Pennsylvania Mine Map Grant Project

NAAMLP 2014 Conference

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PA Department of Environmental Protection
Mine Map Grant Project

• Competitive Grant for Educational Institutions and Not-for-Profit Organizations
• Restore, Scan, Catalog, Georeference, and Vectorize Underground Coal Mine Maps
• $1.65M available over first 3-year grant cycle
• 7 Organizations awarded Grants in 2013
Tracking of Underground Mine Workings

- Earliest mine maps date to mid-1800’s
- Originally hand drafted on canvas-backed paper
- Later, traced on linen or blue-print copies
- More modern maps plotted on digital printers
Why is this information important?

• Mine Subsidence Insurance Program
  – Allows public to know if home is at risk

• Mine Safety
  – Prevent future mining into abandoned mine workings filled with water and/or gas

• Mine Reclamation Projects
  – Identify potential sources of water discharges
  – Identify locations / size of underground voids for grouting
Why is this information important?

• Oil and Gas Drilling
  – Proper casings through coal seam to prevent gas migration

• Make Government More Efficient
  – Allows for more timely permitting

• Civil Construction
  – Plan proper support over voids
  – Prevent accidentally exposing workings and causing water discharges
• What happened to the Maps over time?
  – Scattered over various sources
  – Maps stored in poor conditions
  – Many damaged and lost over the decades
Where are the Mine Maps now?

- PA DEP / DCNR Offices
- Educational Institutions
- Mining Company Collections
- Coal Heritage Museums
- County Courthouses
- Private Collections
How many maps are there?

- DEP has ~60,000 paper mine maps
  - Most scanned, but not to DEP standards
  - ~35,000 scanned to standards
  - Duplications in different offices, need to eliminate

- Continuous intake from outside collections
  - DCNR alone has ~15,000 paper maps
  - New private collections found all the time
Project Goals

• Create a Digital Mine Map Archive for better storage to prevent lost.

• Improves quality, quantity, and delivery methods of mining information to PA residents and industry.

• Provides learning and real world experience in geospatial technologies to students of grantees.
“These grants create an important partnership between DEP and institutions of higher education, develop a skilled workforce for the energy sector, and continue to ensure a safe working environment for Pennsylvania’s miners.”

Governor Tom Corbett
The Grantees

• 2013 – 2016 Mine Map Grantees
  – California University of Pennsylvania (Cal U)
  – Eastern PA Coalition of Abandoned Mine Reclamation (EPCAMR)
  – Harrisburg University of Science and Technology (HU)
  – Harrisburg Area Community College (HACC)
  – Indiana University of Pennsylvania (IUP)
  – University of Pittsburgh Archives Services Center (PITT)
  – Saint Vincent College (StV)
Mine Map Grant Project

• DEP Duties
  – Project Managers
  – Determine mapping priorities/distribute work
  – Provide technical support
  – Quality control completed data
  – Review and approve/deny payments
  – Incorporate into PA DEP’s Digital Map Mine Repository
  – Provide online access through PASDA
Grantee Duties

- Restore maps to workable condition
- Scan mine maps to DEP standards
- Update PHUMMIS database with map data
- Georeference maps to overlay on aerial images
- Vectorize/digitize various features from maps
- Provide deliverables to project managers
- Re-process work determined not to DEP standards
Mine Map Grant Project

First round 3 year awards and goals:

- Cal U: $85,934
  - Georeference and Vectorize 540 maps
- EPCAMR: $321,968
  - Scan 80,000 maps, Georeference 2500 maps, Vectorize 1000 maps
- Harrisburg University: $299,534
  - Scan 4,000 maps, Georeference and Vectorize 500 maps
Mine Map Grant Project

• First round 3 year awards and goals:
  – HACC : $122,101
    • Scan, Georeference and Vectorize 500 maps
  – IUP:  $484,631
    • Scan 16,348 maps and Georeference 8,848 maps
  – PITT: $225,000
    • Restore and preserve 100 maps
  – St Vincent: $110,832
    • Georeference and Vectorize 360 maps
University of Pittsburgh Archive Services Center

Pittsburgh Coal Company canvas hard-back collection donated by CONSOL Energy

Previously 633 of ~800 maps were restored
  – Ideal candidate for grant

Restoring 100 total maps under first round of Mine Map Grant
Mine Map Grant - Restoration
Mine Map Grant - Restoration
• Creating an Archive Quality Digital Mine Map Image

• Current Scanning Standards:
  – Uncompressed tagged image file format (TIFF)
  – 400 dpi (230 dpi for large format maps)
  – 24-bit RGB color depth

• File Size ~ 0.5 GB to 2 GB
Mine Map Grant - Scanning
Mine Map Grant - Scanning
Mine Map Grant - Scanning

• Storing the Image Files at DEP
  – IBM x-Series server and storage array
    • ~76 terabytes configured capacity
    • ~40 terabytes used for digital map images
    • Expandable storage array for future needs
  – IBM TS3200 Library for off-site tape back-up
  – PASDA secondary back-up
Mine Map Grant - Cataloging

- Pennsylvania Historic Underground Mine Map Inventory System (PHUMMIS)
- Metadata entered as map is scanned
  - Mine Name
  - Operator
  - Coal Seam
  - etc.
  - Scale
  - Location
  - Survey Dates
PHUMMIS - Add Sheet

Fields Preceded With an Asterisk (*) are Required.

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Mines

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Add New Mine to Sheet

Save All Information on Sheet  Cancel
• Aligning a scanned map image to a known coordinate system so it can be viewed and analyzed with other geographic data at the same spatial location.
  – Done with ESRI’s ArcMap software
  – Images can then be used in other Geographic Information Systems (GIS)
• Post-Processing of Images for use in GIS
  – Stitching Multiple Scenes
    • Photoshop CS6’s Photo Merge Tool
  – Convert TIFF to Mr.Sid file format
    • Lizardtech’s GeoExpress 8.5
    • Compression at 20:1 size ratio
    • Faster display refresh
    • Reduced network bandwidth for file transfer
Mine Map Grant - Georeferencing

• 4 Coordinate/Projection Systems are allowed
  – All in North American Datum 1983 (NAD83)
    • NAD 83, UTM Zone 17 North
    • NAD 83, UTM Zone 18 North
    • NAD 83, State Plane Pennsylvania South (US feet)
    • NAD 83, State Plane Pennsylvania North (US feet)
Mine Map Grant - Georeferencing

• Require 4 Matching Control Points
• Source Control Point Selection (surface features drawn on the scanned map image)
  – Coordinate Points
  – Road Intersections
  – Bridges / Culverts
  – Structures
  – Property Lines
Mine Map Grant - Georeferencing

- Georeferencing Target Priorities:
  1. Projected Coordinate Points
  2. Aerial Orthoimagery
  3. USGS Topographic Maps
  4. Historic Aerial Imagery (Penn Pilot)
  5. County-supplied Property Parcel Shapefiles
  6. Historic USGS Topographic Maps
  7. Adjacent Georeferenced Mine Maps
Mine Map Grant - Georeferencing

• Limitations
  – Unknown coordinate systems of mine maps
  – Lack of surface control points (i.e. roads, streams, property lines) or movement over time
  – Original draftsmanship
  – Image distortions from paper aging

• Non-Quantitative Accuracy
  – Visual inspection comparison to base maps
  – Field survey to verify before a project
Mine Map Grant - Georeferencing
Mine Map Grant - Vectorization

• Heads-Up Method of Vectorization in GIS
• Also known as “Digitizing”
• Features Being Captured:
  – Mined Out Area Extents
  – Coal Seam Elevations
  – Mine Openings
Mine Map Grant - Vectorization

- Heads-Up Vectorizing Mined Area
• Coal Seam Elevation
  – Interpolated to make Coal Seam Elevation Model
  – “Subtract” from Digital Elevation Models (DEM) to make an Overburden Model
Mine Map Grant - Vectorization

- Overburden Models
Mine Map Grant - Vectorization

• Mine Openings

Shafts

Drifts/Slopes
Mine Map Grant - Vectorization

- Mine Openings
Tracking Completed Grant Work

• PHUMMIS Inventory Control Report
Public Access to Mine Maps

- Pennsylvania Spatial Data Access (PASDA)
  - [www.pasda.psu.edu](http://www.pasda.psu.edu)
  - Administered by Penn State Institutes of Energy & the Environment (PSIEE)
  - FTP of Vector Data and Mine Map Images
  - Interactive Online Imagery Viewer
Public Access to Mine Maps

- Mine Map Scans available on PASDA’s FTP
  - 35,100 Archive TIFF images
  - 33,917 Un-georeferenced MrSid images
  - 10,015 Georeferenced MrSid images
  - ftp://data1.commons.psu.edu/pub/minemaps
Public Access to Mine Maps

- Georeferenced MrSid images on PASDA
  - MrSid Image File
  - .xml file of Metadata
  - 3 georeferencing information files:
    - .sid.aux.xml – Auxiliary file for use in ESRI products
    - .sdw – MrSid World File for use in AutoCAD and ESRI
    - .wld – World file for use in MapServer
Public Access to Mine Maps

- Links in external version of PHUMMIS
- [www.ahs2.dep.state.pa.us/PHUMMISExternal](http://www.ahs2.dep.state.pa.us/PHUMMISExternal) (or Google search “PHUMMIS”!)
Pennsylvania Mine Map Atlas

- Search by Address
  - See what is under your house
- Search by Latitude / Longitude
  - Oil & Gas Well location planning
Pennsylvania Mine Map Atlas

- Click for a pop-up of a list of available maps
- “Download” = Georeferenced MrSID from FTP
- “Map Details” links to PHUMNMIS record
• Additional features
  – “Highlight(Off)” toggles index Feature to see map extents
  – Adjust transparency of map
  – Measure Toolset for area, distance, or get Latitude/Longitude
  – Print PDF, PNG, or JPG to file
Thank You!

RA-MMG@pa.gov
www.dep.state.pa.us
www.pamsi.org
724-769-1100

*Please contact us if you know the location of any mine map collection.