Wetland Ecosystem Services Protocol (WESP)

-- A Short Course

Toppenish, WA
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in collaboration with:
TWIG
Confederated Tribes of the Umatilla Indian Reservation – Scott O’Daniel
US Environmental Protection Agency
Tuesday
8:30  Introductions. Course logistics.
     Brief history of wetland functions assessment
     Definitions: wetland functions, values, and “health” (condition)
     How WESP works
10:30 BREAK
     Delimiting the assessment unit
     Interpreting the field data form questions
12:00 LUNCH on your own
1:15  Fill out Office Form (OF) for first wetland
2:00  Visit first wetland and apply WESP
4:30  end

Wednesday
8:30  Review scores from first wetland
     Lecture: Principles of Hydrologic Functioning & Value
     Lecture: Principles of Water Quality Functioning & Value
10:30 BREAK
     Lecture: Habitat Support – Models for Functions & Values
12:00 LUNCH on your own
1:15  Fill out Office Form (OF) for second wetland
2:00  Visit second wetland and apply WESP
     Discuss results and potential applications
4:30  end
Quick Review of Definitions

Wetland *Determination*

Wetland *Delineation*

Wetland *Classification*

Wetland *Categorization*

Wetland *Assessment*
Wetlands aren’t always wet!

1. Surface Water  + Vegetation → YES
2. If No Surface Water, then:
   soil indicators + plant indicators
   (cannot determine only from aerials)

Which of these are wetlands?
Wetland Soil Indicators
What Is WESP?

A spreadsheet that gives you scores (0-10) for 15 things that a wetland can do (functions) and their likely benefits (values) at the particular location.
• to assess relative importance of a particular wetland.

Data forms that contain questions you must answer for the spreadsheet to operate. Answers based on:
• Information & measurements from a web site & Google Earth.
• Field observations during a visit lasting <3 hours.

Manual (being revised)
How WESP Can Help

1. Where to recommend wetland AVOIDANCE.

2. How much mitigation.

3. For conservation, identifying the most important wetlands.

4. Communicating “practical values” of a wetland to the public.

5. Evaluating whether created/restored wetlands are succeeding in replacing wetland functions.
Different Wetlands are Important for Different Things
Different Wetlands are Important for Different Things
Different Wetlands are Important for Different Things
**WESP:** A spreadsheet with a suite of models for assessing 14 wetland ecosystem services at a *site* scale.

<table>
<thead>
<tr>
<th>Specific Wetland Functions:</th>
<th>Function Score</th>
<th>Benefits Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Storage</td>
<td>7.89</td>
<td>4.21</td>
</tr>
<tr>
<td>Stream Flow Support</td>
<td>3.15</td>
<td>1.29</td>
</tr>
<tr>
<td>Streamwater Cooling</td>
<td>2.14</td>
<td>6.23</td>
</tr>
<tr>
<td>Sediment Retention &amp; Stabilization</td>
<td>6.62</td>
<td>6.95</td>
</tr>
<tr>
<td>Phosphorus Retention</td>
<td>5.73</td>
<td>6.49</td>
</tr>
<tr>
<td>Nitrate Removal</td>
<td>8.21</td>
<td>3.20</td>
</tr>
<tr>
<td>Carbon Sequestration</td>
<td>4.30</td>
<td></td>
</tr>
<tr>
<td>Organic Nutrient Export</td>
<td>8.29</td>
<td></td>
</tr>
<tr>
<td>Aquatic Invertebrate Habitat</td>
<td>9.44</td>
<td>3.69</td>
</tr>
<tr>
<td>Fish Habitat</td>
<td>5.26</td>
<td>7.81</td>
</tr>
<tr>
<td>Amphibian Habitat</td>
<td>6.67</td>
<td>3.15</td>
</tr>
<tr>
<td>Waterbird Habitat</td>
<td>4.20</td>
<td>1.20</td>
</tr>
<tr>
<td>Songbird, Raptor, &amp; Mammal Habitat</td>
<td>8.77</td>
<td>6.14</td>
</tr>
<tr>
<td>Pollinator Habitat</td>
<td>5.54</td>
<td>5.16</td>
</tr>
<tr>
<td>Native Plant Habitat</td>
<td>6.42</td>
<td>8.19</td>
</tr>
<tr>
<td>Public Use &amp; Recognition</td>
<td></td>
<td>6.67</td>
</tr>
</tbody>
</table>
Where Did WESP Come From?

- **United States**
  - Oregon
  - Alaska south
  - Alberta (3 regions)

- **1983, 1987**
- **2009-present**
- **2011-present**
- **2012-present**

**ALSO:**
**Atlantic Canada** (Newfoundland, Nova Scotia, New Brunswick, Prince Edward Island)
Why *standardize* functional assessment?

Few people can predict all wetland functions.
- Few can instantly recall all indicators of functions.
- Different people mentally assign different weights to indicators.

Reduces arbitrariness $\Rightarrow$ increased public confidence.

“Paper trail” -- legal reasons.
What Makes a Method VALID?

- Repeatability (Consistency)
- Sensitivity
- Accuracy
- Documentation
Condition Assessment Methods

Function Assessment Methods

Ecosystem Services Assessment Methods
## “Highest Functioning” vs. “Least Altered” Standards

### Invertebrate Habitat Support

<table>
<thead>
<tr>
<th>Location</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wilson Wildlife Area north pond</td>
<td>1.00</td>
</tr>
<tr>
<td>Willow Creek riverine</td>
<td>0.99</td>
</tr>
<tr>
<td>Willamette Park slough</td>
<td>0.98</td>
</tr>
<tr>
<td>Christensen Park slough</td>
<td>0.93</td>
</tr>
<tr>
<td>McDonald Forest ponds</td>
<td>0.91</td>
</tr>
<tr>
<td>Anderson Park alcove</td>
<td>0.90</td>
</tr>
<tr>
<td>Hileman Park alcove</td>
<td>0.90</td>
</tr>
<tr>
<td>Mt. View enhanced slough</td>
<td>0.89</td>
</tr>
<tr>
<td>Greenberry floodplain</td>
<td>0.88</td>
</tr>
<tr>
<td>Truax slough</td>
<td>0.86</td>
</tr>
<tr>
<td>Buford West slough</td>
<td>0.85</td>
</tr>
<tr>
<td>Snagboat Bend slough</td>
<td>0.85</td>
</tr>
<tr>
<td>Wilson Wildlife Area main pond</td>
<td>0.84</td>
</tr>
</tbody>
</table>
Steps for Using WESP

1. Go online and download current version of:
   Excel spreadsheet
   PDF files for data forms OF, F, and S
Print the PDF files, not Excel spreadsheet.

2. Read and thoroughly understand Manual.

3. Decide on AA boundary.

4. Fill out Office Form (OF) (~1 hour)

5. Visit wetland. Fill out 2 data forms -- FieldF and FieldS.
   Texture the soils. Look for water lines, weeds, veg patterns, etc.
   Interview landowner if possible.

5. Enter data in Excel spreadsheet.

6. Interpret results.
Delimiting the Assessment Areas:
Operating Principles for Delimiting Wetland Assessment Areas (AA’s)

Does adjoining open water cover <20 acres? Include it! Otherwise, break into separate AA’s and include the open water only if question asks.

Delimit separate AAs if *hydroperiod* (surface water duration, extent) differs greatly on opposing sides of a road or berm.

Delimit separate AAs if wetland is bisected by a *watershed divide* (opposing flow directions within the wetland).

Delimit separate AA for each wetland class (the WESPAK-SE ones) within a wetland, BUT ONLY IF:
- They comprise >20% of the wetland’s total vegetated area
- The AA would otherwise be impossible to assess (many miles across)

Delimit as a separate AA the 100-ft buffer adjoining both sides of an anadromous stream.

With rare exceptions, avoid dividing a wetland based ONLY on:
- Property lines
- Fences
- Zoning designations
- Vegetation or Cowardin (NWI mapped polygon) types
Delimiting the Assessment Area (AA)
Challenge faced by all “one-visit” assessment methods: Wetland Conditions can be *Dynamic*. 

Tidal Dynamics

© Doug Wechsler
Seasonal Dynamics
Saturated vs.
Seasonally Flooded Only vs.
Persistently Flooded
**Indicators of HIGH water** (= upper limit of Seasonally Inundated zone)

- Water marks on trees (moss); water-stained leaves; algae amid grass stems
- Drift lines of debris on ground or suspended in shrubs
- Scoured areas on the soil surface
- Fresh deposits of water-borne sediment
- Height of culvert or berm relative to current water level
- Aquatic plants without water beneath
- Airphoto sequence

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**Indicators of where LOW water persists**

(= lower limit of Seasonally Inundated zone) (= upper limit of Persistently Inundated zone)

- Minimal vegetation (all Obligates). No woody.
- Topography
- Airphoto sequence
Key Terms As Defined by WESP

Surface Water
Groundwater
Open Water
Ponded Water
Adjacent

Upland
Perennial Cover
Herbaceous (Herbs)
  Forbs
  Emergents
  Sedges

distance “uphill from”
“predominant” vs. “most”
## Interspersion of Emergents & Open Water

During most of the growing season, the spatial pattern of herbaceous vegetation that has **surface** water beneath it (emergent vegetation -- NOT floating-leaved plants) is mostly:

- **Scattered in small clumps, islands, or patches throughout the surface water area.**

- **Intermediate**

- **Clumped along the margin of the surface water area, or mostly surrounds a channel or central area of open water, or such vegetation covers <100 sq ft and <1% of the AA.**
In "ducks-eye view", the distribution pattern of woody vegetation (including low shrubs) VS. unshaded herbaceous/moss vegetation within the AA is:

<table>
<thead>
<tr>
<th>Interspersion of Herbaceous and Woody Cover</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>In &quot;ducks-eye view&quot;, the distribution pattern of woody vegetation (including low shrubs) VS. unshaded herbaceous/moss vegetation within the AA is:</td>
<td></td>
</tr>
<tr>
<td>(a) Woody cover and herbaceous/moss cover EACH comprise 30-70% of the vegetated part of the AA, <strong>AND</strong> (b) There are many patches of woody vegetation scattered widely within herbaceous/moss vegetation, or many patches of herbaceous vegetation scattered widely within woody vegetation.</td>
<td></td>
</tr>
<tr>
<td>(a) Woody cover and herbaceous/moss EACH comprise 30-70% of the vegetated AA, <strong>AND</strong> (b) There are <strong>few</strong> patches (&quot;islands&quot;) of woody vegetation scattered widely within herbaceous vegetation, or few patches of herbaceous/moss vegetation (&quot;gaps&quot;) scattered widely within woody vegetation.</td>
<td></td>
</tr>
<tr>
<td>(a) Woody cover <strong>OR</strong> herbaceous/moss comprise &gt;70% of the vegetated AA, <strong>AND</strong> (b) There are several patches of the other scattered within it. (e.g., forested AAs with patches -- not limited to corridors -- of skunk cabbage, or muskeg with scattered shrubs).</td>
<td></td>
</tr>
<tr>
<td>(a) Woody over <strong>OR</strong> herbaceous/moss comprise &gt;70% of the vegetated AA, <strong>AND</strong> (b) The other is absent or is mostly in a single area or distinct zone with almost no intermixing of woody and unshaded herbaceous/moss vegetation.</td>
<td></td>
</tr>
<tr>
<td>Total Woody Cover Extent</td>
<td>Within the entire vegetated part of the AA, the percentage occupied by <strong>woody plants taller than 3 feet</strong> (shrubs, trees) is:</td>
</tr>
<tr>
<td>-------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>&lt;5% of the vegetated AA, or there is no woody vegetation in the AA. <strong>SKIP to F39.</strong></td>
<td></td>
</tr>
<tr>
<td>5-25%</td>
<td></td>
</tr>
<tr>
<td>25-50%</td>
<td></td>
</tr>
<tr>
<td>50-75%</td>
<td></td>
</tr>
<tr>
<td>&gt;75%</td>
<td></td>
</tr>
<tr>
<td>Percentage of Bare or Semi-bare Ground</td>
<td>Consider the parts, if any, of the AA that lack surface water for any portion of the growing season. Viewed <strong>from directly above the ground layer</strong>, the predominant condition at that time is:</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Little or no (&lt;5%) <em>bare or semi-bare ground</em> is visible between erect stems or under canopy anywhere in the vegetated AA. Ground is extensively blanketed by dense thatch, moss, lichens, graminoids with great stem densities, or plants with ground-hugging foliage.</td>
<td></td>
</tr>
<tr>
<td>Bare or semi-bare ground is visible in places, but those areas comprise <strong>less than 5%</strong> of the unflooded parts of the AA.</td>
<td></td>
</tr>
<tr>
<td>Bare or semi-bare ground is visible in places, and those areas comprise <strong>more than 5%</strong> of the unflooded parts of the AA.</td>
<td></td>
</tr>
<tr>
<td><strong>Other conditions</strong></td>
<td></td>
</tr>
<tr>
<td>Not applicable. Parts that lack surface water are always &lt;5% of the AA and &lt;100 feet of the AA's perimeter. Nearly the entire AA remains constantly inundated.</td>
<td></td>
</tr>
<tr>
<td>Predominant Depth Class</td>
<td>During most of the time surface water is present, its <strong>depth</strong> in most of the inundated part of the AA is:</td>
</tr>
<tr>
<td>-------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>&gt;6 ft deep</td>
</tr>
<tr>
<td></td>
<td>2-6 ft deep</td>
</tr>
<tr>
<td></td>
<td>1-2 ft deep</td>
</tr>
<tr>
<td></td>
<td>0.5 - 1 ft deep</td>
</tr>
<tr>
<td></td>
<td>&lt;0.5 ft deep</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Depth Class Distribution</th>
<th>During most of the time when surface water is present (select one):</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>One depth class (use the classes in F12) comprises &gt;90% of the AA's inundated area</td>
</tr>
<tr>
<td></td>
<td>One depth class comprises &gt;50% of the AA's inundated area</td>
</tr>
<tr>
<td></td>
<td>Neither of above</td>
</tr>
</tbody>
</table>
### Slope from Disturbed Lands
The land slope in the area from the AA edge to the closest disturbance feature that comprises >10% of the upland edge is mostly: [If no disturbances are present within 100 ft, select the slope that predominates along most of the AA's upland edge and extending 100 ft uphill]

- <1% (flat -- almost no noticeable slope, or there is no upland boundary)
- 2-5%
- 5-30%
- >30%

### Flat Shoreline Percentage
The length of the AA's shoreline (along its ponded open water) that is bordered by areas that are nearly flat (a slope less than about 5%) is:

- <1% of the length
- 1-25% of the length
- 25-50% of the length
- 50-75% of the length
- >75% of the length
**Blind Channel Presence & Complexity**

The AA contains one or more branching internal (blind) channels. These are channels that do not connect to streams originating in the uplands, except where those streams themselves are tidal. Do not count channels that merely loop around and rejoin their source channel. If blind channels present, enter 1. If not, enter 0 and **SKIP to T28**.

**Internal Channel Network Complexity**

The largest number of visible channel junctions (forks where two channels join) belonging to any **single** blind channel network within the AA's wetland is:

- <3
- 3-6
- 7-14
- >14
Wildlife Access
Draw a circle of **radius of 0.5 mile** from the center of the AA. If mammals and amphibians can move from the center of the AA to all other separate wetlands located within the circle without being forced to cross maintained roads (any width), lawns, bare ground, marine waters, and/or steep (>30%) slopes, mark 1= yes can move, or no other wetlands within that distance, or 0= no.
Delimiting a Wetland’s Contributing Area
Basic Principles of Wetland Functioning
Groundwater & Wetlands

**Groundwater:** Subsurface water below the **water table**, which is the depth where soil becomes water saturated (i.e. all pore spaces are water filled).

**Wetland:** Areas of the surface soil layer that receive groundwater (i.e. the water table is near or at the surface; or land covered with shallow water) with great enough frequency to establish characteristic soils and plant communities.

courtesy Pennsylvania State University
Focus: Ground Water

(from: Smith et al. 1995)
## National HGM Classification (Brinson 1993)

<table>
<thead>
<tr>
<th>HGM Class</th>
<th>Water Sources That Define It</th>
<th>Usual NWI Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estuarine Fringe</td>
<td>ocean &gt; runoff &gt; groundwater</td>
<td>Estuarine &gt; Riverine &gt; Palustrine</td>
</tr>
<tr>
<td>Riverine</td>
<td>runoff &gt; groundwater &gt; precip</td>
<td>Riverine &gt; Palustrine</td>
</tr>
<tr>
<td>Slope</td>
<td>groundwater &gt; runoff</td>
<td>Palustrine &gt; Riverine</td>
</tr>
<tr>
<td>Flats</td>
<td>precip &gt; groundwater &gt; runoff</td>
<td>Palustrine</td>
</tr>
<tr>
<td>Depressional</td>
<td>runoff &gt; groundwater &gt; precip</td>
<td>Palustrine</td>
</tr>
<tr>
<td>Lacustrine Fringe</td>
<td>runoff &gt; precip &gt; groundwater</td>
<td>Lacustrine &gt; Palustrine</td>
</tr>
</tbody>
</table>
## Water Quality Functions and Values

<table>
<thead>
<tr>
<th>Functions</th>
<th>Values of the Functions (examples)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Cooling</td>
<td>salmonid summer habitat in lowlands</td>
</tr>
<tr>
<td>Water Warming</td>
<td>marine productivity (&amp; wintering fish habitat?)</td>
</tr>
<tr>
<td>Sediment Retention &amp; Stabilization</td>
<td>protect salmonid spawning areas; keep toxic metals from mobilizing ;</td>
</tr>
<tr>
<td>Phosphorus Retention</td>
<td>maintain preferred food webs?</td>
</tr>
<tr>
<td>Nitrate Removal</td>
<td>maintain preferred food webs? detoxification?</td>
</tr>
</tbody>
</table>
Phosphorus Retention function
Nitrogen Removal function -- wetlands VERY important
Habitat Functions of Wetlands

Functions of Habitat:

- Accessible and Timely Sheltering from Predators and the Elements (Corridors, Refugia, etc.)

- Accessible and Timely Provision of Food, Water, and Special Needs
<table>
<thead>
<tr>
<th>Aquatic Invertebrates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anadromous Fish</td>
</tr>
<tr>
<td>Resident &amp; Other Fish</td>
</tr>
<tr>
<td>Amphibians</td>
</tr>
<tr>
<td>Feeding Waterbirds</td>
</tr>
<tr>
<td>Nesting Waterbirds</td>
</tr>
<tr>
<td>Songbirds, Raptors &amp; Mammals</td>
</tr>
<tr>
<td>Pollinators</td>
</tr>
<tr>
<td>Native Plants</td>
</tr>
</tbody>
</table>
Steps for Regionalizing WESP

1. Which ecosystem services are of greatest regional interest? Which are not applicable to wetlands of this region?

2. Review regional literature → comprehensive bibliography, indexed to function

3. Modify existing indicators and condition choices, as needed. Modify models, as needed.

4. Trial runs with users → modify further for clarity

5. Establish reference conditions for the region’s wetlands: NOT calibrating to “least-altered”
   Use GIS to create attribute database for all mapped wetlands
   Cluster Analysis
   Select calibration sites (>1 per statistical cluster)
   Visit and assess
   Convert scores to categories (optional)

6. Modify the Manual, train the users.
Interpreting the Scores from a Regionalized WESP

• For each function, is its Function Effectiveness score higher, lower, or about the same as the median and range calculated from all other wetlands in the database? By how much?

• For each function, is its Value score higher, lower, or about the same as the median and range calculated from all other wetlands in the database?

• For the other attributes scored by WESP, is its score higher, lower, or about the same as the median and range calculated from all other wetlands in the database?

• Which functions and which values scored the highest relative to the median and range calculated from all other wetlands in their database, and which the lowest?

• *How many* functions scored higher than the median for other wetlands in the database? How many of those *also* had a value score (for that function) that was higher than the regional median?
Thank you!

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