Road To Brook Trout Recovery

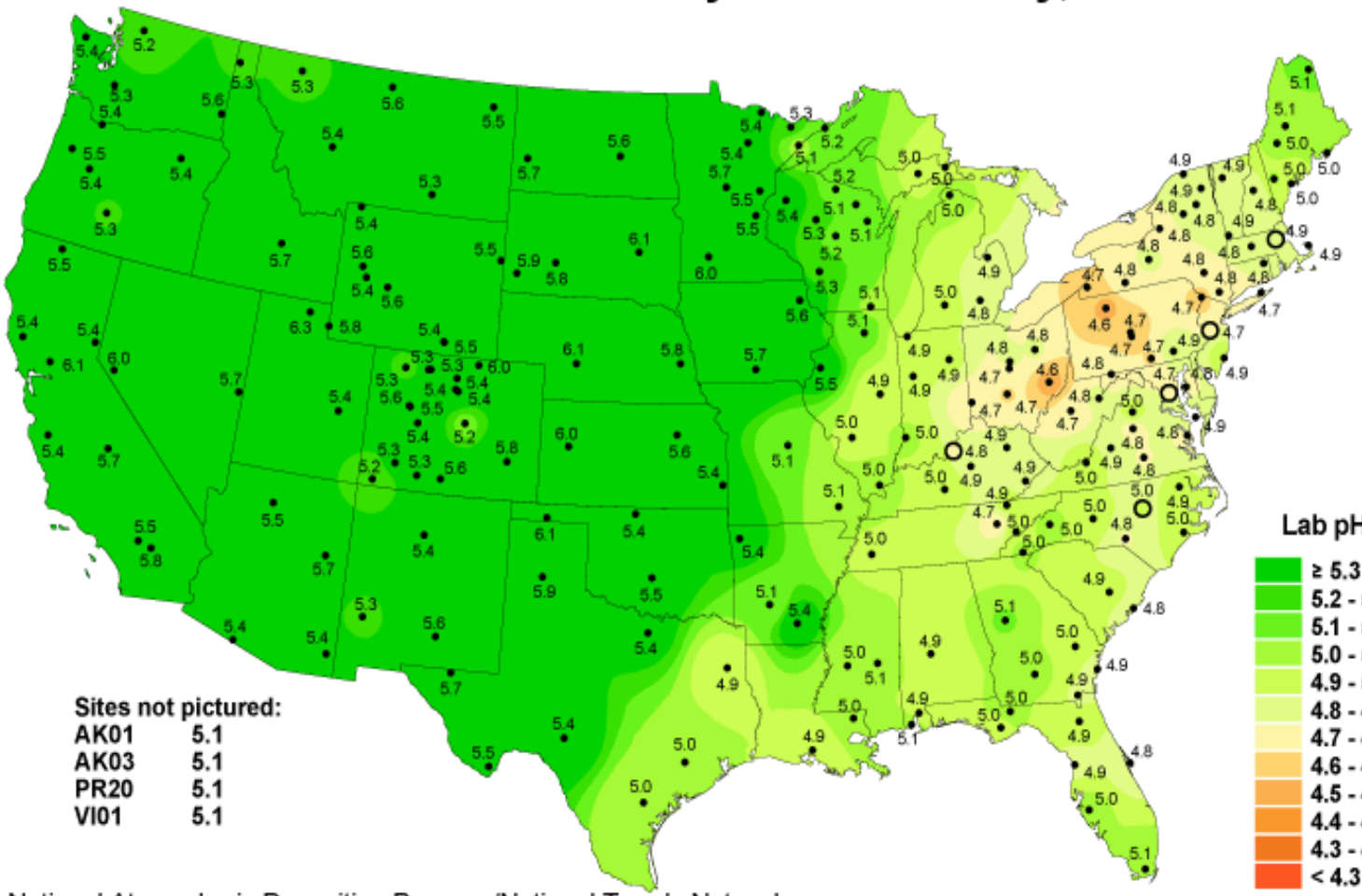
A Passive Remediation of Acid Precipitation at the South Branch of Kinzua Creek

Ken Anderson, Fisheries Biologist II

Division of Habitat Management Area 1

Mission: To protect, conserve, and enhance the Commonwealth's aquatic resources and provide fishing and boating opportunities

Hydrogen ion concentration as pH from measurements made at the Central Analytical Laboratory, 2009

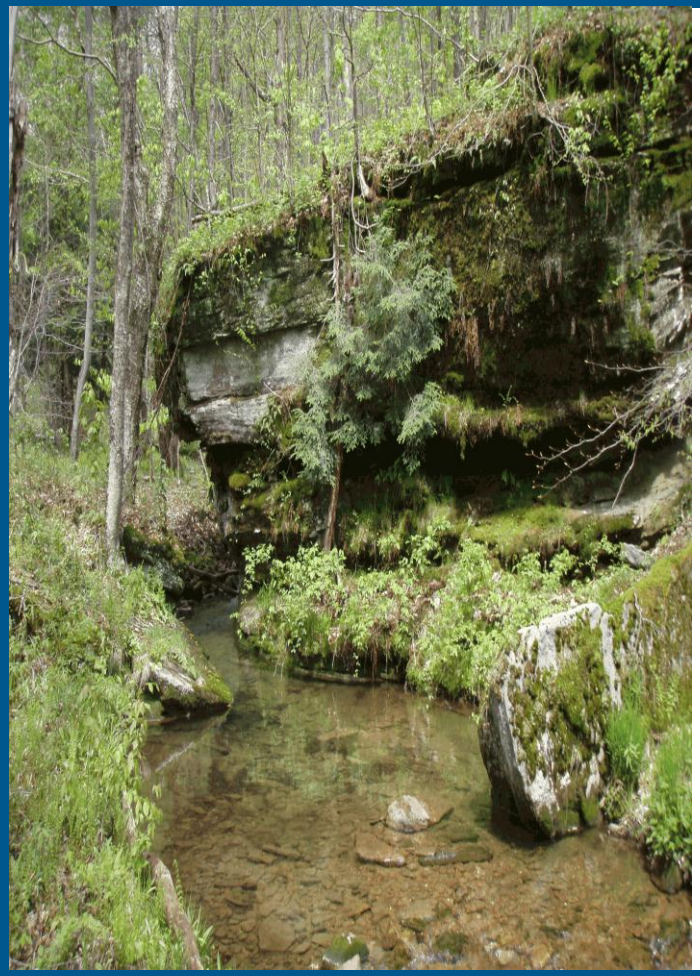


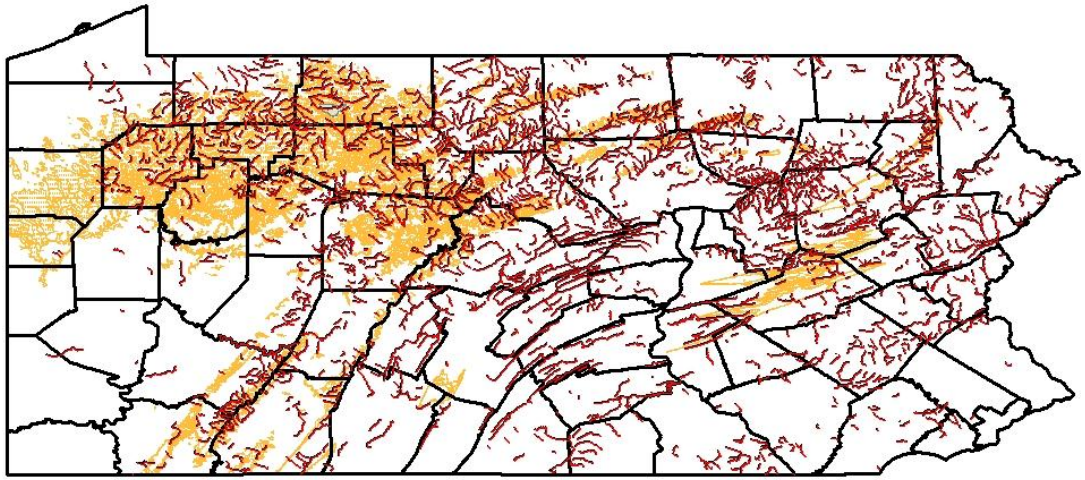
Sites not pictured:

AK01	5.1
AK03	5.1
PR20	5.1
VI01	5.1

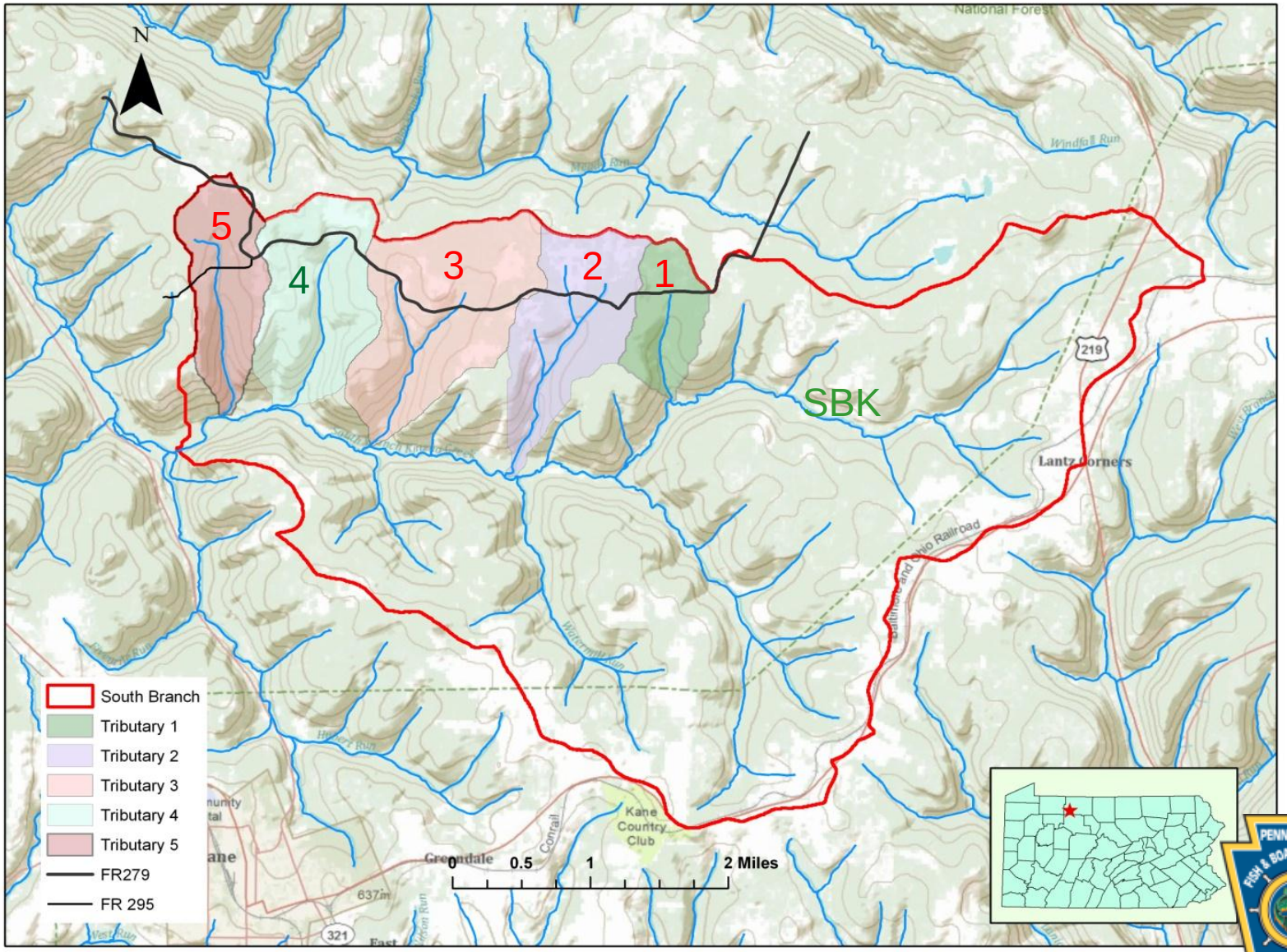
National Atmospheric Deposition Program/National Trends Network
http://nadp.sws.uiuc.edu

Sentinel Geological Formation





Study Area


N
5
4
3
2
1
SBK
South Branch
Tributary 1
Tributary 2
Tributary 3
Tributary 4
Tributary 5
FR279
FR 295
0
0.5
1
2 Miles
Lantz Corners
Kane Country Club
Greendale
219
321
PENNSYLVANIA
FISH & BOAT COMMISSION

Objective & Goals

- **Overall Objective:**
  - Improve water quality of tributaries to South Branch of Kinzua Creek
  - **Re-establish brook trout recruitment** within tributary populations
  - Use ditch-lined passive treatment systems (PTS) to neutralize stormwater runoff

A Treatability Study

Dept. of Civil and Environmental Engineering,

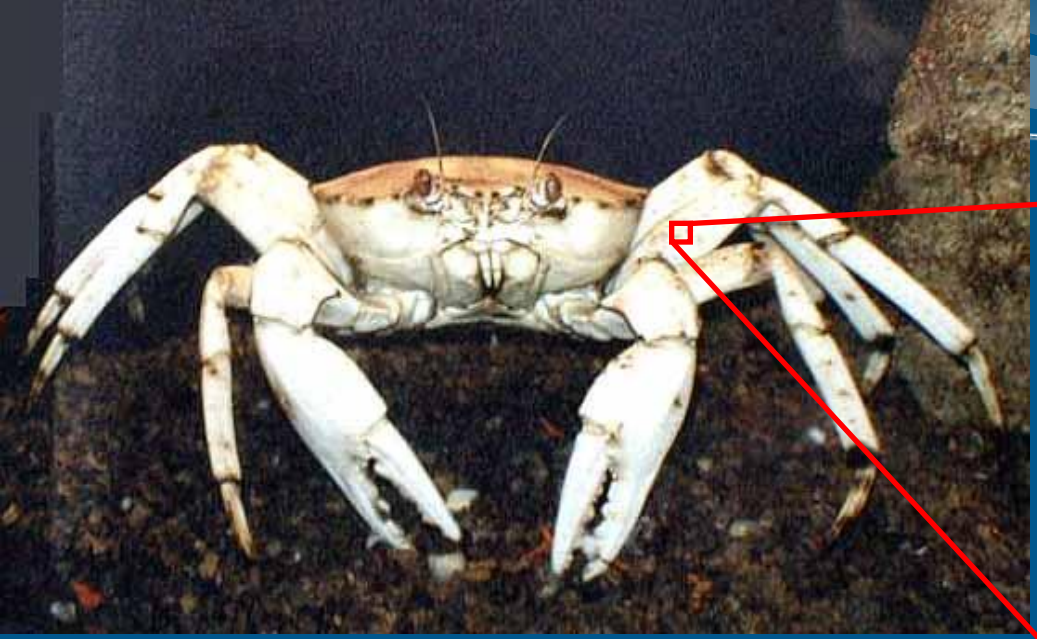
- **Passive Remediation of Acid Precipitation in the South Branch of Kinzua Creek using Crab Shell Chitin:**

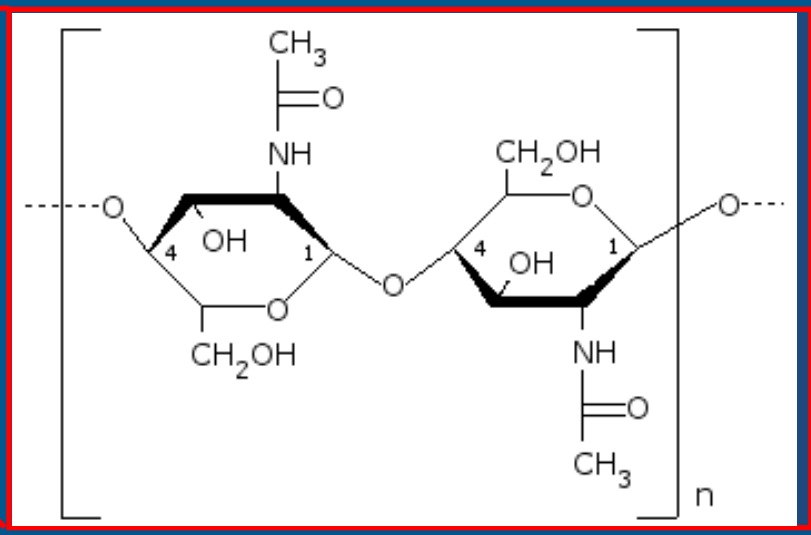
  - A. F. Caporuscio and Dr. R. A. Brennan

Treatability Study Goals

- **Goals of Penn State Laboratory Study:**
  - Compare the effectiveness of limestone vs. crab-shell for application in PTS:
    - Restore pH to circum-neutral values
    - Provide excess alkalinity to buffer downstream waters
    - Remove dissolved metals, such as aluminum

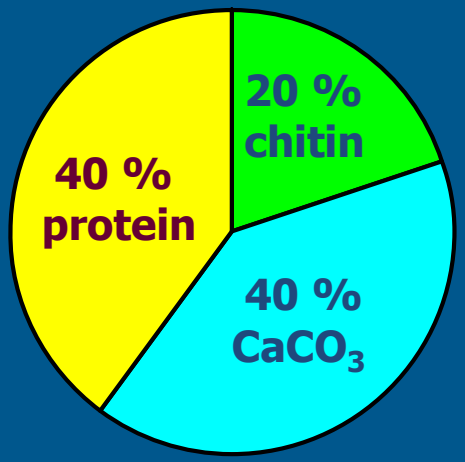
Crab-Shell Chitin





ChitoRem® SC-20:

chitin + protein + $CaCO_3$



Continuous-Flow Column Experiments for Acid Rain Treatment with Different Materials

(Performed by Abby Caporuscio)

Flow rate = 0.5mL/min; HRT = 6 hours.

Column ID	Materials (by Volume)	Mass (g)
1	100% sand (control)	661.6
2	100% limestone	730.5
3	50% chitin + 50% sand	106.6 (chitin) 160.0 (sand)
4	50% chitin + 50% limestone	106.6 (chitin) 182.6 (LS)

Conclusions of Lab Treatability Study

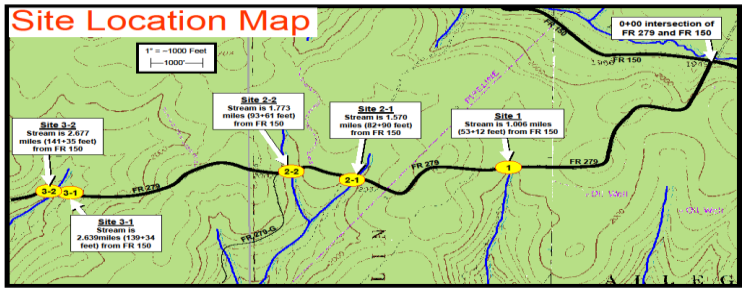
- **Both crab-shell chitin and limestone neutralize pH**

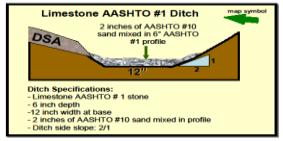
- **Crab-shells produce <u>much</u> greater alkalinity that could buffer downstream waters**
  - Limestone, ave. alkalinity = 23 mg/L as $CaCO_3$
  - Crab-shell, ave. alkalinity = 634 mg/L as $CaCO_3$

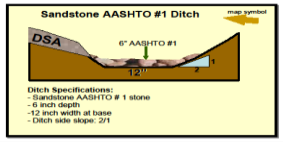
- **A lower mass of crab-shells is required for treatment (therefore, less area is required for application)**
  - Limestone = 13 to 60 g/L
  - Crab-shell = 0.2 to 0.9 g/L

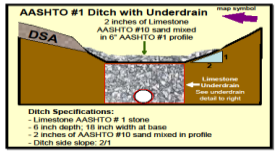
- **Crab-shells are also effective for removal of aluminum**

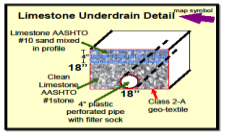
Better Roads, Cleaner Streams

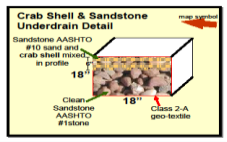


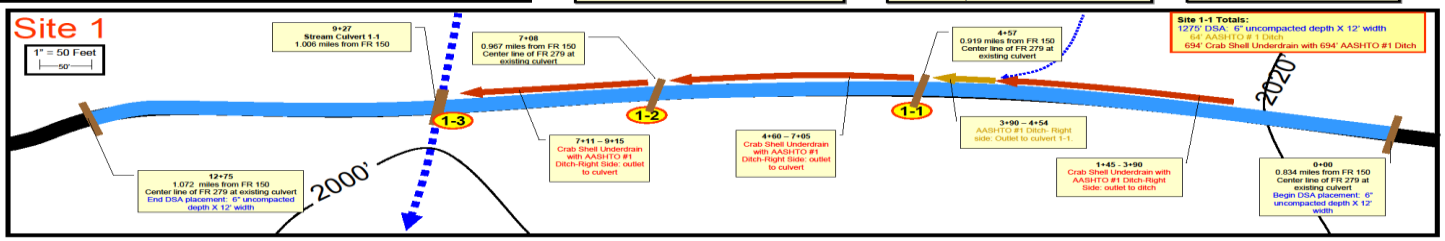


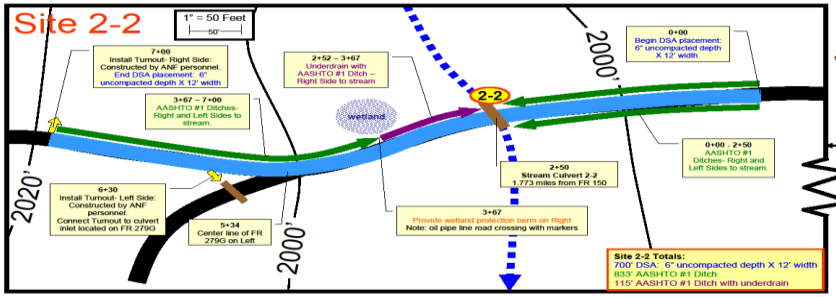






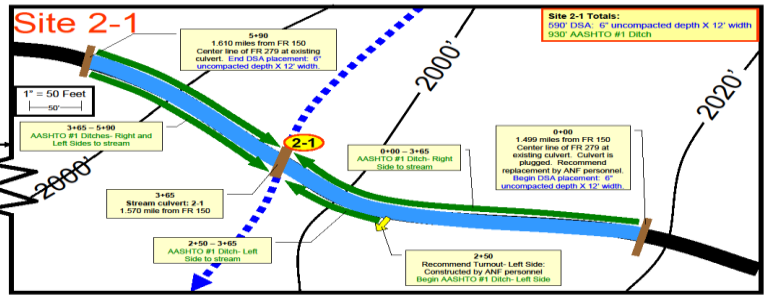


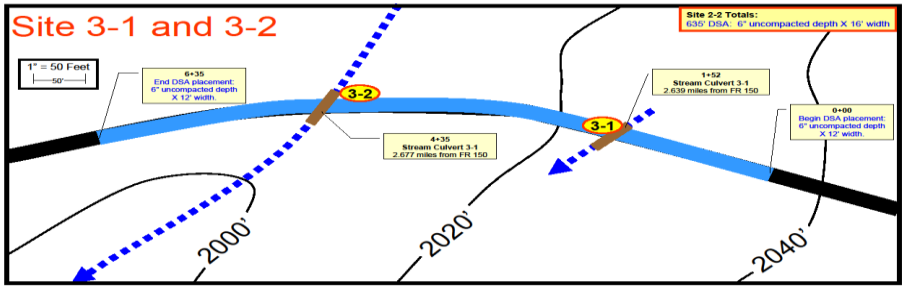




Site 2-1 and 2-2 are shown to scale in relation to each other. 500 feet of terrain in between removed from the map at this gap.

500 feet





Project Totals:
3,200' DSA: 6" uncompacted depth
1,763' AASHTO #1 Ditch
64' AASHTO # 1 Ditch
115' AASHTO #1 Ditch with underdrain
694' Crab Shell Underdrain with 694' AASHTO #1 Ditch

Materials Totals:

	DSA	AASHTO #1	AASHTO #10
Section 1	425 tons		
Ditch		63 tons SS	
Underdrain		58 tons SS	24 tons SS
Section 2-1	197 tons		
Ditch		65 tons LS	22 tons LS
Section 2-2	233 tons		
Ditch		68 tons LS	23 tons LS
Underdrain		10 tons LS	3 tons LS
Section 3-1 & 3-2	285 tons		
TOTAL MATERIAL	DSA 1,140 tons	AASHTO #1 121 tons SS 143 tons LS	AASHTO #10 24 tons SS 48 tons LS
SS = SandStone LS = LimeStone			
Additional Materials			
- Class 2A Geo Textile: 1 Roll (432' x 12.5')			
- 4" perforated pipe with filter sock: 120'			
- 4" schedule 40 pipe with ferrco fittings: 1 @ 4'each = 4'			

NOTES:
- **Driving Surface Aggregate (DSA):**
  - Compacted sub-grade should be crowned at ¼" – ½" per foot prior to Driving Surface Aggregate Placement.
  - 4" keys recommended in sub-grade along shoulder to support edge of Driving Surface Aggregate. Also across road at beginning and end of DSA placement.
  - Recommended DSA crown of ½" -¾" per foot.
  - Recommended DSA placement method is motor-paver. If paver is not available, recommended placement method is spreader box.
  - Minimum 10 ton roller recommended for compaction of DSA.
  - Completed Dirt and Gravel Road Program DSA Certification to be provided by DSA supplier upon delivery of material.
- **Underdrains:**
  - Class 2-A geo-textile fabric specified around all underdrains.
  - 4" of 4" schedule 40 pipe is recommended at outlet of limestone underdrain.
  - Crab shell amendment quantities to be determined by others.
  - Flow directions of underdrains and ditches indicated by arrow directions on plan.
- Existing culvert locations also exhibit corresponding ANF milepost stationing.
- Culvert replacements are not part of this project.
- Ditch dimensions are approximate. Adjust to fit field conditions.
- All material quantities on this plan are approximate.

South Branch Kinzua Creek
Acid Rain Remediation Study on Forest Road 279

Wetmore and Hamlin Townships,
McKean County, PA
Allegheny National Forest
9/15/08 - revised 2/19/09

Center for Dirt and Gravel Road Studies
www.dirtandgravelroads.org 866-668-6683

PENNSYLVANIA FISH & BOAT COMMISSION

Deliveries

Crab-shell

Limestone

Gabion Stone & Pea Gravel

Geo Tex

Under drain

Mulch hay

Construction

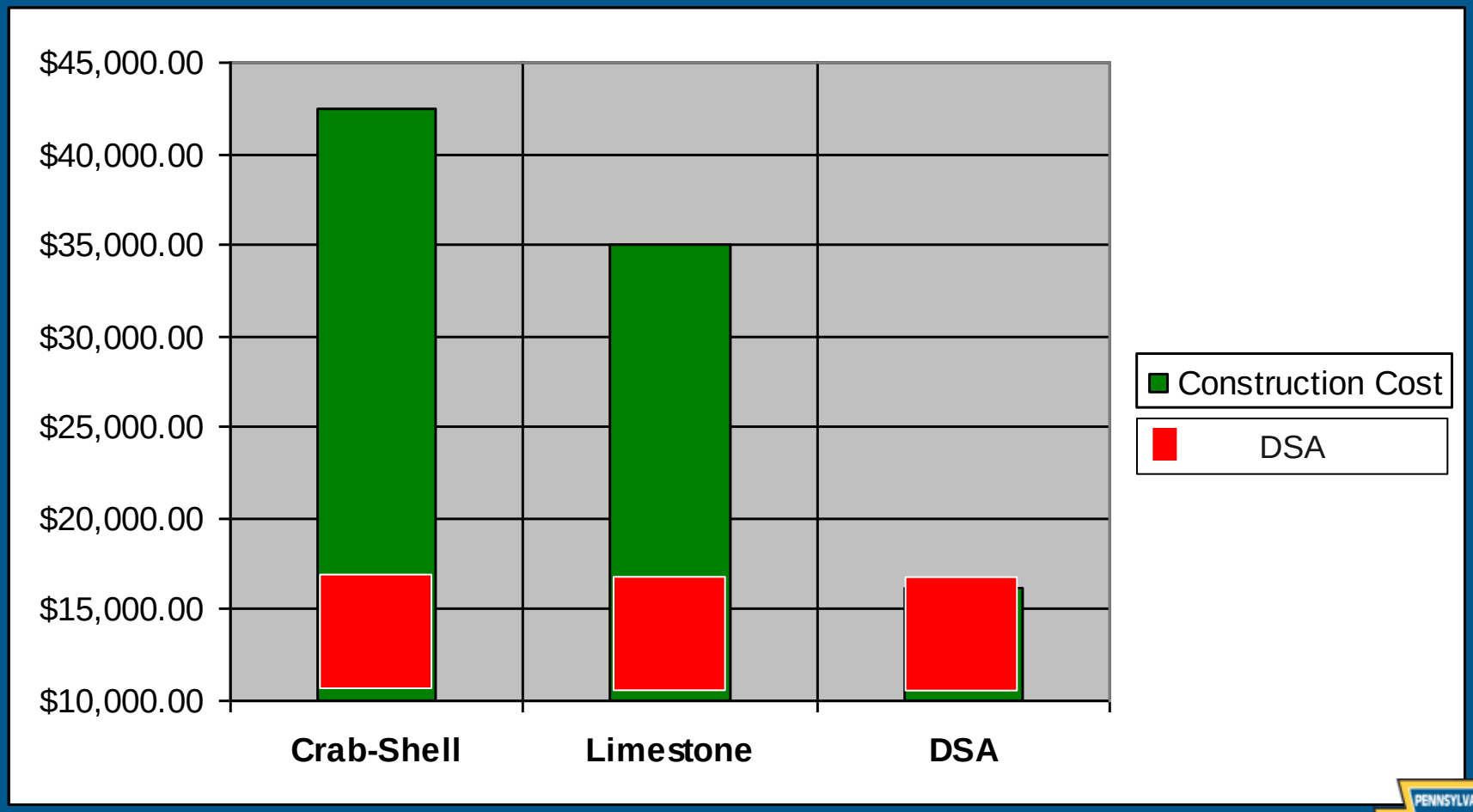
Completed in 3 weeks

10 Passive Treatments

1 Mile of DSA

Seed and mulch

Construction Costs



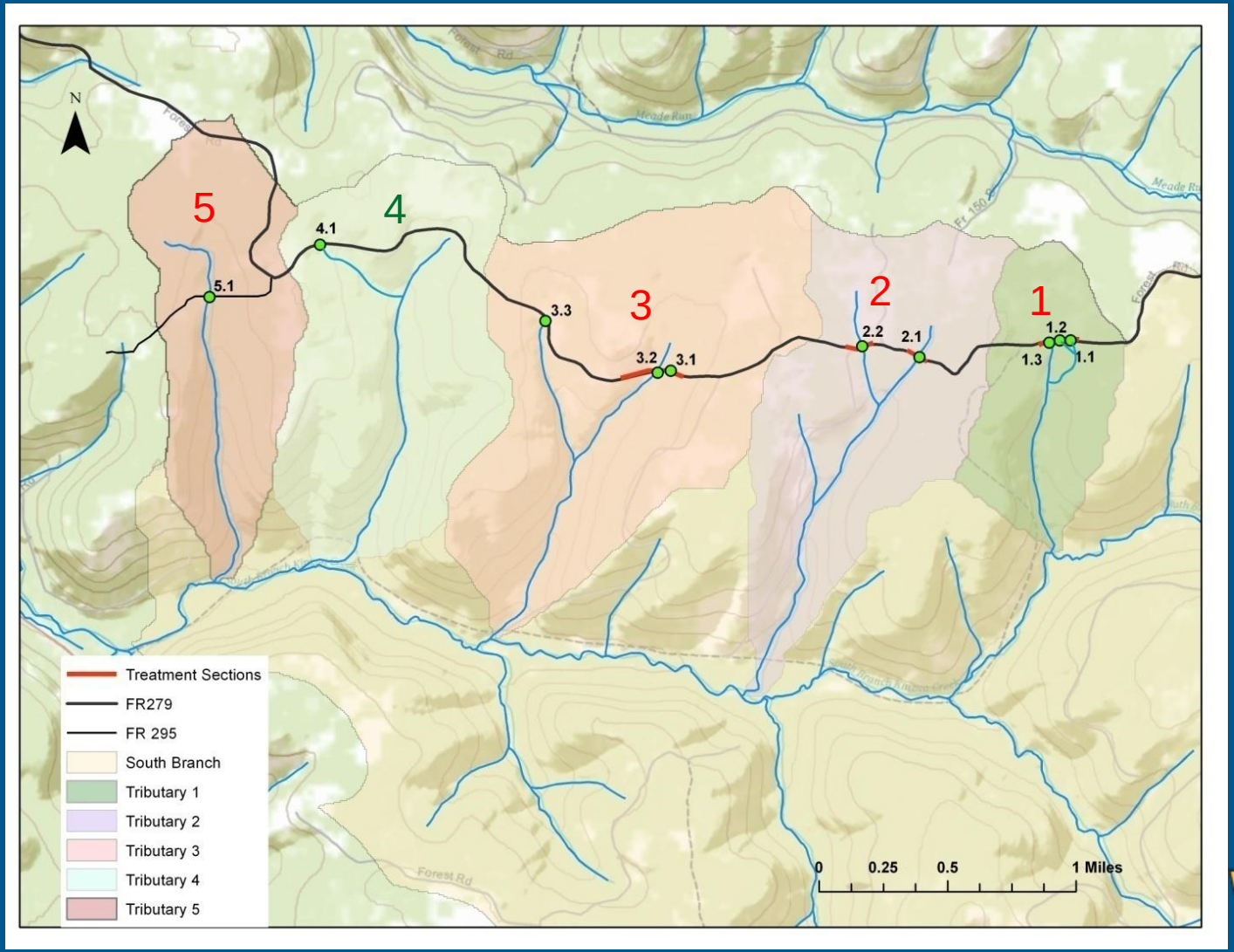
The Road to Brook Trout Recovery

Dept. of Biology,

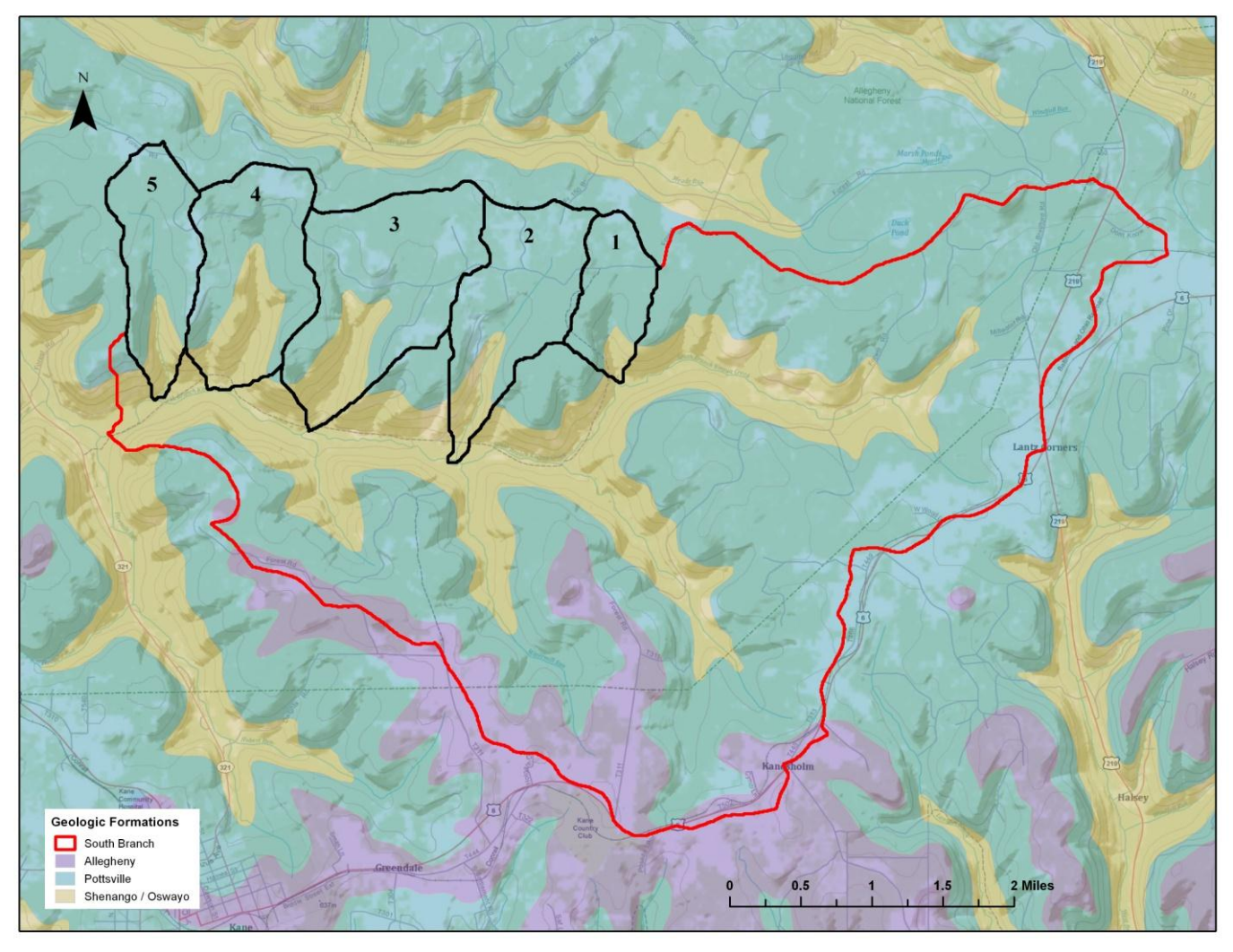
- **Acid Remediation in the South Branch of Kinzua Creek:**

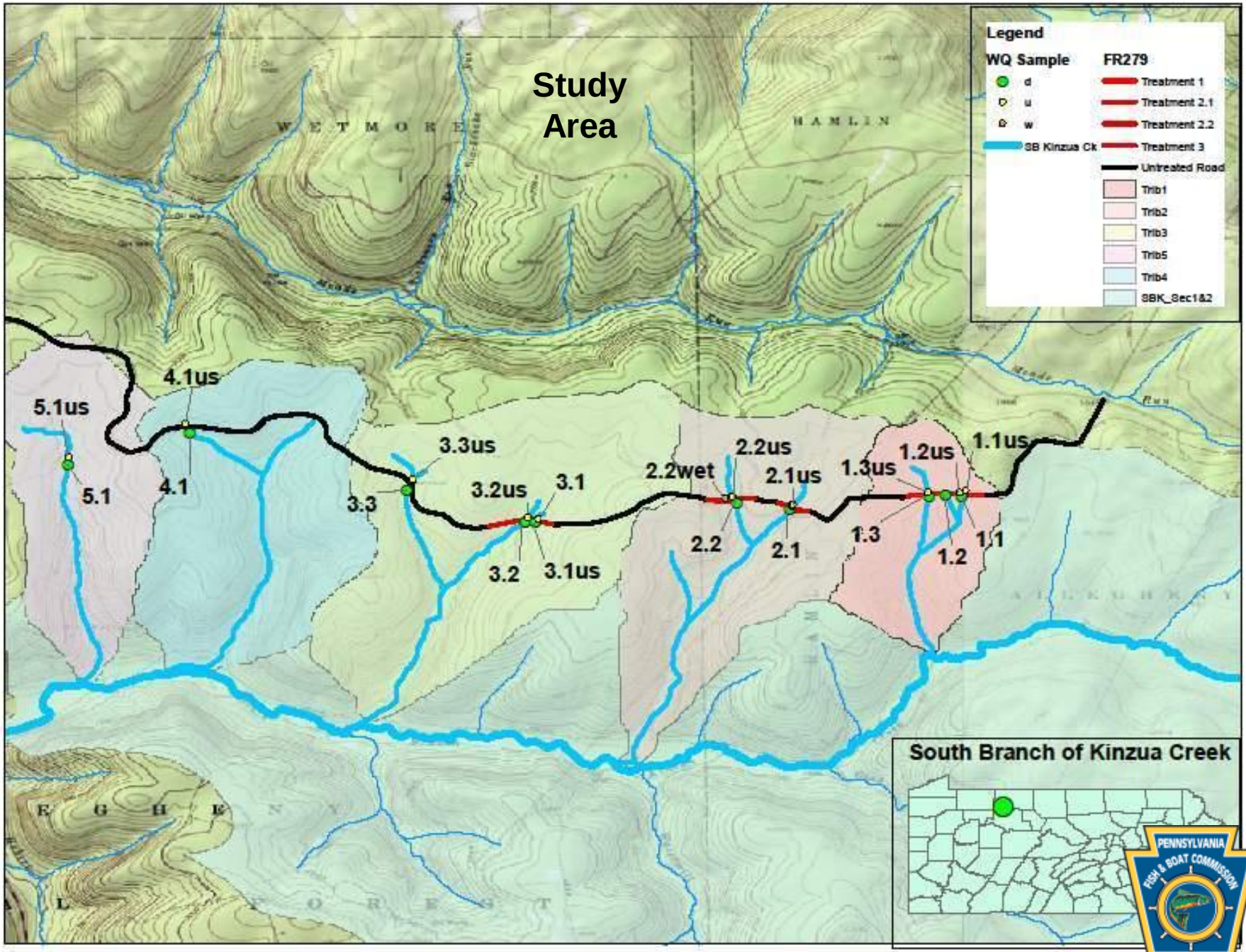
  - Matt Gordon, Clarion University,
  - Kenneth Andersion, PAF&BC
  - Dr. Andrew Turner, Clarion University

Study Area Facts



Sentinel Geology




Study Area
Legend
WQ Sample
d
u
w
SB Kinzua Ck
FR279
Treatment 1
Treatment 2.1
Treatment 2.2
Treatment 3
Untreated Road
Trib1
Trib2
Trib3
Trib5
Trib4
SBK_Sec1&2
WETMORE
HAMLIN
5.1us
4.1us
3.3us
3.2us
3.1
2.2wet
2.2us
2.1us
1.3us
1.2us
1.1us
5.1
4.1
3.3
3.2
3.1us
2.2
2.1
1.3
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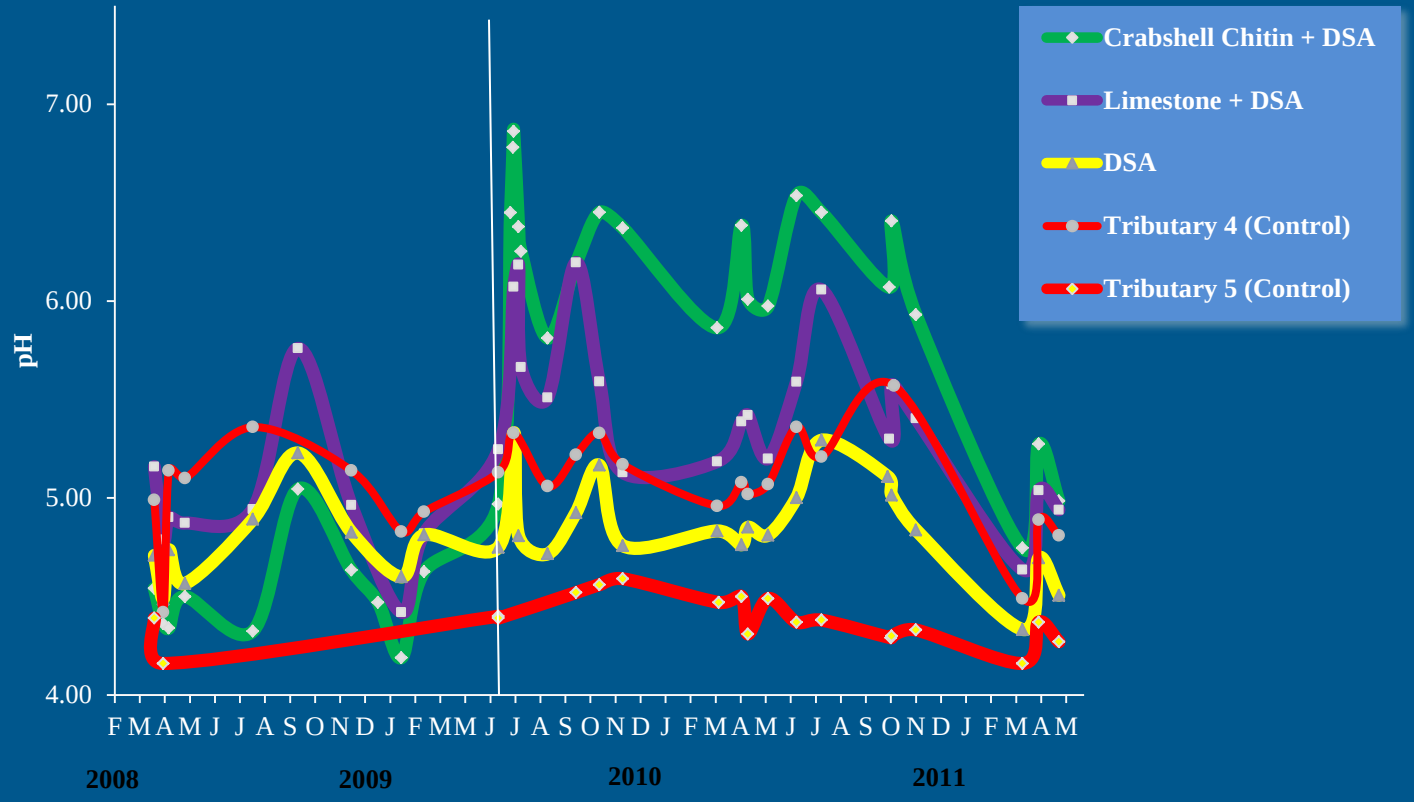
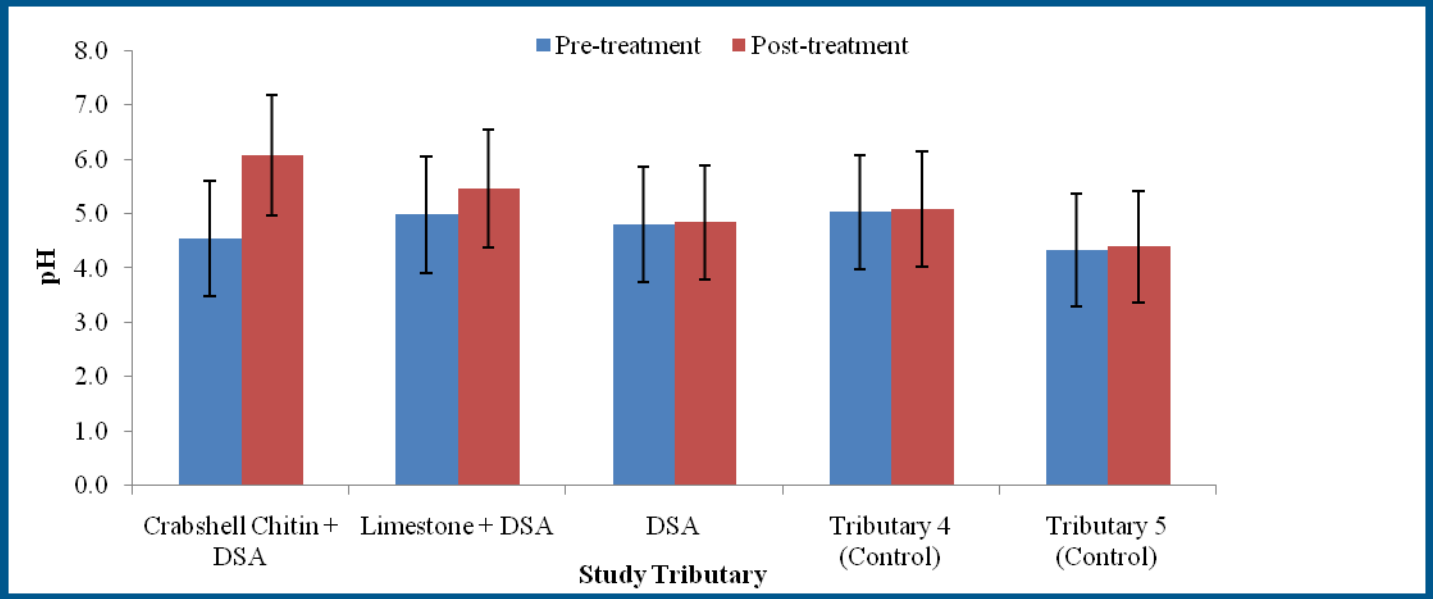
1.1
South Branch of Kinzua Creek
PENNSYLVANIA FISH & BOAT COMMISSION

Water Quality Measures



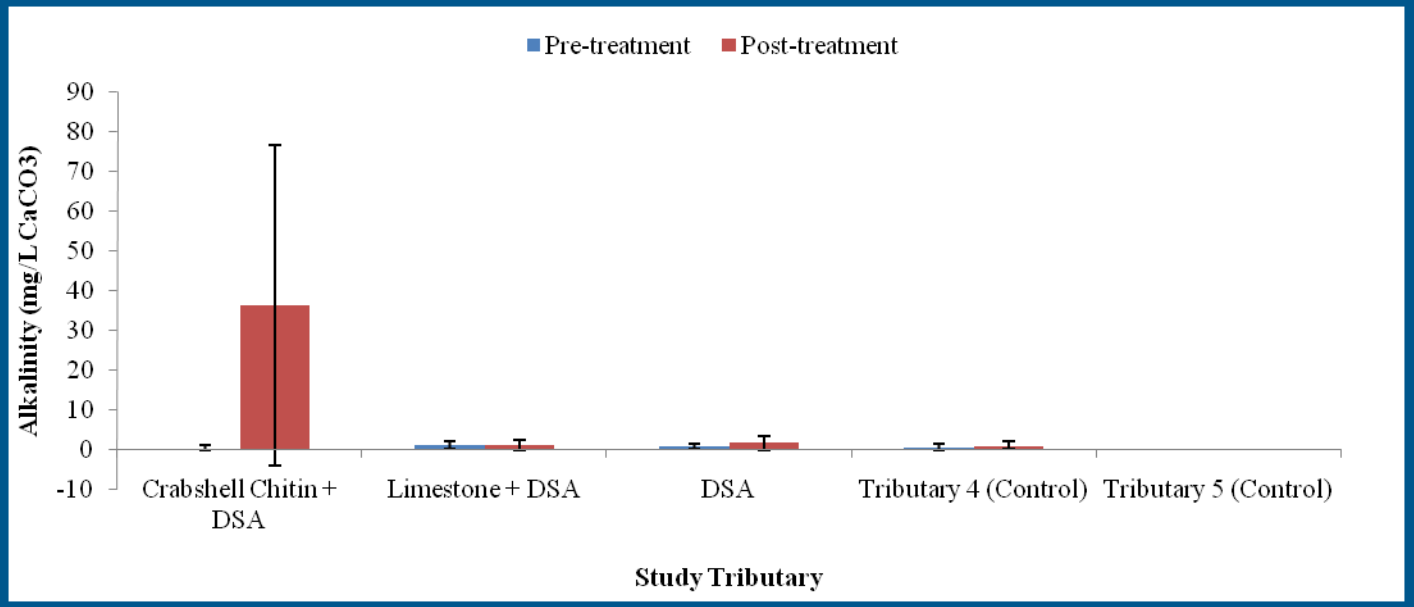
pH values for treatment and control tributaries from April 2008 – March 2011. Data points represent logarithmic averages of measurements taken from culverts at each treatment site and the line is a smoothed continual

pH



A comparison of the logarithmic average of pH values measured before and after treatment system completion at the effluent of established sampling sites. Error bars denote standard deviation.

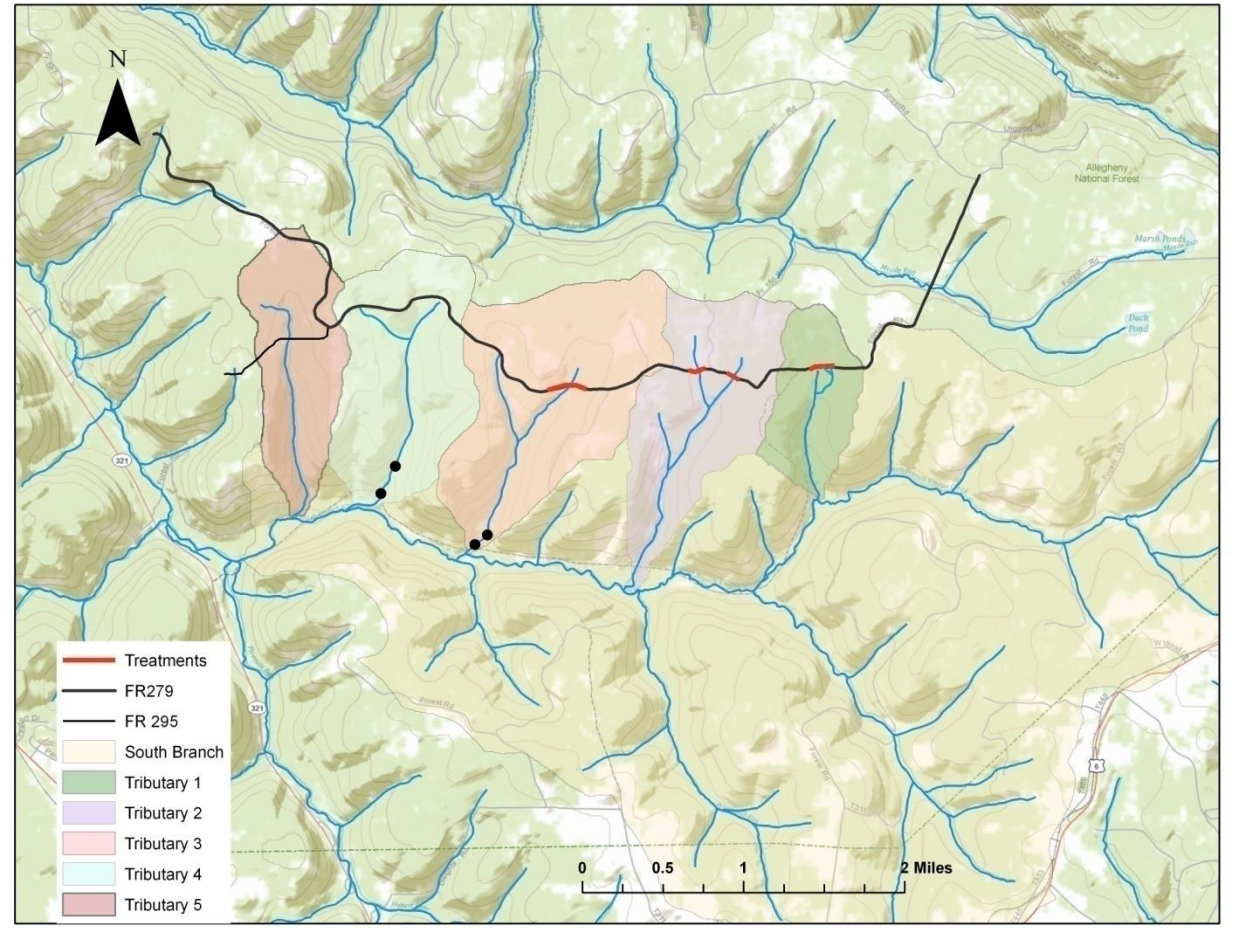
Alkalinity



A comparison of average alkalinity measured in the field before and after treatment system completion at the effluent of established sampling sites. Error bars denote standard deviation.

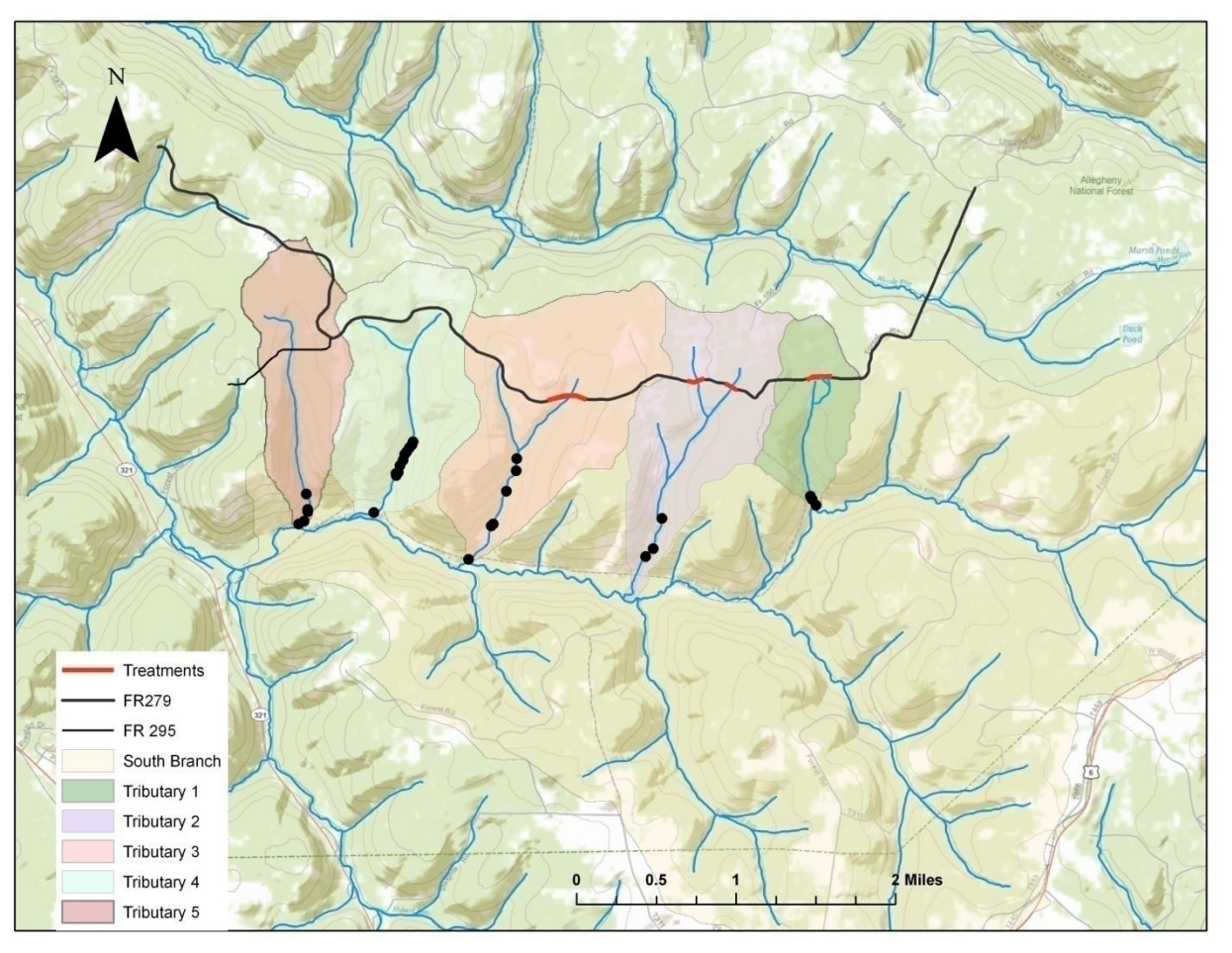
Spawning Survey

Pre Treatment Survey



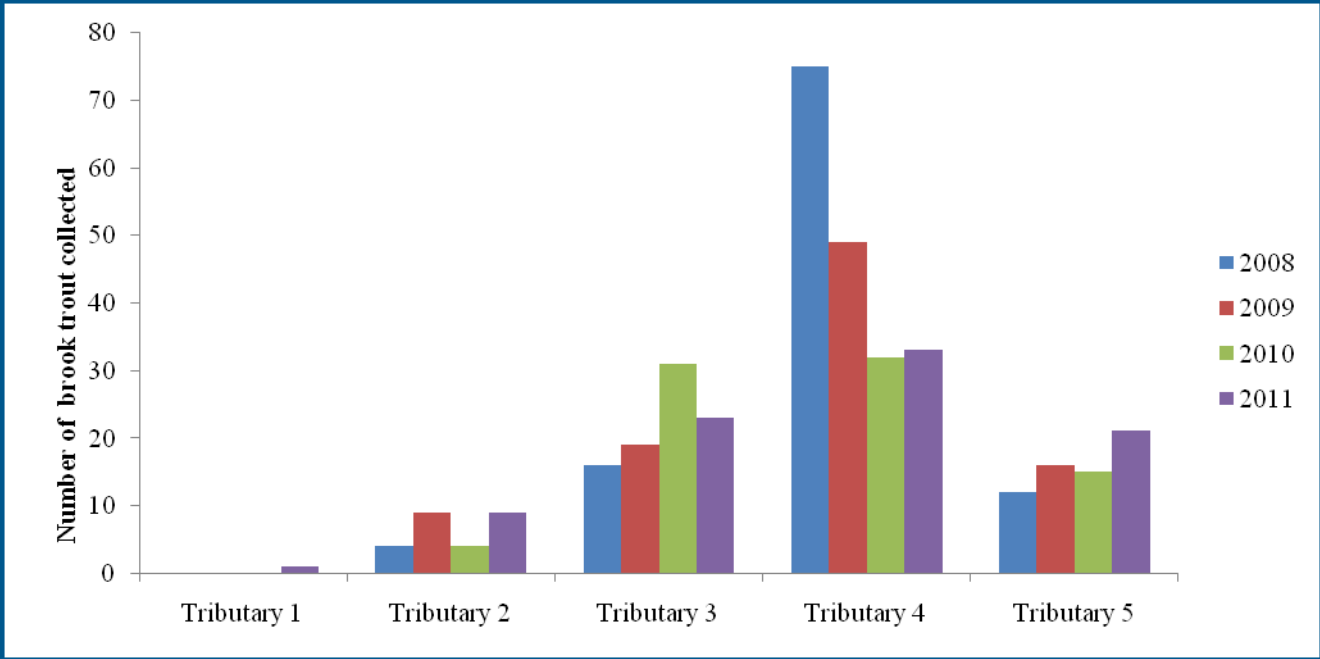
Brook trout redds observed in study tributaries during fall 2008 surveys

Post Treatment Survey



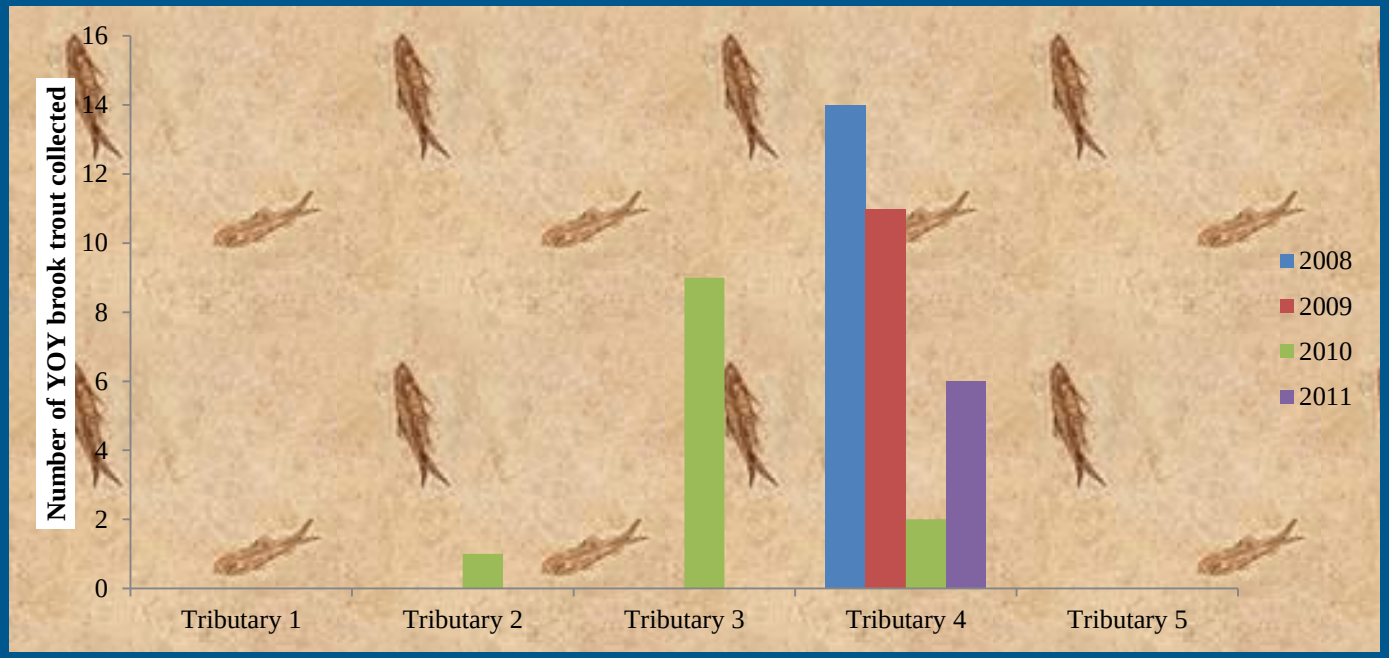
Brook trout redds observed in study tributaries during fall 2010 surveys.

Brook Trout Survey



Total number of brook trout collected in study tributaries via backpack electrofishing from 2008 – 2011

Brook Trout Recruitment



Number of YOY brook trout collected in study tributaries via backpack electrofishing from 2008 – 2010

Brook Trout Cohorts

	2008	2009	2010	2011
Tributary 1	-	-	-	-
Tributary 2	-	-	Mottled sculpin, creek chub	-
Tributary 3	-	-	Brown trout	Brown trout
Tributary 4	Mottled sculpin, brown trout	Mottled sculpin, brown trout	Mottled sculpin, brown trout	Mottled sculpin, brown trout
Tributary 5	-	-	-	Brown trout

Fish species other than brook trout observed during electrofishing surveys in study area from 2008- 2011.

Project Summary

- Crab shell ditches = improved pH and alkalinity the best.

- Brook Trout recruitment reestablished in Limestone ditches and DSA treatment watersheds only in fist year.

- Cohort fish appeared after treatment only in fist year.

- Treatments were not big enough.

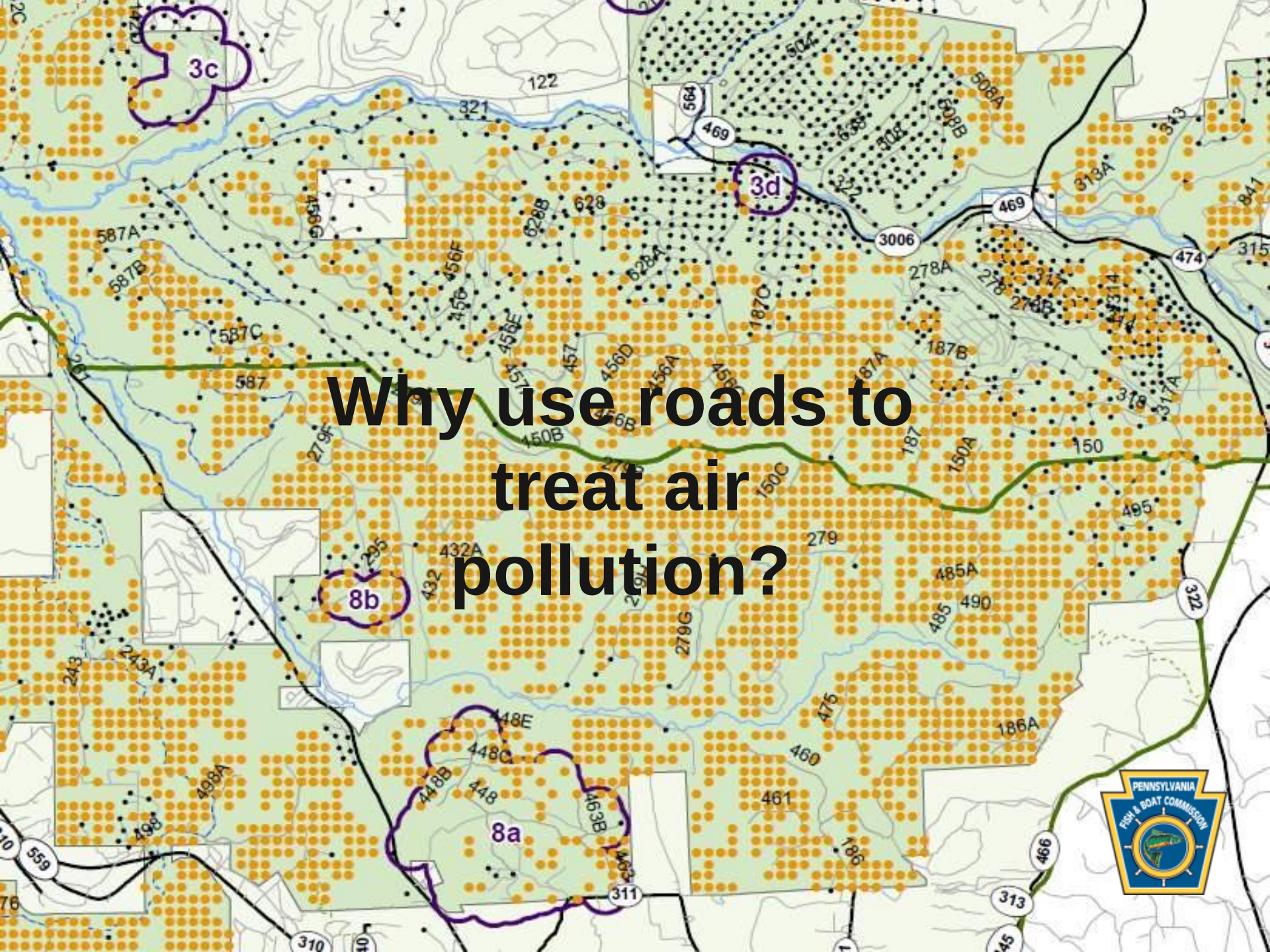
Project Timeline

- 2008-09 Design and Pre-project Monitoring
- 2009 Construction
- 2010-11 Post-project Monitoring

- September 2011
- Additional treatments to approximately 4 miles of road ditch
  - EBTJV Grant $25,000 in South Branch watershed
  - GG Grant $70,000 in Mosquito Creek watershed
- Additional treatment of approximately 6 miles of Limestone Road DSA
  - Marcellus Gas Co. and US Forest Service.

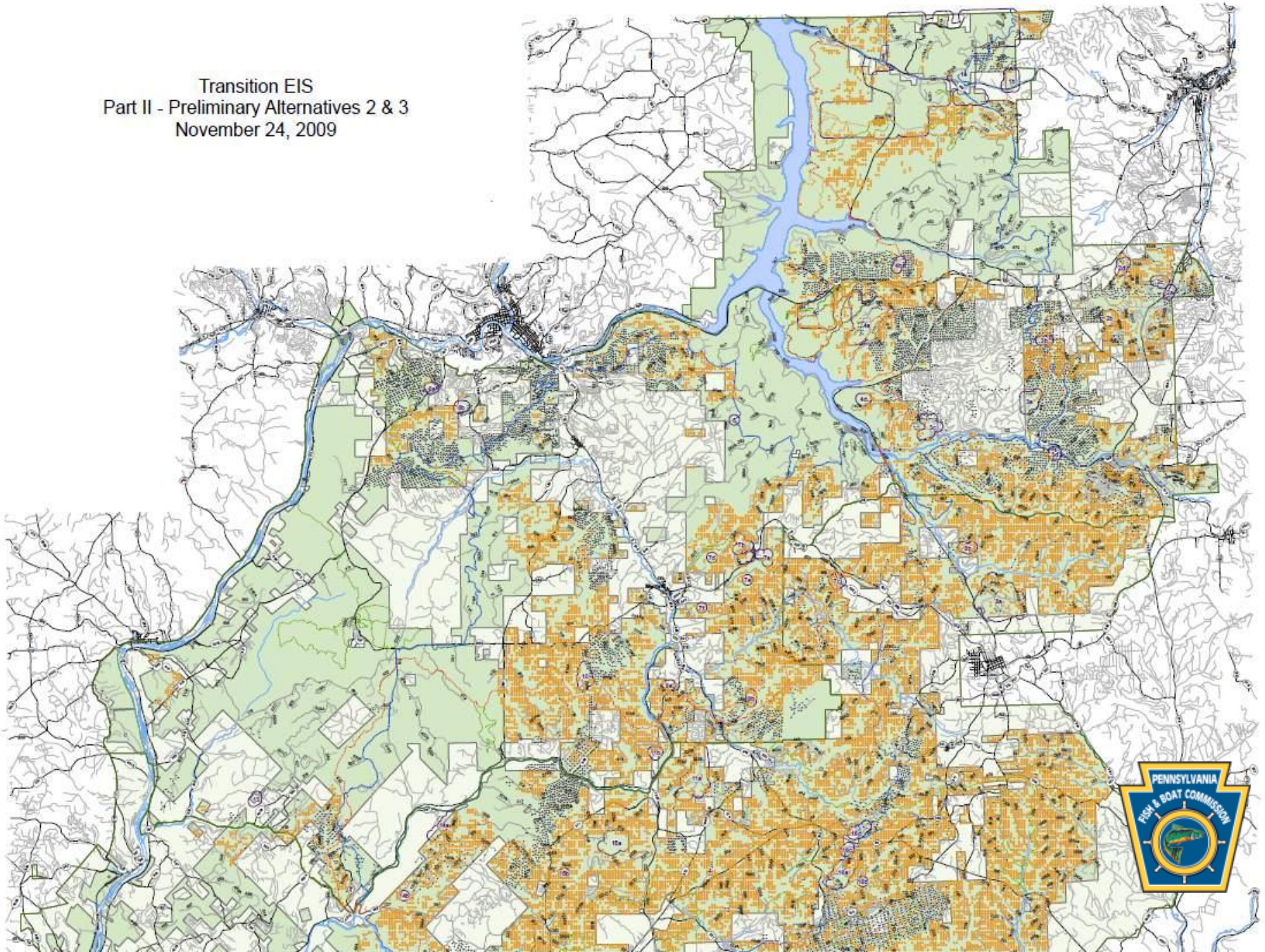
Partners

- US Forest Service
  – Allegheny National Forest
- Penn State University
  – CEE & CDGRS
- Clarion University of Pennsylvania
- Western Pennsylvania Conservancy
  – Allegheny Regional Office
- McKean County Conservation District
- Cornplanter TU



Why use roads to treat air pollution?

Transition EIS
Part II - Preliminary Alternatives 2 & 3
November 24, 2009



Questions?