Using Causal Models for Prioritizing Wetland Conservation and Restoration

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Institute for Natural Resources

Credit

This work is the follow-up of extensive work of a large group of people, particularly:

- Joe Bernert, INR GIS and Database Specialist
- John Bauer, GIS Analyst formerly with The Wetlands Conservancy (TWC), working with Esther Lev, TWC Director
- Joe Weber, GIS Project Manager, Virginia Natural Heritage Program working with Jason Bullock, VANHP Director
- Debbie Blackmore, MS Student working with Heejun Chang, Geography Department Chair at PSU
- The BRI team from SESYNC.

Many slides were freely borrowed from these people!

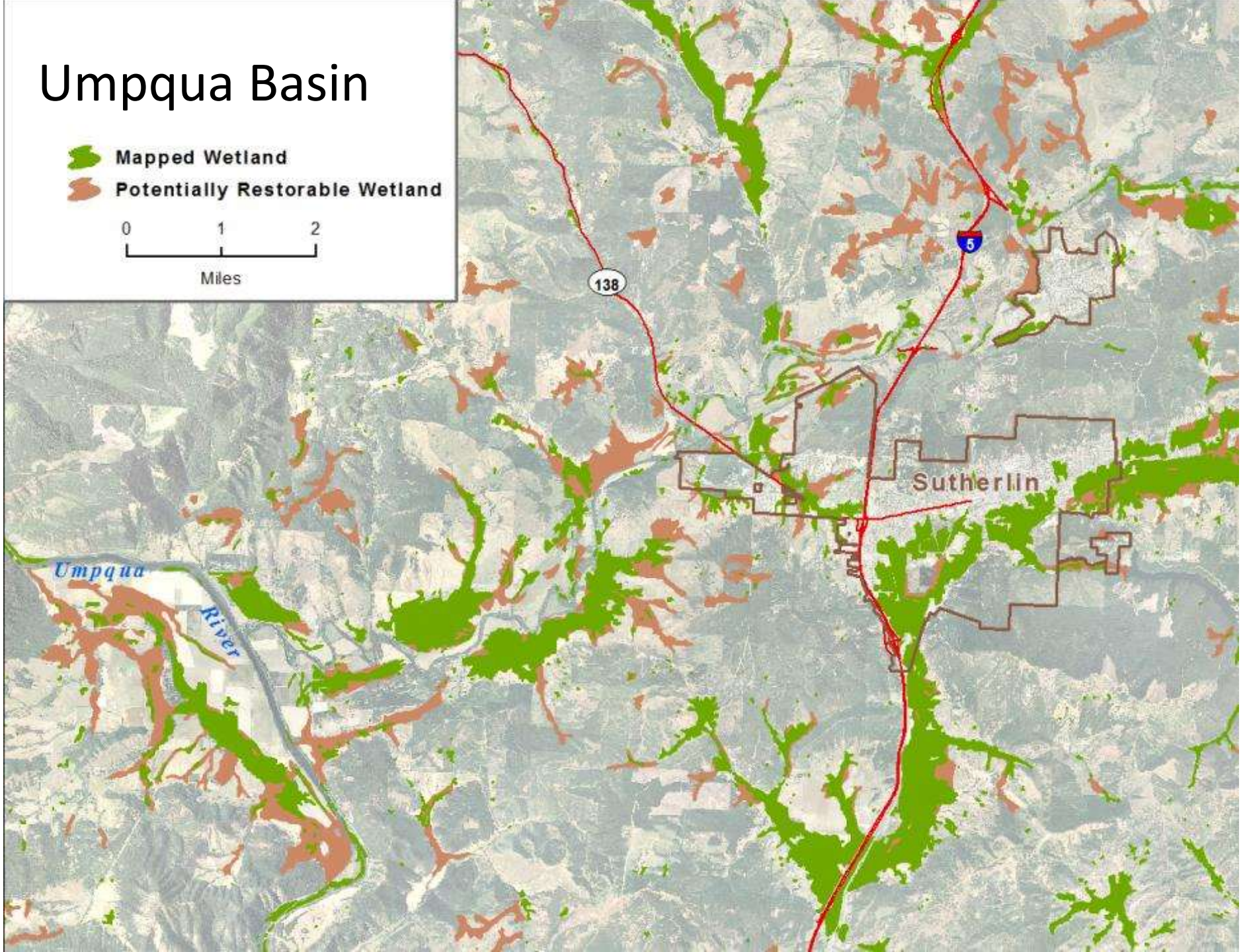
Assumptions

1. Wetlands matter because they provide many services to many people.
2. Wetlands have been and are being impacted and degraded, but laws exist to protect them.
3. Because of these laws, significant resources are available to protect and restore wetlands, but not enough, so priorities are needed.
4. It would be better if wetland regulatory programs or voluntary conservation programs had a method to attribute ALL mapped existing or potentially restorable wetlands in their jurisdiction to identify the services each wetland provides, and how important or valuable they are.
5. To identify how important or valuable services are, it is necessary to identify the beneficiaries, which is not part of functions analyses.

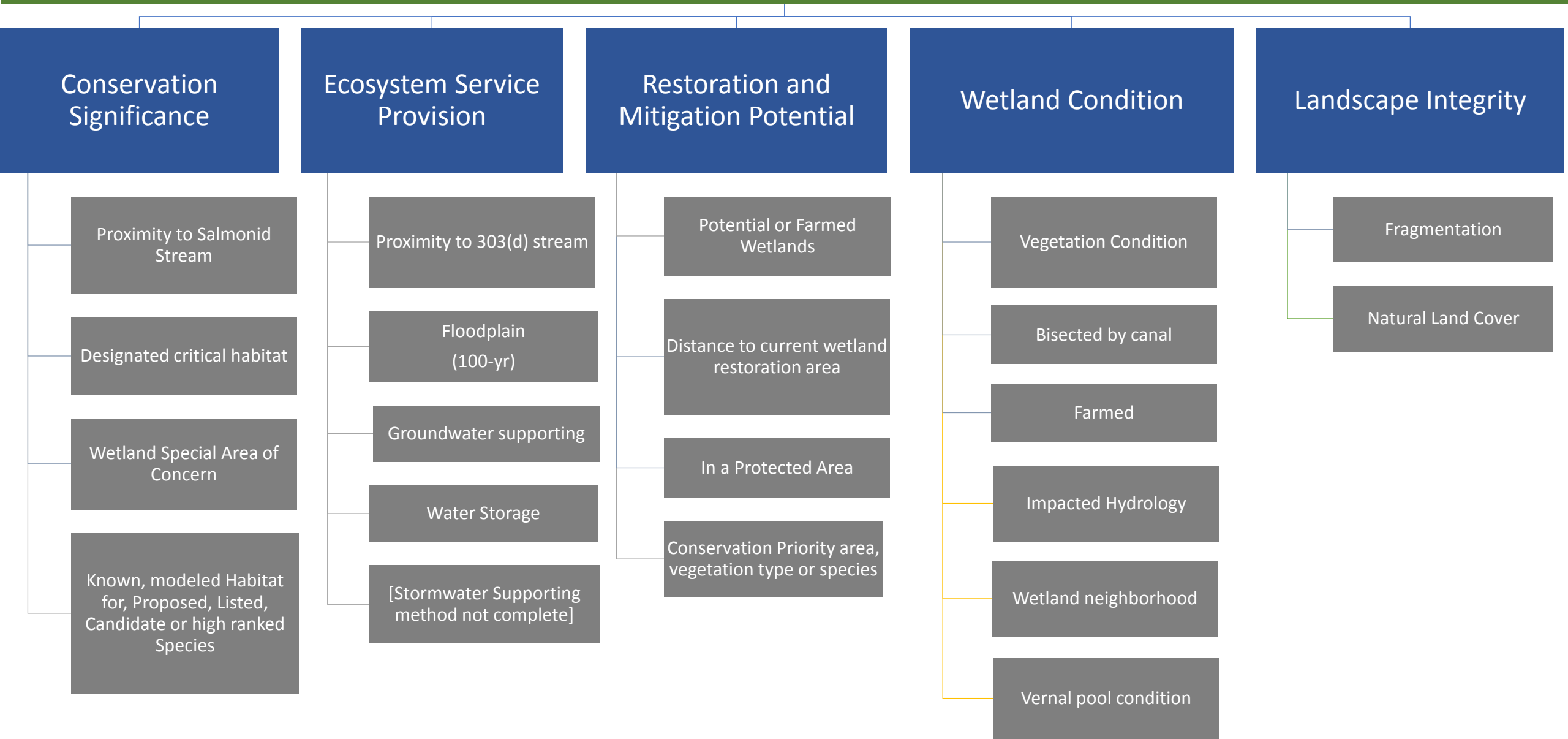
Project Goals

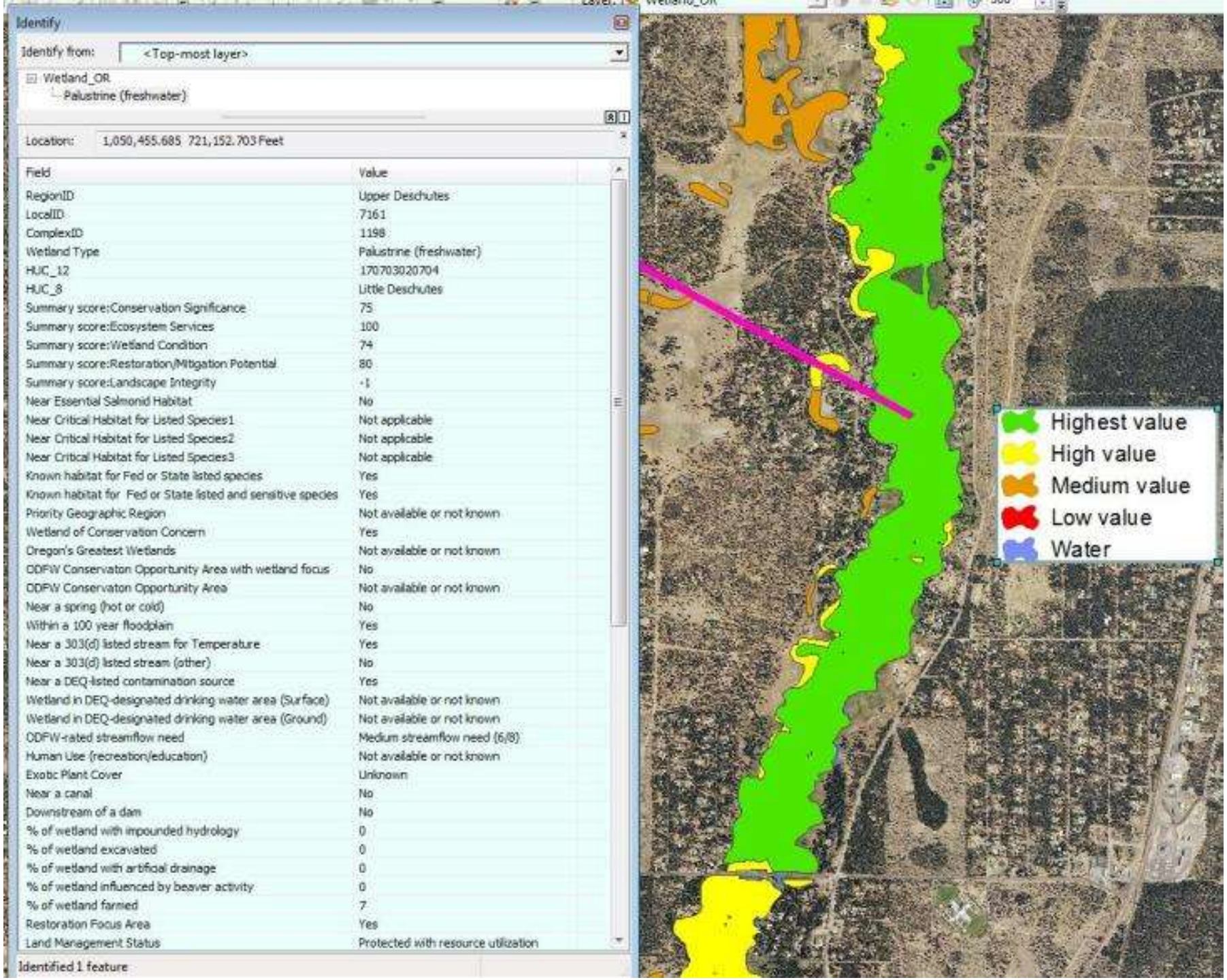
- Assist wetland managers and those interested in wetlands conservation to identify important wetlands by attributing ALL wetlands in a jurisdiction with information about ALL the important ecosystem services each wetland provides.

- Use Benefit Relevant Indicators and Causal Chains to identify important wetland attributes that can be modeled, and relative significance or values of the attributes.


Umpqua Basin
Mapped Wetland
Potentially Restorable Wetland
0
1
2
Miles
138
5
Sutherlin
Umpqua River

Previous Method Oregon Wetland Priorities pre - BRI



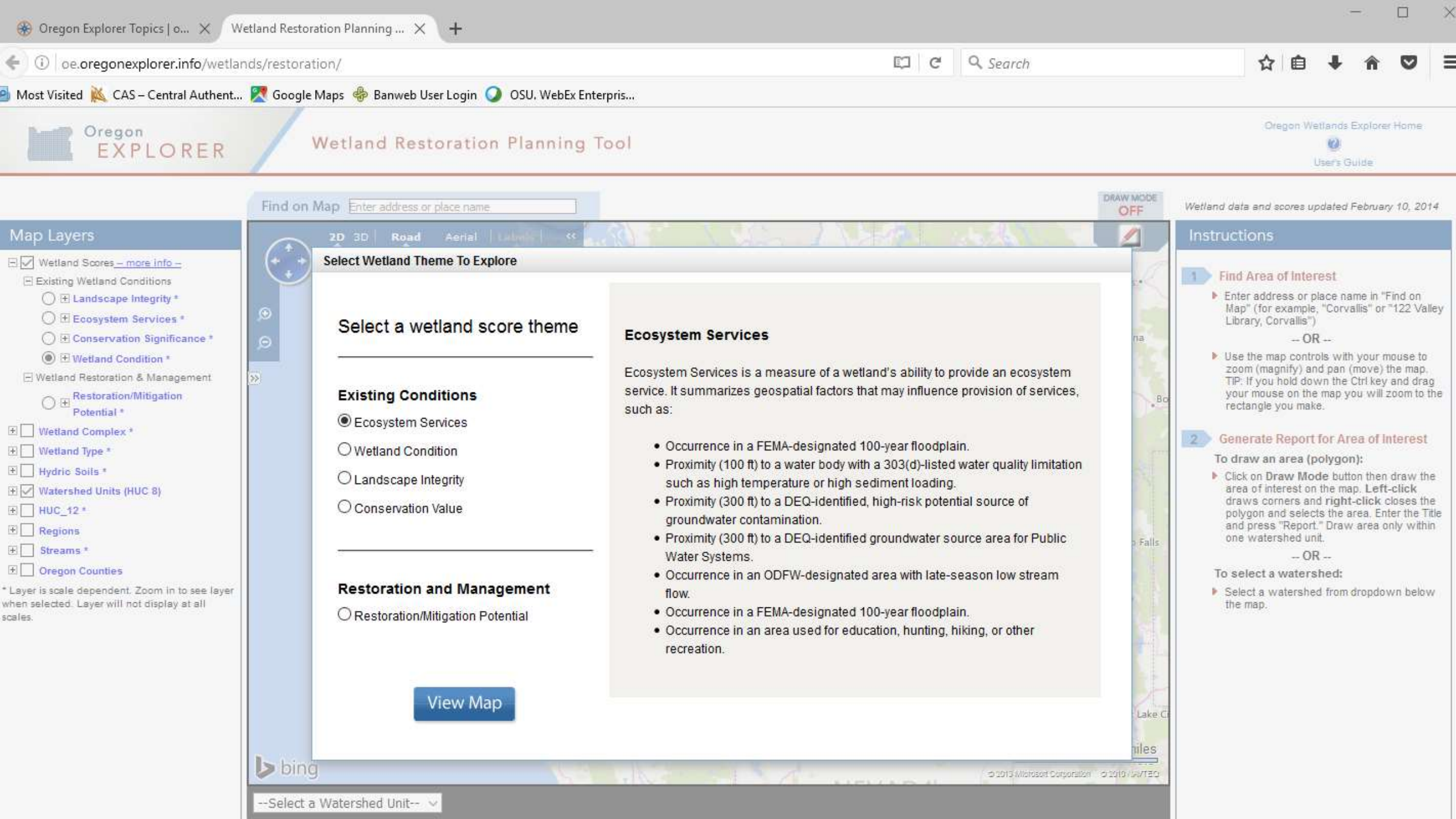


Each Wetlands is Attributed with scores for the 5 primary classes:

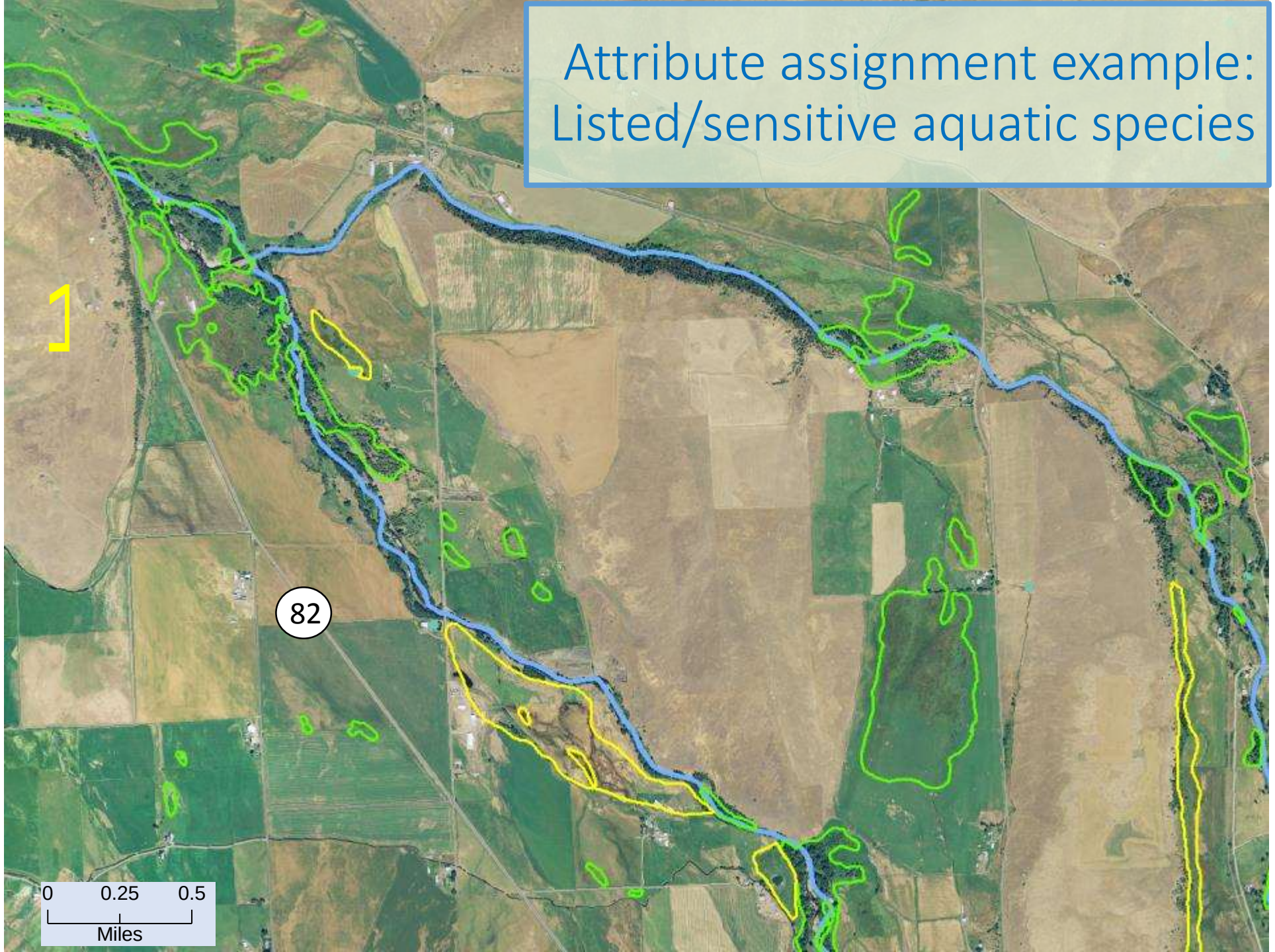
- Ecosystem Services
- Conservation Significance
- Wetland Condition
- Landscape Integrity
- Restoration/Mitigation Potential

The factors that were used to score these 5 classes are also included in the geodatabase

BUT, for ecosystem services, all services were merged, and services were based only on the intrinsic potential of the wetland, not on beneficiaries.


Oregon Explorer Topics | o...
Wetland Restoration Planning ...
oe.oregonexplorer.info/wetlands/restoration/
Search
Most Visited
CAS – Central Authent...
Google Maps
Banweb User Login
OSU. WebEx Enterpris...
Oregon EXPLORER
Wetland Restoration Planning Tool
Oregon Wetlands Explorer Home
User's Guide
Find on Map
Enter address or place name
DRAW MODE OFF
Wetland data and scores updated February 10, 2014
Map Layers
Wetland Scores – more info –
Existing Wetland Conditions
Landscape Integrity *
Ecosystem Services *
Conservation Significance *
Wetland Condition *
Wetland Restoration & Management
Restoration/Mitigation Potential *
Wetland Complex *
Wetland Type *
Hydric Soils *
Watershed Units (HUC 8)
HUC_12 *
Regions
Streams *
Oregon Counties
* Layer is scale dependent. Zoom in to see layer when selected. Layer will not display at all scales.
2D 3D
Road
Aerial
Select Wetland Theme To Explore
Select a wetland score theme
Existing Conditions
Ecosystem Services
Wetland Condition
Landscape Integrity
Conservation Value
Restoration and Management
Restoration/Mitigation Potential
View Map
Ecosystem Services
Ecosystem Services is a measure of a wetland's ability to provide an ecosystem service. It summarizes geospatial factors that may influence provision of services, such as:
Occurrence in a FEMA-designated 100-year floodplain.
Proximity (100 ft) to a water body with a 303(d)-listed water quality limitation such as high temperature or high sediment loading.
Proximity (300 ft) to a DEQ-identified, high-risk potential source of groundwater contamination.
Proximity (300 ft) to a DEQ-identified groundwater source area for Public Water Systems.
Occurrence in an ODFW-designated area with late-season low stream flow.
Occurrence in a FEMA-designated 100-year floodplain.
Occurrence in an area used for education, hunting, hiking, or other recreation.
bing
--Select a Watershed Unit--
Instructions
1 Find Area of Interest
Enter address or place name in "Find on Map" (for example, "Corvallis" or "122 Valley Library, Corvallis")
-- OR --
Use the map controls with your mouse to zoom (magnify) and pan (move) the map. TIP: If you hold down the Ctrl key and drag your mouse on the map you will zoom to the rectangle you make.
2 Generate Report for Area of Interest
To draw an area (polygon):
Click on Draw Mode button then draw the area of interest on the map. Left-click draws corners and right-click closes the polygon and selects the area. Enter the Title and press "Report." Draw area only within one watershed unit.
-- OR --
To select a watershed:
Select a watershed from dropdown below the map.

Attribute assignment example: Listed/sensitive aquatic species



Attribute assignment example: Modeled likely distribution of a federally listed wetland dependent plant (*Sidalcea nelsoniana*)

Wetlands Outline

Sidalcea nelsoniana probability

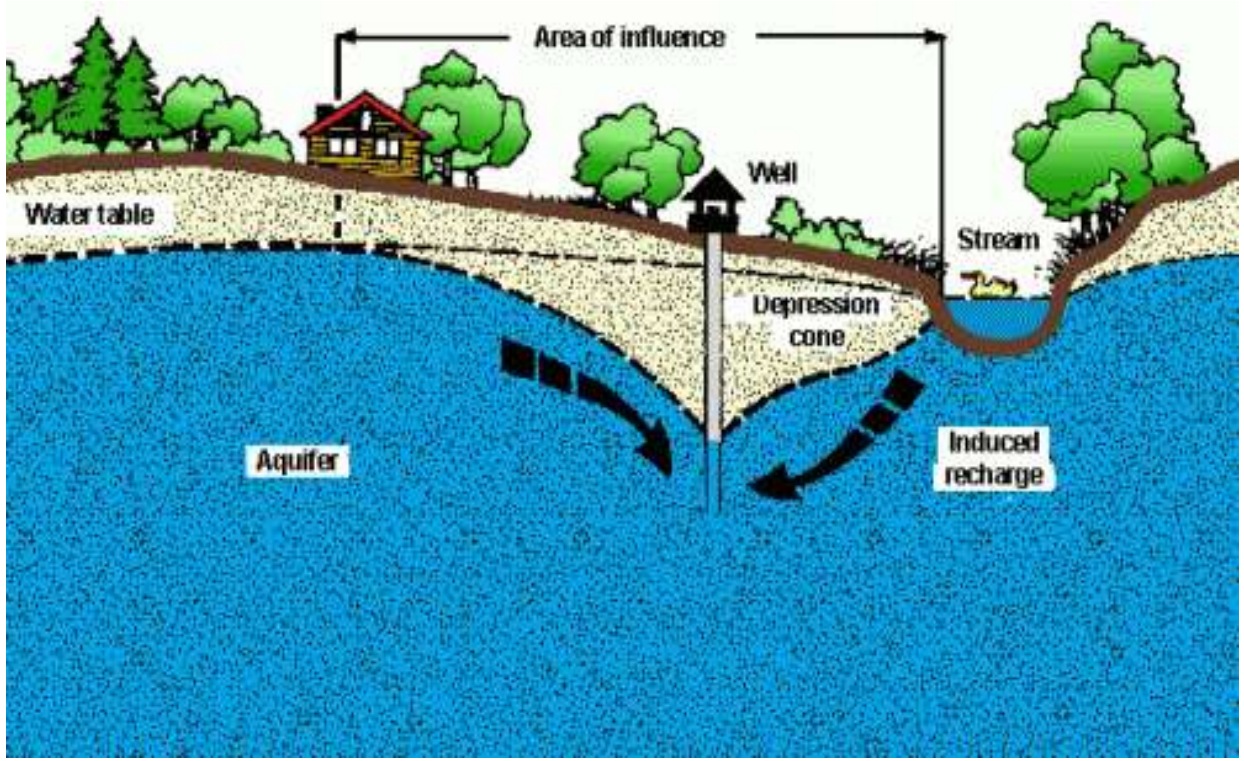
- <20
- 20 - 40
- 40 - 60
- 60 -80
- 80 - 100

0 0.5 1

Miles

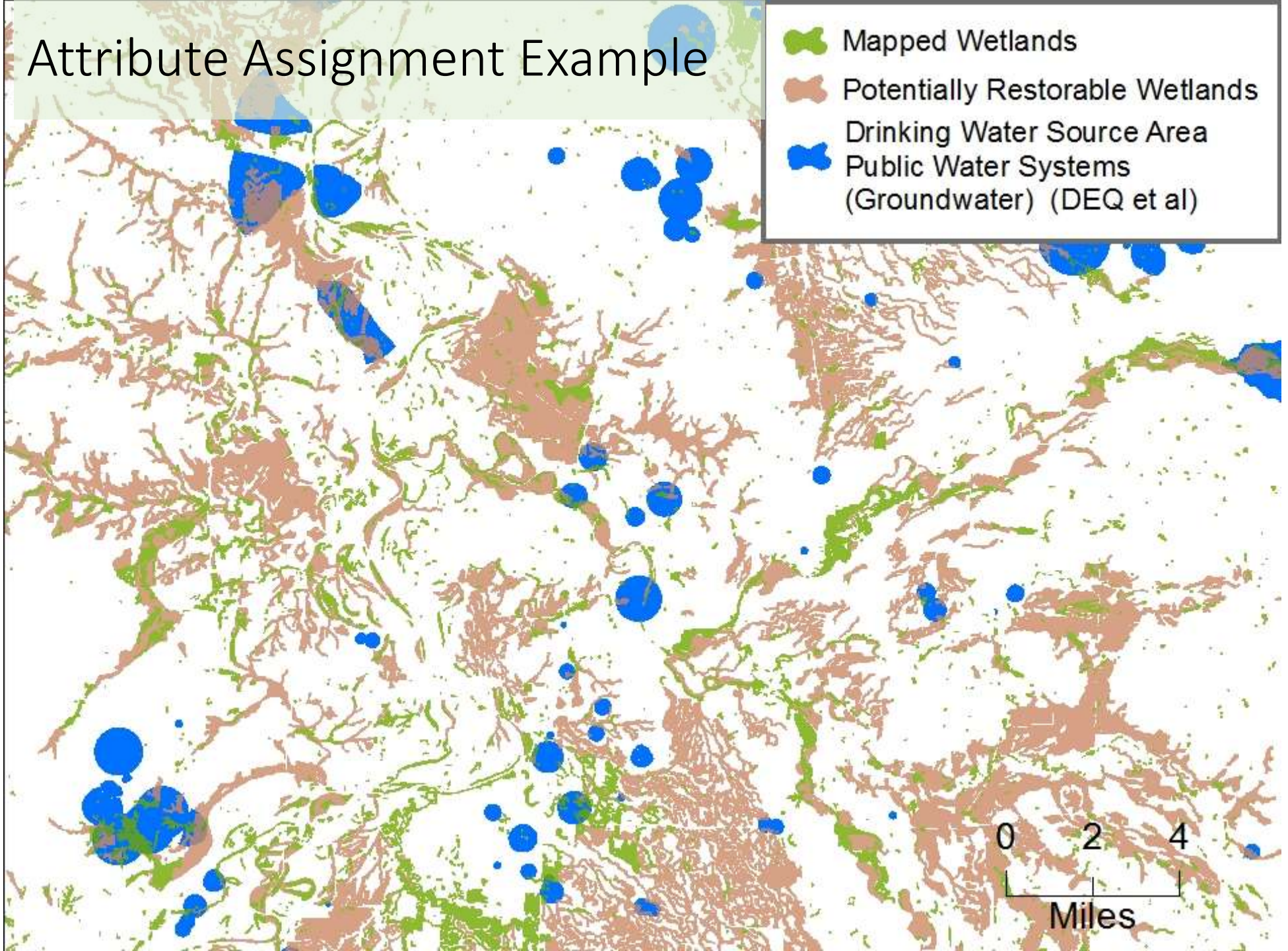
Aquifer Recharge Example

- Wetlands recharge aquifers
- Groundwater (Public) Drinking Water Source Area
  - Oregon DEQ/DHS

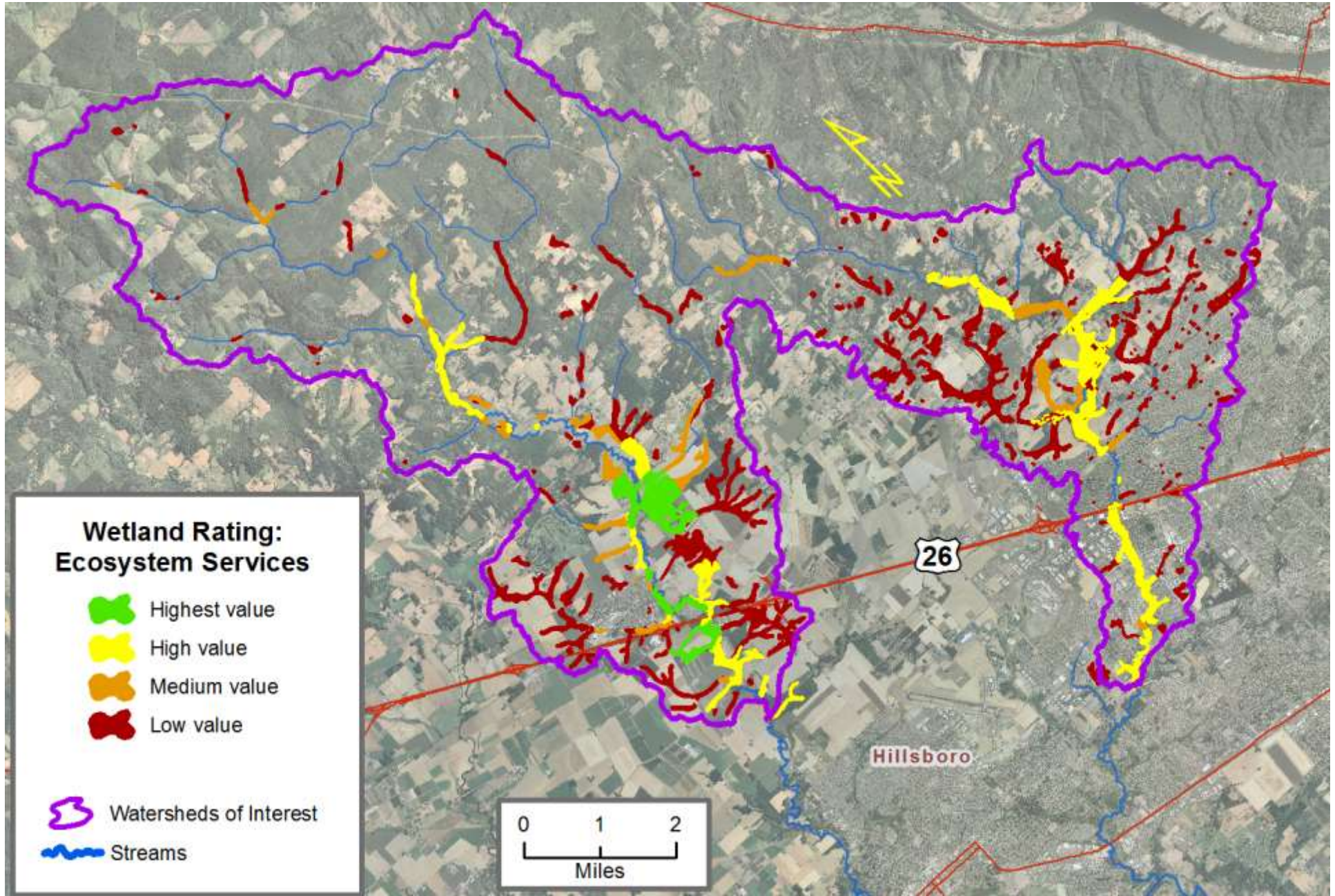


Oregon State U. Extension Service

Attribute Assignment Example



Upper McKay and Rock Creeks, Tualatin Basin – PRE BRI



Where We are Going Now

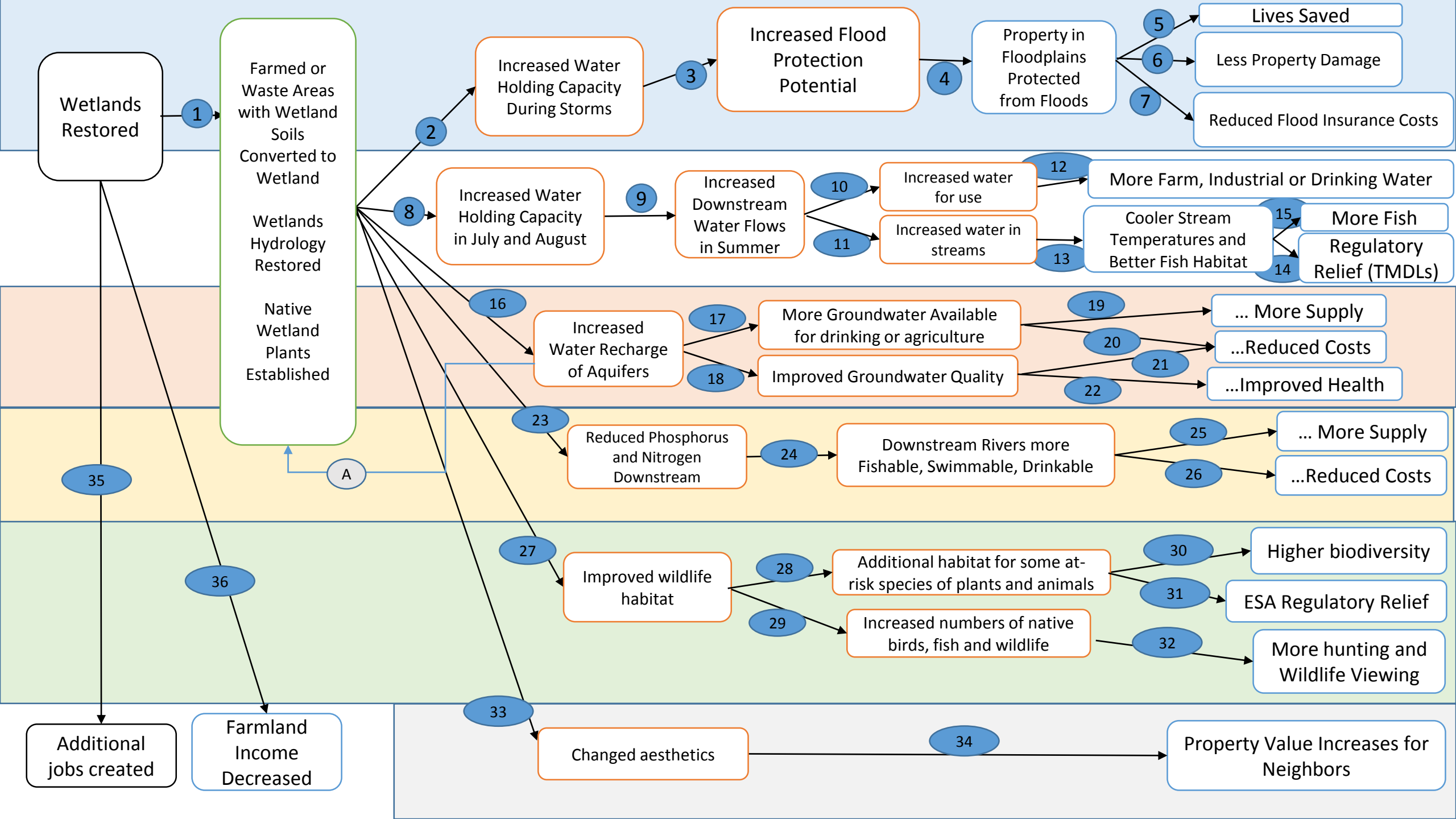
Using ***readily-available*** data sources…estimate the ***relative potential*** of every wetland in a watershed (both 8 and 12 digit HUC) to provide services. Of particular interest in Oregon are the following services that have not been meaningfully attributed with a BRI:

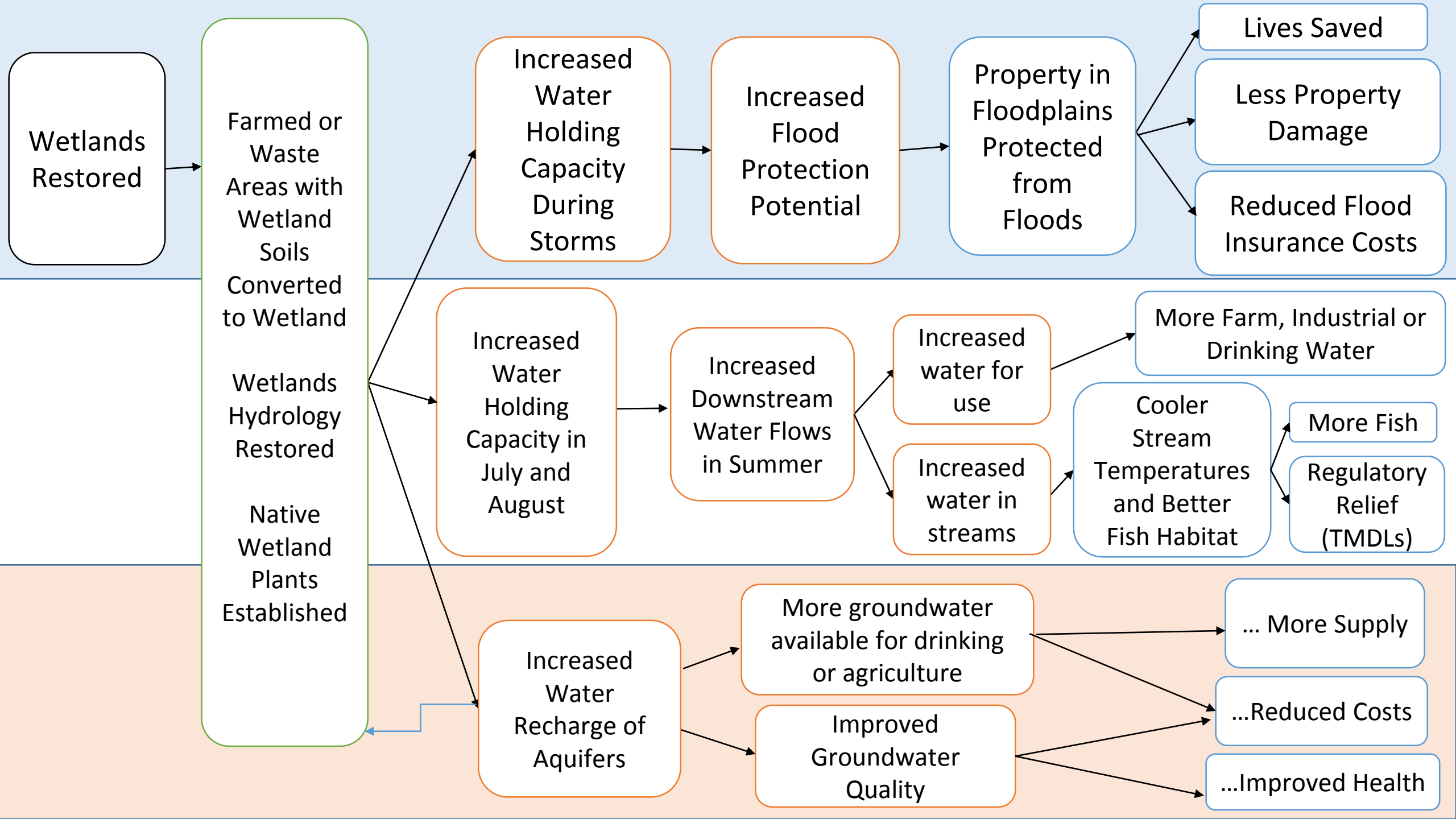
1. Flood Prevention
2. Provision of Late Season Flow for Irrigation, Drinking or Threatened Fish (salmon)
3. Temperature Control (cooling) of streams needing it (most Oregon streams)
4. Nutrient Control
5. Fish and Wildlife Values
6. Groundwater Recharge

More Complete Ecosystem Services Analysis

Modeling Ecosystem Outputs on a causal chain to inform valuation

1. Identify the action or decision point (prioritization of mitigation sites)
2. Identify the service (flood protection) and make a causal chain (next slide)
3. Identify the beneficiaries (downstream residents and property owners within the watershed)
4. Identify the ecological factors that impact ecosystem outputs (two slides down)
5. Measure or model outputs available to beneficiaries
6. Determine the value or the importance of these outputs to beneficiaries.


Wetlands Restored
1
Farmed or Waste Areas with Wetland Soils Converted to Wetland
Wetlands Hydrology Restored
Native Wetland Plants Established
2
Increased Water Holding Capacity During Storms
3
Increased Flood Protection Potential
4
Property in Floodplains Protected from Floods
5
Lives Saved
6
Less Property Damage
7
Reduced Flood Insurance Costs
8
Increased Water Holding Capacity in July and August
9
Increased Downstream Water Flows in Summer
10
Increased water for use
11
Increased water in streams
12
More Farm, Industrial or Drinking Water
13
Cooler Stream Temperatures and Better Fish Habitat
15
More Fish
14
Regulatory Relief (TMDLs)
16
Increased Water Recharge of Aquifers
17
More Groundwater Available for drinking or agriculture
18
Improved Groundwater Quality
19
... More Supply
20
...Reduced Costs
21
...Improved Health
22
23
Reduced Phosphorus and Nitrogen Downstream
24
Downstream Rivers more Fishable, Swimmable, Drinkable
25
... More Supply
26
...Reduced Costs
A
35
36
27
Improved wildlife habitat
28
Additional habitat for some at-risk species of plants and animals
29
Increased numbers of native birds, fish and wildlife
30
Higher biodiversity
31
ESA Regulatory Relief
32
More hunting and Wildlife Viewing
33
Changed aesthetics
34
Property Value Increases for Neighbors
Additional jobs created
Farmland Income Decreased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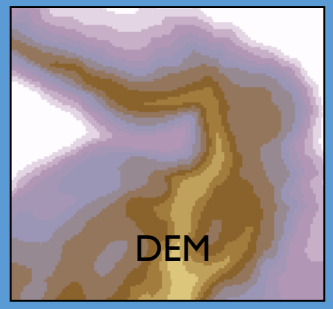
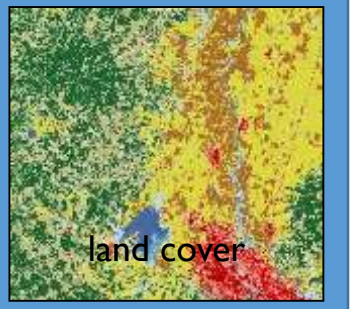
More Farm, Industrial or Drinking Water
Increased water in streams
Cooler Stream Temperatures and Better Fish Habitat
More Fish
Regulatory Relief (TMDLs)
Increased Water Recharge of Aquifers
More groundwater available for drinking or agriculture
Improved Groundwater Quality
… More Supply
…Reduced Costs
…Improved Health

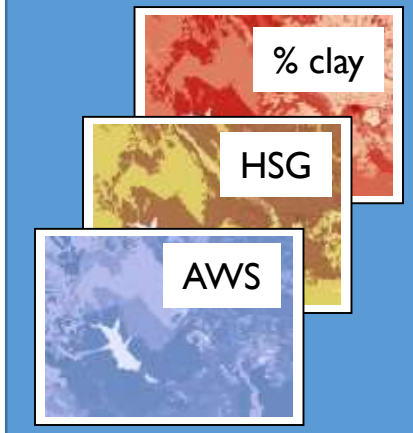
Wetland Ecosystem Services - Available Attributes

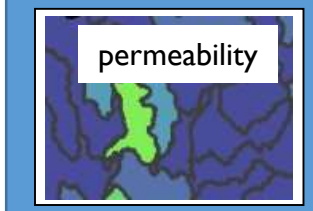
LANDSCAPE DATA

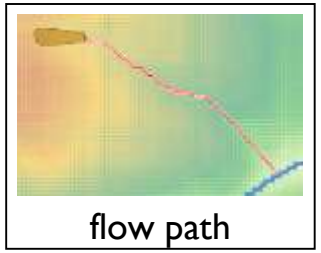


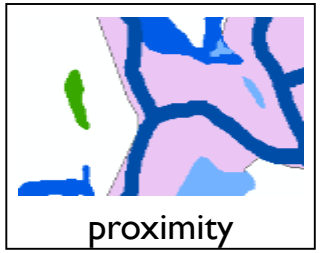


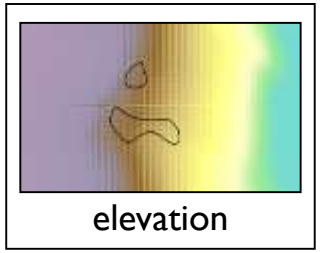
SOIL DATA

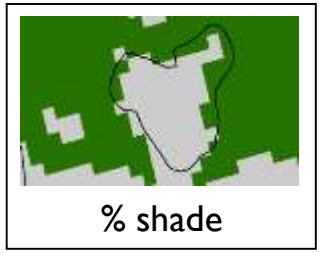


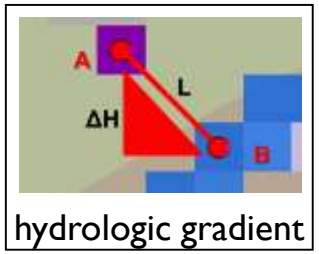


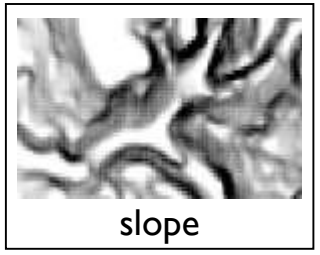






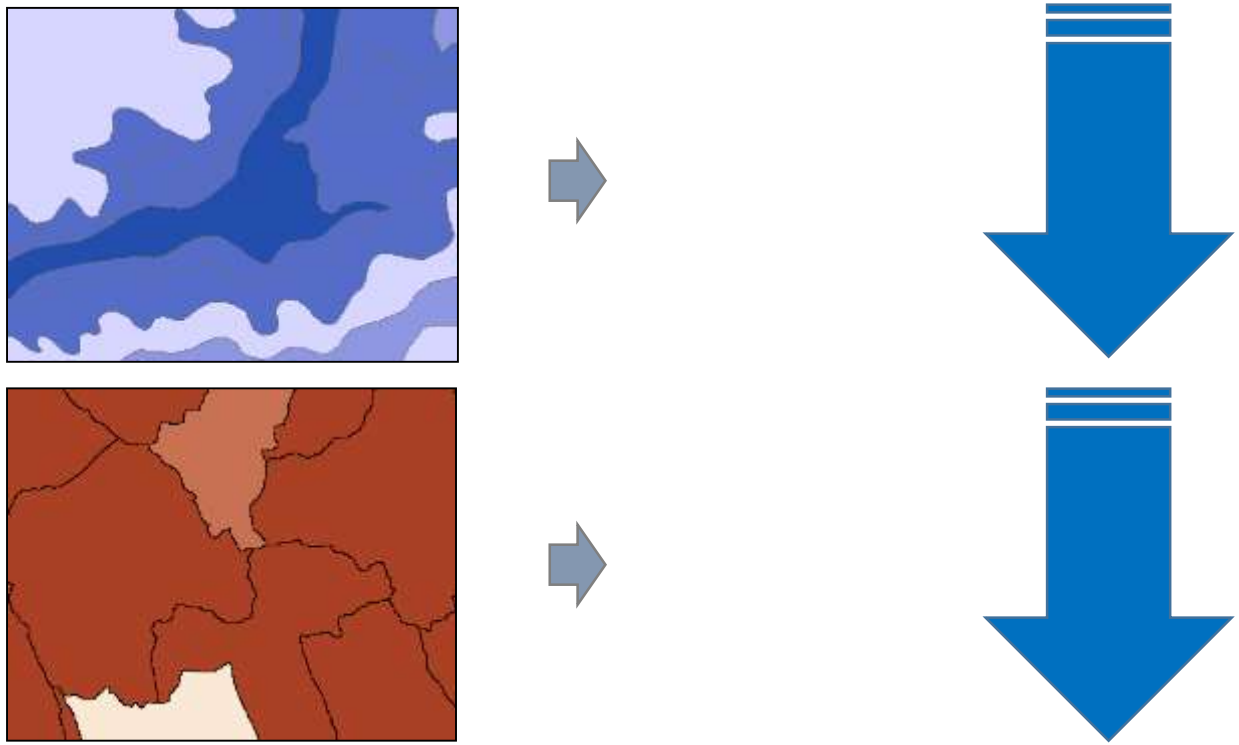




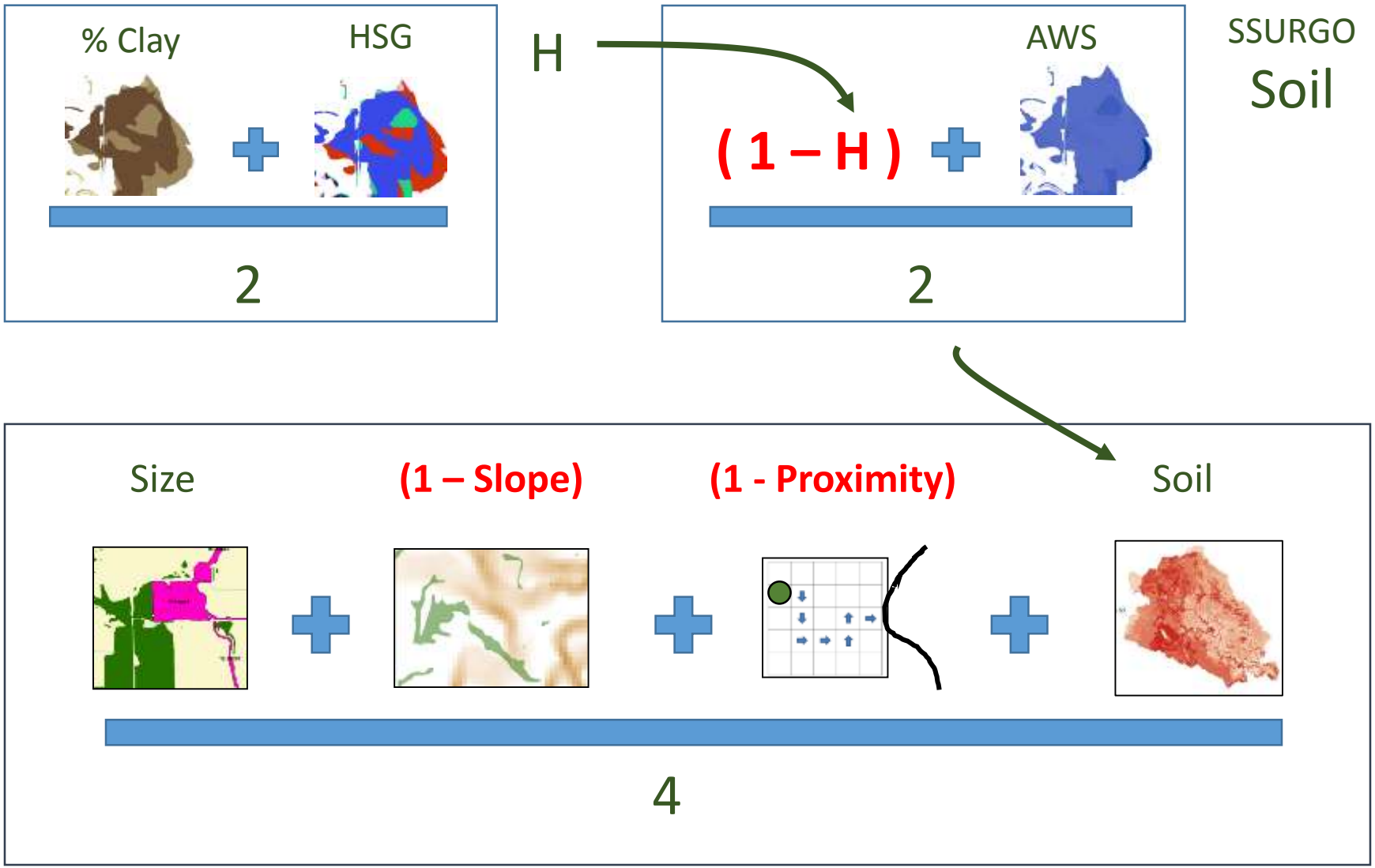


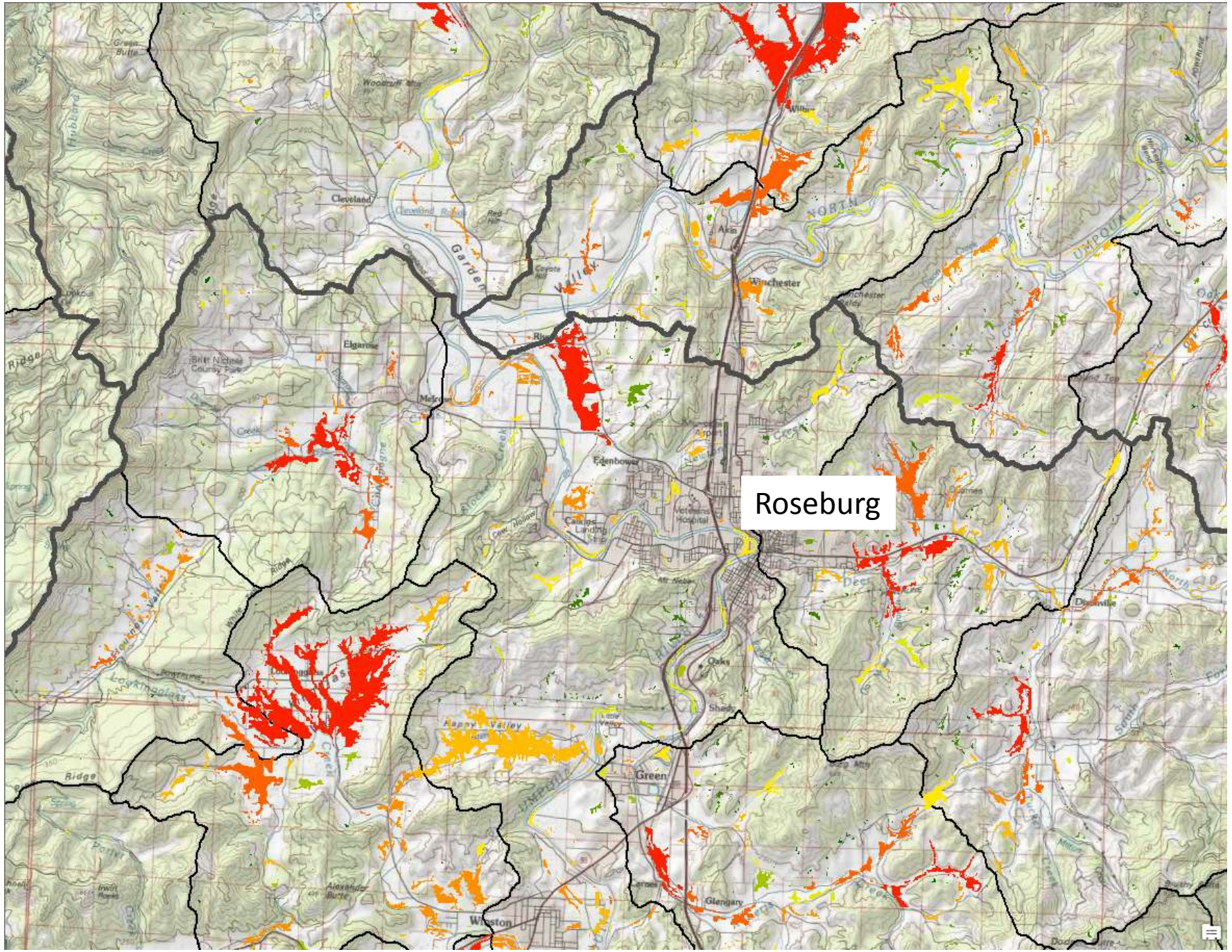
Flood Prevention Functions and Services

Wetland function	Support, examples
Higher water storage (AWS), lower runoff.	Hwang et al. 2012; Gunduz 2007; Morita & Yen 2002; Castillo et al. 2003
Higher 'permeability', lower runoff.	Hoyer & Chang 2014; Adamus 2011; Adamus et al. 2010



Flood Storage F1 Capacity – simple model





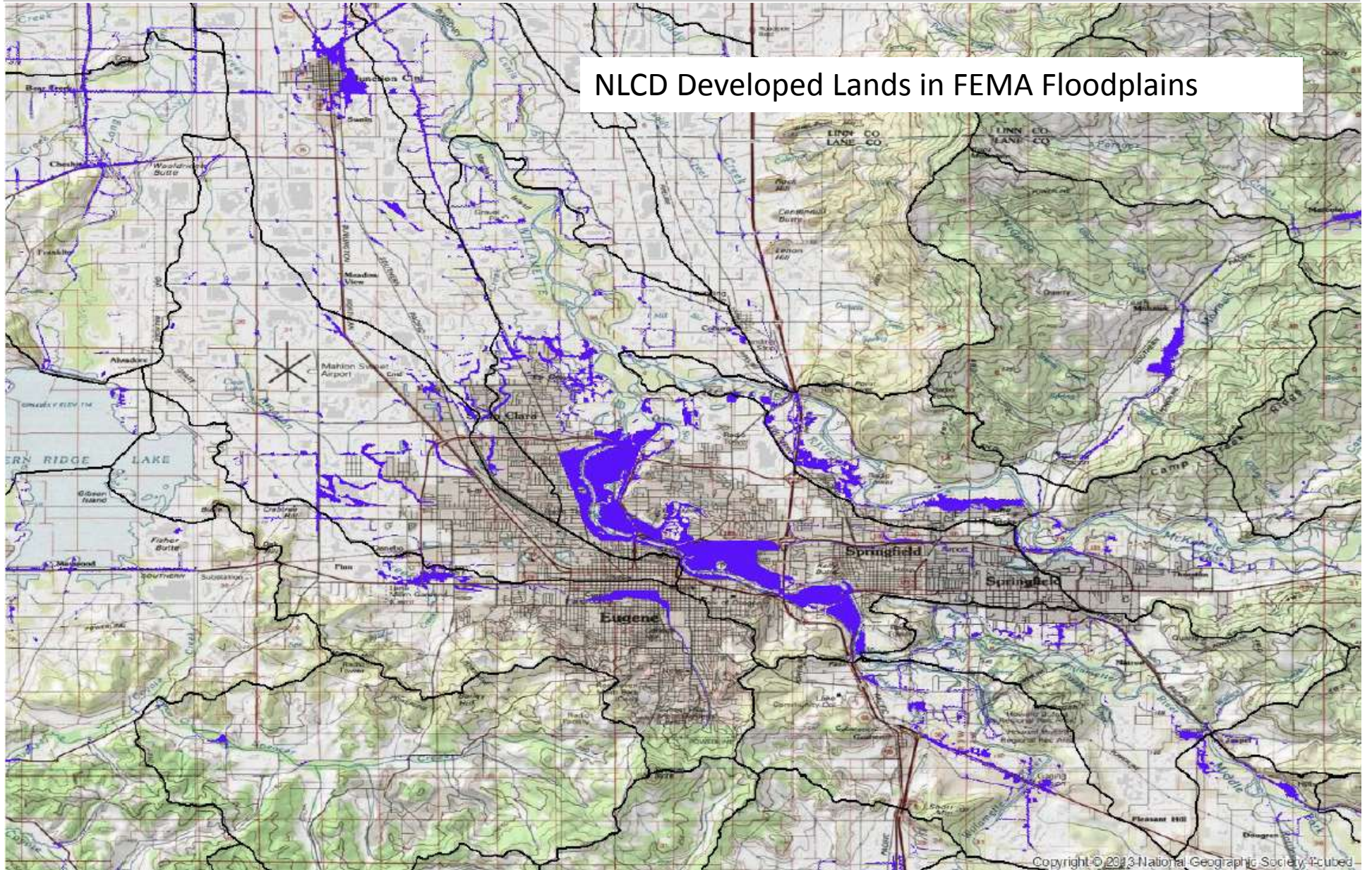
Base Flood Storage Capacity

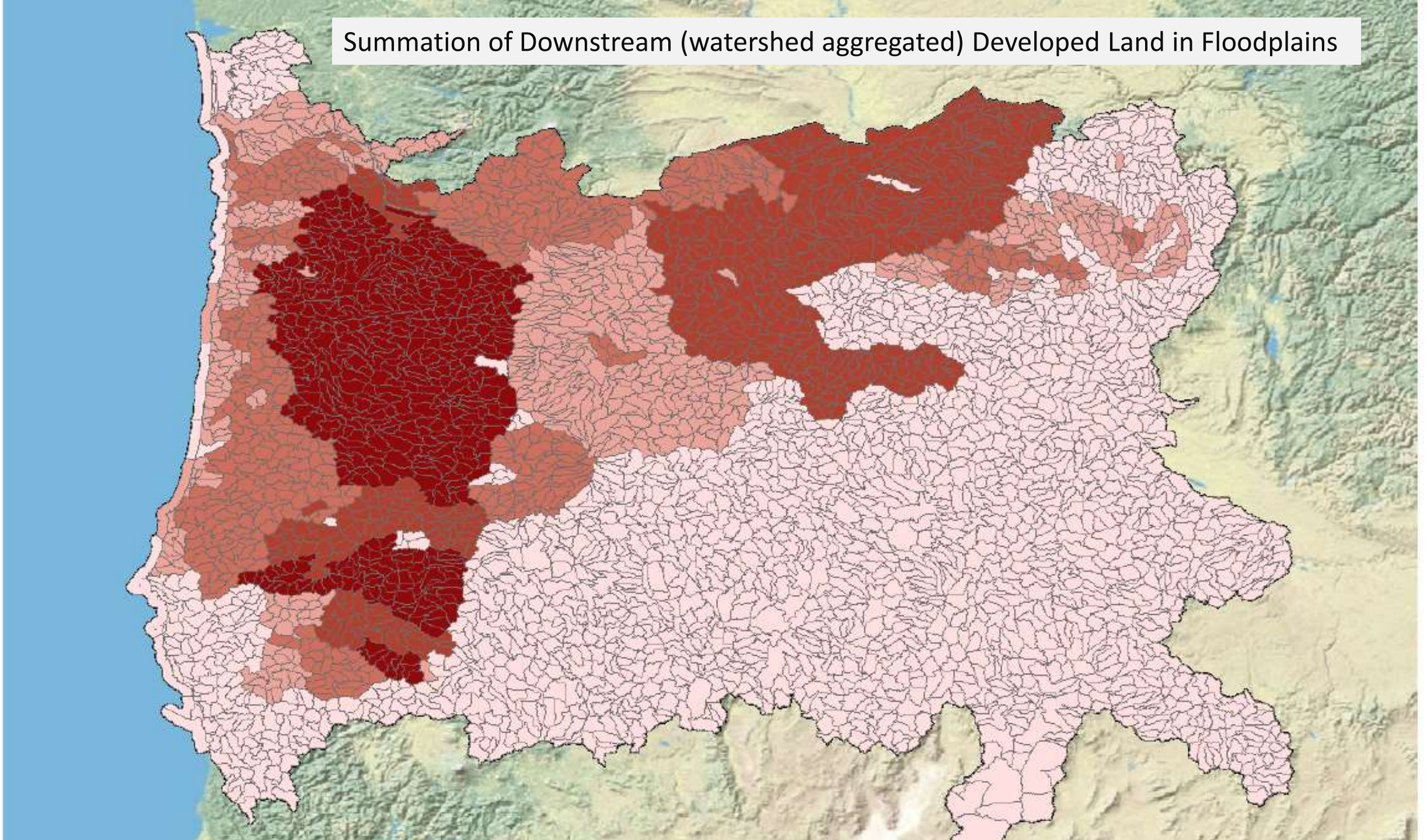
Scores

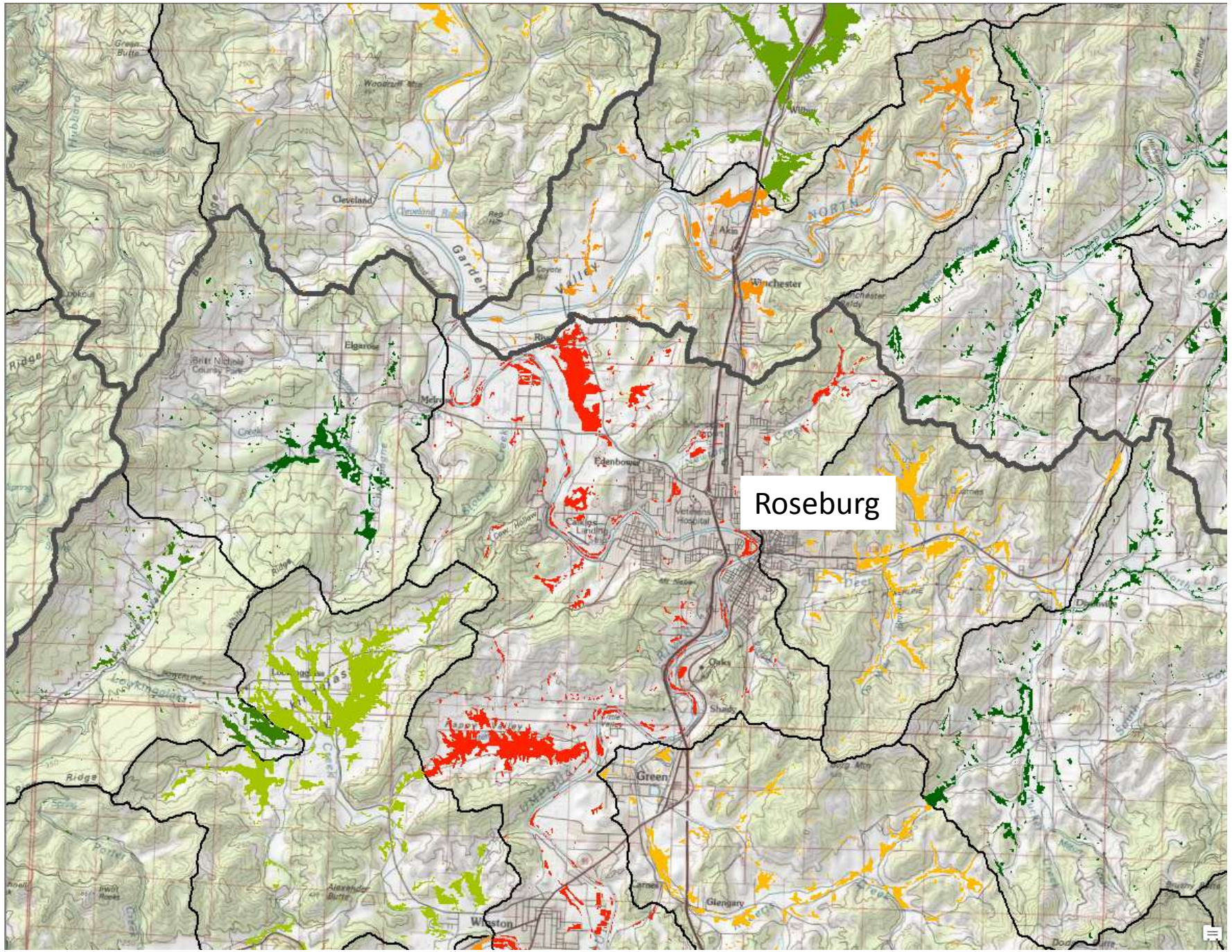
Low

High

Flood Storage Capacity to Ecosystem Service




Summation of Downstream (watershed aggregated) Developed Land in Floodplains

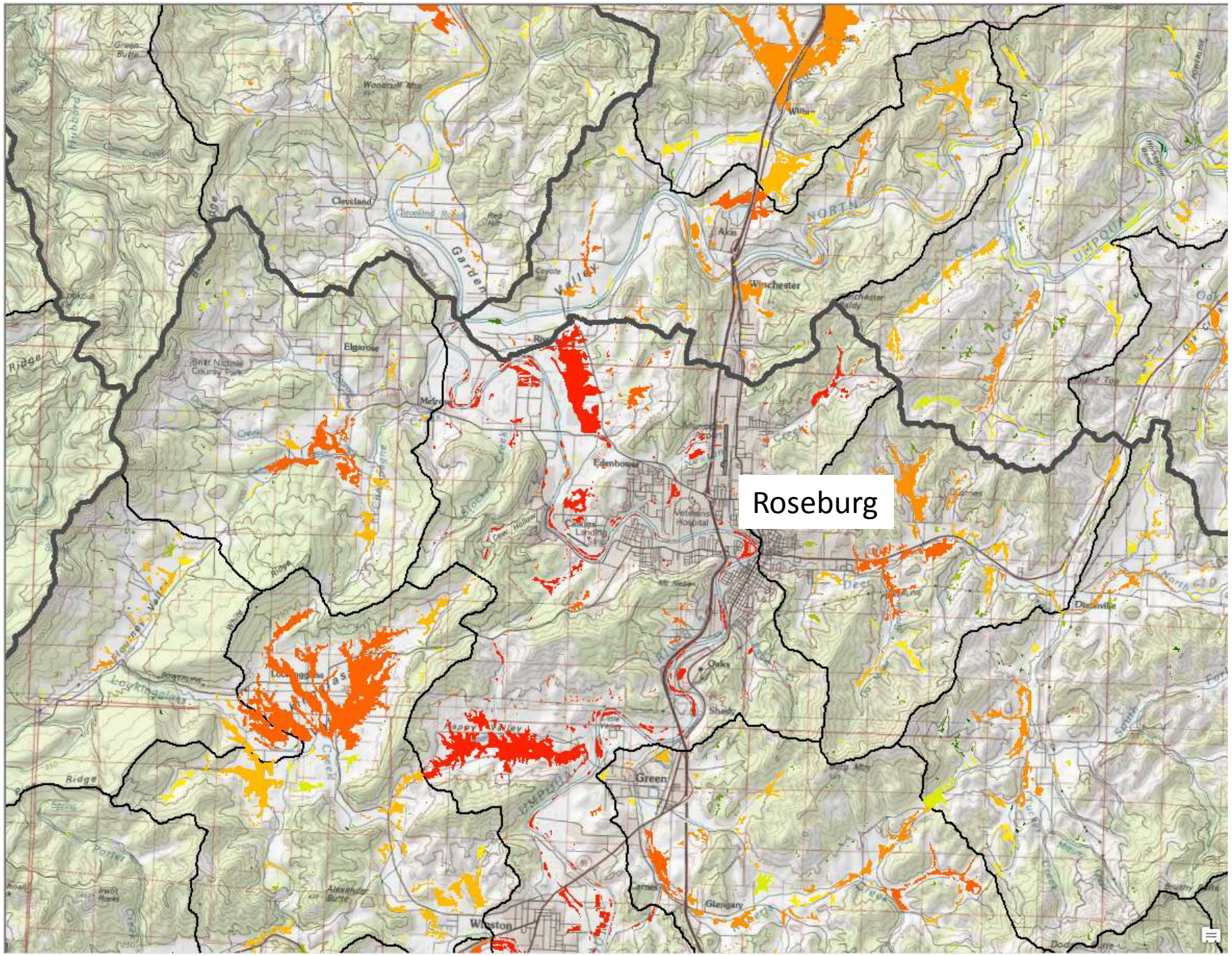


Accumulated Downstream Vulnerable Property Area By 12 digit HUC

Scores

Low

High

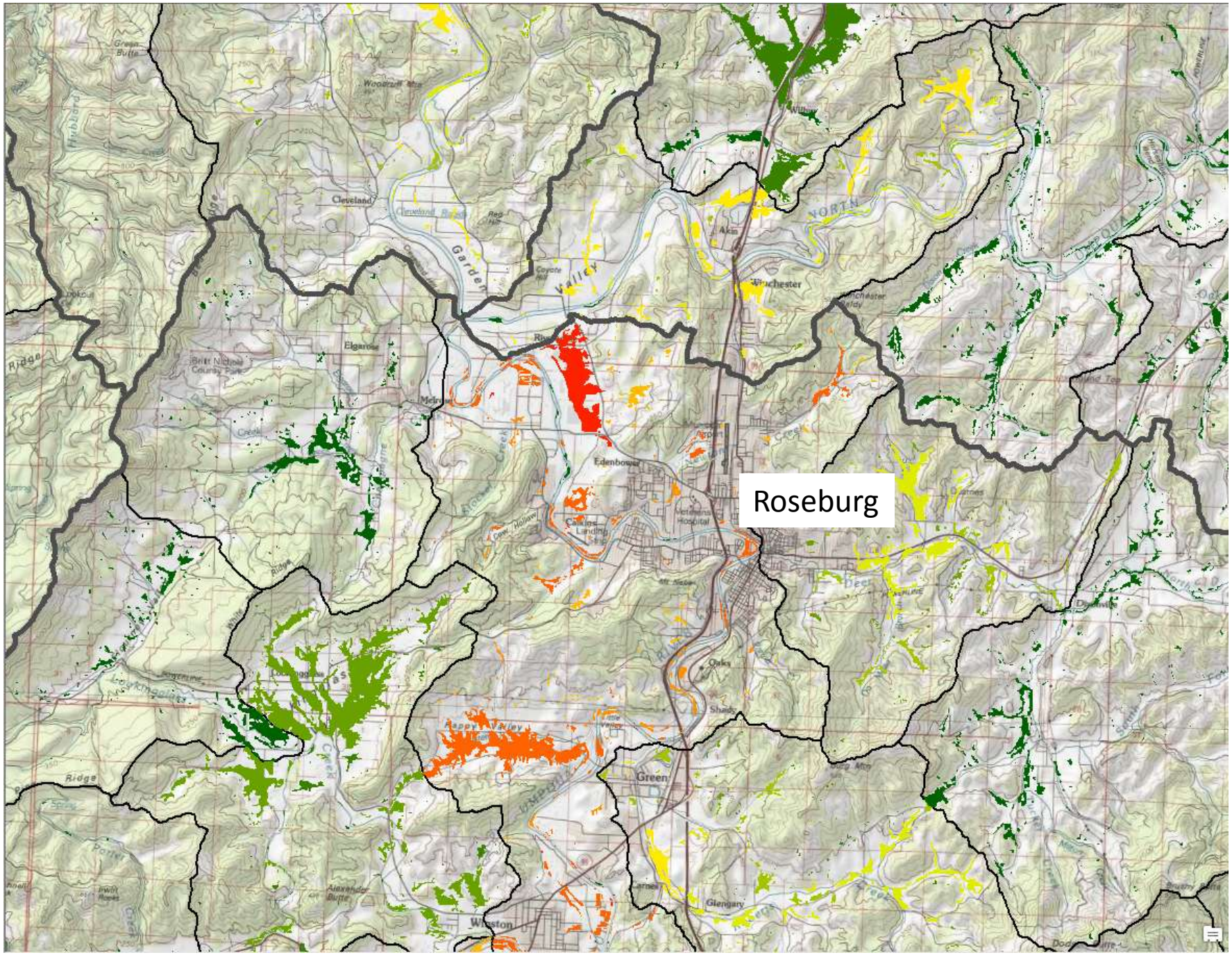


Sum of Vulnerable Property and Flood Prevention Capacity Values

Scores

Low

High



Vulnerable Property and Flood Prevention Capacity Values Multiplied

Scores

Low

High

Next Steps

- The statewide wetland ES scores were completed for flood prevention services for all existing wetlands, but also need to be applied to potentially restorable wetlands, and provided to regulators.
- Similar processes for evaluating other key services in Oregon, primarily:
  - Surface water provision (mostly important in late summer and fall)
  - Temperature control (particularly important for salmon streams)
  - Nutrient control (mostly phosphorus in a few areas or Oregon, along with heavy metals or toxins).
- Figure out how to get local input for recreation, education, and other uses.
- Update the Ecosystem Services page of the wetland restoration planning tool to address the totals.
- And perhaps attempt to allow users to select what matters to them.

Conclusions

- Considering beneficiaries is critical to meaningfully evaluate ecosystem services; and wetland functions may or may not address beneficiaries.
- Creating causal chains or diagrams makes it possible to link ecosystem outputs to beneficiaries.
- Providing this linkage, defining “benefit relevant indicators”, and developing methods for assessing these indicators can provide important guidance to land managers interested in providing services.
- There remains a lot of work to do in order to provide real information, rather than approximations, for multiple services.
- With this method, values of the different wetland services can be combined to help select the most valuable wetland restoration and mitigation sites.

Contact Information and links

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Institute for Natural Resources - Portland, OSU & PSU

Wetlands Portal: http://oregonexplorer.info/topics/wetlands?ptopic=98

Restoration Planning tool:
http://oe.oregonexplorer.info/wetlands/restoration/

Other contacts: Esther Lev (estherlev@wetlandsconservancy.org)

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John Bauer (john.bauer.wet@gmail.com)

Joe Bernert (joe.Bernert@oregonstate.edu)