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Applying Models to Ecosystem Restoration Projects

Philadelphia District



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- **Water Flow Management**
 - Francis E. Walter Reservoir
- **Acid Mine Reclamation**
 - Pine Knot
- **Watershed Sediment Assessment and Restoration**
 - Darby-Cobbs Watershed



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F.E. Walter Reservoir

- **Protect Environmental Resources**
- **Environmental Considerations -
Reservoir Pool Elevation and Release
Changes**
- **Minimize Negative Risk Potential and
Maximize Benefits**
- **Monitoring Plan and Water Quality
Modeling**



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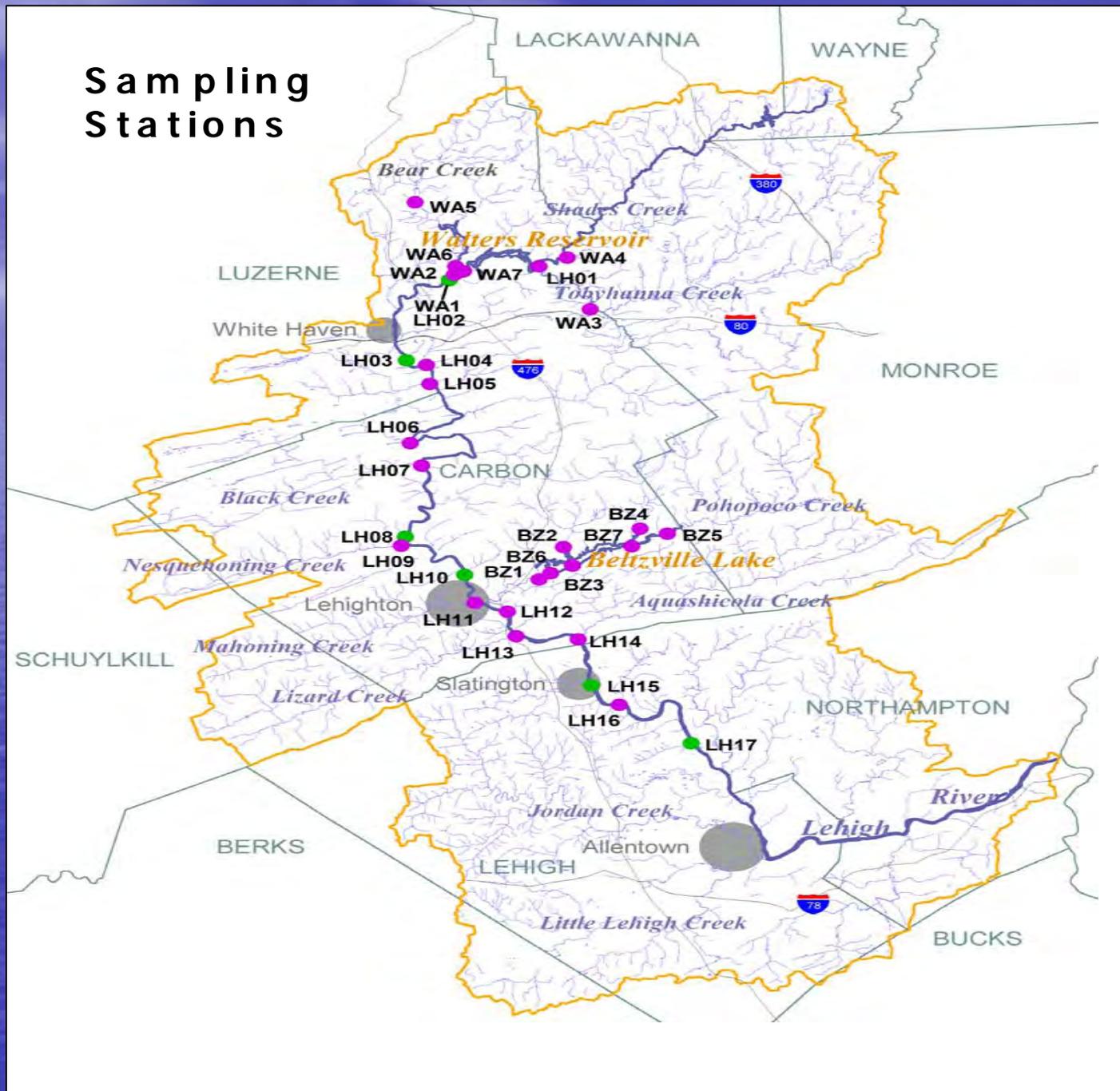
(GREEN)

RIVER
STATIONS



(PINK)

TRIBUTARY and
LAKE STATIONS





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F.E. Walter Reservoir

Total project acreage of 2,949 acres

-Numerous stream and river miles

Lehigh River, Bear Creek, Shades Creek,
Stony Run, Lime Hollow, Whitehouse Run,
Cider Run...

-PA Wild and Scenic River System downstream

-Threatened and endangered species and habitat

- Timber rattlesnake, Bald eagle, Small-footed bat



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Francis E. Walter Reservoir: A Diverse and Thriving Environment

-Aquatic, riparian, wetland, and terrestrial
wildlife and habitat

-Outdoor recreation

Angling (land and water craft)

Rafting/Boating

Hunting

Hiking

Others....



Francis E. Walter Reservoir



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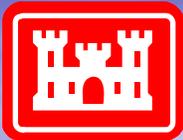
Pennsylvania Fish and
Boat Commission
Reservoir and River Fish
Stocking Efforts





Reservoir Environmental Resources- Stream Habitat





Reservoir Environmental Resources- Wetlands





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Environmental Considerations Associated With Reservoir Pool Elevation and Release Changes

- **Impact on in-lake and river recreation and use of environmental resources**
- **Impact on water chemistry in-lake and Lehigh River**
- **Impact on upstream and downstream aquatic and terrestrial habitat and species use**
- **Impact on threatened and endangered species and their habitat**
- **Others.....**



Walter Reservoir During Elevated Pool Operations





Iron Precipitate and Poor Water Quality During Extended High Pool Level Operations





Iron Precipitate on Lehigh River Sediments Extending Downstream





Iron Precipitate on Lehigh River Sediments Impact the Ecology of the River





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Modeling

- Run different scenarios to increase cold water releases and enhance white water recreation
 - Existing project with increased temporary storage
 - Project with a selective withdrawal tower
 - Project with selective withdrawal and dedicated storage
- Consider
 - Size of white water releases
 - flood control nature of the dam
 - sustainability of optimal fisheries temperatures downstream



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Environmental Changes in a Range of Alternative Pool Elevations

- 1300 Foot Pool Elevation (Water Depth ~45 feet)
 - 80 Pool surface acres (current operation)
- 1392 Foot Pool Elevation (Water Depth ~137 feet)
 - 805 land surface acres inundated
 - 9.6 miles of upstream stream and river inundation
 - Documented negative WQ impacts (in-lake and Lehigh)
 - Documented biological impacts (in-lake and Lehigh)



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Environmental Changes in a Range of Alternative Pool Elevations

- 1370 Foot Pool Elevation (Water Depth ~115 feet)
 - 312 land surface acres inundated
 - 6.3 miles of upstream stream and river inundation
 - Anticipated negative WQ impacts (in-lake and Lehigh)
 - Anticipated biological impacts (in-lake and Lehigh)



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Environmental Changes in a Range of Alternative Pool Elevations

- 1335 Foot Pool Elevation (Water Depth ~80 feet)
 - 101 land surface acres inundated
 - 3.8 miles of upstream stream and river inundation
 - Anticipated no significant negative WQ impacts (in-lake and Lehigh)
 - Anticipated no significant biological impacts (in-lake and Lehigh)



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Minimize Risk and Maximize Benefit

- **2005 plan at pool elevation 1335'**
 - Reduce potential for species of concern impact
 - Reduce potential for aquatic and terrestrial habitat impact
 - Reduce potential for negative water chemistry changes



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Minimize Risk and Maximize Benefit Cont.....

- Improve recreational whitewater rafting potential
- Protect and potentially improve downstream fishery with higher minimum low flow
- Potentially improve downstream water quality under low flow conditions



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Minimize Risk and Maximize Benefit Cont...

- Protect and potentially improve in-lake fishery by minimizing pool fluctuation during in-lake spawning periods
- Reduce likelihood of emptying pool as a flood control response



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Monitoring

- Increase Corps water quality sampling for 2005
 - Annual water quality sampling since 1975
 - Established sampling stations and protocol
 - Historic WQ record and trends
- Biological monitoring of Lehigh River
 - Invertebrate sampling at previously established river stations
- Continuous water temp. monitoring on Lehigh River



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FUTURE WATER QUALITY MODELING

- Large amount of available data from various sources
- 2001 Lehigh Study designed for model input
- Various modeling options that require a minimum of 1-year to develop
- Cost and development is dependent on model complexity

Abandoned Mine Lands



Strip Mines

Underground Mines

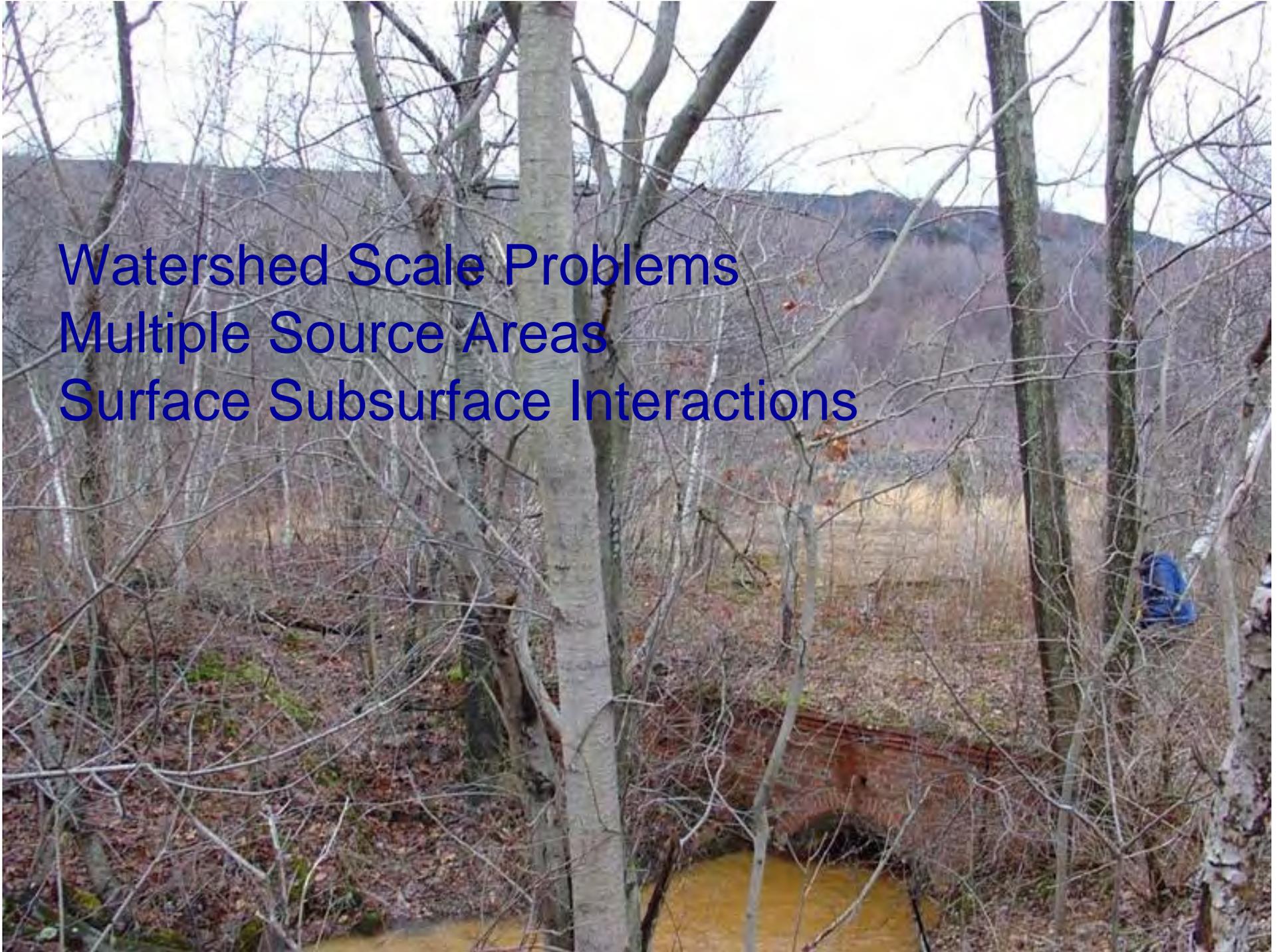
Mine Water Discharge Tunnel

Southern Anthracite Region

Pine Knot and Oak Knoll

Mine Discharges

Watershed Scale Problems
Multiple Source Areas
Surface Subsurface Interactions



Pine Knot Discharge

- Flow Reductions
- Metal Reduction - Al & Fe
- pH Corrections
- Naturalized Stream





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Pine Knot

- Develop models to determine impacts of surface and deep mining on the hydrology and groundwater flow and estimate channel hydraulics
- Model existing and up to three improved flow/water quality conditions
- Screen alternative abatement measures:
 - low-head dams, retention/detention basins, created wetlands, wetland enhancement, open limestone channels, mine waste reclamation or relocation, and mine portal and entry sealing



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Darby-Cobbs Watershed

- Highly urbanized
 - Up to 66% of the surfaces are impervious
- Problems have unbalanced the sediment equilibrium causing excessive sediment deposition or erosion
 - flooding, streambank erosion, ecological degradation, and aesthetics
 - Urban sprawl and the corresponding increased runoff
 - channelized and armored banks



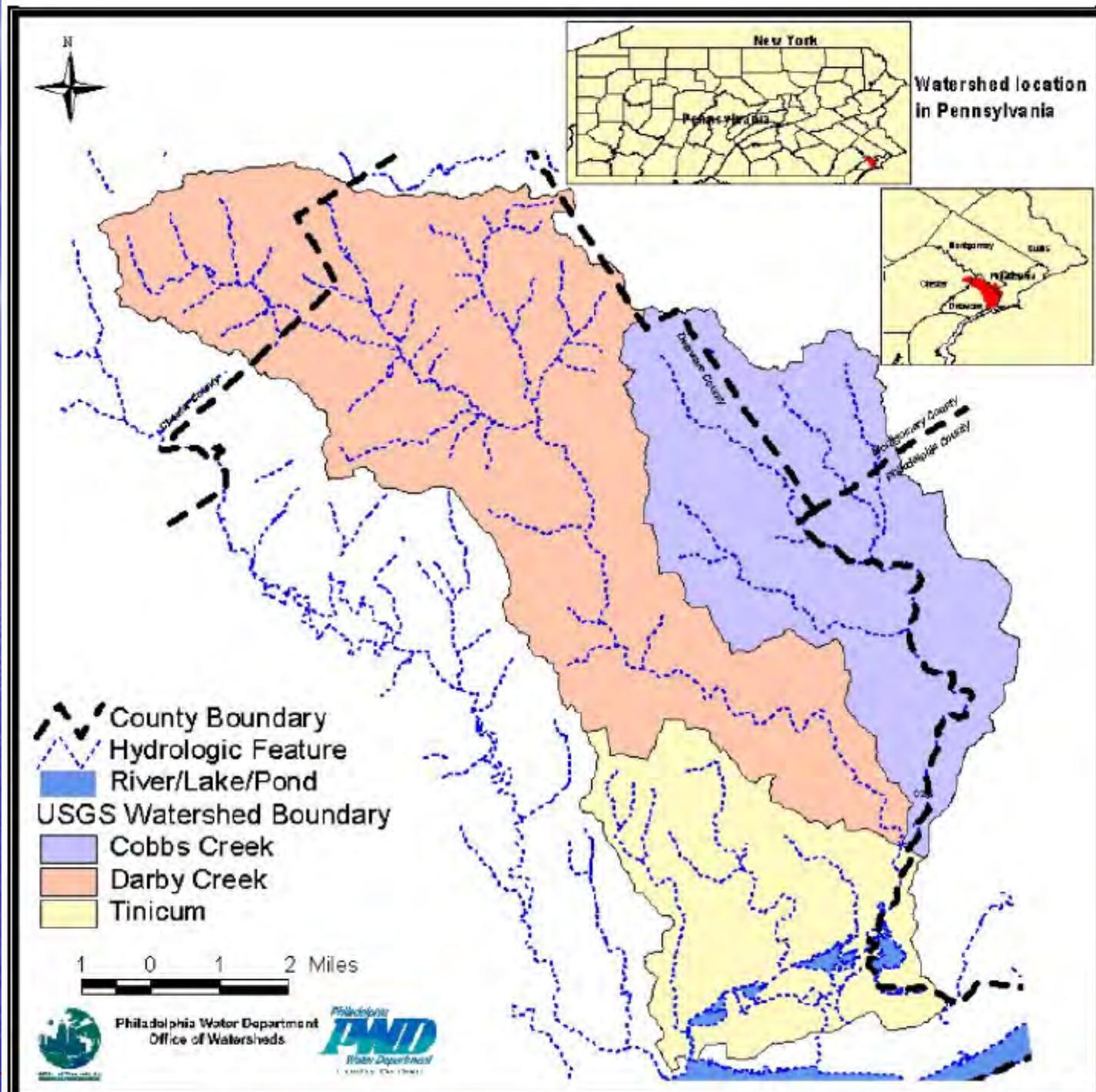
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Darby-Cobbs Watershed

- NAP initiated 16 official projects over the past 35 years
- 34 separate project requests from communities within the Darby-Cobbs watershed in the past year, due in part to recent floods
- Projects from a municipality-based scale has not been effective.
- Need to be examined from a watershed perspective
 - Most problems are a result of imbalances in the sediment equilibrium
- A watershed-scale assessment is needed to provide a map of potential imbalances in order to identify effective design or remediation needs



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20-30 ft. cut eroded streambanks and sediment deposition

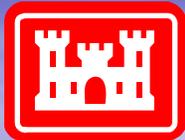




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Detroit riprap





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Channelization and partially exposed sewage infrastructure





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Darby-Cobbs Watershed

- Examine existing data and determine if additional data is needed
- Build SIAM-like model to identify the areas where restoration will have the most significant benefit to the watershed
 - Run various restoration scenarios- stormwater management, barrier removal, etc.



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Darby-Cobbs Watershed

- A comprehensive watershed plan will be written based on the findings and will address
 - bank erosion/sediment deposition, dam/impediment removal, greenways, and riparian buffer re-establishment
 - will also include advance designs (in-stream structures) for more immediate objectives, such as erosion that is threatening homes and sewage infrastructure



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QUESTIONS??