CAZENOVIA CR. @ STEPHENSON ST. BRIDGE

REPLACEMENT OF ONE BANK OF A CONCRETE-LINED CHANNEL

CAZENOVIA CREEK @ STEPHENSON STREET BRIDGE

SPONSOR:

CITY OF BUFFALO, NY

CONSTRUCTED

OCTOBER 2005 - MARCH 2006

CAZENOVIA CREEK @ STEPHENSON STREET BRIDGE

- Urban Urban Urban!! Steep bank slopes-fenced off for public safely, concrete lined channel
- Roads on top of both banks within feet of sloped bank of stream
- Dense urban single-family dwellings
- Floods fairly often due to flow, ice jams, & backwater effects from the Buffalo River
- City of Buffalo, NY project
- Pool-riffle-pool stream, less than 1% slope

PRE-PROJECT PHOTOS
by Lallman Rambali
NYS-DOT REGION 9
WINTER 2003

Ice on US side of Stephenson Street bridge.

From Stephenson St. bridge, looking US.

Pix by Lallman Rambali 2003

PRE-PROJECT PHOTOS
by Dave Derrick
FEBRUARY 24, 2005

Looking across stream, left bank in background.

Pix by Derrick 2/24/2005

CONSTRUCTION PHOTOS

by Jeff Fisk,

Project Engineer,

OCTOBER 2005

Looking across @ left bank, US end of project.

Pix by Jeff Fisk - Oct. 2005

Positioning & driving sheetpile. Note worker.

Pix by Jeff Fisk - Oct. 2005

CONSTRUCTION PHOTOS

by Dave Derrick

NOVEMBER 4, 2005

Looking DS. Old sheetpile removed, new installed.

Looking DS. Driving sheetpile toe. Project is 1,000 ft long.

Pix by Derrick 11/4/2005

CONSTRUCTION COMPLETE

Photos by Derrick

MAY 18, 2006

Looking DS. Trees-fence-shrubs-riprap-stone-sheetpile.

Looking DS. Close-up of soil-choked riprap mid-bank & upper bank shrubs. Note engineered soil-clay-gravel-organic mix for stability & plant growth of shrubs.

Pix by Derrick - 5/18/2006

Robust upper bank rooted stock shrubs.

Looking DS. Shrubs and top-bank trees.

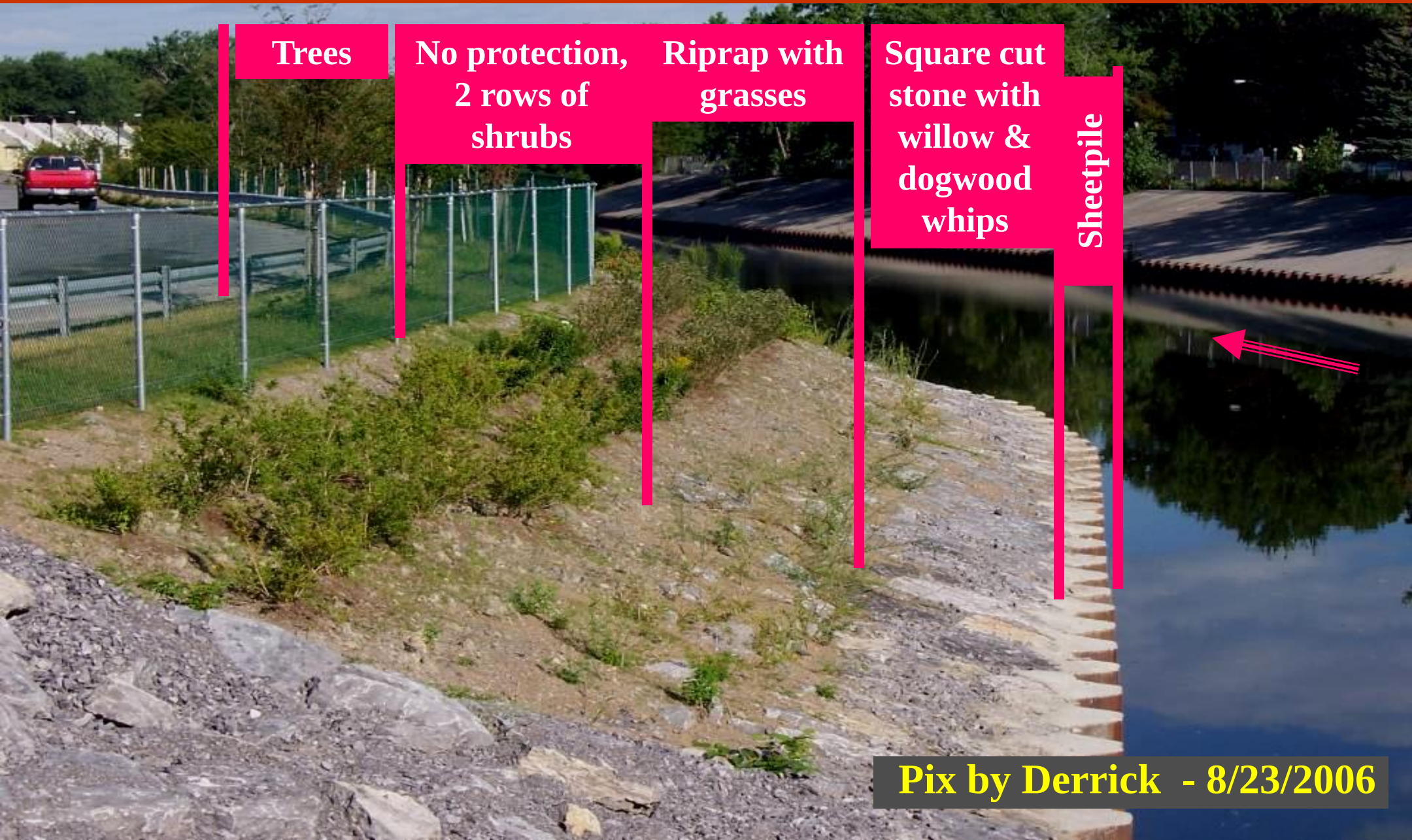
Pix by Derrick - 5/18/2006

5 MONTHS AFTER PROJECT COMPLETION

Photos by Derrick

AUGUST 23, 2006

Mid & Upper bank vegetation growing well



3 YEARS & 1 MONTH AFTER PROJECT COMPLETION

Photos By Derrick

JUNE 12, 2009

Looking DS @ left bank. Nice species diversity of plants.

3YRS 1 MONTH AFTER-CAZENOVIA CR. @ STEVENSON ST-DERRICK 6-12-09

Vines & some veg growing amongst large toe stone.

3YRS 1 MONTH AFTER-CAZENOVIA CR. @ STEVENSON ST-DERRICK 6-12-09

Close up of robust mid & upper bank veg.

3YRS 1 MONTH AFTER-CAZENOVIA CR. @ STEVENSON ST-DERRICK 6-12-09

4.66 YEARS AFTER PROJECT COMPLETION

Photos by Derrick

JUNE 16, 2010

4.66 years after completion. From the bridge looking DS. Except for narrow band of stone at toe, dense veg has covered the entire bank.

4.66 YRS LATER-CAZENOVIA CR. @ STEVENSON ST-DERRICK 6-16-2010

4.66 years after completion. From the bridge looking DS. Good diversity of plant species with some volunteer plants (Cottonwood, Black Locust, herbacious, some invasive Japanese Knotweed).

4.66 YRS LATER-CAZENOVIA CR. @ STEVENSON ST-DERRICK 6-16-2010

4.66 years after completion. From the bank looking DS. Willow is growing well in the riprap section.

4.66 YRS LATER-CAZENOVIA CR. @ STEVENSON ST-DERRICK 6-16-2010

4.66 years after completion. Looking at top bank.

4.66 YRS LATER-CAZENOVIA CR. @ STEVENSON ST-DERRICK 6-16-2010

5 YEARS AFTER PROJECT COMPLETION

Ice is back!!

Photos by Chuck Godfrey

Feb. 18, 2011

5 YEARS AFTER PROJECT COMPLETION. Ice is back!!
DOT closed the bridge for 2 days, concrete channel UGLY

5 YRS LATER-CAZ CR. @ STEVENSON ST-CHUCK GODFREY 2-28-2011

5 YEARS AFTER PROJECT COMPLETION. Ice flowing around plants & pounding project, plants look OK!!!

5 YRS LATER-CAZ CR. @ STEVENSON ST-CHUCK GODFREY 2-28-2011

HAW CREEK, PIKE COUNTY, MISSOURI-TRIB TO SALT RIVER

ERODING STREAM THREATHENING COUNTY ROAD #107, FOURTEEN FT TALL ERODING BANK WITHIN 4 FT OF THE ROAD,

PROJECT CONSTRUCTED IN 1 DAY, MARCH 10, 2009

BY PIKE COUNTY PUBLIC WORKS DEPT, LaDON ATKINSON, ROAD SUPERVISOR

HAW CREEK GENERAL INFORMATION

- Bank erosion is threatening county road, threatening public safety
- Stream wildly meandering in response to historic straightening
- Decent riparian areas in places
- Bed material: gravel-sand. Channel is incised
- Pool-riffle-pool regime, slope less than 1%
- Average width 30-40 ft, 15 ft tall banks
- Funding, equipment, and manpower provided by Pike County, MO

PRE-PROJECT PHOTOS
by
JAYNIE DOERR,
REGULATORY,
ST. LOUIS DISTRICT
FEBRUARY 25, 2009

Looking DS @ the lower end of the project bend

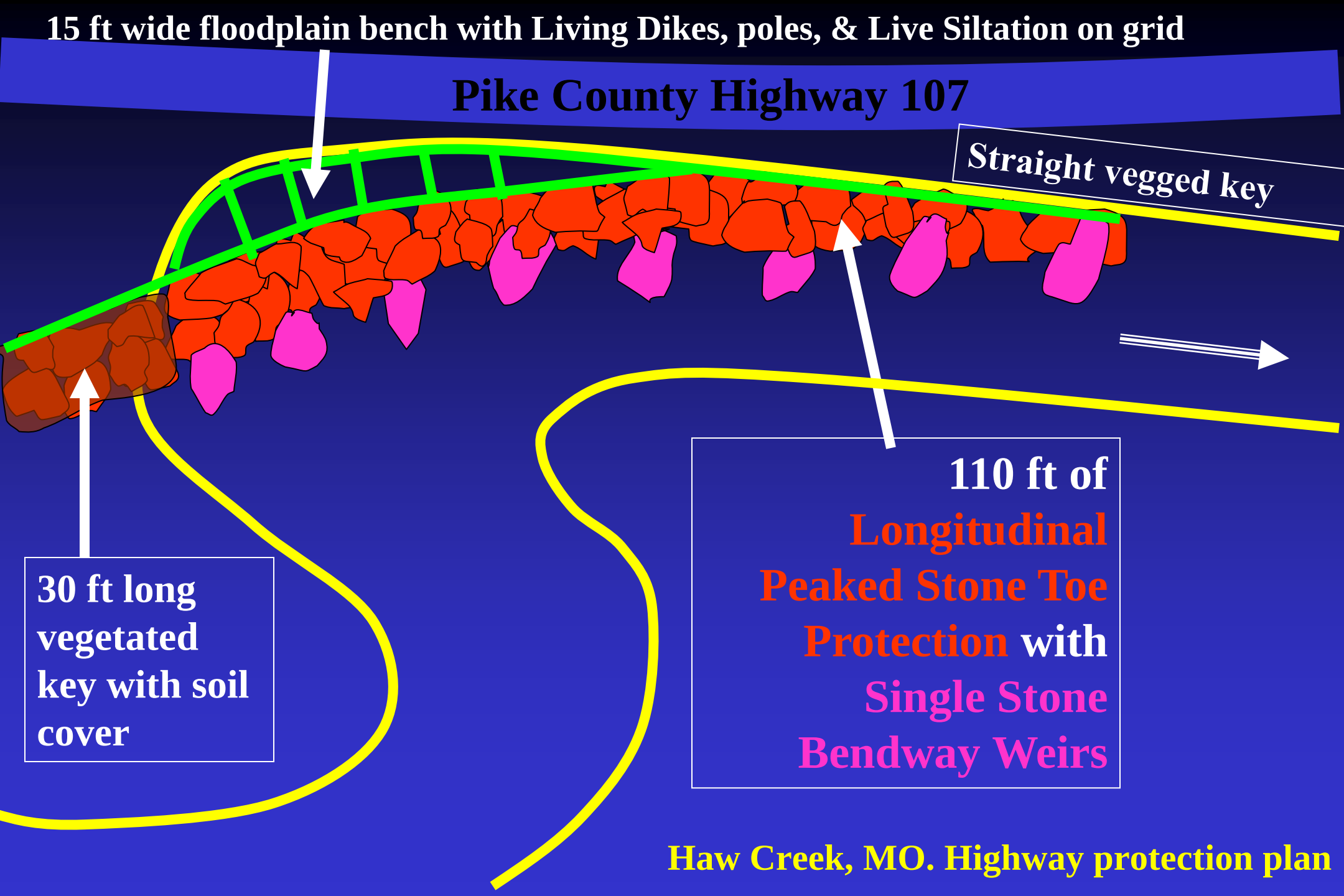
PRE-PROJECT - HAW CREEK-PIKE COUNTY MO. PIX BY JAYNIE DOERR 2-25-09

Looking US @ the project bend. Road is 4 ft from 14 ft tall eroding bank.

PRE-PROJECT - HAW CREEK-PIKE COUNTY MO. PIX BY JAYNIE DOERR 2-25-09

HAW CREEK
METHODS EMPLOYED

- 110 ft of Longitudinal Peaked Stone Toe Protection (LPSTP), crest built to 4 ft above the base flow water surface elevation
- Locked Logs
- A vegetated floodplain bench
- Single-Stone & Short Bendway Weirs
- Live Willow Pole Plantings
- Vegetated & curved upstream key, straight DS key
- Living Dikes
- Slit Brush Layering (Joint Planting) in riprap bank
- Live Siltation


15 ft wide floodplain bench with Living Dikes, poles, & Live Siltation on grid
Pike County Highway 107
Straight vegged key
30 ft long vegetated key with soil cover
110 ft of Longitudinal Peaked Stone Toe Protection with Single Stone Bendway Weirs
Haw Creek, MO. Highway protection plan

QUESTIONABLE STONE

Stone used for keys & LPSTP was a sub-standard shot rock of questionable hardness. The amount of fine material was close to 20-30%. This was a self-filtering stone, but not well-graded, & not self-adjusting.

Stone is not well-graded & too many fines. The stone is self-filtering, but not self-adjusting, but only $4.70/ton delivered.

CONSTRUCTION-HAW CREEK-PIKE COUNTY, MO. PIX BY DERRICK 3-10-09

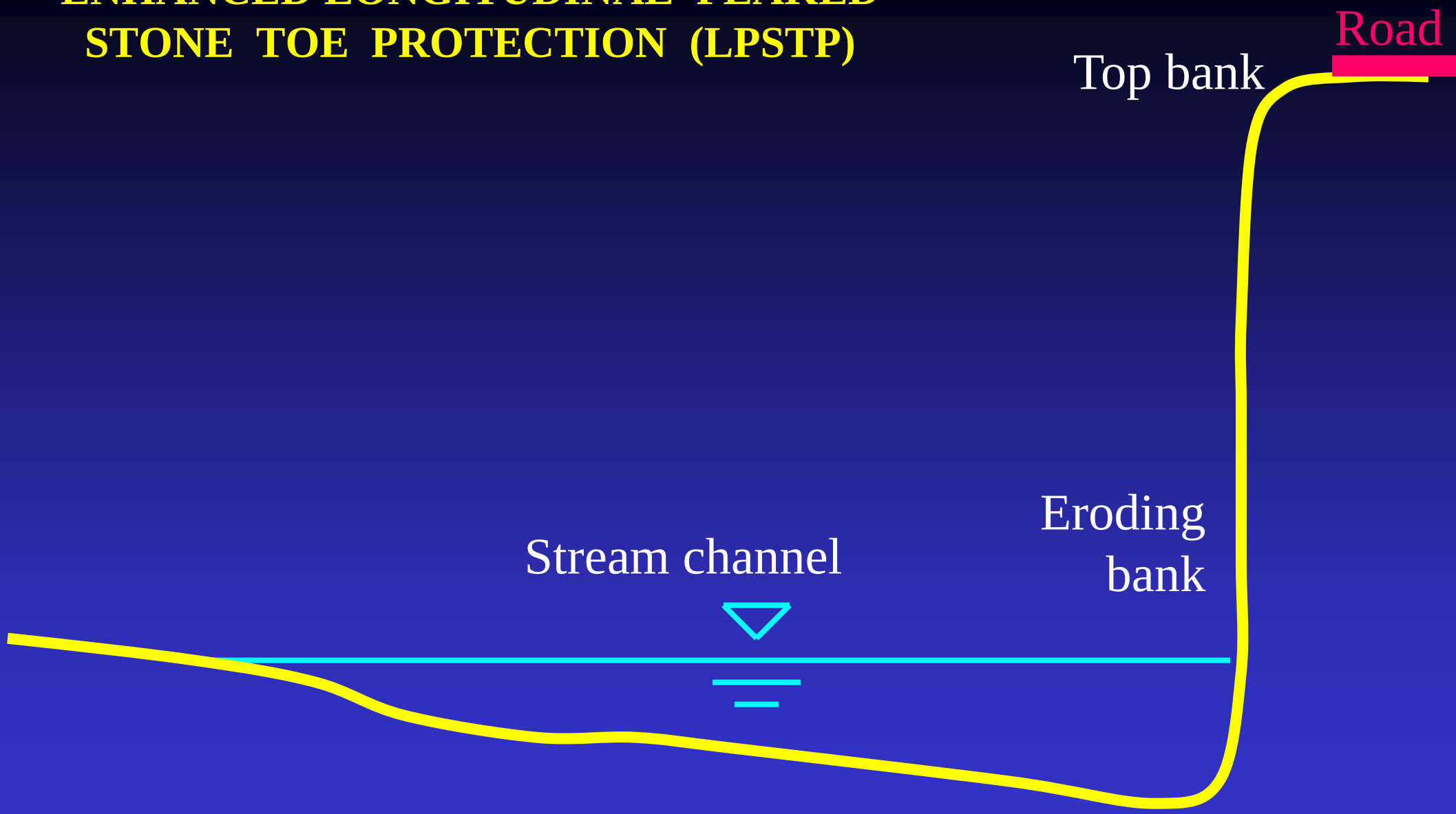
STONE COSTS

However, the stone was extremely inexpensive. The 432 tons of rock used in the project, at $4.70 per ton (delivered) total cost of stone = $2032. That was very cost effective for what we accomplished.

We will construct from upstream (US) to downstream (DS)

LONGITUDINAL PEAKED STONE TOE PROTECTION (LPSTP)

ENHANCED LONGITUDINAL PEAKED STONE TOE PROTECTION (LPSTP)

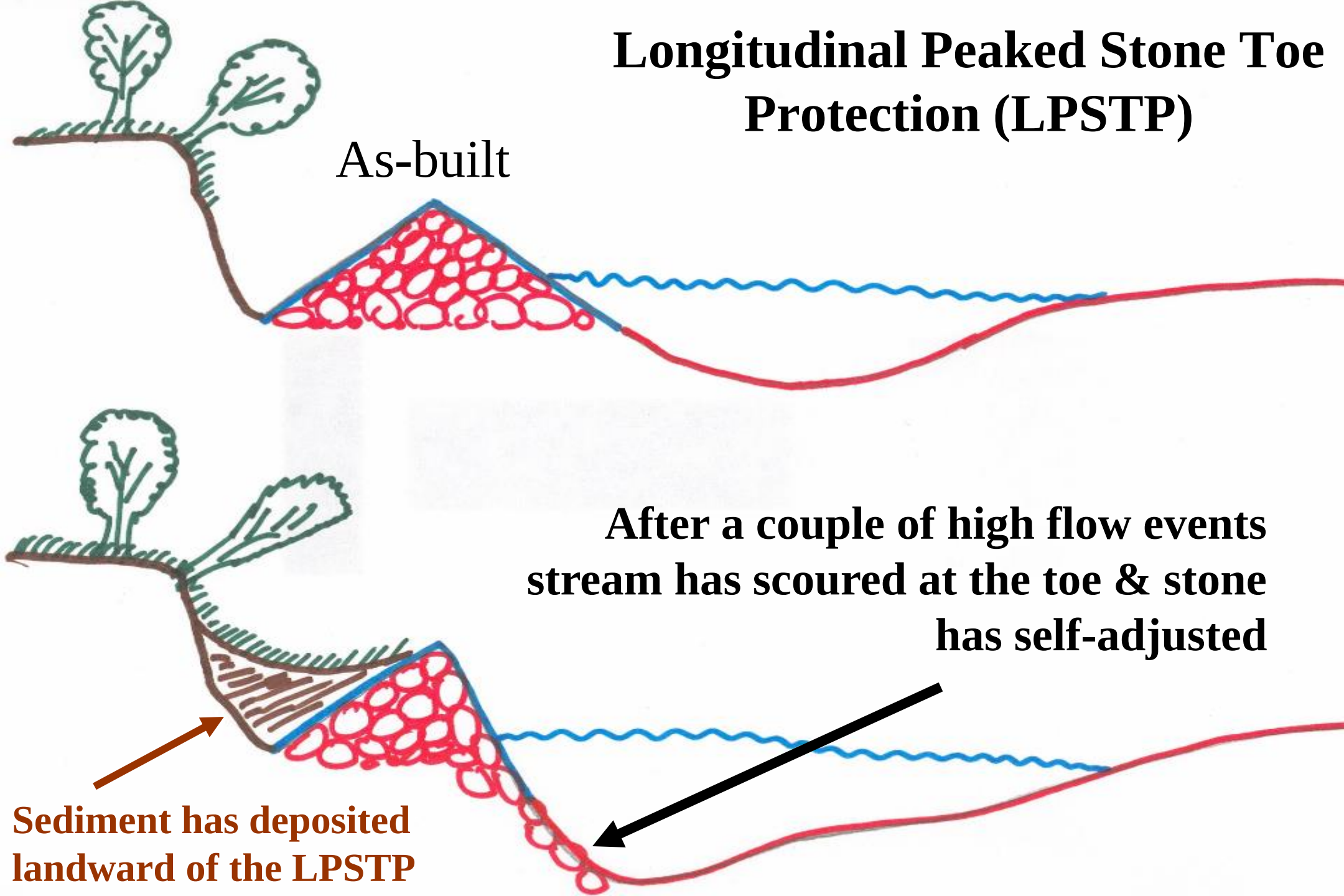


LONGITUDINAL PEAKED STONE TOE PROTECTION {LPSTP}

- Description: A continuous stone dike placed longitudinally at, or slightly streamward of, the toe of the eroding bank. Cross-section is triangular. The LPSTP does not necessarily follow the toe exactly, but can be placed to form a "smoothed" alignment through the bend. Smoothed alignment might not be desirable from the environmental or energy dissipation points of view . Amount of stone used (2 tons/linear ft, 1 ton/ft, or less) depends on depth of scour at the toe, estimated stream forces (impinging flow) on the bank, and flood durations and stages.

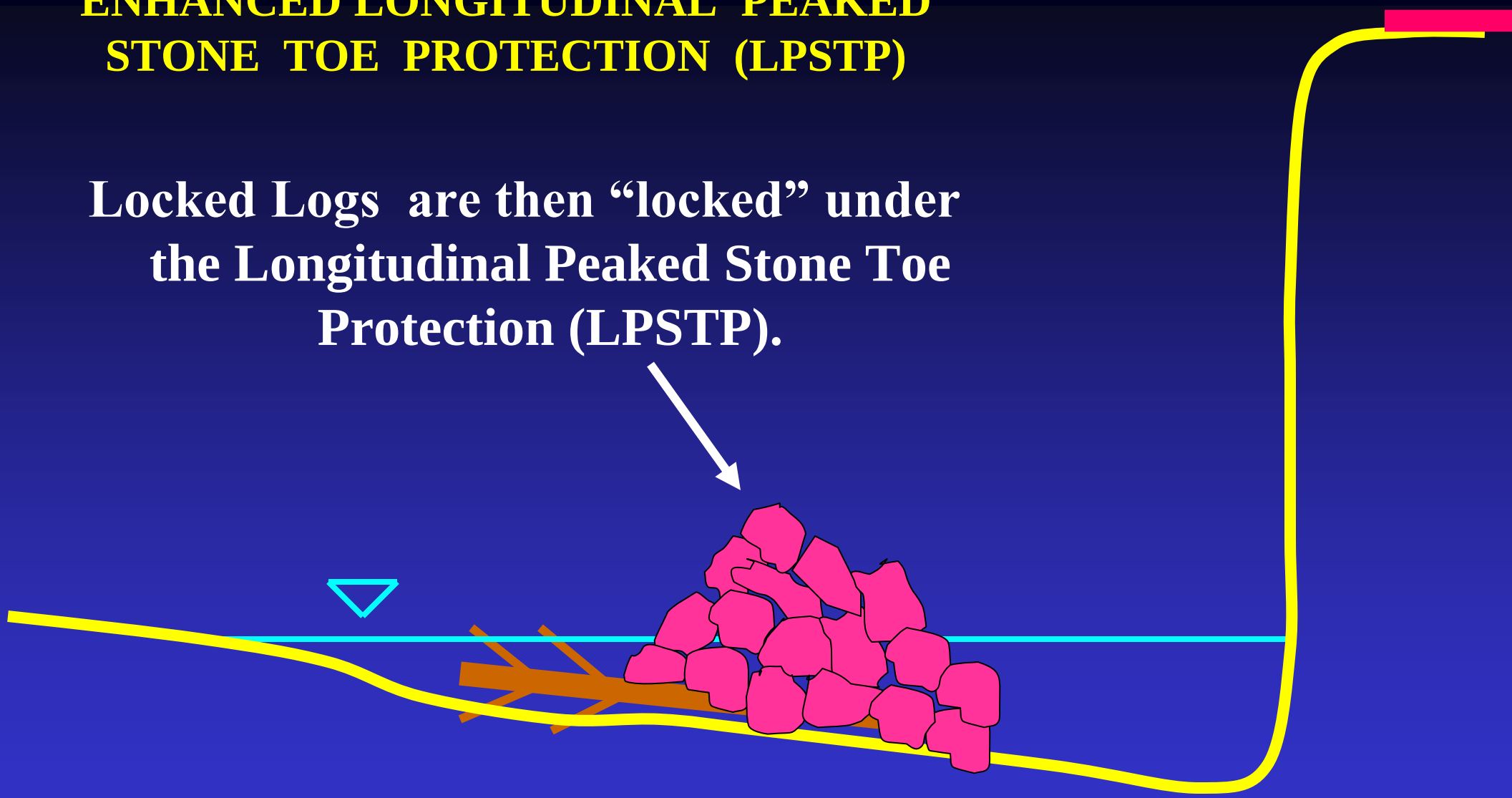
- Tie-backs are short dikes connecting the LPSTP to the bank at regular intervals. Tie-backs are usually the same height as the LPSTP or elevated slightly toward the bank end, and are keyed into the bank. If tie-backs are long they should be angled upstream to act as bendway weirs.

Longitudinal Peaked Stone Toe Protection (LPSTP)



ENHANCED LONGITUDINAL PEAKED STONE TOE PROTECTION (LPSTP)

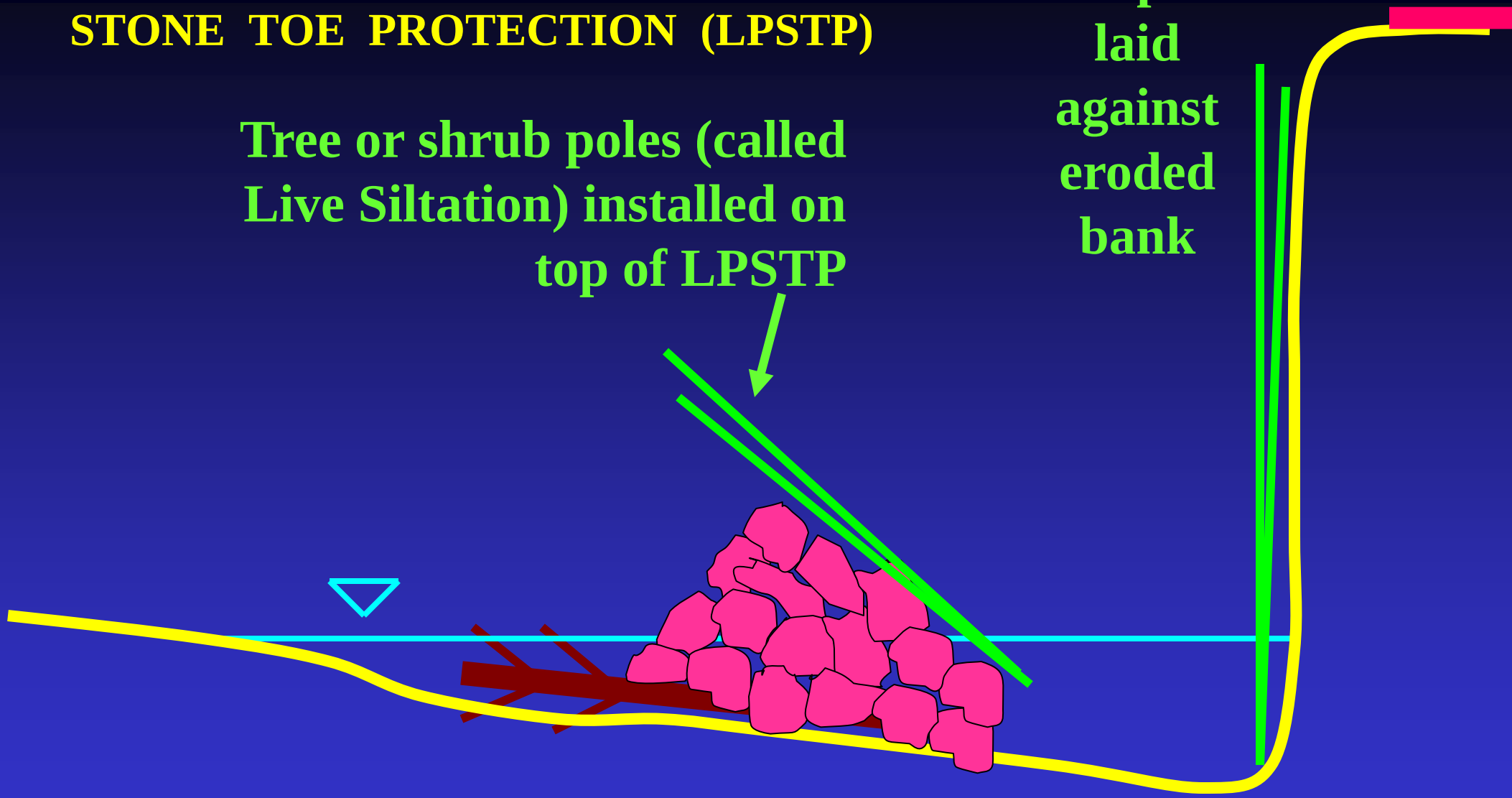
Locked Logs are then "locked" under the Longitudinal Peaked Stone Toe Protection (LPSTP).



Looking US. LPSTP crest is 4 ft above base flow stage.

CONSTRUCTION-HAW CREEK-PIKE COUNTY, MO. PIX BY DERRICK 3-10-09

ENHANCED LONGITUDINAL PEAKED STONE TOE PROTECTION (LPSTP)



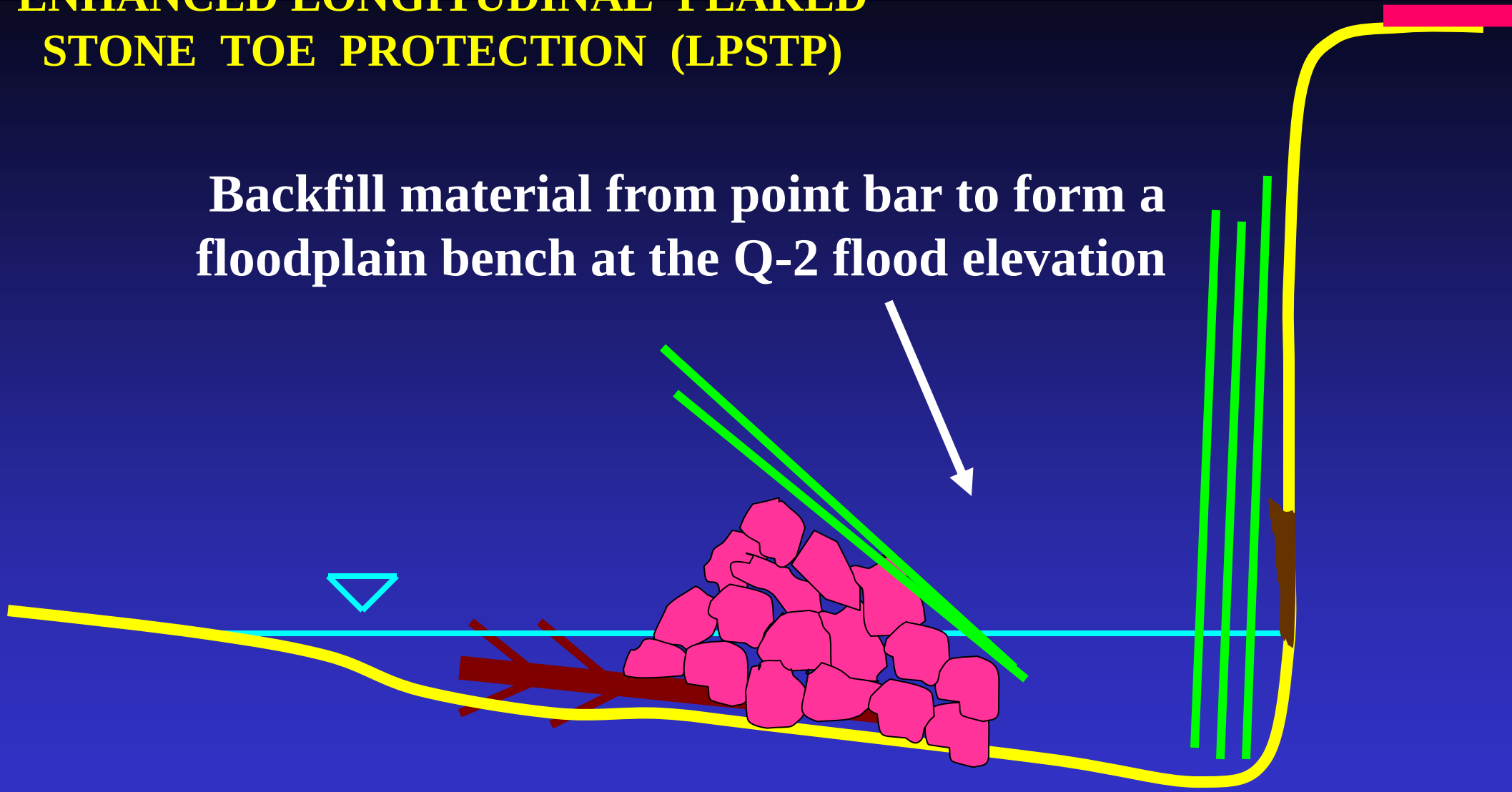
Willow, dogwood, river birch poles can then be laid on the stone and up against the bank. Basal ends should be in vadose zone (capillary zone). Willow used on this project.

Looking US. Class laying willow poles against eroding bank.

CONSTRUCTION-HAW CREEK-PIKE COUNTY, MO. PIX BY DERRICK 3-10-09

ENHANCED LONGITUDINAL PEAKED STONE TOE PROTECTION (LPSTP)

Backfill material from point bar to form a floodplain bench at the Q-2 flood elevation



Looking DS. Backfilling between LPSTP & bank to form floodplain bench @ the Q-2 elevation.

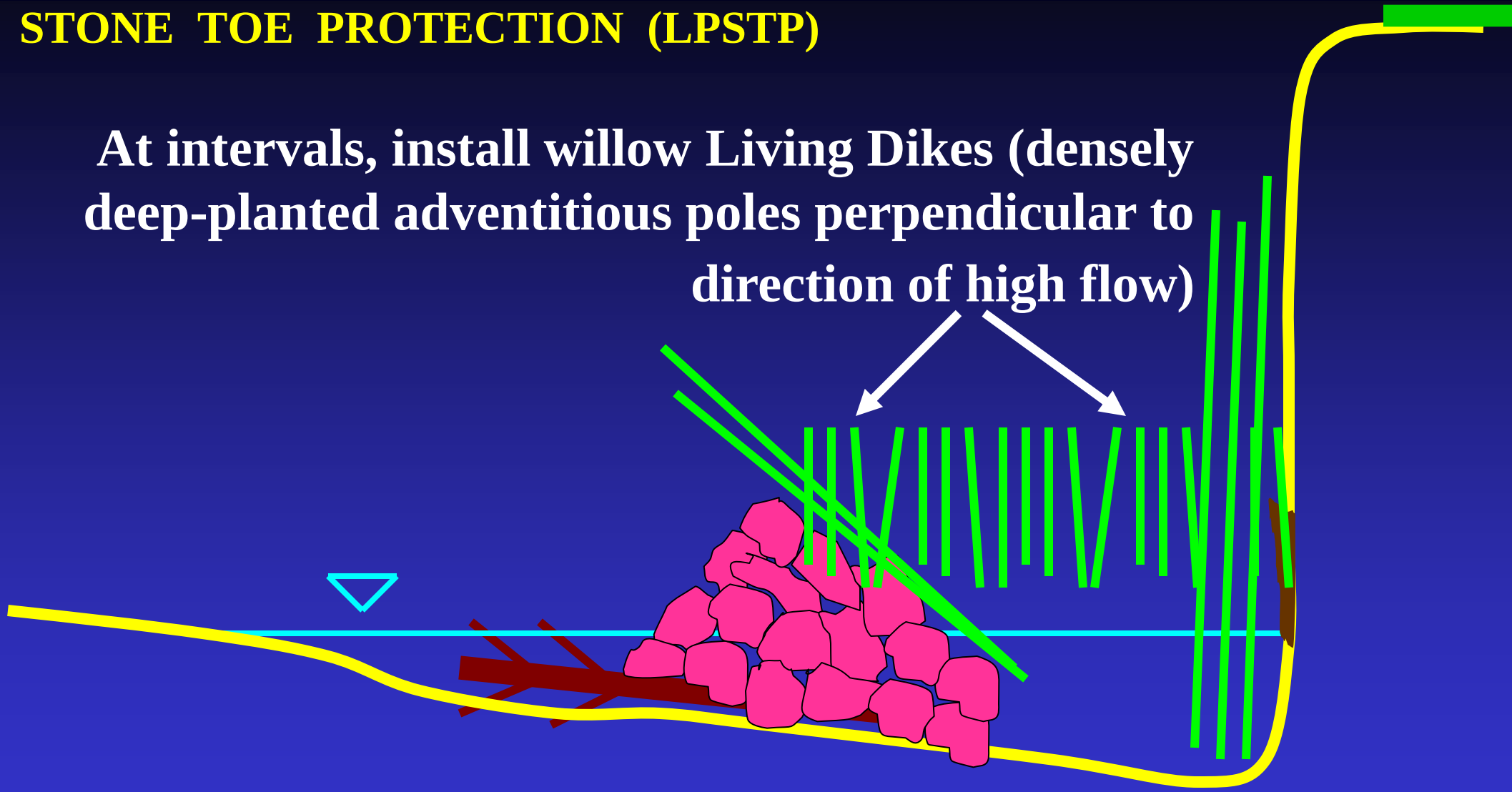
CONSTRUCTION-HAW CREEK-PIKE COUNTY, MO. PIX BY DERRICK 3-10-09

Looking US. Installing Living Dikes perpendicular to high flow, Live Siltation & Live Poles are parallel with the stream.

CONSTRUCTION-HAW CREEK-PIKE COUNTY, MO. PIX BY DERRICK 3-10-09

ENHANCED LONGITUDINAL PEAKED STONE TOE PROTECTION (LPSTP)

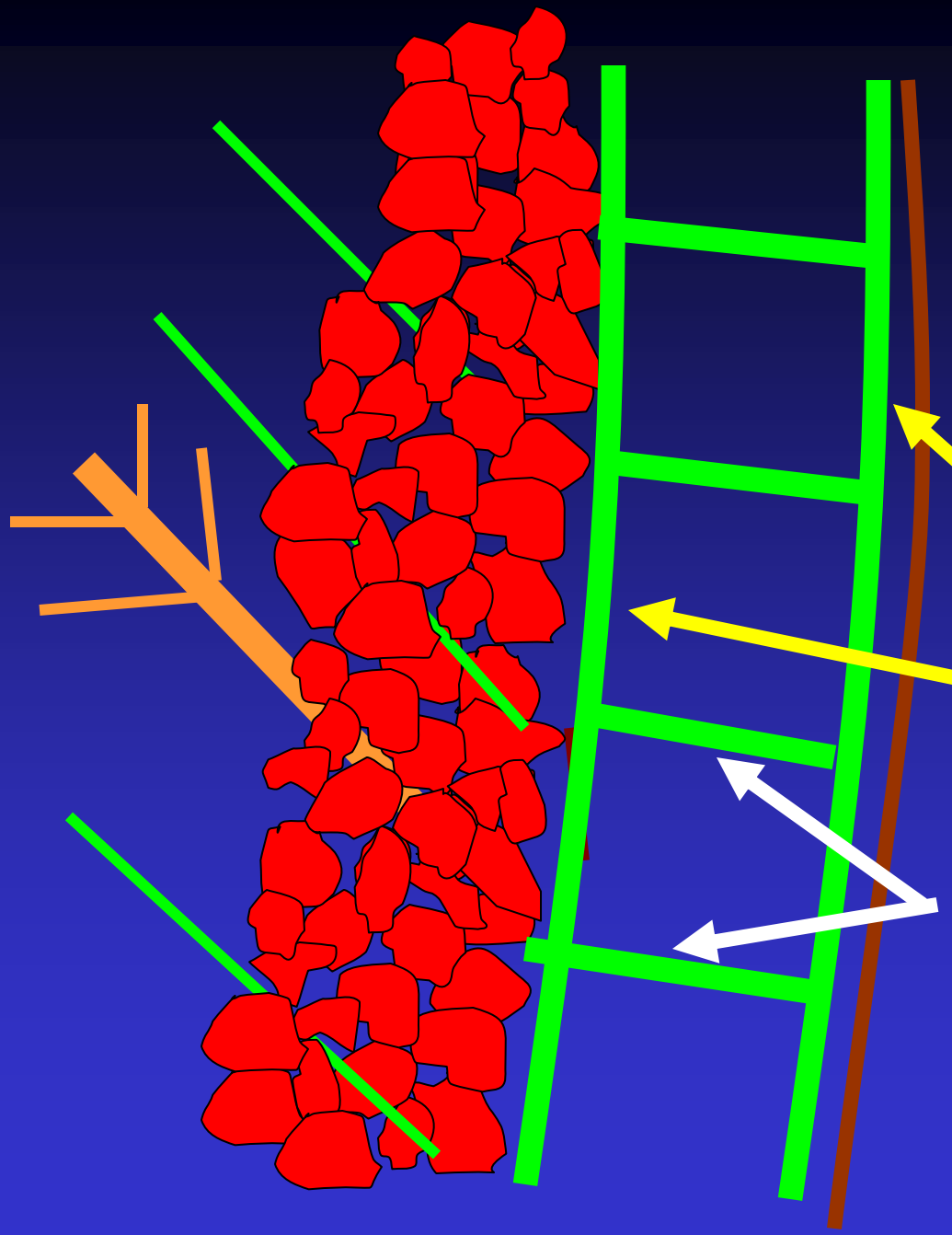
At intervals, install willow Living Dikes (densely deep-planted adventitious poles perpendicular to direction of high flow)



A Living Dike (perpendicular to high flow) on the floodplain bench.

CONSTRUCTION-HAW CREEK-PIKE COUNTY, MO. PIX BY DERRICK 3-10-09

AERIAL VIEW OF ENHANCED LPSTP WITH A FLOODPLAIN BENCH WITH VEGETATION PLANTED ON A GRID PATTERN.



Flow

Floodplain bench planted on a grid pattern

Live Poles

Live Siltation

Living Dikes- plants perpendicular to flow

PROJECT CONSTRUCTED IN 1 DAY, MARCH 10, 2009

4 MONTHS AFTER PROJECT COMPLETION

Looking US to DS

Photos by LaDon Atkinson

JULY 11, 2009

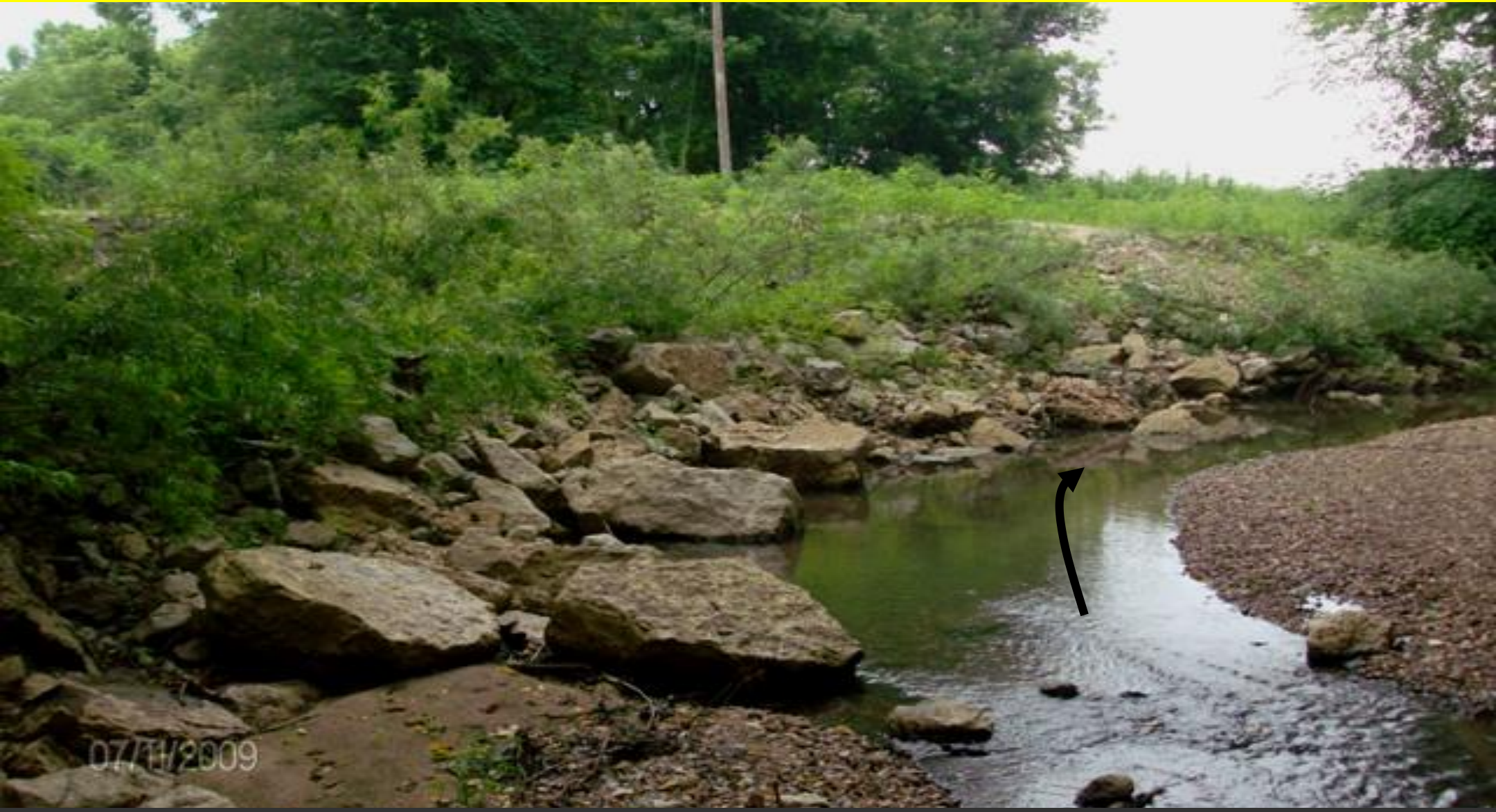
4 MONTHS LATER-Looking DS @ the project bend.

4 MONTHS LATER - HAW CREEK–From LaDon Atkinson-7-11-09

4 MONTHS LATER-Looking DS @ floodplain bench

4 MONTHS LATER - HAW CREEK–From LaDon Atkinson-7-11-09

4 MONTHS LATER-Looking DS @ the thalweg trace, LPSTP, Single Stone Bendway Weirs & the floodplain bench.



4 MONTHS LATER - HAW CREEK–From LaDon Atkinson-7-11-09

After 4 months, great growth from the 500 willows we planted! LaDon says the floodplain bench has about 6 inches of sediment deposition on it.

4 MONTHS AFTER PROJECT COMPLETION

Looking DS to US

Photos by LaDon Atkinson

JULY 11, 2009

4 MONTHS LATER-Looking US @ SSBW, LPSTP & Live Siltation

4 MONTHS LATER - HAW CREEK–From LaDon Atkinson-7-11-09

4 MONTHS LATER-Looking US @ project & road

4 MONTHS LATER - HAW CREEK–From LaDon Atkinson-7-11-09

4 MONTHS LATER-Looking US @ a Living Dike on the floodplain bench

4 MONTHS LATER - HAW CREEK–From LaDon Atkinson-7-11-09

Haw Creek Project

(5 inch rain 48 hours prior to photos)

September 20, 2010
Two Growing Seasons After Completion

Photos By Rob Gramke, Regulatory,
St. Louis District, U.S. Army Corps of Engineers

Looking upstream from road

March 2009-bank 4 feet from road

Sep 2010-notice how wide the shoulder appears now

Looking downstream

March 2009

September 2010

Looking downstream from left descending bank. The vegetation has almost completely grown over the rock – Sept 2010

Short Bendway Weirs & Rock toe

Locked Log still in place

4.5 YEARS AFTER PROJECT COMPLETION

Photos by Dave Derrick

SEPT. 5, 2013

4.5 YEARS LATER-From the road shoulder, looking US @ the project floodplain bench. Where is it? The stream?

4.5 YEARS LATER–HAW CR-PIKE COUNTY, MO - DERRICK 9-5-2013

4.5 YEARS LATER-From top bank, looking US @ the floodplain bench & stream. Planted willow crowded out by lots of plants!

4.5 YEARS LATER–HAW CR-PIKE COUNTY, MO - DERRICK 9-5-2013

4.5 YEARS LATER-Looking DS @ floodplain bench & stream. Great shade, cover, structure, insect production..

4.5 YEARS LATER–HAW CR-PIKE COUNTY, MO - DERRICK 9-5-2013

We planted only willows. Rob Gramke, regulatory, St. Louis Corps, noted after a quick look, that there were over 20 herbaceous & woody species, & 7 species of trees, all on the floodplain bench !!!!!

4.5 YEARS LATER-Looking DS @ stream & grown-up floodplain bench veg hiding all project structures!!

4.5 YEARS LATER–HAW CR-PIKE COUNTY, MO - DERRICK 9-5-2013

4.5 YEARS LATER-Looking DS @ stream, Short Bendway Weirs, LPSTP, & floodplain bench…

4.5 YEARS LATER–HAW CR-PIKE COUNTY, MO - DERRICK 9-5-2013

4.5 YEARS LATER-Looking DS @ DS end of project. Locked Logs still in place, Joint Plantings are vibrant!

4.5 YEARS LATER–HAW CR-PIKE COUNTY, MO - DERRICK 9-5-2013

VEGETATION DOES NOT TAKE A LONG TIME TO GET ESTABLISHED

GOODWIN CREEK, MS.

CONSTRUCTED AS A HANDS-ON WORKSHOP, MARCH 2007

Looking US, Feb. 2007 - BEND #1

GOODWIN CREEK – CONSTRUCTION - FEB 2007 –NICK JOKAY

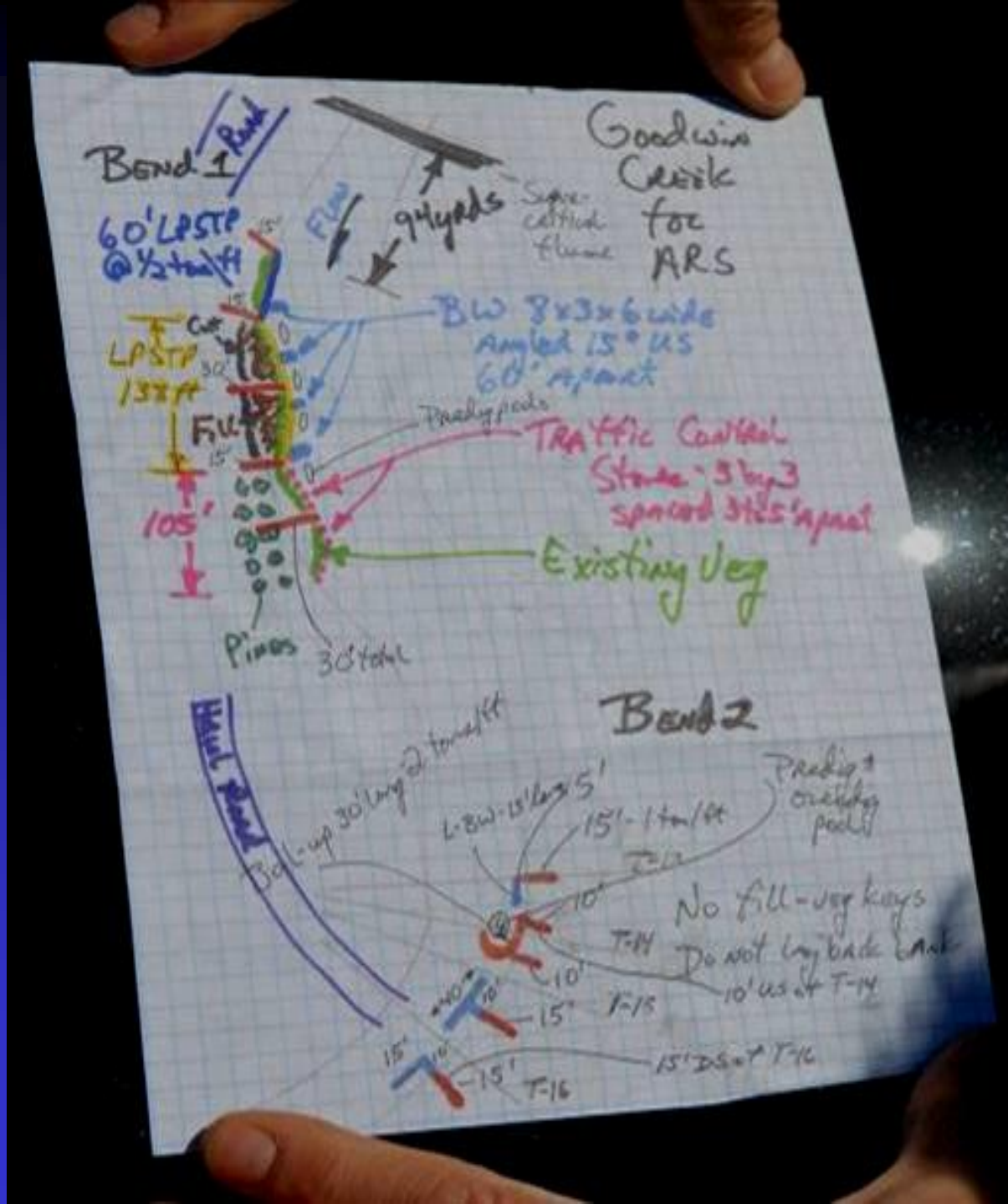
Looking DS at supercritical flume-good hydro data

GOODWIN CREEK – FLOOD APR 6, 2005

THE PLAN

Actually Derrick's cheat sheet

PIX BY DANNY KLIMETZ

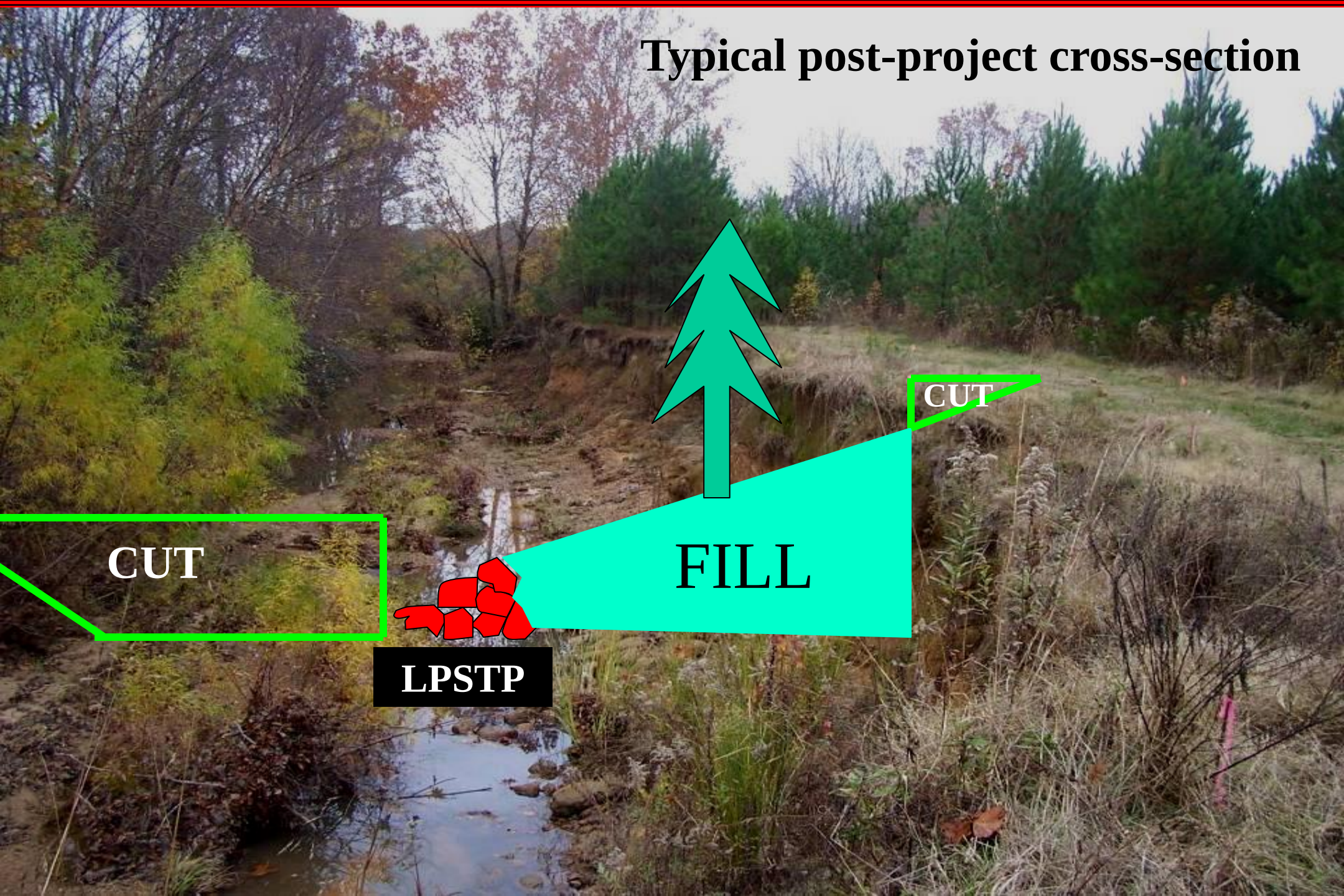


LET'S GET IT STARTED

1 of 7 trucks stuck

GOODWIN CREEK – CONSTRUCTION - FEB 2007 –DANNY KLIMETZ

Typical post-project cross-section



Looking DS, digging floodplain bench & placing soil along toe of right bank

Sloping upper bank - BEND #1

GOODWIN CREEK – CONSTRUCTION - FEB 2007 -DERRICK

Dave Derrick teaching some of the 44 workshop participants

GOODWIN CREEK–CONSTRUCTION-FEB 27, 2007–DANNY KLIMETZ

The cutting, toting, & planting crew, I mean the workshop participants

GOODWIN CREEK–CONSTRUCTION-FEB 27, 2007–DANNY KLIMETZ

Positioning & planting RPM trees & shrubs - BEND #1

GOODWIN CREEK–CONSTRUCTION-FEB 28, 2007–DANNY KLIMETZ

Or slap a Sycamore with the trackhoe & release a thousand seeds!

GOODWIN CREEK – CONSTRUCTION - FEB 2007 -DERRICK

Rolling and spreading hay mulch - BEND #1

GOODWIN CREEK – CONSTRUCTION - FEB 2007 –SHARLA LOVERN

BEFORE & AFTERS OVER TIME

BEND #1

Looking US, Feb 2007 - BEND #1

GOODWIN CREEK – CONSTRUCTION - FEB 2007 –NICK JOKAY

Looking US – Construction Complete - BEND #1

GOODWIN CREEK – CONSTRUCTION - FEB 2007 –NICK JOKAY

Looking US @ Bend #1 – 2.5 months later

GOODWIN CREEK – 2.5 MONTHS – May 18, 2007 – DAVE BIEDENHARN

2.4 YEARS AFTER PROJECT COMPLETION

Photos by Derrick

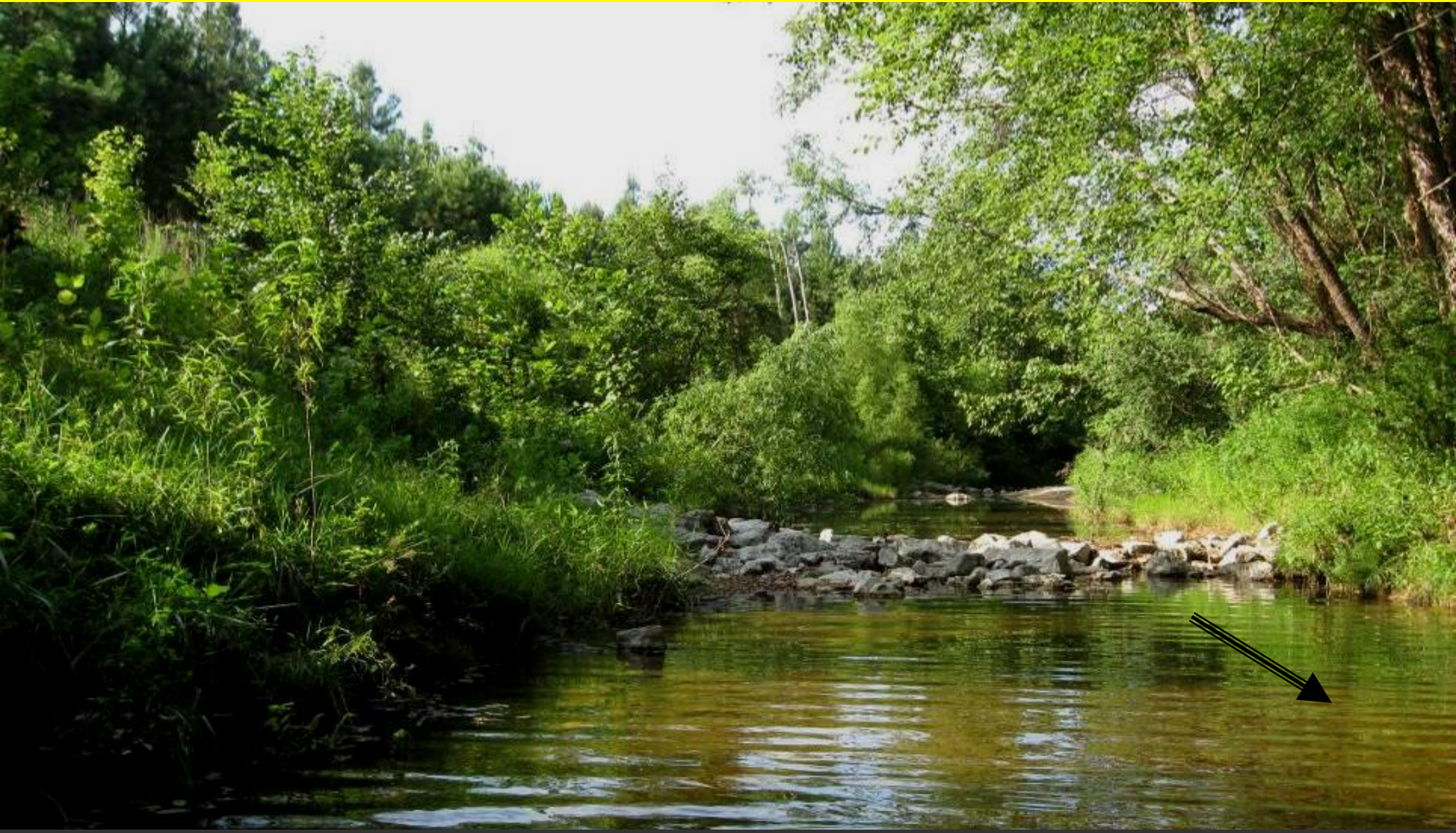
JULY 3, 2009

BEND # 1

2.4 YEARS LATER-Looking US @ Bend #1 – Rooted stock & pole plantings growing exceptionally well!

2.4 YEARS LATER-GOODWIN CREEK – FROM DERRICK-7-3-2009

2.4 YEARS LATER-Looking US @ Bend #1 Rocked Riffle & vegged bank



2.4 YEARS LATER-GOODWIN CREEK – FROM DERRICK-7-3-2009

2.4 YEARS LATER-Looking DS @ upper end of Bend #1. THIS IS WHAT WATER SEES!!!!

2.4 YEARS LATER-GOODWIN CREEK – FROM DERRICK-7-3-2009

Soil was soft enough in places Live Stakes could be pushed in - BEND #1

GOODWIN CREEK–CONSTRUCTION-FEB 28, 2007–DANNY KLIMETZ

2.4 YEARS LATER-Upper bank Sycamore Live Stakes are growing well. Several are 6 to 12 ft tall.

2.4 YEARS LATER-GOODWIN CREEK – FROM DERRICK-7-3-2009

2.4 YEARS LATER- Sycamore Live Stakes growing well on upper third of bank (10-12 ft above base flow water surface elevation).

Sycamore Live Stakes are 6-12 ft tall with robust growth.

2.4 YEARS LATER-GOODWIN CREEK – FROM DERRICK-7-3-2009

Looking downstream, what a difference 2 years after the project was completed makes !!


Brothers
separated at
birth!!