# Stream Restoration: From Concept to Post-Construction Monitoring

Mary Szafraniec, Erik Oij
Water Resources

woodplc.com

# Stream Restoration Overview

- Purpose
- Watershed approach
- Stream restoration concepts
- Desktop and field methods
- Case studies
- Pre/post construction monitoring
- Summary

# Purpose

# Why Restore Streams?

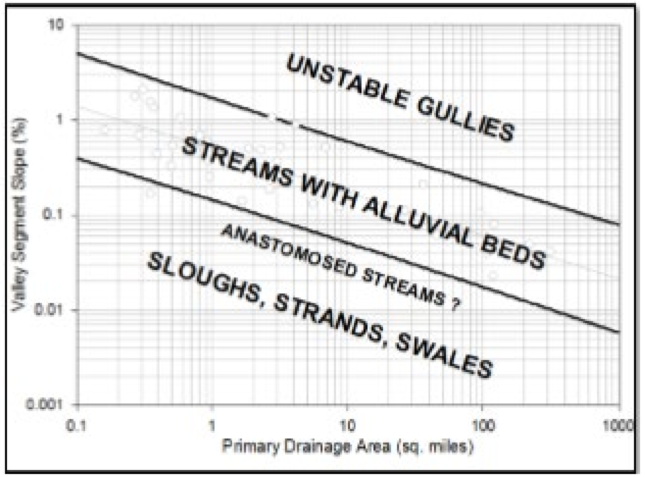
- Existing stormwater control measures in watersheds do not always adequately control channel protection volume
- Many streams are in a state of disequilibrium
- Restoration is needed to correct morphology and stabilize the watershed
- Restore structural/functional habitat losses and enhance in-stream water quality treatment
    - Erosion / Bank-undercutting → Bank stabilization
    - Land disturbances (channelization / historic straightening) → Natural channel design
    - Entrenchment → Grade control

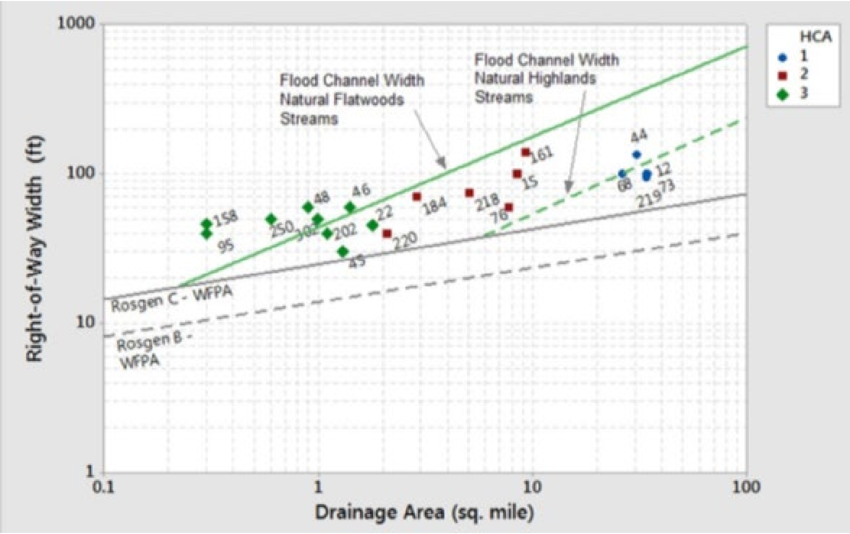
# Watershed Approach

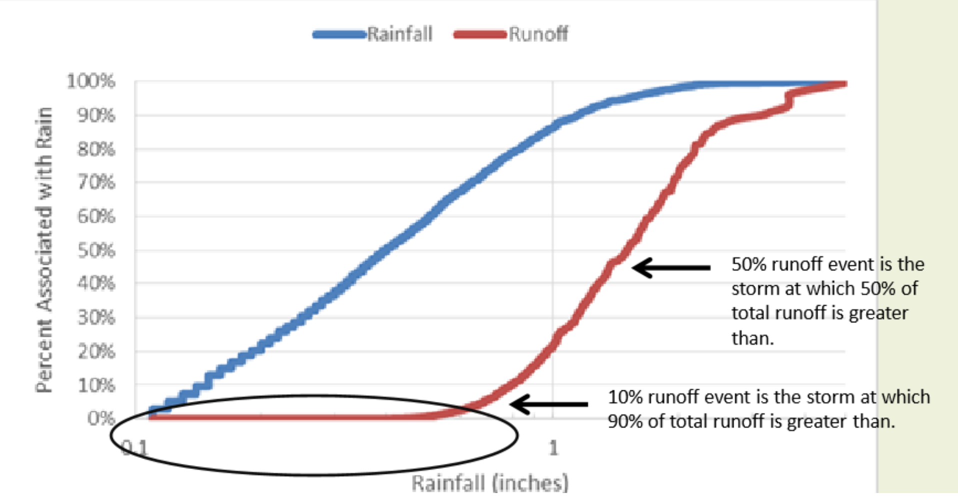
# Watershed Approach

**Is stream restoration a good fit?**

-Fluvial geomorphology characteristics and ROW dictate stream restoration potential and scale with watershed size




- Undeveloped right-of-way size to accommodate flood plain and meander pattern of bankfull channel
- Watershed/drainage area
- Rainfall – runoff
- Seasonal flow variation
- Groundwater inflow
- Valley slope

# Stream Restoration Concepts

# Stream Restoration Concepts

- Natural channel design (NCD)
  - Activities that improve unnatural or impacted stream corridors
  - Become self-sustaining and self-organizing ecosystems

Year 0. Edwards Bottomlands, Starke FL.
(Drainage Area = 25 sq. mi.)

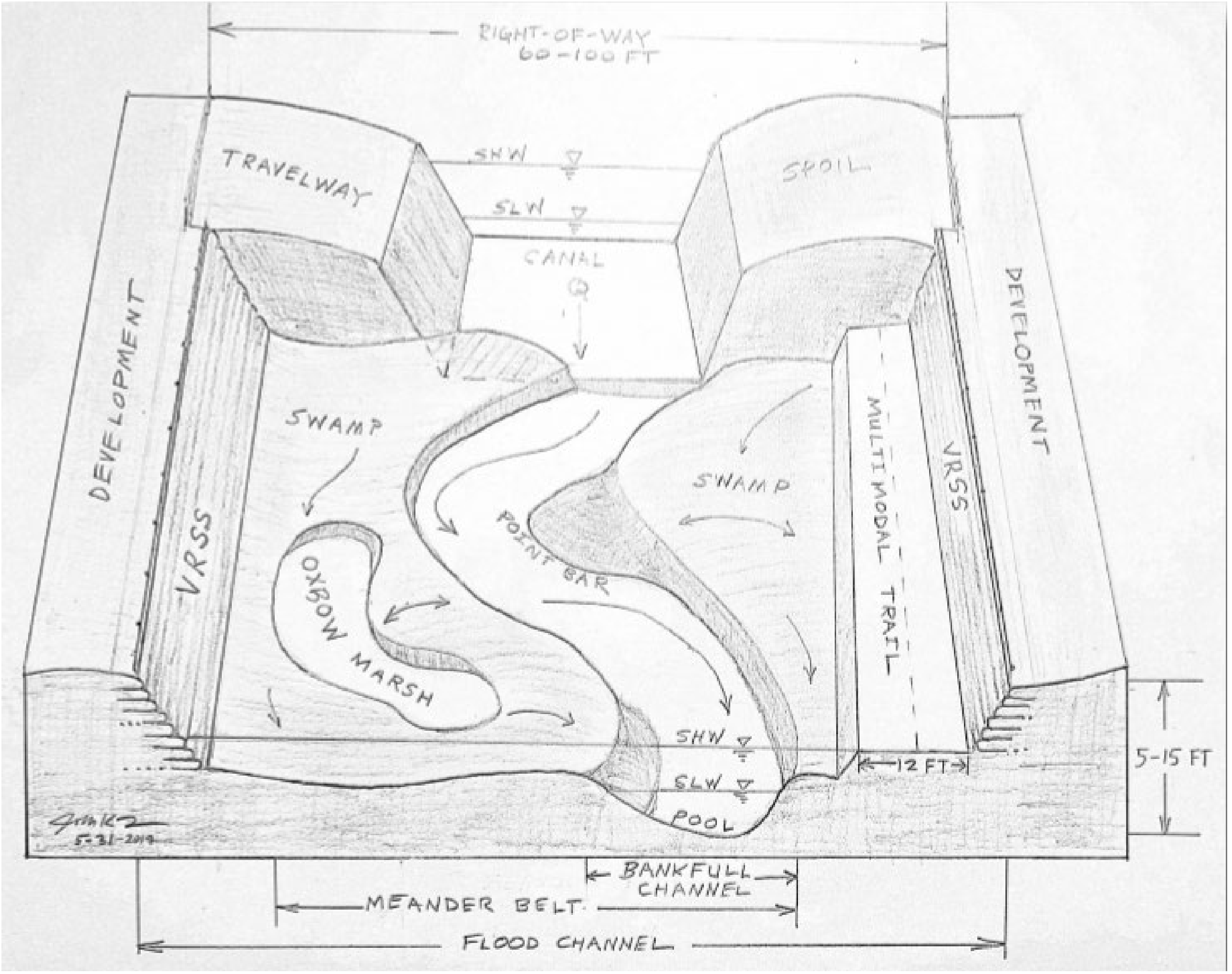
Year 3. Doe Branch 5, Hardee Co. FL.
(Drainage Area = <1 sq. mi.)

Year 12. Maron Run, Polk Co. FL.
(Drainage Area = 3 sq. mi.)

Year 25. Hickey Branch, Hardee Co. FL.
(Drainage Area = 2 sq. mi.)

# Stream Restoration Concepts

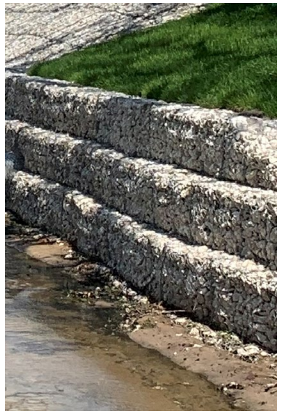
- Natural channel design (NCD)
  - Multi-stage channel
  - Meander belt
  - Incorporate floodplain
  - Enhance stability

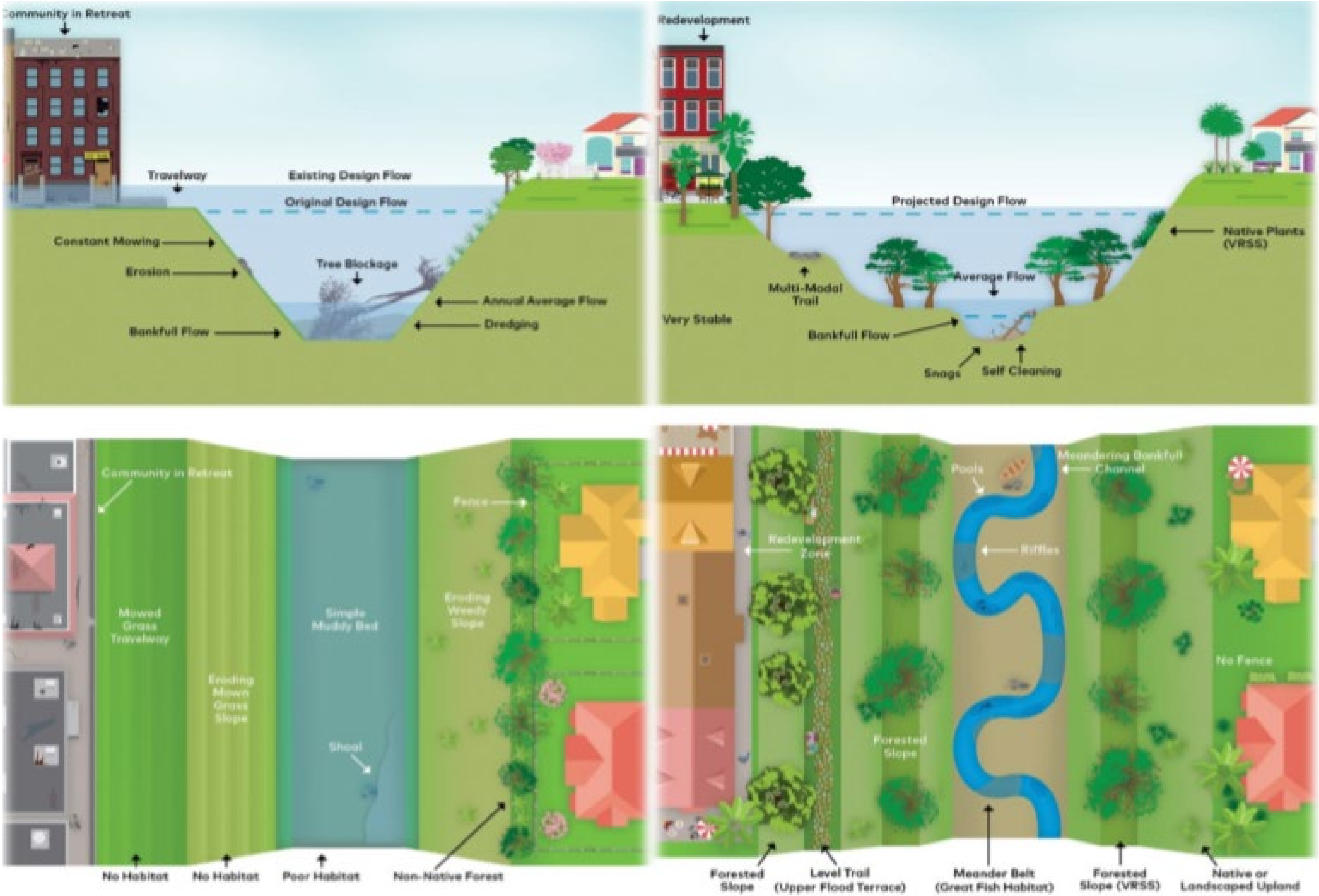


# Stream Restoration Concepts

## Stabilization-in-Place (SIP)

- **Stream Restoration (NCD)**






# Desktop and Field Methods

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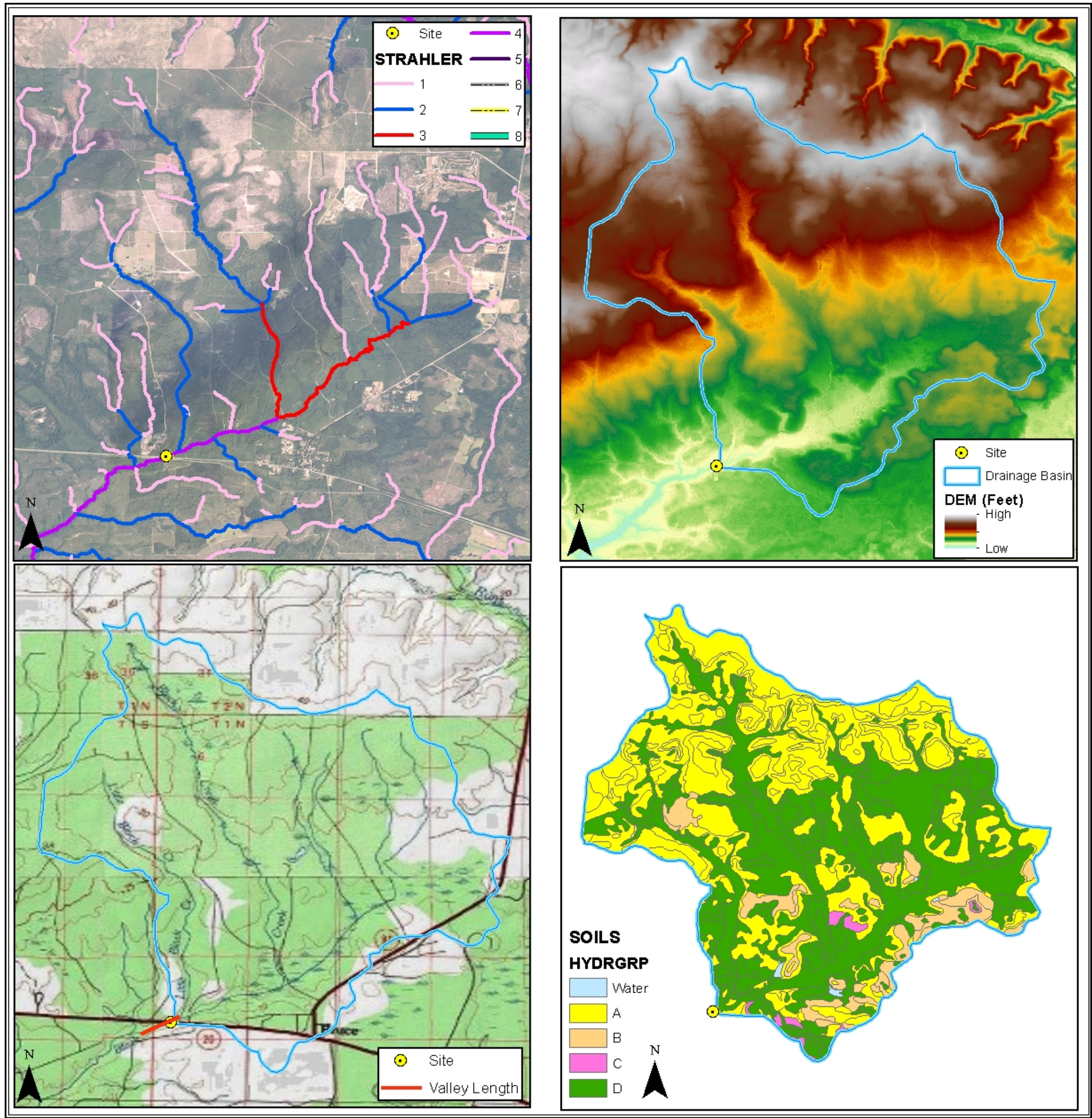
- Geomorphic Assessment
  - Desktop Analysis
  - Field Visit/Survey

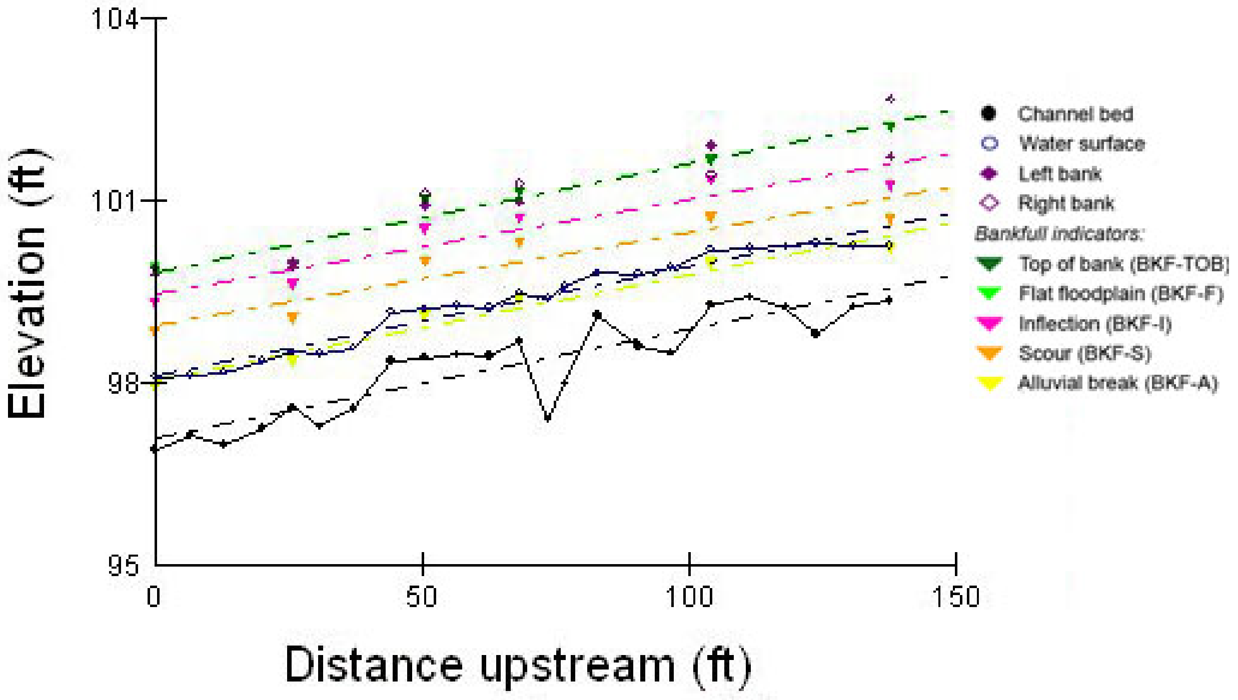

# Geomorphic Assessment-Desktop Analysis

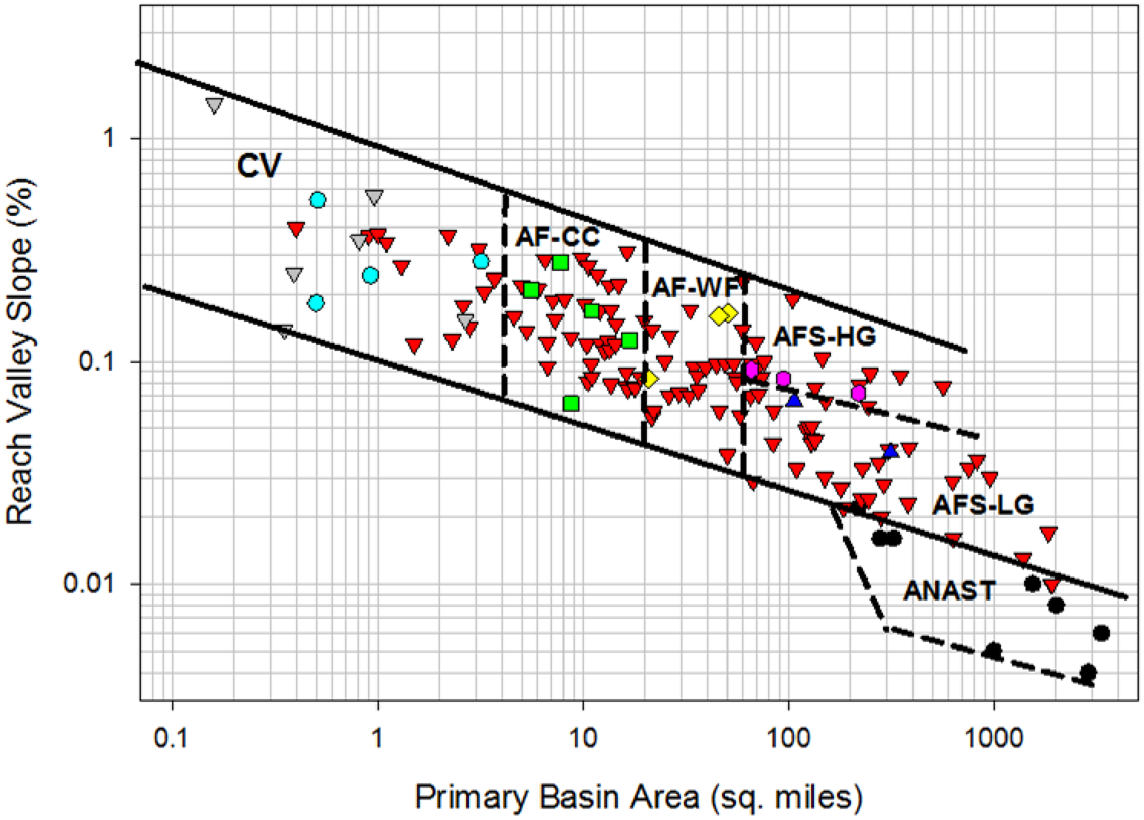
- Review/compile GIS data
  - Basin boundaries
  - Historic/recent aerials
  - Land use
  - Topography
  - Soils
  - Stormwater inventory
- Divide project area into functional process zones (FPZ)

# Geomorphic Assessment-Desktop Analysis

- Drainage Area/Valley Slope relationships
  - Calculate valley slope
  - Delineate detailed drainage area



# Geomorphic Assessment-Desktop Analysis


**Hydrophysiographic Regions**

- NWFCP – NW FL Coastal Plain (Panhandle)
- NEFCP – NE FL Coastal Plain (Big Bend + NE)
- PRCP – Peninsula FL Coastal Plain (Peninsula)
- SFCP – S FL Coastal Plain (Everglades)

<u>Hydrobiogeomorphic (HBG) Classification</u>

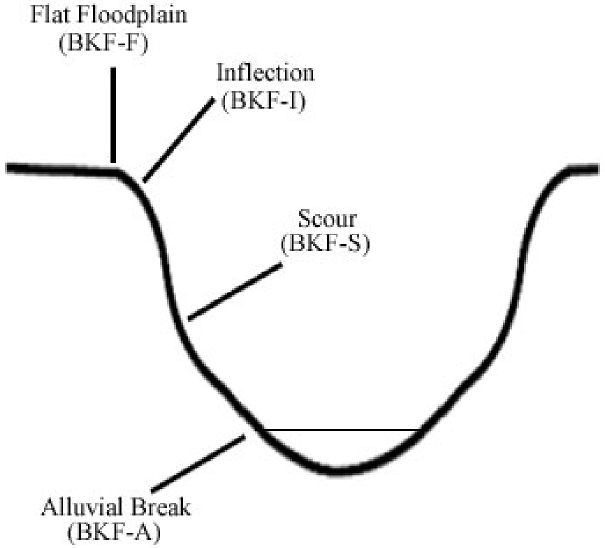
- Flatwoods, highlands, Karst

# Geomorphic Assessment – Field Visit/Survey

- Document erosional features and slope failures
  - Hydraulic erosional forces - channel and overland flow
  - Gravitational forces - steep banks with little vegetation reinforcement
- Identify vegetative community types and cover breaks - "vegetation breaks"

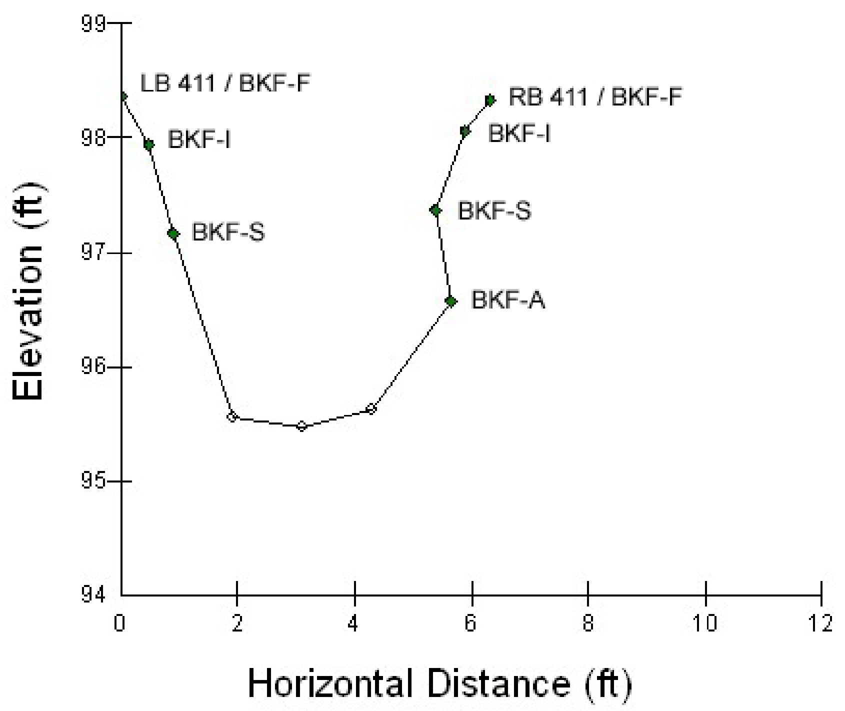
# Geomorphic Assessment – Field Visit/Survey

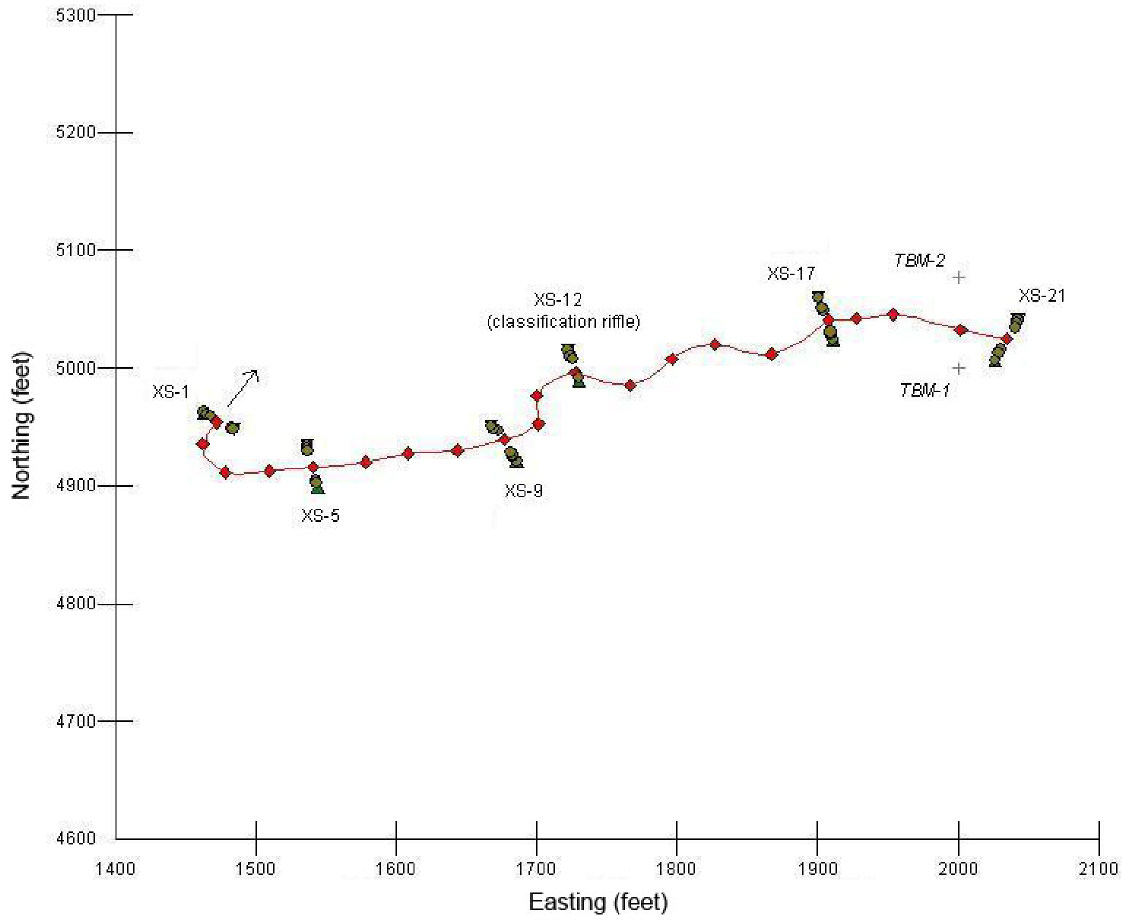
- Bankfull dimensions and indicators (W, D)
  - Break between channel formation (erosion) and floodplain formation (deposition)

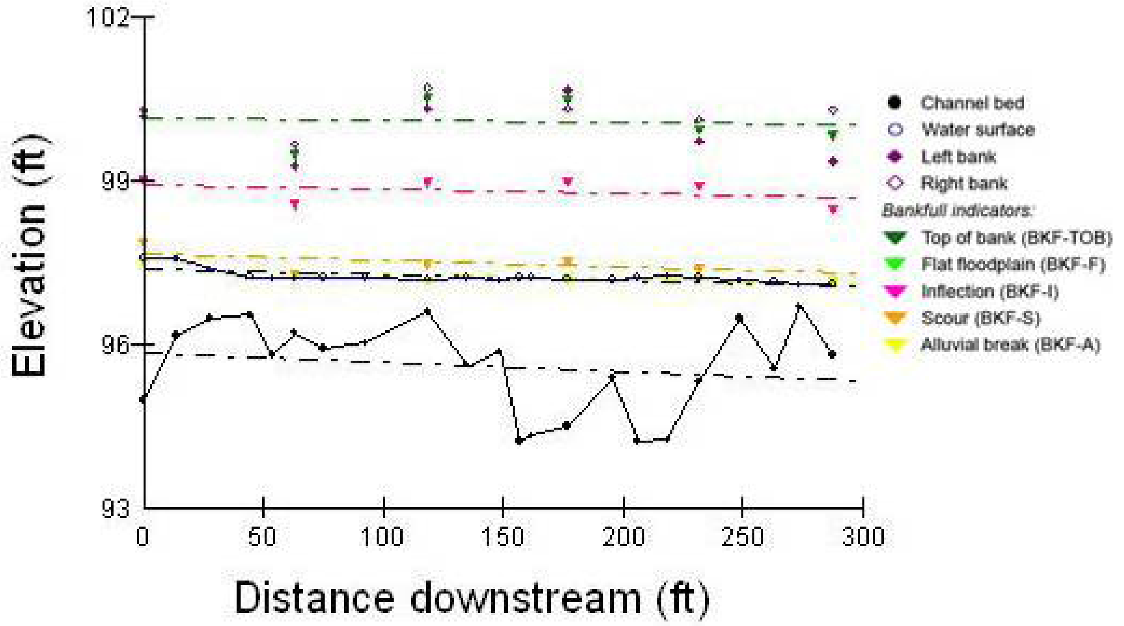


# Geomorphic Assessment – Field Visit

- Typical cross-sections
- Longitudinal profile
- Planform



# Geomorphic Assessment

- Example Cross-sections

Figure A.3 – Cross Section 2 (XS-2)

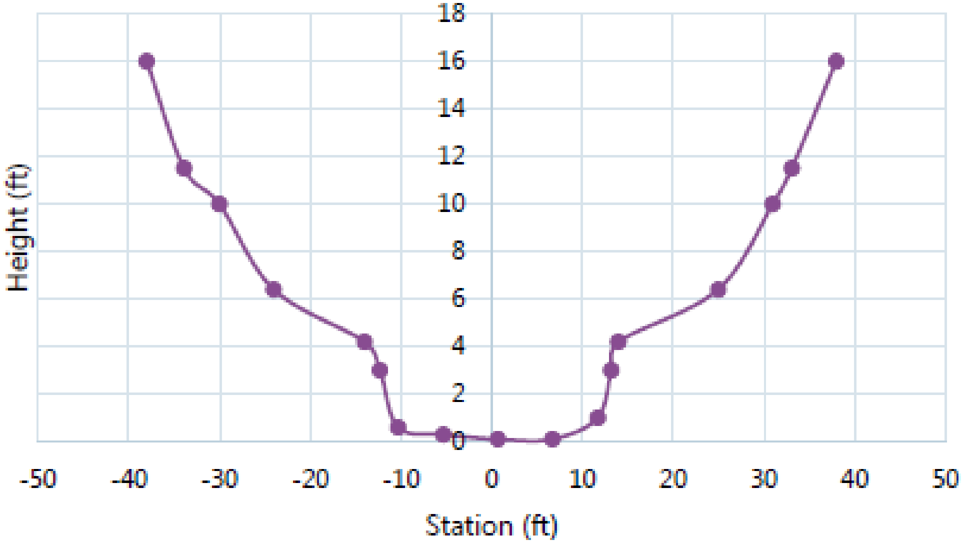
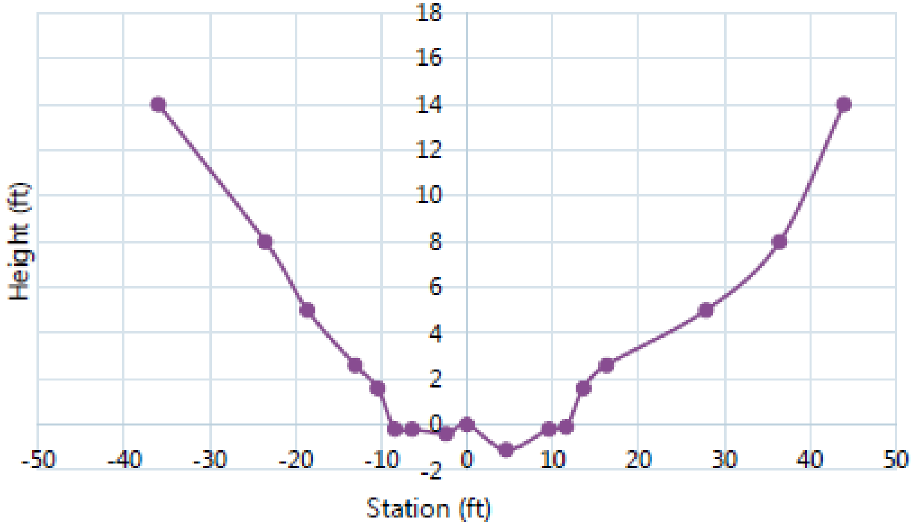



Figure A.2 – Cross Section 1 (XS-1)




Note: Concrete reinforcements (rip-rap) observed under vegetation on banks

# Case Studies

# Construction Methods

- Natural Weathering: weather related flow patterns carve the channel naturally over time
- Mechanical: earthmoving equipment is used to excavate the channel directly
- Hydraulic: flowing water is pumped through a valley to carve the channel via sediment transport

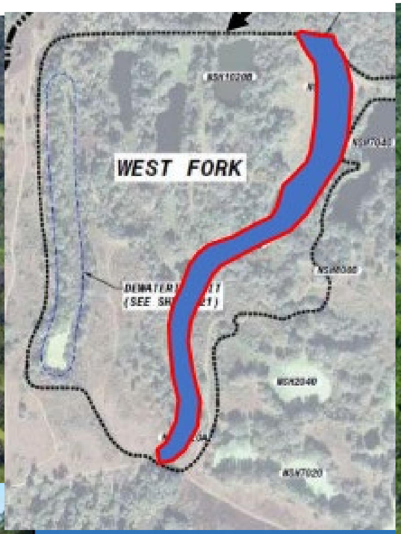
# Hydraulic Carving

SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

Surface Water Improvement and Management SWIM

Florida Department of Environmental Protection

EST. 1834 Hillsborough County Florida




5/30/2019 8:19 am

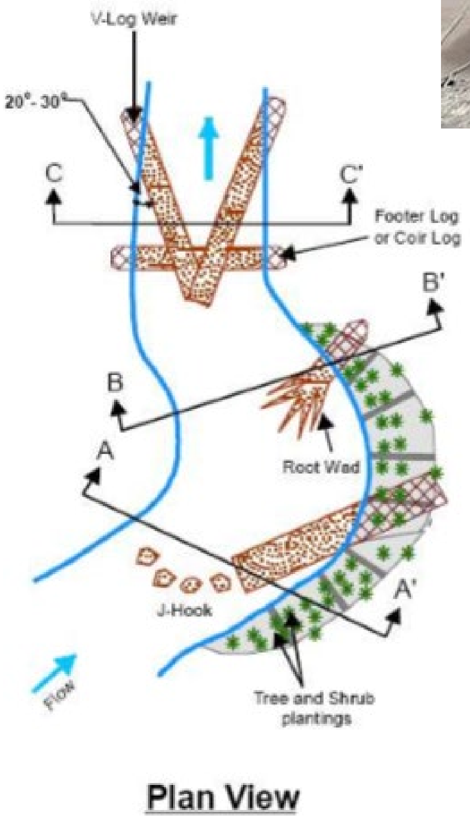
5/30/2019 8:52 am

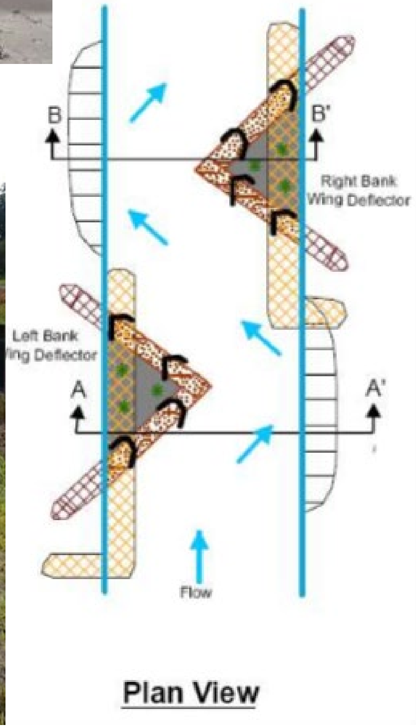
6/5/2019 8:18 am

Photo Credits: SWFWMD

# Hydraulic Carving

- V-log Weir (Grade Control, Pool Formation)
- Wing Deflector (Bend Formation, Pool Formation)
- Root Wad (Bank Protection, Habitat)
- J-Hook (Bend Protection)

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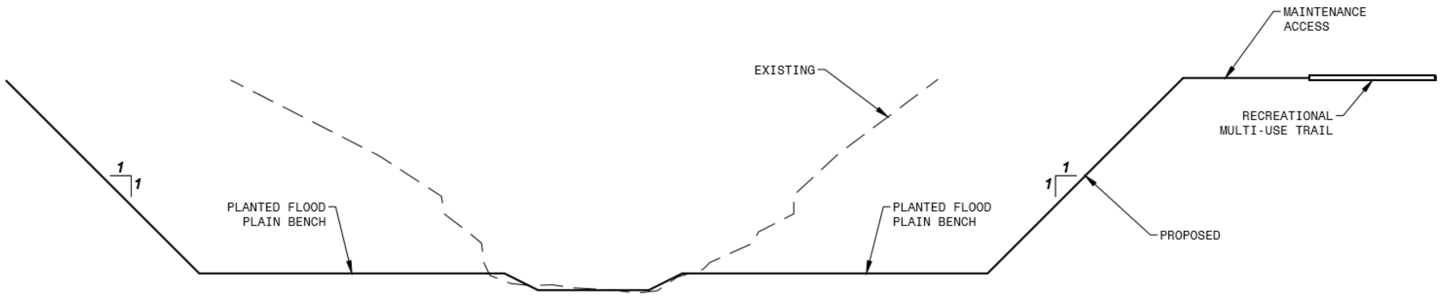
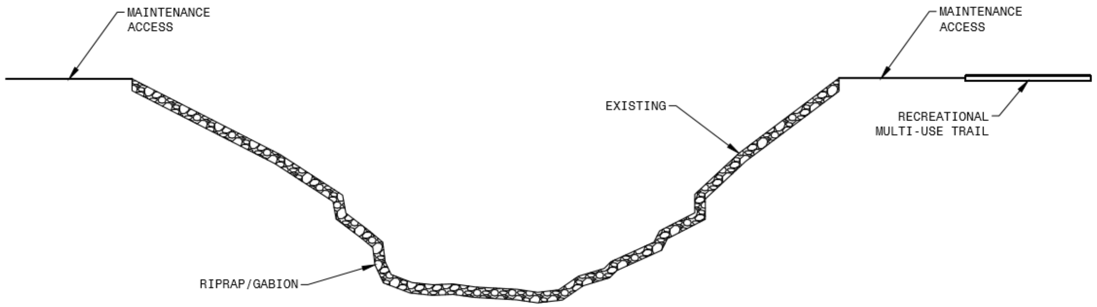
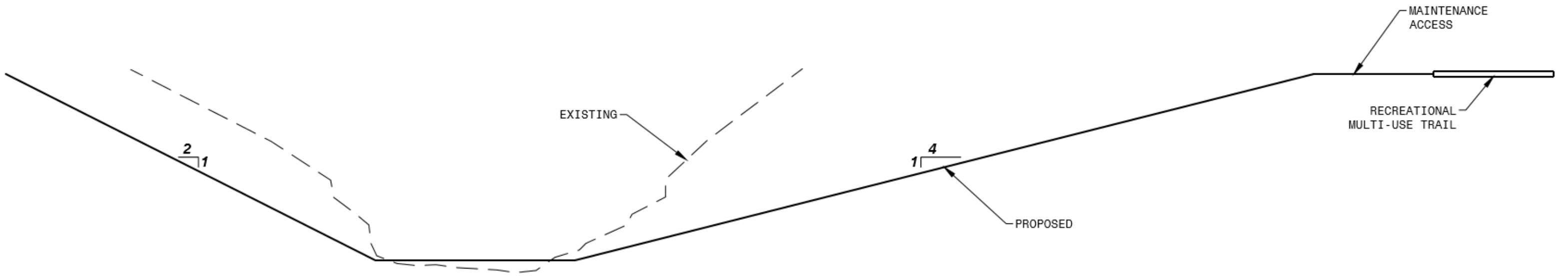
# Urban Bank Stabilization Conceptual Alternatives



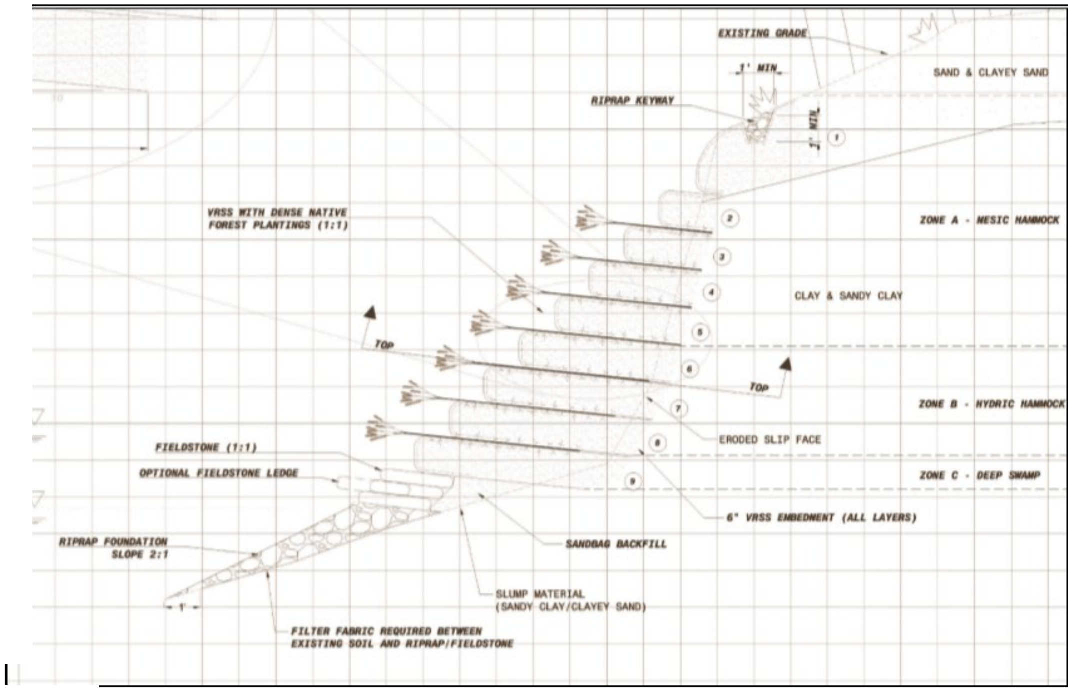

NATURAL CHANNEL STREAM RESTORATION




TYPICAL HARD ARMORING WITH RIPRAP/GABION




TYPICAL FORESTED BANK SLOPE REDUCTION



# Pre/Post-Construction Monitoring

# Methodology to Obtain Nutrient Load Reduction Credit

- Pre/post construction monitoring
- Stakeholder driven effort
- Instantaneous grab and continuous data collection
- Convert sediment load to nutrient load
- Estimate nutrient removal rates
- Instream and riparian nutrient processing during base flow (hyporheic flow) and storm flows (runoff)
  - Estimate a FL specific denitrification rates (lbs/ton/day)

# Pre/Post Performance Efficiency Monitoring

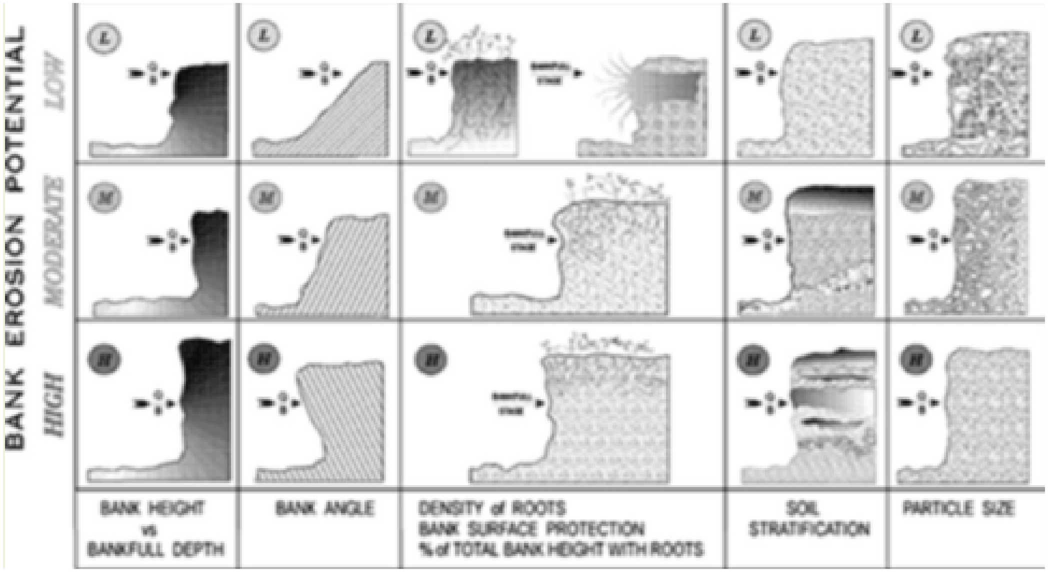
- Water quality
  - Dissolved and particulate nutrients, color, DOC, chl-a, sulfate, calcium, chloride, iron, salinity, turbidity, TSS, VSS
- Flow
- Velocity
- Sediment transport
- Aquatic vegetation
- Aquatic macroinvertebrates

# Summary

Benefits of Stream Restoration

# Benefits of Stream Restoration

1. Restored bank stabilization and sediment transport regime
   - Prevention/minimization of excessive sedimentation
2. Water quality treatment
   - In-stream denitrification
3. Flood plain development or reconnection
4. Reduced flooding
5. Improved resiliency
6. Enhanced habitat for fish and wildlife
7. Recreational opportunities
8. Reduced maintenance effort and cost




Questions?