USING ARCGIS TO BUILD WATER QUALITY GEODATABASES FOR TENNESSEE'S COALFIELD

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US Department of the Interior
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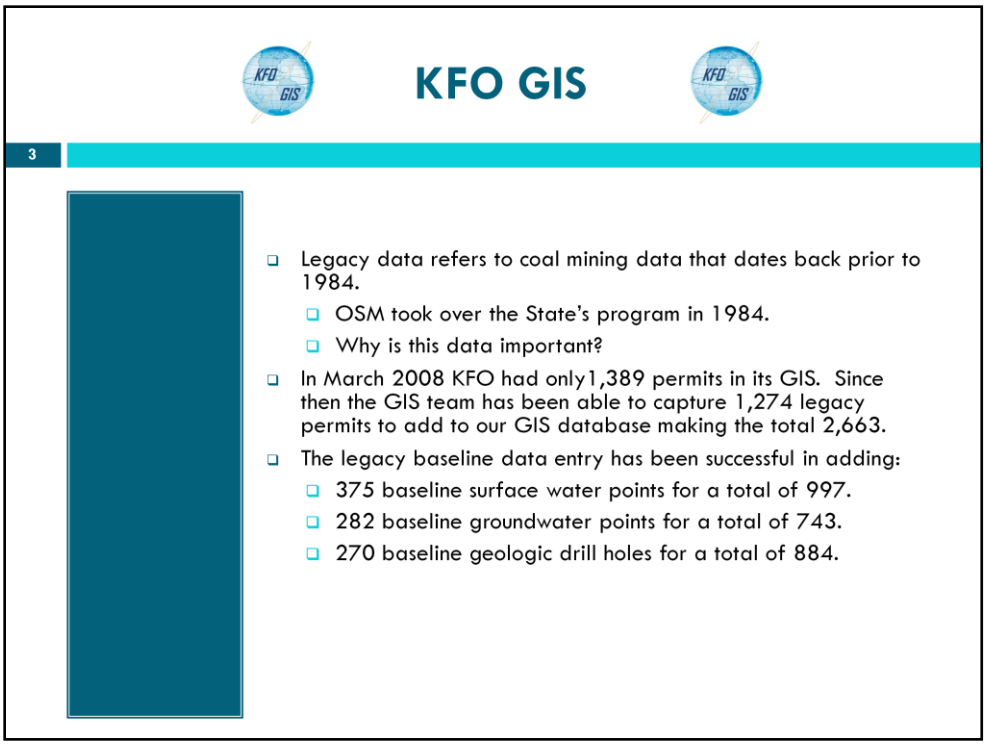
- The Office of Surface Mining (OSM) was created in 1977 when Congress enacted the Surface Mining Control and Reclamation Act (SMCRA). OSM works with State and Indian Tribes to assure that citizens and the environment are protected during coal mining and that the land is restored to beneficial use or back to the approximate original contours when mining is finished.
- The Knoxville Field Office (KFO), serves as the Regulatory Authority in Tennessee. KFO is responsible for permitting, inspection, and enforcement actions in Tennessee, North Carolina, and Georgia. KFO includes the Big Stone Gap Area Office in Virginia.
- KFO has 38 full-time employees including 4 GIS staffers



One of tour top priorities of KFO GIS staff is obtaining legacy data which refers to coal mining data prior to 1984. 1984 is when the State of TN rescinded their regulatory power and the Federal Gov't took the program over. It is still this way today. Capturing legacy data is such a large part of KFOs effort because it gives us baseline information for the way the environment reacts to coal mining over 40+ year timespan. Baseline data refers to the initial collection of data which serves as a basis for comparison. Baseline monitoring points for surface water and groundwater especially help determine the effects of coal mining. Without that data we would only have information back to 1984. However we have coal mining data from as far back as 1968 when the State of Tennessee began regulating coal mining. With the amount of legacy data we have it makes it possible to assess trends over an extensive period of time helping KFOs biologists, engineers, hydrologists, geologists, and coal mine inspectors make educated decisions about coal mining operations. This data helps determine the impacts of all coal mining operations proposed and existing and helps establish proper coal mining techniques, enforcement, and reclamation of a site post-mining. The more points we can capture the more knowledge we have of how coal effects the environment's past, present, and future.

Locate Map: In order to obtain such data interns and staff scrounged the state's office for all coal related information and we were succeeded in finding almost 1300 permits that KFO GIS did not contain. OSM then we convert the maps from paper to digital by scanning, georeferencing, and digitizing.

Converting from Paper to Digital

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- To obtain legacy data from permits:
  - Locate folder – KFO interns and GIS staff members salvaged as many coal mining related folders from the State as possible. Some were headed to the trash and we were lucky to find them before that happened.
  - Locate map with permit boundary and if lucky monitoring point locations
  - Scan map
  - Geo-reference map
  - Digitize permit boundary and monitoring points found on map

Capturing Legacy Data:
Geo-Referencing and Digitizing in ArcMap

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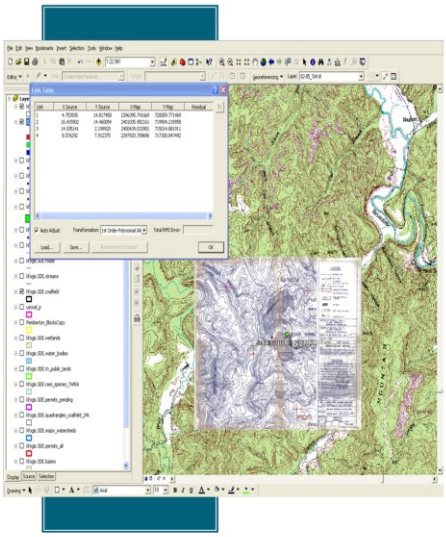
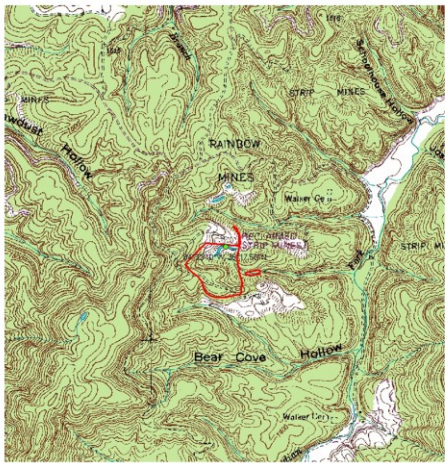
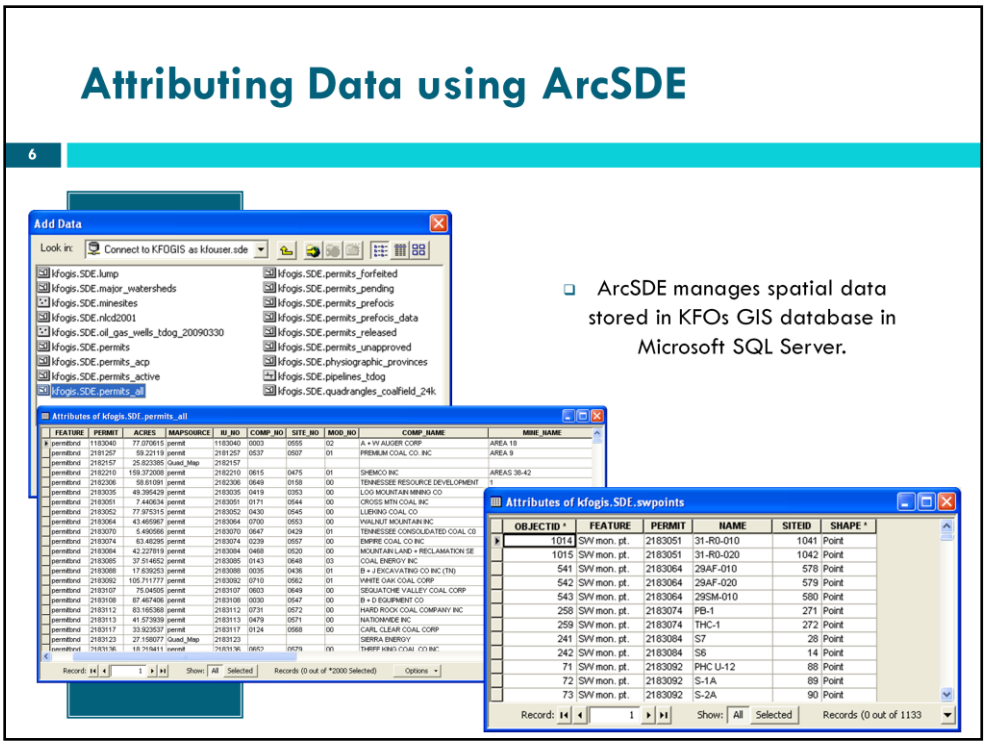




As you can see the map on the left has been georeferenced in ArcMap with a root mean square (RMS) error of less than 10 for accuracy and to ensure that the map is in the correct location before the digitizing process begins. The screen capture on the right is the historic coal mining boundary that was digitized off the original map after it was geo-referenced.



After digiziting we then begin the process of attributing all associated data. We store all GIS attribute data in ArcSDE which manages spatial data in a relational database management system as depicted in the top screen capture. We use the ArcMap's editing tool to type all pertinent information found in the paper file into our GIS database. The middle box highlights one of the 74 layers we currently have in KFOs GIS. It is our permits all layer which contains all information associated with a coal mining permit like company name, mine type, mine name, etc. We also manage all water data (represented in the bottom box) , geologic drill holes which are used to determine depth of coal, sediment basins which capture runoff from coal mines and 70 other databases that facilitate our staff and help implement the Surface Mining Control and Reclamation Act. However KFO staff are not the only ones that benefit from this information. All information is public and is shared with Other government agencies as well as the public such as environmental groups. Our GIS database helps increase the transparency of coal mining. It also helps up make objective decisions and help others understand coal mining issues.

Importance of GIS and Coal Mining

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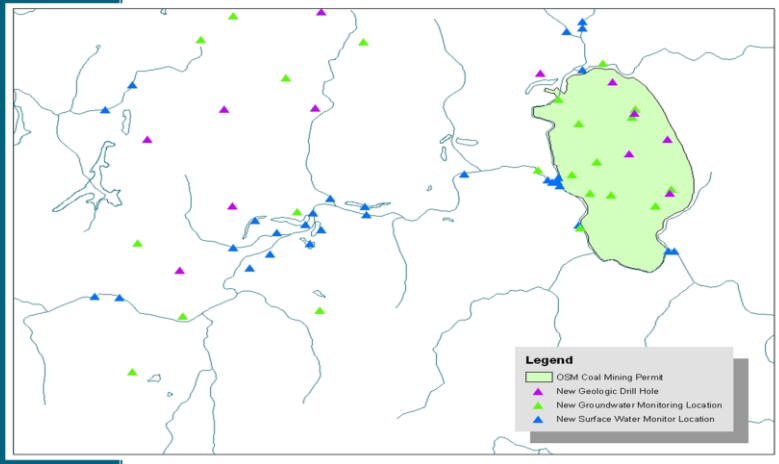

This map shows new surface water, groundwater, and geologic point locations from a current coal mining operation located in the Tennessee Coalfield. As you can see in the legend there is the coal mining permit boundary and three monitoring points. These points are for a current mining operation and only give you data that is more recent. However,

GIS Legacy Data and Coal Mining Regulation

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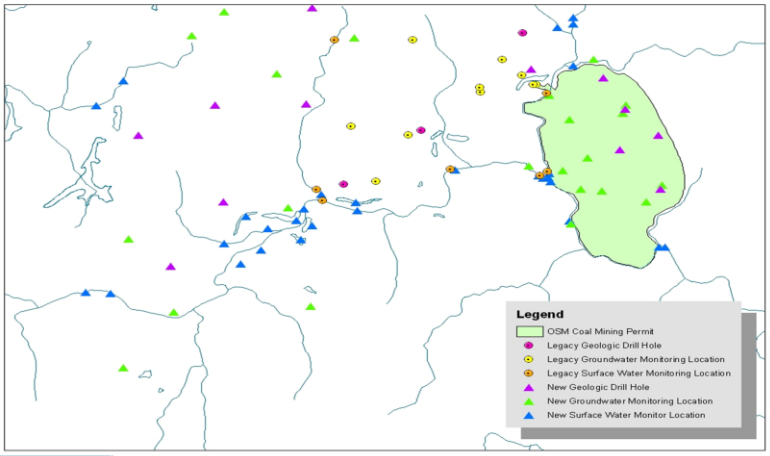
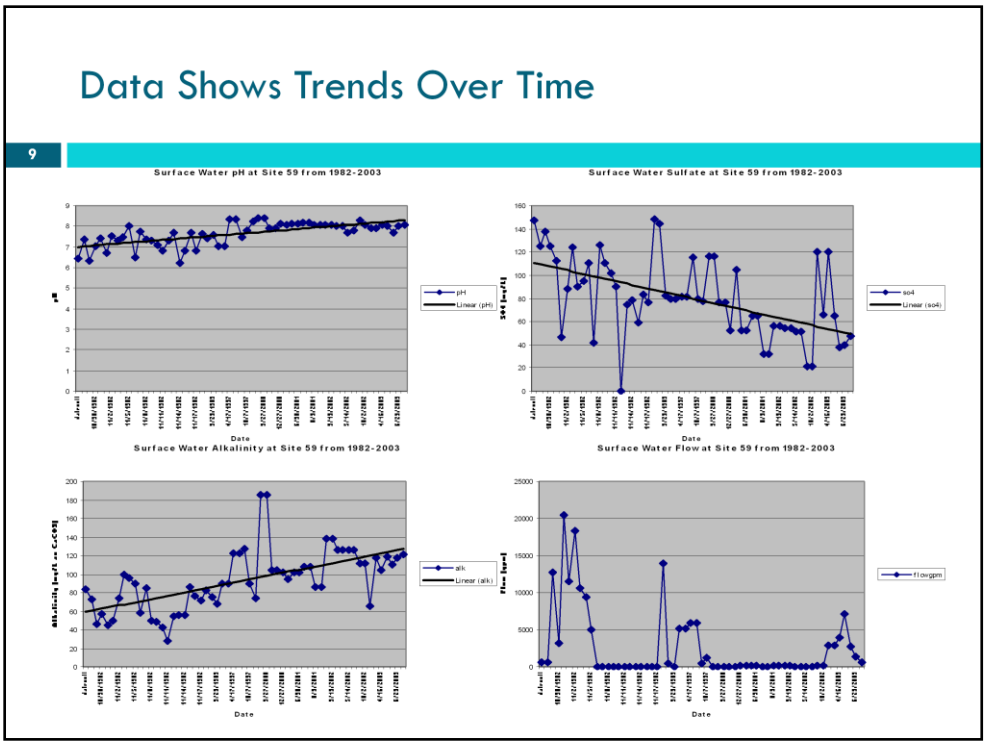


With the addition of the legacy points we are able to add 7 surface water points, 9 groundwater points, and 3 geologic drill holes.



By accessing this data in ArcSDE trend graphs can then be generated to show trends over time. You are looking at a trend graph generated to show long-term trends at the site from the previous slide over a period of 21 years. These particular trends show improvements of water quality over time. The legacy data that we have been able to locate has helped us step back in time and evaluate what the environment looked like 40 years ago. This data is very valuable and irreplaceable. It has also helped us look into the future at how coal mining operations may effect the environment 40 years from now.

Questions?

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