

Assessing Wetlands and Natural Habitats in Watersheds

New Tools from the National Wetlands Inventory Program

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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



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



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

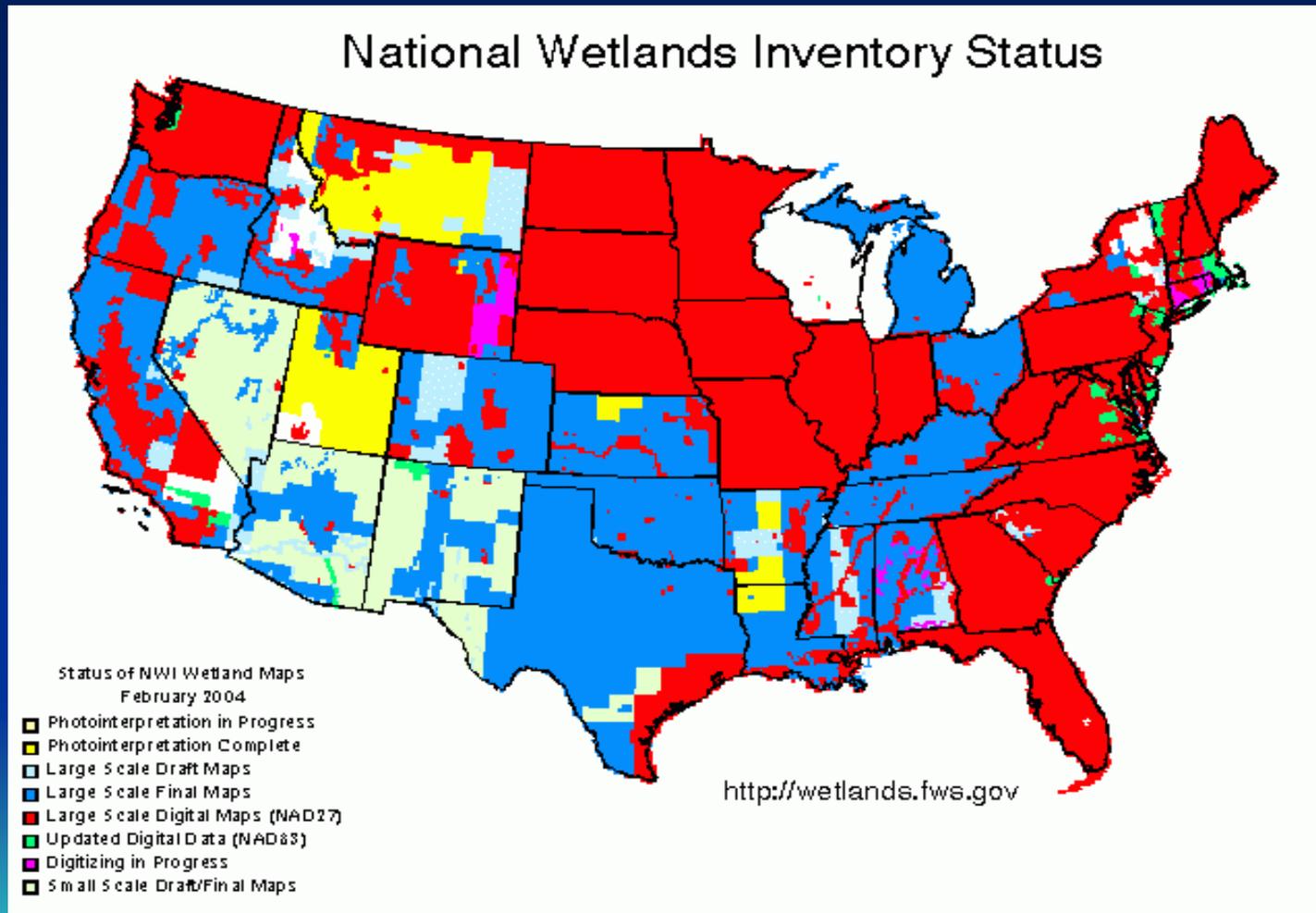


NWI Status

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



Status of NWI Maps/Digits



Potential Uses of NWI Digital Data

- Predict wetland functions for watersheds and large regions
 - Highlight wetlands of significance
- Monitor changes in wetlands and their effect on functions
- Predict the effect of cumulative wetland losses on wetland functions
 - Impact of wetland trends on functions
- Combine with other data for watershed analyses



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



Two Major Uses of NWI Data for Watershed Planning and Management

- Preliminary Assessments of Wetland Functions
- Watershed Assessments of “Natural Habitat” Integrity



Some Basic Questions for Wetland Functional Assessment

- Where is the wetland on the landscape?
- What is its connection to a waterbody?
- Is this wetland connected to other wetlands?
- How many wetlands are on floodplains, in lake basins, or isolated?
- How many wetlands are there?
- What is the physical form of the wetland?
- Does water flow through the wetland?
- Is water flow altered?
- What kind of pond is it?
- Is the waterbody a natural feature or artificial?



Enhancing NWI Data for Functional Assessment

- Additional descriptors
 - Landscape position
 - Landform
 - Water Flow Path
 - Waterbody Type



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

- Correlate Functions with Characteristics
 - 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



Correlation Report

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



Sources Used to Classify Wetlands

- **Primary Source Data**
 - NWI Digital Data
 - USGS Digital Hydro Data (1:24K)
- **Other Sources**
 - USDA Digital Soil Survey Data
 - State Wetland Digital Data
 - More Detailed Hydro Data
 - Aerial Photos



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)



Others Using this Approach

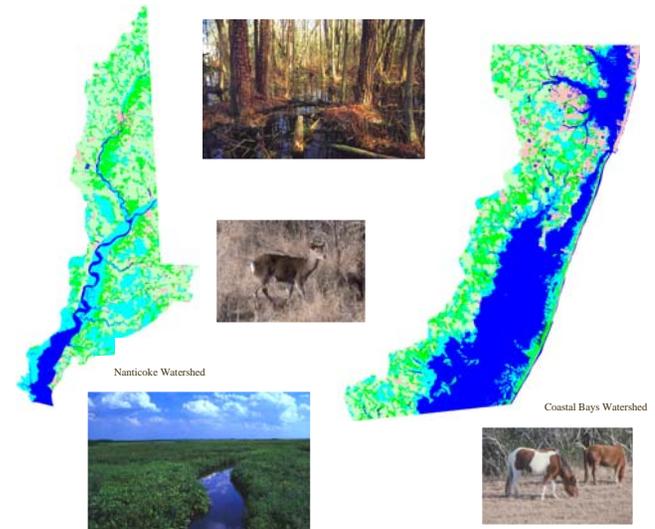
- Federal Agencies
 - EPA (Upper Delaware)
 - NRCS (wetland assessment methodology – draft New England)
- Local Watershed Planning
 - New York City
 - Center for Watershed Protection
 - MI – Lower Grand River
- States
 - Delaware
 - Maryland (our data)
 - Michigan
 - Montana
 - Minnesota (wetland monitoring strategy)
 - New Mexico (planned; funding)
 - Massachusetts (planned; funding)
 - Rhode Island (considering)

Web-based Watershed Report

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

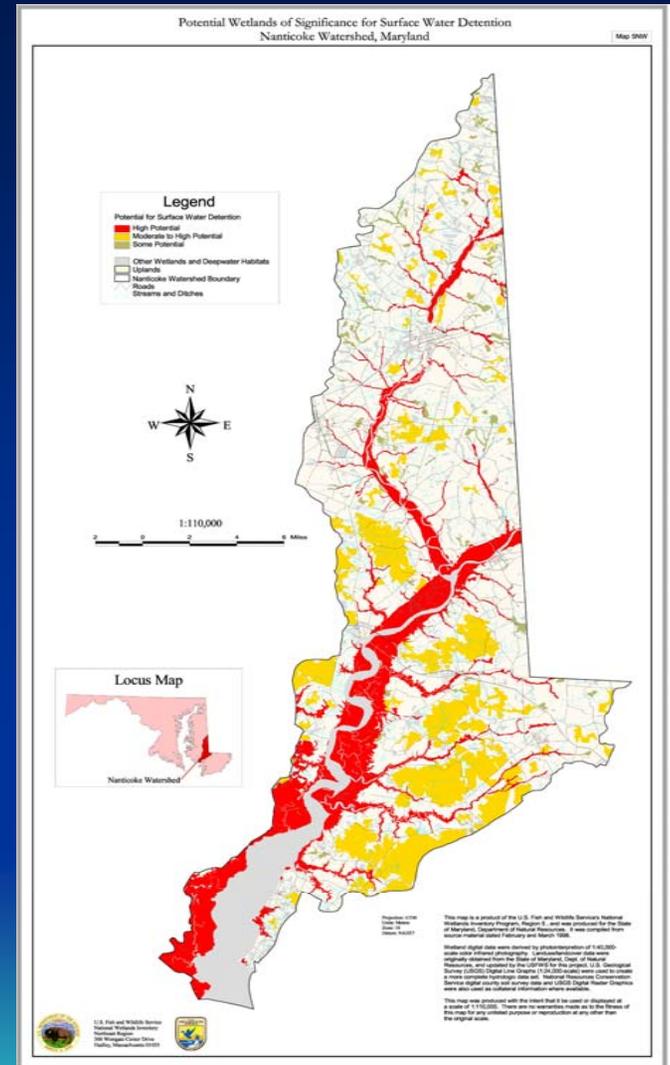
National Wetlands Inventory

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



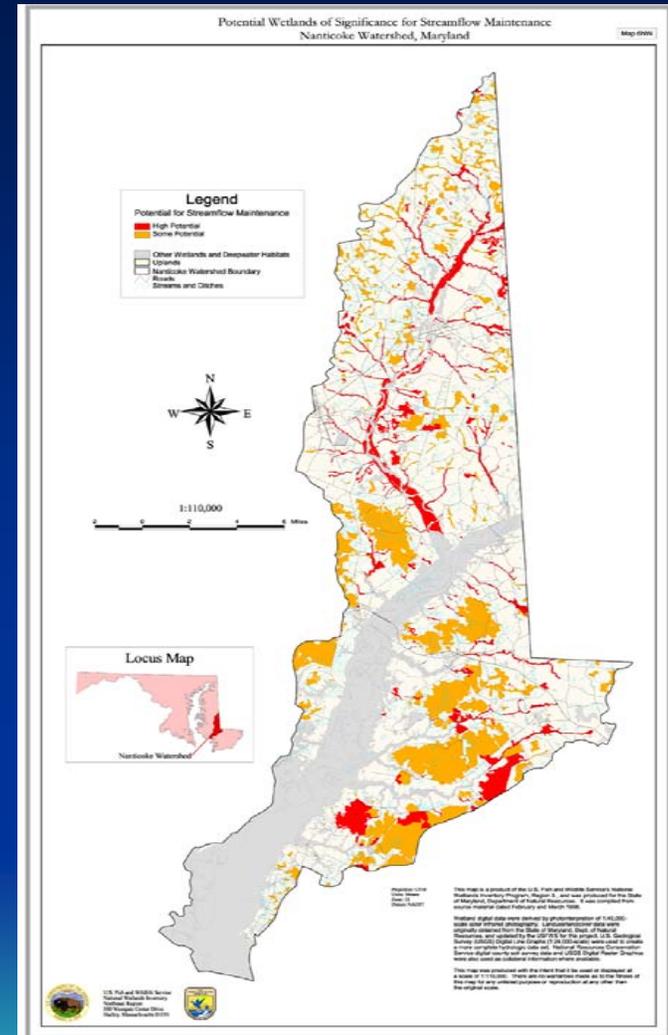
Nanticoke Watershed - Surface Water

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



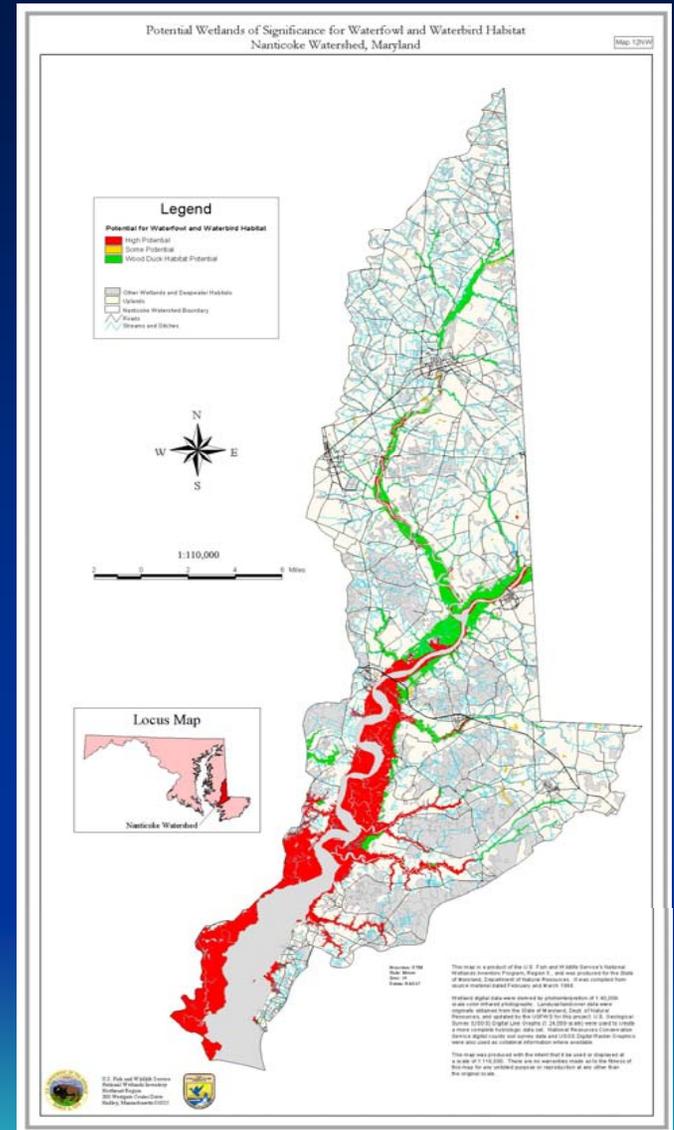
Nanticoke Watershed - Streamflow Maintenance

17% H
58% M
(75%)



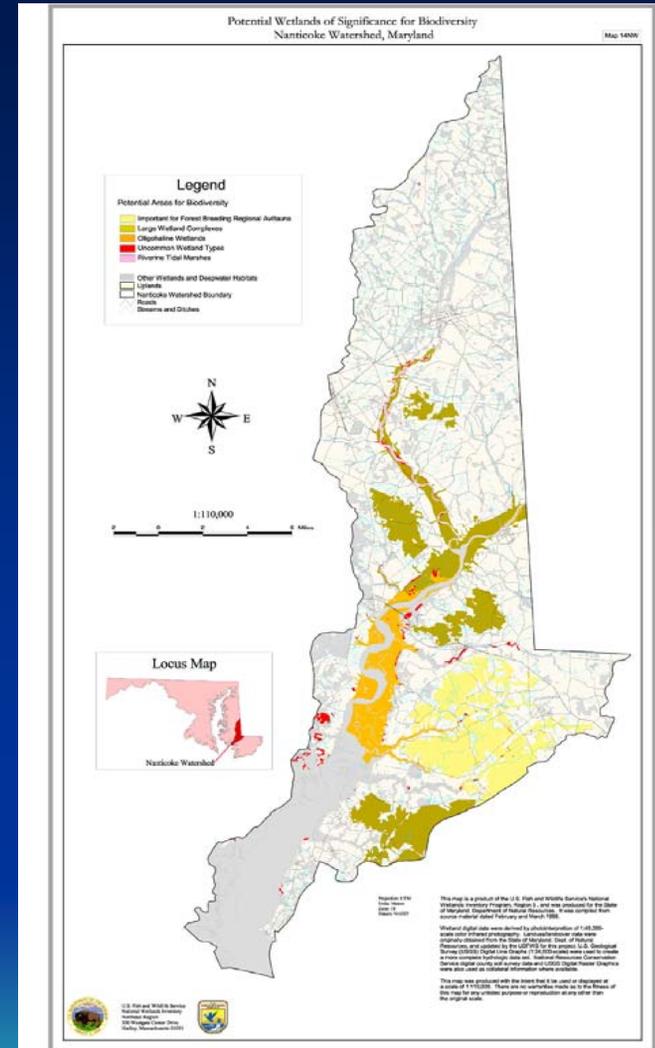
Nanticoke Watershed – Waterfowl & Waterbird Habitat

13% H
7% M
(20%)

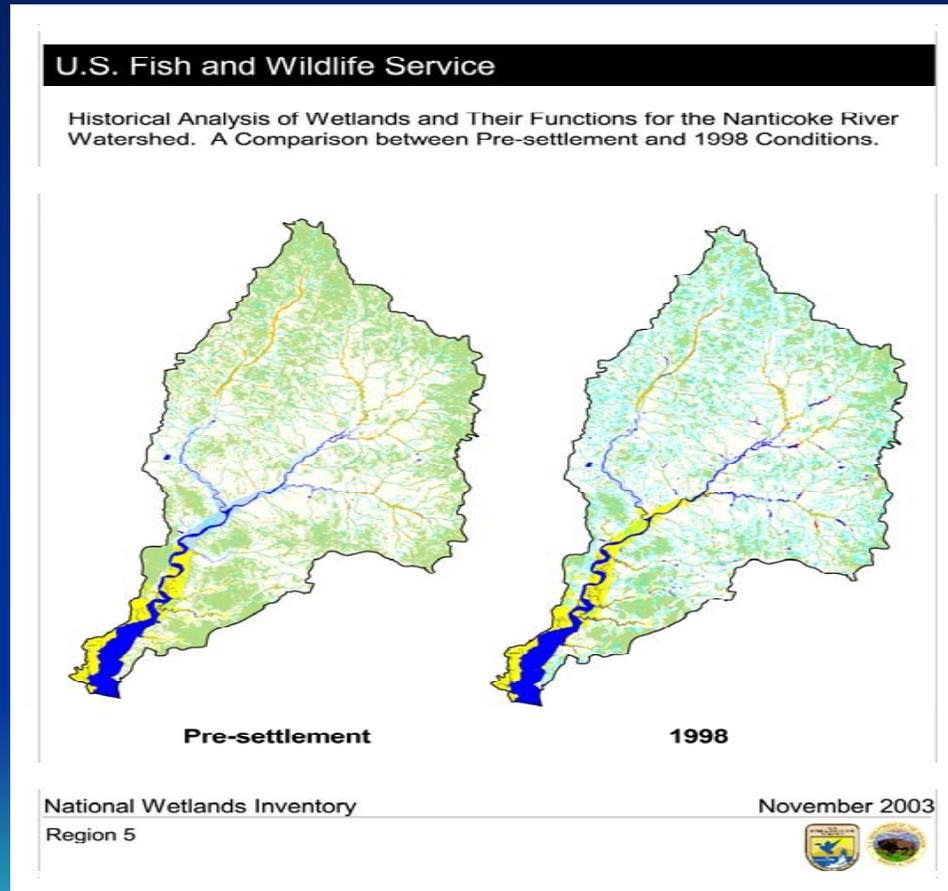


Nanticoke Watershed - Biodiversity

25%



Historical Analysis – Cumulative Impacts



Pre-settlement vs. 1998 Nanticoke River Watershed

Pre-settlement

- 230,000 acres
- 2,813 wetlands
- 72% = interfluve outflow wetlands
 - Aver. Size = 433 a

1998

- 142,000 acres (=62%)
- 5,810 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%



Limitations of Landscape-level Assessment

- First approximation
- Source data limitations
 - All wetlands not shown
 - Possible upland inclusions
 - All streams not shown
 - Age of data
- LLWW wetland classifications based largely on map interpretation
- Correlations between functions and characteristics = work in progress (report available for Northeast US)



Values of Enhancing NWI Data

- Produces a better characterization of wetlands
- Perform landscape-level wetland functional assessments
- Include functional loss assessment in wetland trend studies
- Use enhanced NWI data for restoration planning



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



Sources of Geospatial Data

- Wetlands and Deepwater Habitats
 - NWI and/or State
- Land Use/Cover
 - USGS and/or State
- Hydrography
 - USGS and/or State
- Soils
 - USDA NRCS



Some Important Questions

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



To Answer These Questions

- Use GIS techniques to analyze various geospatial data sets
- Merge NWI (or State wetland data) with Land use/cover data
- Develop set of indices to describe condition of various features



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



Assessing Natural Habitat Integrity

- Site-specific Evaluation
 - Field studies comparison with reference data
 - Rigorous vs. Rapid Assessment
 - Variables to estimate or measure
- Remotely-sensed Data
 - Large geographic areas
 - Broad overview
 - Variables detectable via remote sensing



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



Composite Natural Habitat Integrity Index

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



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)

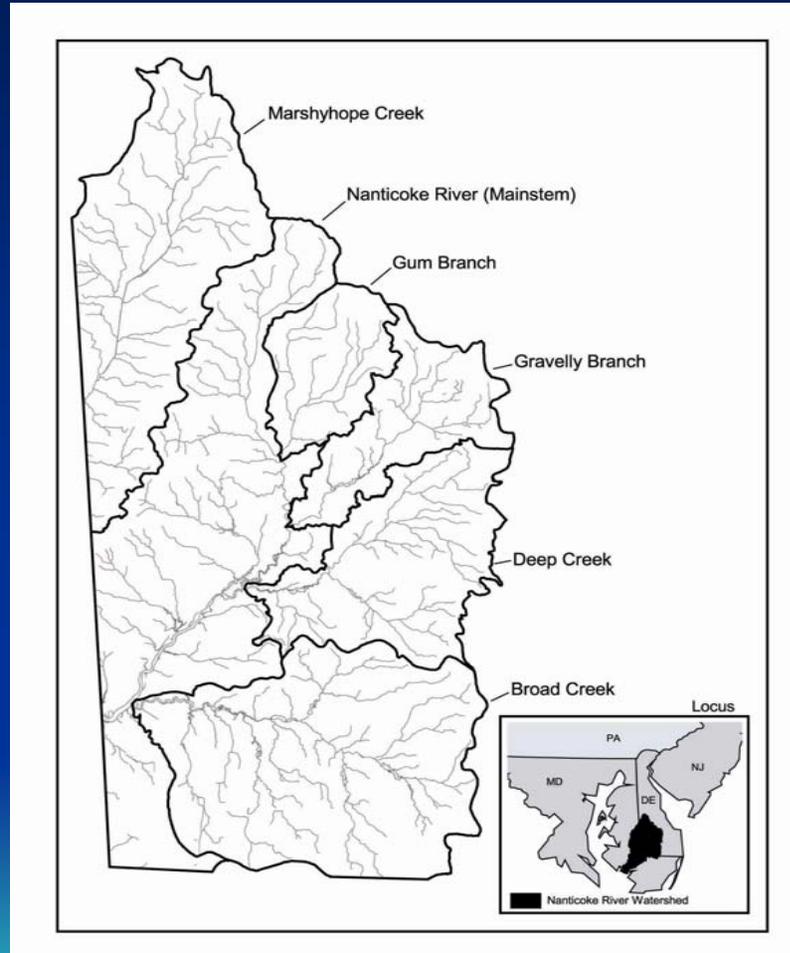


Examples of Data derived from Natural Habitat Integrity Assessment

Nanticoke Watershed
(Delaware)



Nanticoke Watershed



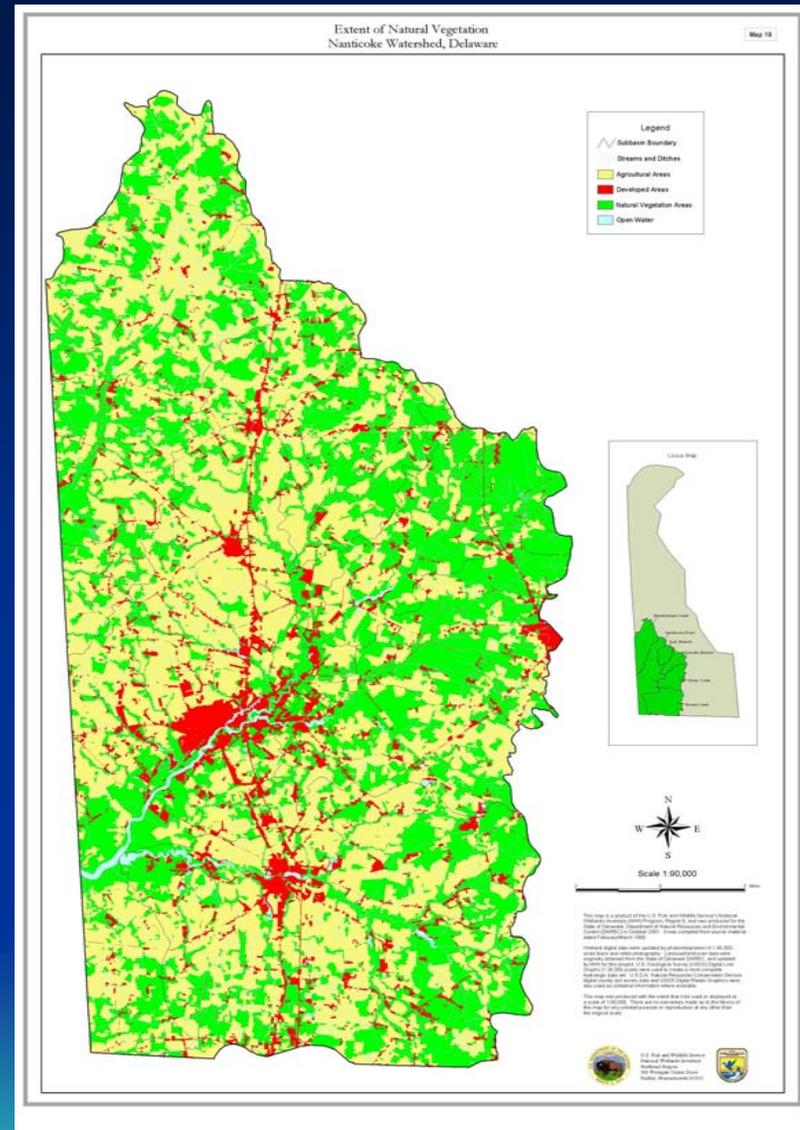
Natural Cover Index

- Area of Natural Vegetation/Area in Watershed
- For Nanticoke Watershed (DE):
 $51,813 \text{ ha} / 126,582 \text{ ha} = 0.41$



Extent of Natural Cover

0.41



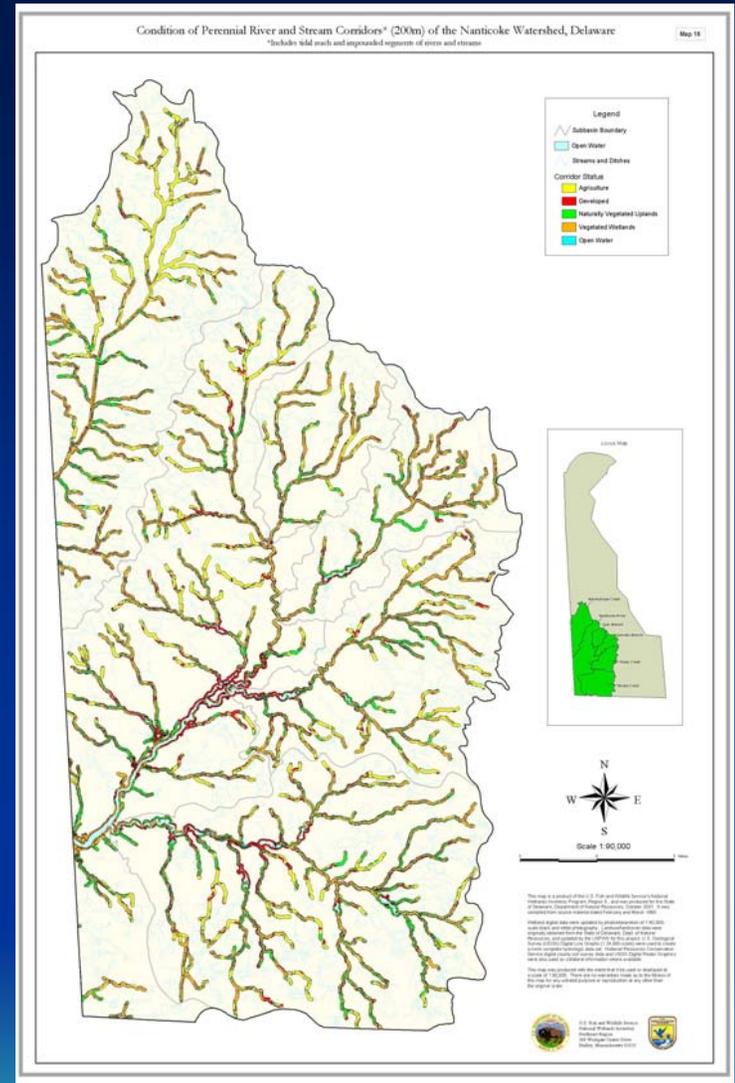
River-Stream Corridor Integrity Index

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



River-Stream Corridor Integrity

0.59



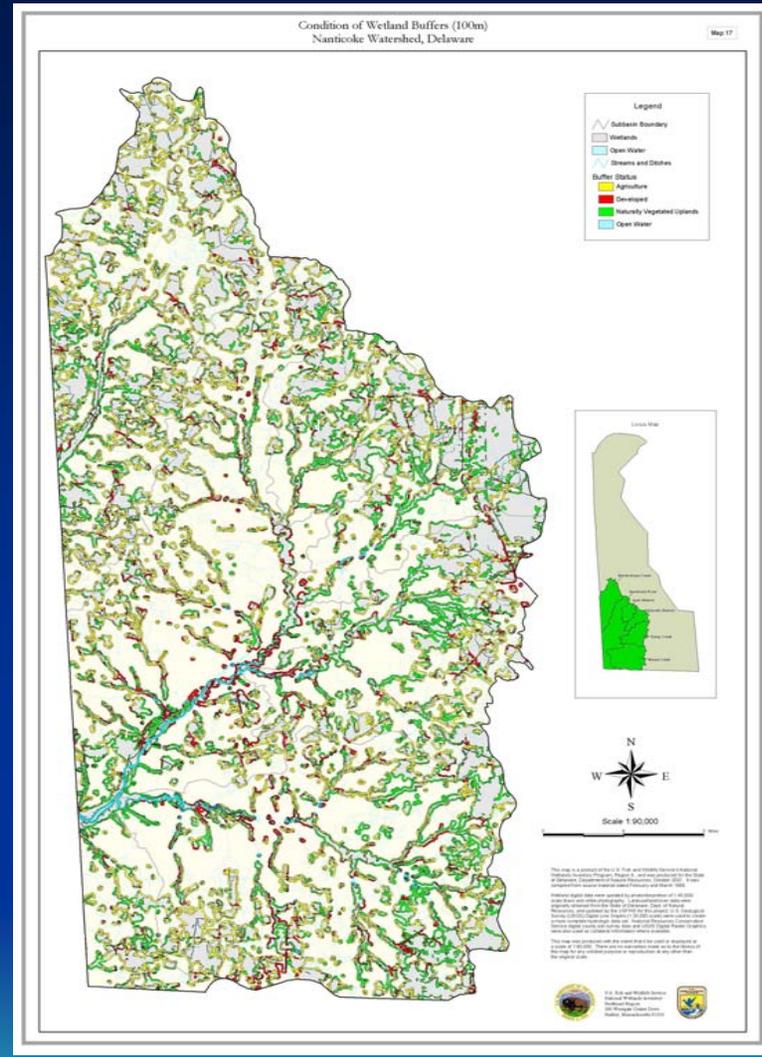
Vegetated Wetland Buffer Index

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



Wetland Buffer

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+



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):
 $22,076 \text{ ha} / 31,308 \text{ ha} = 0.71$



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

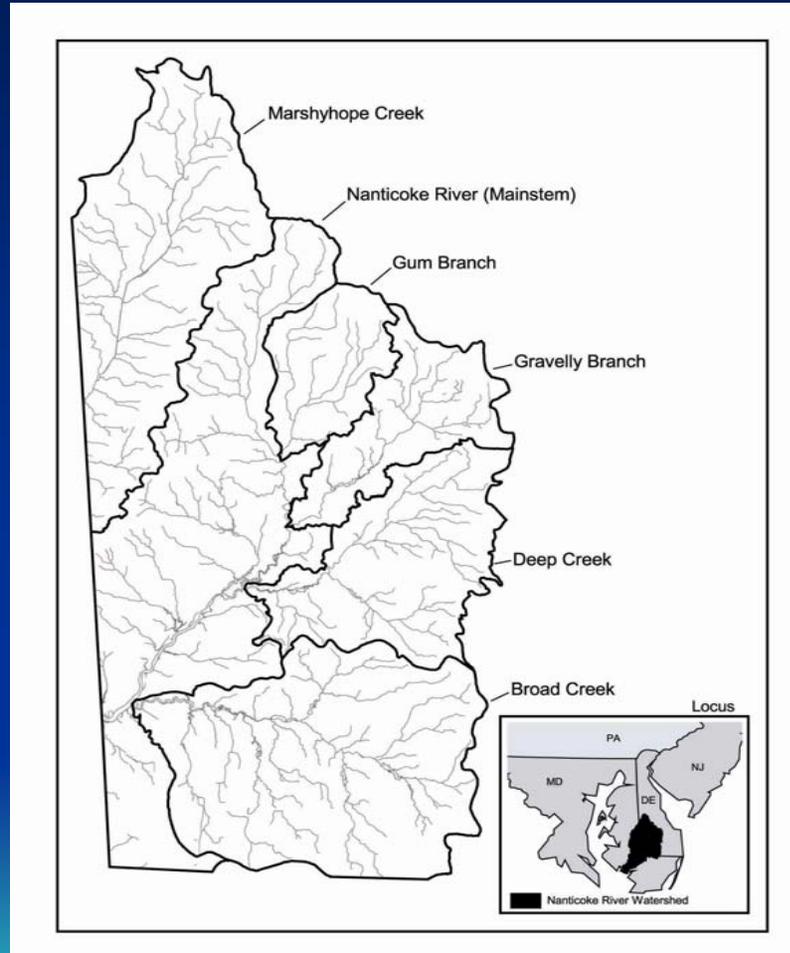
- Weighted Habitat Extent Indices –
Weighted Habitat Disturbance Indices

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

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



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



For Additional Information

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