Overview of the Habitat Restoration Prioritization Strategy for the lower Columbia River

Catherine Corbett[1], Chaeli Judd[2], Keith Marcoe[1], Ron Thom[2], Gary Johnson[2], Antonio Baptista[3], Nate Hyde[3], Bernadette Graham Hudson[4], Tom Murtagh[5] and Jim Brick[5]

[1] Lower Columbia River Estuary Partnership, Portland, OR
[2] Marine Sciences Laboratory, Pacific Northwest National Laboratory, Sequim, WA
[3]Oregon Health and Science University, Portland, OR
[4]Lower Columbia Fish Recovery Board, Longview, WA
[5]Oregon Department of Fish and Wildlife, Clackamas, OR

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Restoration Goals

- **Lower Columbia River and estuary designated "estuary of national significance"**
- **All NEPs create and then implement stakeholder-driven Management Plans (CCMP):**
  - **Actions include-19,000 acres to be protected/restored by 2014**
    - Goal included in EPA Strategic Plan
- **NEPs depend *heavily* on partners for implementation of goals**

*Culvert Removal, Young Creek*

Ecosystem Based Approach to Restoration*

1. **Assess disturbance across landscape and at individual sites**
   - Use this to determine appropriate restoration technique (e.g., protection, enhancement, restoration or creation)

2. **Determine extent and types of habitat loss from historic conditions**
   - Prioritize the remaining stands of habitats where large losses have occurred, for future protection

3. **Determine which habitats are most important for each salmonid life history type**
   - Ensure adequate habitat needs are met to ensure diversity in life history strategies

4. **Develop an inventory of priority actions at site, landscape scales**
   - Ensure project sponsors and funding agencies support and use in funding priorities

5. **Monitor, analyze and report efficacy of actions using standardized, comparable methods across basin, adaptively manage program**

   *Johnson et al., 2003 (Stakeholder-driven and approved approach)

Habitat Restoration Prioritization Strategy

- **Addresses steps 1, 2, ~3 in Approach**

- **Three-tiered - Scales from system-wide to project specific**

  - **Tier 1** assesses disturbance across landscape and site scales

  - **Tier 2** evaluates individual projects

  - **Tier 3** "Top –down" restoration strategy prioritizing locations for protection/restoration
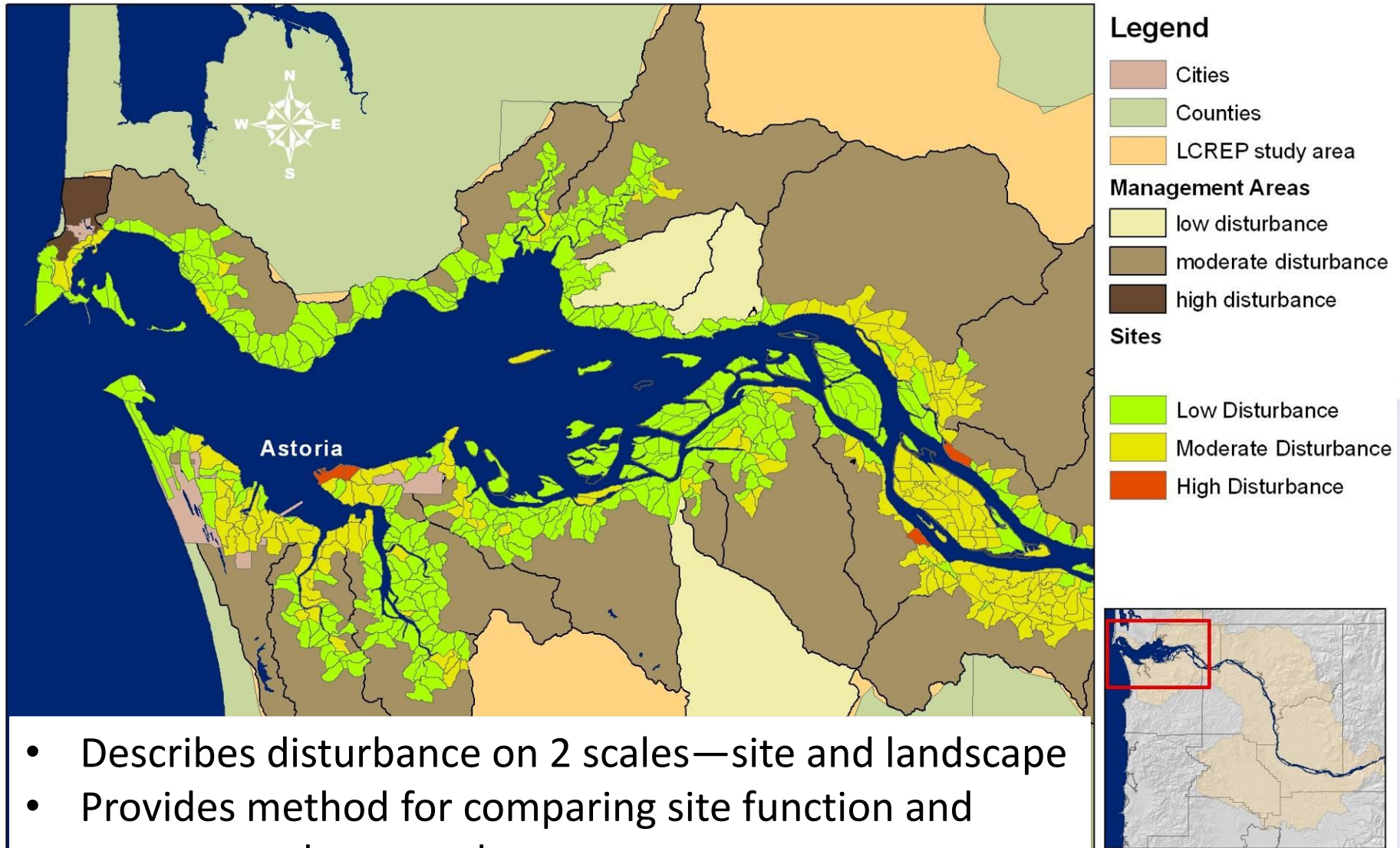
- **Focuses on existing data**
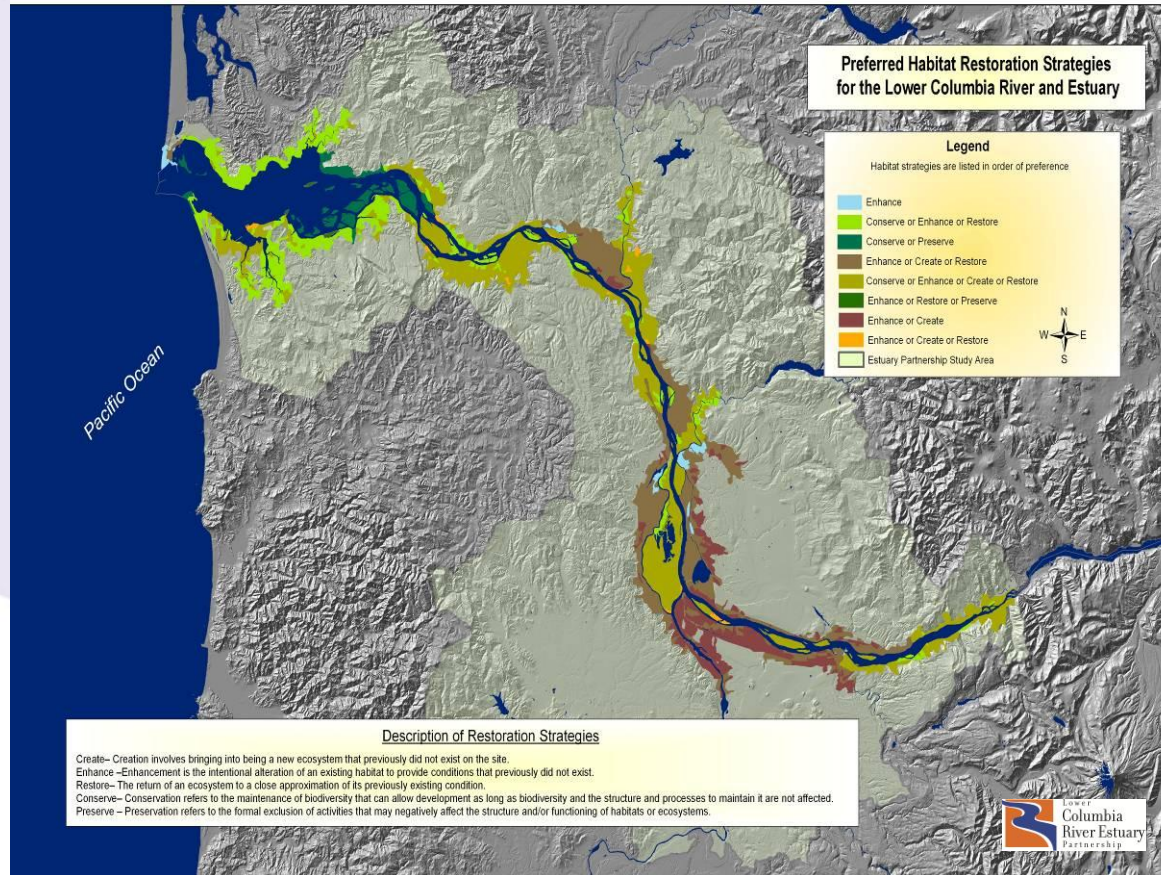
*Estuary Partnership and PNNL

**Funding from Bonneville Power Administration and US Environmental Protection Agency
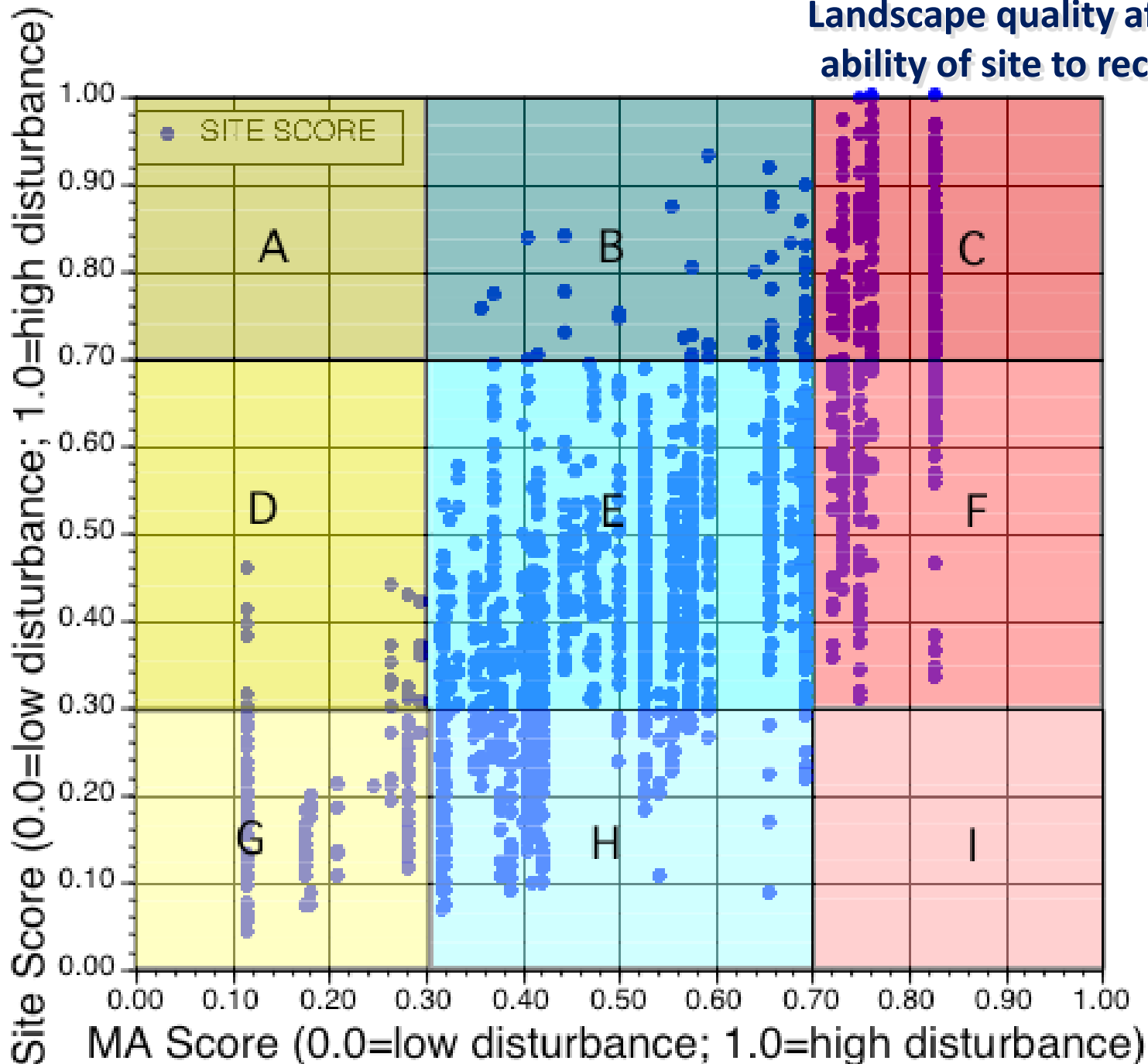
Habitat Restoration Prioritization— Tier 1
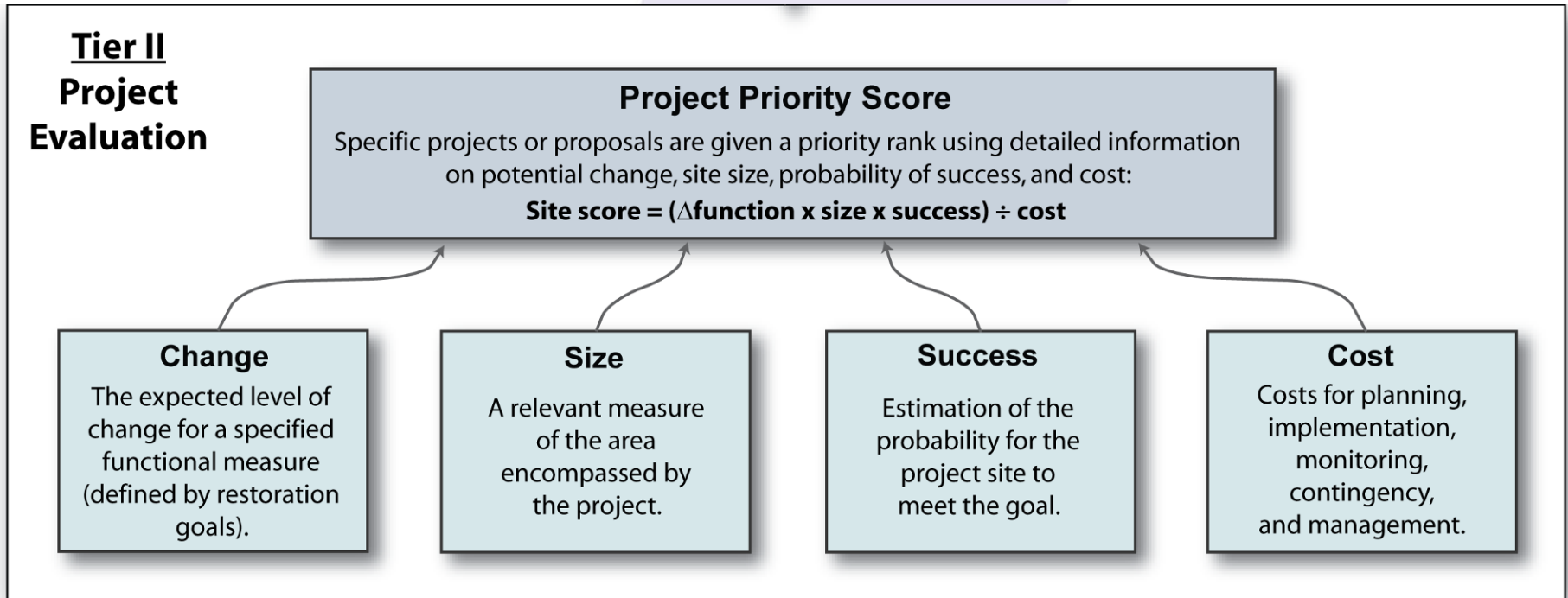## Site and Management Area Rankings (Reach A,B)

- Describes disturbance on 2 scales—site and landscape
- Provides method for comparing site function and structure at larger scales

Landscape quality affects ability of site to recover

Tier 2 Project Evaluation

Tier II Project Evaluation

Project Priority Score

Specific projects or proposals are given a priority rank using detailed information on potential change, site size, probability of success, and cost:

Site score = (Δfunction x size x success) ÷ cost

Change

The expected level of change for a specified functional measure (defined by restoration goals).

Size

A relevant measure of the area encompassed by the project.

Success

Estimation of the probability for the project site to meet the goal.

Cost

Costs for planning, implementation, monitoring, contingency, and management.

Site Score = (Δ function x size x success) ÷ cost

Where,

Δ Function = change in site ecological functions

Size = relevant measure of the area encompassed by the project

Success = an estimate of the probability for the site to meet the goal

Cost = planning, implementation, monitoring and management costs

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Tier 2 Project Evaluation

Site Score = (Δ function x size x success) ÷ cost

Function/process	Preserve	Greater	Lesser	No Change	Unsure	Not applicable
Primary production		X				
Organic matter flux		X				
Sediment trapping		X				
Nutrient processing		X				
Flood attenuation		X				
Food web support			X			
Opportunity			X			
Capacity		X				
Natural complexity		X				
Natural biodiversity				X		
Total	0	7	2	1	0	0

Tier 2 Project Evaluation

Site Score = (Δ function x size x success) ÷ cost

Success Factor	High	Moderate	Low	Unsure
Case studies indicate success of…	X			
Restoration strategy is suitable	X			
Habitat forming processes will be…	X			
Landscape features are…		X		
The site condition is…			X	
Adjacent habitats are…	X			
Self-maintenance		X		
Resilience		X		
Time Frame				X
Total	4	3	1	1

Tier 3 "Top-Down" Habitat Restoration Prioritization

- **Ecosystem-based with focus on juvenile salmon**
  - **Goals:**
    - restoring ecosystem structure, function and resiliency through restoring natural habitat diversity
    - restoring diversity of salmonid life history strategies

- **Employ multiple lines of evidence approach**
  - Aka "multi-criteria decision analysis" (Malczewski 1999)
  - Multiple analyses with each identifying areas of importance for protection and restoration
  - Results of analyses can be used independently or in combination, depending on user's goals

- **Uses data currently available basin wide**

Tier 3 "Top- Down" Habitat Restoration Prioritization: Multiple Lines of Evidence Concept

Line of Evidence

Selection Factor	Criteria	→	Optimal Decision (Location)

- Crime Rate
- Price
- Schools

- Low (< 300 events/ 100,000 people/year)
- Price (<$300K)

Where should I buy a house?
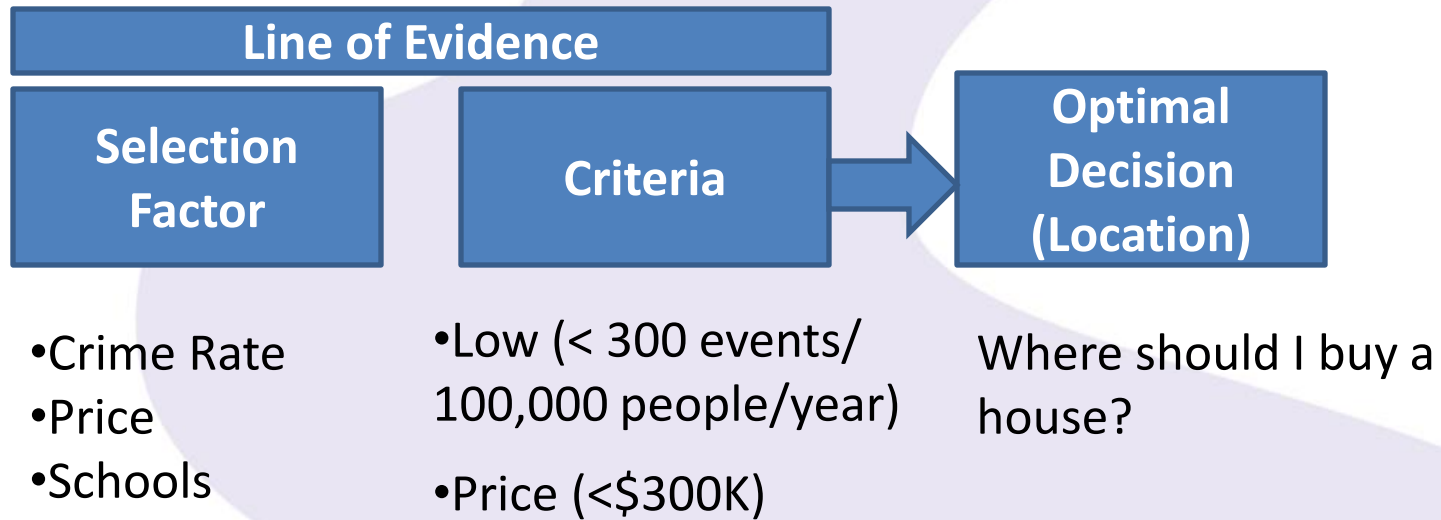
- **Selection Factors** are those elements that you want to consider when making a decision

- **Criteria** are the range or threshold of values you need to act on

- In a multi-criteria assessment, these are spatially mapped to identify locations meeting and/or not meeting targets

- Often debates about thresholds in criteria, and how information comes together (is weighted) in a decision

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Tier 3 "Top-Down" Habitat Restoration Prioritization

Multiple lines of evidence approach:

1. **Historic vs. current habitat coverage change analysis**
   - Historic habitat coverage is proxy for natural habitat diversity
   - Identify losses by lower river, region and habitat type

2. **Juvenile salmonid Habitat Suitability Index model**
   - Identify locations in mainstem of optimum water velocities, temperature, and depth, adapting regional criteria, employing OHSU SELFE model results

3. **Priority tributaries in OR and WA Salmonid Recovery Plans**
   - Tidal reaches of tributaries priority for chum and fall and late fall run Chinook (subyearling life history strategy that may rear extensively in tidal areas); weighted system on mainstem

4. **Tidally impaired floodplain habitat (altered by dikes, etc)**

*This strategy identifies key areas for protection and restoration based on possible ecological uplift; it assumes the next step in identifying and developing projects will always include working with individual landowners to determine mutual objectives

Tier 3 - Line of Evidence 1:
Historic to Current Habitat Change Analysis

- **Addresses Task 2 of ecosystem restoration approach in Johnson et al. (2003)**

- **Used for developing restoration targets in other "estuaries of national significance" (e.g., Tampa Bay, Charlotte Harbor, Sarasota Bay, Indian River Lagoon)**

- **Key Assumptions:**
  - Historic habitat coverage (locations, quantity) can be used as a proxy for natural habitat diversity

- **Targets:**
  - ➢ Identified changes in habitat coverage by river reach, by region and by habitat type
  - **<u>Prioritize locations of remnant habitat for protection and restoration</u>**

Tier 3 - Line of Evidence 1:
Historic to Current Habitat Change Analysis

Examples of target setting approach:

- **Tampa Bay**
  - **Methods:**
    - used 1950s FDNR/USFWS habitat data as historic and compared to current landcover for wetlands and uplands
    - used 1940-50s black and white DOT/USACE photos for historic submerged aquatic vegetation in comparison to 1990s and subsequent color imagery for current
  - **Results:**
    - 5,130 acres loss in emergent tidal wetlands (mangrove, marsh, salt barren), with higher losses in some bay segments than others
    - 27,900 acres of submerged aquatic vegetation
      - 12,800 acres are considered non-restorable
    - Bay segment specific restoration targets

- **Charlotte Harbor**
  - used 1850s survey (GLOS) in combination with NRCS soils data as historic and compared to current landcover for wetlands and uplands
  - used 1940-50s black and white DOT/USACE photos for historic submerged aquatic vegetation in comparison to 1990s and subsequent color imagery for current

Tier 3 - Line of Evidence 1:
## Historic to Current Habitat Change Analysis

- **Methods:**
  - Used classified T sheets and 1850s survey (GLOS) as historic data and compared to 2010 landcover

- **Targets (2 scales):**
  1. Reach specific habitat goals
  2. Region specific habitat goals

- **Follow Up Work:**
  - Identify where losses are recoverable
  - Overlay on public lands to determine where protection is still needed
  - Numeric targets for environmental indicators
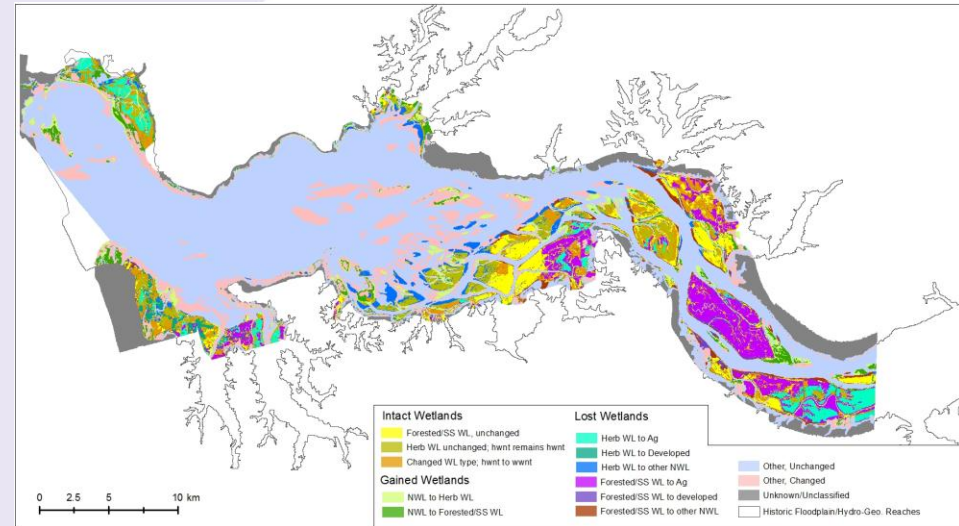
Habitat	Relevant Reaches
Tidal herbaceous wetlands	A – E, G
Tidal wooded wetland	A - D
Forested	A, D - G
Herbaceous	D - G
Shrub scrub	E, F
Non-tidal herbaceous wetland	F
Non-tidal wooded wetland	H

See Marcoe poster presentation for more detail

Tier 3 - Line of Evidence 2:
Juvenile Salmon Habitat Suitability Index model

Temperature

Salinity

Both Criteria

Legend: 100 - 90% | 75 - 90% | 50 - 75% | 30 - 50% | 0 - 30%

- **Methods:**
  - Adapt criteria based on NOAA literature and recent work (Bottom et al 2005; Burla 2009)
  - Examine frequency of suitability of area based on: water temperature, velocity, depth
  - Map spatial and temporal patterns for limiting factors

- **Results:**
  - Maps of areas that meet individual criteria consistently through time and areas that drop off during some periods or for some criteria

- **Targets:**
  1. Areas meet all criteria consistently across time
  2. Areas with specific limiting water conditions or for limited time periods
  3. Areas with suitable water conditions and potential floodplain opportunities

See Judd poster presentation for more detail

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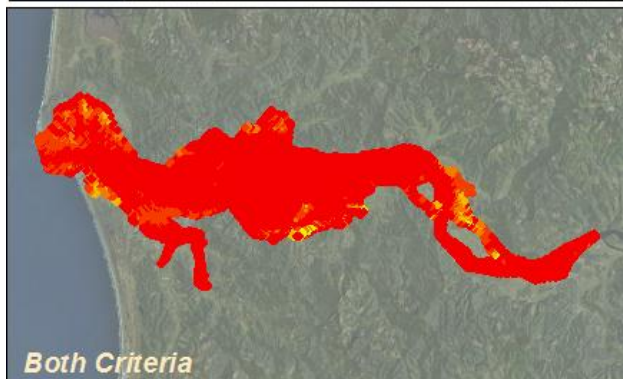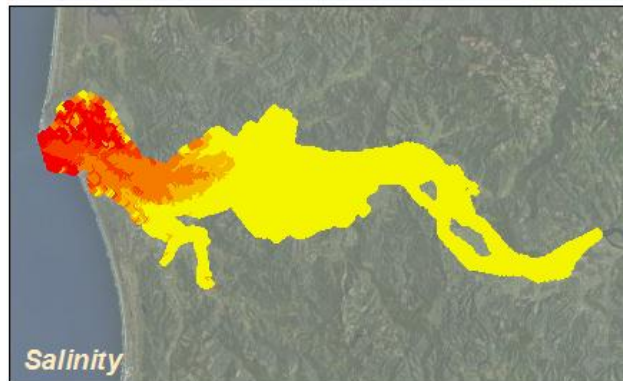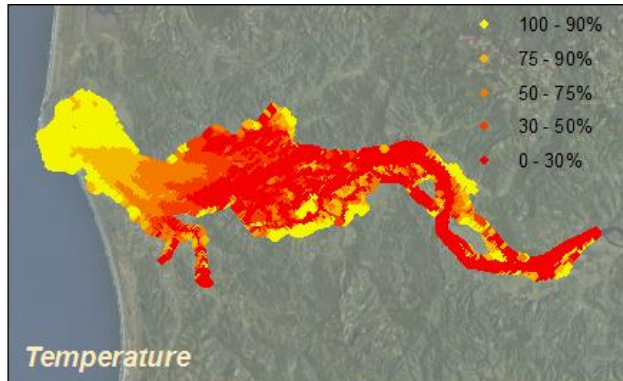
Tier 3 - Line of Evidence 3:
Priority tributaries in OR and WA Recovery Plans

- **Rationale:**
  - **Fall, late fall Chinook and to lesser degree chum can rear extensively in tidally influenced habitats of tributaries to lower Columbia River**

- **Methods:**
  - Incorporate WA and OR recovery plans for LCR salmonids
  - Protect habitats key to this stage of salmonid life cycle

- **Targets (Priority):**
  - **Very High:** Tidally influenced areas of tributaries identified as "primary" for *both* late fall/fall Chinook and chum
  - **High:** Tidally influenced areas of tributaries identified as "primary" for one (Chinook OR chum)
  - **Weighted:** Mainstem areas <25 km of tributaries listed as "primary" for fall Chinook
  - **Moderate:** Remaining tributaries and mainstem areas

Tier 3-Line of Evidence 3: Priority Tributaries in State Recovery Plans

Targets:
• Tidally influenced areas listed as primary for chum and/or Chinook
• Mainstem <25 km of primary fall Chinook tributaries

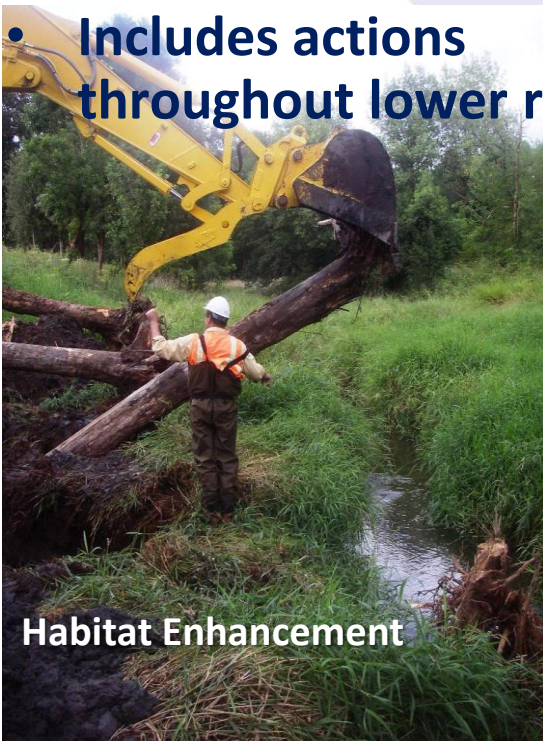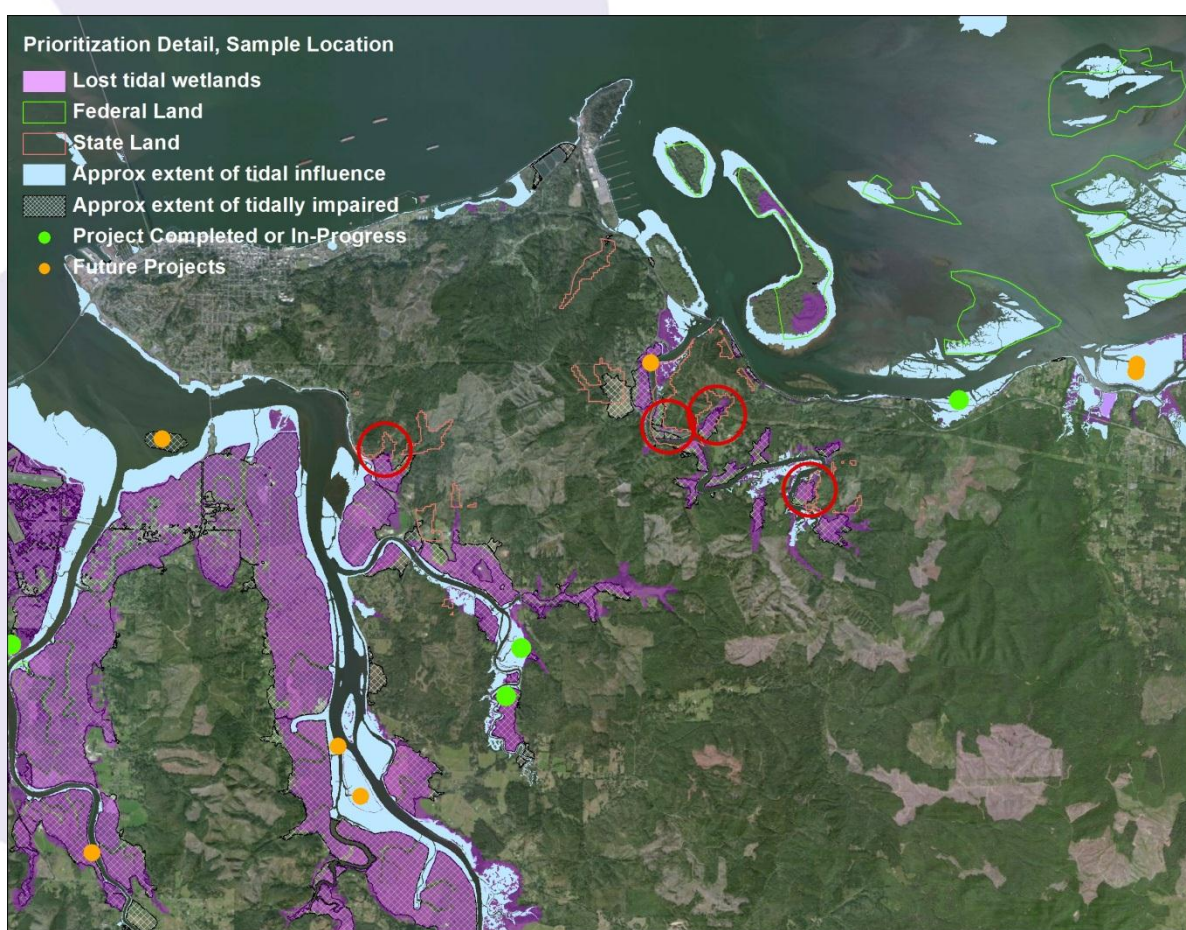| Tributary	Lower Columbia River Chinook Salmon (*Oncorhynchus tshawytscha*)			Lower Columbia River Coho salmon (*Oncorhynchus kisutch*)	Columbia River Chum salmon (*Oncorhynchus keta*)		Lower Columbia River Steelhead (*Oncorhynchus mykiss*)	
	spring	fall	late fall		summer	fall	winter	summer
Youngs Bay		stabilizing		stabilizing		stabilizing		
Big Creek		contributing		stabilizing		stabilizing		
Chinook, Deep, Wallacut Rivers		contributing		primary		**primary**	primary	
Grays River		contributing		primary		**primary**	primary	
Skamakowa Creek		**primary**		primary		**primary**	contributing	
Elochoman River		**primary**		primary		**primary**	contributing	
Mill Creek		**primary**		contributing		**primary**	primary	
Abernathy Creek		**primary**		contributing		**primary**	primary	
Germany Creek		**primary**		contributing		**primary**	primary	
Clatskanie River		**primary**		primary		**primary**		
Scappoose River		**primary**		primary		**primary**		
Cowlitz River		contributing		primary	contributing	contributing	contributing	
Toutle SF	contributing	**primary**		primary			primary	
Toutle NF	contributing	**primary**		primary			primary	
Upper Cowlitz	primary	stabilizing		primary			primary	
Cispus	primary	stabilizing		primary			primary	
Tilton	stabilizing	stabilizing		stabilizing			contributing	
Coweeman River		**primary**		primary		contributing	primary	
Kalama River	contributing	contributing		contributing		contributing	primary	primary
Lewis River (North Fork)	primary	**primary**	**primary**	contributing		**primary**	contributing	stabilizing
Lewis River (East Fork)		**primary**		primary		**primary**	primary	primary
Salmon Creek		stabilizing		stabilizing		stabilizing	stabilizing	
Willamette River	primary	contributing		primary		contributing	primary	
Clackamas River	primary	contributing		primary		contributing	primary	
Washougal River		**primary**		contributing		**primary**	contributing	primary
Sandy River	**primary**	contributing	**primary**	primary		**primary**	primary	
Lower Gorge Tributaries		contributing		primary		**primary**	primary	

Tier 3 - Line of Evidence 4:
Tidally Impaired Floodplain Habitat

- **Floodplain habitat disconnected or hydrologically altered by dikes, levees, tidegates, etc**

- **Represents habitat that could be restored as juvenile salmon rearing/refugia, contribute macrodetritus to food web, contribute to flood attenuation, water quality improvements and other ecosystem services**

- **Potential Target:**
  - 63,000 acres of potential floodplain habitat
- **Follow Up Work:**
  - Identify where habitats are recoverable
  - Overlay on land use maps to determine next steps

Restoration Inventory

- **Addresses step 4 of Approach in Johnson et al. (2003)**

- **Database describing over 200 identified actions and status**

- **Includes actions throughout lower river**

Prioritization Detail, Sample Location
- Lost tidal wetlands
- Federal Land
- State Land
- Approx extent of tidal influence
- Approx extent of tidally impaired
- Project Completed or In-Progress
- Future Projects

Habitat Enhancement

Passage Improvements

Floodplain Reconnections

Action Effectiveness Program (AEM)

- **Addresses step 5 of Approach in Johnson et al. (2003)**

- **AEM for individual restoration projects**
  - 4 long term, intensively monitored sites
  - Represent different habitat types, restoration actions, river locations
  - Basic pre/post construction collected at other sites

- **System of Reference Sites**
  - To be used as targets for restoration actions
  - 43 sites representing different habitat types, river locations
  - Measured hydrology, channel morphology, vegetation, elevation profiles, and sediment accretion

- **Cumulative Effects of Restoration Study**
  - Developed standardized monitoring, analyses protocols
  - Meta-analysis to roll-up, evaluate basin-wide efforts

Coordinated Regional Effort to ensure:

✓ **Data are comparable across sites and time for similar types of actions and habitats**

✓ **Results are scalable**

Acknowledgements

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Contact for More Information:
Catherine Corbett (503) 226-1565 ext 240, ccorbett@lcrep.org