Elm Creek Stream Restoration Site:
A Demonstration in Channel Stabilization

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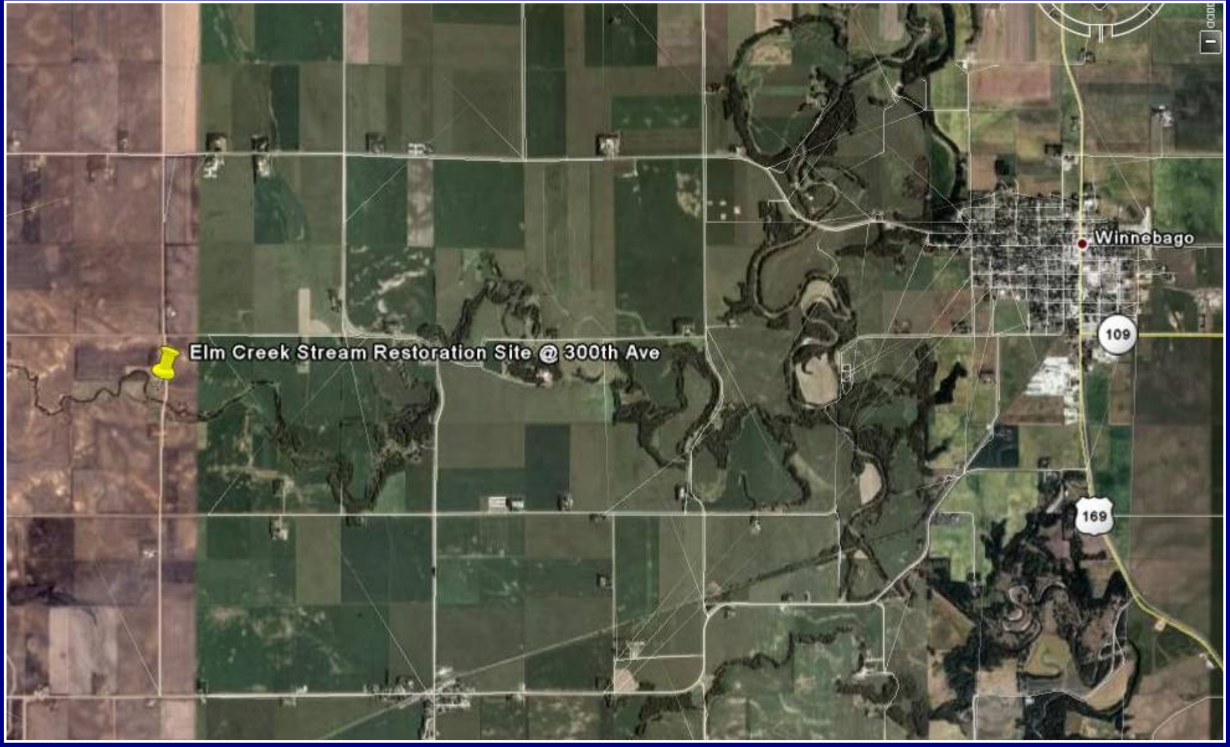
Site Location

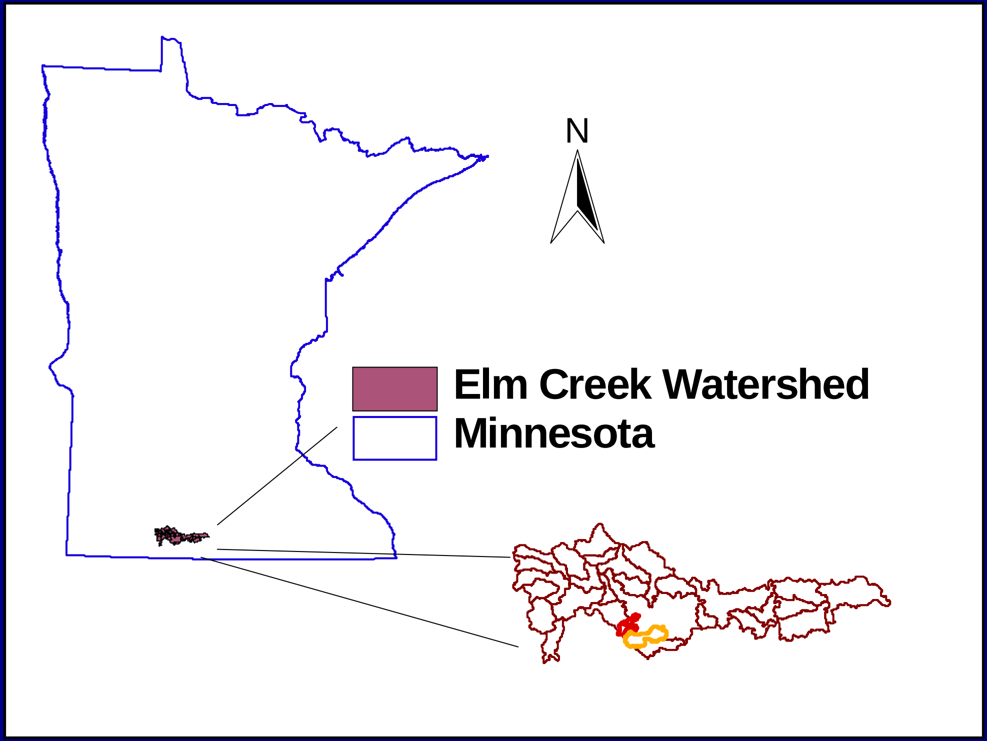
- Elm Creek at 300th Avenue
  - Martin County
  - West of Winnebago, MN
  - 300th Ave. bridge crossing
  - Near outlet of Elm Creek into the Blue Earth River

- Landowners:
  - North Property:
    Josh Stensland
  - South Property:
    Dick Mair
  - Farmer:
    Jeff Mathiason



Project Location and Landscape Characteristics

- A tributary to Blue Earth River in Minnesota River Basin
- Geological setting:
  - Glaciated - Des Moines lobe till plain
- Land Use:
  - 86% corn-soybean agriculture
  - 2% wetland
  - Livestock grazing
- Hydrology:
  - Heavy tile and ditch drainage
- Geomorphology:
  - Flat slopes, <.002 ft/ft
  - Cohesive banks
  - Sand /gravel stream bed



Elm Creek Basin: PAST

- Landscape is originally known as “Prairie Pothole”
  - Many isolated wetlands and storage basins

- Landscape has been heavily farmed and grazed for over a century
  - Intensive land use practices with annual crops
  - Drain tile networks and ditches
  - Prairie Pothole landscape is changed into arable land

- Drain tiles and ditches designed to discharge directly into natural stream channels

Elm Creek Basin: PRESENT

- Severe channel erosion in Elm Creek and other streams in the Blue Earth River Basin
  - Increased peak flows
- Mass wasting
  - Slumping
  - Causing property damage and loss

Elm Creek Basin: PRESENT

- Channel erosion causes a HIGH suspended sediment load in creeks
  - Elm Creek and many rivers in the region often exceed legal standards for turbidity (> 25 NTU)
- Presently listed on EPA 303(d) list

State Impairments:

ELM CREEK

State Impairment	Parent Impairment	Priority	Rank	Targeted Flag	Anticipated TMDL Submittal
FECAL COLIFORM	PATHOGENS				DEC-31-2008
FISH COMMUNITY RATED POOR	CAUSE UNKNOWN - IMPAIRED BIOTA				DEC-31-2017
TURBIDITY	TURBIDITY				DEC-31-2009

Elm Creek Basin: PRESENT

Channel erosion in Elm Creek is a result of <u>HIGH FLOWS</u> due to:

1. **A lack of land cover in peak precipitation months**
   - Corn-Soy Bean fields are vacant in spring
   - RESULT: Increased surface runoff, decreased ET, rain drop impact, and soil erosion

2. **Intensive land use practices over time**
   - 90% annual crop production (limited perennial vegetation)
   - RESULT: Reduced ET, decreased root strength, soil erosion

3. **Subsurface drain tile systems**

   - Millions of feet in networks, pumping straight into streams
   - “Hungry water”
   - RESULT: Increased peak flows, increased erosion, nutrients to stream

…Channel erosion in Elm Creek is a result of **HIGH FLOWS** due to….

4. Decreased channel sinuosity with road and bridge construction

- Increase in stream gradient
- RESULT: increased stream velocity, increased energy, increased shear stress, increased channel/bank erosion, increased turbidity

5. Livestock grazing

-Livestock allowed to graze in marginal lands (often riparian areas), reducing vegetation and causing soil compaction

-RESULT: Decreased infiltration, increased surface runoff, decreased root strength and bank cohesion.

6. A lack of riparian buffer areas

- No deep rooted vegetation, no buffer system, cattle grazing

-RESULT: Bank erosion, mass wasting, surface runoff, nutrient runoff

Main Goals of Elm Creek Project

- The purpose of this project is to restore a section of Elm Creek in order to demonstrate cost-effective methods that can be implemented to:

1. Reduce channel erosion
2. Enhance channel stability
3. Enhance riparian vegetation
4. Reduce sediment load

HYPOTHESIS

- By demonstrating cost-effective methods to restore a small section of Elm Creek, we can:
  - Improve water quality
  - Reduce channel erosion and stream sediment load
  - Enhance channel stability at the selected site
  - Create an effective riparian zone to act as a multi-functional buffer system

Restoration Plans

- Data collection and field work has been conducted over time to determine appropriate restoration measures
  - Chris Lenhart (former PhD Student) located site and completed initial “scouting” for project
    - 2005-2007
  - Lenhart used Rosgen Method to design project
- Restoration plans designed by Chris Lenhart and Joe Magner (MN PCA)
  - Assisted by Dr. Ken Brooks and Britta Suppes

METHODS

- Measurements Taken:
  - Channel width
  - Channel depth
  - Channel slope
  - Channel material
  - YSI Measurements
  - Water Quality sampling

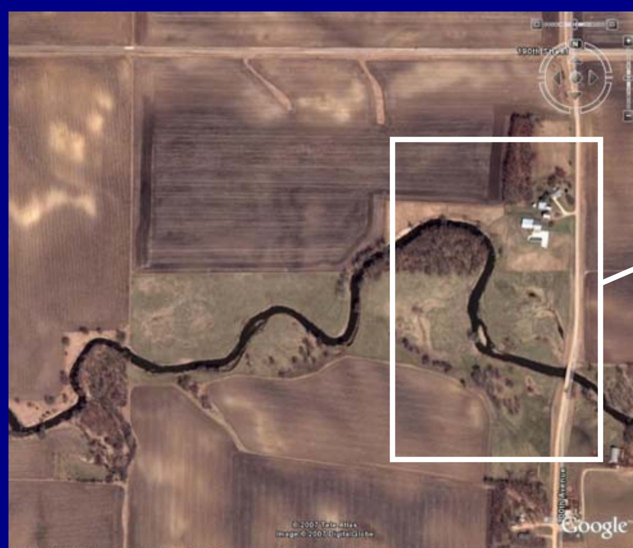
LASER LEVEL

- Calculations for design:
  - Width/Depth ratio
  - Entrenchment ratio
  - Bankfull level

- Rosgen Method
- Pfankuch Stability Assessment

Phases 1-3: Guide

- The demonstration site was divided up into 3 phases
- Restoration designs were made for each phase (1-3)



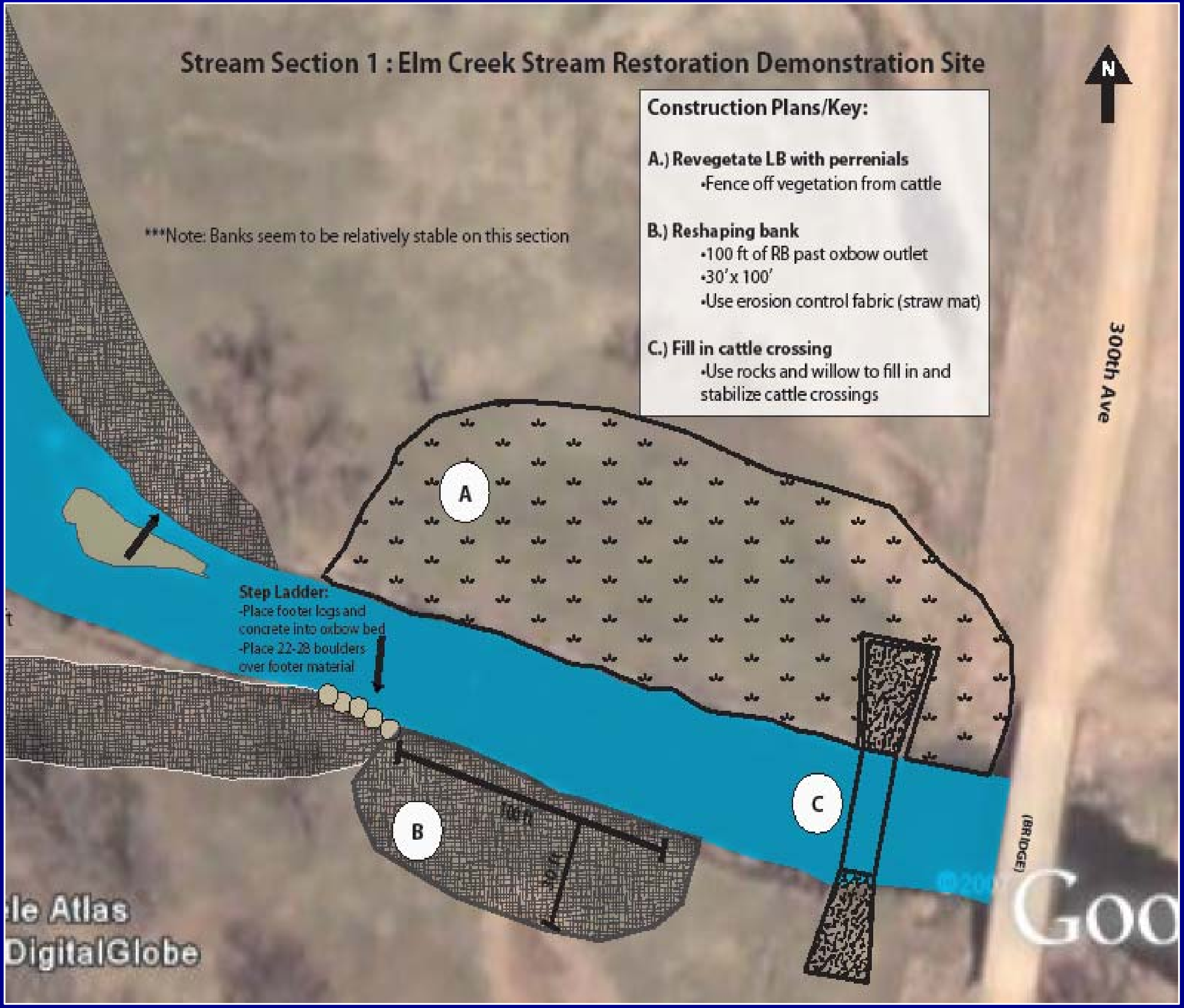
Phase 1: PROBLEMS

- Heavy cattle grazing
  - No riparian buffer
  - Minimal vegetation besides turf grass
  - Soil compaction=surface runoff
  - Highly impacted and eroded cattle crossings
- Channel Straightened
  - Channel was straightened for bridge crossing
  - Oxbow cut off unnaturally
- Stream entrenchment
  - Elm Creek is entrenched at Phase 1
  - Stream cannot access flood plain during peak flows

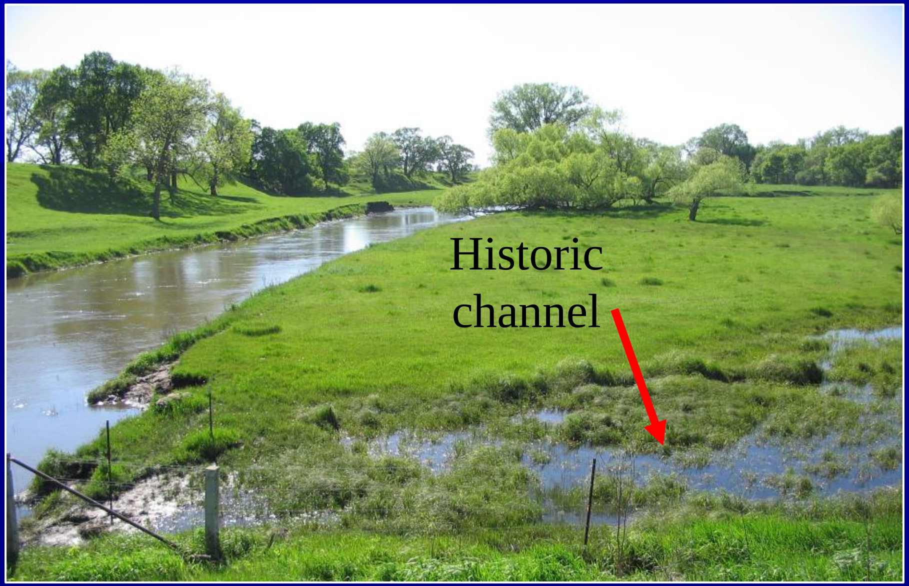
Phase 1: PLANS

Goals:

1. Revegetate left bank with perennial vegetation
2. Reshape bank
    - Recreate bankfull levels and floodplain
    - Stabilize with erosion control fabric and veg
3. Stabilize cattle crossing



Phase 1: PHOTOS



Phase 2: PROBLEMS

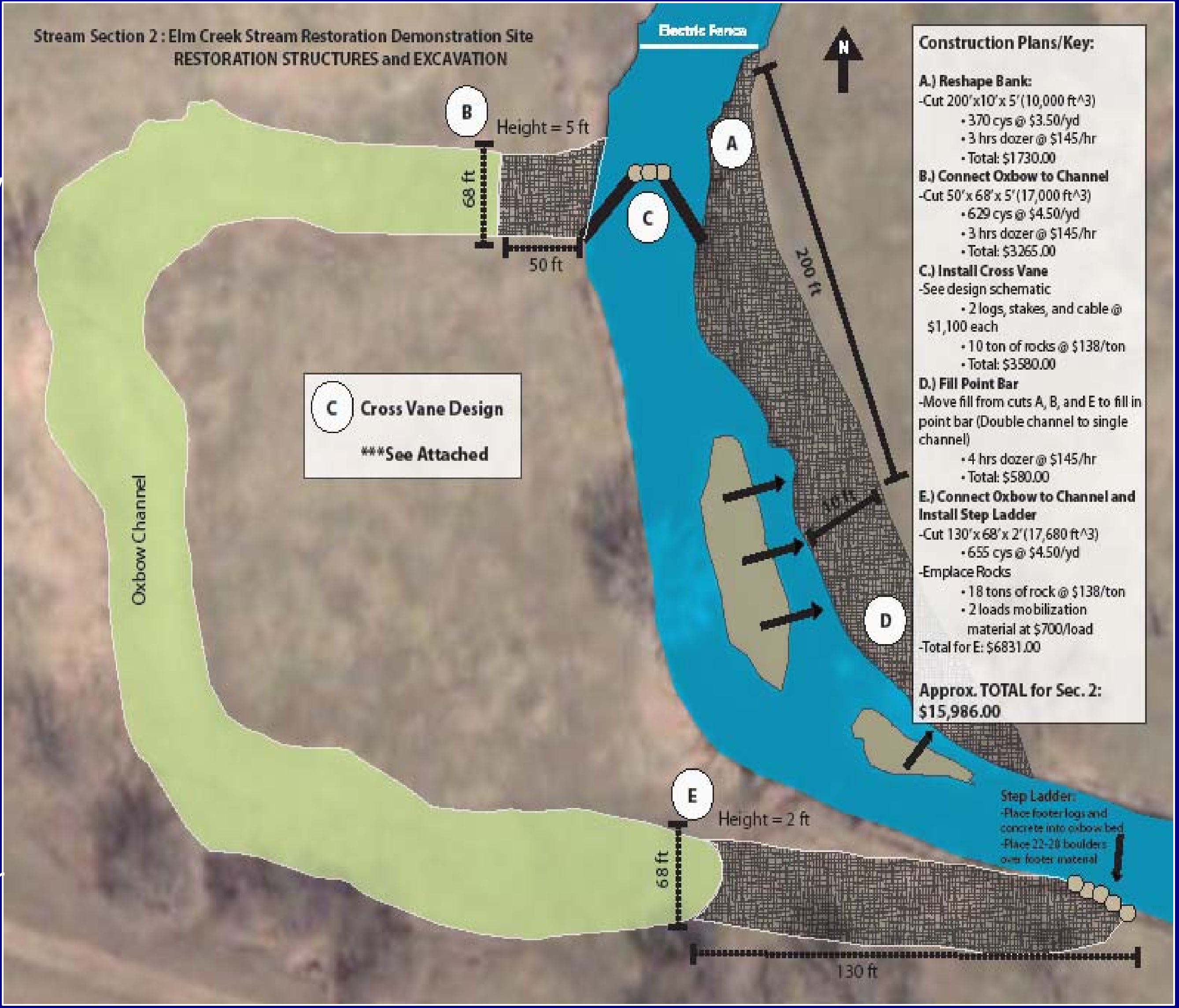
- Cattle Grazing
  - Cattle crossing caused the stream to widen
  - Sediment deposition in center of channel
    - Created two channels
  - No riparian buffer vegetation
- Stream entrenchment
  - Elm Creek is entrenched at Phase 2
  - Stream cannot access flood plain during peak flows

View: Standing on RB looking north, upstream

Phase 2: PLANS

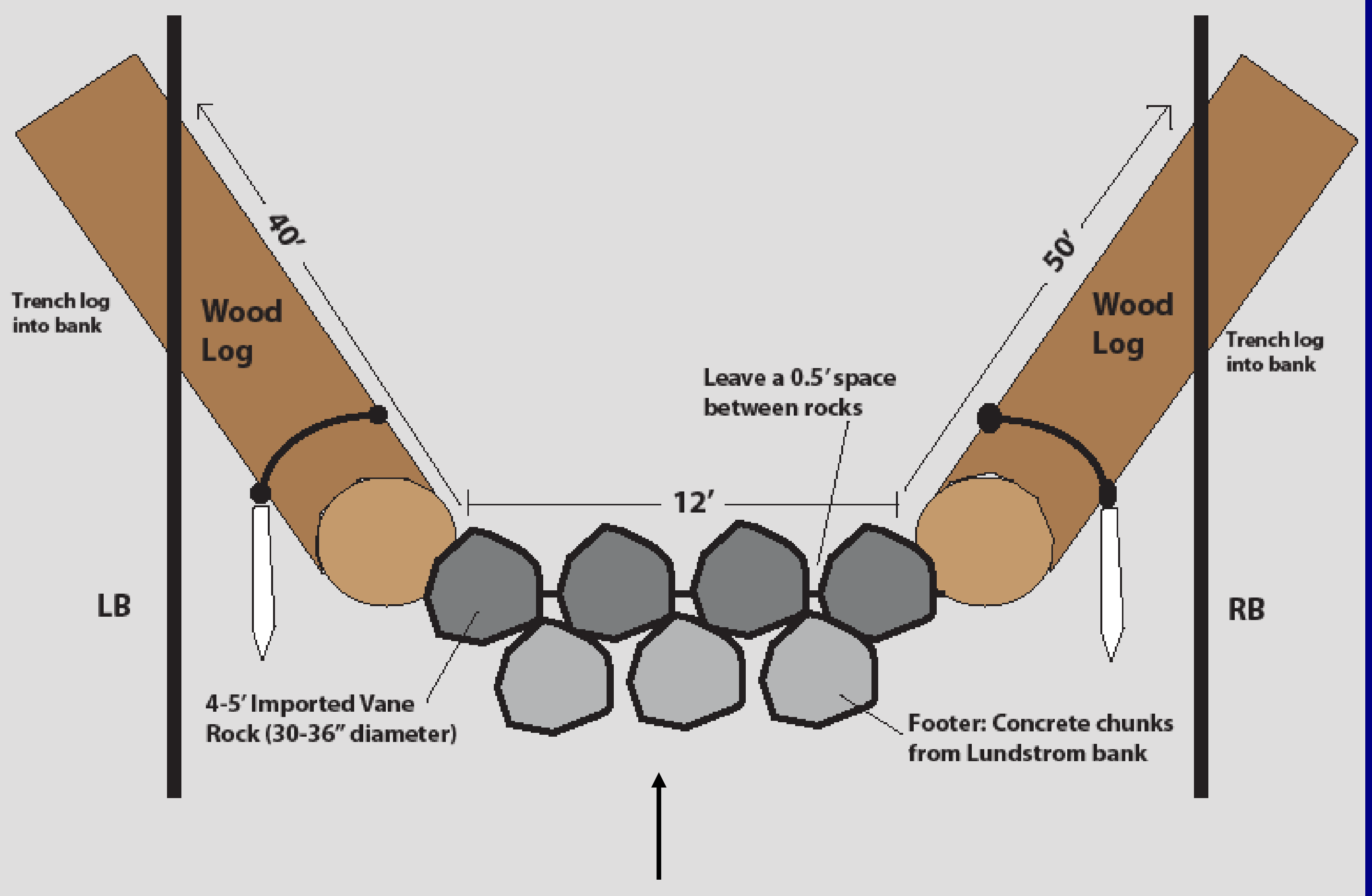
Goals:

1. Reconnect oxbow to active channel
   - To reduce energy of flow during high water
   - Construct cross vane to redirect flow in channel during high water
   - Construct step ladder at oxbow exit
2. Reshape bank
   - Recreate bankfull levels and floodplain
   - Stabilize with erosion control fabric and veg
3. Revegetate left bank with perennial vegetation
4. Stabilize cattle crossing
5. Remove aggraded sand bar to create a single channel



Cross-Vane Construction

Figure 1: Cross vane design for the Elm Creek restoration demonstration site. Section 2, C



Phase 2: Photos

BEFORE:
Oct. 2007

Phase 2: Photos

AFTER:

11/30/07

Phase 2: Photos

AFTER:
7/17/08

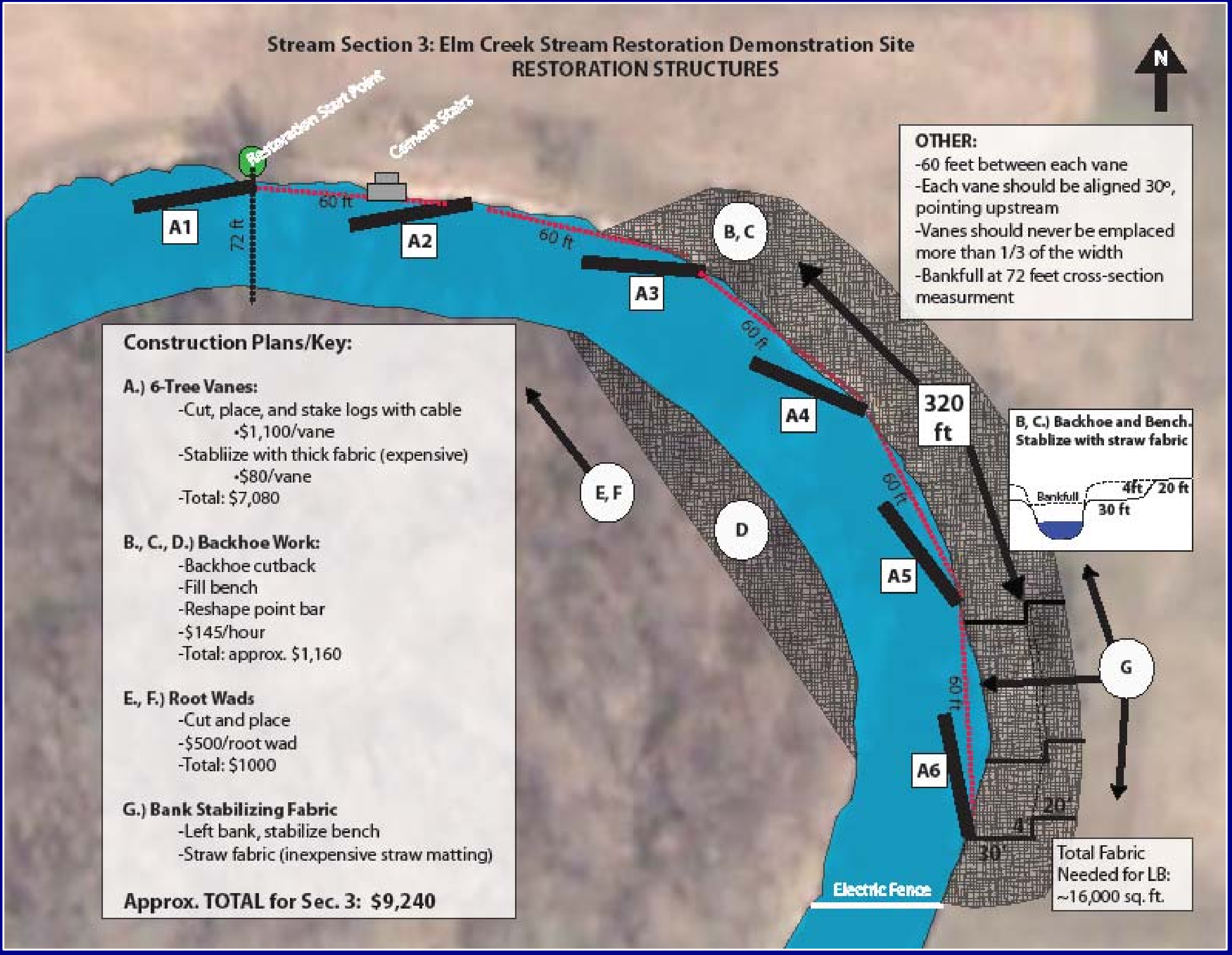
Phase 3: PROBLEMS

- Cutbank is eroding at an estimated rate of ~5 ft/yr
  - Quickly eroding into Stensland property
- Stream entrenchment
  - Elm Creek is entrenched at Phase 3
  - Stream cannot access flood plain during peak flows

Phase 3: PLANS

Goals:

1. Emplace 6 tree vanes
   - Deflect flow away from cutbank
2. Reshape bank
   - Recreate bankfull levels and floodplain
   - Stabilize with erosion control fabric and veg
3. Revegetate left bank with perennial vegetation
4. Emplace root wads



Phase 3: PHOTOS

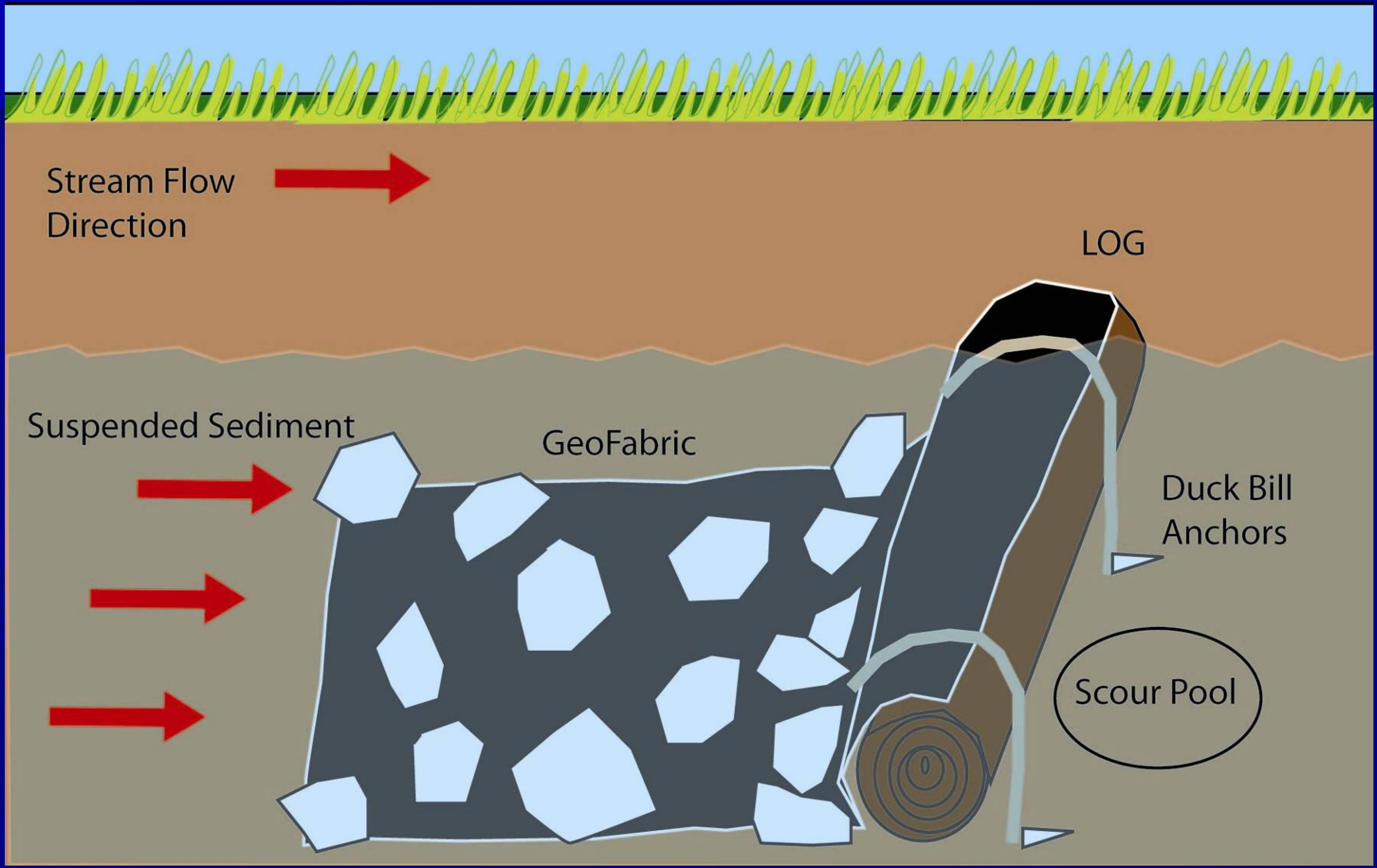
BEFORE:

Oct. 2007

and

Nov. 2007

LOG VANE DESIGN



Phase 3: Log Vane Construction

Phase 3: Photos

AFTER:

Nov. 2007

Phase 3: Photos

AFTER:
7/17/08

CONSTRUCTION RESULTS

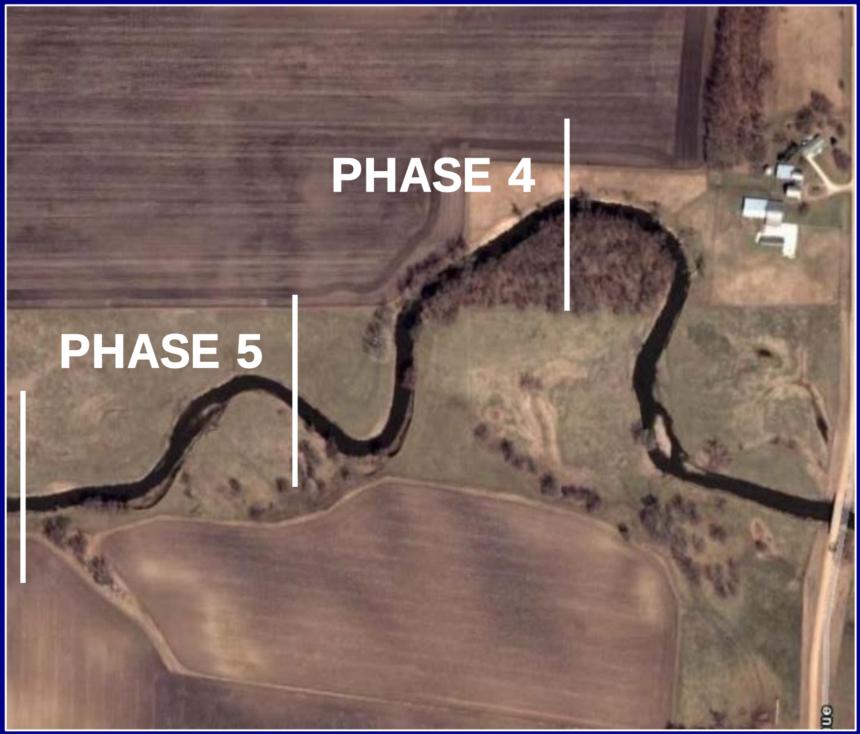
- Contractor finished work on 11/26/07
- Weather forced us to cease work
  - Ground frozen by 11/28/2007
- Restoration work continued Spring 2008

Spring 2008: Phases 1-3 Finished

- Planted prairie grasses on exposed, raw stream banks
- Stapled erosion control fabric on raw banks
- Planted willow stakes in riparian areas
- Developed a long term perennial vegetation plan
  - Used landowner input to select ideal vegetation
  - Agroforestry opportunities

FALL 2008: Phases 4 & 5

- Severe channel erosion upstream of Phases 1-3 on Mair property
  - Designed a Phase 4 and 5 to extend restoration work
  - Restoration work funded and conducted by Martin County SWCD
    - LCCMR Grant



GOALS: Phases 4 & 5

- Goals:
  - To continue to improve the overall quality and stability of Elm Creek by adding on to Phases 1-3
    - Reduce channel erosion
    - Reduce suspended sediment
    - Enhance channel stability

Phase 4– Pre-Restoration (Before)

PROBLEMS:

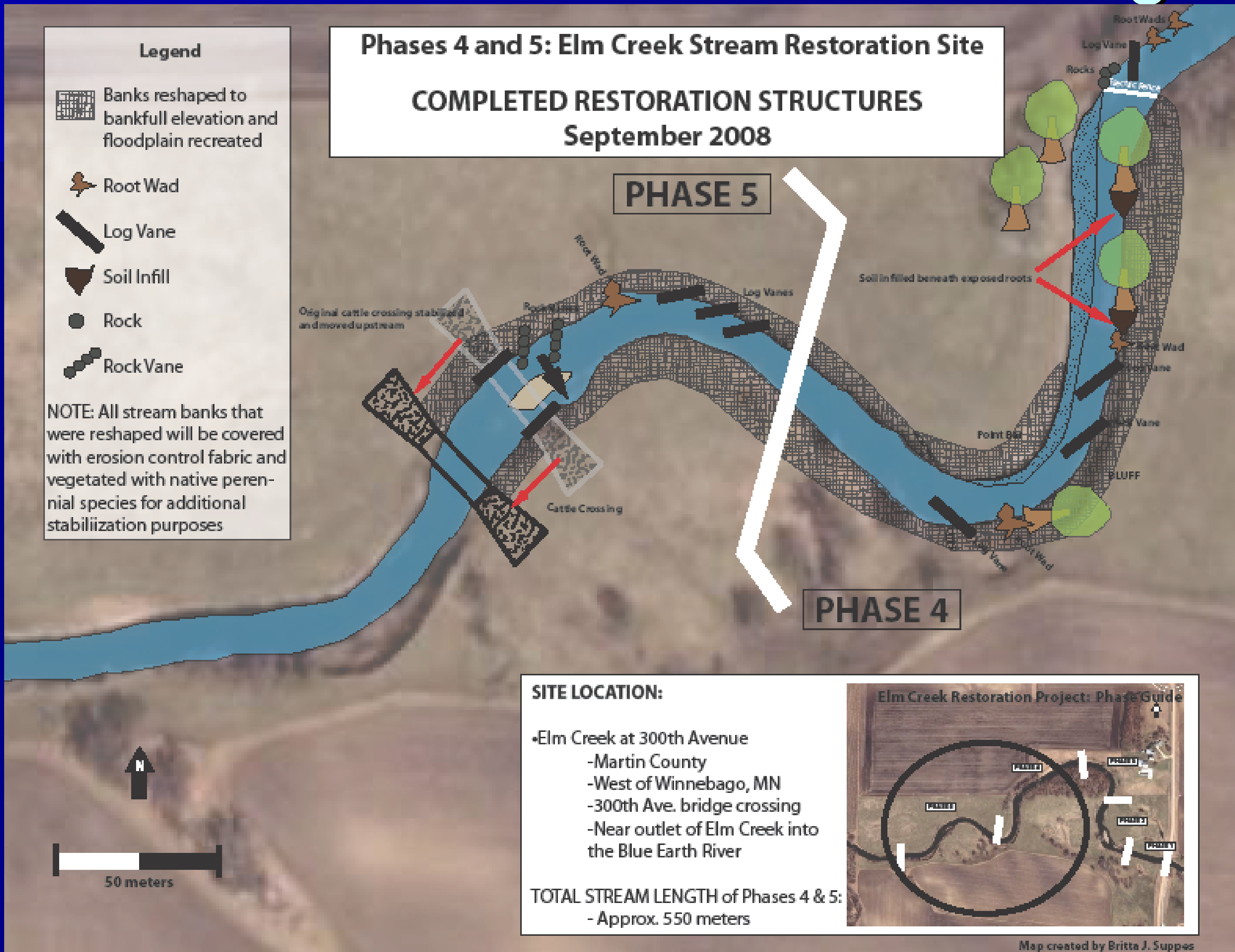
- •Channel erosion
- •Mass wasting (slumping)
- •Channel widening
- •Grazing degradation
- •Limited riparian vegetation
- •Shallow rooting depths of grasses

Phase 5– Pre-Restoration (Before)

PROBLEMS:

- Channel erosion
- Mass wasting (slumping)
- Channel widening
- Grazing degradation
- Limited riparian vegetation
- Large cattle crossing in channel

Phases 4 & 5: Construction Designs



AFTER Construction: Phases 4 & 5

- Construction completed Sept. 2008
- Perennial grasses and willows planted Oct. 2008
- Erosion control fabric stapled onto bare soil

Future Work: Elm Creek Site

- Monitor effectiveness of structures over time

- Evaluate erosion rates at site over time
  - Improvements?

- Conservation Easements

- Design agroforestry regime

QUESTIONS?

References

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- Palmer, M.A., E.S. Bernhardt, J.D. Allan, P.S. Lake, G. Alexander, S. Brooks, J. Carr, S. Clayton, C.N. Dahm, J. Follstad Shah, D.L. Galat, S.G. Loss, P. Goodwin, D.D. Hart, B. Hassett, R. Jenkinson, G.M. Kondolf, R. Lave, J.L. Meyer, T.K. O'donnell, L. Pagano, and E. Sudduth, 2005. Standards for ecologically successful river restoration. *Journal of Applied Ecology* 42:208-217.
- Rosgen, D.L., 1994. A classification of natural rivers. *Catena* 22:169-199.