Snoqualmie Fish, Farm, Flood

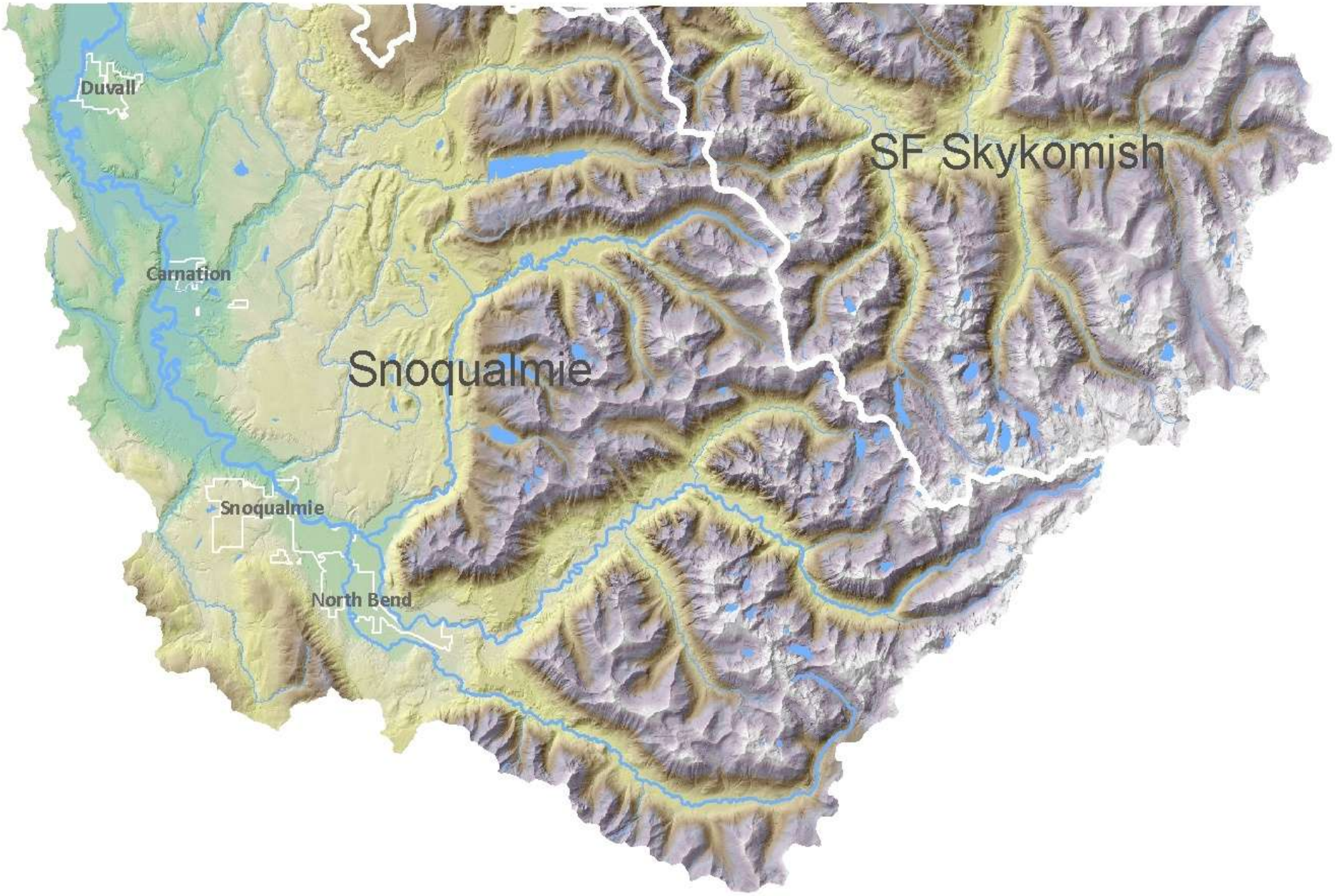
Advisory Committee
Meeting #1

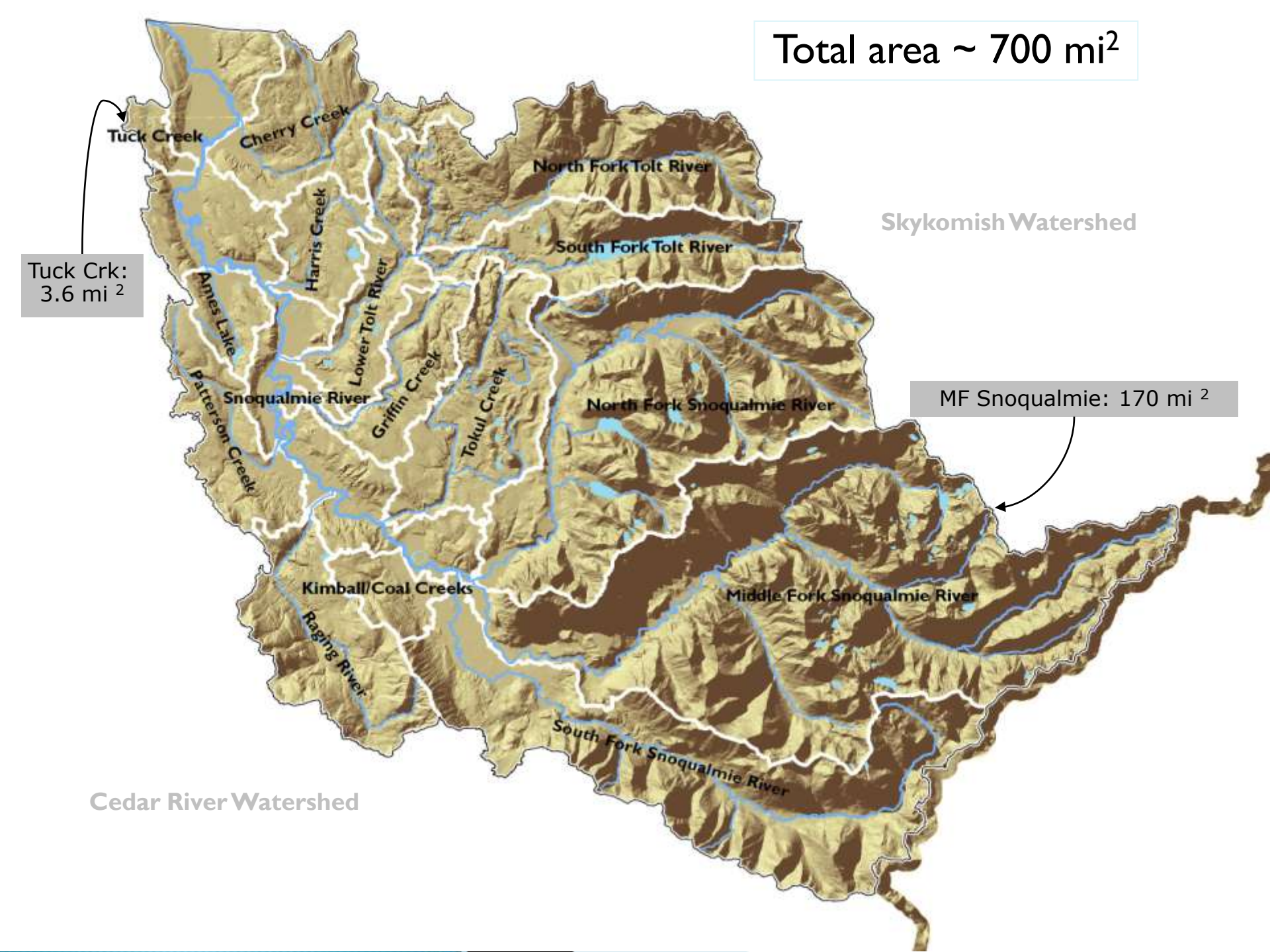
November 19, 2013

King County

Physical Setting

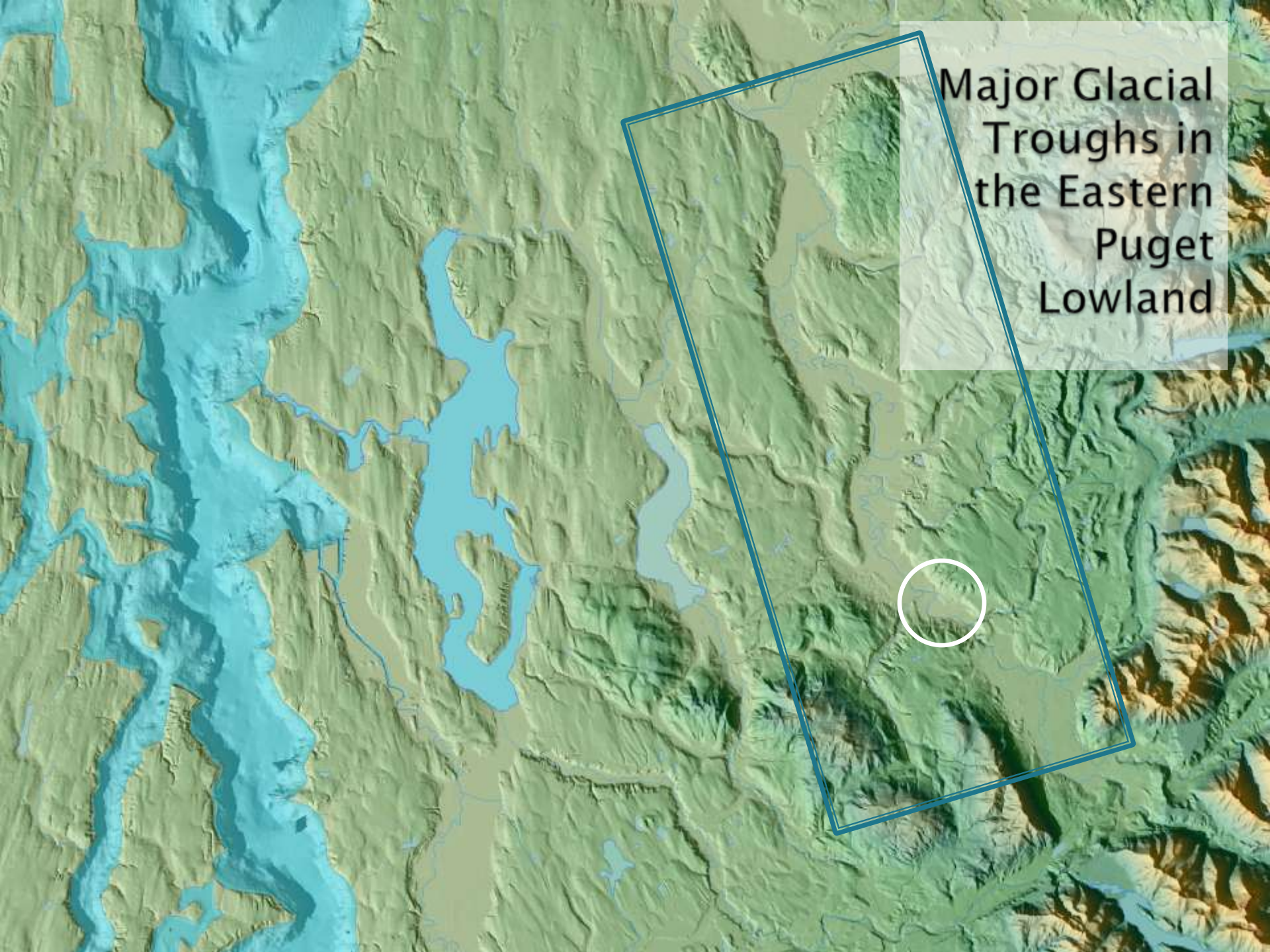
- Quick primer on Snoqualmie watershed
  - Geography
  - Geology
  - River valley form
  - Land use & history

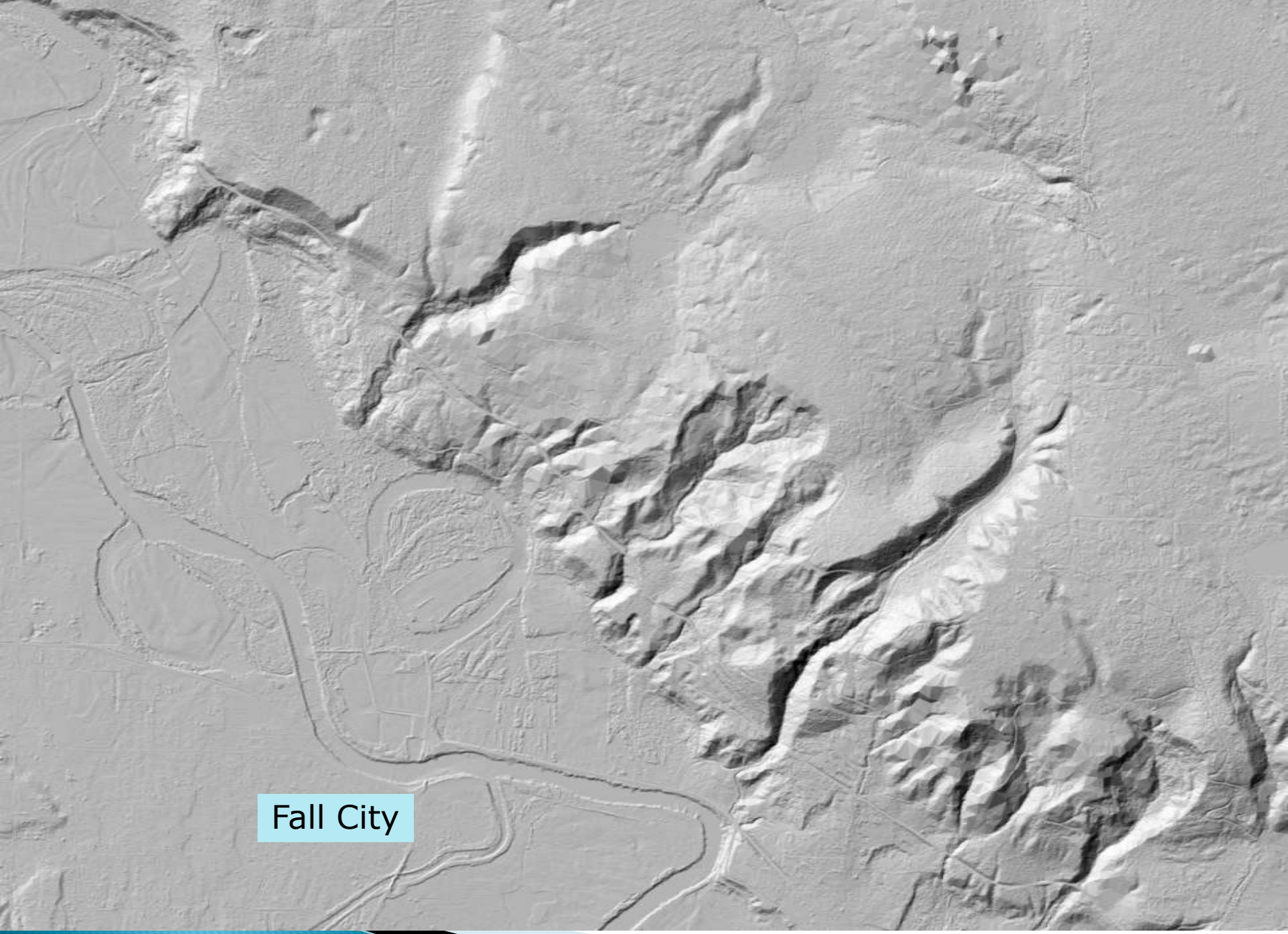

Duvall
Carnation
Snoqualmie
Snoqualmie
North Bend
SF Skykomjsh


Total area ~ 700 mi²
Tuck Creek
Cherry Creek
North Fork Tolt River
Skykomish Watershed
South Fork Tolt River
Tuck Crk:
3.6 mi ²
Harris Creek
Ames Lake
Lower Tolt River
Patterson Creek
Snoqualmie River
Griffin Creek
Tokul Creek
North Fork Snoqualmie River
MF Snoqualmie: 170 mi ²
Kimball/Coal Creeks
Middle Fork Snoqualmie River
Raging River
South Fork Snoqualmie River
Cedar River Watershed

Middle Fork Snoqualmie River at Three Forks

Snoqualmie Falls
270 ft.


Major Glacial Troughs in the Eastern Puget Lowland


Fall City

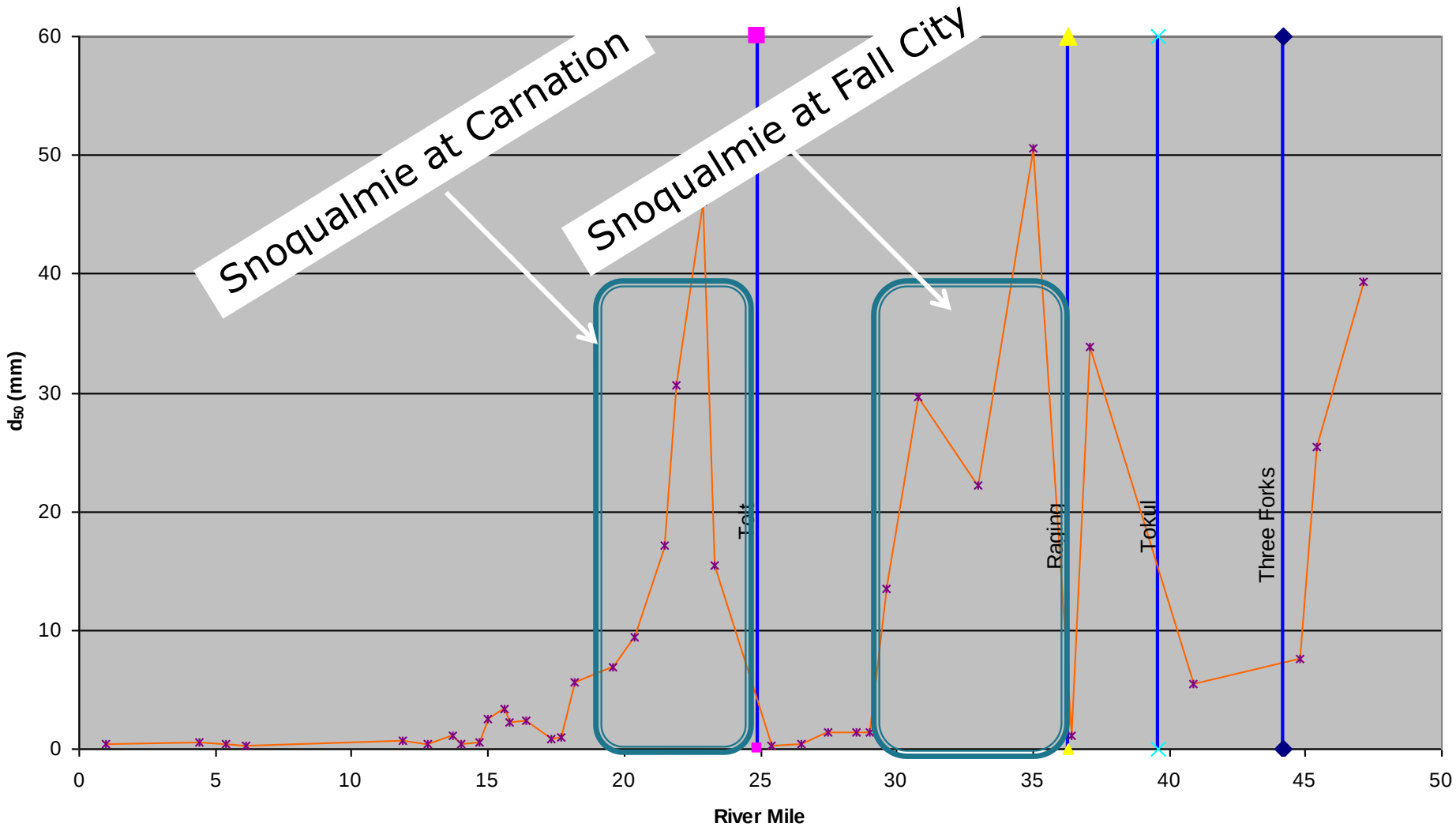
Key Points – Part 1

- Valley carved by glacial processes, not river processes
- Mountains erode – valley filling in over time (but very slowly)
- Valley and floodplain much broader than a river of this size would form through alluvial processes
  - This has implications for what sized sediment the river can effectively move.

The River and Its Sediment

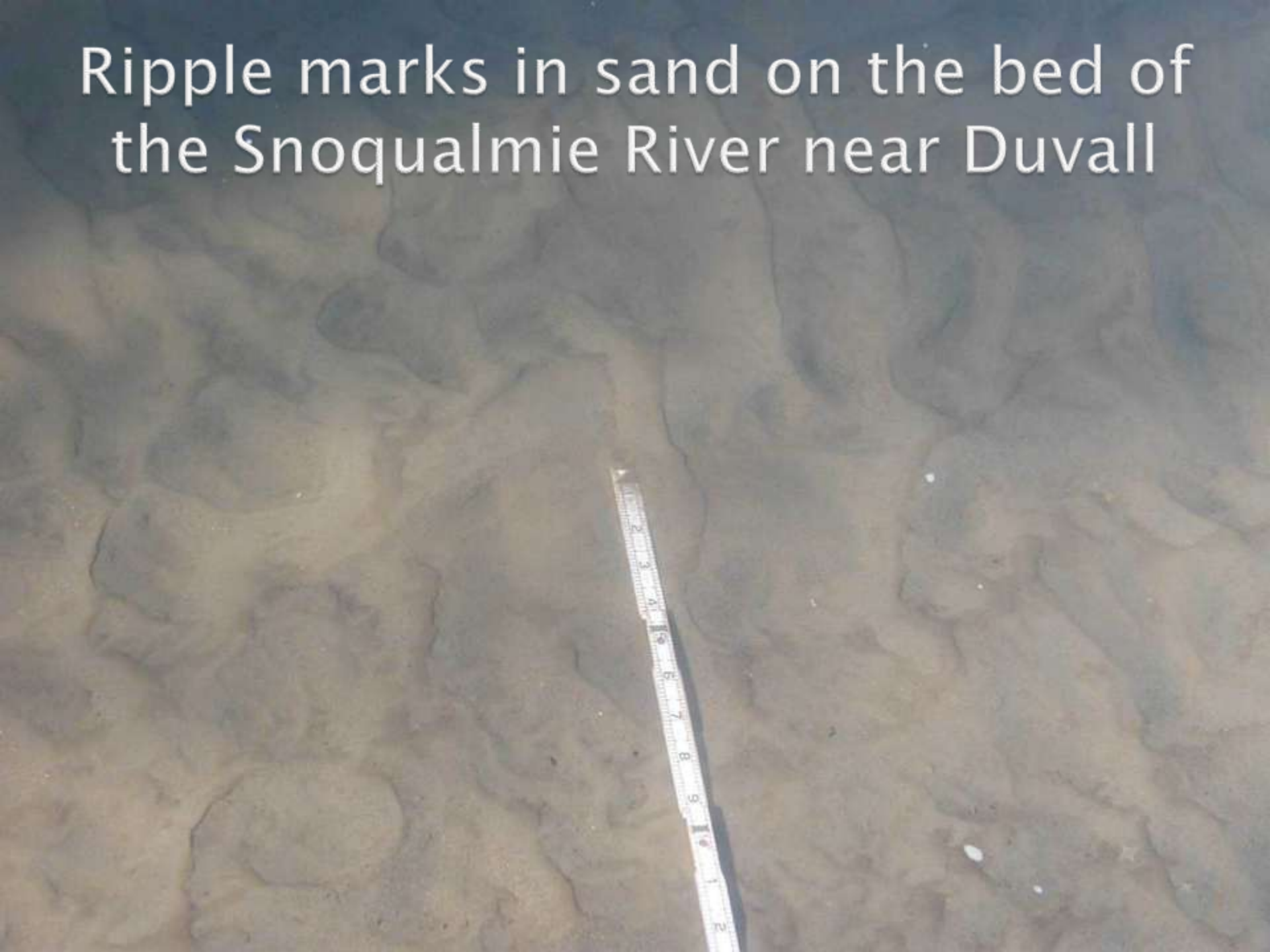
- Without gradient, very difficult for a river to move large sediment (gravel and cobble)
- Snoqualmie valley below the falls is very flat (i.e., extremely low gradient)
  - Also flat above the falls to roughly Three Forks
- Lower Snoqualmie's "own" sediments mostly fine textured.
- Gravel comes in from steeper tributaries, such as Tolt, Raging, Tokul Creek

Figure 21 Snoqualmie Streambed Sediment Texture (Booth et. al. 1991)



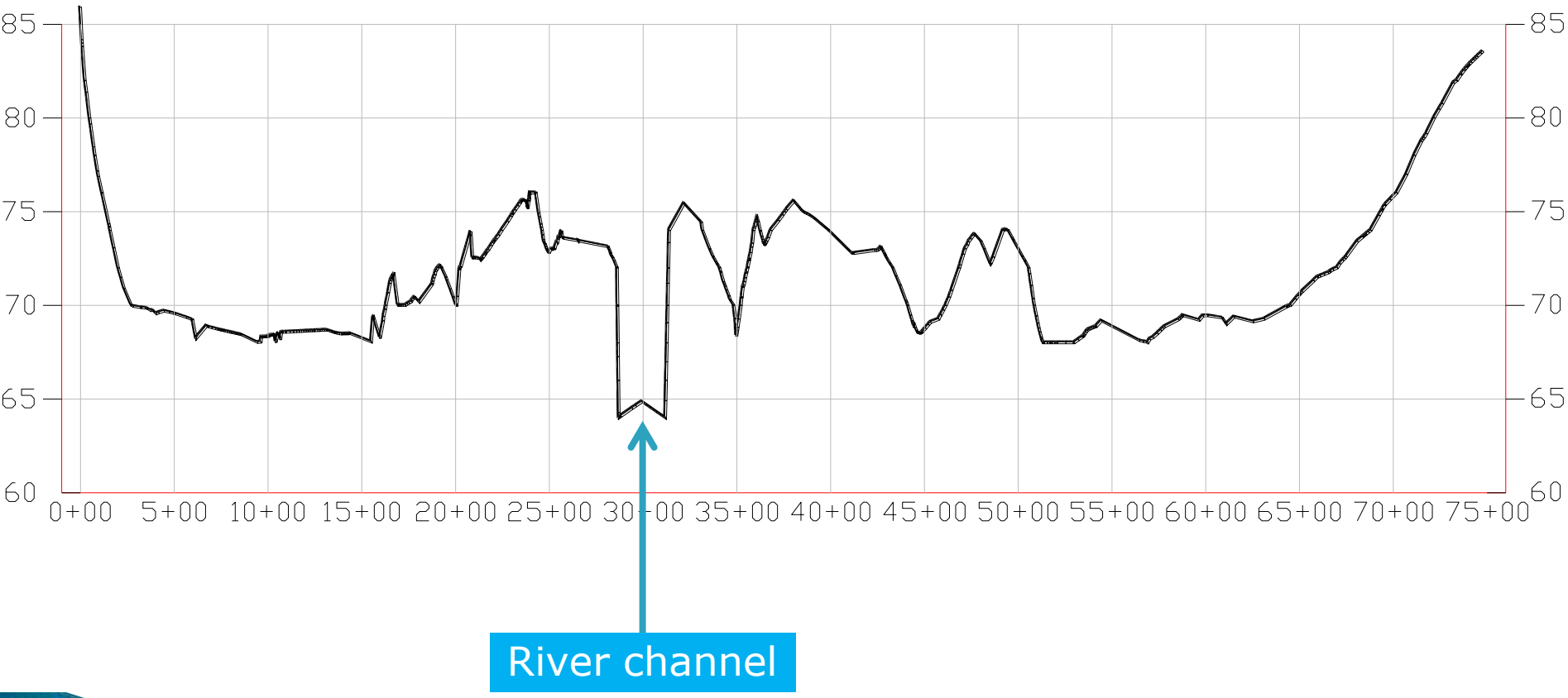
The particle size shown is for for the median particle size (d_{50}) for the subsurface sample collected at each sample site. The texture of the subsurface sediment in an alluvial channel bed is similar to the texture of the of the bedload sediment in transport at the sample location.

Ripple marks in sand on the bed of the Snoqualmie River near Duvall



Deposits at edge of channel from 12/04 flooding (Near Duvall)

Cross-section across the Snoqualmie Flood Plain at Carnation Marsh



Carnation Marsh

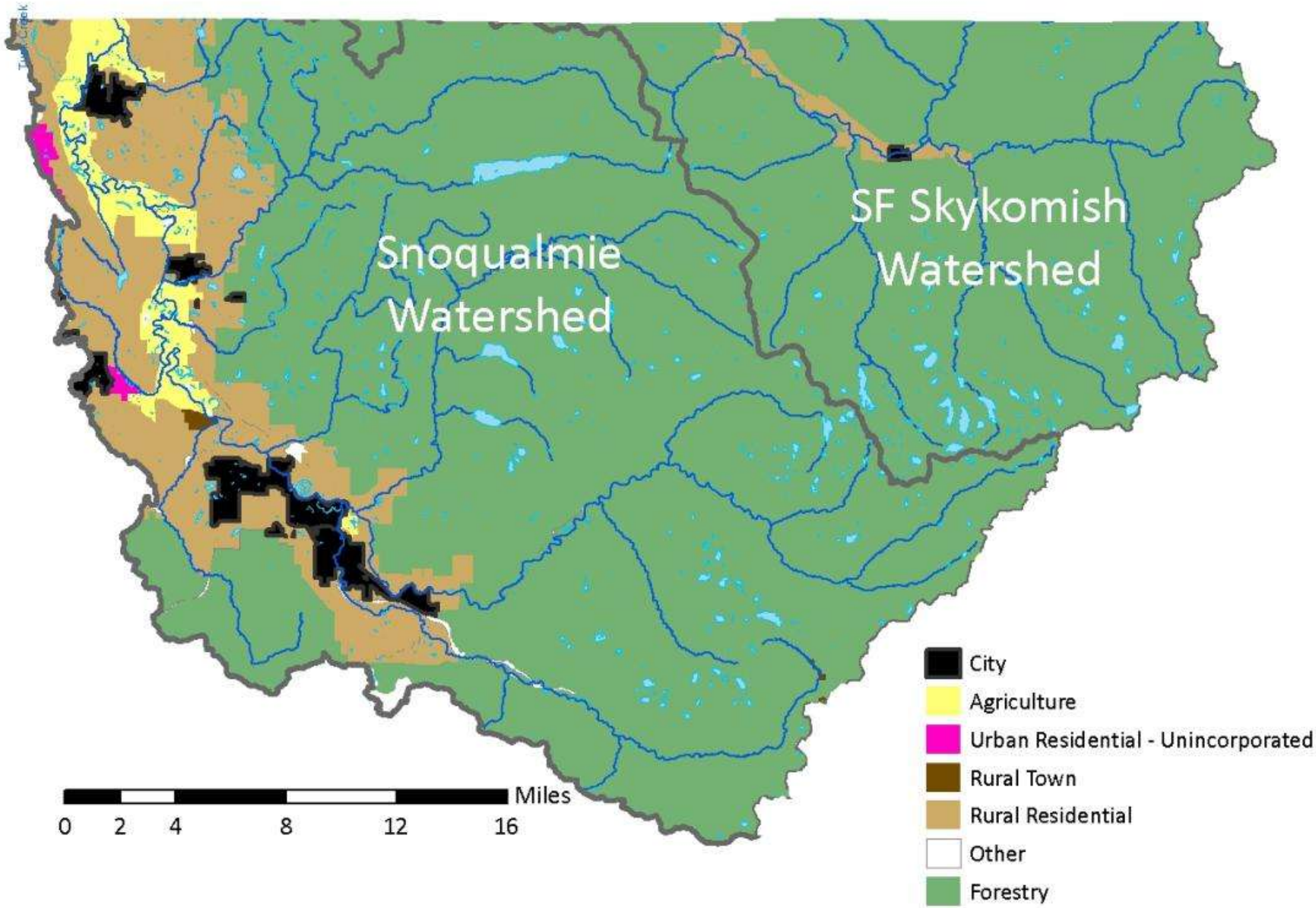
Key Points – Part 2

- The lower Snoqualmie imports its gravel from tributaries (esp. Tolt & Raging Rivers)
  - These reaches very dynamic, complex, erosive. Highest value Chinook salmon habitat.
- Unable to move large sediment very far, so gravel portions of river are limited.
- River forms “natural levees” from fine sediment
- In many areas, highest ground may be closest to river.
- Even in moderate flood events, inundation extends from valley wall to valley wall.

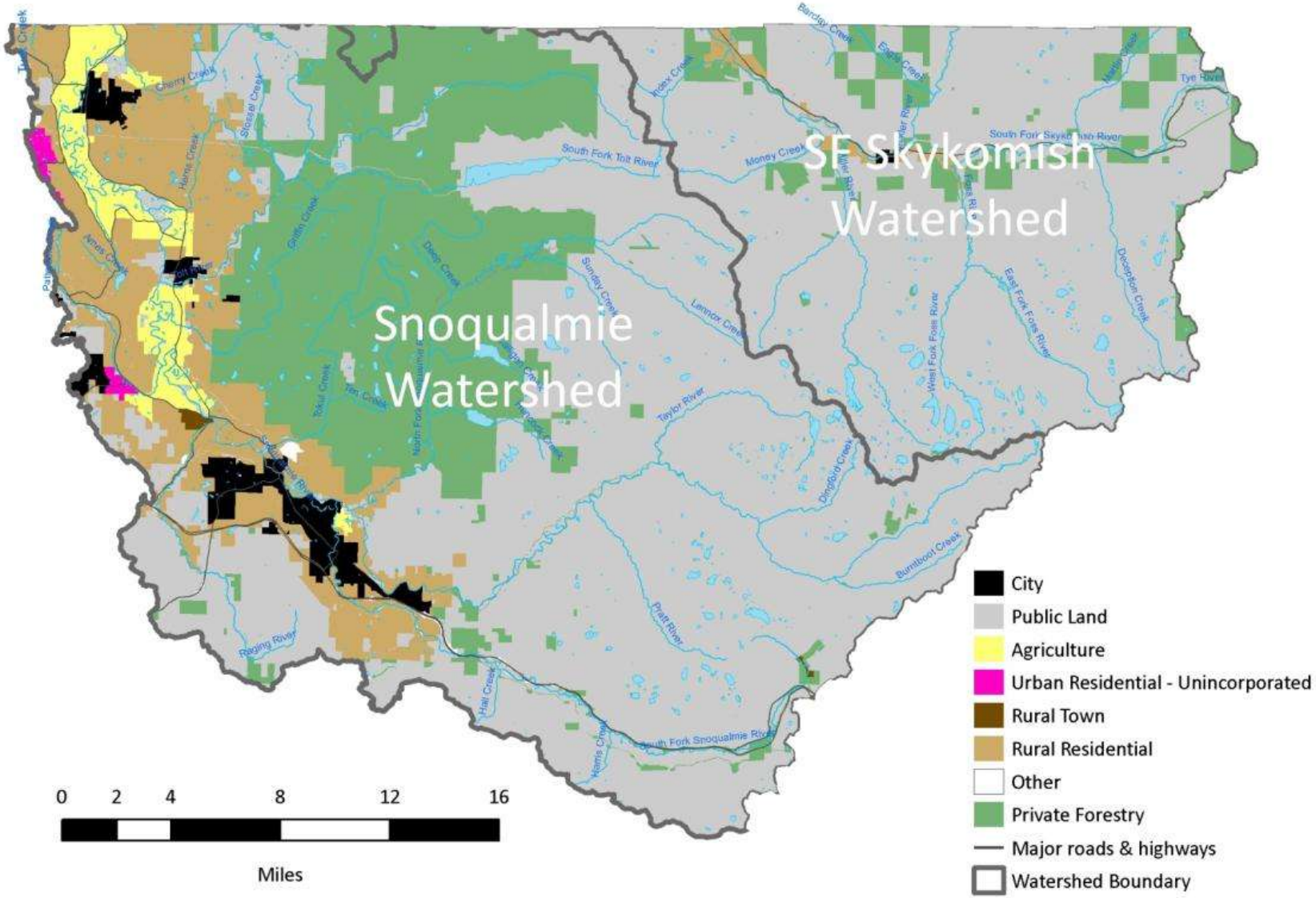
Land Use & History

- Over 70% of watershed is forested, including areas of active timber harvest.
- Only ~2% in cities. Populations range from <2000 in Carnation to roughly 10,000 in Snoqualmie.
- Approximately 4% (14,560 acres) in Agricultural Production District ("APD")
- Most of remainder in rural-residential land use

Land Use


Snoqualmie Watershed
SF Skykomish Watershed
City
Agriculture
Urban Residential - Unincorporated
Rural Town
Rural Residential
Other
Forestry
Miles
0 2 4 8 12 16

Public Land & Land Use



A Closer Look at Forests

Hydrologic Effects?

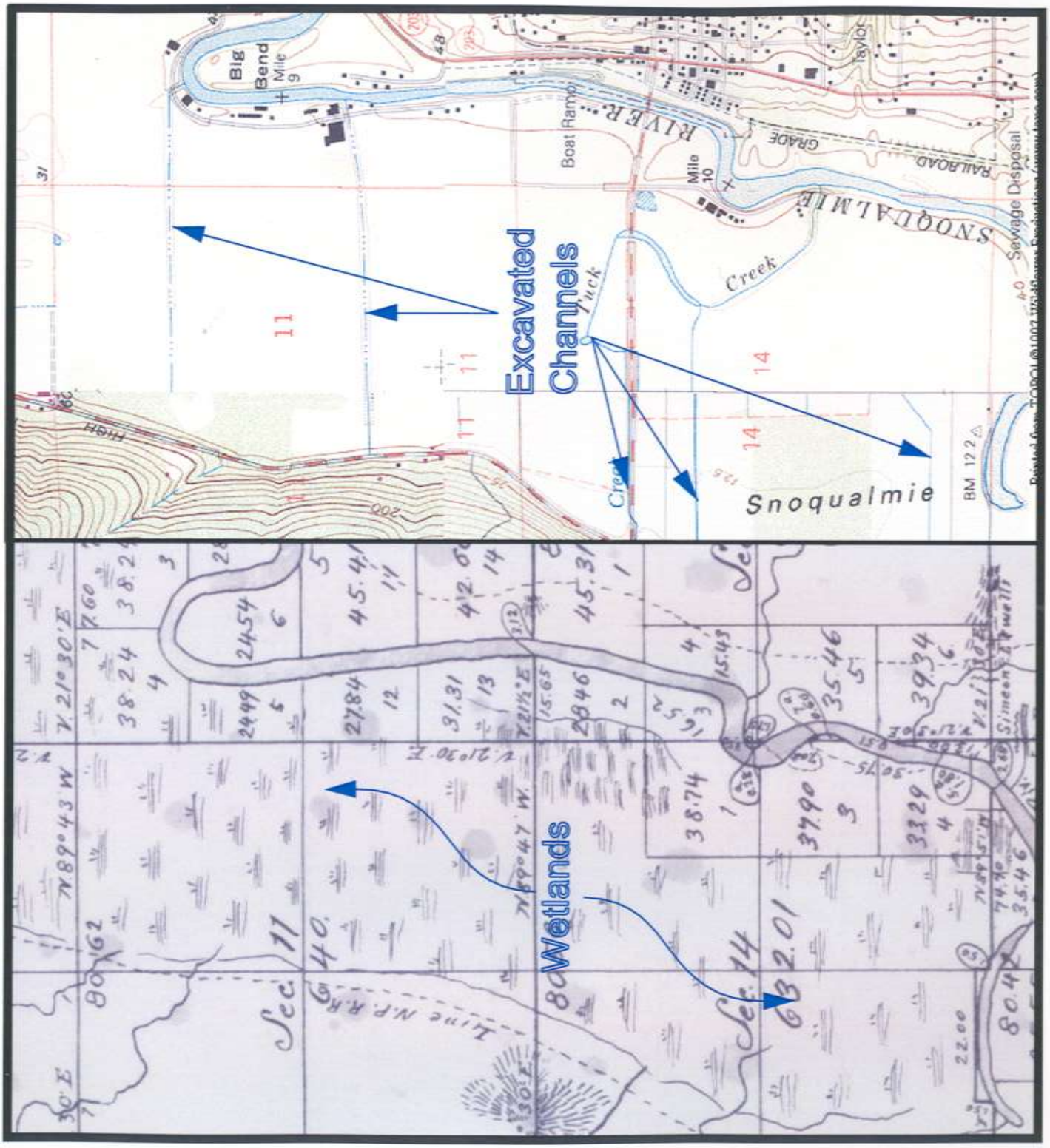
Valley Floor Alteration

- Mid- to late 1800's logging and draining of valley floor for agriculture and timber
- Valley floor forest reduced by >85% by 2000 compared to pre-European settlement
  - Largely hardwoods, but also very large conifers
- Over 80% of wetlands on valley floor lost by 2000, due to drainage and fill.

River & Stream Channel Alteration

- Approximately 64% of stream channels in floodplain have been straightened/modified to improve drainage for agriculture
- 40% of the mainstem Snoqualmie below the falls has levees or revetments
  - Levees contain floodwater, to varying degrees
  - Revetments armor the bank to prevent migration and erosion

A comparison of wetlands shown on the floor of the Snoqualmie Valley in 1873 GLO mapping (left) with recent USGS mapping (right).



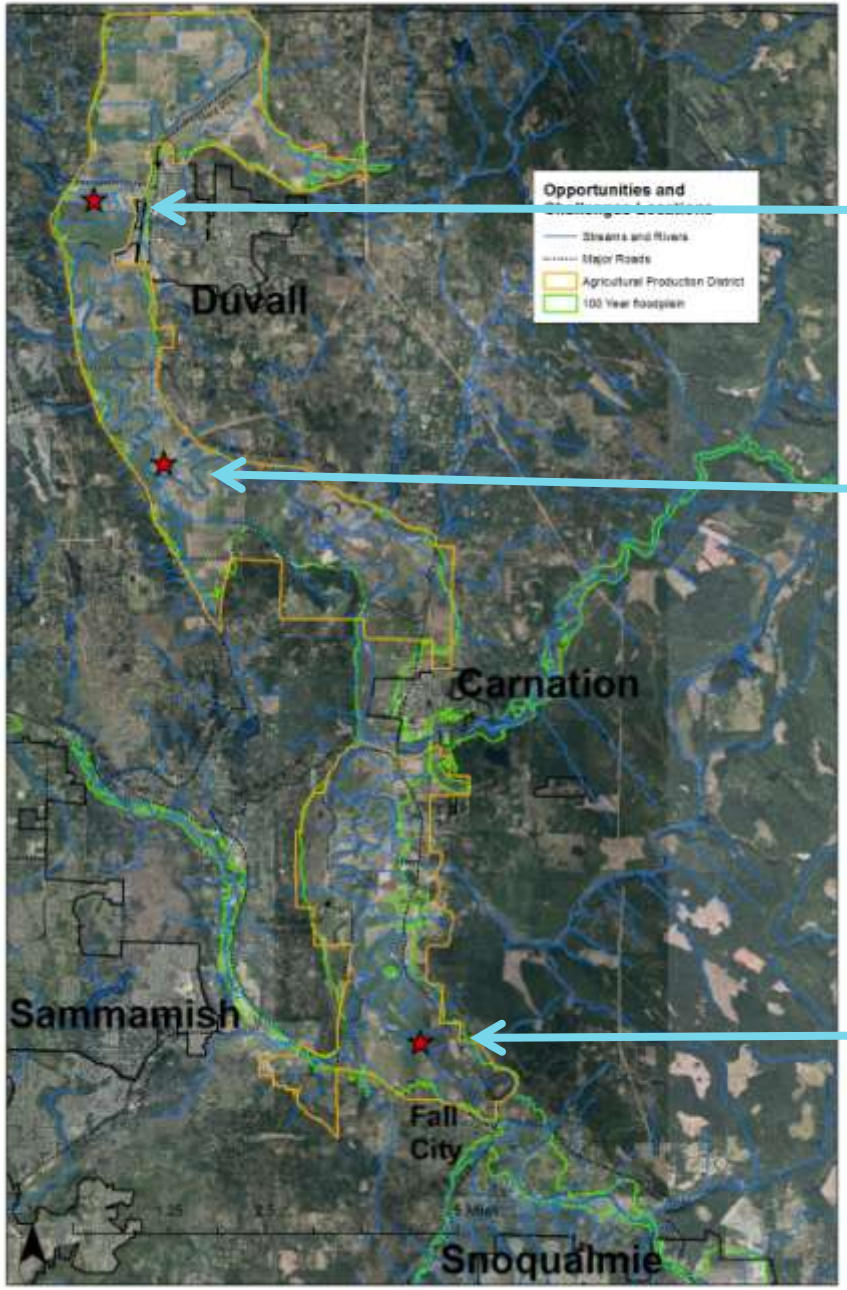
Examples of "river facilities"

Floodplain and APD

- Turn to the map section in your binder

Issue Snapshots

1. Snoqualmie at Fall City
   - Large capital actions in an agricultural area
2. Snoqualmie River Constrained Reach
   - Farm pads & limits on floodplain fill
3. Farms and riparian buffers
   - Effects of riparian planting on agricultural waterways



3. Farms and riparian buffers

2. Snoqualmie R. Constrained Reach

1. Snoqualmie at Fall City

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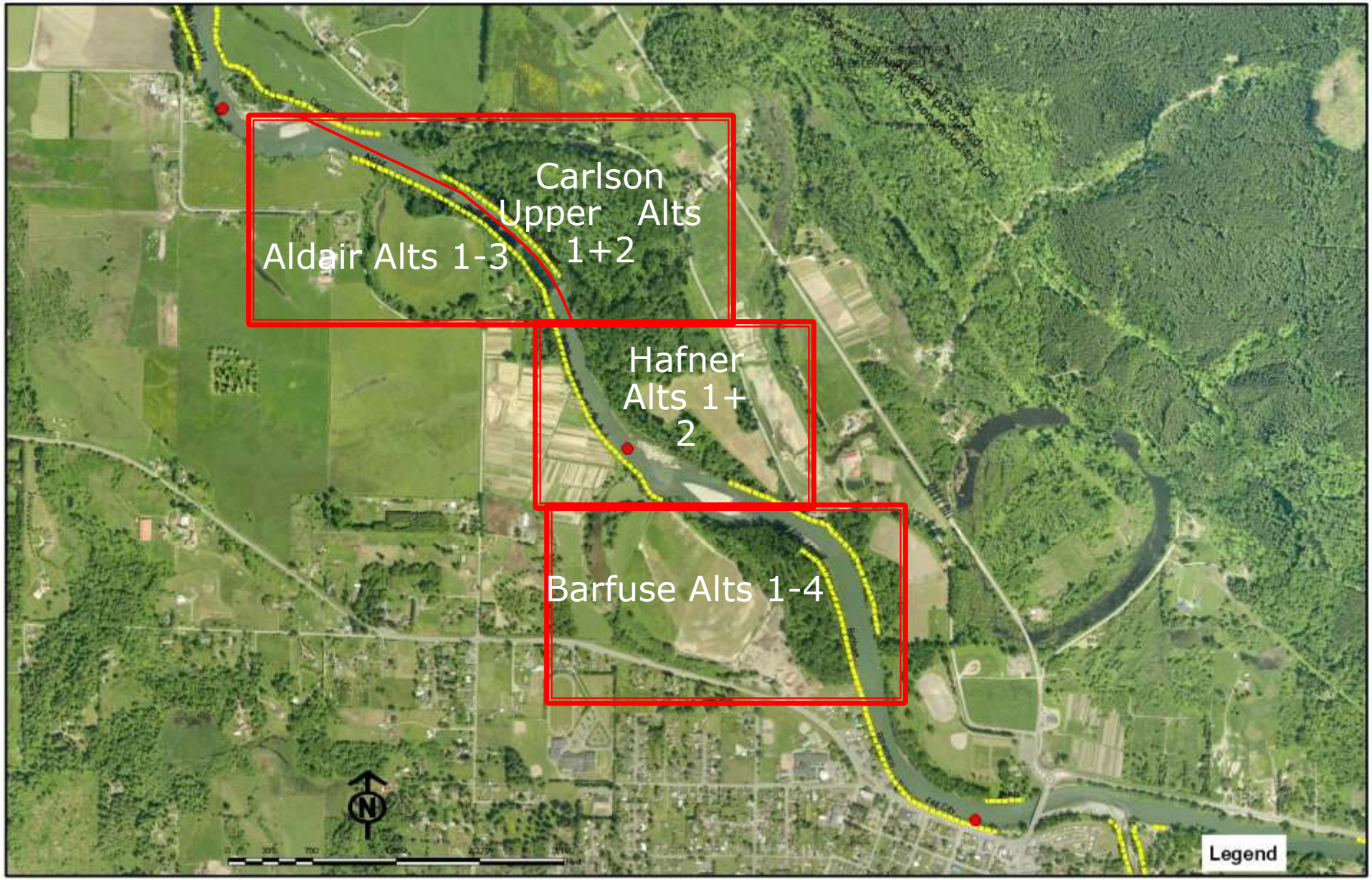
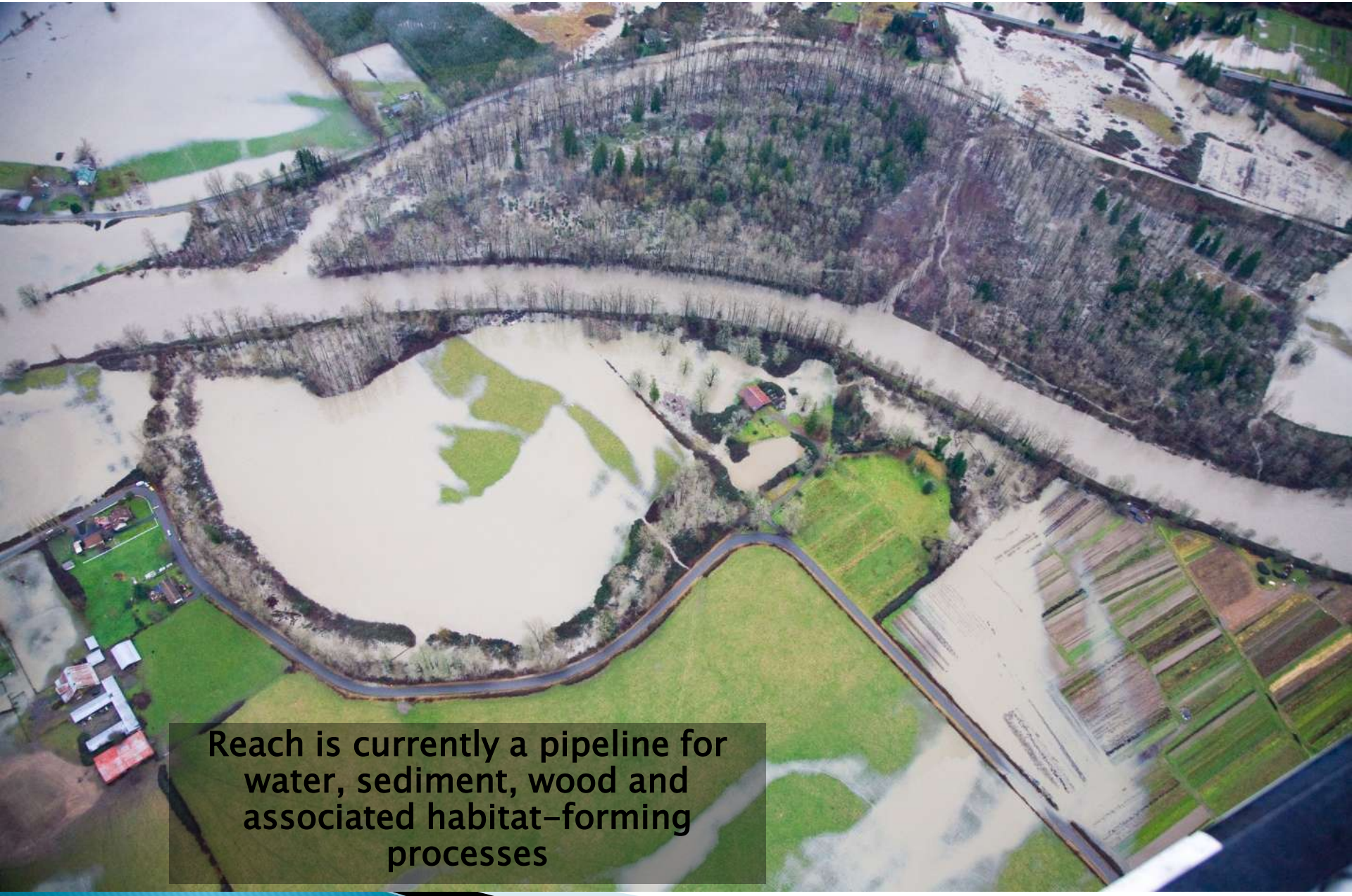
1. Snoqualmie at Fall City

4 Projects were evaluated

Focus on 2 of the projects

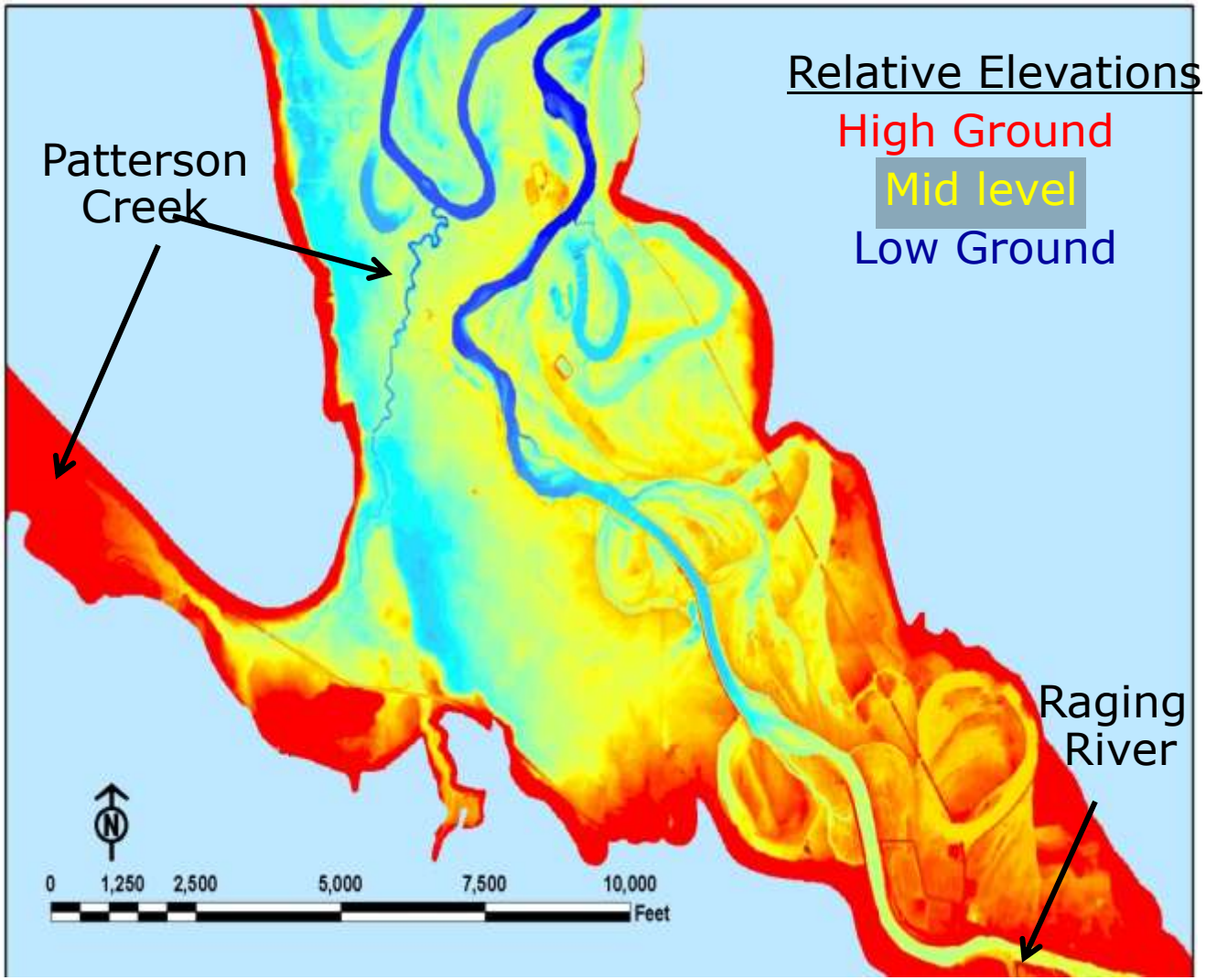


Upper Carlson and Aldair Facilities at ~ 28,000 CFS



Landscape Setting

- Deep, broad floodplain – flooding impacts farms, roads, homes
- Raging River: steeper gradient, more sediment – important for salmon spawning/rearing
- High risk of channel migration and fast/ erosive flows
- Facilities built in 1930s; do not contain floods
- Higher ground for farming



Why Make this Effort Here?

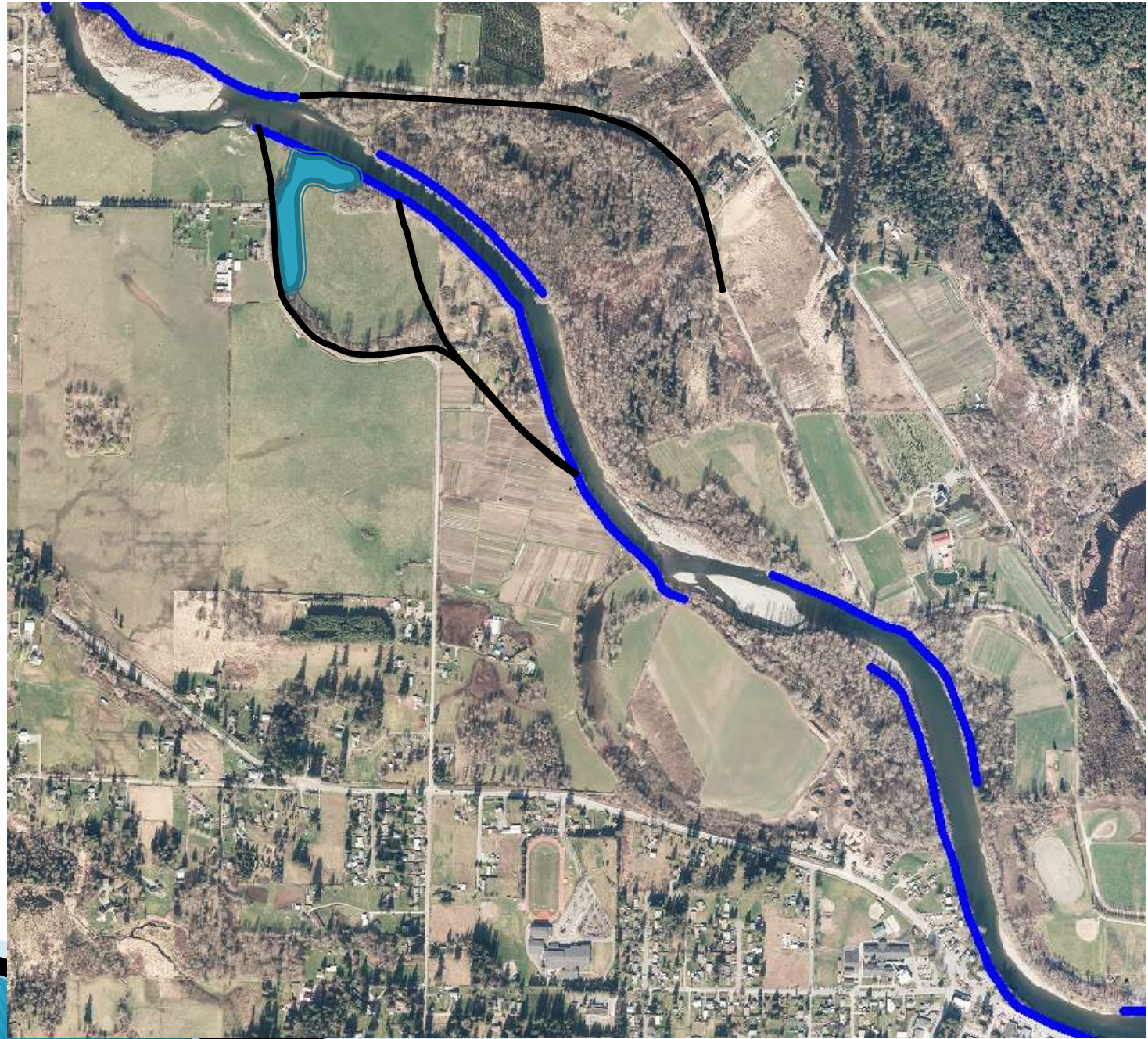
- Snoqualmie Chinook population is ~ 5.7% of historic abundance
- One of two core Chinook spawning areas on the Snoqualmie
- Reach very constrained w/ high potential for rapid improvement
- Priority Reach in Snohomish Basin Salmon Conservation Plan
- Progress to date towards the Plan's 10 year Targets (2015):
  - 1 of 5 miles Mainstem Edge Habitat (20%)
  - 21 of 84 Acres Mainstem Off-Channel Habitat (25%)

Project Alternative Development

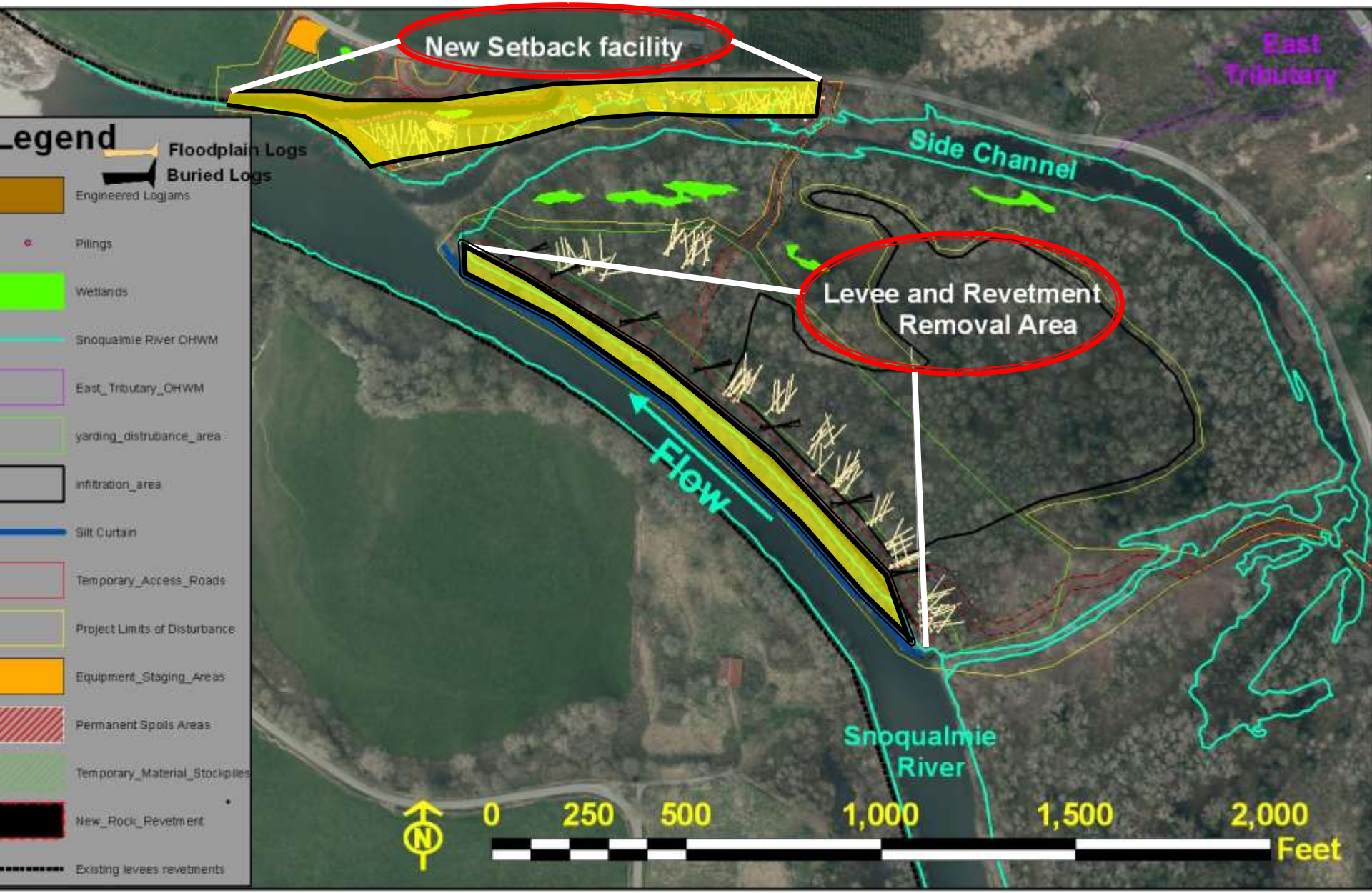
Impact Areas

Carlson
0.5-1 Acre

Aldair
2-30
Acres



Primary Actions Overview



Potential Impacts/Benefits to Ag

- Impacts
  - 1.5 acres taken out of production
- Benefits
  - Replace & extend right bank revetment with modern flood facility
  - Store sediment in the project reach which reduces sediment transport downstream
  - Reduce rate of erosion of Richmond's property on left bank
  - Provide fill for Farm Pads (Requests for the fill have already been received)

Aldair levee – concerns

- Levee has structural problems – seepage and piping which could lead to failure
- Repeated damages and repairs
- Actions to date:
  - ✓Letters sent in 2003 and 2008
  - ✓Dike property purchased 2008; tenants relocated, structures demolished

Aldair levee

Aldair levee – next steps

- **Geotechnical analysis to determine** character and probability of potential failure mechanisms
- **Hydraulic modeling** and hazard analysis to determine potential impacts of failures
- **Alternatives analysis** – acquisitions, rebuild in place, levee setback, other?
- **Considerations** – impact on agricultural land and structures, habitat benefits, funding, landowner willingness

Just Two Examples of Large Projects in the APD

- Upper Carlson – Project with high salmon benefits, modest flood risk reduction benefits, modest Ag benefits with relatively small impact on Ag.
- Aldair Levee – Project with high salmon benefits, high flood risk reduction benefits, potential Ag benefits, and potential Ag impacts.

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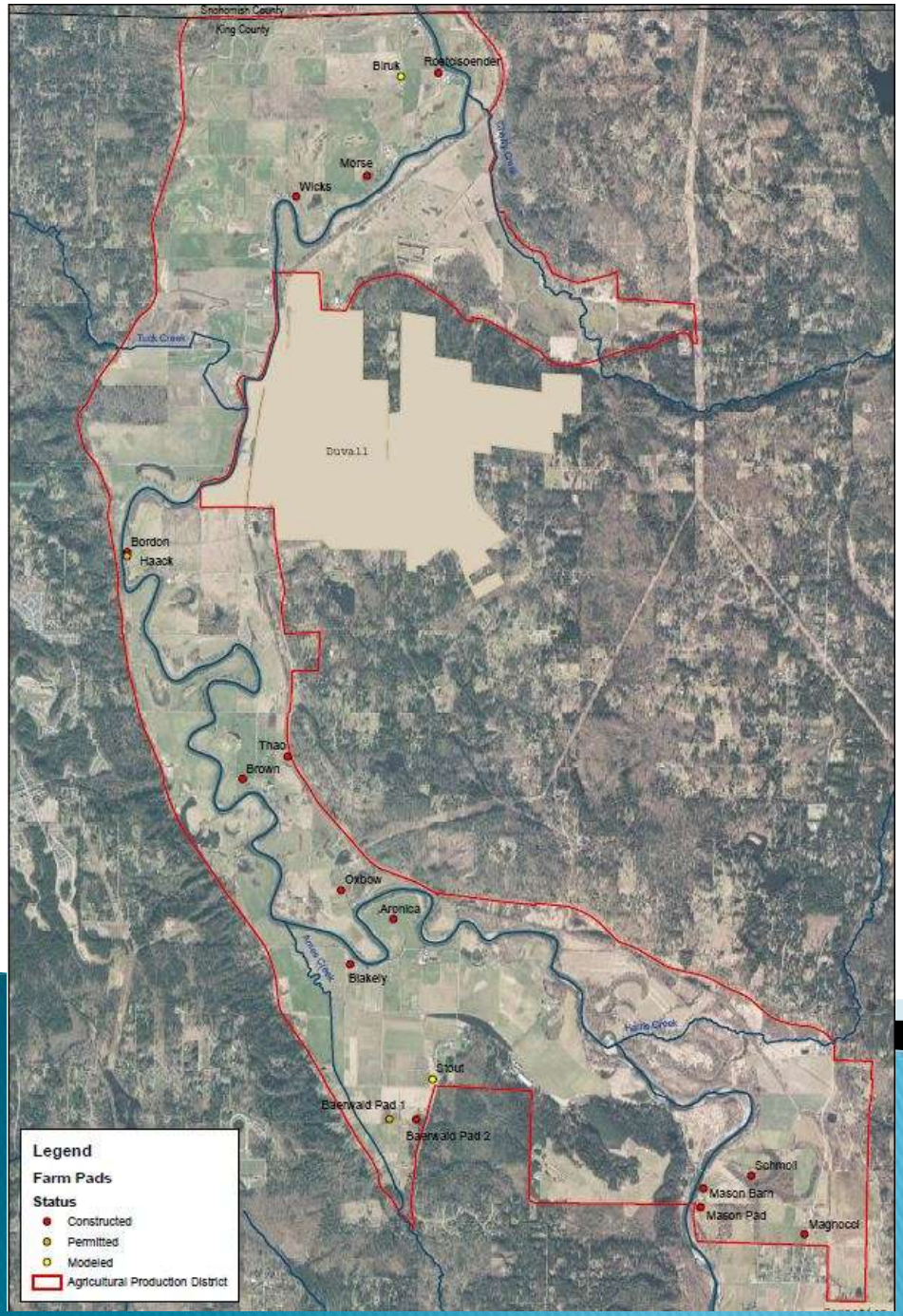
2. Constrained Reach of Snoqualmie

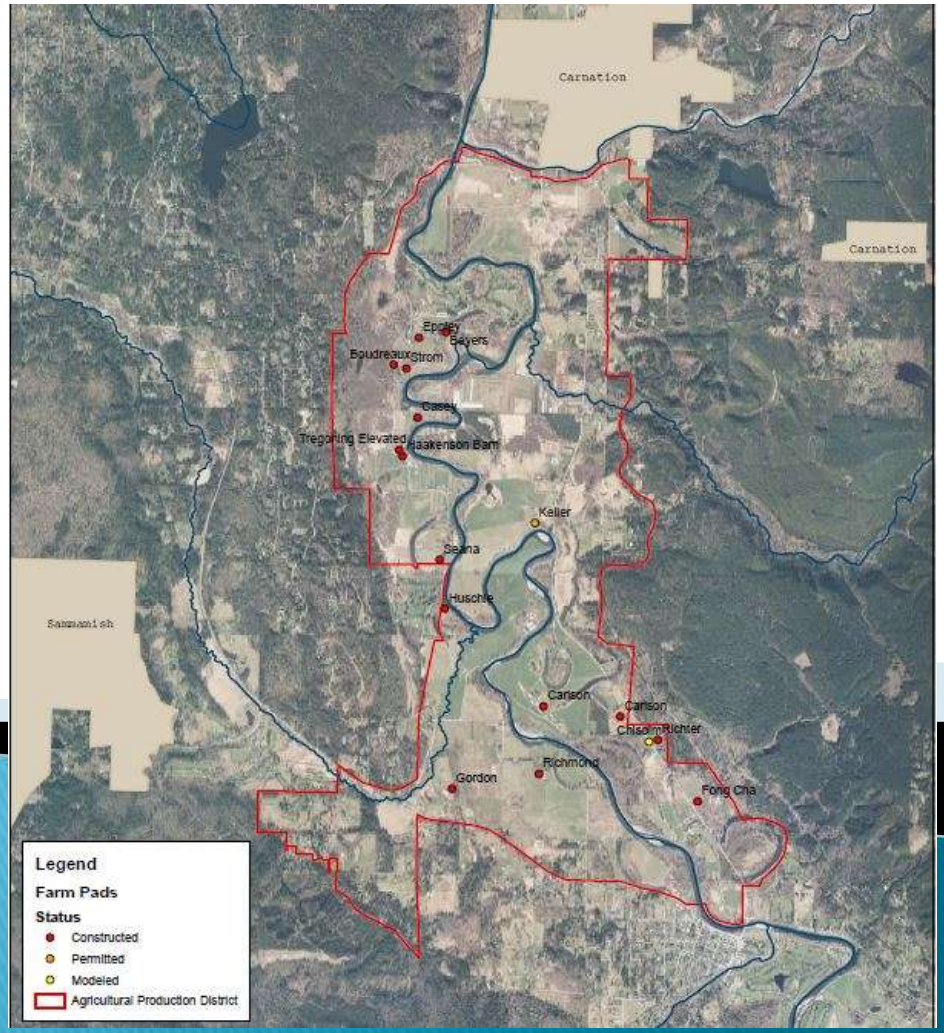
- Farm pads – placing fill above 100 year flood – to protect farm operations from flooding
- Since 2008 Snoqualmie Flood–Farm Task Force Report, code changed to allow farm pads
- 25 farm pads built since then

Farm Pad Program

- Pads vary by size, purpose, location
- County does annual modeling of cumulative impacts to upstream and downstream properties (modeled 33 pads)
- Several areas in valley more sensitive to fill – one is between 124th Street and Ames Creek

Farm Pads
Lower Snoqualmie Valley





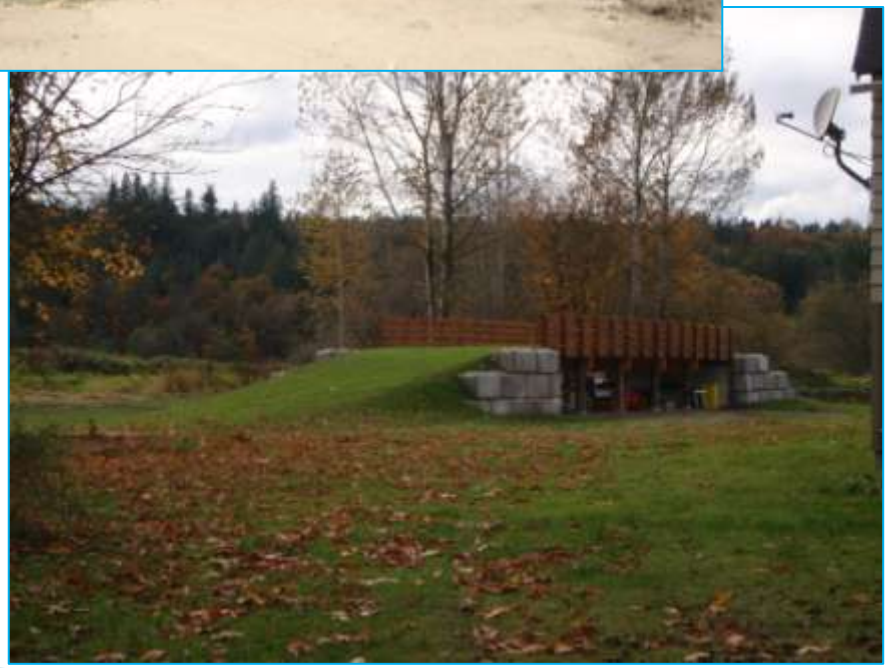
Snoqualmie reach of limited capacity

Issue of limited floodplain capacity

- Possible explanations: width of floodplain/floodway, number of fill prisms in close proximity, roadways
- Met with farmers May 2013 to hear about their flood related needs and discuss alternatives to farm pads
- Options include elevated platforms, elevated barns, using Snoqualmie Valley trail to store farm supplies during floods
- Challenge is cost and technical issues of non-fill options

Options: elevated platform

- Pilot project constructed 2012
- Significant county cost share
- Learned re: cost, permitting, technical issues



Options: agricultural structure elevations

- Lift barn, then rebuild foundation with flow through vents
- Avoids fill
- Water flows under barn
- Challenges include: geotech, access, cost

Pilot Barn Elevation Project

Constrained reach option: construct elevated platform off existing pad for expansion of ag operation

Constrained reach option: construct elevated platform in existing barn

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Buffer Benefits for Fish

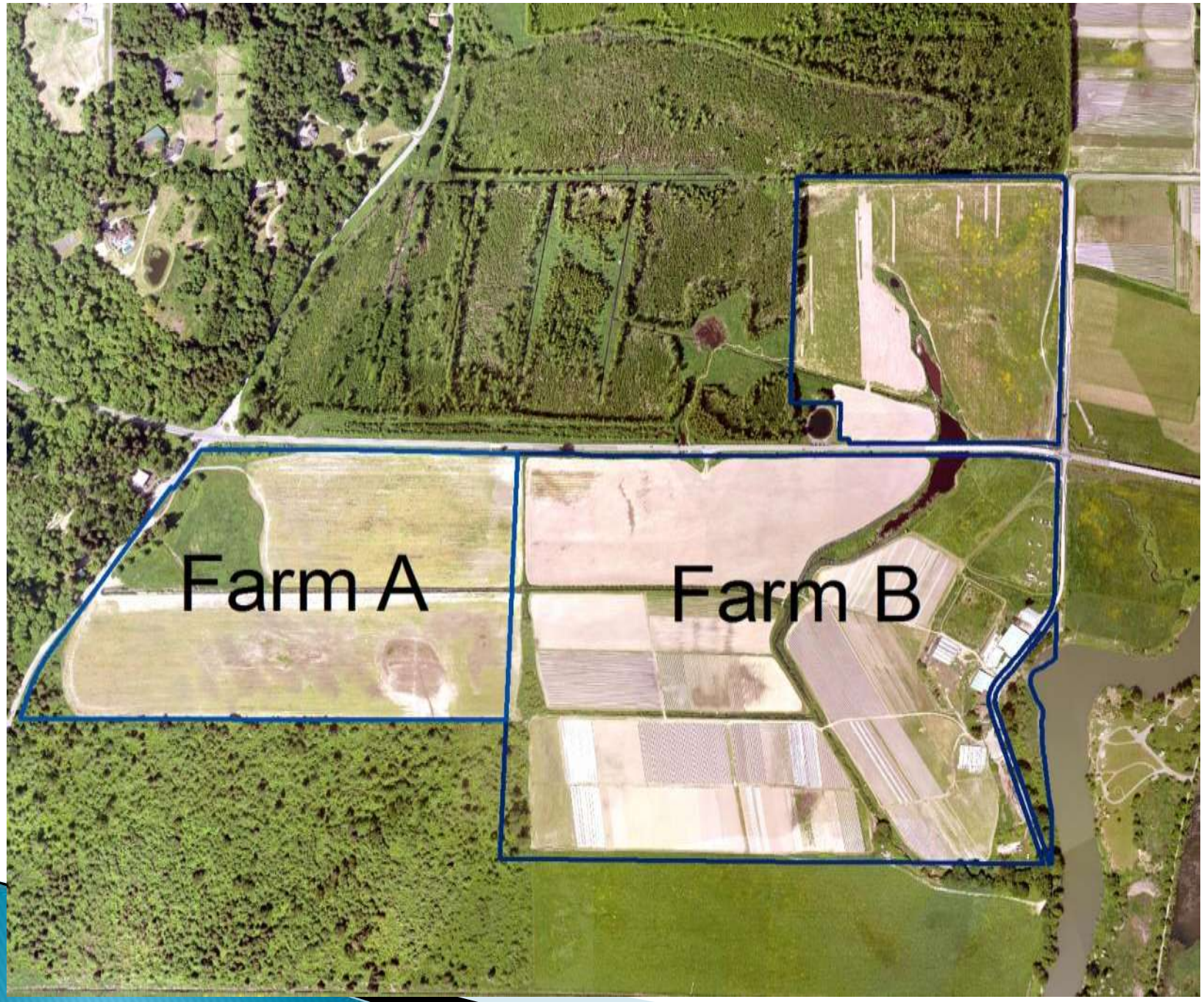
- Shade; decreased temperatures, more O_2.
- Increased food; cover from predators.
- Water quality filters for overland flow.
- Cool subsurface flows when needed in summer.
- Wider/taller buffers improve functions.
- Channelized streams do not have quality of in-stream habitat as meandered streams…

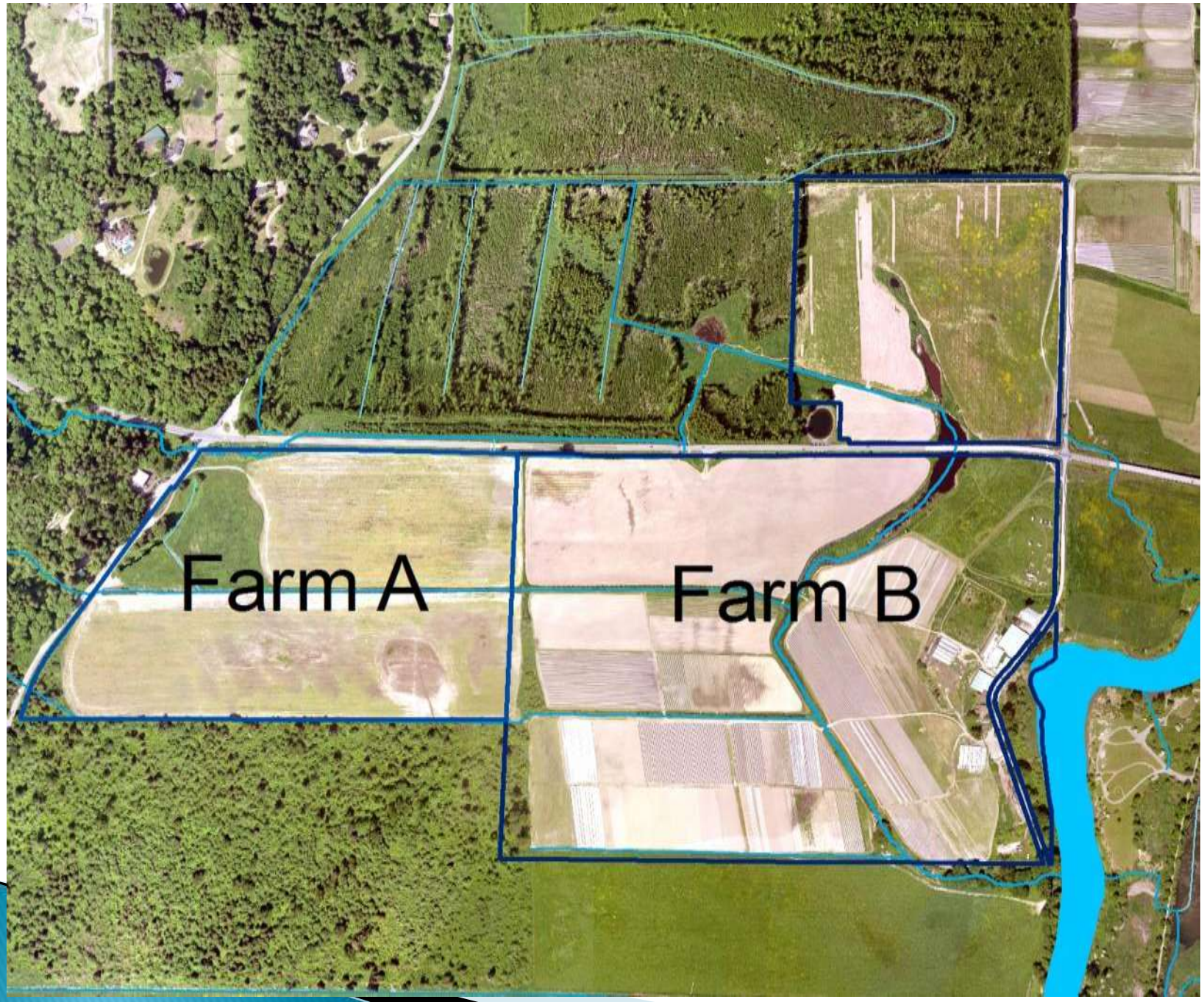
Buffer Benefits for Ag

- On main stem may act as traps that prevent flood debris from reaching fields.
- Stabilize banks from erosive forces.
- Keep livestock from streams/river.
- Improve aesthetics/provide privacy.
- Shade for livestock; windbreaks.
- Shade out reed canary grass.
- Provide beneficial insects, birds/wildlife.
- Compatible with ethos of and potentially certification for “organic agriculture.”

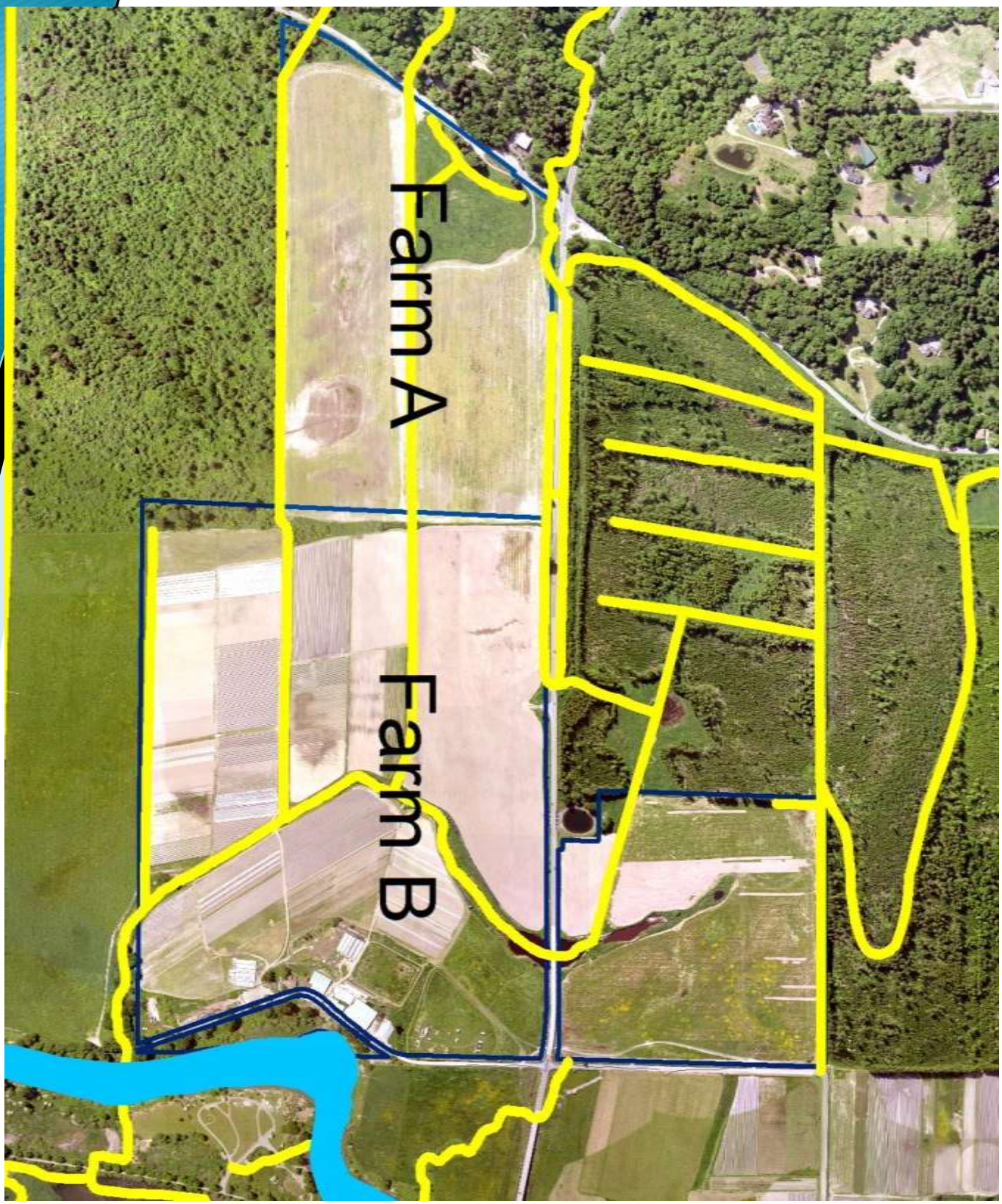
Buffer Challenges for Ag

- Shade adjacent fields.
- Harbor negative pests: weeds, seeds, cones; deer, rodents, coyote, elk.
- Block oversight views of livestock.
- Increase beaver problems.
- Potential Flood dangers: contribute debris, trap flood debris, impede flows, increase erosion at edges.
- Roots can damage subsurface field drainage pipes (tiles).
- **Remove land from production.**

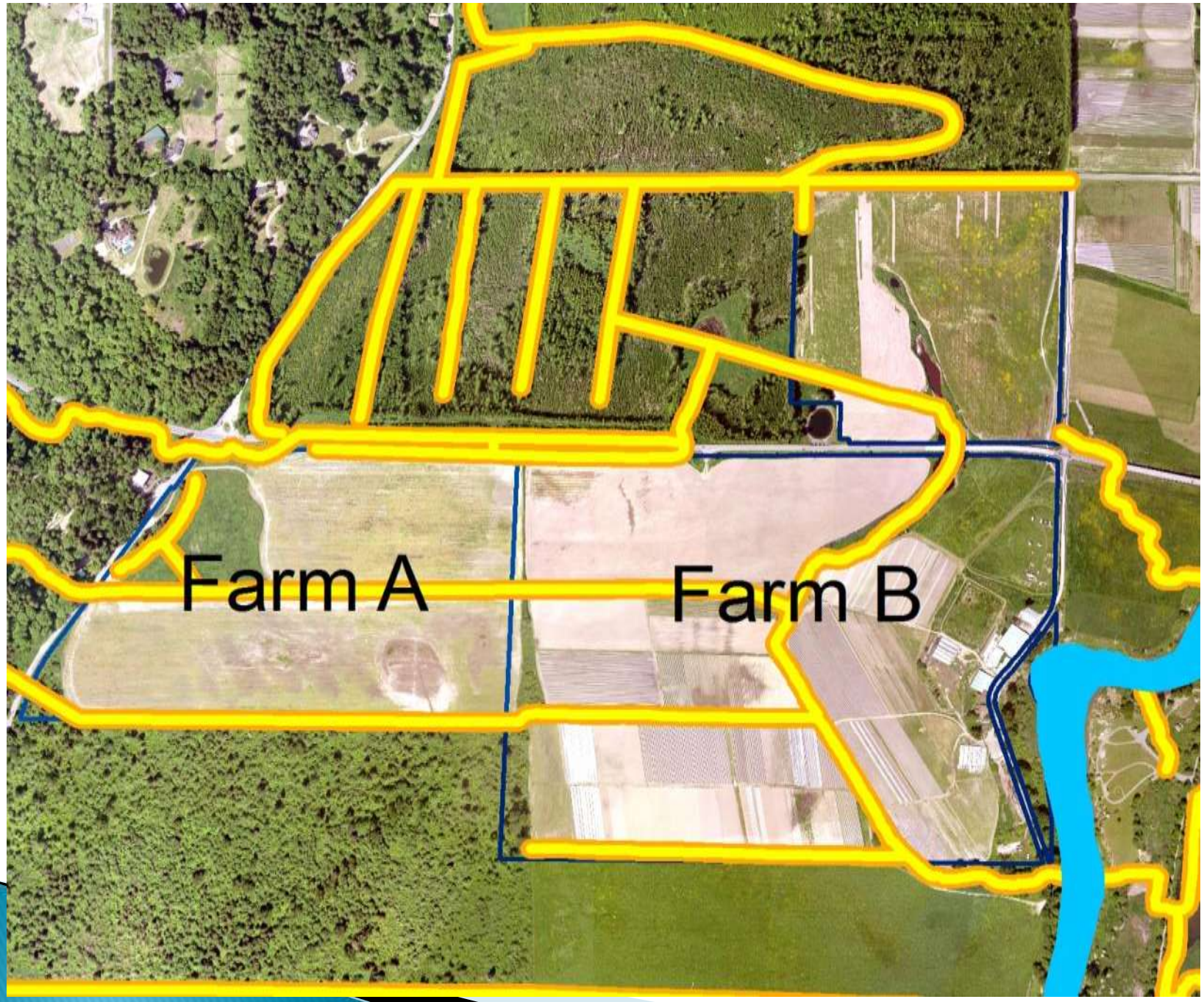

Farm A
Farm B


Farm A
Farm B

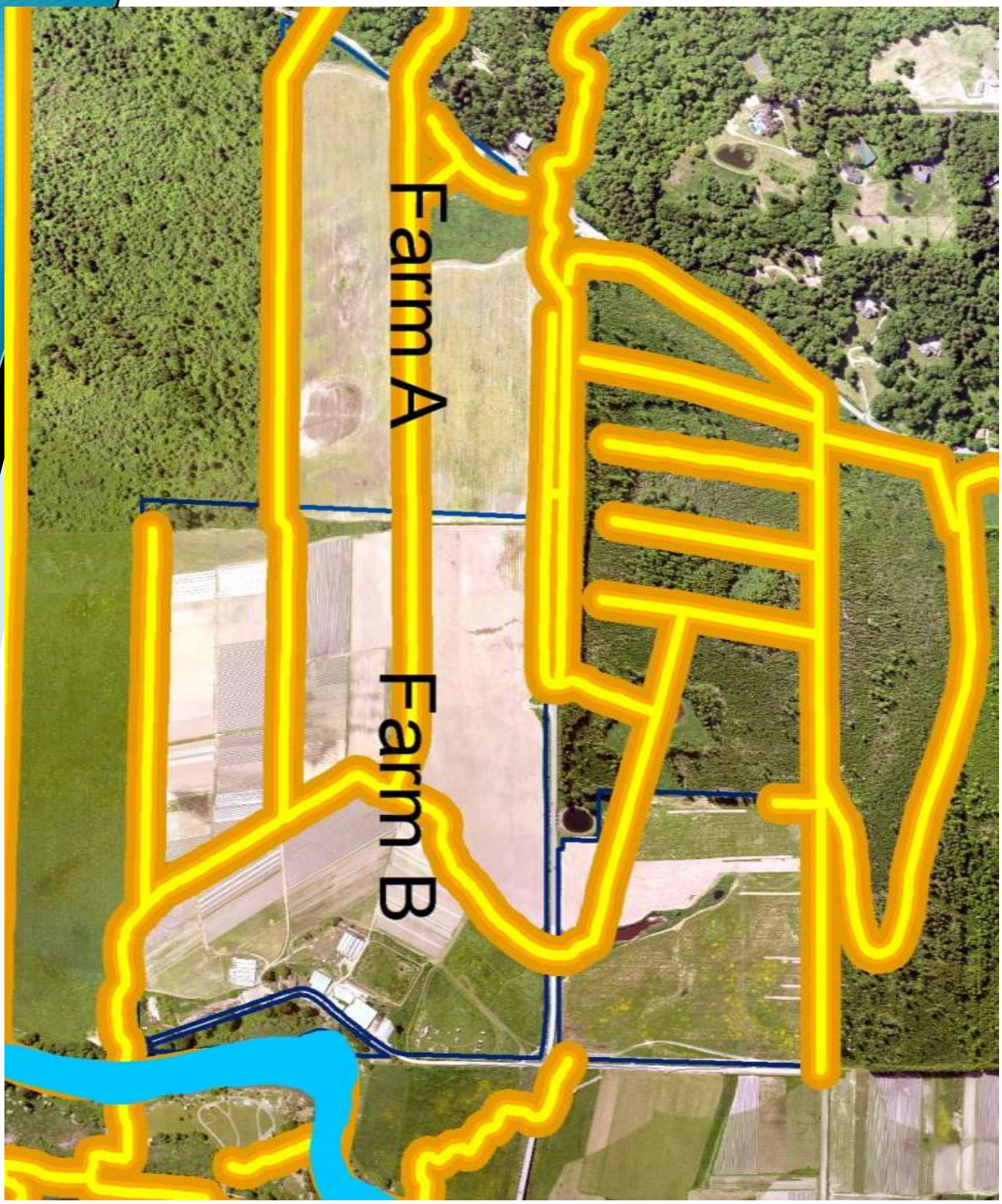
25 ft. buffer



50 ft. buffer



100 ft. buffer



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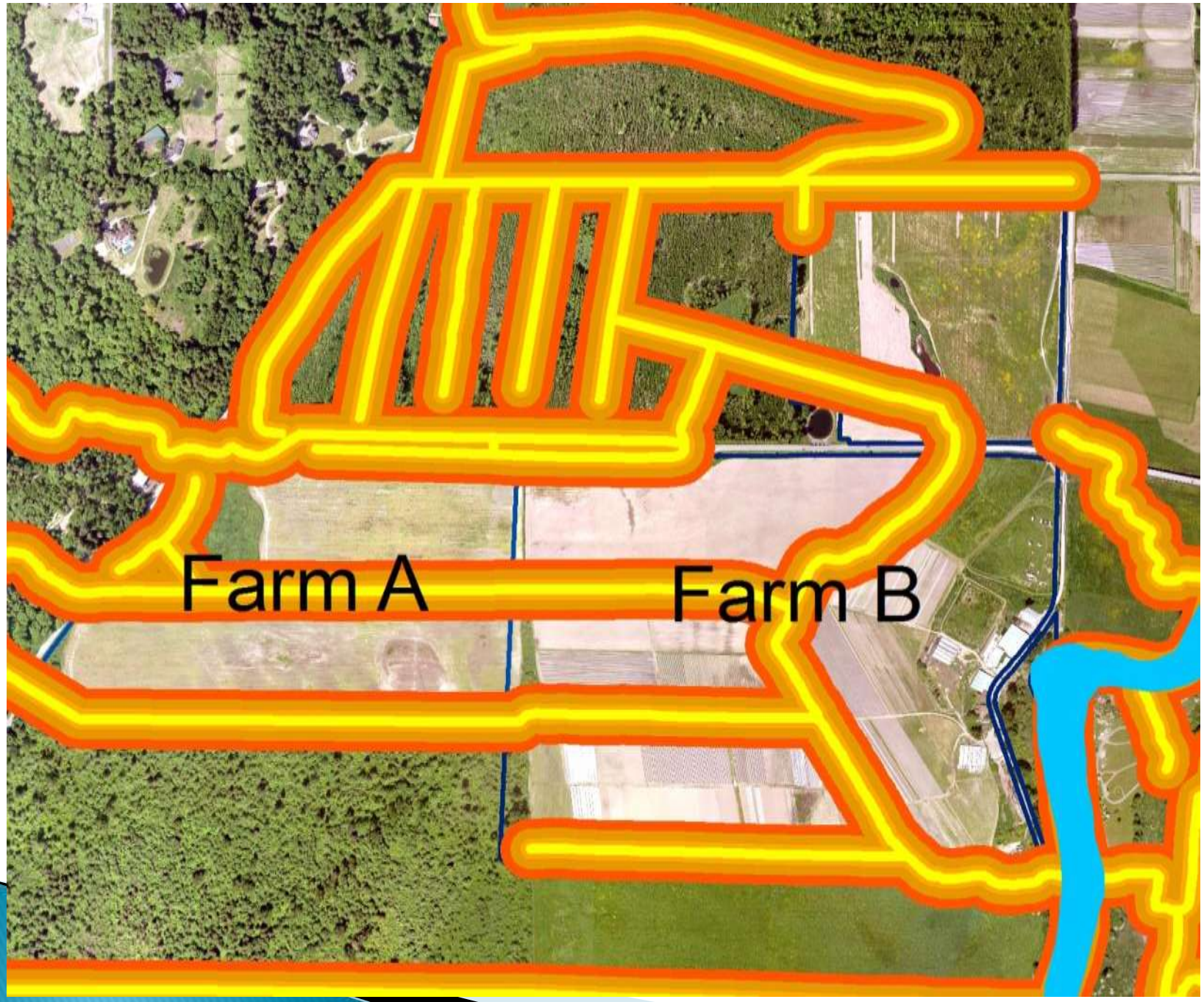

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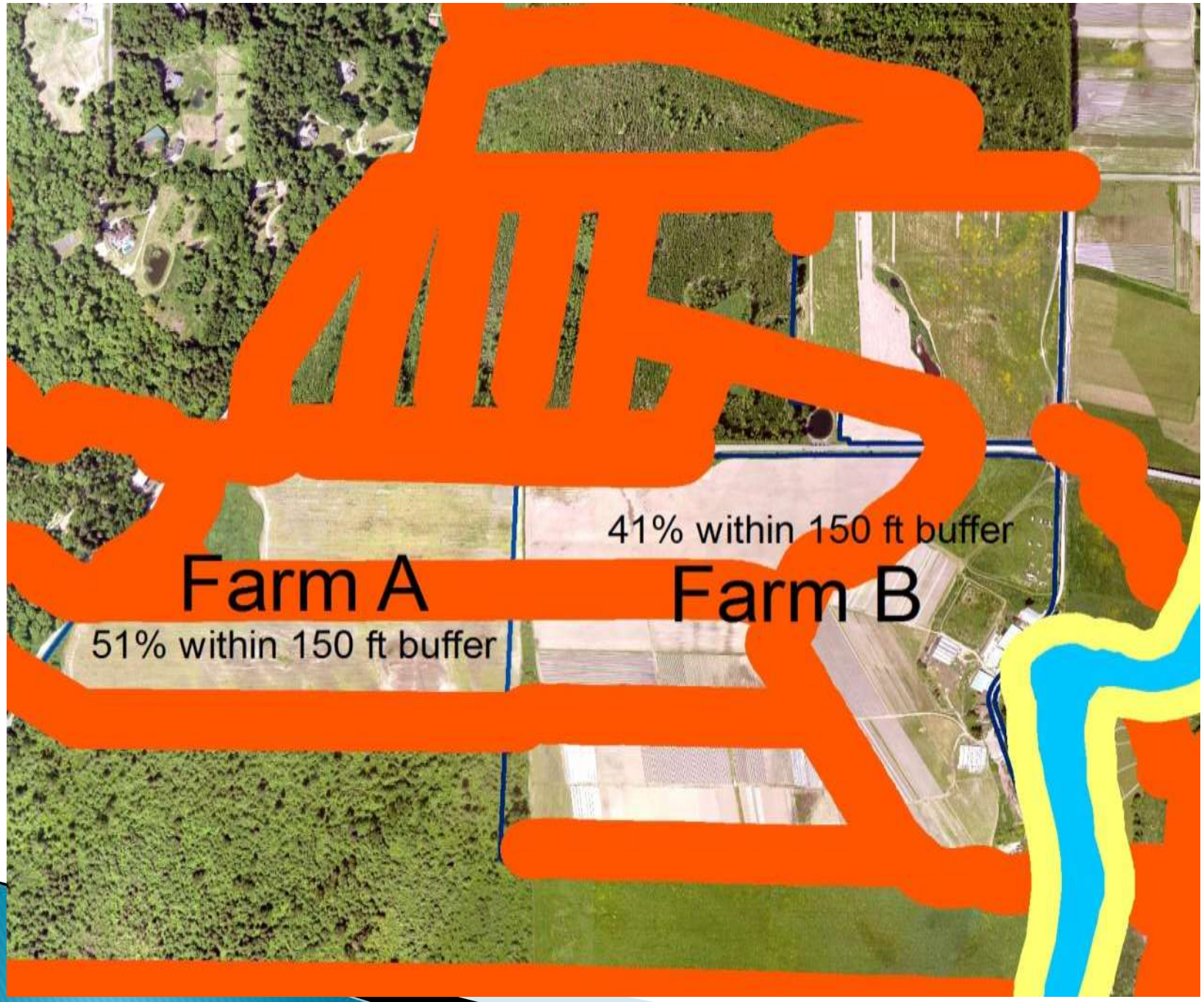
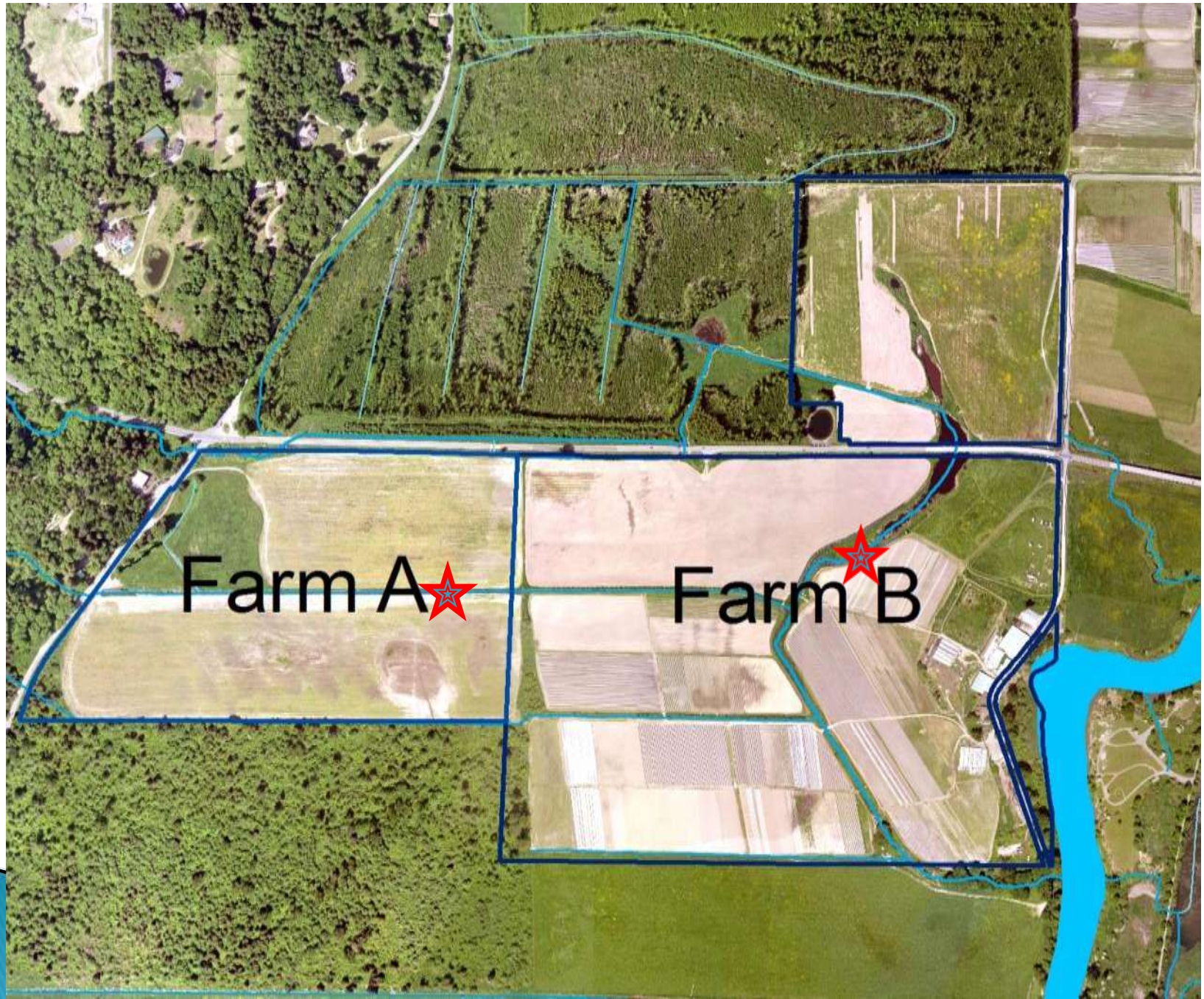
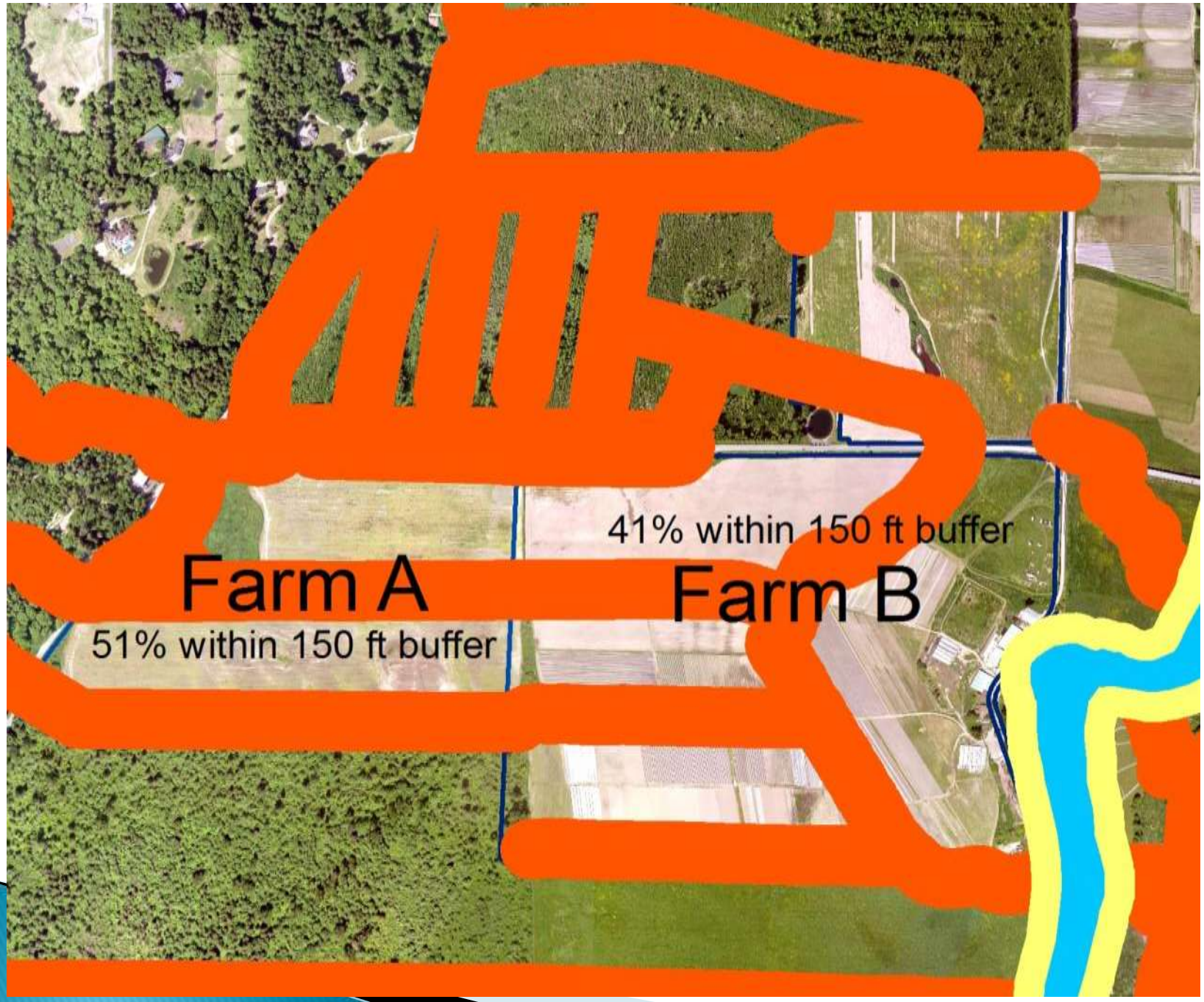
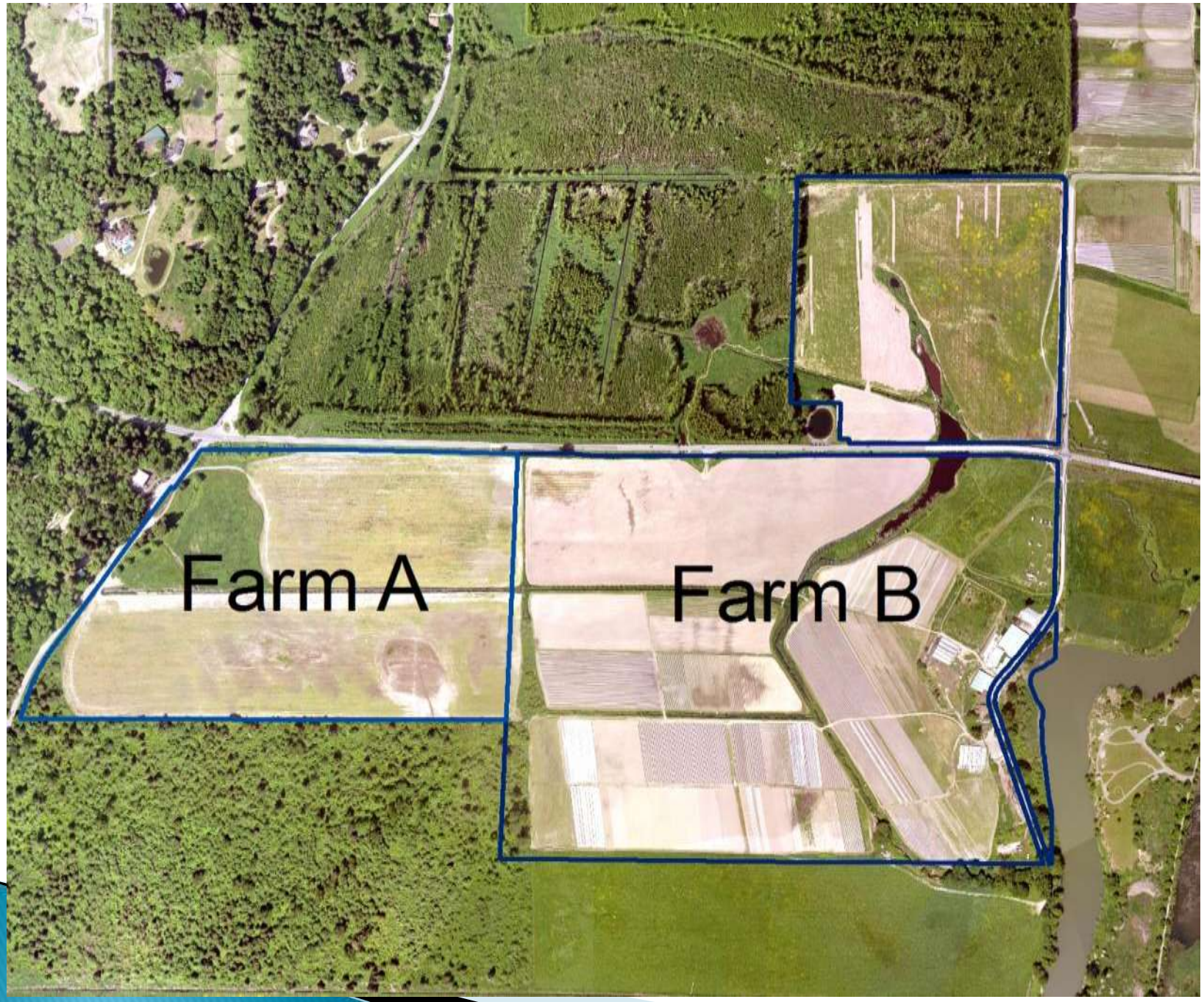



Farm A
Farm B

150 ft. buffer




Farm A
Farm B

Key Questions on Buffers

- What size buffers should happen where?
- What mix of regulatory and voluntary tools should be used?
- Who decides?
  - At scale of farm/landowner?
  - At scale of APD/Floodplain/basin?
- Is there an order of priority for these investments and if so, how does this happen?

Questions?