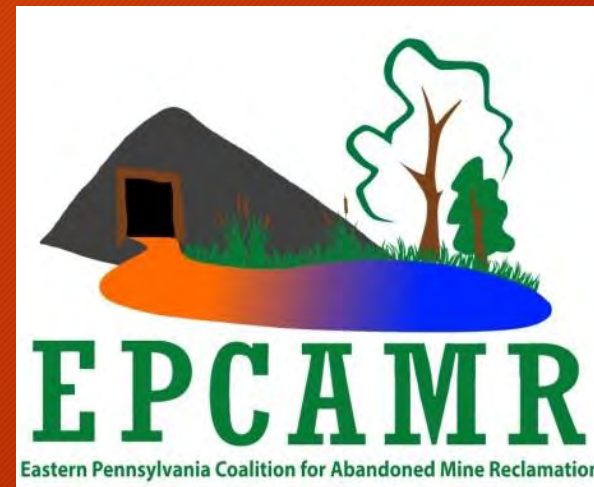




The Watershed Congress Along the Schuylkill



Key Challenges & Opportunities in dealing with (AMD) and Underground Mine Pools Across PA

Robert E. Hughes

Executive Director

Eastern PA Coalition for Abandoned Mine Reclamation (EPCAMR)

rhughes@epcamr.org

www.epcamr.org; #EPCAMR on Twitter ; EPCAMR on FaceBook

www.treatminewater.com



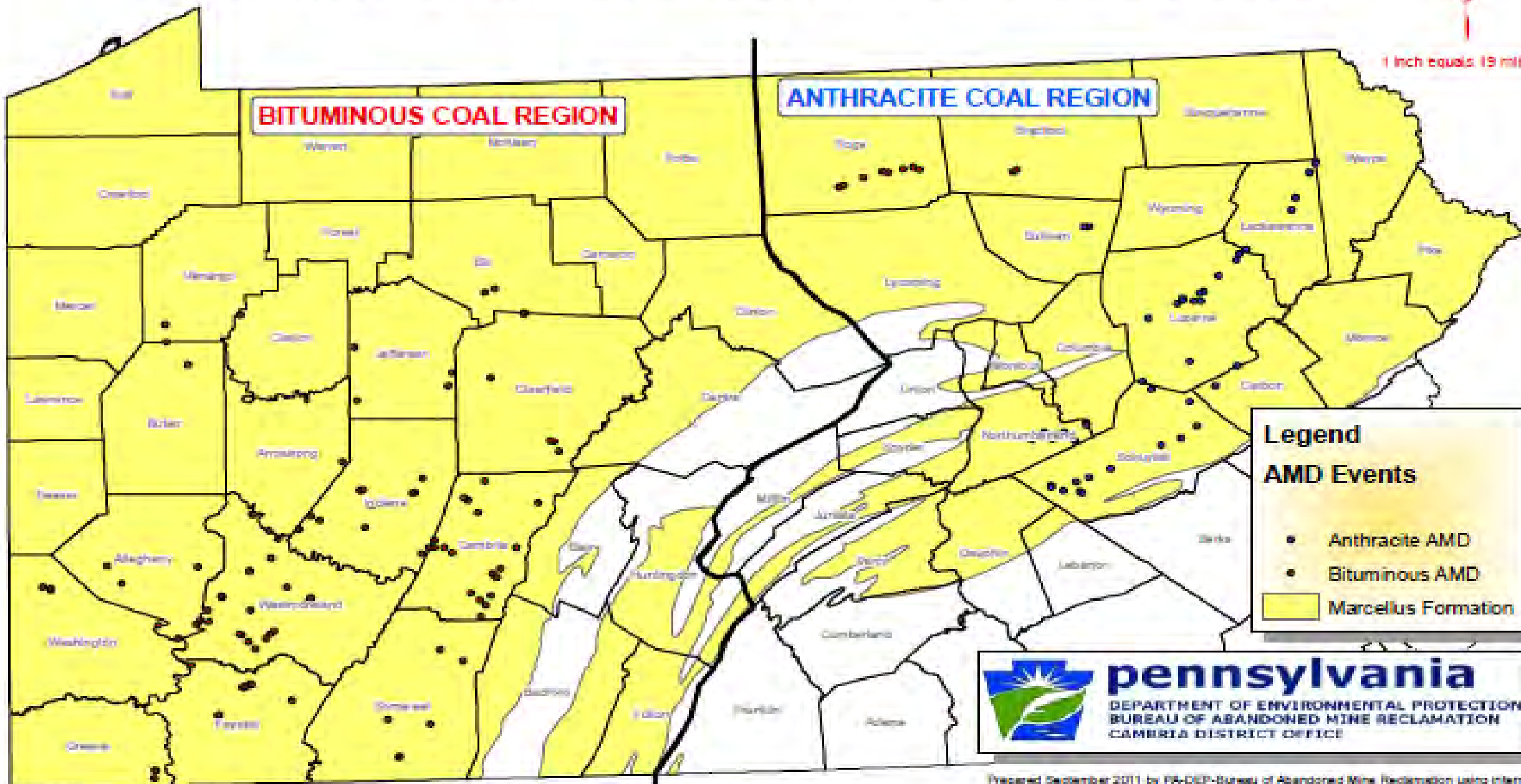
SIGNIFICANT ABANDONED MINE DISCHARGES IN PENNSYLVANIA



1 Inch equals 19 miles

BITUMINOUS COAL REGION

ANTHRACITE COAL REGION



Legend

AMD Events

- Anthracite AMD
- Bituminous AMD
- Marcellus Formation



pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF ABANDONED MINE RECLAMATION
CAMBRIDGEMOUNTAIN DISTRICT OFFICE

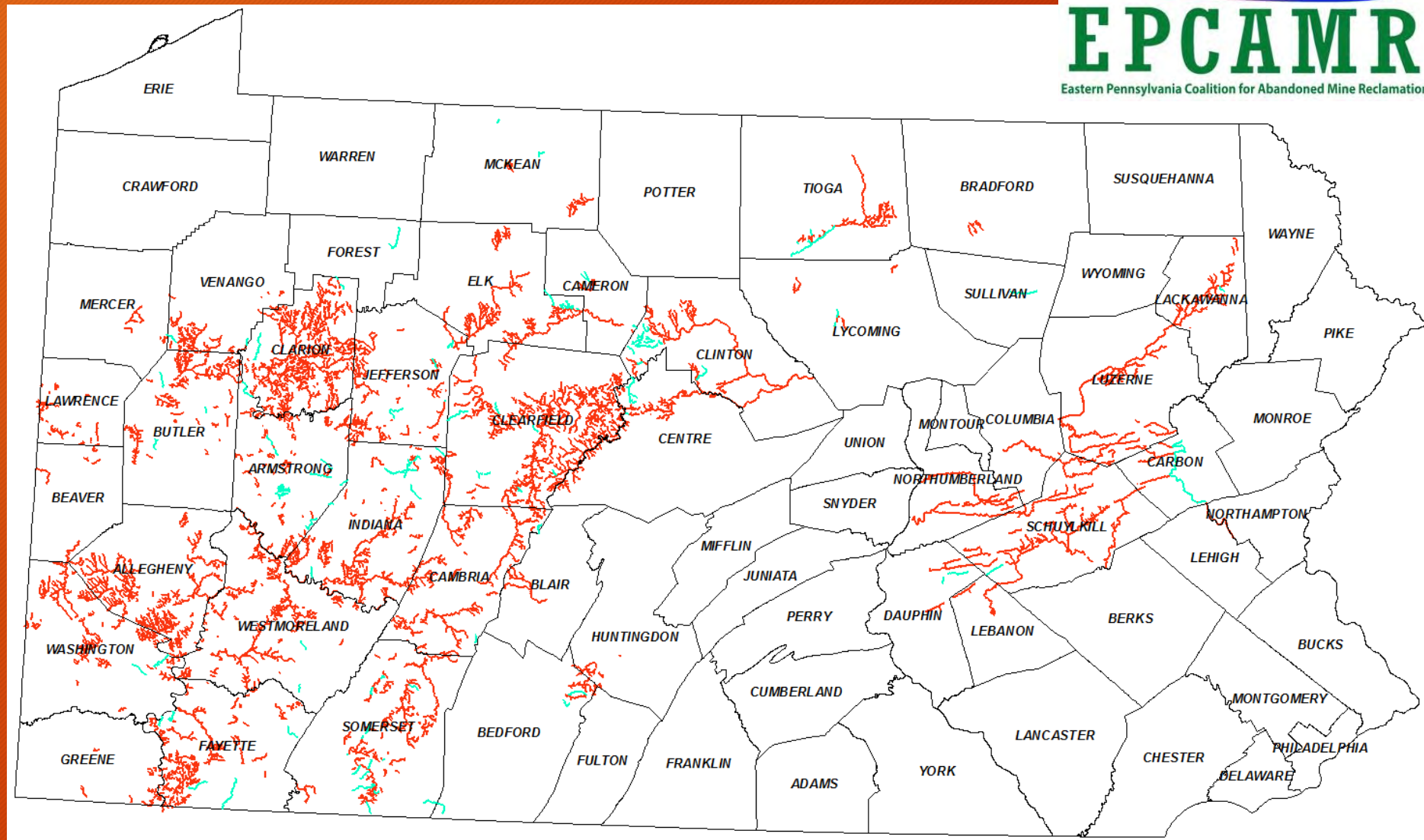
Prepared September 2011 by PA-DEP-Bureau of Abandoned Mine Reclamation using internal sources and data from the USGS (C.A. Chivetta II / Applied Geochemistry 23 (2008) 188-202)

432.5 stream miles formerly impacted by AMD now cleaned up in PA since 1996 according to the 2015 PA DEP Integrated Waters List and Assessment Department databases.



- Datashed lists
- 21 Active Treatments Systems
 - 321 Passive Treatment Systems
 - There are a total of 5,594 stream miles still impacted

AMD Impacts Across PA



Challenges

- Conflicting priorities within PA Bureaus/Agencies for funding

- a. Comprehensive Plan for Abandoned Mine Reclamation (1998) Guidance

- i. PA DEP, 1998. PA's Comprehensive Plan for Abandoned Mine Reclamation



- b. Bureau of Conservation and Restoration (CWA Section 319(h) Funding from the US EPA & Growing Greener Plus Watershed Protection

- i. PADEP, 1999. A Model Plan for Watershed Restoration, by PADEP, USACOE, NRCS, OSM, PA DCNR, EPCAMR, WPCAMR
 - ii. <http://www.portal.state.pa.us/portal/server.pt?open=514&objID=588907&mode=2#Appendix%20A>



- c. Commonwealth Finance Authority AMDTAP Marcellus Legacy Funding (Act 13)

- i. <http://www.newpa.com/find-and-apply-for-funding/funding-and-program-finder/abandoned-mine-drainage-abatement-and-treatment-program-amdatp>

Challenges



- Conflicting priorities within PA Bureaus/Agencies for funding
 - a. Federal Surface Mining Control & Reclamation Act Funding (Title IV & Set Aside Project Implementation Guidelines)
 - i. http://files.dep.state.pa.us/Mining/Abandoned%20Mine%20Reclamation/AbandonedMinePortalFiles/AMD_Set_Aside_Program_Guidelines_Revised_Draft_07_15_2009.pdf
 - a. PA Bureau of Abandoned Mine Reclamation's Hydrologic Unit Plans for AMD
 - b. Watershed Restoration Action Strategy Plans
 - i. http://www.depweb.state.pa.us/portal/server.pt/community/nonpoint_source_management/10615/watershed_restoration_actions_strategies/554276
 - c. PA DCNR Rivers Conservation Plans and Conservation Landscape Initiatives
 - i. <http://www.dcnr.state.pa.us/brc/conservation/rivers/riverresourceprogram/riversconservation/>
 - ii. <http://www.dcnr.state.pa.us/cli/>



Challenges

- Increasing the Awareness of the Environmental Good Samaritan Act Benefits
 - i. The EGSA provides certain protections from civil liability under state law to landowners or providers of equipment, materials or services at no charge or at cost for a “water pollution abatement project”—defined essentially as treatment of water pollution on abandoned mine lands or treatment of mine influenced water
 - ii. The protection provided by the EGSA includes liability for operating and maintaining water pollution abatement facilities constructed as part of an EGSA project
 - iii. A for-profit company can qualify as an Environmental Good Samaritan under EGSA as long as it meets the criteria in § 8105
 - iv. <http://www.amrclearinghouse.org/Sub/LEGAL/GoodSamaritanFactsheet.pdf>
 - v. <http://www.legis.state.pa.us/cfdocs/legis/LI/consCheck.cfm?txtType=HTM&t1=27&div=0&chpt=81>
(Link to Legislation)
- Establishment of Additional AMD Treatment Trust Funds for future Operation, Maintenance, Repair or Rehabilitation of AMD Treatment Systems

Challenges

- Management and Control of Underground Mine Pools Discharges Across PA
 - i. Directly linked to the majority of the large mine discharges in the Bituminous and Anthracite Region of PA
 - ii. Present substantial challenges in terms of both mitigation of environmental damage and alleviating health & safety impacts to residents, mine subsidence, watershed restoration and public infrastructure
 - iii. Vertical and Horizontal (Directional) drilling techniques need to be further evaluated across the Commonwealth for controlling mine pool hydraulic head and/or relocating discharges, conveyance structures to combine and/or redirect discharges
 - iv. Comprehensive hydrogeologic investigations need to be conducted to evaluate mine pool responses to precipitation events for future potential storage, in situ treatment, low flow augmentation, and controlled releases for consumptive use mitigation
 - v. Increasing the number of public/private partnership arrangements for treatment and reuse of mine pools that not only benefit the private sector, but will improve the land and waters impacted in the affected AMD impacted communities and watersheds

Challenges

- Availability of Accurate Underground Mine Maps
- Mine Pool Water Quality & Stratification
 - i. New Focus on Monitoring Needed
- Overburden Geology and Existing Infrastructure in the Coalfields
- Surface and Mineral Ownership including Solution Mining within the Mine Pools
- Conditions of the Underground Mine Workings
 - i. Flooded Workings
 - ii. Weak Roofs
 - iii. Flushing Projects
 - iv. Adjacent Fires
 - v. Subsidence Areas



Challenges

- Hydrologic Conditions of the Mine Workings
- Land Availability for future AMD Treatment Systems Construction
 - i. Over 300 systems constructed to date across PA
- Establishment of Conservation Easements along Right-of-Ways on private property to access AMD discharges for monitoring, conveyance, and or treatment
- Creation of economic redevelopment potential opportunities and incentives for incubator “green” industries and start-ups
 - i. developing ways to recover and sell metal oxides
 - ii. reuse the mine water for electricity
 - iii. low-flow augmentation
 - iv. consumptive use mitigation
 - v. fishery improvements



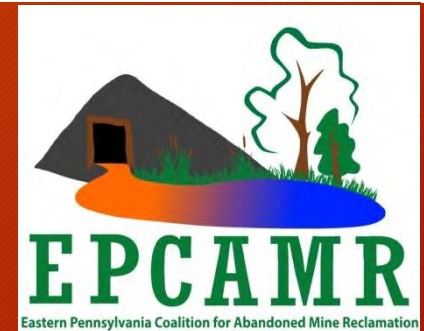
Opportunities

- Resurgence of the Grassroots Volunteer Watershed Movement Across PA

- Community Watershed Groups
- Foundation for PA Watersheds
- Pennsylvania Environmental Council
- Stream Restoration Inc.
- Trout Unlimited's Eastern Abandoned Mine Program
- Chesapeake Bay Foundation
- Delaware Riverkeeper Network
- PA Association of Conservation Districts
- Western PA Coalition for Abandoned Mine Reclamation
- Eastern PA Coalition for Abandoned Mine Reclamation
- Involvement of Historical Societies
- SRBC, ORSANCO, DRBC
- ARIPPA and the Co-Generation Plants
- Elementary Schools, High Schools, and Colleges and Universities
- Local governments, Conservancy Groups, & Land Trusts

- Clearinghouses of information

- www.amrclearinghouse.org
- www.epcamr.org
- www.treatminewater.com
- <http://www.minemaps.psu.edu/>
- www.pamsi.org



Opportunities

- Mine Influenced Water for Natural Gas Extraction Activities

- i. PA DEP has developed a “White Paper” outlining how the Commonwealth can promote the voluntary use of mine-influenced water by the oil and gas industry
- ii. Establishes a process for DEP to review & evaluate proposals to use mine-influenced water for natural gas extraction
- iii. However, additional considerations and technical comments should be built into this document
- iv. Use of AMD for the Development of Marcellus Shale Gas Wells in PA, provided that treatment is priority at the point of withdrawal
- v. http://files.dep.state.pa.us/Mining/Abandoned%20Mine%20Reclamation/AbandonedMinePortalFiles/MIW/Final_MIW_White_Paper.pdf

- Dashed

- i. Contains information about passive AMD treatment systems constructed across PA that details chemistry, flows, treatment system type, locations, responsible parties for operation & maintenance
- ii. <http://www2.datashed.org/>

- SRBC Mine Drainage Portal and Anthracite Region Mine Drainage Remediation Strategy

- i. This program involves assessment and restoration planning leading to design and construction of mine drainage treatment and/or mine land restoration projects
- ii. <http://mdw.srbc.net/minedrainageviewer>
- iii. http://www.srbc.net/pubinfo/techdocs/Publication_279/techreport279.htm

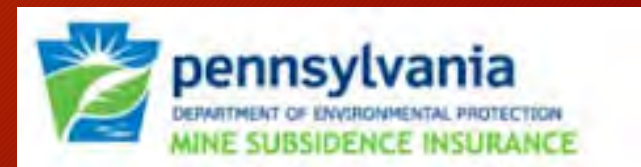


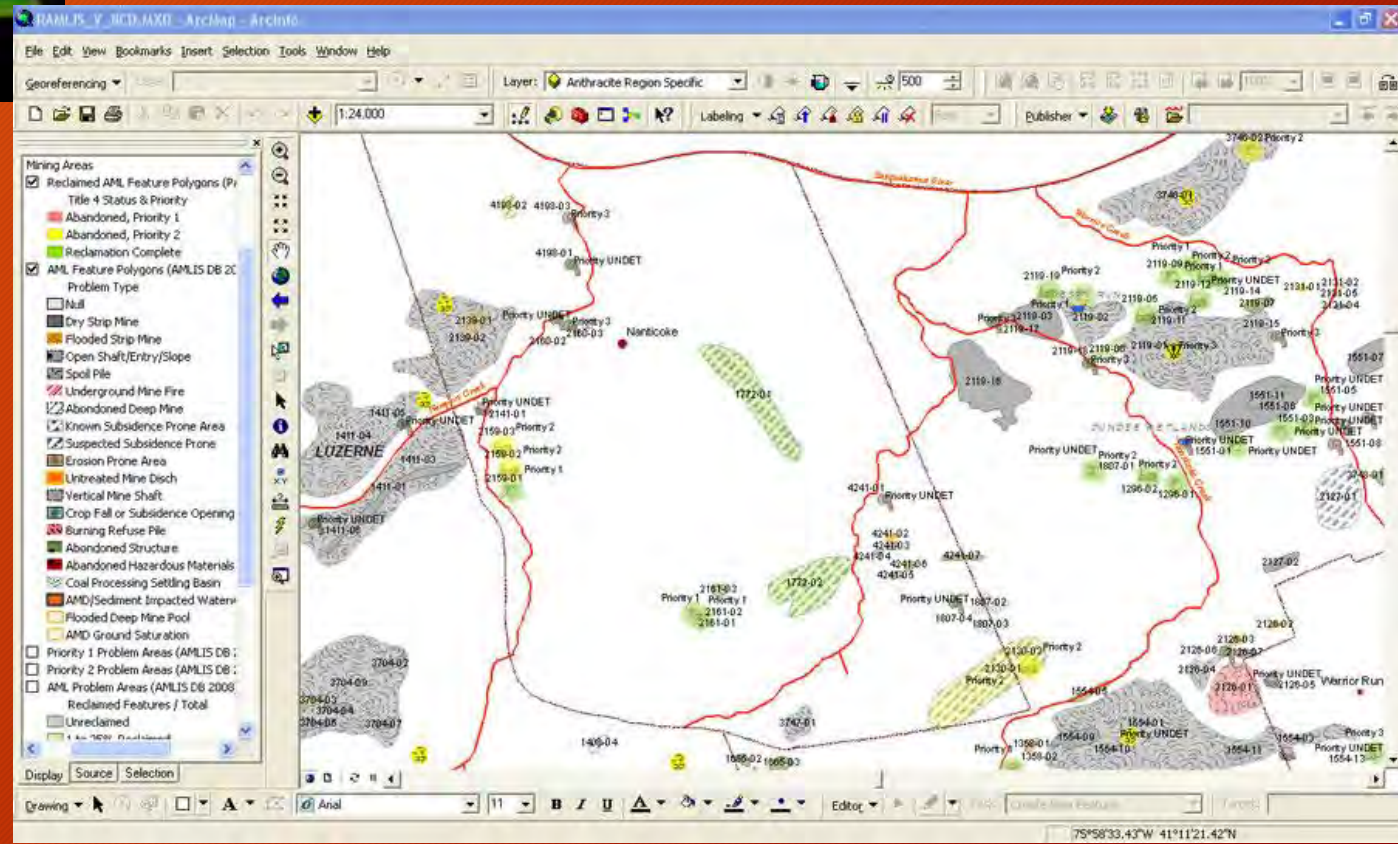
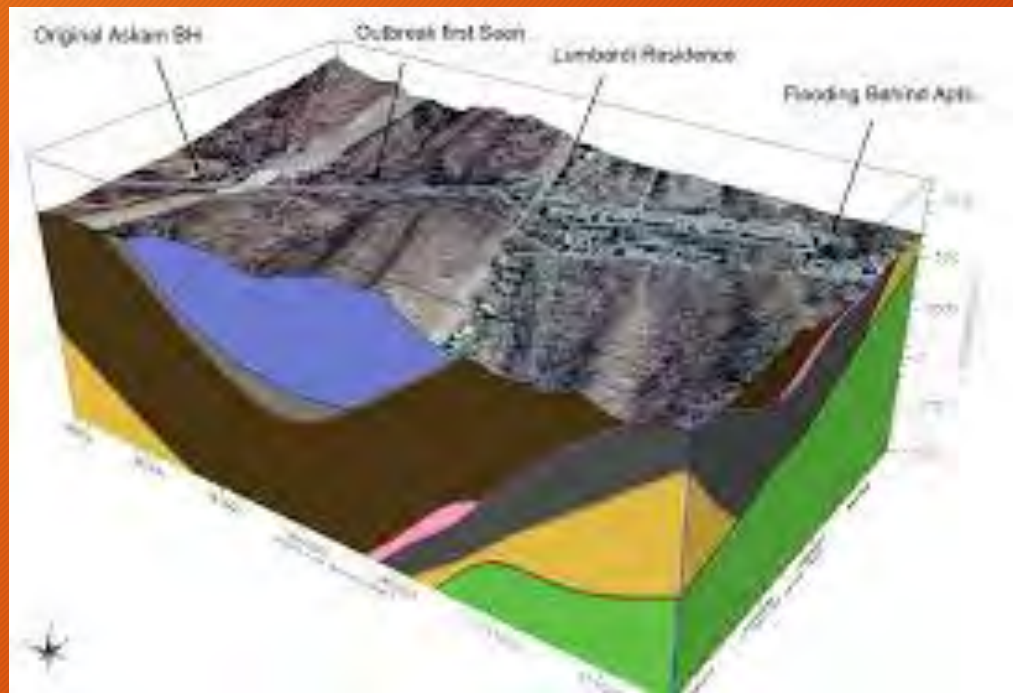
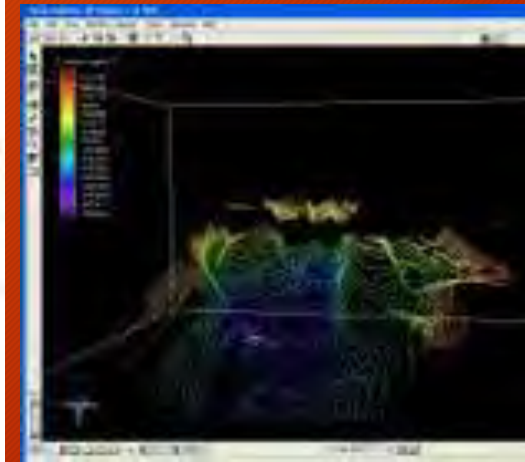
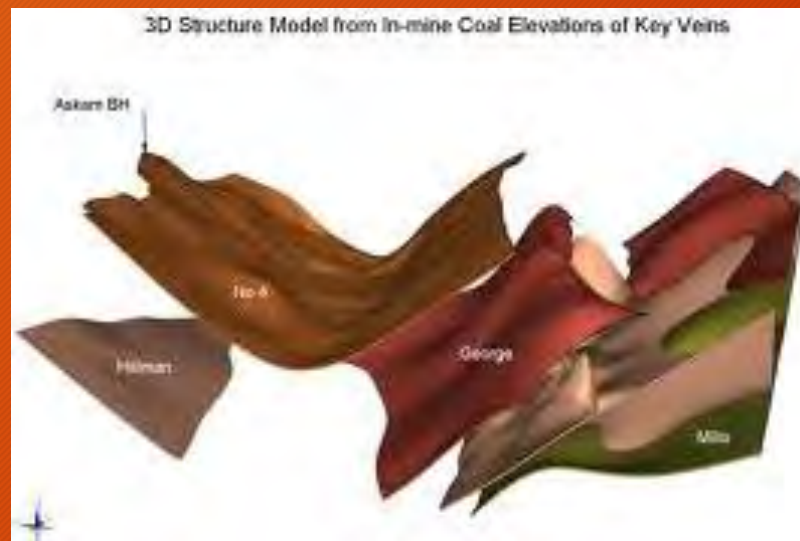
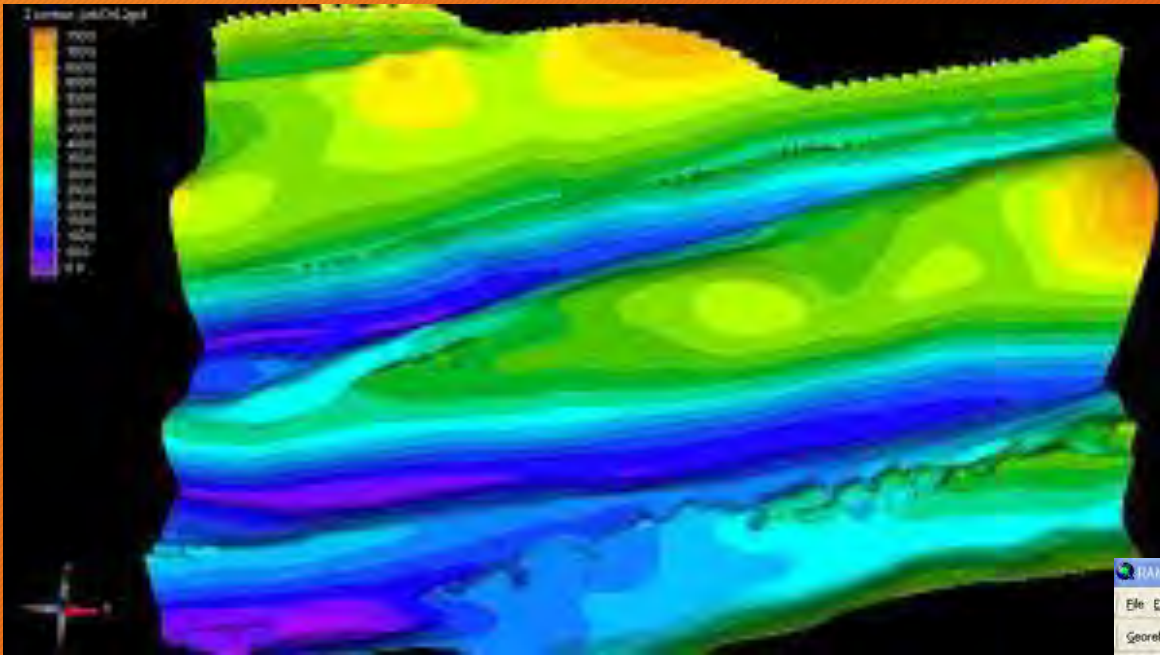
- Innovative AMD Treatment Technologies

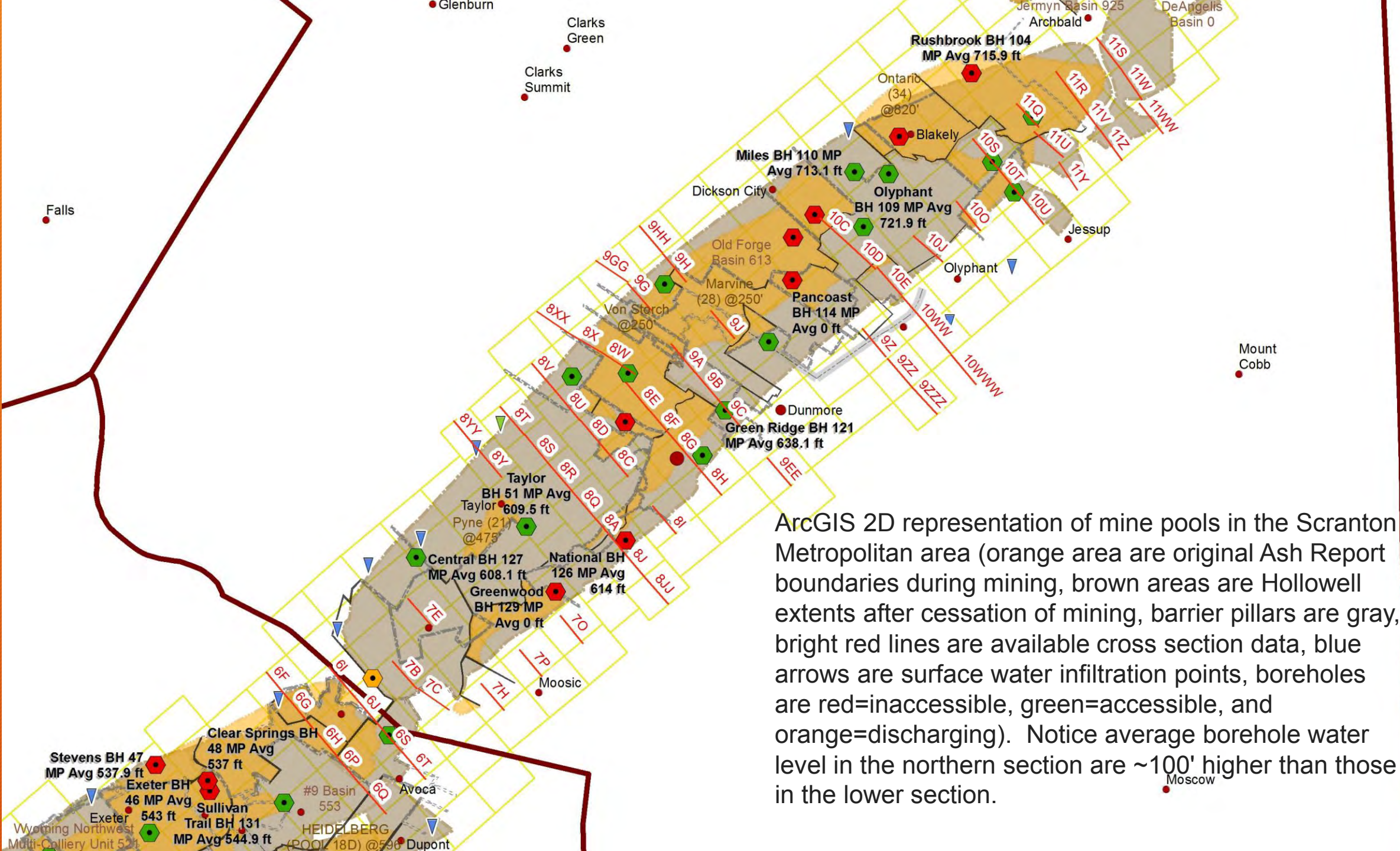
- i. AMD Treat 5.0.2 Plus- <http://amd.osmre.gov/> (application for estimating abatement costs for AMD both, active and passive)

Opportunities

- EPCAMR is working on innovative technologies
 - i. Updating historic mine maps & reports by State Geologists and other authors on AMD resources
 - ii. Converting barrier pillar studies and mine pool studies into 3D Models
 - iii. Backtracking from AMD discharges to mine pool boundary limits
 - iv. Monitoring dozens of boreholes regionally that provide current elevations and fluctuations in the mine pools since the cessation of pumping in most of the areas as coal companies shut down.
- EPCAMR is rewriting and updating the region's understanding of our vast hydrogeologically complex, multi-colliery hydrologic units (mine pools)
- EPCAMR has been estimating conservative mine pool water volumes in these underground reservoirs and have been interpreting their hydrogeological connections or isolation from one another
- Recent efforts to scan, catalogue, geo-reference, and digitize the historic mine maps for the Commonwealth's Mine Subsidence Insurance Program that will enhance EPCAMR's 3D Mine Pool Modeling of specific areas throughout the NorthCentral and Northeastern PA Coalfields using EarthVision and Global Mapper software are underway
 - i. <http://www.dep.state.pa.us/msihomeowners/>
 - ii. <http://www.pamsi.org/>





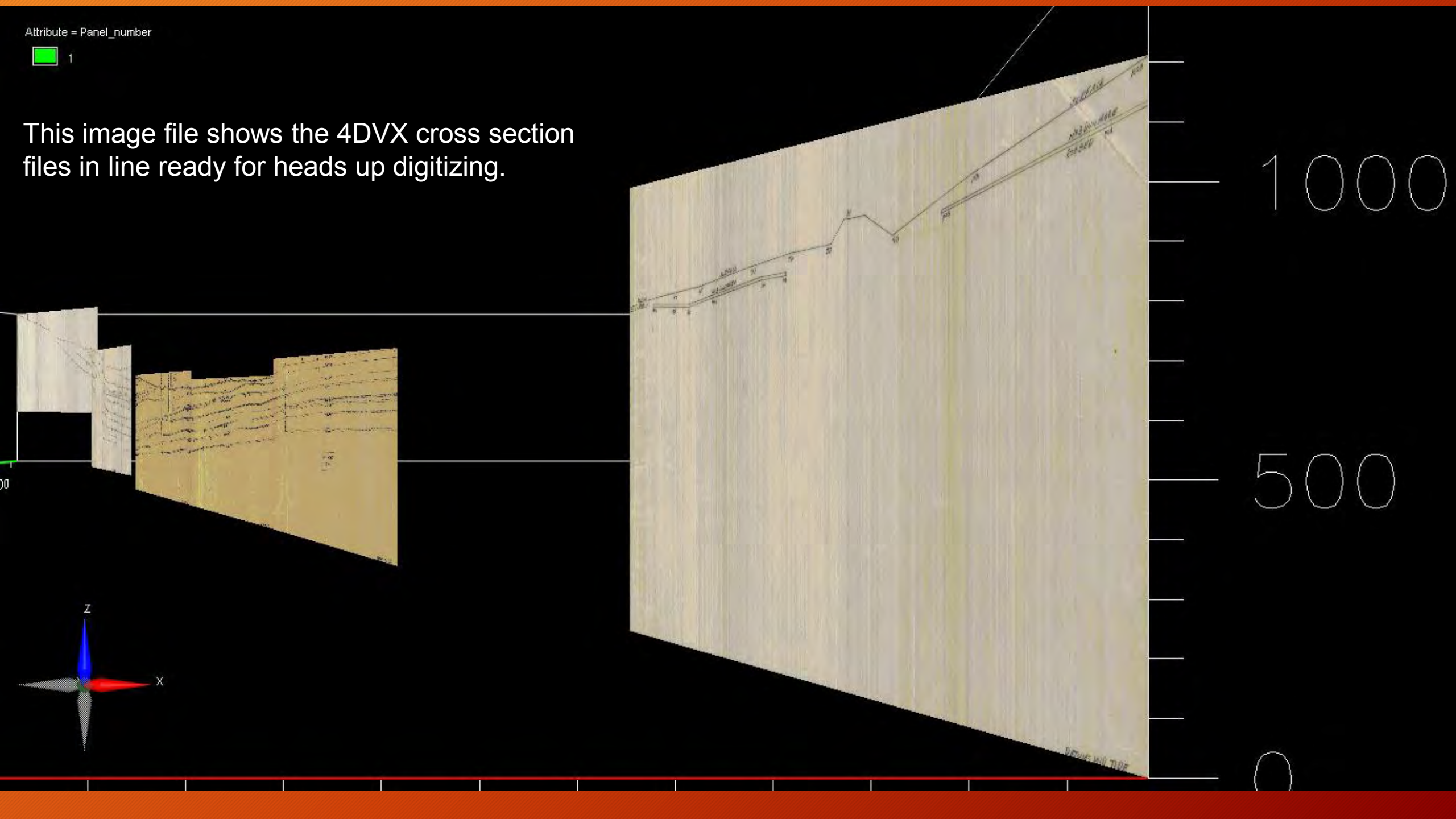


ArcGIS 2D representation of mine pools in the Scranton Metropolitan area (orange area are original Ash Report boundaries during mining, brown areas are Hollowell extents after cessation of mining, barrier pillars are gray, bright red lines are available cross section data, blue arrows are surface water infiltration points, boreholes are red=inaccessible, green=accessible, and orange=discharging). Notice average borehole water level in the northern section are ~100' higher than those in the lower section.

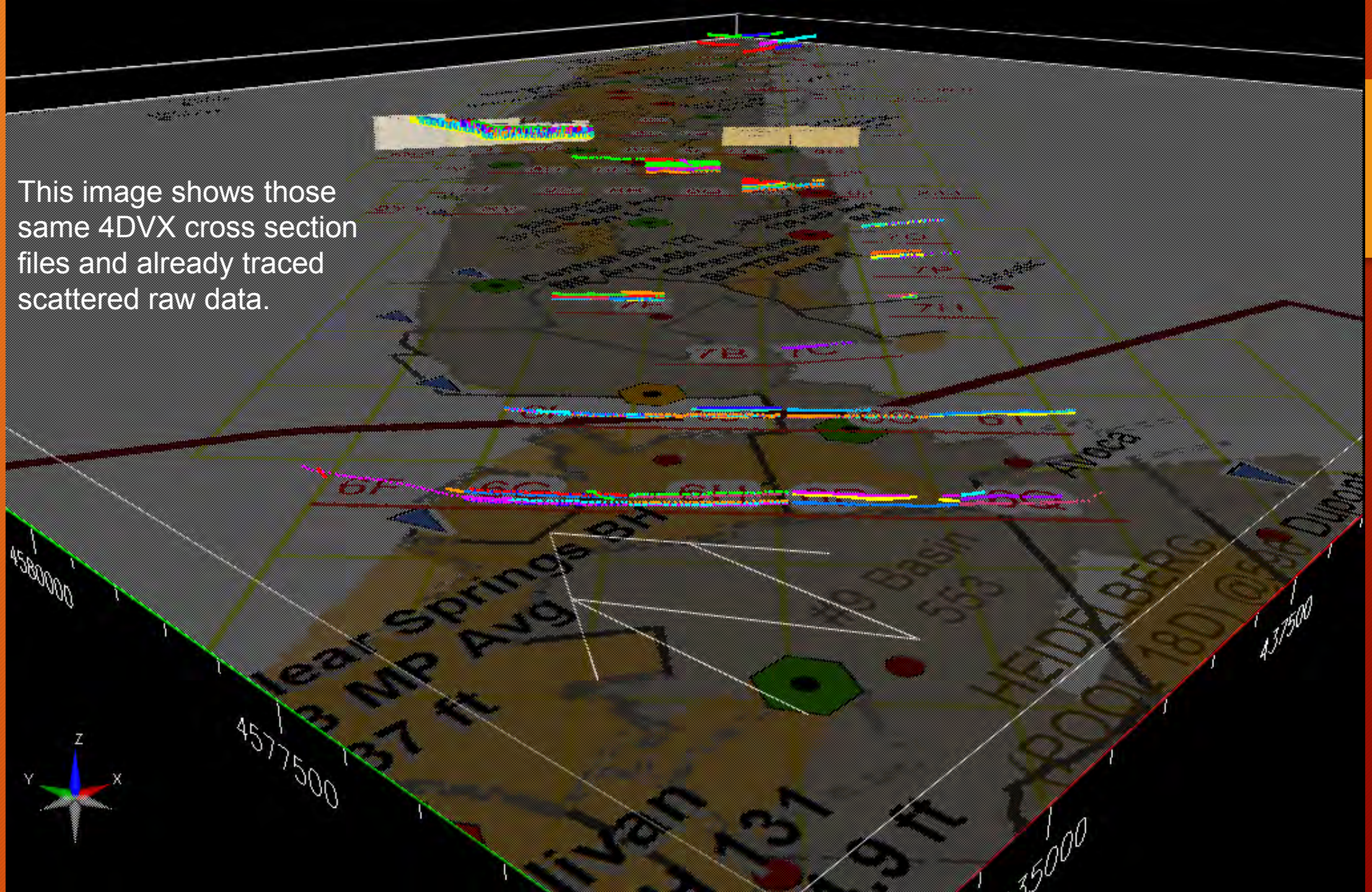
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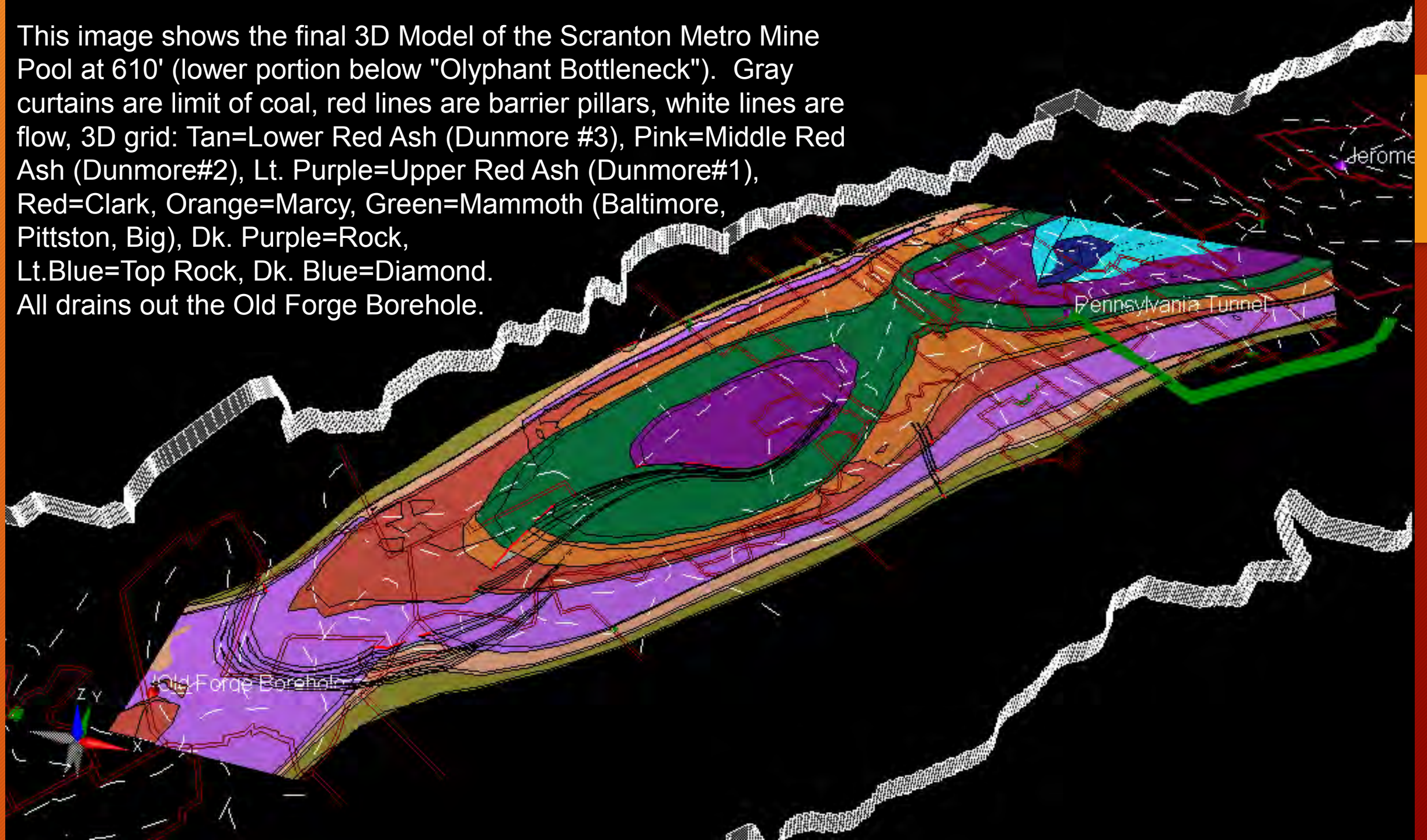
This image file shows the 4DVX cross section files in line ready for heads up digitizing.



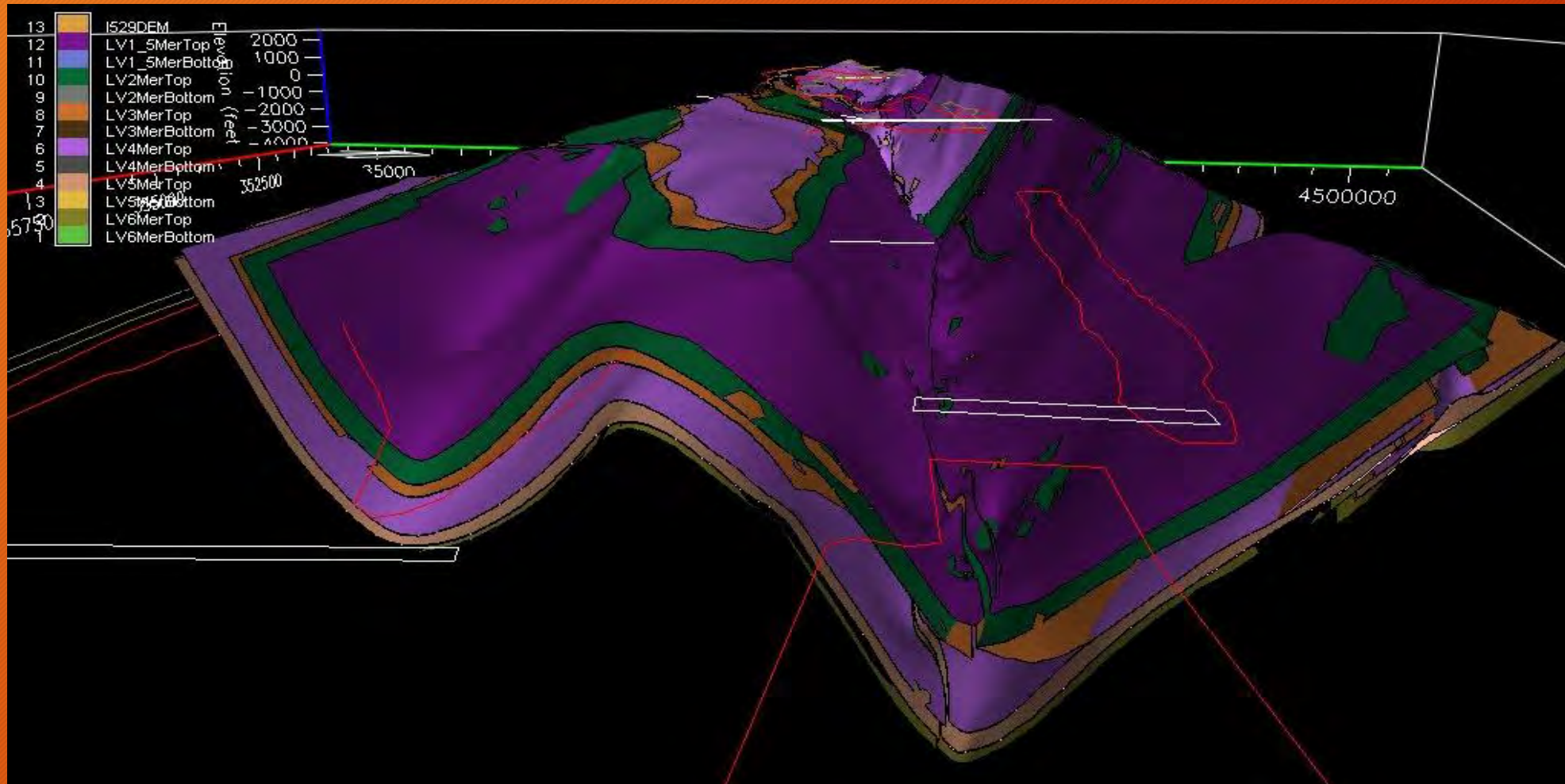
This image shows those same 4DVX cross section files and already traced scattered raw data.



This image shows the final 3D Model of the Scranton Metro Mine Pool at 610' (lower portion below "Olyphant Bottleneck"). Gray curtains are limit of coal, red lines are barrier pillars, white lines are flow, 3D grid: Tan=Lower Red Ash (Dunmore #3), Pink=Middle Red Ash (Dunmore#2), Lt. Purple=Upper Red Ash (Dunmore#1), Red=Clark, Orange=Marcy, Green=Mammoth (Baltimore, Pittston, Big), Dk. Purple=Rock, Lt.Blue=Top Rock, Dk. Blue=Diamond. All drains out the Old Forge Borehole.



EarthVision Model of virgin coal volumes of the Lykens Valley Veins in the Brookside (left), Valley View (middle) and Markson (right) Mines cross section looking west in the Southern Coal Fields



Red lines indicate colliery boundaries

White lines indicate barrier pillars

Southern Anthracite Field Mine Pool Map from U.S. Bureau of Mines Technical Paper 727

Figure 1, April 1917

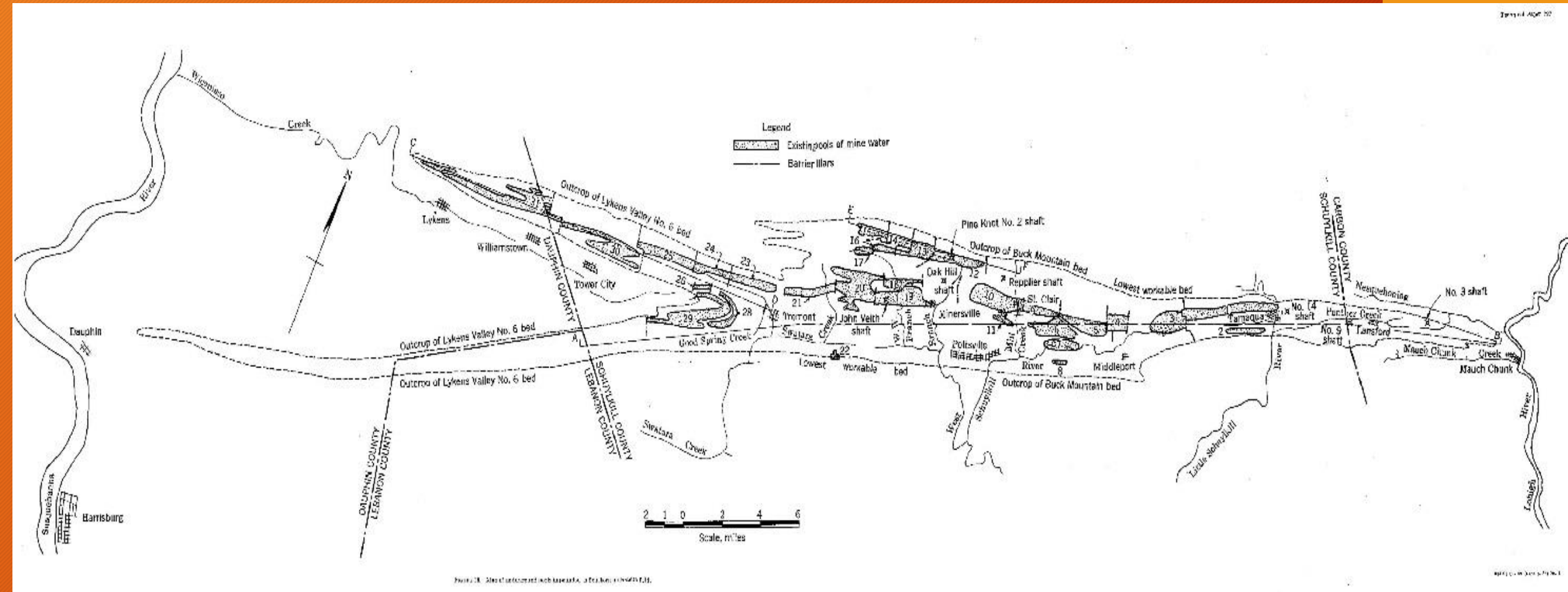


FIGURE 1. Mine pools and barrier illars in the Southern Anthracite Field.

U.S. GEOLOGICAL SURVEY

Susquehanna River Basin, Upper Schuylkill River Headwaters, Upper Lehigh River Basin

Mine pool extents, pool flow direction, barrier pillars and AMD in the northern portion of the Southern Coal Field as depicted in a PA Bureau of Forests and Waters (Beisecker) Report

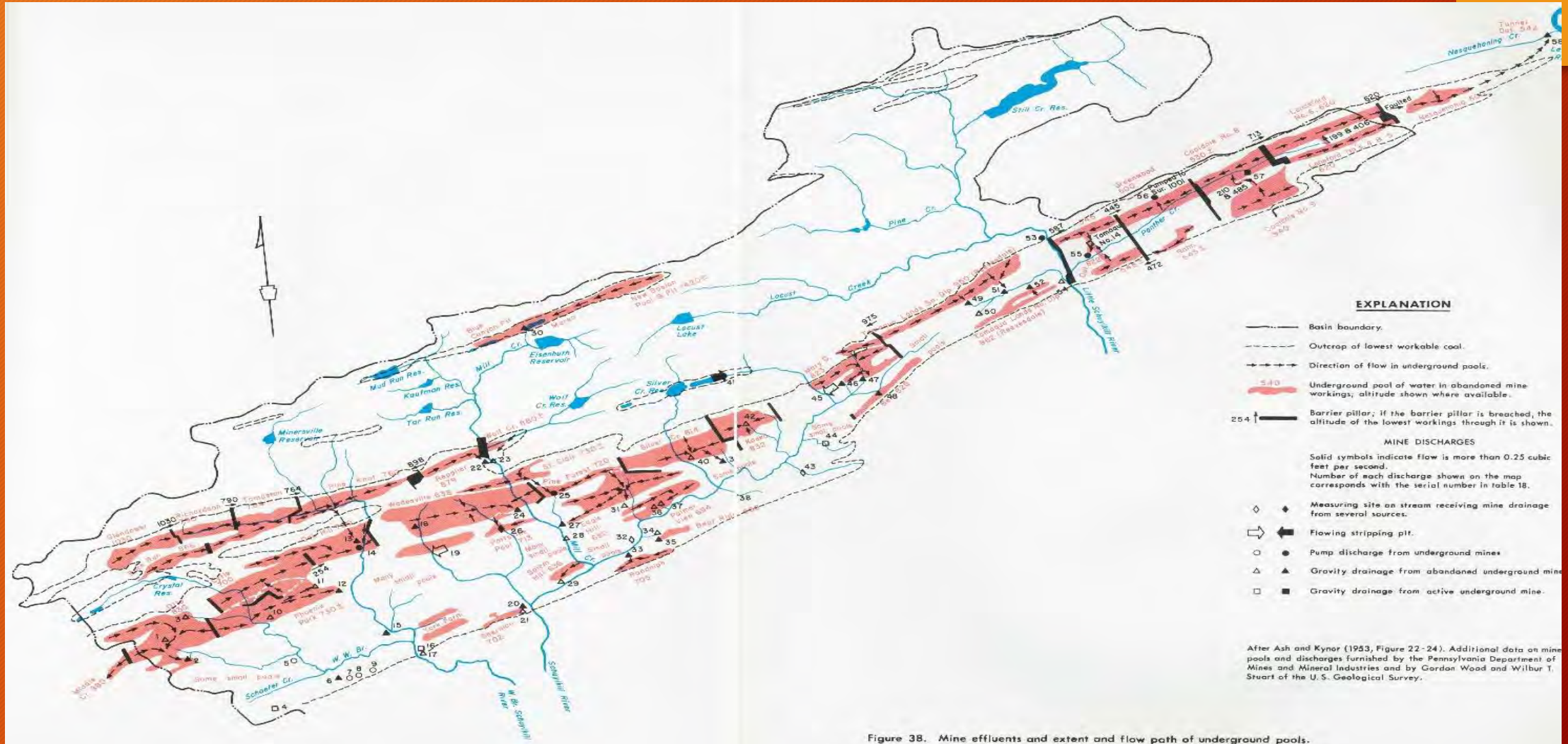


Figure 38. Mine effluents and extent and flow path of underground pools.

EPCAMR Mine Pool Volume Calculations

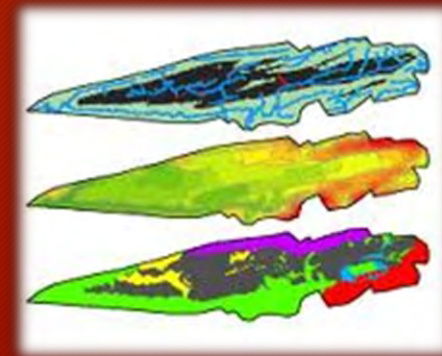
earthVision[®]
by DYNAMIC GRAPHICS, INC.



Streamline the Model Building Process

EarthVision is an industry leader for 3D modeling of complex structural environments

- EPCAMR calculations from EarthVision true 3D Grids:
 - Total for the Northern Anthracite Coal Field is estimated to be 434 billion gal. of water
 - i. Total for Lackawanna Valley is ~160 billion gal.
 - a. Scranton Metro Mine Pool is ~130 billion gal.; ~2-3x volume stored in Lake Wallenpaupack
 - b. http://www.lrca.org/LRCA/pdf/LLWRAP_Exec_Summary1.pdf
 - ii. Total for Wyoming Valley is ~274 billion gal.
 - iii. Total for the Southern Fields in 10 pools is ~ 8,831,448,748 gal.
 - a) Heckscherville Valley Mine Pools Estimate: Total 6,268,433,252 gal.
 - a) Buck Run Dam & Old Basin, Neumeister, Glendower, Richardson, Thomaston, Pine Knot, Repellier
- USGS estimate from ModFlow:
 - i. Total for Western Middle field is 60-220 billion gal. (conservative estimate) (Additional Mine Pool Modeling is necessary in EarthVision)
 - a. <http://pa.water.usgs.gov/projects/groundwater/westernmiddle/>



Opportunities



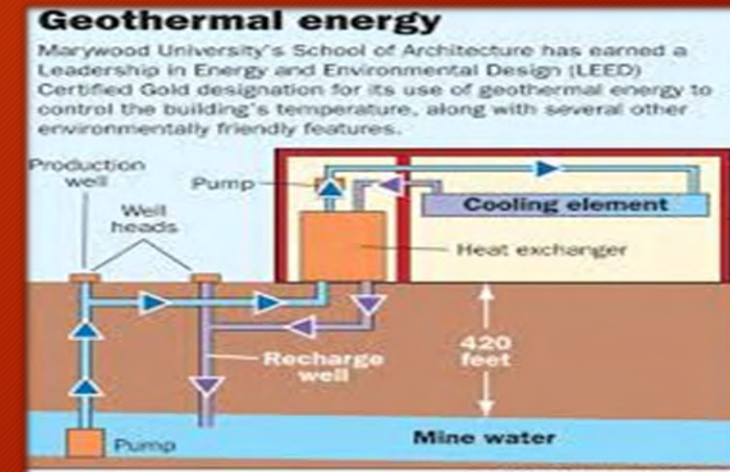
- AMD and Mine Water Resource Potential Across PA

- i. http://www.epcamr.org/storage/projects/MinePoolMapping/Mine_Water_Resources_of_the_Anthracite_Coal_Fields_-_Report.pdf

- AMD as a potential recoverable resource and solution mining as a commodity for various industries that can spur and encourage economic redevelopment, watershed restoration, and land reclamation

- Mine Pool Reuse by various industries

- I. Geothermal Use of Mine Pools for Open and Closed Loop Systems
 - II. Consumptive Use Mitigation
 - III. Low flow Augmentation
 - IV. Industrial Uses
 - V. Power Plant Water Usage for heating and cooling and generation of electricity and the Co-Generation Industry Plants (ARIPPA)
 - VI. MicroHydro Turbine Electrical Generation (Antrim Treatment System in Tioga County)-FERC License Approved recently





#EPCAMR



LEAD EXHIBIT
OBSERVE
DIRTY JOB
SUPPORT
HIKE PIGMENT
IMPACT TREAT
ELECTROSHOCK
DOCUMENT CREATE ANTHRACITE HISTORY
COMMUNICATE CHANGE ORIGINATE
WADE COORDINATE ASCEND
UNITE SCAVENGE CONNECT

LEAD MONITOR ART
TRAIN PHOTOGRAPH
GIS FACILITATE RISE
ZEAL DEDICATION
STRUCTURE FILM

MINEPOOL COOPERATE
REUSE IDENTIFY SALVAGE
ROW EXPLORE ADVENTURE
RISE PROTECT REMEDIATE SHARE
BOREHOLE BACKPACK RECYCLE CONSERVE
SUBSIDENCE ENCOURAGE INNOVATE
PASSION BRING TOGETHER ESTABLISH
WETLANDS INITIATE ENLIGHTEN
AFFILIATE NETWORK ACHIEVE OVERCOME
ORIGINAL RECLAIM IMAGINE PEOPLE
PARTNERSHIPS PLACES PRIDE



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ACTIONS SPEAK LOUDER THAN WORDS