Monongahela Basin
Mine Pool Project

Paul Ziemkiewicz, Director

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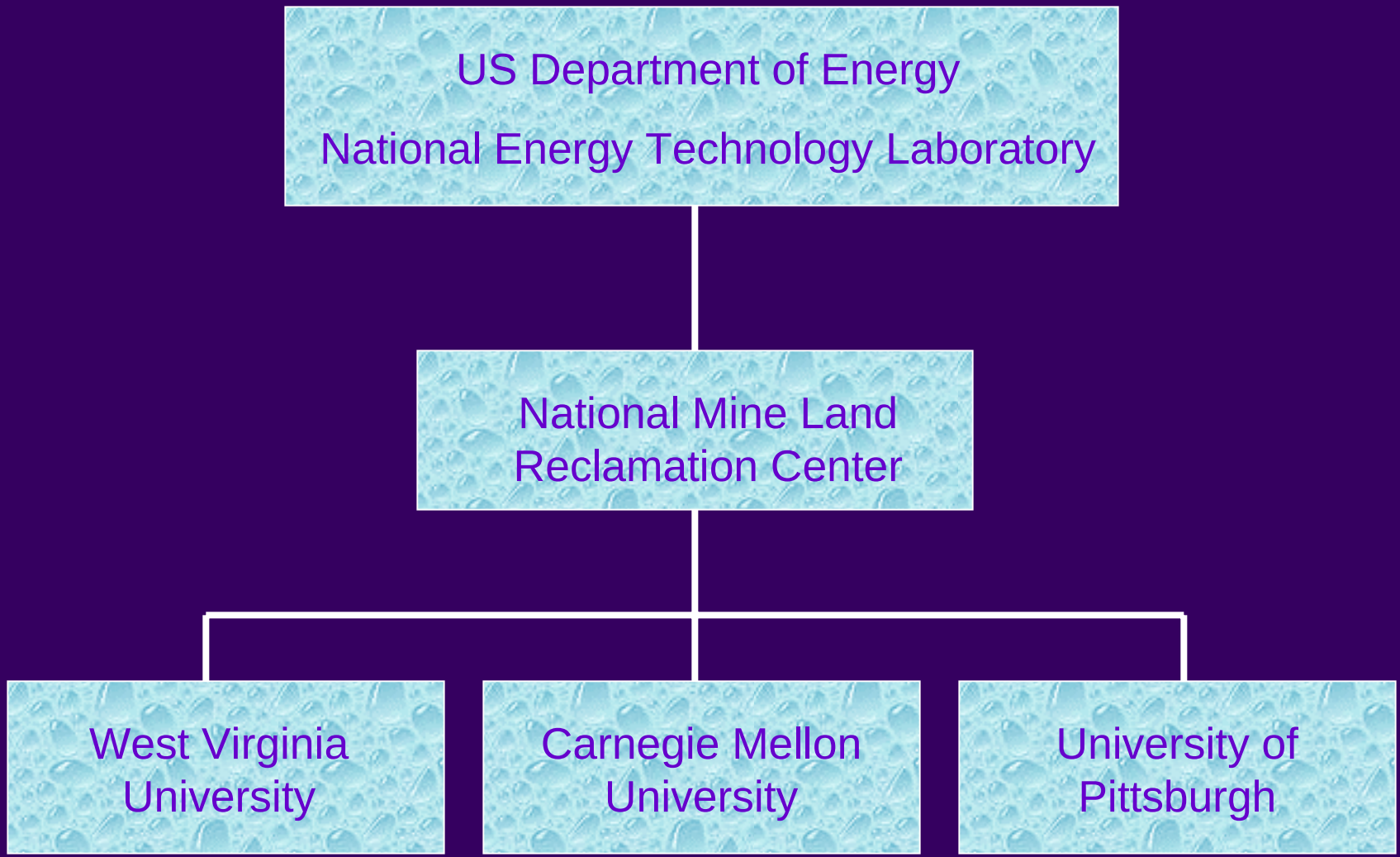
National Mine Land Reclamation Center

Participating Organizations



Project Tasks

- Delineate underground mines and mine pools in the Monongahela Basin
- Identify monitoring protocols, sampling network and implement sampling for water quality in mine pools
- Apply a numerical model to describe current and projected future groundwater flow in the basin

Project Tasks Continued

- Digitize mine maps relevant to the Monongahela Basin
- Characterize the chemical evolution over time within the flooded and partially flooded portions of the Pittsburgh seam mines
- Compare the hydro geochemistry of Monongahela and Allegheny group coals

Project Tasks Continued

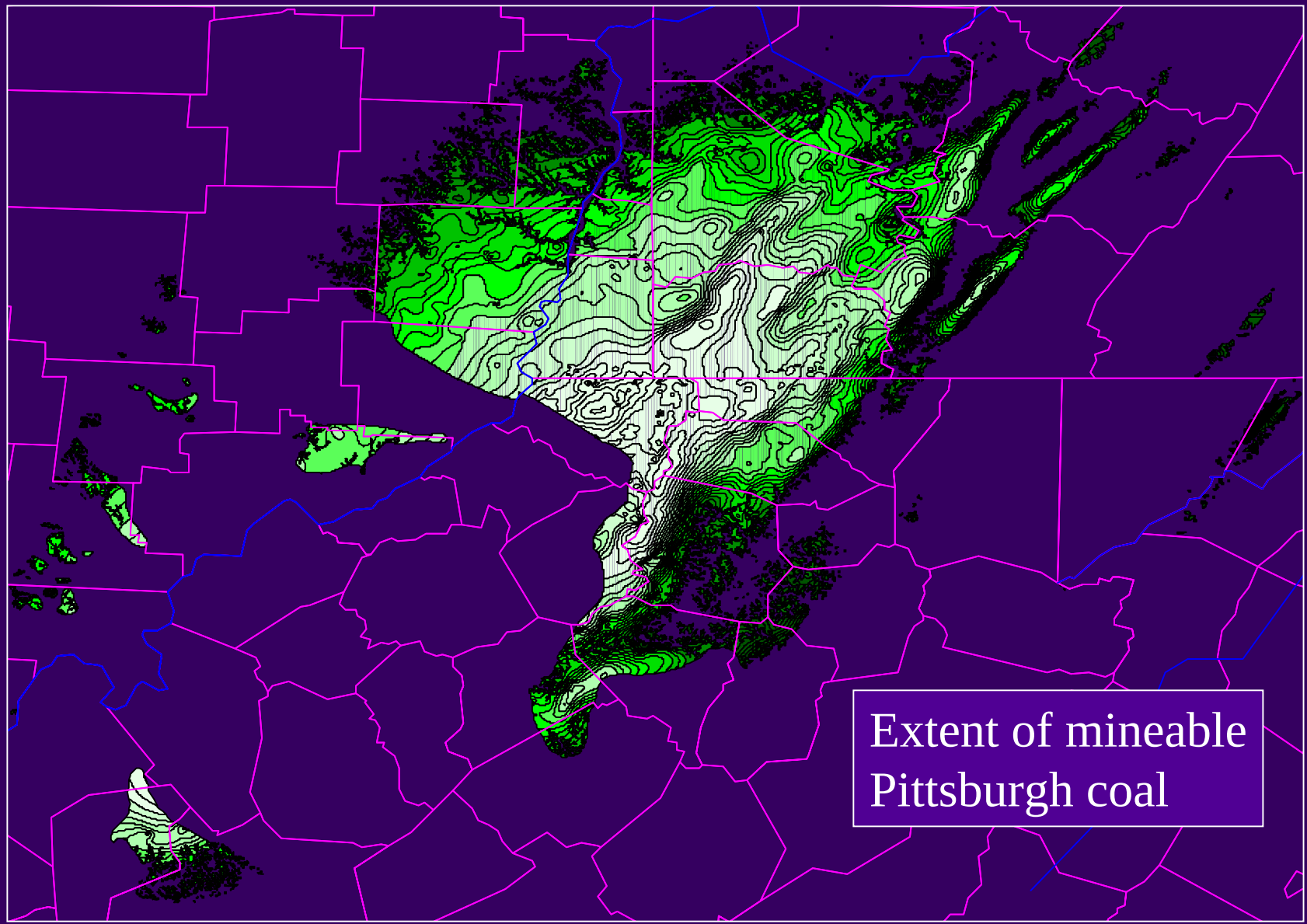
- Using STORET and other databases, characterize changes in stream water quality in the basin since the mid 1960's
- Perform an economic analysis
- Conduct cost engineering and prioritization of resource expenditures

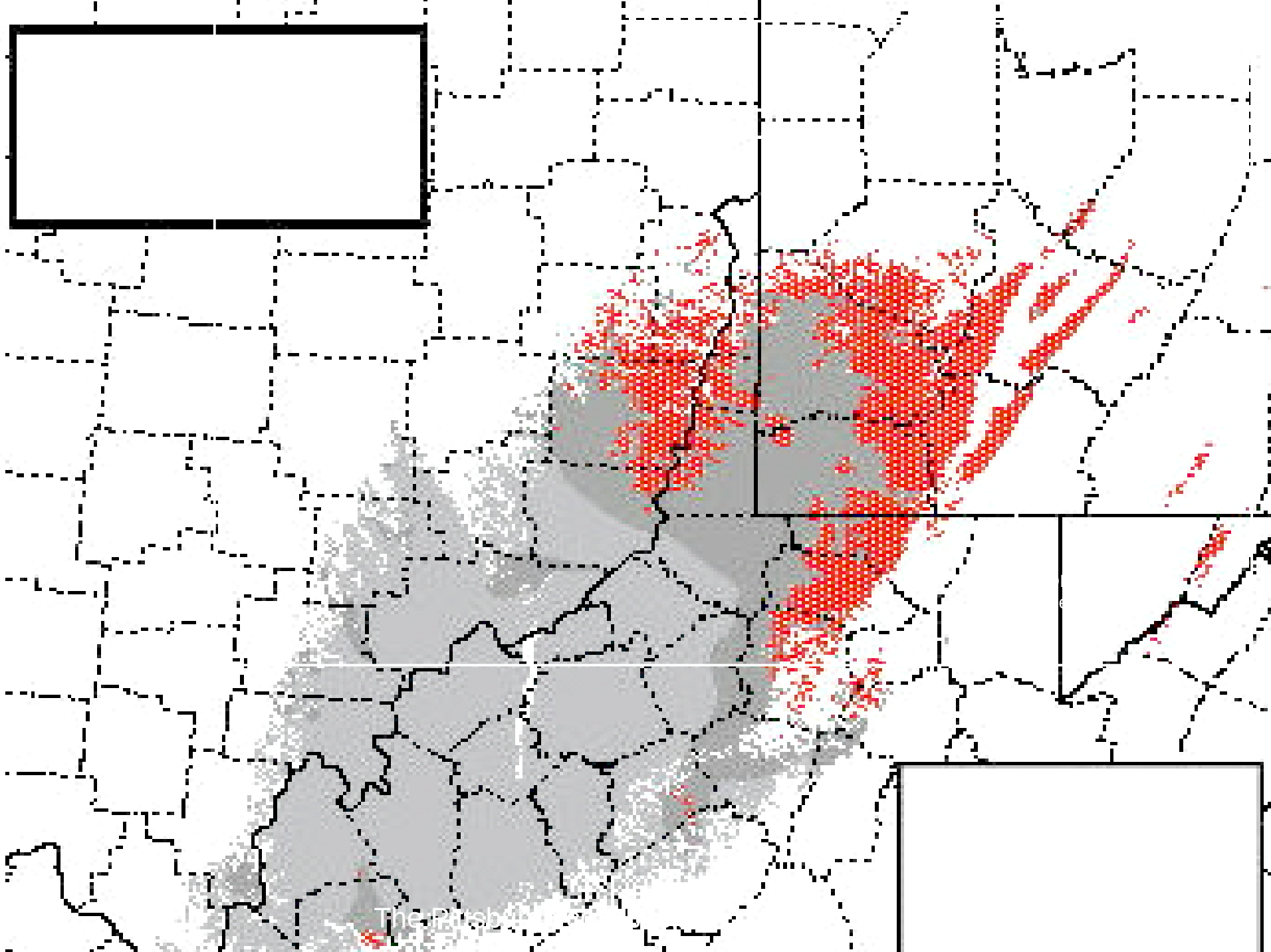
Principal Investigators

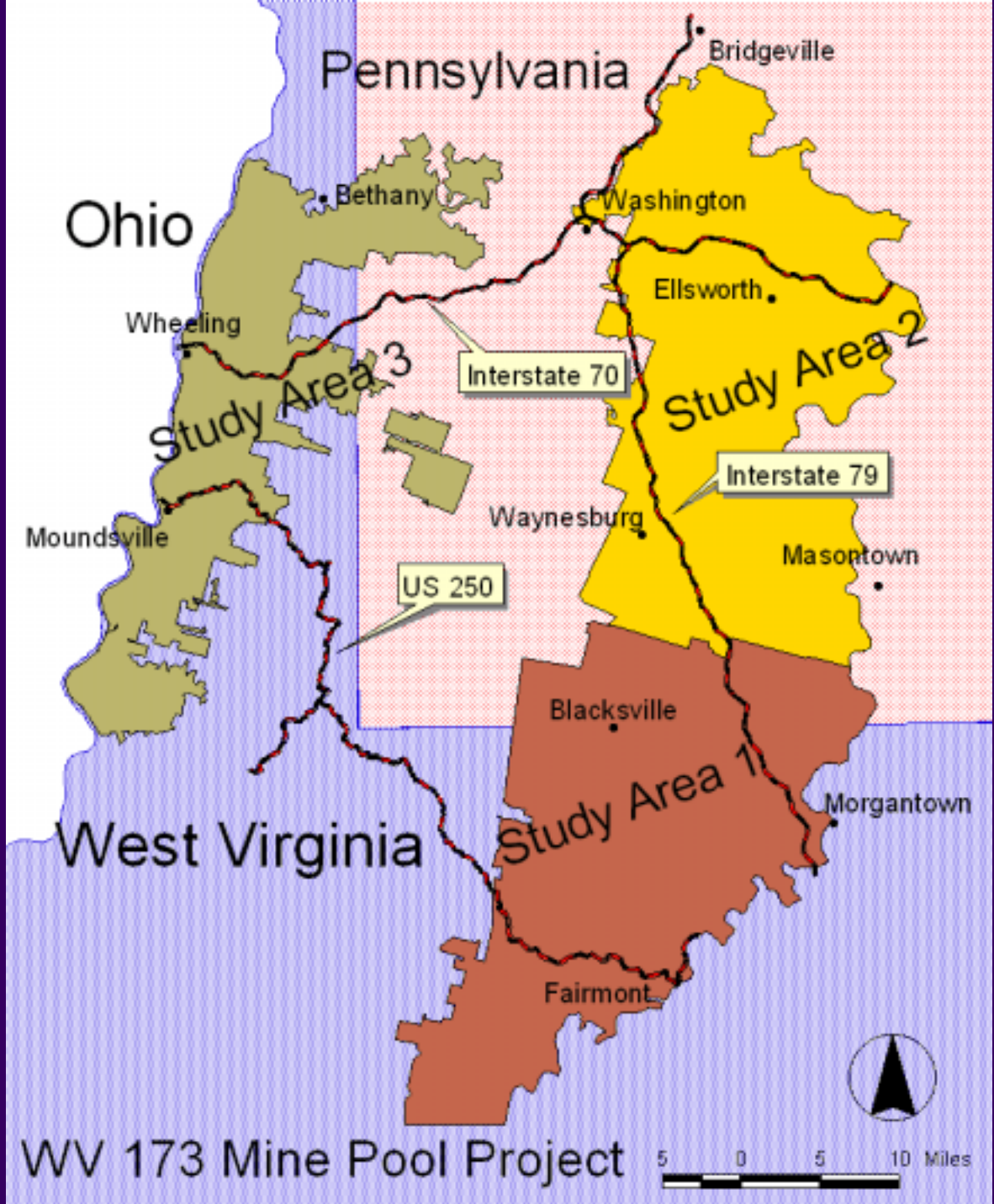
- Joseph Donovan, Geology & Geography, WVU
- Jerald Fletcher, Resource Management, WVU
- Jeffrey Skousen, Plant & Soil Sciences, WVU
- Jack Fuller, Management, Business, and Economics, WVU

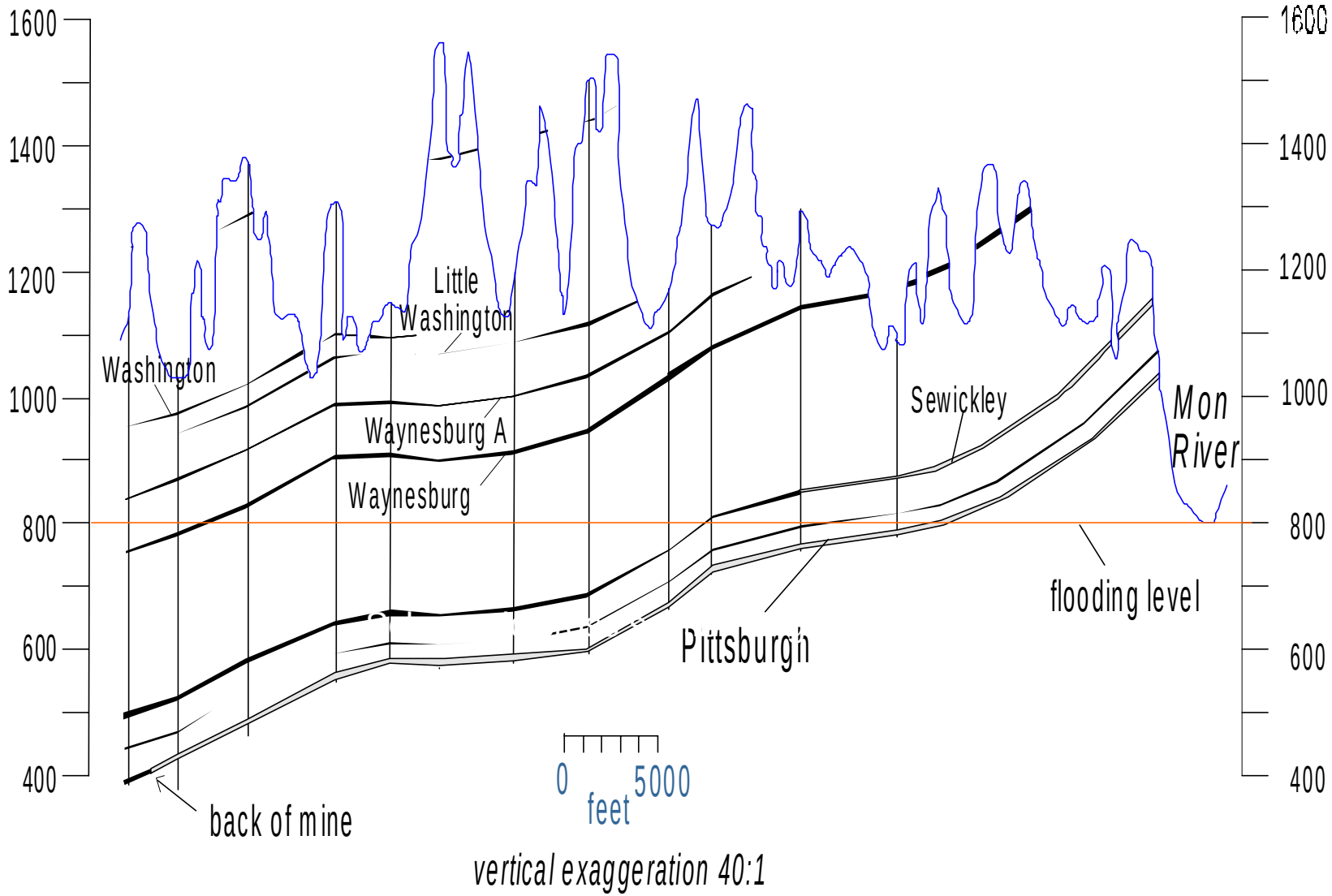
Principal Investigators Continued

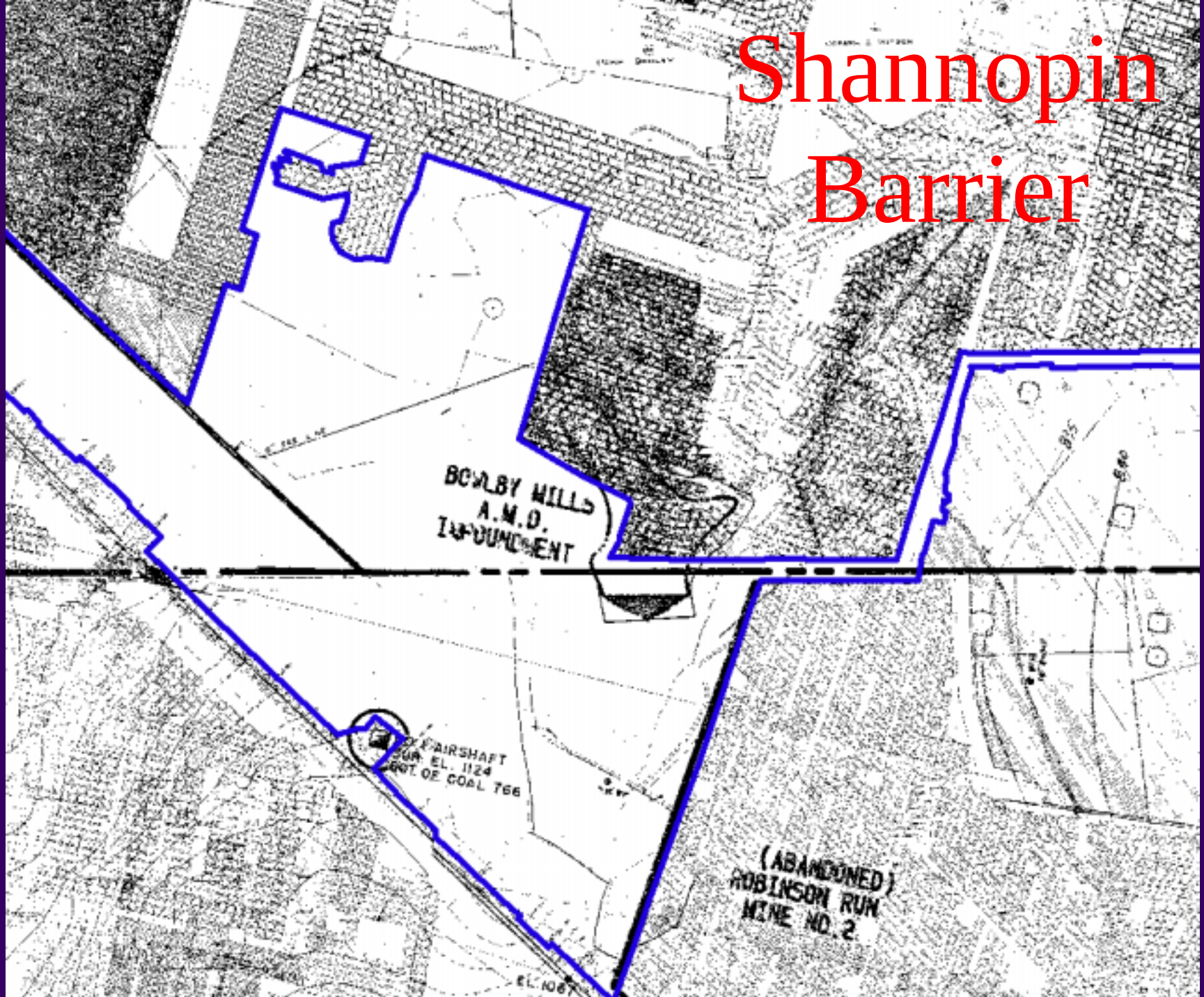
- David Dzombak, Civil and Environmental Engineering, CMU
- Rosemary Capo, Geology and Planetary Sciences, UP


Extent of mineable
Pittsburgh coal



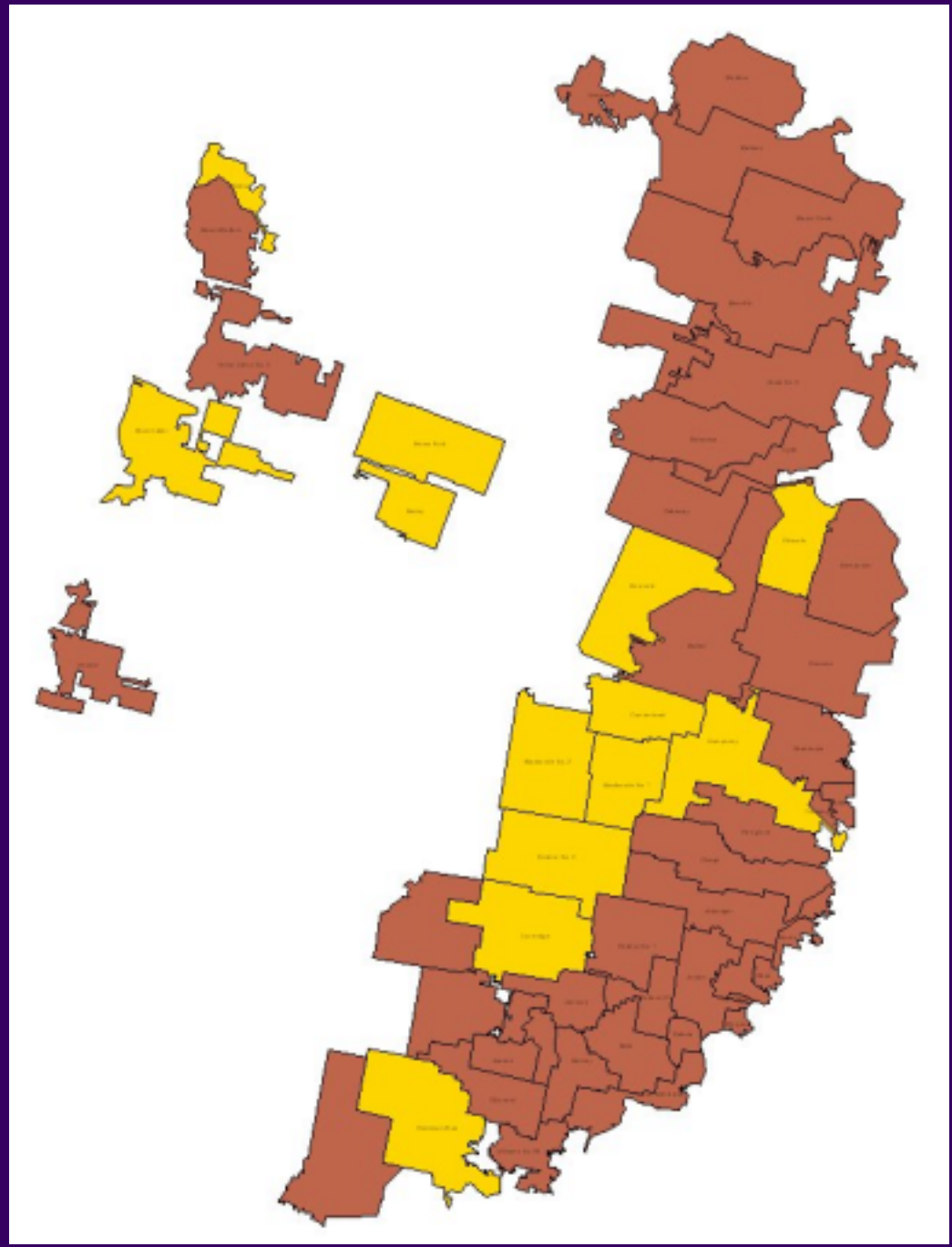

Pennsylvania
Bridgeville
Ohio
Bethany
Washington
Ellsworth
Wheeling
Interstate 70
Study Area 3
Study Area 2
Interstate 79
Waynesburg
Moundsville
Masontown
US 250
Blacksville
Study Area 1
Morgantown
West Virginia
Fairmont
WV 173 Mine Pool Project
5 0 5 10 Miles


1600
1400
1200
1000
800
600
400
Washington
Little Washington
Waynesburg A
Waynesburg
Sewickley
Mon River
flooding level
Pittsburgh
back of mine
0
5000
feet
vertical exaggeration 40:1


Shannopin
Barrier
BOWLBY MILLS
A.M.D.
IMPOUNDMENT
AIRSHAFT
EL. 1124
OF COAL 766
(ABANDONED)
ROBINSON RUN
MINE NO. 2

Active Mines
June 2000

Robinson Run
Loveridge
Blacksville #1 & #2
Humphrey
Federal #2
Cumberland
Emerald
Dilworth
Enlow Fork
Bailey
Shoemaker
Windsor



Hydrogeology of Area 1: key questions

- FLOODING HISTORY

  how did these mines flood and how can we use this to predict future flooding?

- BREAKOUT LOCATIONS

  where would discharge occur if uncontrolled?

- STEADY-STATE HYDROGEOLOGY UNDER GROUNDWATER CONTROL

  what will the “stabilized” hydrogeology look like under pumping control?

- RECHARGE RATES

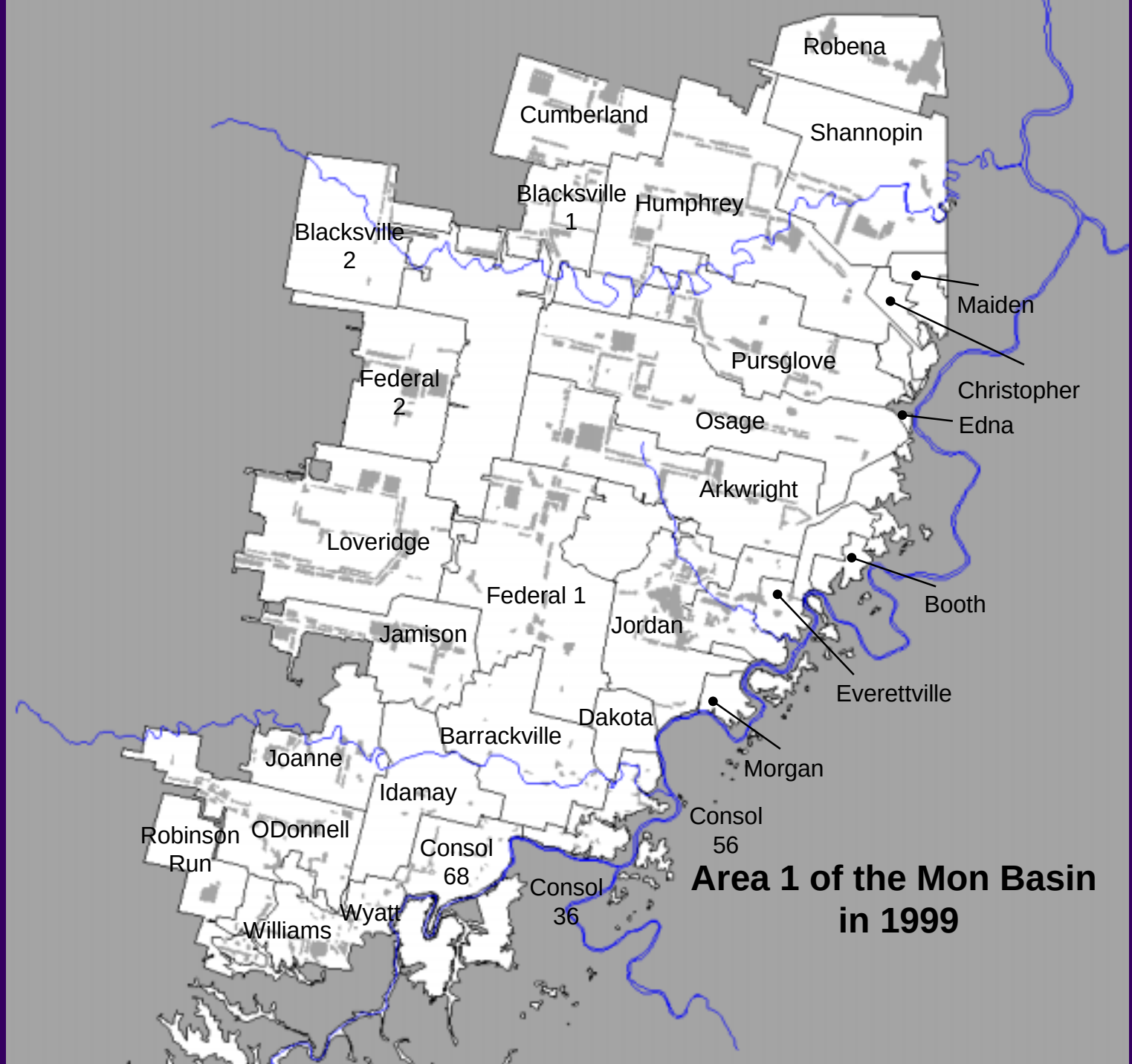
  how much water needs to be controlled and where?

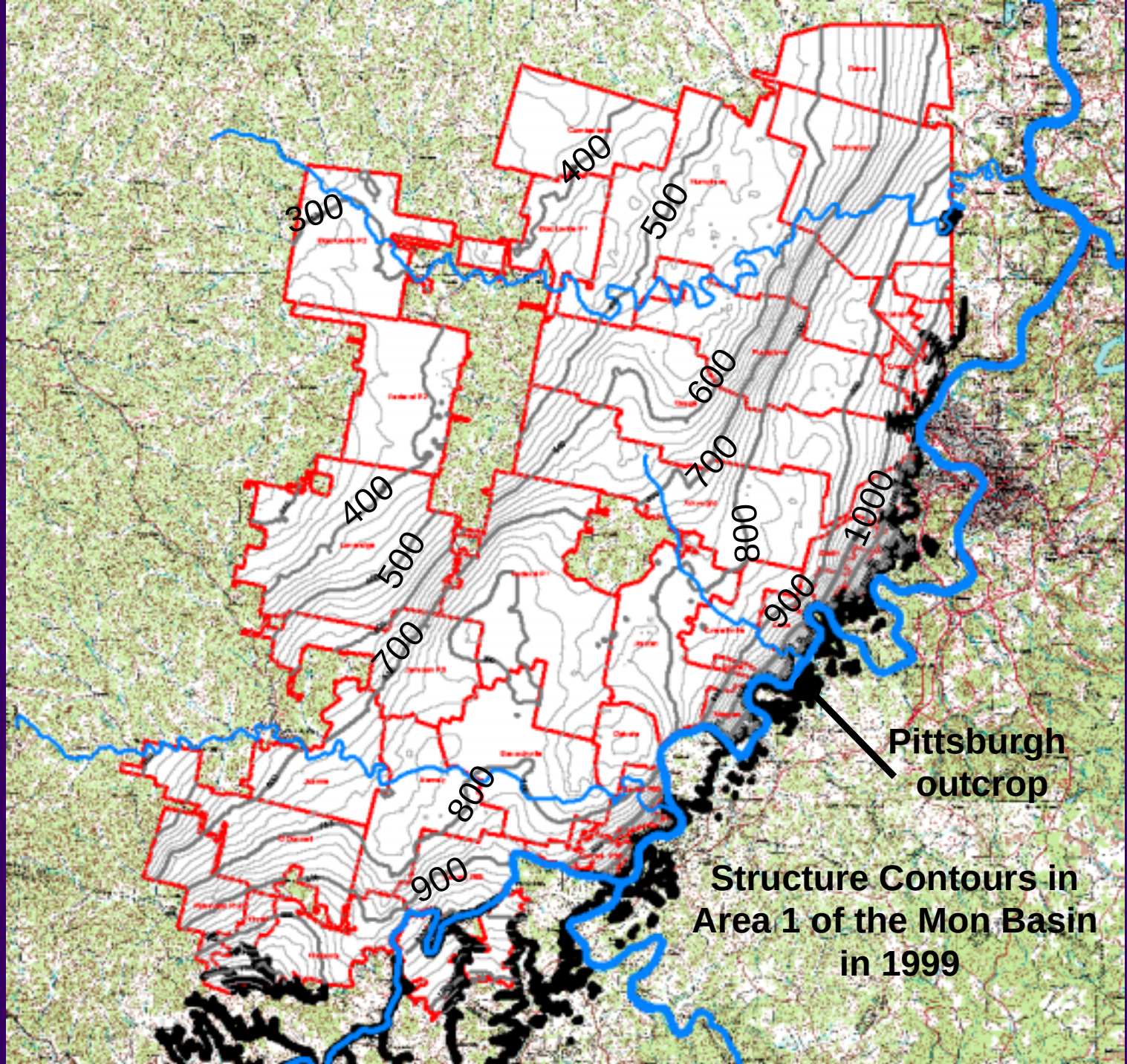
changes in mining history, 1980-2010

- 1980
  - most mines still active except shallow mines (<300 feet) along outcrop
  - new longwall mines begun in deep part of basin
  - intermediate depth mines
  - hydrogeology (flooding extent in 1999, potential breakouts)
- 1990
  - intermediate-depth mines near completion
- 2000
  - all intermediate-depth mines (<600 feet) abandoned
  - some deep mines abandoned
- 2010 (?)
  - only deep longwall mines, with thick barriers updip (200-500 feet)

changes in mine hydrogeology, 1980-2010

- 1980
  - flooding in shallow workings only -- many AML discharges (mine discharges, flowing wells)
- 1990
  - flooding extends to deeper workings
  - formation of Fairmont pool
- 2000
  - formation of Jordan pool
  - remaining intermediate-depth mines flood
- 2010
  - full flooding of intermediate and shallow mines, hydraulically isolated from deeper mines (????)

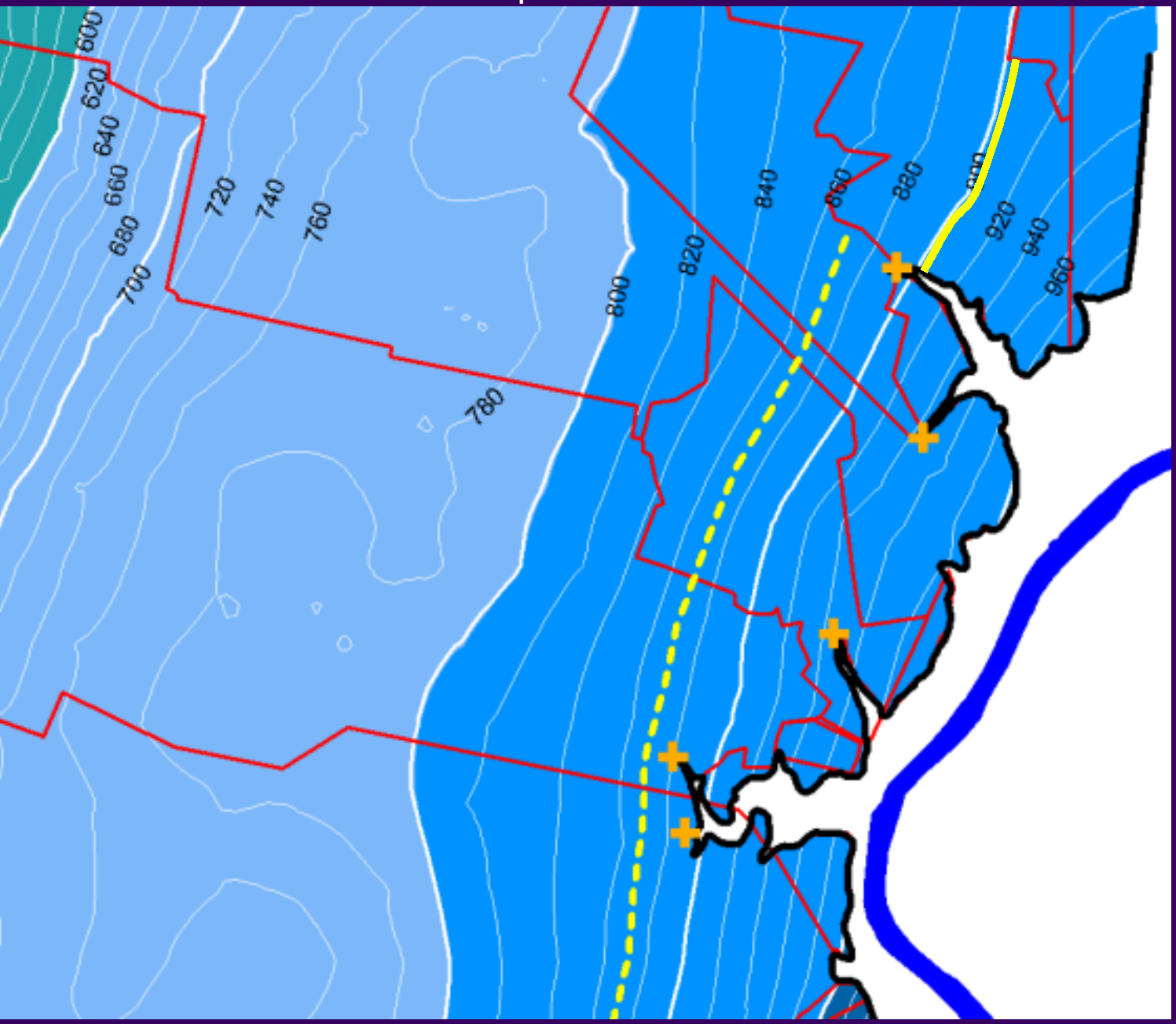

Robena
Cumberland
Shannopin
Blacksville 1
Humphrey
Blacksville 2
Maiden
Pursglove
Federal 2
Christopher
Osage
Edna
Arkwright
Loveridge
Federal 1
Booth
Jordan
Jamison
Everettville
Dakota
Barrackville
Joanne
Morgan
Idamay
Consol 56
Robinson Run
ODonnell
Consol 68
Consol 36
Wyatt
Williams
Area 1 of the Mon Basin in 1999


300
400
500
600
700
800
900
1000
400
500
700
800
900
Pittsburgh
outcrop
Structure Contours in
Area 1 of the Mon Basin
in 1999

evolution of “mine pools”

- a *mine pool* is a collection of adjacent flooded mines which are near the same water level elevation and tend to covary closely in water level -- that is, they are hydraulically interconnected by leaky barriers
- mine pools tend to evolve as a mining district floods, forming “clusters” of hydro geologically-related mines
- mine pools are important because they represent regions of the aquifer that may be controlled from central locations
- by convention, mine pools may be named by the first major mine to flood and to control water levels in surrounding mines

breakouts: the cropline model



potential breakout location

actual flooding level

future control water level

Hydrogeology of Area 1: answers

- FLOODING HISTORY

  mines have evolved into pools that flooded, slowly at first and more rapidly after mining ceased

- BREAKOUT LOCATIONS

  two stream locations and approximately 6 cropline locations are candidates for main pool. Discharges from shallow mines near crop have been occuring for many years

- STEADY-STATE HYDROGEOLOGY UNDER GROUNDWATER CONTROL

  a series of 3 or 4 pools at successively lower elevations

- RECHARGE RATES

  still under study

Deliverables

- Final Report
- Map delineating underground mines and mine pools in the Monongahela Basin
- Monitoring Protocols and Sampling Network Report
- Report on Mine-water Chemistry
- Report on Groundwater Flow Conditions

Deliverables Continued

- Production of a GIS Platform
- Framework for a Geochemical Model for Minewater Chemistry
- Inventory of Water Quality Measurements and Passive Treatment Feasibility Report
- Collected surface water quality data

Deliverables Continued

- Copies of the statistical analysis of the stream quality and hydrologic data
- Copies of the water quality simulation model(s)
- Economic Benefits Analysis
- Economic Benefits Report