Landscape-level Wetland Functional Assessment

- Using maps, digital geospatial data, and remotely sensed data
- Develop inventory of wetlands
  - With attributes needed to relate to wetland functions
- Use GIS technology and manual review to produce preliminary assessment of wetland functions for a large geographic area (e.g., watershed, county, province, state, etc.)
Data Needs for Landscape-level Wetland Functional Assessment

- Wetlands Inventory
- Plant community (general types)
- Hydrology
- Streams and other waterbodies
- Relationship between wetlands and waters
U.S. Data

- Start with National Wetlands Inventory (U.S. Fish and Wildlife Service)
- Add other attributes to address properties not in the database that can be readily extracted from maps, aerial imagery, or geospatial databases
- Can also do in other countries where fairly comprehensive wetland inventories have been or are conducted
Inventory Data Considerations and Limitations

- Completeness
  - Wetlands
  - Waterbodies (e.g., streams)

- Currentness
  - May need to update data

- Accuracy of Classifications

- Recognize Limitations
  - Not all wetlands and streams
  - Possible classification issues (esp. hydrology)
Wetland Geospatial Data

- National Wetlands Inventory Data
Wetland Classification

- Cowardin et al. 1979
- Ecological System/Subsystem
  - M, E, P, R, and L
- Class
  - AB, EM, SS, FO, US, UB
- Water Regime
- Special Modifiers
Common Types

- **Marine Intertidal**
  - Unconsolidated Shore, Rocky Shore

- **Estuarine Intertidal**
  - Emergent Wetland, Scrub-Shrub Wetland, Unconsolidated Shore

- **Palustrine**
  - Unconsolidated Bottom, Aquatic Bed, Emergent Wetland, Scrub-Shrub, Forested Wetland

- **Lacustrine**
  - Unconsolidated Bottom or Shore, Aquatic Bed

- **Riverine**
  - Unconsolidated Shore, Aquatic Bed
Nation’s Wetlands

- **Conterminous US**
  - 95% are freshwater types
    - 50% = forested
  - 5% are saline tidal types
    - 67% = estuarine emergent

```
Emergent     Scrub-Shrub  Forested  Uncon. Bottom
21.5         11.8        66.7     6.4
```

```
Emergent     Scrub-Shrub  Nonvegetated
6.4          17.8        80.2
```
Need more information for landscape-level functional assessment

- Especially for freshwater types
- Some important questions:
  - Association with a waterbody ("landscape position")
  - Is wetland a depression, flat, slope, floodplain, or island ("landform")
  - Connection to other wetlands and waters ("water flow path")
  - Headwater location
- For tidal wetlands
  - How many have restricted tidal flow?
LLWW Descriptors

- Add to NWI digital database
  - Landscape position
  - Landform
  - Water flow path
  - Waterbody type
- Then use all attributes to help predict wetland functions for the geographic area of interest
Dichotomous Keys and Mapping Codes

- Detailed Keys and Mapping Codes
  - Landscape Position
    - MA, ES, LS, LR, LE, TE
  - Landform
    - BA, FL, FP, IL, SL, FR
  - Water Flow Path
    - BT, BI, OU, TH, IN, IS, etc.
  - Waterbody Type
  - Other descriptors
    - hw, dd, ed, tr, td, etc.

- Simplified Keys
Enhancing NWI Data

- Adding LLWW descriptors to NWI databases
- Automation/Manual Review (VTech)
- This plus existing NWI data = NWI+ database
NWI+ Database

- Increases functionality of NWI database for:
  - Improved characterization of wetlands
    - Associations with waterbodies via the landscape position descriptor
    - Separates depressional wetlands from flat, floodplain, fringe, island and slope wetlands via the landform descriptor
    - Connectivity to other wetlands via the water flow path descriptor
    - Adds more specific waterbody types – e.g., farmed ponds, vernal pools, playas, Carolina bays, etc.
  - Use expanded database to predict wetland functions

- **Not a standard NWI product** –
  - User-funded or
  - May be part of NWI updates depending on available funding and regional priorities
# Watershed Reports

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Results  
Maps  
Acreage Summaries  
NWI Types  
LLWW Types  
Preliminary Functional Assessment  
Acknowledgments  
References
Data for Improved Wetland Characterization

**Traditional NWI Data**
- Acres of wetland types by
  - System (Marine, Estuarine, Riverine, Palustrine, Lacustrine)
  - Class (Emergent, Scrub-Shrub, Forested, Unconsol. Shore, Aquatic Bed)
  - Water Regime (e.g., Seasonally flooded, Temporarily flooded, Saturated, Regularly flooded, Irregularly flooded)
  - Other modifiers (e.g., water chemistry, farmed, beaver, diked, partly drained)

**Expanded Data – More Descriptive**
- Acres of wetlands by:
  - Landscape Position (Marine, Estuarine, Lentic, Lotic River, Lotic Stream, Terrene)
  - Landform (Fringe, Island, Floodplain, Basin, Flat, Slope)
  - Water Flow Path (e.g., Inflow, Outflow, Throughflow, Isolated, Bidirectional-nontidal, Bidirectional-tidal)
  - Other descriptors (e.g., headwater, estuarine-discharge, tidally restricted, drainage-divide, pond-associated)
- Different pond types
# NWI vs. LLWW Acreages

Table 4. Wetlands classified by NWI type for the Upper Wappinger Creek watershed.

<table>
<thead>
<tr>
<th>System</th>
<th>Class, Subclass</th>
<th>Acreage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lacustrine (L2)</td>
<td>Aquatic Bed (AB)</td>
<td>21.33</td>
</tr>
<tr>
<td></td>
<td>Emergent (EM)</td>
<td>70.08</td>
</tr>
<tr>
<td></td>
<td>(Subtotal Lacustrine)</td>
<td>91.41</td>
</tr>
<tr>
<td></td>
<td>Aquatic Bed (AB)</td>
<td>6.30</td>
</tr>
<tr>
<td></td>
<td>(Subtotal)</td>
<td>6.30</td>
</tr>
<tr>
<td>Palustrine (P)</td>
<td>Emergent (EM)</td>
<td>621.67</td>
</tr>
<tr>
<td></td>
<td>Emergent (EM) / Forested (FO)</td>
<td>3.23</td>
</tr>
<tr>
<td></td>
<td>Emergent (EM) / Scrub-Shrub (SS)</td>
<td>123.05</td>
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<tr>
<td></td>
<td>(Subtotal)</td>
<td>747.94</td>
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<tr>
<td></td>
<td>Forested, Broad-leaved Deciduous (FO1)</td>
<td>2357.49</td>
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<tr>
<td></td>
<td>Forested, Needle-leaved Evergreen (FO4)</td>
<td>7.10</td>
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<td></td>
<td>Forested, Dead (FO5)</td>
<td>29.84</td>
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<td></td>
<td>(Subtotal)</td>
<td>2394.44</td>
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<tr>
<td></td>
<td>Scrub-Shrub, Broad-leaved Deciduous (SS1)</td>
<td>742.46</td>
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<tr>
<td></td>
<td>Scrub-Shrub, Needle-leaved Evergreen (SS4)</td>
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<td></td>
<td>(Subtotal)</td>
<td>742.99</td>
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<td></td>
<td>Unconsolidated Bottom (UB)</td>
<td>695.97</td>
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<tr>
<td></td>
<td>(Subtotal)</td>
<td>695.97</td>
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<tr>
<td>Riverine (R)</td>
<td>(Subtotal Palustrine)</td>
<td>4587.65</td>
</tr>
<tr>
<td></td>
<td>Unconsolidated Shore (US)</td>
<td>1.47</td>
</tr>
<tr>
<td></td>
<td>(subtotal Riverine)</td>
<td>1.47</td>
</tr>
<tr>
<td></td>
<td>GRAND TOTAL</td>
<td>4680.53</td>
</tr>
</tbody>
</table>

Table 5. Wetlands classified by LLWW type for the Upper Wappinger Creek watershed.

<table>
<thead>
<tr>
<th>Landscape Position</th>
<th>Landform</th>
<th>Water Flow Path</th>
<th>Acreage</th>
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<tbody>
<tr>
<td>Lentic (LE)</td>
<td>Basin (BA)</td>
<td>Bidirectional (BI)</td>
<td>116.51</td>
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<tr>
<td></td>
<td></td>
<td>Throughflow (TH)</td>
<td>165.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Subtotal)</td>
<td>281.51</td>
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<tr>
<td>Flat (FL)</td>
<td></td>
<td>Bidirectional (BI)</td>
<td>2.74</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Subtotal)</td>
<td>2.74</td>
</tr>
<tr>
<td>Fringe (FR)</td>
<td></td>
<td>Bidirectional (BI)</td>
<td>116.70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Subtotal)</td>
<td>116.70</td>
</tr>
<tr>
<td>Island (IL)</td>
<td></td>
<td>Bidirectional (BI)</td>
<td>2.20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Subtotal)</td>
<td>2.20</td>
</tr>
<tr>
<td>(Subtotal Lentic)</td>
<td></td>
<td></td>
<td>403.14</td>
</tr>
<tr>
<td>Lotic Stream (LS)</td>
<td>Basin (BA)</td>
<td>Throughflow (TH)</td>
<td>1874.25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Throughflow- Intermittent (TI)</td>
<td>10.61</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(subtotal)</td>
<td>1884.86</td>
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<td>Flat (FL)</td>
<td></td>
<td>Throughflow (TH)</td>
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<td></td>
<td></td>
<td>(subtotal)</td>
<td>92.20</td>
</tr>
<tr>
<td>Fringe (FR)</td>
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<td>Throughflow (TH)</td>
<td>97.72</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(subtotal)</td>
<td>97.72</td>
</tr>
<tr>
<td>(Subtotal Lotic Stream)</td>
<td>Basin (BA)</td>
<td></td>
<td>2074.79</td>
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<tr>
<td>Terrene (TE)</td>
<td>Inflow (IN)</td>
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<td>1.08</td>
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<td></td>
<td>Isolated (IS)</td>
<td></td>
<td>671.78</td>
</tr>
<tr>
<td></td>
<td>Outflow (OU)</td>
<td></td>
<td>603.77</td>
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<tr>
<td></td>
<td>Outflow Intermittent (OI)</td>
<td>12.73</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Throughflow (TH)</td>
<td></td>
<td>17.26</td>
</tr>
<tr>
<td></td>
<td>(subtotal)</td>
<td></td>
<td>1306.63</td>
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<td>Flat (FL)</td>
<td>Isolated (IS)</td>
<td></td>
<td>29.43</td>
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<tr>
<td></td>
<td>Outflow Intermittent (OI)</td>
<td>4.96</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Outflow (OU)</td>
<td></td>
<td>15.21</td>
</tr>
<tr>
<td></td>
<td>Inflow (IN)</td>
<td></td>
<td>0.85</td>
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<td></td>
<td>(subtotal)</td>
<td></td>
<td>59.45</td>
</tr>
<tr>
<td>Fringe (FR)</td>
<td>Outflow (OU)</td>
<td></td>
<td>7.55</td>
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<tr>
<td></td>
<td>(subtotal)</td>
<td></td>
<td>7.55</td>
</tr>
<tr>
<td>Slope (SL)</td>
<td>Isolated (IS)</td>
<td></td>
<td>59.56</td>
</tr>
<tr>
<td></td>
<td>Outflow (OU)</td>
<td></td>
<td>78.00</td>
</tr>
<tr>
<td></td>
<td>(subtotal)</td>
<td></td>
<td>137.56</td>
</tr>
<tr>
<td>(Subtotal Terrene)</td>
<td></td>
<td></td>
<td>1502.19</td>
</tr>
<tr>
<td>GRAND TOTAL</td>
<td></td>
<td></td>
<td>3980.12</td>
</tr>
</tbody>
</table>
Examples of Maps

NWI Types

Landscape Position

---

Wetlands of the Upper Wappinger Creek Watershed, Dutchess County, New York
Classified by NWI Types

---

LEGEND

NWI Types
- Palustrine Aquatic Bed Wetland
- Palustrine Emergent Wetland
- Palustrine Scrub-Shrub Wetland
- Palustrine Evergreen Forested Wetland
- Palustrine Deciduous Forested Wetland
- Palustrine Forested (Dead) Wetland
- Palustrine Water (Pond)
- Lacustrine and Riverine Wetland
- Water

Other Features
- Streams
- Watershed Boundary

---

Wetlands of the Upper Wappinger Creek Watershed, Dutchess County, New York
Classified by Landscape Position

---

LEGEND

Landscape Position
- Terrestrial Wetlands
- Lotic Wetlands
- Lentic Wetlands

Other Features
- Streams
- Open Water (including ponds, lakes, rivers)
- Watershed Boundary
Use NWI+ Database to Predict Wetland Functions

- Identify key variables related to wetland functions
- Have done for 11 functions:
  - Surface water detention
  - Coastal storm surge detention
  - Streamflow maintenance
  - Nutrient cycling
  - Carbon sequestration
  - Bank and shoreline stabilization
  - Sediment/particulate retention
  - Provision of habitat for:
    - Fish/aquatic invertebrates
    - Waterfowl/waterbirds
    - Other wildlife
    - Unique, uncommon, or highly diverse plant communities
Relationships between Characteristics and Functions

- 2003 Report
  - Focus on Northeastern U.S.
  - General literature review
  - Peer review

- Regional Reports
  - Start with 2003 Report
  - Modify for new Region
    - Workshop
      - GA
      - WI
### Table – Function: Characteristics

**EXAMPLE: Bank and Shoreline Stabilization**

<table>
<thead>
<tr>
<th>Level</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High</strong></td>
<td>E2__(AB, EM, SS, FO and mixes; not IL), E2RS (not ESIL), E2US_P, M2RS(not MAIL), M2AB1N (not IL), LR_(AB, EM, SS, FO and mixes; not LRIL and not “fm”), LS_(AB, EM, SS, FO and mixes and not “fm”), LE__(AB, EM, SS, FO and mixes; not LEIL and not “fm”), R_RS, L2RS</td>
</tr>
<tr>
<td><strong>Moderate</strong></td>
<td>E2US_N or M (not IL), M2US (not IL), TE__pd (AB, EM, SS, FO and mixes), TE__OUhw (AB, EM, SS, FO and mixes), E2RF (when occur along a shoreline), M2RF (when occur along a shoreline)</td>
</tr>
</tbody>
</table>
### Table 6: Preliminary wetland functional assessment findings for the watershed.

<table>
<thead>
<tr>
<th>Function/Significance Level</th>
<th>Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Water Detention</td>
<td></td>
</tr>
<tr>
<td>High (H)</td>
<td>2624.12</td>
</tr>
<tr>
<td>Moderate (M)</td>
<td>1873.37</td>
</tr>
<tr>
<td>(Total SWD)</td>
<td>4497.49</td>
</tr>
<tr>
<td>Streamflow Maintenance</td>
<td></td>
</tr>
<tr>
<td>High (H)</td>
<td>2364.74</td>
</tr>
<tr>
<td>Moderate (M)</td>
<td>1077.23</td>
</tr>
<tr>
<td>(Total SM)</td>
<td>3441.97</td>
</tr>
<tr>
<td>Nutrient Transformation</td>
<td></td>
</tr>
<tr>
<td>High (H)</td>
<td>3781.28</td>
</tr>
<tr>
<td>Moderate (M)</td>
<td>110.4</td>
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<tr>
<td>(Total NT)</td>
<td>3891.68</td>
</tr>
<tr>
<td>Sediment and Other Particulate Retention</td>
<td></td>
</tr>
<tr>
<td>High (H)</td>
<td>2624.12</td>
</tr>
<tr>
<td>Moderate (M)</td>
<td>1872.3</td>
</tr>
<tr>
<td>(Total SR)</td>
<td>4496.42</td>
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<tr>
<td>Shoreline Stabilization</td>
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</tr>
<tr>
<td>High (H)</td>
<td>2464.2</td>
</tr>
<tr>
<td>Moderate (M)</td>
<td>731.95</td>
</tr>
<tr>
<td>(Total SS)</td>
<td>3196.15</td>
</tr>
<tr>
<td>Fish and Shellfish Habitat</td>
<td></td>
</tr>
<tr>
<td>High (H)</td>
<td>172.97</td>
</tr>
<tr>
<td>Moderate (M)</td>
<td>1034.05</td>
</tr>
<tr>
<td>(Total FISH)</td>
<td>1207.02</td>
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<tr>
<td>Shade</td>
<td></td>
</tr>
<tr>
<td>Stream Shading (SS)</td>
<td>1607.47</td>
</tr>
<tr>
<td>(Total SHADE)</td>
<td>1607.47</td>
</tr>
<tr>
<td>Waterfowl and Waterbird Habitat</td>
<td></td>
</tr>
<tr>
<td>High (H)</td>
<td>616.59</td>
</tr>
<tr>
<td>Moderate (M)</td>
<td>671.03</td>
</tr>
<tr>
<td>Wood Duck (D)</td>
<td>1544.71</td>
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<tr>
<td>(Total PBRD)</td>
<td>2832.33</td>
</tr>
<tr>
<td>Other Wildlife Habitat</td>
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</tr>
<tr>
<td>High (H)</td>
<td>1880.12</td>
</tr>
<tr>
<td>Moderate (M)</td>
<td>2121.02</td>
</tr>
<tr>
<td>(Total PWILD)</td>
<td>4001.14</td>
</tr>
</tbody>
</table>
Maps Highlighting Wetland Functions

POTENTIAL WETLANDS OF SIGNIFICANCE FOR STREAMFLOW MAINTENANCE
Upper Wappinger Creek Watershed, Dutchess County, New York

LEGEND
Streamflow Maintenance
- High Potential
- Moderate Potential

Other Features
- Other Wetlands and Open Water
- Watershed Boundary
- Streams

POTENTIAL WETLANDS OF SIGNIFICANCE FOR WATERFOWL AND WATERBIRD HABITAT
Upper Wappinger Creek Watershed, Dutchess County, New York

LEGEND
Waterfowl and Waterbird Habitat
- High Potential
- Moderate Potential
- Wood Duck

Other Features
- Other Wetlands and Open Water
- Watershed Boundary
- Streams
NWI+ Databases for US – Special Projects

Northeast Region (over 500 quads or 30,000 sq. miles) to date:

- Maine
  - Casco Bay watershed (state funded)

- Massachusetts
  - Cape Cod and the Islands
  - Boston Harbor Islands (NPS funded)

- Connecticut
  - Entire state (state funded)

- New York
  - 12 small watersheds (state funded)
  - New York City water supply watersheds (city funded)
  - Long Island

- Pennsylvania
  - Coastal Zone (state funded)

- New Jersey
  - Hackensack River watershed (field office funded)

- Delaware
  - Entire state (1/2 state funded)

- Maryland
  - Nanticoke watershed, MD/DE (state funded)
  - Coastal Bays watershed (state funded)

Other Regions

- Ventura watershed, CA
- Shirley Basin, WY
- Corpus Christi region, TX
- Horry and Jasper Counties, SC
- Coastal Mississippi
- Anchorage area, AK
Functional Assessment in Progress

- **Northeast**
  - New Jersey (entire state)
  - Rhode Island (entire state)
  - Connecticut (entire state)
  - Massachusetts (entire state)

- **Southeast**
  - Horry/Jasper Counties, SC
  - Mississippi Coast

- **Elsewhere**
  - Shirley Basin, WY
  - Fond du Lac reservation, MN
  - Corpus Christi region, TX
  - Anchorage, AK

- **Planned for 2013**
  - Pennsylvania’s Lake Erie watershed (state funded)
  - Chesapeake Bay tidewater MD
  - James River mainstem, VA
  - New York’s Lake Ontario watershed (portion)

- **Post data on website**
  - Wetlands One-Stop (Virginia Tech)
    - Geospatial data
    - Maps/reports
    - Links to other wetland geospatial data and gov’t websites
    - www.cmiweb.org/WetlandsOneStop/Default.aspx
NWI+ by State Agencies

- Delaware – entire state (jointly w/FWS)
- Georgia – coastal counties
- Michigan – selected watersheds
- Minnesota – entire state
- Wisconsin – selected watersheds
- New Mexico – pilot area
- Montana – selected watersheds
Uses of Findings

- **Better characterization of wetlands**
  - Link wetlands to waterbodies
    - How much of the wetland resource is isolated
    - More information on ponds and lakes

- **Preliminary landscape-level assessment for conservation planning**
  - Recommended for use in watershed planning
    - Center for Watershed Protection’s wetlands-at-risk protection tool
  - Prioritization of sites for acquisition/easement
  - Likely functions of potential wetland restoration sites
    - Match improved functions with watershed deficits

- **View wetlands of interest and their functions in landscape context**

- **Inform landowners and general public on the significance of wetlands for performing various functions**
Questions

ralph_tiner@fws.gov