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Use of Hay Bales in Stream Restoration:

-A Review of Their Performance, and Vegetation Establishment to Secure Stability

Tuesday August 2nd

3:50pm

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5 Smooth Stones Restoration/River SHARED

Hay Bale Structures for NCD (2009-2022)

- Idea first shared with RiverSHARED members in 2005 but structures had not been constructed at that time based on my understanding
- RiverSHARED members first constructed structures in Oklahoma in 2010 that were designed in 2009
- Since 2009:
  - >30 miles of restoration projects (OK, TX, CO, and SK)
  - >300 structures constructed (OK, TX, CO, and SK)
  - No recorded failures

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Advantages

- Savings of money and time
  - Hay Bale ~$15/lf
  - Brush Toe ~$75/lf
  - Coir Lift ~$100/lf
  - Toe Wood with Coir ~$125/lf
- Saves resources and transport
- Local material sourcing

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Preliminary Design Criteria (Very Important)

#1 Low risk

#2 Intermittent streams or ephemeral (Bankfull Width = 6-15ft)

#3 Drainage area less than ~0.3 square miles OK/TX (Based on Region)

#4 Velocity less than 2.5ft/s (100yr, design storm and/or BKF)

#5 Average Boundary Shear Stress less than 1.5psf (100yr, design storm and/or BKF)

#6 High potential for revegetation (including upland vegetation)

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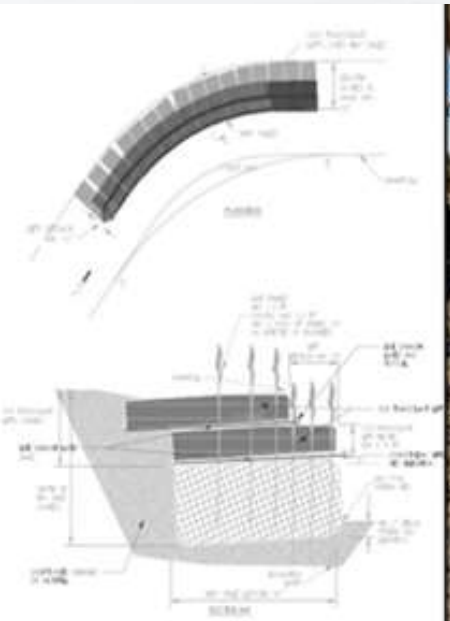
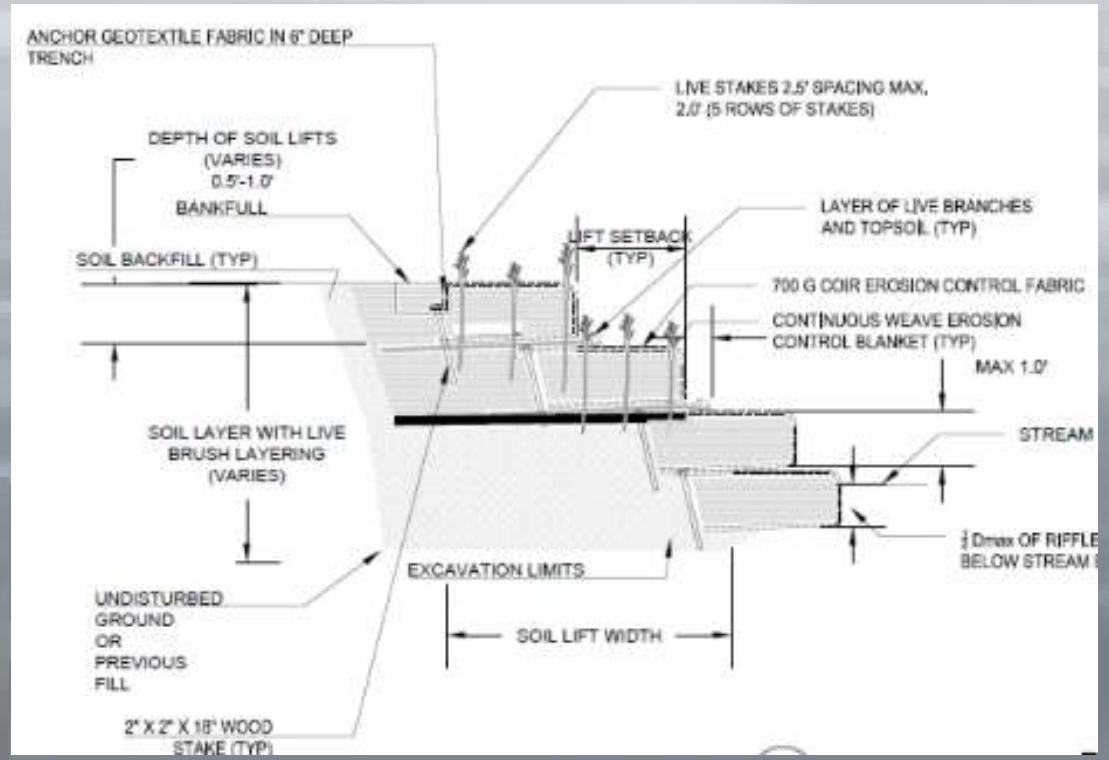
Hay Bale Structures For Channel Design



Example Detail

Post-Construction

2 years Post-Construction



Coir Lifts– Bank Protection – Cherry Creek

April 2019

April 2022

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Round Bale Gully Grade Control 2010

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Hay Bale Floodplain Sills and Riffles 2010


Hay Bale Riffle
Construction
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Pre-Construction 3-2010

Post-Construction 10-2010


Hay Bale Meander Bank protection and
Grade Control Installation
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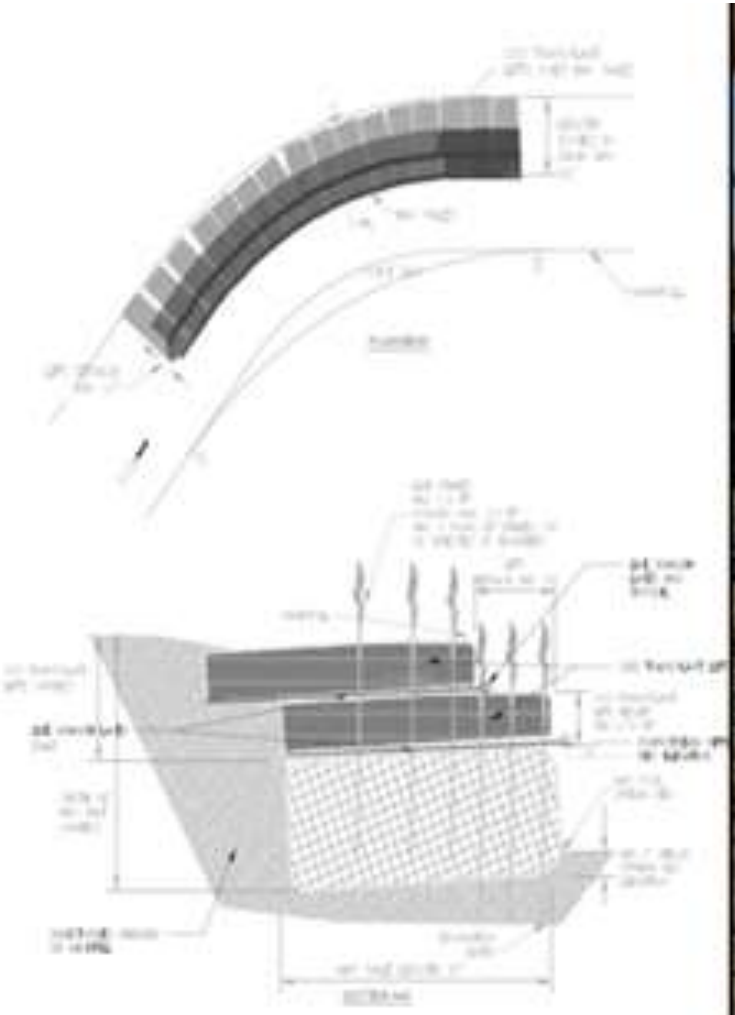
Trimble
CB460
0.03
968.50
968.80

Hay Bale Toe and Bank Stabilization

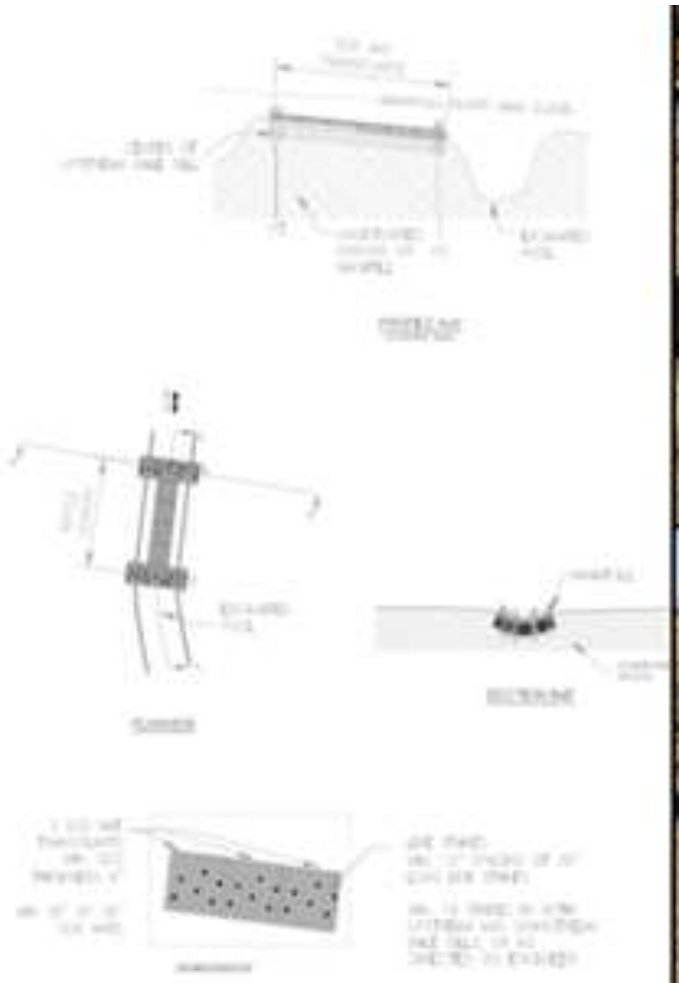


Example Detail

Post-Construction

2 years Post-Construction

Hay Bale Constructed Riffles for Small Channels

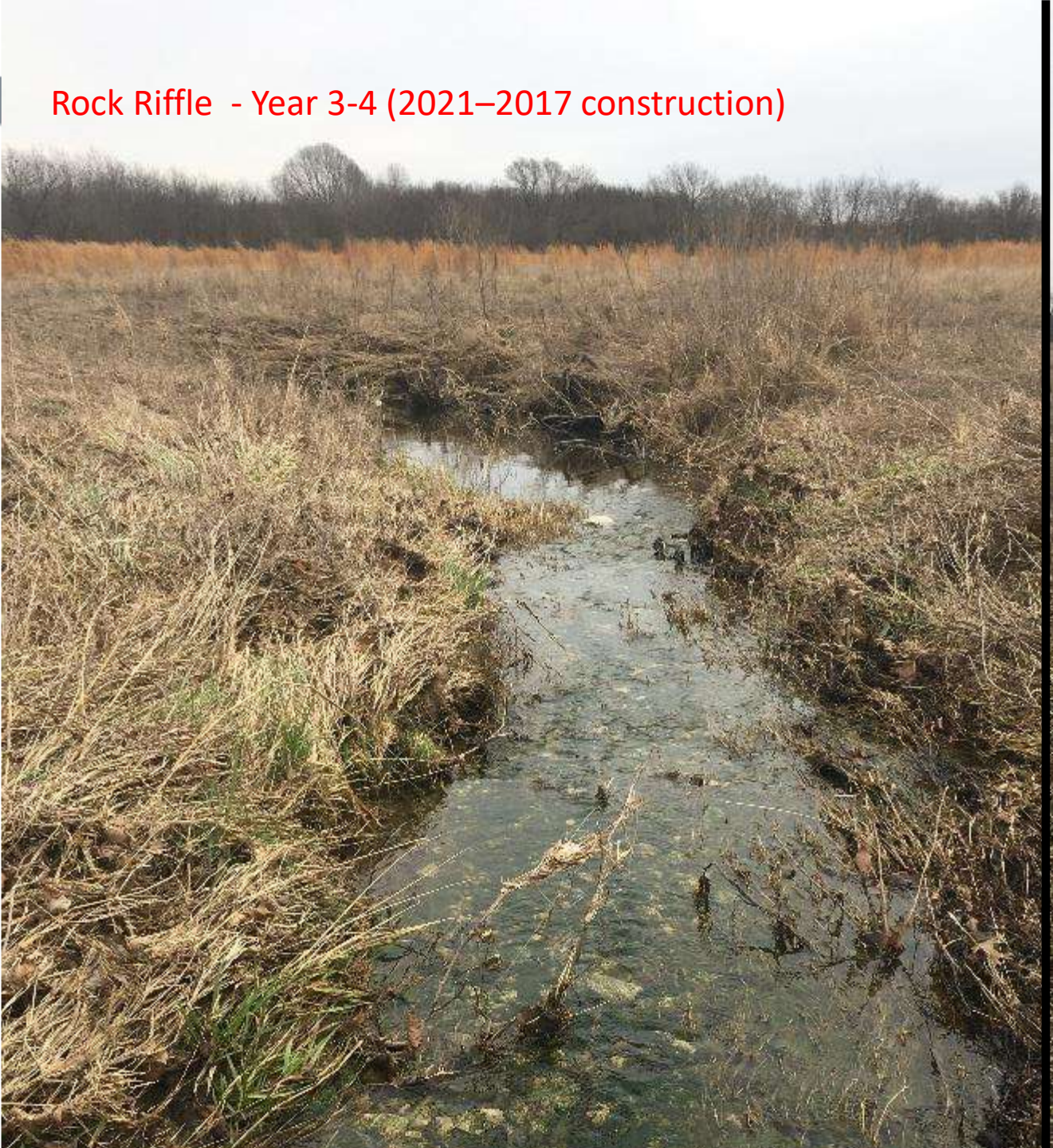


Example Detail

Post-Construction

2 years Post-Construction

Rock Riffle - Year 3-4 (2021–2017 construction)



Hay Bale Riffle Year 3-4 (2021–2017 construction)

Important Considerations When Procuring Hay Bales

- Hay bales should be harvested from areas near project site
  - Similar plant populations
  - Desirable plant seeds
- Avoid introduction of invasive weed via seed
- Small square bales work best for structures

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Re-Vegetation of These Areas

- Ephemeral and prairie streams
- Due to low flow and low risk conditions, sod mats (sourced on-site) are typically a good choice
  - Biology of local grasses
  - Suitability for sod mats
- Locally sourced willows and transplants are additional possibilities depending on current vegetation conditions

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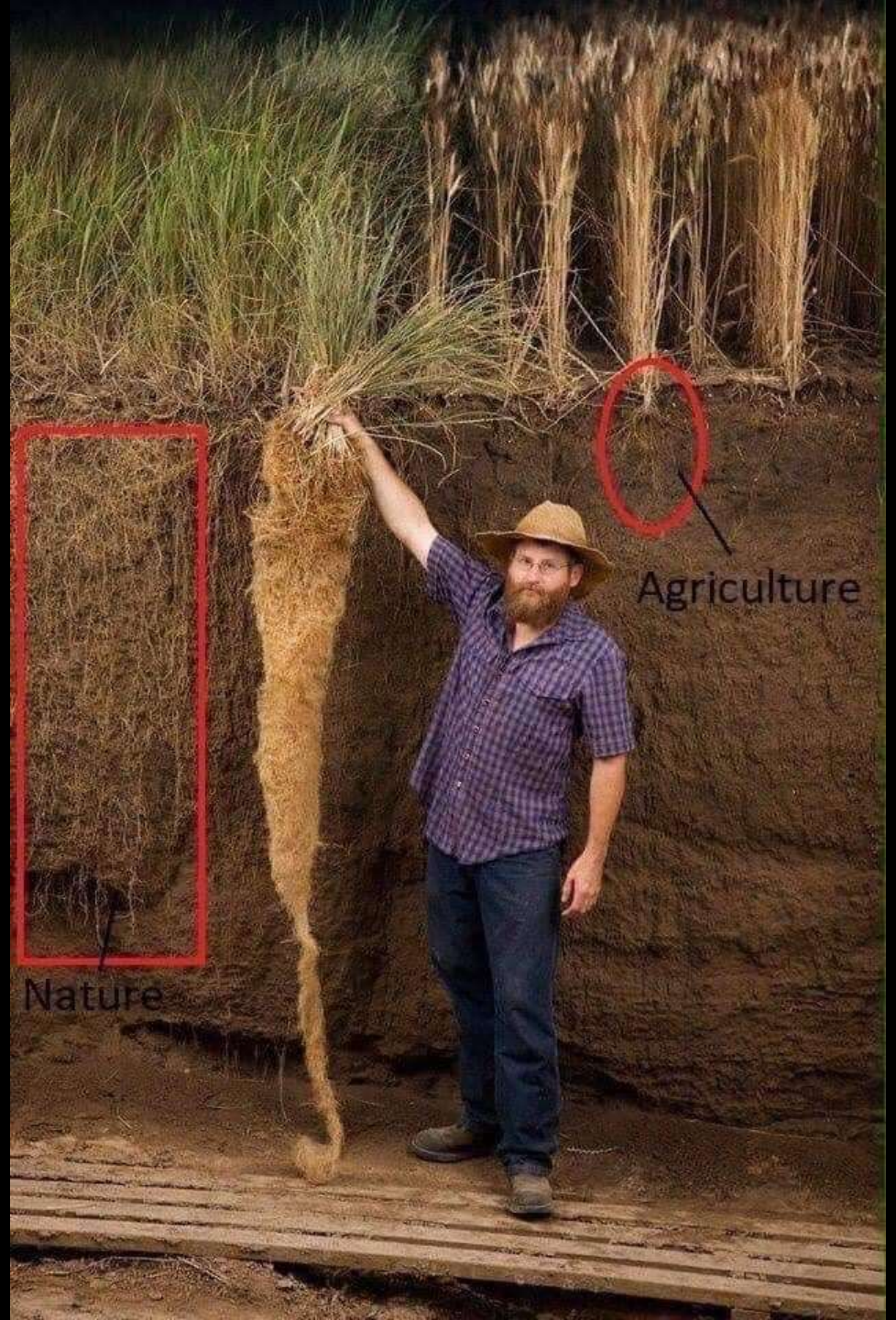
Agriculture
Nature

Summary

- Is there a place for Hay Bale Structures in Stream Design/Development
- Experiment with Design Insurance
- Increase warranty from 1yr to 3yr
- RiverSHARED 3yr Construction Maintenance Pre-MHFD

- Saves money?
- Saves resources?
- Local Material Sourcing?