Applied Fluvial Geomorphology in NH: Warren Brook Restoration

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March 31, 2011

Acknowledgements

Cold River Local Advisory Committee

New Hampshire DOT Department of Transportation

United States Department of Agriculture NRCS Natural Resources Conservation Service

New Hampshire Department of Environmental Services

U.S. Fish & Wildlife Service Department of the Interior

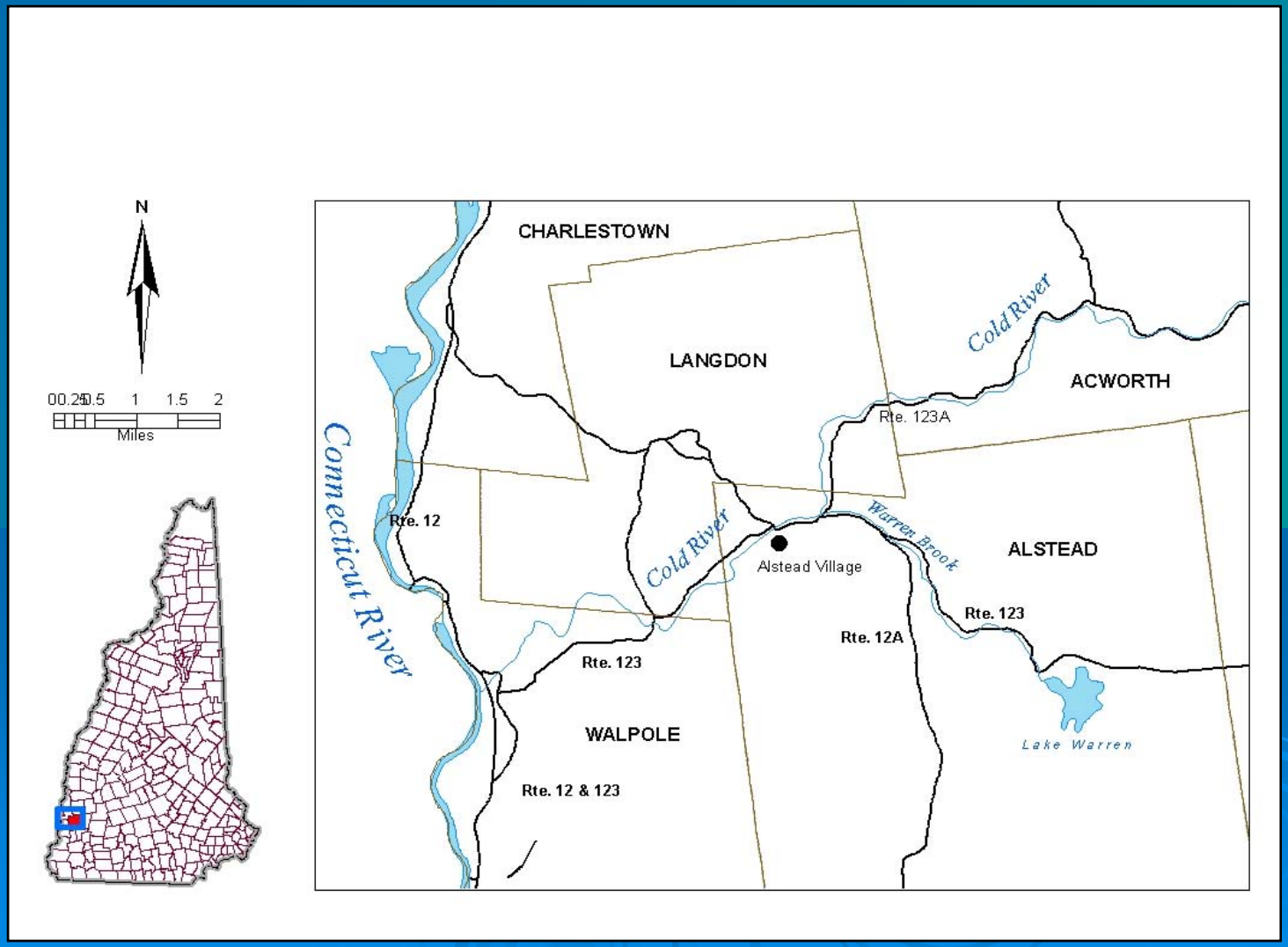
NHCWRP

Welcome to Alstead Village Town Chartered 1763

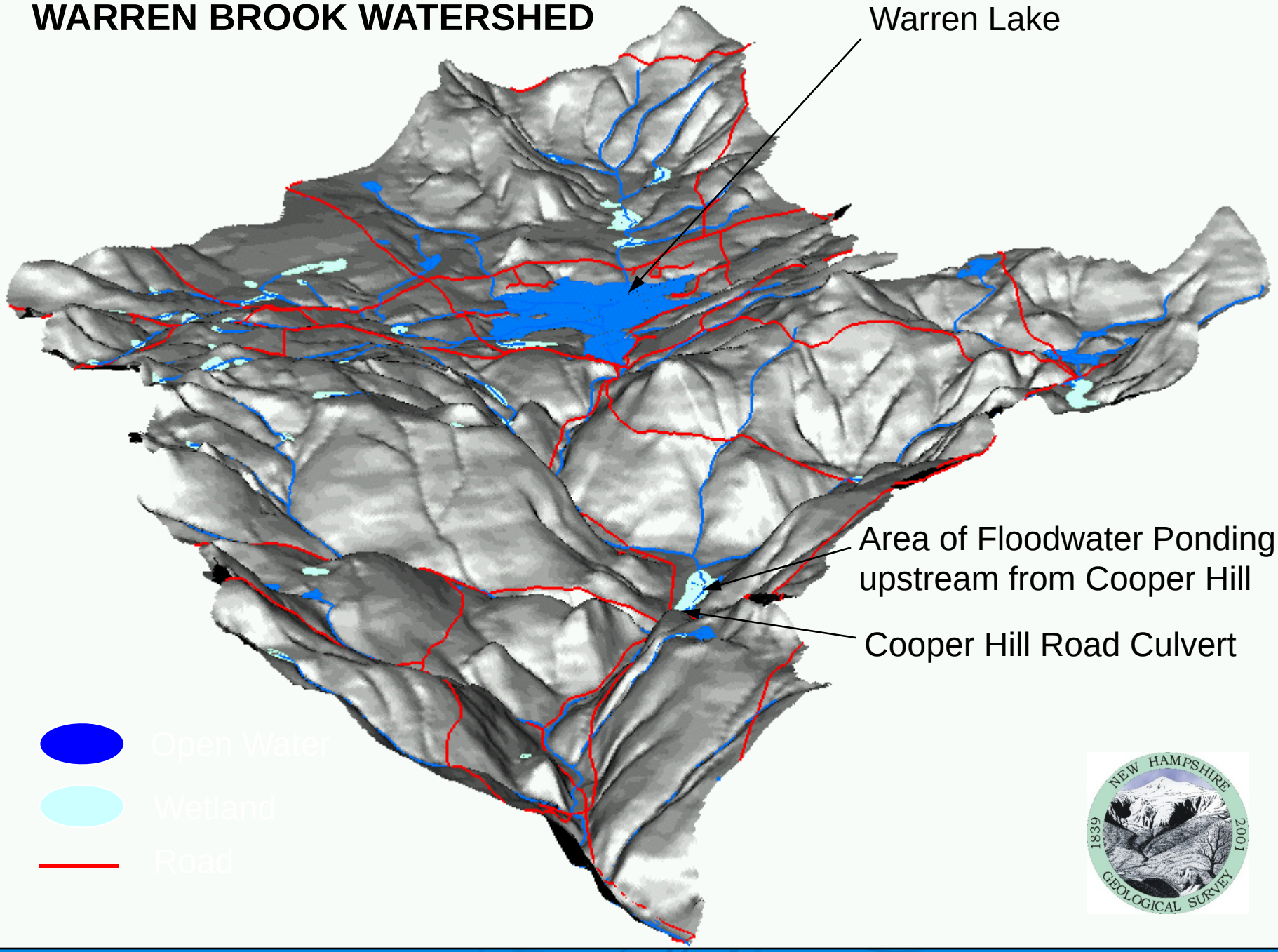
Fluvial Geomorphology

- Science of assessing the form of river systems and the sediment and water processes responsible for that form
- Application of science identifies ***dynamic*** equilibrium state of river systems

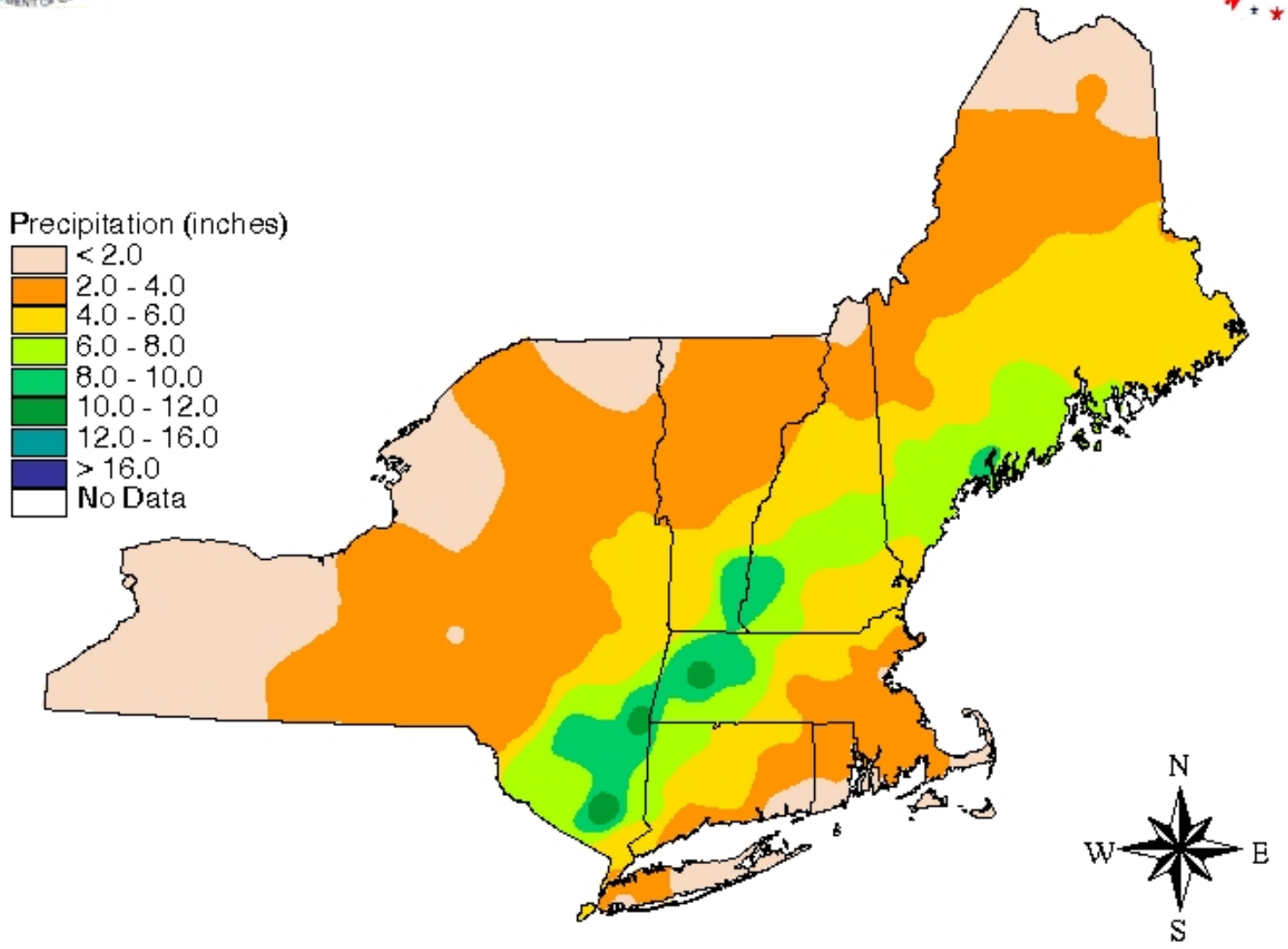
Cooper Hill Road Culvert and Embankment failure – Warren Brook



WARREN BROOK WATERSHED



Storm Total Precipitation
8 am 10/07/2005 thru 8 am 10/10/2005



Produced by the Northeast River Forecast Center

View of broad valley where floodwaters ponded upstream of Cooper Hill Road

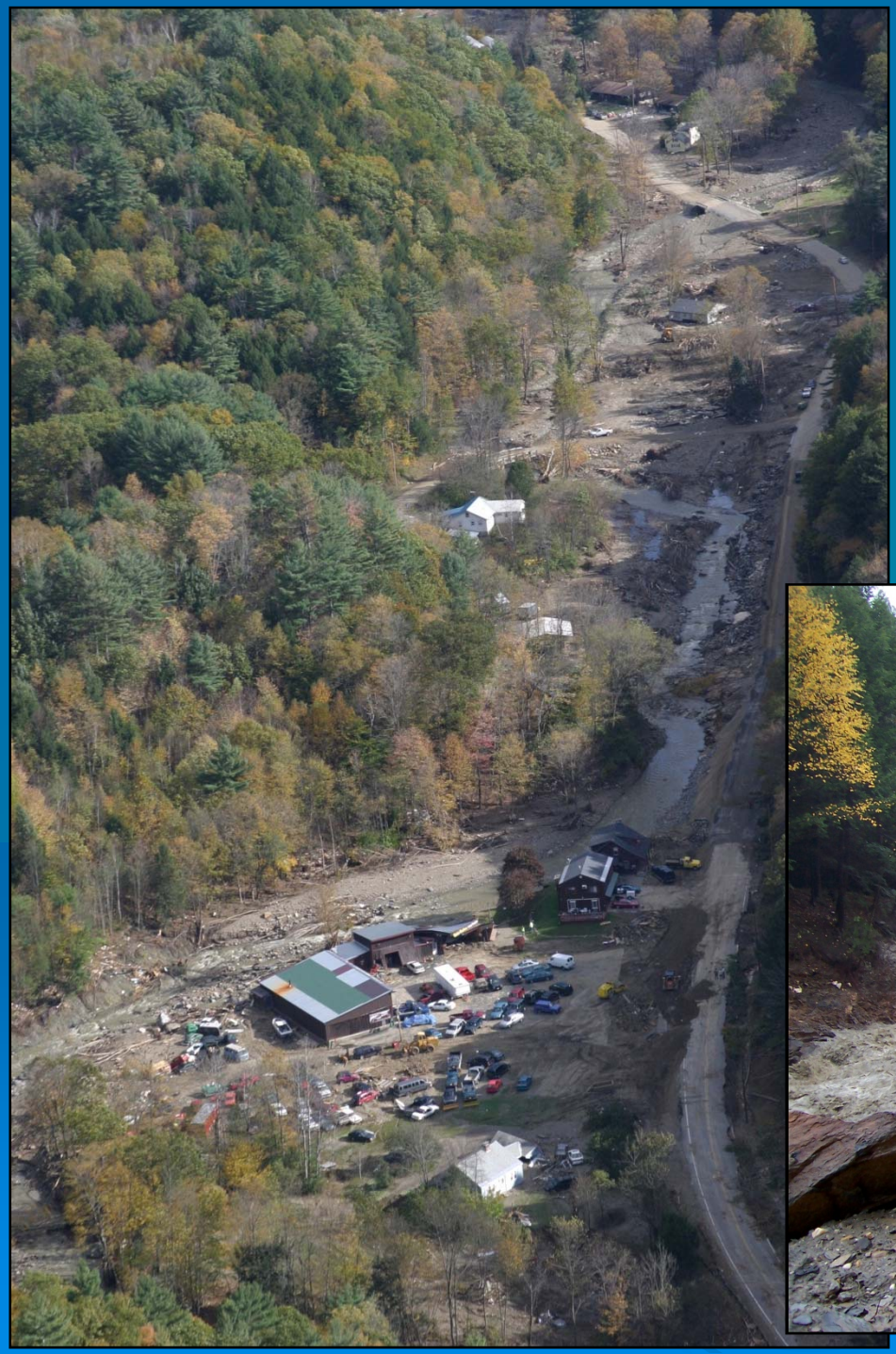
View of Cooper Hill Road from NH Route 123 after embankment failure

Photo by NHGS staff

View downstream after embankment failure

Photo by Chris Covel

Aerial view of embankment failure



Embankment failure sent a flood wave downstream (similar to a dam breach).

USGS estimated peak flow ~25,000 cfs in Warren Brook.

Confluence of Warren Brook and Cold River

Warren Brook below Griffin Hill Road

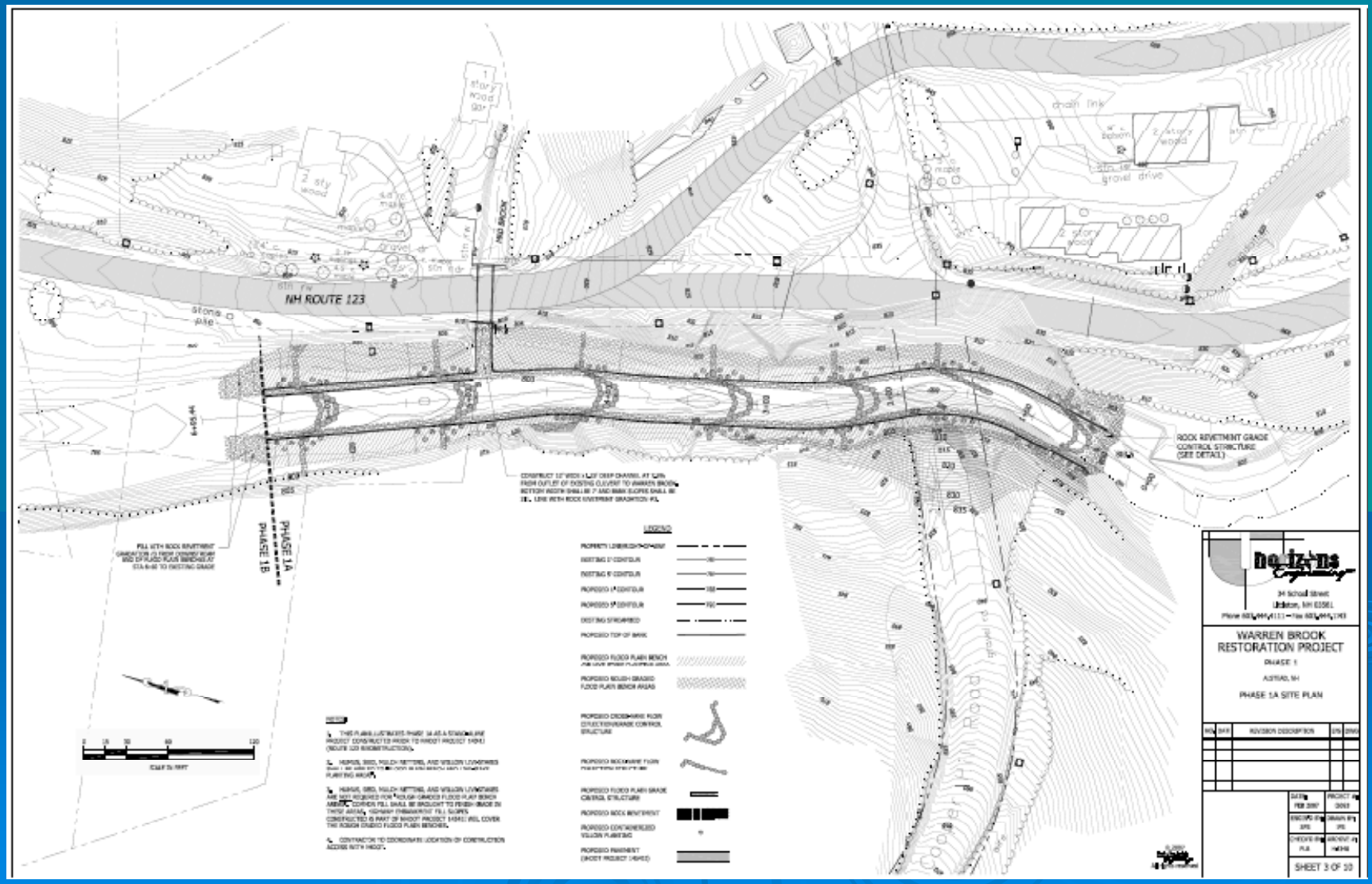
The flood caused the streambed to downcut several feet, creating an “incised” or, in many areas, an “entrenched” channel.

Response

- USGS Flood Recovery Mapping
- Fluvial Geomorphic Assessment
  - Restoration Master Plan ($80,000)
    - Included 18 Miles of geomorphic assessments
    - NRCS, NHDOT, NHDES, NHF&G
  - 700 linear feet of Warren Brook restored immediately below Cooper Hill in 2007 ($210,000)
- NRCS Stabilization ($7.3 Million)
- 900 linear feet of Warren Brook restored at Griffin Hill Road in 2010 (~$250,000 in grants from DES and USFWS)

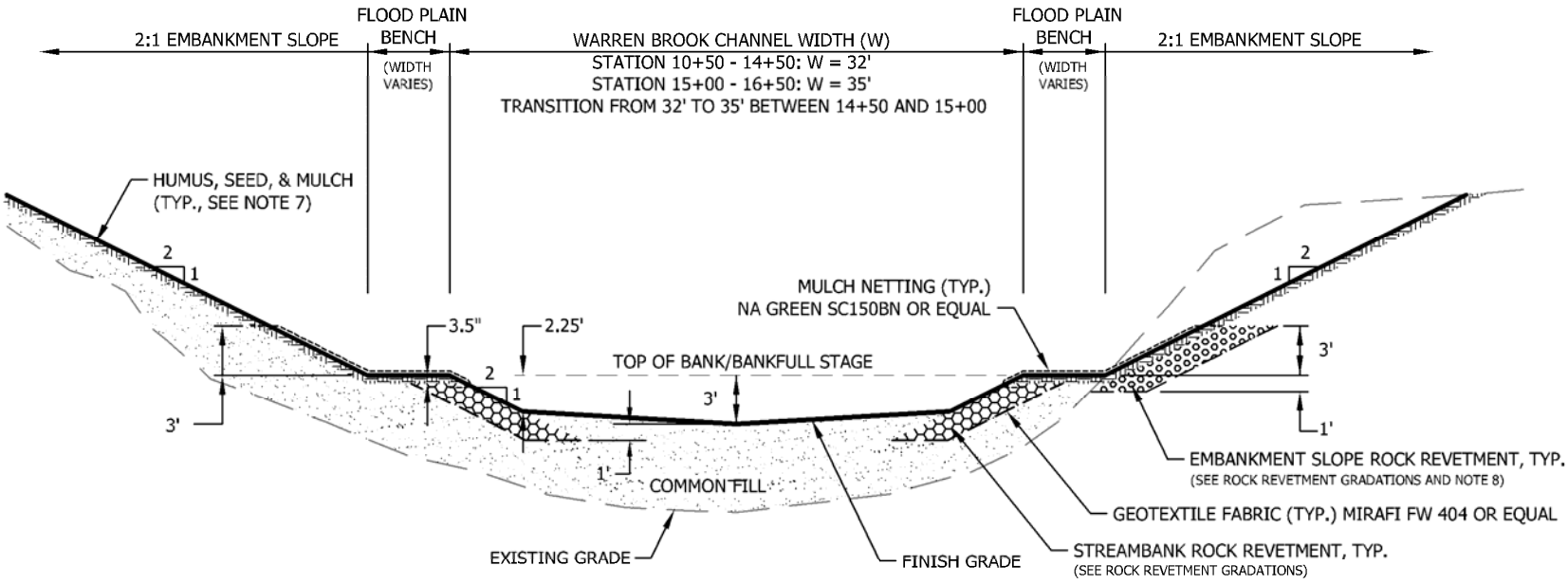
Warren Brook at Cooper Hill Road

Restoration Site Plan



Warren Brook at Cooper Hill Road

Typical Cross-Section



TYPICAL BROOK SECTION FOR RIFFLE BED FEATURES

NOT TO SCALE

APPLICABLE TO BROOK STATIONS: 10+50 - 11+50, 12+00 - 13+14, 13+66 - 15+07, AND 15+62 - 16+50

Warren Brook at Cooper Hill Road

Construction Photos

Summer 2007 construction

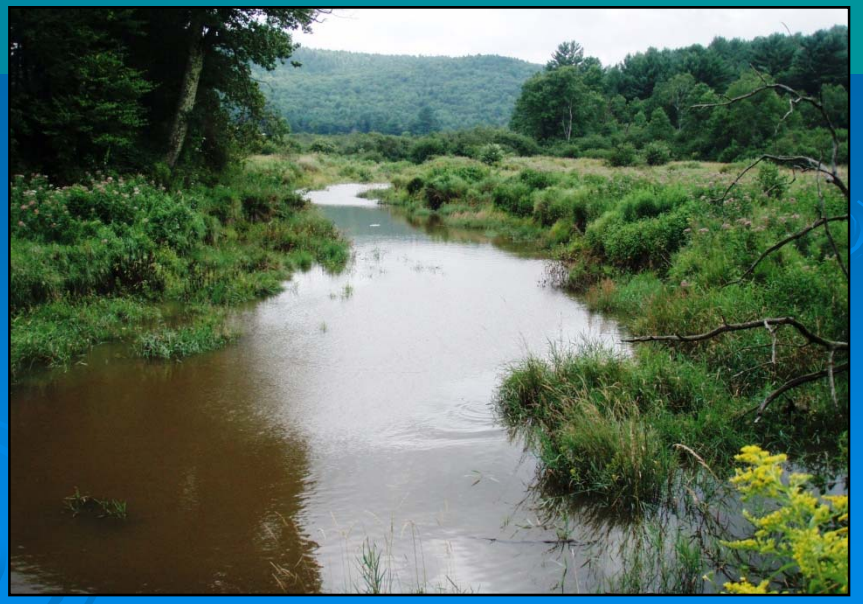
Warren Brook at Cooper Hill Road

Post-Construction Photos

Raised streambed
to pre-flood levels

Warren Brook at Cooper Hill Road

Post-Construction Photos



Passive restoration of stream and wetlands upstream of project

Warren Brook at Griffin Hill Road

Post-Flood Aerial Photo

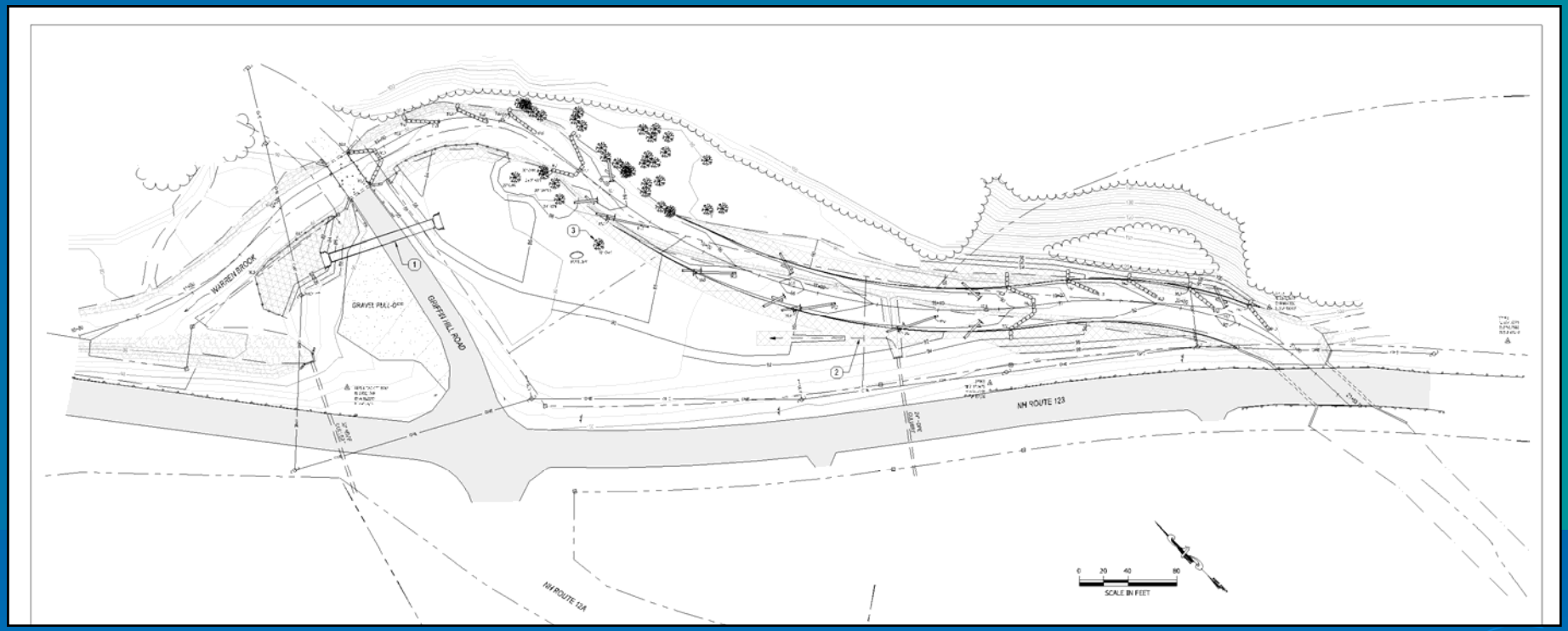
Warren Brook at Griffin Hill Road

Post-Stabilization / Pre-Restoration

- Channel incised (no access to floodplain)
- Additional streambed degradation likely
- Minimal riparian vegetation
- Very little in-stream structure
- Poor aquatic and riparian habitats

Warren Brook at Griffin Hill Road

Restoration Site Plan



Design Elements

- Realign channel to restore meander pattern
- Lower overbanks to active floodplain level (alleviate incision)
- Floodplain culvert through Griffin Hill Road
- In-stream structures for habitat and bank stability
- 800+ riparian shrub plantings

Warren Brook at Griffin Hill Road

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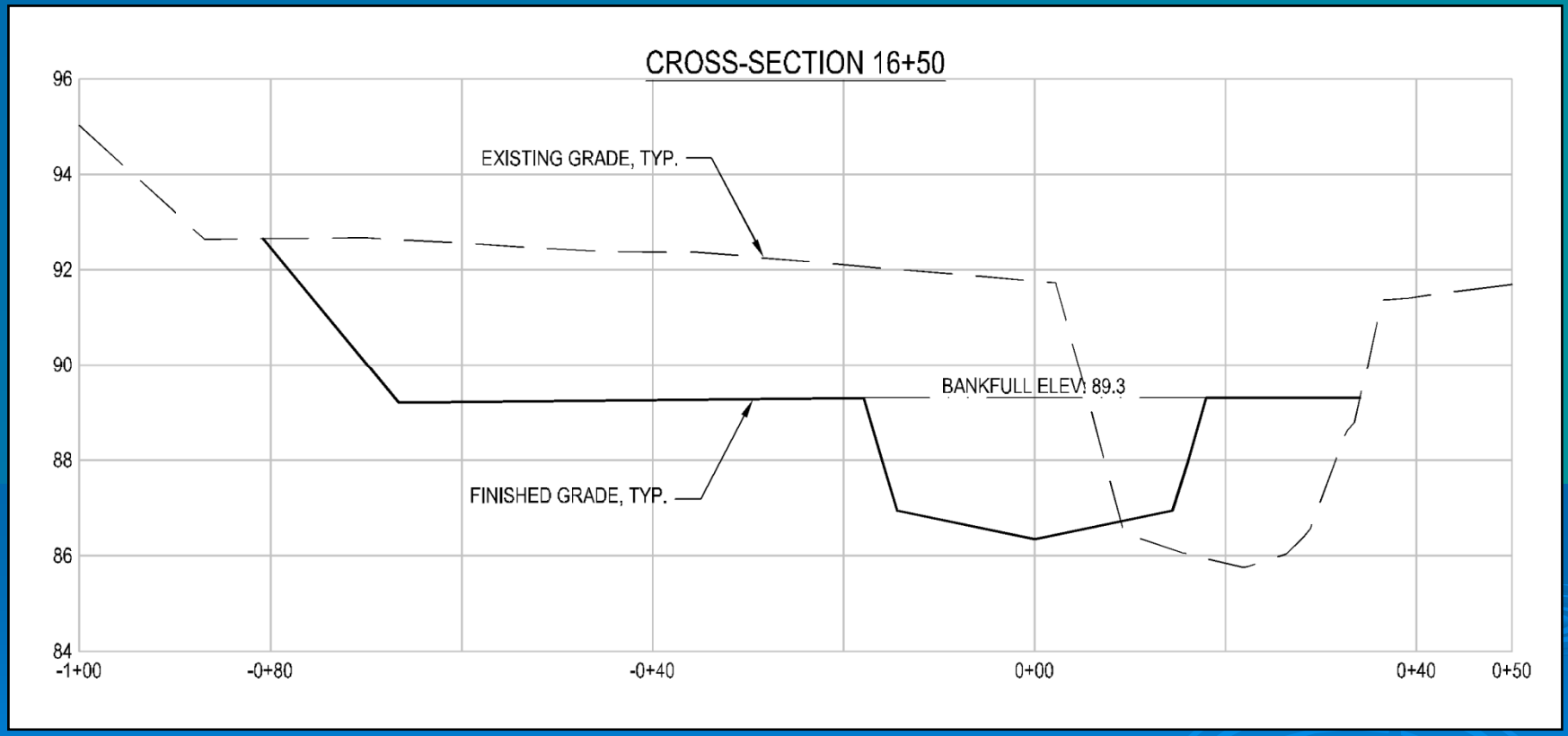

Warren Brook at Griffin Hill Road

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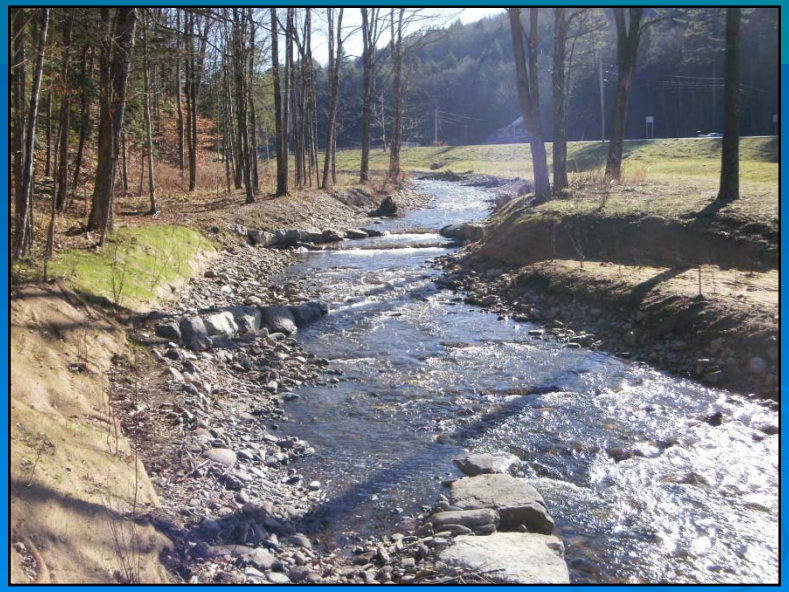
Post-Construction Photos

Warren Brook at Griffin Hill Road

Post-Construction Photos