Sulphur Creek @ Dunnigan Burn Dump,

Yolo County, CA.

(30 miles north of Sacramento, CA.)

BUILT 1998

Pre-Project conditions, going from upstream to downstream

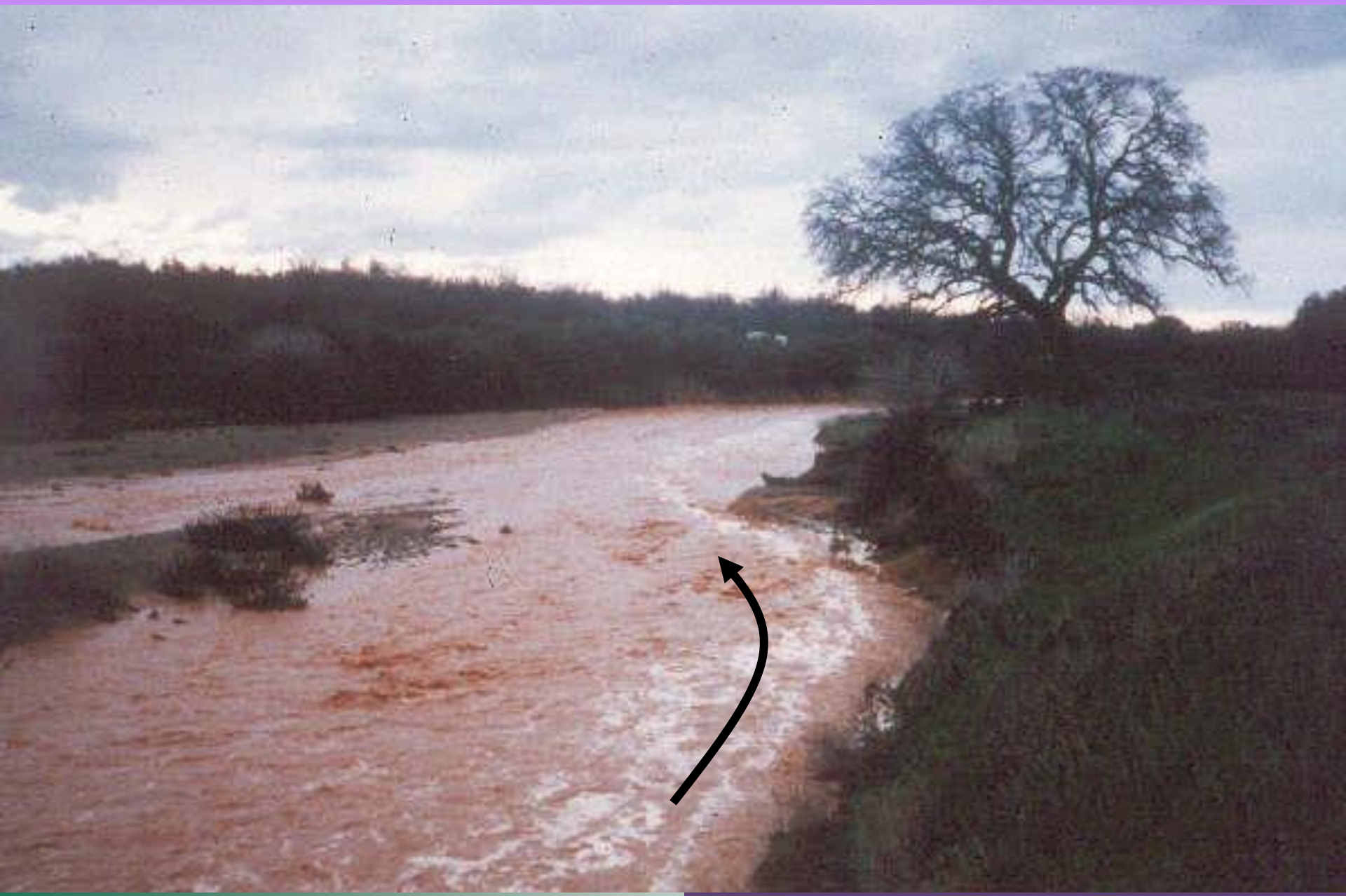
Pre-Project conditions-High water, looking US. Thalweg @ toe of cliff.

Pix by John McCullah-Winter 1997

Pre-Project conditions-Looking US @ US end of project.

Pix by John McCullah

Pre-Project conditions, high water, looking DS @ project area.



Pix by John McCullah-Winter 1997

Pre-Project conditions-High water, looking DS @ project area.

Pix by John McCullah-Winter 1997

Pre-Project conditions-Looking DS @ exposed burn dump material.

Pix by John McCullah-Oct 1998

Design Concepts

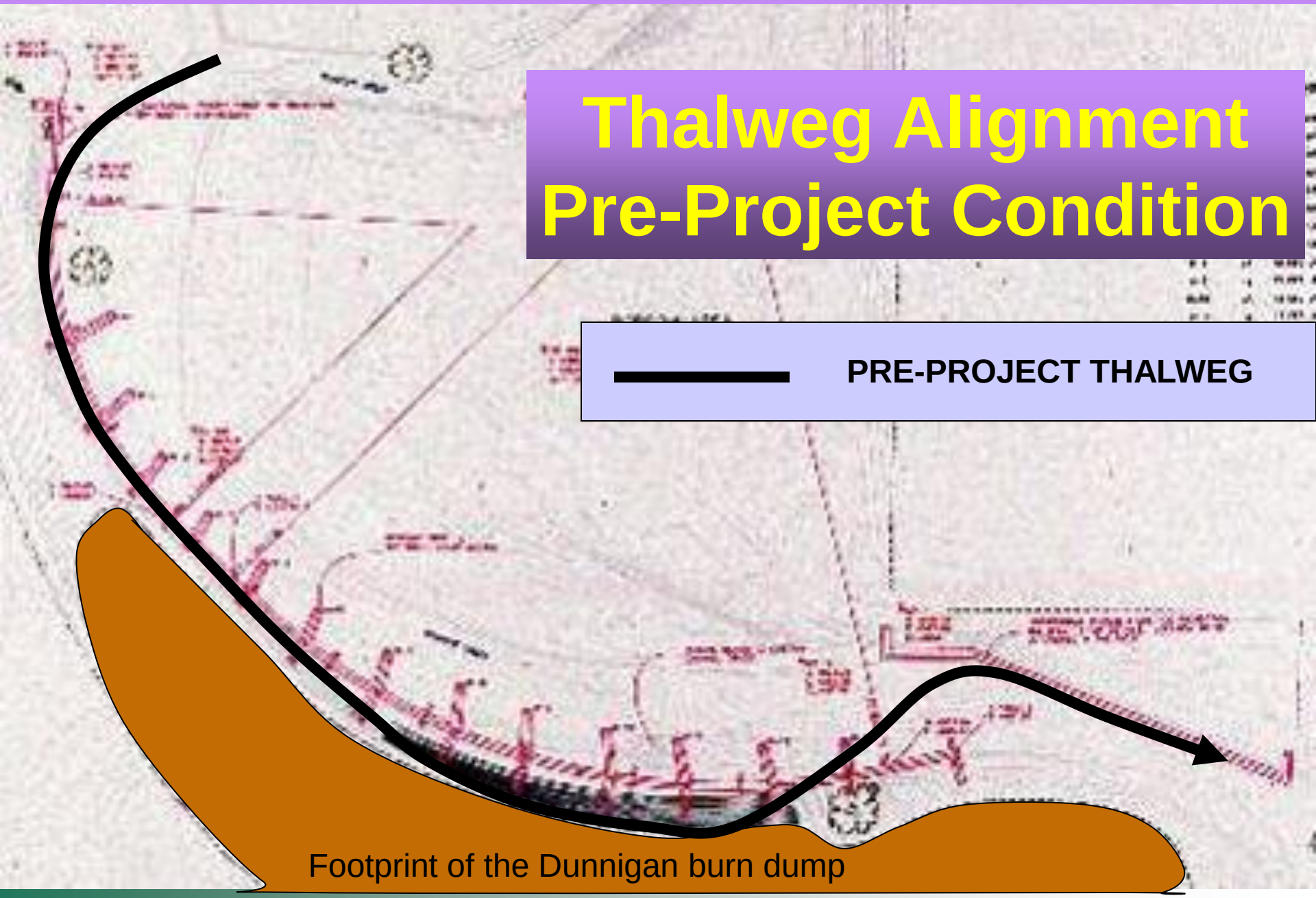
Conceptually, for this project, we need complete separation between the stream & the material in the burn dump, Longitudinal Peaked Stone Toe Protection (LPSTP) is the answer!!

Bendway Weirs will reduce energy near the LPSTP & realign the thalweg to the stream ends of the Bendway Weirs.

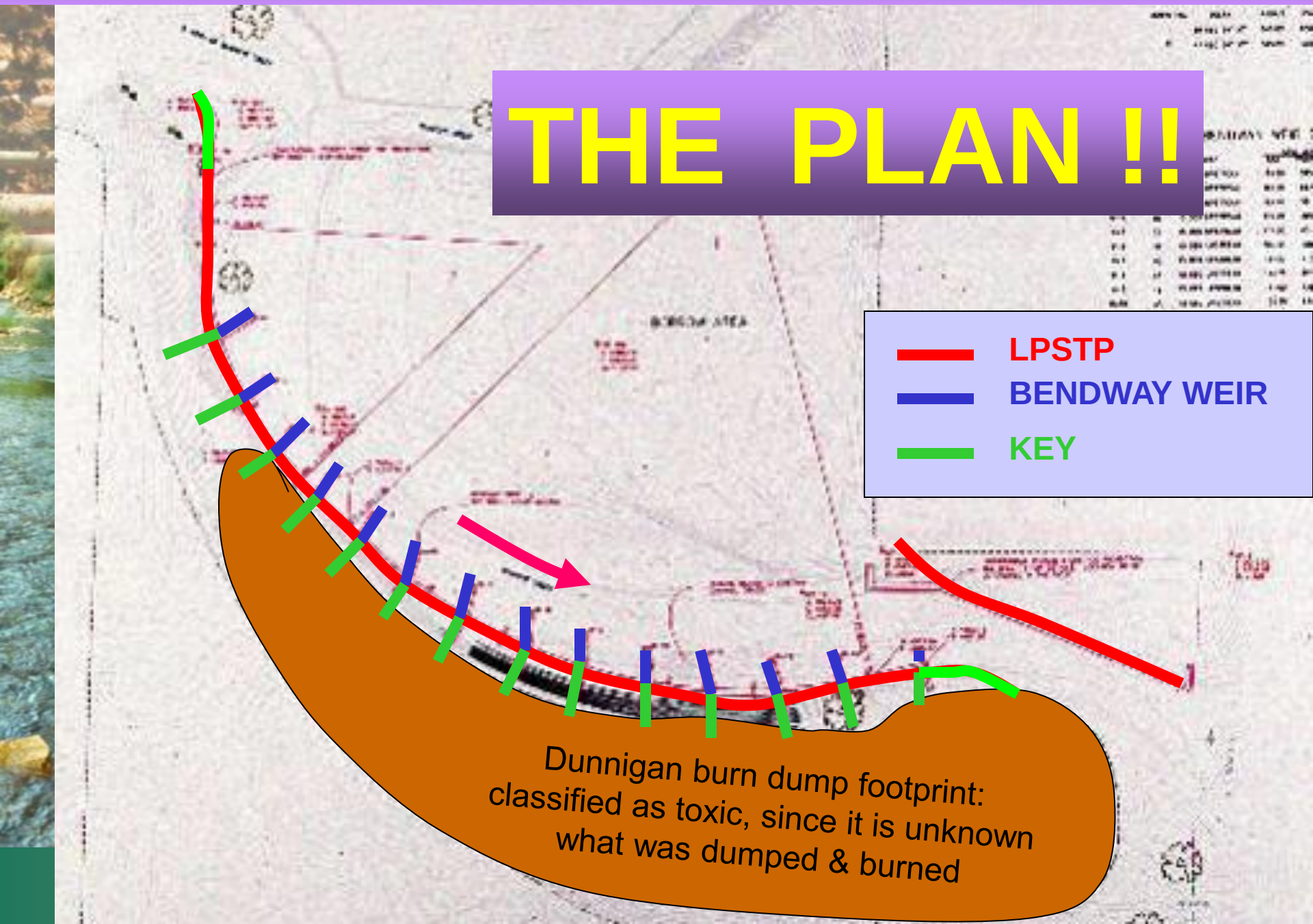
Native plants will stabilize all eroded & disturbed areas!!

The PLAN

THE PLAN !!

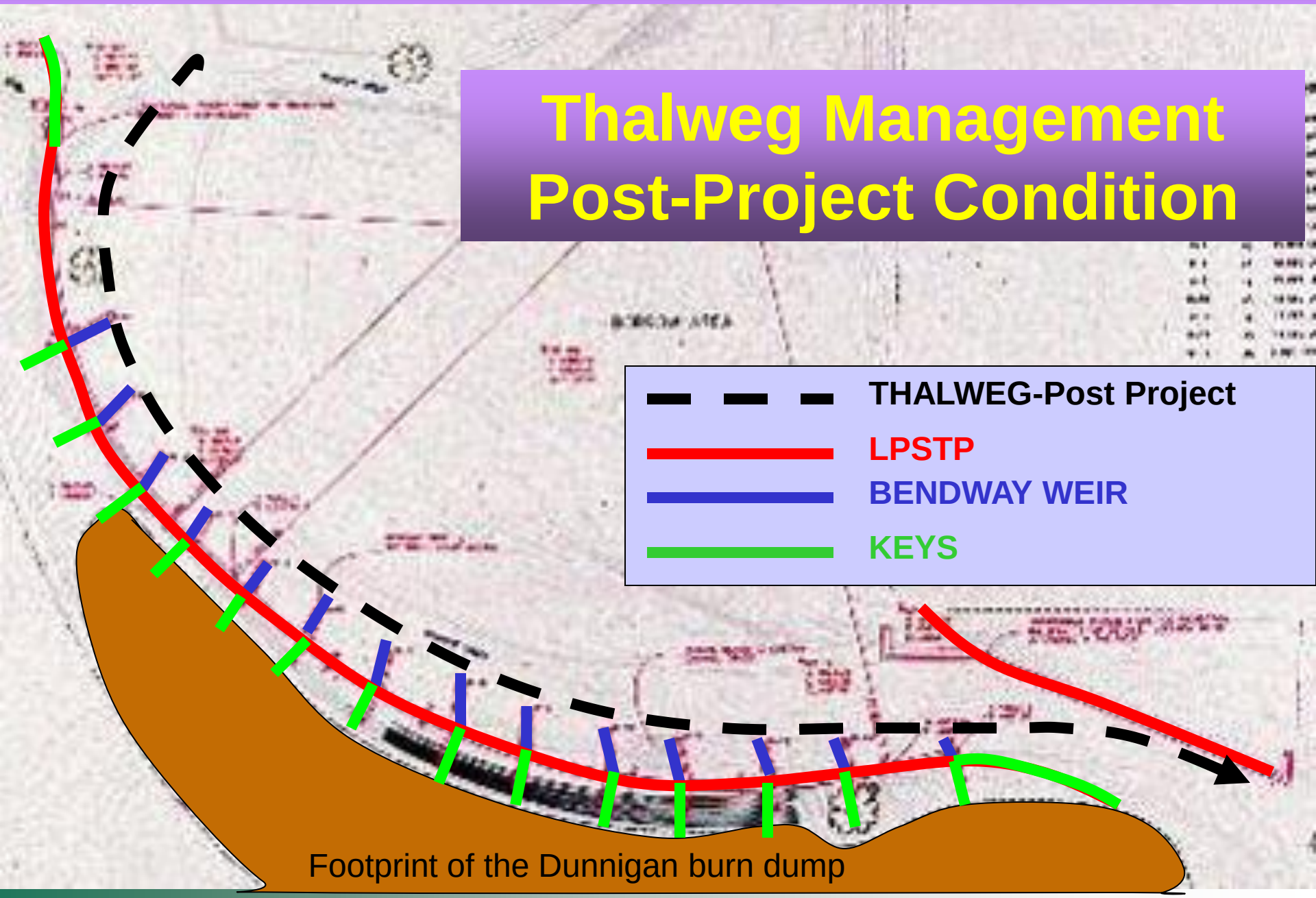

Thalweg Alignment
Pre-Project Condition
PRE-PROJECT THALWEG
Footprint of the Dunnigan burn dump

THE PLAN !!

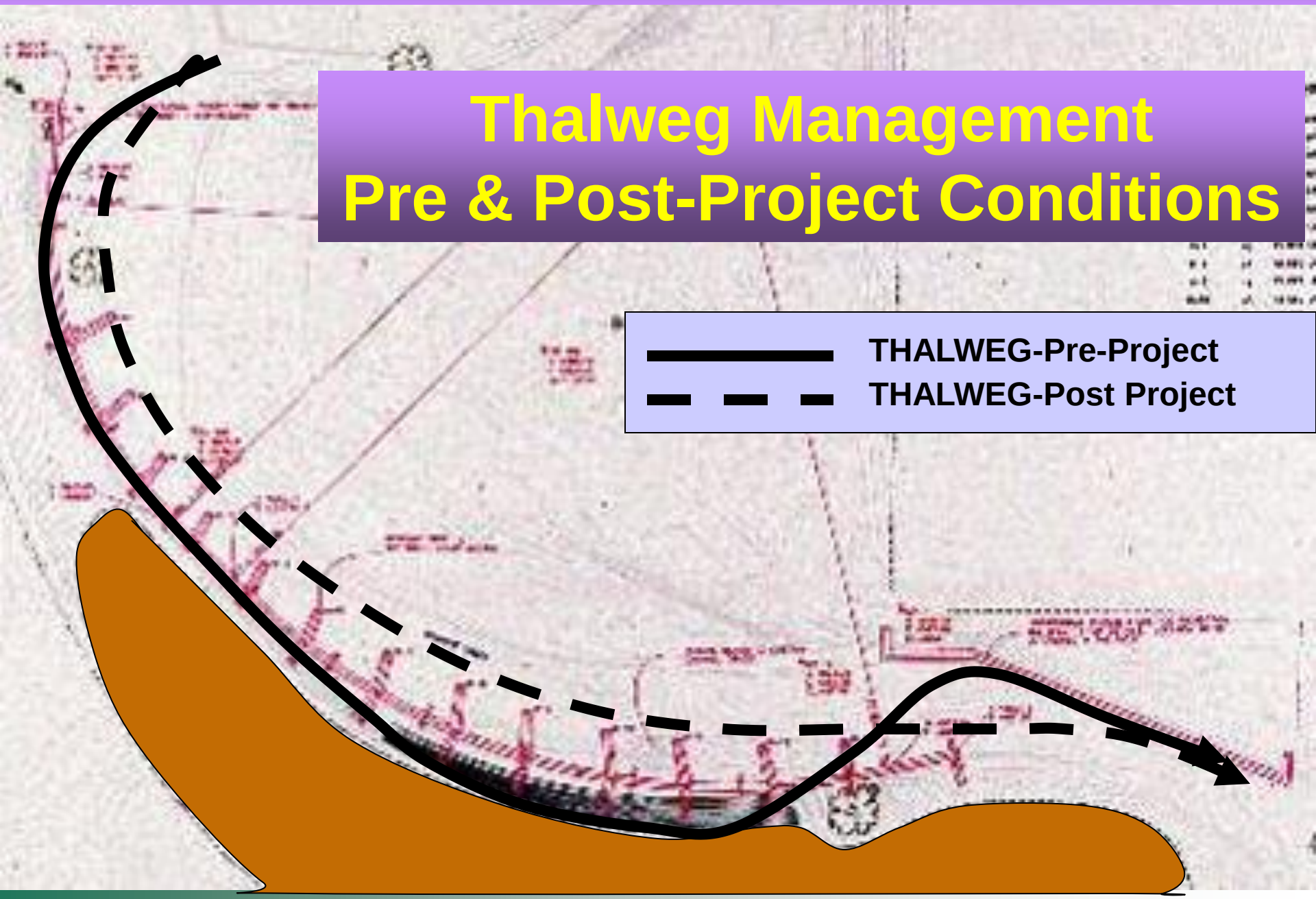

LPSTP
BENDWAY WEIR
KEY
Dunnigan burn dump footprint:
classified as toxic, since it is unknown
what was dumped & burned

THE PLAN !!

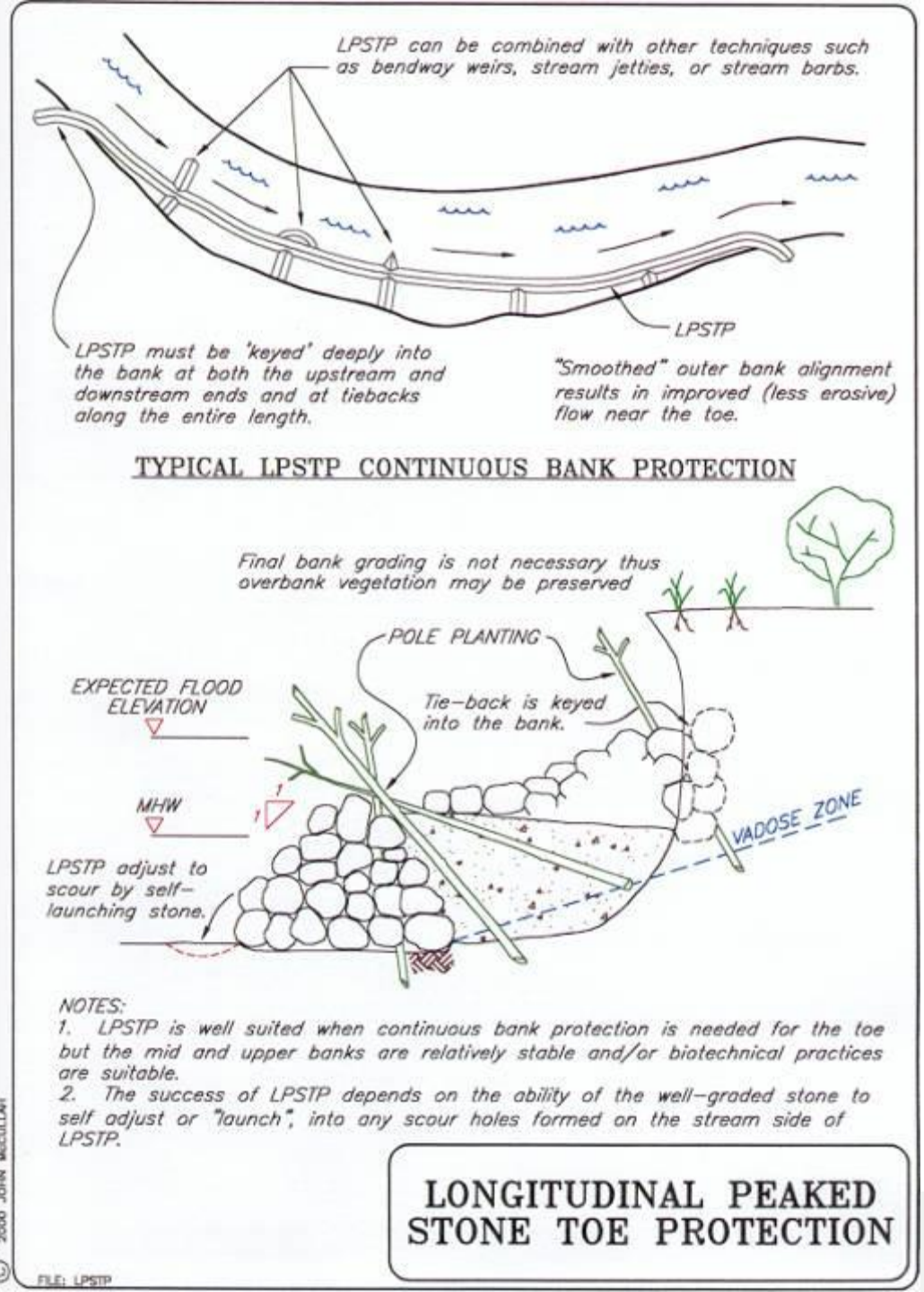
Thalweg Management
Post-Project Condition



Thalweg Management
Pre & Post-Project Conditions



The original design had 800 ft of gabions for $300k. Our design had 2400 ft of LPSTP plus 13 Bendway Weirs plus bioengineering for $110k!!



From www.e-senss.com

The Longitudinal Peaked Stone Toe Protection (LPSTP) is constructed from a Self-Adjusting, Self-Filtering stone

Self-Adjusting, Self-Filtering Stone

Depending on size, angularity, and gradation, stone can be neither, either, or both!!

- **Self-Adjusting Stone:**

  Stone must be well-graded (from coarse to fine) so that it has the ability to "launch", or self-adjust into, and armor, scour holes formed on the streamward side, and/or stream end, of a river training structure.

  -Charlie Elliott says a good rule of thumb in Mississippi sand-bed streams {CAUTION: this might not apply equally well to every stream in the world} is that one ton of rock per linear ft will armor three ft of scour

- **Self-Filtering Stone**

  A soil analysis should always be performed to determine stability and erodability of bank materials and whether a filter material, (either granular or synthetic) is required.

  A self-filtering stone that has worked well on the Mississippi River, and numerous other rivers and smaller streams (acting as a granular filter to prevent loss of underlying bank material) has 10% to 15% of the gradation either less that 4 inches in diameter, or less than one pound in weight, depending on how the stone is specified.

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.

Construction begins

Looking upstream @ LPSTP and the US key & flow entrance conditions

3+ Years later-Looking US @ confluence near US end of project.

Pix by John McCullah - January 2002

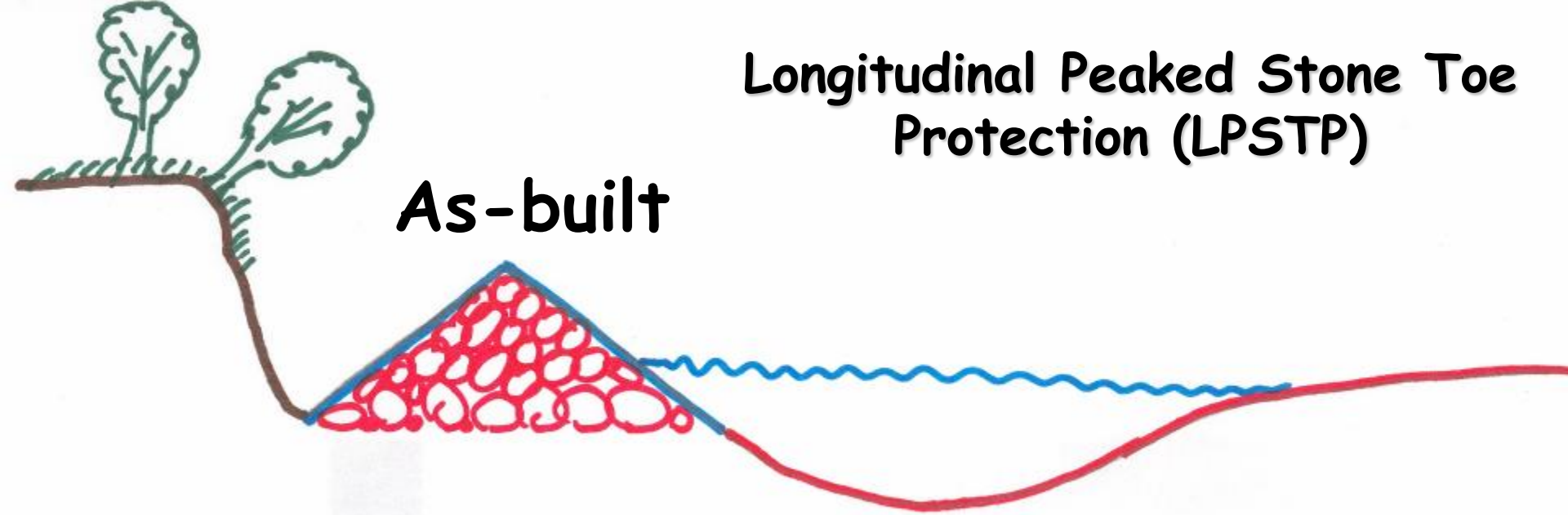
9+ Years Later-Looking US @ confluence of two creeks coming into the project

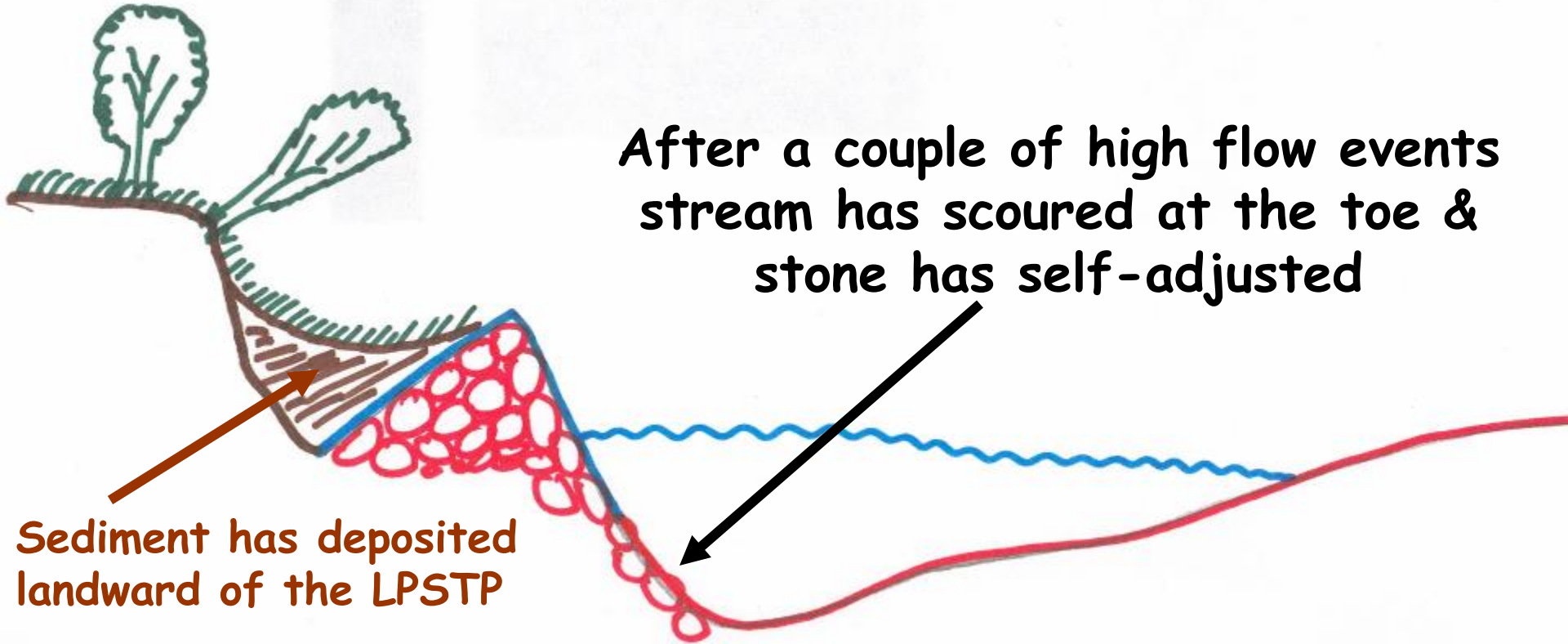
Buckeye Creek @ Dunnigan Burn Dump-Pix by McCullah-Feb 14, 08

When scour occurs, the LPSTP is designed to launch into the scour hole, thereby armoring it.

Longitudinal Peaked Stone Toe Protection (LPSTP)

As-built





After a couple of high flow events stream has scoured at the toe & stone has self-adjusted

Sediment has deposited landward of the LPSTP

DURING CONSTRUCTION-Looking DS @ LPSTP.

Pix by John McCullah - October 1998

Key Construction

DURING CONSTRUCTION-Digging a key trench.

Pix by John McCullah - October 1998

DURING CONSTRUCTION-Placing key stone in key trench.

Pix by John McCullah - October 1998

6 months later-Looking DS @ LPSTP with deposition.

Pix by John McCullah-Spring 1999

9+ Years Later-Looking DS @ deposition in weir field at cliff area

Sulphur Creek @ Dunnigan Burn Dump-Pix by McCullah-Feb 14, 2008

DURING CONSTRUCTION-Transplanting tree behind LPSTP.

Pix by John McCullah - October 1998

From upstream at the cliff looking downstream at the section of the project immediately adjacent to the burn dump area

(Mini case study-10 slides)

The Bendway Weirs are designed to reduce velocities near the LPSTP, & move the thalweg to a location off the ends of the Bendway Weirs. Weirs also provide protection redundancy.

DURING CONSTRUCTION-Looking DS @ LPSTP & 1 Bendway Weir

Mini case study: 3 of 10

Pix by John McCullah - October 1998

3 months later-Looking DS @ tall cliff area. The weirs were not overtopped the first winter.

Mini case study: 4 of 10

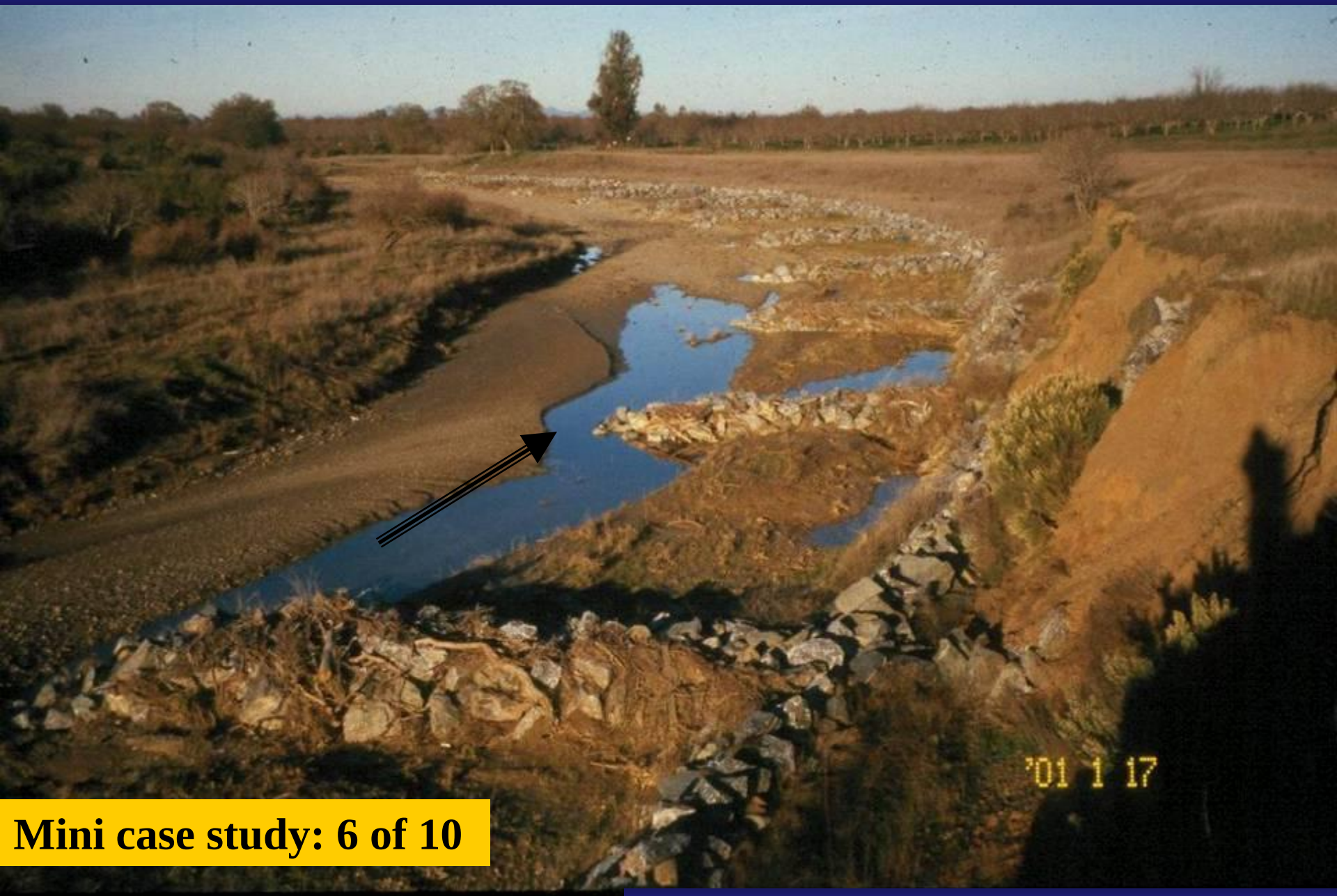
Pix by John McCullah-Jan 1999

3 months later-after the water receded-Looking DS. Note very little deposition between weirs.

Mini case study: 5 of 10

Pix by John McCullah-Jan 1999

2+ Years-Looking DS @ the project bend, deposition in weir field.



Mini case study: 6 of 10

Pix by John McCullah - Jan 17, 2001

3+ Years later-Looking DS @ deposition in weir field with some scalloping of deposited material at stream ends-as can

Mini case study: 7 of 10

Pix by John McCullah - Jan 2002

3+ Years later-Looking DS @ BW with racked debris on each

Mini case study: 8 of 10

Pix by John McCullah - January 2002

4 yrs later, looking DS, BW's & LPSTP separate Dunnigan Burn Dump from the stream erosion, note deposition between weirs, thalweg trace (black line), & cutbank on edge of pointbar.

Mini case study: 9 of 10

Pix by John McCullah-Winter 2002

9+ Years Later-Looking DS @ completely filled in Bendway Weir field results in a wide buffer of protection for the burn dump.

Mini case study: 10 of 10

Sulphur Creek @ Dunnigan Burn Dump-Pix by McCullah-Feb 14, 2008

Looking upstream @ the section of the project adjacent to the burn dump area

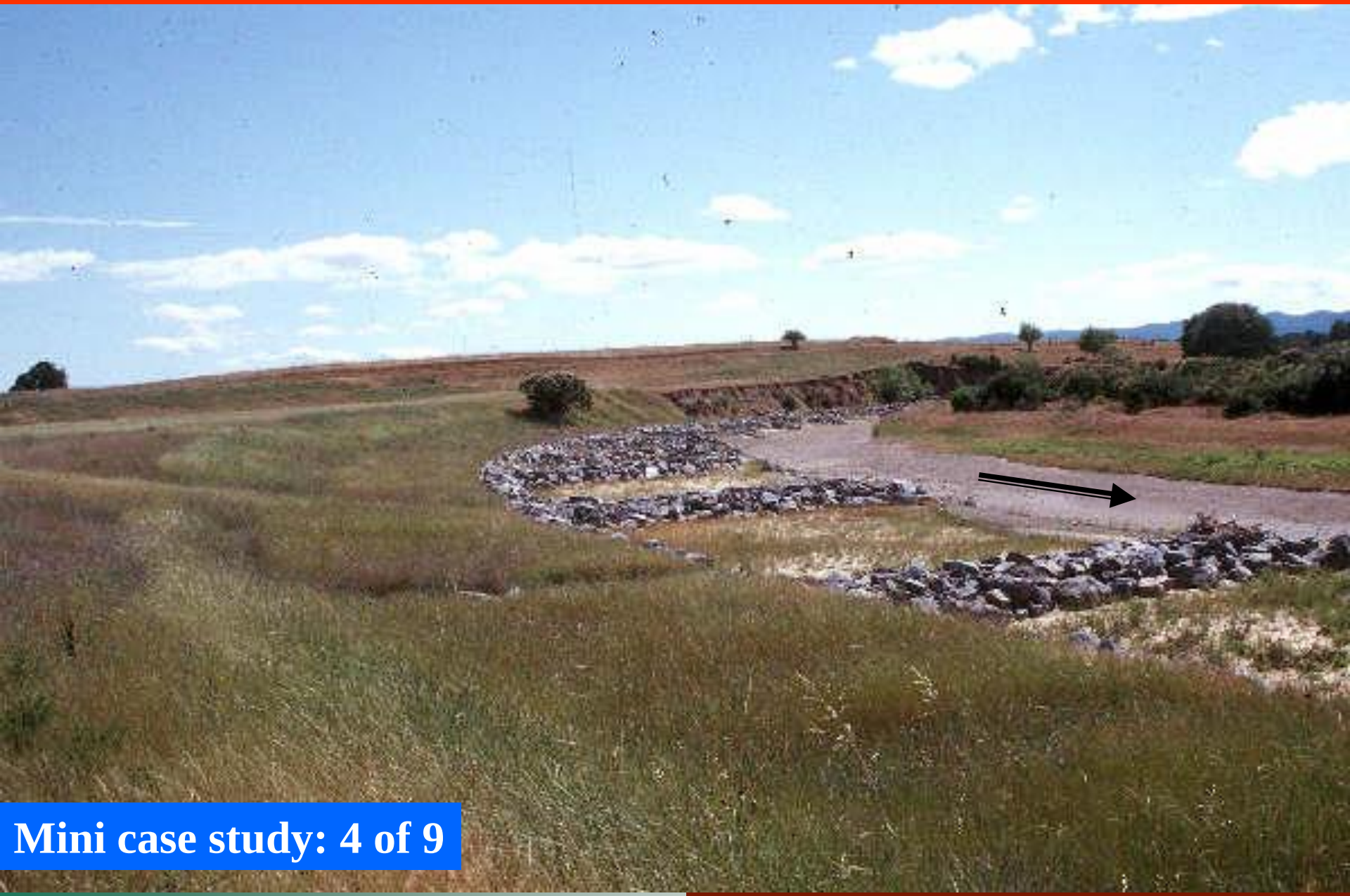
(Mini case study-9 slides)

DURING CONSTRUCTION-Looking US @ LPSTP (next to dump)

Mini case study: 2 of 9

Pix by John McCullah - October 1998

4+ Years later-Looking US @ burn dump area & weir field



Mini case study: 4 of 9

Pix by John McCullah-Spring 2002

9+ Years Later-Looking US @ deposition in weir field.

Mini case study: 9 of 9

Buckeye Creek @ Dunnigan Burn Dump-Pix by McCullah-Feb 14, 2008

Looking downstream @ the section of the project right next to the burn dump area

DURING CONSTRUCTION-Looking DS @ LPSTP (next to dump)

Pix by John McCullah - October 1998

DURING CONSTRUCTION-Hydro seeding burn dump area.

Pix by John McCullah - October 1998

3+ Years later-Looking DS @ scour, debris, & deposition in weir field

Pix by John McCullah - January 2002

3+ years After

Pix by John McCullah - January 2002

9+ Years Later-Looking DS @ completely filled in Bendway Weir field

Buckeye Creek @ Dunnigan Burn Dump-Pix by McCullah-Feb 14, 08

9+ Years Later-Looking DS @ burn dump in foreground, keys, top of LPSTP, completely filled in Bendway Weir field, & excellent transition from the right bank to the left bank ("S" shaped bend)

Buckeye Creek @ Dunnigan Burn Dump-Pix by McCullah-Feb 14, 08

Looking downstream @ the downstream right bank key

DURING CONSTRUCTION-Looking DS @ the right bank DS key.

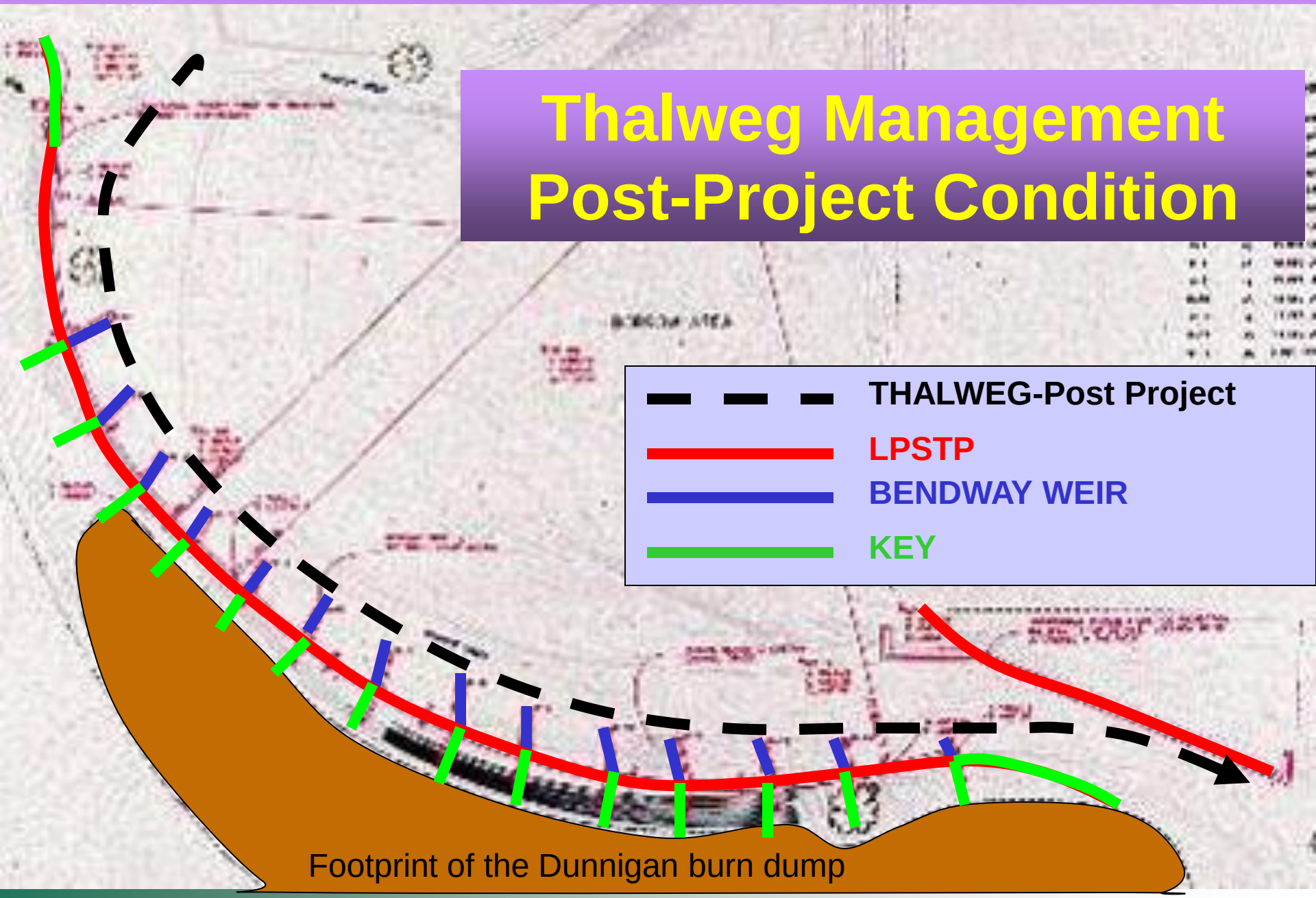
Pix by John McCullah - October 1998

The right to left crossing & the left bank protection

(first THE PLAN, note thalweg trace, then the crossing pix)

THE PLAN !!

Thalweg Management
Post-Project Condition



3 months later-Looking DS @ Bendways and left bank LPSTP

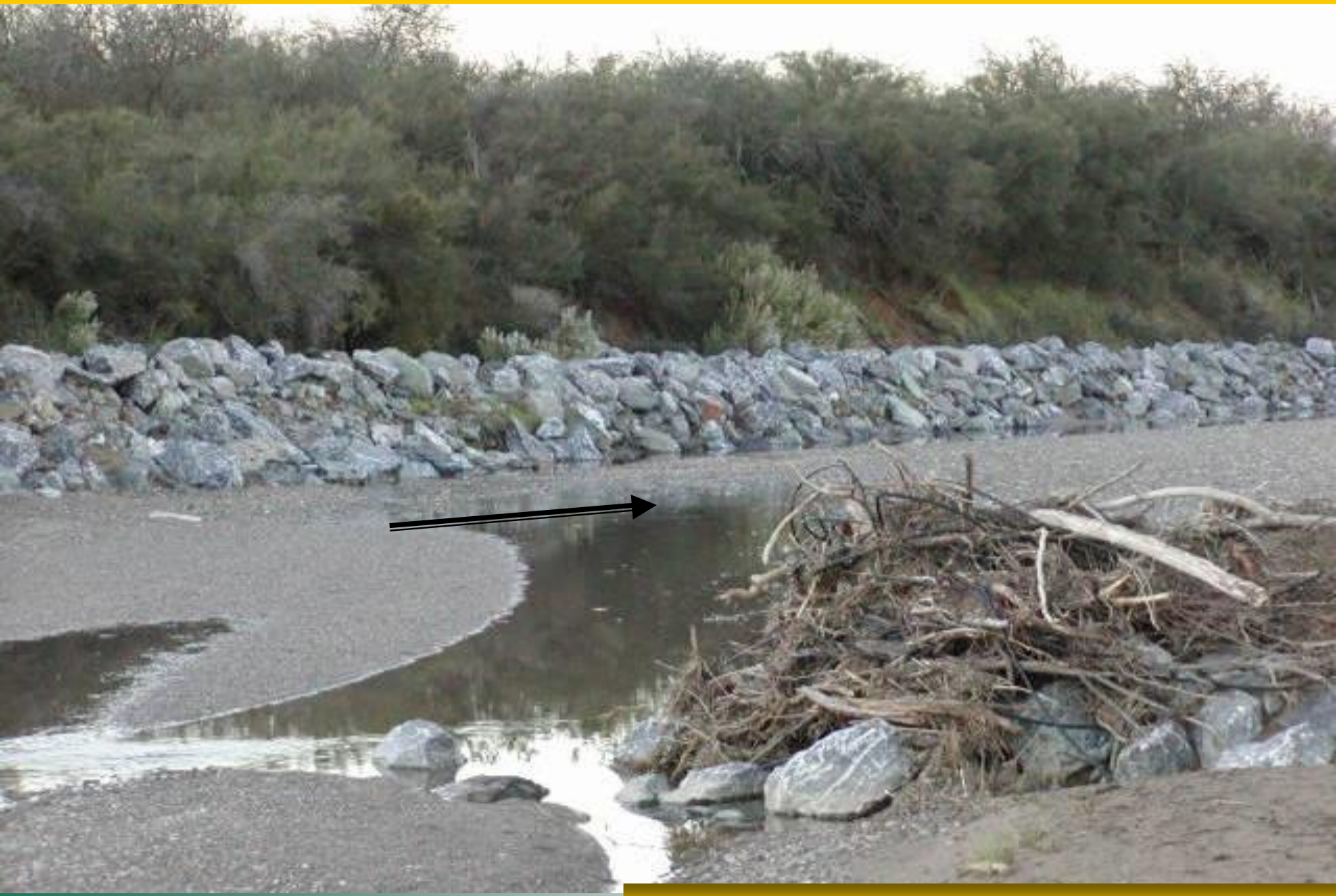
Pix by John McCullah-Jan 1999

9+ Years later-Looking DS @ ends of BW's & left bank LPSTP protection

Buckeye Creek @ Dunnigan Burn Dump-Pix by McCullah-Feb 14, 2008

Looking downstream @ the LPSTP left bank protection

3+ Years later-Looking DS @ left bank LPSTP



Pix by John McCullah - January 2002

9+ Years Later-Looking DS @ left bank LPSTP with road @ DS end

Buckeye Creek @ Dunnigan Burn Dump-Pix by McCullah 2008

CURRENT STATE OF THE PROJECT: What water sees 9 years & 8 months after project completion. Starting US & flowing DS.

9+ Years-Looking US @ the confluence US of the project

Buckeye Creek @ Dunnigan Burn Dump-Pix by Derrick - May 30, 2008

9+ Years-Looking @ the US end of the project. The US key extends far upstream of the current flow attack area. Channel is stable in all dimensions.

Buckeye Creek @ Dunnigan Burn Dump-Pix by Derrick - May 30, 2008

9+ Years-Looking DS @ flow in cliff area. All stable (veg in weir field area)

Buckeye Creek @ Dunnigan Burn Dump-Pix by Derrick - May 30, 2008

9+ Years-Looking DS @ channel alignment adjacent to burn dump area. Deposition in weir field, Bendway Weirs in good shape, smooth channel alignment results in stability through this entire critical reach.

Buckeye Creek @ Dunnigan Burn Dump-Pix by Derrick - May 30, 2008

9+ Years-Looking DS @ deposition within weir field provides 50 ft wide buffer between stream and LPSTP bank protection for dump area. Note smooth transition from right bank to left bank flow.

Buckeye Creek @ Dunnigan Burn Dump-Pix by Derrick - May 30, 2008

9+ Years-Looking DS @ transition of flow from right bank to left.

Buckeye Creek @ Dunnigan Burn Dump-Pix by Derrick - May 30, 2008

9+ Years-Looking @ deposition streamward of left bank US key.

Buckeye Creek @ Dunnigan Burn Dump-Pix by Derrick - May 30, 2008

9+ Years-Looking US @ self-adjusting stone & veg in left bank protection

Buckeye Creek @ Dunnigan Burn Dump-Pix by Derrick - May 30, 2008

9+ Years-From road looking US @ left bank protection & DS key, all stable

Buckeye Creek @ Dunnigan Burn Dump-Pix by Derrick - May 30, 2008

LESSONS LEARNED: For the last 9+ years the project overall has performed extraordinarily well. The Bendway Weirs were designed too tall, however, over time the weir field has filled in completely & become vegetated, providing a 50 ft wide buffer between the stream & the main protection, the LPSTP. All keys are located in depositional areas. The flow transition from the right bank protection to the left bank protection is as good as can be expected. But check your seed tickets!!

THE JOHN & DAVE SHOW THANKS YOU FOR YOUR ATTENTION !!