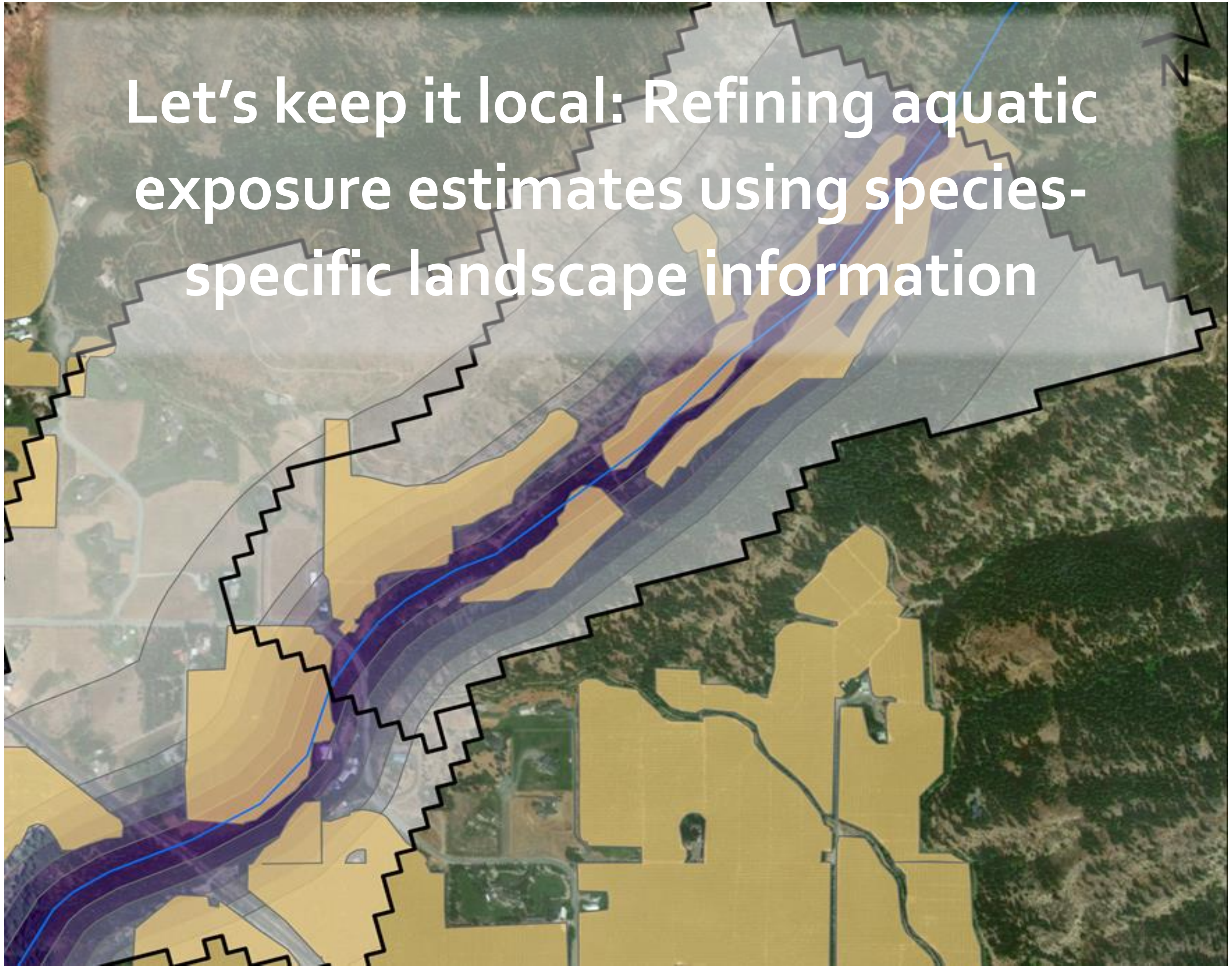
Let’s keep it local: Refining aquatic exposure estimates using species-specific landscape information



SETAC North America 43rd Annual Meeting

Bridging Innovation and Sustainability

Session: Developing Endangered Species Assessments for Pesticides in the United States: Progress to Date and Next Steps

November 17, 2022

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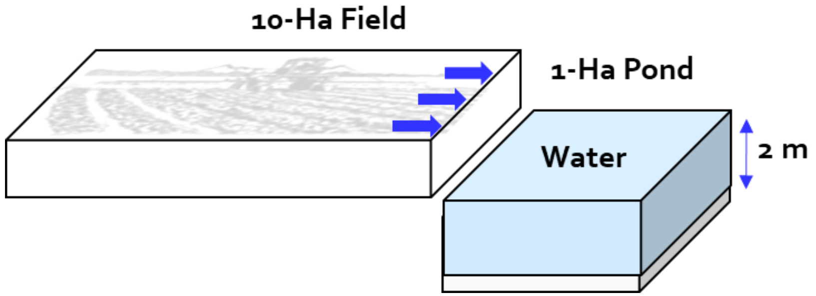
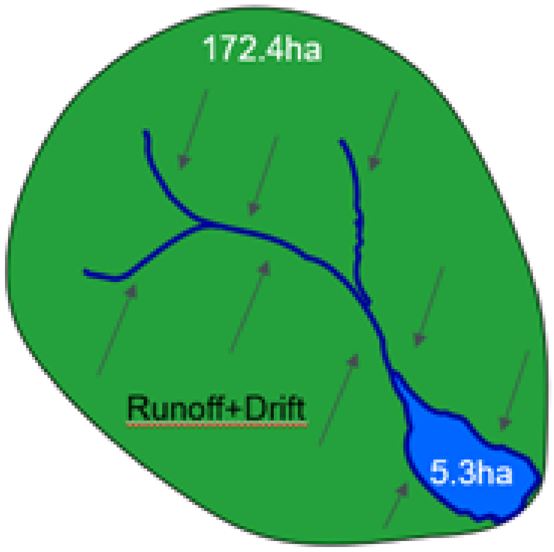
Introduction

- Prospective aquatic exposure modeling is a key aspect in the assessment of potential jeopardy during the preparation of a Biological Opinion (BO)
- The Biological Evaluation (BE) provides the foundation of aquatic exposure estimates
- Subsequent refinements incorporating spatial, temporal, and pesticide usage variability can be applied to better inform the weight of evidence process
- Distributions of exposure identify locations of and influences on potentially high exposures allowing for evaluation and appropriately targeted mitigations
- Development of the modeling framework “PWC+”
  - A highly efficient & structured approach that builds on the EPA’s aquatic modeling,
  - to increase the spatial/temporal context and resolution of exposure estimates,
  - and produces well-defined and reproducible species-specific estimated aquatic concentrations

Prospective aquatic modeling used in Biological Evaluation

- The BE uses well-established pesticide fate and transport models
- Applied to a standardized set of crop/soil/weather scenarios
- Exposure estimates are based on 30 years of model simulation implementing labeled uses of the pesticide
- Surface water scenarios
  - Static water: field-> pond
  - Flowing water: catchment -> reservoir





PWC+ refinements

- Refinements incorporating spatial, temporal, and usage variability
- Address uncertainties that have been mentioned in the Revised Methods document, BEs and BOs
- Approach continues with BE scenarios and assumptions, but applies <u>species-specific</u> landscape information
- Illustrate approach using the Upper Columbia River Steelhead Trout (UCRST), Wenatchee Major Population Group (MPG)

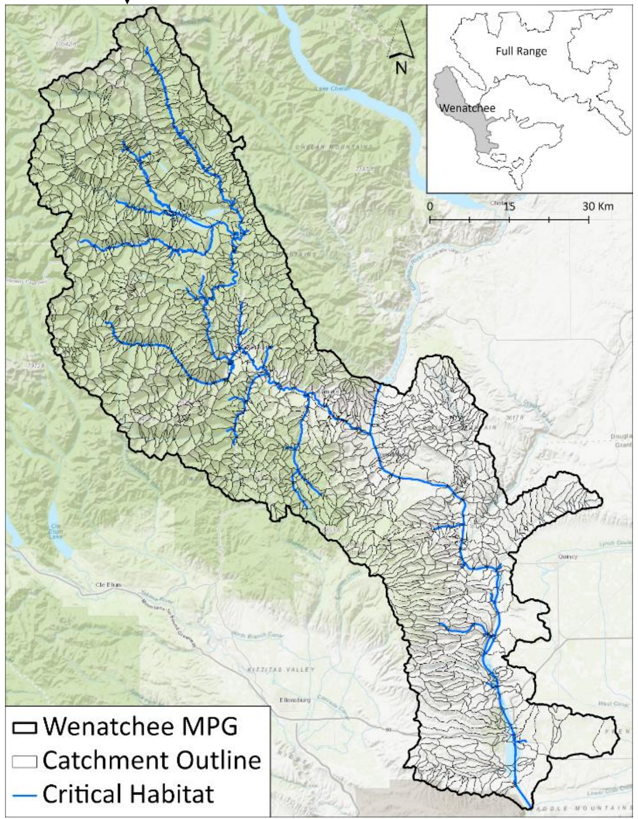
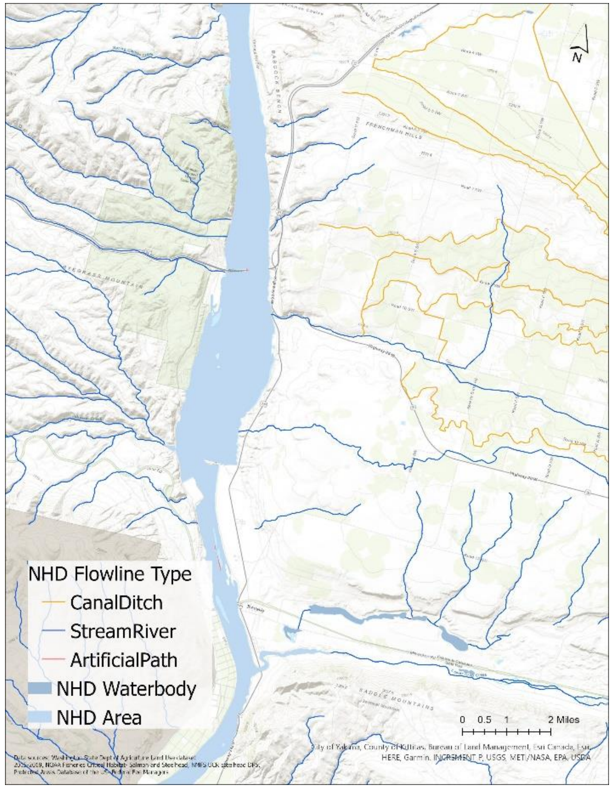


Photo Credit: NOAA (https://www.fisheries.noaa.gov/species/steelhead-trout)

PWC+ refinement framework

- PWC+ is a series of steps that sequentially refine the baseline PWC EEC values reported in the BE
- Applied at the NHD+ level as a basic unit of analysis (e.g., catchments)
- Unit-level analysis allows for species relevancy
- Stepwise approach improves transparency and usability



Step 1 — PWC by UDL
- Standard EPA Scenario for HUC
- One EEC per UDL (highest EEC of all labeled uses)
- 12 EECs per Range / CH
- 100% Crop adjacency
- 100% PCA
- 100% PCT

Step 2 — PWC for Catchment
- PWC EECs scaled by UDL % within catchment
- 1 EEC per catchment
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Step 3 — Proximity adjusted PWC
- PWC EECs by 8 Proximity Zones
- 0-30, 31-60, 61-90, 91-120, 121-150, 151-300, 301-900, >900
- Runoff/Erosion: 0-90m
- Drift: 0-300m (ground, airblast)
- 100% PCA
- 100% PCT

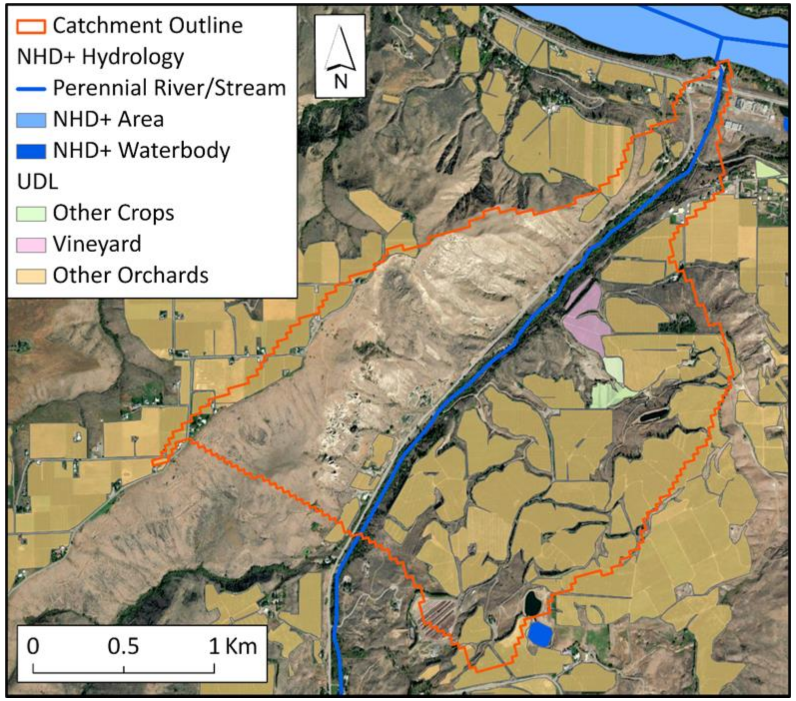
Step 4 — PCA + Proximity adjusted PWC
- PWC EECs by 8 Proximity Zones
- Actual PCA by Proximity Zone
- 100% PCT

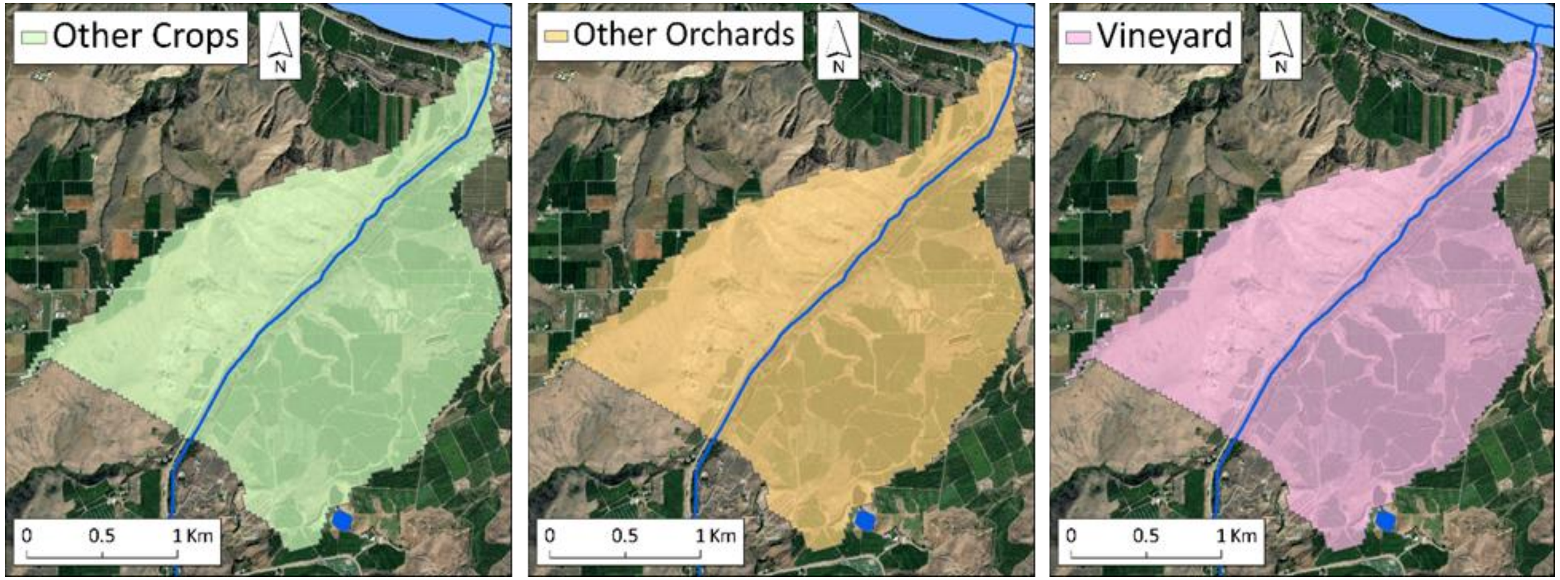
Step 5 — Usage + PCA + Proximity adjusted PWC
- PWC EECs by 8 Proximity Zones
- Actual PCA by Proximity Zone
- UDLs with <u>any</u> reported usage = 100% PCT
- UDLs with <u>no</u> reported usage = 2.5% PCT
  - Uniform Distribution Method
  - Multiplier Method

Step 6 — PCT + PCA + Proximity adjusted PWC
- PWC EECs by 8 Proximity Zones
- Actual PCA by Proximity Zone
- State-specific PCT applied
  - 5-year maximum
  - Uniform Distribution Method
  - Multiplier Method

The starting point: Baseline EECs from BE **Step 1**

- Baseline EECs reflects assumptions regarding landscape factors:
  - 100% of the crop area is directly adjacent to the water body (proximity)
  - 100% of the catchment area is cropped for each Use Data Layer (UDL) (PCA)
  - 100% of the crop is treated (PCT)
- One EEC for each UDL in the catchment



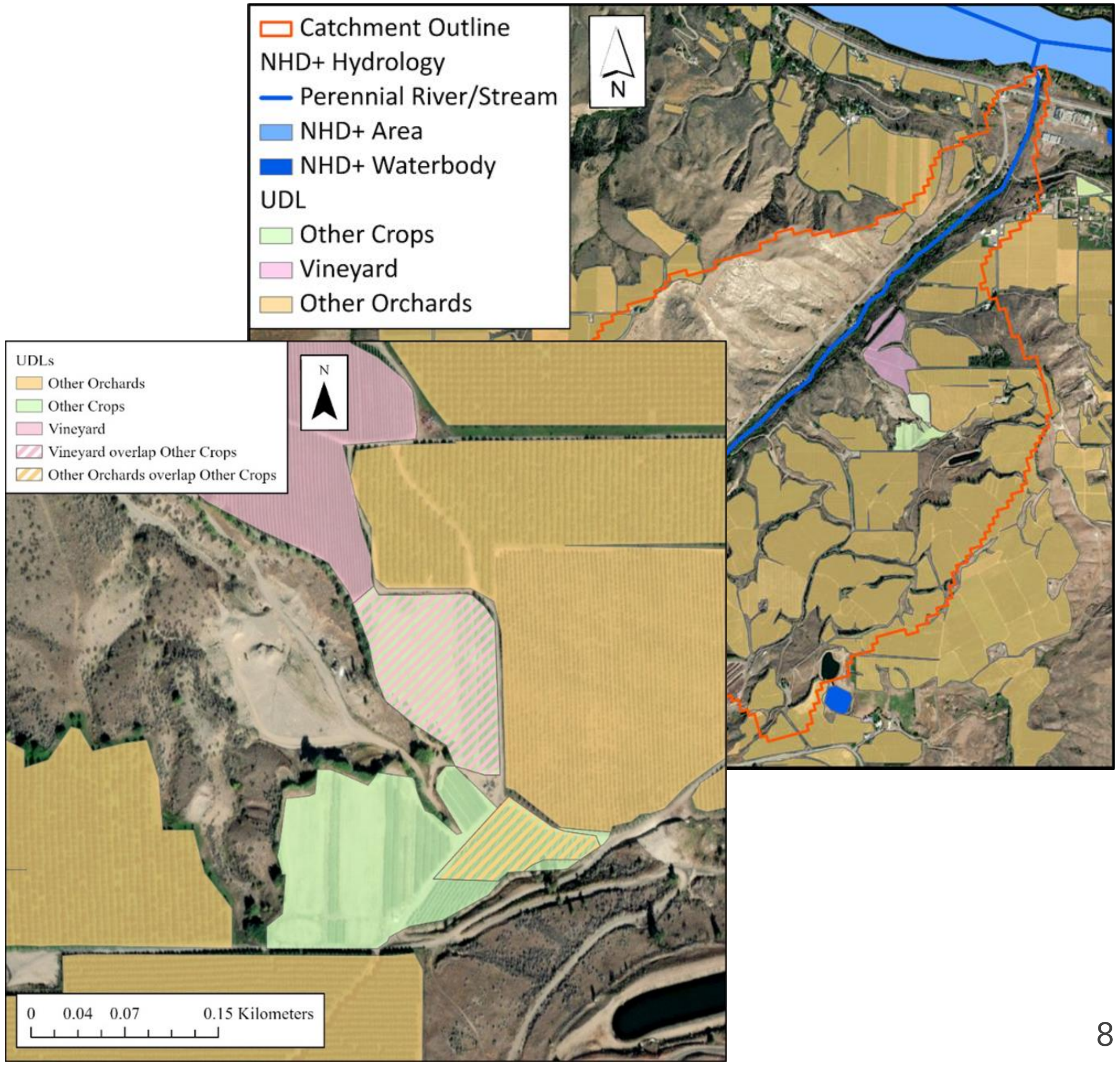


*Note, UDLs derived from WA State Department of Agriculture, Agricultural Land Use dataset
https://agr.wa.gov/departments/land-and-water/natural-resources/agricultural-land-use

Addressing real world crop heterogeneity: UDL Proportioned EECs

Step 2

- Catchments usually contain more than one UDL
- Generate a single EEC that is representative of the UDLs present in the catchment (i.e., proportioned)
- Each UDL contributes a fraction of its baseline EEC according to the % of the overall UDL area that it comprises

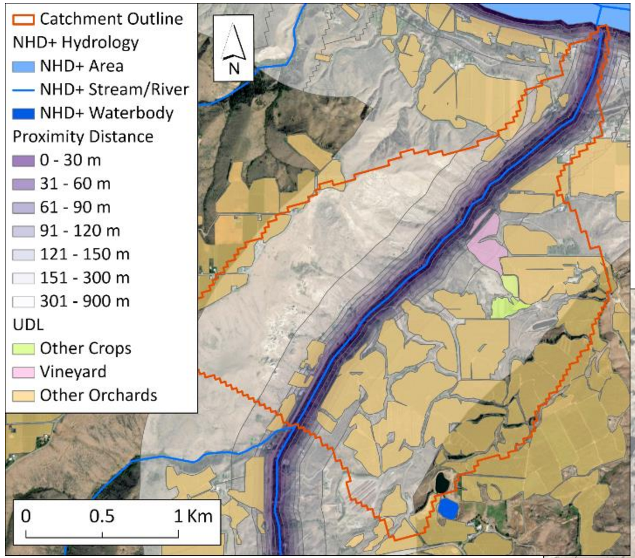


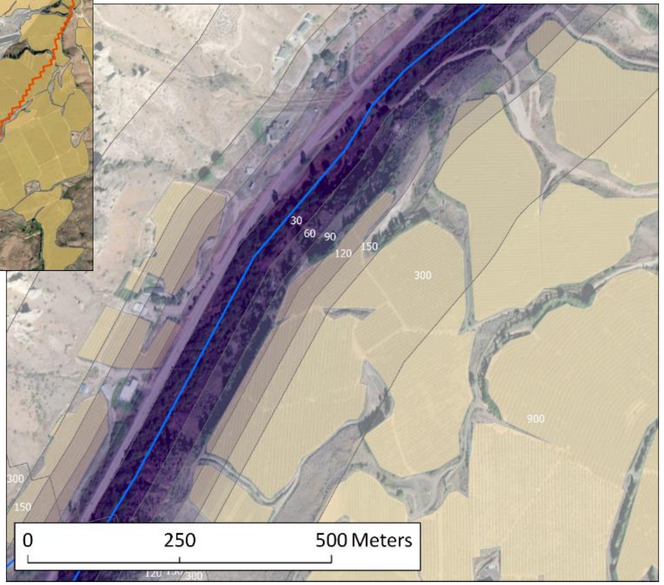
- UDLs have an inherent potential for spatial overlap
- UDL overlap scaling factor used when fields have more than one UDL assigned
- Scaling factor = “AllAg” footprint area / ΣUDL area
- Scaling factor applied equally to all UDLs

Including proximity of crop to water

Step 3

- Starting assumption is that all crop contributes loading as if it were directly adjacent, but loading generally decreases with distance
- Eight proximity zones (PZs) created around water bodies
- Additional PWC runs to align with proximity zones adjusting drift deposition based on AgDRIFT®
- Still assumes catchment is 100% cropped and treated
- Which proximity zones included for simulation of runoff and/or drift loading is configurable





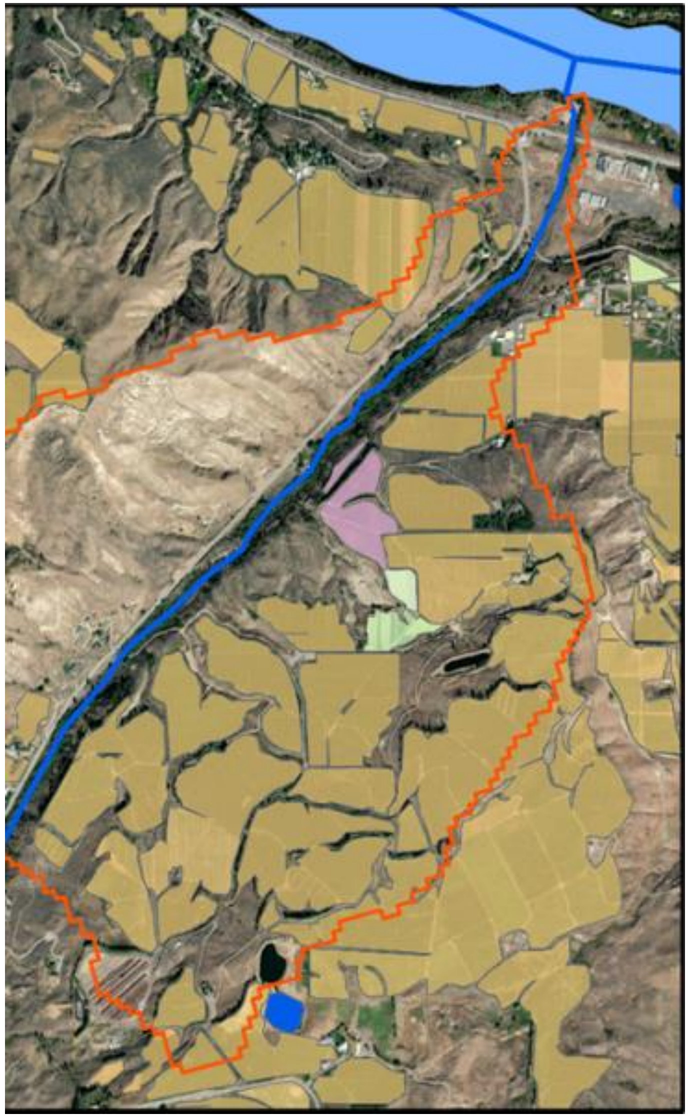
Proximity Zone Distance	PZ Area (ha)	% Catchment Area	UDL Composite Area (ha)	% UDL Composite Area
0-30m	20	4%	0	0%
31-60m	20	4%	<1	<1%
61-90m	19	4%	1	1%
91-120m	18	4%	4	2%
121-150m	18	4%	6	3%
151-300m	80	17%	28	16%
301-900m	247	51%	94	53%
>900m	61	13%	43	24%
	484	100%	176	100%

Addressing cropping density: Percent Crop Area

Step 4

- PCA used as a multiplier to baseline EEC Step 1
- Applied to each UDL / proximity zone combination
  - Contribution to overall catchment EEC
- Contributing EECs summed for all UDLs / PZs for catchment total EEC
- PCA 'multiplier' can be used to address 15-year assessment window for ESA
- Still assumes 100% UDL is treated

UDL	PCA
Other Orchards	38.0%
Vineyard	2.0%
Other Crops	0.7%
Total	40.7%



Incorporating pesticide usage

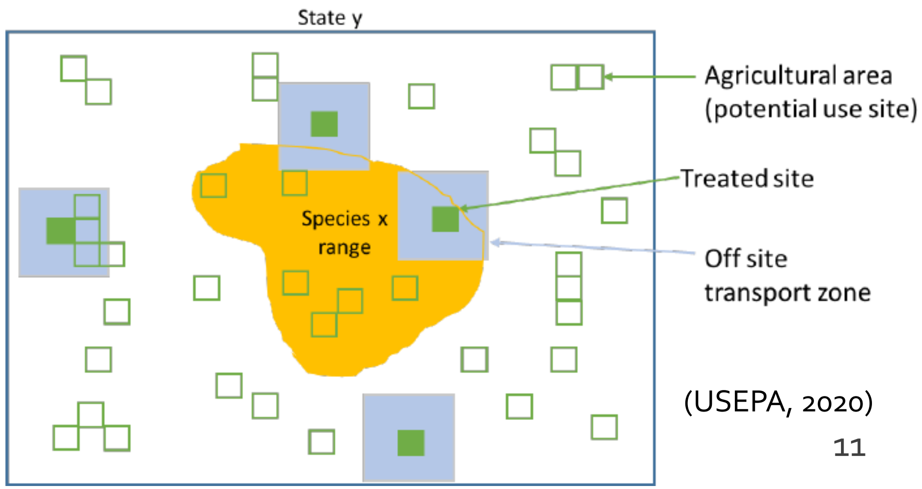
Steps 5 & 6

Uncertainty in state-level PCT and method to distribute treated acres to species range/CH

1. UDL-level PCTs
   - Combine usage data for all crops within a single UDL
   - Increases sample size and weights PCT according to most treated crops
   - Consistent with concept used to develop CDL-based UDLs
2. 100% treated for any UDL containing a labeled crop with *any* reported usage in state

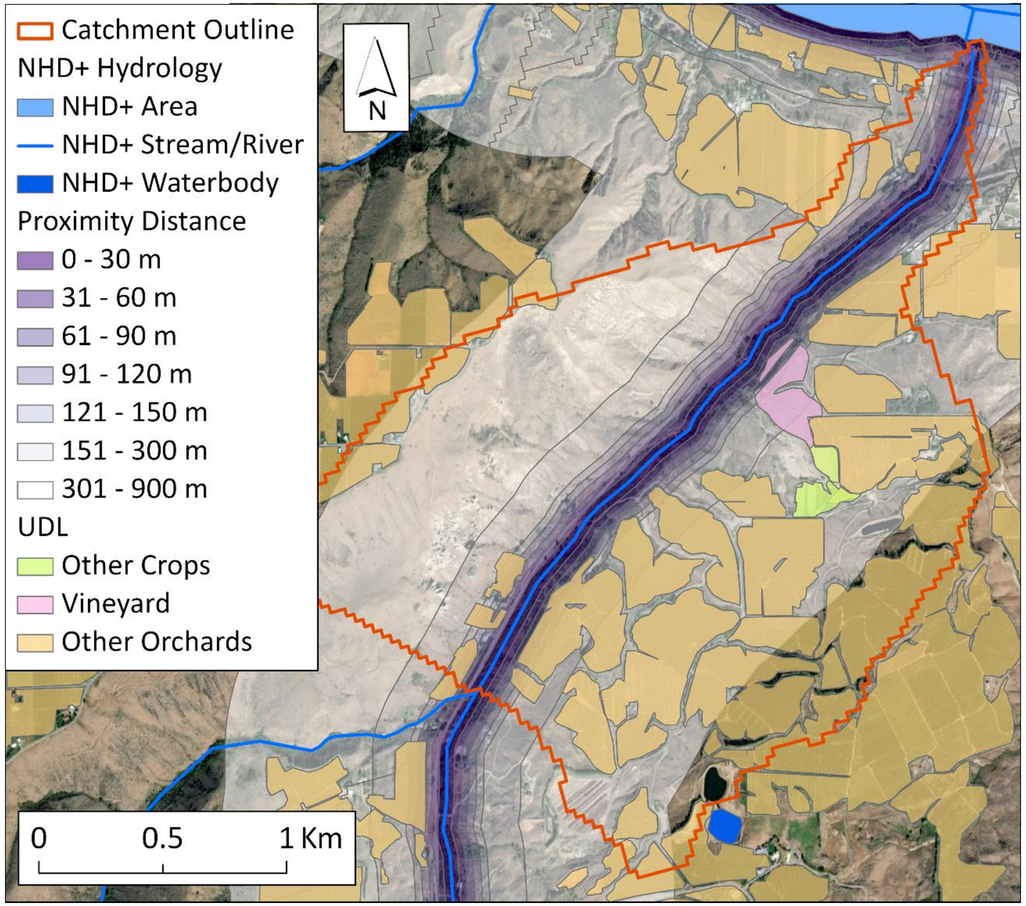
   Step 5
3. BE Uniform Method of treated acre distribution with a 'PCT multiplier'

   Step 6
   - Increased clarity of what specific exposure results represent
4. Minimum PCT of 2.5% for all crops/UDLs (even when no usage reported)



(USEPA, 2020)

Single catchment using PWC+



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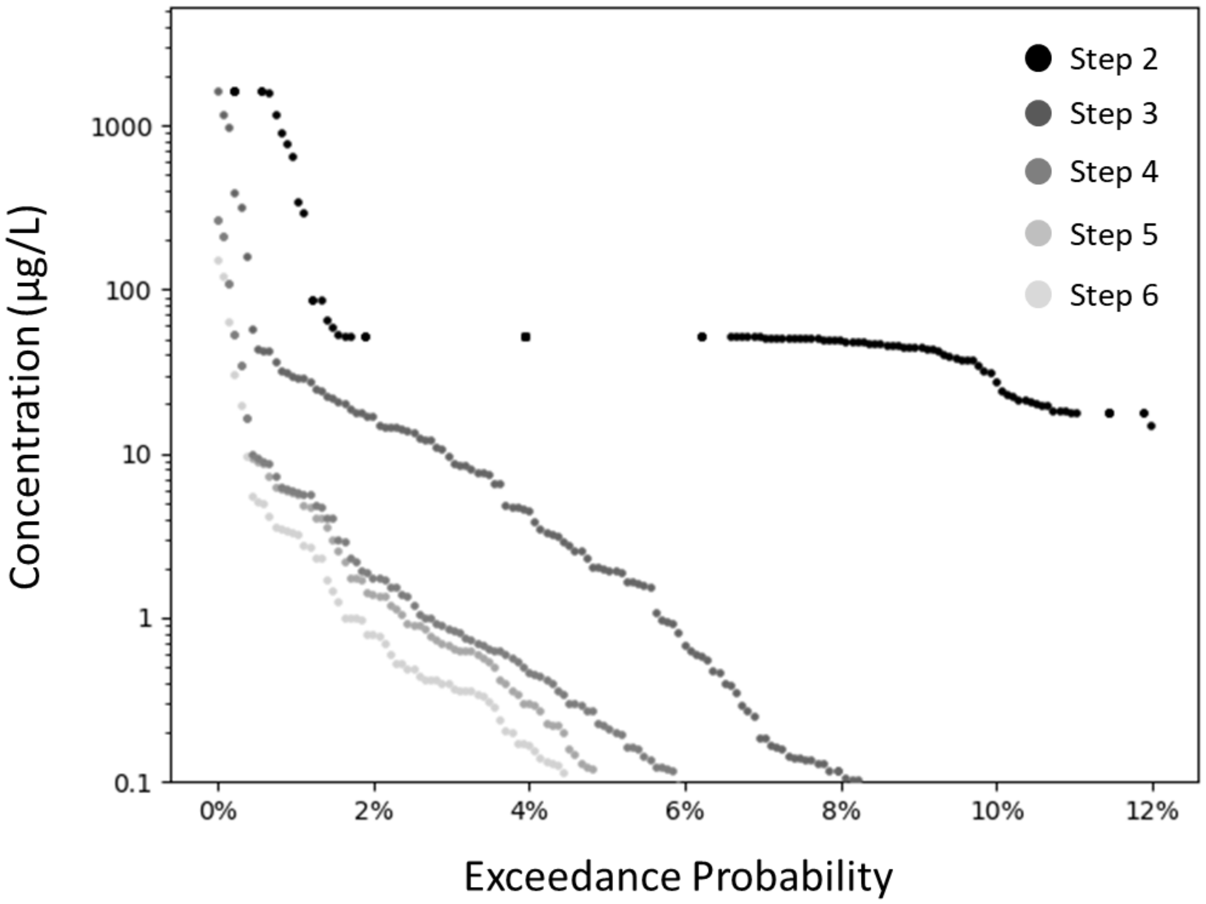
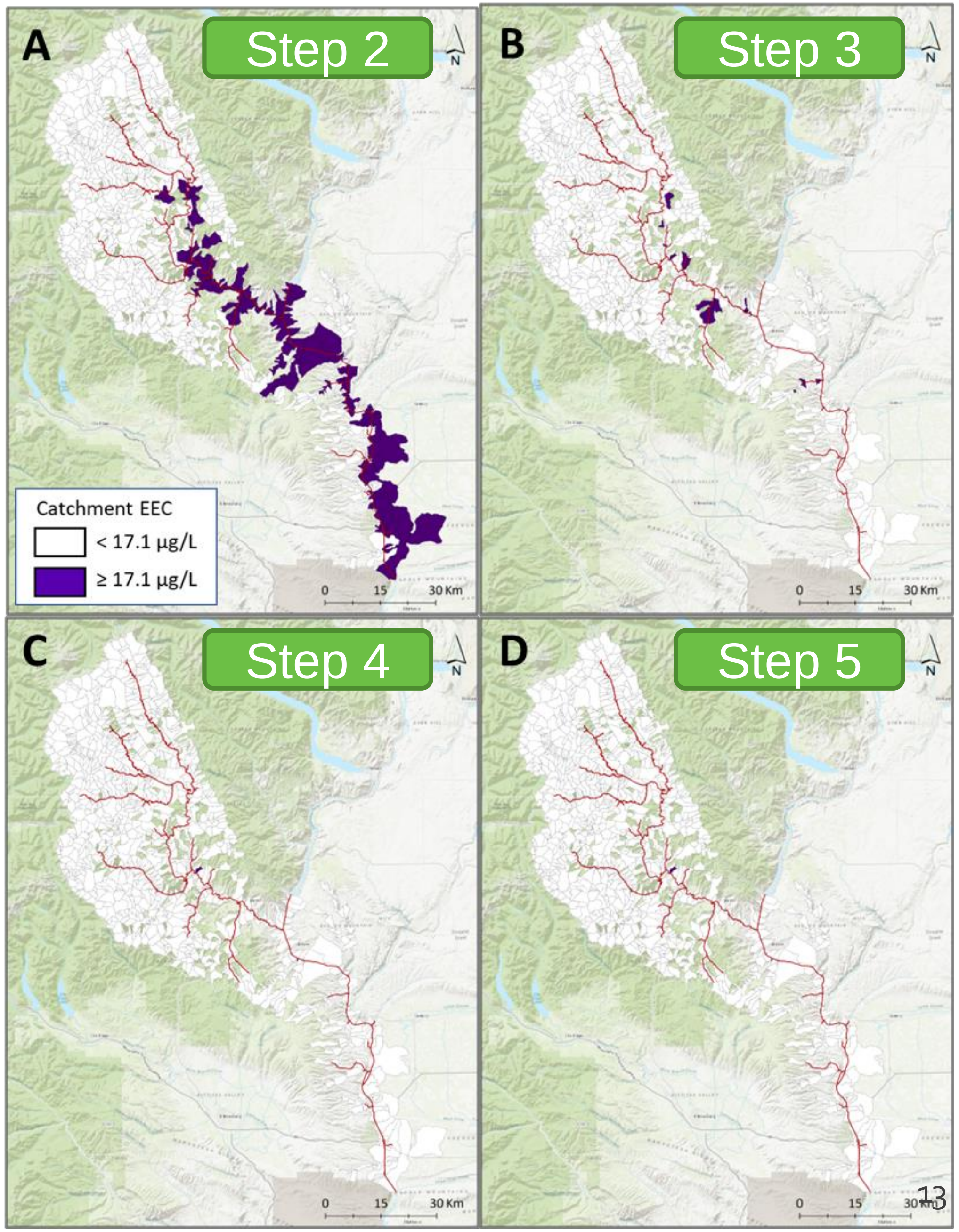
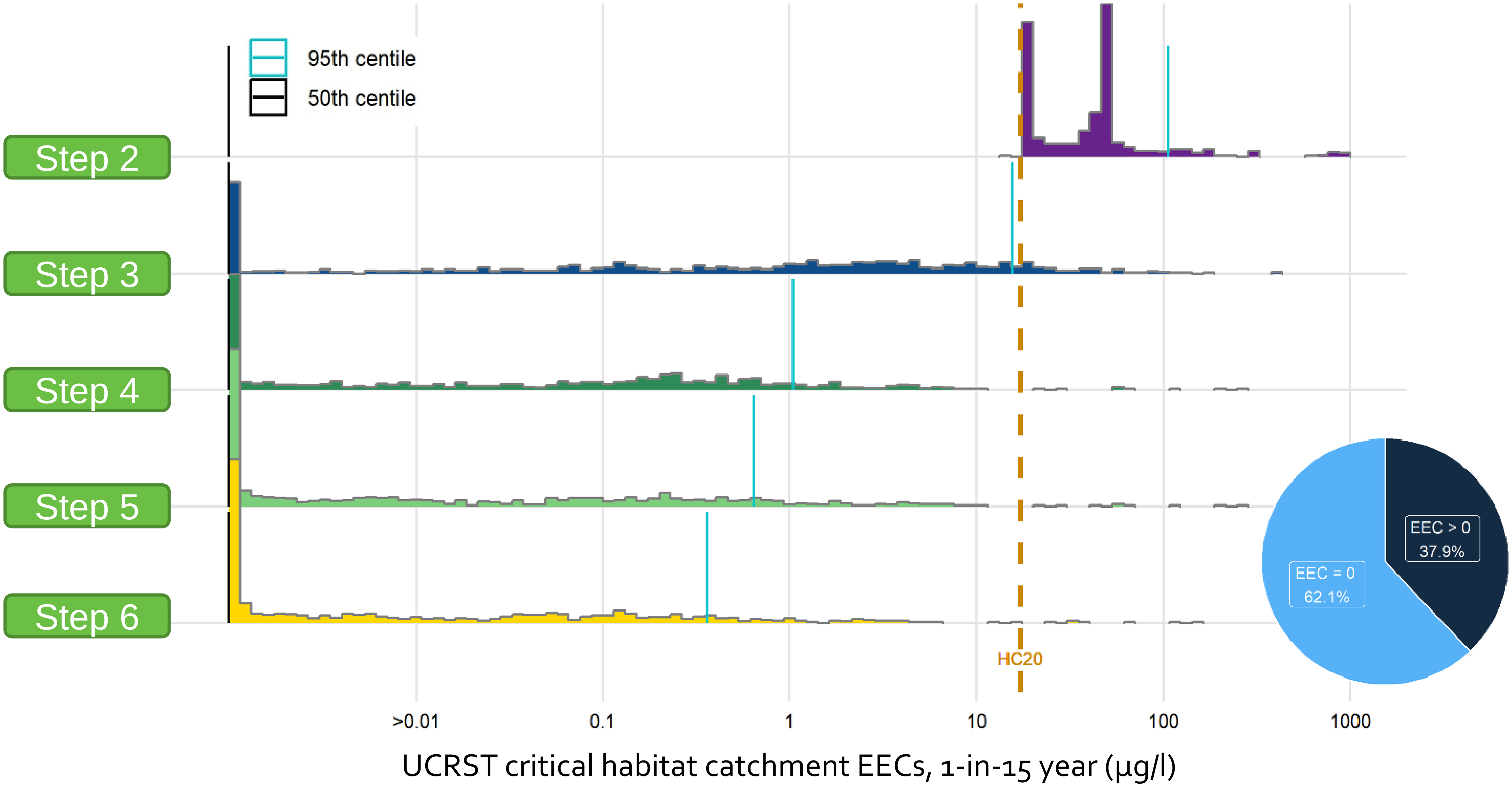
Distribution of catchment-level EECs

- Exceedance probability of 1,353 catchments in Wenatchee MPG at each PWC+ Step



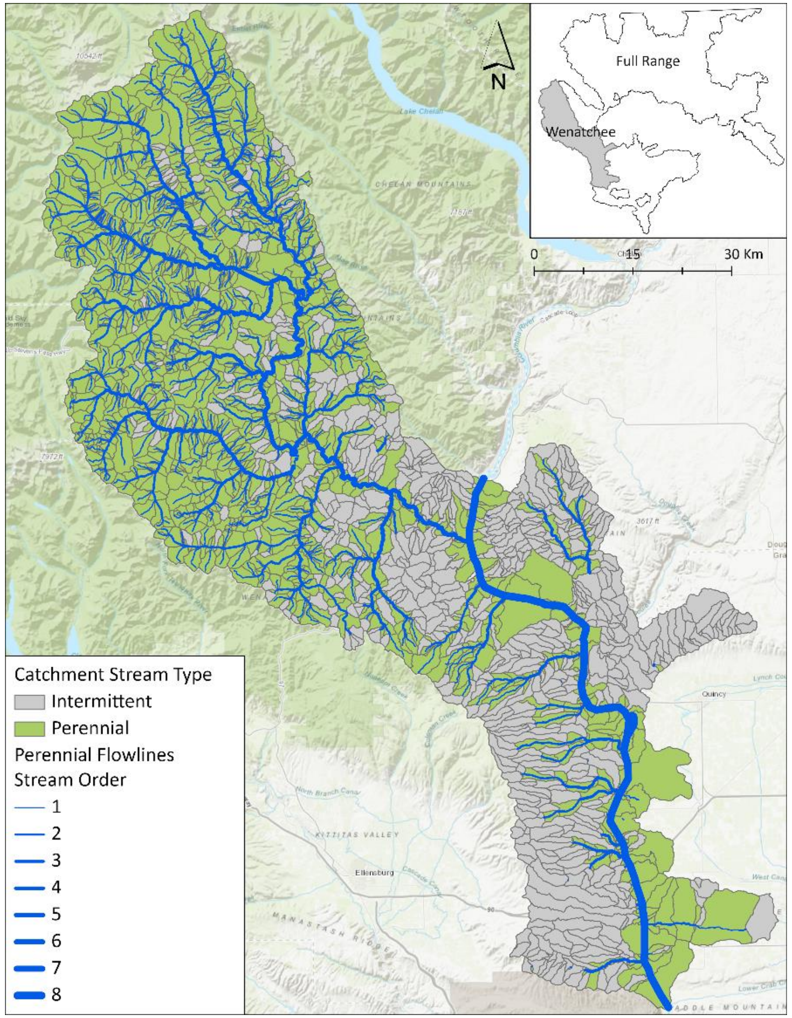


Frequency of threshold exceedances

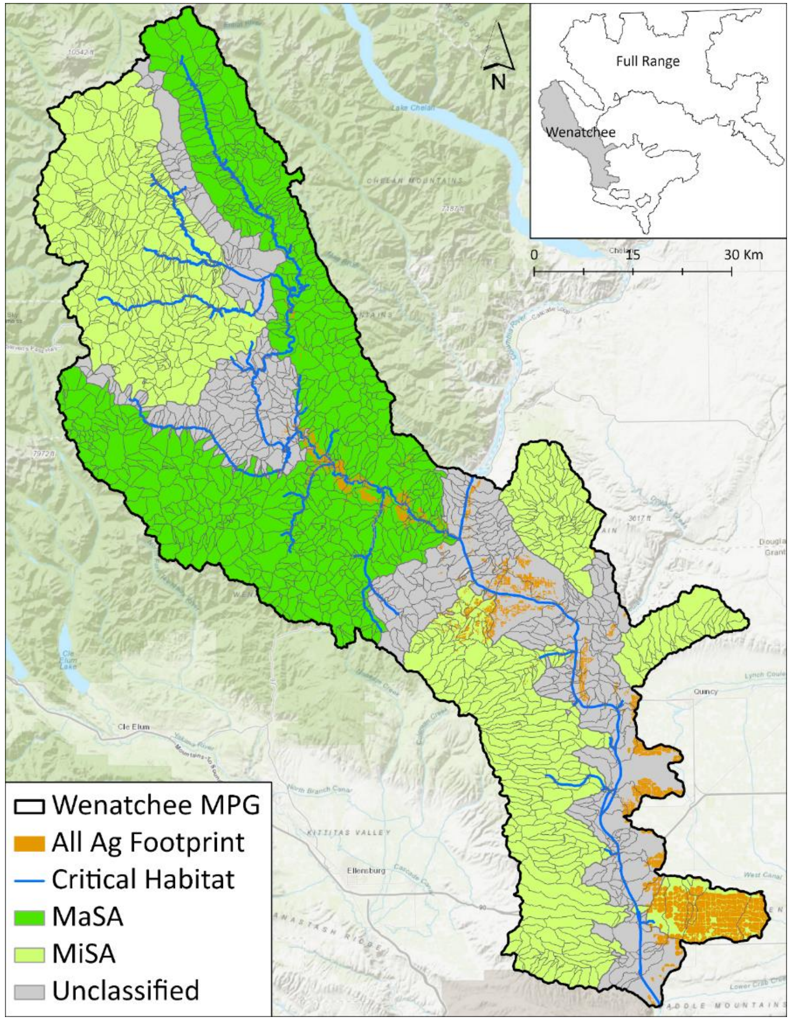


Flexibility in catchment aggregation and/or filter to species-relevant groupings

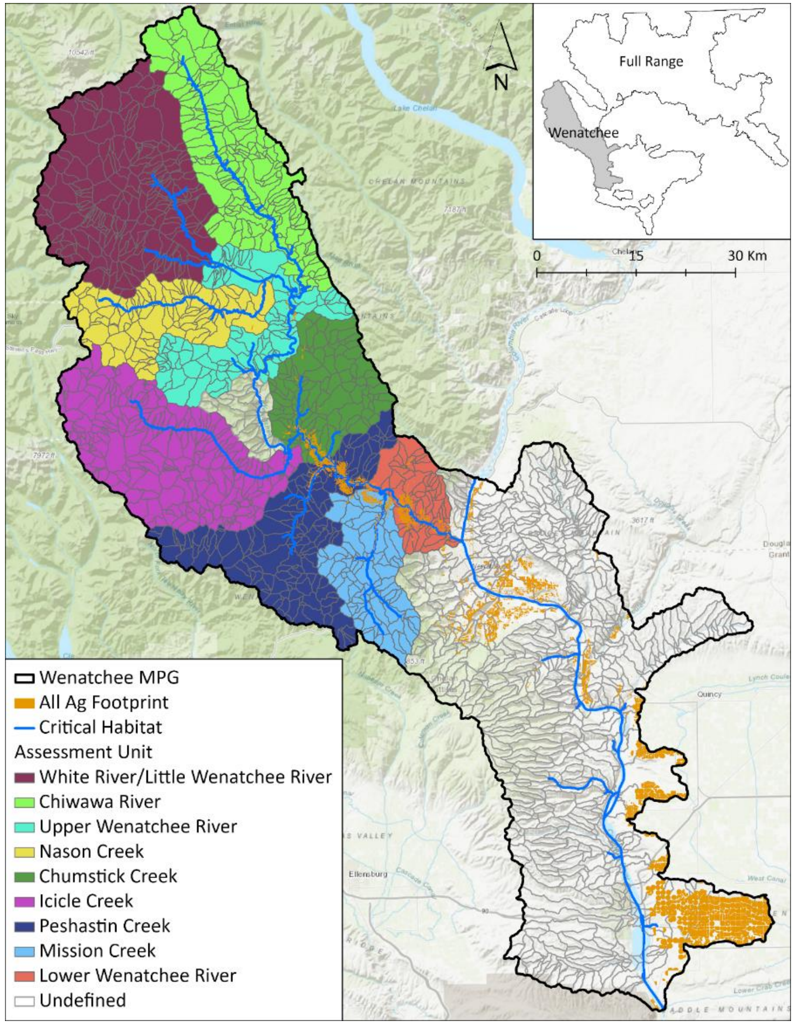
Stream order & Permanence



Spawning Groups



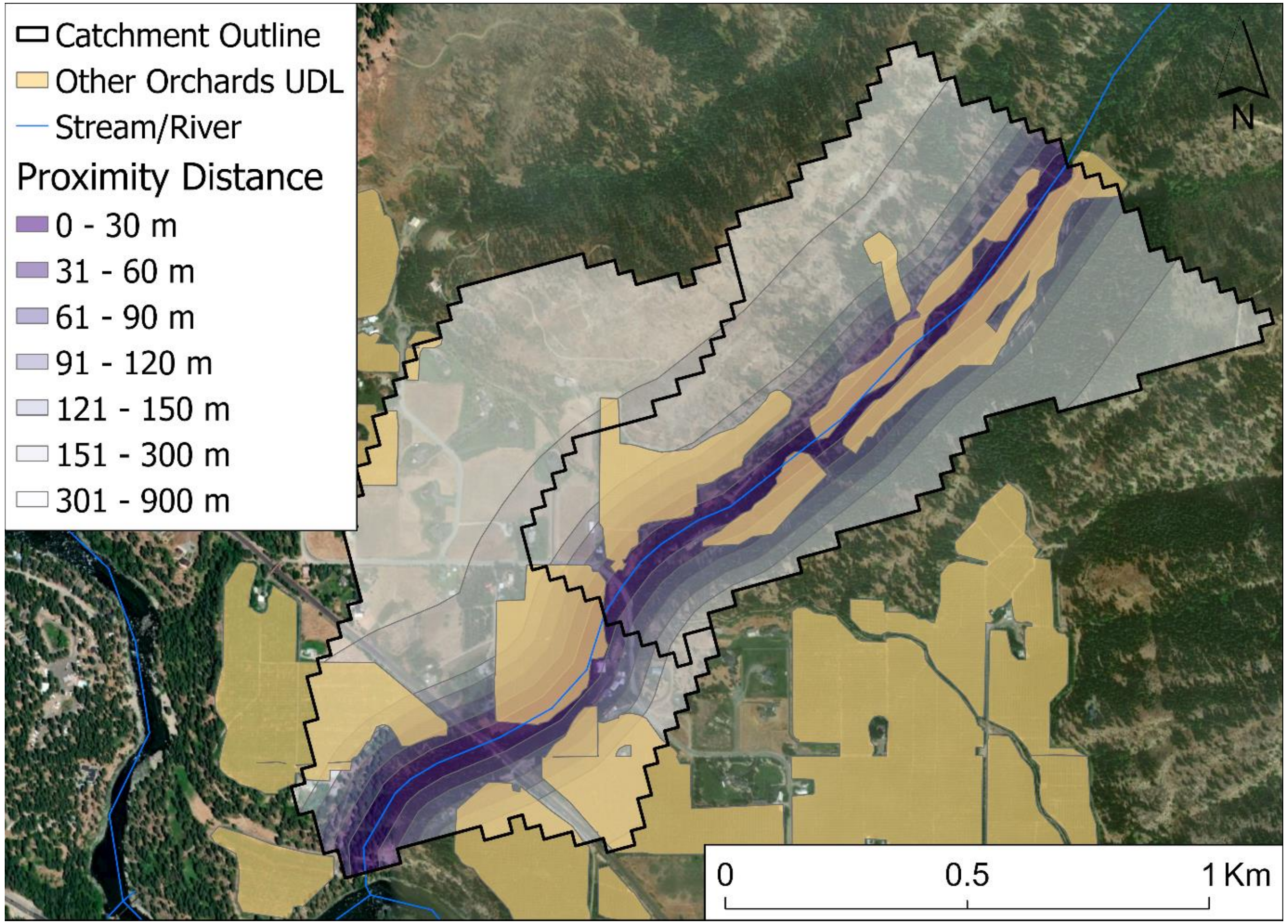
Assessment Units



A biological strategy to protect and restore salmonid habitat in the Upper Columbia Region. A Draft Report to the Upper Columbia Salmon Recovery Board from The Upper Columbia Regional Technical Team. 2017

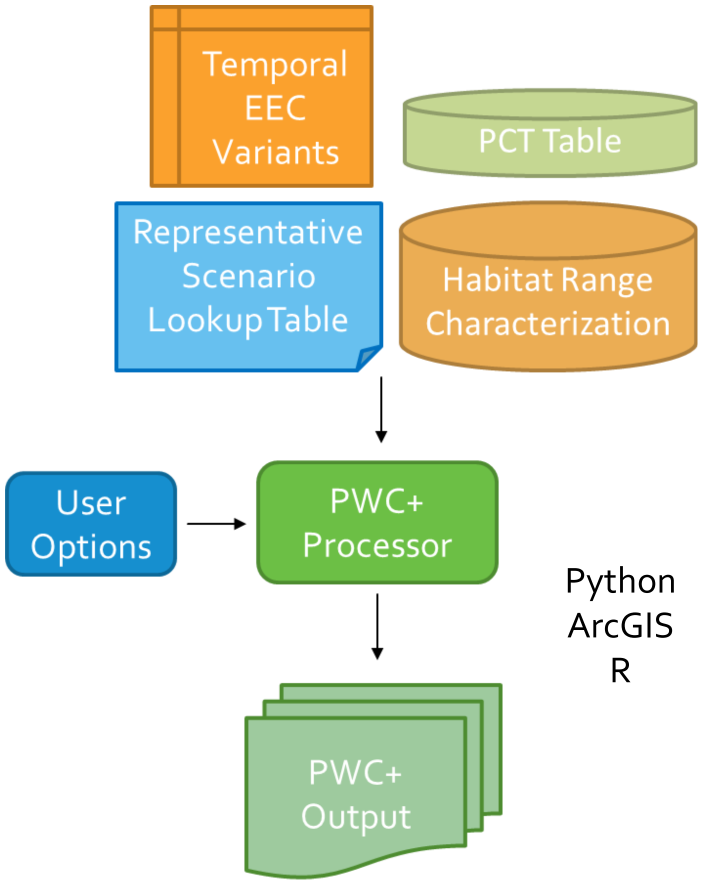
Localized Species Avoidance (LSA)

- Map shows top two ranked catchments when landscape proximity and landscape PCA are applied (i.e., Step 4)
  - Includes large amount of OtherOrchards UDL located near the stream
  - This situation presents the greatest likelihood for carbaryl loadings to the waterbody
- Can identify and apply localized mitigations or avoidance to appropriate set of catchments
  - i.e., apply where they may be needed rather than over entire species range



PWC+ framework builds on BE aquatic modeling as a foundation

- EPA aquatic scenarios refined with species-specific landscape information
  - Cropping density, proximity and usage
  - Optionally, alternative usage information and/or temporal EEC endpoints
  - Ideal for probabilistic implementation
- Overall approach:
  - Maintain assumptions from BE modeling
  - Incorporate landscape variability where it can be quantified
  - Address uncertainty with user options to provide context and customization
- Driving factors for development:
  - Efficient
  - Transparent
  - Reproducible
  - Documented
- Implementation of refinements allows us to:
  - Understand where higher concentrations may occur
  - Determine the local driving factors for that concentration
  - Aid in the development of landscape-specific avoidance or mitigations



THANK YOU

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