Ecological Considerations for Mitigation Bank Site Selection and Design – Emphasis on the Watershed Approach

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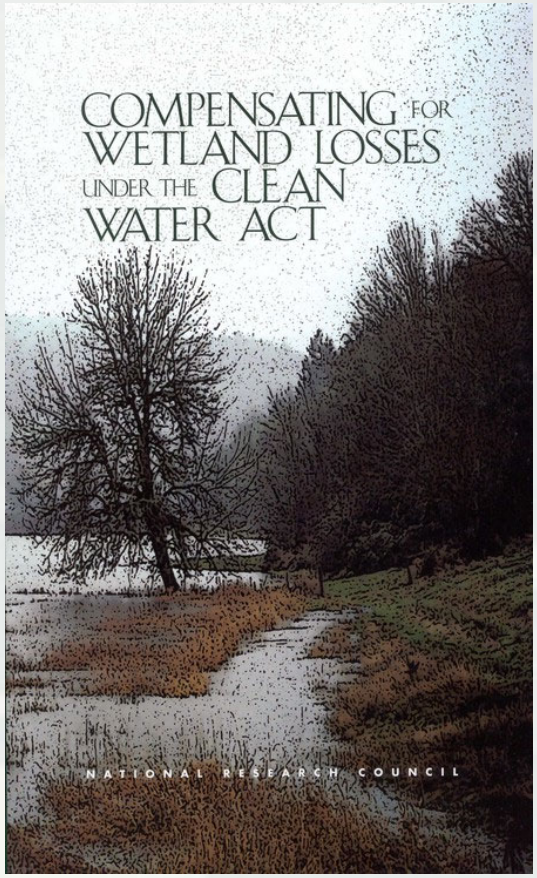
US Army Corps of Engineers®

Session Topics

- Findings on role of site selection in ecological success, including National Research Council (NRC) operational guidelines
- Federal policy on site selection
- Watershed Approach, Strategic Site Selection, and Design
- Tips and Tools for Reviewing

NRC Recommendations

- Whenever possible, choose restoration over creation
  - Was the site a wetland or stream?
- Avoid over-engineered structures in wetland design
  - Will this look / function naturally without manipulation?
- Restore or develop naturally variable hydrological conditions
  - Will the site mimic a natural hydrograph?



NRC Recommendations

- Consider complications with mitigation in seriously degraded/disturbed sites
  - What is the restoration potential of this site given the conditions?
- Consider the hydrogeomorphic, ecological landscape, and climate
  - Does the proposal match the site?

NRC Recommendations

- Adopt a dynamic landscape perspective
  - Does the proposal meet watershed needs now and in the future?
  - Does the restoration potential of the site change given the expected trajectory of modifications to the surrounding landscape?
- Consider subsurface conditions, including soil & groundwater
  - Will the site be able to function like a natural wetland or stream?
  - Are water table fluctuations, hydric soil development, hyporheic zone development possible at the site?

Compensatory Mitigation Objective:

- Ensure mitigation projects provide important functions lost through permitting
  - Creating/buffering reserves
  - Establishing corridors
  - Habitat for rare, T&E species
  - Water quality improvement
  - Carbon sequestration
  - Flood storage, etc.

Mitigation Site Must Be Ecologically Suitable For Providing Desired Functions (332.3(d)(1))

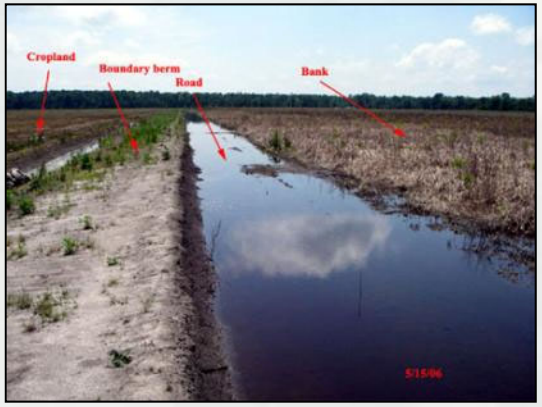
- Considerations
  - ▶ Physical characteristics
  - ▶ Watershed scale features
  - ▶ Size & location relative to hydrologic sources
  - ▶ Compatibility with adjacent land uses
  - ▶ Likely effects on important resources
  - ▶ Other relevant factors

What do these have to do with your site?

- Mosquitos and nuisance pests
- Road flooding
- Tree trimming
- Trenching and utility installation
- Flight corridors
- Change in water table elevations

Compatibility with adjoining uses 332.3(d)(1)

Consider effects of project on adjoining lands



Consider effects of adjoining land use on project

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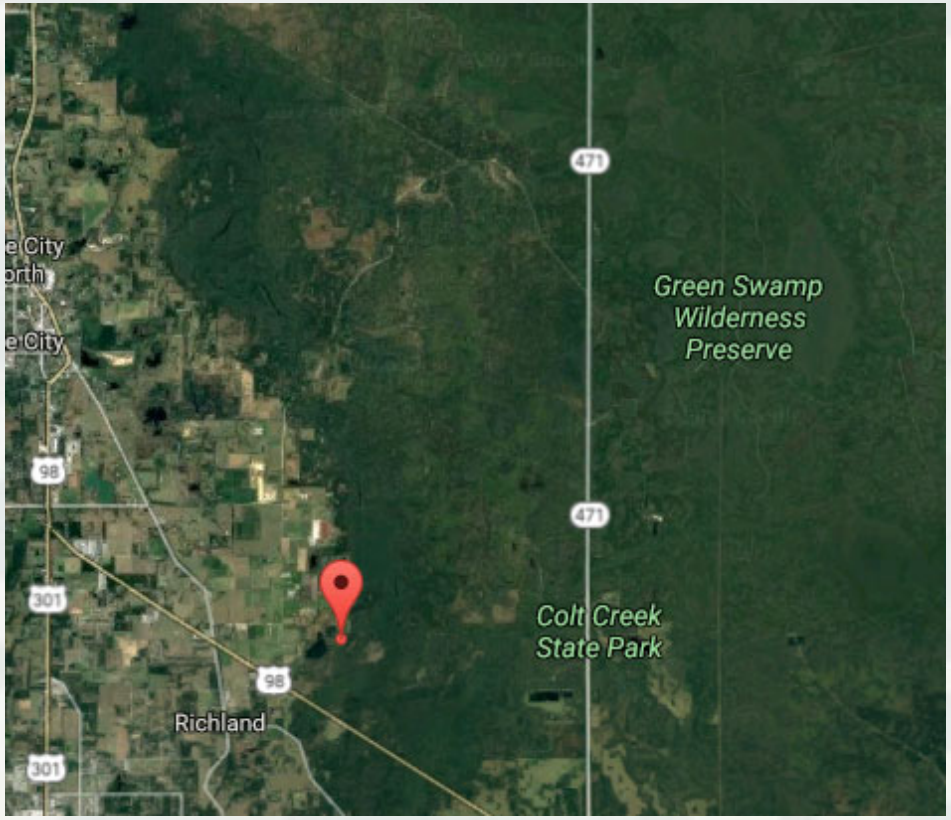
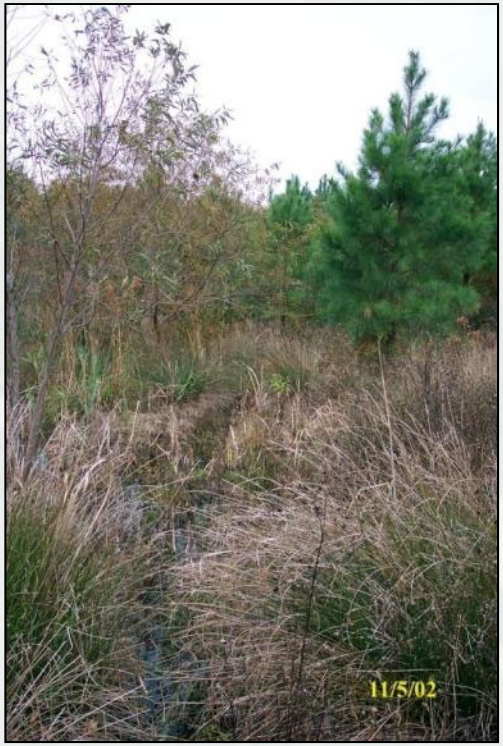
Boarshead Ranch Mitigation Bank



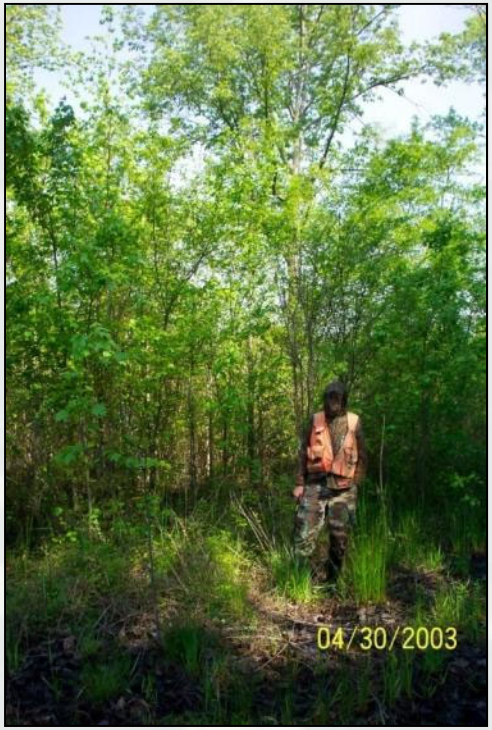
- Southwest corner of central Florida's Green Swamp
- Eastern edge of the project abuts the Withlacoochee River and state preserved lands

Preference for restoration (332.3(a)(2))

- Greater likelihood of success (NRC Operational Guidelines)
- Reduced impacts to ecologically important uplands

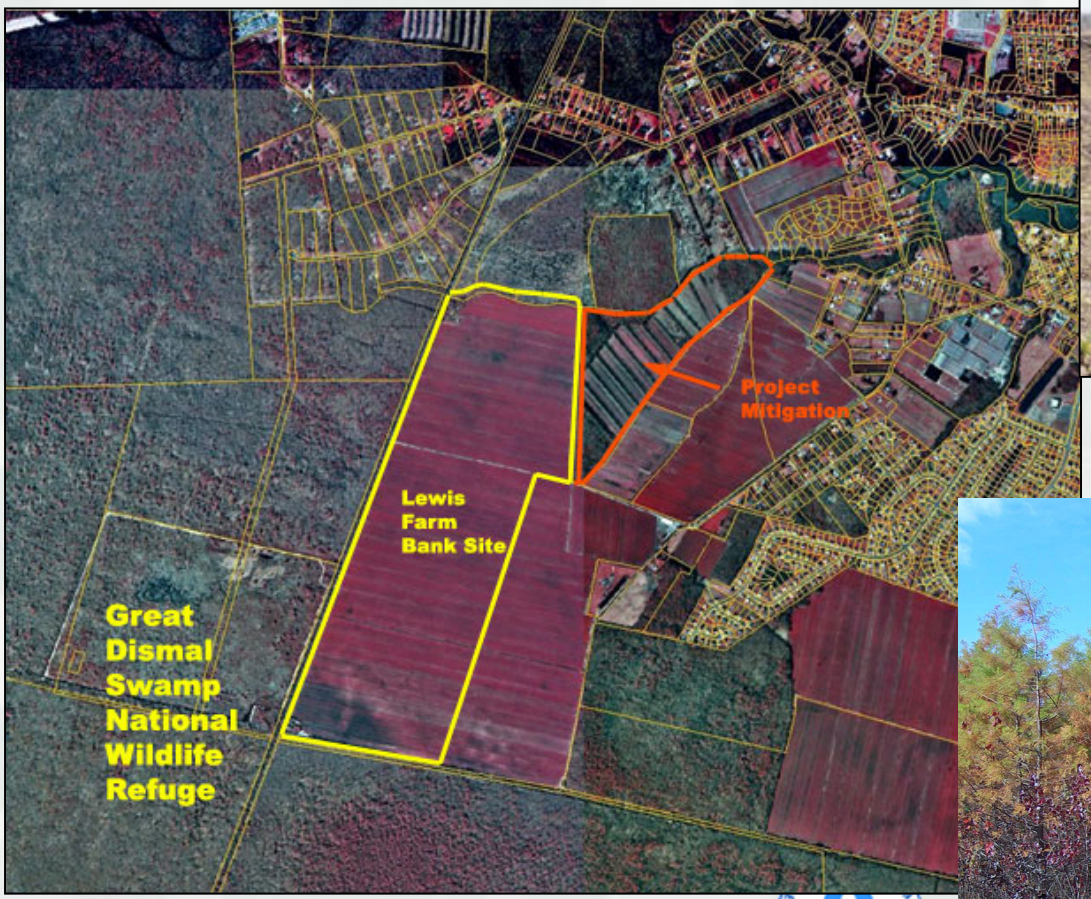


12 year old wetland creation



8 year old wetland restoration

Propose Mitigation Sites Adjacent to Existing or Former Resources (332.3(d)(3))



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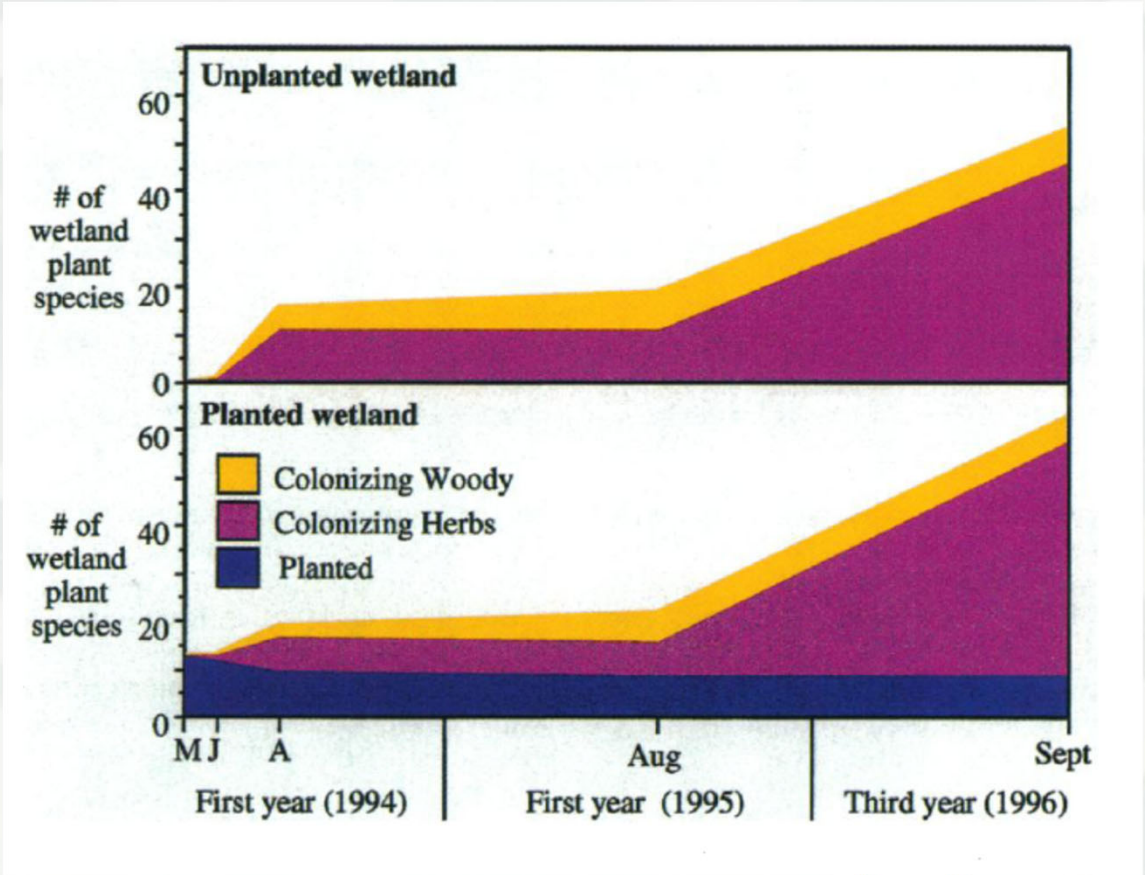
Benefits of Appropriate Site Selection



- Two 1-hectare wetland creation projects, one planted & one unplanted
- Natural hydrology for both
- 200 feet away from river
- Size and proximity allowed for natural recruitment
- Plant composition, gross primary productivity, and avian richness identical

Mitsch et al. (1998) © AIBS

Describe factors considered during site selection - 332.4(c)(3):

- Watershed needs
- Practicability of self-sustaining mitigation
- Compensation planning framework for ILF – 332.8(c)
- Prospectus – ecological suitability of site to achieve objectives - 332.8(d)(2)
    - •Physical, chemical, & biological characteristics of site
    - •How site will support planned aquatic resources & functions
    - •Assurance of sufficient water rights to sustain site

Site Selection* will influence the proposed *Site Design* that will lead to achieving the *Site Objectives

Boarshead Ranch Mitigation Bank

- Hydrologic restoration
  - removal of berms
  - installation of culverts and low water crossings, and
  - removal of portions of the elevated farm road network.
- Proximity allows access to an adequate and reliable source of hydrology
- Wetland restoration
  - historically wetland areas
  - agricultural and silvicultural altered
- Creation areas next to, and designed to mimic historic wetlands
- Adjacent wetland systems provide seed source, hydrology and hydrological benchmarks.

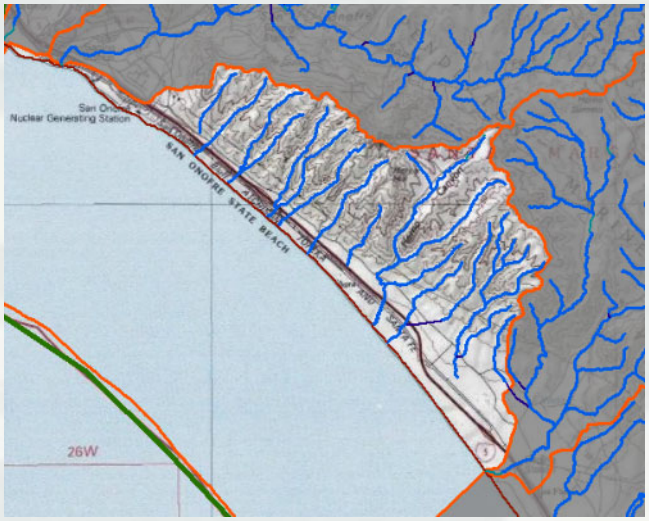
General Siting (332.3(c)(2)(ii-iii))

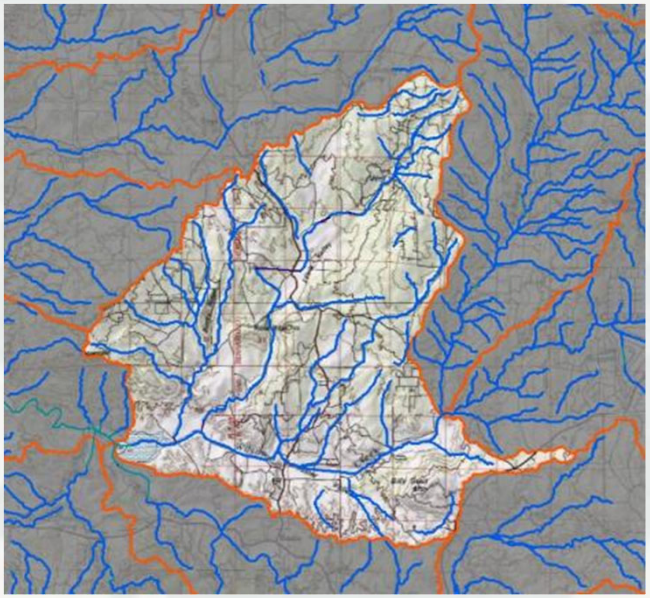
- Locational factors (hydrology/land use)
  - Habitat services should be sited away from project location
  - Mitigation for water quality/flood control services at project location
- Multiple mitigation options
  - On-site
  - Off-site (PRM / MB / ILF)
  - Combination

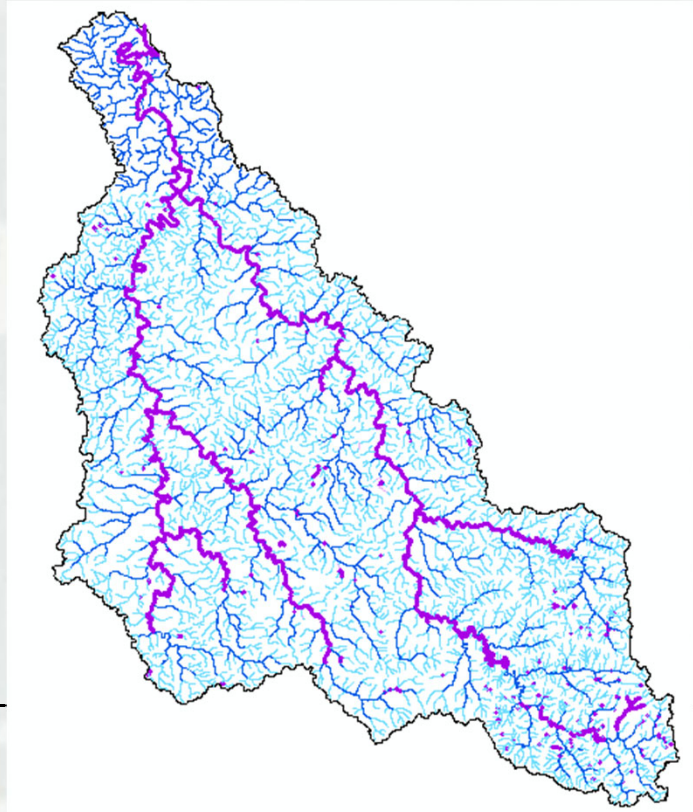
What is a Watershed Approach?

Watersheds

- Definition:
  - “A land area that drains to a common waterway, such as a stream, lake, estuary, wetland, or ultimately the ocean.” (33 CFR 332.2)







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Watershed Approach Overview (332.3(c)(1))

- A general framework for better decision-making
- Goal: maintain and improve quality and quantity of aquatic resources within watersheds through **strategic selection** of mitigation sites
- Watershed approach must be used
  - ► "to the extent appropriate and practicable"
- May use an existing watershed plan

Watershed Plans

- NRC 2001
  - Need to proceed without a formal written plan
  - Professional judgment of multiple agencies can set watershed priorities
- Mitigation Rule:
  - Does not require the development of watershed plans
  - Plans can be developed by F/T/S/L agencies or appropriate NGOs for aquatic resource restoration, establishment, enhancement, and preservation. (33 CFR 332.2)

Definition of Watershed Approach

"An analytical process for making compensatory mitigation decisions that support the sustainability or improvement of aquatic resources in a watershed." (33 CFR 332.2)

- Considers **watershed needs** and uses a **landscape perspective** to identify the types and locations of compensatory mitigation projects to benefit the watershed and offset losses.
- **May** involve consideration of:
  - Landscape scale
  - Historic and potential aquatic resource conditions
  - Past and projected aquatic resource impacts in the watershed
  - Terrestrial connections between aquatic resources

Watershed Approach Elements (332.3(c)(2)(iv))

- “ . . . to the extent practicable”
- Elements of a watershed approach
  - Inventories of historic and existing resources
  - Identification of degraded resources
  - Identification of immediate and long-term needs
  - Identification/prioritization of restoration, establishment, enhancement, and preservation of existing aquatic resources (as specific as possible)

What could you use these for?

- Status and Trends of Wetlands in the Coastal Watersheds of the Conterminous United States
- Chesapeake Bay Watershed Implementation Plans
- National Land Cover Database
- ORM Data
- 303(d) lists
- Section 729 Watershed Studies

Information Needs (332.3(c)(3))

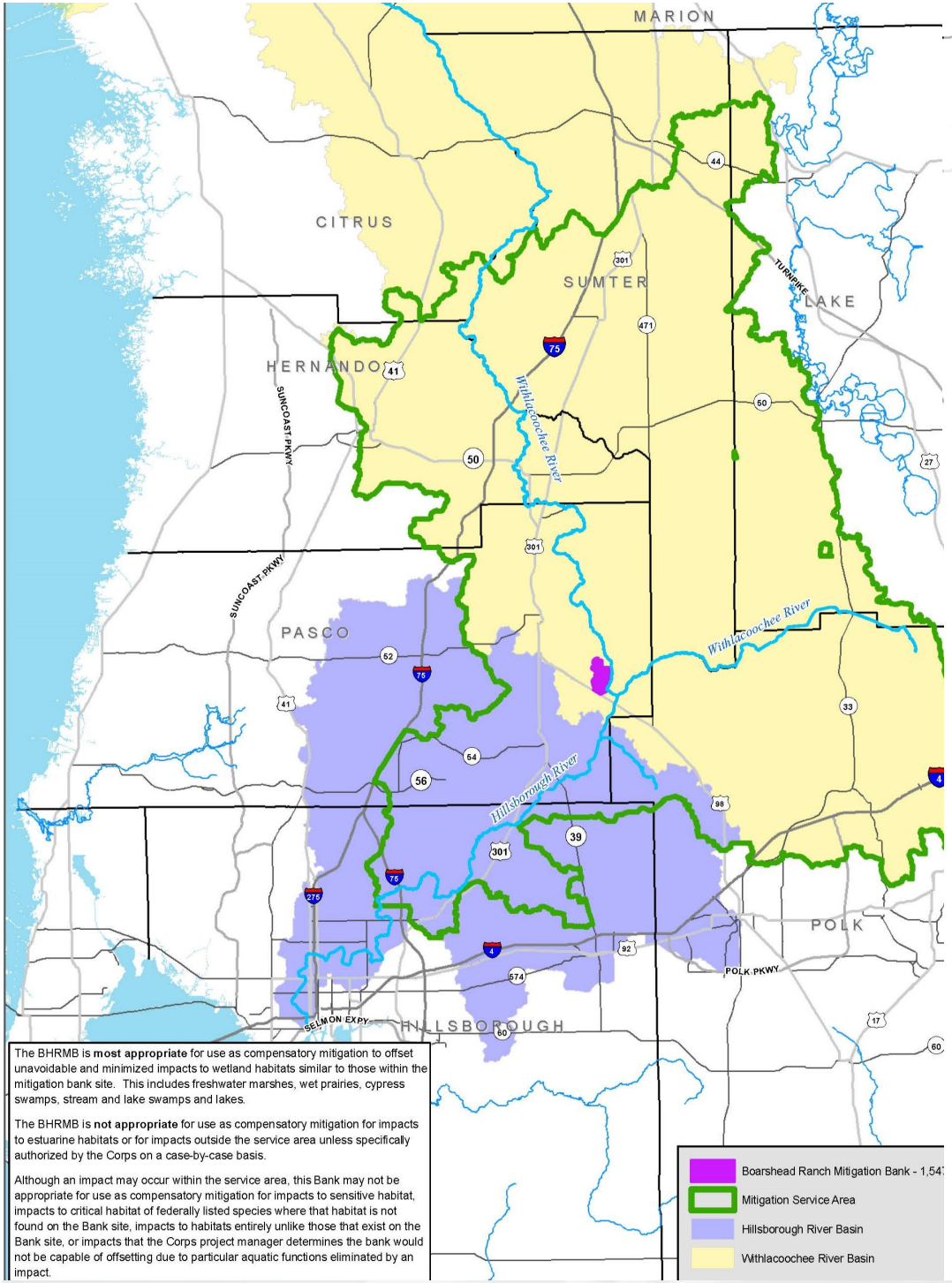
- Information on watershed condition and needs
  - Current trends in habitat loss/conversion
  - Cumulative impacts of past development activities
  - Current development trends
  - Presence/needs of sensitive species
  - Conditions favoring/hindering mitigation success
  - Chronic environmental problems (flooding, water quality)
- Potential sites and priorities for restoration / preservation

Boarshead Ranch Mitigation Bank

- Goals
  - Restore a natural hydrologic regime, enhance the existing communities, restore agricultural areas, and create additional wetlands within the Bank;
  - Provide viable and sustainable ecological and hydrological functions within the service area;
  - Benefit wetlands and critical wildlife habitat on-site and within the Withlacoochee and Hillsborough ecosystems;
  - Expand the area of natural upland and wetland habitats within the Green Swamp Area of Critical State Concern; and River watersheds;
  - Provide a direct ecological and hydrological linkage to the natural communities of the adjacent conservation lands along the Withlacoochee and Hillsborough Rivers.

Boarshead Ranch Mitigation Bank

- Objectives
  - ► Hydrologic restoration (Hydro periods)
  - Proximity of adjacent riverine floodplain allows access to an adequate and reliable source of hydrology
  - Removal of onsite hydrology barriers
  - Grading and replanting of appropriate wetland species and upland species



Boarshead Ranch Mitigation Bank

- Site Selection
  - Within a headwaters region
  - Within a historical floodplain with records of the presence of historical wetlands
  - Hydrology of riverine system historically documented
  - Adjacent to conservation lands
  - Low site disturbance and presence of existing wetlands
  - Part of a Watershed Management Plan

Watershed Approach and Strategic Site Selection: Science and Art

General Considerations (332.3(c)(2)(i))

- Landscape position & resource type
- Habitat requirements of important species
- Habitat loss/conversion trends
- Sources of watershed impairments
- Already owned by the applicant
- Current trends in development
- Regulatory & non-regulatory program requirements
- Terrestrial/riparian resources
- Suite of functions (not just habitat, water quality)

Causes of Environmental Impairment Determine Restoration Potential

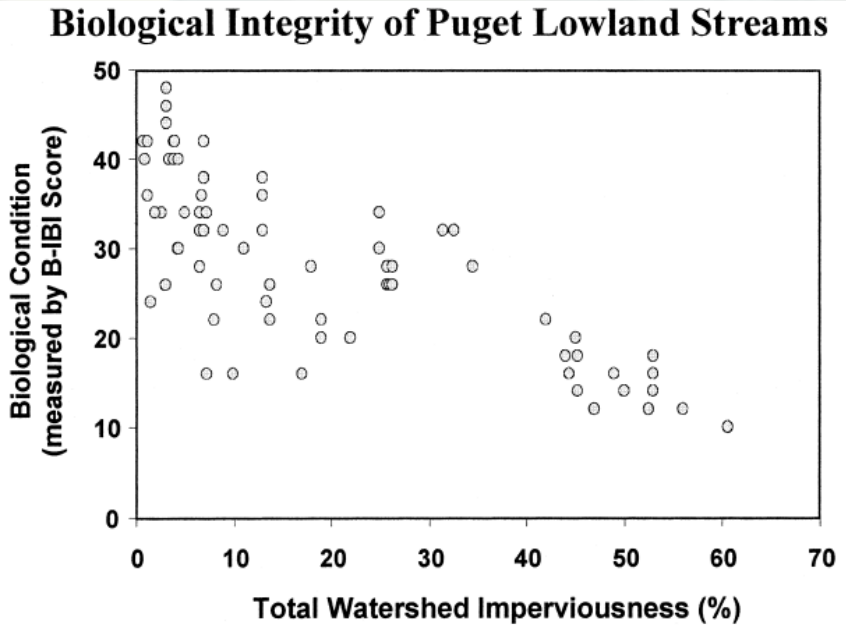
- Environmental impairments interfere with ecological processes
- Landscape condition drives environmental impairments
- Degradation can occur without direct impacts
  - Indirect impacts are important
- Watershed needs → address environmental impairments
  - If impairments are outside the reach of the proposal / program then it may not be appropriate

Key Landscape Considerations: How site selection influences site design

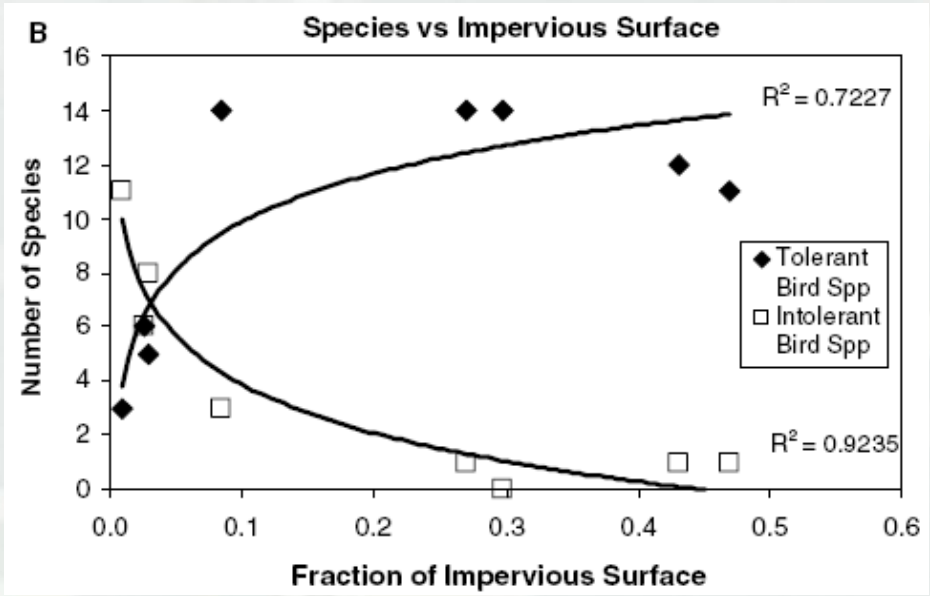
- Mitigation decisions should **focus** on *ecosystem processes*
  - Landscape position informs **potential** ecosystem processes
- Mitigation decisions should **address** causes of *environmental impairments*
  - Environmental impairments inferred by landscape condition
  - Landscape condition determines **actual** processes

Restoration Potential: Landscape Condition Effects on Ecologic Integrity

Macroinvertebrates

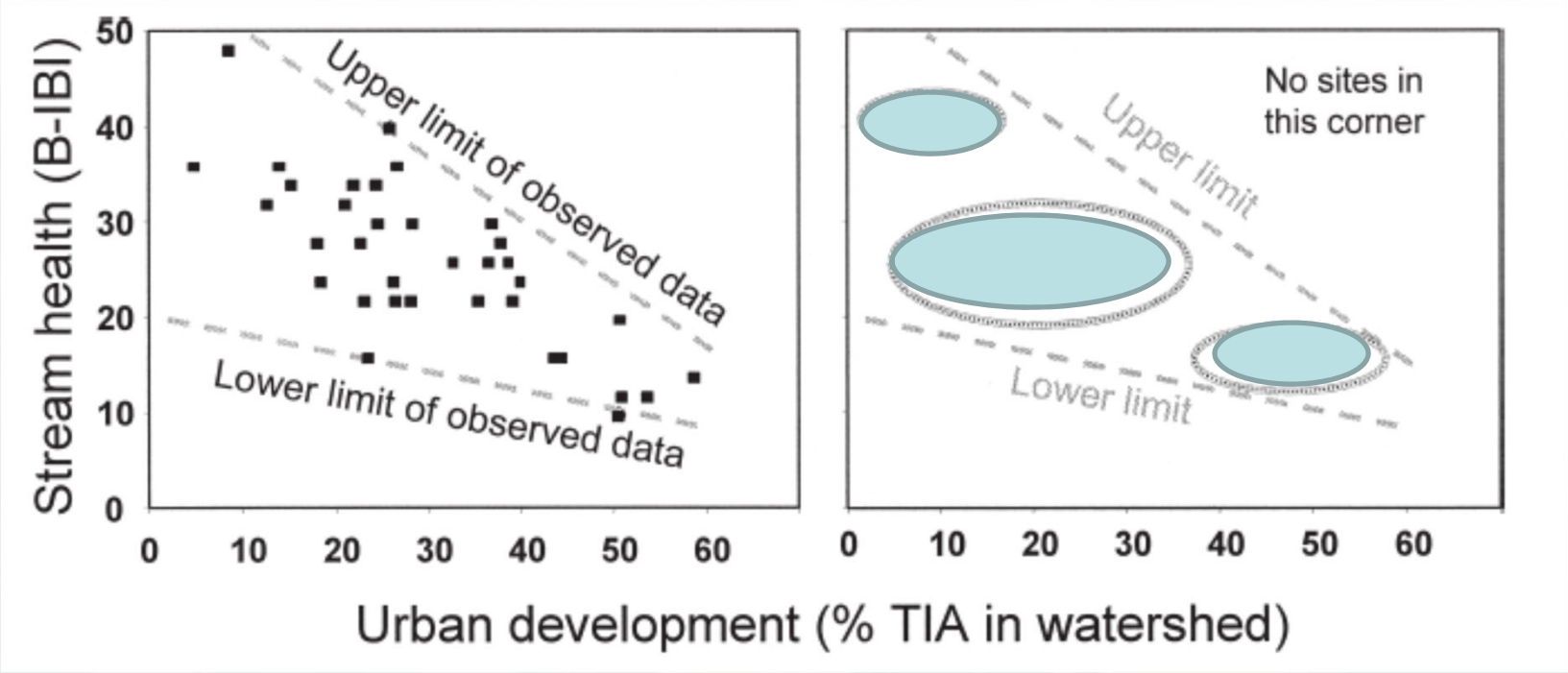


Riparian Birds



Booth et al. (2002) © Wiley-Blackwell; Lussier et al. (2006) © Springer-Science

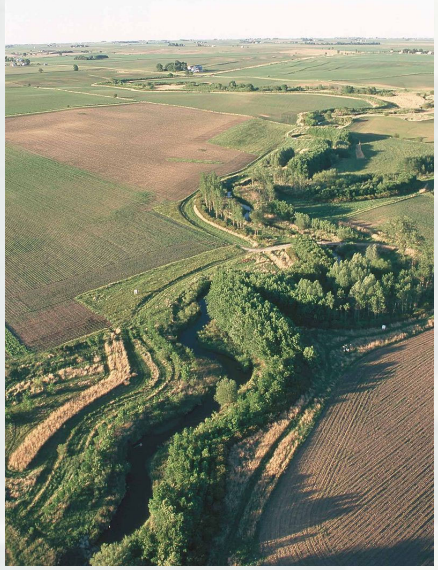
Level of Degradation on Habitat Restoration: Lessons from WA



Booth et al. (2004) © Wiley-Blackwell

Buffers: Reducing Stressors and Helping Meet Watershed Needs

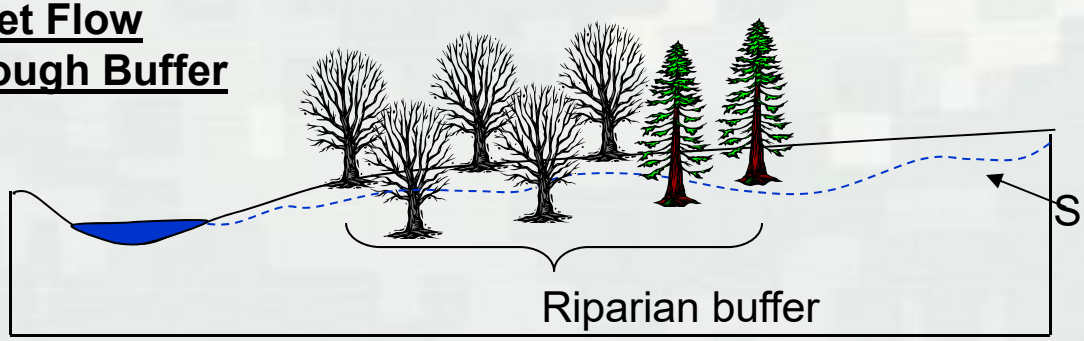
- Buffers for water quality
  - ≥5 m trapped 90% of nitrates and phosphates
  - ≥30 m trapped 75-80% of sediments
- Buffers for amphibians
  - ≥30 m for general amphibian protection in TX
  - ≥165 m for protection of salamanders for E US
- Buffers for birds
  - ≥50 m for Neotropical migrants in VA
  - ≥100 m for Neotropical migrants in KY
  - ≥100 m for 6 common breeding Neotropical species in GA
  - ≥150 m to protect 90% of bird species in VT



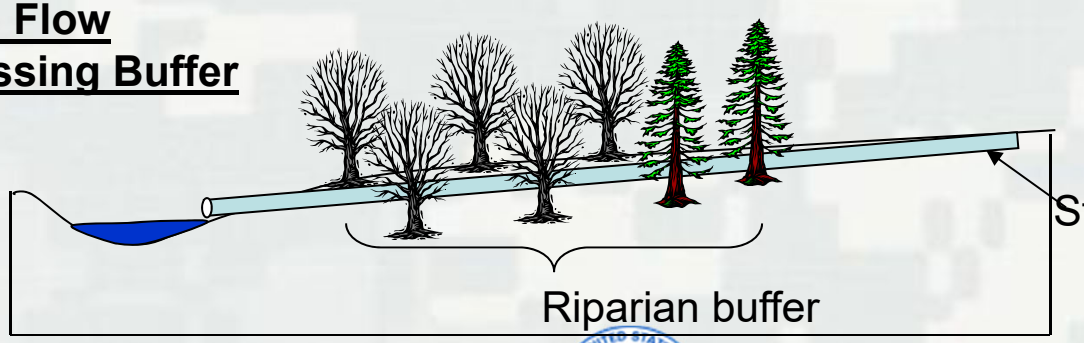
Fischer and Fischenich (2000)

Environmental Impairment: Bypass

Sheet Flow Through Buffer

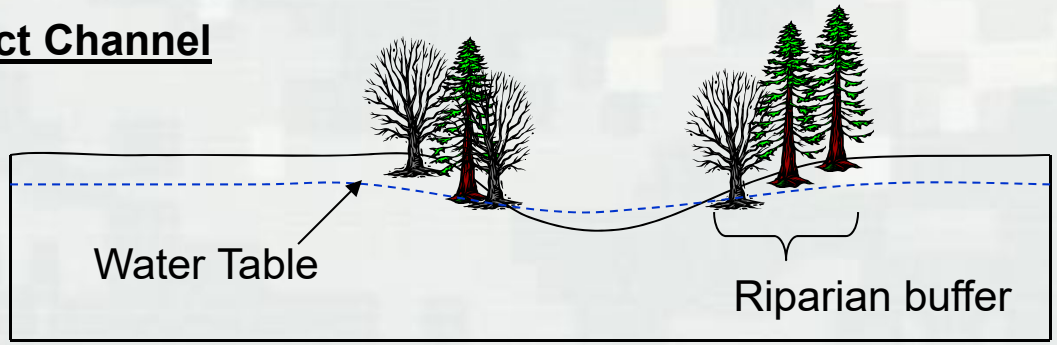


Piped Flow Bypassing Buffer



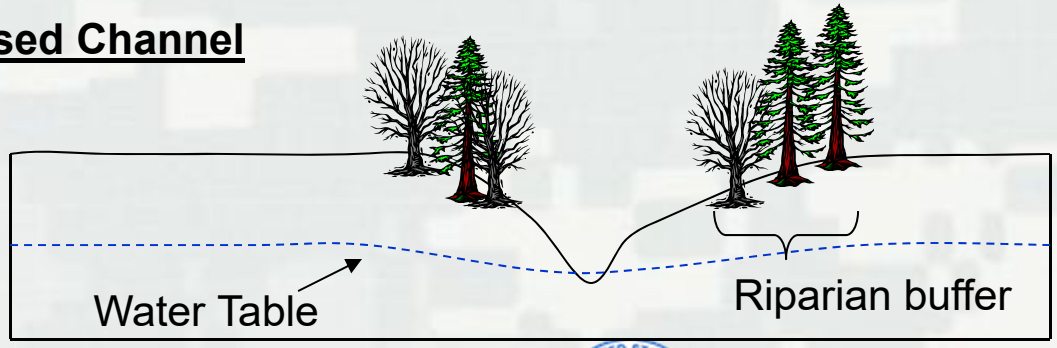
Environmental Impairment: Incision or Ground Water Disconnection

Intact Channel



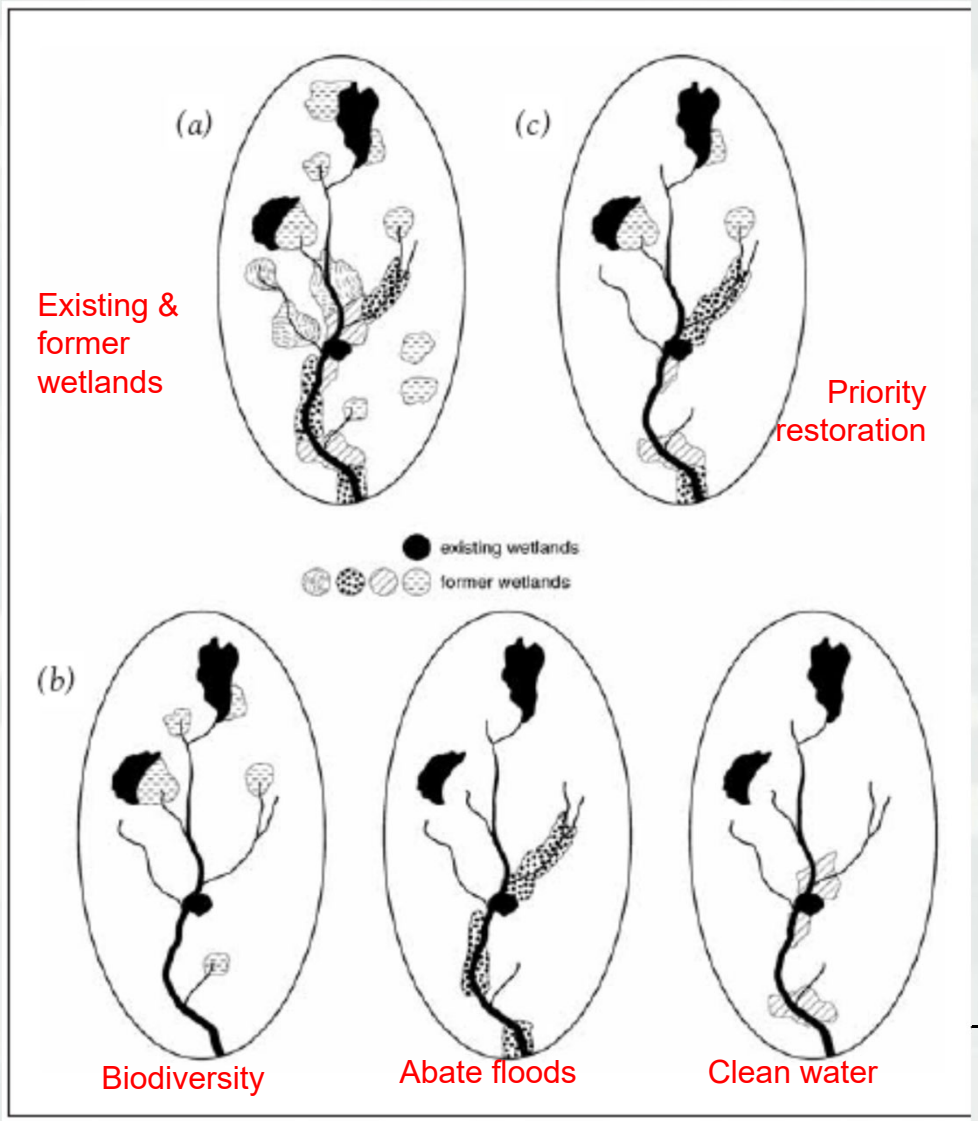
Riparian buffer interacting with **wetland** soils ➔ denitrification

Incised Channel



Riparian buffer interacting with **upland** soils ➔ no denitrification

Watershed Needs May Target Different Sites for Different Reasons



"Mitigation sites that receive nutrient rich surface-water runoff are well situated to perform water-quality-improvement functions, but biodiversity-support functions may suffer in the process." (NRC 2001)

Zedler (2003) © Ecological Society of America

Tips and Tools for Review

Questions

- Is the proposal appropriate for the site?
- Do their actions reduce or remove the causes of impairment for the site?
- Does the restoration potential of the site support the proposed final condition?
- Does proposal meet watershed needs?

Is this an appropriate site for this project? Check HGM Class

- Does the proposal make sense for the hydrogeomorphic position?
- Wetlands with similar landscape position, similar water sources, & similar hydrodynamics will have similar functions.

Hydrogeomorphic Class	Dominant Water Source	Dominant Hydrodynamics	Example Functions and Services
Riverine	Overbank flow from channel	Unidirectional, horizontal	Flood storage, water quality improvement, erosion control, habitat, recreation
Depressional	Return flow from groundwater & interflow	Vertical	Flood storage, erosion control, habitat, recreation
Slope	Return flow from groundwater	Unidirectional, horizontal	Erosion control, habitat
Soil Flat	Precipitation	Vertical	Habitat, recreation
Fringe	Overbank flow from estuary/lake	Bidirectional, horizontal	Shoreline protection, water quality improvement, habitat, recreation

Brinson (1993); Smith et al. (1995)

Example: Kettle Bog (Organic Soil Flat)

- Receives only precipitation
- Nutrient poor
- Plants adapted to low nutrients
- Water quality functions?

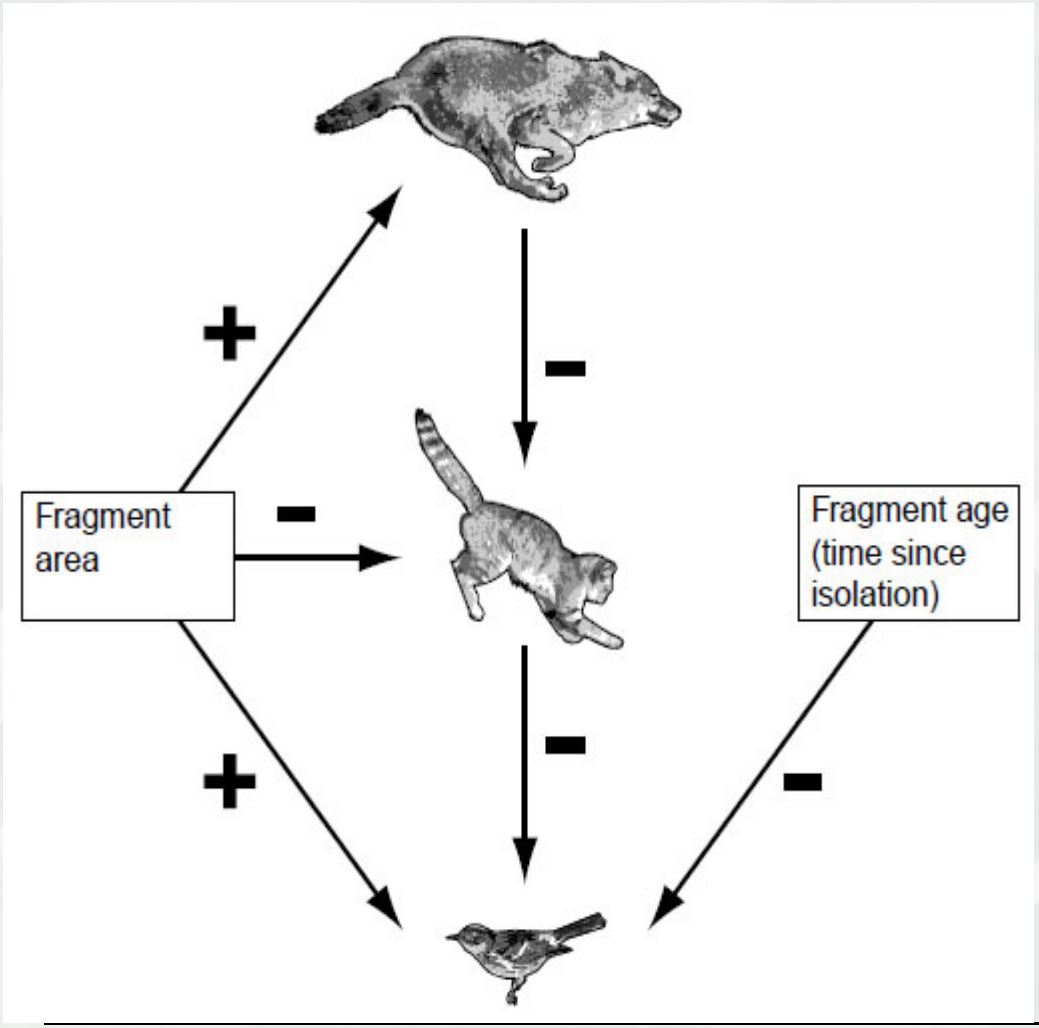
Is the site connected to other conserved resources?

- National Hydrography Dataset
  - https://nhd.usgs.gov/
- National Wetland Inventory
  - https://www.fws.gov/wetlands/
  - https://coast.noaa.gov/digitalcoast/data/ccapregional.html
- National Land Cover Databases
  - https://gapanalysis.usgs.gov/gaplandcover/
  - https://www.mrlc.gov/
- Current/historical aerial photographs (Google Earth, etc)
- Protected Areas Database of the United States (PADUS)
  - https://gapanalysis.usgs.gov/padus/

Is the Site Appropriate?
Role of Connectivity

- Can the site / area support
  - Full lifecycle
  - Breeding population
- Movement of plant propagules (see Mitsch)
- Movement of animals (mammals, amphibians)
  - Longitudinal movement
  - Lateral and interbasin (upland) movement
- Aquatic and upland connectivity

Example: Maintaining Important Predator/Prey Relationships



- In So Cal, coyotes control mesopredators (cats, racoons, skunks)
- Coyote presence correlated positively with avian diversity
- Corridors for coyote increases diversity of riparian/wetland birds

Crooks and Soule (1999) © MacMillan Magazines Ltd

What May Limit the Restoration Potential of My Site?

- US Census data – Growth and Development Trends
- EPA Permitted Facilities – NPDES, Brownfields, Superfund, etc
  - https://www3.epa.gov/enviro/
- Historic and Current Mining and abandoned mine lands
- Current/historical aerial photographs (Google Earth, etc)
- Soil maps (Soil Survey Geographic Database (SSURGO))

Stream Restoration Potential: Thresholds for Landscape Level Stressors

Region	Output	Threshold	Source
Maryland	Macroinvertebrate diversity	10-15% imperv cover	As reviewed by Schueler (1995)
Delaware	Macroinvertebrate diversity	10-12% imperv cover	As reviewed by Schueler (1995)
Virginia	Macroinvertebrate diversity	10-15% imperv cover	As reviewed by Schueler (1995)
Maryland	Fish diversity	10-12% imperv cover	As reviewed by Schueler (1995)
Washington	Fish diversity	10-15% imperv cover	As reviewed by Schueler (1995)
Wisconsin	Fish IBI	8-12% connected imperv cov	Wang et al. (2001)
Ohio	Fish IBI	10-15% imperv cover	Miltner et al. (2004)
W. Virginia	Fish IBI	7% urban land use	Snyder et al. (2003)
Georgia	Benthic macroinvert IBI	15% urban land cover	Roy et al. (2003)
California	Native amphibians	8% urban land cover	Riley et al. (2005)
Mass.	Riparian birds	3% impervious cover	Lussier et al. (2006)

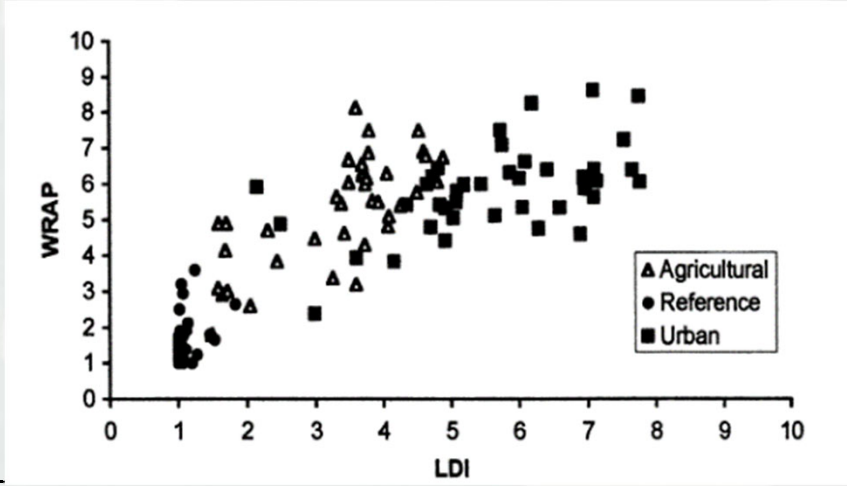
Is this site Appropriate: Water Quality

- Source of Pollution:
  - Lateral → Riparian Wetlands and Buffers
  - Upstream (already in the water column) → Not many good options for removal
- Water quality is most effectively addressed at the source

Restoration Potential Check: Landscape Development Intensity (LDI) Index

- Coefficient based land cover summary (Brown and Vivas 2005)
- Weighted summary of land cover used in 186 publications
  - Watershed assessments
  - Mitigation banking
  - HGM development
- Alternative to impervious cover
- Used in Florida, Oklahoma, Ohio, California, etc.

NLCD Class	Land Use Score
Developed Open Space	0.7
Light Intensity Development	0.2
Med-High Intensity Development	0
Pasture	0.7
Cropland	0.3
Barren	0.5
Forest, shrubland, wetland, open water,	1.0



Does This Meet Watershed Needs?

- Water Quality - State / EPA Impaired waters datasets and Monitoring Data
  - ► https://www.epa.gov/waterdata/waters-geoviewer
- Fish and Wildlife Habitat Plans – Contact your local office
- Information on sensitive species and critical habitat (USFWS and NatureServe)
  - ► USACE staff have limited access to NatureServe Surveyor http://www.natureserve.org/

Summary of Landscape Considerations

- It's all about location!!!
- HGM classification/landscape stream position informs understanding of functions
- Land use change/inadequate buffers contribute to impairment

Questions?