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ecological restoration

Less is More:
Sustainable Strategies for Stream Restoration Design and Construction

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Presented by:
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Less is More

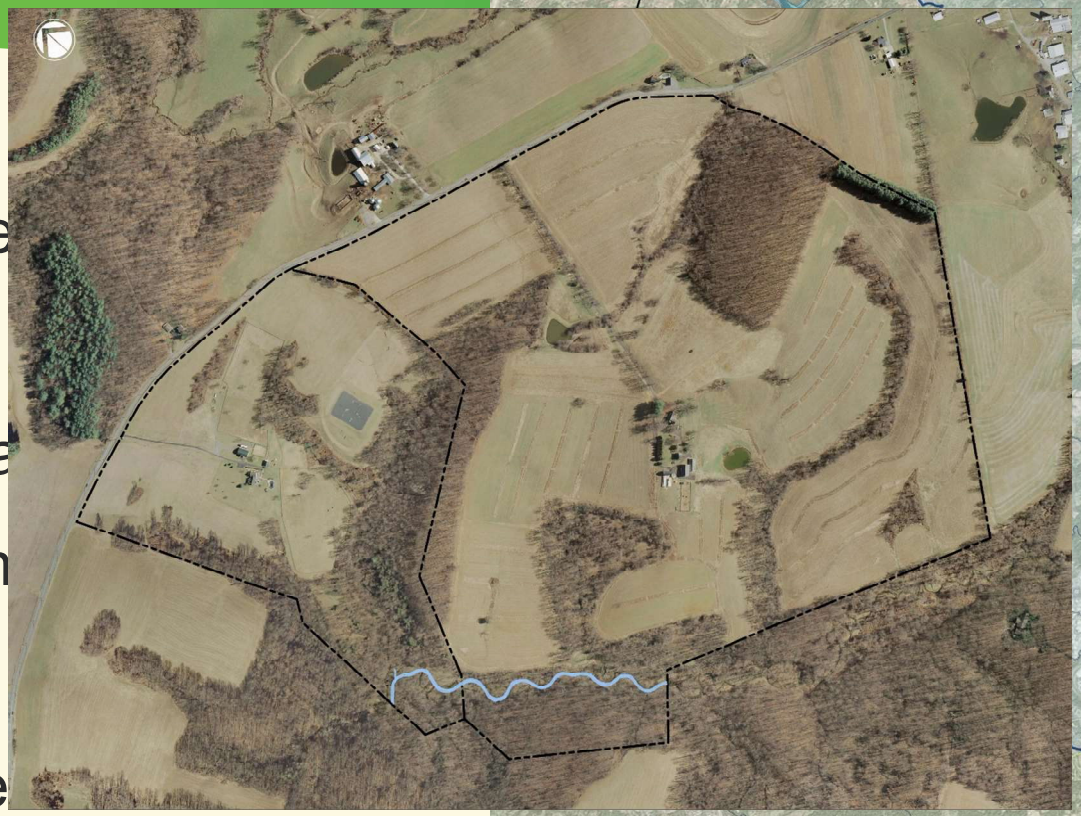
- **Always be sustainable (ABS)**
  - **Site Assessment**
  - **Design**
  - **Construction**
- **Use design constraints as a tactic for a sustainable project**
- **Design for the long now**
- **Ecosystems services and trophic cascades**


SAVING MONEY
SUSTAINABILITY
Less is more!!

Rock, rock, rock

More or Less?

First Mine Branch



- 1.3 Square Mile
  Area
- Loch Raven Wa
- Northern Baltim
- Brown trout
- 2,400 linear fee
  restored

Existing Conditions

- Bed and Bank Erosion
- Meander Migration
- Low/No Floodplain Connectivity

Project Goals

- Stabilize
- Maximum Habitat
- Design Constraint

“When forced to work within a strict framework the imagination is taxed to its utmost – and will produce its richest ideas. Given total freedom the work is likely to sprawl."

— T.S. Eliot

Identify opportunities for reuse of materials at initial site analysis

1.Wood/brush/trees/root wads
2. Rock/cobble/gravel
3. Topsoil
4. Sod/grass
5. Transplants/live stakes
6. Seeds –peat

What's on site?

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FIRST MINE STREAM RESTORATION

DESIGN SUSTAINABILITY REVIEW CHECKLIST

Mandatory Sustainability and Constructability Review at 60% design

INITIAL SITE INVENTORY

- ✓ Rock/Gravel source – Wide variety of gravel size/plenty to salvage d84 ≈ 30 mm
  - Are soil borings necessary/beneficial? Yes would be beneficial
- ✓ Wetland peat layer
  - Beneficial to plot profile? potential wetlands present to be delineated
- ✓ Wetland sod/upland sod sources – quantify – majority of site is completely wooded/source of upland sod
- ✓ Sod grow areas – quantify – large adjacent fields/discussion with the landowner
- ✓ Live stake source – quantify ≈120 trees (via tree survey)surrounded by trees to be used as potential live stake source
- ✓ Root wads/logs – quantify ≈120 trees (via tree survey) in construction area/adequate amount of quality tress
- ✓ Inventory summary spreadsheet completed

DESIGN CONSIDERATIONS

- ✓ Utilize inventory spreadsheet to maximize use of on-site materials
- ✓ Vegetation/wood vs. Rock – a lot of wood
  - Maximize use of vegetation/wood and keep submerged
  - If using Rock, justify – No rock to be used as main structures
- ✓ Are there opportunities to recycle/reuse materials? Yes-trees can be used for structures and adequate riffle material
- ✓ Sun vs. shade, aspect – consider for bioengineering plan Is currently forested/and will still have some tree cover
- ✓ Furnished materials available locally - Majority of material can be salvaged on site
- ✓ Reduce Transport Costs
  - Haul Off Reduced by using on-site materials and spoils areas -little/no haul off abundance of on-site material
  - Haul On Reduced by balancing cut/fill -adjacent fields for balance

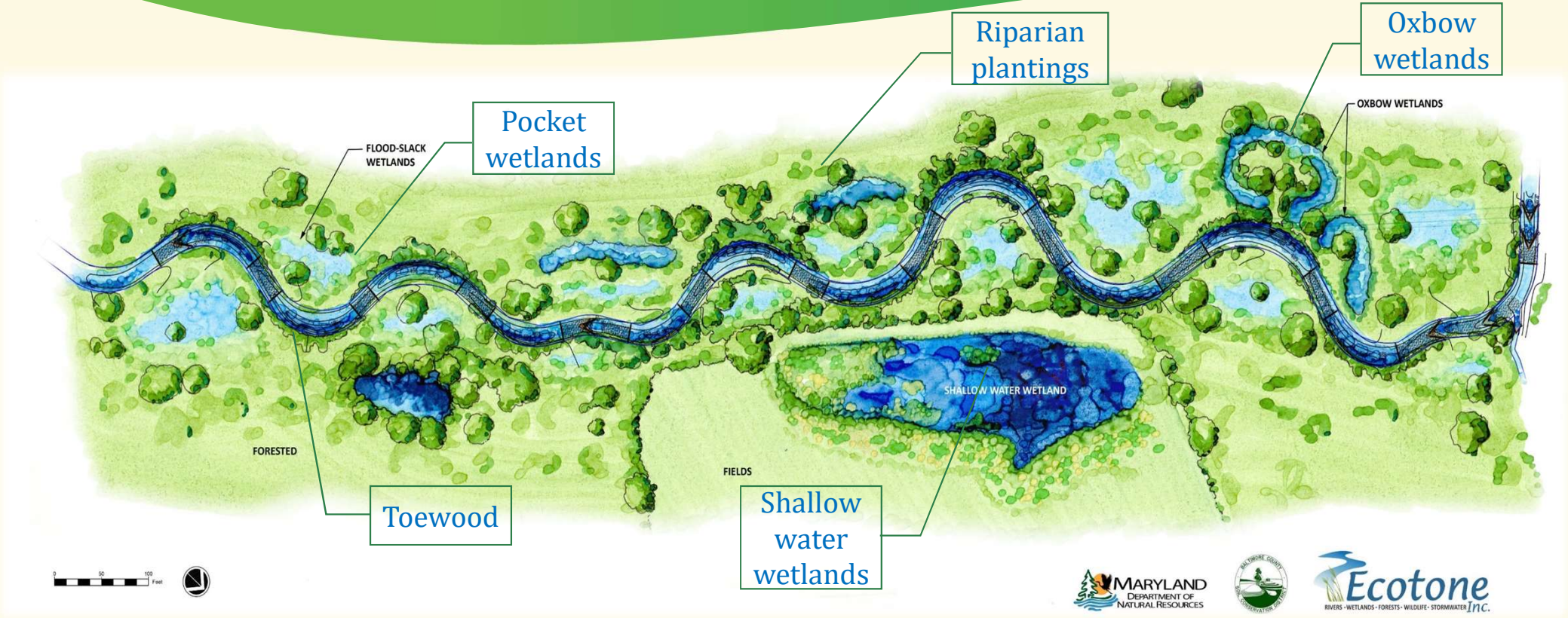
CONSTRUCTABILITY CONSIDERATIONS

- ✓ Stockpiles
  - Short Dirt - Are locations of spoils areas adequate Yes-large adjacent fields, discuss with landowner if there is anywhere else they may want soil
  - Is the stockpile area large enough for construction needs Yes
- ✓ Is the LOD adequate for efficient construction Yes no restrictions
- ✓ Does the design allow for creativity/flexibility during construction Yes no restrictions
- ✓ Reviewed by Director of Construction at 60% design

FOR PLANS

- ✓ Description of project in 20 years – function, appearance, sediment transport condition (aggrading/degrading)
- ✓ Materials list with salvaged and furnished materials – completed at 90%, need additional construction review
- ✓ Local sources of material identified on plans with contact information – hopefully not required, hopeful to use all materials from on-site

Design Approach



Sod


Legacy Sediment
Peat Layer
Cobble Layer

Peat

Free Seeds!!

Soft rush	*Juncus effusus*	20%	FACW
Straw Colored Flat Sedge	*Carex straminea*	12%	OBL
Canada rush	*Juncus canadensis*	7%	OBL
Barnyard grass	*Echinochloa crus-galli*	7%	FACU
Cattail	*Typha latifolia*	5%	OBL
Tussock sedge	*Carex stricta*	5%	OBL
Lurid Sedge	*Carex luridia*	3%	OBL
Square stem Money flower	*Mimulus ringus*	<2%	FACW
Walter Millet	*Echinochla walteri*	<2%	FACW
Pennsylvania smartweed	*Polygonum pensylvanicum*	<2%	FACW
Rice Cutgrass	*Leersia oryzoides*	<2%	OBL
Slender St. Johns Wort	*Hypericum mutilum*	<2%	FACW
Eastern burreed	*Sparganium americanum*	<2%	OBL
Jewelweed	*Impatiens capensis*	<2%	FACW
Blunt Spike rush	*Eleocharus obtusa*	<2%	OBL
American Water horehound	*Lycopus americanus*	<2%	OBL
American Water Wort	*Elatine americana*	<2%	OBL
Seedbox	*Ludwigia paulustris*	<2%	OBL
Beaked spike rush	*Eleocharis rostellata*	<2%	OBL
False Nettle	*Bohemaria cylindrica*	<2%	OBL
Boneset	*Eupatorium perfoliatum*	<2%	FACW
Soft Stem Bulrush	*Scirpus validus*	<2%	OBL
Woolgrass	*Scirpus cyperinus*	<2%	FACW
White Clover	*Trifolum repens*	<2%	FACU
Duck Potato	*Saggittaria latifolia*	<2%	OBL
Swamp milkweed	*Asclepias incarnata*	<2%	OBL
Littleleaf Goldenrod	*Solidago graminacea*	<2%	FAC
White Aster	*Aster vimminuem*	<2%	FAC
Arrow arum	*Peltandra virginica*	<2%	OBL
Black Eyed Susan	*Rudbeckia hirta*	<2%	FACU
Arthraxon	*Arthraxon hispidus*	<2%	NI
Morning Glory	*Ipomea eriocarpa*	<2%	FACU
Goldenrod	*Solidago spp*	<2%	FACU
Speedwell	*Veronica anagallis-aquatica*	<2%	OBL

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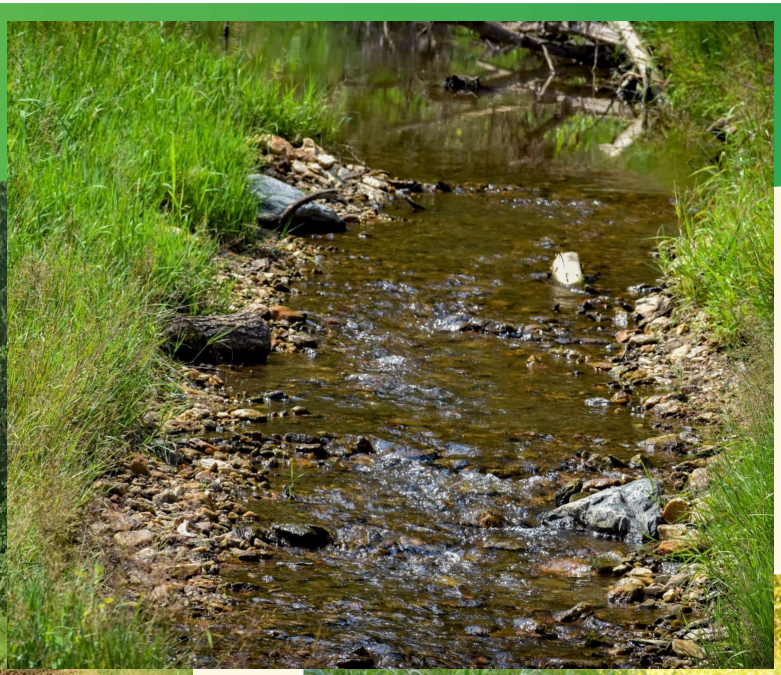
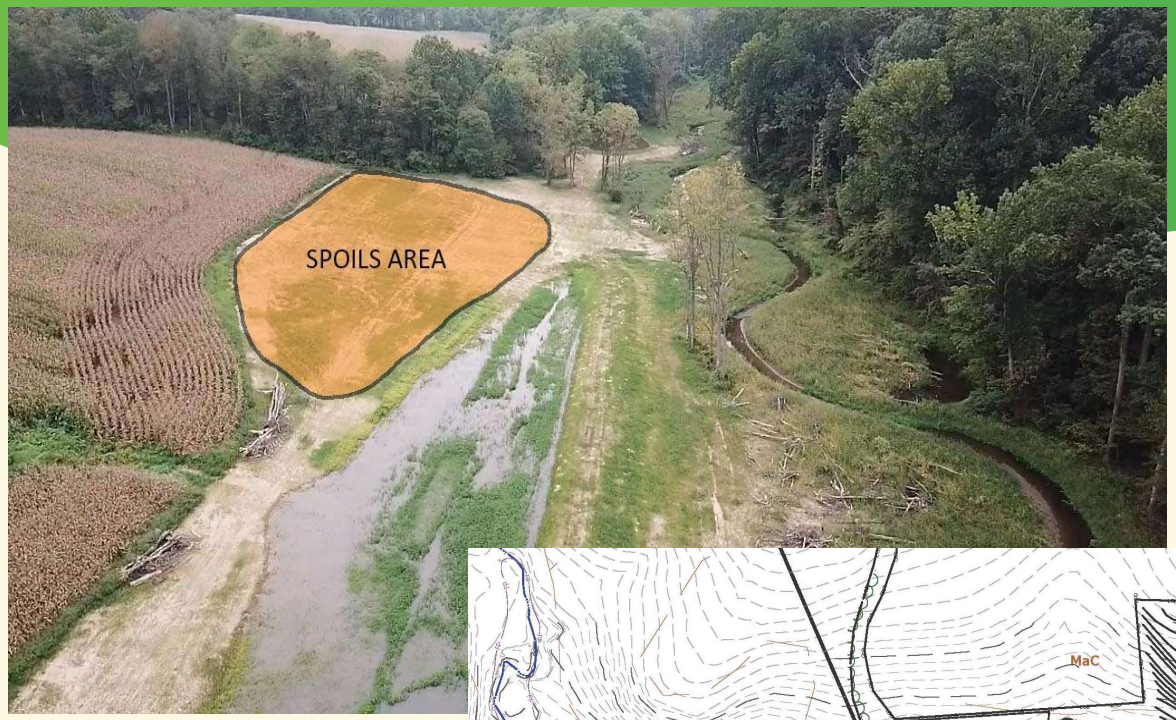
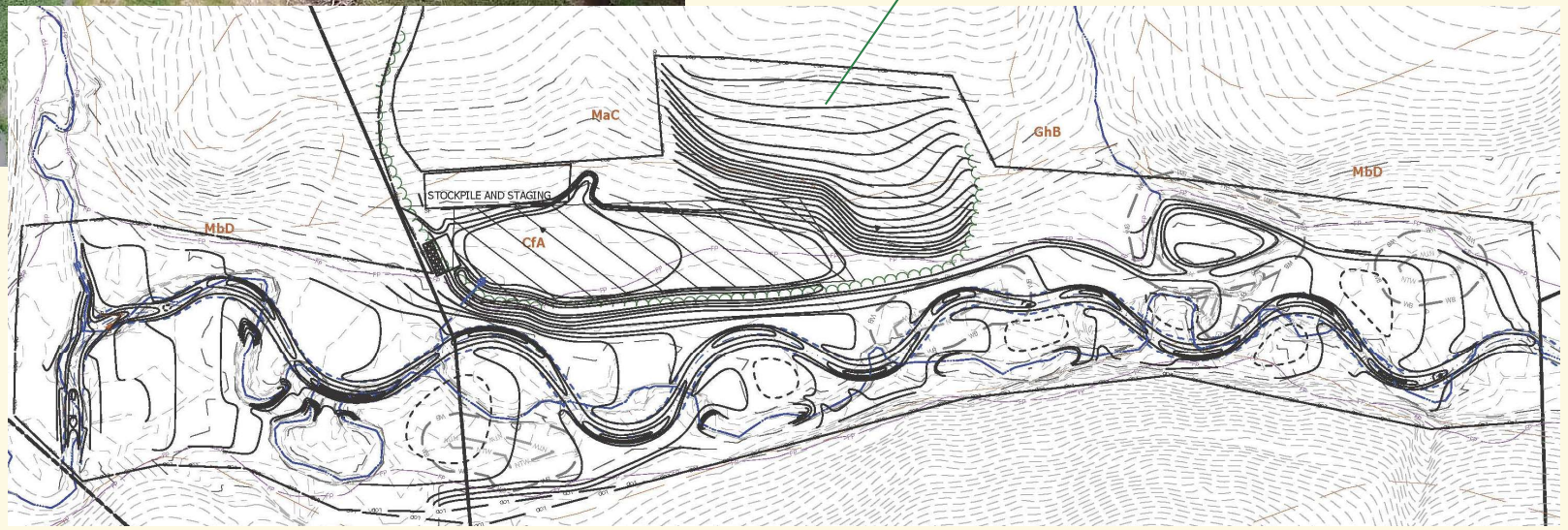
Riffle Material



Lots O‘Wood

Spoils


SPOILS AREA


Spoils area
MaC
GhB
MbD
STOCKPILE AND STAGING
MbD
CfA

Savings of $64,500!

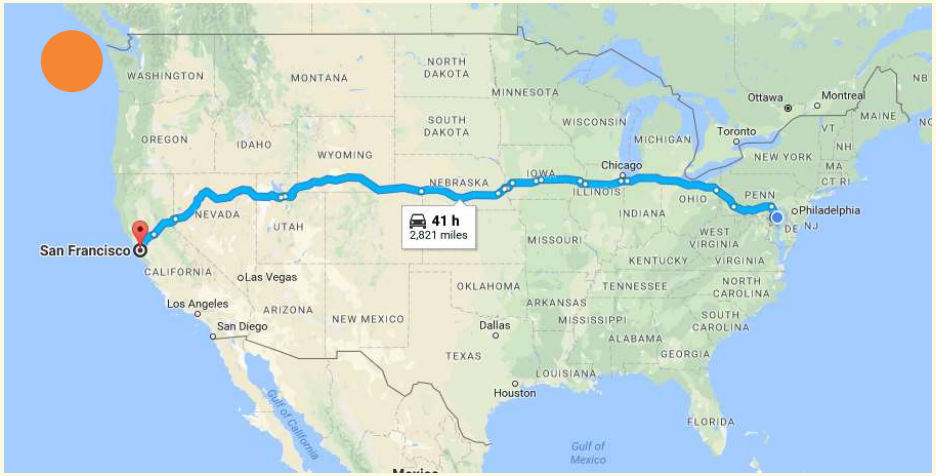
Material	Cost to Import/Export
Riffle Material	$15,000
Log Vanes	$2,500
Toewood	$10,000
Sifted Topsoil	$12,000
Spoil Haul Off	$25,000+
	$64,500+

Plus 5,378 miles of hauling

& Roughly 900 gallons of diesel fuel not burned

Design + Construction = $202/LF

What!?! That's almost to San Francisco and back!!



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Urban Less is More?

Urban Less is More?

Tributaries to Middle Patuxent River

How to incorporate “Less is More?”

What materials are onsite?

Tributaries to Middle Patuxent River

Salvaged Step Pools

Was Less is More possible here?

Design + Construction = $525/LF

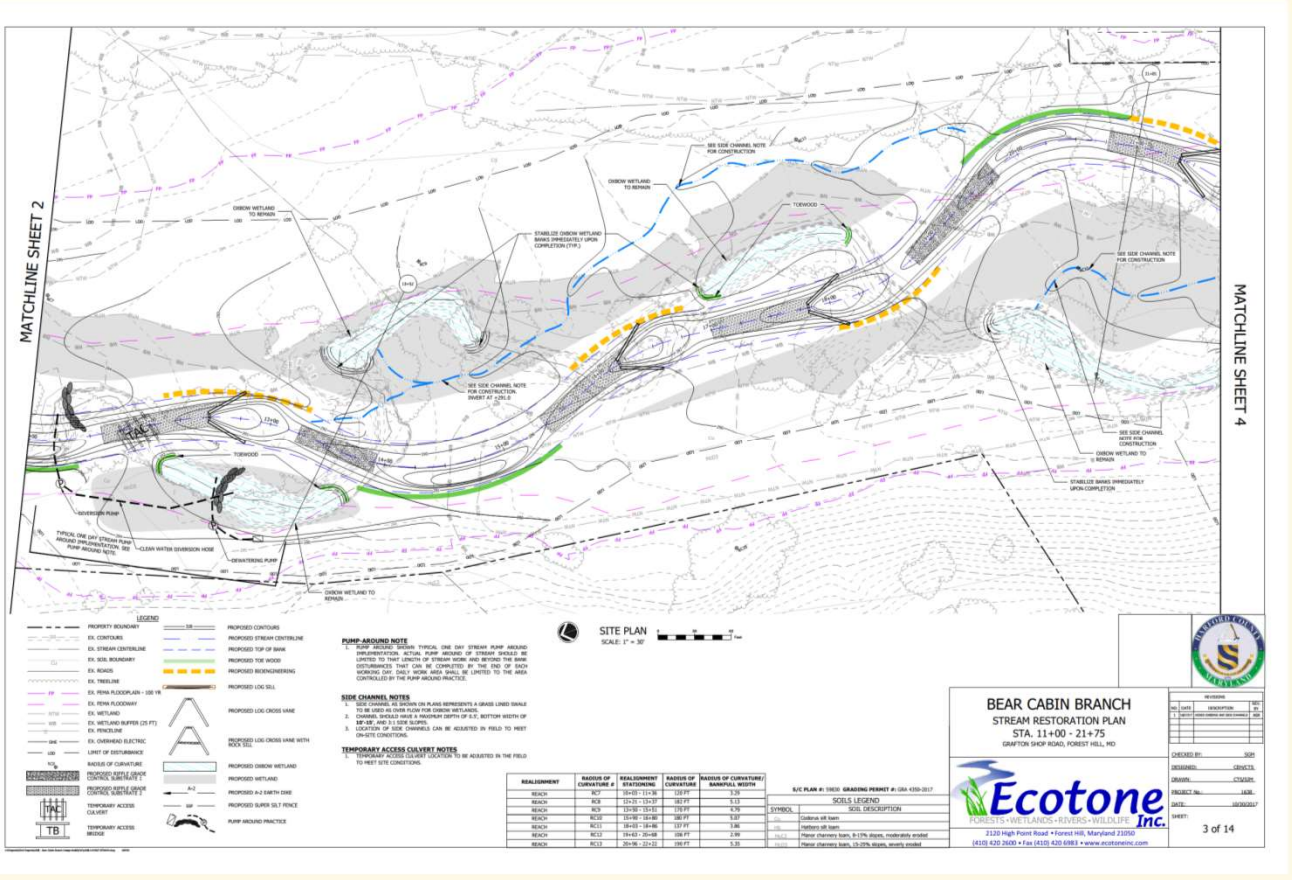
Looking Forward

Bear Cabin Branch

- Legacy sediment from mill dam
- 20% impervious watershed
- County property

Getting to Stage Zero

- Oxbow wetlands
- Side channels
- Low, wet floodplain
- Roughness







Design + Construction = $296/LF

Alluvial channels have 9 degrees of freedom*

- Width
- Mean depth
- Maximum depth
- Bed grain size
- Bed gradation
- Centerline wavelength
- Centerline amplitude
- Meander wavelength
- Meander radius of curvature

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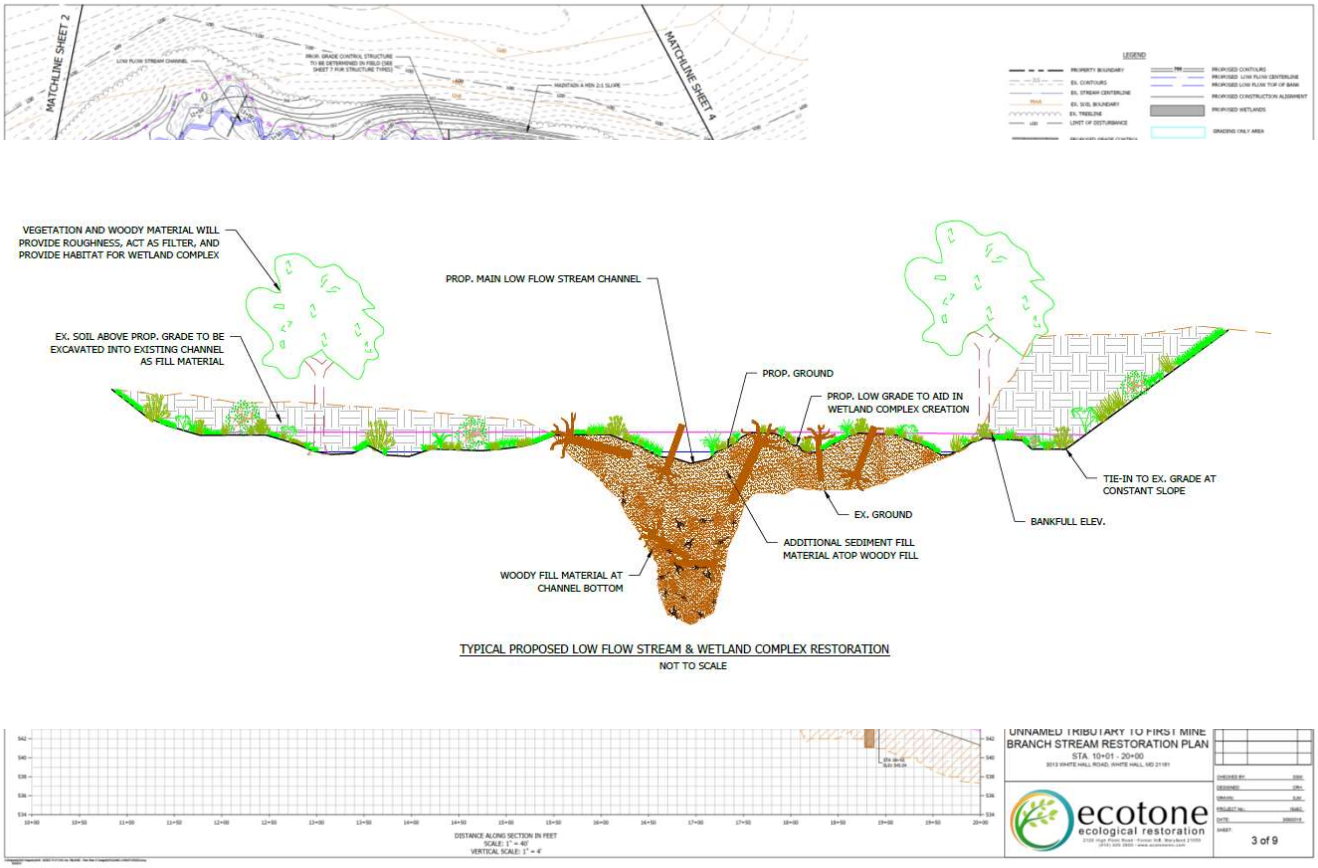
*Richard Hey (1997) Stable River Morphology, in 'Applied Fluvial Geomorphology for River Engineering and Management' Thorne, Hey, and Newson (eds)

First Mine II

Design approach

- Fill channel
- Incorporate clay blocks
- Let the water do the work
- Lots of wood



STAGE ZERO

Design + Construction = $217/LF

Bridge Creek, Oregon


Less than Less
is More.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THINK LIKE A MOUNTAIN