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

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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
Challenges

• Conflicting priorities within PA Bureaus/Agencies for funding

   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)
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%20Reclamation/Abandoned Mine Portal Files/AMD_Set_Aside Program_Guidelines_Revised_Draft_07_15_2009.pdf](http://files.dep.state.pa.us/Mining/Abandoned%20Reclamation/Abandoned Mine Portal Files/AMD_Set_Aside Program_Guidelines_Revised_Draft_07_15_2009.pdf)
  b. PA Bureau of Abandoned Mine Reclamation’s Hydrologic Unit Plans for AMD
  c. 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](http://www.depweb.state.pa.us/portal/server.pt/community/nonpoint_source_management/10615/watershed_restoration_actions_strategies/554276)
  d. PA DCNR Rivers Conservation Plans and Conservation Landscape Initiatives
    i. [http://www.dcnr.state.pa.us/brc/conservation/rivers/riverresourceprogram/riversconservation/](http://www.dcnr.state.pa.us/brc/conservation/rivers/riverresourceprogram/riversconservation/)
    ii. [http://www.dcnr.state.pa.us/cli/](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. [Link to Factsheet]

v. [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
Hazlebrook Creek
Beaver Dam
holding back AMD
Upper Lehigh River
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
  i. Community Watershed Groups
  ii. Foundation for PA Watersheds
  iii. Pennsylvania Environmental Council
  iv. Stream Restoration Inc.
  v. Trout Unlimited’s Eastern Abandoned Mine Program
  vi. Chesapeake Bay Foundation
  vii. Delaware Riverkeeper Network
  viii. PA Association of Conservation Districts
  ix. Western PA Coalition for Abandoned Mine Reclamation
  x. Eastern PA Coalition for Abandoned Mine Reclamation
  xi. Involvement of Historical Societies
  xii. SRBC, ORSANCO, DRBC
  xiii. ARIPPA and the Co-Generation Plants
  xiv. Elementary Schools, High Schools, and Colleges and Universities
  xv. Local governments, Conservancy Groups, & Land Trusts

• Clearinghouses of information
  i. www.amrclearinghouse.org
  ii. www.epcamr.org
  iii. www.treatminewater.com
  iv. http://www.minemaps.psu.edu/
  v. 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

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

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.
EPCAMR Mine Pool Volume Calculations

- 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
  
  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)
Opportunities

• AMD and Mine Water Resource Potential Across PA
  i.  [Link](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
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Creativity, accomplish, connect, coal, initiate, andd, abandoned, mines, underground, reclamation, respect, nature, commitment, research, donate, grow, analyze, model, lead, exhibit, observe, dirty job, support, pigment, impact, treat, electroshock, documentary, 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, subsidence, encourage, passion, bring, together, establish, wetlands, initiate, affiliate, network, overcome, original, reclaim, imagine, people, partnerships, places, pride.

Actions speak louder than words.

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