Wetland Banking & Monitoring for Consultants

BOARD OF WATER AND SOIL RESOURCES

Minnesota Wetland Professional Certification Program

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Wetland Banking & Monitoring for Consultants Course Agenda

Day One

- Overview of Wetland Bank Approval Process
- Performance Standards Exercise
- Lunch
- Setting up a Monitoring Program
- Monitoring Well Installation Exercise
- Hydrology Monitoring

Day Two

- Vegetation Sampling
- Vegetation Sampling Exercise
- Lunch
- Vegetation Data Interpretation
- Monitoring Reports

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Wetland Banking Process

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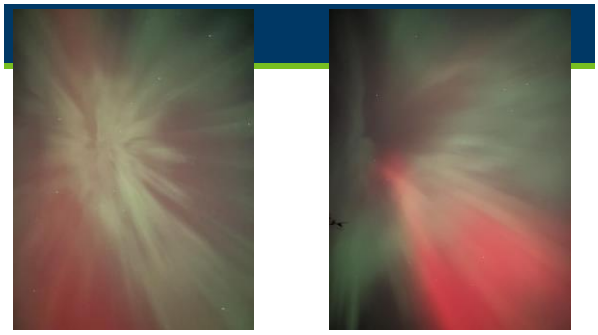

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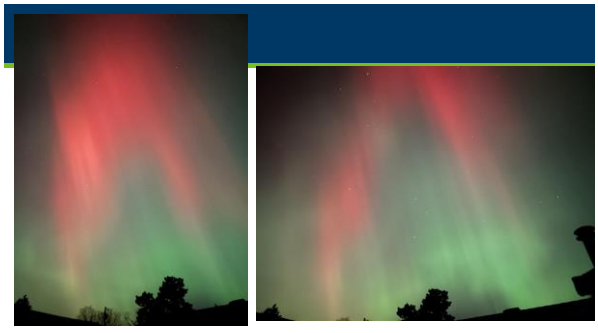

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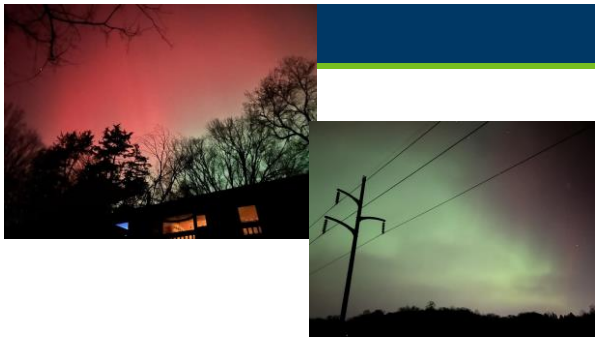

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Wetland Replacement

State and Federal regulations require wetland impacts to be offset by actions that add or improve wetlands on the landscape (aka…mitigation)

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Wetland Replacement

Replacement Types

- PRM (Permittee Responsible Mitigation or Project-specific)
- ILF
- Wetland Bank

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Wetland Replacement

- Replacement Types
  - PRM (Project-specific)
  - ILF
  - Wetland Bank

- The person impacting a wetland is fully responsible for providing replacement
- Design, build, manage, maintain, and monitor
- Directly tied to the replacement site for at least 5 years

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Wetland Replacement

- Replacement Types
  - PRM (Project-specific)
  - ILF
  - Wetland Bank
- Once the fee is paid (ILF) or credits are purchased (Bank), the person impacting a wetland is done.
- The ILF or bank "Sponsor" takes on the replacement responsibility and must manage, maintain, and monitor the site.

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Local Government Road Wetland Replacement Program

- 1996 State Statute requires BWSR to provide compensatory mitigation for local road authorities
- These wetland credits also satisfy U.S. Army Corps of Engineers' Section 404 permit requirements.

Local Road Authority Impacts Wetland for Road Repair/Rehabilitation

BWSR Provides Wetland Mitigation Required by State and Federal Permits

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Wetland Bank

Market-based commodity system (***Price not determined by BWSR***)

Wetlands are restored, enhanced, created, or preserved to generate wetland "credits"

Credits deposited into account

Credits sold to others to offset wetland losses somewhere else

Goal is no-net-loss

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Why Wetland Banks

2008 Federal Rule – wetland banks are preferred replacement type

- Larger more ecologically valuable sites (> 5 ac)
- Bank instrument/plan approved using rigorous scientific and technical analysis, planning, and implementation
- Entire site is permanently protected by a conservation held by BWSR (State)
- Success must be demonstrated BEFORE credits are released
- No temporal loss of wetland function or area
- Reduced risk and uncertainty

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Why Wetland Banks

Bank sponsor's plan is approved

⇩

Project is built and protected (certified)

⇩

Demonstrate success (monitoring)

⇩

Credits are released/deposited.

⇩

Credits can be sold to offset impacts

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Why Wetland Banks

Bank sponsor's plan is approved

⇩

Project is built and protected

⇩

Demonstrate success (monitoring reveals no bueno)

⃠

Credits are released/deposited.

⇩

Credits can be sold to offset impacts

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How are Credits Generated

- Preserve (>80% area)
- Vegetation
- Hydrology
- Area

- Offset wetland losses elsewhere

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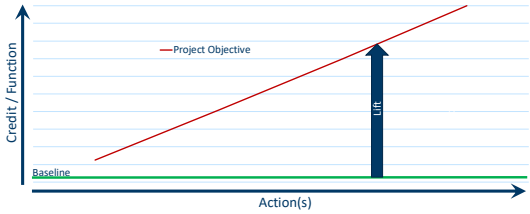
How are Credits Generated



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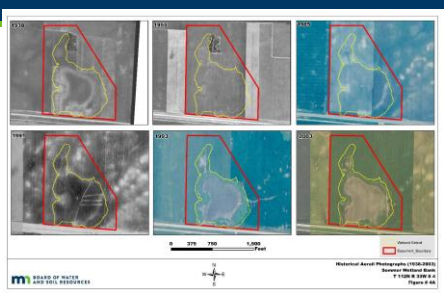
How are Credits Generated



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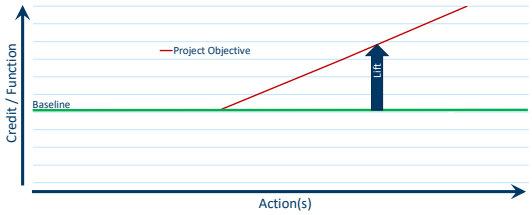
How are Credits Generated



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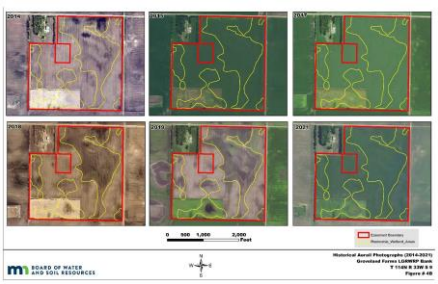
How are Credits Generated



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How are Credits Generated

General Action Categories

- Restoration
- Enhancement
- Creation
- Preservation
- Buffer

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How are Credits Generated

General Action Categories

- Restoration
- Enhancement
- Creation
- Preservation
- Buffer

- Fully or partially drained wetland
- Vegetation, Hydrology, and Area*
- High credit yield (typically 50-100%)

Re-Establishment* vs. Rehabilitation

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How are Credits Generated

General Action Categories

- Restoration
- Enhancement
- Creation
- Preservation
- Buffer

- Wetland with no significant drainage
- Vegetation only
- Low to moderate credit yield (33-50%)

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How are Credits Generated

General Action Categories

- Restoration
- Enhancement
- Creation
- Preservation
- Buffer

- Wetland created where none existed
- Vegetation, Hydrology, and Area
- Moderate to high credit yield (50-100%)

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How are Credits Generated

General Action Categories

- Restoration
- Enhancement
- Creation
- Preservation
- Buffer

- Existing high-quality unique wetland protected and sustained
- Under credible threat of loss, important functions, contributes to watershed sustainability
- No Vegetation, Hydrology, or Area
- Low credit yield (12.5%)

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How are Credits Generated

General Action Categories

- Restoration
- Enhancement
- Creation
- Preservation
- Buffer

- Upland adjacent to wetland improved or protected.
- Improves or protects wetland function and sustains functional improvements from adjacent actions
- Required when feasible (don't fill in wetland to create buffer)
- Low credit yield (10-25%)

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How are Credits Generated

WCA Credit Actions	Corps Credit Actions
Subp. 2 – Buffer	Buffer
Subp. 3 – Restoration, completely drained	Re-Establishment
Subp. 4 – Restoration, partially drained	Rehabilitation
Subp. 5 – Vegetation on farmed wetland	Enhancement
Subp. 6 – Protection, previously restored	Extended Restoration
Subp. 7 – Creation	Establishment
Subp. 8 – ENRV	Any or None
Subp. 9 – Preservation	Preservation

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What about the new Cultivated Field Credit (CFC)?

WCA Credit Actions	Corps Credit Actions
Subp. 2 – Buffer	Buffer
Subp. 3 – Restoration, completely drained	Re-Establishment
Subp. 4 – Restoration, partially drained	Rehabilitation
Subp. 5 – Vegetation on farmed wetland	Enhancement
Subp. 6 – Protection, previously restored	Extended Restoration
Subp. 7 – Creation	Establishment
Subp. 8 – ENRV	Any or None
Subp. 9 – Preservation	Preservation

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What about the new Cultivated Field Credit (CFC)?

Guidance Document

- Wetlands must be drained
- Subject to effects of cultivation
- Read and use the guidance document

Call it "CFC – Reestablishment or Rehabilitation"

U.S. Army Corps of Engineers St. Paul District & Minnesota Board of Water and Soil Resources

Alternative Method for Determining Wetland Credit Potential for Hydrologic Restorations on Cultivated Fields in Minnesota

Purpose and Applicability

Background

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Review Teams

- WCA LGU and Corps use review teams
- Review teams provide comments to each program lead
- Public comments can be received
- Program lead responds to the bank sponsor

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Review Teams

WCA Technical Evaluation Panel (TEP)

- LGU
- SWCD
- BWSR
- DNR

Corps Interagency Review Team (IRT)

- Corps
- EPA
- BWSR
- DNR
- FAA
- Others

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Review Teams

BWSR Review Roles:

- WS is BWSR's lead and coordinates BWSR comments to TEP
- Evaluate easement issues
- Engineering comments
- Statewide consistency
- Technical answers and interpretations
- Coordinate with Corps

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Bank Review Phases

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Bank Phases

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Draft Prospectus


Wetland Mitigation Proposal
Draft Prospectus

- Optional
- No decisions required
- Complex or difficult projects
- Minimal investment
- New Form!

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Draft Prospectus

WCA Review Process:

- LGU distributes document to TEP member for review
- Optional phase for WCA, no NOA or 15.99 time-limits
- TEP members comment and discuss the project's potential
- No engineering review
- TEP plans a site visit

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Draft Prospectus

WCA Outcome:

- Comments received and project discussed at TEP meeting
- TEP writes Findings and recommendation for bank sponsor
- Sponsor decides what to do

- Goal of TEP findings within 30 days

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Draft Prospectus

Corps Outcomes:

- IRT comments received and meeting held if needed
- Recommendation: contact Corps to schedule a site visit if you're within the growing season
- Corps PM writes letter to bank sponsor indicating whether the site has good potential for approval or not.
- Goal: Corps determination on potential within 30 days.
- Sponsor decides to proceed or not

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Draft Prospectus

General Outcome Options

- Your project has potential to generate bank credits! Proceed to the Prospectus phase!
- Or…here are some opportunities and obstacles to address as you move forward.
- Or…there are some significant challenges you face, and we recommend you not proceed

- Comments are commensurate with information provided

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Site Considerations

What makes a good bank

- Look at historical conditions…was it historically wetland?
- Soils data (hydric soil/drainage classification)
- Restoring hydrology (tile blocks and/or ditch plugs)
- Lidar
- Will it affect neighboring properties
- Minimal grading or construction (costs add up quickly)
- Look at Restorable Wetland Index (NRRI – U of M)

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Prospectus


Wetland Mitigation Proposal
Prospectus

- Required by Corps
- Not required by WCA
- Baseline Information
- Concept Plans
  - Justify Credit Actions
  - Justify Credit Allocation

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Prospectus

WCA Review Process

- LGU distributes Prospectus to TEP members for review
- Optional phase for WCA, no NOA or 15.99 time-limits
- Engineering review requested
- TEP site visit if needed
- TEP members assemble comments for meeting and discussion

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Prospectus

General Considerations

- Baseline information must justify credit actions and allocations
- Some credit actions require more information
- Use the form and read the headings to provide what is requested
- Project concept considered but no detailed plans required
- Comments commensurate with information provided*

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Prospectus

No performance standards needed

No credit release schedule needed

No monitoring plan needed

Focus on Baseline Conditions and credit eligibility

Title opinion recommended

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Prospectus

WCA Outcome:

- TEP and engineering comments received and project discussed at TEP meeting
- TEP writes Findings based on comments and discussion
- Sponsor decides to proceed or not

- Goal of TEP findings within 60 days

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Prospectus

COE Outcome:

- Remember, Prospectus REQUIRED by COE
- Outcome is the Initial Evaluation Letter (IEL) stating whether or not the site has potential to provide compensatory mitigation
- Should receive IEL within 90 days of a complete submittal

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Mitigation Plan/MBI


Wetland Mitigation Proposal
Mitigation Plan (Full Application) BWSR

- Required for both programs
- NOA required
- Section 15.99 time-limits!
- LGU Decision Required*
- "Attachment A" to Corps MBI
- Plan Details and Final Crediting

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Mitigation Banking Instrument (MBI)

What is an MBI?

- Required by the Corps (it is not a WCA document)
- Legal agreement signed by bank sponsor and the Corps
- Dictates operation, establishment, and conditions of the bank
- MBI includes a Mitigation Plan as an attachment

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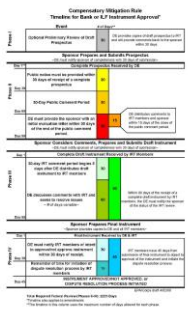

Draft MBI/Mitigation Plan

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Draft MBI/Mitigation Plan

WCA Review Process

- 15.99 applies so LGU reviews for completeness and sends NOA
- LGU distributes to TEP members for review
- Engineering review if construction included
- TEP site visit if needed
- TEP members assemble comments for meeting and discussion
- 15.99 time limit extension should be planned

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Draft MBI/Mitigation Plan

- Button-up baseline information
- Accurate credit calculations needed
- Credit release schedule needed
- Performance standards needed
- Detailed vegetation plans needed
- Detailed construction plans needed
- Detailed monitoring plans needed

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Performance Standards

Performance standards determine "if" credits can be released

- Observable or measurable physical, chemical, and/or biological attributes confirming project objectives are met
- Demonstrate improvement beyond baseline condition
- Show progression to the Final release
- All credit areas and actions need to achieve their standard(s) for credits to be released

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Performance Standards

Common hydrology metrics*

- Meet standard for 2 full growing seasons
- Reference site (± 20%)
- Water table/inundation timing and duration measurements
- Expect wells with daily readings

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Performance Standards

Common vegetation metrics:

- Interim 1 met for 2 consecutive seasons
- Interim 1 NNI relative cover ≥ 50%
- Final NNI relative cover ≥ 70% - 90%
- Species richness of 5, 10, and 15 NNI species for most communities
- > 50% hydrophytes for wetland communities
- Maximum bare ground/open water area
- Multi-strata communities may have metrics in each stratum

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Draft MBI/Mitigation Plan

WCA Review Results

- Expect multiple MP submittals
- Track 15.99 time-limit and extend as needed
- TEP and engineering comments received and discussed at TEP meeting
- TEP writes Findings and recommendations to LGU based on comments and discussion
- If plan approval is not recommended the TEP instructs the sponsor to resubmit a revised MP to address findings

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Draft MBI/Mitigation Plan

WCA Review Results

- If plan approval is recommended the LGU makes their decision and sends NOD
- Clearly identify and retain the approved Mitigation Plan
- WCA and Corps should approve the same plans whenever possible
- Goal of TEP findings within 90 days (for each version)

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Draft MBI/Mitigation Plan

Corps Outcome

- Corps PM considers IRT comments and notifies sponsor whether the Draft MBI is generally acceptable and whether they can proceed to Final MBI or not (Status Update Letter aka SUL)
- Options:
  - If the Draft MBI is acceptable the sponsor can proceed to the Final MBI phase, usually with minor edits
  - If the Corps determines the draft Instrument is NOT generally acceptable, the sponsor cannot automatically proceed to FMBI.
  - There may also be times when the Corps wants to review just a couple parts of a DMBI before letting the sponsor proceed to FMBI (ex. Updated performance standards)

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Final MBI

- This is a Corps only step and is required
- Sponsor submits Final MBI to IRT members
- FMBI content:
  - All the same items as were needed for a complete Draft Instrument, updated
  - PLUS "other information deemed necessary by the DE"

    ….aka…items identified in previous Corps letters
  - PLUS a narrative from the sponsor documenting how they addressing previous Corps and IRT comments

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Final MBI

Day 0 - Sponsor submits Final Instrument to All IRT members

By Day 30 - Corps notifies IRT of intent to approve/not approve, thus initiating their opportunity to initiate the "dispute resolution process"

IRT has 15 days from notification to dispute Corps decision

Corps arranges for signatures from the IRT if no dispute

= 45 days

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After Approval

Once both programs approve the MBI/Mitigation Plan a check should be completed to identify programmatic differences.

Bank sponsor implements their plan, monitors the site, and if performance standards are achieved they request credit deposits in accordance with approved release schedule

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Here is what I do…

- Submit Prospectus (Phase 1)
- Receive IEL/TEP Comments
- Address IEL/TEP Comments in "Draft" Full Application/DMBI (not formerly requesting approval from WCA as this is draft) (Phase 2)
- Receive Status Update Letter (SUL)/TEP Comments
- Address SUL/TEP Comments in "Final" Full Application/FMBI (now I request WCA approval) (Phase 3) – This is where I submit the joint application
- This avoids WCA approval before SUL/FMBI
- 3 phases (4 if you do draft prospectus)

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Questions?

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US Army Corps of Engineers BUILDING STRONG.®

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Overview of Wetland Bank Process – Generating Credits

Ben Carlson – BWSR Wetland Mitigation Coordinator

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MWPCP

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Your plan is approved….now what?

- Easement Acceptance
  - Held by the State of MN
- Site Certification
  - As-Built Survey
  - Seed Tags
  - Monumentation
- Monitoring Process
  - Duration of monitoring
  - Performance Standards
  - Deposit of Credits
- Maintenance Responsibilities/Corrective Actions
  - Vegetation Issues
  - Hydrology Issues
  - Encroachment
- Close Out
  - Delineation
  - Final Deposit

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Easement Acquisition

1. Preliminary Ownership Review (Section 1 Documents – Likely started during bank application process)…start with Brittany
2. Legal Boundary Survey
3. Title Insurance Commitment
4. Easement Execution (Review by BWSR and AGO)
5. Easement Recording & Final Title Insurance Policy

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Easement Acquisition

Key Step	Description	BWSR Processing Time	Cost
Easement Initiation	Preliminary ownership and boundary review	15 - 30 Days	$1,000 (Initial Easement Acquisition Fee)
Legal Boundary Survey	Easement boundary surveyed; certificate of survey provided for BWSR review and comment	30 - 60 Days	$3,000 - $6,000 (Surveyor defined)
Title Commitment	Title commitment prepared for BWSR review and comment; title must be cleared by landowner as directed by BWSR	45 - 90 Days	$1,500 - $3,000 (Title Agent defined)
Easement Recording / Title Insurance Policy	Easement executed by landowner and state and sent to title agent for recording and title policy	30 - 60 Days	$2,400 (Final Easement Acquisition Fee)
		120 - 240 Days	$7,900 - $12,400

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Easement Acquisition

Title opinion highly recommended to identify title issues early

- Liens and other easements
- Severed rights
- Mortgage holders must consent to BWSR easement

Access – must be able to access the site

Multiple easements = more complicated

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Easement Acquisition/Acceptance

- Typically initiated after Mitigation Plan approval
- Sponsor/landowner initiates the easement acquisition process
- Managed by BWSR Easement staff, not Wetland Specialists
- May take 6 months or more, generally 1-2 months
- No easement = no bank = no credits

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Site Certification – Initial Deposit (15%)

- As-Built Survey
- Seed Tags
- Monumentation Posts
- Recorded Easement/Title Insurance

(includes legal survey)

- Monitoring wells installed (installation logs)
- Other considerations (public tile abandonment, flowage easement, etc).

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Site Certification – Initial Deposit

- As-Built Survey

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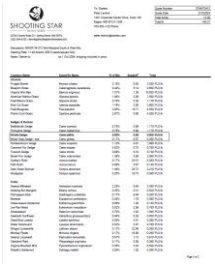
Site Certification – Initial Deposit

- Seed Tags
- Actual tags or PDF of mix use with any adjustments



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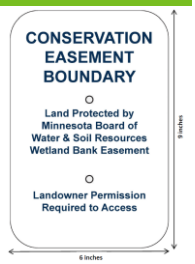
Site Certification – Initial Deposit

- Monument signs/Posts
- BWSR Template
- Where to get them…



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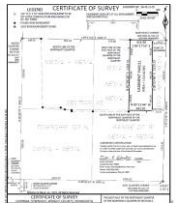
Site Certification – Initial Deposit

- Recorded Easement/Title Insurance (includes legal survey)



(d) Shall not graze livestock on the Easement Parcel(s).

(e) Shall not place any materials, substances or other objects on the Easement Parcel(s), or erect or construct any type of structure, whether temporary or permanent, on the Easement Parcel(s).

(f) Shall not allow vehicular traffic on the Easement Parcel(s) except for the purpose of implementing construction or maintenance activities specifically authorized in the Plan;

(g) Shall not alter the topography of the Easement Parcel(s) by any means including plowing, dredging, filling, mining or drilling; and

(h) Shall not modify the hydrology of the Easement Parcel(s) in any way or by any means, including pumping, draining, ditching, diking, impounding or diverting surface or ground water into or out of the Easement Parcel(s).

8. Acknowledge that Grantor(s) are responsible, at their cost, for weed control on the Easement Parcel(s) by complying with noxious weed control laws, and for emergency control of pests necessary to protect the public health.

9. Acknowledge that this Easement may be modified only by the joint written approval of the LGU and State. If the Easement Parcel(s) have been used to mitigate wetland losses under FWPCA, the USACE must also agree to the modification in writing and must be provided with at least 60 days' advance notice before any action is taken to void or modify this Easement, including the transfer of title to, or the establishment of any other legal claims over, the Easement Parcel(s). If the Easement Parcel(s) have been used to satisfy conservation compliance responsibilities for agricultural producers under federal farm programs, the NRCS must also agree to modification of this Easement in writing.

10. Acknowledge that this Easement may be enforced, at law or in equity, by the LGU or State. The LGU and State shall be entitled to recover an award of reasonable attorney's fees from Grantor(s) in any action to enforce this Easement. The right to enforce the terms of this Easement is not waived or forfeited by any forbearance or failure to act on the part of the LGU or State. If the Easement Parcel(s) are to be used partially or wholly to fulfill permit requirements under the FWPCA or federal farm programs, then the provisions of this Easement running to the LGU or State may also be enforced by the federal government in

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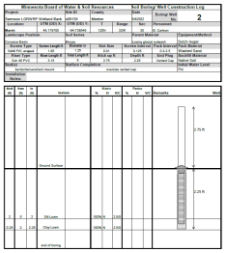
Site Certification – Initial Deposit

- Monitoring Wells/Log



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Make sure to get plenty of ATV's stuck

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Site Certification – Initial Deposit

- Other considerations
- Public tile abandonment
- Flowage easement/agreement
- Others??

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Random Thought…Things to consider

- If possible, grow crops up until construction to control weeds (generally we do fall construction)
- Be careful of herbicides used, some have 12–18-month residual effect (NDSU herbicide carryover sheet)
- Some sites we plant oats the growing season prior to construction to reduce the “herbicide effect” (generally in upland/buffer areas)

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Let the monitoring begin…

- The first full growing season following site certification
- Generally, 5 growing seasons
- May be more or less depending on crediting action and site characteristics (preservation may be less…floodplain forest may be more), determined by the approved plan

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Let the monitoring begin…

- May be more than 5-years if performance standards aren't being met!
- Monitoring continues until performance standards are met to get credit

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Monitoring Techniques

Monitoring:

- Hydrology Monitoring Techniques/Plan

a) Monitoring Wells (groundwater/stilling)

b) Reference Site

- Vegetation Monitoring Techniques/Plan

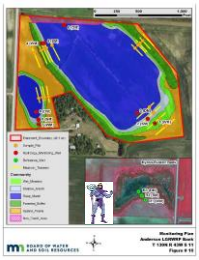
a) Timed Meander

b) Step-Point

c) Sample-Plot

d) FQA??

- Monitoring Duration (typically 5-years)



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Hydrology Monitoring

- Most hydrology performance standards require hydrology met for two growing season.
- Hydrology PS must be met before vegetation credits can be released…you need to prove it's a wetland first!

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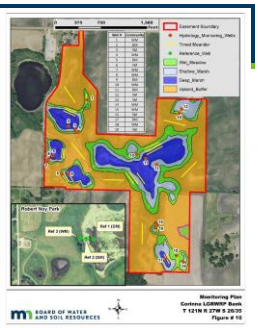
Hydrology – Reference Site

- Use an existing wetland or well-established site with similar characteristics to the site being restored (hydrology duration generally within 20%)
- Same or similar soils (mineral or organic, similar soil series)
- Same wetland types
- Similar landscape position
- Look for easement land (RIM or former Bank sites)
- How far away?? Ideally the reference site would be affected by similar rain patterns. As close as possible….



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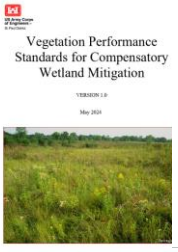
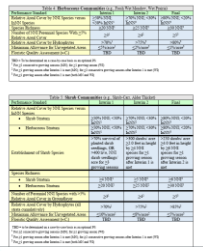
Bank Plan – Performance Standards (ACOE St. Paul District – Regulatory – Mitigation)





ACOE Guidance Documents – If you meet ACOE standards you'll meet WCA

83

Bank Plan – Performance Standards - Hydrology

Initial Release (15% of total projected credits)	**Approval of MBI/Plan, Conservation Easement Recorded, Approval of As-Built plans, and areas initially seeded have been completed. Drainage authority approval of the public tile re-route.**	
Hydrology Performance Standards Release of additional 35% of total projected credits	**Each performance standard met for ≥2 growing seasons to qualify for credit release**	
	Wet Meadow: Water tables within 12-inches of the surface for 28- consecutive days or two periods of 14-days during the growing season under normal to wetter than normal conditions or, Duration of water table ≤ 12 inches below the soil surface is within 20 percent of that of the reference wetland.	
	Shallow Marsh: Water table is at the surface or inundation up to 12-inches in depth for at least 28 consecutive days during the growing season under normal to wetter than normal conditions or, Water levels within 20 percent of that of the reference wetland.	
	Deep Marsh • Hydrology shall consist of inundation 6 to 48 inches in depth throughout the growing season under normal to wetter than normal conditions or, • Water levels within 20 percent of that of the reference wetland.	

- Hydrology credit release percent dependent on reestablishment vs rehabilitation
- Reestablishment up to 45% (fully drained)
- Rehabilitation up to 20% (partially drained)
- Combination of the two generally around 35% (delineation necessary to determine credit)
- Spring 2022 – Corps mitigation newsletter guidance

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Bank Plan – Performance Standards - Vegetation

	Each performance standard met for ≥2 consecutive growing seasons to qualify for credit release once hydrology performance standards are met
Interim 1 Vegetation Performance Standards Release of additional 20% of total projected credits	**Wet Meadow:** • > 50% relative cover by native non-invasive species composed of at least 8 species • ≤ 50% relative cover of non-native/invasive species • > 50% relative cover by hydrophytes • Bare ground not to exceed 5% per acre and no continuous bare areas > 400 ft2
	Shallow Marsh: • > 50% relative cover by native species composed of at least 3 species • ≤ 50% relative cover of non-native/invasive species • ≥ 70% relative cover by hydrophytes • open un-vegetated water not to exceed 50% absolute cover
	Deep Marsh: • > 50% relative cover by native species composed of at least 3 species • ≤ 50% relative cover of non-native/invasive species • ≥ 70% relative cover by hydrophytes • open un-vegetated water not to exceed 80% absolute cover
	Upland Prairie: • > 50% relative cover by native, non-invasive species composed of at least 6 species • ≤ 50% relative cover of non-native/invasive species • bare ground not to exceed 5% per acre and no continuous bare areas > 400 ft2

- Typical release schedule
- Initial release (15%)
- Hydrology (45%-20%)
- Interim 1 (Vegetation)
- Interim 2 (Vegetation)
- Final Release (Delineation/Vegetation)

85

Bank Plan – Performance Standards - Vegetation

	Approval of Final Wetland Delineation Report Each performance standard met for ≥1 additional growing season to qualify for credit release
Final Vegetation Performance Standards Release of final 20% of total projected credit	**Wet Meadow:** • ≥ 80% relative cover by native, non-invasive species composed of at least 20 species • ≤ 20% relative cover of non-native/invasive species • ≥ 70% relative cover by hydrophytes • bare ground not to exceed 1% per acre and no continuous bare areas > 100 ft2
	Shallow Marsh: • ≥ 70% relative cover by native species composed of at least 7 species • ≤ 30% relative cover of non-native/invasive species • ≥ 90% relative cover by hydrophytes • open un-vegetated water not to exceed 30% absolute cover
	Deep Marsh: • ≥ 70% relative cover by native species composed of at least 7 species • ≤ 30% relative cover of non-native/invasive species • ≥ 90% relative cover by hydrophytes • open un-vegetated water not to exceed 60% absolute cover
	Upland Prairie Buffer: • ≥ 80% relative cover by native, non-invasive species composed of at least 15 species • ≤ 20% relative cover of non-native/invasive species • Bare ground not to exceed 2% per acre and no continuous bare areas > 100 ft2

- Final Release (Delineation/Vegetation)
- Make sure crediting areas match what was proposed
- >10% difference may require an MBI Modification

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Vegetation Monitoring - Crediting

- Initial deposit (15%)
- Hydrology deposit (20-45%)
- Interim 1 standards met for ≥ 2 consecutive growing seasons (once hydrology PS is met)
- Interim 2 standards met for ≥ 1 growing season (once int 1 PS met)
- Final PS - Approval of Final Wetland Delineation Report & Final PS Met for 1≥ Growing season (once Int 2 is met)

Credit Release Schedule

Area	WCA Credit Actions and Corps Type of Compensation	Acres	Type of Wetland Credit	Credit Ratio	Final Projected Credits	Initial Release (15%)	Hydrology Performance Standards (release of additional 20% of total projected credits)	Interim 1 Vegetation Performance Standards (release of additional 20% of total projected credits)	Interim 2 Vegetation Performance Standards (release of additional 20% of total projected credits)	Final Vegetation Performance Standards & Approval of Final Wetland Delineation Report (25% final release)
1	Rehabilitation - CFC	16.0	2 - Fresh Wet Meadow	100%	16.0000	2.4000	3.2000	3.2000	3.2000	4.0000
2	Reduced Wetland Credit - CFC	0.9	2 - Fresh Wet Meadow	50%	0.4500	0.0675	0.0900	0.0900	0.0900	0.1125
3	Rehabilitation - CFC	14.9	3 - Shallow Marsh	100%	14.9000	2.2350	2.9800	2.9800	2.9800	3.7250
4	Reduced Wetland Credit - CFC	0.5	3 - Shallow Marsh	50%	0.2500	0.0375	0.0500	0.0500	0.0500	0.0625
5	Rehabilitation - CFC	15.7	4 - Deep Marsh	100%	15.7000	2.3550	3.1400	3.1400	3.1400	3.9250
6	Buffer - 2	48.0	2 - Fresh Wet Meadow	25%	4.2000	0.6300	0.8400	0.8400	0.8400	1.0500
			3 - Shallow Marsh	25%	3.8400	0.5760	0.7680	0.7680	0.7680	0.9600
			4 - Deep Marsh	25%	3.9600	0.5940	0.7920	0.7920	0.7920	0.9900
NA	Non Credit (Excess Upland Buffer)	20.8	NA	0%	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
NA	Non Credit (Fill)	0.10	NA	0%	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
NA	Non Credit Existing Wetland	0.70	NA	0%	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total Easement Area		117.7			59.3040	8.8956	11.8608	11.8608	11.8608	14.8260

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Corrective Actions

- If, during the monitoring period, the LGU/Corps or TEP determine that a bank site does not meet the approved plan's specifications, the LGU must require corrective actions
- BWSR can freeze accounts by restricting deposits, withdrawals, transfers until the LGU determines the site is in compliance
- Noncompliance of bank sites is subject to enforcement procedures

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Maintenance Responsibilities

- Sponsor responsible for vegetation implementation and maintenance of the site (usually first 5 years or until closed out)
- Landowner is responsible for long-term management of the site
- Landowner's can (and do) sell (or donate) the land the bank is on

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Vegetation Issues

- Non-native/invasives (common species)
- Bare ground
- Poor seed establishment (herbicide carryover??)
- Drought
- Other issues???

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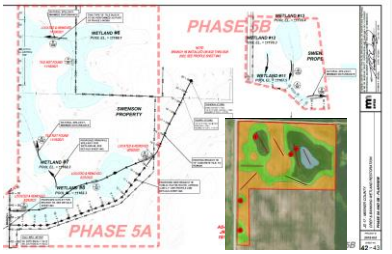
Hydrology Issues

- Not meeting hydrology…
- Leaky structure
- Rodent issues
- Missed tile
- Poor design
- Drought?? (reference wetland)
- Other issues???



91

Encroachment Issues

- Farmers encroaching during planting/Turn around in the easement
- ATV's
- Trespassing
- Structures (deer stands)
- Started to install T-posts every 100' (in addition to the easement posts every 500')

92

Monitoring Report = Credits

- Submitted following the first full growing/monitoring season no later than 1/31 (?)
- Then submitted as per approved bank plan (typically each year)
- May include Transaction Form to Deposit Credits (years 2, 3, and 5…)


Transaction Form to Deposit Credits
Minnesota Wetland Bank Program

Contents of the report:

- Project location map
- Description of performance standards
- Activities completed and planned
- Hydrology measurements
- Plant communities' map
- Color photographs
- Other information specified from approved plan

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Credit tables

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General Monitoring roles once wetland bank is approved

LGU/Corps roles:

- certify construction (review as-builts, seed tags, confirm easement posts up) – Contingencies (Flowage agreement, proof of public tile reroute)
- review monitoring reports
- certify credits for deposit
- may require corrective actions as needed

Sponsor/landowner roles:

- Sponsor responsible for maintenance
- Submitting as-built documentation
- Submitting wetland credit deposit transaction form(s)
- Submitting monitoring reports
- Paying administrative fees

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Reviewing Monitoring Reports

A. Success Criteria Summary

Summary of Success Criteria Standards and Current Metrics for 2017.

Metric	Success Criteria	Measured Criteria	Success Criteria Met?	Comments
Hydrology – *Standards used for 2011 - 2016*				
Elevation	Water between 6-8 inches above and one foot below ground surface	Measured hydrology is between 6 inches above and one foot below ground surface	Yes	*Formal hydrology monitoring not required for 2017. Success based on direct site observations*
Duration	Majority of the growing season	Hydrology was within the desired range for the majority of the growing season.	Yes	
Vegetation				
Diversity	Minimum of five native species	79 native species have been observed	Yes	Species diversity increased from 2016 to 2017
Composition	Minimum two sedges and two grasses	Eight sedges and eight grasses have been identified	Yes	Species composition stable
Invasive species coverage	No more than 10% total cover	Total cover of invasive species is less than 10%, and has been effectively controlled.	Yes	Reed canary grass is less than 5% coverage.
Invasive species concentration	No single areas greater than one-quarter acre in size	Invasive species remain under control with no single area greater than one-quarter acre in size	Yes	Slight increase of wing ditches, but sprayed again in fall 2017 to control

- Know performance standards
- Interpret data to determine whether the site meets those standards
- If not, document with data what is not meeting standard
- Consult with TEP & Corps
- Then corrective actions should be recommended

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Reviewing Monitoring Reports

Community	Interim 1 Performance Standards (≥ 2 consecutive growing seasons)	2022	2023	2024	Performance Standard Met? (Yes/No)
Wet Meadow	≥ 60% RC by native non-invasive species composed of at least 15 species	47.5%, 36 species	71%, 45 species	78%, 48 species	Yes
	<40% RC of non-native/invasive species	52.5%	29%	22%	Yes
	≥ 60% RC by hydrophytes	50%	70%	78%	Yes
	Bare ground not to exceed 6% AC and no continuous areas >200 ft².	7%	3.2%	2.7%	Yes
Shallow Marsh	≥ 50% RC by native species composed of at least 8 species	11.4%, 10 species	56.9%, 18 species	77.6%, 27 species	Yes
	<50% RC of non-native/invasive species	83%	43.1%	22%	Yes
	≥ 80% RC by hydrophytes	36%	90.9%	96.4%	Yes
	Areal extent of open un-vegetated water not to exceed 25% of community (per basin)	14.6% (avg of transects)	7.1% (E basin at 33%)	6.7% (All basins <25%)	No (see conservance in Summary)
Upland Prairie	≥ 75% RC by native, non-invasive species composed of at least 6 species	89%, 28 species	87.9%, 31 species	88.2%, 29 species	Yes
	<25% RC of non-native/invasive species	11%	12.1%	12%	Yes
	Bare ground not to exceed 6% AC and no continuous areas >400 ft².	2%	0.8%	0%	Yes

- Use Tables! Easy to read and understand, can show valuable information quickly…allows TEP/COE to justify credit releases

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In Summary…

- Phase 1 – Construct Bank
- Phase 2 – ???
- Phase 3 – Profit

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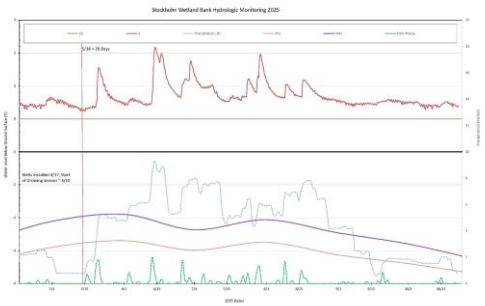
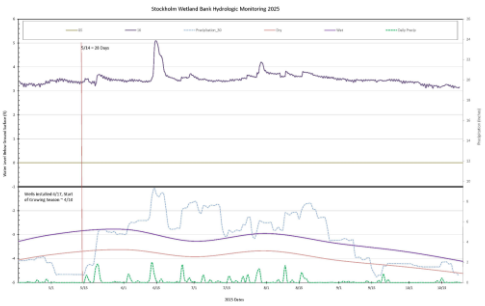
- Questions…???

99


Stockholm Wetland Bank Hydrologic Monitoring 2025

100


Stockholm Wetland Bank Hydrologic Monitoring 2025

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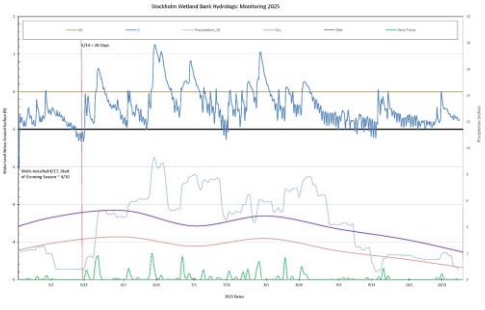
Stockholm Wetland Bank Hydrologic Monitoring 2025

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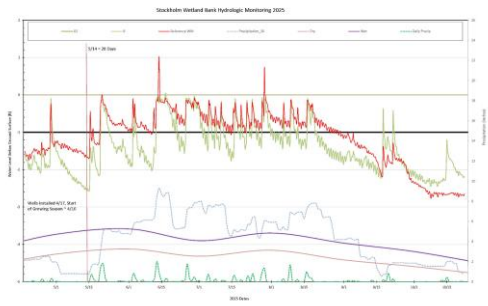
Stockholm Wetland Bank Hydrologic Monitoring 2025

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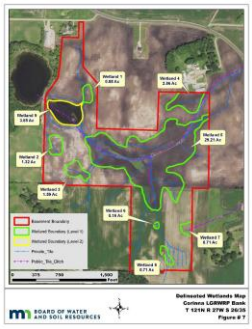
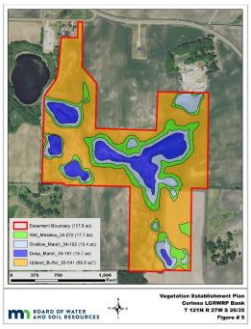

Delineated Wetlands Map
Corteva LGRWRP Bank
T 101N R 27W S 26/35
Figure # 7
BOARD OF WATER AND SOIL RESOURCES


Vegetation Establishment Plan
Corteva LGRWRP Bank
T 101N R 27W S 26/35
Figure # 9
BOARD OF WATER AND SOIL RESOURCES

104

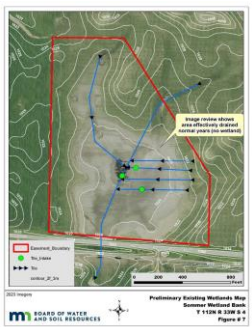
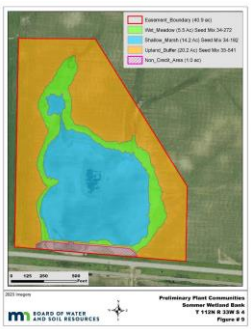
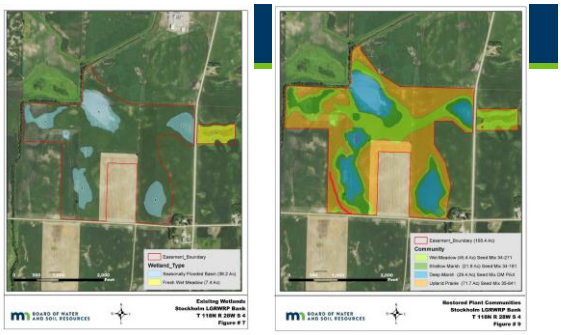


Image review shows area effectively drained normal years (no wetland)
Preliminary Existing Wetlands Map
Sommer Wetland Bank
T 112N R 33W S 4
Figure # 7
BOARD OF WATER AND SOIL RESOURCES


Preliminary Plant Communities
Sommer Wetland Bank
T 112N R 33W S 4
Figure # 9
BOARD OF WATER AND SOIL RESOURCES

105



106

Developing a Monitoring Program

BOARD OF WATER AND SOIL RESOURCES

Minnesota Wetland Professional Certification Program

107

Timing and Duration

- Monitoring must begin no later than the first full growing season after the LGU has determined that construction specifications have been met
- Monitoring plan must have a monitoring period that is sufficient to determine whether the wetlands have met performance standards
- Minimum 5 full growing seasons
- May be less if all performance standards are met and waived by LGU

Monitoring may be required for more than 5 growing seasons

108

Monitoring Report

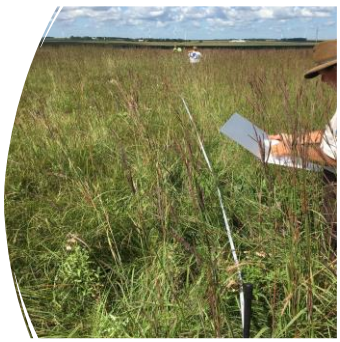
- Monitoring Reports must be submitted consistent with approved plan and timeline
- Reports must be submitted annually unless another schedule is approved

109

Monitoring Plan Guidance

110

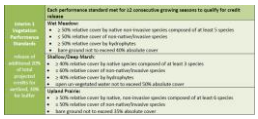
Vegetation Monitoring



111

Basic Overview

- Establish performance standards – **Already done**
- Identify appropriate methods for monitoring vegetation
- Select appropriate number and location of sampling locations
- Set monitoring schedule
- Monitor!



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Bank Site Goals

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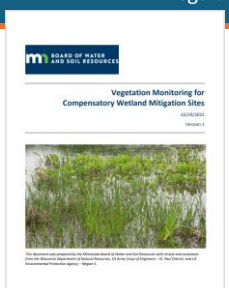
Vegetation Monitoring on Mitigation Sites



Link to Vegetation Monitoring on Mitigation Sites

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Meeting Performance Standards

Typical performance standards

1. Quality/Diversity of vegetation
2. Percent cover of vegetation – native and non-native
3. Percent cover of bare ground or open water
4. Percent cover by hydrophytes

Make sure to consider the needs for each community type

115

Vegetation Monitoring and Hydrology

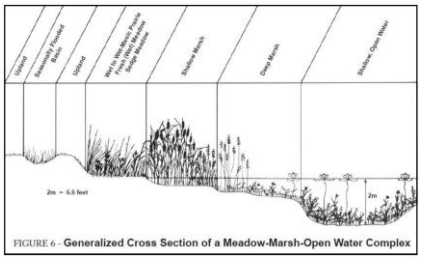

FIGURE 6 - **Generalized Cross Section of a Meadow-Marsh-Open Water Complex**

116

Vegetation Monitoring – Timing



117

Plant Community Mapping

Plant communities need to be identified as Performance Standards for vegetation monitoring are usually set by the community

Mapping plant communities is also important for determining success of restoration and goals

Also important in tracking invasive species spread or reduction

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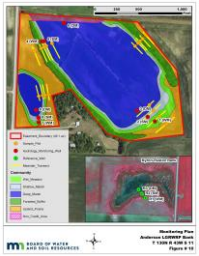
Vegetation Monitoring Methods

Vegetation Monitoring Techniques/Plan

a) Timed Meander
b) Step-Point
c) Sample-Plot
d) FQA
e) Invasive vegetation mapping



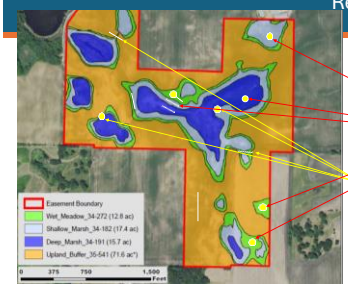
119

Number of Sampling Locations

- Should be consistent with the size of the site
- Different types of sampling may require more or less sampling points
- More sampling generally can't hurt

120

Representative Sampling



Finding the best sampling locations is key

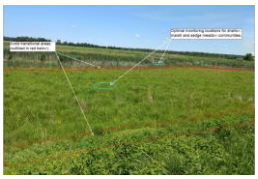
- Better data on the community
- Less chance of not meeting performance standards

Sampling in transition areas can be problematic!

Areas that are well within plant communities will give a more representative sample

Transition zones can be problematic and give mixed results

121



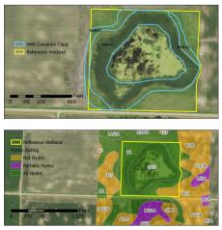
122

Other Useful Monitoring Data

123

Reference Wetlands

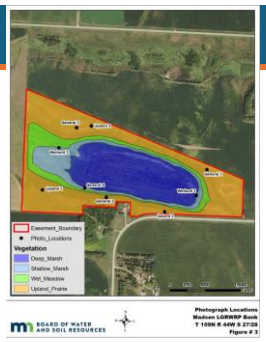
- Provide a baseline to measure restored wetland function to existing wetland
- Can be used to set performance standards
- Helpful in situations when normal conditions may not be present for several monitoring periods (i.e. drought)



124

Photo Points

125



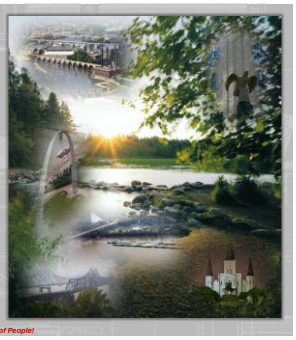
126

Exercise – What would you do?

127

Hydrology Monitoring

Presenters:
Leslie Day, Corps
Alyssa Core, BWSR



US Army Corps of Engineers

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Hydrology Performance Standards

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- Vegetation community and soil specific
- Measures surface and/or groundwater on a daily basis (minimum)
- For a # of days within the growing season
- For a # of growing seasons with normal or wetter than normal
- Can refer to reference sites IF you identify it up front (prospectus recommended) and get it approved (typically will require monitoring)

D. **Fresh (Wet) Meadows, Sedge Meadows and Wet Prairies (Mineral Soils).** *Hydrology shall consist of a water table 12 inches or less below the soil surface for a minimum of 28 consecutive days, or two periods of 14 or more consecutive days, during the growing season under normal and wetter than normal hydrological conditions (per Sprecher and Warne 2000). Inundation during the growing season shall not occur except: (1) at the start of the growing season (due to snowmelt/precipitation); and (2) following the 10-year, 24-hour—or greater—precipitation events. Depth of inundation during the growing season shall be 6 inches or less with duration of less than 14 consecutive days. An exception can be made for sites with hummocky microtopography—hollows between hummocks can have standing water depths up to 6 inches for extended duration.*

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Developing Hydrology Monitoring Plans

Hydrology drives wetland systems and is a critical component of a compensation site.

The goal of successfully restoring wetland hydrology at a compensation site is not to establish the minimum wetland hydrology, but to **establish the optimal wetland hydrology for targeted wetland communities and associated functions and services**.

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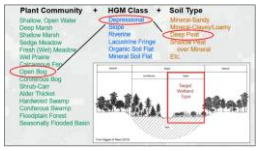
Developing Hydrology Monitoring Plans

Sponsors should consider each of these variables when developing a hydrology monitoring plan for their site: **acreage, topography, plant communities, hydrogeomorphic (HGM) wetland classes, soil types, and disturbances (e.g., ditches, berms)**.



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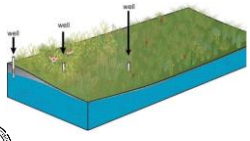
Developing Hydrology Monitoring Plans

Ideally, the target hydrology for a compensation site would be determined by collecting and applying data from a **reference wetland**. If there is not an appropriate reference wetland available for a compensation site, sponsors should utilize **baseline hydrology monitoring and/or surface water runoff calculations** to determine target hydrology at the site.



Example of baseline hydrology monitoring.

Important to establish a transect of wells to determine the extent that hydrology has been altered (or would remain altered) by drainage systems at a compensation site.

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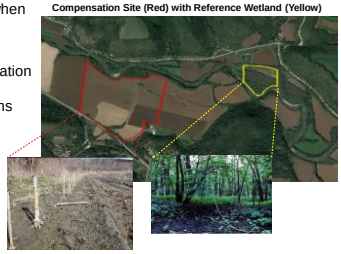
Reference Wetlands

What should you consider when identifying a good reference wetland?

- Proximity to the compensation site
- Similar landscape positions
- Similar community types
- Similar soil types
- Natural wetland systems (undisturbed)

Compensation Site (Red) with Reference Wetland (Yellow)



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Determining Number of Monitoring Wells

The amount of monitoring wells that should be installed at a compensation site is influenced by:

- Size of the compensation site
- Number of proposed wetland communities
- Differences in soil types (mineral vs. organic)
- Variability in topography (naturally sloping landscape, microtopography, etc.)
- Disturbances
- IRT concerns

Sponsors should carefully consider these variables to ensure that an appropriate number of monitoring wells are installed in each wetland community in order to assess if target hydrology performance standards are being met.

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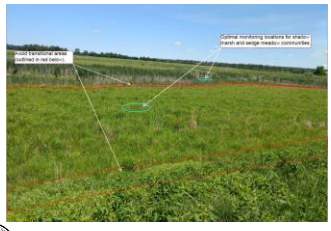
Optimal Hydrology Monitoring Locations



Sponsors should…

- Avoid transitional areas
- Target elevations that are expected to be representative of the proposed wetland community (may be difficult at sites with variable topography, e.g., slopes, drainageways, microtopography)

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Timing and Duration of Monitoring

Hydrology monitoring should begin at the start of the growing season and conclude at the end of the growing season.

- Monitoring wells should be installed before the start of the growing season (ideally when frost is out of the ground)
- Hydrology monitoring must be conducted with data loggers (manual readings should only be used to ensure data loggers are functioning properly)

Reminder… the start of the growing season can be determined by **"green up"**, **WETS tables**, and **soil temperature**

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Reporting Hydrology Monitoring Data

Hydrographs should include the following:

- Daily hydrology data for the entire growing season
- Line showing 12 inches below the ground surface
- Daily rainfall totals should be plotted along the bottom
- Highlight number of consecutive days with a water table within the upper 12 inches of the soil surface
- Title should include the well number and the wetland community

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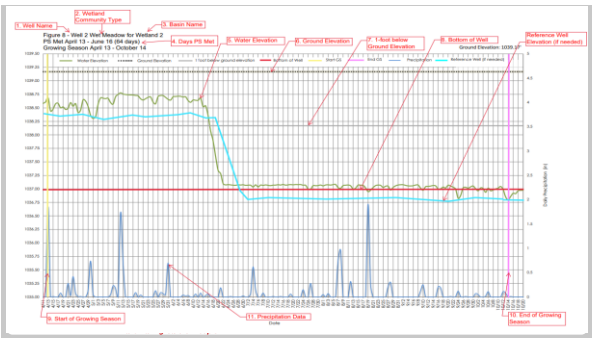

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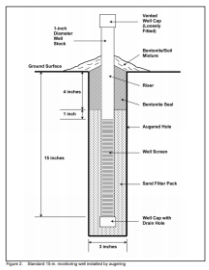
The importance of submitting well logs

Document sound data and the danger of restrictive layers

Include:
- Diagram including depths
- Soil profile with textures and depths

Other:
- Bentonite
- Caps



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Knowledge Check!

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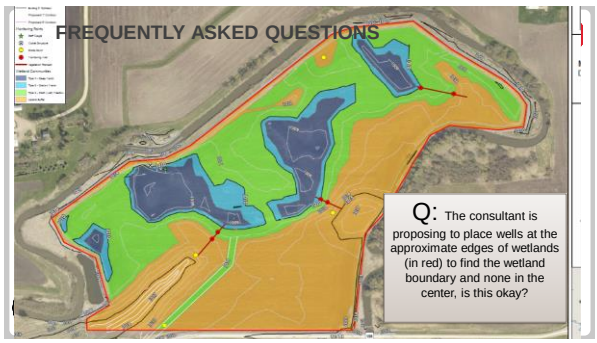
FREQUENTLY ASKED QUESTIONS



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FREQUENTLY ASKED QUESTIONS

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A: We should address this!

- While we can use wells to find the boundary between upland and wetland (delineation) secondary indicators can also serve to fill this purpose.
- Those portions of wetland plant communities near the wetland/upland boundary would tend to be “drier” than the overall plant community,
- Wells should be in representative areas

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Hydrology Monitoring

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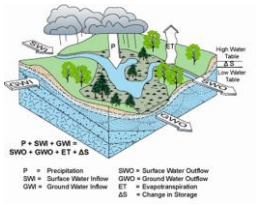
Hydrology - The Driving Force

Wetlands gain and lose water constantly through a variety of pathways.



"The Presence and movement of water defines, creates and sustains the wetland."

- Affects Soil chemistry, oxygen availably, formation and decay
- Plants are determined by the duration and extent of hydrology (tolerance levels)

If sufficient hydrology exists over a long enough period of time, the veg and soils will follow.

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Hydrology – Reasons to Monitor

- ID Wetland type, hydro regime, and/or boundary determination
- Provides insight into wetland function/value
- Highly variable and dynamic; snapshot is not enough
- Assess Alterations/impacts
- Determine Progress/Success of Restoration

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Hydrology - Why Monitor?

- To demonstrate hydrology has returned/stabilized to some sufficient targeted depth and duration
- Most hydrology Performance Standards require hydrology met for two growing season.
- Hydrology PS must be met before vegetation credits can be released…you need to prove it's a wetland first!

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Monitoring Techniques - Hydrology

Monitoring Wells

- Groundwater/Subsurface
- Stilling/Surface
- Staff Gauge

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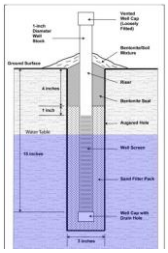
Monitoring Techniques - Hydrology

Monitoring Wells

- Monitor Water table subsurface
- Perforations just below surface/seal
- Seal and/or filter fabric may be needed
- Used for pre/post project monitoring
- Depth at least 15 in for Technical Standard but often pair with deeper for trouble shooting.



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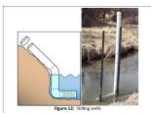
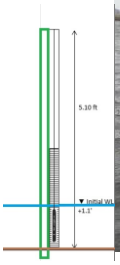
Monitoring Techniques - Hydrology

Stilling Wells

- Deep Marsh
- Stabilizes measurements due to wave/turbulence/current
- Permanent/Semi-Permanent Inundation





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Monitoring Techniques - Hydrology

Staff Gauge

- Shallow/Deep Marsh
- Permanent/Semi-Permanent Inundation
- Floodplain settings
- Pair with Programmable Camera for better data

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Monitoring – Data Loggers

- Measures water levels at set intervals (programmable)
- Long-battery life
- Blue tooth capabilities or direct download
- Some require correction for pressure/temp
- Software required

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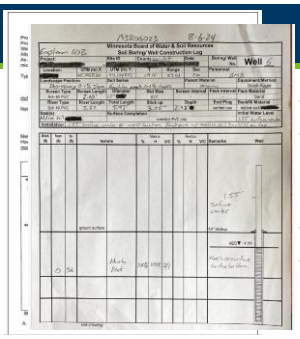
Well Installation Log



- Detailed Record of construction
- Includes Depth, materials, soil details, water table at time of install, elevations/hts, well test, etc
- Supports accuracy of data
- Can be used for troubleshooting

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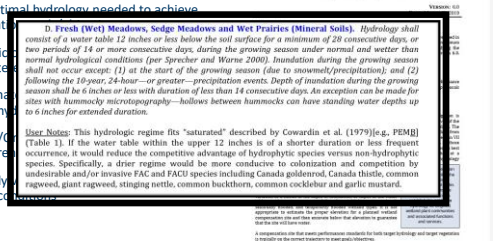
Target Hydrology

The optimal hydrology needed to achieve restorat

- Mimic
- Estima and hy
- AND/O Refere
- Highly and co



D. **Fresh (Wet) Meadows, Sedge Meadows and Wet Prairies (Mineral Soils).** *Hydrology shall consist of a water table 12 inches or less below the soil surface for a minimum of 28 consecutive days, or two periods of 14 or more consecutive days, during the growing season under normal and wetter than normal hydrological conditions (per Sprecher and Warne 2000). Inundation during the growing season shall not occur except: (1) at the start of the growing season (due to snowmelt/precipitation); and (2) following the 10-year, 24-hour—or greater—precipitation events. Depth of inundation during the growing season shall be 6 inches or less with duration of less than 14 consecutive days. An exception can be made for sites with hummocky microtopography—hollows between hummocks can have standing water depths up to 6 inches for extended duration.*

User Notes: This hydrologic regime fits "saturated" described by Cowardin et al. (1979)[e.g., PEMB] (Table 1). If the water table within the upper 12 inches is of a shorter duration or less frequent occurrence, it would reduce the competitive advantage of hydrophytic species versus non-hydrophytic species. Specifically, a drier regime would be more conducive to colonization and competition by undesirable and/or invasive FAC and FACU species including Canada goldenrod, Canada thistle, common ragweed, giant ragweed, stinging nettle, common buckthorn, common cocklebur and garlic mustard.

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Hydrology Performance Standards

Initial Release (15% of total projected credits)	**Approval of MBI/Plan, Conservation Easement Recorded, Approval of As-Built plans, and areas initially seeded have been completed. Drainage authority approval of the public tile re-route.**
Hydrology Performance Standards Release of additional 35% of total projected credits	**Each performance standard met for ≥2 growing seasons to qualify for credit release**
	Wet Meadow: Water tables within 12-inches of the surface for 28- consecutive days or two periods of 14-days during the growing season under normal to wetter than normal conditions or, Duration of water table ≤ 12 inches below the soil surface is within 20 percent of that of the reference wetland.
	Shallow Marsh: Water table is at the surface or inundation up to 12-inches in depth for at least 28 consecutive days during the growing season under normal to wetter than normal conditions or, Water levels within 20 percent of that of the reference wetland.
	Deep Marsh • Hydrology shall consist of inundation 6 to 48 inches in depth throughout the growing season under normal to wetter than normal conditions or, • Water levels within 20 percent of that of the reference wetland.

- Hydrology credit release percent dependent on reestablishment vs rehabilitation
- Reestablishment up to 45%
- Rehabilitation up to 20%
- Combination of the two generally around 35% (delineation necessary to determine credit)
- Guidance on Corps Website

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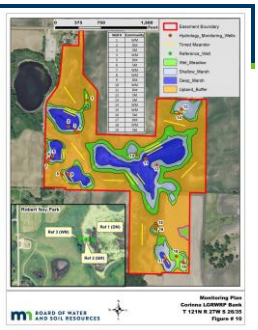
Hydrology – Reference Site

- Use an existing wetland or well-established site with similar characteristics to the site being restored
- Same/similar soils (mineral or organic, similar soil series)
- Same wetland community
- Similar landscape position
- Look for easement land (RIM or former Bank sites)
- How far away?? Ideally the reference site would be affected by similar rain patterns. As close as possible….



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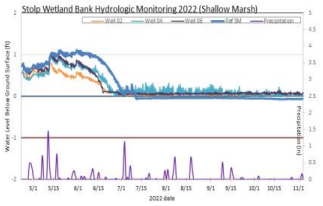
Hydrographs

- Graphical Representation
- Displays frequency, depth and duration of inundation/water table
- Understand hydro regime
- Assess impacts
- Banking - Baseline conditions & monitoring post restoration



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Hydrographs in Banking

Items to Include

- Well info (Name, Community Type, Basin ID)
- Ground Elev., Water Elev. and 1 ft below Ground
- Bottom of Well helpful
- Reference Wetland Data
- Precipitation Data (Normal "envelope", 30 day rolling total, Daily precip.)
- Growing Season Start/End

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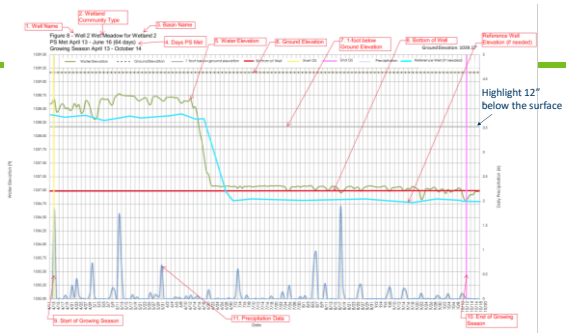
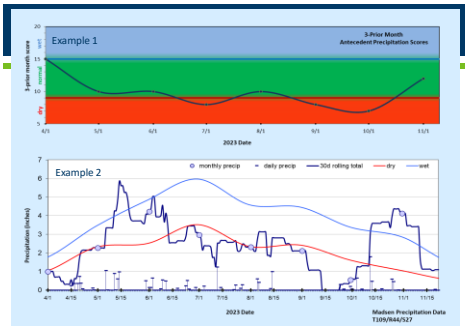


159



Precipitation Data

- Normal Range
- Rolling total
- Daily

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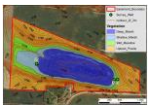
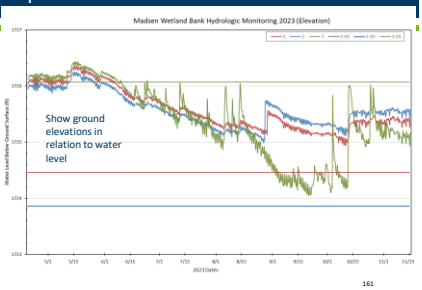
Hydrograph Examples





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Hydrograph Issues in Monitoring Reports

- Insufficient figures/graphs (Clear labels/missing info)
- Data logger problems (battery/erratic readings- duplicate or check periodically?)
- Well placement (correct community? Adjust as needed)
- Performance standards not matching bank plan (include PS & Summarized..)
- Data interpretation (slight differences from PS? Add narrative to support)

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Narrative Summary

The performance standard for the wet meadow community required: Water Tables within 12-inches of the surface for 28- consecutive days or two periods of 14-days during the growing season under normal to wetter than normal conditions or, duration of water Table ≤ 12 inches below the soil surface is plus or minus 20 percent of that of the reference wetland.

- **2022 Growing Season:**

✓ Well 1 (WM) showed water within 12-inches of the surface from April 22 (date of installation) to June 13 (53 consecutive days).

✓ Well 3 (WM) showed water within 12-inches of the surface from April 22 (date of installation) to June 2 (42 consecutive days).

✓ Well 5 (WM) showed water within 12-inches of the surface from April 22 (date of installation) to June 16 (56 consecutive days).

- **2023 Growing Season:**

✓ Well 1 (WM) showed water within 12-inches of the surface from April 19 (date of installation) to June 15 (58 consecutive days).

✓ Well 3 (WM) showed water within 12-inches of the surface from April 19 (date of installation) to June 14 (57 consecutive days).

✓ Well 5 (WM) showed water within 12-inches of the surface from April 19 (date of installation) to June 16 (59 consecutive days).

All three wet meadow wells (1, 3, 5) met the wet meadow performance standards for two consecutive growing seasons.

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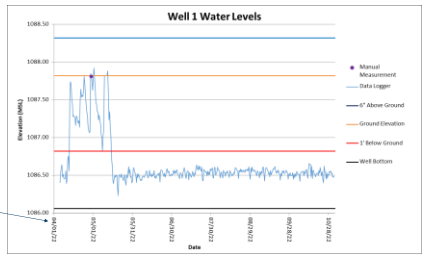
PS= '…water table within 12 in.of surface, min. 28 consecutive days or 2- 14 day periods…"

Hydrograph Examples



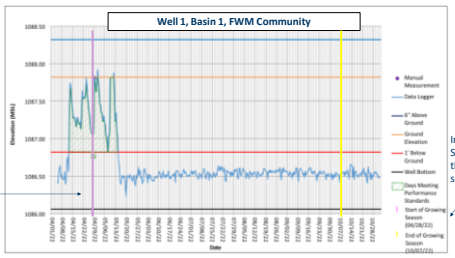
How do we verify that 28 consecutive days are met?

When does the growing season start?

164

PS= '…water table within 12 in.of surface, min. 28 consecutive days or 2- 14 day periods…"

Hydrograph Corrected



Lines depicting daily intervals

Includes Start/End of the growing season

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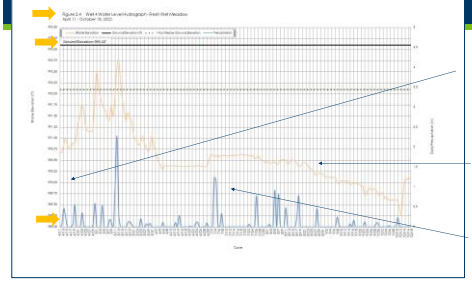
Issues?



Lacking demarcation of the bottom of the well

Despite multiple rain events, the hydrograph continues to drop

1.25 inches of rain but no spike in the hydrograph

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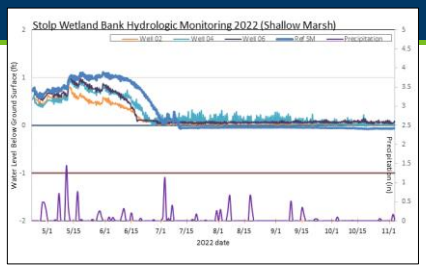
Questions?



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