

The Association of State Wetland Managers Presents:  
**Improving Wetland Restoration Success  
2014 — 2015 Webinar Series**  
*Riverine/Riparian Wetland Restoration*

**Presenters:**

***Richard Weber, NRCS Wetlands Team  
Lawrence Urban, Montana DOT***

***Moderators: Jeanne Christie & Marla Stelk***



Supported by EPA Wetland Program Development Grant 83541601



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1. You were sent a link to instructions for how to use the Go To Webinar software.
2. You were also sent a PDF of today's presentation. This means you can watch the PDF on your own while you listen to the audio portion of the presentation by dialing in on the phone number provided to you in your email.



# AGENDA

- **Welcome and Introductions (5 minutes)**
  - **Restoration Webinar Schedule & Past Recordings (5 minutes)**
- **Riverine/Riparian Wetland Restoration (60 minutes)**
- **Question & Answer (15 minutes)**
- **Wrap up (5 minutes)**



# WEBINAR MODERATORS



Jeanne Christie,  
Executive Director



Marla Stelk,  
Policy Analyst

# WETLAND RESTORATION PROJECTS

- Convened interdisciplinary workgroup of 25 experts
- Developing monthly webinar series to run through September 2015
- Developing a white paper based on webinars and participant feedback
- To be continued through 2016 in an effort to pursue strategies that:
  - Maximize outcomes for watershed management
    - Ecosystem benefits
    - Climate change
  - Improve permit applications and review
  - Develop a national strategy for improving wetland restoration success

# WEBINAR SCHEDULE & RECORDINGS

Association of State Wetland Managers - Protecting the Nation's Wetlands.



## What's New:

- Less Than Half of Americans Make Anthropogenic Connection
- Clean Water Act 2.0: Rights of Waterways
- Virginia Coastal Partners Workshop: Save the Date
- FGCU appoints director for new Everglades Wetland Research Park
- LA: Expanded Louisiana Coastal Zone Boundary Approved
- Wetland Breaking News - Current Issue

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## Conference Schedule

State Wetland Managers holds webinars on topics of which relate to a specific project and work ASWM holds webinars as part of its members' topics of interest to members. Please click on name below for more details about individual webinars, if you have any questions about a webinar, please contact Laura at [email address]. If you are a member, and you missed a webinar, please contact Laura at [email address]. If you are a member, and you missed a part of the members' webinar series, please contact Laura at [email address]. Post the recordings of the webinars going on.



A presentation given during a webinar.

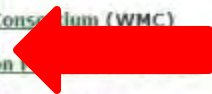
## Webinar Series

Function Alliance (NFFA) [Future](#) [Past](#)

Consensus (WMC)

[Wetland Program Plans Project](#)

[Stream Identification/Delineation/Mitigation Project](#)



# WEBINAR SCHEDULE & RECORDINGS

Association of State Wetland Managers - Protecting the Nation's Wetlands.



**In the News:**

- EPA, Rockefeller Foundation Team Up for Resilient Cities
- Leading the Way for Carbon-Financed Investments in Coastal Wetlands
- CO: Saving the Colorado River Delta, One Habitat at a Time
- Great Barrier Reef at risk from 'washed' sediment dumping plan at Abbot
- Political Sprawl and a Lost Steward for Wetlands in China
- Wetland Breaking News - Current Issues

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### ASWM Webinars/Conference Schedule

The Association of State Wetland Managers holds webinars on various topics, most of which relate to a specific project and work group. In addition, ASWM holds webinars as part of its members' webinar series on topics of interest to members. Please click on the webinar group name below for more details about individual webinars. In all cases, if you have any questions about registering for a webinar, please contact Laura at [laura@aswm.org](mailto:laura@aswm.org). If you are a member, and you missed a webinar that was part of the members' webinar series, please contact us. We will post the recordings of the webinars going ahead.

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A presentation given during a webinar

### Special ASWM Webinars

**Past:**

- [Special ASWM Webinar: Wetland Link International North America Webinar II: Best Practice in Designing, Building and Operation of Wetland Education Centers](#) - July 30, 2014
- [Special ASWM American Wetlands Month Webinar](#) - May 29, 2014
- [Status and Trends of the Prairie Pothole Region](#) - May 8, 2014
- [Special ASWM Webinar: Options for Financing Environmental Enhancement at the Local Level in Oregon](#) - January 23, 2014
- [Special ASWM Webinar: Wetland Link International North America](#) - October 29, 2013
- [Special ASWM Webinar - Koontz v. St. Johns River Water Management District: What Happened and Where Do We Go From Here](#) - Wednesday, July 17, 2013 - 3:00 p.m. ET

### Members' Wetland Webinar Series

[Future](#) [Past: Members Only](#) [Past: Nonmembers](#)

### Natural Floodplain Functions Alliance (NFFA)

[Future](#) [Past](#)

### Wetland Mapping Consortium (WMC)

[Future](#) [Past](#)

### Improving Wetland Restoration Success Project

[Future](#) [Past](#)



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# FUTURE SCHEDULE - 2015

- **Tuesday, July 14, 3:00pm eastern:**

- **Peat Land Restoration**

- Presented by:**

- Norman Famous & Marcia Spencer-Famous, Spencer-Famous Environmental Consultants
      - Richard Weber, NRCS Wetlands Team
      - Larry Urban, Montana Department of Transportation

**FOR FULL SCHEDULE, GO TO:** <http://aswm.org/aswm/6774-future-webinars-improving-wetland-restoration-success-project>

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Please contact **Laura Burchill**  
[laura@aswm.org](mailto:laura@aswm.org)

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Provide:

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- Webinar date and Title

# PRESENTERS



**Richard Weber**  
NRCS Wetland Team, CNTSC



**Larry Urban**  
Montana Department of  
Transportation

## A “COOKBOOK” APPROACH TO WETLAND RESTORATION WON’T WORK



*There are too many variables.*

- *Ingredients are always different*
- *Reason for ‘cooking’ varies*
- *Recipe isn’t always correct*
- *Inexperienced cooks*
- *Cooking time varies*
- *Poor inspection when “cooking”*
- *Additional ingredients may be needed*
- *Is it really done?*

**WE NEED TO  
UNDERSTAND THE  
PLANNING PROCESS  
AND VARIABLES FROM  
SITE TO SITE THAT  
MUST BE STUDIED,  
UNDERSTOOD AND  
ADDRESSED**



## EACH WETLAND RESTORATION PROJECT IS UNIQUE:

- *Consider both historic and current landscape setting*
- *Analyze how water moves into and out of the site*
- *Evaluate soils present and identify any onsite drainage*
- *Focus first on hydrology and soil first, last on plants*
- *Develop a plan that is achievable for the site*
- *Develop comprehensive cost estimates*
- *Ensure plan is followed*
- *Hire experienced and knowledgeable contractors*
- *Adapt plan as needed during construction*
- *Determine if monitoring criteria will measure progress*
- *Keep good records and share with others*



# Riverine/Riparian Wetland Restoration

IT WILL TAKE US A FEW MOMENTS TO MAKE THE SWITCH...



Photo Credit: Laura Hubers, USFWS

# Riverine / Riparian Wetland Restoration

Richard Weber, USDA – NRCS Fort Worth, Texas

And

Lawrence Urban, Montana Department of  
Transportation



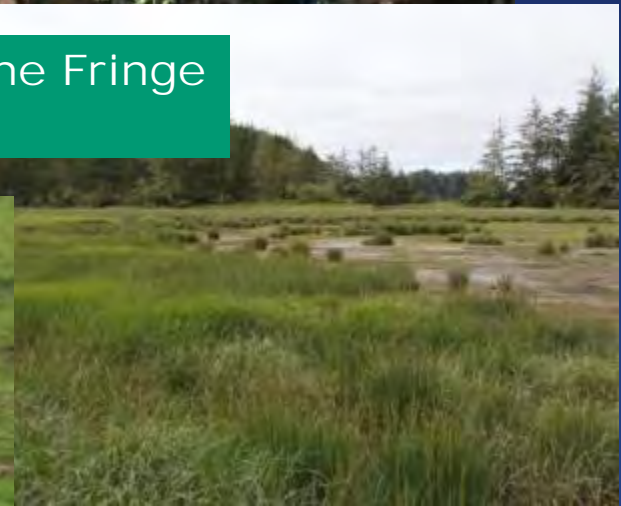
# The 7 HGM Wetland Classes

- RIVERINE
- SLOPE
- MINERAL SOIL FLAT
- ORGANIC SOIL FLAT
- ESTUARINE FRINGE
- LACUSTRINE FRINGE
- DEPRESSION

Depressional  
Carolina Bay



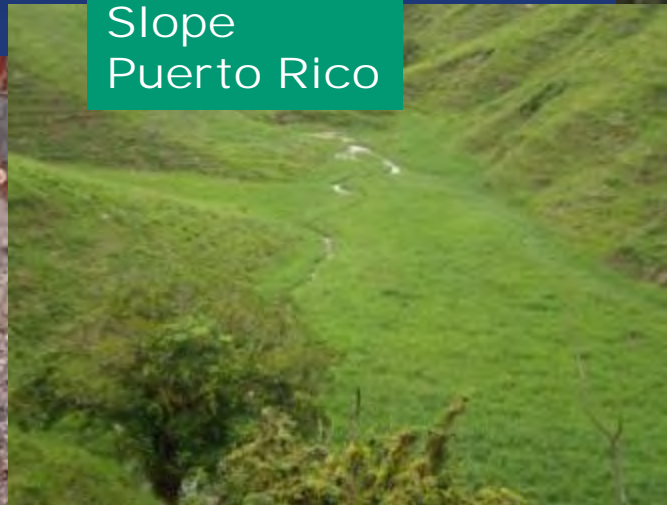
Estuarine Fringe  
Oregon



Mineral Flats  
Indiana Flatwoods



Slope  
Puerto Rico



# RIVERINE Wetlands

Landscape Position

Floodplains

Dominant Water Source

Stream Hydrographs (Surface and Groundwater)

Hydrodynamics

Horizontal,

Bi-Directional

- Geomorphic Channels
- Hydrologically Connected to a Floodplain
- Formed and Maintained by Flow and Sediment



Floodplain Oxbow  
-Wyoming



**Geomorphic position of riparian wetlands – Big Hole River, MT**

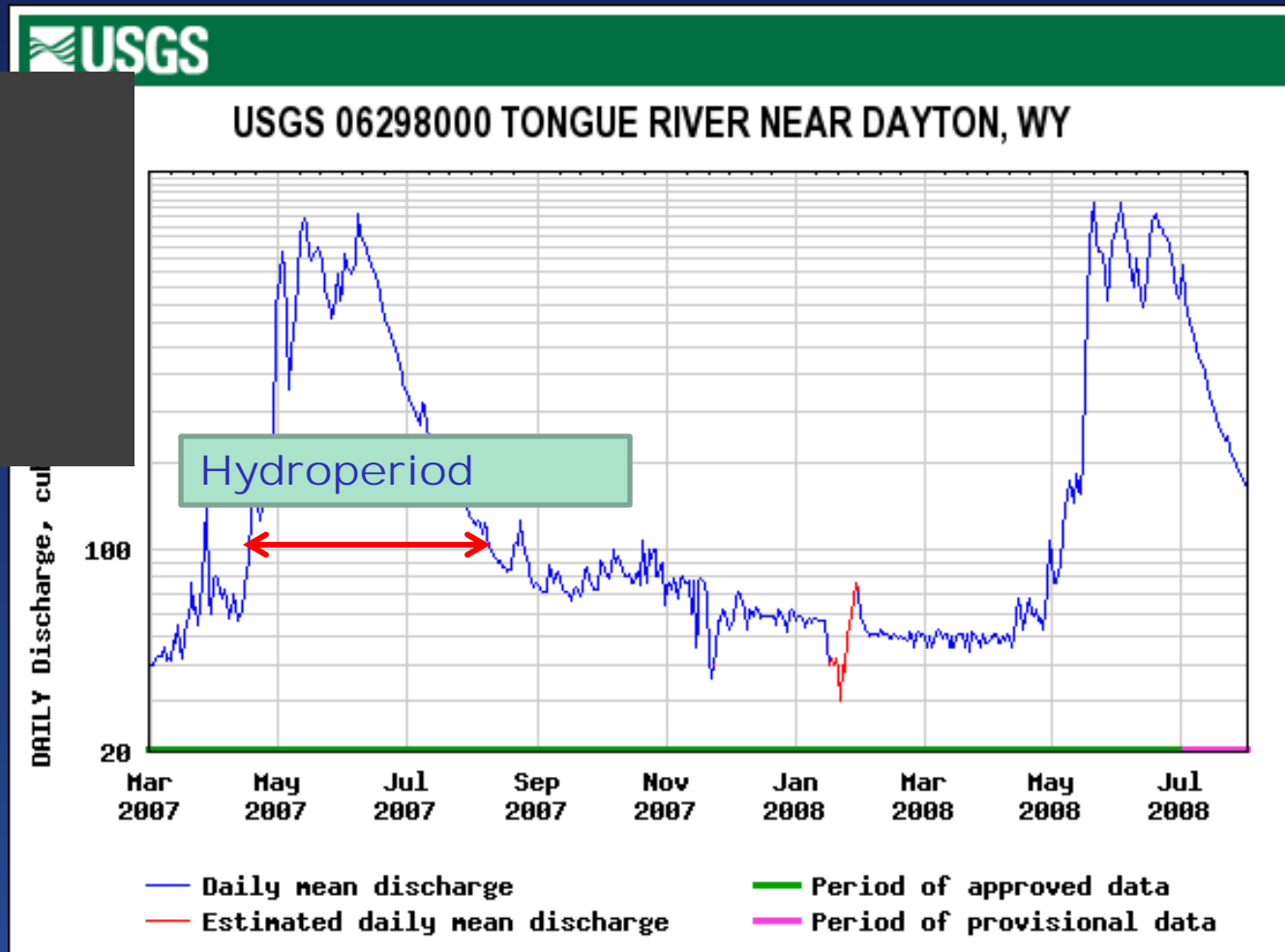


**Old oxbows & meander scars within floodplain of Milk River near Chinook, MT**

# RIVERINE – Dominant Water Source – Stream Hydrograph

## Hydrograph Supports -

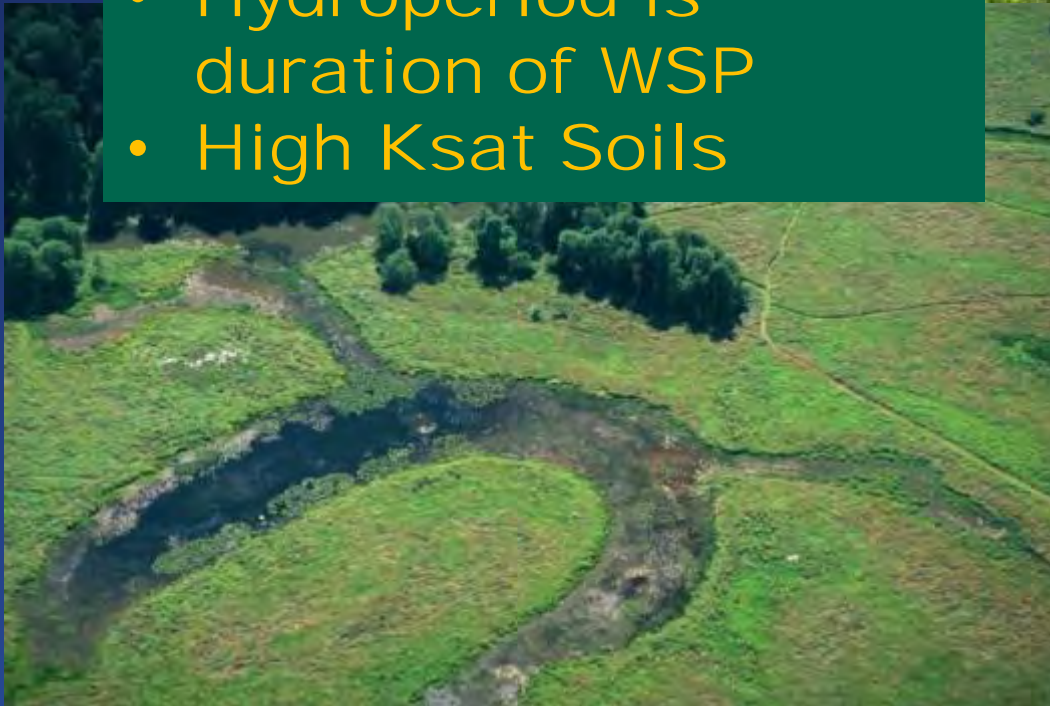
- Flooding
- Ponding
- Groundwater



# RIVERINE Wetlands

## “Endosaturated” Floodplains

- Strong Groundwater Connection
- Hydroperiod is duration of WSP
- High Ksat Soils



# RIVERINE Wetlands

## “Episaturated” Floodplains

- Surface Flooding from Peak Discharges
- Weak Groundwater Connection
- Hydroperiod is Flood Duration + Ponding
- Low Ksat Soils





## RIVERINE – Surface Flooding (Lotic)

- Dynamic Surface Water Storage
- Sediment Cycling

Ponding

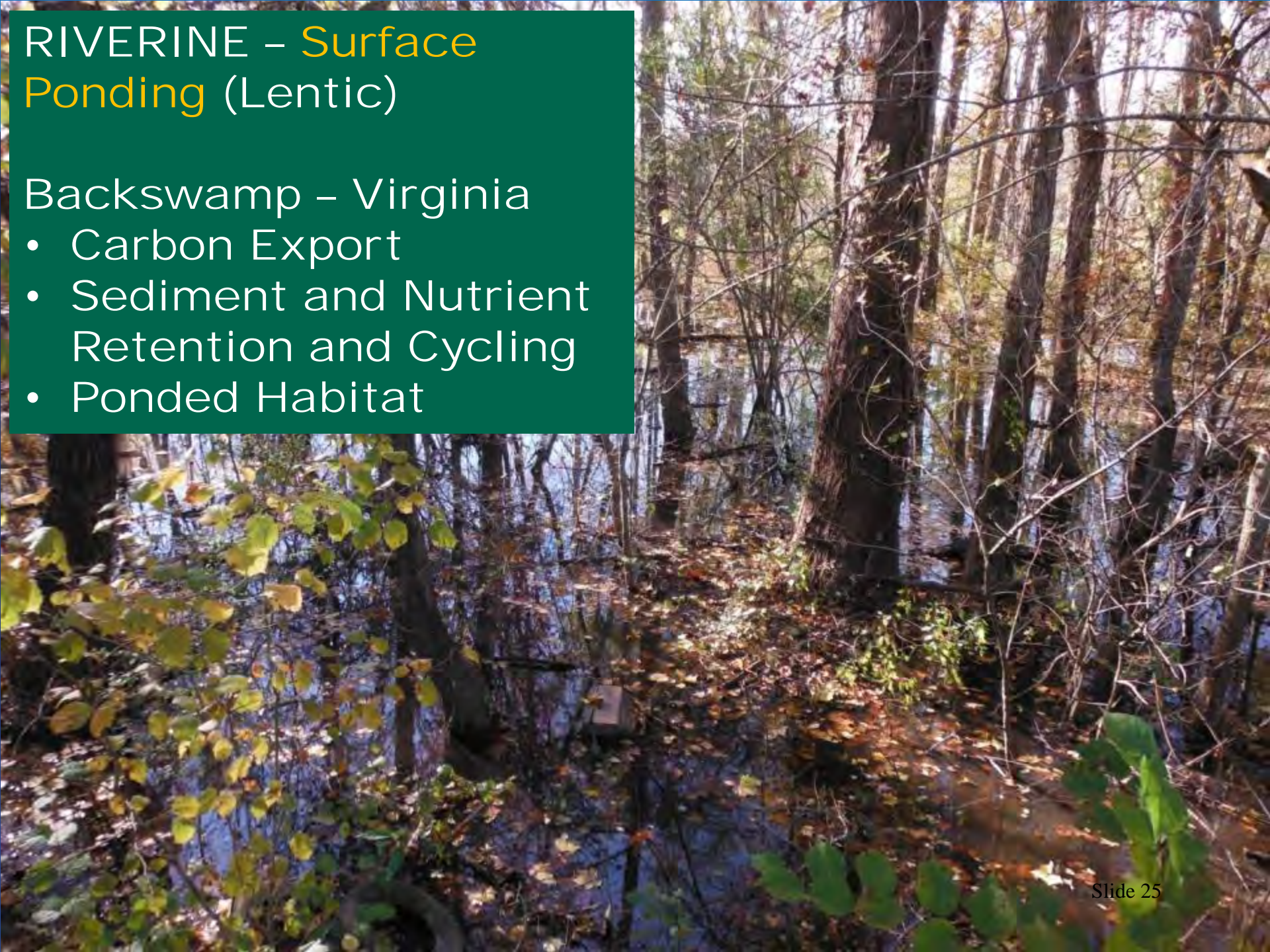
Flooding



# RIVERINE – Surface Ponding (Lentic)

## Backswamp – Virginia

- Carbon Export
- Sediment and Nutrient Retention and Cycling
- Pondered Habitat

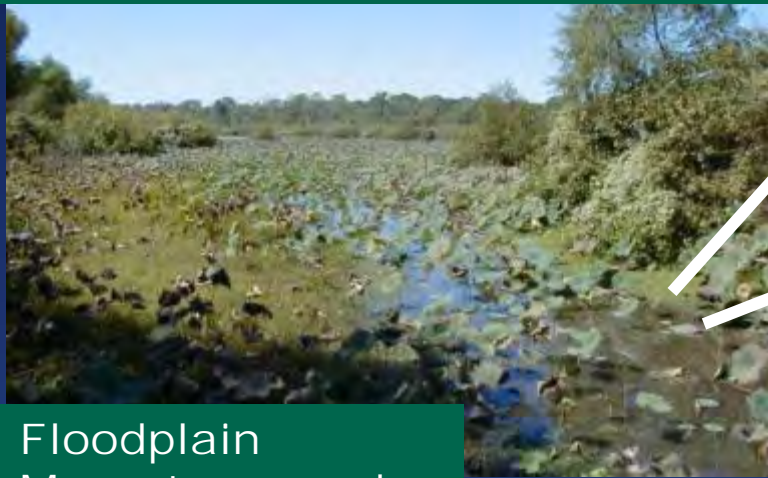




## RIVERINE – Floodplain Groundwater

- Base flow Maintenance
- Alluvial Aquifer Storage

# Floodplain Landforms



Floodplain  
Macrotopography  
- Abandoned  
Oxbow



The  
Bankfull  
Channel



Wetland Vegetation -  
Floodplain Flat

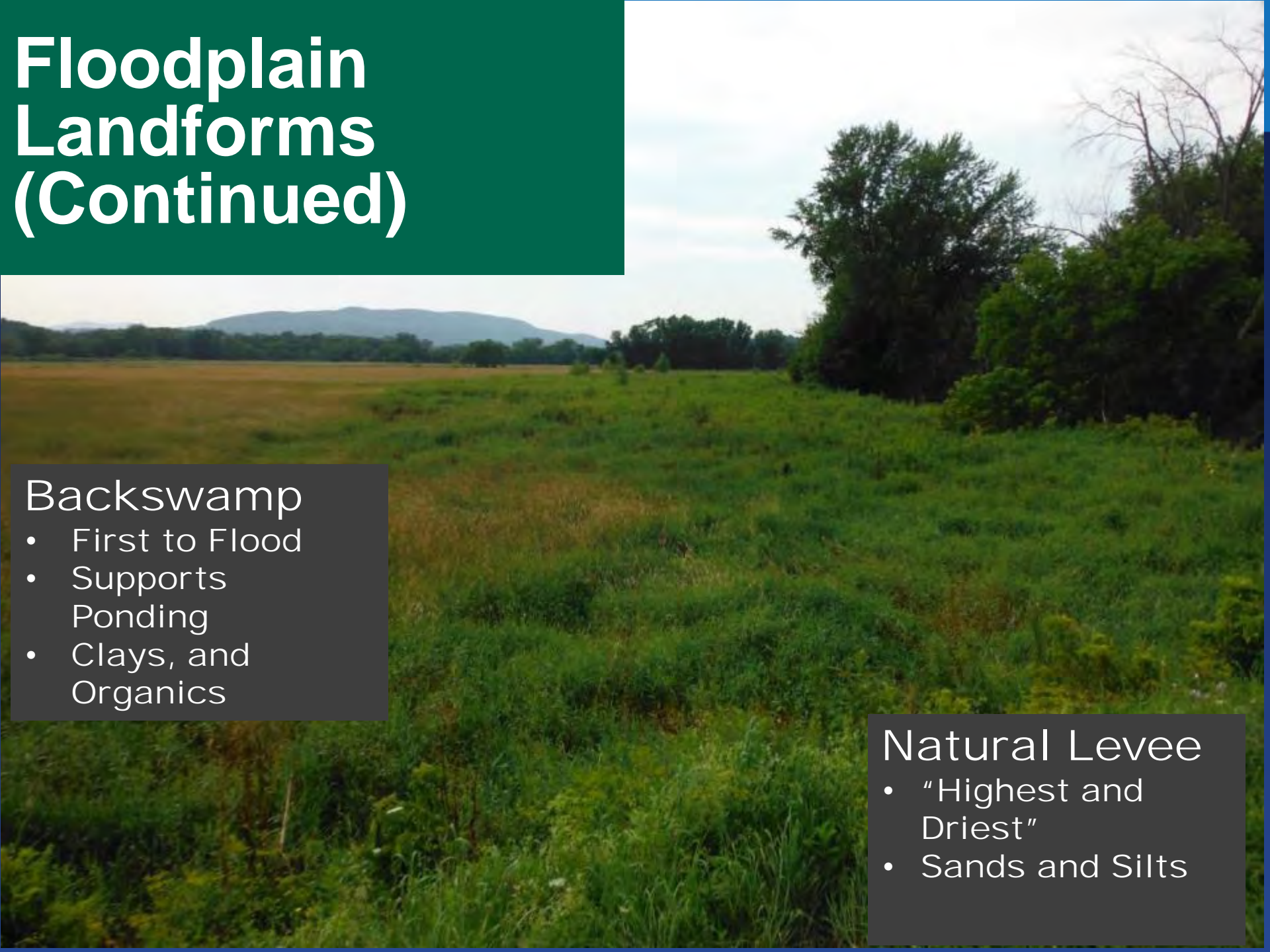
# Floodplain Landforms (Continued)

## Backswamp

- First to Flood
- Supports Ponding
- Clays, and Organics

## Natural Levee

- “Highest and Driest”
- Sands and Silts

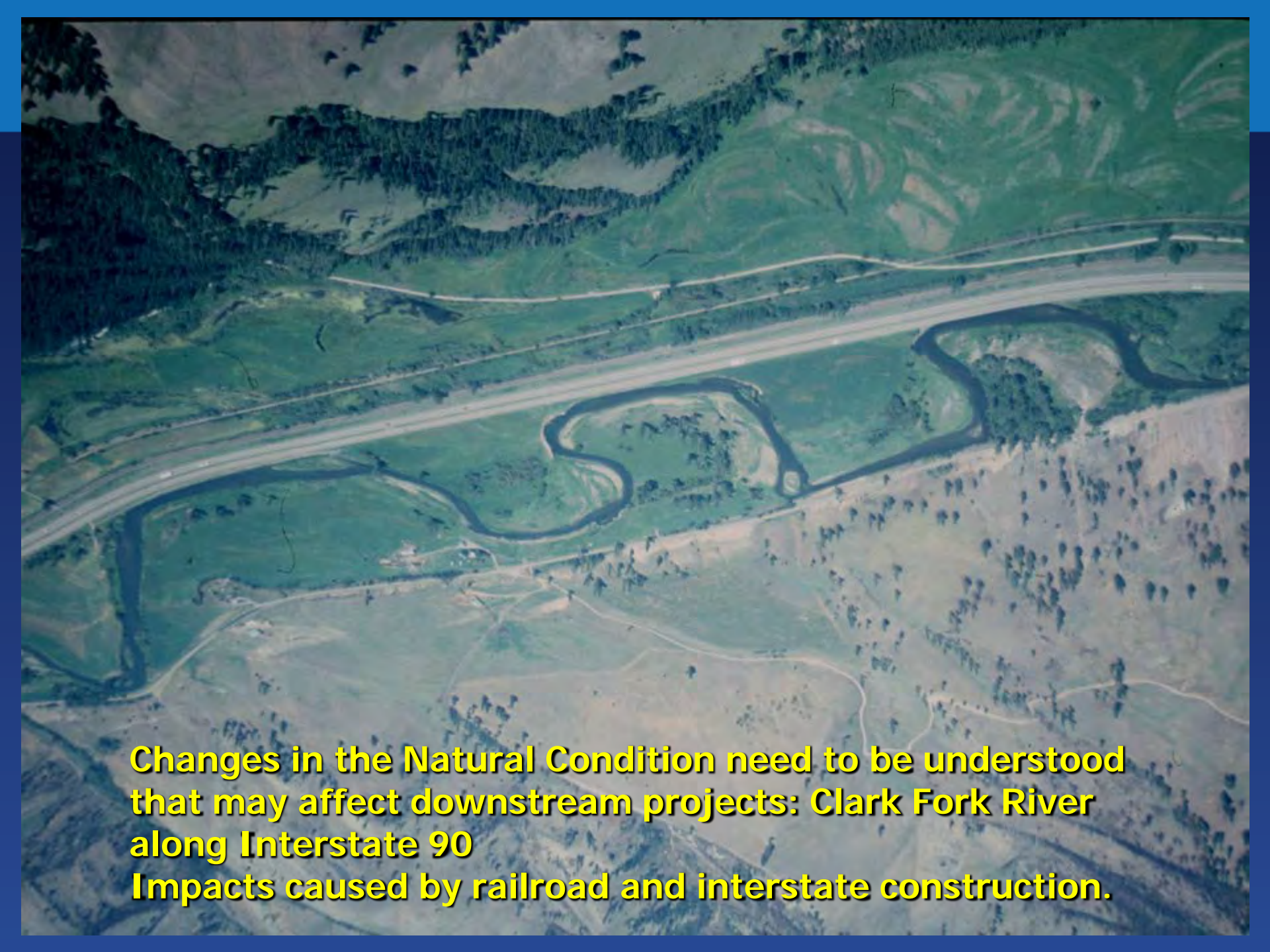


# Restoration Techniques

- Large Episaturated System



Levee Breach  
Restores  
Lateral  
Connectivity



**Changes in the Natural Condition need to be understood that may affect downstream projects: Clark Fork River along Interstate 90  
Impacts caused by railroad and interstate construction.**

# Restoration Techniques

## - Large Episaturated System



### Constructed Macrotopography

- Flat Slopes
- Replicate Natural Landforms



### Modified/Channelized Stream Restoration

- Designing new stream system to match historic system
- Restoring and reconnecting stream corridors
- Allowing for seasonal inundations of adjacent floodplains
- Understanding the geomorphic setting for placement

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# Restoration Techniques

- Small Endosatuated System
- Incised Channel



- Raise Channel WSP
- Floodplain GW Rises
- Structures in Series
- BE CAREFUL



A photograph of a stream flowing through a grassy area. The stream is surrounded by tall grasses and some rocks. There are two points where the stream appears to be blocked or constricted by structures, which are labeled as 'Failed Grade Control Structures'. The water is clear and blue. The streambank on the right is eroded, showing dark soil and exposed roots. The streambank on the left is covered in dense grass. The overall scene is a natural stream environment with some human-made or semi-natural structures that have failed.

## Failed Grade Control Structures

**Insure Grade Control Structures are designed and installed correctly for streambank soils and high flows to prevent channel down-cutting.**

**Properly installed grade control and log structures will:**

- **Maintain higher water elevations within stream and wetlands**
- **Allows for vegetation to develop to stabilize stream banks**
- **Provides for higher quality fish habitat**
- **Provides opportunities for high flows to flood adjacent floodplain wetlands**



# Stream Restoration Parameters

- ***Geomorphic bankfull discharge***
- ***Channel geometry***
  - ***Alluvial Channels***
  - ***Threshold Channels***
- ***Sediment Transport (in channel)***
  - ***Bedload***
  - ***Wash Load***

# Riverine Wetland Restoration Parameters

- *Flow duration and frequency*
  - *Flow Duration - Probability*
- *Floodplain macrotopography*
- *Sediment **Cycling** (between channel and floodplain)*
  - *Scour*
  - *Deposition*
  - *Vertical Accretion*

# SLOPE Wetland Reaches



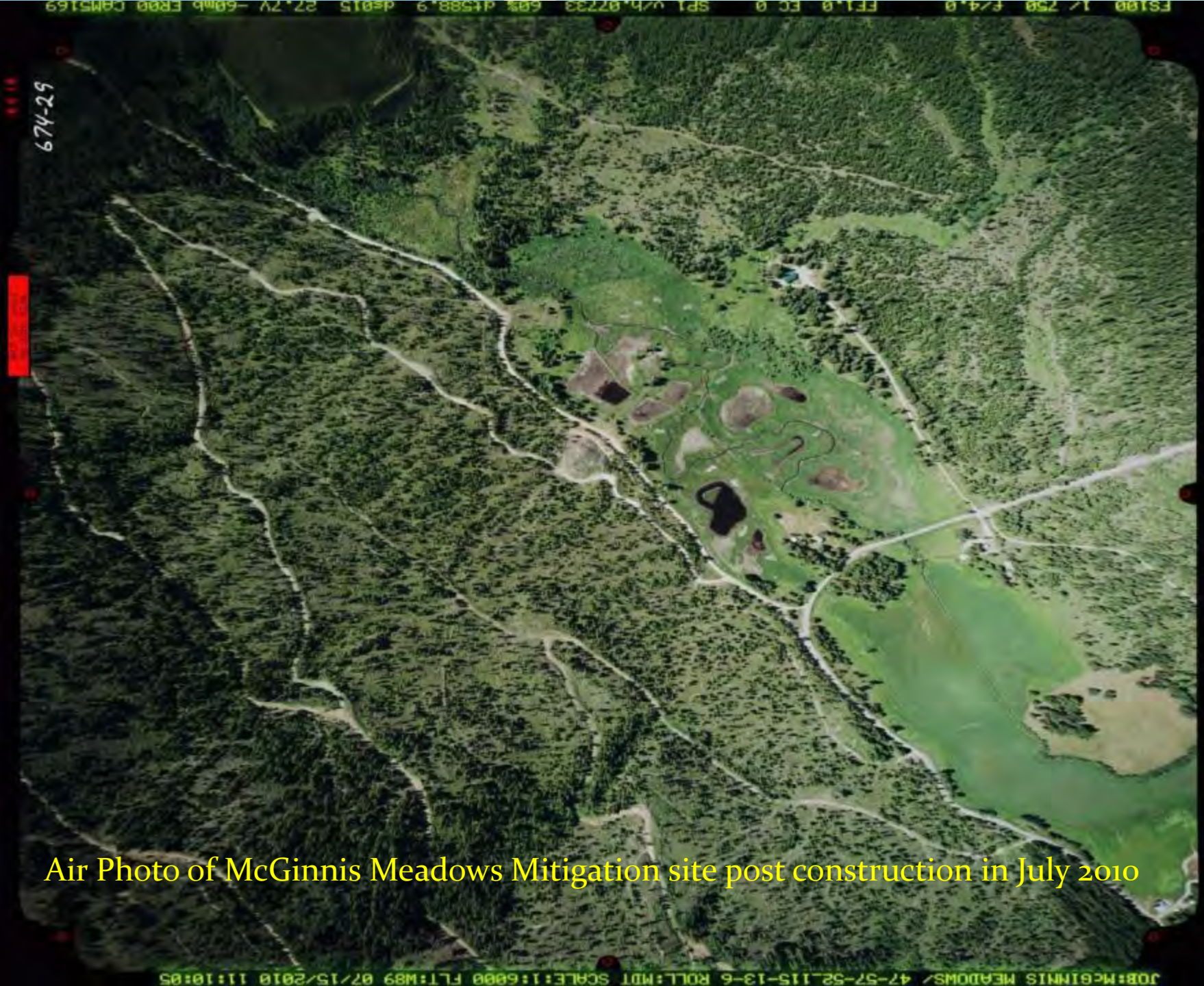
- Lower Stream Orders
- Groundwater Driven
- No separate Channel and Floodplain
- CHANNEL RESTORATION TECHNIQUES DO NOT APPLY!

drainage network. "1" = first order stream; "2" = second order stream, etc. Principles, Processes, and Practices (10/98). Working Group (15 federal agencies)(FISRWG).

# Slope Wetland Reaches

- “Channels” are Signs of Degradation
- Lower GW Level
- Loss of D.S. Base flow
- “Stream” Restoration Does not Apply





Air Photo of McGinnis Meadows Mitigation site post construction in July 2010

JOB: MCGINNIS MEADOWS / 47-57-52-115-13-6 ROLL: MDT SCALE: 1:6000 FLT: M89 07/15/2010 11:10:05

674-29

ES100 17.250 F/4.0 F1.0 FC 0 SFL W/H: 07733 60% DT588.9 depth 27.2X -6mmP ER00 CAM5169



# Site Selection - Initial Evaluation

- Locate Potential Site – Office Component
- Research of existing data from databases:
  - USGS Topographic maps
  - Aerial photographs – current or historic
  - NRCS Web Soil surveys
  - DNRC Water rights
  - National Wetland Inventory Maps (if available)
  - Montana Natural Heritage Tracker system of State Listed Species of Concern
  - US Fish & Wildlife Service Threatened and Endangered Species Lists and Critical Habitat Designations



**Historic 1947 USFS Aerial Photo of Schrieber Meadow and Lake Area**

# Site Evaluation Considerations

- Existing and adjacent land uses
- Landscape – identify man-made topographic alterations
- Existing vegetation communities
- Wetland delineations & Functional Assessments
- Soils & Geotechnical studies
- Historic aerial photos
- Cultural investigations
- Hydrologic studies including watershed basin
- Stream classification
- Water rights research

# Classification of Stream Types (Rosgen one method)

Entrenchment ratio (ER) estimation – see User’s Manual for additional guidance. Entrenchment ratio = (flood-prone width)/(bankfull width)  
 Flood-prone width = estimated horizontal projection of where 2 x maximum bankfull depth elevation intersects the floodplain on each side of the stream.

$$\frac{\text{Flood-prone width}}{\text{Bankfull width}} = \text{Entrenchment ratio (ER)}$$



Slightly Entrenched ER = >2.2			Moderately Entrenched ER = 1.41 – 2.2	Entrenched ER = 1.0 – 1.4		
C stream type	D stream type	E stream type	B stream type	A stream type	F stream type	G stream type

ii. Are ≥10 acres of wetland in the AA subject to flooding AND are man-made features which may be significantly damaged by floods located within 0.5 mile downstream of the AA (circle)? Y N Comments:

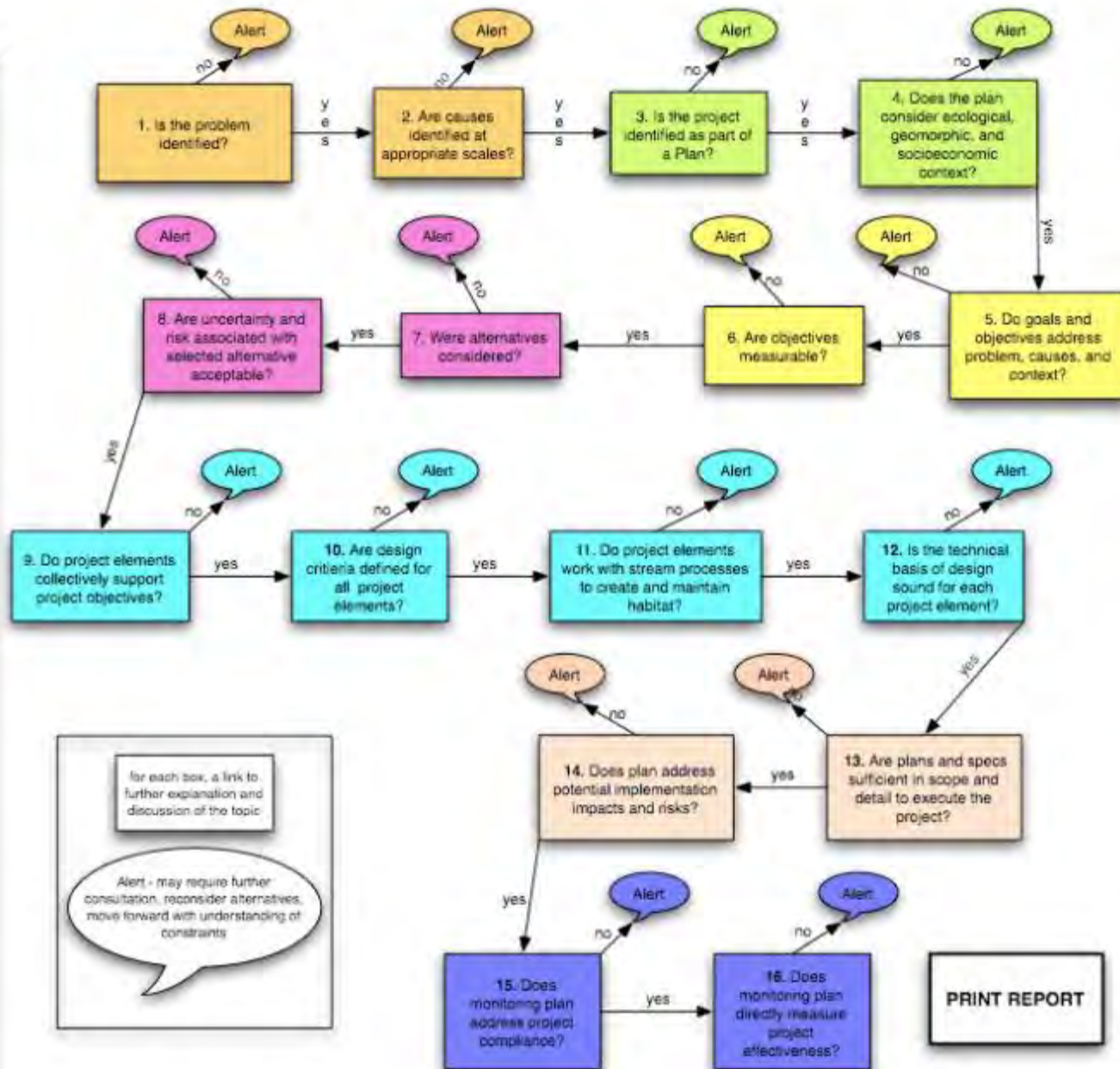
## Determine Project Goals & Objectives:

- **Provide wetland mitigation acre credits to compensate for wetland impacts in advance of project impacts.**
- **Provide stream mitigation credits to compensate for stream impacts.**
- **Develop mitigation sites that provide a variety of habitat types – stream & wetland.**
- **Meet Federal, State and Tribal permit conditions and requirements.**
- **Provide a “No Net Loss” of wetlands – acre for acre.**

# Mitigation Goals & Objectives:

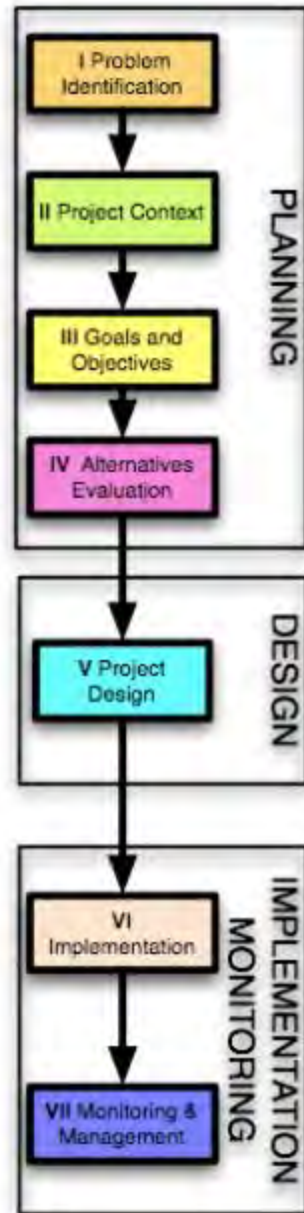
- **Establishment, Restoration and enhancement of wetland ecosystems.**
- **Rehabilitation and Re-establishment of degraded stream channels and their associated riparian wetland floodplain habitat.**
- **Improve habitat for State-Listed species of concern and ESA listed fish, plant and wildlife species.**
- **Determine what types and kinds of wetland functions and values would be best suited for the proposed mitigation/restoration area such as flood control, improved water quality and enhanced fisheries & wildlife habitat.**
- **Utilize a planning analysis model such as RiverRAT or other Ecosystem models to determine goals and objectives.**

RiverPRAT  
River Restoration Analysis Tool



for each box, a link to further explanation and discussion of the topic

Alert - may require further consultation, reconsider alternatives, move forward with understanding of constraints



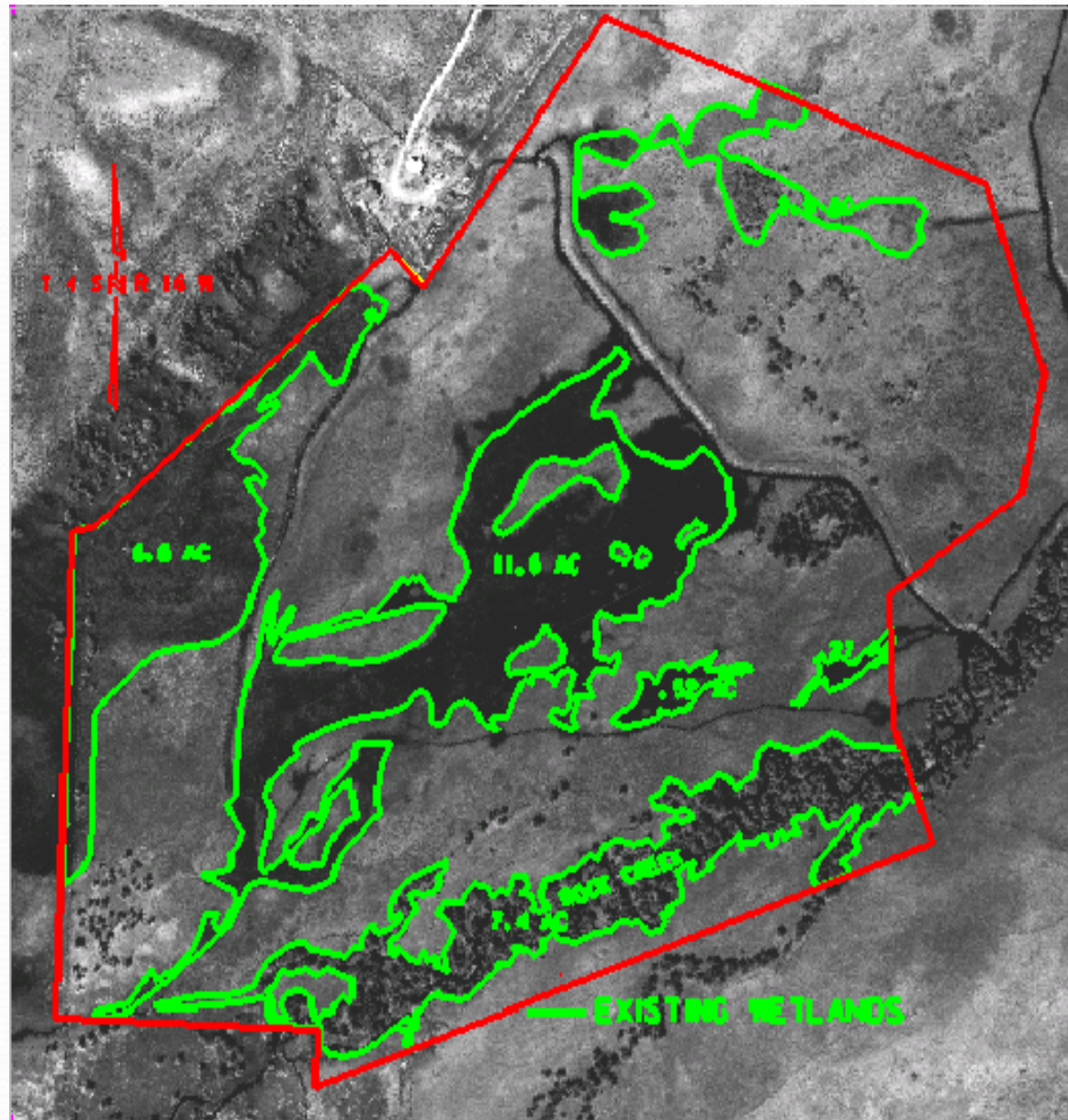
# Project Development - Feasibility Studies

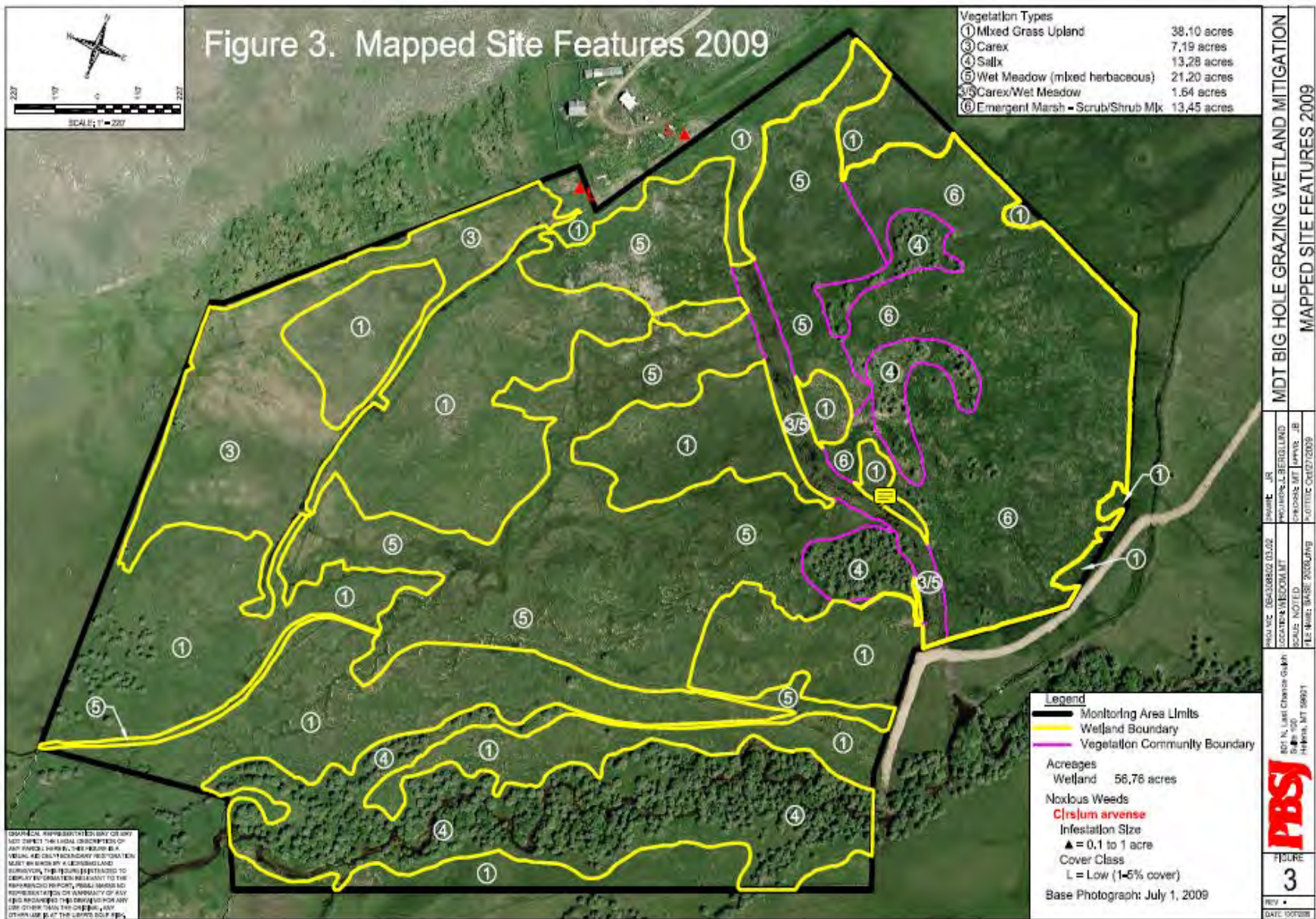
- Feasibility studies conducted on suitable potential sites.
- Feasibility studies evaluate and provide technical information:
  - Available ground and surface hydrology sources
    - Drainage ditches, tile drains, channelized streams, etc.
  - Topographic surveys
  - Water Rights – important in the Western US
  - Geology & Soils
  - Cultural Resources
  - Biological Resources (T&E)/ Wetland Delineations
  - Hazmat
  - Permits & regulatory requirements
  - Public Involvement
- Technical Studies utilized for NEPA/MEPA documents.



# Map Existing or Degraded Wetlands

- Big Hole Grazing Association Wetland Delineation June, 2001 by MDT personnel.
- Approximately 29 acres of degraded wetlands identified.





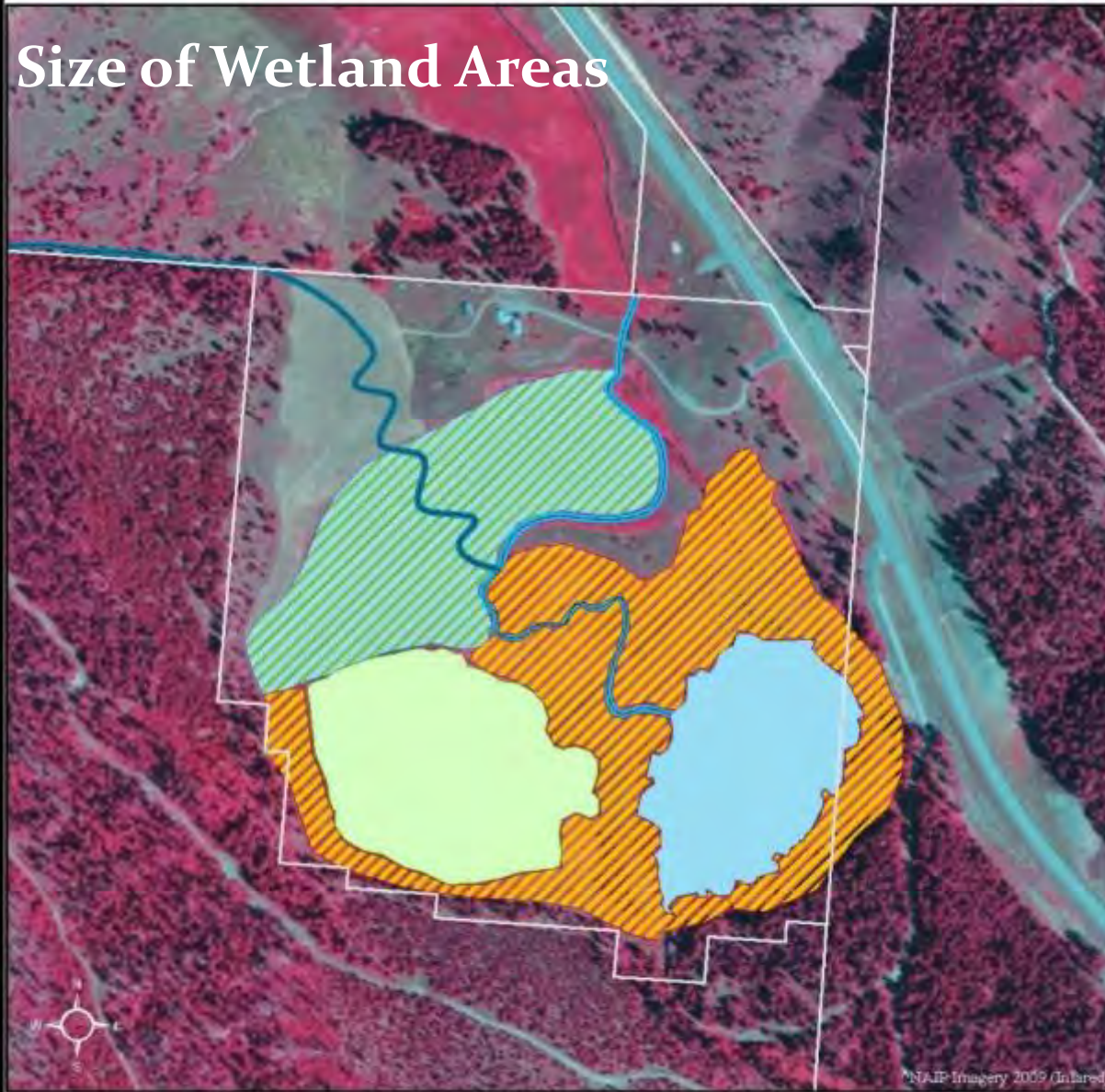
Big Hole Grazing Association - wetland delineation 57 acres in 2009

# Conceptual Design Development

- Development of aquatic resource mitigation plan to meet mitigation goals and objectives within chosen site:
  - Restoration, creation, enhancement and preservation of wetlands to provide credit acres.
  - Increased stream length and sinuosity, pool/riffle, fish habitat, stream hydraulic modeling, etc.
  - Determine which stream/wetland functions are practical for development. (floodplains, water storage, wildlife habitat, etc.)
  - Utilize reference wetlands and streams in area (if available) as a basis for developing conceptual designs and for determining types of plants to re-establish within site.
- Work within the geomorphic setting of the site.
- Crediting scheme for wetland and stream mitigation credits for permitting agencies.

# Size of Wetland Areas

## Schrieber Lake Wetland Mitigation Site



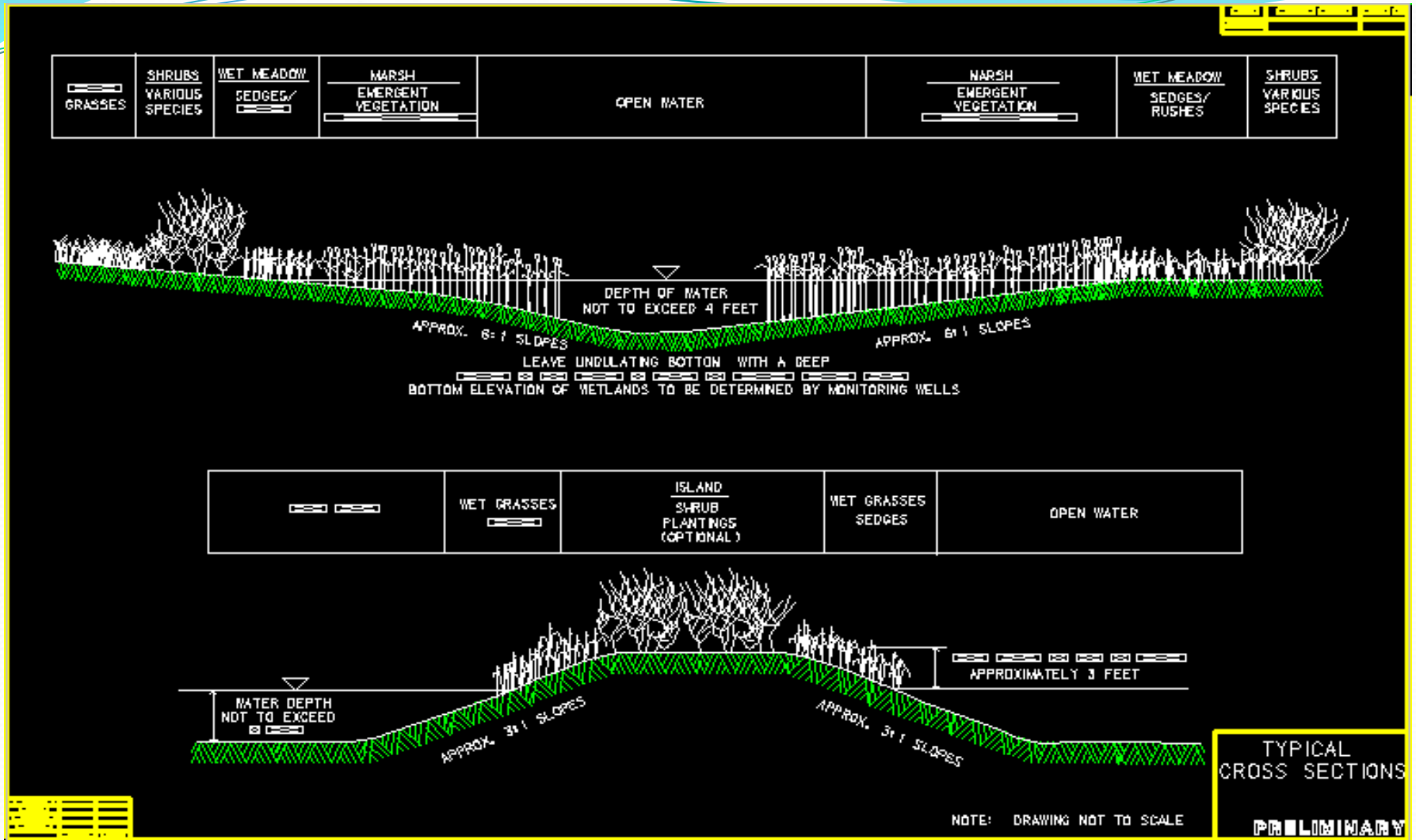
AREA	Acres	Feet
Wetland Creation Area	13	
Preservation Area	10	
Restoration Area	19	
Schrieber Lake	8	
Coyote Creek (Proposed)		2488
Schrieber Creek (Proposed)		2317
<b>TOTAL</b>	<b>50</b>	<b>4805</b>

- Property Boundaries
- Preservation Area
- Schrieber Lake
- Restoration Area
- Wetland Creation Area Proposed\*
- Schrieber Creek Proposed\*
- Coyote Creek Proposed\*

\* Subject to change  
 -These figures were calculated from the NAIP imagery, has not been surveyed. Areas calculated in the Attribute Table using 'Calculate Geometry' feature.



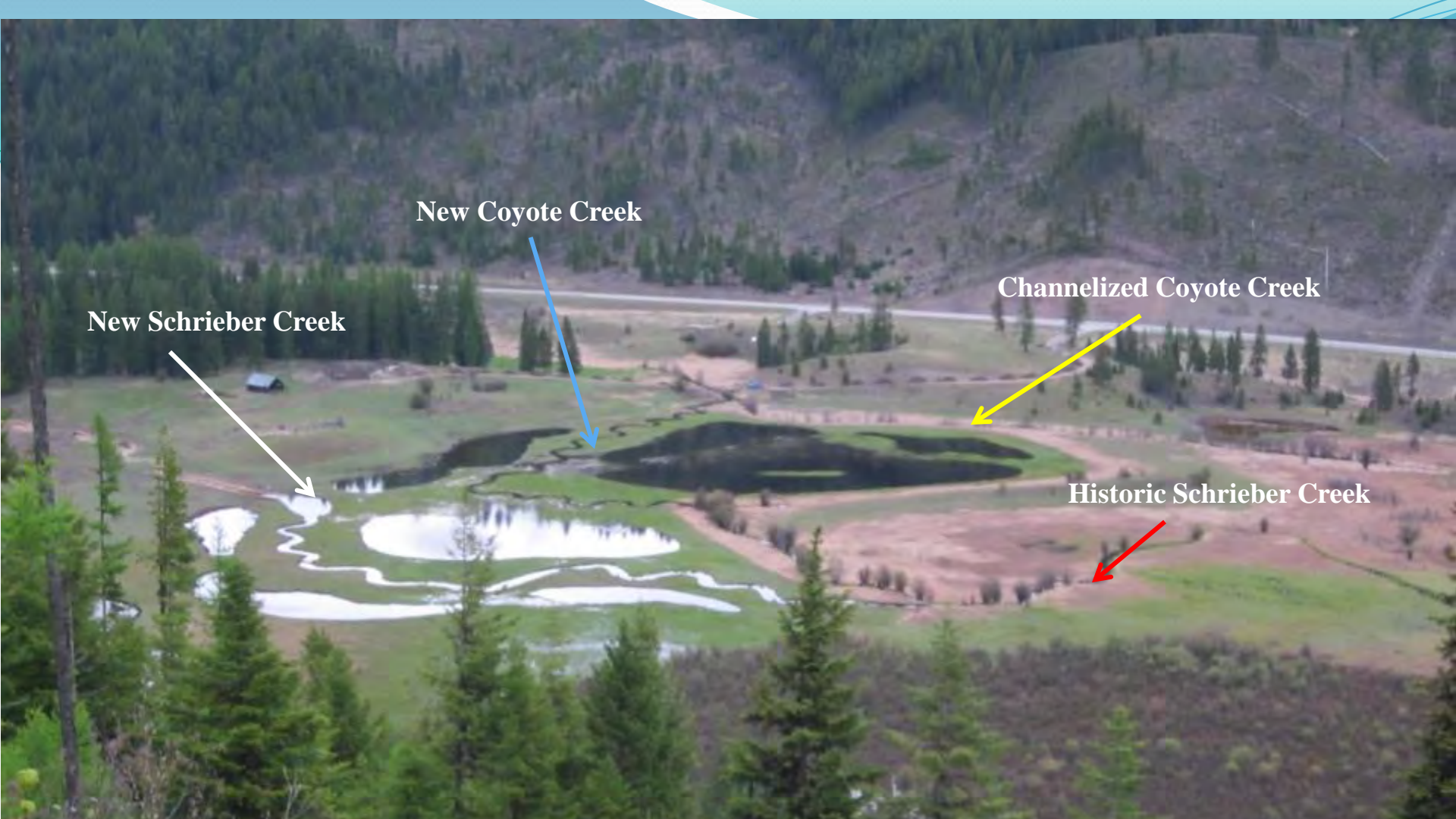
Initial Conceptual design and wetland/stream crediting for Schrieber Lake Site.



Development of typical wetland design cross-sections for agency review and comment.



**Creating shallow (1-3 feet deep) wetland cells to mimic oxbow wetlands. Insure a small pocket of deeper water in cell (tied to groundwater) for aquatic life refugia during dry periods.**



New Coyote Creek

Channelized Coyote Creek

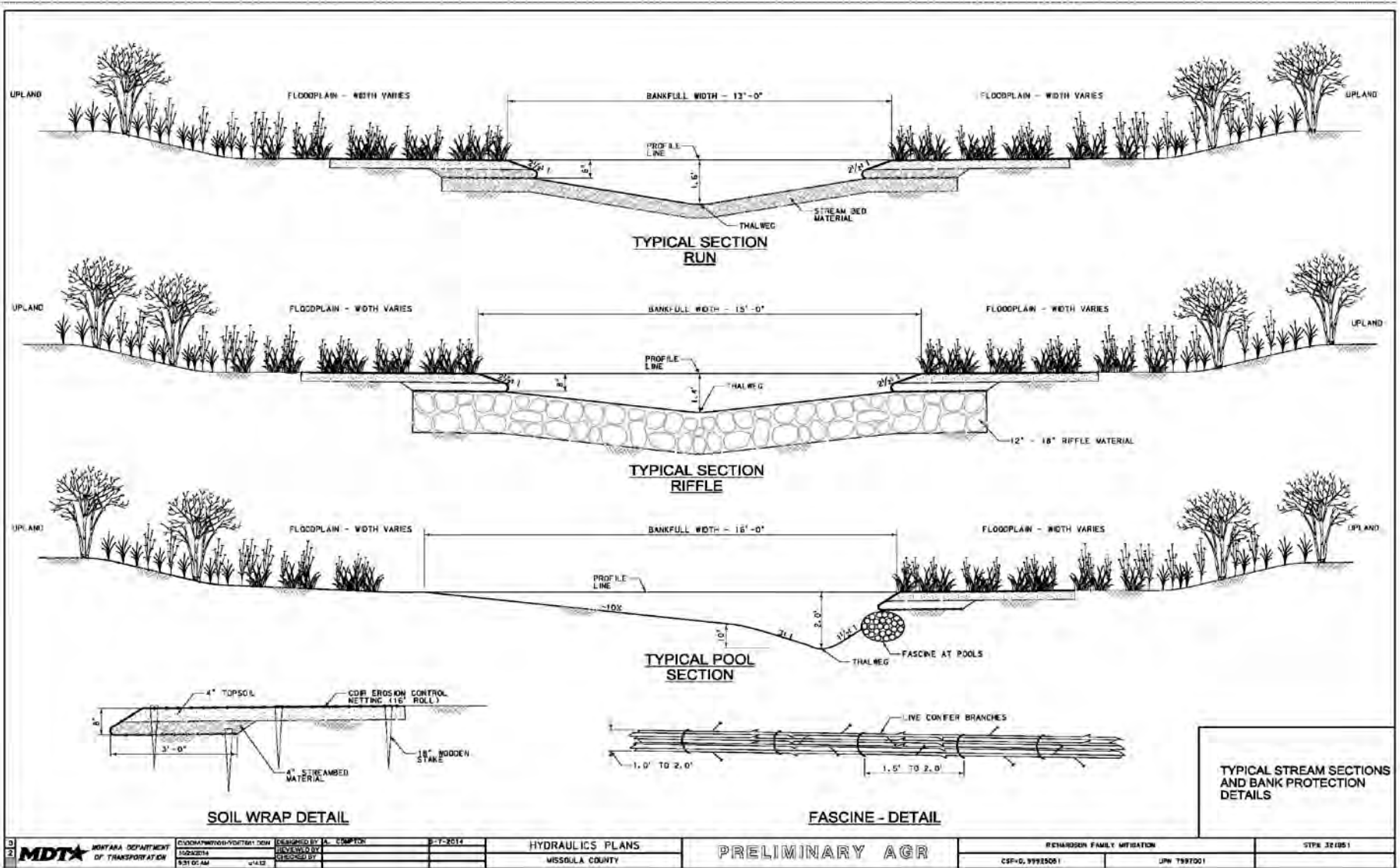
New Schrieber Creek

Historic Schrieber Creek

**Wetland Cells**

- Designed primarily for high groundwater elevations
- Allows for flood inundation during spring runoff from adjacent streams.
- Designed and setback to prevent capture by new stream channel

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Development of typical design cross-sections for pool, riffle and run segments of the stream channel for agency review and comment.



**Riffle Drop segment of stream with erosion occurring along one edge of channel. Coir blanket will need to be re-staked.**





Insure the establishment of floodplain benches along new stream channels that allow for high flow events to inundate these areas. Insure roughness in floodplain as this promotes sediment deposition and seed dispersal for riparian plants to establish.



Natural vegetation establishment and sediment deposition on coir fabric streambank wrap within floodplain. Note passive wood in channel.

# Design Plan Development

- Topographic surveys critically important for design
- Hydraulic design analysis:
  - Stream flow modeling for high gradient or low gradient channel designs including bedload analysis using software such as HEC-RAS, HEC-HMS, FISHPASS, HY-8, etc.
  - Groundwater elevations for depressional wetlands – installation of wells to monitor for several years if possible.
  - Water budget for wetlands to evaluate sources of water for wetlands (precip., surface flows, flood flows, irrigation, groundwater levels, evapo/transpiration, etc.)
- Design parameters for, wetland cells, islands, channel configuration, grade control and water diversion structures, channel plugs, root wads, bank treatments, borrow/fill/material quantities, construction costs, etc.
- Stream / Wetland Cross-sections
- Seeding/planting plans.



Channel designs must understand sediment load movement in streams containing decomposing granitic, sandy, organic and/or silty soils.



Conduct geotechnical borings along proposed stream channel locations to understand substrate of new channel location. Organic soil layers not identified early in the process leads to channel down-cutting and incising. Agency review - July 2014



Same organic soil channel bottom stabilizing with vegetation, but incised stream creating undercut banks. May 2015



Organic soils eroded away creating plunge pools due to more resilient clays and rock strata in portions of the streambed. Fish habitat structure by accident.

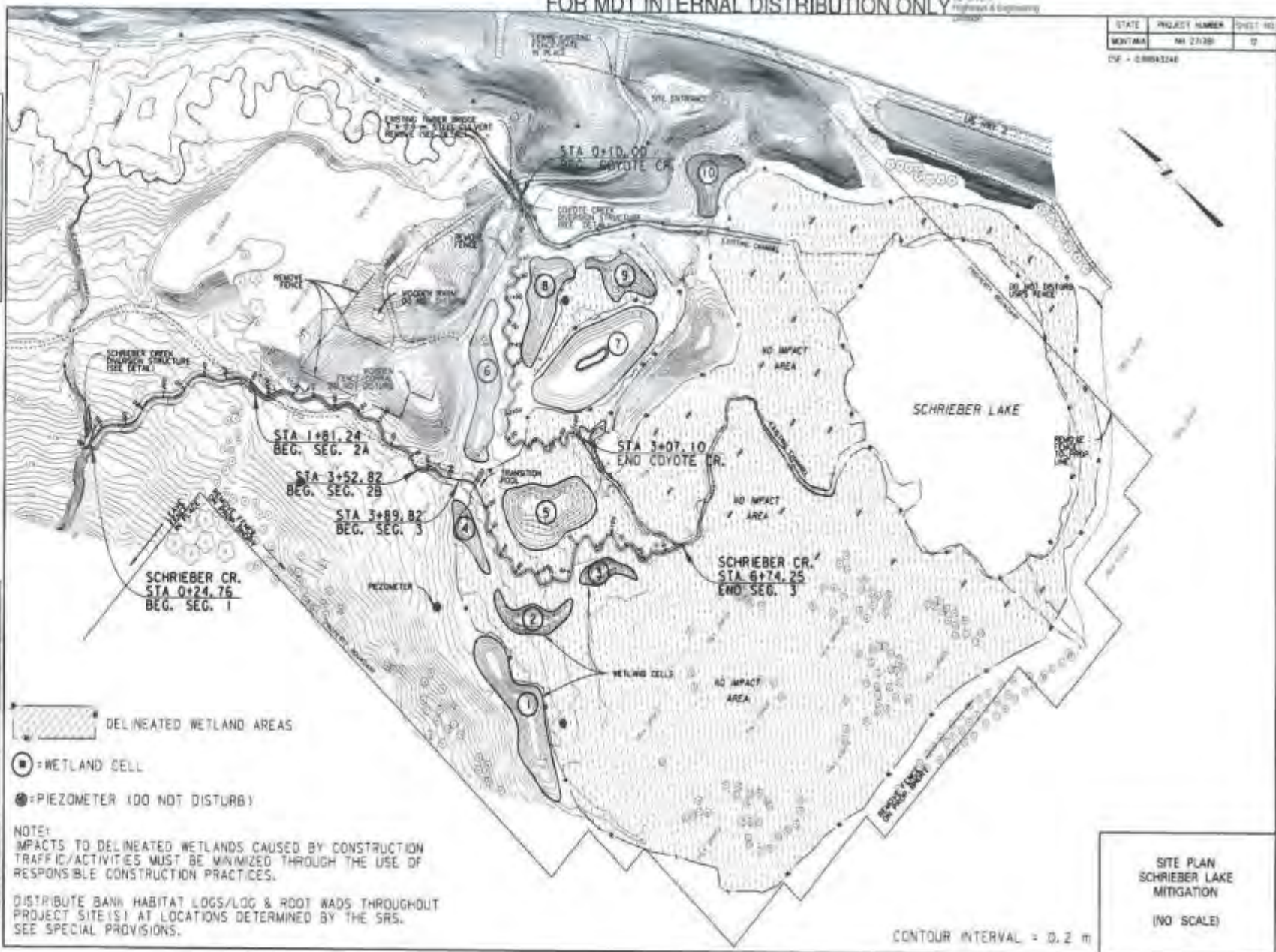


STATE	PROJECT NUMBER	SHEET NO.
MONTANA	MI 27130	12

DATE = 08/04/2014

MONTANA DEPARTMENT OF TRANSPORTATION  
CONTRACT NO. 27130

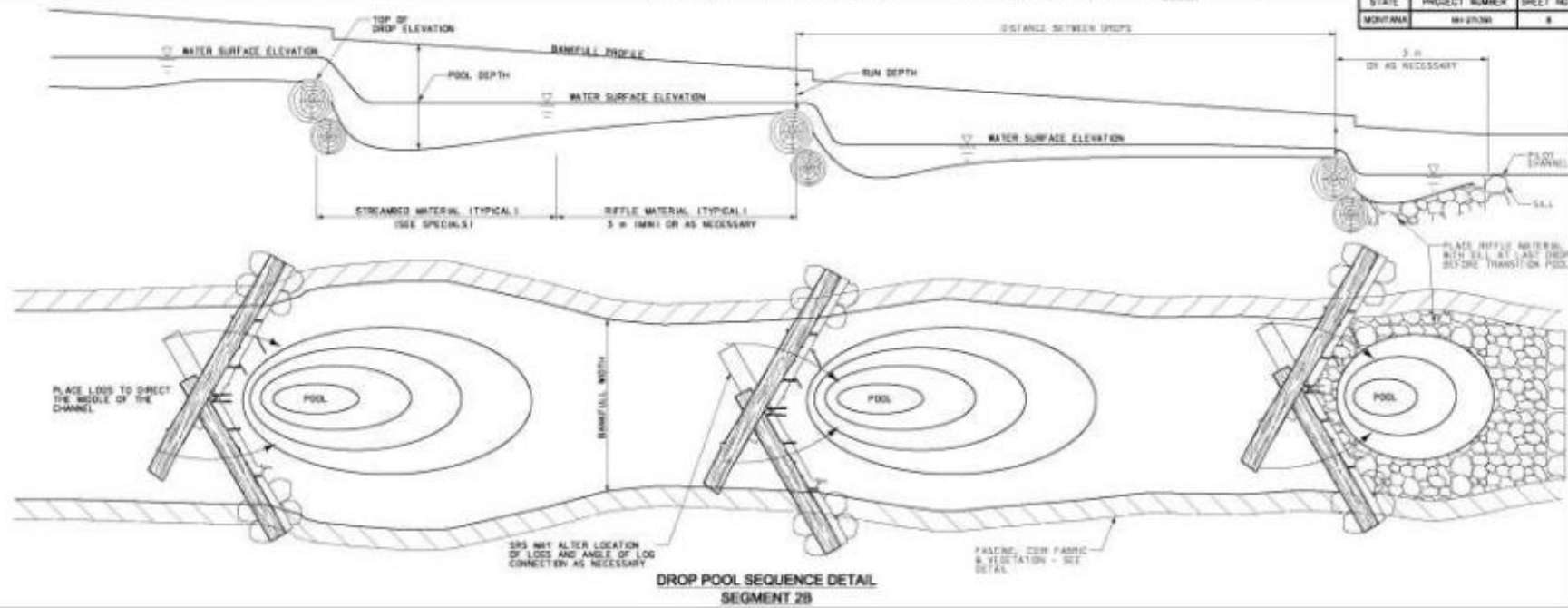
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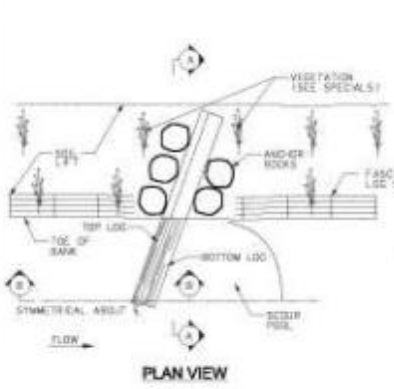


High elevation view of Schrieber Lake aquatic resource mitigation project showing new stream channels and depressional wetlands created in a former hay field.

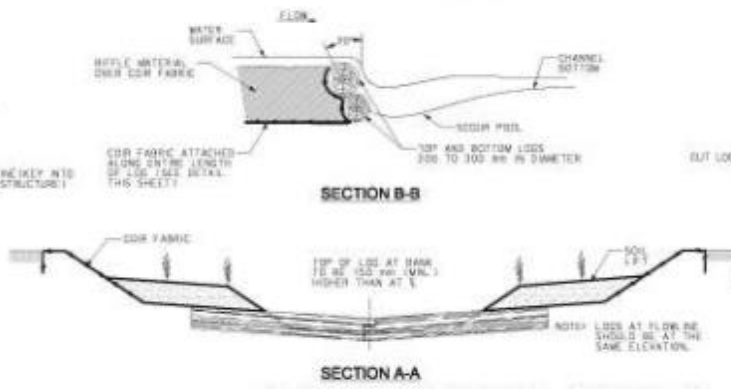
STATE	PROJECT NUMBER	SHEET NO.
MONTANA	MS-275(3)	8



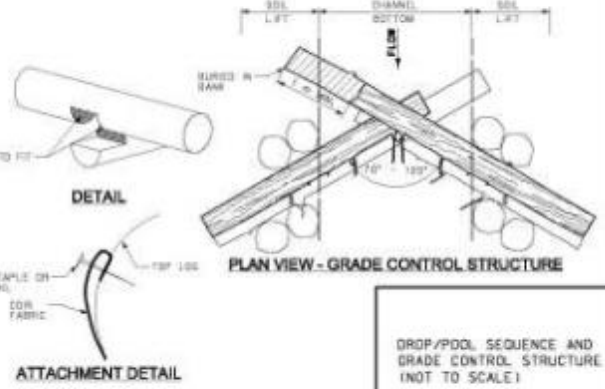
DROP POOL SEQUENCE DETAIL  
SEGMENT 2B



PLAN VIEW



SECTION A-A  
GRADE CONTROL STRUCTURE DETAIL - SEGMENTS 1 & 2B



DETAIL

PLAN VIEW - GRADE CONTROL STRUCTURE

DROP/POOL SEQUENCE AND  
GRADE CONTROL STRUCTURE  
(NOT TO SCALE)

MONTANA  
MONTANA DEPARTMENT OF TRANSPORTATION

DATE: 04/08/2014  
DRAWN BY: J. W. HARRIS  
CHECKED BY: J. W. HARRIS  
SCALE: AS SHOWN  
PROJECT: MS-275(3)



Log Drop Structures being constructed at Schrieber Creek. Note geotextile fabric tacked to upstream end of logs.



Log Drop Structures installed to mimic beaver dams that failed as they were undercut by stream flows. No geotextiles were installed although recommended and overruled by permitting agency.

STATE	PROJECT NUMBER	SHEET NO.
MONTANA	WH 27130	14
CSF - 0.00043216		

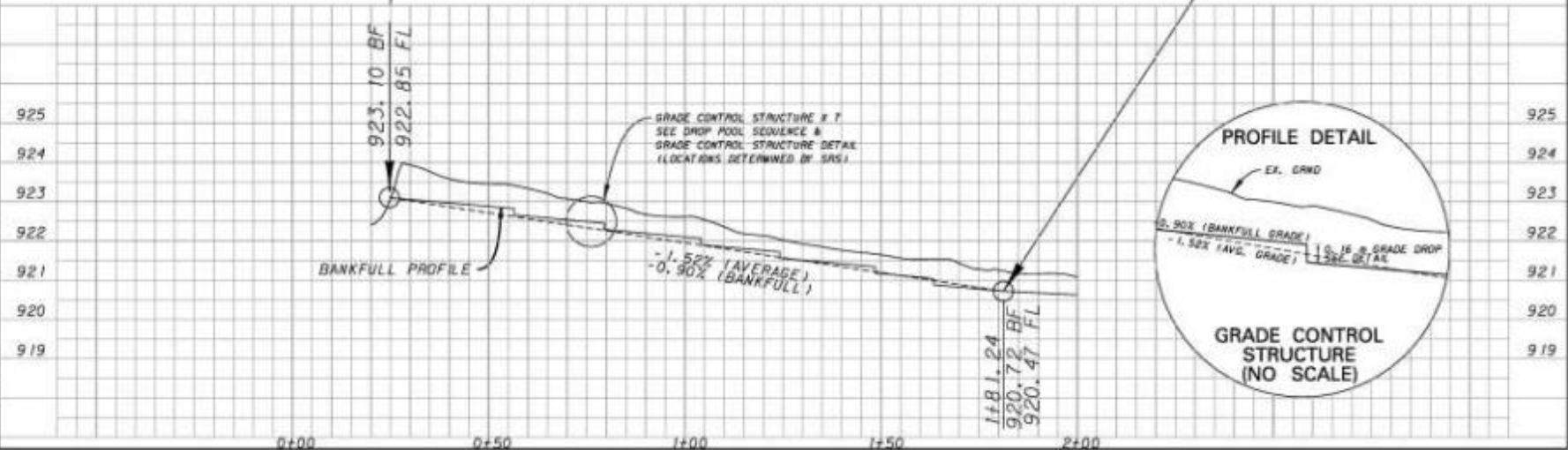
NOTE: DISTRIBUTE BANK HABITAT LOSS/ON & ROOT MASS THROUGHOUT PROJECT SITE AT LOCATIONS DETERMINED BY THE SRS. SEE SPECIAL PROVISIONS.

SCHRIEBER CREEK  
DIVERSION STRUCTURE  
(SEE DETAIL)

SCHRIEBER CREEK  
STA 0+24.76  
BEGIN SEGMENT 1

GRADE CONTROL STRUCTURES,  
(LOCATIONS DETERMINED BY SRS)

SCHRIEBER CREEK  
STA 1+81.24  
END SEGMENT 1



Log Drop Pool Design for Schriber Creek channel.



Completed log drop pool structures with coir fabric wrap and fascines on Schrieber Creek channel. Note flat floodplain areas and passive wood.

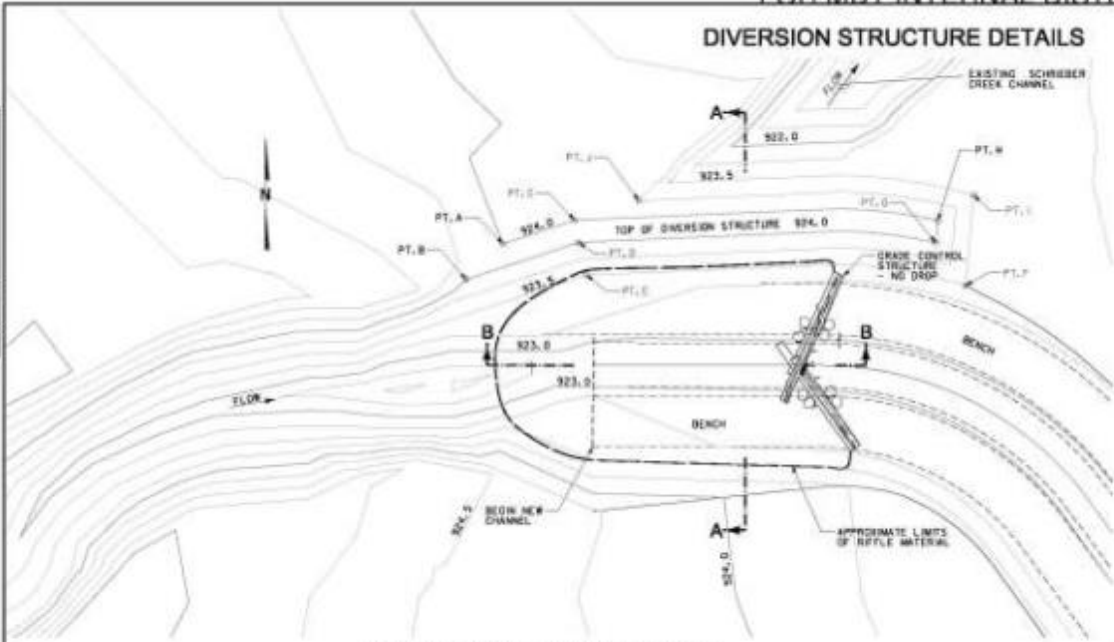


P. Hooper – USFS 2015

Completed log drop pool structures functioning during spring runoff March 2015.

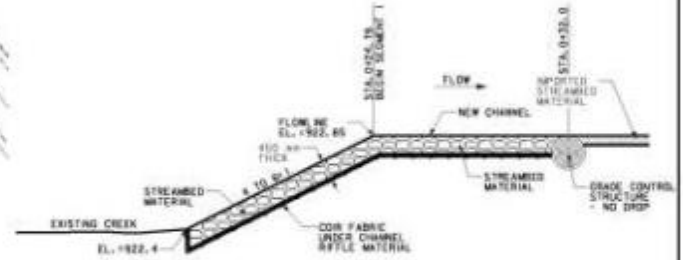


DIVERSION STRUCTURE DETAILS

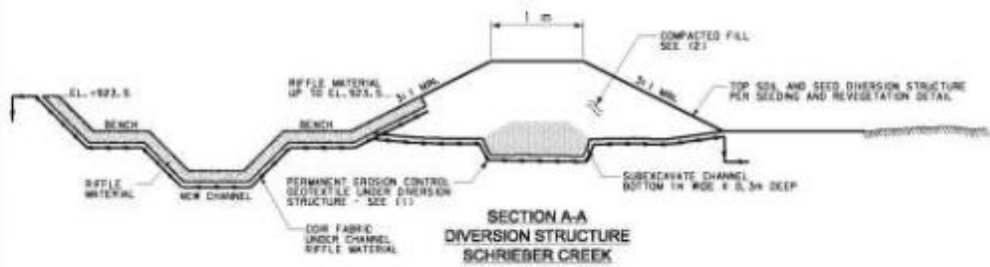


DIVERSION STRUCTURE - SCHRIEBER CREEK

POINT	NORTHING (FT)	EASTING (FT)	ELEVATION (FT)
A	445285.811	160092.257	924.0
B	445264.213	160092.409	924.0
C	445268.158	160095.284	924.0
D	445283.945	160095.466	924.0
E	445264.825	160095.272	923.5
F	445263.993	160112.850	923.5
G	445263.523	160111.328	924.0
H	445266.926	160111.620	924.0
I	445268.037	160113.229	923.5
J	445267.812	160099.171	923.5



SECTION B-B  
SCHRIEBER CREEK  
EXISTING CHANNEL TO  
NEW CHANNEL TRANSITION



SECTION A-A  
DIVERSION STRUCTURE  
SCHRIEBER CREEK

- (1) BURY AND ANCHOR PERMANENT EROSION CONTROL GEOTEXTILE SO THAT NO PORTION OF THE FABRIC IS EXPOSED.
- (2) PLACE AND COMPACT SUITABLE MATERIALS PER SECTION 205, EARTH EMBANKMENT.

SCHRIEBER CREEK  
DIVERSION STRUCTURE DETAIL  
(NOT TO SCALE)

MDT HIGHWAYS & ENGINEERING  
 CIVIL DIVISION  
 PROJECT: WY-07389  
 SHEET: 9 OF 10  
 DATE: 04/08/2014  
 DRAWN BY: [Name]  
 CHECKED BY: [Name]

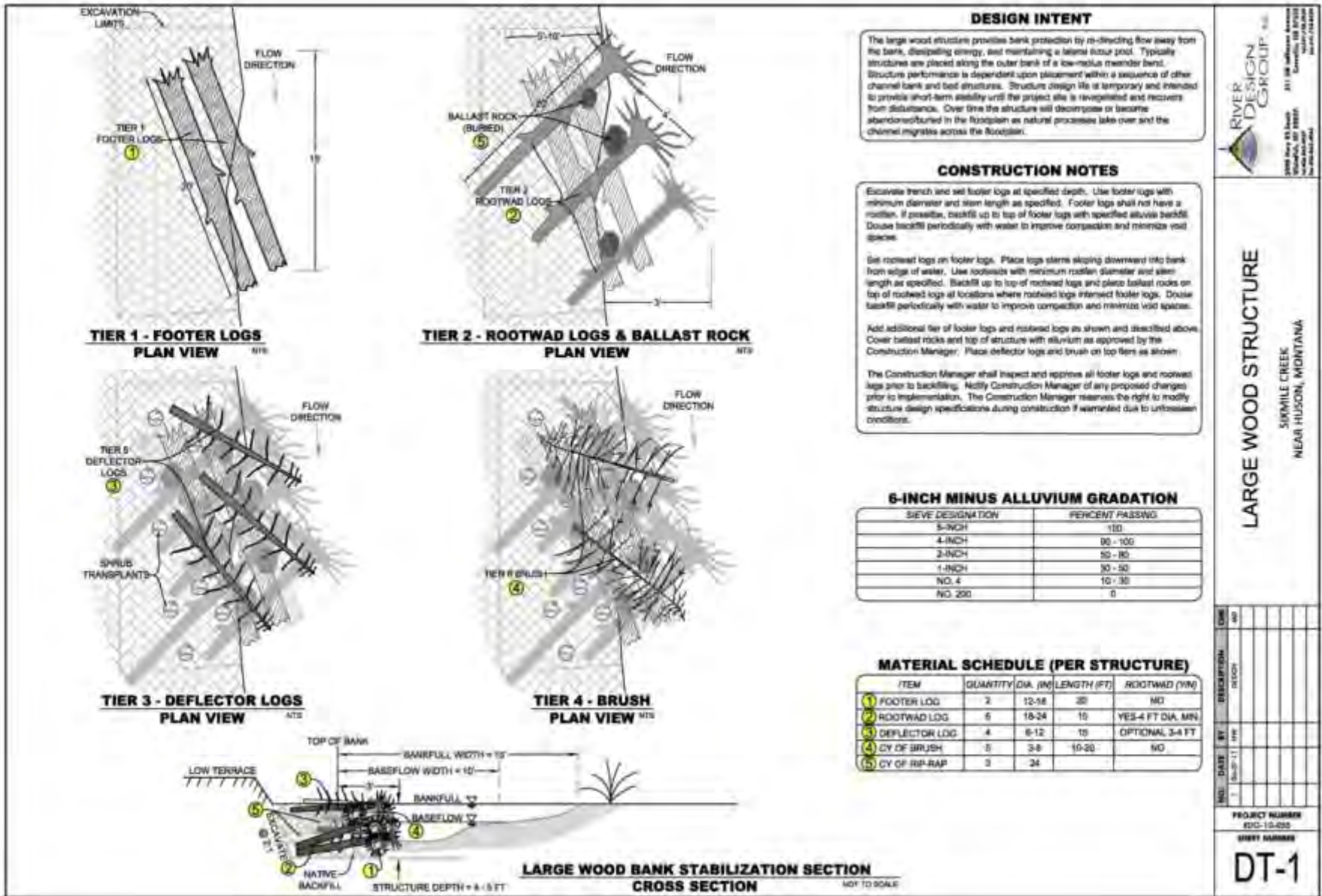
Channel plug/diversion detail



Coyote Creek channel plug diverting stream into new channel. May 2015



Root wad ditch block installation at Schrieber Meadows – September 2011



**DESIGN INTENT**

The large wood structure provides bank protection by re-directing flow away from the bank, dissipating energy, and maintaining a lateral scour pool. Typically structures are placed along the outer bank of a low-mobility meander bend. Structure performance is dependent upon placement within a sequence of other channel bank and bed structures. Structure design life is temporary and intended to provide short-term stability until the project site is revegetated and recovers from disturbance. Over time the structure will decompose or become abandoned/buried in the floodplain as natural processes take over and the channel migrates across the floodplain.

**CONSTRUCTION NOTES**

Excavate trench and set footer logs at specified depth. Use footer logs with minimum diameter and stem length as specified. Footer logs shall not have a rootlet. If possible, backfill up to top of footer logs with specified alluvium bankfill. Douse bankfill periodically with water to improve compaction and minimize void space.

Set rootwad logs on footer logs. Place logs stems sloping downward into bank from edge of water. Use rootwads with maximum rootlet diameter and stem length as specified. Backfill up to top of rootwad logs and place ballast rocks on top of rootwad logs at locations where rootwad logs intersect footer logs. Douse bankfill periodically with water to improve compaction and minimize void space.

Add additional tier of footer logs and rootwad logs as shown and described above. Cover ballast rocks and top of structure with alluvium as approved by the Construction Manager. Place deflector logs and brush on top tiers as shown.

The Construction Manager shall inspect and approve all footer logs and rootwad logs prior to backfilling. Notify Construction Manager of any proposed changes prior to implementation. The Construction Manager reserves the right to modify structure design specifications during construction if warranted due to unforeseen conditions.

**6-INCH MINUS ALLUVIUM GRADATION**

SIIEVE DESIGNATION	PERCENT PASSING
5-INCH	100
4-INCH	90 - 100
3-INCH	90 - 100
1-INCH	90 - 95
NO. 4	10 - 30
NO. 200	0

**MATERIAL SCHEDULE (PER STRUCTURE)**

ITEM	QUANTITY	DIA. (IN)	LENGTH (FT)	ROOTWAD (Y/N)
1) FOOTER LOG	2	12-18	35	NO
2) ROOTWAD LOG	6	18-24	10	YES-4 FT DIA. MIN
3) DEFLECTOR LOG	4	6-12	15	OPTIONAL 3-4 FT
4) CY OF BRUSH	5	3-8	10-20	NO
5) CY OF RIP-RAP	3	34		



**LARGE WOOD STRUCTURE**  
 SIVWILE CREEK  
 NEAR HUSON, MONTANA

NO.	DATE	BY	DESCRIPTION
1	08-11-11	YFM	DESIGN

PROJECT NUMBER  
 RDC-13-010  
 SHEET NUMBER  
**DT-1**

Courtesy of Matt Daniels of River Design Group, Inc.

# Stream Habitat Structures





Series of root wad bank structures to serve as flow deflectors and habitat structures in an ephemeral stream channel.

# Streambank Treatments



Coir log installation over a rock toe with willow cuttings installed above and below the coir log.



Two coir log bank installation with a rock toe and willow cutting mat between coir logs sprigged with willow cuttings.





Insure that coir fabric wraps do not unravel or tear to prevent bank instability.  
Protect wraps with fascine installation below.



Coir fabric bank treatment underlain by evergreen/willow branch fascines. Note passive wood root wad in stream channel to create habitat and sediment deposition. Woody plantings have been made in point bar location at edge of channel.



Coir wraps will eventually sag and slough into channel as channel develops, which may add to bank stability and plant rooting success.





Coir fabric bank treatment after vegetation has re-established.

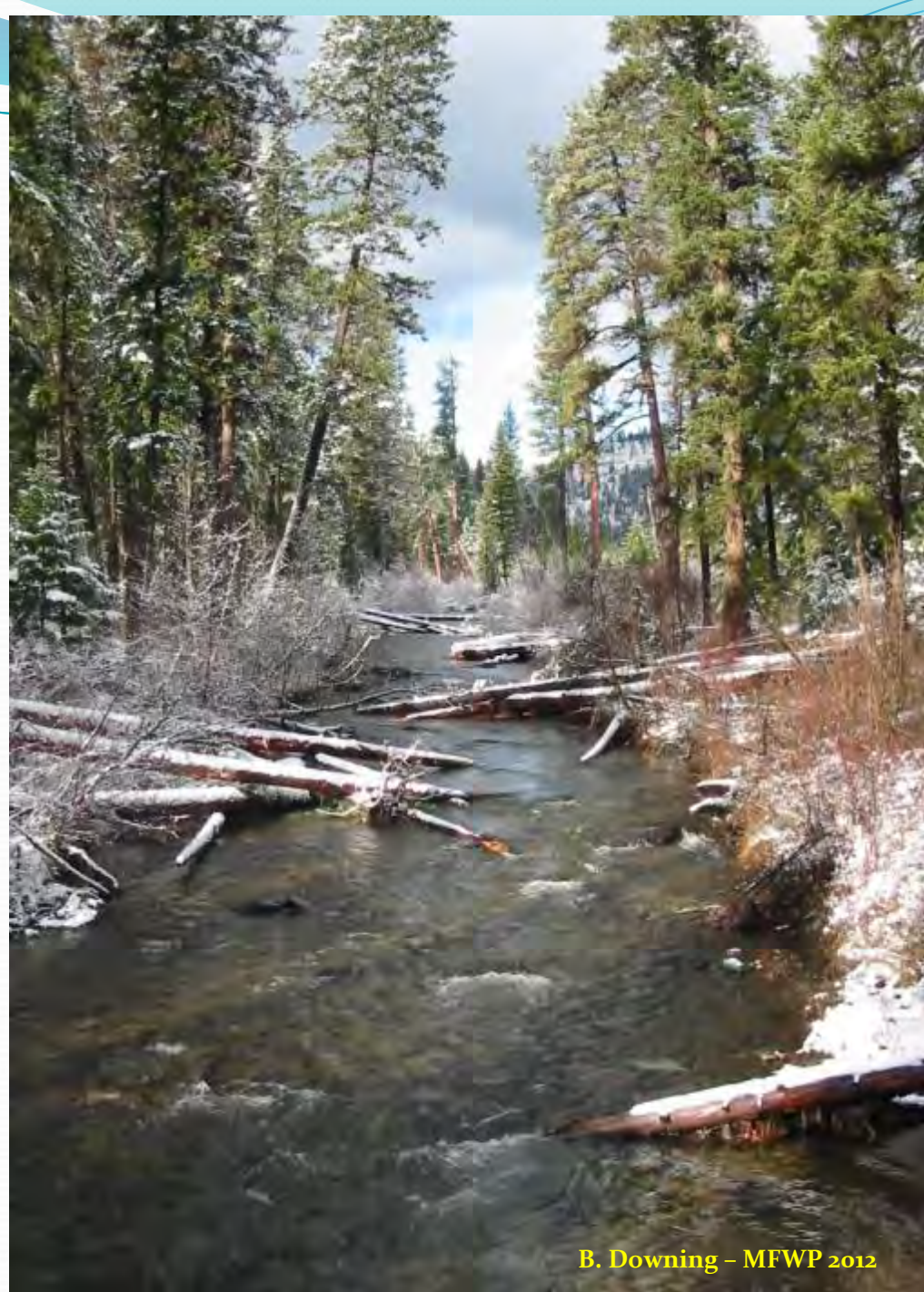


## PASSIVE WOOD INSTALLATION:

For streams established in forested areas, habitat features such as the installation of passive wood in stream restoration is important for the overall health of the stream.

These are not stream structures, but rather simple installation of downed trees into the stream as would be found in a natural system.

Follow regulations for such wood installation as in some areas of the country, FEMA frowns upon the installation of passive wood that is unanchored in the floodplain or extends into the stream. As it has the potential to wash out in large storm events and piles up against bridges and other infrastructure creating hazardous conditions.





Placement of passive wood in a newly constructed stream channel and floodplain.





Placement of new channel to naturally fit into the landscape.



New stream channels should be placed to minimize disturbance of existing vegetation communities and allow for natural plant colonization. Note passive wood into stream.

# Construction Monitoring

- MDT Aquatic Resource Unit in conjunction with a Stream/Wetland Restoration Consultant conduct Project Oversight on all aquatic resource mitigation project sites under construction.
- Stream/Wetland Restoration Consultant assists Contractor, and MDT Construction personnel concerning design plans and construction issues onsite.
- Post Construction Reviews with Regulatory Agencies.

# Before: East Bozeman Wetland Fall 2009



# After: East Bozeman Wetland – April 2010





**Monitoring: East Bozeman Wetland – August 2010**

# Post Construction Review with Regulators at East Bozeman site – Sept 2009



# Post Construction Monitoring

- **Period of monitoring of each mitigation site minimum of 5 years. Could be longer if drought conditions persist, or shorter if site develops quickly.**
- **Monitoring requirements and durations are outlined in Corps 404 permits.**
- **Performance goals and objectives must be measurable and quantifiable in order to be considered complete and approved by agencies.**
- **Costs of monitoring are variable dependent upon mitigation requirements and size of sites.**
  - **Streams – Require transects at pools/riffles dependent upon channel length (every 100-500 feet), bank pins, longitudinal channel surveys, photo points, vegetation belt transects within the floodplain stream buffer, etc.**



# Post Construction Monitoring Continued

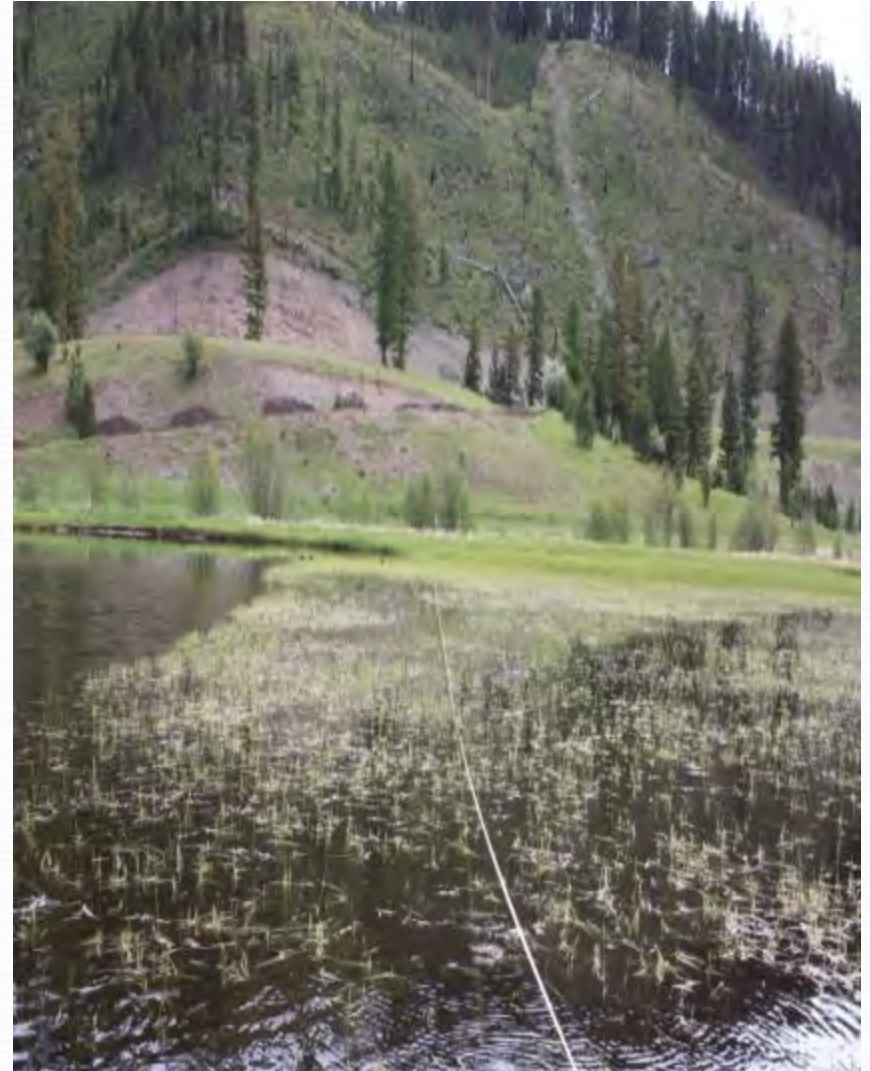
- Wetland Monitoring includes: establishment of vegetation transects; assessment of woody planting survival; soil borings; photo points; wetland delineations and functional assessments; wildlife observations (birds, mammals, herpetiles), etc.
- Mitigation monitoring reports must be prepared annually for submission to the various permitting and natural resource agencies until the site is approved.
  - MDT Monitoring Reports can be viewed at this website:  
<http://www.mdt.mt.gov/other/environmental/external/wetlands/>
- Adaptive management and maintenance is required for all mitigation sites into perpetuity.



R. McEldowney -2013

Channel cross-section transect

# Wetland vegetation monitoring belt transects marked by T-posts and tapes across riverine wetland areas.



**Established photo-points for monitoring: New Channel  
Camp Creek – Winter 2001**





Same Camp Creek channel showing migration after 2011 flood events. Channel migration in some instances is beneficial to riparian system.

# Camp Creek Channel Spring 2006





**Camp Creek channel Fall of 2011**

**Learning from our mistakes - Camp Creek, fall 2001.  
Road contractor building a stream channel.**







Qualified and experienced stream contractors and aquatic restoration professionals now hired for the construction and oversight of all stream/wetland projects.

# Recommendations

Cause of Failure	Recommendation	Selected Measures
Problems encountered during construction due to lack of information.	Feasibility studies must address all technical aspects of a proposed project in enough detail to prevent problems from occurring during construction.	<ul style="list-style-type: none"> <li>-Accurate topographic survey</li> <li>-Geotechnical information – soils, rock strata, groundwater elevations, etc.</li> <li>-Hydrologic analysis – modeling for the watershed</li> </ul>
Inexperienced construction oversight personnel.	Contract specifications should require that an experienced Stream/Wetland Restoration Specialist provide oversight during the entire construction project.	Develop standard contract language requiring experienced Construction oversight personnel.
Undermined log drop structures in stream.	Install geotextile fabric on all log drop structures to prevent undermining by streams flows by tacking to logs	Develop a standard plan detail for construction plans showing the location of geotextile in relationship to log drop structure design.
Inexperienced construction contractors.	Hire only contractors experienced in stream and/or wetlands work.	Contract bid requirements should require experienced construction firms to construct the aquatic resource restoration projects, specifically for riverine systems. More efficient and knowledgeable in building such systems, may reduce costs.
Post-construction reviews	Recommend separate post construction meetings with agencies and contractor /oversight professional.	Agency review may provide recommendations for future projects. Post con with contractor and oversight professional to discuss the good, bad and ugly for improvements to future plans, specifications and projects.
Hydrology Not Restored	Match Channel Water Surface Profile to Stream Corridor Groundwater Table, Flood frequency and Duration	Properly Identify System as Riverine or Slope. Design Channel Water Surface Profile to support system's groundwater and flooding frequency and duration

# Important Website Links:

- MDT Mitigation Program website:
  - <http://www.mdt.mt.gov/publications/datastats/wetlands.shtml>
- Montana Wetland Assessment Methodology links:
  - MWAM Manual
    - [http://www.mdt.mt.gov/other/environmental/external/wetlands/2008\\_wetland\\_assessment/2008\\_mwam\\_manual.pdf](http://www.mdt.mt.gov/other/environmental/external/wetlands/2008_wetland_assessment/2008_mwam_manual.pdf)
  - Computerized MWAM Form:
    - <http://app.mdt.mt.gov/wetlands/>
  - RiverRAT – River Restoration Analysis Tool link:
    - <http://www.restorationreview.com/>
  - Rosgen Stream Classification System:
    - [http://www.fgmorph.com/fg\\_4\\_16.php](http://www.fgmorph.com/fg_4_16.php)

# Questions?

Richard Weber

[richard.weber@ftw.usda.gov](mailto:richard.weber@ftw.usda.gov)

(817)509-3576

Larry Urban

[lurban@mt.gov](mailto:lurban@mt.gov)

(406)444-6224

*Thank you for your  
participation!*



[www.aswm.org](http://www.aswm.org)