TUDARE
Stream Restoration Project Planning Workshop
Westby, WI
April 12-13, 2014

TUDARE Stream Monitoring Protocols for Evaluating Stream Restoration Benefits, Including Resilience to Climate Change:

Assessment of Pre- and Post-Restoration Temperature and Habitat Conditions

Jeff Hastings, TUDARE Project Manager, Trout Unlimited
Kent Johnson, Kiap-TU-Wish Chapter, Trout Unlimited
Matt Mitro, Coldwater Fisheries Research Scientist, WDNR

Trout Unlimited Driftless Area Restoration Effort (TUDARE)

- A National TU Initiative
- Restore and protect coldwater streams and watersheds of the Driftless Area
- Founded on the good work of TU volunteers
- Goals: Reduce soil erosion and pollution, benefit fish and their habitat, expand recreational opportunities
- Building alliances with agencies and organizations in the DA to marshal necessary resources for development and execution of restoration projects
- “The Economic Impact of Recreational Trout Fishing in the Driftless Area” (April 2008): $1.1 billion annual economic benefit to local economy (Direct + Indirect/Induced Effects)

Contact: Jeff Hastings, TUDARE Project Manager
http://www.tu.org/site/c.kkLRJ7MSKtH/b.3302703/

The New York Times

Science Times

Tuesday, June 24, 2008

"Follow the Silt"

By Cornelia Dean

"Stream restoration is a big business with increasing popularity but patchy success. Since 1990, more than a billion dollars have been spent annually on stream restoration. Scientists wonder if it's being done right."
-Cornelia Dean, *New York Times*

"Many hydrologists and geologists say people embark on projects without fully understanding the waterways they want to restore and without paying enough attention to what happens after a project is finished."
-Cornelia Dean, *New York Times*

"An awful lot of stream restoration, if not the vast majority of it, has no empirical basis. It is being done intuitively, by looks, without strong evidence. The demand is in front of the knowledge. Most agencies want to spend the money making things happen and not spending the money finding out if they work."
-Dr. William E. Dietrich, Geomorphologist, University of California-Berkeley and NCED

"Unfortunately, we have not done enough monitoring to know what works and what doesn't."
-Chris Conrad, Environmental Engineer, United States Geological Survey

"Most people agree that the best approach is to create landforms and water flows that streams can maintain naturally. But how you translate that into action and at this stream rather than that stream really requires a lot of work to figure out."
-Dr. David R. Montgomery, Geomorphologist, University of Washington

"Efforts are underway to bring more academic rigor to the stream restoration business. Many opportunities to learn from successes and failures, and thus to improve future practices, are being lost."
-Cornelia Dean, *New York Times*

What Defines Stream Restoration Success?

Before

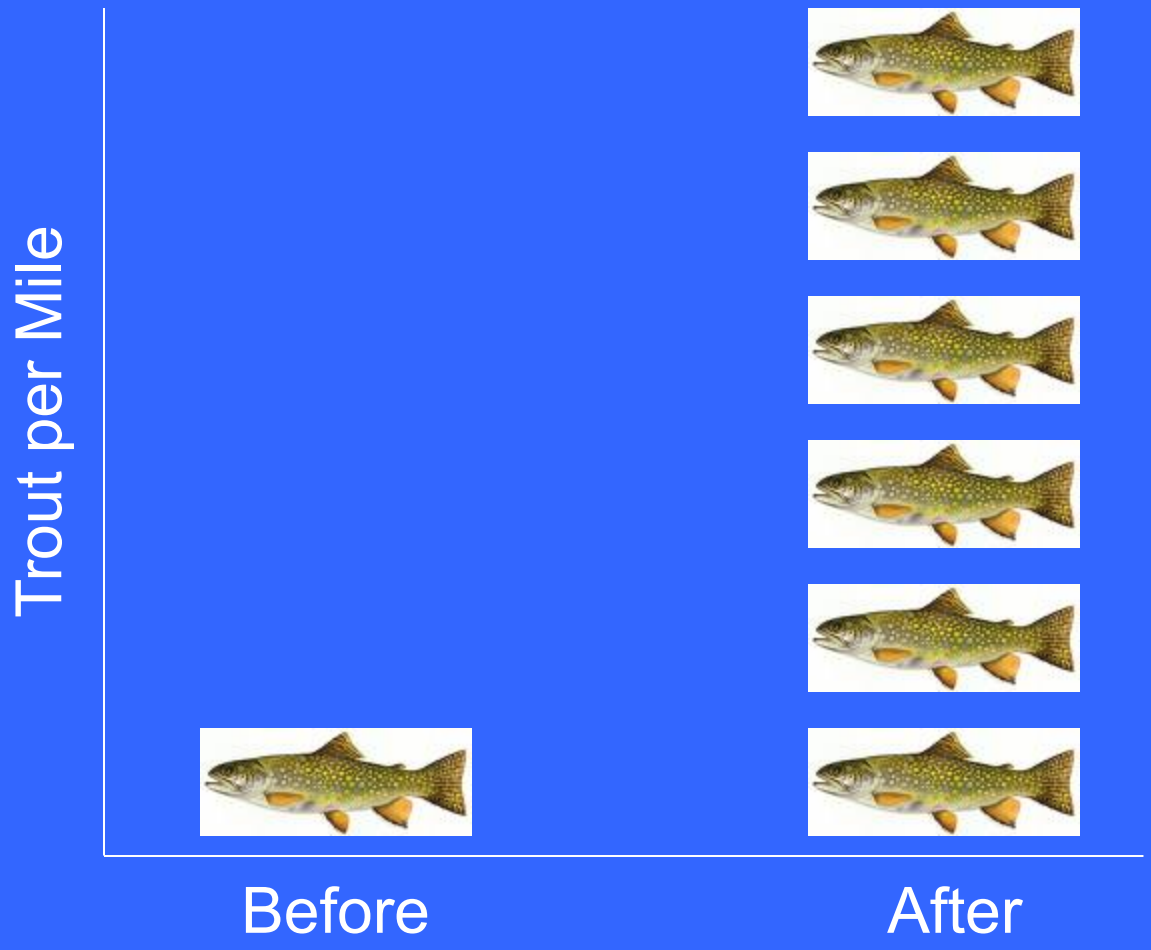
After

What Defines Stream Restoration Success?

Before

After

What Defines Restoration Success?



Pine Creek Restoration Project

TROUT UNLIMITED

WEST WISCONSIN LAND TRUST
Preserving Western Wisconsin's Natural Character

WISCONSIN DEPT. OF NATURAL RESOURCES

Maiden Rock, Wisconsin

Project Background

- Pine Creek is located in Maiden Rock Township, Pierce County, WI
- Spring-fed creek, with 3 miles of permanent flow
- Drains to Mississippi River at Lake Pepin
- Watershed lies within the karst landscape of the Driftless Area
- Creek supports a wild population of Eastern Brook Trout
- Creek had excellent water quality, but severe stream bank erosion, due to poor agricultural practices and overgrazing

Pine Creek Restoration Cost 2007-2011

- 11,167 feet restored @ $270,273 ($25/foot)
- 10,000 miles of classified brook and brown trout streams in WI
- $1.3 Billion in potential restoration costs

Project Financing

The Pine Creek Restoration Project was financed by:

- Wisconsin Trout Stamp Funds (WDNR Trout Crew)
- Kiap-TU-Wish and Twin Cities Chapters of Trout Unlimited
- Friends of Wisconsin Trout Unlimited
- Trout Unlimited Embrace-A-Stream Grants
- U.S. Fish and Wildlife Service (NAWCA Grant)
- National Fish Habitat Action Plan Grant
- Trout and Salmon Foundation
- Patagonia
- Fairmount Minerals/Industrial Minerals Association

Can we demonstrate restoration success for the money ($270,000) and volunteer time invested in the project?

Project Goals and Objectives

- Project comprises an important piece of Trout Unlimited Driftless Area Restoration Effort (TUDARE)
- Overall project goal is to restore and conserve the native Eastern Brook Trout population in Pine Creek
- Restoration goal is to stabilize severely eroding banks, provide in-stream cover, and improve aquatic habitat
- Project will be accomplished using techniques developed by WDNR fish managers across the Driftless Area:

  * Grade and shape banks to achieve a 3:1 slope
  * Stabilize banks with riparian vegetation
  * Narrow the stream channel
  * Install LUNKER structures, root wads, and boulder clusters
  * Install plunge pools

Project Goals and Objectives

Project objectives should be stream-specific and:

- Appropriate
- Relevant
- Feasible
- Achievable

Objectives need measurable metrics (monitoring) that allow:

- Success to be documented
- Failure to be productive

Project Goals and Objectives

Project objectives and metrics should be established for:

- In-stream habitat and biota
- Riparian habitat and biota (vegetation and nongame wildlife)

Agency natural resource professionals (county, state, federal) can help you set project goals and objectives, select metrics, and provide monitoring guidance.

Project Goals and Objectives

Measurable project objectives include:

- Restore 3,500 feet of stream bank and habitat in Pine Creek
- Increase numbers of Eastern Brook Trout by 40-50%
- Increase numbers of Eastern Brook Trout >/= 10 inches by 50-100%
- Reduce stream bank erosion to 10% of pre-existing conditions
- Reduce fine sediment and increase coarse bottom substrate by 50%
- Increase aquatic macrophyte growth by 25%

Climate Change Impacts on Wisconsin's Coldwater Streams

Wisconsin Initiative on Climate Change Impacts (WICCI)
Cold Water Fish and Fisheries Working Group:

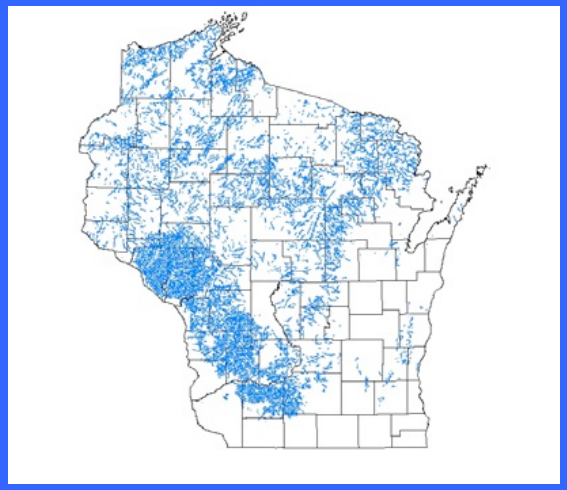
http://www.wicci.wisc.edu/coldwater-fish-and-fisheries-working-group.php

Mitro, M., J. Lyons, and S. Sharma. 2011. Wisconsin Initiative on Climate Change Impacts: Coldwater Fish and Fisheries Working Group Report. 31 p.

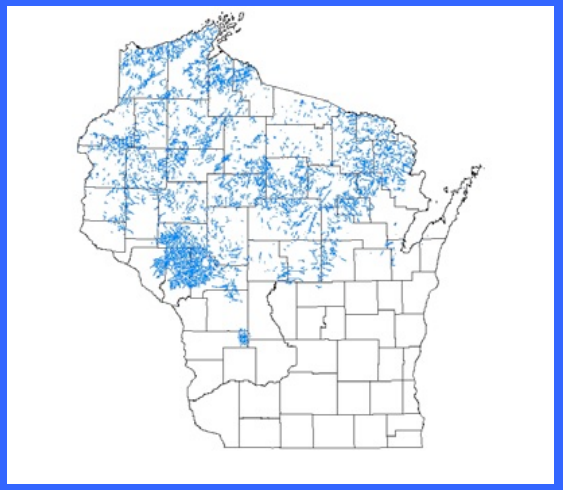
http://www.wicci.wisc.edu/report/Coldwater-Fish-and-Fisheries.pdf

Brook Trout

Current climate

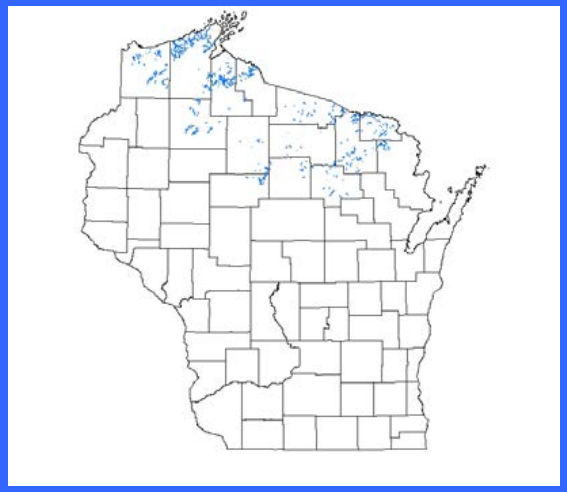


Best case (-43.6%)



1.0 C (0.8 C)

Moderate case (-94.4%)



3.0 C (2.4 C)

Worst case (-100%)

5.0 C (4.0 C)

Mitro, Lyons, and Sharma, 2011

Can Stream Restoration Provide Resilience to Climate Change?

WICCI Climate Adaptation Strategies:

Create and enhance refugia from high water temperatures

In streams that may show resilience to climate change impacts (those receiving sufficient groundwater input), stream habitat may be managed to create and enhance refugia from high water temperatures:

- Stream channels can be narrowed and deepened
- Overhead cover can be added
- Deep pools can be created to provide coldwater refugia
- Riparian areas can be managed to provide shading by tall grasses or trees.

Can Stream Restoration Provide Resilience to Climate Change?

Improve stream temperature regime by facilitating groundwater flow through the restoration reach, thereby minimizing air temperature exposure:

- Narrowing the stream channel
- Deepening the stream channel
- Increasing current velocity and reducing travel time
- Providing canopy cover

Promote Groundwater Conveyance

Before

After

Wisconsin's 2010-11
Citizen-Based Monitoring Partnership Program
and
Trout Unlimited Driftless Area Restoration Effort (TUDARE)

TUDARE Stream Monitoring Protocols

Jeff Hastings, TUDARE Project Manager, Trout Unlimited
Kent Johnson, Kiap-TU-Wish Chapter, Trout Unlimited
Matthew Mitro, Coldwater Fisheries Research Scientist, WDNR

TUDARE
Pre- and Post-Restoration Temperature Monitoring Methods

- Minimum of 3 monitoring sites in the restoration reach (top, mid, bottom); sites at 0.25-mile intervals if restoration reach is ≥ 1 mile long
- Onset TidbiTv2® temperature logger
- Stream temperature measured at 15-minute to 1-hour intervals during the summer period (June 1 – August 31)

TUDARE
Pre- and Post-Restoration Temperature Monitoring Methods

- Weather station established in the vicinity of the stream restoration reach
- Onset HOBO Pro v2® temperature/relative humidity logger
- Air temperature, relative humidity, and dew point measured at 15-minute to 1-hour intervals during the summer period (June 1 – August 31)

TUDARE
Pre- and Post-Restoration Habitat Assessment Methods

- Key habitat indicators are measured on 1-meter wide transects
- Transects are located at approximately 125-meter intervals along the entire restoration reach
- Represent all 3 hydrologic features: riffle, run, and pool
- Locate transects close to temperature monitoring sites, if possible
- Habitat assessment work is conducted in the summer (May and June), during baseflow conditions

TUDARE
Pre- and Post-Restoration Habitat Assessment Methods

Four Key Habitat Features (Greatest impact on stream temperature):

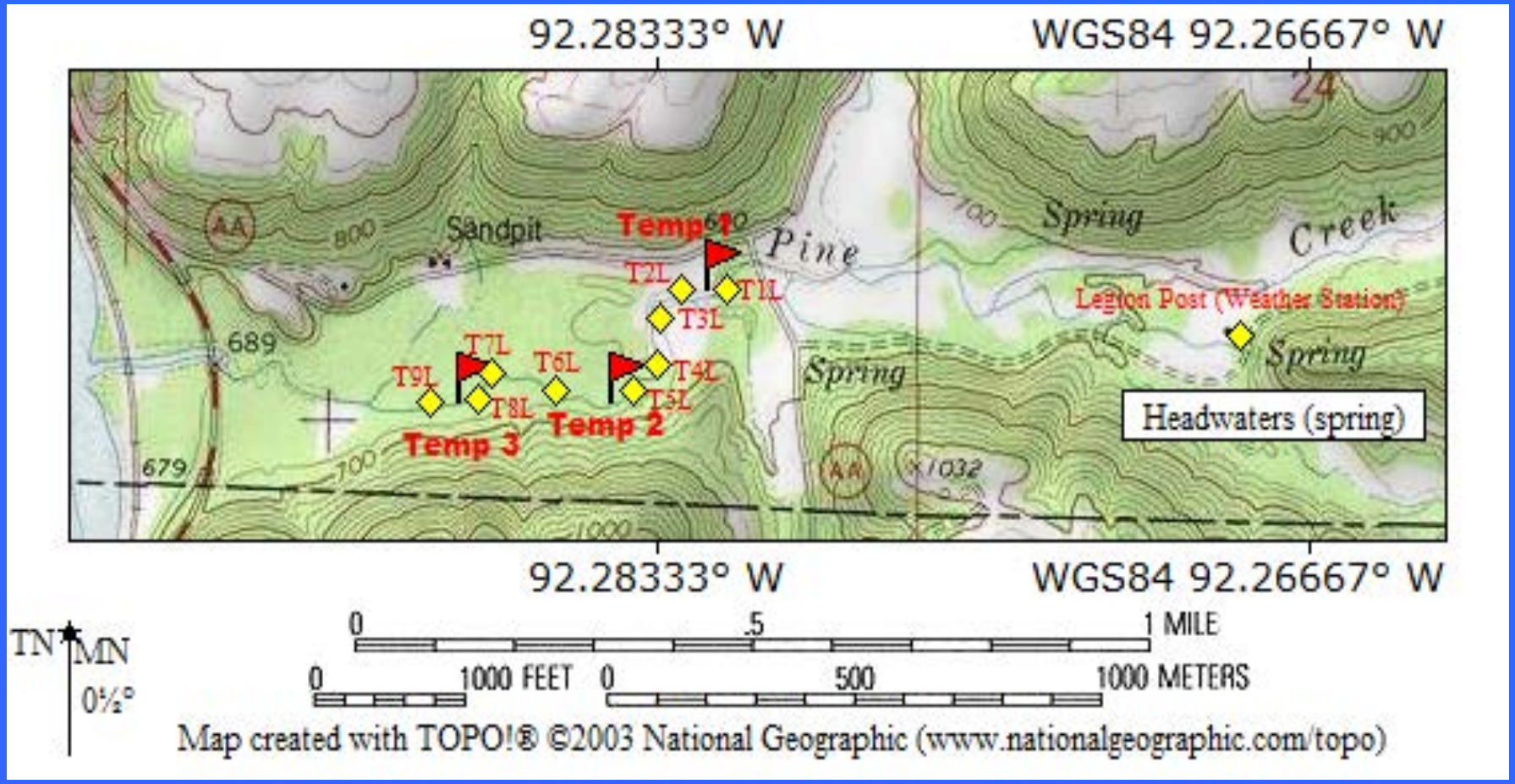
- Stream Width (water's edge to water's edge)
- Water Depth (quarter points + 2 near-bank locations)
- Water Velocity (quarter points + 2 near-bank locations)
- Canopy Cover (4 measurements, facing N, E, S, W)

TUDARE
Pre- and Post-Restoration Habitat Assessment Methods

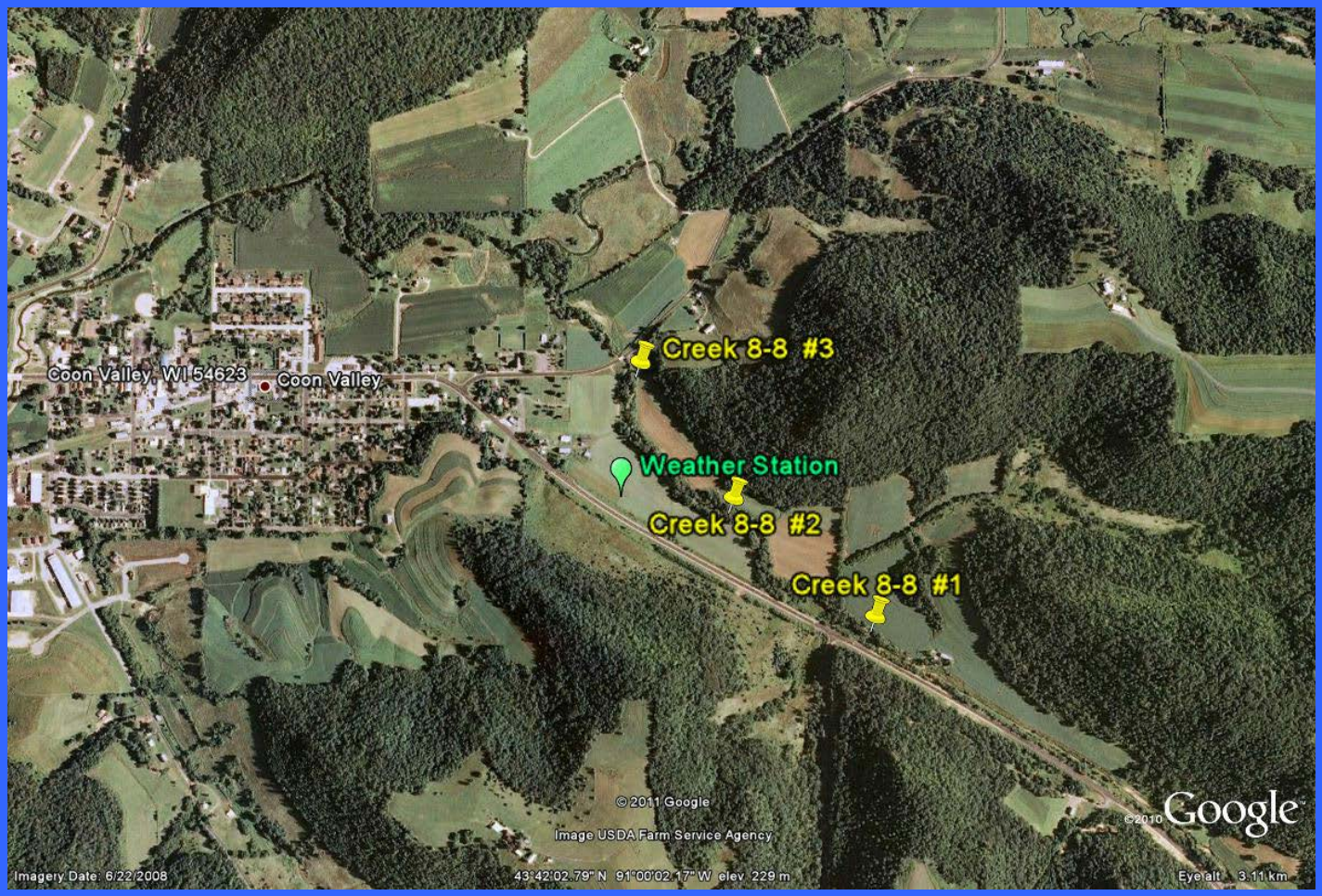
Other Key Habitat Features and Biota:

- Water flow
- Stream channel bankfull width and depth
- Stream bank height, depth, slope, soil type, vegetation
- Stream bed substrate composition and embeddedness
- Presence of aquatic vegetation (macrophytes and periphyton)
- Presence of aquatic macroinvertebrates

Lower Pine Creek
Pre-Restoration Habitat Assessment



Creek 8-8 Restoration Project
Coon Valley, WI



Monitoring conducted by:

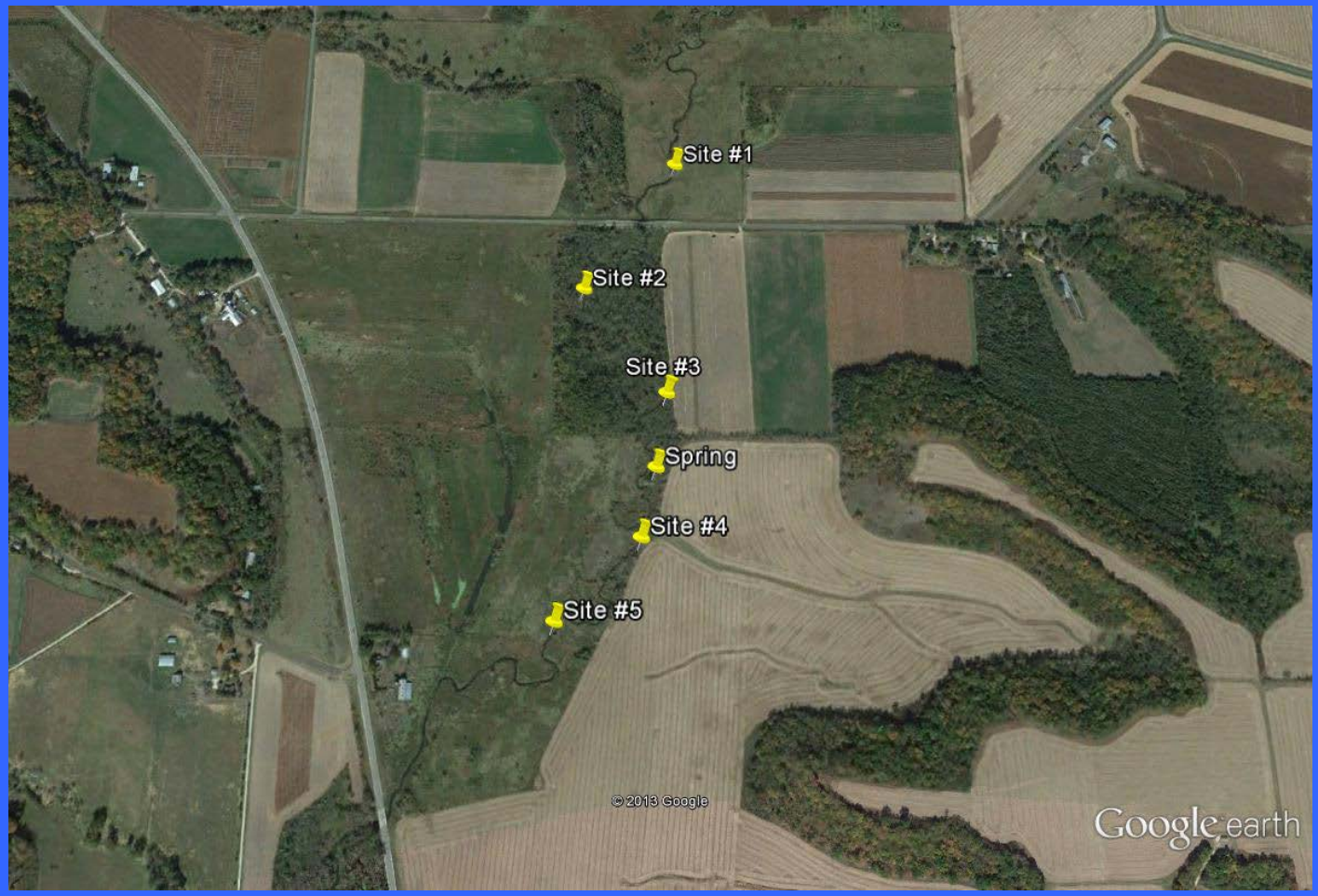
Wally Bock Oak Brook Chapter Trout Unlimited

Wilson Creek Restoration Project
Knapp, WI

Monitoring conducted by:

Dale Dahlke Clear Waters Chapter Trout Unlimited

Trimbelle River Restoration Project
Beldenville, WI



Monitoring conducted by:

John Kaplan Kiap-TU-Wish Chapter Trout Unlimited

Pine Creek Macroinvertebrate Assessment

Kick Sampling (Pre- and Post-Restoration)

6 Sites in Upper and Lower Pine Creek

2 Sites in North and South Tributaries

Pine Creek Macroinvertebrate Assessment

Mini-LUNKERS (Post-Restoration)

Dimensions: 8” W x 11.5” L x 2” T

SA = Hester-Dendy Artificial Substrate

2 “Mini-LUNKERS” per LUNKER

4 LUNKER Structures

Nongame Wildlife Habitat Guide:
Complementary Opportunities for Stream Restoration Projects

Jeff Hastings, TUDARE Project Manager, Trout Unlimited

Nongame Wildlife Habitat Guide:

Monitoring Section
(Pages 21-23)

Guidance for establishing measurable objectives

Monitoring methods and protocols for nongame groups:

- **Amphibians**
- **Reptiles**
- **Birds**
- **Mammals**
- **Nongame Fish**

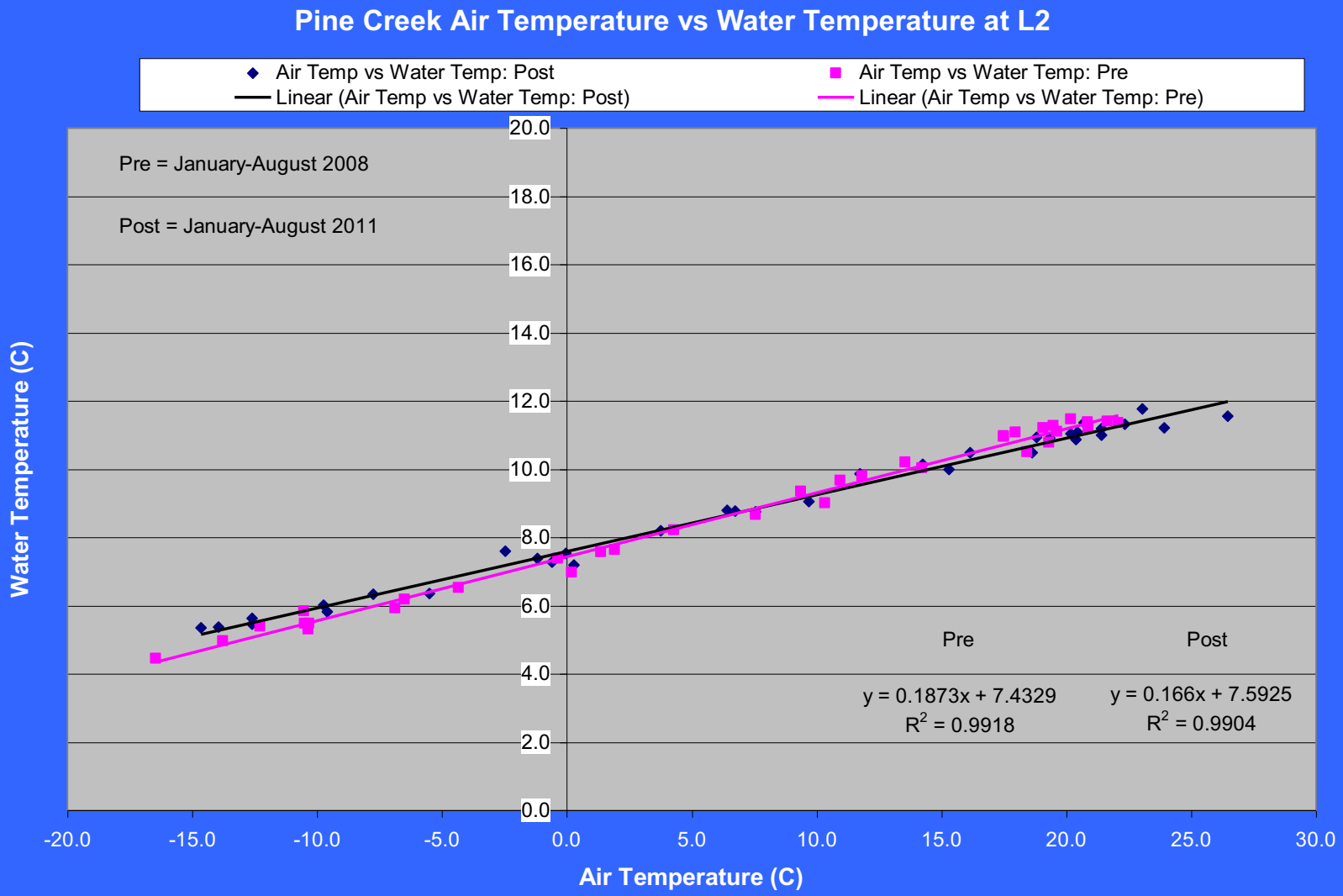
Pine Creek: Restoration Success?

Before

After

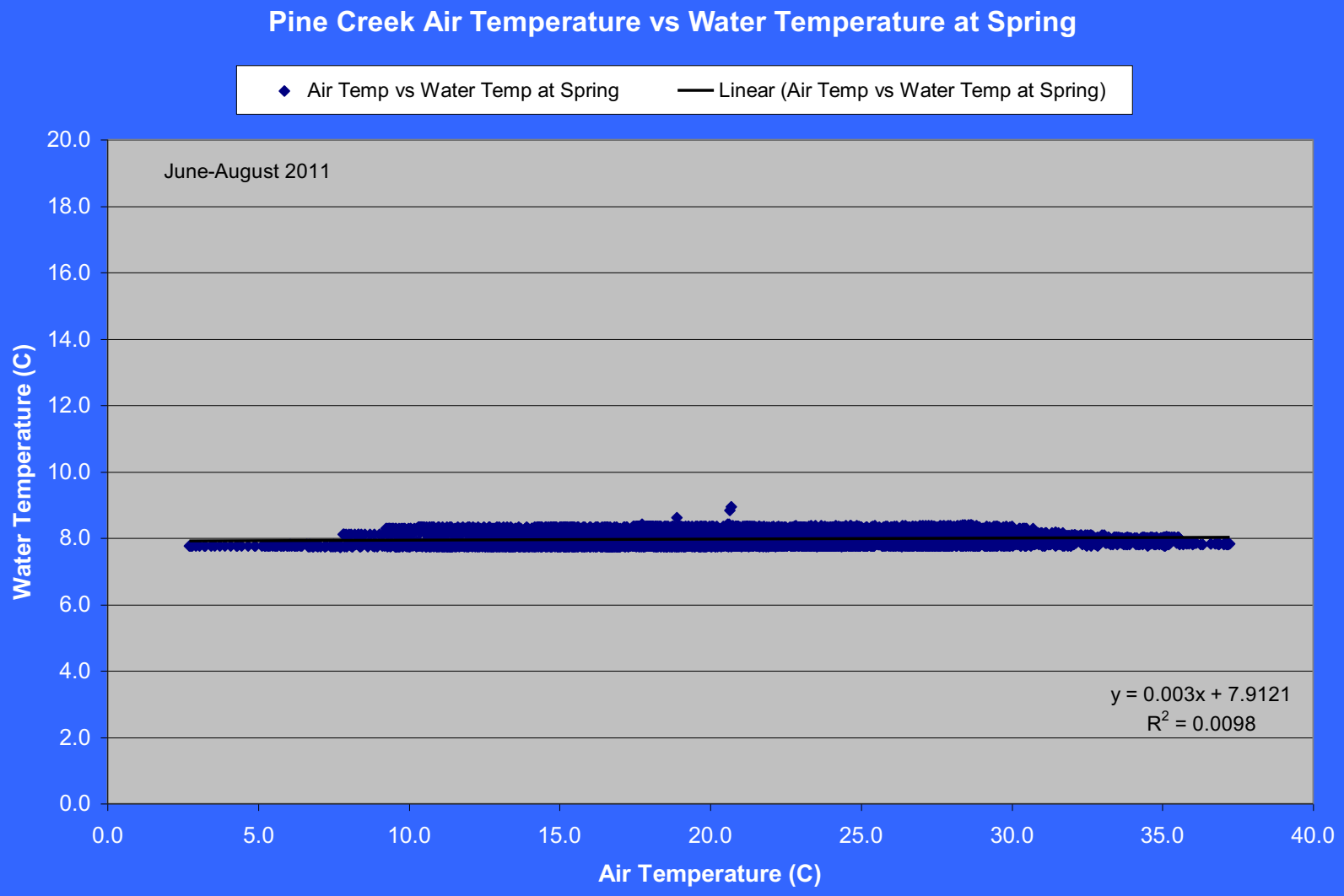
Pine Creek: Pre-Restoration vs Post-Restoration

Project Objective:
Improve stream temperature regime and armor for climate change



Pine Creek: Pre-Restoration vs Post-Restoration

Project Objective:
Improve stream temperature regime and armor for climate change



Pine Creek: Pre-Restoration vs Post-Restoration

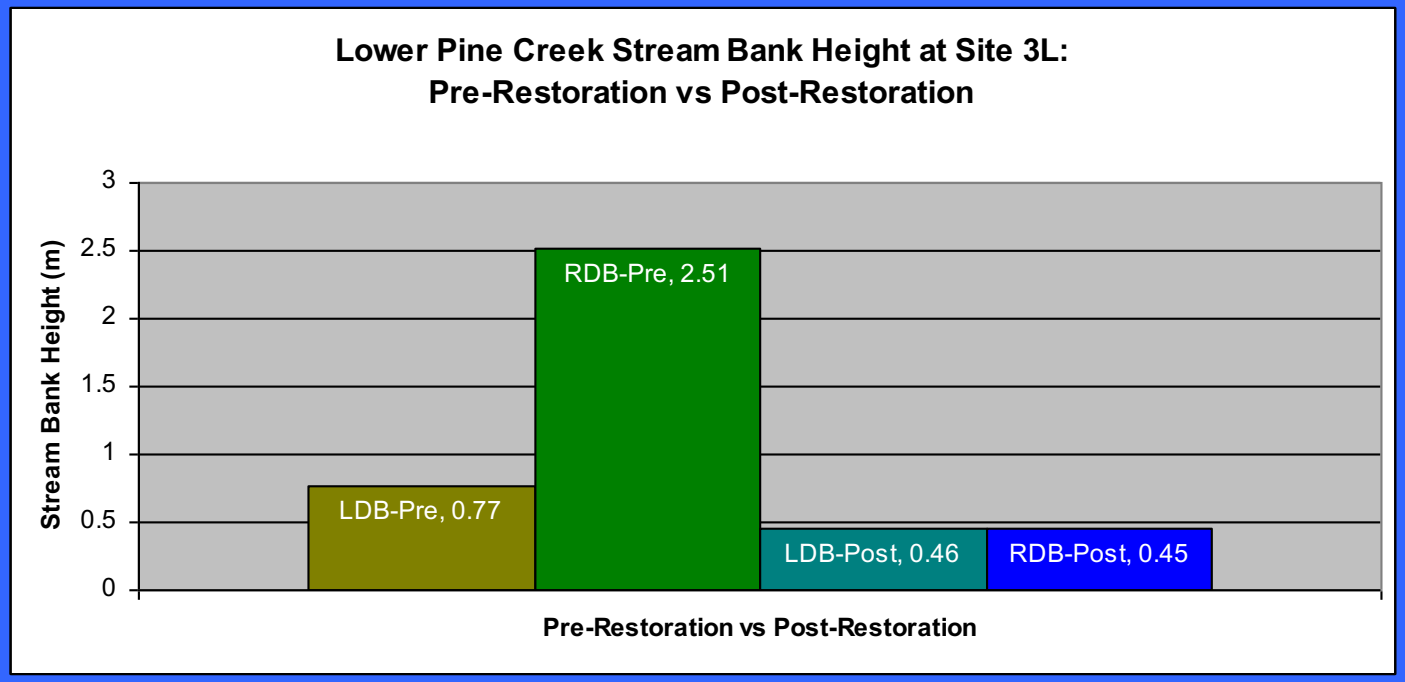
Project Objective:

Narrow and deepen stream channel; increase water velocity and canopy cover

	Site 2L	Site 3L
Stream Width:		
Pre-Restoration:	6.2 m	6.5 m
Post-Restoration:	4.1 m	4.2 m
Water Depth:		
Pre-Restoration:	0.27 m	0.20 m
Post-Restoration:	0.15 m	0.20 m
Water Velocity:		
Pre-Restoration:	0.10 m/sec	0.19 m/sec
Post-Restoration:	0.70 m/sec	0.51 m/sec
Canopy Cover:		
Pre-Restoration:	0%	0%
Post-Restoration:	0%	0%

Pine Creek: Pre-Restoration vs Post-Restoration

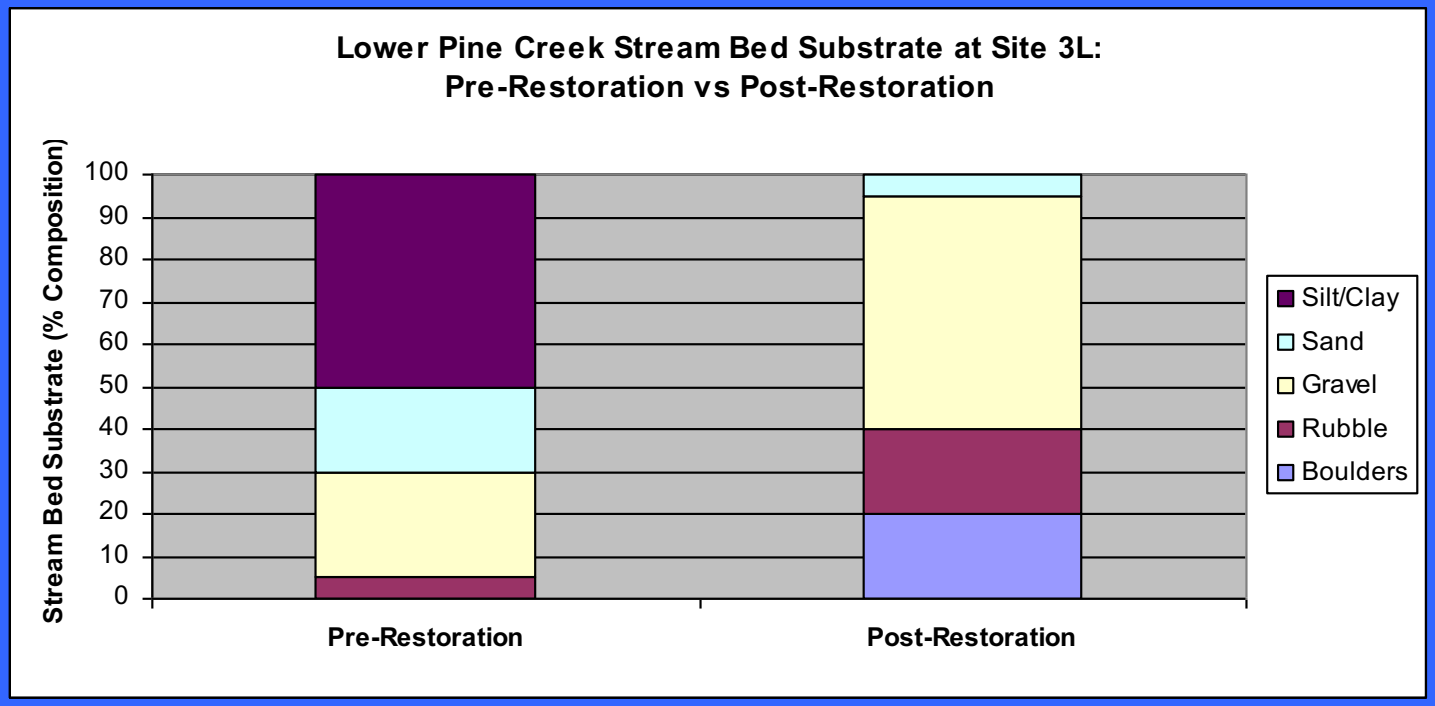
Project Objective:
Reduce stream bank erosion to 10% of pre-existing conditions



Bare soil exposed: Pre-Restoration = 3.34 m^2 Post-Restoration = 0.64 m^2
Reduced stream bank erosion to 20% of pre-existing conditions

Pine Creek: Pre-Restoration vs Post-Restoration

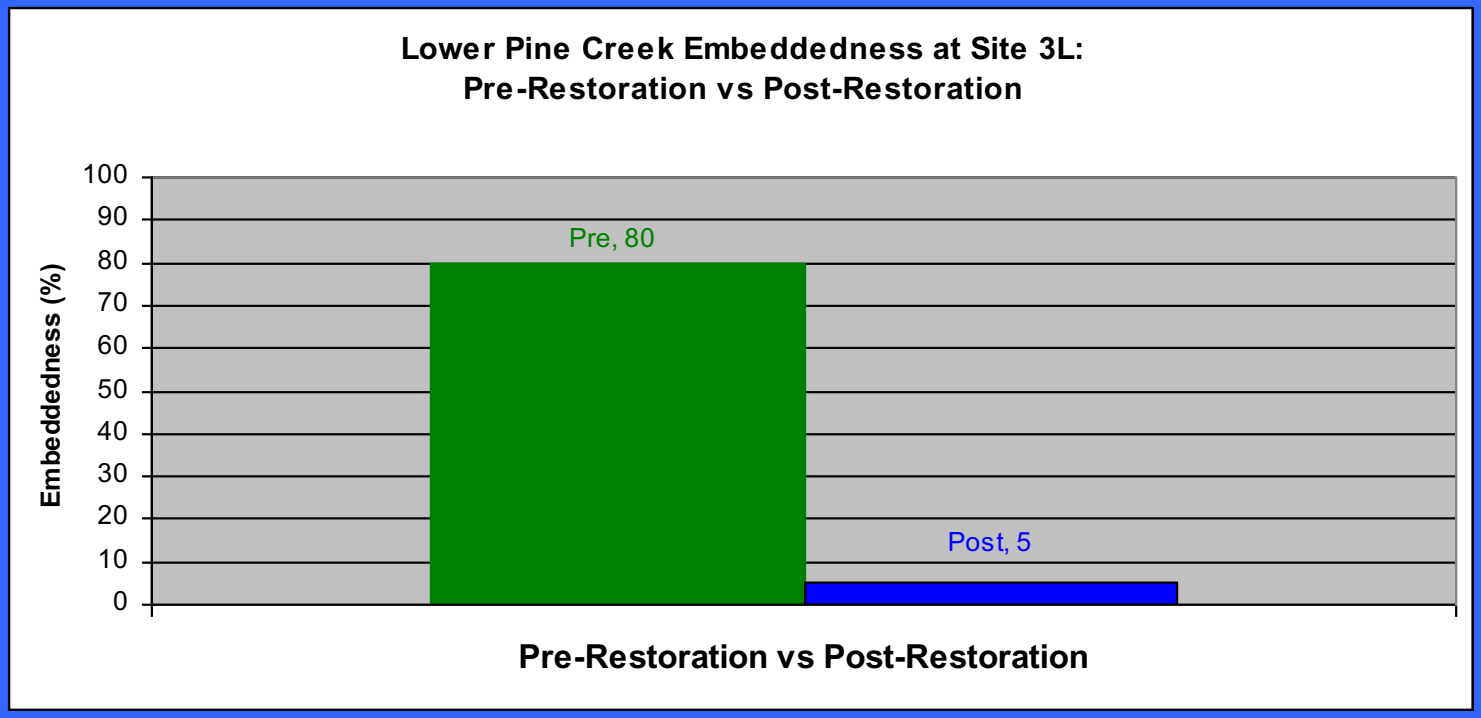
Project Objective:
Reduce fine sediment and increase coarse bottom substrate by 50%



Coarse bottom substrate: Pre-Restoration = 30% Post-Restoration = 95%
Increased coarse bottom substrate by 65%

Pine Creek: Pre-Restoration vs Post-Restoration

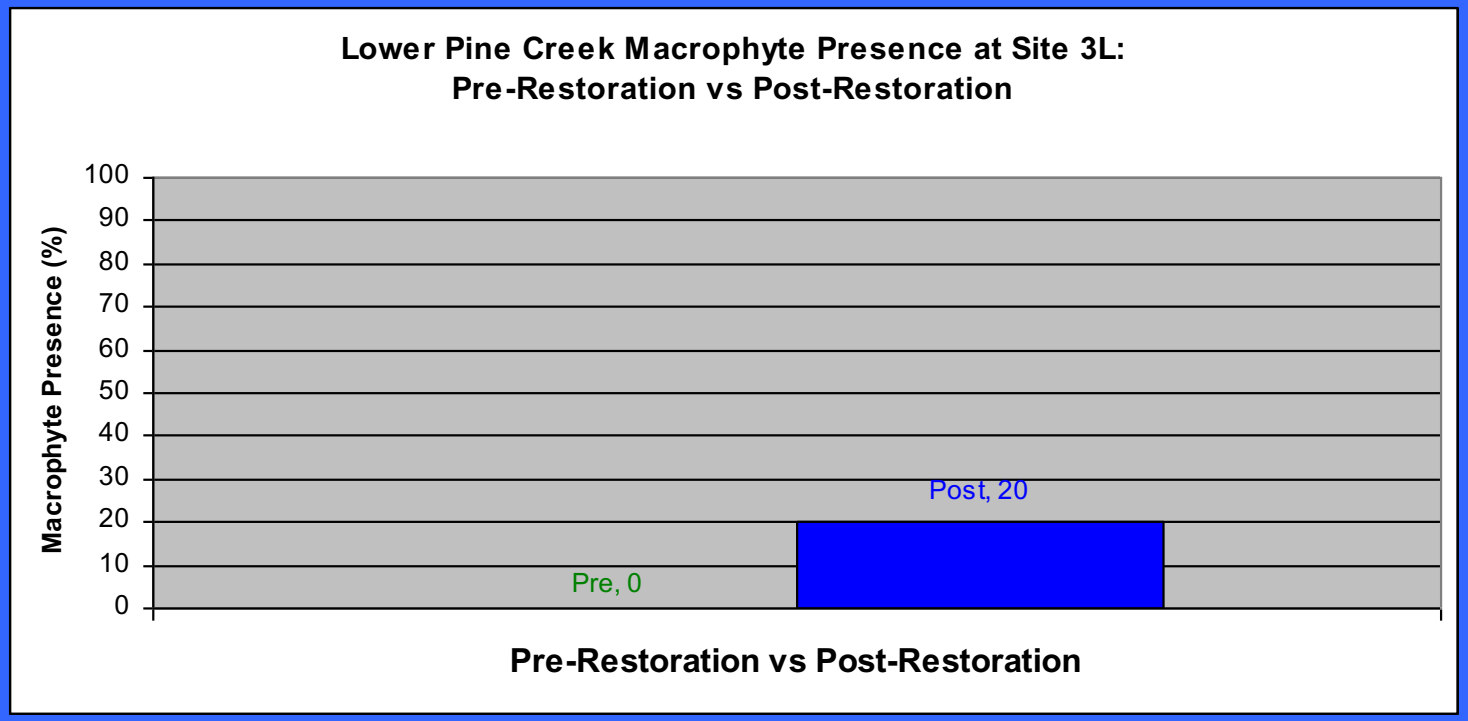
Project Objective:
Reduce fine sediment and increase coarse bottom substrate by 50%



Embeddedness: Pre-Restoration = 80% Post-Restoration = 5%
Decreased embeddedness by 75%

Pine Creek: Pre-Restoration vs Post-Restoration

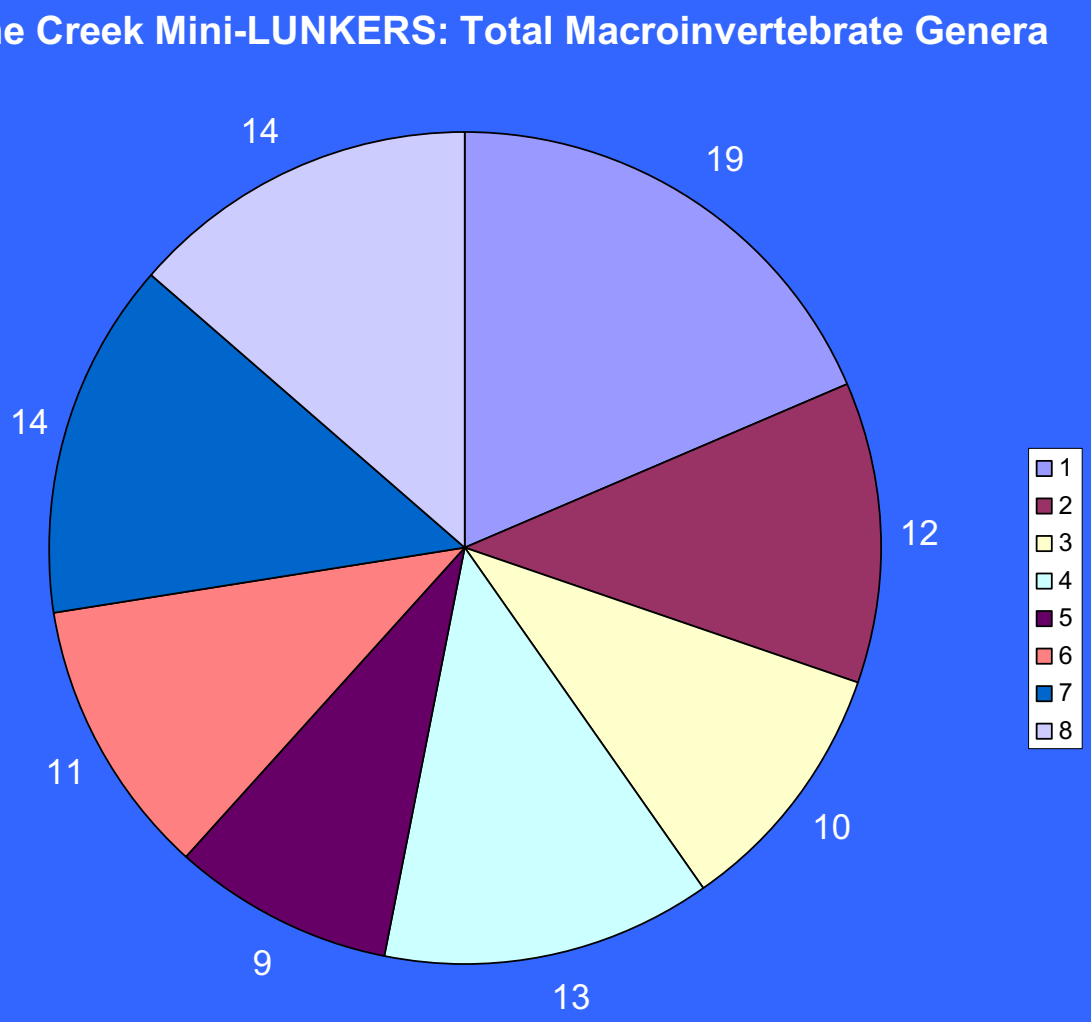
Project Objective:
Increase aquatic macrophyte growth by 25%



Macrophyte presence: Pre-Restoration = 0% Post-Restoration = 20%
Increased macrophyte presence by 20%

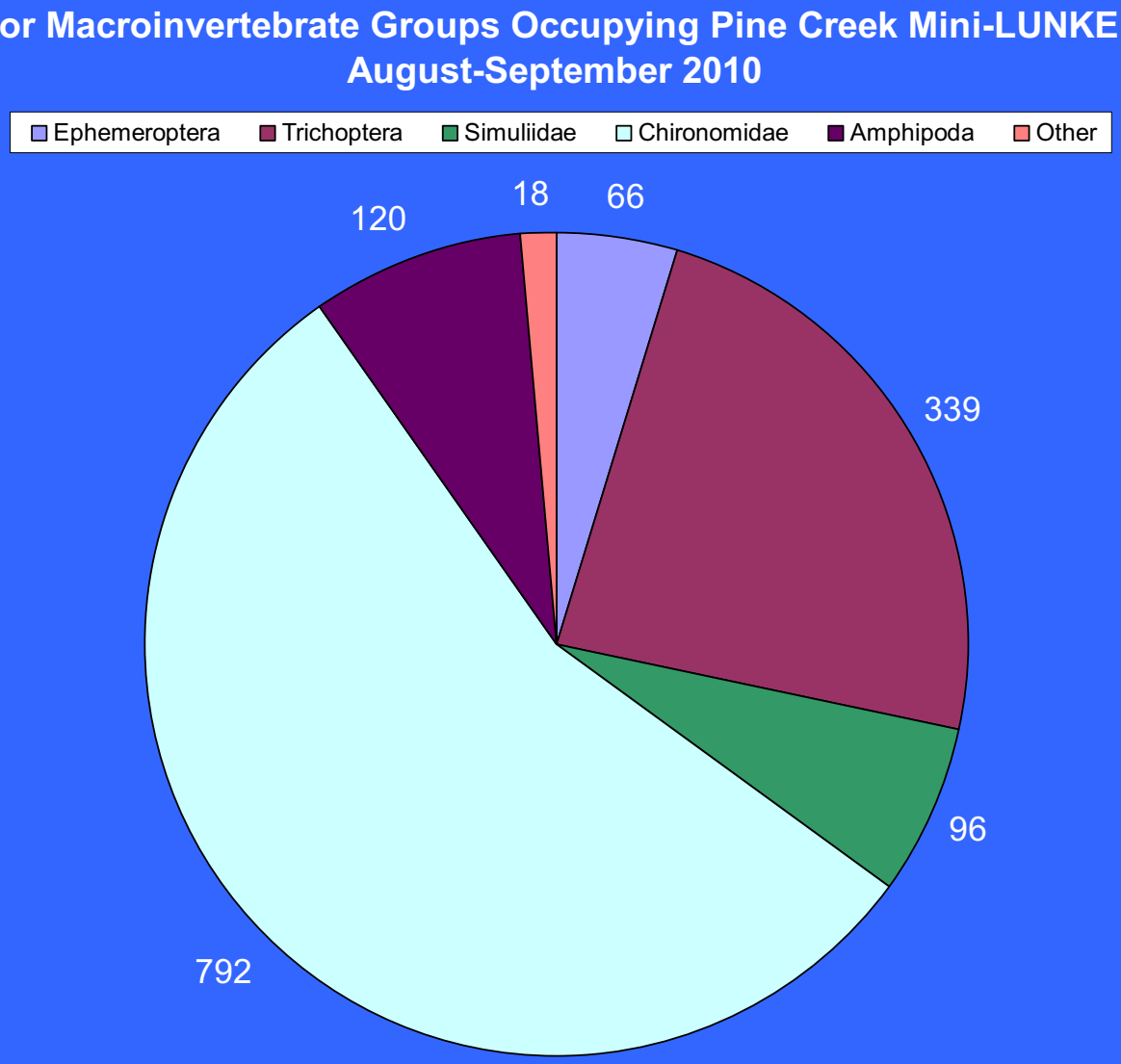
Pine Creek Macroinvertebrate Assessment

Mini-LUNKERS (Post-Restoration)



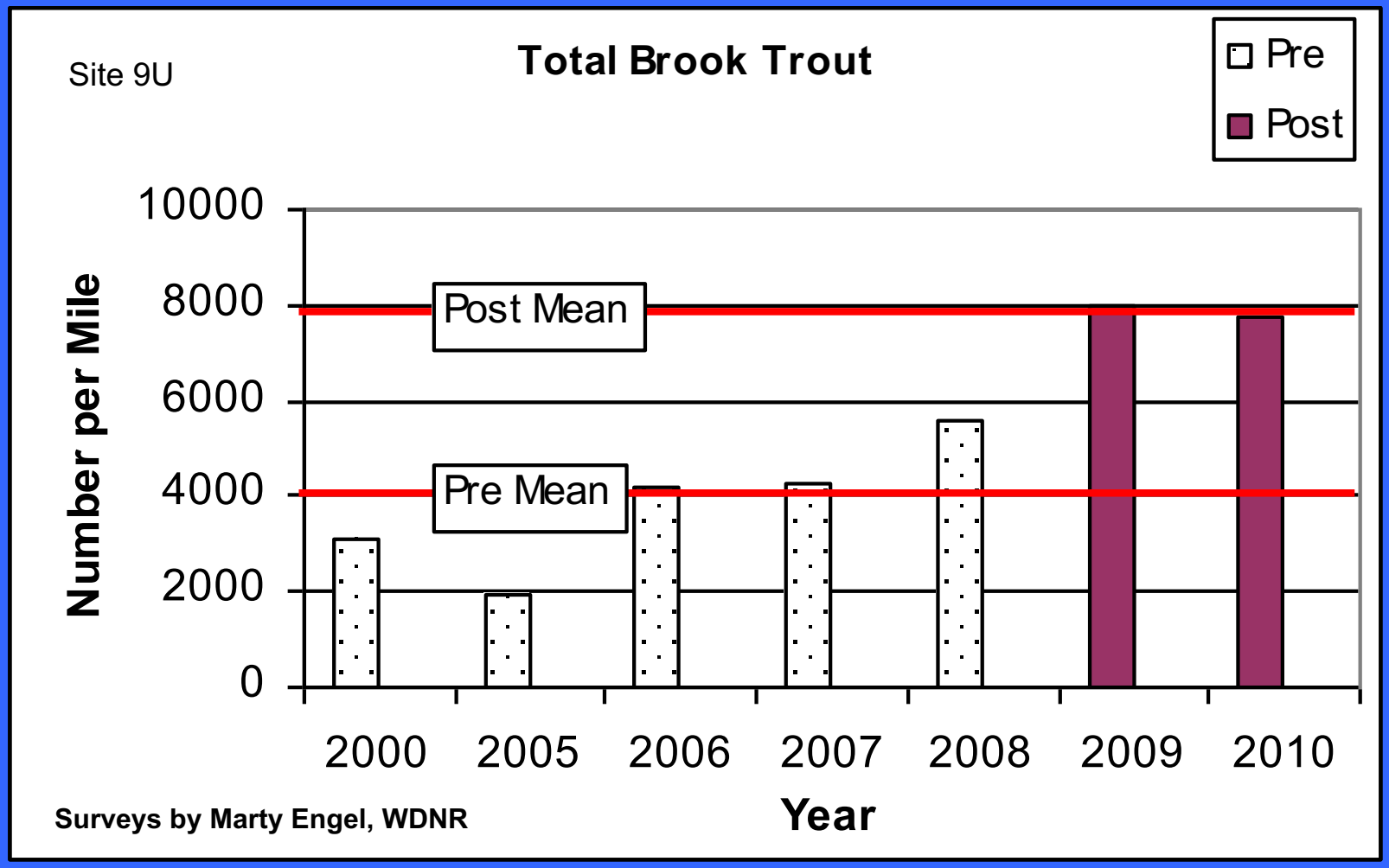
Pine Creek Macroinvertebrate Assessment

Mini-LUNKERS (Post-Restoration)



Pine Creek: Pre-Restoration vs Post-Restoration

Project Objective:
Increase numbers of Brook Trout by 40-50%



Pine Creek: Pre-Restoration vs Post-Restoration

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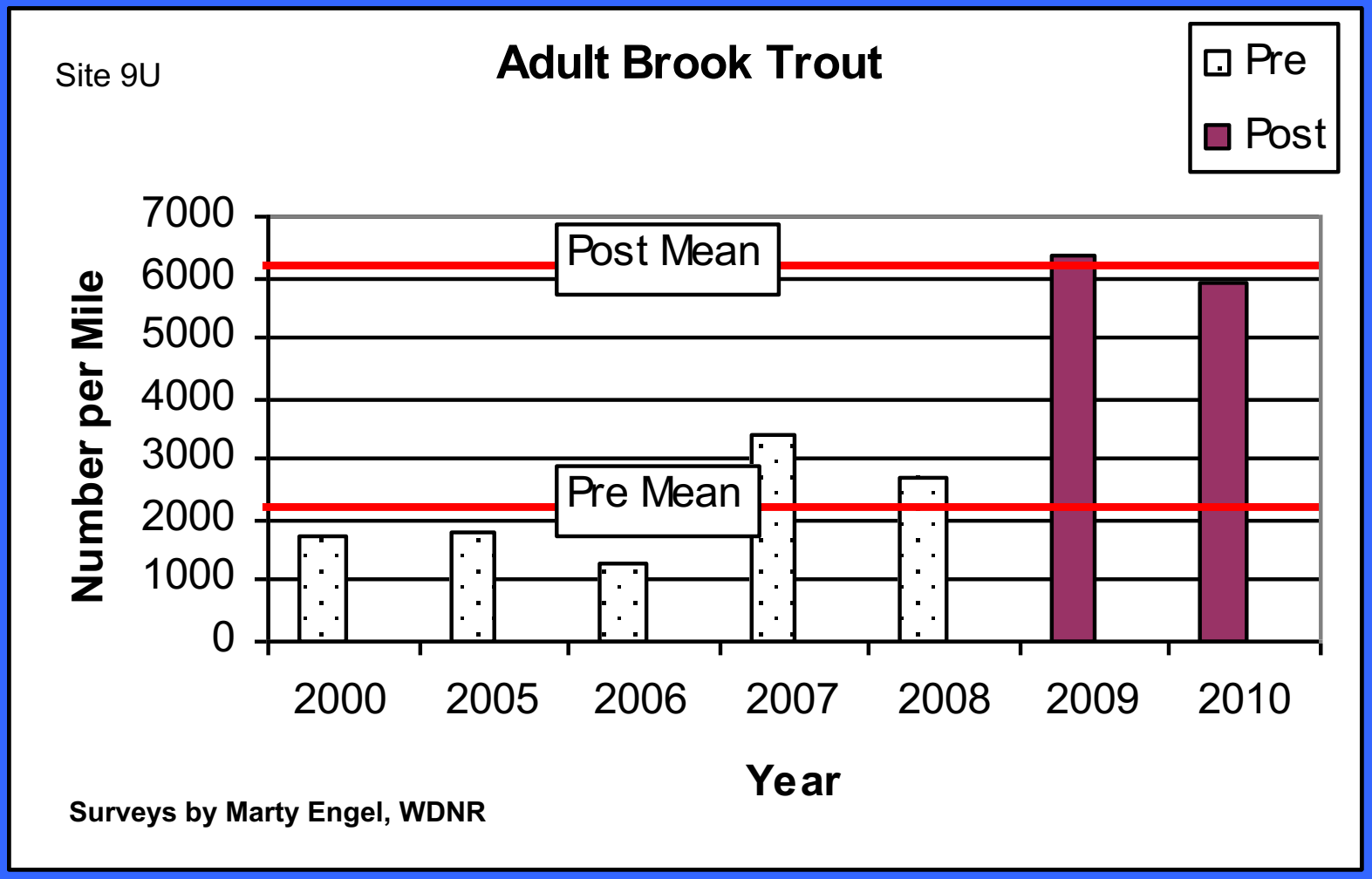
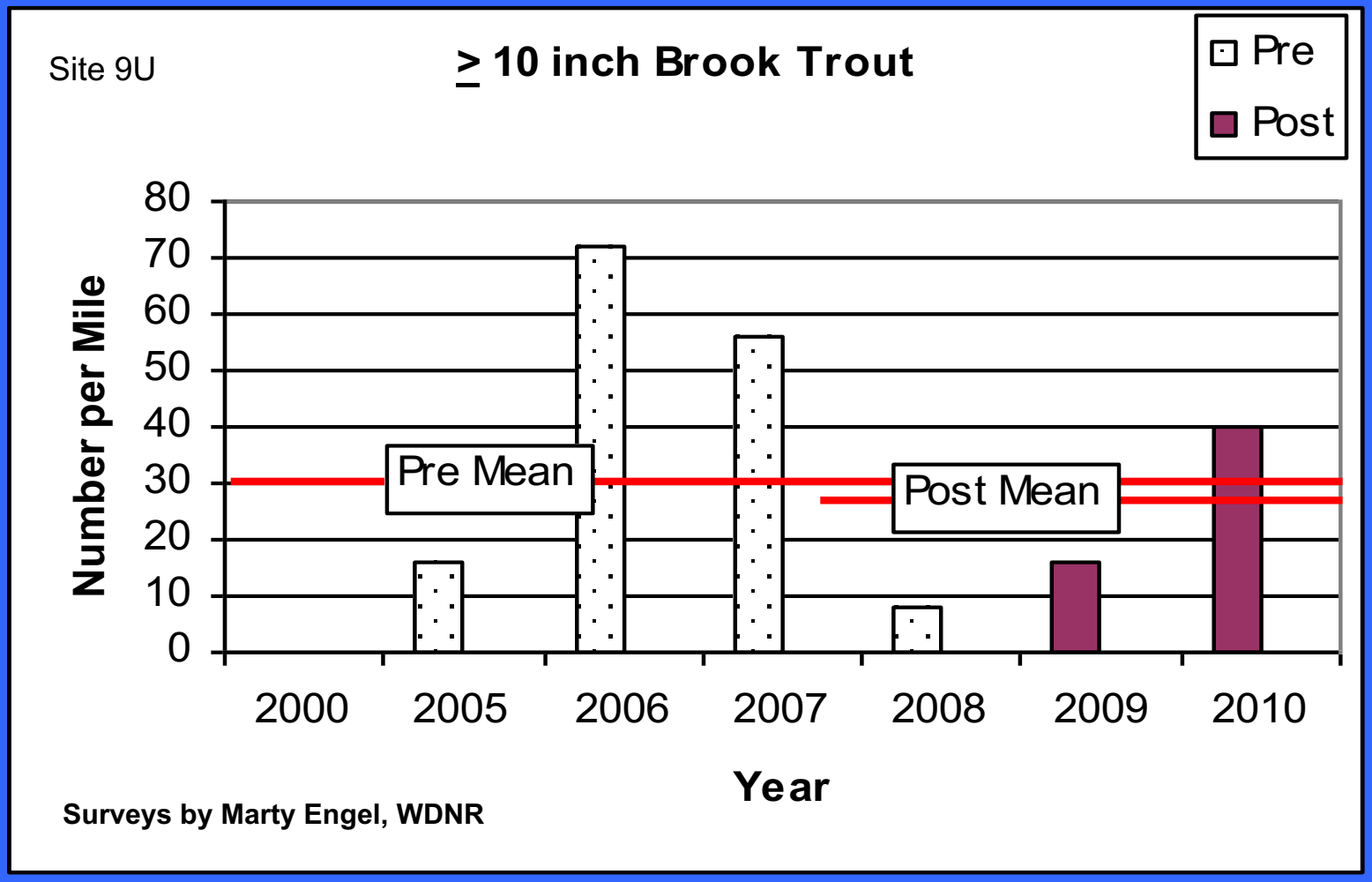


Pine Creek: Pre-Restoration vs Post-Restoration

Project Objective:
Increase numbers of Brook Trout ≥ 10 inches by 50-100%




Lower Pine Creek
Post-Restoration Brookie
Questions?