

# Land Cover for Environmental Applications

Kevin Fuchs

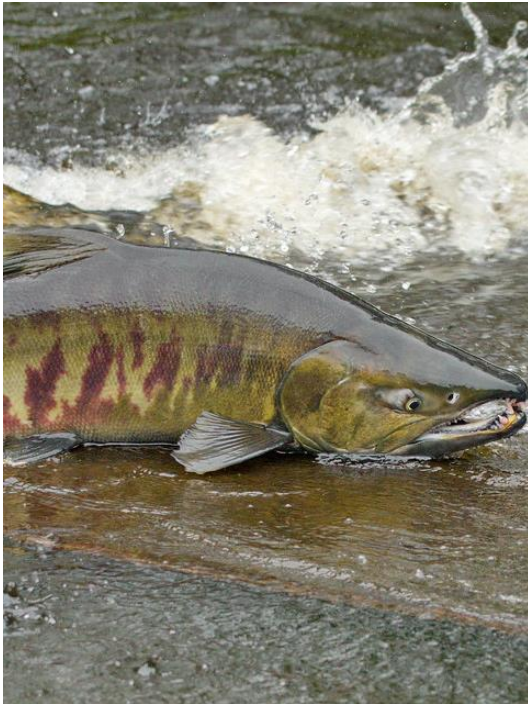
GIS & Imagery Analyst, Habitat Program

5/20/2026



Washington  
Department of  
**FISH &  
WILDLIFE**

# Washington Dept. of Fish and Wildlife



**Preserve**

**Protect**

**Perpetuate**

**Fish, Wildlife, and Ecosystems**

All while providing sustainable fish and wildlife recreational and commercial opportunities.

# Land cover classes

- Trees
- Shrub
- Herbaceous
- Ground
- Stream Gravel
- Water
- Nearshore
- Built



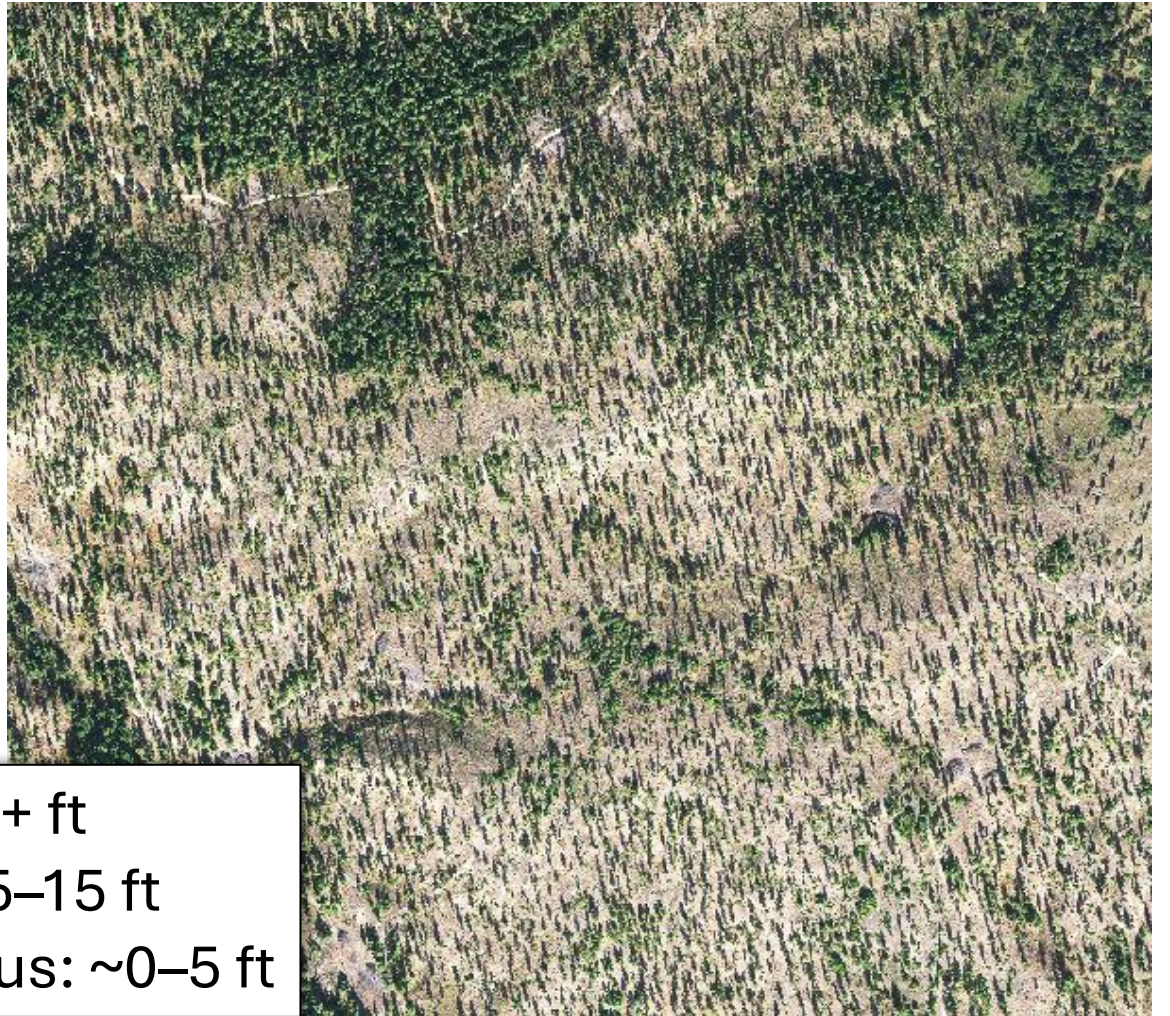
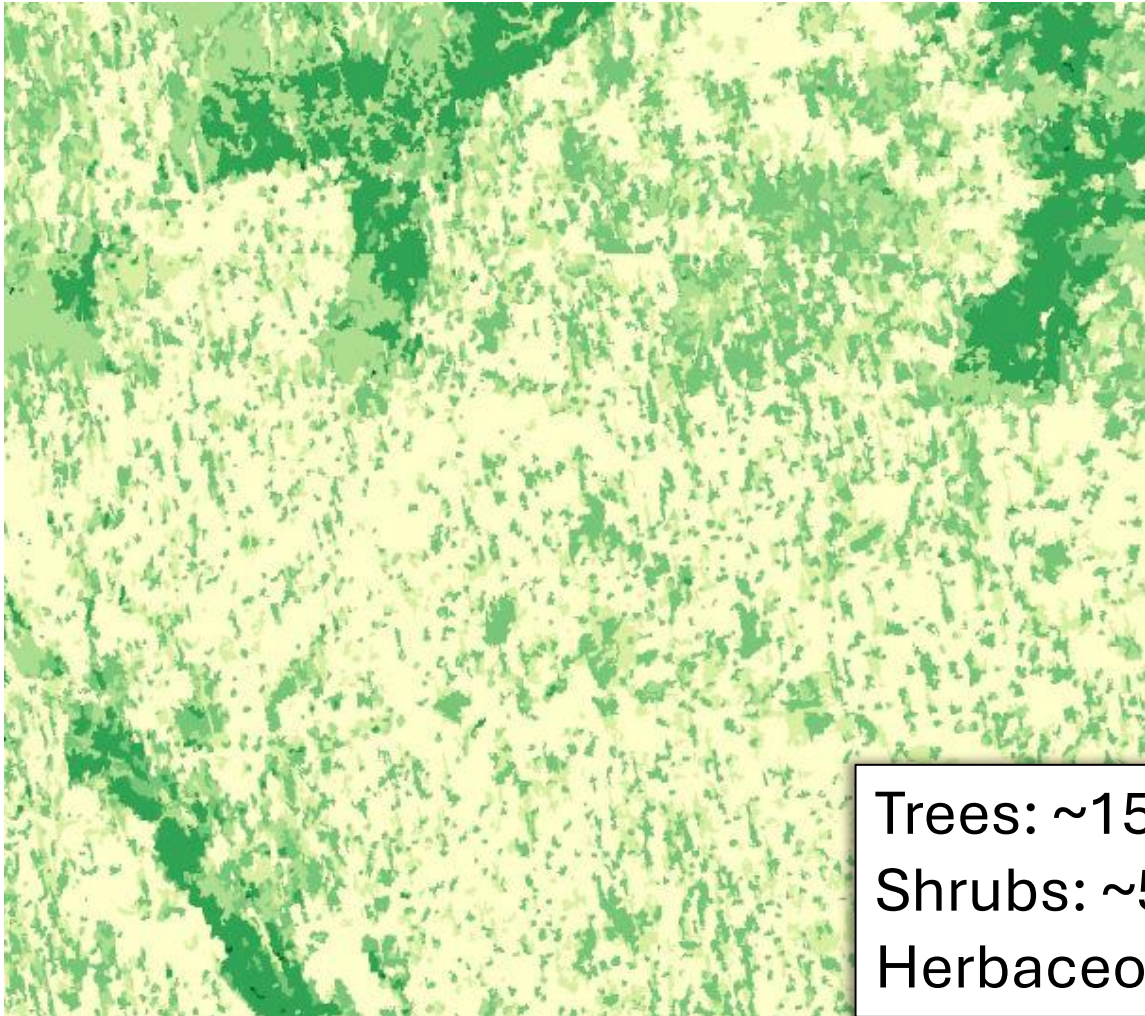
# Modeled height

## Height (ft)

- 0 - 10
- 11 - 20
- 21 - 50
- 51 - 80
- 81 - 110
- 111 - 255

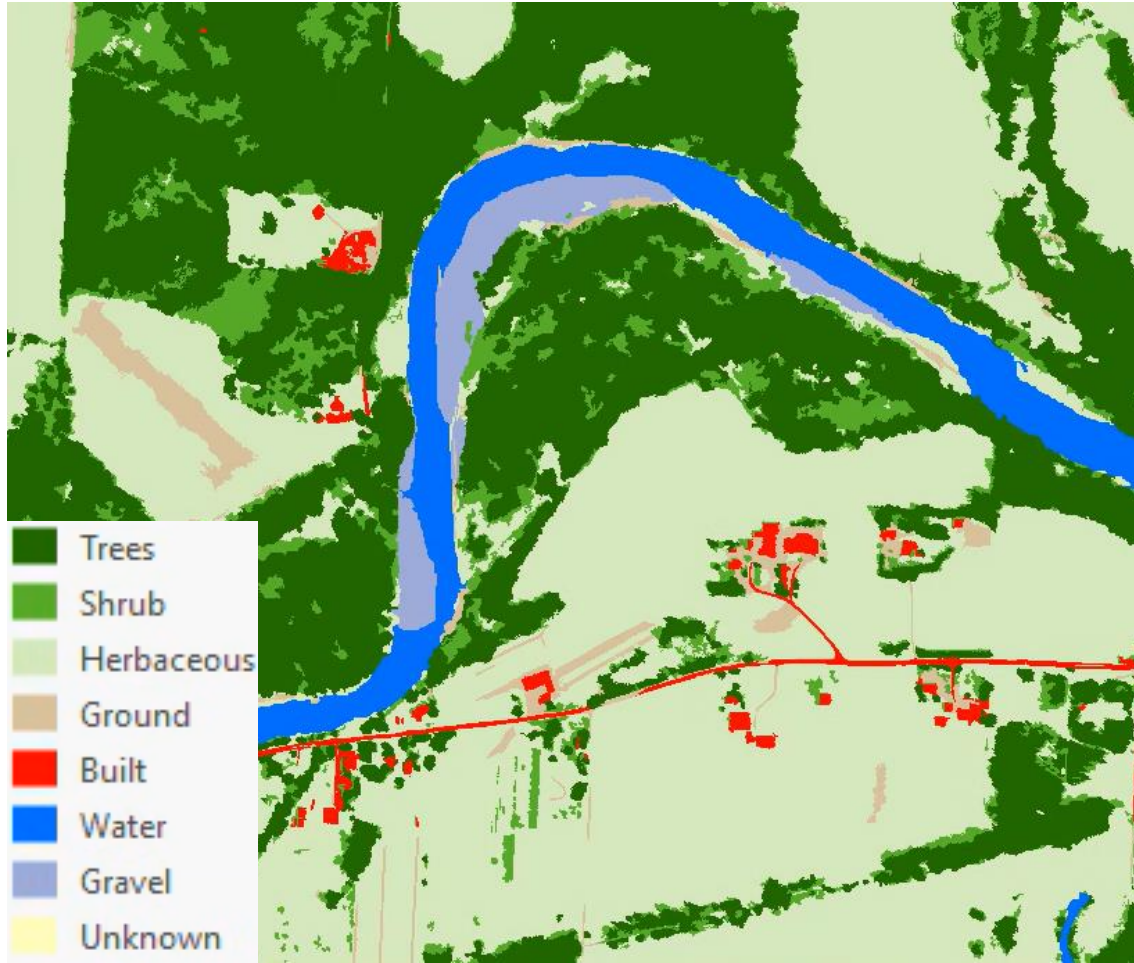


# Vegetation height



Trees: ~15+ ft  
Shrubs: ~5–15 ft  
Herbaceous: ~0–5 ft

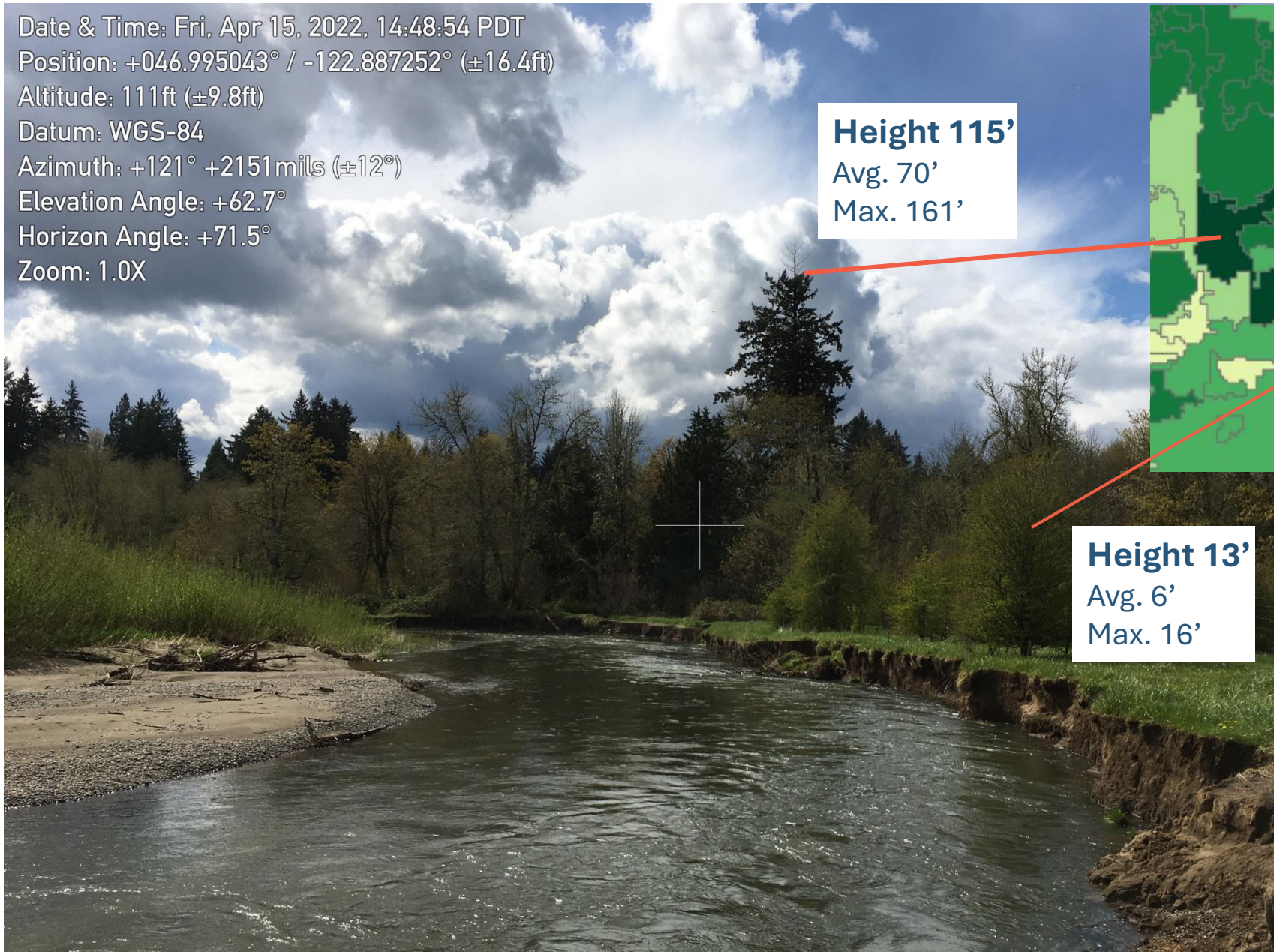
# Western WA example



# Eastern WA example

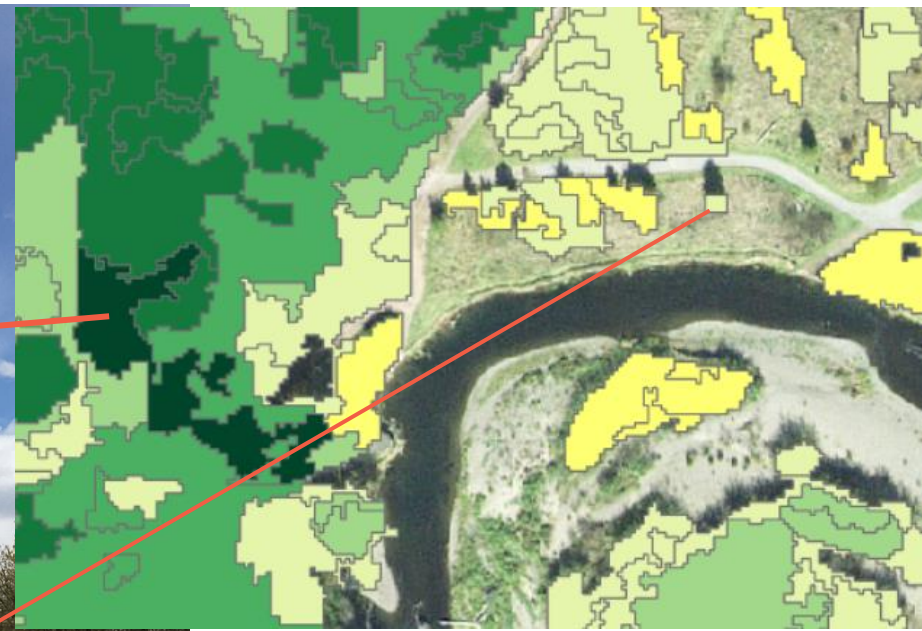


Date & Time: Fri, Apr 15, 2022, 14:48:54 PDT  
 Position: +046.995043° / -122.887252° (±16.4ft)  
 Altitude: 111ft (±9.8ft)  
 Datum: WGS-84  
 Azimuth: +121° +2151mils (±12°)  
 Elevation Angle: +62.7°  
 Horizon Angle: +71.5°  
 Zoom: 1.0X

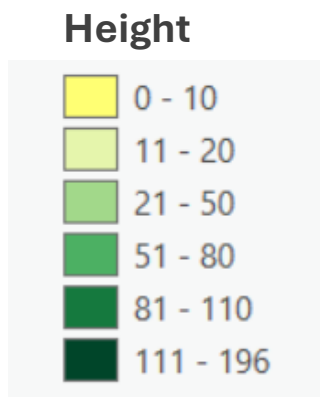


**Height 115'**  
 Avg. 70'  
 Max. 161'

**Height 13'**  
 Avg. 6'  
 Max. 16'



Attributes
Height
Average Height
Minimum Height
Maximum Height
Standard Deviation of Heights
Normalized Difference Vegetation Index



# Production steps



# High resolution imagery and lidar inputs

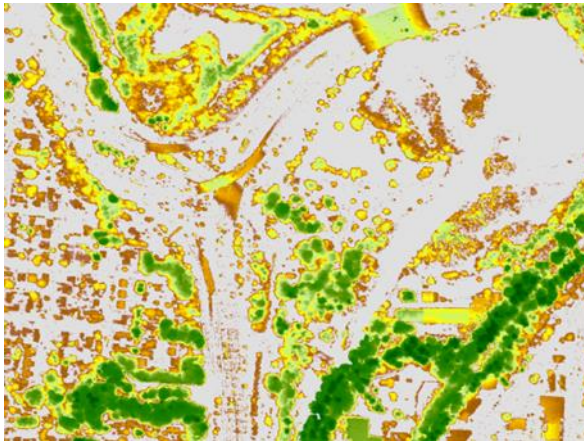
*RGB  
(1ft)*



*Near-  
infrared*



*Calculated  
Height  
Model*



*Normalized  
Difference  
Vegetation  
Index  
(NDVI)*



# Calculated Height Model

Digital Surface Model



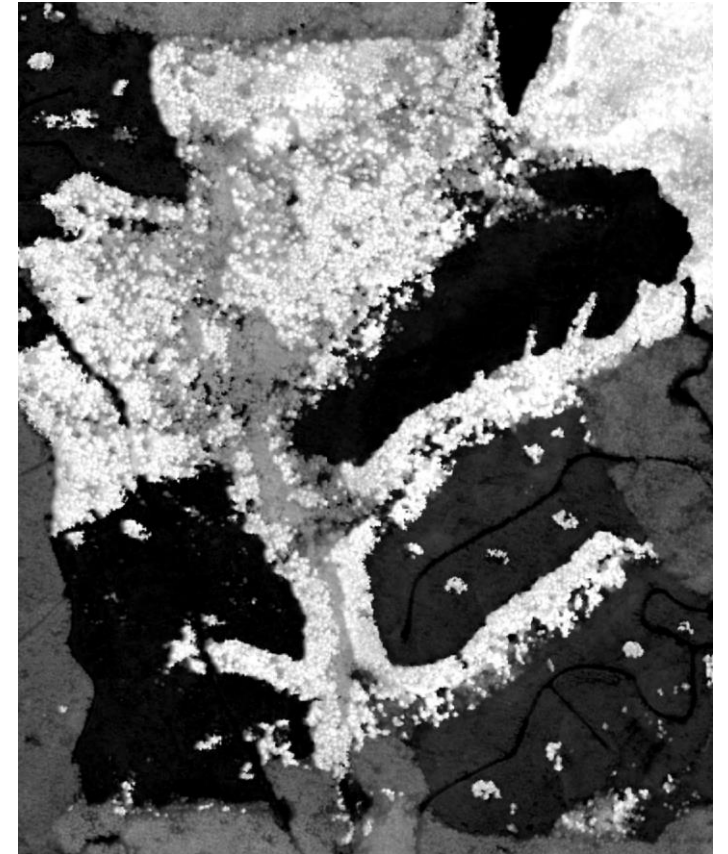
Digital Terrain Model



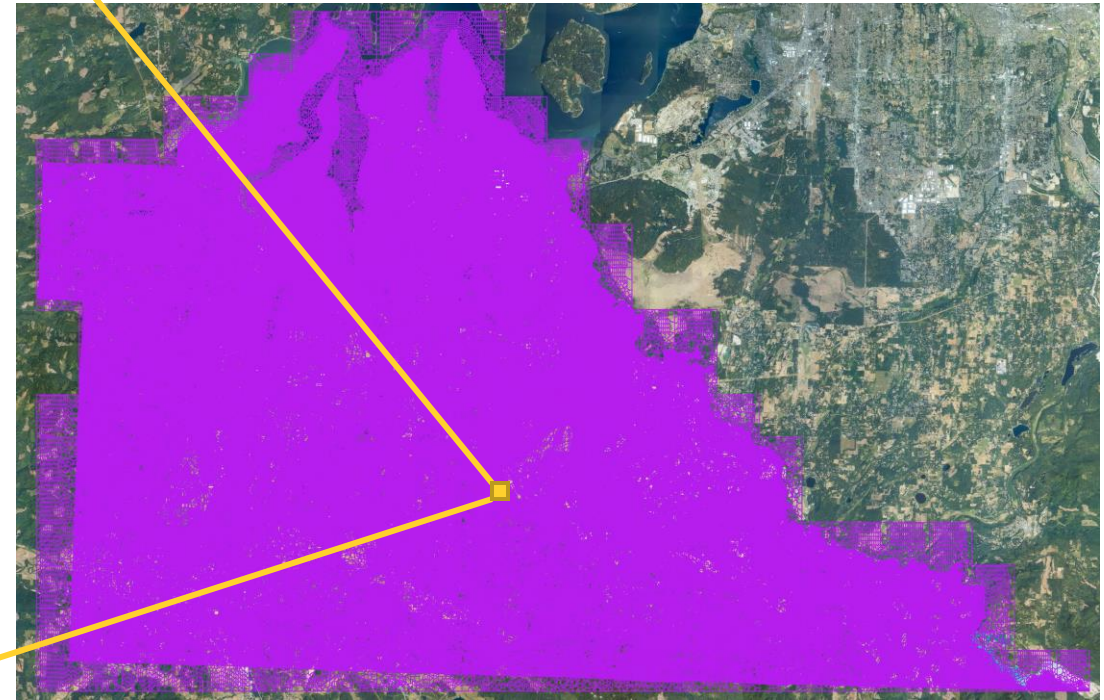
-

=

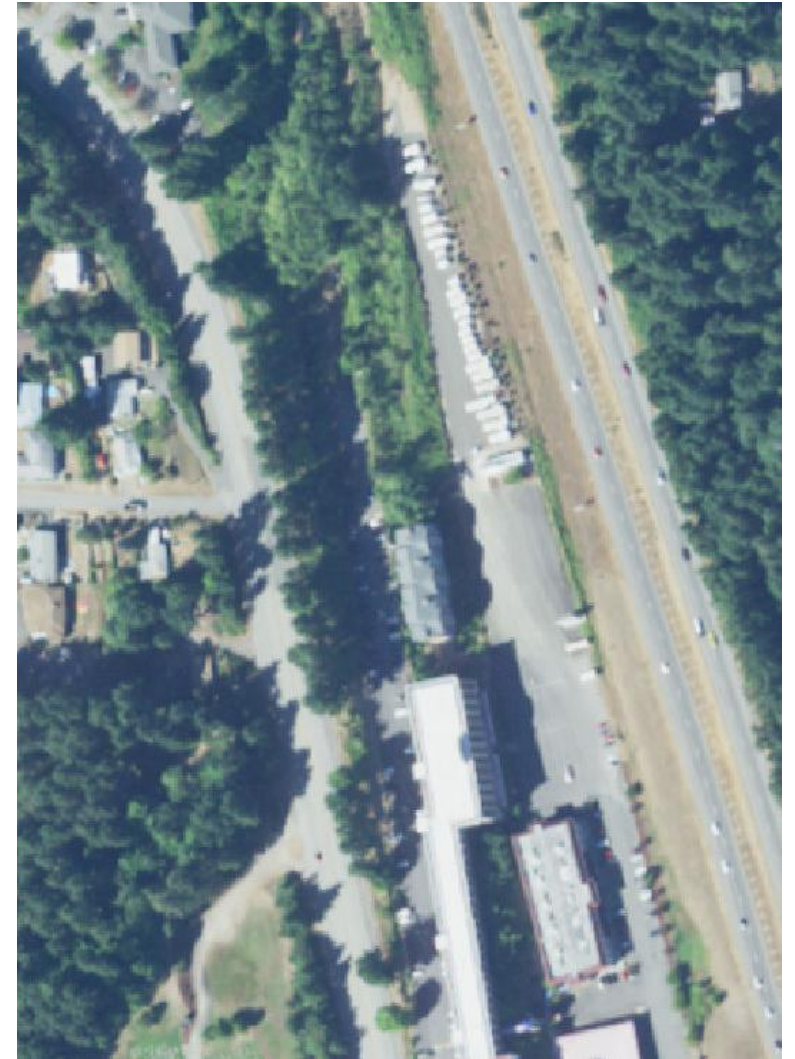
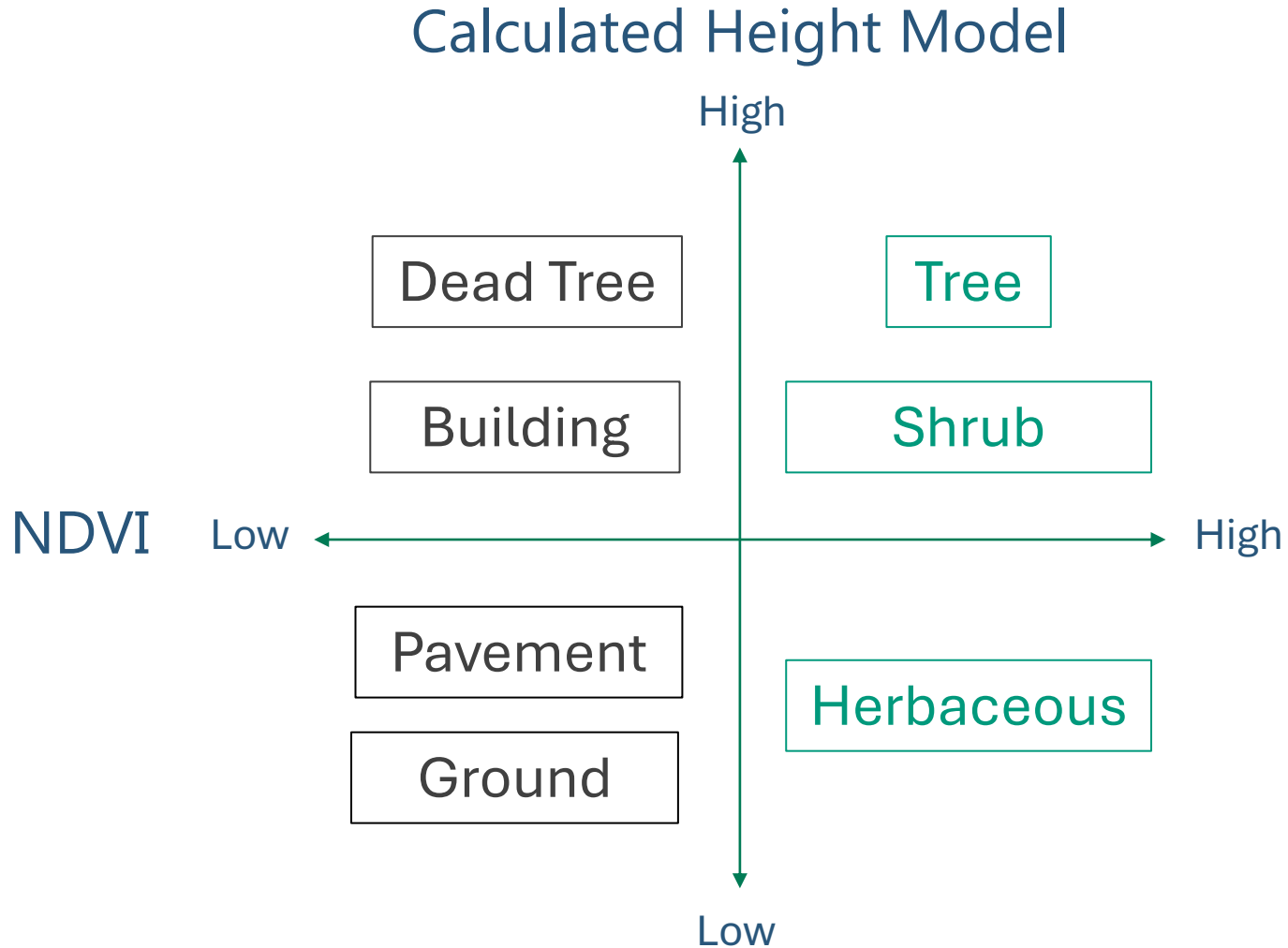
Calculated Height Model



# Object segmentation

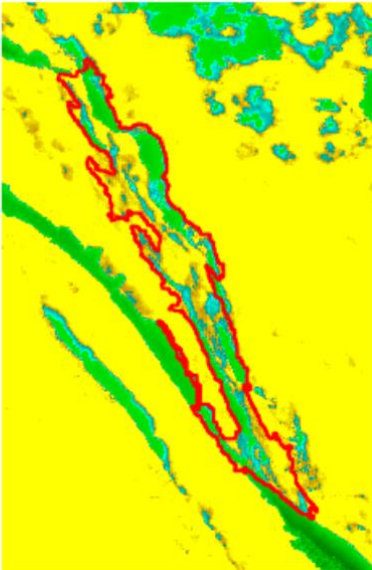


# Simplified land cover mapping




# Sample review

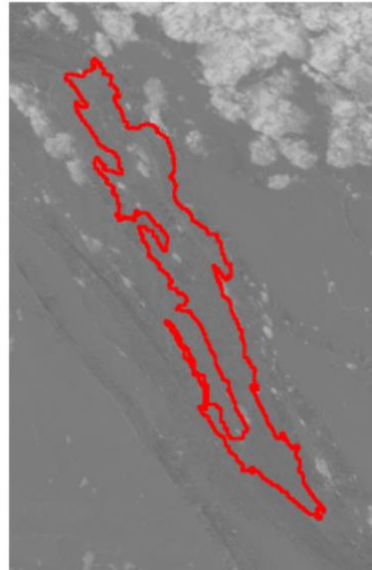
CHM



RGB



NDVI






Filters

Land Class  Filter LC

PolyID  Filter PID

Reference

Copy LC Copy ID

Previous

Next

Settings

Load/Set Path Save

Land Class 2

Acres 0.366391

Enhanced NumPad  DSM Error NumPad \* =

Instant Numbers

11 Water	55 SAD Trees	77 7's	88 Snow	999 Outside
7 Trees	8 Herbaceous	9 Bad Imagery		
4 Mixed Classes	5 NOT USED	6 Shrubs		
1 Building	2 Natural Surface	3 Human Surface		

18100

18623

19068

25539

Images 461

Filtered 461

PolyID 137020

9 36

88 3

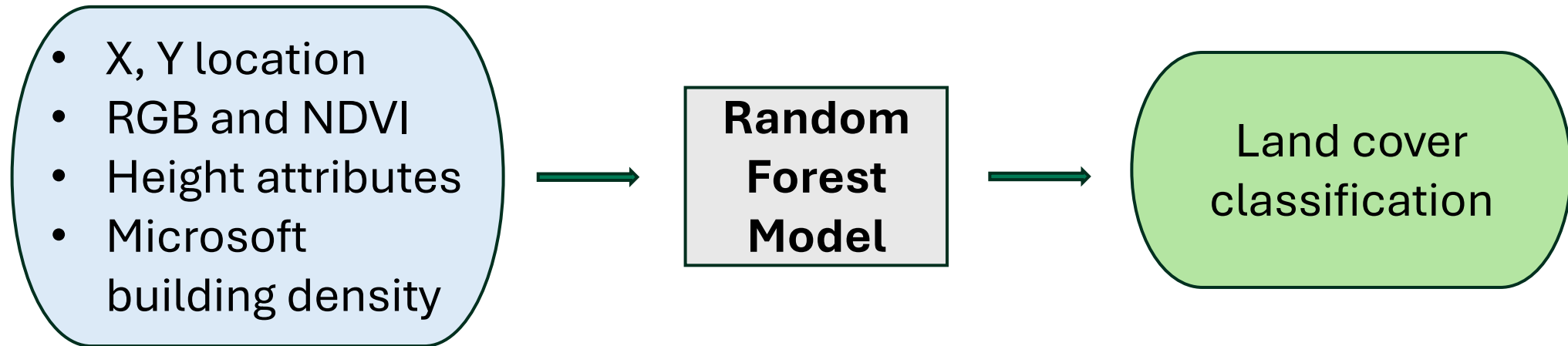
2 125

6 78

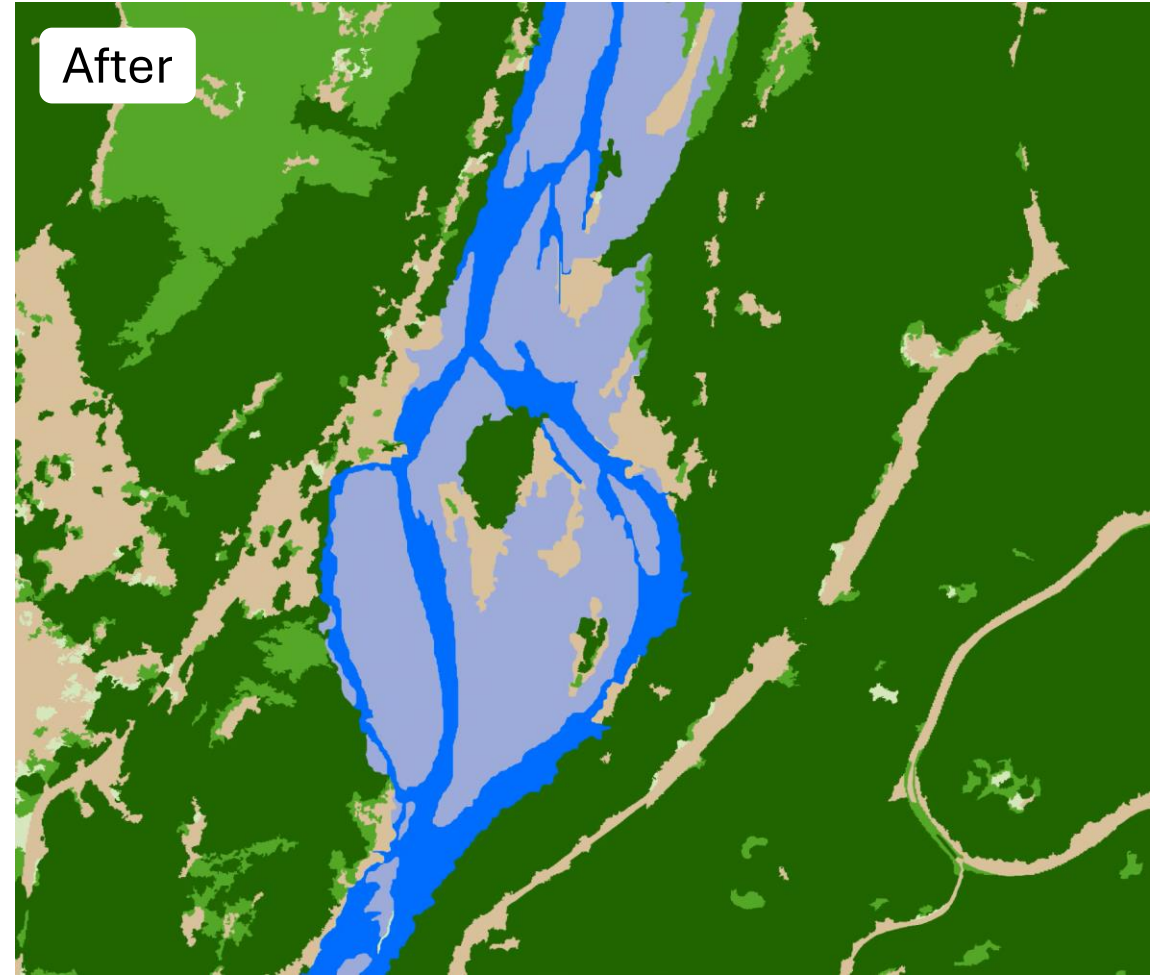
Reviewer KF

Date 4/21/2025

# Random forest classifier



# QA/QC



# Accuracy assessment

		Predicted						
		Building	Herbaceous	Shrubs	SurfaceHuman	SurfaceNat	Trees	Water
Actual	Building	1196	33	14	5	47	13	0
	Built	70	245	5	796	338	3	0
	Herbaceous	0	635	42	2	9	13	0
	Shrubs	0	95	104	1	0	19	0
	SurfaceNat	8	164	9	42	331	3	0
	Trees	9	25	34	1	1	845	0
	Water	0	18	0	0	2	0	569

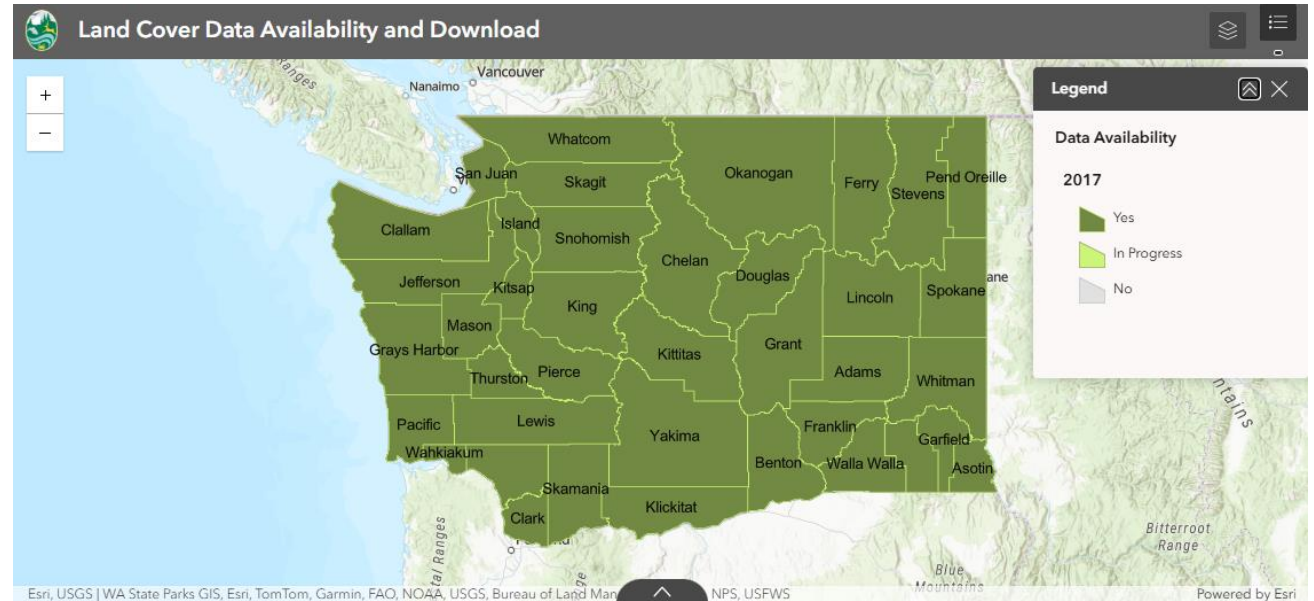
Required:  
90% fuzzy  
trees

Example:  
96.2%



# Current coverage

- [hrcd.wdfw.wa.gov](http://hrcd.wdfw.wa.gov)
- Statewide 2017 coverage\*
- Some counties for 2011, 2021, and 2023



\*Exact extent depends on lidar and imagery availability

# Download or request high-res data

Land Cover Data Availability and Download

Yakima County Availability

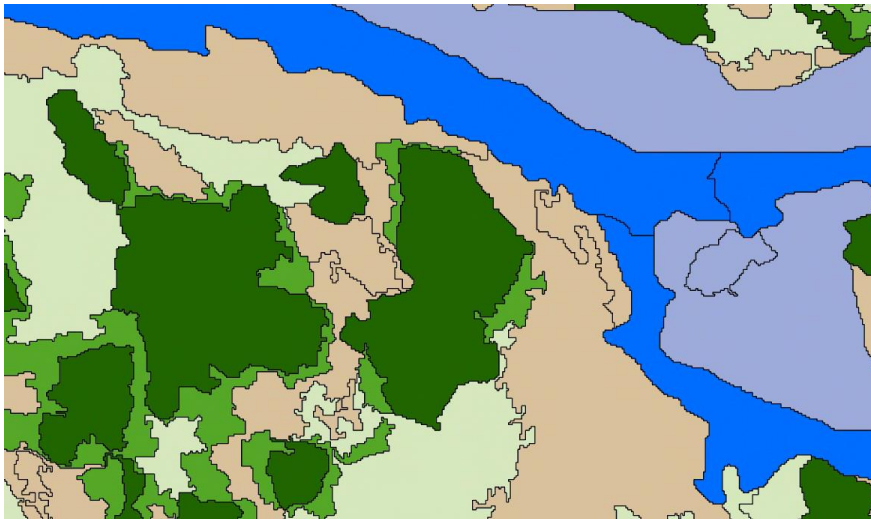
2011	Yes	<a href="#">Download</a>
2017	Yes	<a href="#">Download</a>
2021	No	<a href="#">Send inquiry</a>
2023	No	<a href="#">Send inquiry</a>

Esri, USGS | WA State Parks GIS, Esri, TomTom, Garmin, FAO, NOAA, USGS, Bureau of Land Management, NPS, USFWS  
Powered by Esri

# Data formats

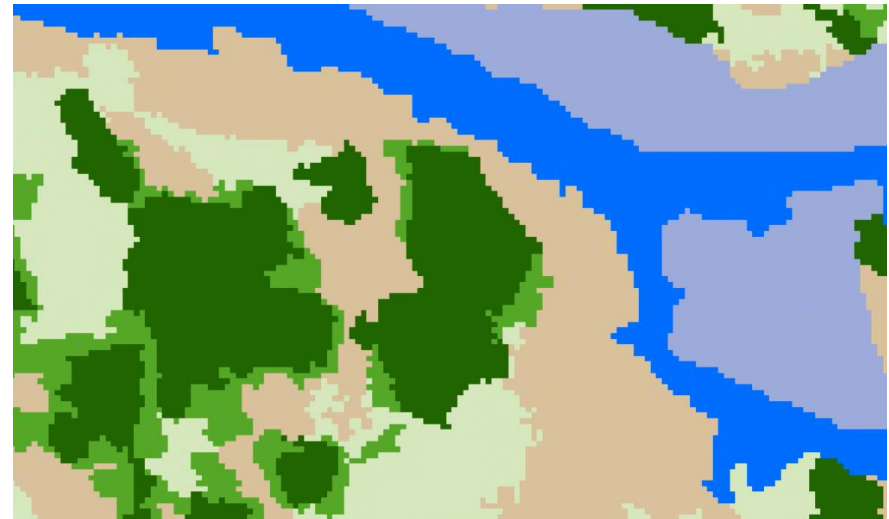
## Vector:

- Height and NDVI attributes for broader applications
- Edges may be more precise



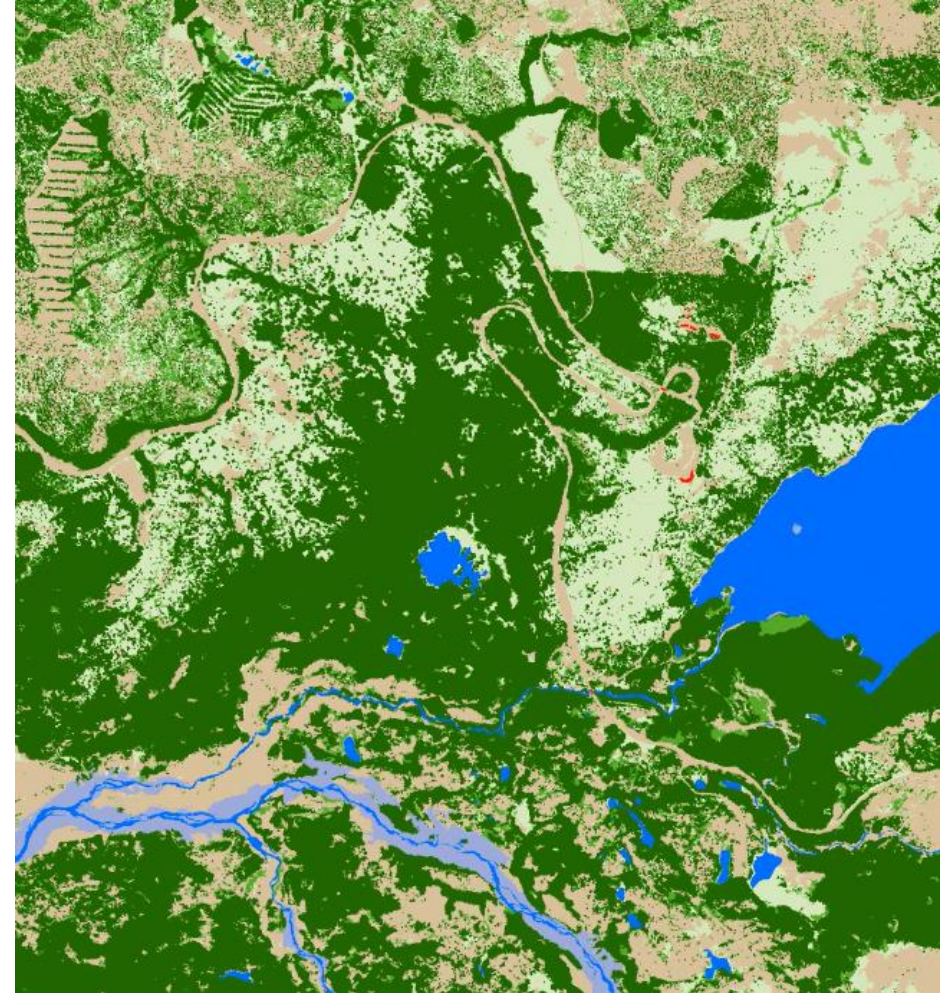
## Raster:

- Smaller file size
- Faster display
- 3 ft cell size



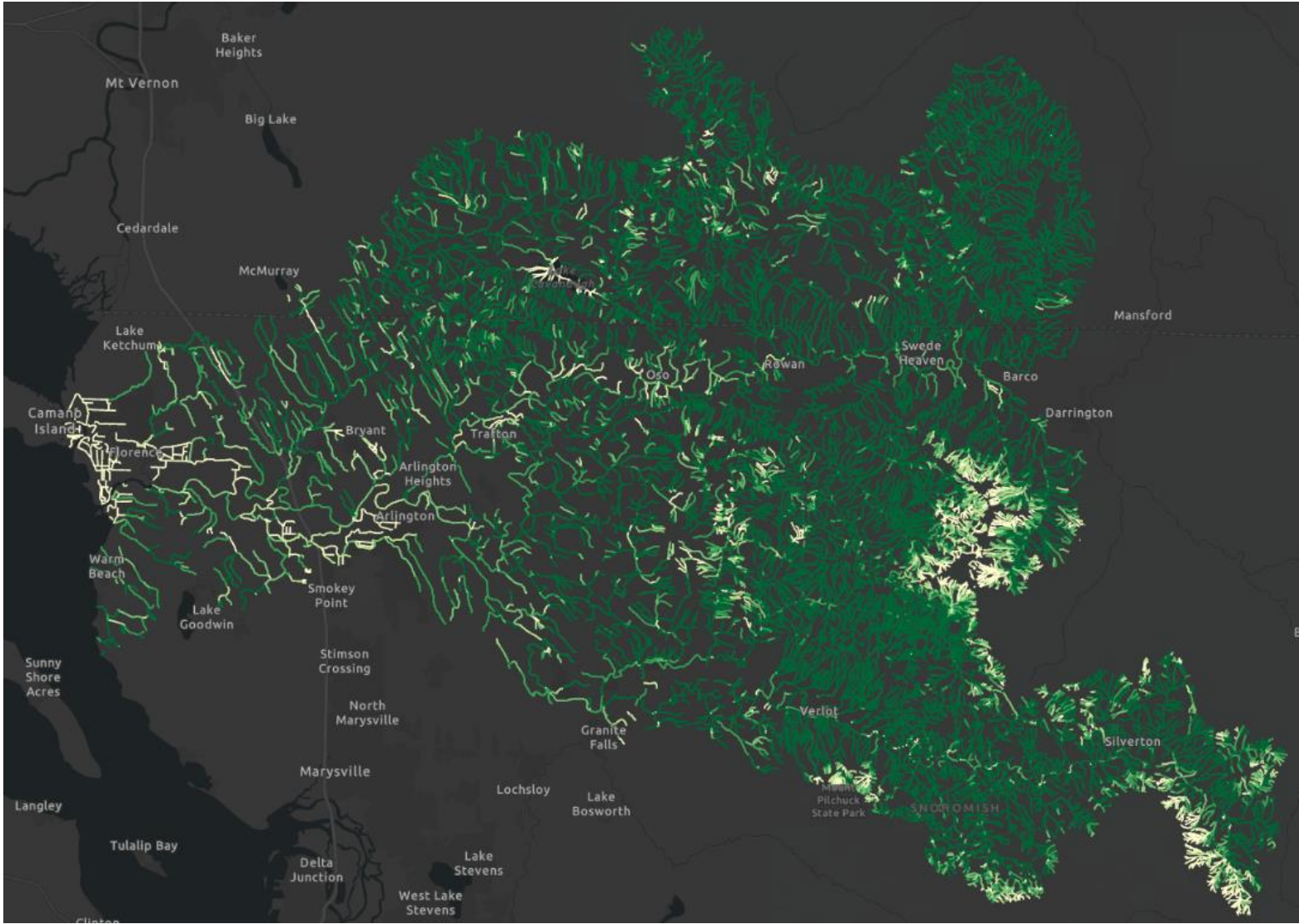
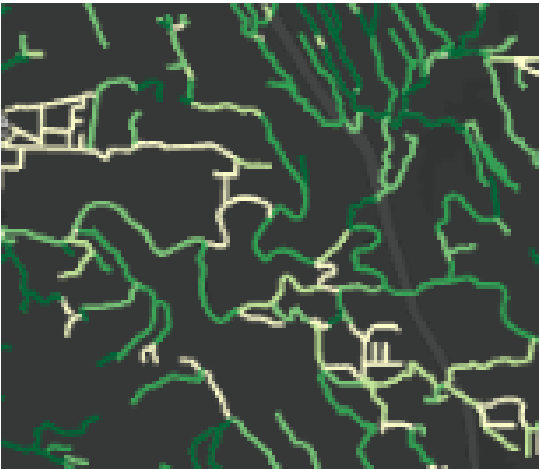
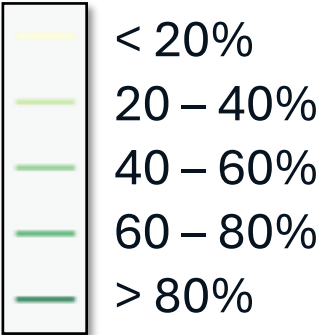
# What is this data good for?

- Vegetation precision, especially trees
- Height information
- Statewide
- Multiple years
- Combine with change detection
- Habitat monitoring



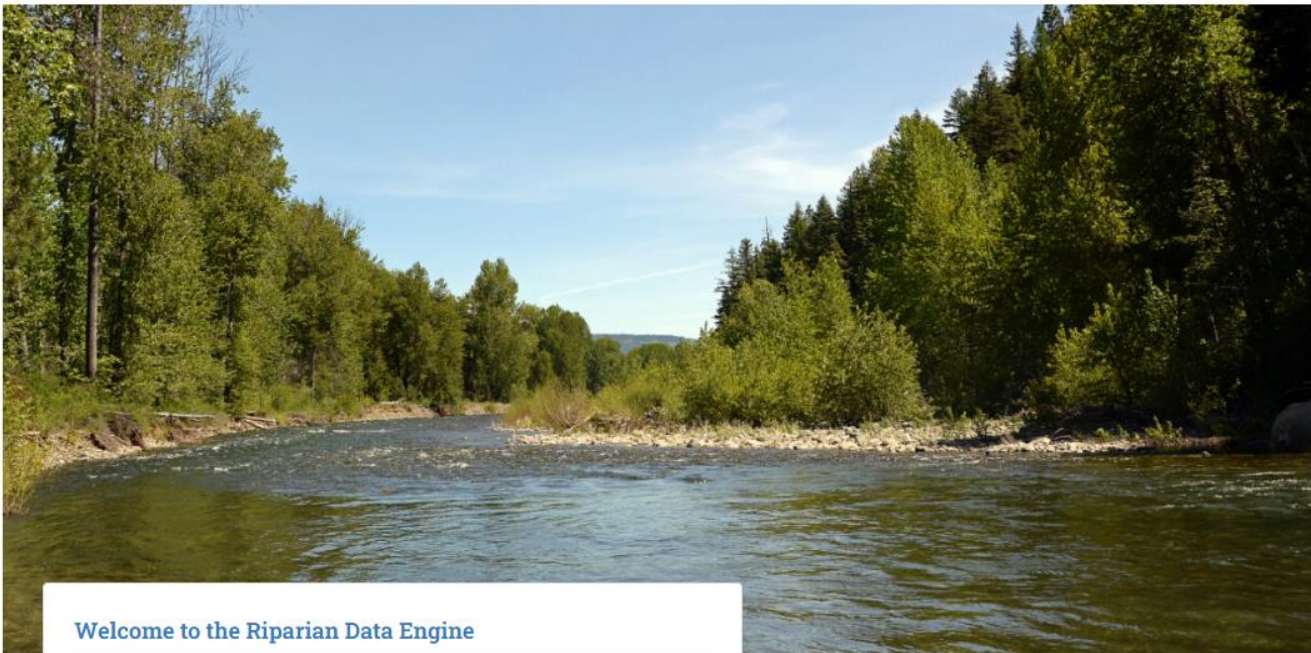
# Riparian tree proportion (WRIA 5)

Percentage with tree canopy



# Riparian Data Engine

[ripariandata.wdfw.wa.gov](http://ripariandata.wdfw.wa.gov)



## Welcome to the Riparian Data Engine

Hi, Kevin Fuchs! ([Log out](#))

The Riparian Data Engine unites WDFW riparian datasets in Washington State. The platform tools allow planners to evaluate the conditions of riparian ecosystems, and make data-informed planning decisions.

## Statewide <sup>?</sup>

All Watersheds

All Counties

## Regional <sup>?</sup>

Jump to a Watershed ▼

Jump to a County ▼

# Riparian Data Engine

### Reach

	EOW	RMZ	Flood
Acres	0.0	24.0	0.0
Percent Tree Cover		19.6%	
Percent Vegetated		92.4%	

- Miles of Stream: 1.0
- Temperature Impairment Category: Not Impaired
- Fish Passage Barriers: 0 (0)
- Salmonids Species Present: 1

### Upstream Statistics

	EOW	RMZ	Flood
Acres	0.0	1,128.5	0.0
Percent Tree Cover		4.2%	
Percent Vegetated		92.2%	

- Reach Count: 65
- Miles of Stream: 47.0
- Miles of Temperature Impaired Stream: 0.0

146832270 (WRIA 35)

Bookmark

Map | Land Cover | Salmon | Land Use | Reach Table

Stream Network

- Downstream
- Upstream

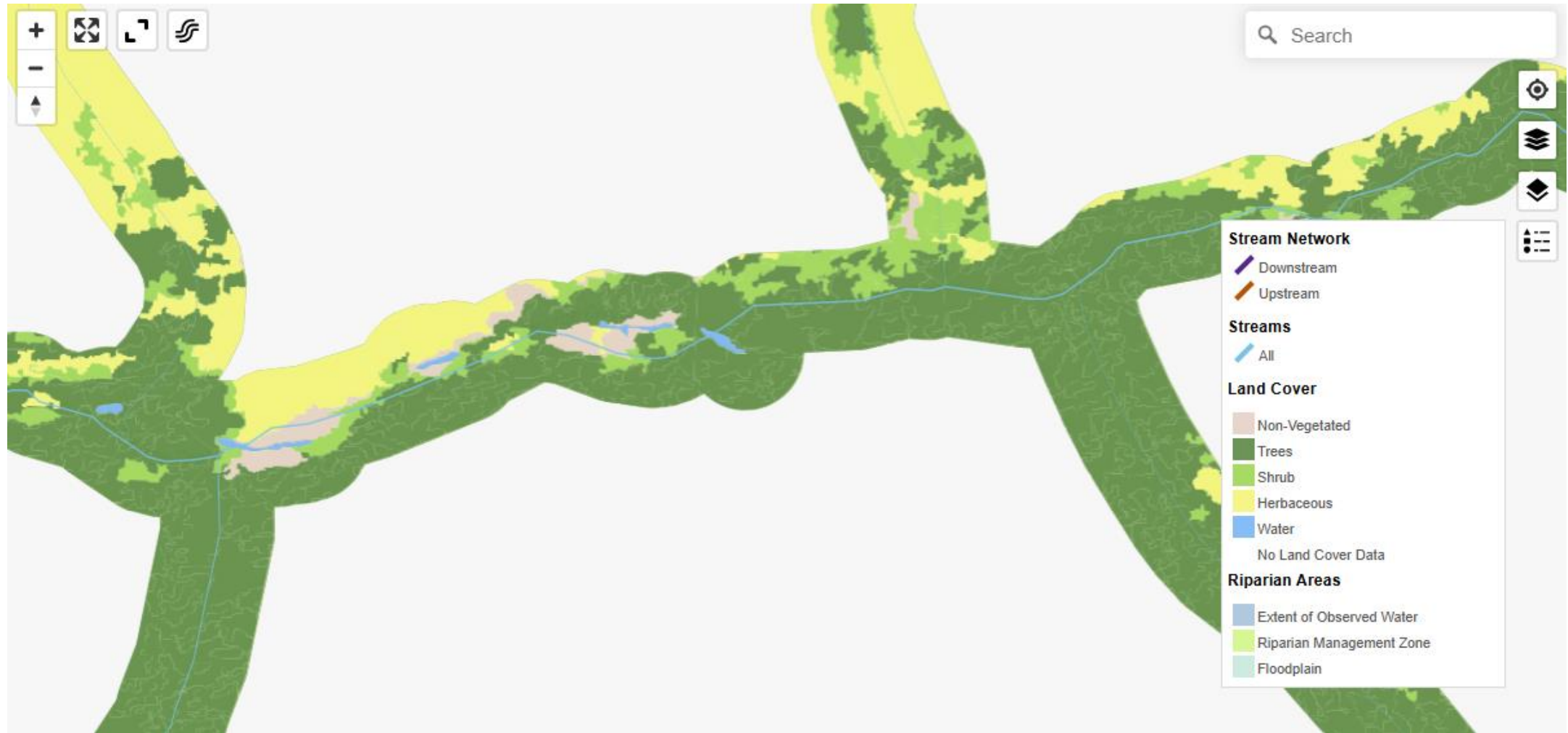
Streams

- All

Riparian Areas

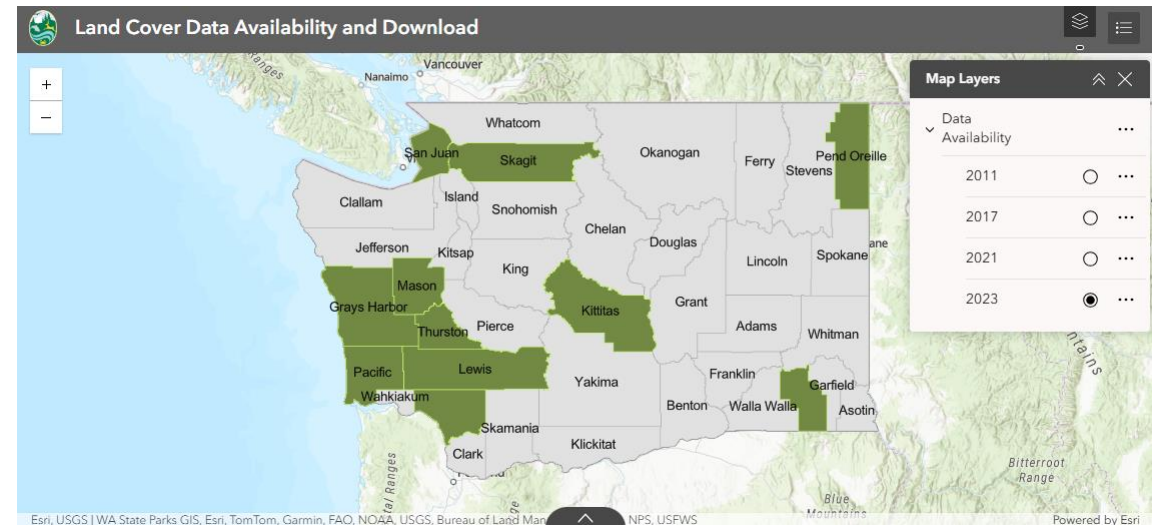
- Extent of Observed Water
- Riparian Management Zone
- Floodplain

# Riparian Data Engine



# Upcoming data – funding dependent

- Statewide 2023
- Planning for statewide every 3-6 years
- Fill in previous data gaps with newly available lidar
- Improve deep learning models



# How do you use land cover?

- Team:
  - [hrcd.wdfw.wa.gov](http://hrcd.wdfw.wa.gov)
  - [hrcd@dfw.wa.gov](mailto:hrcd@dfw.wa.gov)
- Production manager:
  - Syler Behrens
  - [syler.behrens@dfw.wa.gov](mailto:syler.behrens@dfw.wa.gov)
- Presenter/GIS Analyst:
  - Kevin Fuchs
  - [kevin.fuchs@dfw.wa.gov](mailto:kevin.fuchs@dfw.wa.gov)

