Low-Tech Stream Restoration

For small, incised creeks in the Southeastern Piedmont

C. Alex Pellett

April 17, 2024

Hydraulic Geometry of Small Streams in the SC Piedmont

"Nature-Based Solutions for Eroding Stream Banks and Shorelines"

Joshua Robinson, MS, PE

"Uncertainty Analysis of SC Piedmont Regional Hydraulic Geometry Curves"

2022 SC Water Resources Conference

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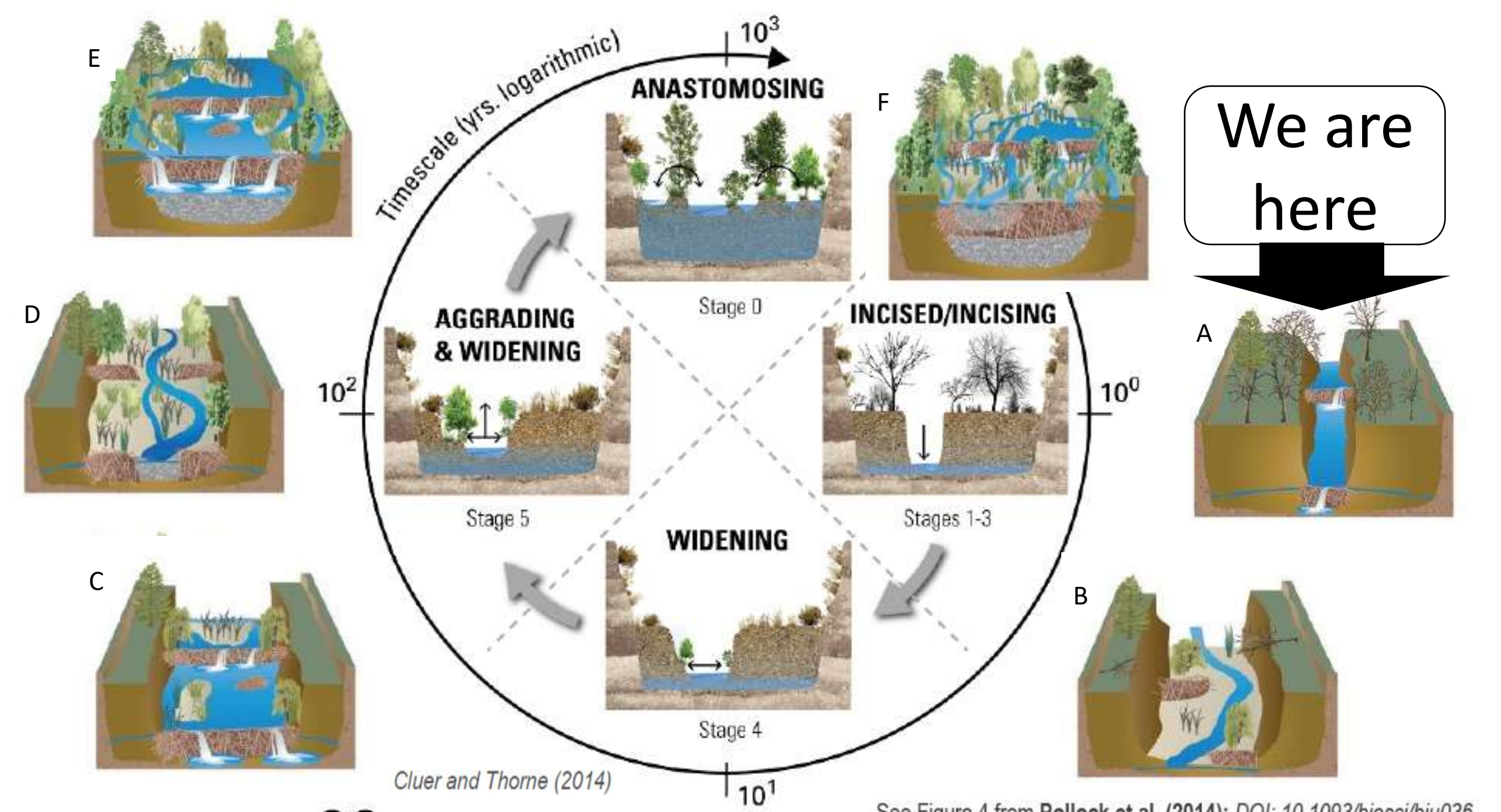
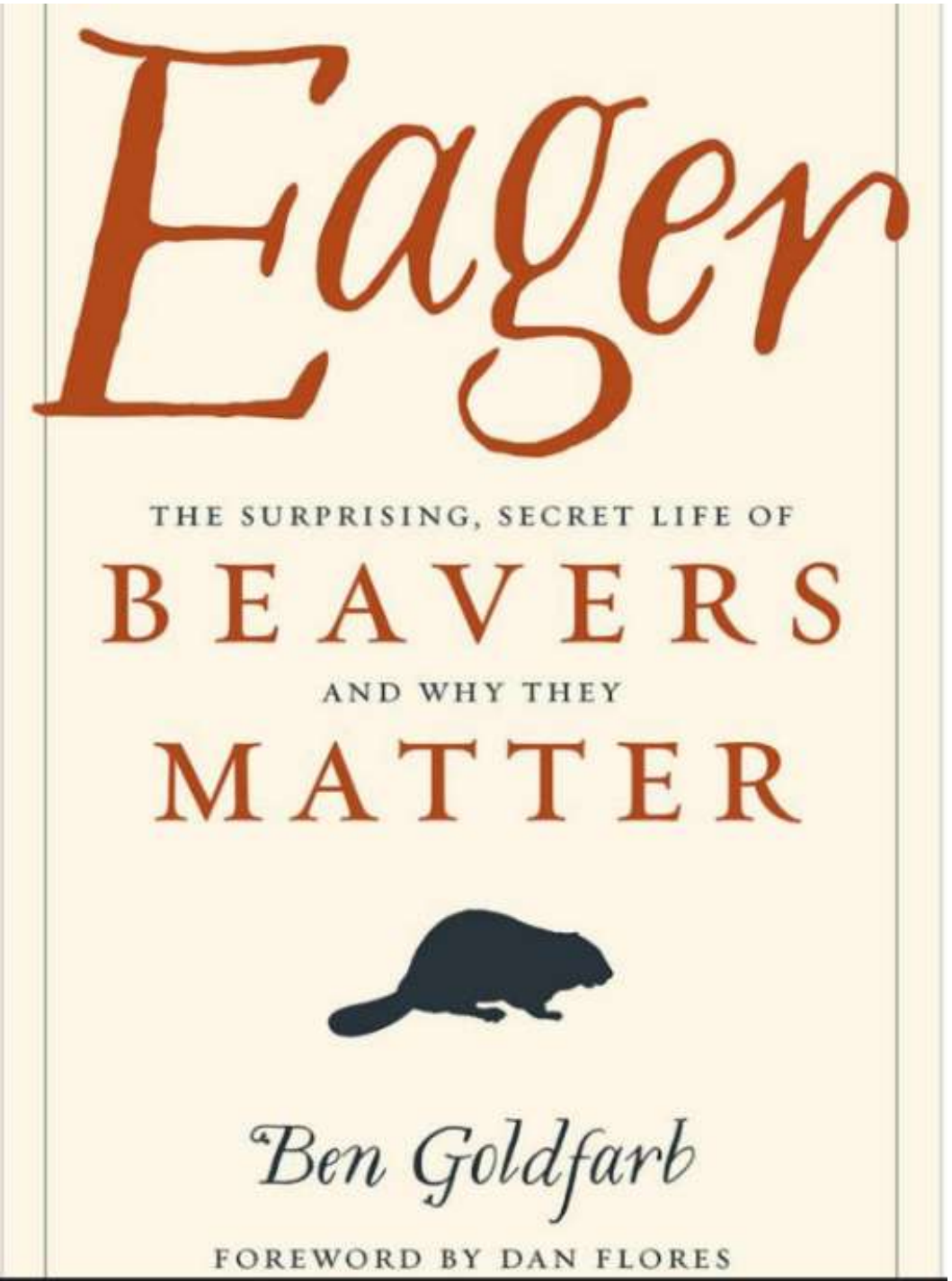


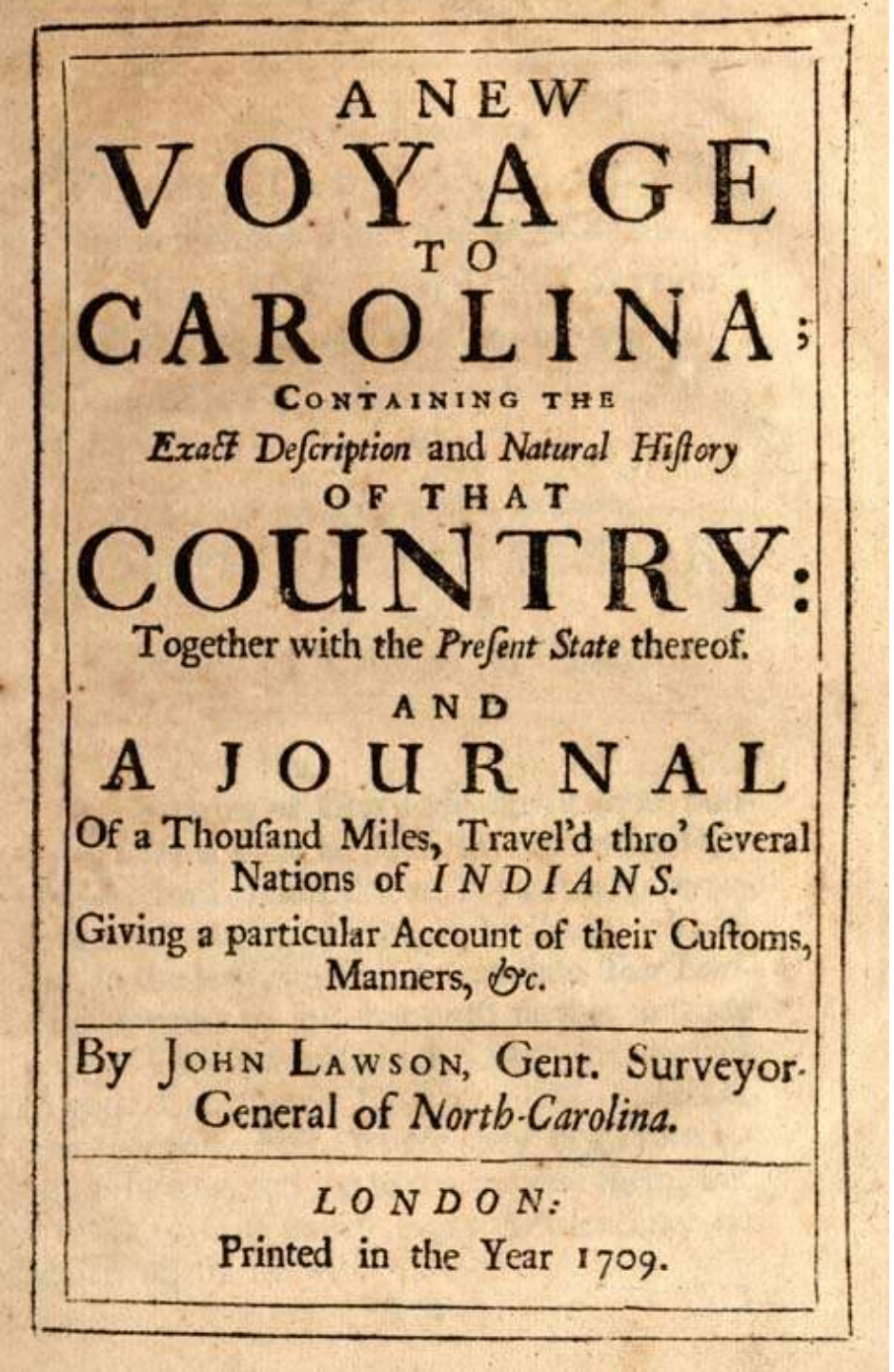
See Figure 4 from **Pollock et al. (2014):** *DOI: 10.1093/biosci/biu036*



Beavers are a keystone species, creating habitat for other native species.

Extirpated from SC by 1900, reintroduced in 1940. Now in all counties, but probably only a fraction of their pre-colonial population.
https://www.dnr.sc.gov/wildlife/species/beaver.html

Beaver can damage buildings, septic systems, roads & culverts, dam spillways, agriculture, forestry, etc. They can also carry disease. A beaver that is habituated to humans could be aggressive if approached, and a rabid beaver could attack you, but that is not common.
https://www.dnr.sc.gov/wildlife/publications/nuisance/beaver.pdf



A NEW
VOYAGE
TO
CAROLINA;
CONTAINING THE
Exact Deſcription and *Natural Hiſtory*
OF THAT
COUNTRY:
Together with the *Preſent State* thereof.
AND
A JOURNAL
Of a Thouſand Miles, Travel'd thro' ſeveral Nations of *INDIANS.*
Giving a particular Account of their Cuſtoms, Manners, *&c.*

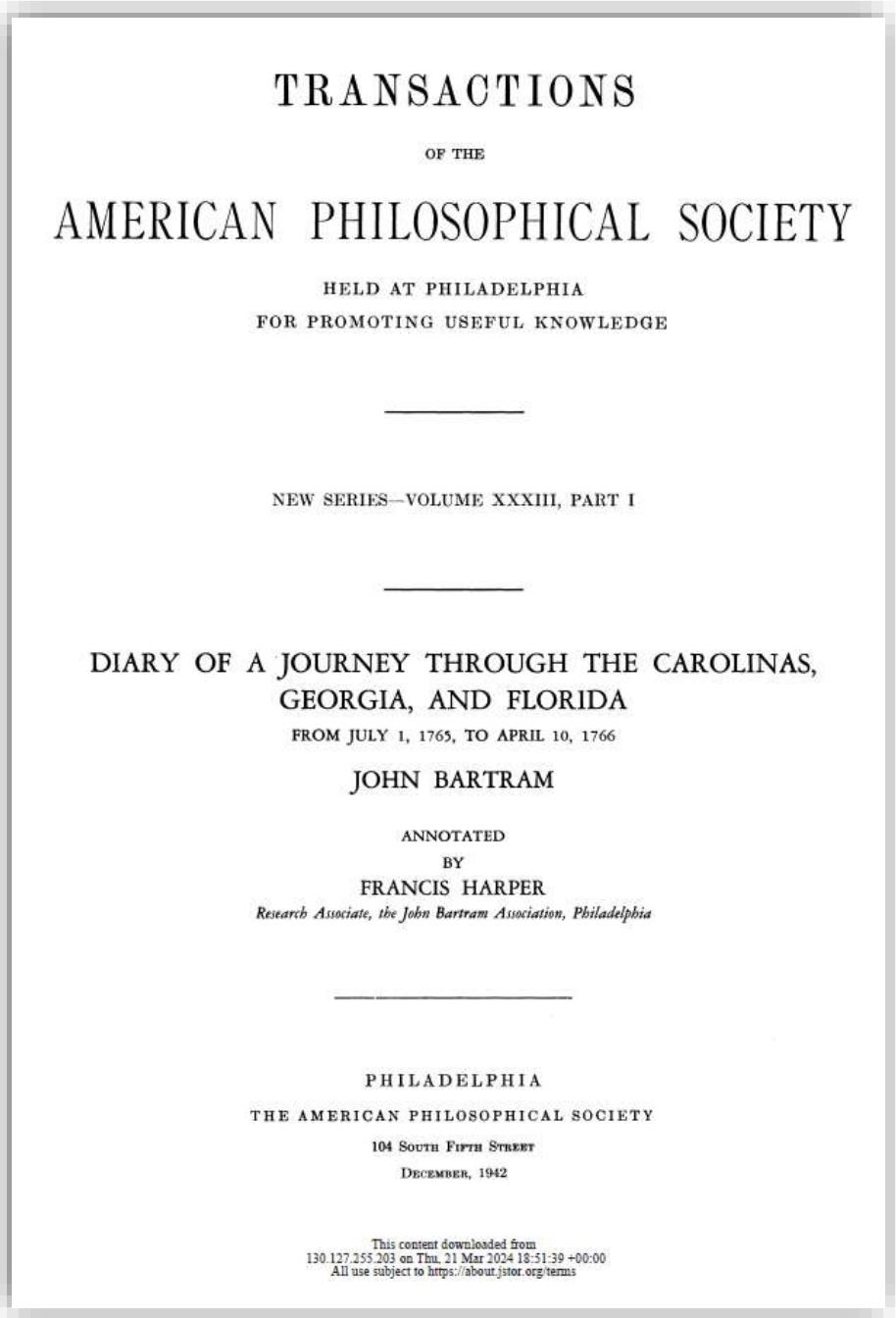
By JOHN LAWSON, Gent. Surveyor-General of *North-Carolina.*

LONDON:
Printed in the Year 1709.

John Lawson's Journal, published 1709

"**Bevers are very numerous in *Carolina,* their being abundance of their Dams in all Parts of the Country, where I have travel'd**. They are the most industrious and greatest Artificers (in building their Dams and Houses) of any four-footed Creatures in the World. Their Food is chiefly the Barks of Trees and Shrubs, *viz.* Sassafras, Ash, Sweet-Gum, and several others. If you take them young, they become very tame and Domestick, but are very mischievous in spoiling Orchards, by breaking the Trees, and blocking up your Doors in the Night, with the Sticks and Wood they bring thither. If they eat any thing that is salt, it kills them. Their Flesh is a sweet Food; especially, their Tail, which is held very dainty. There Fore-Feet are open, like a Dog's; their Hind-Feet webb'd like a Water-Fowl's. The Skins are good Furs for several Uses, which every one knows. The Leather is very thick; I have known Shooes made thereof in *Carolina,* which lasted well. It makes the best Hedgers Mittens that can be used."

https://docsouth.unc.edu/nc/lawson/lawson.html



TRANSACTIONS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY

HELD AT PHILADELPHIA

FOR PROMOTING USEFUL KNOWLEDGE

NEW SERIES—VOLUME XXXIII, PART I

DIARY OF A JOURNEY THROUGH THE CAROLINAS, GEORGIA, AND FLORIDA

FROM JULY 1, 1765, TO APRIL 10, 1766

JOHN BARTRAM

ANNOTATED

BY

FRANCIS HARPER

Research Associate, the John Bartram Association, Philadelphia

PHILADELPHIA

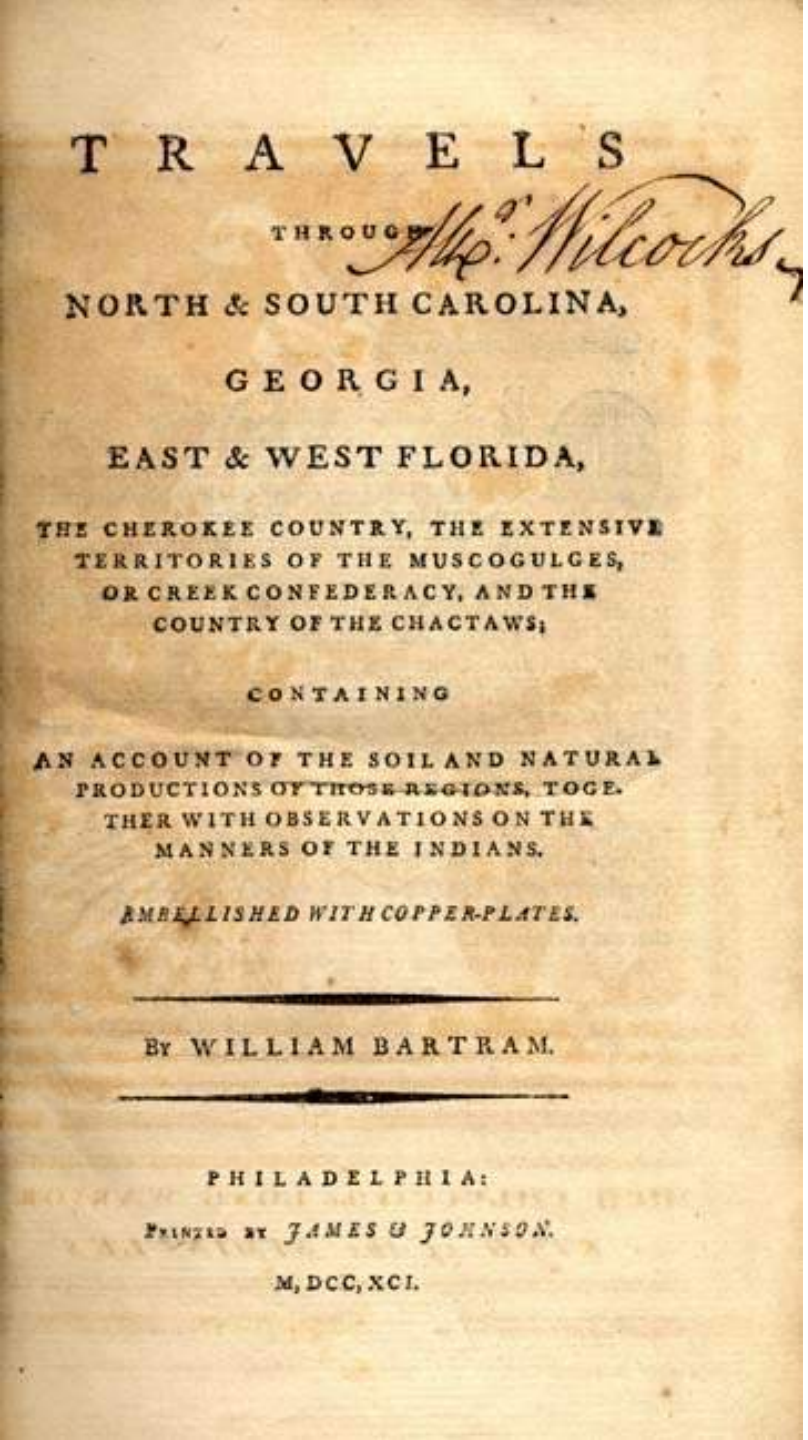
THE AMERICAN PHILOSOPHICAL SOCIETY

104 South Fifth Street

December, 1942

John Bartram's Diary of a Journey, 1765-1766

"Rode eight miles farther to Mr Galphin's, an Indian trader, who constantly employs 400 pack-horses in trading through the Creek nations, Chicasaws, Chactaws, and other Indian tribes, who are supplied with European commodities in exchange for skins, **bever**, and other peltry, which are **the chief articles of Indian merchandize.**"



TRAVELS

THROUGH

NORTH & SOUTH CAROLINA,

GEORGIA,

EAST & WEST FLORIDA,

THE CHEROKEE COUNTRY, THE EXTENSIVE TERRITORIES OF THE MUSCOGULGES, OR CREEK CONFEDERACY, AND THE COUNTRY OF THE CHACTAWS;

CONTAINING

AN ACCOUNT OF THE SOIL AND NATURAL PRODUCTIONS OF THOSE REGIONS, TOGETHER WITH OBSERVATIONS ON THE MANNERS OF THE INDIANS.

EMBELLISHED WITH COPPER-PLATES.

By WILLIAM BARTRAM.

PHILADELPHIA:

PRINTED BY JAMES & JOHNSON.

M, DCC, XCI.

William Bartram's *Travels*, published 1791

"**There are yet a few** beavers in East-Florida and Georgia, but they abound most in the north of Georgia, and in West-Florida, near the mountains."

https://docsouth.unc.edu/nc/bartram/bartram.html

“A rock check dam is a small, temporary or permanent rock fill dam constructed across a drainage ditch, swale, or channel to lower the speed of concentrated flows.”

“Do not place check dams in Waters of the State or USGS blue-line streams (unless approved by SCDHEC, State, or Federal authorities).”

South Carolina DHEC July 31, 2005 Storm Water Management BMP Handbook

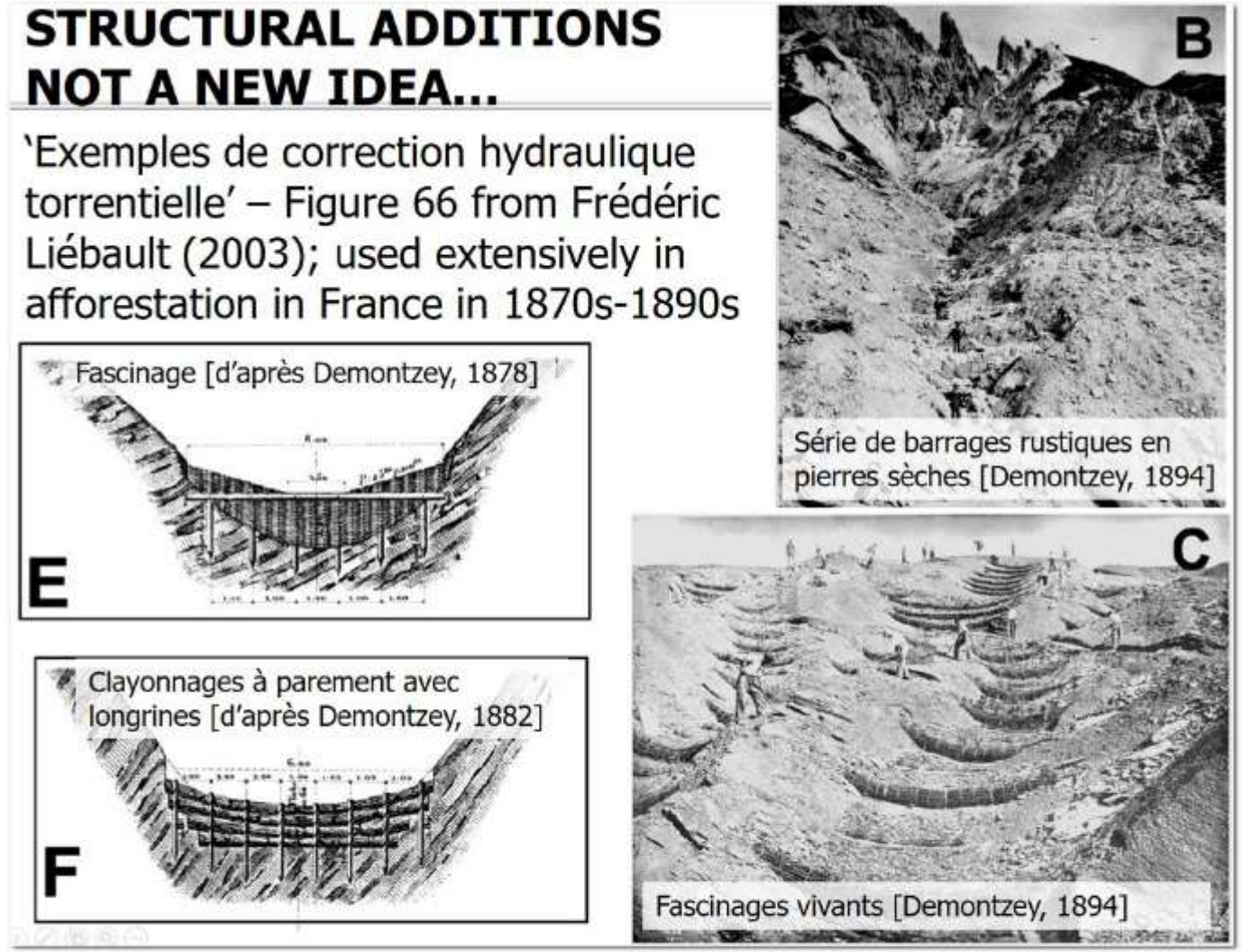


Figure 10 – An example from the Drome Catchment in France in the 1800s where large numbers of simple hand-built structures were added to degraded streams ('hydraulique torrentielle') to restore (correct) the problem. This figure highlights just how long some of these concepts have been around (even if forgotten). The pen and ink drawings of Demontzey in E & F show the use of posts, wicker weaves, and log cribs in what later became known as 'check dams' and are similar to techniques we use with post-assisted log structures. Adaptation of figure from figure 66 of Liébault (2003) PhD thesis. Slide from Wheaton (2018).

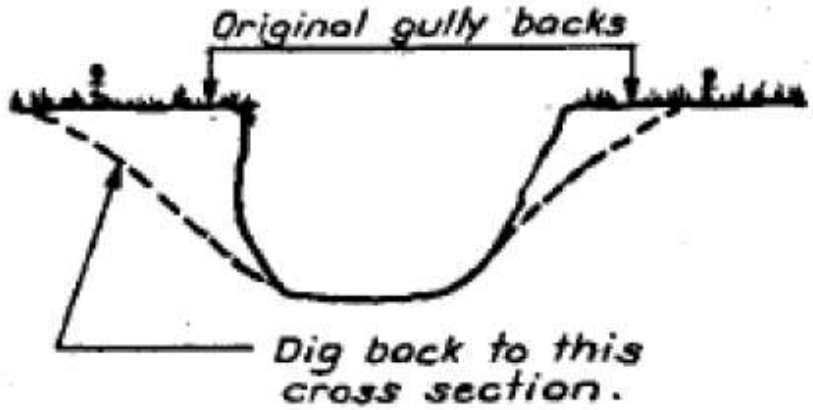


Figure 25
Sectional elevation of gully showing how banks should be sloped back.

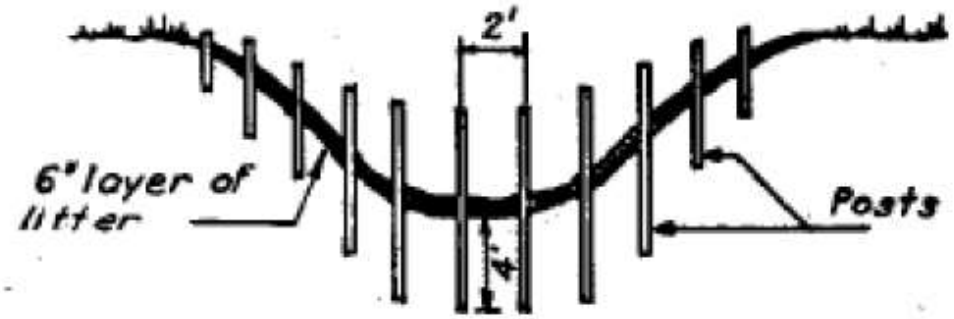


Figure 26
Sectional elevation of gully showing posts and litter in place for dam. Note that the posts are lower in the center.

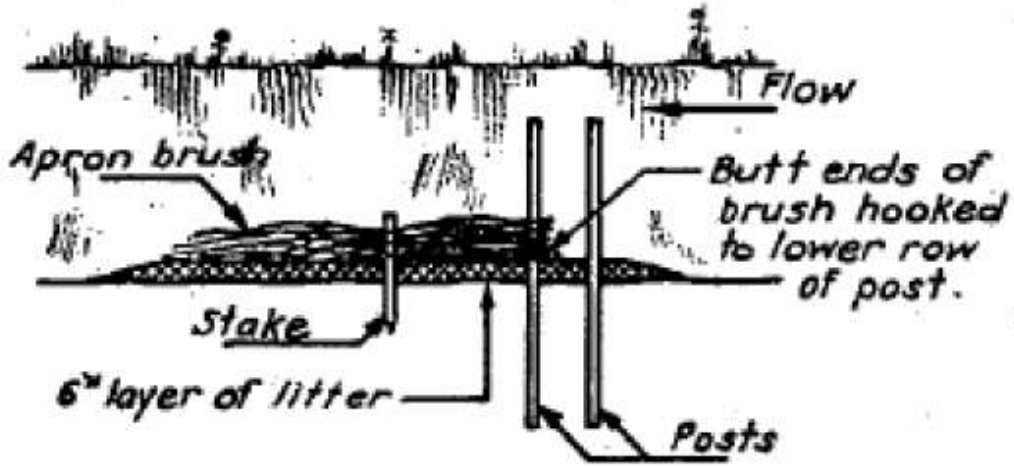


Figure 27
Side section of dam after apron brush has been placed.

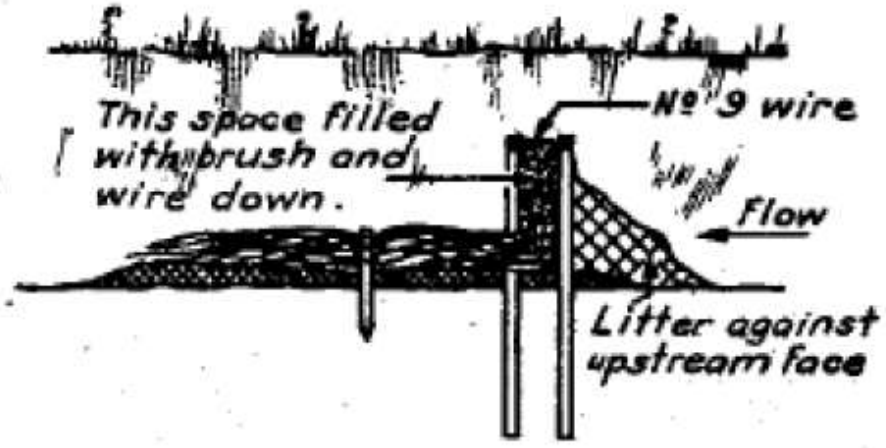
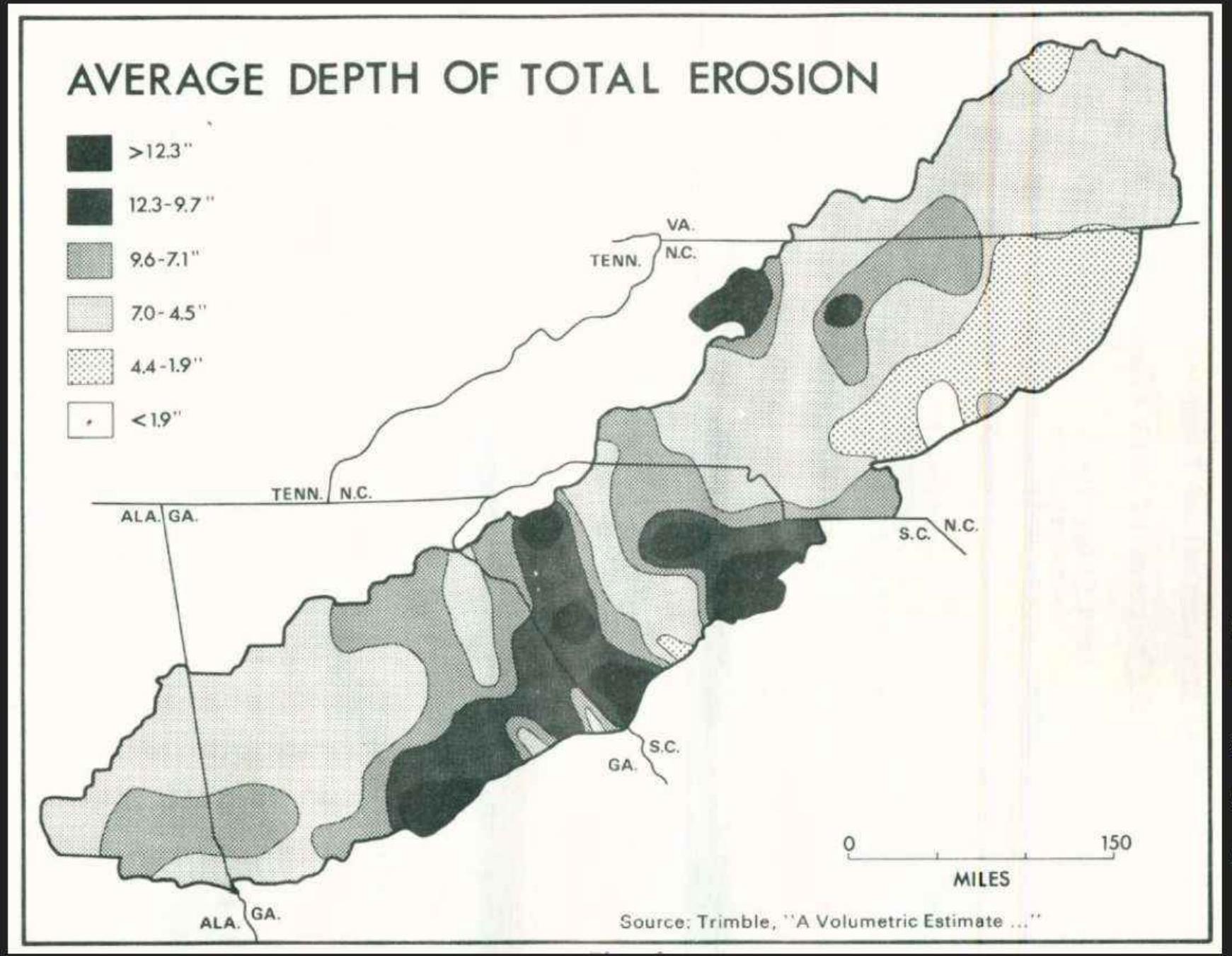


Figure 28
Side section of completed dam.

Figure 8 –Figures from Handbook of Erosion Control in Mountain Meadows (Kraebel and Pillsbury, 1934). The approach to restoration and many of the specific techniques are similar to the approaches outlined in this manual, though tending to focus on ephemeral channels.



Trimble, S.W. (1974)

"Man-induced soil erosion on the southern Piedmont, 1700-1970."

Soil Conservation Society of America.

Robinson Design Engineers

FORESTED VIRGIN LAND DAMAGED BY GULLIES

THAT STARTED IN AN ADJACENT HIGHER-LYING FIELD. SPARTANBURG COUNTY, SOUTH CAROLINA.

Bennett, H.H. and W.R. Chapline

(1928)

"Soil Erosion A National Menace."

US Department of Agriculture

Robinson Design Engineers

RESERVOIR FILLED WITH EROSIONAL DEBRIS

TO THE TOP OF THE DAM (BUT NOT TO THE TOP OF THE FLASHBOARD EXPEDIENT ON TOP OF THI STONE MASONRY FOR MAKING SOME LAST, SHORT-PERIOD USE OF THE COSTLY STRUCTURE). PACOLET RIVER, 7 MILES NORTH OF SPARTANBURG, SOUTH CAROLINA.

Bennett, H.H. and W.R. Chapline

(1928)

"Soil Erosion A National Menace."

US Department of Agriculture

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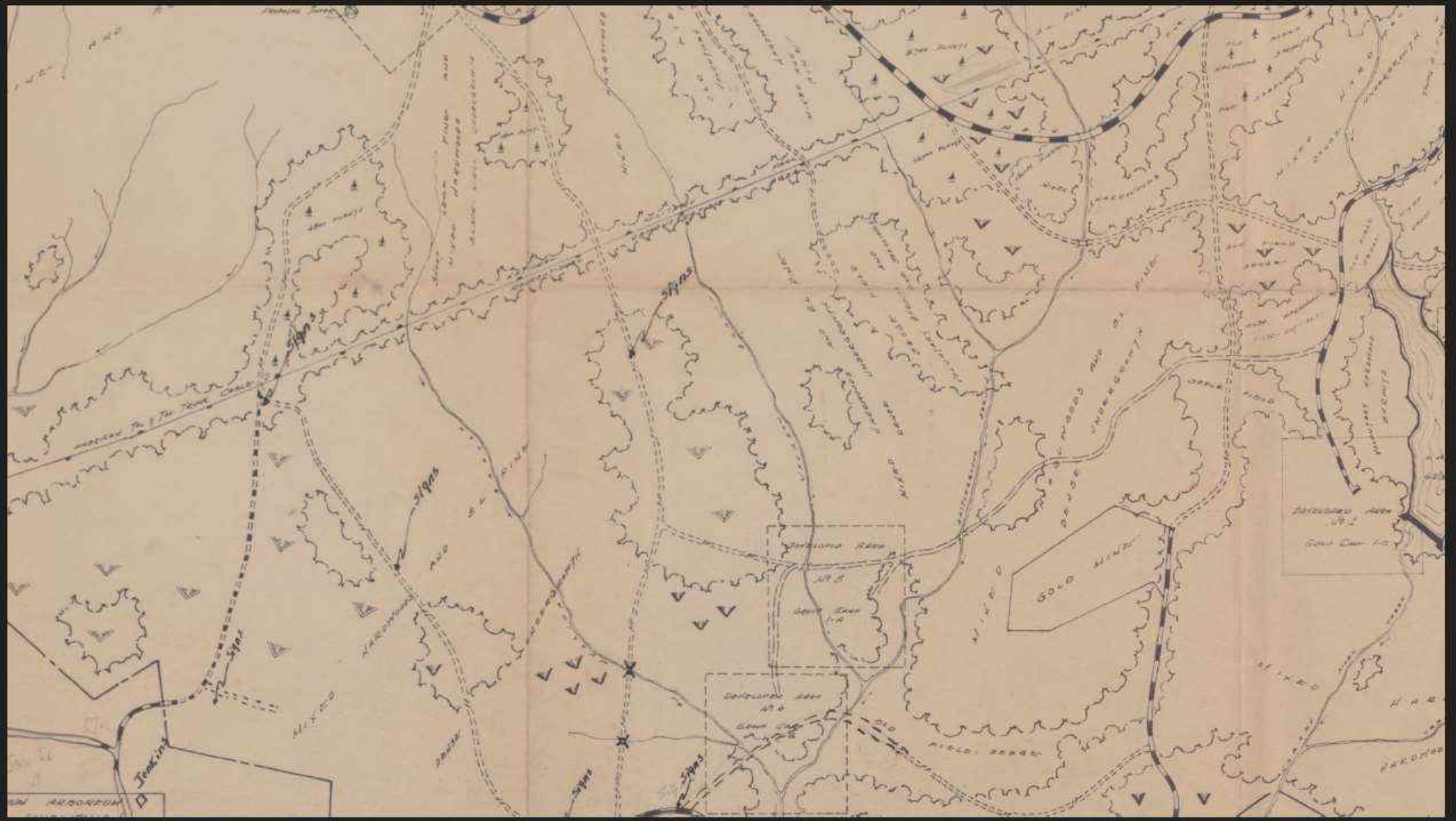
Kings Mountain Park, 1937
5070



FIELD PLANTING - TREES

EROSION CONTROL TREATMENT

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LTPBR PRINCIPLES

RIVERSCAPES PRINCIPLES:

1. **Streams need space.** Healthy streams are dynamic, regularly shifting position within their valley bottom, re-working and interacting with their floodplain. Allowing streams to adjust within their valley bottom is essential for maintaining functioning riverscapes.

2. **Structure forces complexity and builds resilience.** Structural elements, such as beaver dams and large woody debris, force changes in flow patterns that produce physically diverse habitats. Physically diverse habitats are more resilient to disturbances than simplified, homogeneous habitats.

3. **The importance of structure varies.** The relative importance and abundance of structural elements varies based on reach type, valley setting, flow regime and watershed context. Recognizing what type of stream you are dealing with (i.e., what other streams it is similar to) helps develop realistic expectations about what that stream should or could look (form) and behave (process) like.

4. **Inefficient conveyance of water is often healthy.** Hydrologic inefficiency is the hallmark of a healthy system. More diverse residence times for water can attenuate potentially damaging floods, fill up valley bottom sponges, and slowly release that water later elevating baseflow and producing critical ecosystem services.

RESTORATION PRINCIPLES:

5. **It's okay to be messy.** When structure is added back to streams, it is meant to mimic and promote the processes of wood accumulation and beaver dam activity. Structures are fed to the system like a meal and should resemble natural structures (log jams, beaver dams, fallen trees) in naturally 'messy' systems. Structures do not have to be perfectly built to yield desirable outcomes. Focus less on the form and more on the processes the structures will promote.

6. **There is strength in numbers.** A large number of smaller structures working in concert with each other can achieve much more than a few isolated, over-built, highly-secured structures. Using a lot of smaller structures provides redundancy and reduces the importance of any one structure. It generally takes many structures, designed in a complex to promote the processes of wood accumulation and beaver dam activity that lead to the desired outcomes.

7. **Use natural building materials.** Natural materials should be used because structures are simply intended to initiate process recovery and go away over time. Locally sourced materials are preferable because they simplify logistics and keep costs down.

8. **Let the system do the work.** Giving the riverscape and/or beaver the tools (structure) to promote natural processes to heal itself with stream power and ecosystem engineering, as opposed to diesel power, promotes efficiency that allows restoration to scale to the scope of degradation.

9. **Defer decision making to the system.** Wherever possible, let the system make critical design decisions by simply providing the tools and space it needs to adjust. Deferring decision making to the system downplays the significance of uncertainty due to limited knowledge. For example, choosing a floodplain elevation to grade to based on limited hydrology information can be a complex and uncertain endeavor, but deferring to the hydrology of that system to build its own floodplain grade reduces the importance of uncertainty due to limited knowledge.

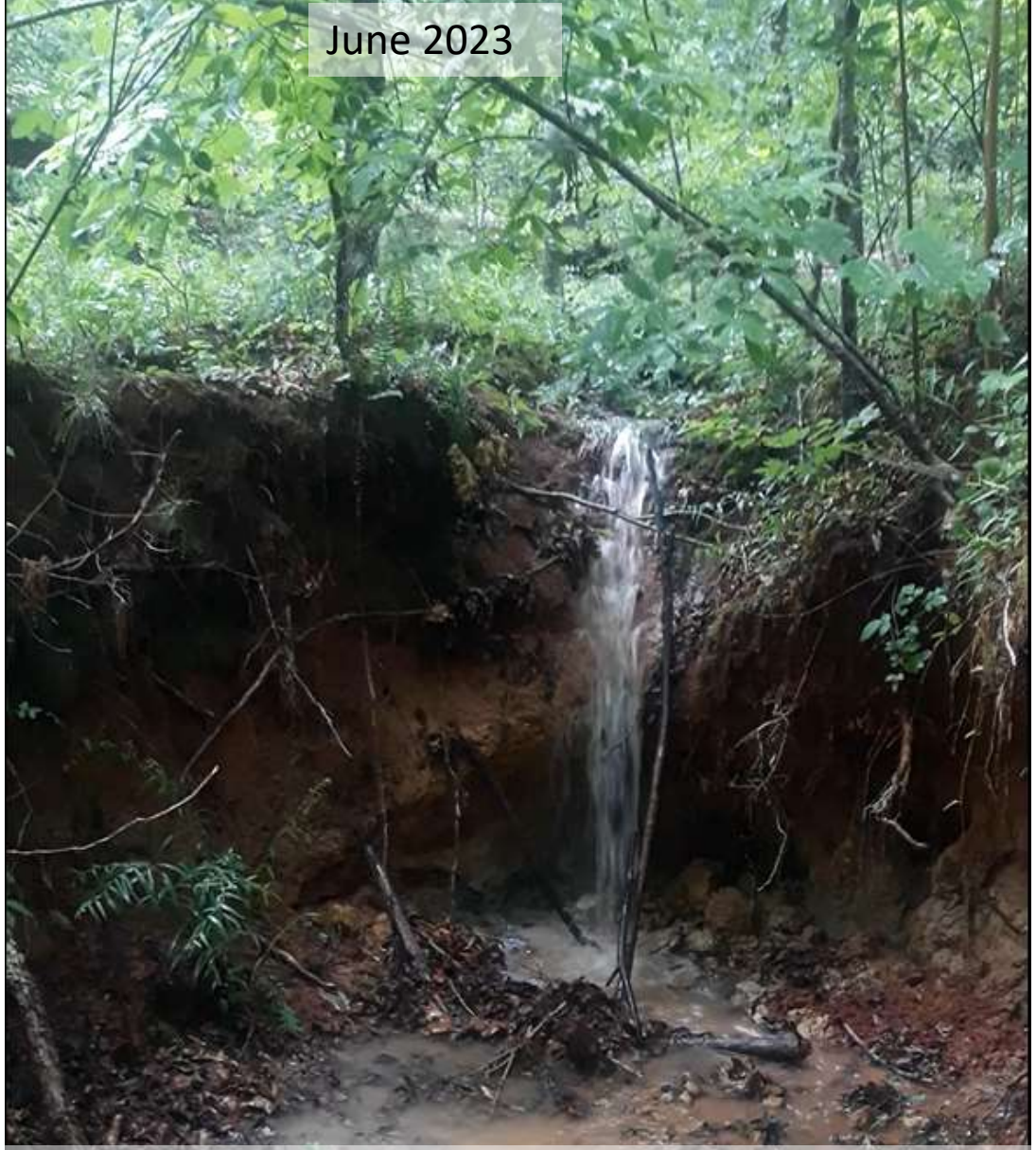
10. **Self-sustaining systems are the solution.** Low-tech restoration actions in and of themselves are not the solution. Rather they are just intended to initiate processes and nudge the system towards the ultimate goal of building a resilient, self-sustaining riverscape.

Free Books!

- Wheaton JM, Wheaton A, Maestas J, Bennett S, Bouwes N, Shahveridan S, Camp R, Jordan C, Macfarlane W, Portugal E, Weber N. 2019. Low-Tech Process-Based Restoration of Riverscapes: Pocket Field Guide. Utah State University Restoration Consortium. DOI: 10.13140/RG.2.2.28222.13123/1.
- Wheaton J.M., Bennett S.N., Bouwes, N., Maestas J.D. and Shahverdian S.M. (Editors). 2019. Low-Tech Process-Based Restoration of Riverscapes: Design Manual. Version 1.0. Utah State University Restoration Consortium. Logan, UT. 286 pp. DOI: 10.13140/RG.2.2.19590.63049/2.

Both banks are undercut, exposing an old tire about halfway down from the bank to the bed.

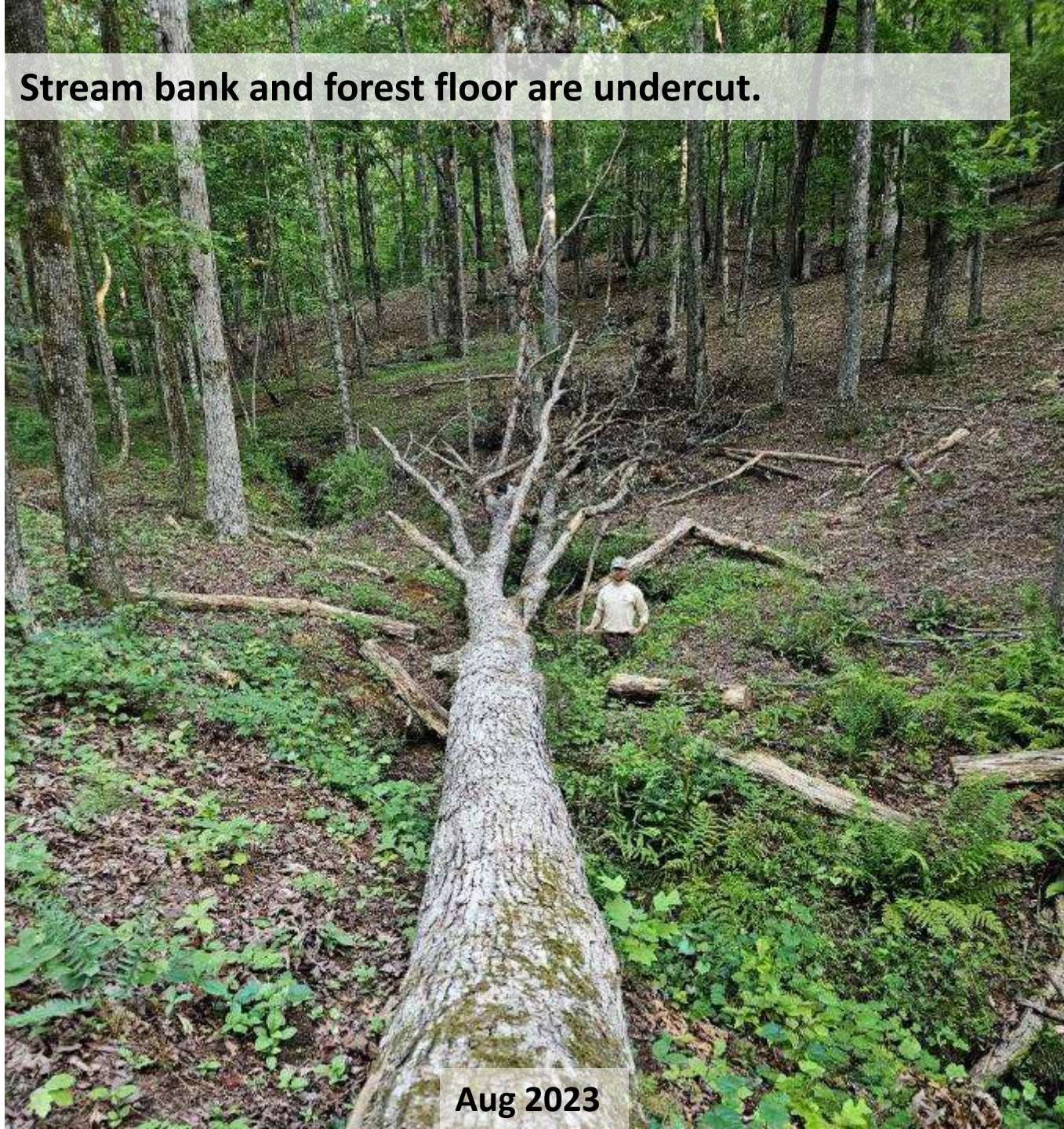
Upstream, logs bucked off a widow-maker snag and dropped into the creek – they've accumulated inches of sediment...



The springhead, in a totally forested watershed, is incised over five feet.

Stormwater from the road flows in an open channel through the forest to the creek, exposing roots along the way.

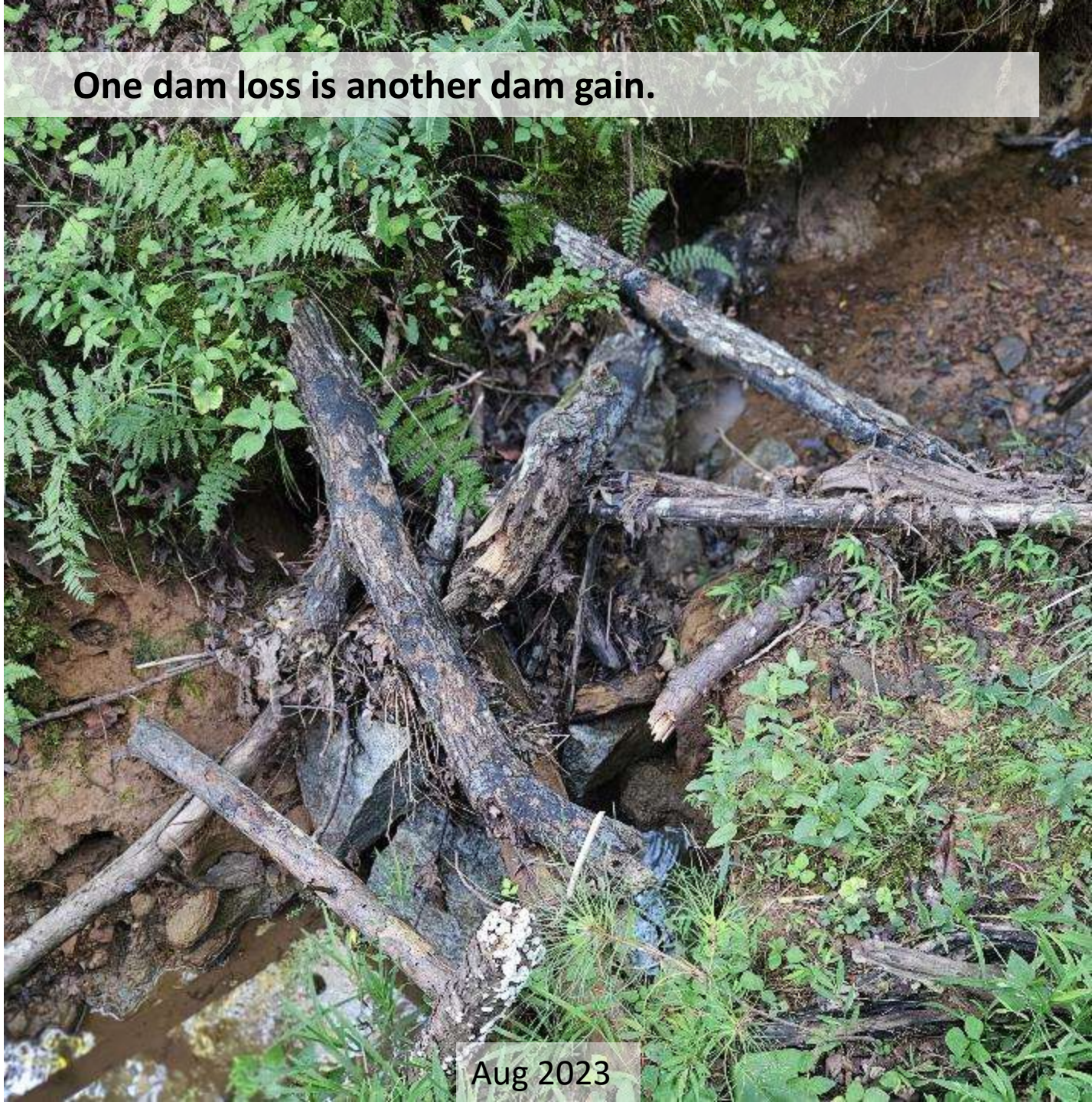

Stream channel is incised into legacy sediment.
Aug 2023


Stream bank and forest floor are undercut.
Aug 2023

Plenty of material to build habitat structure.

Aug 2023

One dam loss is another dam gain.



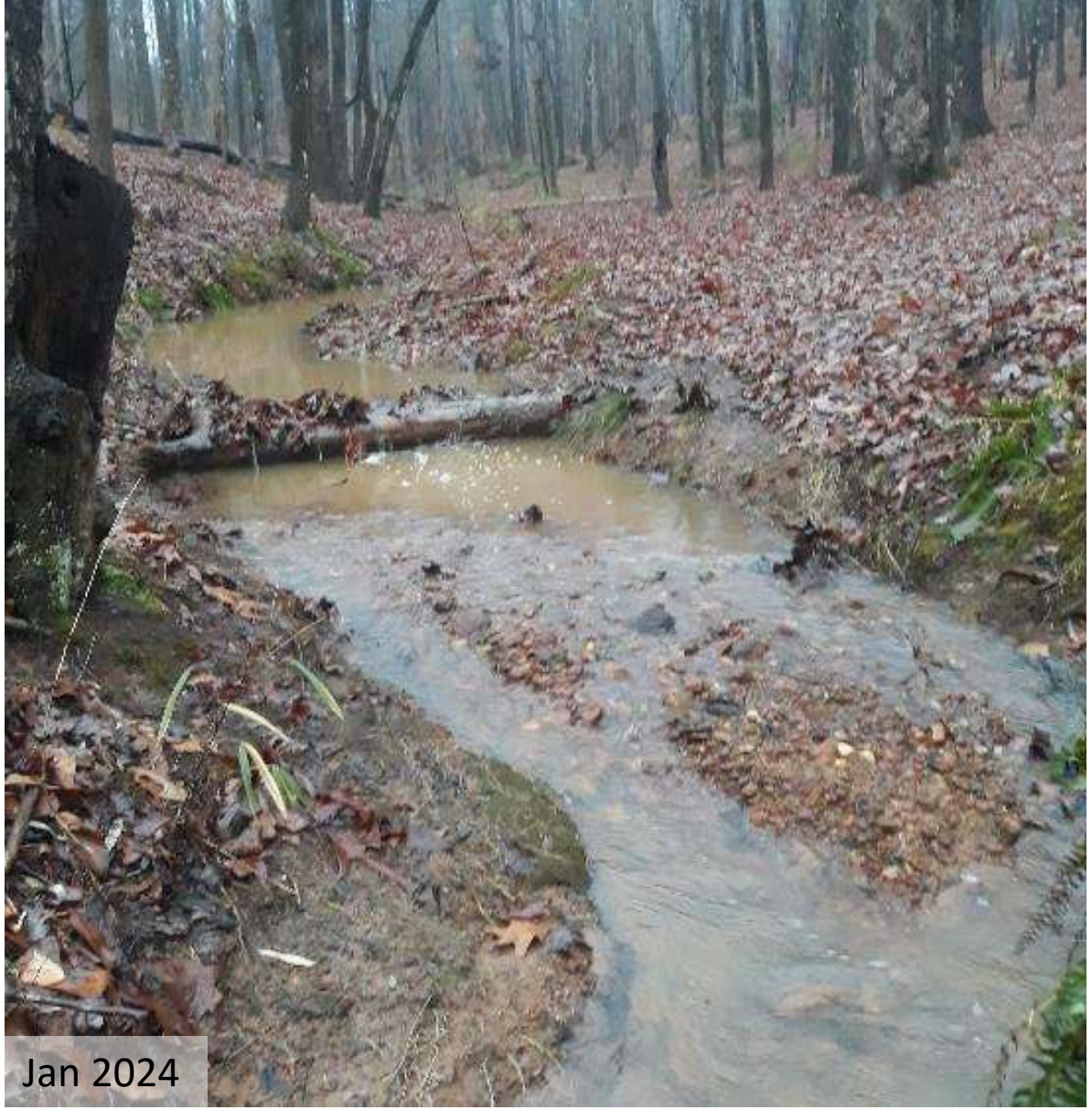
Aug 2023


Jun 2023


Jun 2023


Jan 2024


Jan 2024



Low effort: 1 log, dug into the banks a few inches.

Extremely low effort: a couple of logs left where they lay.

Moving forward

- Guidance on USACE NWP 13 – Bank Stabilization
- Guidance on USACE NWP 27 – Stream Restoration
- Watershed Based Plans
- River Basin Plans
- Forestry BMPs
- Adopt-a-stream?
- NRCS funding?
- ~~Mitigation Credit?~~
- Research, monitoring, and evaluation:

Daniel Hanks and others install posts for habitat enhancement, 2023.