EVERYTHING I LEARNED ABOUT STREAMS IN 34 YEARS IN LESS THAN 34 MINUTES
by dave derrick
“NEVER UNDERESTIMATE THE POWER OF WATER”

Lesta Ammons
Buffalo Dist. Corps regulatory
If you can, let your river be a river!!
Let it breathe and have some freedom!

And rivers meander too, these are natural river functions
STUDY NATURE, UNDERSTAND NATURAL PROCESSES
Don’t be “confused by the dirt”
DO IT ONCE & DO IT RIGHT!!!
BE THE LAST PERSON TO HELP THE STREAM, NOT THE SECOND LAST!
USE GOOD SCIENCE, FUNCTION-BASED DESIGN, & RIVER EXPERIENCE IN DECISION MAKING
STABILIZE HEADCUTS FIRST, THEN WORRY ABOUT BANK INSTABILITY SECOND
HEADCUTS GONE BAD!!
Las Vegas Wash, NV. has degraded from a 3 ft deep by 100 ft wide channel in 1975, to a 40 ft deep by up to 1,000 ft wide channel in 1995.

I am standing on the roots of dead wetland plants, over 2,200 acres of wetlands lost.

Huge problems with perchlorate interception from the groundwater table.
Then

2,400 Acres of Wetlands
Now

2000 acres of wetlands lost!

Photo by Gerry Hester
SEVERAL LOW GRADE CONTROL STRUCTURES ARE BETTER THAN ONE BIG MONSTER GRADE CONTROL STRUCTURE
SELF-ADJUSTING, GRADE CONTROL STRUCTURES WORK WELL!!
Arresting an active headcut at the downstream end of the Articulating Concrete Mattress
Pickens, MS. ACM “tail” was laid on flat bathymetry, headcuts have migrated US and mat has adjusted and arrested the headcut.

“Hinged” ACM grade control, more mats can be added as needed.
RIGID OBJECTS IN DYNAMIC SYSTEMS TEND TO FAIL CATASTROPHICALLY DURING THE CATASTROPHIC EVENT!!
When the concrete-lined channel breaks up it is not pretty, Vensel Creek, Tulsa, OK
BIG NON-ADJUSTABLE OBJECTS GET MOVED AROUND IN SPACE!
Looking DS @ concrete road crossing, good rattlesnake habitat!! Big objects get moved around by flow.
Same stream, same site, way smaller well-graded, self-adjusting stone built as an Engineered Rocked Riffle is working quite well
NEVER PUT RIPRAP ABOVE TOP BANK....

THERE IS NO CURE FOR STUPID!
THIS IS WAY WORSE! Crazy BIG stone that will not adjust (use ChanlPro to size stone). Stone was 6 ft above floodplain. Significant scour will occur here. (black line)

DON’T DISCONNECT THE STREAM FROM ITS FLOODPLAIN!!

AS-BUILT – GILA RIVER, NM - DERRICK 5-15-2013
i am a minimalist, ask not how high
the hard protection has to go, but how
low can we take it (long, low and
hydraulically smooth is the idea)…
Nudge the river, never fight it!!!!

• Minimal hard protection has to go hand-in-hand with
laying back the banks to a stable angle & planting all of
the appropriate vegetation (aquatic, emergent, pioneer,
veg within the protection & mid- and upper bank areas)

• RE-USE EVERYTHING THAT HAS TO BE
MOVED OR REMOVED
WATER IN = WATER OUT
SEDIMENT IN = SEDIMENT OUT
CARBON IN = CARBON OUT

SIMPLE GOALS:

Photo by Nate Muenks, MoDOT
PROJECT MANAGEMENT

*NO SURPRISES!! *NO DRAMA!!
NO BACKING UP!
Luxuries We Like To Have

- The “Luxury of Space”
- The “Luxury of Time” (nature strengthens the project over time)
- The “Luxury of Monitoring”
- The “Luxury of Adaptive Management”

Think conceptually regarding functions, use Derrick’s “LAW OF EXTREMES” to understand how things work. Example-ditch narrow & deep, or 500 ft wide & 1 inch deep
STREAM STABILIZATION IS ALL ABOUT ENERGY MANAGEMENT
HOW DID THE STREAM DISSIPATE ENERGY BACK IN HISTORY? WHAT ARE THE OPTIONS NOW?
HOW STREAMS NATURALLY DISSIPATE ENERGY!!

Purloined from Brad Humber, The Nature Conservancy

Longitudinal Profile
Attack Angles, Thalweg Profile, & cross-sections.

Note: There are sine waves for both stream planform, & the vertical profile!
HOW TO TELL WHEN A POOL IS WORKING PROPERLY
Looking US at a properly functioning pool, note roostertail dies out at DS end of pool during bankfull event, 9/1/2005, McKinstry Creek, Delevan, NY

Gravel-cobble bed, 1% slope, rural, pool-riffle-pool
Looking US at a properly functioning pool, note roostertail dies out at DS end of pool during bankfull event, 9/1/2005, McKinstry Creek, Delevan, NY
Looking DS at a pool that is not functioning as well, fast water through length of pool. Needs to have more volume in pool, or roughness, McKinstry Creek, Delevan, NY
THE SECRET TO BANK STABILIZATION: MAKE THE BANK THAT IS PROTECTING SOMETHING TOUGHER & HYDRAULICALLY ROUGHER THAN THE OPPOSITE BANK (OPPOSITE BANK SHOULD BE SMOOTHER & WEAKER)
A bank protection project should start & end in stable (usually depositional) areas.
Protection starts late & ends early, resulting in erosion at both ends of project.
KEY ALL STRUCTURES INTO THE BANK, EVEN VEGETATION!!
A key has one main function: to connect bank protection (or a river training structure) to the rest of the world, & not let the river “flank” (get behind) the improvement or protection works.
Flanked perpendicular grade control structure. Water should be flowing over this structure.
VEGETATE THE KEYS TO MAKE THEM HYDRAULICALLY ROUGHER
Constructed Engineered Rocked Riffle with extended vegetated keys
VEGETATION CAN HOLD YOUR WORLD TOGETHER !!!
PLANT PLANTS ON A GRID

(PERPENDICULAR & PARALLEL TO THE DIRECTION OF HIGH FLOW)
Rubber tired backhoe digs 4-5 ft deep trench with a narrow bucket. Pix by Bill Frederick
Many hands get things done quickly, 2,740 plants planted in about 6 hours. That’s why they call it a workshop. Pix by Derrick
Plant other species that require less water than the willow. In this case, Sycamore & Red Osier Dogwood.
LET'S SEE HOW IT GROWS
AFTER 5-15-2007 noon. Pix by Derrick
Black Willow, Streamco Willow, Red Osier Dogwood & Sycamore were planted using the Slit Trench bioengineering method. 40 RPM container plants (7 species of trees & shrubs) were planted in the green oval areas.

Plantings form a grid to flow. No matter how water flows through the project, it encounters rows of vegetation (Living Dikes).
Aug 3, 2007 {less than 3 months after installation}. Looking US at right bank floodplain. Pix by Mark Schaub
2 YEARS & 1 MONTH AFTER PROJECT COMPLETION

Photos by Derrick

JUNE 18, 2009
2 YEARS & 1 MONTH LATER-Looking US @ the planted floodplain (Mark hidden in plants). Very lush growth, dense as desired from a hydraulic point of view.
2 YEARS & 1 MONTH LATER-Mark with 10-14 ft tall willows.
SELF-ADJUSTING, SELF-HEALING BANK STABILIZATION METHODS ARE BEST!!
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.
CASE STUDY- Hickahala Creek Pipeline Protection Project at milepost 347.64 Tate County, Senatobia, MS

Constructed Sept. 2003

Longitudinal Peaked Stone Toe Protection \{LFSTP\} with upper bank paving
Looking US at the entire stream trying to flow underneath the exposed pipeline, the first bend downstream of a long straight stretch is hard to repair, the water does not want to turn!!! This stream put sediment 1,000 ft in a straight line out into the farmer’s field.
Looking US at impinging flow impact zone. Note steep angle where LPSTP was undercut & launched (self-adjusted)

April 2006
Note steep angle where LPSTP was undercut and launched (self-adjusted)
Looking at us,

March 2007

4 years after construction, very stable, veg growing well

March 2007
7 years later, bank steep near water but very stable, veg growing well, no rock appears to have launched since high flows hit shortly after construction.
KICK THE THALWEG OUT INTO THE CHANNEL AT LEAST A LITTLE BIT WHEN USING RESISTIVE BANK STABILIZATION METHODS (Bendway Weirs, Locked Logs, Rock Vanes, etc.)
AERIAL VIEW OF LPSTP WITH LIVE SILTATION, SOIL CHOKE, LOCKED LOGS, BENDWAY WEIRS, & A PLANTED BANK
Thalweg moved out by Locked Logs & Bendway Weirs

CONSTRUCTION - DUCK CR. E. OF EASTERN AVE. PIX BY DERRICK 7-1-2008
From DS looking US @ thalweg trace.
First Law of River Engineering:

Complex Problems Often Have Simple, Easy-to-Understand WRONG ANSWERS

Let’s straighten this stream just like Grandad did, that worked for the last 50 years, & get that gravel for the driveway too!!!
Last Law of River Engineering:

When in over your head, go get help!

IF ANYONE SAYS THEY HAVE ALL OF THE ANSWERS, THEY DON’T!!!