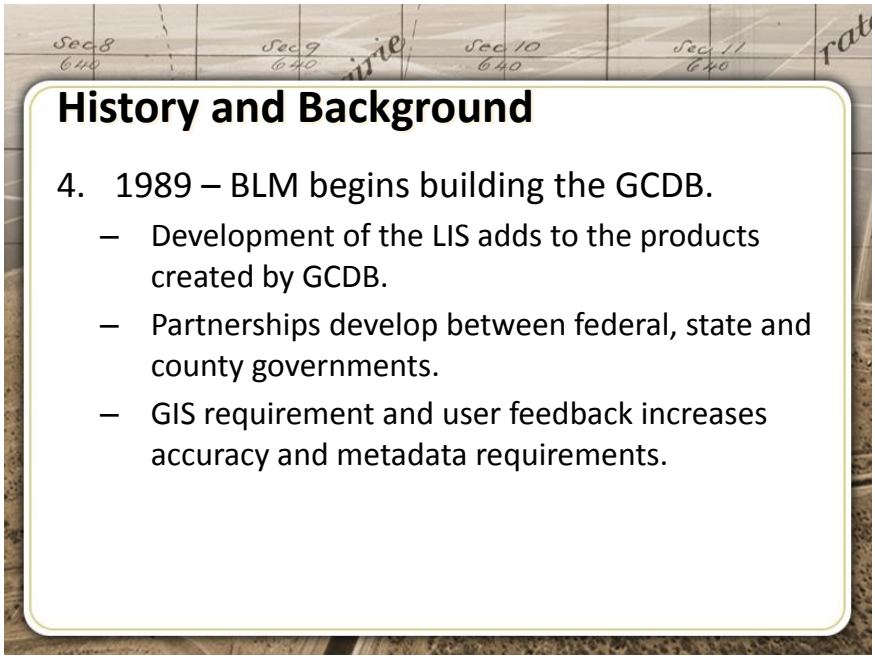


I began work for BLM in '73, and I remember when the instruction came down that you had to make these ties and how upset all of the field surveyors were. It was some forward thinking people who understood why we needed to do that and the value that we would gain has been tremendous.

They softened the requirement a little bit by saying when "*practicable*". As I said in my introduction, I was involved in the Western Oregon Digital Database project, and one of the elements that they required was a PLSS. They had been digitizing the USGS quads up until that time and perhaps some of you have been in Western Oregon. The timber canopy is such that it was very difficult for the USGS to accurately position their corner record information on those quads due to the timber canopy.

What we were able to do, was use existing software that allowed us to take survey measurements, in this case the GLO and BLM surveys, that existed in our office. Using those measurements and with some points of known coordinate control on the corners, we

could calculate the intervening corners for the remainder of the PLSS one township at a time.



BLM was required to do this resource management plan every 10 years, which involved creating maps. It created each layer of the map by collecting data such as roads, the PLSS, terrain, vegetation types, species types, streams, and the human or the culture features that were on the land. Because of this plan, they were spending a lot of time hand drawing all of these maps. This was the first effort to say let us quit doing these things repeatedly by hand and move into some kind of digital environment. Initially, they had tried to update the USGS PLSS by reading the field notes and then proving the positions and it was a fruitless effort.

At that time in the late 80's, all this data that we described was collected by the USGS and published in the North American Datum 27 (NAD27). It just meant less of a problem trying to convert anything and some of the software did not exist to convert that data efficiently. That decision was not made lightly. The new adjustment was coming but we have all of this old data and needed a decision now. The decision was to go with NAD27. In some cases it was met with a lot of opposition but as time has gone on it has proven to be an acceptable decision.

The resource management plan had to deal with the static dataset for a certain period of time to make their analysis, publish their plan and put it out for public comment. They were not ready to switch datums until well into the 90's.

What are some other things that went on historically here?

In 1989, the Bureau had finally positioned themselves funding wise and began to staff up the GCDB collection process. In January 1989, they had made the selections for the GCDB Coordinators for ten western United States. Those coordinators went out and hired additional staff to begin the GCDB collection. The majority of that collection was performed under contract. Oregon was one exception, we had lessons that we learned in the WODDB project. We knew that we wanted to include the recorded documents that were in the county. One of the largest lesson we learned from WODDB was that our solutions did not always meet the cut lines that were on the face of the earth and in that imagery. It upset the resource managers a great deal.

Let us just review a minute to make sure everybody understands. What happened in WODDB was that we used only the official survey records. These were records the Forest Service had - surveys that they had contracted. We had a few other records but we did not go to the county and get all of the survey data. We were given two years time to complete the collection of PLSS for WODDB and that did not afford us enough time to get records that we knew would improve the solution. The lesson we learned was we are not going to let time impact us.

I have just an interesting story to tell you because at the time of the WODDB project, I was involved in that. I made an estimate for collecting the data for the entire state of Oregon and I presented it to our Associate State Director. He asked me are you sure this is a doable thing. I said yes we could do that. On that basis, we got funding and moved forward and my estimate was that we would have it done in two years. I have always blamed Marc for dragging his feet because it is 15 years later and it is still not done - 87% done.

As the GCDB became more important, we began to collect more data and it became a much bigger project. WODDB managers had asked us only to collect the section level PLSS. If you look at the ownership pattern in Western Oregon, BLM manages many 40-acre parcels. The ownership can go up to meandered bodies of water or donation land

claims, so we needed to collect much more for them to accurately do there resource management plan.

We had to calculate the subdivision of sections and collect those special surveys. In the case of GCDB, we started out doing the extra work but in order to make our land information system work in BLM we had to attribute polygons we had created with the legal land description attribute that would link to other tables in the land information databases. That would be an aliquot part, like the southwest of the southwest, or government lot 1. They needed that information to make the land information system work.

In the very beginning, GCDB nationwide was designed to not only do the section corners and quarter corners but also subdivide sections and get to the parcel level. It wasn't until later they said "uh oh we need the attributes". These datasets have been out there in the public domain. BLM, Forest Service, or when we shared that data with the counties is using them.

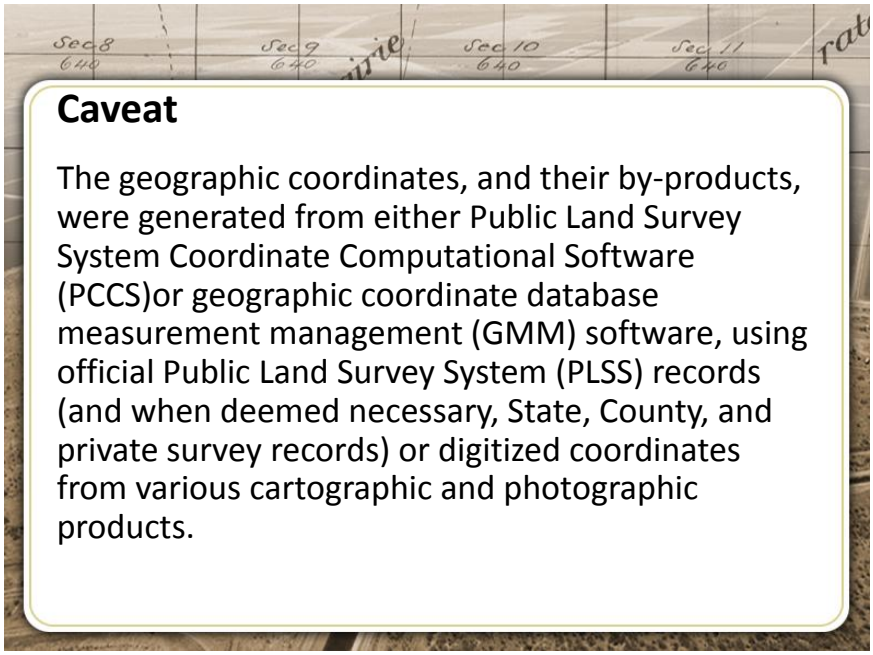
We have tried to capture the accuracies and do the best we could. Unfortunately, we had no funding to go out in the field and obtain greater control or improve the linear measurement on a particular length of line. Over the years, the counties have become more sophisticated and are demanding higher accuracies so that their work is more reliable. We are heading in that direction as well.

The GIS can be used for many things even when it is not very accurate. But the more accurate it gets the more things it can be used for. Counties are out there trying to get data about good positions on corners to improve the information. Now this data is available to everyone from a website, it is called Geocommunicator. It presents mapping information about surface management agencies but you can also download the GCDB data from that site.

GCDB Caveat

Now let's talk about a key component of using the GCDB data. There are certain things you can use it for, there are certain things you cannot, and so there is a caveat that goes with it.

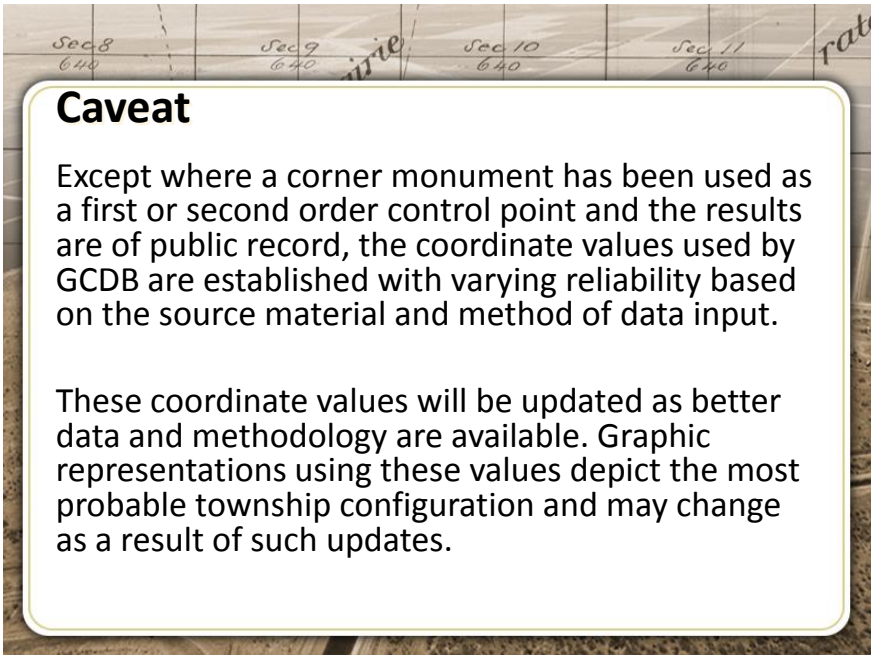
The geographic coordinates, and their by-products were generated from with Public Land Survey System Coordinate Computational Software (PCCS) which is no longer in use at this time or geographic coordinate database measurement management (GMM) software that you may even be aware of, using official Public Land Survey System (PLSS) records (and when deemed necessary, State, County, and private survey records) or digitized coordinates from various cartographic and photographic products.



We have been talking about trying to get accurate stuff but yet we are talking about digitized products and that is part of the reason this caveat is there because we use whatever is the best evidence. Sometimes the best evidence or the best position on a corner may be a digitized product. In large areas of the United States and lands that are still in federal ownership, the best source of control might be digitized corners. In some of those areas, BLM or the Forest Service has not performed a dependent resurvey. So the original survey and quad sheet is all that is there.

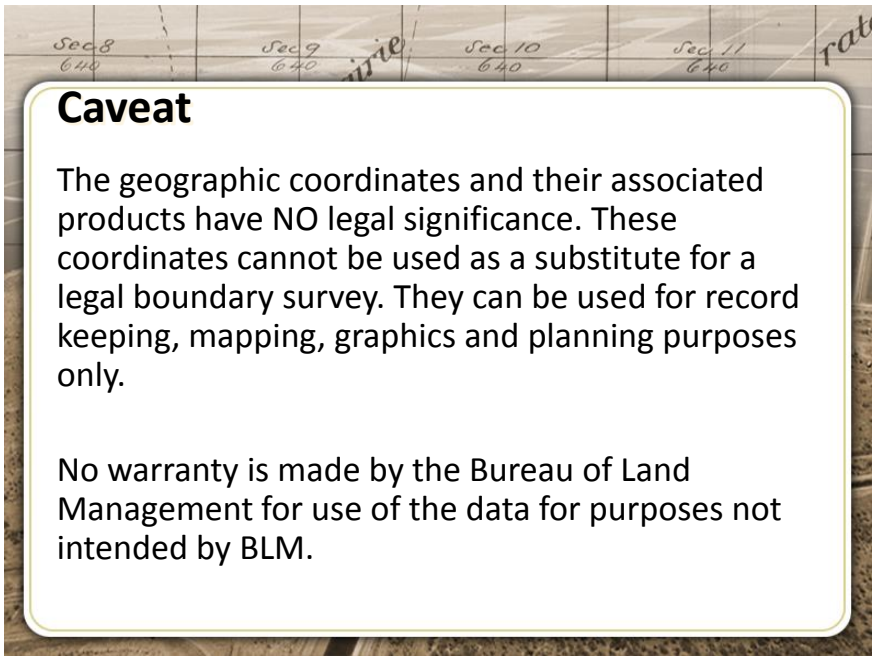
Except for a corner monument that has been used for a first or second order control point and the results are of public record, the coordinate values used by the GCDB are established with varying reliability based on the source material and the method of data input. These coordinate values will be updated as better data and technology and methodology are available. Graphic representations using these values depict the most probable township configuration and may change as a result of these updates.

This is saying do the best we can do with the information we have. We may have positions where the value is only good up to 500 feet. We may have others where we have very good control and the values are very good.



In the later years of GCDB collections, we have been able to acquire from counties many more GPS coordinate values that have been obtained on the PLSS. We are talking survey accuracy - centimeter accuracy. The GCDB can contain some very good data and it will have some bad data. It can all be updated and proven over time with your data and the work that BLM and the Forest Service do. What it does represent is the best data we can find. Whatever it is. It is only a spatial depiction of the PLSS.

The last part of the caveat says, the geographic coordinates and their associated products have NO legal significance. We wanted to make this especially clear because there is a lot of concern in the surveying community that these products might be misused.



Anybody can buy GPS resource grade receivers, go out, and find things. The reality is, even if the coordinates in GCDB come from a survey grade GPS position, the GCDB is not where you should go to find that coordinate, the survey record is. You go to the county court house, county surveyor if there is one, to BLM. You go to the source documents where that information was published on a legal document. This is for mapping, record keeping and planning. It is not for re-establishing corners. So that is a real important thing that we need to say repeatedly. It has **no** legal significance. These coordinates are not for re-establishing or surveying. No warranty is made by the Bureau of Land Management for use of the data for purposes not intended by BLM.

What tools and processes did BLM have available when they began this process?

Point ID Numbering System

One of the first things we had to do was to develop a unique Point ID for every PLS corner. A predicable Point ID and one that would fit nationally. We developed for regular townships a standard PLSS Point ID composed of a prefix (100) and a suffix (100). Six digits. If you couple that six digit Point ID with township and range which can be two or three, we are up to nine.

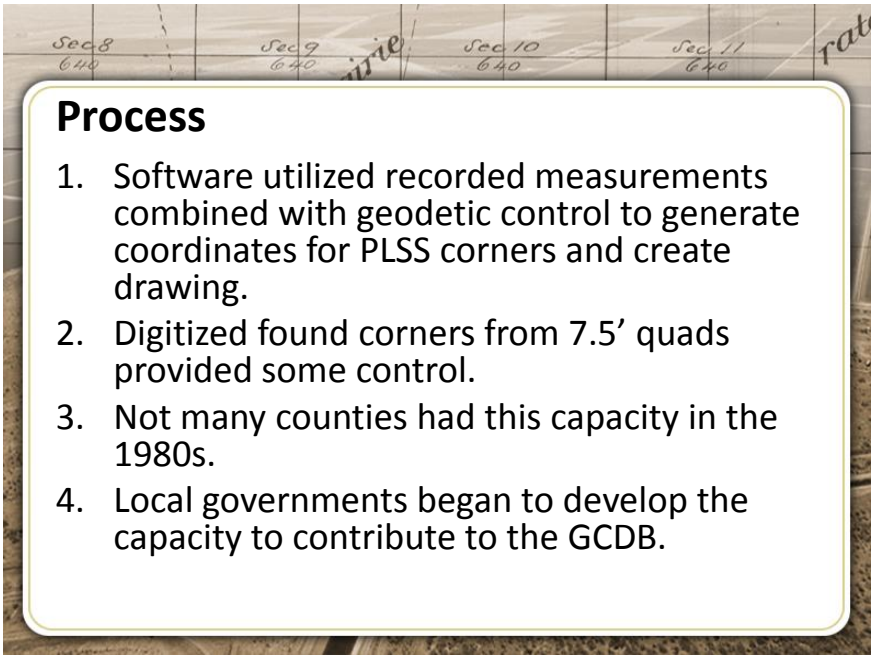
Add the meridian code and the state code. If you couple all of those, I think we are up to sixteen. You have a unique point identifier for every PLS corner in the United States or the western United States. You need that because we are in a digital environment each point has to have some type of ID. You cannot have duplicates. You do not want a duplicate one in Oregon and one in Colorado with the same ID. They have to be unique.

Well we are going to ask you to take a break now and complete the Point ID (Numbering) web problem. And this problem will explain the process, give you a real clear picture of how the system works so you'll be able to work in that system. Once you have completed it, come back and we will proceed with the next portion of the course.

GCDB Process

Welcome back. I hope you enjoyed the Point ID (Numbering) web problem and found it interesting and informative. Now we are going to look at some other issues in the GCDB Process.

What are some other issues that we had to resolve and work through in the process?



We were still developing software as we worked with it. It is measurement based and combines geodetic control so that we could generate those coordinates. We had to digitize

the 7.5-minute quads, the found corner ticks from the quad whether or not we were going to use them. We had to have that data on hand.

What we are talking about is on the quad sheet. There is a brighter red X on the corners that when they did the mapping they felt they found a corner point. We would digitize those because we would be using them for control in many cases because they were the best and the only source in many states. We would also try to supplement that control with better control if we can find it at the county or with another agency.

We reached out to the counties, but not many counties had the same kind of level or capability that we did at the time. We were pioneers at the BLM. We were involving them so we had to educate them about this. I remember at the WODDB project in the very beginning, we were not involved a lot with the counties but we were with the state. The state took a real interest in what we were doing. The Department of Revenue had been creating parcel maps for about 15 counties in Oregon. They were doing it using the old methods and they were really looking forward to utilizing our data to give them a push into the digital environment.

Any other local governments involved? As time progressed, the local governments began acquiring the software on their own and the capability. They started making the effort to automate their own mapping programs.

How did you really go about creating these coordinates?

Process Steps

What we are really talking about is latitude and a longitude that we are going to report for our corner point. The first effort was to go out and get all of the records that we knew existed. We had to decide where in the state we were going to start. Because we knew that we were going to use county data, we had to pick a whole county to start with. We had to get their records.

Because this was done in various state offices under various GCDB directors, some states had very few records in the county if any. Each state had to make a decision about what records they were going to use. Based on our earlier experience in WODDB, we decided to incorporate that county information in Oregon and Washington.

What percentage of the states do you suppose now use the county data.?

I know that in California, part way through their collection process, embraced that concept and they have been going to the counties, collecting that information, and sharing that data back with the product that we produced with the counties. It probably has to do with how much data the counties have and how easy it is to get in your particular state.

One of the things we did, we started with an Eastern Oregon county where all of the records were in paper. They did not have the capability to make copies. We bought a copy machine. A long one for large format and put it on an ambulance gurney and loaded it on the back of our carry all and traveled all the way to Eastern Oregon to these remote counties. Wheeled into town with a supply of paper and started making copies. Sure that was the only way you could then. We took our labor. We could not impose our labor on the counties, so we did it. Especially some of small counties that cannot absorb that. Many of the rural counties are still in federal ownership and their tax base is small.

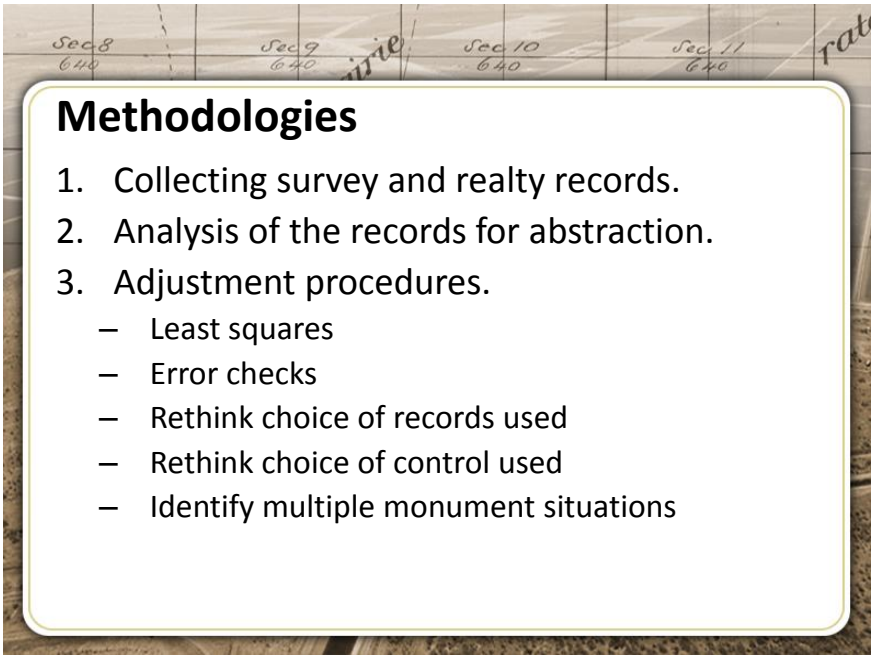
In other states, where there is not much data out there, I am not getting data, or the decisions made not to get that data ,then they would not have incorporated those records. They would be using the federal records that they had in house or at some other federal agency that they could get easily. Maybe through the Forest Service, Bureau of Reclamation, something like that.

We are not only looking for linear measurement data, the recorded surveys, but we were also looking for control. Early on there was not much out there unless say something like a power company had put in utility and tied to the PLS or had a project and put state plain coordinates on those.

A large federal agency like Bonneville Power with their interstate and transmission lines have state plain coordinates on the PLS corners that they recovered to get their right of ways. Surveys done by BLM after 1974 when we were required to make the tie if there was a horizontal control station nearby. In some states they have the ability to gather all of the survey records they can find, either measurement or control. Other states it was not there, the counties did not have much or any. They made the decision to go with the federal records. Still, you had to find as much control as they could which included control for maps like the quad sheets.

Methodologies

Once we collected the data, we had to bring it all back to the office and then start to go through it. The GCDB process is based on abstracting the data a township at a time. We would try to do all of the townships in a county before we would ever start our adjustments. Because you do not know where the good data is or what you should process first until you have looked at all of it. You might start with one township and say I do not have any control and a half mile into the next township is a control point. So, you want to know everything that is there before.



To carry that example a little farther, we would want to get into the next county to see if there was data in that county that could influence our product. You are going through all of this data that you collected from the county and you have to look at these surveys much as you would prepare to do a field survey. You want to see where the surveyors have been, what they found in the way of monuments. Do these surveys close? What is the basis of bearing on these surveys?

Do you want to talk a little about basis of bearings?

Basis of bearing when you are calculating the geodetic coordinates, latitude and longitude of the PLS corners is important. One of the things we have to do in looking at these

surveys is to determine their basis of bearings and work that back to see what it was ultimately. It could be based on several different previous private surveys and the original survey was based on the GLO survey. Or an assumed bearing.

You are never very sure how an assumed bearing is going to work out in the whole process. So you could have a significant amount of good measurement data but without a good basis of bearing, you really cannot compute good coordinates because you do not know what the swing of all that is. Unless you have some control that is reliable, can you constrain that and keep that influence of that assumed bearing from influencing your final product. Hopefully, the control would be on extreme ends and two points. Two points or more would be ideal, then we have something to check the bearings against and adjust it.

In rural areas you do not often find that, so lots of survey measurement data that was based on or did not have a good basis of bearing could not be used. We could use distance. Yes, but influence in the adjustment would be placed on the distance. The overall coordinate accuracy and reliability is still suspect. You may have real good spatial relationships in the survey itself but not being able to portray it properly in the GIS. That is why one of the requirements of the CFedS, one of the things we asked CFedS to do with all of their surveys is to give us true bearings on their surveys. That way we can relate it all together and then use it.

The counties are discovering this now that they have taken on more of the workload and they have to deal with this same basis of bearings issue. In the urban areas, they have better GPS control so it becomes less of an issue or easier to rectify. You have gone through the records for a single township and now you have to put the bearings and distances that you have chosen on paper or into the computer. You have chosen some because you might have seven or eight surveys or you might have four or five measurements of the same line over a period of years. You may even have several monuments for the same corner point.

What would you do in this situation? I go through the record and find out that at the section corner the original corner is not there and I have four monuments each purport to monument the section corner, how do you choose?

We try to look at the procedures that they left in – the legacy, the notes on their plats about the procedures they used, and if it is a section corner we will check to see if the double proportion used was done properly using the proper original record and that their

measurements get the right answer. If we can determine that then obviously that is the monument we want to use. The distance may be older and less precise than someone who used electronic measuring device between the same corner, and another.

We would validate which corner is the proper one and we might use a different measurement. So we do choose, if we have four monuments, we are going to make a choice and choose one. Just as if you were preparing for a field survey. You make a choice.

However, it is not legal. What you are saying -- I have a 1950 survey that I find in the county that double proportions in the section corner. You look at that information and it was done properly. Then I have a 1999 survey that did the same thing but did not quite agree with those measurements and set a pipe three feet away. If you decide to stay with that 50 monument, you might use the latest measurements for the positions.

If we do run into a situation like that we have to first ask ourselves is there federal interest in the position of this monument this particular corner. Either surface or subsurface federal interest. If there is none, call the county surveyor and say in 1950 your predecessor set this monument we think it is the best one. Ultimately, they are going to be the one who use that for their mapping purposes. We all will, but they have more say. In whatever state we are in, some states have county surveyors some do not.

Most states have some kind of a local authority that is going to have to help you make that decision when it is a corner that only affects them. That does not affect the federal interest.

If there is no authority, we will decide. We will portray what we think is best. On the diagram, you can see that there are some different colors and the bearing and distances and in this case, there is a triangle shape at the center corner of Section 10.

One of the early clues we had in deciding how our adjustments would go was a technology break in the era of surveys. After 1980, most of the surveys were being performed with a theodolite an electronic measuring device. We colored those red, and that helps us tell what the expected accuracy might be and the better reliability with the resulting coordinates.

We also made a separation rightly or wrongly between agencies like federal agencies that do base their surveys on true bearing and the recorded surveys, which more often than not did not. Along with the technology we made that distinction. If there were a federal survey that was pre-1980, we would have colored that green.

Is that all federal agencies or just BLM? It was primarily BLM but there was probably some Forest Service. Some forest surveys did require true bearing or at least coordinates on their surveys. Bonneville Power might have some in there. The Corps of Engineers would put a lot of coordinates on their projects. The other colors for the surveys that we

receive from the county we also make the same date distinction technology wise and we would color private after-1980 orange pre-1980 green.

We have a color code that basically says we can look at this diagram, and just by looking we can say these were done in this timeframe and here is basically who did it and I've got true bearing on these and I might but might not on these. We would have left a note in our folder if we were unable to reconcile the bearing but it does not show on here. Now you also notice that some of the sections were subdivided and we included that in our abstract.

Subdivided by survey and in this case down to the center quarter. The other things you will see on this diagram on the east boundary of the township, the corners are offset. They are not common corners on the range line with the adjacent township. This diagram shows that relationship.

We discovered early on in the adjustment process, especially on the exteriors of the township is that you need to abstract the positions of the 16th corner on both sides and work out the distances for them on the range line or the township ranges. If you do it later, they may not calculate it properly on the same line and you create slivers or overlaps that you have to rectify. You have to rectify them either now or later. You want to have a Point ID number for every point along that position line. Now, you are set to subdivide the sections of your subject township.

Was a diagram like this was created for every township and how universal is that from state to state?

This sort of thing developed over time. A lot of it can be done now in a CAD system. If you do it in CAD, it is nice to print it and stick it in the folder. It is a lot of work that goes into these to resolve the spatial relationships, because you are not only doing the PLSS but also the special surveys. Which would be the donation land claims, land grants, mineral surveys, meandered bodies of water, or homestead entry surveys.

At this point in time most states would be creating this kind of a diagram. They probably started or they may not have started originally doing those but at some point they have begun to do them. If you resolve the boundary in this manner, the person working next door does not have to duplicate that effort. Sure for the next township. They have to agree that if they found something wrong with the work you have done, then you can work that out.

We do need to have edge matching, because we do not want to have the picture in one township and the adjacent to this township not looking the same. Once you have built all of these for an extent like a county, for each township, then you are ready to decide where to begin your adjustment process. You can look at all of these and say this is where the best data is. This is where we should start to calculate the coordinates. Normally, at least in our office, we would constrain the adjustments within a township if we could to keep that best data uninfluenced by data far away that was of less accuracy.

If you had good data that crossed a township line, you might adjust across the township line. We might. However, in other states they may not have taken that approach. There is another method to do this. If you had a relatively small county, you could abstract all of this data in the county and you could use a least square solution for all of it. However, you still have to weight everything. Therefore, there are two types of methods. One is weighting the data based on when the survey was done, what the technology was, etc. The other method is starting with the best survey data and adjusting it, holding it and then working your way down to the worst.

Either method gives us good data. Good information where we have good data and poor coordinates where we have poor data. That is just the way it is. The thing about it is that we have surveyors doing this who can make that professional judgment on the data and the process. That is one of the things we did not mention is that this process, these decisions are made by surveyors. We did not hire a bunch of people who knew nothing about surveying, say here you go look at these records, and go abstract it. We got people with survey expertise, surveyors to do this. It really requires it.

We know what we are looking for when we look at the records, and we can spot problems in the records. It is what we do everyday surveying in the fields. It is a natural progression to this environment. I know we have a few people, we may have some in the training right now and some of the earliest CFedS who have been involved in the data collection process in GCDB under contract.

Well as you do your computations, you are going to get different results that the software is going to tell you about error ellipses about how this data is adjusting to the control. So at some point though we had to, somebody had to sit down and enter all of this stuff. This is another good reason why the diagram is so helpful. You have resolved the bearing and distances that you are going to use, and the spatial relationships. And it helps as a data entry tool.

At this point you created that diagram, made your decision about what you are using, now you enter that data into a raw data file and then it is there to start your adjustments. When you are doing your adjustments, as you look at those error ellipses and the reports from the software, you may discover that you may have some data entry errors. This is the time to find those. Transposition of numbers, the wrong quadrant for a bearing, or in many of the cases, we converted the distances to chains. Well you have to do it either way. Either you have to convert chains to feet or feet to chains because we have records that are in both. So we would convert all of the feet distances to chains. I would imagine in some offices they might have done the opposite. They may have converted everything to feet.

When we look for errors, or we think we might have had some data entry errors, we can go to a file that I have here on the slide that shows the raw data entry file.

R-File (*or* .RAW file)

R-file - Contains Distance, Bearing, and Source ID used to build traverse routes between known coordinates (control on PLSS corners), and generate geographic coordinates for the intervening points.

```
TWP 23S RNG 12E PM WILL        OR              DATE 91/7/29
999999
700100          700140          40.000          4               0.      1
700140          700200          40.000          4               0.      1
700200          700240          40.000          4               0.      1
700240          700300          40.000          4               0.      1
700300          700340          40.000          4               0.      1
700340          700400          40.000          4               0.      1
700400          700440          40.000          4               0.      1
700440          700500          40.000          4               0.      1
700500          700540          40.000          4               0.      1
700540          700600          40.000          4               0.      1
700600          700640          40.000          4               0.      1
700640          700660          20.000          4               0.      1
700660          700700          17.000          4               0.      1
240200          200200          39.975          4          894800.      2
200200          140200          40.000          4          894300.      2
140200          120200          20.000          4          894300.      2
120200          100200          20.400          4          894300.      2
700300          640300          40.085          4          893600.      2
640300          600300          40.085          4          893600.      2
600300          540300          39.865          4          895300.      2
540300          500300          39.865          4          895300.      2
500300          440300          40.160          4          894200.      2
440300          400300          40.160          4          894200.      2
|--------------------------| |--------------------| |--| |--------------------| |--|
             1                         2             3     4                    5
```

1 - From and To station Point ID's

2 - Horizontal distance in chains

3 - Bearing quadrant 1 =NE, 2=SE, 3=SW, 4=NW

4 - Bearing in degrees, minutes, and seconds. The decimal is located after the seconds. Bearings refer to the true meridian (astronomic).

5 - Source Identifier number (SID). Each data source, whether it is an official cadastral survey plat, state or local survey plat, deed, etc., utilized in generating coordinates for the GCDB, will be assigned a unique (within the township) SID number. (See Z-file example)

Notice that there are the Point IDs of from and to and the distance, the quadrant, the bearing, and the record number. We assign a record number to the source documents. With the bearing it says zero. Zero - North. So we could have used one as northeast zero. Probably what that is telling us is, that this is original survey data. That is the only thing we have for that line is the original GLO survey. The lower the number, this is number one. That is probably original survey data. It is easy then to look at this raw data entry file and what is on the abstract diagram if you made a transposition of numbers or picked the wrong quadrant. It is also where if you decide to use a different measurement, you will see that change in this file.

If you are not finding errors in your records of data entry you might decide to use another record, another survey, different controls, or error ellipses that come out of the least square adjustment. This was a pretty time consuming and labor intensive process. Many people do not like to do data entry, they think it is terrible. I can understand. It takes the least amount of time in the whole thing because you are pouring over the records to decide which records you want to use, which you want to go in and then once you get to the adjustment you are also thinking about how that adjustment is turning out. It is that thought process, trial and error that takes so much time.

Now I believe you actually went in and did some comparison of the coordinates that you calculated based on later GPS survey grade on those corners. We did ground truthing and in fact we did a test area early on at the request of USGS and our other partners one of which was the Department of Revenue, Oregon State Department of Revenue. We used all of this data that had come to us, and threw out a lot of the control that was given to us, because the good measurement data we got from the counties we felt calculating coordinates gave use better more reliable coordinates.

There was a lot of suspicion about that, so what we were able to do was to send a team out with GPS and at that time there were many night observations. Those observations and our hypothesis was proven correct. We should have never used the control that a particular group had given us.

What it is telling me is this analysis and the time and effort you spent analyzing data, gathering data, making these decisions was worth it. It was. We were producing very good coordinates within the reliability that we expected and it was nice. That is a good thing. When we said it was bad, it was bad. When you said it was good. It was good. Now in some, again different things happen in different states because our records and history are different. So in some states, maybe all there is, or all that was used was the GLO

BLM records, which I assume, would not take near as much of the evaluation. Because they all have true bearing, there is isn't as much data to deal with so it was probably a little easier to evaluate. You would think so, I would. And that is probably why you gave a two year completion estimate for finishing. A fifteen-year job and I could not do it. There are no easy townships. I would like to put up another slide on the overhead, it is a product that comes from the raw data entry file and it's called a Source ID file and it tells you which records and where they came from that we used for the measurements in our final solution.

Z-File (or .SID file)

TWP 14S RNG 15E PM WILL OR				DATE 93/06/31
7	OR013	23-OCT-1984	02	TYE, J.R.
9	OR013	26-OCT-1917	02	UNKNOWN
11	OR013	06-OCT-1986	02	ARMSTRONG, D.B.
13	OR013	24-FEB-1988	02	ARMSTRONG, D.B.
20	OR013	01-NOV-1973	02	GRAVE, R.H.
25	BLM	19-OCT-1869	01	MELDRUM, J.
12	OR013	14-APR-1987	02	ARMSTRONG, D.B.
10	OR013	04-APR-1980	02	ARMSTRONG, D.B.
4	OR013	09-APR-1976	02	MANSFIELD, E.G.
3	OR013	01-JUN-1979	02	MANSFIELD, E.G.
1	OR013	21-DEC-1982	02	ARMSTRONG, D.B.
2	OR013	21-DEC-1982	02	HICKMAN, G.W.
8	OR013	06-MAR-1985	02	HOLLINGSWORTH, J.E.
26	OR013	16-NOV-1992	02	ARMSTRONG, D.B.
27	OR013	21-DEC-1982	02	HICKMAN. G.W.
17	OR013	01-JUL-1978	02	ARMSTRONG, D.B.
22	OR013	05-APR-1988	02	ARMSTRONG, D.B.
23	OR013	27-APR-1987	02	ARMSTRONG, D.B.
24	OR013	26-MAR-1981	02	ARMSTRONG, D.B.
1	2	3	4	5

1 - Source Identifier number (SID) Each source document that was used in the GCDB collection process will be assigned a unique SID. The SID is unique only to the township the file relates to.

2 - Source Identifier Agency. A code identifying the source of the survey document by agency. The code is explained in the Data Element Dictionary. See Attached Table A.

3 - Acceptance Date. For BLM and GLO plats this is the date the Surveyor General or Cadastral Branch Chief signed the plat. For private surveys it is the date when the plat was filed or recorded with the county.

4 - Survey Procedure. A Data Element Dictionary code number for the type of survey procedure used, e.g., original survey, dependent resurvey, etc. See Table B.

5 - Surveyor Name. The name of the surveyor who conducted the field survey or who signed the recorded plat.

There is a reference to the person that performed the survey and the date performed. This leads us back to what monument was used in those cases where there might have been multiple monuments. If I have a situation where there are multiple monuments, say there are four, this doesn't tell me which monument was used, but it tells me which record measurement was, in addition to the document to go to find the history. This is a lead to the metadata to identify where this information came from. You still need to get that and we kept copies of those documents in our folder for each township.

This is a file that no matter which state we are in, this RAW and Source ID files are created. So even though we have different histories, amount of records, we have worked hard to come up with what I think are some standard outputs. So you are going to be able to find those same records in any GCDB office.

What we have accomplished so far, we settled on the adjustment for just the sections lines and the major surveys that exists, we still have to subdivide the sections. One of the things that we have done in the process of abstracting is to calculate all of the parenthetical distances for the lottings. We tried to solve them completely, accurately so that it was also a value added product for the surveyors. Now you chose that process in Oregon and Washington. Some states chose a process because this is GCDB and because this is not a legal decision, so they chose a process that maybe did not always end up with the exact parenthetical distances but was very close.

It is a time consuming process as you may have seen in some of your previous training courses. Some are very commonplace. However, since we were there and we had the skills, we figured let's do this now. We often get inquires from private surveyors from Oregon and Washington about those solutions and better to pay for those once, do it once, use it many times. That was our thinking behind that.

As a CFedS, I could probably ask BLM, have you done these parenthetical distances and get that information from their GCDB files. Now I believe that one of the issues you have is storage of all this paper data. I believe some states have been forced to dispose of some of that information. This is less of a problem than it used to be. Now, we have more of our records scanned, we have them available digitally and place them on the web. More counties are getting their records scanned and on the web. It makes this job of collecting records much faster.

So parenthetical distances, you may come to one state office and ask for them and they say you know what we don't have them anymore we were forced to get rid of them. And other states will say yes and here they are in my file. The last step in the adjustment

process to meet BLM's land information requirements is to subdivide the sections. This calls obviously for more calculations, but we have to intersect and calculate the intersections with the special surveys. So if you have a mineral surveys out there, we need to know where it is so we can calculate. And you have to develop a Point ID for that intersection.

We have to create those polygons in our solution of the PLSS to meet our land information system needs. This can be shared with the counties because what we are doing is creating a parcel that we have closed. We have created a bunch of polygons, closed parcels and I imagine not only special surveys, meander lines you have to intersect those.

When you subdivide, how far are you subdividing down to?

We can subdivide quite low although as with every system the Point ID's get a little strange in the smaller parcels, the 2 ½ acre parcels. It gets difficult if there are a lot of those. Ordinarily when you have reached that point, you can call it whatever you must to give it a unique ID and deal with creating the polygon.

If we are going to go to 1/256 corners or 1/16 corners, it is dependent upon the ownership pattern or the federal interest pattern. It could be surface ownership or at the patent level. The master title plat shows the patents and that has been our driving force in GCDB is the patents. The master title plat show a lot more information about the status and interest of the United States or public interest. Our goal was to provide what was needed for the master title plat at the patent level. We have more to do to get all of that other information that is on the master title plat.

The thinking is we do it to that level anything that has happened after that a county or state can do it during maintenance. If it is near an urban area, we might be able to get the geometry from the county. If a parcel has come into federal ownership, it may be a tax lot parcel that already has a geometry created. We will not recreate it if it is the accuracy we want. We will just import it from the county base set. So, the Forest Service has purchased some lots around Lake Tahoe, we need that parcel information. We need the coordinates around that parcel, so we are going to look to the state, the county or whoever might have that. If they have it, we will try to import it and then just use it. Another good example is the Columby River Gorge, they are purchasing parcels to let them go back into their natural state in the scenic area. National Park is continually purchasing land and there is a lot of acquisition or exchanges going on.

After the subdivision of sections, I want to show you the final file, which is on our viewer. This is the LX file in our terminology. It will show you the coordinate or the Point ID , the latitude and longitude and an assumed elevation. The elevation is not accurate in GCDB it is a scaled median elevation for the township. We have reliabilities, pen instructions that were important in the early software. We had to know so the pens could draw from this point to that point and then stop. That created the geometry. Then in the final two columns, we have Cartesian coordinates, which might be state plain or UTM coordinates.

LXGCF POINT and LINE FILE
LX-file (or .LX)

LX-File - Contains Point ID, Latitude and Longitude, an approximate elevation for the township, Reliability Code, Maximum Closure of Traverse in Feet, Pen Instructions for Graphics, State Plane (or UTM) X and Y Coordinates.

```
TWP 23S RNG 12E PM WILL  OR                DATE 92/08/11
ORIGIN 433400.0000 1211600.0000 1.0 1.0000 1796807.96 693370.89
100100  433151.2031  1211955.1123  5400.00  4 40 1 0 2 1779369.92  680496.86
100120  433204.2153  1211955.0735  5400.00  4 40 1 0 3 1779385.87  681814.16
100140  433217.2274  1211955.0350  5400.00  4 10 1 0 3 1779401.79  683131.46
100160  433230.2639  1211954.9861  5400.00  4 40 1 0 3 1779418.50  684451.22
100200  433243.3004  1211954.9376  5400.00  4 40 1 0 3 1779435.19  685770.98
100220  433256.2851  1211954.7512  5400.00  5 58 1 0 3 1779461.97  687085.39
100240  433309.2699  1211954.5650  5400.00  5 58 1 0 3 1779488.74  688399.82
100260  433322.2546  1211954.3785  5400.00  5 58 1 0 3 1779515.53  689714.24
100300  433335.2394  1211954.1923  5400.00  4 40 1 0 3 1779542.30  691028.68
100320  433348.3475  1211954.2096  5400.00  4 40 1 0 3 1779554.20  692355.74
100340  433401.4557  1211954.2271  5400.00  4 30 1 0 3 1779566.09  693682.82
100360  433414.5638  1211954.2444  5400.00  4 40 1 0 3 1779578.00  695009.89
100400  433427.6719  1211954.2619  5400.00  4 40 1 0 3 1779589.89  696336.96
100420  433440.7127  1211954.2917  5400.00  4 40 1 0 3 1779600.81  697657.22
100440  433453.7536  1211954.3218  5400.00  4 27 1 0 3 1779611.71  698977.50
100460  433506.7943  1211954.3516  5400.00  4 40 1 0 3 1779622.63  700297.76
100500  433519.8353  1211954.3818  5400.00  4 40 1 0 3 1779633.52  701618.05
|-------| |----------------------------------| |-------| |--| |--| |-----| |-------------| |------------|
    1                    2                    3     4  5    6          7           8
```

1 -Point ID
2 -NAD-27 Latitude and Longitude
3 -Scaled project elevation
4 -Reliability code
5 -Maximum misclosure of traverse in feet, or in the case of "control", this value will be the estimated circle of positional error.
6 -Pen instructions used in graphics software. The first field is line sequence, the second is line type (solid, dashed, etc.), the third is pen command: 1 = skip, 2 = pen down, 3 = draw, 4 = pen up
7 -State Plane coordinates, X value in feet
8 -State Plane coordinates, Y value in feet

Is this a good spot to talk a little bit about reliability?

As I understand it, you might get a couple different kinds of information. If you go to the states themselves to get this LX file. This is the transportable file, the final product file that has the most utility in the GIS and LIS sector. If you go to the state offices to acquire the flat file the ASCII files for GCDB, in most cases in most states you will find the ellipsoid values that come out of the computations.

Early on in Oregon, we had decided on a code for reliability. It allowed us to express our professional opinion on how accurate, how reliable we thought the coordinates were. It also played into the other themes, that people who were stewards of the other themes in the GIS who could use the code because they did not have the benefit of the ellipsoids.

I have an eagle's nest out here that is on one of the themes how accurate is that, or a road. They digitized roads, they digitized streams from the 7.5 minute quads. Now, the USGS says those are within forty feet. If you have newer imagery or if you have driven the road with GPS you have greater accuracy in your data, and you want to know which one I am going to use. I want the one that is more accurate.

When you are looking at the information, you want to know, as a user did they derive it with a GPS or are they telling me this is within ten feet or is this road within 100 feet. Unless they are collecting the metadata, you may never know that. The code will help. They felt strong enough to give it a code, so you can feel better about that.

Depending upon which state you might be in, you may get some different information in that reliability and just make sure that you understand that sometimes it is a code and sometimes it is actual ellipsoid or the error ellipse. When it becomes corporate dataset in BLM, all of it will be presented uniformly, so our code is going to go away when it becomes corporate data at the national level.

This is what a surveyor can actually get - this data. In fact, you will see that this file can be exported into a resource grade GPS that you can take into the field. It can also be coupled with other GIS products or image producing products like Google Earth. We talked through this whole process and really, it is involved. There are many steps, decision-making, record gathering and evaluating all to end up here. However, this is not the final step because all of that data can be improved upon the next time a survey is done.

That is the beauty of having a measurement-based capability of updating this particular theme like PLS and parcel. Now parcels are still waiting for a good measurement based tool. At the parcel environment like the assessors map, Point ID might become a bit of a problem because it may not fit because you have so many small parcels. There are so many and angles in those parcel descriptions. The industry is working on that sort of toolkit for parcels.

You mentioned maintenance, now that this township is done. So, next week we go out and do a survey, we have better data, we were able to tie to some controls, and we've got GPS coordinates out there. You have to know that data exists. I hope that it is being filed in the county. If there is no county recordation mechanism for you then, if you like this tool and find it useful in your business, you need to know who is doing the maintenance on the PLSS portrayal, if it is GCDB then that data needs to be delivered to BLM or BLM needs to seek it out. More and more counties are assuming stewardship of both the PLS and certainly their tax lot parcel data in areas with little or no federal interest.

BLM may have done the initial collection, but if there is not much federal interest in there, counties are beginning to take that over. They are updating that with the latest information because they really want more accurate data. They do and we do too. It's just that early on we had the budget to do this, and as I have missed my deadlines to get the state done, BLM is receiving less funding and they have fewer staff to do what we did and maintain what we did. We need to share this workload with those that want to. We need to coordinate with them.

Let's talk a little about the west. When I say the west, let's say the states with BLM offices which would basically be Montana, Wyoming, Colorado, New Mexico west.

What percentage of the townships approximately do we have GCDB coordinates on?

In Oregon, we have about 87% of the townships, and in Washington it is about 20%. Some of the states have full GCDB collection done. So some have 100%. I believe that is Wyoming and perhaps Arizona, New Mexico, and Montana. California is still working. As I said they adopted the idea of using county data. It is a big state with a huge population with a lot of survey records.

Of course they have land that moves around down there with every earthquake it shifts around a little bit. We all have been working on for a long time this big project. There is a lot of information out there on a large part of the west.

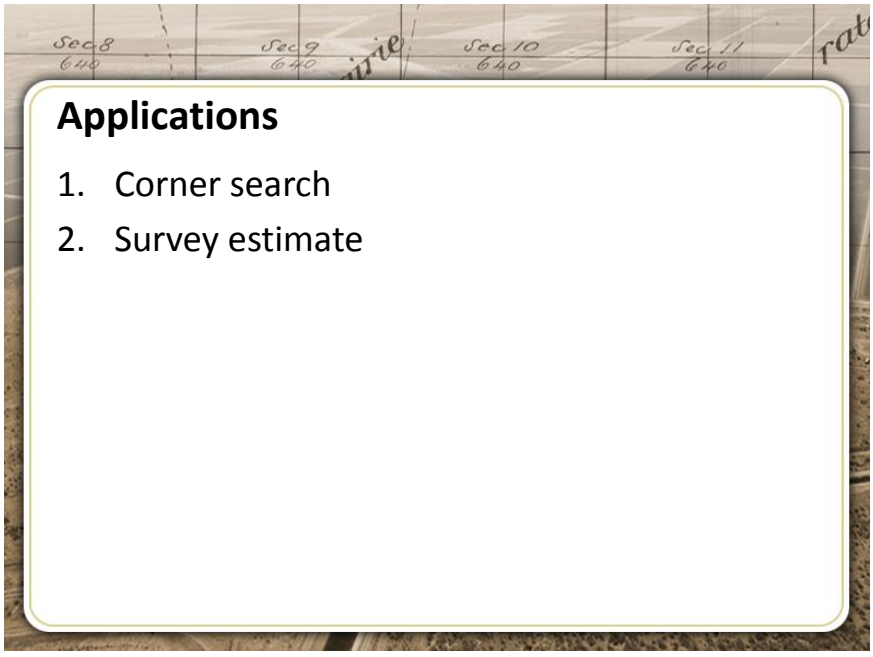
In the East, is GCDB happening there at all?

It is happening at the county level. Many of those states east of the Mississippi, while there might be a high Forest Service presence, the Forest Service is taking on some of this GCDB collection. They may have digitized the quads, but now they are in a position where they can transition to a measurement based tool for updating and maintenance and adding to that PLS that wasn't portrayed on the USGS quad.

Does it look like the products are similar to what our GCDB is?

Yes, it is survey data. It does not differ that much around the U.S. It is bearing and distance, you process and we all process pretty much the same way. Would there be an LX file created? In many cases, they are using the same software that we have the GMM program that is in the public domain.

How might a CFedS use the data?



Corner Search

Obviously if you have some coordinates for the PLSS corners for a township and reliability how accurate are those. If you put those coordinates in a GPS unit and go out and search for them you can narrow your search area. We used to get telephone calls from surveyors in field saying what's the coordinate of this. Instead of trying to scale something off of a quad sheet or whatever. Pace into a place with a hand compass. Now it is faster and more efficient.

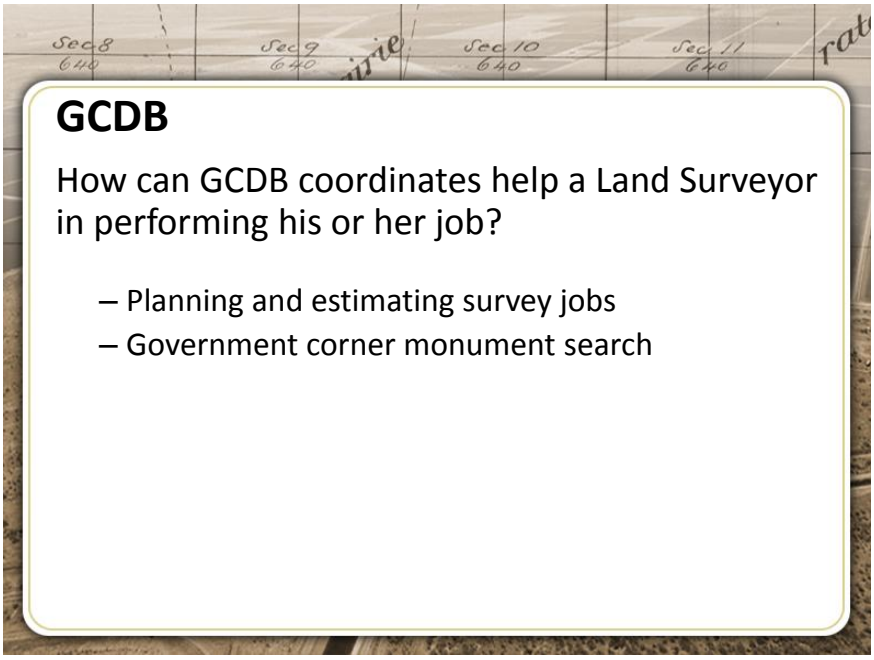
Survey Estimate

If you are trying to compute an cost estimate for a job, you can take our line work and the coordinates we have for the PLSS, and see where the roads are. In more recent imagery for instance, Google Earth you can see where the roads are that you might drive in on. You can see to some degree the vegetation that is in the area, much better than you could on a USGS quad. I imagine the reliability, if I look at a corner and the reliability tells me maybe this position is within two feet I can walk there and I know that I am not going to be spending two days looking for that corner. Whereas, if the reliability says 500 feet, it could be anywhere, I had better budget more time and I may be running control and all kinds of things.

We are going to take a break here and we want you to spend some time and do the project planning and corner point exercise or module. Take some time finish that and after you have done that come back and we will continue to talk about the GCDB Applications.

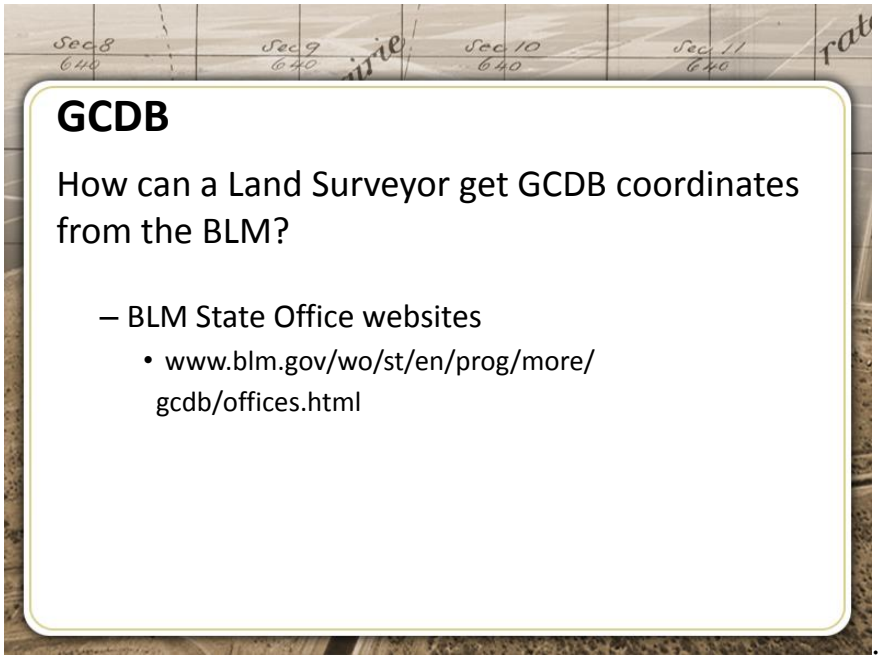
Project Planning

Hello, my name is Janet Wilkins. I am a BLM Land Surveyor in the Oregon State Office. I have been working on the GCDB project for about four years now. Today, I would like to talk to you about how the Geographic Coordinate Database coordinates can help you as a land surveyor. GCDB coordinates can help you in planning and estimating your survey jobs as well as helping you to narrow down your search when you are searching for government corner monuments.



Getting Coordinates from BLM

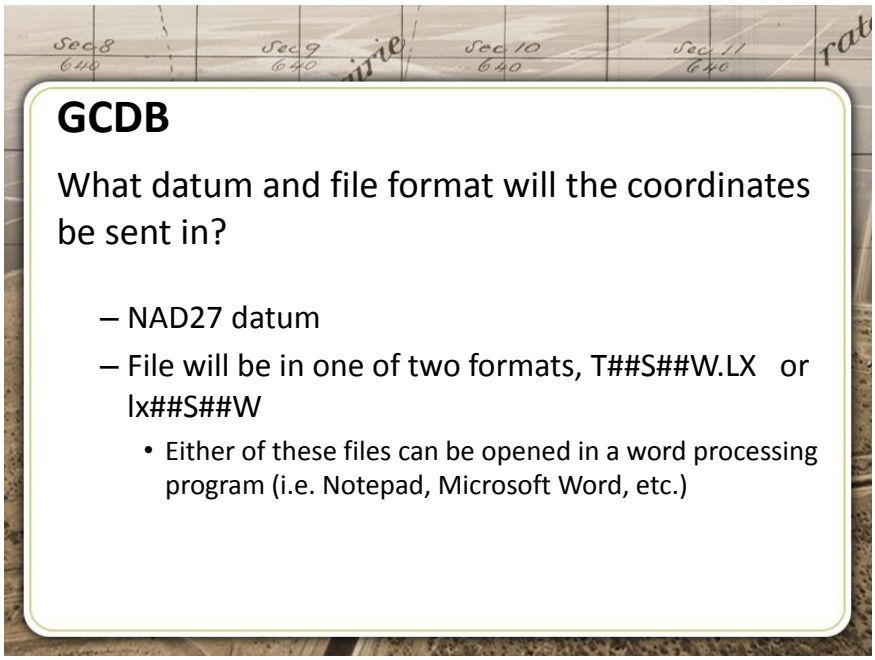
There are a few ways that a land surveyor can get GCDB coordinates from the BLM. Some state offices publish their GCDB coordinates on the Internet. You can go to the state office website that you are interested.



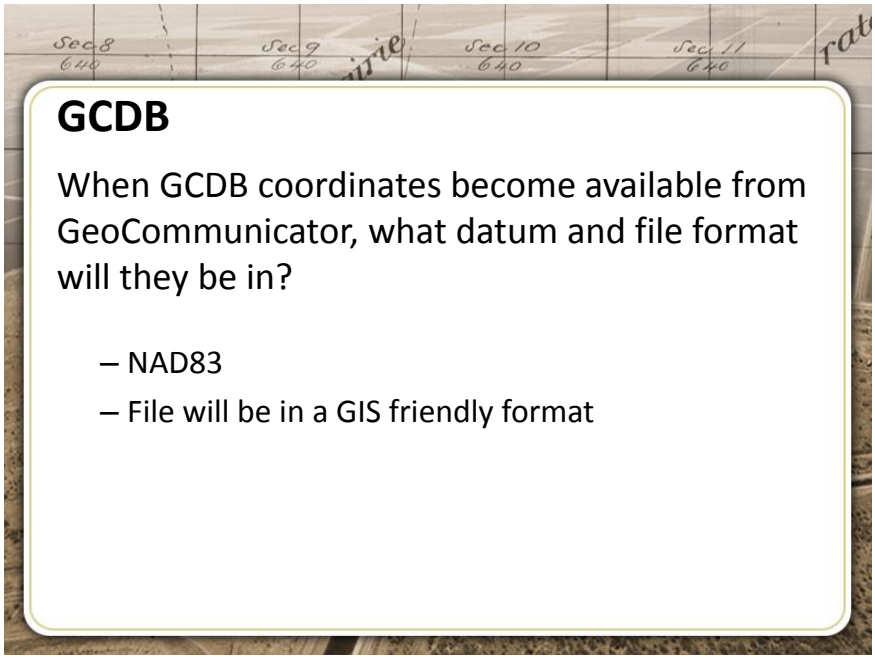
If you are interested in getting coordinates from a state that does not publish their GCDB coordinates on the Internet, you can contact the GCDB staff directly. Go to the same website, to locate contact information for each state office.

There is also a national website www.Geocommunicator, where you can find PLSS line work. Currently, the coordinates for GCDB corners are not available on that website, but we are working towards that and they should be available soon. Go to that website first to see if the coordinates are available and while there, look at the other information concerning federal lands.

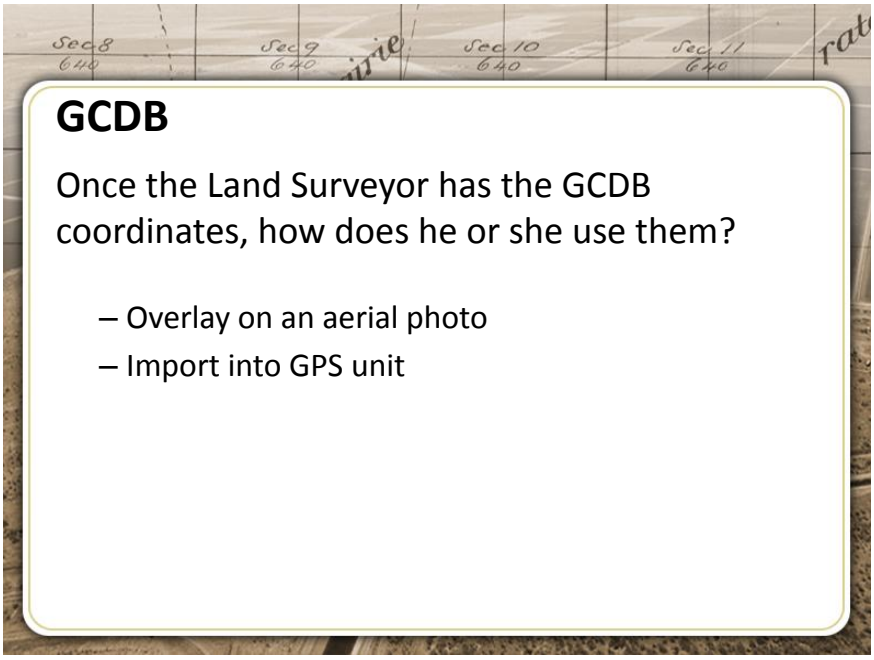
When you receive GCDB coordinates, they will be in the datum of NAD27. The file format will be an .LX file. The file will have either a dot LX extension or no extension at all. Either of these can be opened using a word processing program such as Notepad or Microsoft ® Word.



When the coordinates become available on the Geocommunicator website, they are going to be published in the datum of NAD83 and in a GIS friendly format.



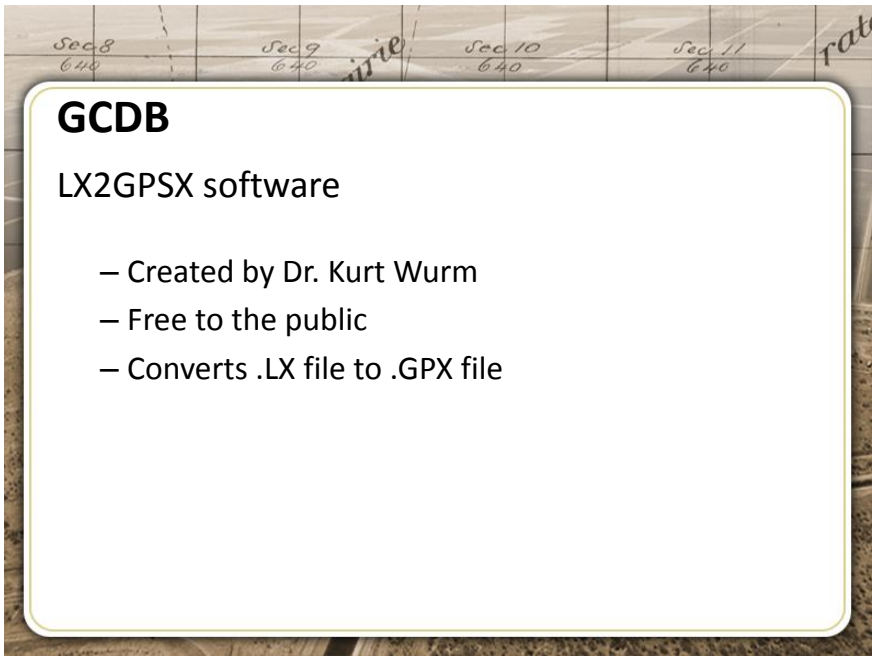
Once you have your GCDB coordinates, you can overlay them on an aerial photo and import them into a web-mapping program such as Google Earth. You can also import them into your GPS unit to help you with your government corner search.



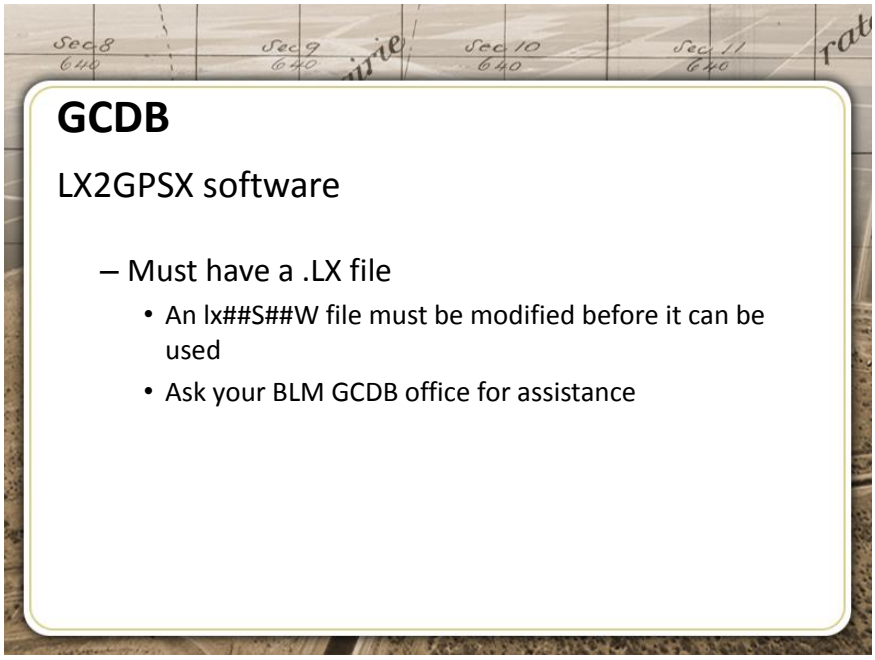
Before you can do either of those things, you will need to convert the files into a format that can be downloaded into those programs. To do that we will use a program called LX2GPSX software.

LX2GPSX Software

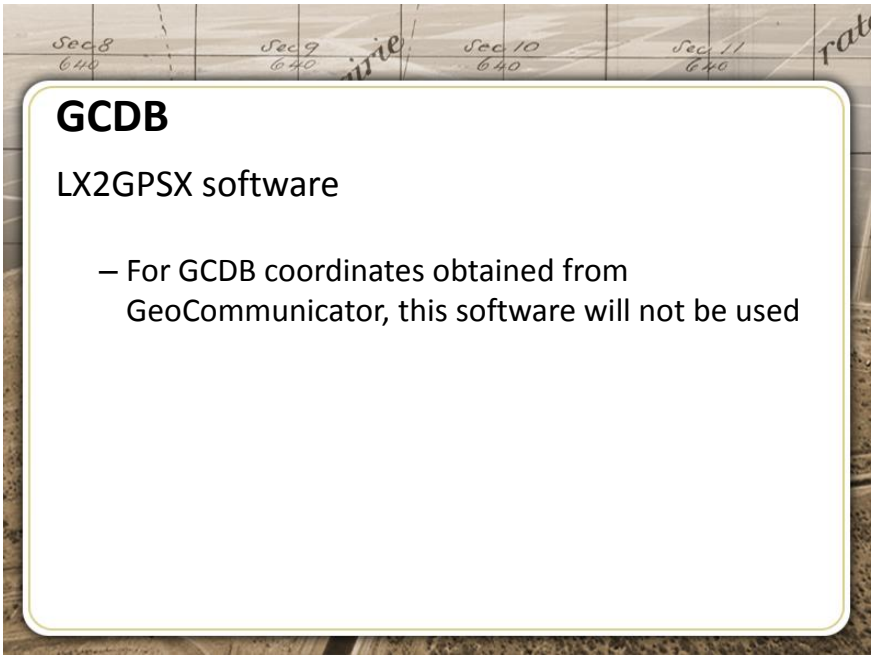
Dr. Kurt Wurm created this software, which is free to the public. LX2GPSX will convert LX files to a dot GPX file. Google Earth and other mapping services and GPS units easily read the .GPX file.



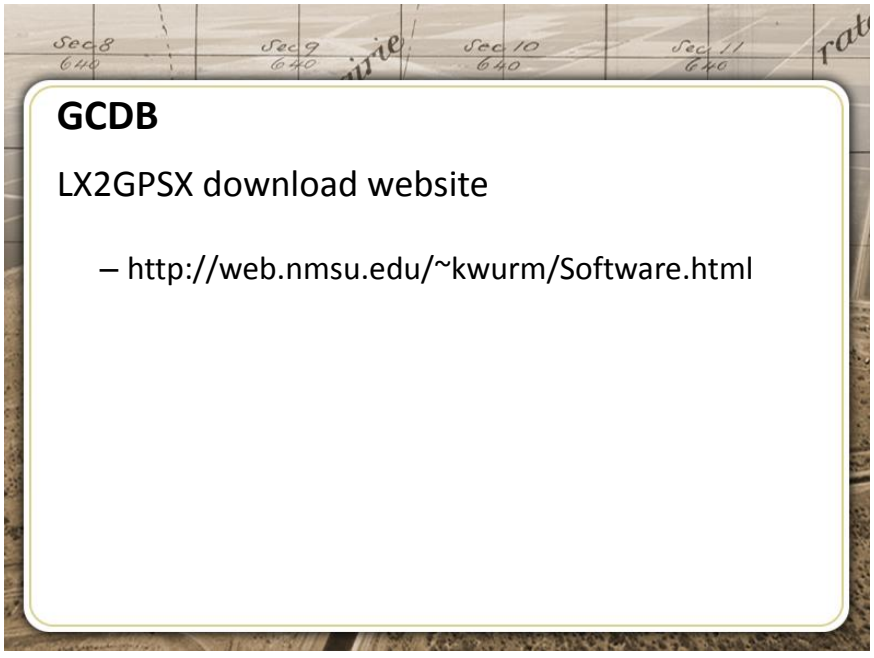
To use the LX 2GPSX software, you must have the .LX file. If you received a file from your GCDB office that does not have the .LX extension, you will need to have that modified before you can run it through this program. Contact your state GCDB staff if you need assistance in having this file modified.



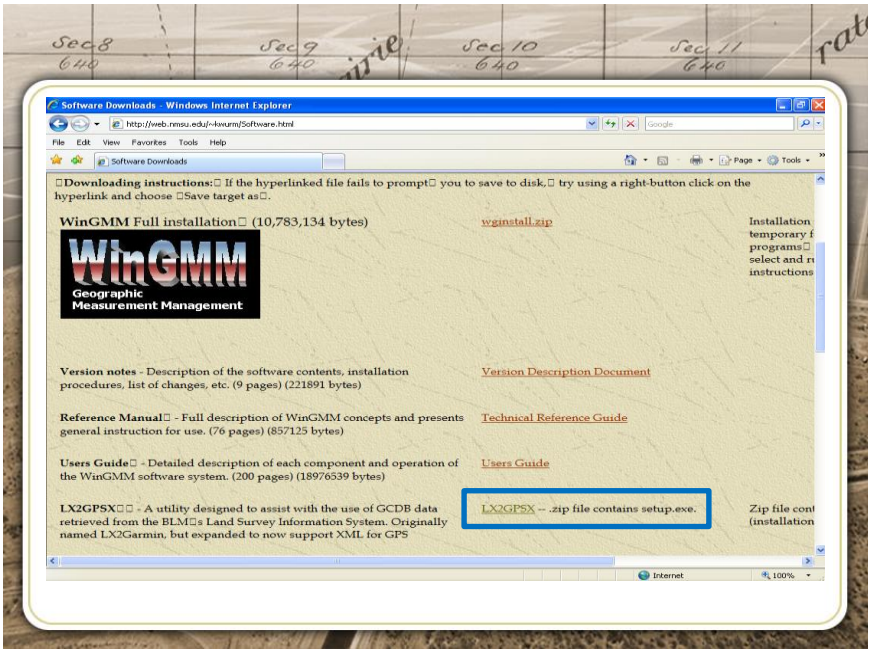
Once the GCDB coordinates become available on the Geocommunicator website, you will not need to use the software to convert those coordinates. Until then, we do need to use it.



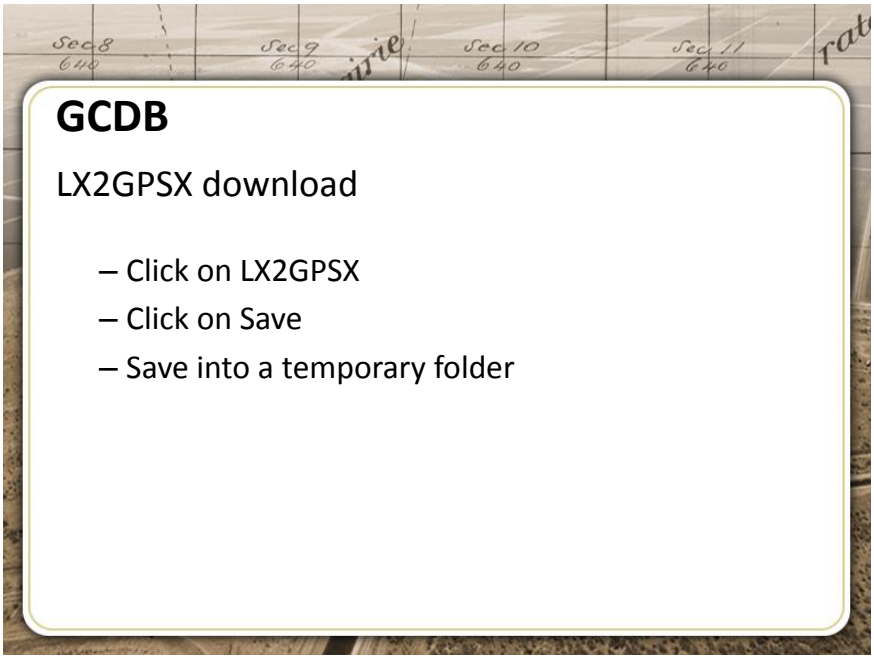
To download the LX2GPSX software, you must be connected to the Internet and go to the website on your screen.



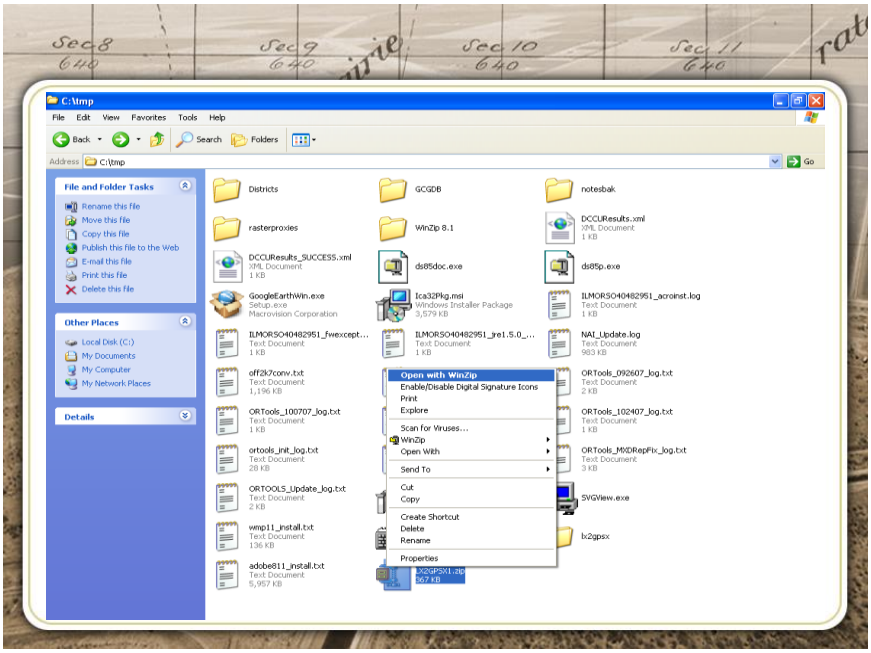
Near the bottom of the website, you will see a zipped file that says LX2GPSX. You will need to click on that to begin.



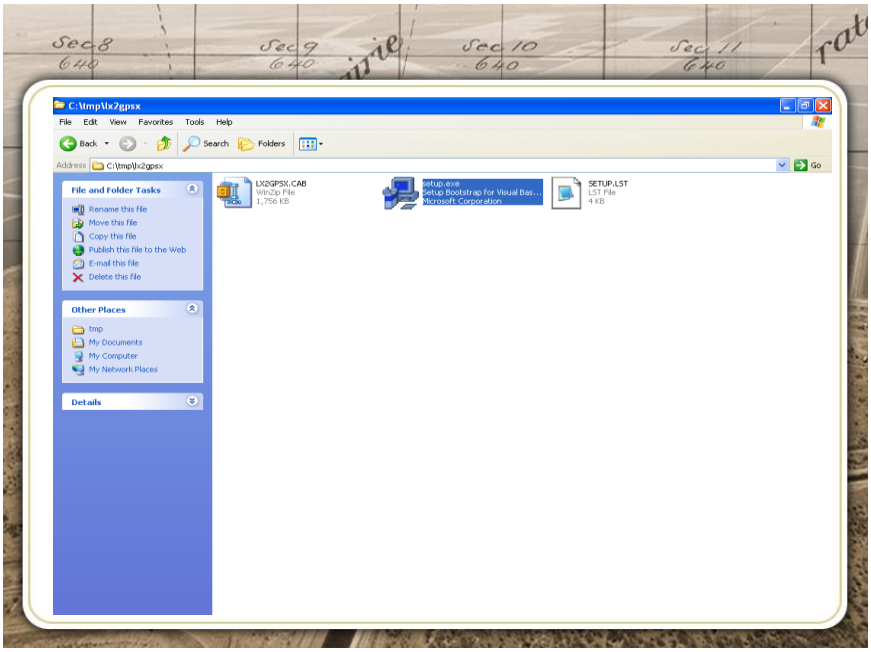
Next, click on Save and save the file to a temporary folder.



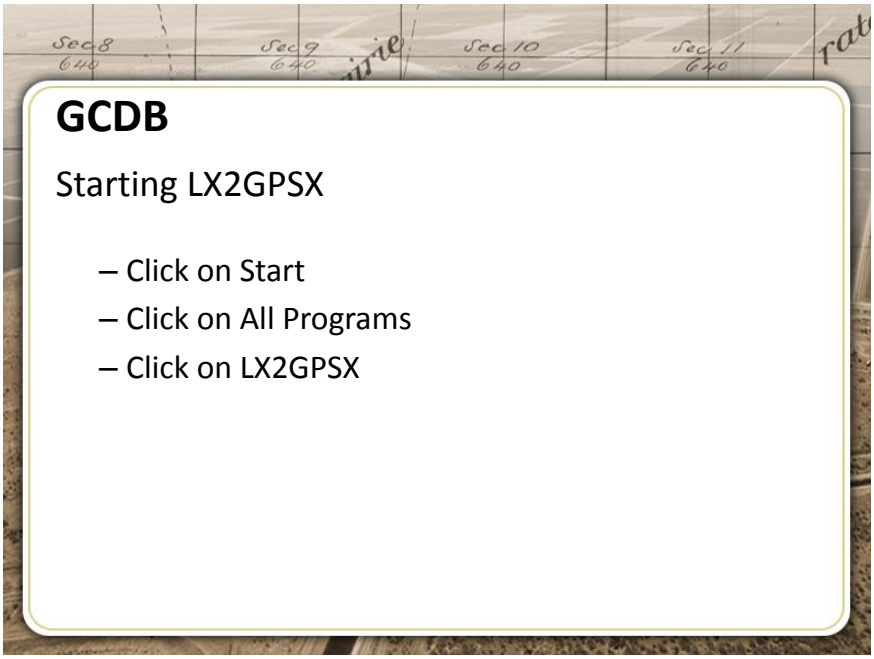
Now, let us see what the computer will look like as we walk through those steps. Right-click on your LX2GPSX1.zip file and open it with your unzipping utility.

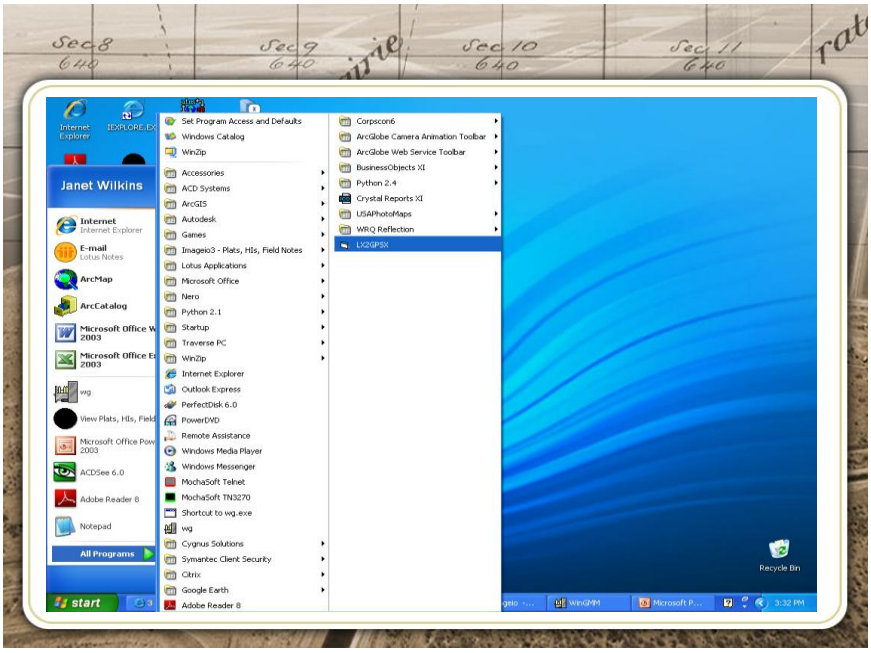


After your file is unzipped, you will find the setup.exe file. Double-click on it to launch the instructions that will walk you through the remainder of the installation process.

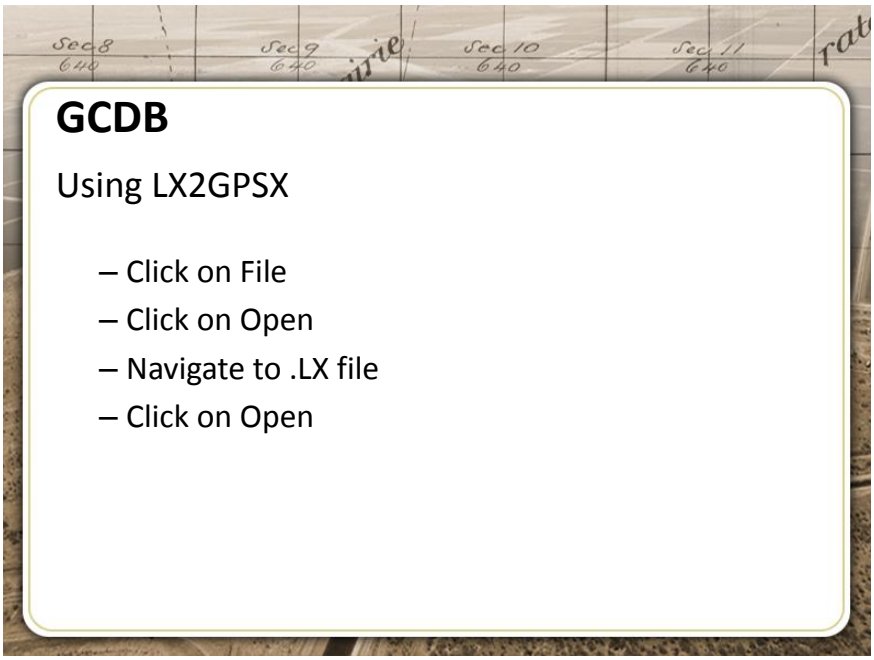


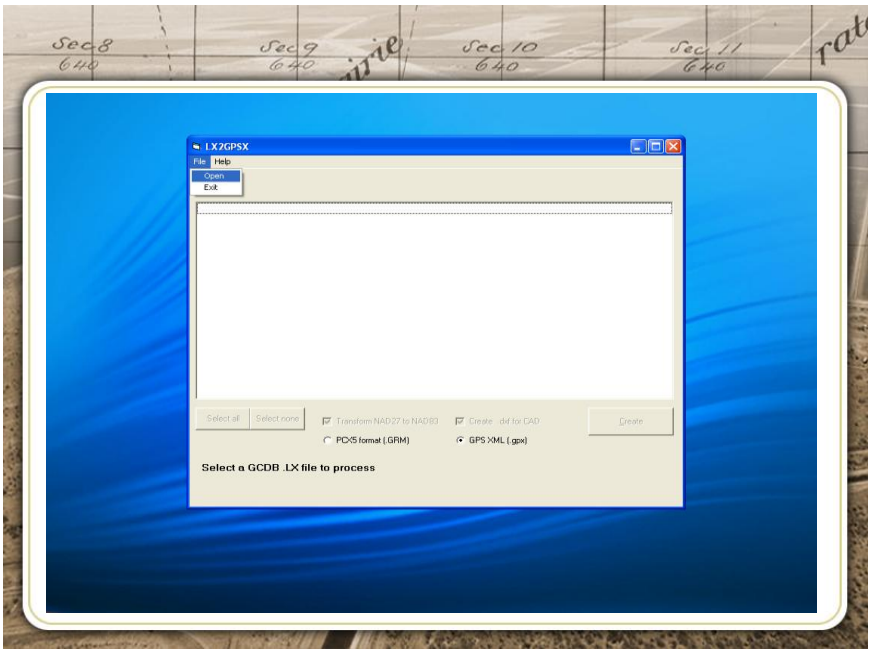
Once installed, you can click Start, All Programs then click on the LX2GPSX program.



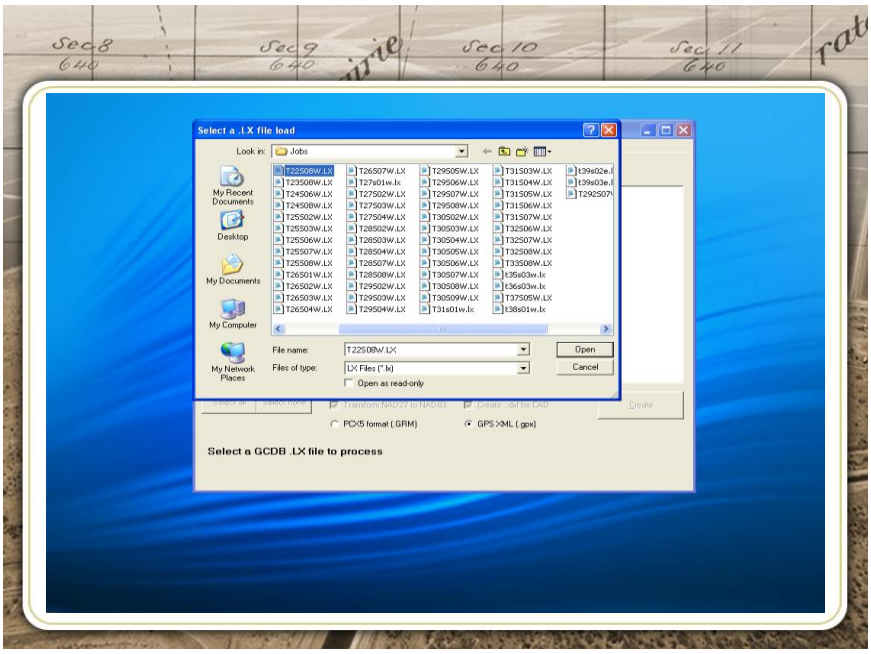


To use LX2GPSX, click on File, Open then navigate to the .LX file that you want to convert and click on Open again.

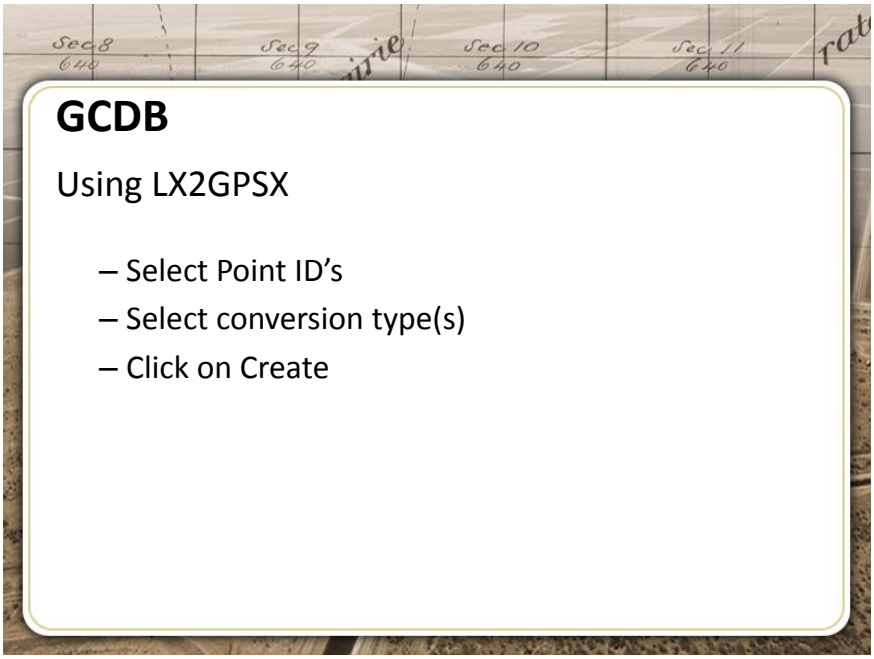




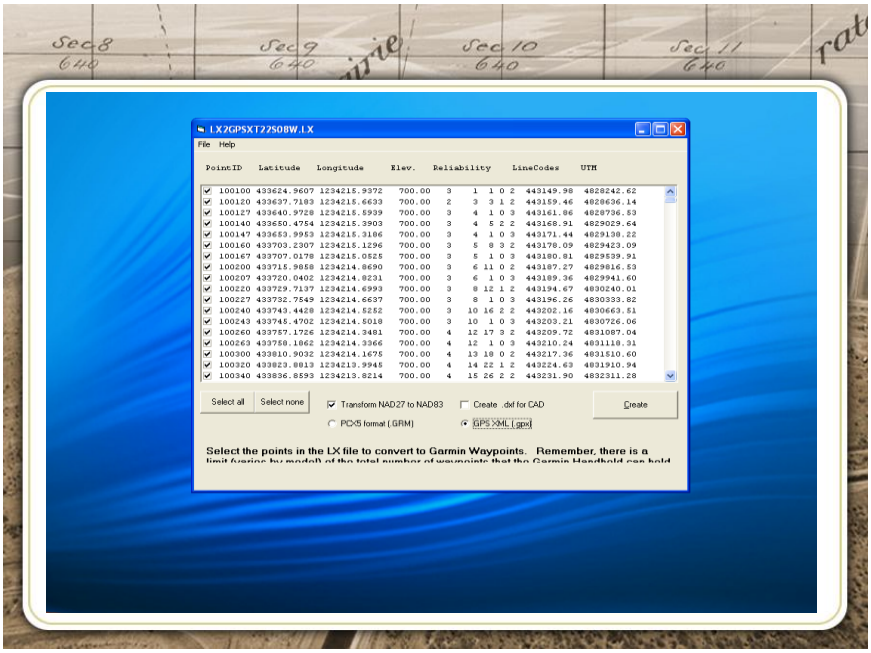
I have clicked on File then Open. I have navigated to the directory where the .LX file is located, then clicked open.



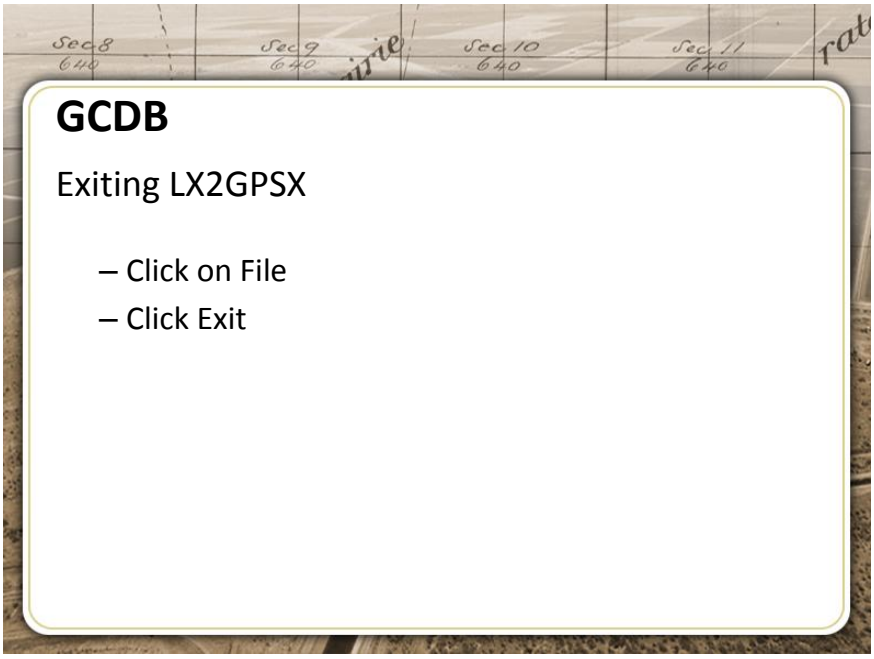
To use the LX2GPSX program, you are going to select the Point ID's that you want to convert. Then, you will select the type of conversion you want perform, then click on Create.

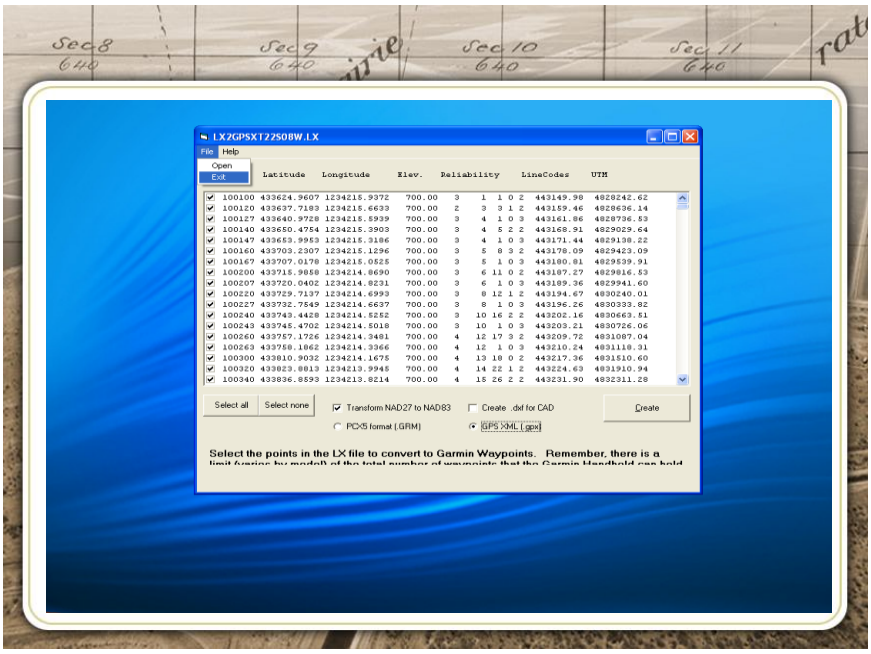


If you would like to select all of the points that have been downloaded for your township, you will select the all button.

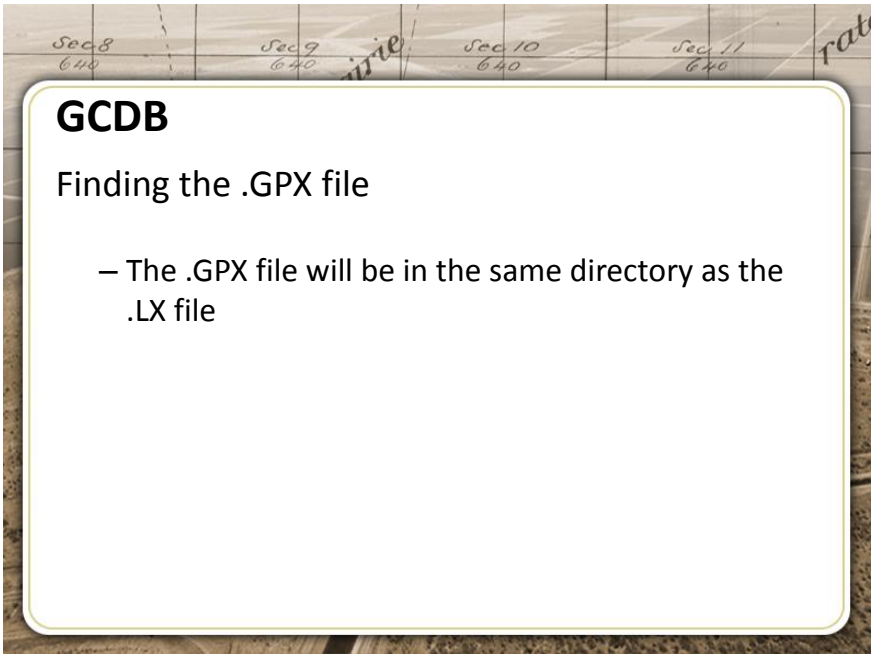


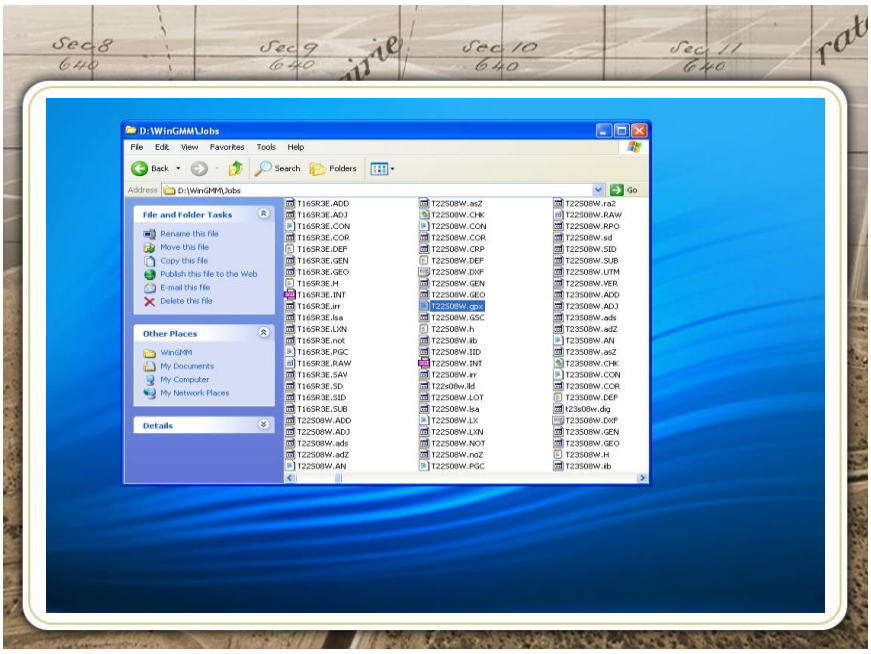
Notice that there is a transformation between NAD27 to NAD83 option if you like to do that at the same time, then click on Create. To exit the program, you will click on File then Exit.





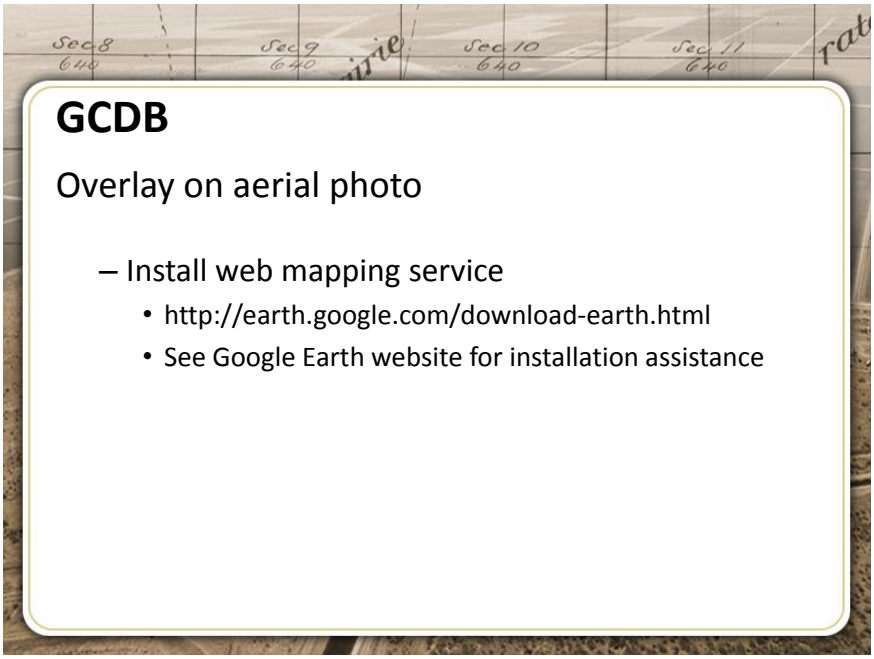
After you have converted your LX file to a GPX file, you are going to want to access that GPX file in the same directory that your LX file was located.



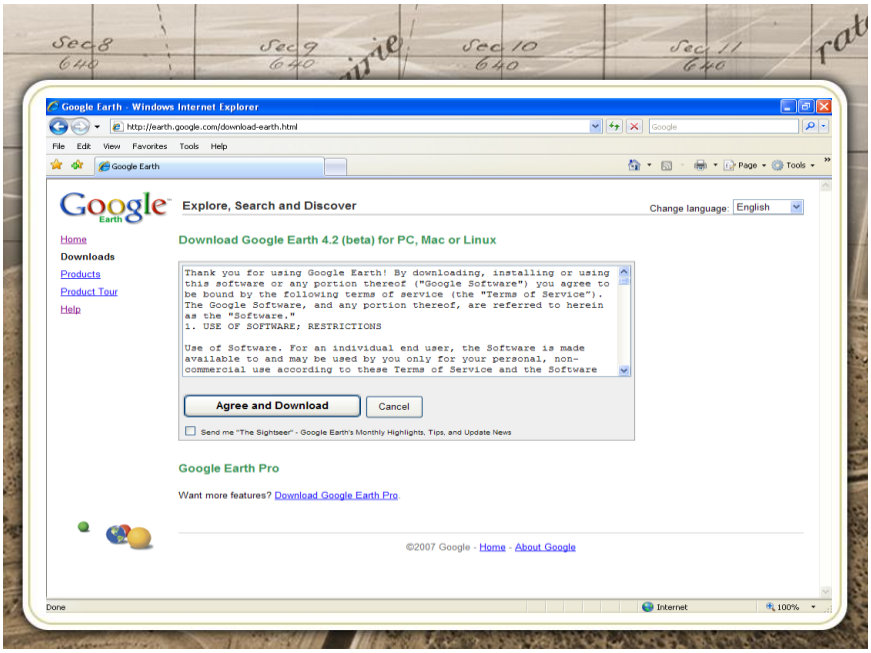


Overlay Example

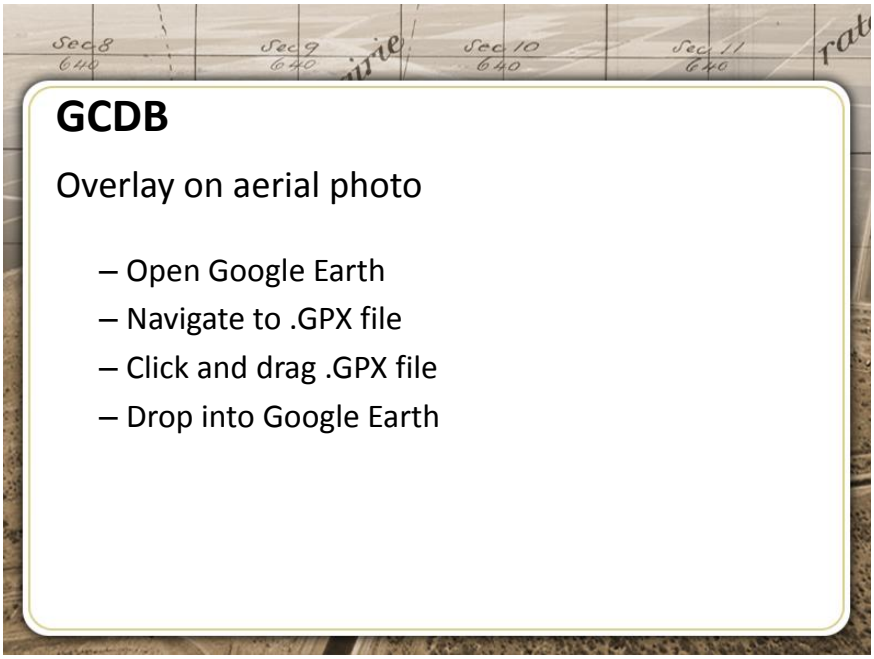
Now, let us walk through an exercise with our .GPX file and laying it over an aerial photograph. First, you will need to download a web-mapping service such as Google Earth. You can go to the website on your screen and download it free.

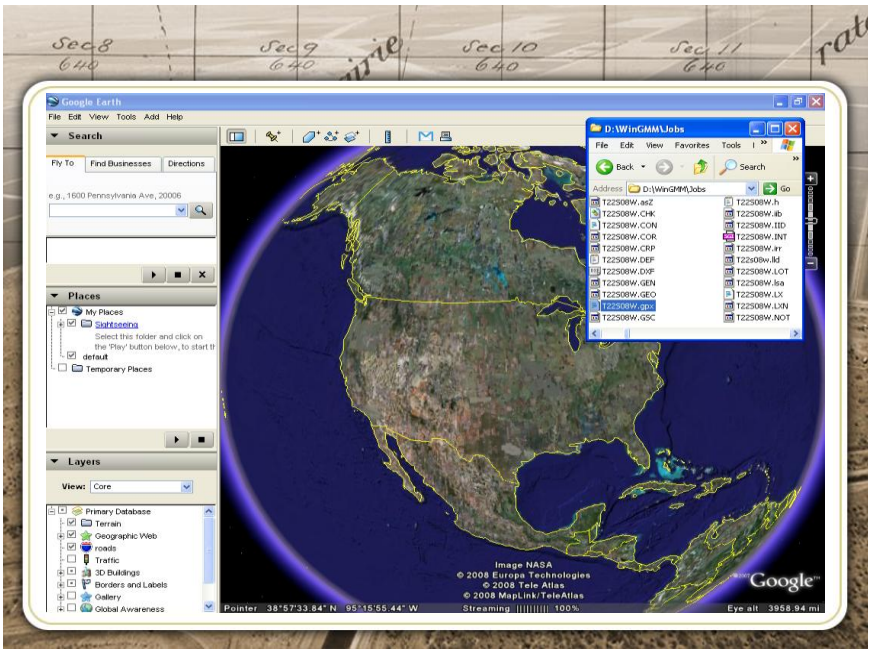


For installation assistance, help is available on the website. Remember that you will have to accept the terms and conditions for using the program in order to download.

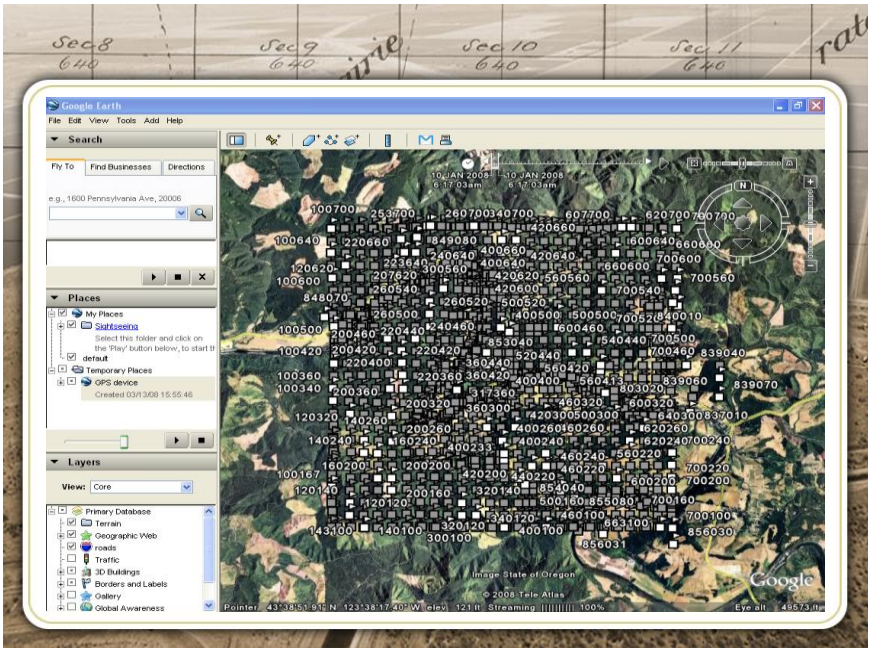


To overlay your .GPX file on your aerial photo, open Google Earth, navigate to the GPX file. Click, drag and drop the GPX file onto the Google Earth interface.

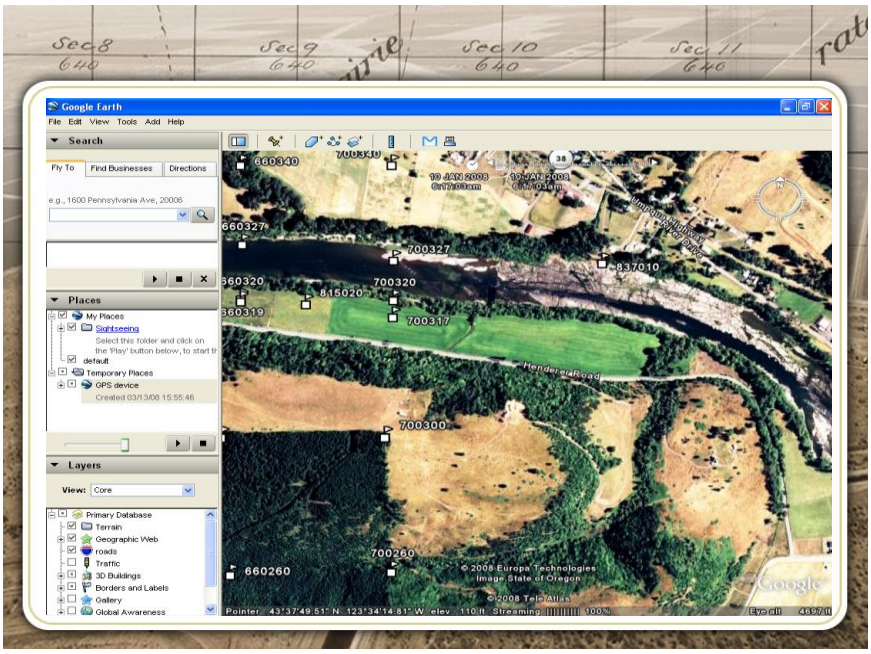




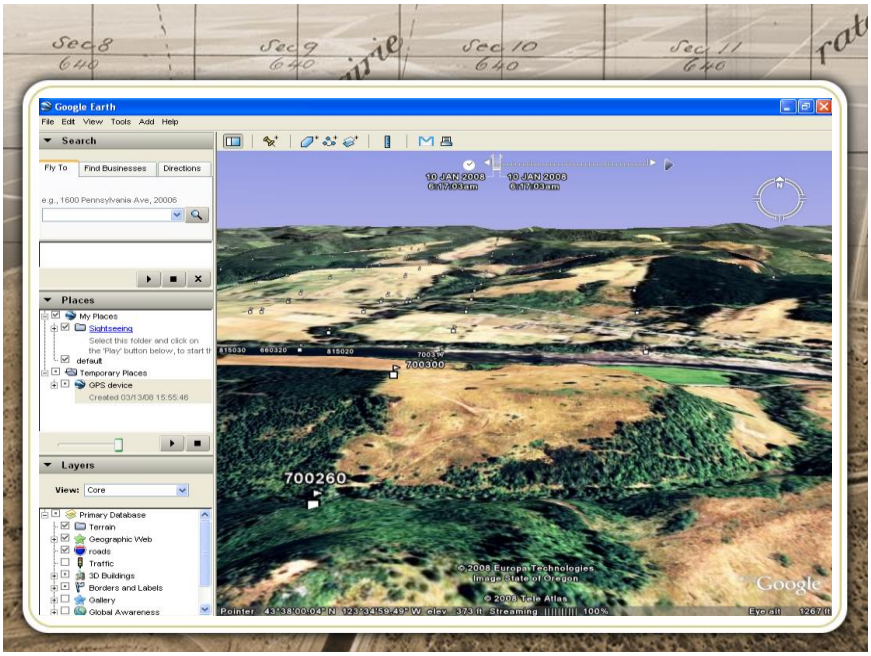
Google Earth will zoom into the township that you have dropped in. If you selected all of the points in a township it is going to look very crowded.



You can zoom into a point or into a set of points. Here I have zoomed into Point 700 – 300.



If you were going to do a survey in this area, and you needed to visit corner 700-300, you would see that you have access through Hinderer Road. You can also see what the topography looks like and that there are some manmade structures. In Google Earth, you can rotate the map and get a better look at the topography as well.



Now let us have you try Corner Point Exercise. First you'll need to download and install the LX2GPSX software. Then if you do not have Google Earth on your computer, you will need to download and install that. Then import your .GPX file into Google Earth and zoom in to point 700 -300 and see if it looks the same as when we did it here in the class. Good luck and we will see you in a few minutes.

Corner Point Exercise

Using the .LX file provided, create a .GPX file and import it into Google Earth.

Step 1 – Download LX2GPSX
Step 2 – Install LX2GPSX onto your computer
Step 3 – Use LX2GPSX to convert the .LX file into a .GPX file
Step 4 – Install the free version of Google Earth onto your computer
Step 5 – Open Google Earth and drop your .GPX file into it
Step 6 – Zoom to point ID 700300. Does point 700300 on your screen, look the same as point 700300 on the Power Point slide.

If you are having trouble completing this exercise, here are a few common problems.

1. **Downloading the LX2GPSX software is taking to long.**
    a. If you are using a dial-up internet connection, the download could take a while and may be interrupted. If you cannot get a complete download, you may need to find a computer with a faster internet connection.
2. **After LX2GPSX is installed, it is not listed under "All Programs".**
    a. If you can not find the program name under "All Programs", look for a file named LX2GPSX.exe in the same directory that the Setup.exe file is in. Double click on LX2GPSX.exe to open the program.
3. **The LX2GPSX program creates a .GPX file, but there are no coordinates in it.**
    a. Make sure you select the GCDB Point ID's to be converted before clicking the create button.
4. **Google Earth will not install.**
    a. See the Google Earth 'Help' section at http://earth.google.com/support/.
5. **The township points will not display in Google Earth.**
    a. Make sure that your .GPX file is not empty. If it is, see problem # 3 above.
    b. You may need to change the time setting. Click on 'View', 'Time Setting', then 'Never'.
    c. If .GPX file is fine, see Google Earth 'Help' section at http://earth.google.com/support/.

After completing the corner point exercise, answer the following questions. Remember to zoom in and out and rotate the view in Google Earth to get a better view of all of the features of this township. Also remember to turn on all of the necessary layers. For example, if the road names are not appearing, then the road layer may not be turned on. Make sure that there is a check mark in the box next to roads (this is usually in the bottom left corner of your screen).

1. Zoom into the SW ¼ of Section 30. Which GCDB Points would you be able to use your GPS unit on to acquire corner coordinates?

2. From Umpqua Highway (HWY 38), what road would you turn onto to drive to GCDB Point 440540?

3. Look at the SW ¼ of Section 4. Is it possible that accretion or erosion has occurred on the south side of the river that would affect the boundary of Donation Land Claim (DLC) 49?

4. When visiting GCDB Point 700340, does it appear that you would be on public or private land?

5. If you had accepted a job that required you to subdivide Section 22 of this township, what information could you collect, before heading out to the field, from the GCDB points that you overlaid onto the aerial photo in Google Earth?

Optional Exercise

Contact your State's GCDB office and request a .LX file for a township near your local area (or download the GCDB coordinates on-line, if available).

Step 1 – Download LX2GPSX (if necessary)
Step 2 – Install LX2GPSX onto your computer (if necessary)
Step 3 – Use LX2GPSX to convert the .LX file into a .GPX file
Step 4 – Install the free version of Google Earth onto your computer (if necessary)
Step 5 – Open Google Earth and drop your .GPX file into it
Step 6 – Review the township in Google Earth.
Step 7 – Download or manually enter one or two GCDB points into your GPS unit.
Step 8 – Make a field visit to the GCDB coordinates that you entered.

Corner Point Exercise Answer Sheet

1. Zoom into the SW ¼ of Section 30. Which GCDB Points would you be able to use your GPS unit on to acquire corner coordinates?

   100200 – Thick canopy (No)
   120200 – Thin to medium canopy (Maybe)
   140200 – Edge of thick canopy (Maybe)
   100207 – Thick canopy (No)
   100220 – Medium to thick canopy (Maybe)
   120220 – Thick canopy (No)
   140220 – Thin canopy (Maybe)
   100227 – Medium to thick canopy (Maybe)
   100240 – Thick canopy (No)
   120240 – No canopy (Yes)
   140240 – No canopy (Yes)

2. From Umpqua Highway (HWY 38), what road would you turn onto to drive to GCDB Point 440540?

   Paradise Creek Road

3. Look at the SW ¼ of Section 4. Is it possible that accretion or erosion has occurred on the south side of the river that would affect the boundary of Donation Land Claim (DLC) 49?

   It appears that accretion may have occurred. A field visit would be necessary to determine the situation on the ground. If accretion has occurred, then the boundary of DLC 49 may be affected.

4. When visiting GCDB Point 700340, does it appear that you would be on Public or private land?

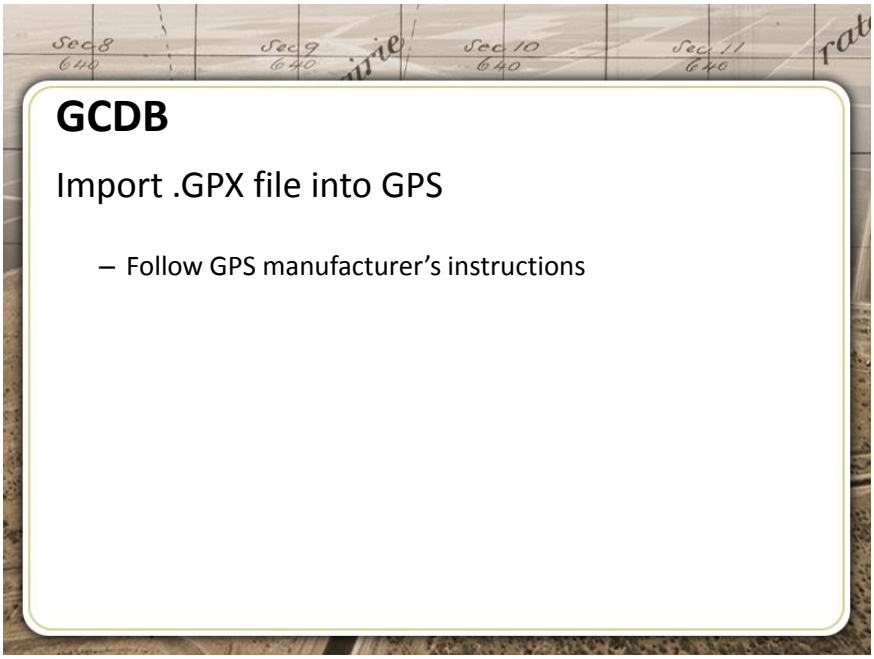
   GCDB Point 700340 appears to be in a cultivated field. It is probably privately owned.

5. If you had accepted a job that required you to subdivide Section 22 of this township, what information could you collect, before heading out to the field, from the GCDB points that you overlaid onto the aerial photo in Google Earth?

    a. The south half of the township is very mountainous and covered in timberland, which may require more strenuous hiking and prohibit the use of GPS.
    b. There is a road that leads directly to the ¼ corner common to Sections 22 and 27 (440300).
    c. Hinderer Road runs across the south half of the section and can be used for access.
    d. Umpqua Highway runs across the north half of the section, north of the Umpqua River. The highway could be used for access to the corners north of the river.
    e. The north half of the township is mostly agricultural land. Hiking should be much easier in this area.
    f. There are a few houses in the section, so you may want to notify the private landowners of your presence.
    g. The Umpqua River runs through this section, which may bring up special water boundary issues.
    h. Some of the section and subdivision lines run through the Umpqua River.
    i. The NE Section corner appears to fall within the Umpqua River.

Using GCDB Coordinates and GPS to Locate Corners

Welcome back. I hope the exercise went smoothly for you. As I mentioned earlier, you can also import the .GPX file into many GPS units. Every GPS unit is just a little bit different, so you will need to follow the manufacturer's instructions to get those imported.



I have imported a few coordinates into my handheld GPS unit. Let us head out to the field and see how GCDB coordinates can help with government corner to monument search. I have imported GCDB coordinates into my handheld GPS unit. I have also imported those same coordinates into Google Earth while I was in the office. This was a great help because I was able to view the terrain and determine how accessible the corner would be before I went into the field. Now, let us go over to the corner common to Sections 2, 3, 34 and 35.

When you do a corner search always, look at the field notes and plats before you head out. Let us go see what we can find. Well it looks like we are still 80 ft. from the corner. Well, according to the original notes, the monument is just east of a ravine. This looks like something. Here is the corner of Sections 34, 35, 2 and 3. Our GCDB coordinates are within 6 ft. of the actual monument. You now know how to obtain, convert and use GCDB coordinates. By using these coordinates to help plan and estimate survey jobs and for corner monument search, you should be able to save both time and money.

GCDB Applications

Welcome back. We hope you enjoyed that module and found it informative. Before we talk about some other applications, we want to talk about the FGDC.

What is the FGDC?

One of the recommendations in this 1980 publication was to define the federal role in the building of the national cadastre. They created a body called the Federal Geographic Data Committee (FGDC). Under that large committee, there are subcommittees. One for each of the principle layers that everybody uses in his or her GIS or mapping. For the cadastre, the BLM Cadastral Office is the lead and chairs the cadastral subcommittee of the FGDC. I am part of that subcommittee under the western states where I am the chairman of everything west of the Mississippi River.

The committee is trying to work with the states and the counties in the development of the public land survey system, the digital portrayal and parcel data that the counties collect. What we hope to accomplish is to have the states involved, state governments where counties collect the parcel data. If they can submit that up through the states with a standard content and format with metadata. They could publish it for everyone to use.

Not everyone is comfortable with publishing that information just yet for wide use. There are certain applications that all government agencies will use the data for. What you are telling me is that some either county, state and even federal agencies may have some data that they have collected and generated and they are not comfortable making that available to the whole world right now. Some of that is considered sensitive data. Because with the county, they may have parcels with the names, addresses and value of properties.

Those are important attributes, especially in the realm of emergency response and we will go into some of those elements that all levels of government have to deal with.

Where do the other representatives on the FGDC come from?

We have members from all of the federal agencies, and representation from the national association of counties. The international association of assessment officers now has a presence on our subcommittee with Census, U.S. Forest Service, and BLM. I believe that the Department of Homeland Security is now a member of this subcommittee.

Do you actually do anything?

Yes. This is a long struggle to get all of the levels of government to talk to one another and share what they collect and their expertise. As usual, funding or lack thereof is a problem. The counties, they are collecting parcel data as a matter of their routine business. Whether or not they are collecting it in a digital environment or still using the older methods, they can use help getting to that digital environment.

There may be grants available that this committee helps foster. I would imagine that is especially true with counties that are more rural and do not have the resources. Where the larger counties in the cities I am sure are in the digital environment. Because the GIS provides an economy and efficiency in building and maintaining this type of data.

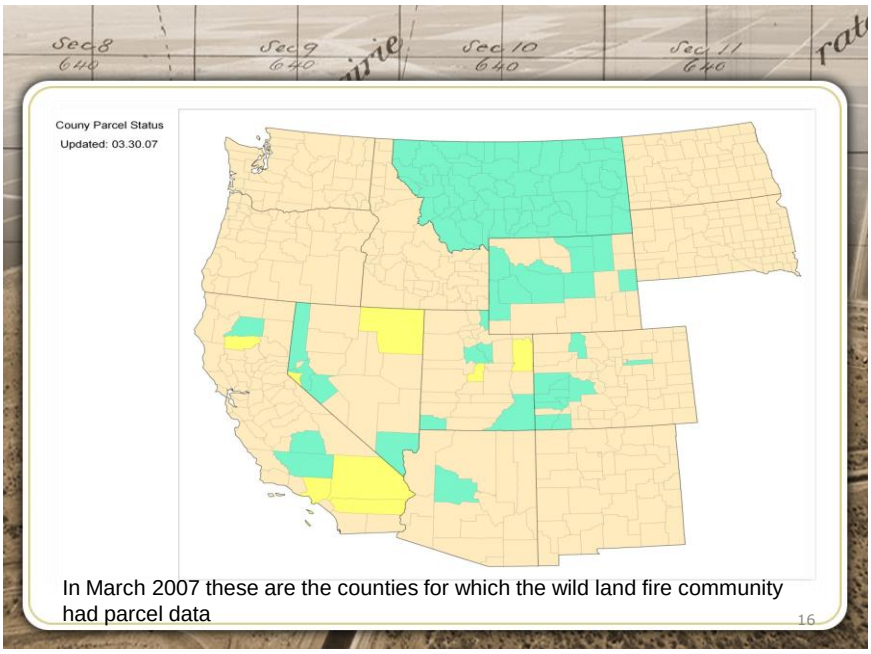
Wild land Fire

The cadastral subcommittee recently undertook a pilot effort to try to accumulate the parcel data for an emergency response. The official website for the cadastral subcommittee is the www.nationalcad.org website and there is a lot of information out there that we share with our partners and those counties and states who want to build this. One of our examples is wild land fire and how the FGDC – this is an example of something they really accomplished and we can see drastic results.

Members of the cadastral subcommittee in BLM undertook with BLM funding to inventory, accumulate county parcel information for wild land fire pre planning, during fires, and of course post fire efforts. This is something you have been heavily involved in. We called about 500 counties to ask if they would share their data with us. This was a recent fire in California and it really displays the immediacy of the problems an approaching fire to a major subdivision. These are values of structures and lives at risk. However, it is not just value - no lives.

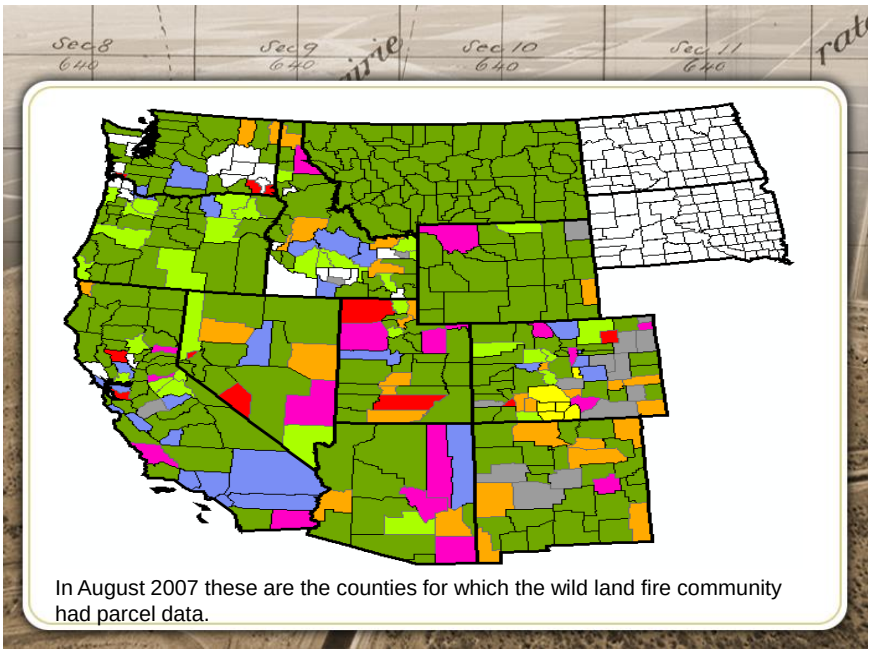
There is the immediate concern because the fire is approaching the structures, peoples homes and that fire will be vigorously addressed. But in the analysis using GIS tools, not only do they look at the structures and their values, access road access to fight the fire. They look at elevation, the weather and all of the other themes in GIS.

As we started our effort to collect the data, this was pretty much the condition we knew about. What you see in green is parcel data that exists and was readily available. So this is areas that had it and were willing to share. Some of them share it openly and freely on the Internet and some of these counties would require sharing agreement or even a fee to acquire the data. This is March 2007, that year saw a extreme fire season.



There were expected drought areas, see the Boise Interagency Fire Center had a drought map and I do not have that as an example but it turns out that it was very true and turned out to be very accurate. They had intense fires in those areas and we had focused our initial collection efforts according to that drought map and then tried to fill in the rest.

So March 2007 these are the counties that had data and would share it some openly, some with some sort of agreement. The next slide shows by August well into the fire season, these are the 500 counties we had called.

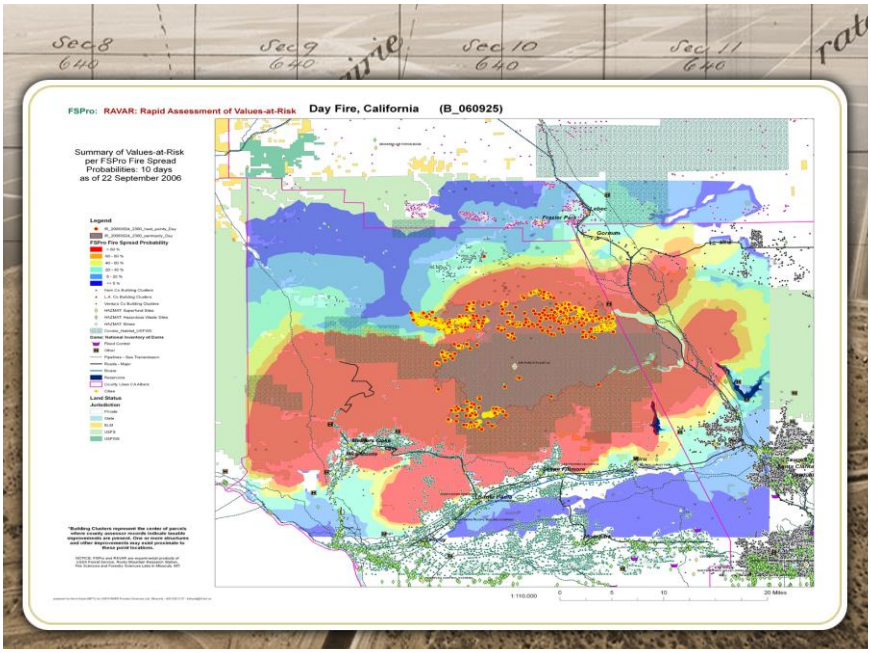


The dark green indicates those counties that have digital parcel data that is available that they were comfortable sharing with us for wild land fire purposes. One of the things that we did was assure these counties that this information would not be shared. It is a concern with counties that when this data comes into the federal ownership a FOIA request, we might have to release it and that is a concern with some of them.

This map shows where an agreement was required. Because we did not pay. We had no money to pay for acquiring the data. All FGDC was doing was coordinating these various levels of government facilitating this interaction and sharing of data to come to sort of a common good out there. What we tried to do was have a state government lead working with us in the contacting of the counties.

Ultimately, we would like to see the FGDC cadastral subcommittee not be involved in this. The states and the counties can work together to make this data available again for emergency response purposes.

This is an example of a map created by the Rapid Assessment of Values At Risk (RAVAR) program. This is where GIS tools take the information such as elevation, weather, fuels, parcel data and all its attributes and put it together in pre-fire view. They can see where if the humidity drops to a certain level and the winds pickup and there is a lightning strike in a particular area, they can model how a fire might progress.

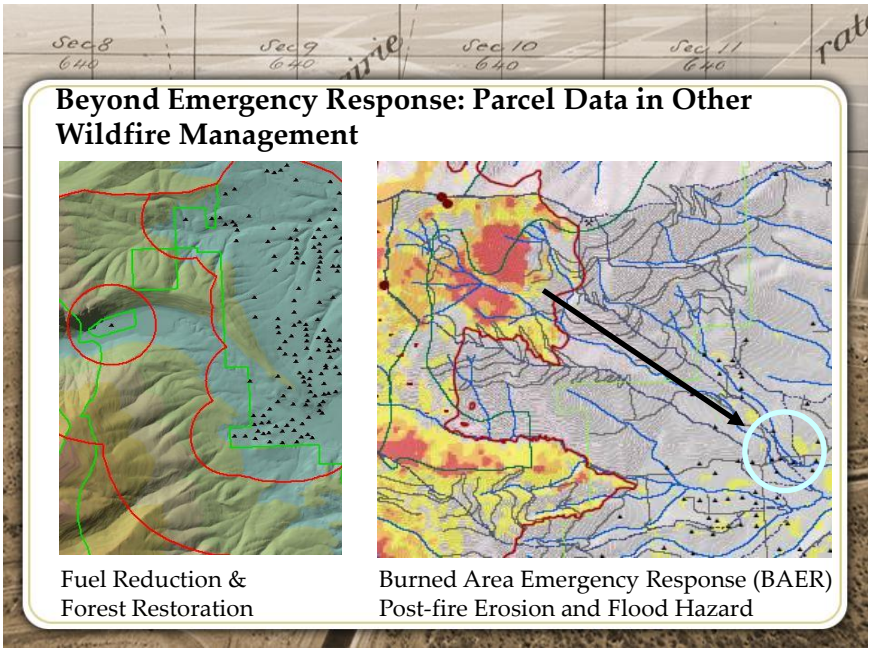


When there is an actual fire, they can supply this information to the firefighters on the ground or anyone involved in the fire. They can introduce new information, new lighting strikes and this identifies where there are structures and where a fire might progress. It also has how many people live in those structures, so if you have to evacuate an area it gives information about how many people will need to be evacuating.

There are also symbols for abandoned mines and firefighters want to know about that. We have symbols for hazmat sites and even a superfund sites. These are some of the things that may not be valuable but they need to be considered in an emergency response. You do not want your firefighter wading into an area like that. Not knowing what is there and what might pose a life risk. There may also be propane tanks, what houses have propane tanks so the firefighters know. So this is just a tremendous amount of information all compiled in a nice neat package. What the FGDC has done actually is getting the right people talking, communicating and sharing information.

As more and more people are moving into what they call the wild land urban interface (sometimes called the WUIE), there is a lot of danger. With people moving out there because of the fuel, they are so far removed from fire response and one of the things that counties can use this data for is to look at abatement measures (clearing brush away from the structures).

Let us look at this next slide because this talks a little about that. On the left, we are talking about pre-fire things. As I mentioned we are talking about fuel reduction this can identify for the Forest Service where they could exert more effort to remove brush and debris on the forest floor where it is near to structures, homes and people.



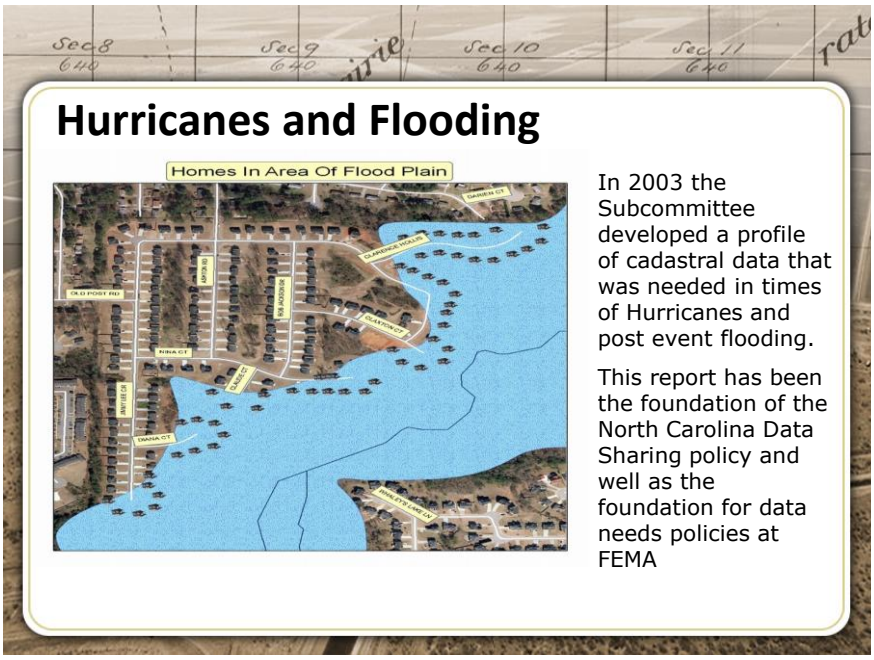
On the right, this is after a fire where there are some additional issues and concerns because of loss of ground cover. With the coming of the winter after the fire season, you have rain and snow and slides. So here it gives a slope information so we can identify possible slide areas. We can identify maybe roads that are in danger, how many houses might be back there. It begins to help us plan what kinds of things might be coming down the road.

With a slide, in the wild land urban interface area a slide may take out the only access road or bridge. You are also looking at evacuation and where will and how will these people

get out. Where will they go and how many because you have to think about having an area large enough to put them up for days or to feed them.

Many of you in the CFedS program are associated with counties, some work for counties or states or local governments. Some of you are city surveyors, county surveyors and this is just one example of how all of this data in the GCDB fits together with the other layers to really be beneficial to local governments, state governments, whoever. For you as a CFedS, having a survey involved in this process is very important and may give you some ideas for how your state, your county, your city might become involved. FGDC is out there to help coordinate and facilitate things to get done. One of the things that you can help provide is to increase the accuracy of the PLSS and these parcel representations that they use for the GIS and in particular emergency response.

You can also see how it applies to any emergency. In fact they learned, one of the other pilot efforts was to see how the GIS was helpful in the response to the Katrina Hurricane. They really needed to intersect the path of the hurricane with the parcel information for insurance and response purposes.

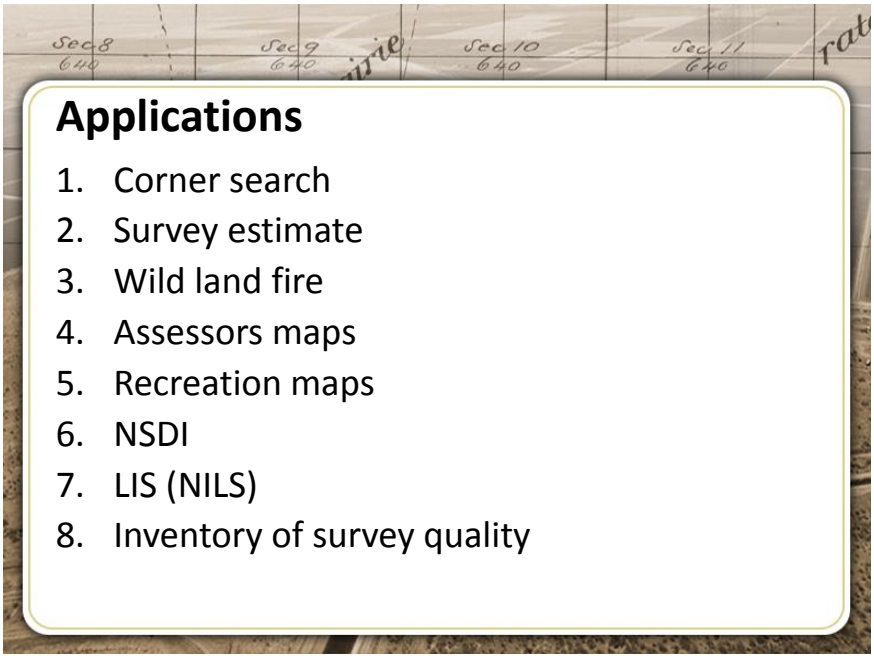


We had some recent flooding in the Northwest in December due to high rains and storms and we got a call out of the blue one day from FEMA that said they needed the parcel data. The wife of the individual who helped develop RAVAR also works for Red Cross

and she knew that the parcel data existed and they needed to know how many people were being affected by the floods so that they could feed them and house them in emergency shelters. Now as I understand it, you had to work out some agreements there.

Remember we had promised the counties that we would not share this with anyone other than for the wild land fire purpose, but we were able to call the counties and get permission in this instance. So ideally, we would like to have permission at the state level where all this county data or at least core attributes about the parcels would be published by the state government and available to all emergency personnel who respond to all types of emergencies.

FGDC has gotten the ball rolling and hopefully the counties, states and the federal agencies will follow-thru and make it happen. We are not there yet, but I think what you see here is a real impetus to the effort.



Assessors Maps

The counties that are involved in generating digital assessors' maps are pretty far along and as we said before they have a requirement for accuracies that usually exceed what BLM and GCDB was able to provide just because we have limited budgets. They have taken over that aspect. BLM and GCDB in the federal sector has something to supply

them in return because we deal in the non-taxable areas. Together our collection efforts can be zeroed in on areas of responsibility or stewardship. We can both collect, bring together and form a complete picture in a county or in the state. I imagine in those more rural counties with fewer resources, they may rely more on BLM for much of their data. They may strain their collection efforts to only within the town or small cities where they have the money to focus in on their tax lot parcels.

Recreation Maps

All maps still need to be made and GIS is the tool to use to create those maps. So you can really tailor your recreation map to what you want it to look like. They are made faster with more current data. You just get a better product and they are easily shared.

NDSI

NSDI is the National Spatial Data Infrastructure. It is like in the old USGS 7 ½ minute quad that provides the seven principle layers of every map(Cadastral, PLSS, Elevation, Highways, Streams, Manmade Structures and Vegetation). Those are the base themes. One thing we have not talked about yet is the critical nature of the PLSS and the parcels geometry to the creation and portrayal of the geopolitical boundaries.

This is another area that we need to have the geopolitical boundaries collected and portrayed with the same kind of accuracy that we have with parcels. It is a little bit larger of a project because they are out in the rural areas. So we are talking county boundaries, city boundaries to the extent of the city limits and some of those are based on the PLSS, some are based on topographic features and some are based on specific latitude and longitude.

It's important that we try to identify the best source for that and you mentioned a boundary defined by a feature like a hydrographic divide, the crest of the rocky mountains, or the crest of the cascade range. The best source for that since it is not typically surveyed and monumented might be the USGS watershed boundary theme, which is critical in another aspect of water management, water rights. You want to think about having the same data sets define the geopolitical boundaries in your GIS. County boundaries are critical because it defines so much of the "other" geopolitical boundaries that nest within state boundaries. I think we have identified there are as many as 140 geopolitical boundaries that counties use. Many of which are emergency response like fire

and ambulance and they may or may not follow the PLS or parcel like some of the school district boundaries may just bisect a parcel, you just never know where they go from here.

All of this comes back to surveyors and surveys on the ground. As surveyors whether you are a CFedS, work for a county, whoever you are the more accurate survey data we have the better we can present all of this for the user. And I think that word present is key. They have no legal significance. These are used for mapping, GIS and analysis planning. However, you really want to portray them as accurately as possible because it will be used in analysis. It has no legal significance but as we just saw in our wild land fire example, it has a tremendous impact on economically on people's lives and all kinds of things. Traditionally we use maps for that purpose but now we are using the GIS. That analysis can be performed much faster, so the better data that surveyors can help put in that. You may still have your misgivings about GIS but better decisions will be made. Part of your role as a surveyor is to identify where there are problems with the data, the recorded data, the legal data that you work with to help resolve those issues because they will be portrayed and it identifies work for us.

LIS (NILS)

Next let's talk a little about the LIS (Land Information System) because we have been talking about geographic information systems (GIS) more the mapping and the land use. The LIS is more of the records side of it. The LIS really uses GIS software or tools to portray the land records. If you create your LIS digitally, that information will just transition or be used by the GIS planning offices in the counties or the state level and government or federal level.

Inventory of Survey Quality

One thing we have not talked about specifically would be Indian reservation if you are performing the analysis. If you go out and collect all of the records to build a parcel data set for an Indian reservation along with the PLSS, you have examined all of the surveys that have transpired in that extent. By examining your field work that you performed out there, you get a feel for how accurate these surveys are or how well performed they have been. Therefore, you compile a record of this geographic extent. You have an idea of the quality of that survey work for that geographic extent and you can then tell your customer where it is strong and where it is weak so that they are spending their dollars more wisely to meet their concerns.

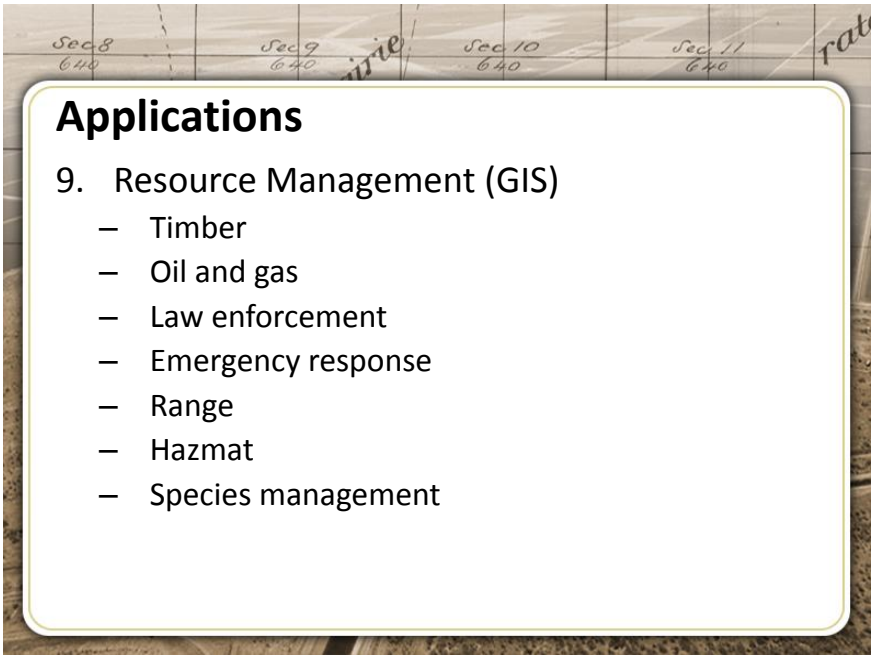
One of the things that I think we've been talking about really since the beginning of the GCDB process is once people begin to use the data and they realize how important it is to have good data to do the things they want to do. It is going to generate work for surveyors by providing better position on corners, reestablishment of corners properly.

We were talking earlier about overlaying the GCDB on some sort of orthophoto and you can identify where there is a power line across this parcel and when you examine the record information there is no right of way for a line across there. It helps to begin to bring all of this information together. If you don't have that accurate base level, it is really difficult because if your parcels aren't accurate, you don't really know where the power line is in relationship to the parcel.

You also have to address how accurate is my ortho. You may need to tell your client, "well we are not sure how accurate this is so you may want to consider getting better imagery". What seems to be happening as people begin to use the tools that the GIS gives them, they really recognize the need for a better base layer. You can pinpoint where it is more important through that and you have a better handle on what exists.

Resource Management

Within the federal government this is a big one. I am just going to click down through the slide here.



Timber management in the northwest is a big issue as I mentioned earlier about our earlier effort with the Western Oregon Digital Database and the Presidents Forest Plan that turned out. Oil and gas is a big one with the Energy Policy Act so in the Midwest oil and gas is a big issue to do about leasing.

If you have accurate data, you have accurate photography or orthophotos or whatever, you can spot people who maybe are off of their lease or off of their parcel on a federal land or a federal lease that is onto private land. Or a wellhead that is too close to the boundary of the parcel they are leasing and they might be taking oil or gas from a neighbor and they may have to pay some royalties to the neighbor.

There is law enforcement. In the geopolitical boundaries there is an awful lot of uncertainty with some of those boundaries especially in the neighborhood of water boundaries where the law enforcement has jurisdiction. An an accurate portrayal of a boundary is very important. Obviously if it ever went to court, you would have to do something else. BLM every now and then surveys to determine which side of the line a crime was committed. An accurate portrayal in the GIS with a reliability indication of how accurate that is might indicate whether the attorney will pursue a case or pursue a survey.

Emergency response is the biggest one and right now that is where the cadastral subcommittee is going to focus their efforts on. Range management is another because of leases for cattle. All of those things we need to know about. Hazmat is another concern. There are point source pollution factors that may come into play. Something like a meth lab. Where someone dumps all of that materials that they used on a piece of property. People like to dump stuff on the public lands, county lands, state lands. Out there in the forest, far from prying eyes. We also have in the public land in the west growing marijuana. The federal government has agreements with local sheriff departments to help patrol those lands and do eradication procedures. Finally, the federal government has to deal with endangered species management so they can map extents of species at risk.

Let us talk about Indian land specifically in the west. When we say west that includes Montana, Wyoming, Colorado, and New Mexico. That is where the BLM has the most presence. In the collection of GCDB what happened on most of the Indian land in that process.

The Bureau's land information system has to have a PLS grid for every township in those states in order to automate their land data. GCDB was collected at a minimum to the section and subdivision of section to the 40-acre government lot, PLS level. Now BLM does not track inside Indian reservations. All of the transactions that have taken place falls under the tribal responsibility or the BIA. At least we have the section line level information collected.

Some tribes have developed that much further and BLM has worked in cooperation to do that. In the east, it is upon request. Really, the metes and bound states are mostly in Forest Service or National Park lands. The counties play a larger role in the east in that collection effort. All of those upper Midwest states and Oklahoma, most of that has not been collected. Or is being collected either by the state or the counties themselves. They are also tied to the PLSS in many cases. But they will not collect on reservation land often. That is something that tribes want, it is something that we are working towards and that is going to be a place where the CFedS may fit into that collection effort on a lot of those reservations. Either getting better GPS data on corners or actual data entry or adjustment.

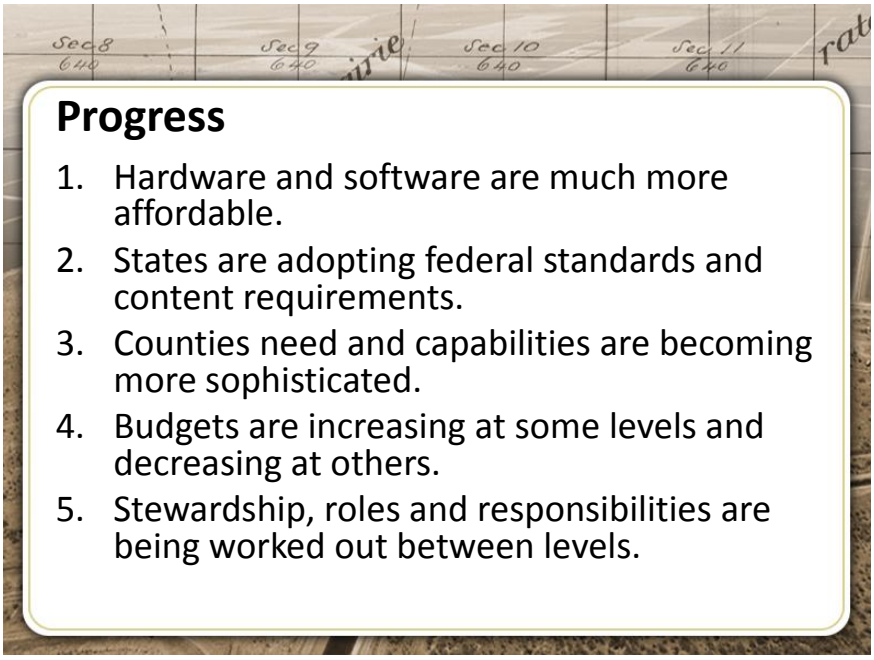
So we are almost 20 years into this, where are we?

Generally, we have had some examples but we still have a long way to go. There is a new publication "National Land Parcel Data" recently out that is a follow-up to the 1980 publication "The Need for a Multipurpose Cadastre", both of which you can look at – at the national academy press website. This is a recent publication and right now they are saying about 70% of the counties in the nation have digital parcel information. So many federal agencies are involved in a digital process as well. There needs to be more coordination and that is what we are attempting to do right now is to prevent duplication of effort at all levels of government.

Part of that has to be some standards, so that when data is collected, it can be shared easily. This is something that FGDC is working on. The FGDC is not trying to impose on various levels of government that they have to do their own collection in a specific format. They need to collect their data to their business requirements.

What we do want to see is that when the data is compiled hopefully at the state level there is core data content and it is in a certain format that customers are used to and it is easier to bring that data into their systems. Its edge matched, so that there is less manipulation each user has to go through.

There is a real opportunity for surveyors and a need for surveyors to be involved because even though we collected all of this data. A lot of places the data is not good and the only way to improve it is through surveys.



We hope that you enjoyed this presentation, we hope it has been helpful and that it has been informative and we appreciate your attention.

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