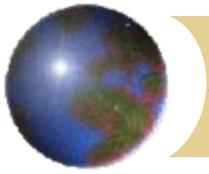


# *The Need for National Mining Geospatial Data Standards*

First Meeting of  
the National Coal Mining  
Geospatial Data Stewards

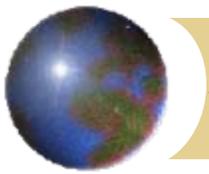
Presented by  
**Larry Evans**

**June 28,2006**



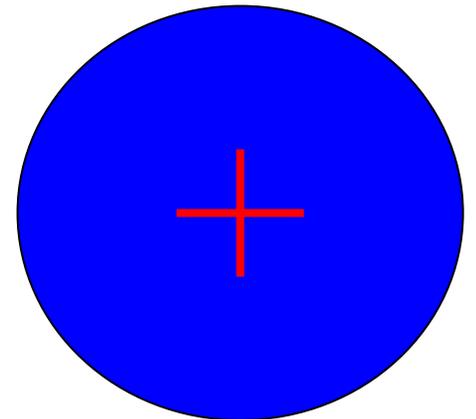
# Topics

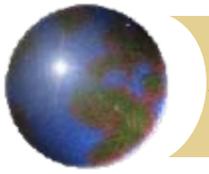
- Why create unified national coal mining geospatial standards?
  - Litigation
  - Typical problems with permit maps
  - Recent mining accidents/disasters
    - Recent
    - Future
  - Public's right to know
  - Benefits to industry
- How technology improvements make national standards possible for the first time.
  - Recent
  - Future
- Participation is voluntary



# *Why create unified national coal mining geospatial standards?*

- Litigation → a case study
  - In 1992 the WVDEP active mining program's geospatial data model looked like ...
  - Each mine site was represented by just a point
  - Representing mine sites as points instead of polygons limited geospatial analyses to buffering a circle with an area equal to the disturbed area on the ground





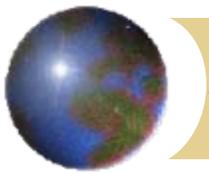
# *Why create unified national coal mining geospatial standards?*



- Litigation → a case study

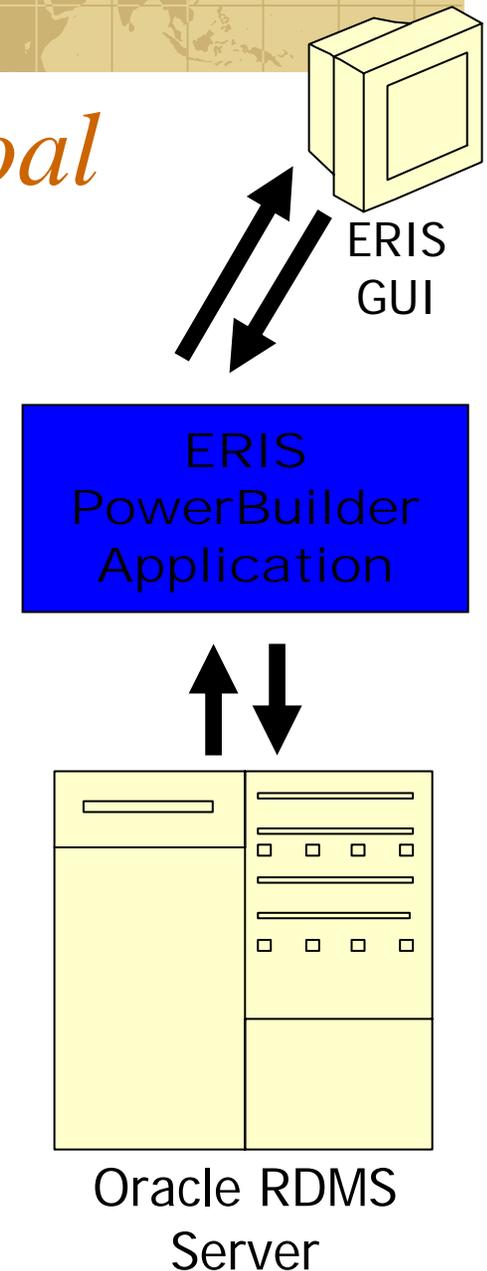
- Using spatial analysis to evaluate the quality of our point data we found in 1992 that:

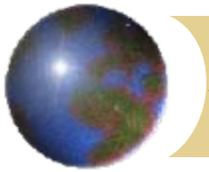
- ~26% of lat/longs were suspect
- ~15% didn't even fall in the right county or on the right quad



# *Why create unified national coal mining geospatial standards?*

- Litigation → a case study
  - In '92 an OSM/WVDEP agreement mandated that IT funding would be dedicated to creating an Oracle-based client server app (ERIS)
  - The ERIS project was:
    - a permitting and I&E system
    - conventional RDBMS technology
    - without spatial analysis capabilities and without funding to move from points.





# *Why create unified national coal mining geospatial standards?*

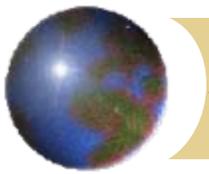


## ● Litigation → a case study

■ Then came the Bragg (Mountain Top Mining) case

■ Unfortunately non-spatial ERIS could no answer basic Bragg geospatial questions ...

- How many acres had been mountain top mined in the State?
- How many valley fills had actually been constructed?
- How many miles of streams had been impacted?



# *Why create unified national coal mining geospatial standards?*

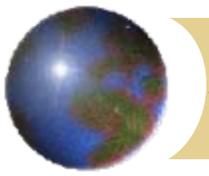


- Litigation → a case study

- More than **\$4,000,000** in litigation costs later ...

**funding became available to move from a point dataset to a more appropriate geospatial model for mining data.**

- In 1999, after an initial demo project developing a multi-layer dataset of just mountain top mining permits, ERIS points were overlaid on the newly created polygons to re-examine the point dataset's accuracy → 46% of the points **DID NOT** fall within their matching polygon.

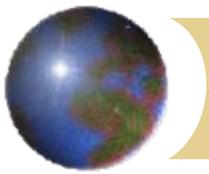


# *Why create unified national coal mining geospatial standards?*



- Moving beyond representing mining features as a single point greatly improved our situation but ...

all certainly isn't perfect →

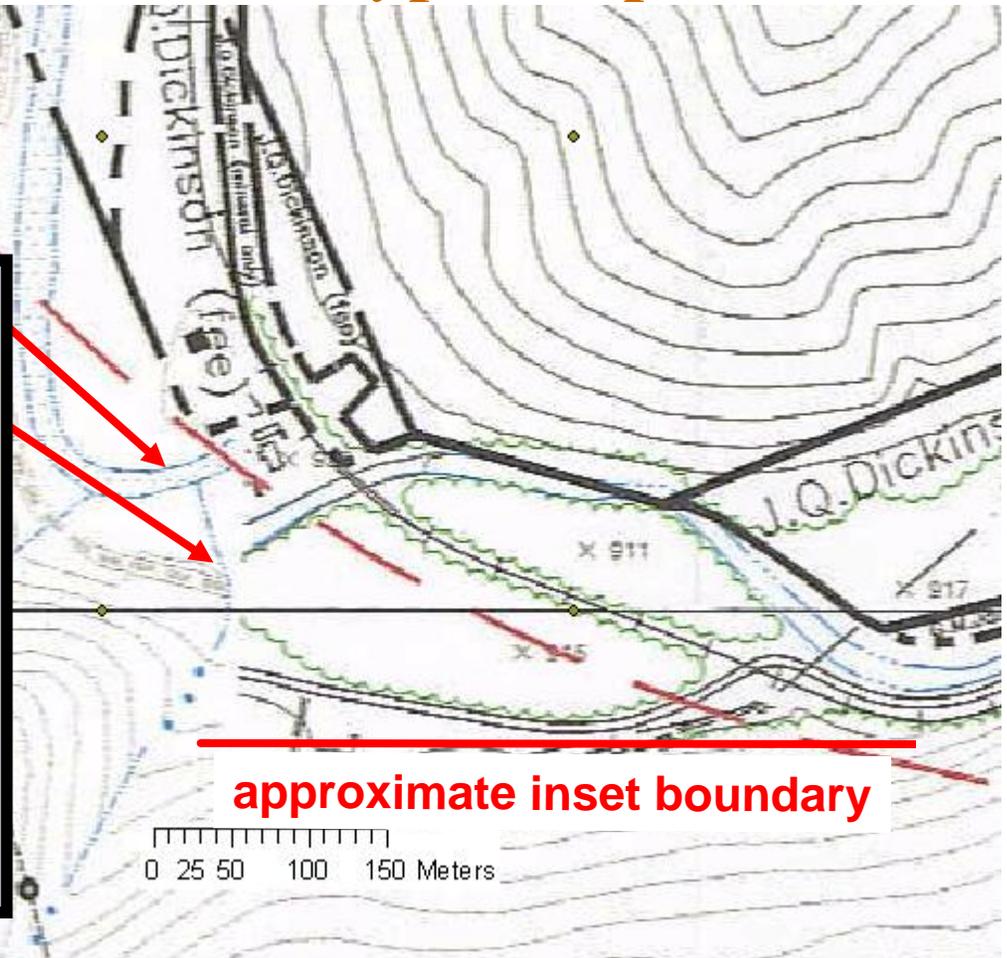


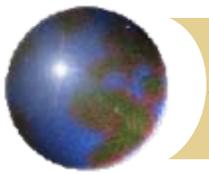
# *Why create unified national coal mining geospatial standards? → typical problems*

**Stream, outset layer**

**Stream, inset layer**

The applicant tried to combine layers derived from a USGS quad with an inset area containing more detail. The result is badly misaligned. To georeference the map using both data sources produces unacceptable error. Also brings into question the care taken to ensure relative and absolute accuracy for other map layers.

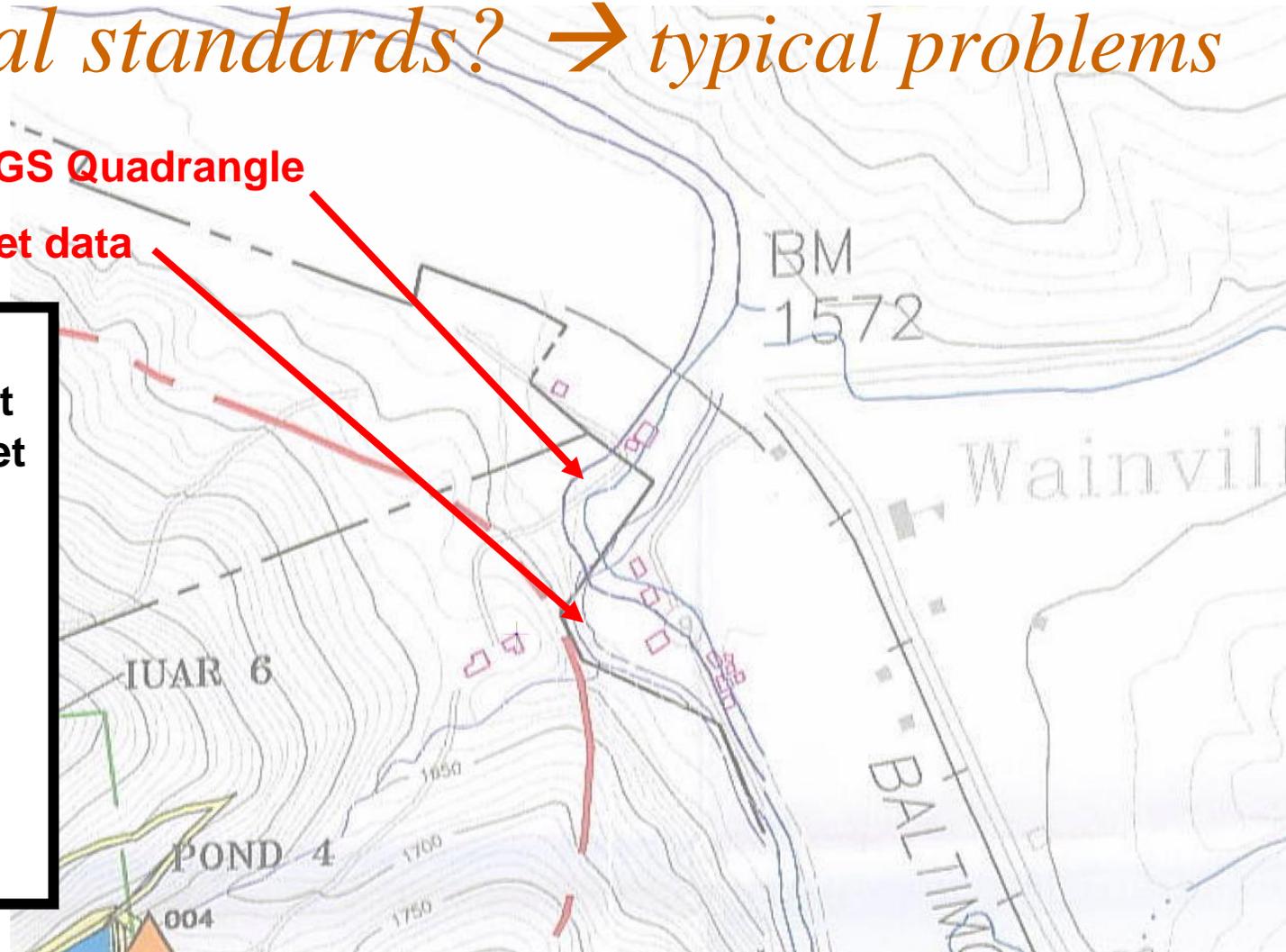




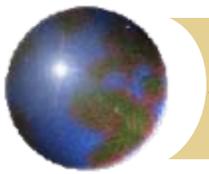
# *Why create unified national coal mining geospatial standards? → typical problems*

**Stream, from USGS Quadrangle**

**Stream, from inset data**

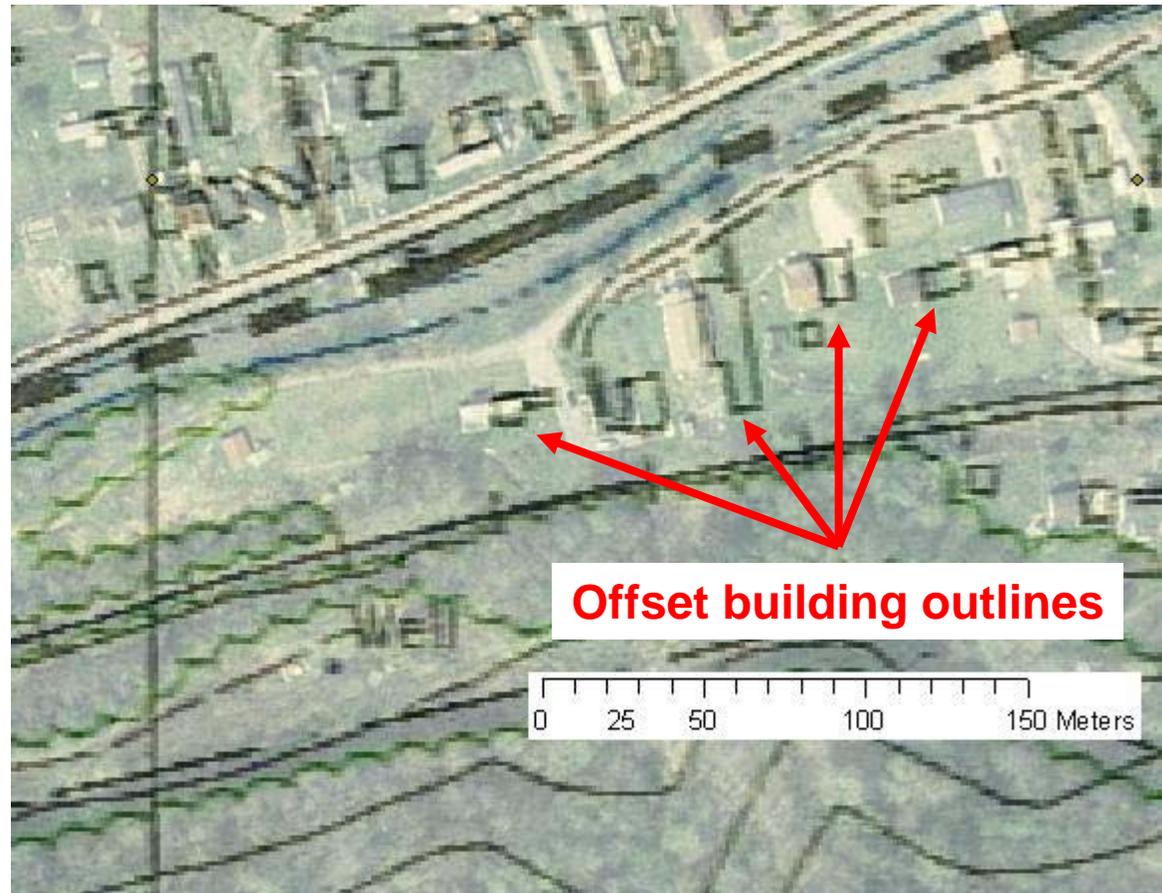


**This map is similar to the last ... a detailed inset was combined with layers derived from USGS quadrangles. Again the two data sources do not align.**



# *Why create unified national coal mining geospatial standards? → typical problems*

**Semi-transparent permit map over a 2' pixel resolution orthophoto. Buildings offset is 15-meters to the east. The map was rectified to the state plane grid depicted on the map. Shift is not caused by a datum mismatch.**



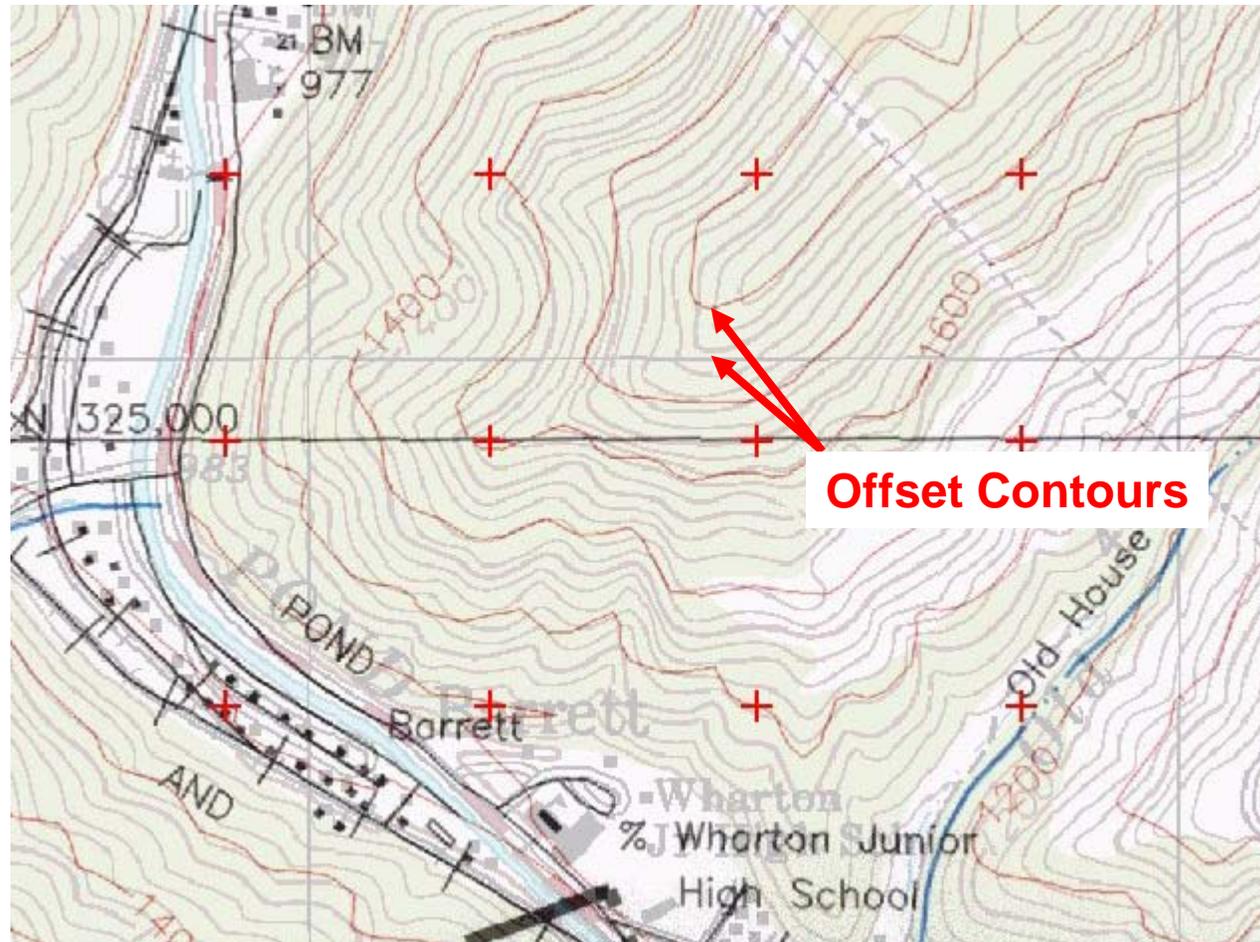
**Offset building outlines**

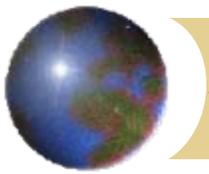
0 25 50 100 150 Meters



# *Why create unified national coal mining geospatial standards? → typical problems*

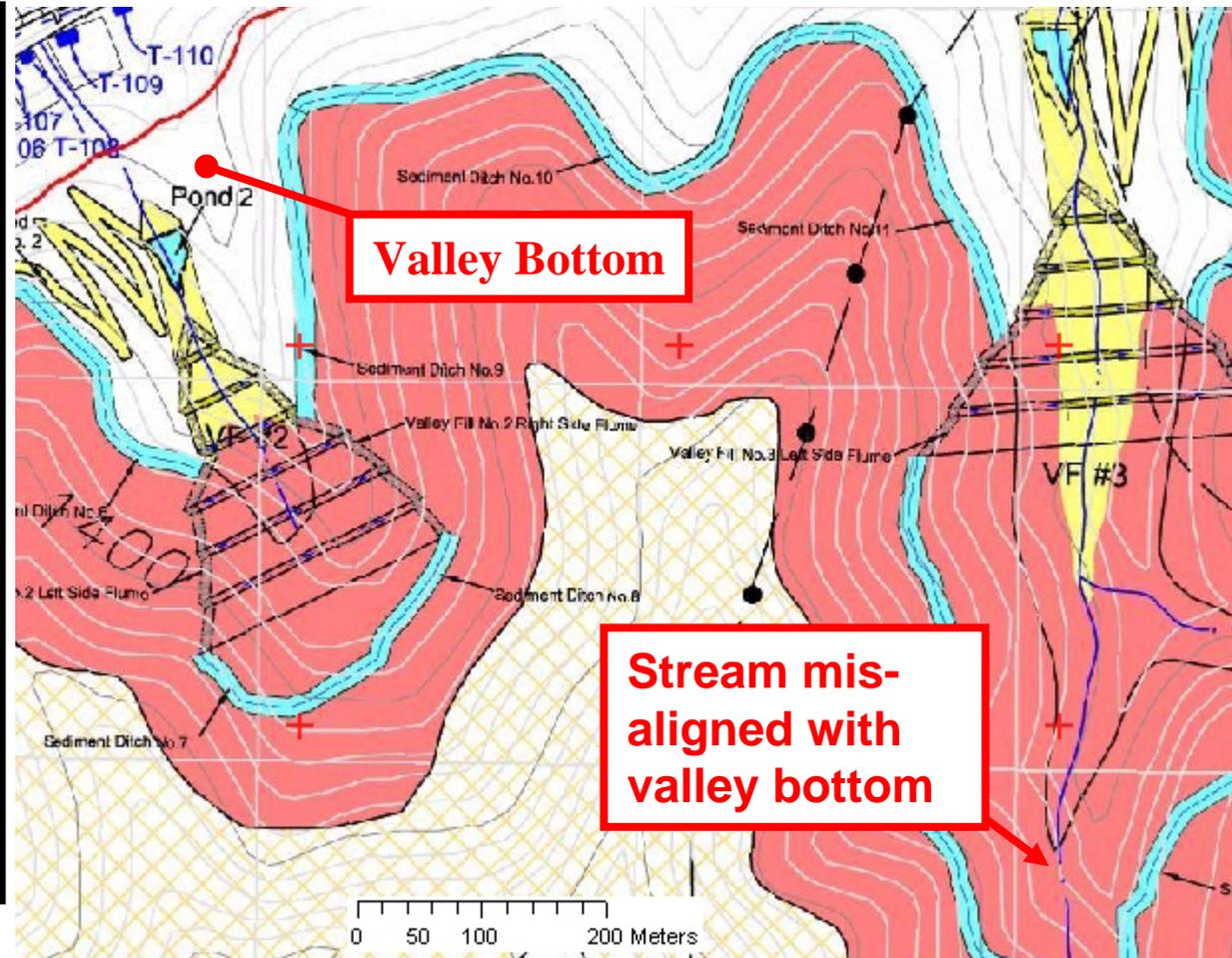
**Semi-transparent permit map shown over USGS quadrangle. Map was rectified to the state plane grid with good alignment of cultural features. Contours on the two sources remained significantly offset.**

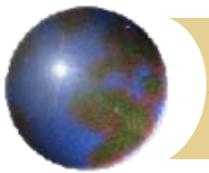




# Why create unified national coal mining geospatial standards? → typical problems

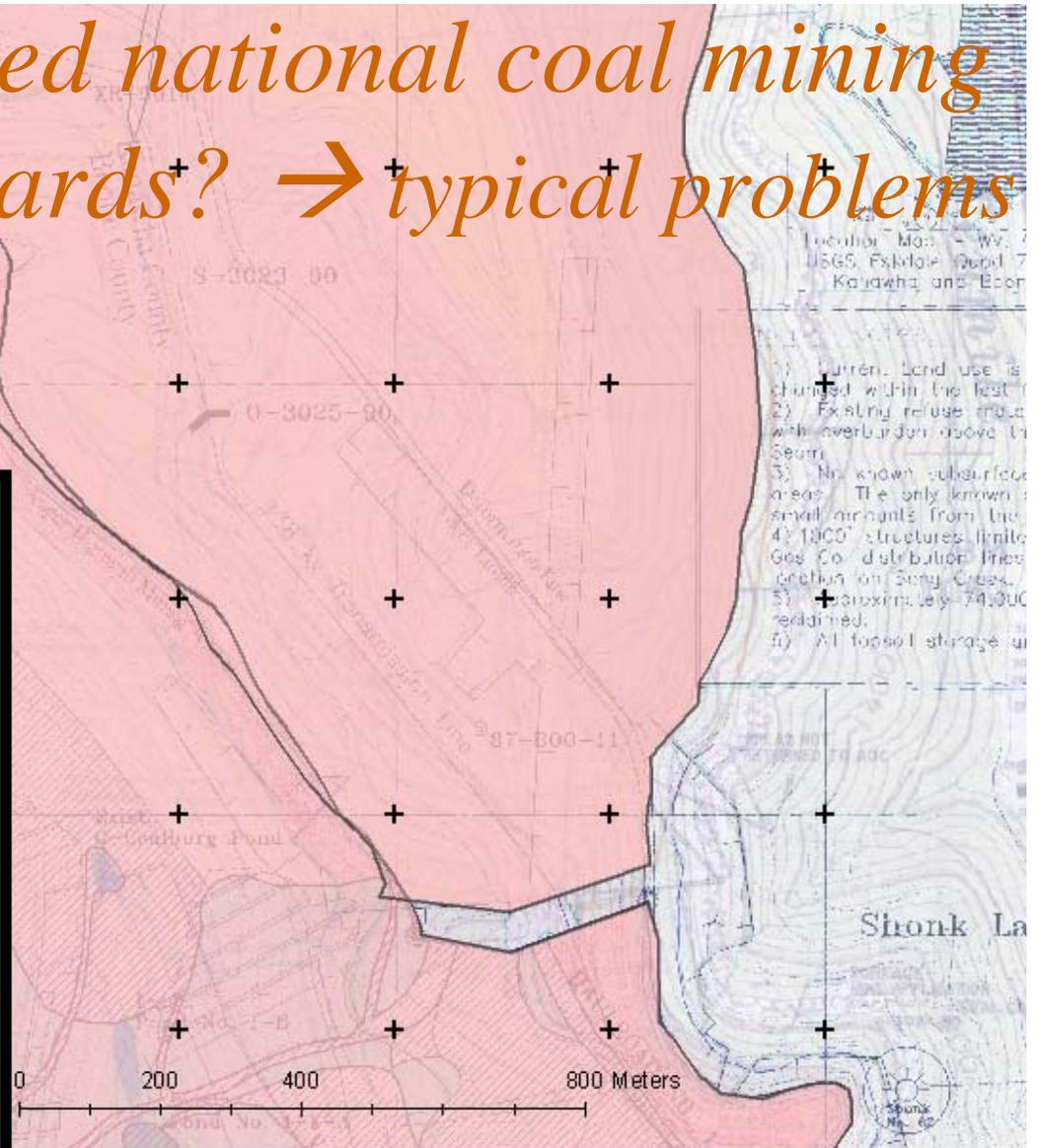
Map with contours that do not match other features. The 2 valley fills will be built along the side of a hill, 50 meters southwest of the bottom of their respective valleys. Attempting to rectify this map based on the contours (which match USGS quadrangles) would cause the entire permit boundary to be incorrectly located.

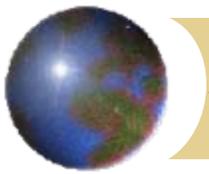




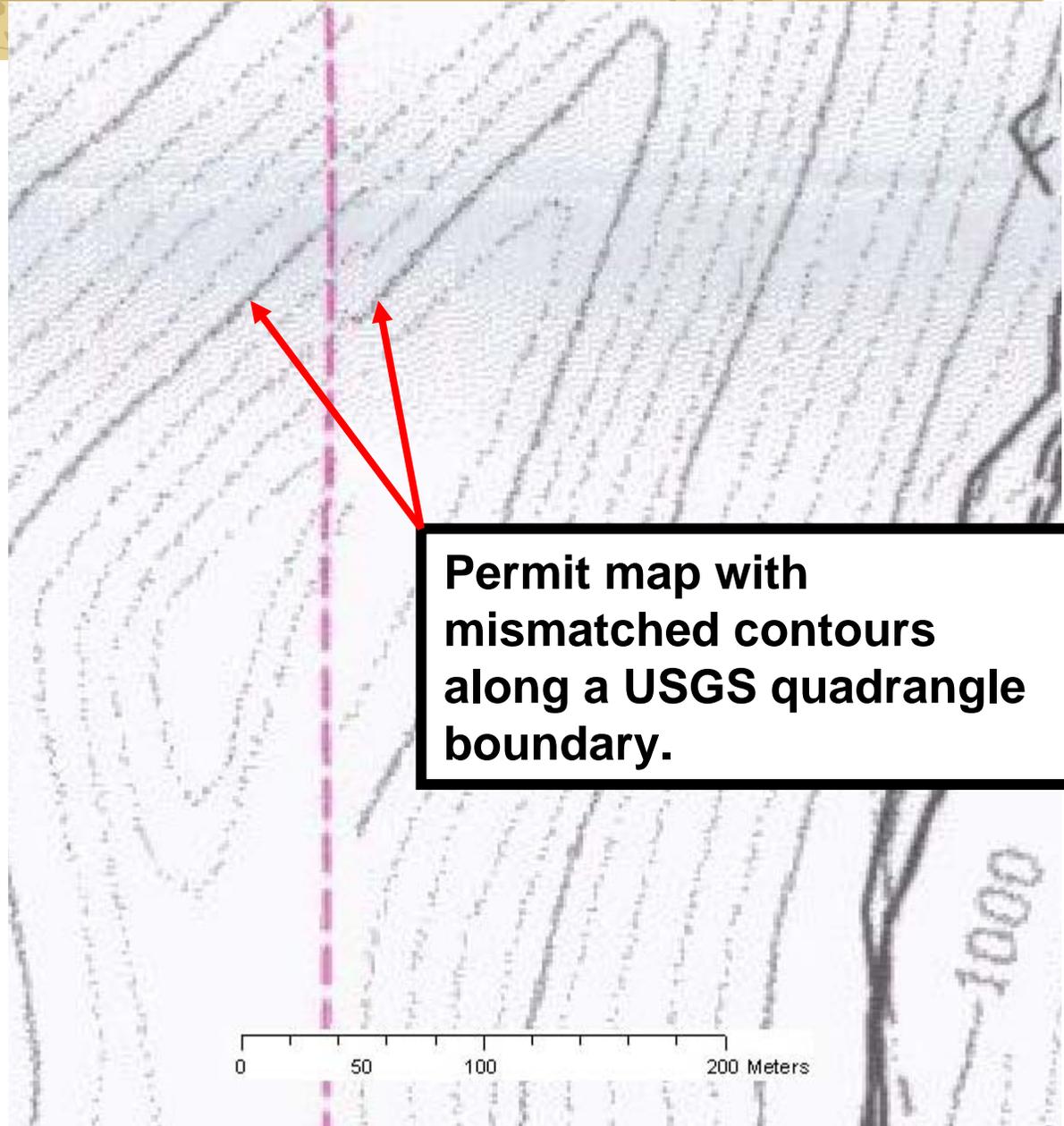
# *Why create unified national coal mining geospatial standards? → typical problems*

**Both permits shown were issued to the same company. Top map used a 1:24,000 scale USGS map background. The bottom permit map included a state-plane grid. Both maps could be reliably georeferenced with minimum error. The maps should indicate a shared boundary between permits without gaps or overlay.**

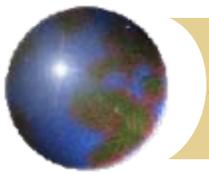




*Why create  
unified  
national  
coal  
mining  
geospatial  
standards?  
→ typical  
problems*



**Permit map with mismatched contours along a USGS quadrangle boundary.**

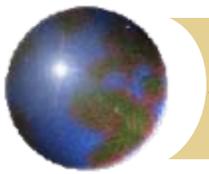


# *So ...why create unified national coal mining geospatial standards?*

- 20<sup>th</sup>. century maps still rule & resulting error kills.
- Far more permit mapping problems will be found if submittals are accurate, digital spatial data created to a national standard.
- Lives WILL be saved!



**Governor of Pennsylvania et. al. look at paper map during Queecreek rescue.**



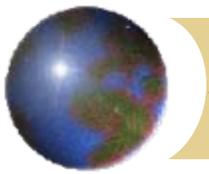
# *Why create unified national coal mining geospatial standards?*

- Mining accidents & disasters

- Recent

- Quecreek

The United States Mine Safety and Health Administration issued a report on 7/24/06 citing **faulty maps** as a cause for the Quecreek Mine disaster in June 2002, where nine miners were trapped for 4 days. According to the report, "The **primary cause of the water inundation** was the use of an undated and uncertified mine map of the Harrison No.2 mine."



# Why create unified national coal mining geospatial standards?

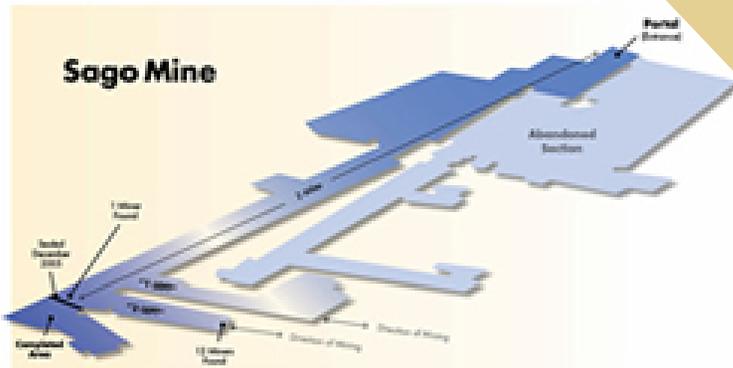
## ● Mining accidents & disasters

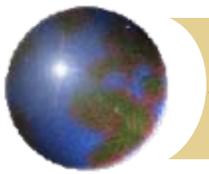
### ■ Recent

- Quecreek
- Sago



Local Trimble geodetic survey expert called in to survey spot to drill. Hours later drilling begins. The delay ... establishing **survey control to drill required** creating a link to a rover positioned on a known point outside the permit boundary.





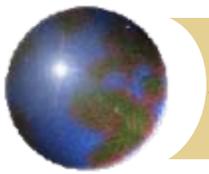
# *Why create unified national coal mining geospatial standards?*

## ● Mining accidents & disasters

### ■ Recent

- Quecreek
- Sago
- Aracoma

*“Timmy Paul Morgan, who died April 9 of a heart attack, gave a statement to an attorney representing the widow of Mr. Hatfield. In that statement, **Mr. Morgan** said rescue team members **complained that the map they were given to search for the missing men was inaccurate**, showing doors and stoppings in places that did not exist.”*



# *Why create unified national coal mining geospatial standards?*

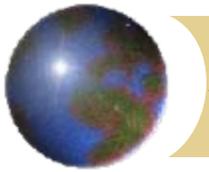
## ● Mining accidents & disasters

### ■ Recent

- Quecreek
- Sago
- Aracoma
- Searching Google for "mining accident" + map yields **54,100** hits



Unfortunately the importance of accurate  
radar!!!



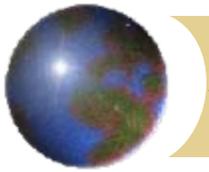
# *Why create unified national coal mining geospatial standards?*

## ● Mining disasters

### ■ Recent

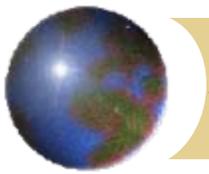
### ■ Possible future mining emergencies may extend across state boundaries

- A common national data structure and map accuracy standard will:
  - save time trying to combine dissimilar dataset from adjoining states and ...
  - eliminate future poor spatial accuracy problems.



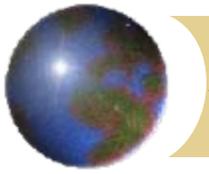
# *Why create unified national coal mining geospatial standards?*

- Could allow new users of this new national information asset
  - Federal → MSHA, DOE, BLM, etc.
  - State → Emergency response entities
  - Local → County, municipal.
  - Others interested in sharing national mining geospatial data assets.



# *Why create unified national coal mining geospatial standards?*

- Could substantially enhance OSM's e-Permitting initiative.
  - Speed up the permit review process
- Public's right to know
  - Allow a check for mining below properties that are changing hands → Subsidence
  - Proximity of schools, residences, businesses, etc. to mining related features:
    - Impoundments
    - Valley fills
    - Abandoned portals

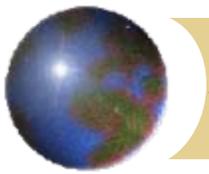


# *Why create unified national coal mining geospatial standards?*

## ● Benefits to industry

### ■ Reduced liability

- Fewer accidents caused or aggravated by poor mapping → **Queecreek**
- Fewer emergencies situations in which rescues are impeded by inaccurate mapping → **Aracoma, Sago**



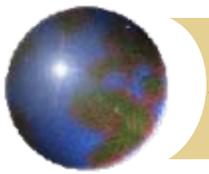
# *Why create unified national coal mining geospatial standards?*

## ● Benefits to industry

- Fewer conflicts with other interested parties.
  - Oil and gas pipeline strikes
  - Cutting into oil and gas well casings
  - Etc.



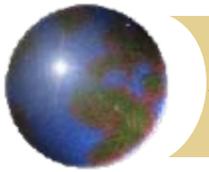
**February 1, 2006 Boone County, WV a front-end loader operator was killed removing material above a coal seam when his loader bucket penetrated a buried 20" high pressure natural gas transmission line.**



# *Why create unified national coal mining geospatial standards?*

- Fewer environmental catastrophes
  - Inez coal tailings dam failure →

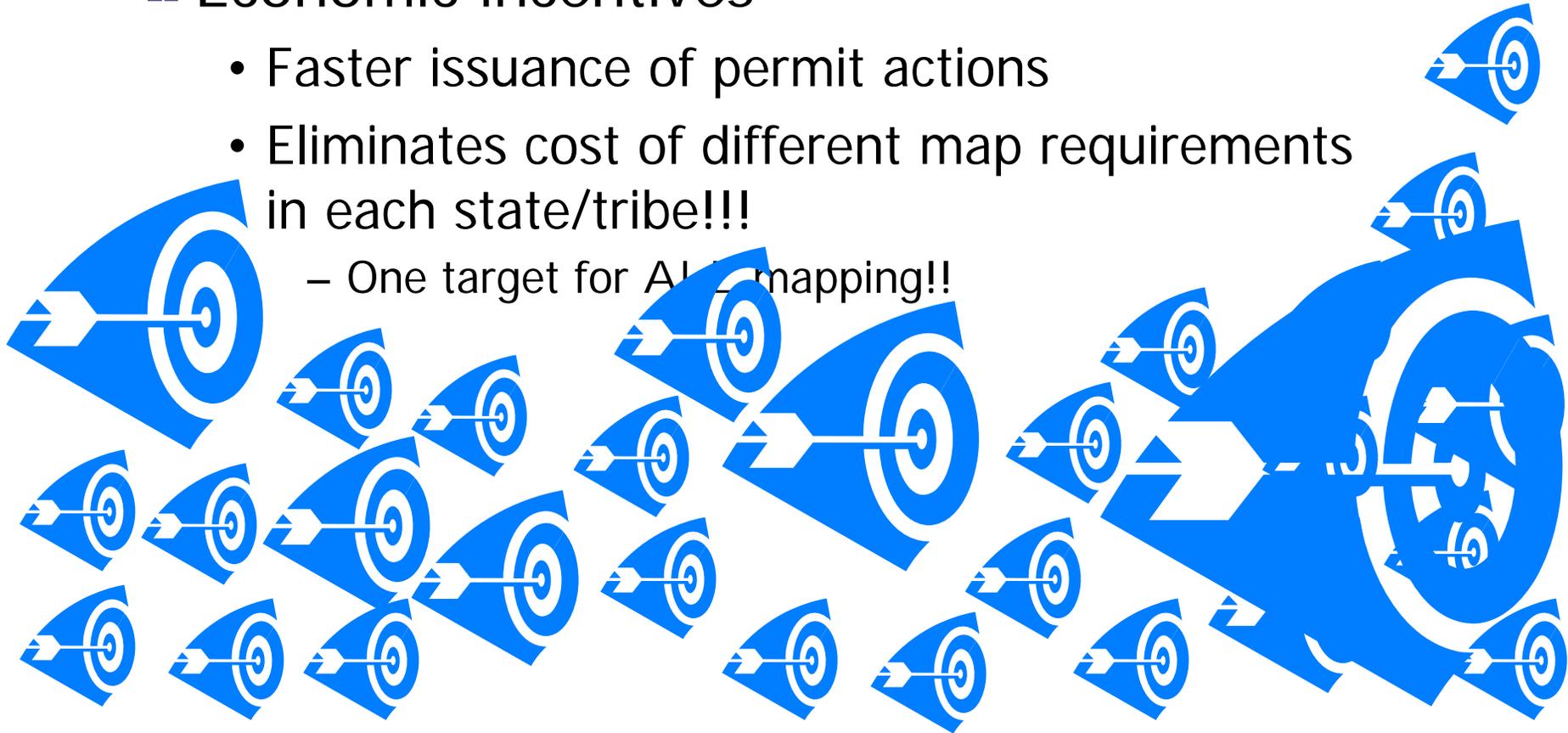
*“The investigation of the spill shows that **the protective barrier between an underground mine and the Martin County coal-waste impoundment was far thinner than regulators thought. Map information** Martin County Coal Co. gave the state in seeking a permit to expand the impoundment **showed** a barrier of about 70 feet (21 m) between the bottom of the impoundment and the mine. However, ... the **barrier was** apparently **less than 10 feet** (3 m) thick.”*

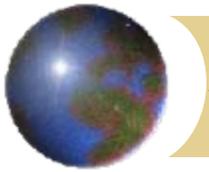


# *Why create unified national coal mining geospatial standards?*

## ■ Economic incentives

- Faster issuance of permit actions
- Eliminates cost of different map requirements in each state/tribe!!!
  - One target for ALL mapping!!





# *Technology improvements making this vision possible*

## Recent

- ArcGIS software accommodates different projections and/or datums in the same desktop session → each state can keep data in the projection/datum already decided on.
- **ALL** mining data can share a core set of attributes of national interest and still have State/Tribe unique tables preserving existing attributes.

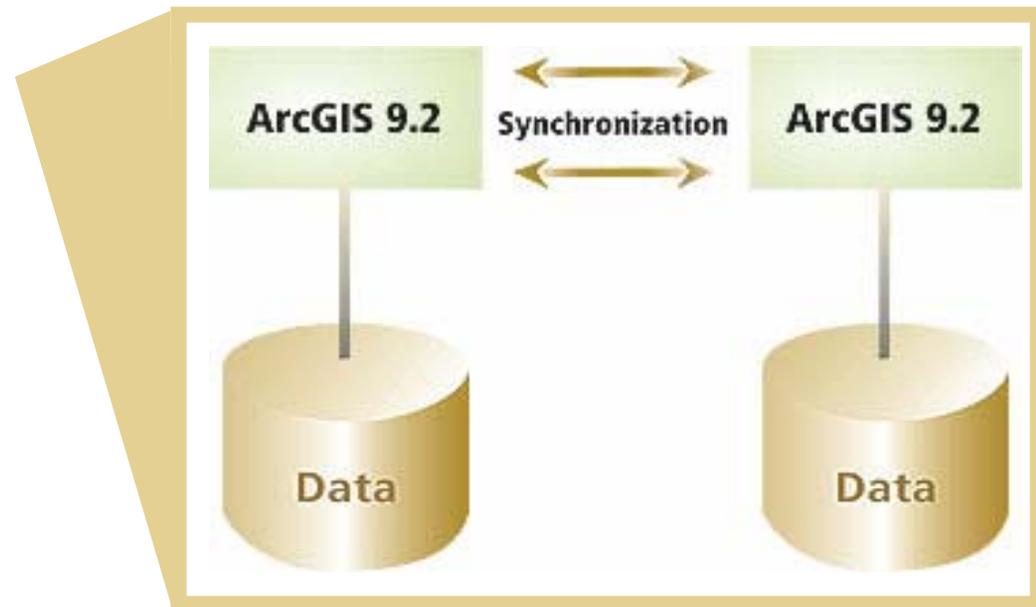


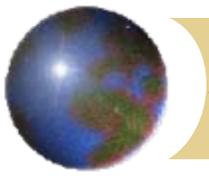
# *Technology improvements making this vision possible*

## ⊕ Future

### ▣ ArcGIS enterprise features

- Database synchronization





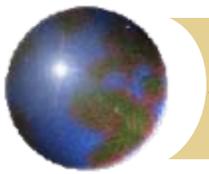
# *Technology improvements making this vision possible*

## ⊕ Future

### ⊞ ArcGIS enterprise features

- Database synchronization
- **Versioned data replication**

The challenge of providing distributed users access to federated databases (a single logical database spread over several network nodes) is addressed in ArcGIS 9.2. It allows a version of a geodatabase to be replicated to another geodatabase.



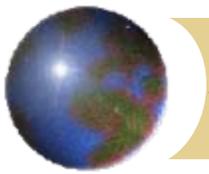
# *Technology improvements making this vision possible*

## ● Future

### ■ ArcGIS enterprise features

- Database synchronization
- Versioned data replication
- **Nonversioned editing**

**Prior to ArcGIS 9.2, a geodatabase could only be edited by multiple users if it had been versioned. This included all spatial and nonspatial database tables. At ArcGIS 9.2, multiuser editing is possible without versioning.**



## *Should you volunteer to participate?*



To answer that question consider whether you would trust your life to be saved using the paper maps we receive today??