

# Using NWI Data as the Foundation for Watershed Assessment

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# Watershed Management and Planning

- Increasing interest in watershed management
  - Water quality and aquatic biota
  - Disappearing wildlife habitat
  - Degraded fish and wildlife habitat
  - Opportunities to protect, enhance, and restore



# Some Information Needs for Natural Resource Planning in Watersheds

- Status of Natural Habitats
  - Condition and Extent
    - Aquatic Habitats (including wetlands)
    - Terrestrial Ecosystems
- Trends
- Potential Restoration Sites
  - Wetlands, Buffers, Riparian Habitat



# Existing Geospatial Data

- Aquatic Habitats
  - Wetland Maps and Digital Data
  - Wetland Trends Analyses
  - Rivers, Lakes, and Stream Digital Data
- Terrestrial Habitats
  - Land Use/Cover Maps and Digital Data
  - Trends Analyses
- Other
  - Soils Maps and Digital Data



# Watershed Analyses

- Use GIS technology and existing digital data to:
  - Assess wetland functions
  - Assess status of “natural habitats”
  - Monitor trends
  - Identify potential wetland restoration sites



# National Wetlands Inventory Program

- Created by USFWS in 1974
- Mapping U.S. wetlands
  - Large-scale maps (1:24K) based on interpretation of aerial photographs
- National wetland trends
  - 10-year intervals
  - Statistical sampling-based study
- Local wetland trends

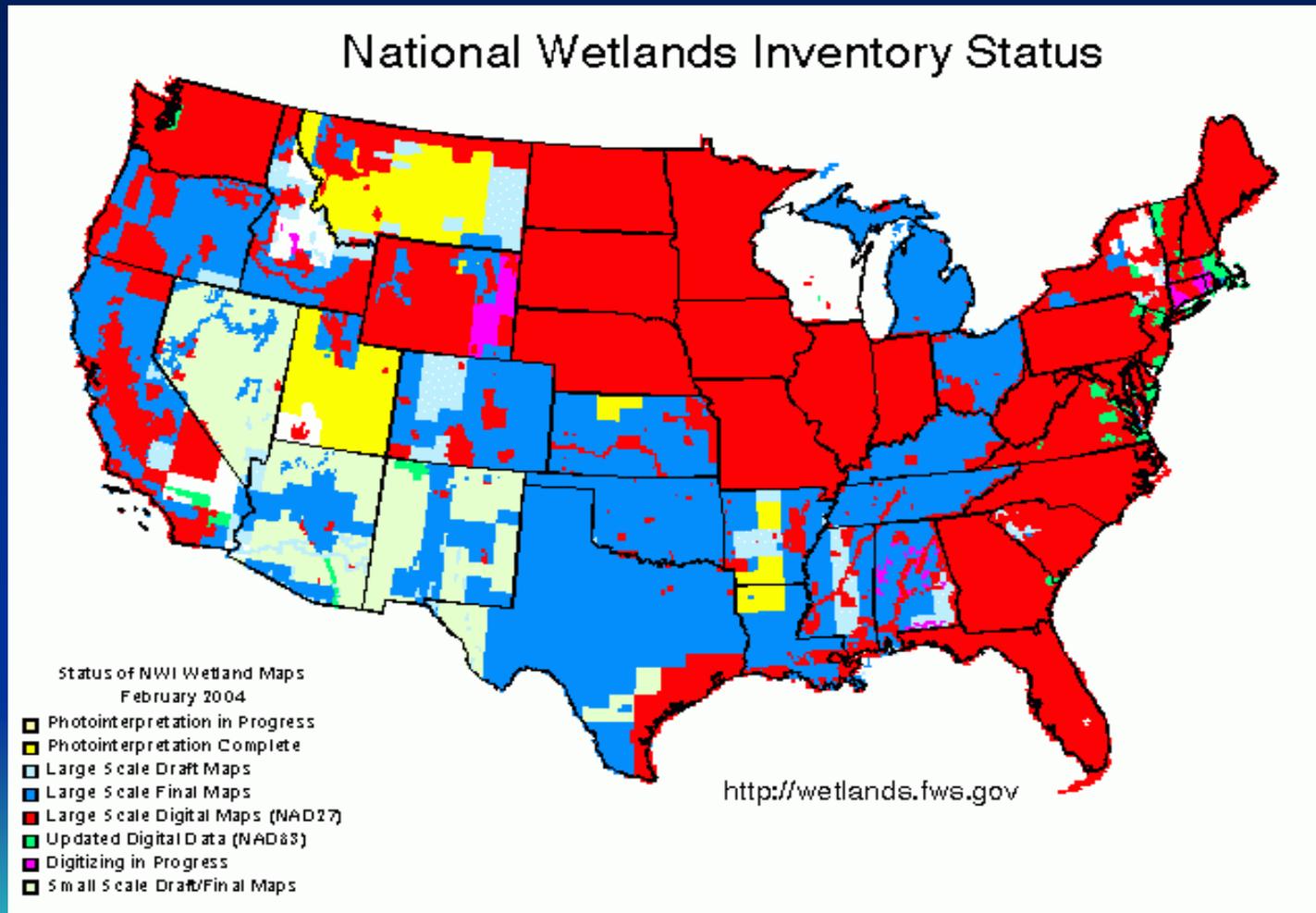


# NWI Status

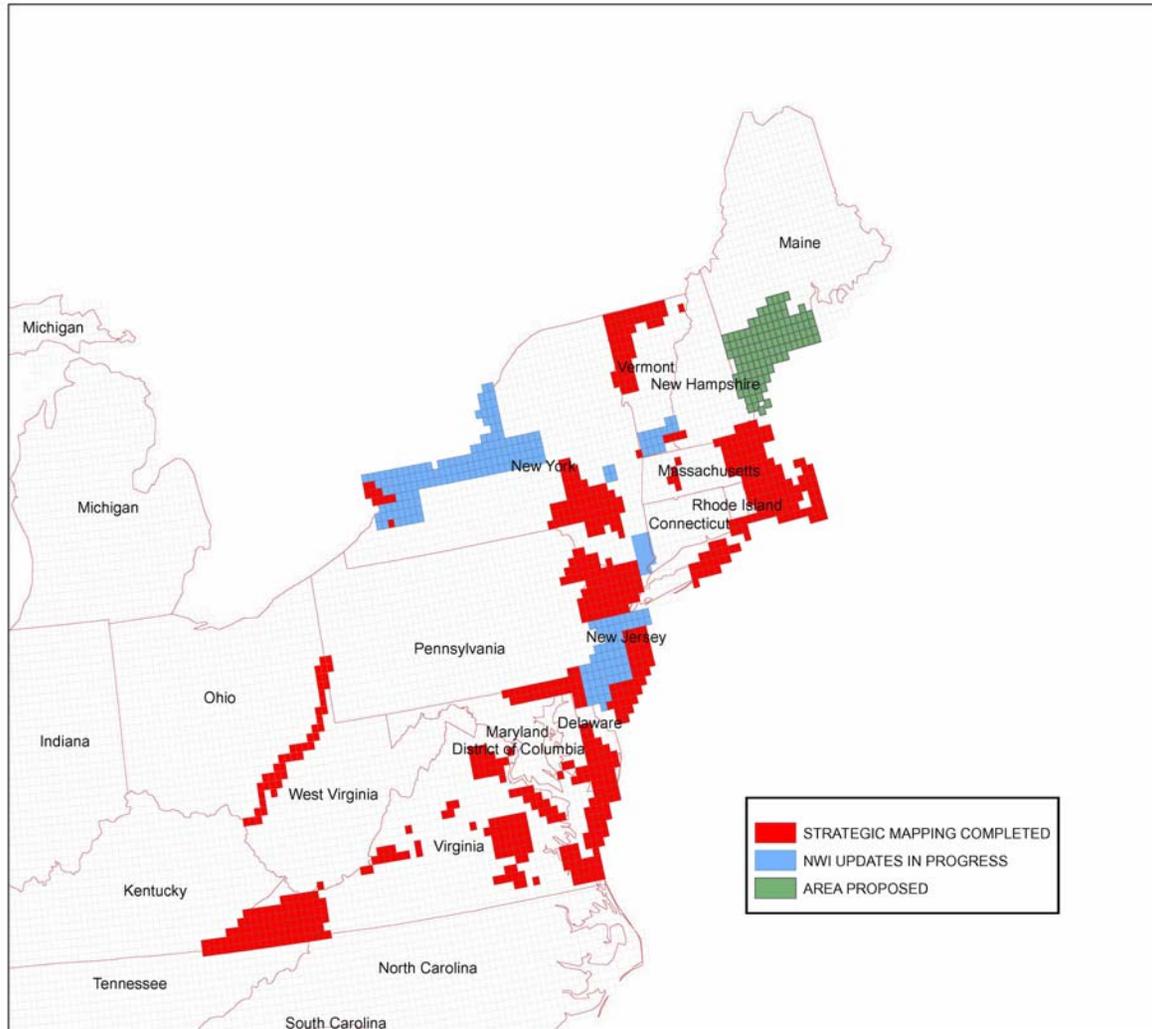
- NWI maps
  - 91% of coterminous U.S.
  - 35% of Alaska
- NWI digits
  - 40% coterminous U.S.
  - 18% of Alaska



# Status of NWI Maps/Digits



# NWI Mapping Updates from 2000 - 2005



# Potential Uses of NWI Digital Data

- Predict wetland functions
- Monitor changes in wetlands and their effect on functions
- Predict the effect of cumulative wetland losses on wetland functions
- Combine with other data for watershed analyses
- Identify potential wetland restoration sites



# Some Limitations of NWI Data

- All wetlands not shown
- Drier-end wetlands conservatively mapped
- Aquatic beds may not be mapped
- Boundaries approximate

Despite limitations, data are useful for preliminary assessments for watersheds and other large geographic areas



# Existing Wetland Classification

- “Classification of Wetlands and Deepwater Habitats of the United States”

Cowardin et al. (1979)

- Characteristics Emphasized
  - Vegetation
  - Hydrology
  - Salinity
  - Soils and substrates
  - Human impacts



# Shortcomings of FWS System

- No landscape position
- No landform
- No water flow direction
- No specific pond, lake, and estuary types

Features important for assessing many functions  
Can determine much from map examination but  
information is not in digital database



# Three Major Uses of NWI Data for Watershed Assessment

- Preliminary Assessments of Wetland Functions
- Watershed Assessments of “Natural Habitat” Integrity
- Inventory of Potential Wetland Restoration Sites



# Preliminary Assessment of Wetland Functions

- Add information to NWI Database
  - Landscape position
  - Landform
  - Water Flow Path
  - Waterbody Type



# New Descriptors (LLWW)

- **Landscape Position** - relationship between a wetland and an adjacent waterbody or not (isolated).
- **Landform** - the shape or physical form of wetlands (e.g., basin, flat, slope, island, etc.).
- **Water Flow Path** – the directional flow of water
- **Waterbody Type**



# Landscape Position

- **Marine** – along ocean shores
- **Estuarine** – in an estuary
- **Lotic** - in or along rivers and streams or on floodplain and periodically flooded by river or stream
- **Lentic** - in or along lakes
- **Terrene** – isolated, source of a stream, or wetland crossed by streams but not periodically inundated



# Landforms

- Slope
- Island
- Fringe
- Floodplain (basin, flat)
- Interfluve (basin, flat)
- Basin
- Flat



# Water Flow Path

- Bidirectional-tidal
- Bidirectional-nontidal
- Throughflow (intermittent, entrenched, artificial)
- Outflow (artificial, intermittent)
- Inflow
- Isolated (geographically)
- Paludified

Note: Can consider groundwater connections



# Waterbody Types

- **River and Stream Gradients** (tidal, dammed, intermittent, high, middle, and low)
- **Lake** (e.g., natural, dammed river valley-reservoir, other dammed, excavated)
- **Pond** (e.g., natural, artificial, beaver, sinkhole, farm, golf, prairie pothole, vernal)
- **Estuary** (e.g., fjord, rocky headland bay, river-dominated, drowned river valley, bar-built)
- **Ocean** (e.g., open, reef-protected, atoll, fjord)



# Functional Assessment Potential

- Preliminary Assessment (without significant field verification)
- Consider Possible Functions
  - Surface Water Detention
  - Streamflow Maintenance
  - Shoreline Stabilization
  - Nutrient Transformation
  - Coastal Storm Surge Detention
  - Sediment Retention
  - Fish and Wildlife Habitat



# Developing Functional Correlations

- **Matching Form to Function**
  - Some emphasize LLWW descriptors
    - Surface Water Detention
    - Streamflow Maintenance
  - Some rely on NWI + LLWW
    - Shoreline Stabilization
    - Sediment Retention
    - Habitat for Fish, Shellfish, Waterfowl and Waterbirds
  - Others only use NWI
    - Nutrient Transformation
    - Habitat for Other Wildlife



# Coordinated Effort

- Worked with numerous wetland specialists across the Northeast to develop correlations
  - Maine Wetland Advisory Group
  - NYCDEP
  - Nanticoke Wetlands Study Group
  - FWS biologists
  - Others



# Function-Form Correlation Report

- Documents linkage between wetland characteristics and functions
- Posted on the web at:  
<http://wetlands.fws.gov>



# Steps for Enhanced Classification and Functional Assessment

1. Update NWI digits
2. Build wetland database for study watershed
3. Classify LLWW
4. Review and edit LLWW classifications
5. Apply functional correlations to database
6. Review stats/working maps
7. Produce draft report/maps (CD format)
8. Peer review
9. Produce final report/maps (CD format)



# Watershed Assessment Studies

- Casco Bay Watershed (ME)
- New York City Water Supply Watershed
- Coastal Bays Watershed (MD)
- Nanticoke River Watershed (MD/DE)
  - 1998 and Pre-settlement analyses
- Pennsylvania Coastal Zone
- Hackensack Meadowlands (NJ)

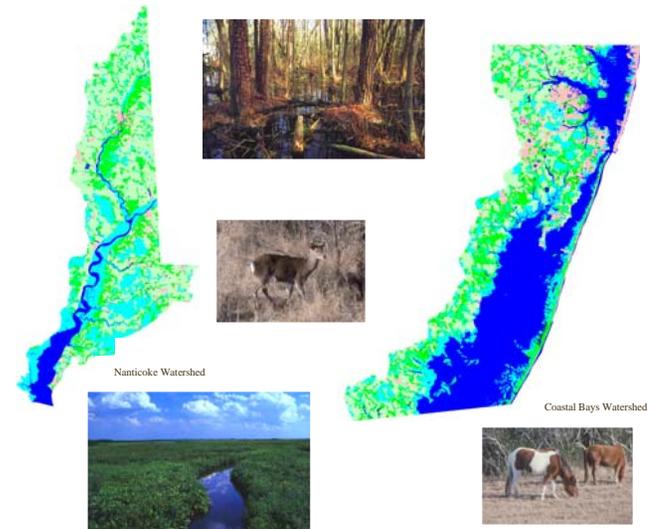


# Web-based Watershed Report

- CD Version
- View on Internet at:  
<http://wetlands.fws.gov>

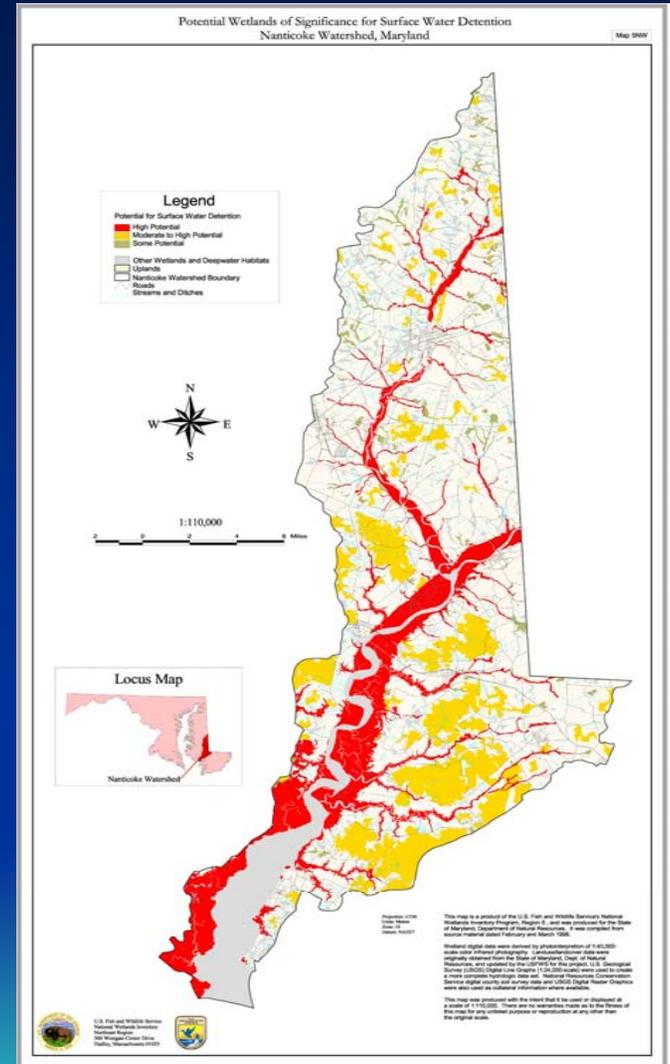
## National Wetlands Inventory

Watershed-based Wetland Characterization for Maryland's Nanticoke River and Coastal Bays Watersheds:  
A Preliminary Assessment Report



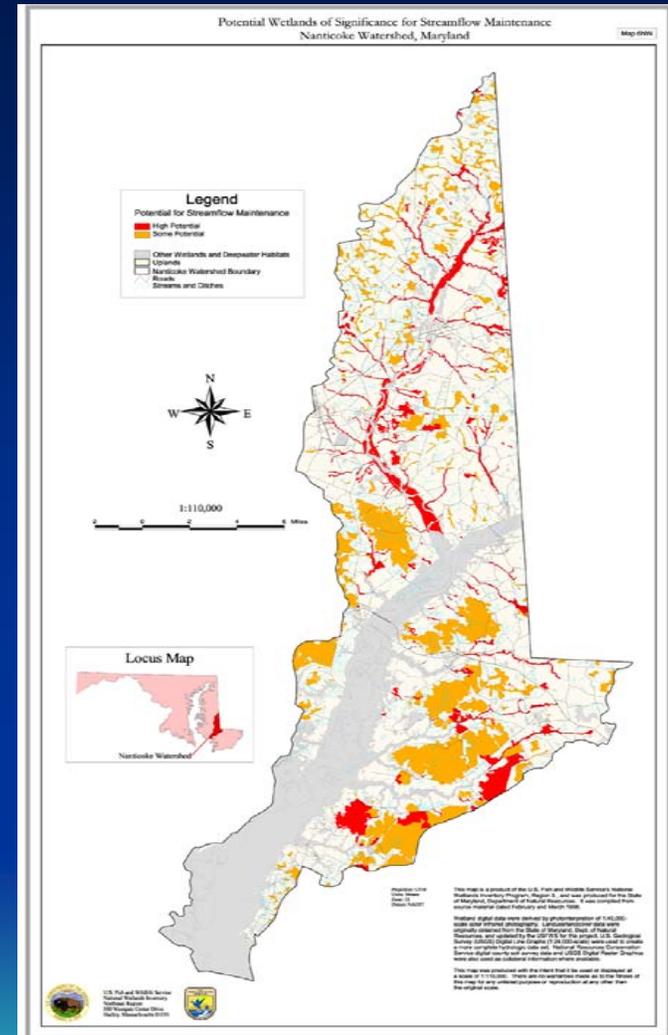
# Nanticoke Watershed - Surface Water Detention

28% High  
69% Moderate  
(97% of all wetlands)



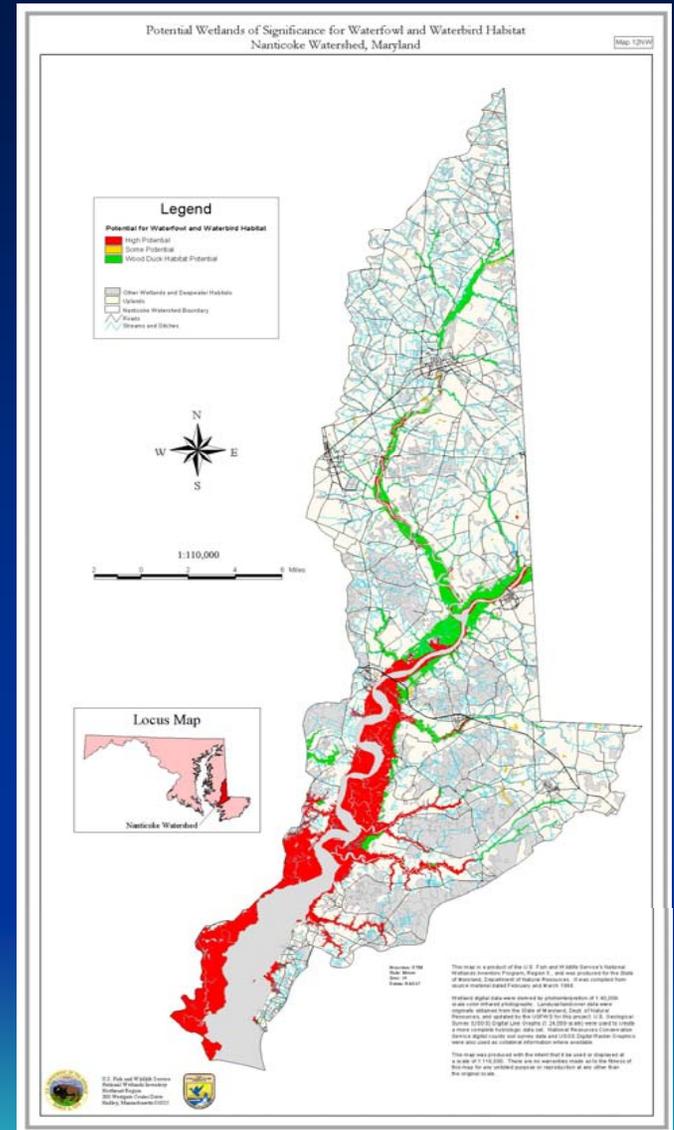
# Nanticoke Watershed - Streamflow Maintenance

17% H  
58% M  
(75%)

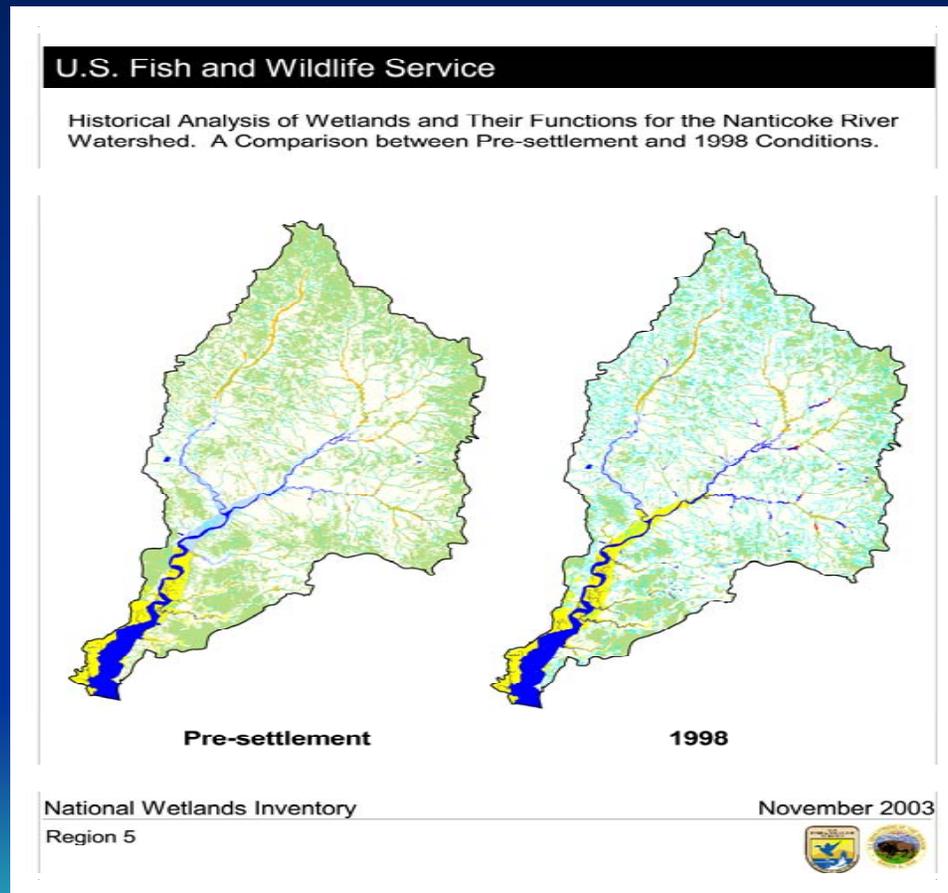


# Nanticoke Watershed – Waterfowl & Waterbird Habitat

13% H  
7% M  
(20%)



# Historical Analysis – Cumulative Impacts



# Pre-settlement vs. 1998 Nanticoke River Watershed

## Pre-settlement

- 230,000 acres
- 2,809 wetlands
- 72% = interfluve outflow wetlands
  - Aver. Size = 433 a

## 1998

- 142,000 acres (=62%)
- 4,920 wetlands
- 43% decrease in interfluve outflow type
  - Aver. Size = 44 a
- Palustrine -40%
- Estuarine -28%



# Functional Losses for Nanticoke

- Surface Water Detention -36%
- Streamflow Maintenance -64%
- Nutrient Transformation -47%
- Sediment Retention -46%
- Cstl Storm Surge Detention -23%
- Fish/Shellfish Habitat -33%
- Waterfowl/Waterbird Habitat -34%
- Other Wildlife Habitat -41%



# Watershed Assessment

- Must look **BEYOND** wetlands
  - Buffers
  - Land use/cover in the watershed
  - Human disturbance to land and water resources
- Use GIS techniques for assessment



# Some Important Questions

- How much “natural habitat” is there in the watershed?
- How much alteration has taken place?
- What is the condition of buffers and stream corridors?
- How much wetlands and waterbodies exist vs. historic numbers?



# Indices to Describe the Extent and Condition of “Natural Habitat” in the Watershed



# “Natural Habitat” Definition

- Land with “natural cover” – wetlands, forests, prairies, dunes, old fields, and thickets (plus commercial forest lands in successional stages) = wildlife habitats
- It is not developed lands:
  - Agricultural land (cropland, heavily grazed pastures, orchards, vineyards)
  - Turf (lawns, golf courses, turf farms)
  - Impervious surfaces



# Natural Habitat Integrity

- “the state or condition of unbroken natural habitat”
- Focus on “natural” ecosystems not on highly managed, altered ecosystems



# Assessment - Products

- **Statistics**

- Values between 1.0 and 0.0 (=%)

- Example: Natural Cover Index

- 1.0 = undeveloped watershed (100% integrity)

- ~ 0.0 = a major city

- Example: Channelized Stream Length

- 1.0 = all streams channelized

- 0.0 = all streams not channelized (100% integrity)

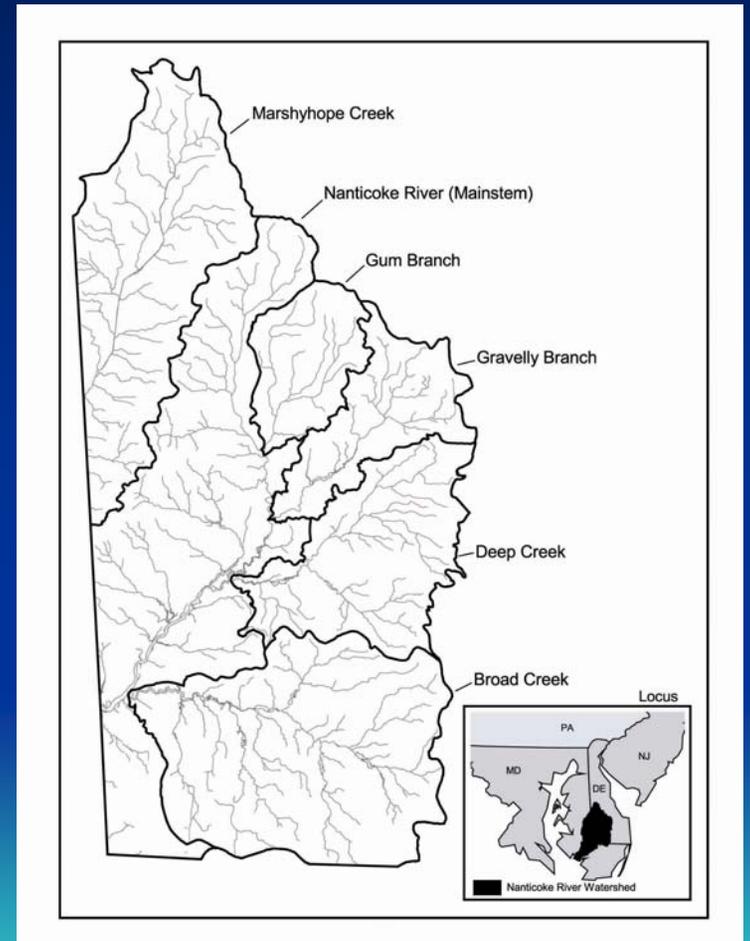
- **Maps**

- **Database** (for additional analyses)



# Examples of Data derived from Natural Habitat Integrity Assessment

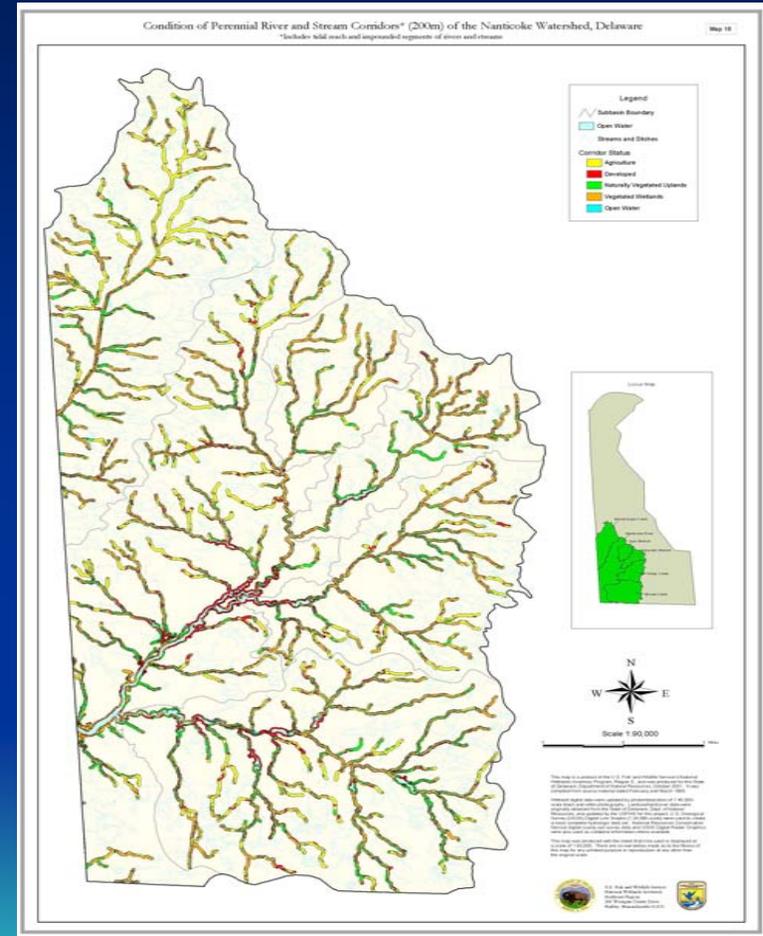
- Nanticoke Watershed





# River-Stream Corridor Integrity Index

- Area of Natural Vegetation within 100m/Area of Corridor in Watershed
- For Nanticoke Watershed (DE):  
11,369 ha/19,143 ha = 0.59



# Vegetated Wetland Buffer Index

- Area of Natural Vegetation in 100m Buffer/Area of Buffer in Watershed
- For Nanticoke Watershed (DE):  
 $11,647 \text{ ha} / 32,125 \text{ ha} = 0.36$



# Pond and Lake Buffer Index

- Area of Natural Vegetation within 100m/Area of Buffer in Watershed
- For Nanticoke Watershed (DE):  
 $996 \text{ ha} / 2,545 \text{ ha} = 0.39$



# Wetland Extent Index

- Current wetland area/historic wetland area
- For Nanticoke Watershed (DE):  
24,091 ha/58,255 ha = **0.41** (based on soil data for 85% of watershed)



# Standing Waterbody Extent Index

- Historic gain due to impoundment and pond construction
- For Nanticoke Watershed (DE):  
Index = 1.0+



# Remotely-sensed Natural Habitat Integrity Indices

- Habitat Extent Indices
- Habitat Disturbance Indices
- Composite Index



# Habitat Extent Indices

- Natural Cover
- River-Stream Corridor Integrity
- Wetland Buffer Integrity
- Pond and Lake Buffer Integrity
- Wetland Extent
- Standing Waterbody Extent



# Habitat Disturbance Indices

- Dammed Stream Flowage
- Channelized Stream Length
- Wetland Disturbance
- Habitat Fragmentation by Roads
- Land Drainage??



# Dammed Stream Flowage Index

- Length of dammed stream/total perennial stream length
- For Nanticoke Watershed (DE):  
 $28.2 \text{ km} / 918.9 \text{ km} = 0.03$



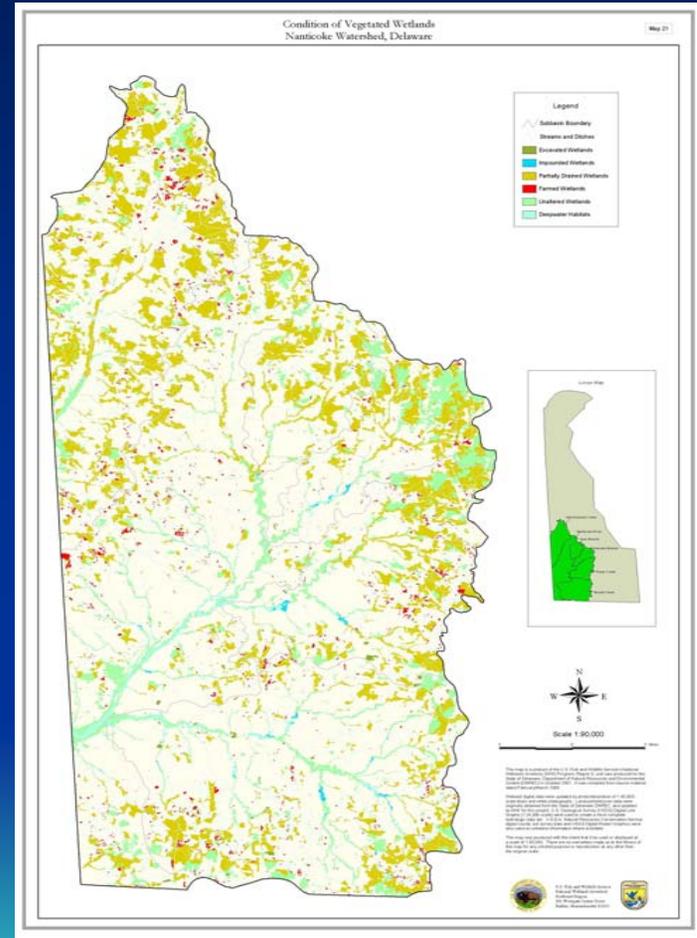
# Channelized Stream Length Index

- Length of channelized streams/total stream length
- For Nanticoke Watershed (DE):  
 $700.5 \text{ km} / 890.7 \text{ km} = 0.79$



# Wetland Disturbance Index

- Area of altered wetlands/total wetland area
  - Excavated, impounded, farmed, ditched
- For Nanticoke Watershed (DE):  
22,076 ha/31,308 ha = 0.71



# Habitat Fragmentation by Road Index

- Area of roads/total area times high density coefficient (16)
- For Nanticoke Watershed (DE):  
 $3,081/126,582 \times 16 = 0.38$



# Composite Natural Habitat Integrity Index

- Sum of Weighted Habitat Extent Indices Minus the Sum of Weighted Habitat Disturbance Indices
- How to weigh variables?



# Composite Natural Habitat Integrity Index

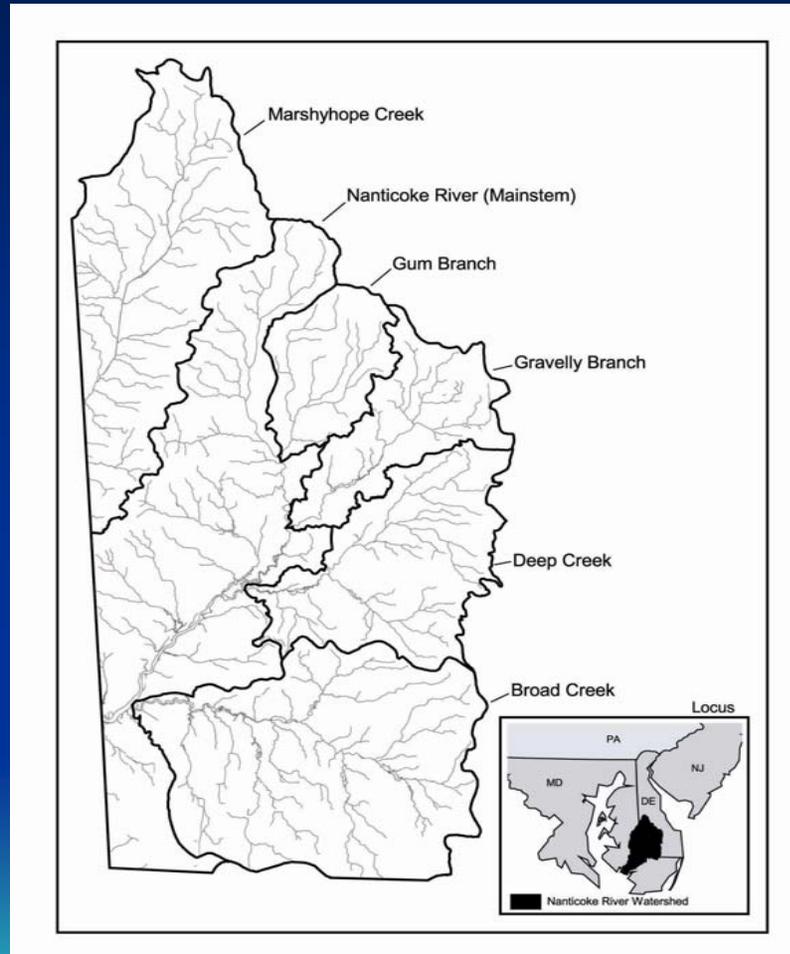
- Weighted Habitat Extent Indices –  
Weighted Habitat Disturbance Indices

$$0.5 \text{ NC} + 0.125 \text{ RSC} + 0.125 \text{ WB} + \\ 0.05 \text{ PLB} + 0.1 \text{ WE} + 0.1 \text{ SWE} = 0.485 \\ 0.1 \text{ DSF} + 0.1 \text{ CSL} + 0.1 \text{ WD} + 0.2 \text{ HF} = \\ 0.191$$

$$0.485 - 0.191 = 0.294 \text{ (severely} \\ \text{degraded watershed)}$$



# Subbasin Comparison



# Selected Indices for Subbasins

<u>Subbasin</u>	<u>NC</u>	<u>RSC</u>	<u>Comp</u>
– Broad Creek	0.40	0.59	0.32
– Deep Creek	0.52	0.64	0.35
– Gravelly Branch	0.63	0.80	0.47
– Gum Branch	0.46	0.73	0.33
– Marshyhope Creek	0.41	0.54	0.26
– Nanticoke Mainstem	0.30	0.53	0.23



# Some Uses of Data

- Report on current watershed condition
- Conduct trend analyses
- Monitor changing condition of watersheds
- Comparisons between and within watersheds
- Target areas for restoration of “natural habitat”
- Data to correlate with field studies (IBIs, etc.)
- To help in developing watershed resource management plans
- Statistics for State-of-the-Watershed Report



# Web-based NWI Watershed Report

- CD Version
- View examples on Internet at:  
<http://wetlands.fws.gov> – look under publications



# Restoration Planning

- Potential Restoration Sites
  - Wetlands
    - Type 1 Sites (Former Wetlands)
    - Type 2 Sites (Degraded Wetlands)
  - Wetland Buffers
  - Riparian Habitat



- Use NWI for degraded wetlands and Soil Survey Data + Land Use for former wetlands
- Land Use/Cover Data for nonwetlands
- Supplement with new photointerpretation or map interpretation (orthophotoquads)

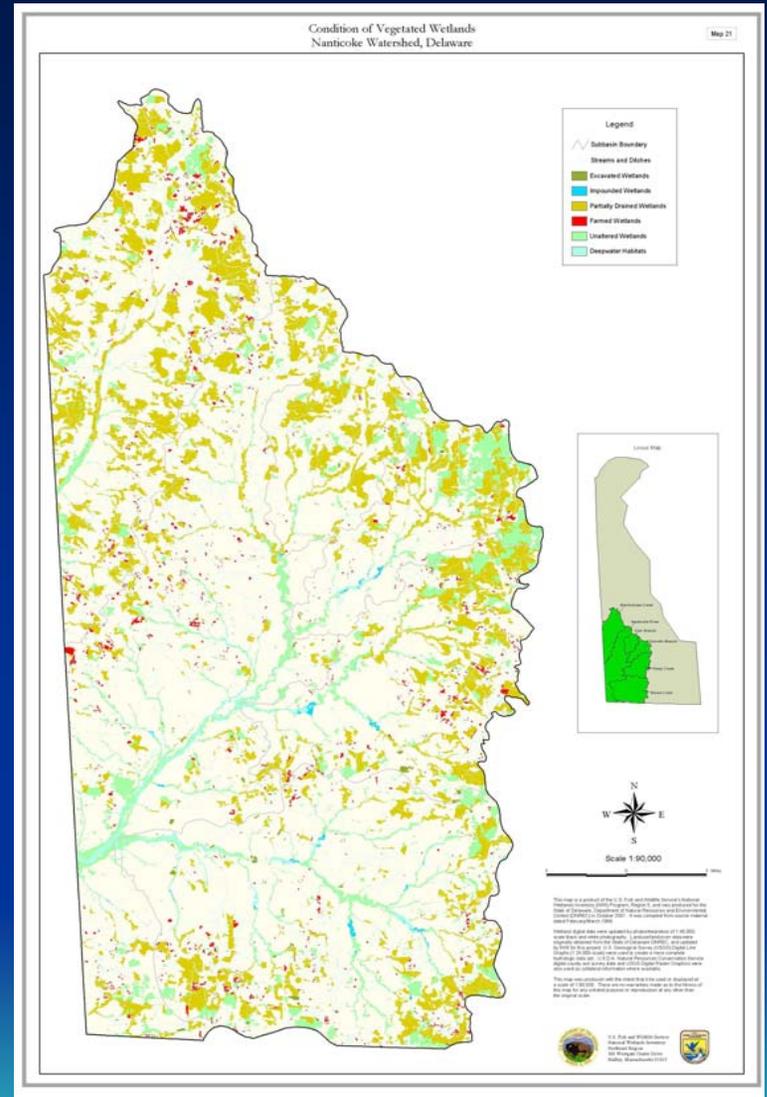


# Potential Wetland Restoration Sites

- Type 1 Sites – Former Wetlands
  - Effectively Drained Land
  - Deepwater Habitats
  - Filled Land (Not Developed)
- Type 2 Sites – Degraded Wetlands
  - Diked
  - Partly Drained
  - Excavated (shallow ponds)
  - Farmed Wetlands (Type 1?)



# Potential Wetland Restoration Sites (Type 2)



# For Additional Information

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