A Review of Two Novel Water-Tight Beaver Dam Analogs (WTBDA) to Restore Eroded Seasonal Creeks in Drain Tile Zones, to Permanent Beaver Wetlands.

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Abstract
This study reviews the design and impact of two novel *water-tight* beaver dam analogs (BDAs) developed in Iowa for settings where seasonal rains wash out beaver dams and conventional beaver dam analogs. This concept combines traditional BDA technology, mimicking natural structures that last and earthen dam science. Deep bank incision and increased drainage have created vast ecosystems where beaver dams and riparian habitat are impossible, because they get washed out. This study intends to remedy this situation and attract beaver wetland ecosystems to historic coordinates.

Introduction
The traditional beaver dam analog has been met with much enthusiasm and success. However, it has limitations in seasonal creek areas where creeks are less than 1” deep and beavers are unlikely to dam.

Hypothesis
If a water-tight beaver dam analog were constructed, it could hold enough water year round, that a beaver colony could take over maintenance of the structure resulting in a permanent and thriving wetland ecology.

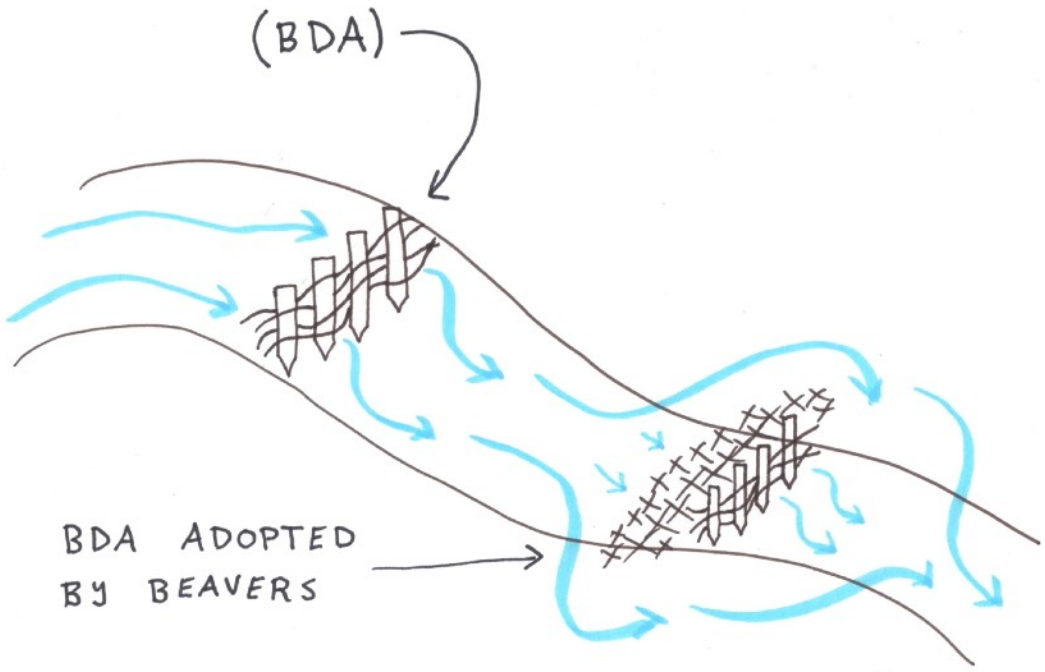

Figure 1. Traditional Beaver Dam Analog (BDA)

Scientific Method - Log Spillway Design

- Identify a natural log bridge across the creek or precision-drop a tree. Pin with stakes and mimic nearby flood tolerant natural structures.
- Drive vertical posts into the creek bed, supported by the natural log spillway bridge. Scrap ash logs milled to 3”x3” and up to 9’ long were utilized. Ends were cut to point and driven in with a Titan gas powered post pounder.
- Invasive honeysuckle and overgrowth were cleared for wetland sun. Dormant native wetland species were observed and expected to return.
- Weave branches into BDA - beaver dam analog.
- Use 4wd dump truck to deposit water tight clay plug.
- Dump gravel and rocks on top of and around clay plug to prevent erosion of clay. Fill in the area between clay plug and BDA.
- Plant scrub willow and native wetland seeds into dam and bank for habitat and future beaver food.

- Willow stakes 2’-8’ long were used. Thicker, longer and straighter posts are ideal. Ends sharpened. Scrub willow is a beaver’s favorite food and gets about 15’ tall. Species vary and include red, white, black and coyote willow in the west.

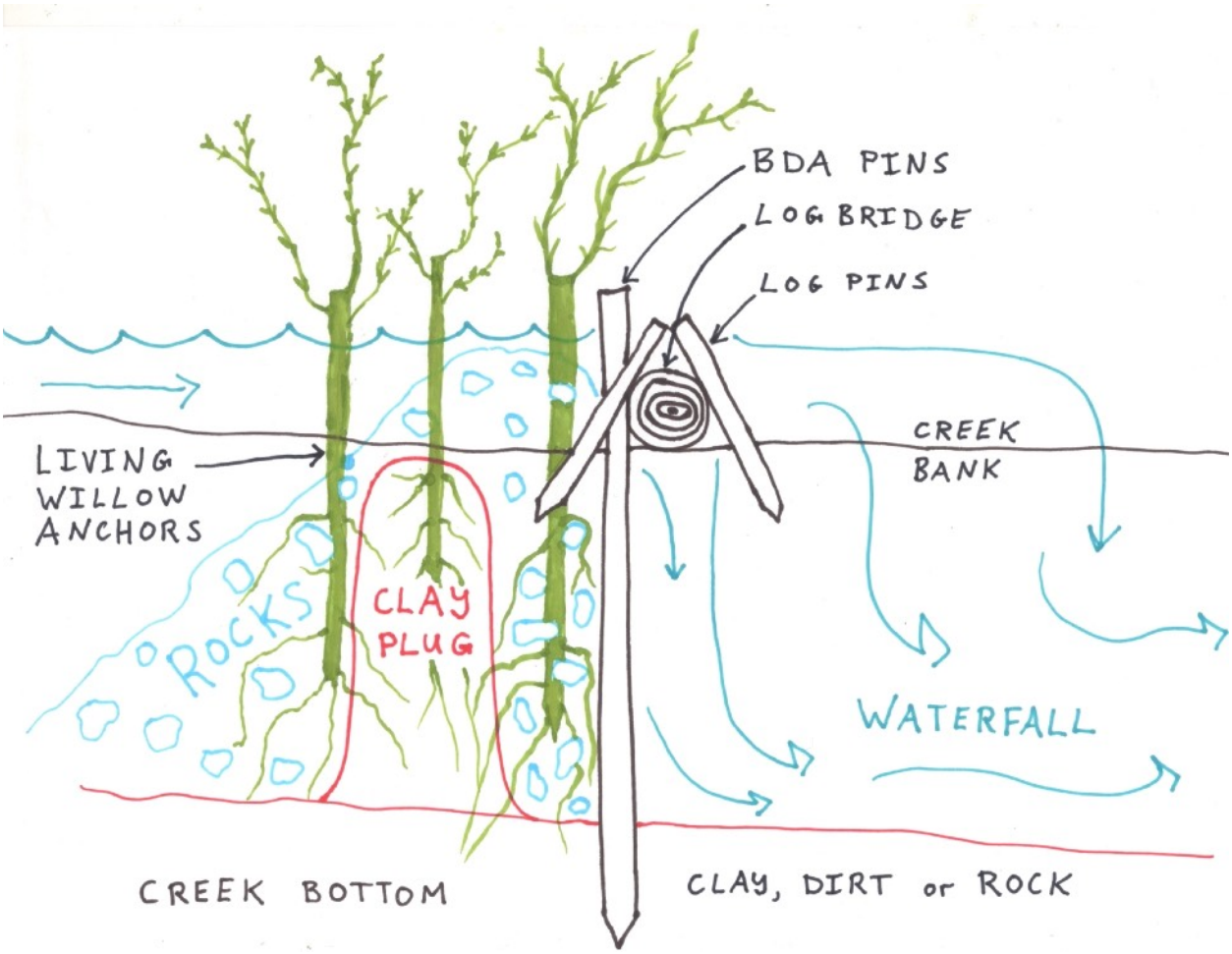

Figure 2: Water Tight Beaver Dam Analog (Log Spillway WTBDA)

Figure 3: WTBDA After 1 Year.

Figure 4: WTBDA Upstream View

Scientific Method - Berm Design

- Identify a spot with easy access for dump truck and potential for successive pools.
- Dump 3 loads of clay at 1.5 tons per load to achieve desired water depth.
- Tamp and pack clay between each load.
- Dump and spread rocks, 1 load 3” gravel, 1 load 1” gravel.
- Add native wetland grass seed.
- Use mini sledge to drive in willow stakes in 1/sf grid.
- Use grafting wax or non-toxic glue to seal open wounds on willow.
- Build a “safety dam” downstream of berm to create a scour pool during high flow.

Figure 5: Berm Style WTBDA Upstream Side

Figure 6: Berm Style, Downstream Side with Safety Dam

Figure 7: Clay Berm Under Construction

Figure 8: Safety Dam Closeup

Figure 9: Upstream View with Abandoned Standards BDA

Results

- Water increased from 1 inch to 2-3 feet deep.
- Observed fish, tadpoles and frogs grow to normal size in the first week.
- Observed dragonflies in 2nd week.
- Greater varieties of butterflies and moths.

- In about 3 years, beavers are expected to arrive and maintain dams.
- Tree protection and water leveling devices can be used if needed.
- Mosquitoes are expected to reduce due to increased predators.
- Native fish can migrate up the dam during high flow.
- Crayfish burrowed around the clay plug, through the topsoil and leaked water downstream. This appeared to not disturb the WTBDA structure.
- Touch up rocks and heavier rocks may be placed around edges after heavy rainfall as needed. Piles of extra rocks are recommended.
- Creek widening into braided channels was observed, as well as saturation of lower bank soil. Existing grasses and mosses prevented erosion during high flow.
- Little to no erosion was observed and sediment appeared.
- Pools formed for about 100’ in both upstream forks and reached the road culvert.
- 1.5 tons was comfortably loaded into 3/4 ton Chevy diesel 4WD. Mudding tires are used to reduce soil compaction and ruts. Care was taken to not bottom out and only cosmetic scratches were observed to the truck.
- Erosion and dam failure appeared to start at the downstream end. Therefore the “safety-dam” was developed and tested to disburse kinetic energy of bottom ends of successive BDAs.

Notes

- Invasive carp theoretically cannot go up the natural dam, thereby encouraging emergent vegetation.
- Beaver colonies can occupy dam complexes for over 30 years and then repopulate years later after tree food has grown back.
- Beavers mate for life and offspring will look to populate upstream and downstream areas first.
- They are non-violent and build scented mounds to mark their territory.
- High beaver concentration areas like the midwest can expect nuisance beavers to comb the entire area every 2-3 years, seeking out potential habitat that is rare to find. Currently, man-made ponds are usually the best option.

- Clay and rocks are piled up higher along edges in a H formation such that if failure occurs, it will not cause bank erosion.

Cost Analysis

Considering the overwhelming scale and cost burden of restoring a significant amount of creeks, along with strong potential of failure, it was hypothesized that minimal impact, over a longer range, would yield more efficient results in the long term. With a $2000 investment of a dump-kit style dump truck, cost per WTBDA/BDA is about $2000-$3000. Compared with the $30,000 cost for government contract style BDAs and $5000 cost without dump-kit, these methods are concluded to be the most cost effective and ease-of-use for wide scale implementation. This analysis is also intended to serve as an instruction manual for any landscaping or contracting firm to fulfill any beaver friendly ecological objectives.

Conclusion

The WTBDA was developed over 4 years of research and development in Iowa. Previously, BDAs washed away, beavers ate willow BDAs, undesired creek widening and everything imaginable. It took about 2-3 man hours to shovel a load out of the truck, therefore a Pierce-Arrow hydraulic dump kit was installed. A good investment for contractors, due to rust-proofing and easy underbody pressure washing. As with standard beaver dams, WTBDAs work better in succession. With downstream pools touching upstream dams. In conclusion, these WTBDA designs are suitable for any type of grant for restoration and water quality including Gulf of Mexico dead zone projects. Also, the berm style is recommended for most applications due to less tools required and simpler construction. Berm style is recommended for first time builders and also the standard BDA with log bridge for bigger watersheds in drain tile zones.

References

https://lowtechpbr.restoration.usu.edu

https://www.beaverinstitute.org

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