Today's Schedule – Wetland Monitoring and Restoration

- AM Lectures on Wetland Restoration
  - Introduction to Wetland Restoration
  - Planning, Monitoring, and Evaluating "Success"
  - Identifying Potential Wetland Restoration Sites
- Early-morning – head to the field
  - Evaluate one or more restoration sites
- Lunch on bus
- PM lectures
  - History of Wetland Drainage
  - Practical Wetland Restoration Techniques

INTRODUCTION TO WETLAND RESTORATION

DEFINITIONS

Wetland Restoration

Wetland Creation

Wetland Enhancement

WETLAND RESTORATION

- “the act, process, or result of returning a wetland of any kind to a place where a wetland formerly existed or re-establishing a wetland to a close approximation of its condition prior to the disturbance.”
- The former is sometimes called “*wetland re-establishment*”, while the latter may be referred to as “*wetland rehabilitation*.”

TYPES OF RESTORATION – *Re-establishment*

- **Re-establishment** (Type 1 restoration) – bringing wetland back at a site where it formerly existed
  - Produces an increase in both wetland acreage and function
- Examples

Filled Former Wetland

Effectively Drained Wetland

Channelization and Subsurface Drains

Permanently Flooded Former Wetland

TYPES OF RESTORATION – *Rehabilitation*

- **Rehabilitation** (Type 2 restoration) – improving conditions to an existing wetland that is degraded or altered in some way
  - Improve to a more natural condition

    May include what some folks may consider "enhancement" (e.g., removal of invasives or trash)
- Increase in function; perhaps at the expense of other functions that it may be serving
- Examples

Partly Drained Wetlands

Diked Marshes

Impounded Wetlands

Farmed Wetlands

Grazed Wetlands

Livestock in Streams

Invasive Species

Purple Loosestrife

Common Reed

Partly Filled and Cleared Forested Wetland

Trash in Wetlands

WETLAND CREATION

- “the act, process, or result of building a wetland at a location where one never existed.”
- Not the site of a former wetland

- Produces gains in wetland acreage and function

WETLAND ENHANCEMENT

- “the act, process, or result of a project which modifies an existing wetland to improve its functions beyond what this wetland type does naturally.”
- Favor certain functions over others (e.g., waterfowl over more terrestrial species; longer storage of water)
- Changes the wetland type (e.g., wet meadow to marsh)
- Does not change acreage but does raise the level of performance of certain functions, usually at the expense of other functions
- Examples

Waterfowl Management

Pond Creation in Wetlands

WETLAND PLANNING, MONITORING, AND EVALUATING "SUCCESS"

Reasons for Restoration, etc.

- Mitigation – to compensate for wetland losses elsewhere
- Proactive Restoration – to increase wetland functions because they are highly valued by society and increasing the capacity of watersheds to provide these functions is desirable.

Fundamental Questions to Answer

1. What type of wetland?
2. Any gov't regulations that need to be addressed?
3. Re-establishment or Rehabilitation?
4. Suitable sites? For mitigation – onsite vs. offsite?
5. Water source for appropriate hydrology?
6. Plant community desired – seedling, planting, natural colonization?
7. Risk of failure? Repair plan?
8. Monitoring – metrics?
9. Long-term management (e.g., invasive species control)?
10. Adaptive management plan?

What Type of Wetland?

- What type of wetland existing in past for Type 1 restoration?
- Reference wetlands in locale
  - Landscape Position
  - Landform
  - Water Flow Path
  - Water Regime
  - Water Chemistry
  - Plant community
- Nature of disturbance for Type 2 restoration
  - Assessment of current site condition
  - Likelihood of restoration success
- Mitigation requirements – type and size

Setting Goals and Objectives

- Should be clearly defined from start
- Ideal goal for Type 1 Restoration – a persistent, self-sustaining wetland that functions +/- “like” natural wetland in locale
- Goal for Type 2 Restoration – bring the wetland closer to its unaltered, natural condition
- Structural similarity vs. “Functional equivalency”
- Specific objectives that are measurable

General Objectives

- Return hydrology
- Restore elevations including microtopography
- Restore substrate characteristics
- Re-establish native biota
- Restore chemical integrity

Restoring Hydrology

- Remove drainage structures
- Divert water to site or away from site depending on the impact (drainage v. flooding)
- Improve water retention

Restoring Topography/Substrate

- Remove fill and expose hydric soils
- Remove accumulated sediments
- Put back natural contours and microrelief (e.g., mounds and pools)
- Add hydric soil, if necessary (excavated sites)

Re-establishing Native Biota

- Eliminate grazing or mowing
- Control exotics and invasive species
- Plant or otherwise enhance colonization and survival of native species

Restore Chemical Integrity

- Remove pollution source
- Remove contaminated substrates
- Establish buffer around wetland
- Improve hydrology

Developing Performance Standards

- To determine “success” or “compliance”
- Metrics
  - Hydrology
  - Vegetation
  - Other
    - Soil
    - Wildlife use
    - Water chemistry/quality
    - Functions (e.g., water storage, sedimentation, habitat)
  - Determine wetland extent (Type 1 projects)

Establish Baseline Conditions and As-built Conditions

- Site conditions prior to construction
  - What you had to work with
    - Existing wetland or Former wetland or Upland
    - If existing wetland, is it significantly disturbed to warrant restoration? What was its pre-altered condition?
  - Any rare or endangered species present?
- Site conditions after construction
  - What you created
- Monitoring Plan

MONITORING

Monitoring - an ongoing evaluation of some entity to see if and how it changes overtime

For wetland restoration, monitoring requires evaluation of selected parameters to determine whether:

- the project is heading in the right direction, or
- a mid-course correction is needed;

and when:

- the project is fully successful.

Monitoring Plan

- Metrics
  - To determine progress, “success”/compliance or need for adaptive management
- Frequency of sampling

Vegetation and Other Features

- Vegetation
  - Aerial photos – before, and during peak of growing season
  - Photos from fixed points
  - Plot sampling
    - Species composition
      - Dominants
      - Prevalence Index
    - % cover
    - Height of woody plantings
    - Density of herbs
    - Survival of plantings
    - Signs of reproduction
    - Signs of dead plants
    - Signs of disease
    - Evidence of herbivory
    - Cover by invasives
- Soil
  - Organic matter content
  - Sedimentation
  - Soil water chemistry
- Hydrology (vs. Reference)
  - Flooding frequency/duration
  - Saturation (wells)
    - Don’t puncture restrictive layer
  - Wet part of growing season
- Fish and Wildlife Use
  - Observations/trapping

Examples of Project Objectives and Parameters

Vegetation

- Hydrophytic Plant Community
  - >50% of dominants = OBL and FACW (Plot Sampling)
  - Prevalence Index = <2.0 (Point Intercept Sampling)
  - 80% of dominants same as reference site (Plot Sampling)
- Plantings
  - 80%+ survival (check # live v. # dead plts)
  - Plantings are growing/reproducing (check dbh, # stems, height, spread of clumps, flowering and fruiting)

Examples of Project Objectives and Parameters

- Hydrology
  - Similar to reference wetland (compare hydrographs)
  - Similar to wetlands based on literature (compare hydrographs)
- Soil
  - Accumulation of organic matter (compare v. ref. wetland)
  - Restore original elevations (remove fill to original soil profile; measure elevations v. neighboring wetland)

Examples of Project Objectives and Parameters

- Wildlife Use
  - Specify species, use, and season of use (observations; compare to reference wetlands)
  - Produce an abundance of aquatic inverts (benthic sampling)
  - Provide food plants for wildlife (check berry/seed production; compare with reference wetland/literature)
- Water Quality
  - Serve as sediment trap (measure annual deposition; compare with reference wetlands)
  - Provide vegetated stream bank and 100-foot vegetated buffer (evaluate vegetation)

“Thou Shalt Not” Objectives

- Facilitate the spread of invasives
- Elevate water temperatures of trout streams
- Adversely impact endangered....species
- Jeopardize local wells
- Increase flooding of low-lying development

BASELINE DATA REQUIREMENTS FOR MONITORING

- Document Pre-existing Conditions
- Document As-built Conditions
- Establish/examine Reference Wetlands

MONITORING TECHNIQUES

- Hydrology
  - Flooding Frequency/Duration (standing pipe)
  - Water Table Fluctuations (monitoring wells)
  - Saturation Level (dig pit)
  - KEY PERIOD: March through May (biweekly), except for marshes (bimonthly from March to September)
  - Years 1, 2, 5 (+7 and 10 for PFO, PSS, drier-end PEM)

MONITORING TECHNIQUES

- Hydrophytic Vegetation
  - Cursory Assessment: Year 1 Observations
  - Detailed Assessments: Years 2, 3, and 5 (+7 and 10 for PFO)
    - PLOT SAMPLING
    - POINT INTERCEPT SAMPLING
    - PLANTING SUCCESS
  - Photographs
  - Sketches of Plant Communities

MONITORING TECHNIQUES

- Accumulation of Organic Matter
  - Colored sand test
- Salinity
  - For salt marsh restoration (measure soil salinity)
- Wildlife Use
  - Breeding bird census
  - Small mammal trapping
  - Winter bird counts
  - Amphibian breeding surveys
  - Fish/invertebrate sampling

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RECOMMENDED MINIMUM WETLAND MONITORING

- Identify and Evaluate 2-3 Reference Wetlands
- Vegetation
  - Cursory: Year 1
  - Plot Samplings : Years 2, 3, 5 (+7 and 10 for PFO)
  - Photos
  - Locate/eradicate invasives if necessary
- Organic Accumulation (certain types)

RECOMMENDED MINIMUM WETLAND MONITORING (cont'd)

- Hydrology
  - bimonthly observations: October to February
  - weekly sampling: March to May
  - monthly sampling: June through September
  - Years 1, 2, 3, and 5 (+7 and 10 for PFO, PSS3B...)
- Wildlife Uses
  - Years 1, 2, and 5 (+7 and 10 for PFO, PSS, drier..)

IDENTIFYING POTENTIAL WETLAND RESTORATION SITES

Wetland Restoration Opportunities

- Type 1
  - Drained wetlands on farmland
  - Undeveloped fill sites
  - Other effectively drained sites
- Type 2
  - Partly drained wetlands
  - Diked/impounded wetlands
  - Excavated wetlands
  - Polluted wetlands
  - Wetlands infested with invasive species
- Other Beneficial Actions
  - Restoring vegetated buffers along wetlands and waterbodies

Finding Potential Restoration Sites

First Step – Review existing data

- Map comparison
  - Soil survey vs. Wetland maps
- Map vs. aerial imagery
- Aerial imagery
  - Multiple years
  - Look for flat sites next to existing wetlands

Next Step – Field inspection

Type 1 Sites (Re-establishment)

- Review existing information
  - Compare soil survey to mapped wetlands or aerial imagery
  - Look for the following on hydric soil map units not mapped as wetland:
    - Agricultural fields and pastures
    - Impoundments
    - Undeveloped fill sites (e.g., parking lots)
  - If not wetlands are not mapped, review aerial imagery for:
    - Landscapes likely to support wetlands – floodplains, broad flats
    - Then check soil type

Field Surveys

- Verify photointerpretation, or
- Simply locate suitable locations along existing wetlands and waterways; examine soils (if filled, examine original soil below fill) to determine if soil shows hydric signs; if yes, site may have potential for restoration

Identification of Type 2 Sites – Impaired Wetlands

Identify through photointerpretation (e.g., diked, impounded, partly drained, wetlands adjacent to landfills, sand/gravel pits, etc.)

- Certain NWI types

Alternatively, identify through ground surveys

Signs of Altered Vegetation

- Are there signs of invasive species?
- Has vegetation been mowed, cut, bulldozed, or removed in other ways?
- Is area grazed?
- Are streambanks denuded?
- Are tree roots exposed? (May be a sign of subsidence due to hydrologic alteration)
- Is the area farmed and wet depressions present?

Changes in Elevation

- Is there fill in the wetland? (Trash, dirt, concrete/pavement, rocks, dredged material, other)
- Is there a manmade berm or levee present?
- Is there evidence of sediment deposition in the wetland? (Source? - Stormwater runoff, adjacent development, cropland, or sand/gravel op?)

Changes in Hydrology

- Are there ditches present?
- If a stream goes through the wetland, is the stream channelized?
- Is there a manmade levee or berm that may restrict flooding?
- Has the wetland been excavated?

Changes in Hydrology (cont'd)

- Is there a noticeable scouring basin on one or both sides of an existing culvert? (Suggests too small an opening to pass flow)
- Is there evidence of dying trees/shrubs in water? (Sign of increased flooding)
- Are there puddles in the farm field where crops are reduced in size or absent?

Signs of Water Quality Degradation

- Is there stormwater discharging directly into the wetland? (Do you see a pipe?)
- Do you see oil residue, trash, or algal blooms in the wetland?
- Does the stream or wetland smell like raw sewage or does the water look milky or cloudy?

Water Quality Degradation (cont'd)

- Are the streambanks heavily eroding?
- Is the wetland adjacent to a landfill where it may be exposed to leachates?
- Is it adjacent to a highly contaminated sites (e.g., Superfund site) that may be adversely affecting the wetland?

Challenges

- Predicting outcome in the face of global climate change
- Changing conditions and stressors
- Maintenance of any structures
- Private land – landowner attitude
- Enforcing easement agreements
- Planning at the watershed- or landscape-level
  - Conducting large-scale inventories of potential sites
- Documentation of successes, failures, and mid-course corrections (monitoring = critical component of any restoration project)

National Research Council Recommendations

- Use a landscape-level approach (bioregion or watershed) with advanced identification of sites that will provide the largest gains
- Inventory and establish potential sites; prioritize
- Integrate restoration with the rest of the landscape
- Incorporate long-term studies, new findings, and local expertise in adaptive management for restoration sites
- Favor restoration of damaged wetlands over wetland creation

NRC Quotable Quotes

- “Any attempt to achieve 100 percent success in restoration is a desirable, but not essential, criterion for undertaking projects” (p. 309)
- “…careful long-term monitoring of selected restoration projects will fill gaps in information on how ecosystem functions develop.” (p. 323)

- “Despite the constraints on achieving 100 percent success, despite our inadequate knowledge of how to restore wetlands, and despite the problems that will occur during implementation, there is an urgent need to restore large areas of wetlands throughout the nation.” (p. 320)