

An Ecological Framework for Reviewing Compensatory Mitigation - Biology (Mostly Plants)



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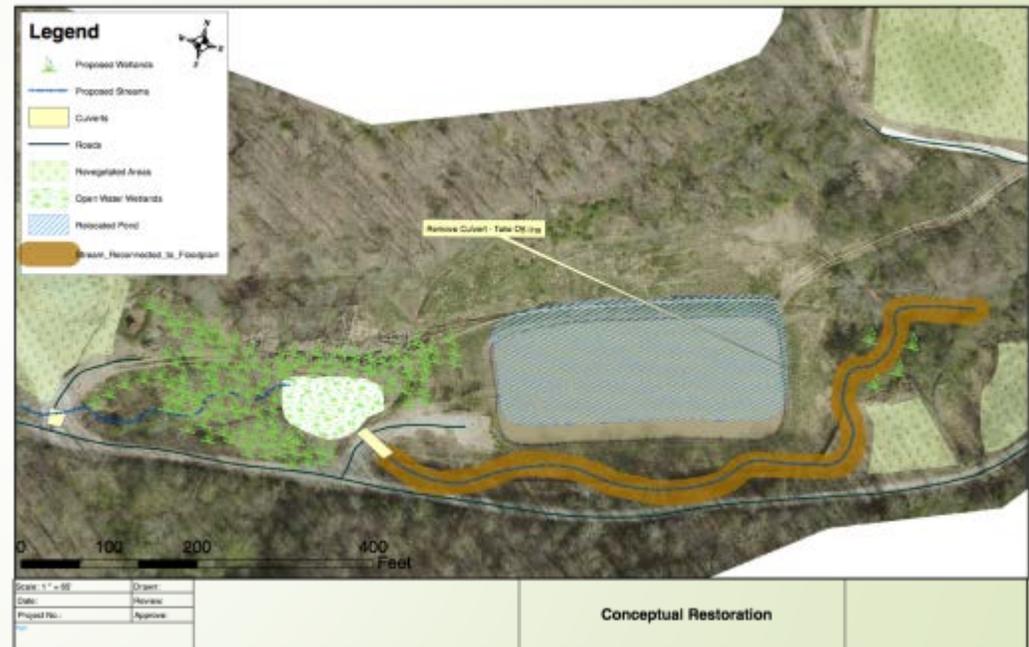


Where do Plants Fit In? A Simplified Hierarchy

- Watershed
- Landscape Position
- Hydrologic Regime & Connections
- Soil
 - Organic / Mineral Content
 - Structure / Bulk Density
- Leads to ...
- Target Plant Community(ies) / Species

Plants: Sustainable Hydrologic Regime and Connections

- If this isn't understood, you're not ready to consider plants (or much else)
 - Critical consideration for plants and all biotic components, especially connections
 - Must know —
 - Seasonal fluctuations
 - Tidal ranges and frequencies
 - Salinity content (coastal & arid west)



Plants: Soils and Organic Content

- Organic and/or Mineral Soil?
- Impact Site and Reference Site are your guide
 - Cautions re impact site disturbances
 - Need sampling data to analyze for appropriate constituents and ranges (or contaminants)
- Proposed sources?
 - Need data to compare to impact site and/or reference
 - Location of source(s)
 - Surrounding land uses?
 - Transport (distance)? Storage & time?





Plants



- If there isn't sufficient information about hydrology and soils, or there isn't sufficient time to obtain that information, just overcome that deficiency by doubling or tripling the intensity and/or density of your planting plan ...
- Nooooooooooooo!** It doesn't work that way.



Plants

- Impact Site and Reference Site are your guide
- Note —
 - vertical and horizontal structure
 - dominant and non-dominant species
 - natives v. exotics / invasives
 - patchiness / mosaic
 - stressors



Plants- Sources

- Are impact site individuals or whole sections available as donors / seed bank?
 - Impact Site may be useful but be cognizant of disturbances, exotics & invasives on-site, nearby and upstream.
- Nurseries
 - Should be as local as possible and well-established (references?)
 - Grow native species under the correct soil and hydrologic conditions
 - No cultivars
 - Caution re seed mixes for herbs
- Does nursery do its own installation?
- Does nursery warranty stock? Installation?

What is Reference, and Why Does it Matter?

- Reference provides a template or anchor point to guide restoration
- Reference must reflect comparable landscape connections
 - Focus on hydrologic and physical process and connections
 - Don't define reference based on biology, but don't ignore it.
- “Pristine” (i.e., Reference Standard) often is not the most appropriate reference (often can't find “pristine,” especially in older portions of nation (e.g., New England)
 - Specific deviation from reference may be the most appropriate restoration target
- **Determine most appropriate reference given objectives of the mitigation site — don't let perfect get in the way of good**





Does the Planting Plan Make Sense?

On-line Information Sources

- Corps of Engineers National Wetland Plant List
 - http://wetland-plants.usace.army.mil/nwpl_static/home/home.html
- Distributions, frequencies of occurrence (Ratings), historical lists & ratings, testing methods, related references, images
- National Technical Committee for Wetland Vegetation meetings and minutes



Does the Planting Plan Make Sense? On-line Information Sources

- USDA Natural Resources Conservation Service Plant Materials Program
 - <https://www.nrcs.usda.gov/wps/portal/nrcs/site/plantmaterials/home/>
 - Invasive and noxious plants
 - Technical resources
 - Photo gallery
 - Handbooks, guides, terminology/glossary



Does the Planting Plan Make Sense?

On-line Information Sources

- USDA Natural Resources Conservation Service PLANTS Database
 - <https://plants.sc.egov.usda/java>
 - Characteristics, Classification, Distribution
 - Plant Hardiness
 - Fact Sheets & Plant Guides
 - Introduced, Invasive, Noxious
 - Threatened & Endangered
 - Identification Keys

Restoration Takes Time ...

“Dear God, I pray for patience. And I want it *right now!*”

- Most plant communities take longer than the typical 5-10 year monitoring period to mature
 - Emergent wetlands may take 3-5 years to assess
 - Shrub / Forested wetlands may take 15-20+ years, especially if hydrology is challenging
 - Uncommon / unusual wetlands may take ?? years ...
 - Bogs, fens, playas, some vernal pools, etc.
 - Should this even be attempted?
- Conditions will naturally fluctuate over time and in response to episodic events
 - Need to focus on long-term **trajectory** of site conditions
- Need to couple long-term monitoring at mitigation sites with regional reference/comparator sites (if available) in order to assess trajectories of response relative to expectations.

Restoration Takes Time ...

- Plants: Monitoring and Reset Events
 - Monitoring
 - Hydrologic regime, seasonal variability
 - Health & survival of plant stock; community development — trajectories
 - Invasives management — management does not necessarily mean eradication; may mean ‘control’
 - Upsets
 - Climate Change — more frequent & severe storms
 - Floods, tidal surges, wind, insects, disease
 - Learn from the monitoring results — the definition of “insanity” — don’t throw good \$\$ after bad

Learn From Reset Events



- Executed according to the plan
- Unexpected storm surge
- Resiliency measures not considered adequately considered



Plants: Again ... What Should I Ask For?

- Historical condition prior to major disturbance (if possible) in addition to historical degraded condition
- Diagrams of key hydrologic processes (e.g., directions of water flow, distance to groundwater seasonally)
 - Hydrologic impacts, e.g., tile drains, diversions, discharges, physical barriers
 - Mouth dynamics (for coastal systems)
 - History - frequency of large “reset” events
 - Predictive - Expected future changes to hydrology and climate change induced alterations of flood-drought cycles (frequency and magnitude)
- Current soil conditions (and historic if possible)
 - Compaction, salinity, organic matter, duration of inundation or saturation
- Biological connections
 - Adjacent land uses + expected changes to these in the future (also important for hydrologic conditions)
 - Proximity to wetlands that operate in a complex (e.g., vernal pools, prairie potholes, reservoir populations)
 - Sources of invasion
 - Other stressor inputs both current and expected future

REMEMBER

(thank you Eric)

- Move beyond landscape setting to ensuring landscape connection
- You cannot recreate the past – don't try!
- You will not be able to achieve “reference” condition – at least probably not in your work-life time - set reasonable expectations! **Its about trajectory.**
- Restoring upland processes is often an important design element, especially for biological functions
- Things may (and usually will) not always go as planned — reset events — be prepared for only partial achievement of desired functions*
 - *embrace adaptive restoration and take the “long view”*
 - *be like a doctor ... Have patience*



**Finally, for Truly Challenging
Restoration Sites, We Have a Team
of Top-Tier Experts That Can Assist
You ...**



