Source Water Protection Planning in an Agricultural Watershed

2026 AWWA-PNWS Conference
Thursday, May 7, 2026

PRESENTED BY:

ANNEAR WATER RESOURCES

Joint Water Commission
JWC

Overview

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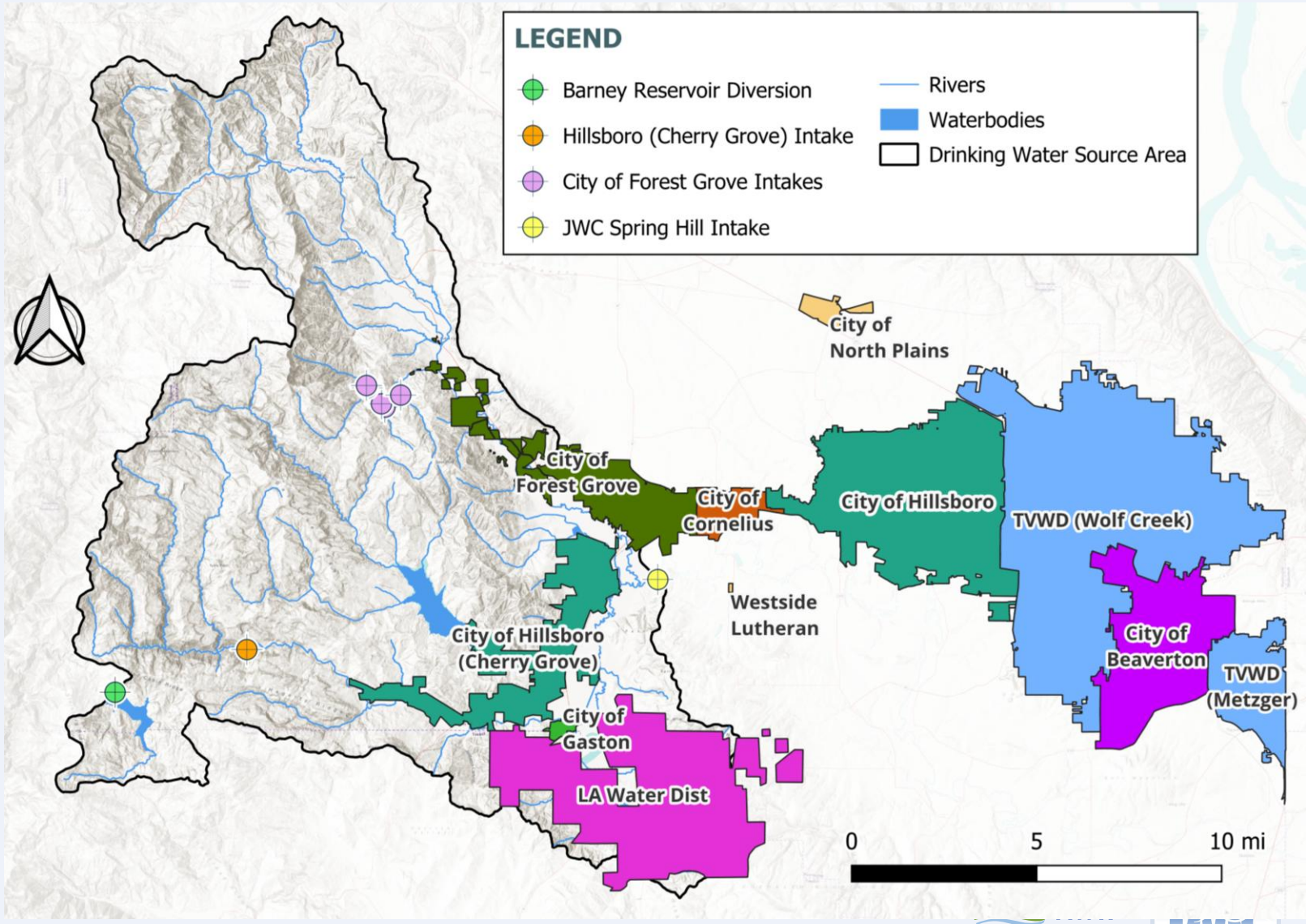
Joint Water Commission (JWC)

Introduction

The JWC is the primary drinking water supplier for 458,000 customers in Washington County, Oregon.

The JWC is formed by:

- City of Hillsboro
- City of Forest Grove
- City of Beaverton
- Tualatin Valley Water District
- Other Customers
  - Wholesale JWC (North Plains, Westside Lutheran)
  - Wholesale Hillsboro (Cornelius, Gaston, LA Water Co-Op)



2024 Source Water Protection Plan (SWPP)

Introduction

The JWC received a National Resource Conservation Service (NRCS) grant to update the 2014 SWPP, focusing on agricultural risks.



Purpose and function of the SWPP

- Maintain and safeguard the quality of water used as a drinking water source.
- Identify and prioritize a list of projects and programs to help reduce potential biological and chemical contamination risks.
- Integrate with other source water protection programs and projects.





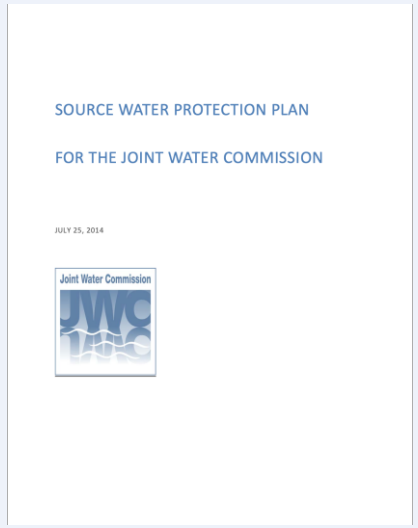
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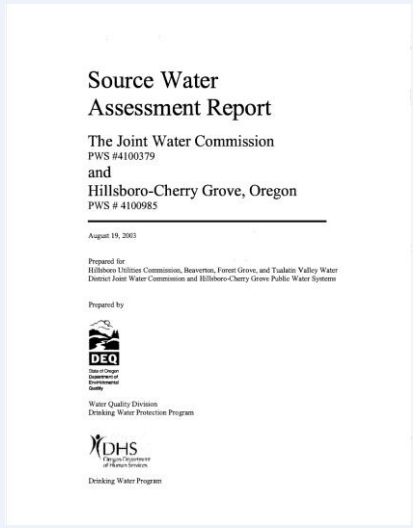
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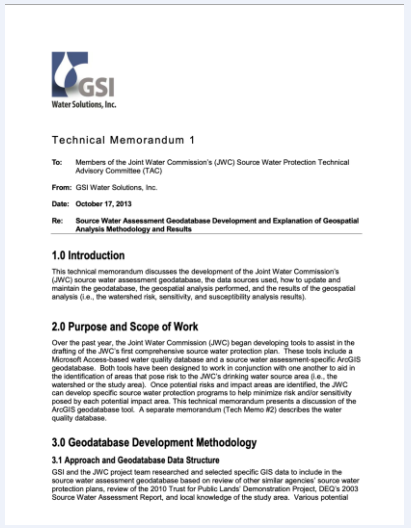
2024 SWPP

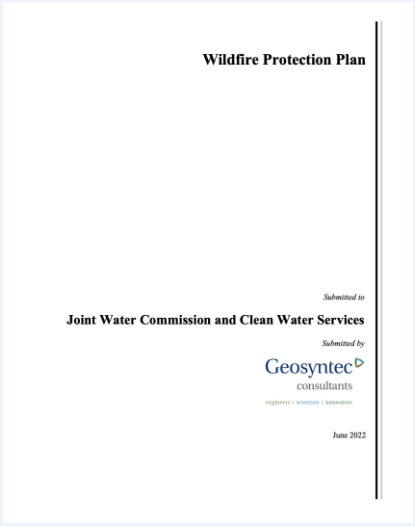
Summary of Past Work

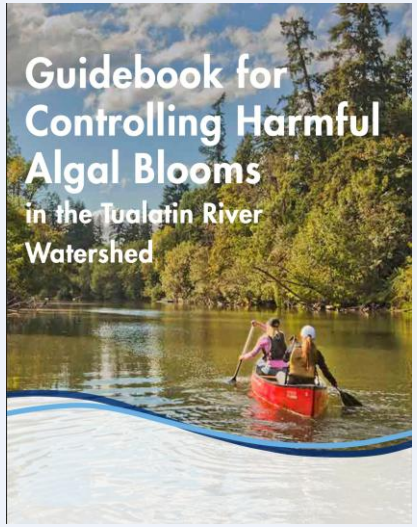
- 2003 DEQ Source Water Assessment
- 2013 GIS Risk Analysis
- 2014 Source Water Protection Plan
  - 2014 SWPP Technical Memo’s
- 2019 Updated DEQ Source Water Assessment
- 2022 Wildfire Protection Plan
- 2022 HAB Impoundment Report

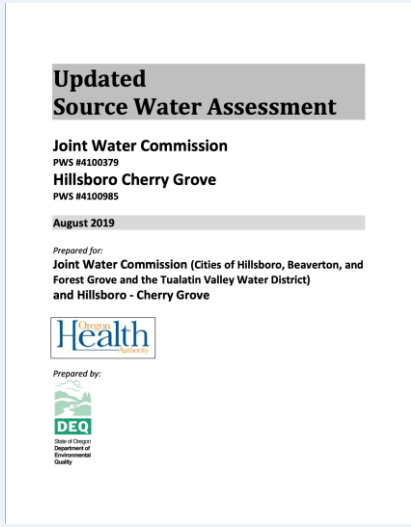












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Drinking Water Source Area (DWSA)

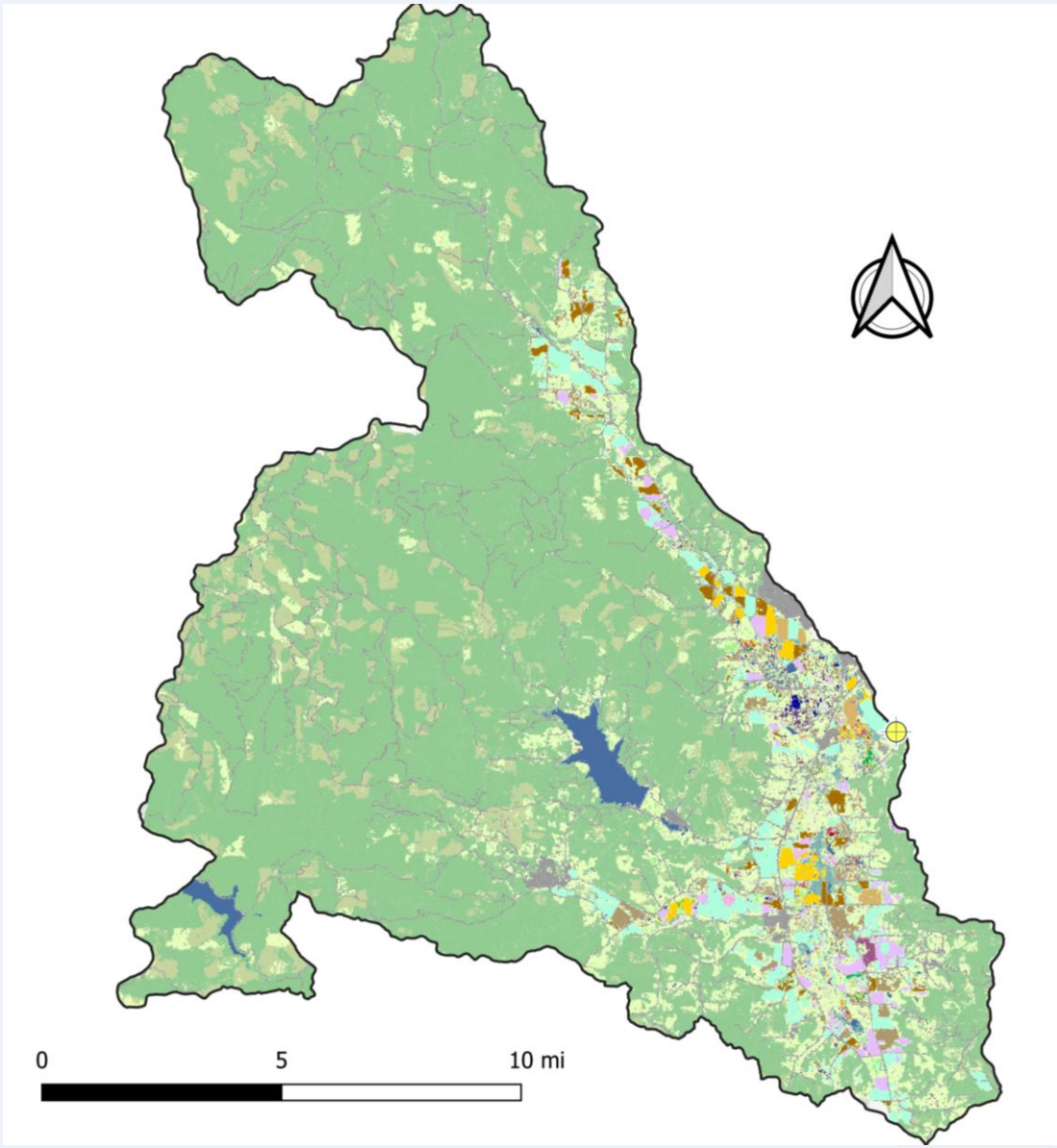
Introduction

The DWSA encompasses 228.2 mi.^{2}

- 220 mi.^{2} Tualatin River basin
- 8.2 mi.^{2} Barney watershed

Agriculture represents 19.8% of the DWSA with over 45 different crop types.





Phase I

Characterization of the DWSA

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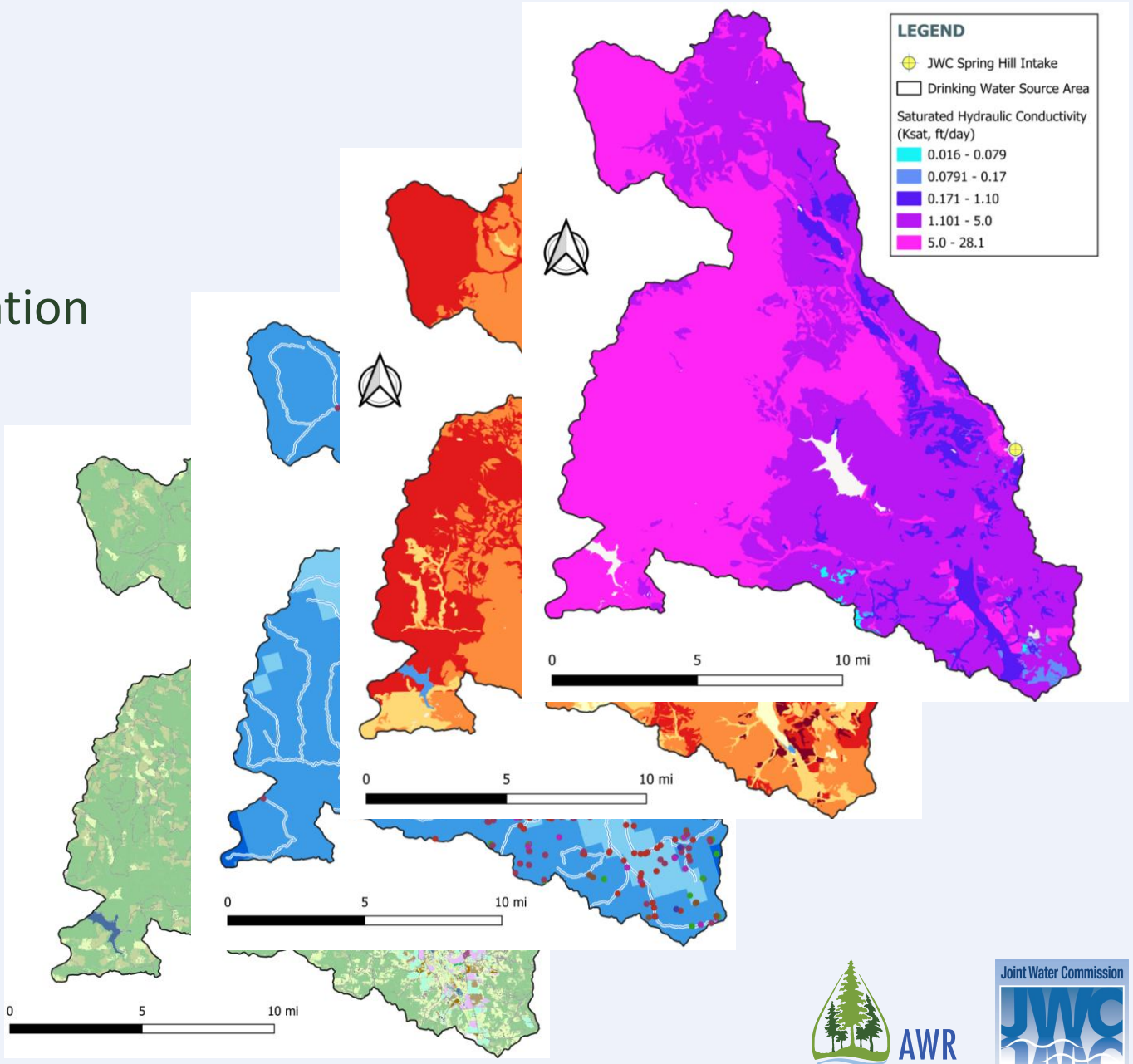
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Overview

Phase I: Characterization of the DWSA

Characterization of the DWSA included:

- Population and socioeconomic information
- Landscape and land use
- Surface hydrology and topography
- Geology, geomorphology, and hydrogeology
- Soils and septic systems
- Climate
- Dam operations
- Wildfires



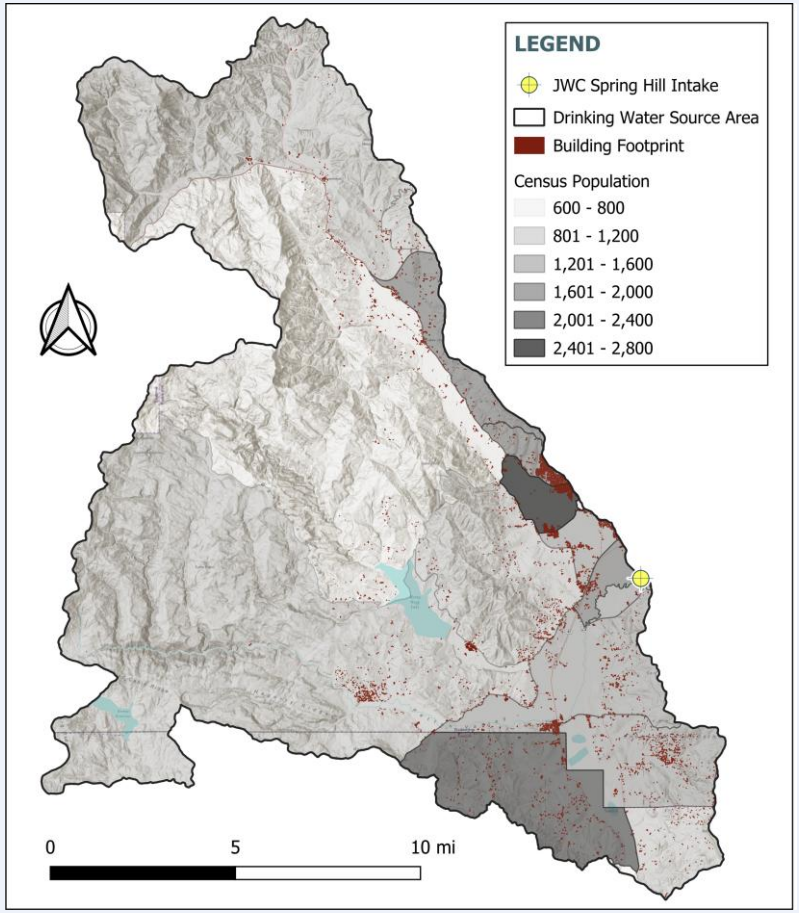
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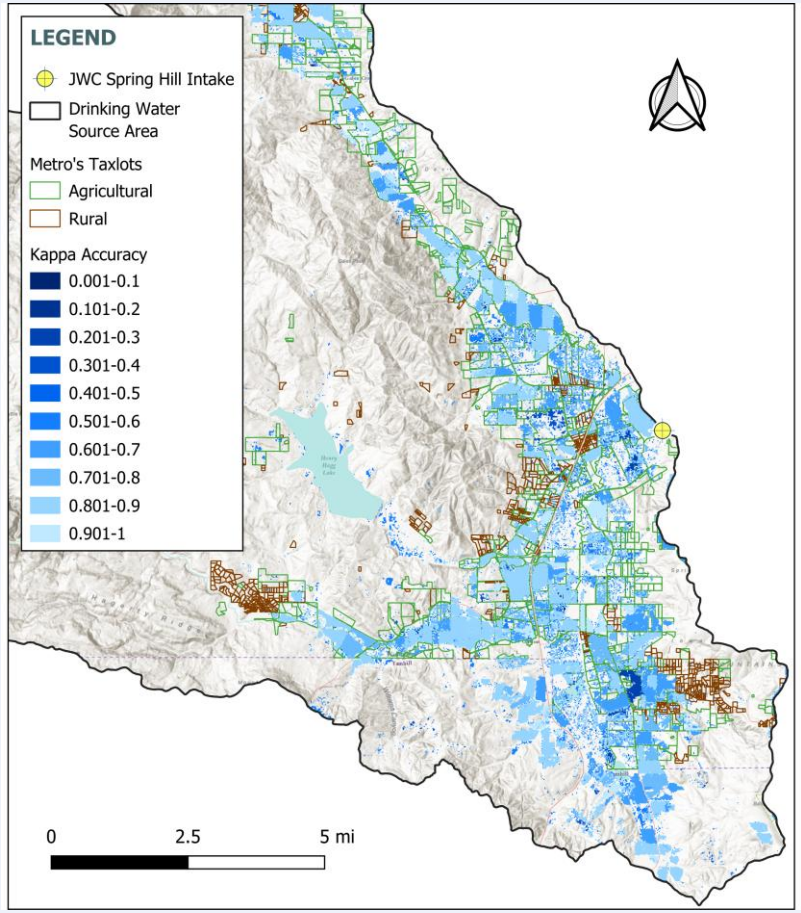
Sample Characterizations

Phase I: Characterization of the DWSA

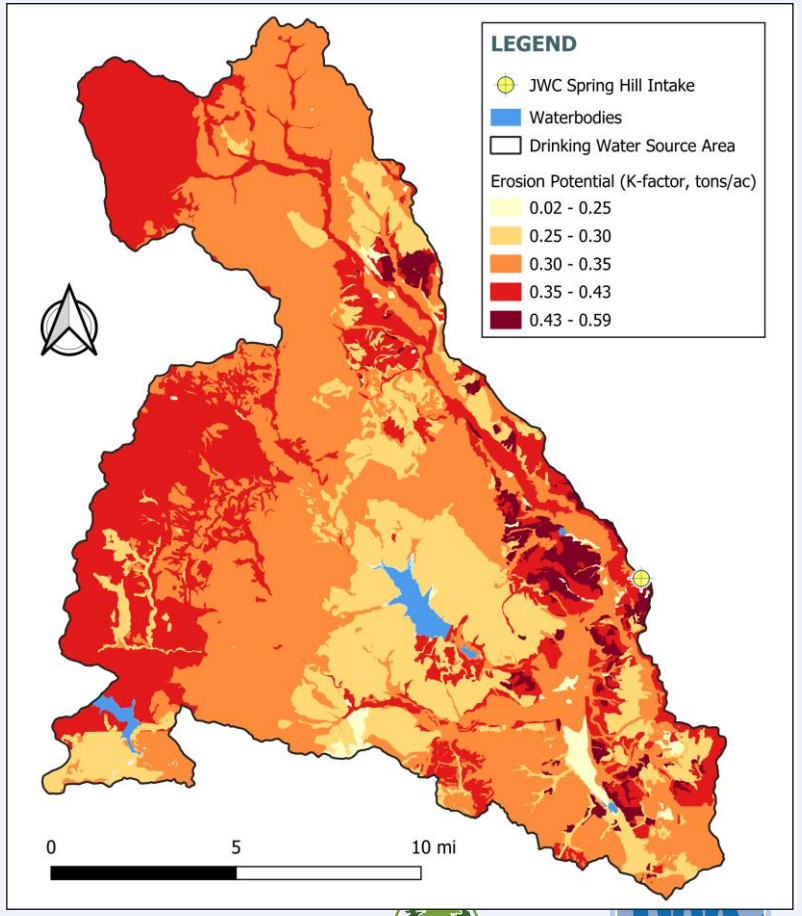
Population and Socioeconomic Data



Landscape and Land Use



Erosion Potential of Soils

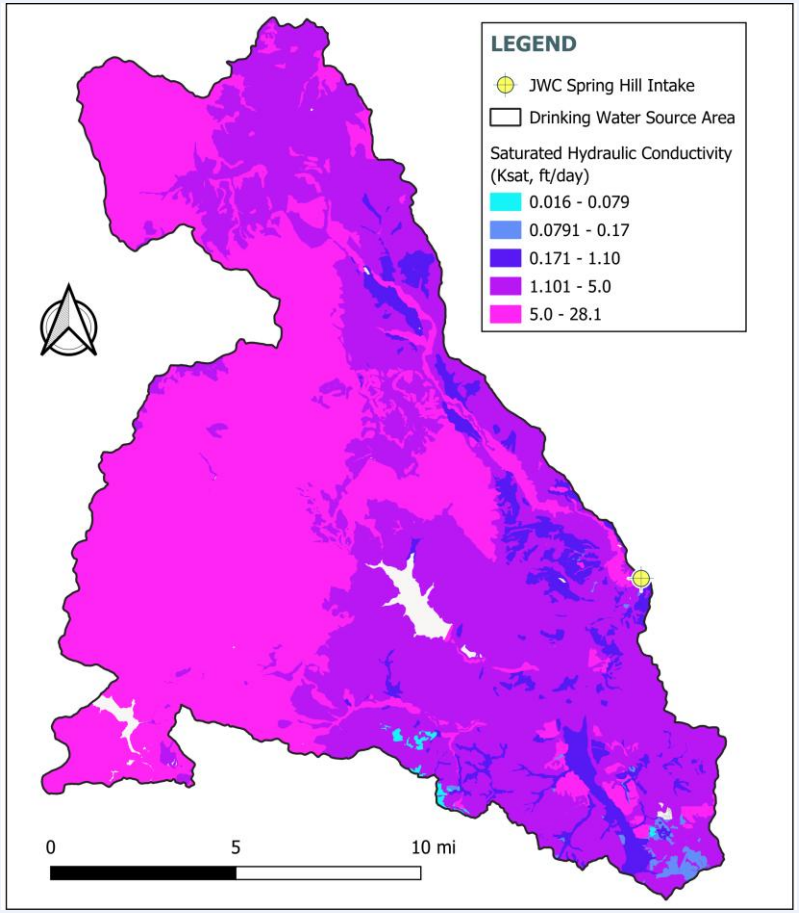


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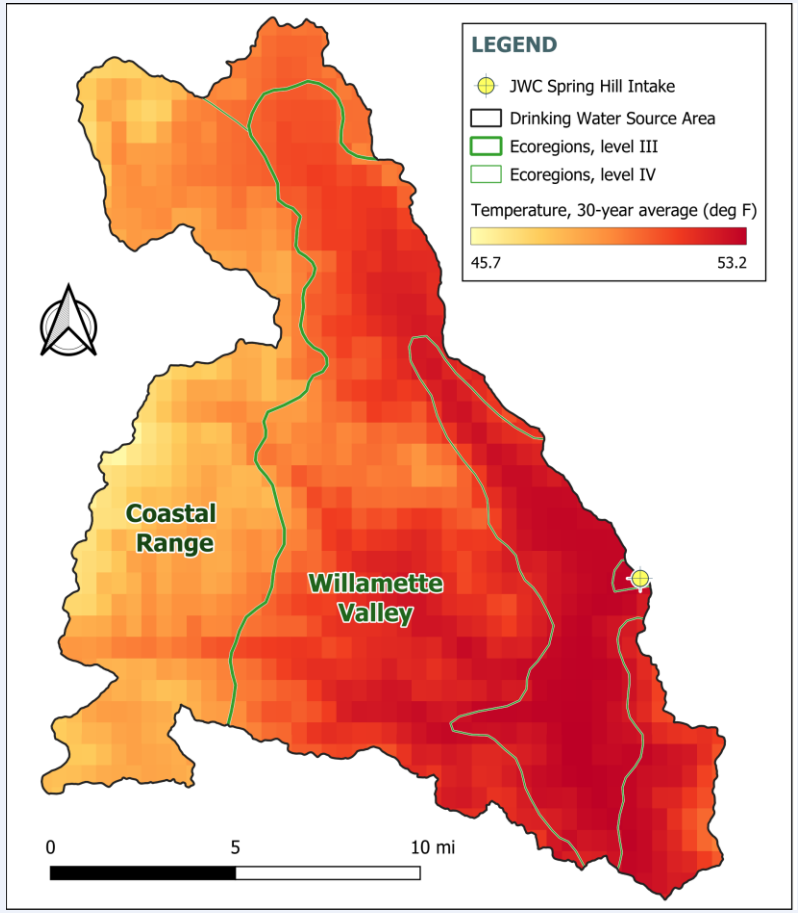
Sample Characterizations (cont.)

Phase I: Characterization of the DWSA

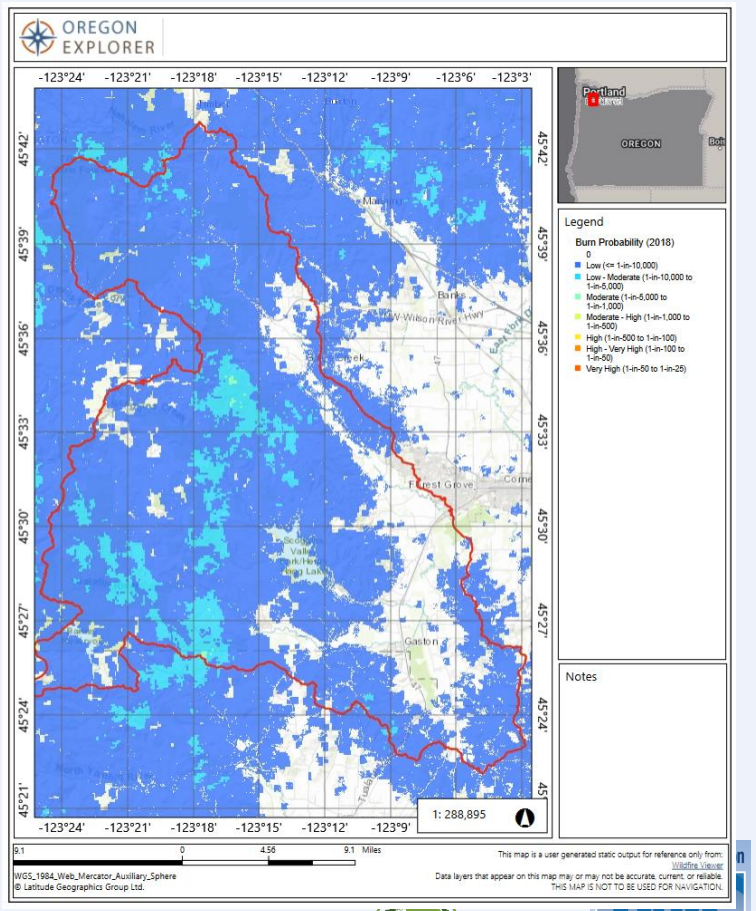
Soil Hydraulic Conductivity



Historic Air Temperature



Wildfire Risk



Key Takeaways

Phase I: Characterization of the DWSA

- Forestry and agriculture are the dominant land use.
- Agricultural practices will be the highest risk.
- Changes in crop type are important to categorize.
- Will be necessary to maintain dataset to facilitate Best Management Practice (BMP) assistance.
- More specific septic data may be important for characterizing risk.
- Wildfire risk will increase during the duration of this SWPP.
- Commercial nursery holding ponds are a demonstrated source of downstream water quality impairment.

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Phase II

Hydrologic and Water Quality Characterization

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Hydrology – Characteristics of Sub-catchments

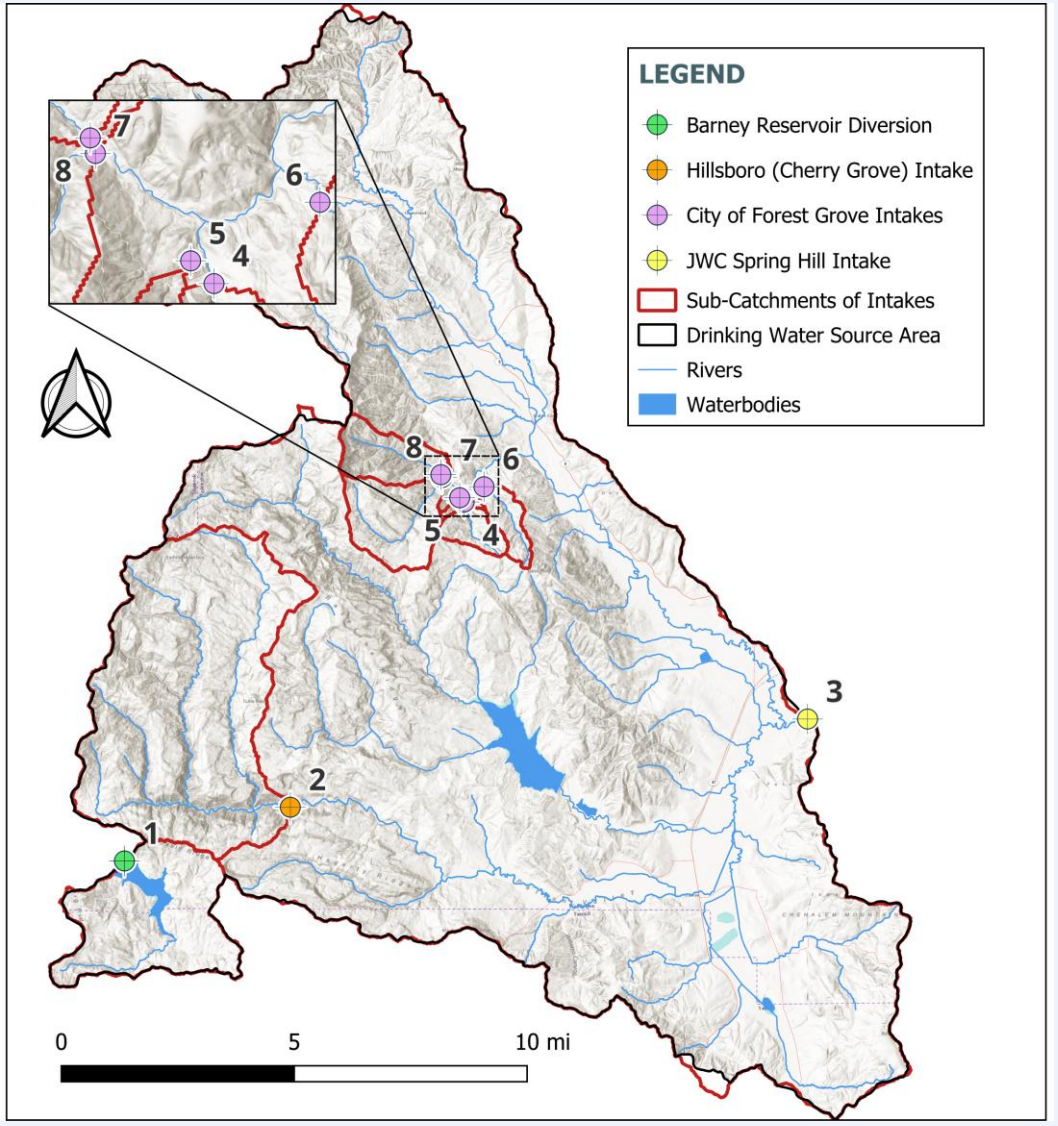
Phase II: Hydrologic and Water Quality Characterization

Slope is huge factor in sub-catchment runoff characteristics

Basin 3, Spring Hill Pump Plant has the largest drainage area and the largest range in the elevation, and the highest slope.

Smaller basins have tighter elevation range, smaller drainage, but still a wide range of slopes (Thomas, Roaring and Clear Creeks)

Subcatchments of intakes	Elevation, ft		Slope, degrees	
	Max	Min	Max	Min
1. Barney Reservoir Diversion below Dam	2,740	1,590	32.6	0
2. Haines Falls Intake	3,470	590	47.6	0
3. Spring Hill Pump Plant	3,470	153	48.2	0
4. Deep Creek	1,680	489	40.3	0.44
5. Smith Creek	1,600	537	30.9	1.51
6. Thomas Creek	1,770	514	33.0	0.33
7. Roaring Creek	2,350	460	45.5	0.08
8. Clear Creek	2,350	476	45.5	0.18



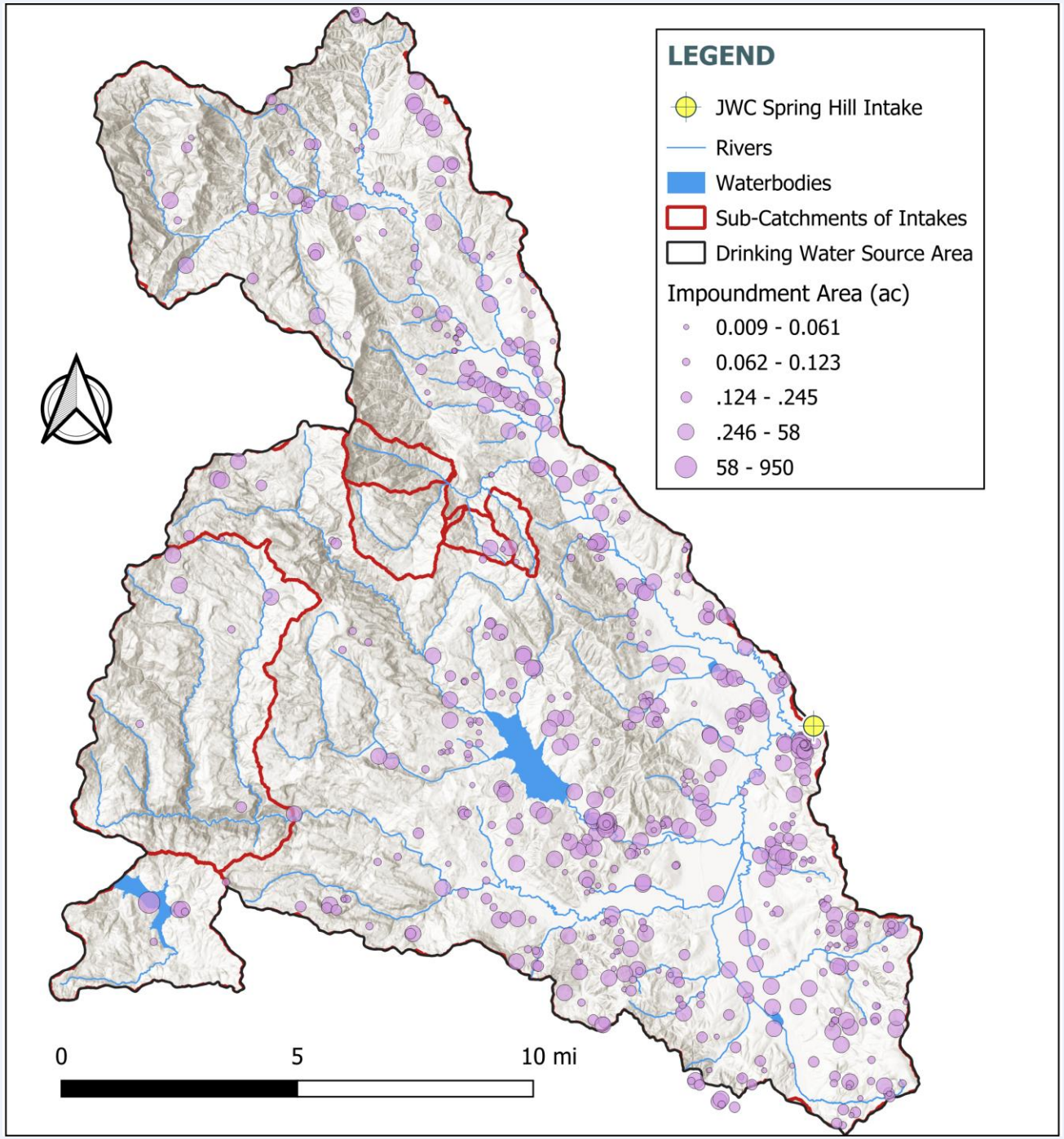
Hydrology – Impoundments

Phase II: Hydrologic and Water Quality Characterization

890 mapped impoundments.

- Average: 2.6 acres
- Standard deviation: 34.6 acres

Impoundments support reduction in runoff and amelioration of peak flows.

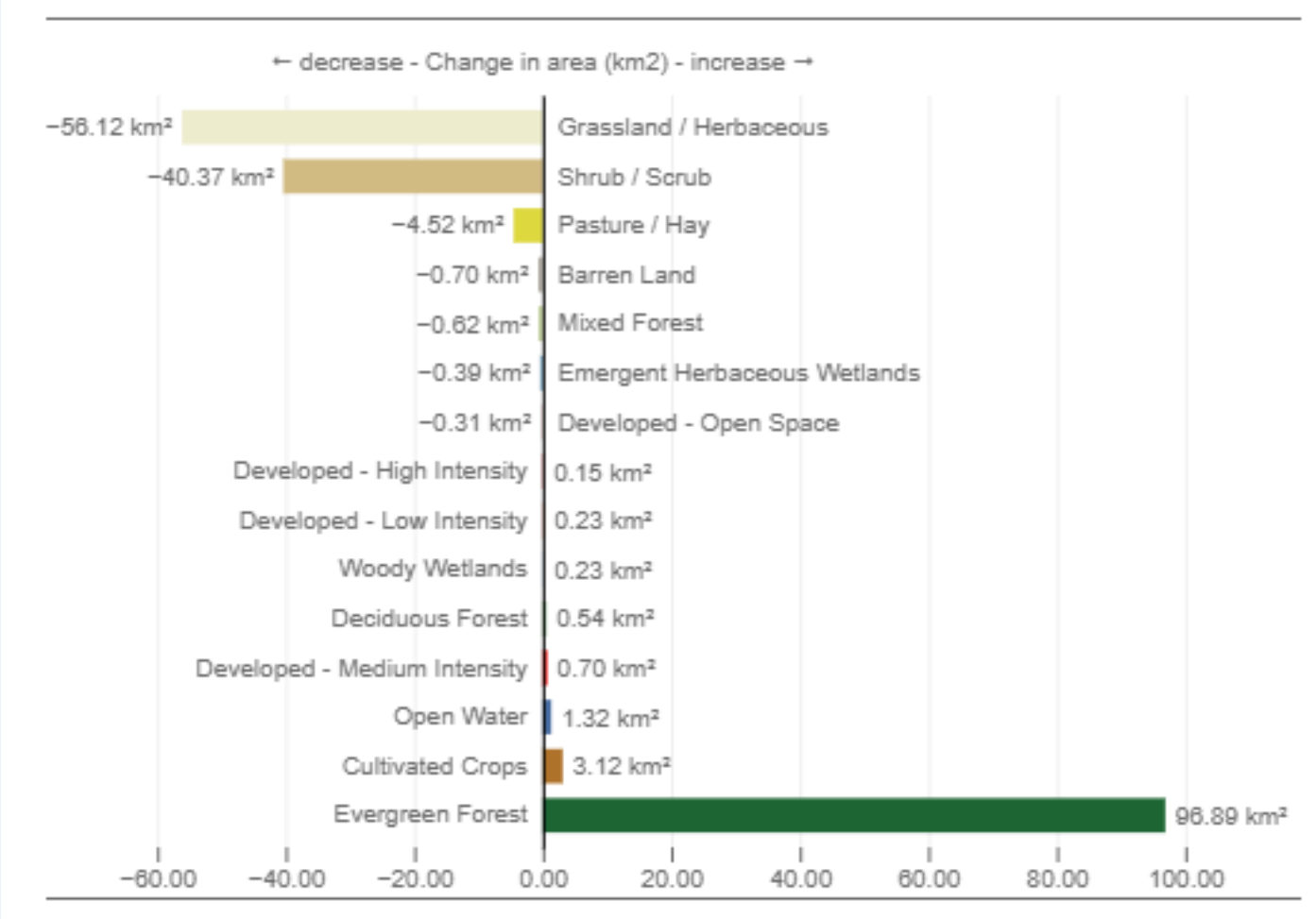


Hydrology – Land Cover Changes

Phase II: Hydrologic and Water Quality Characterization

Change between 2011 and 2019.

- Increase in **Evergreen Forest** is offset by **Shrub and Grassland**
- **Cultivated Crops** increased by 6.8%
- **Medium** and **High Intensity Developed Land** has increased by over 11%



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Hydrology – Points of Diversion (PODs)

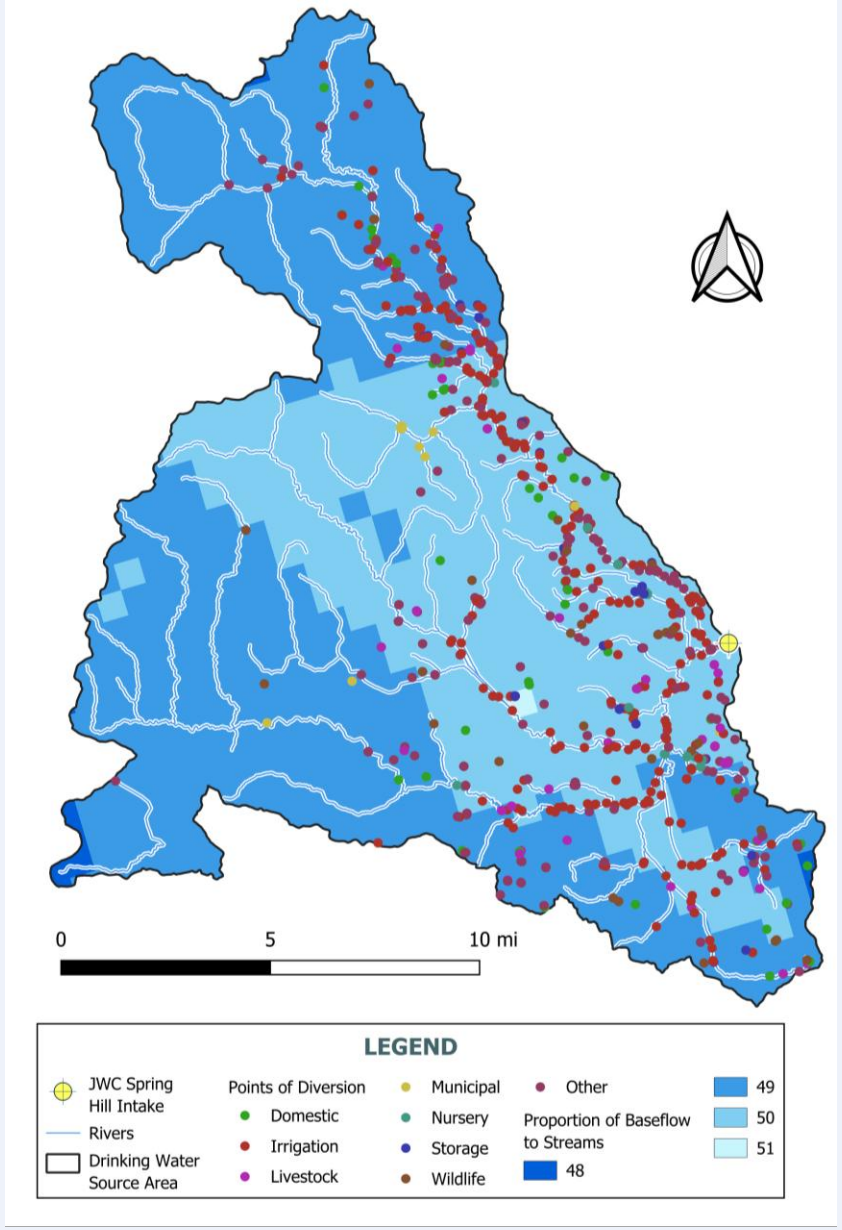
Phase II: Hydrologic and Water Quality Characterization

1,056 Points of Diversion, including:

1. Irrigation, livestock, fish culture, & supplemental irrigation (509, or 45%)
2. Multipurpose, recreation and others (240, or 23%)
3. Domestic (84, or 8%)
4. Nursery (72, or 6.8%)
5. Storage (67, or 6.3%)
6. Wildlife (39, or 3.7%)
7. Municipal (37, or 3.5%)
8. Groundwater (10, or 0.94%)

Did not consider water rights volumes – a majority of water rights are associated with agriculture, including nurseries.

***Result:** Return flows via surface and subsurface pathways.

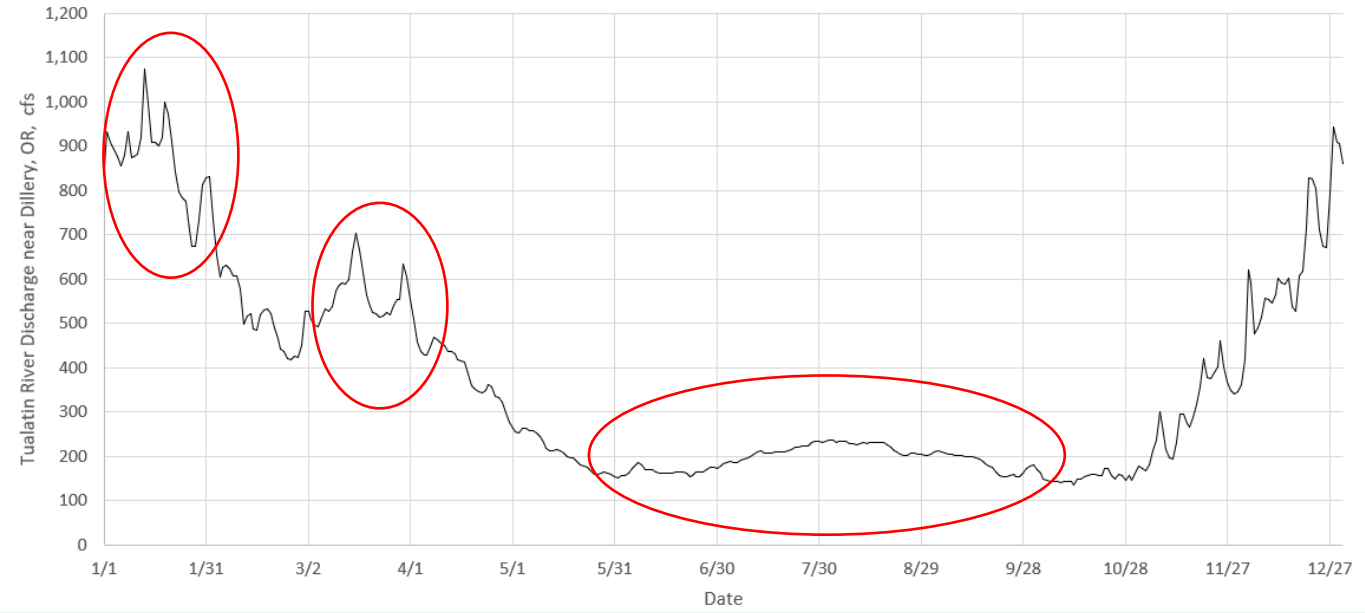


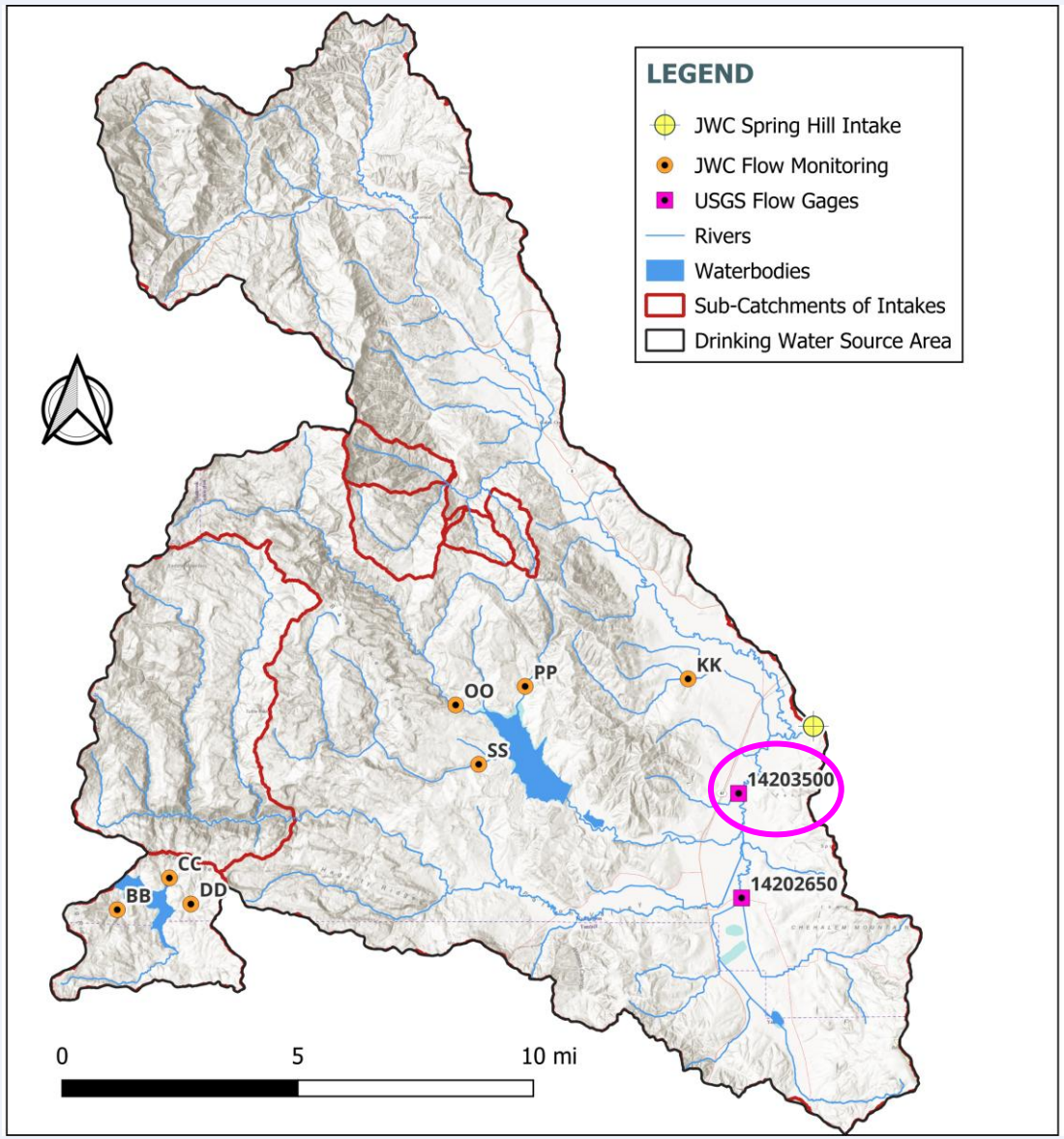
Hydrology – Flow and Runoff

Phase II: Hydrologic and WQ Characterization

Tualatin River near Dilley (USGS 14203500) average daily flows (2003-2023)

- Winter and spring flow increases - expected
- Increase in summer flow (June to Sept), likely due to irrigation & flow releases for water quality mitigation
- ***Result**: Reduced travel time in summer





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Key Takeaways – Hydrology

Phase II: Hydrologic and Water Quality Characterization

- Subbasins with higher slope are more susceptible to:
  - higher intensity runoff events,
  - more erosion, and
  - sediment transport
- Impoundments influence hydrology and potential release of contaminated water.
- Increases in Medium and High Intensity developed land increases impervious areas.
- The majority of water rights are associated with agriculture
- Stream flows follow a consistent seasonal pattern
  - Winter and spring flow increases
  - Increase in summer flows can reduce travel times for pollutants to reach intakes.

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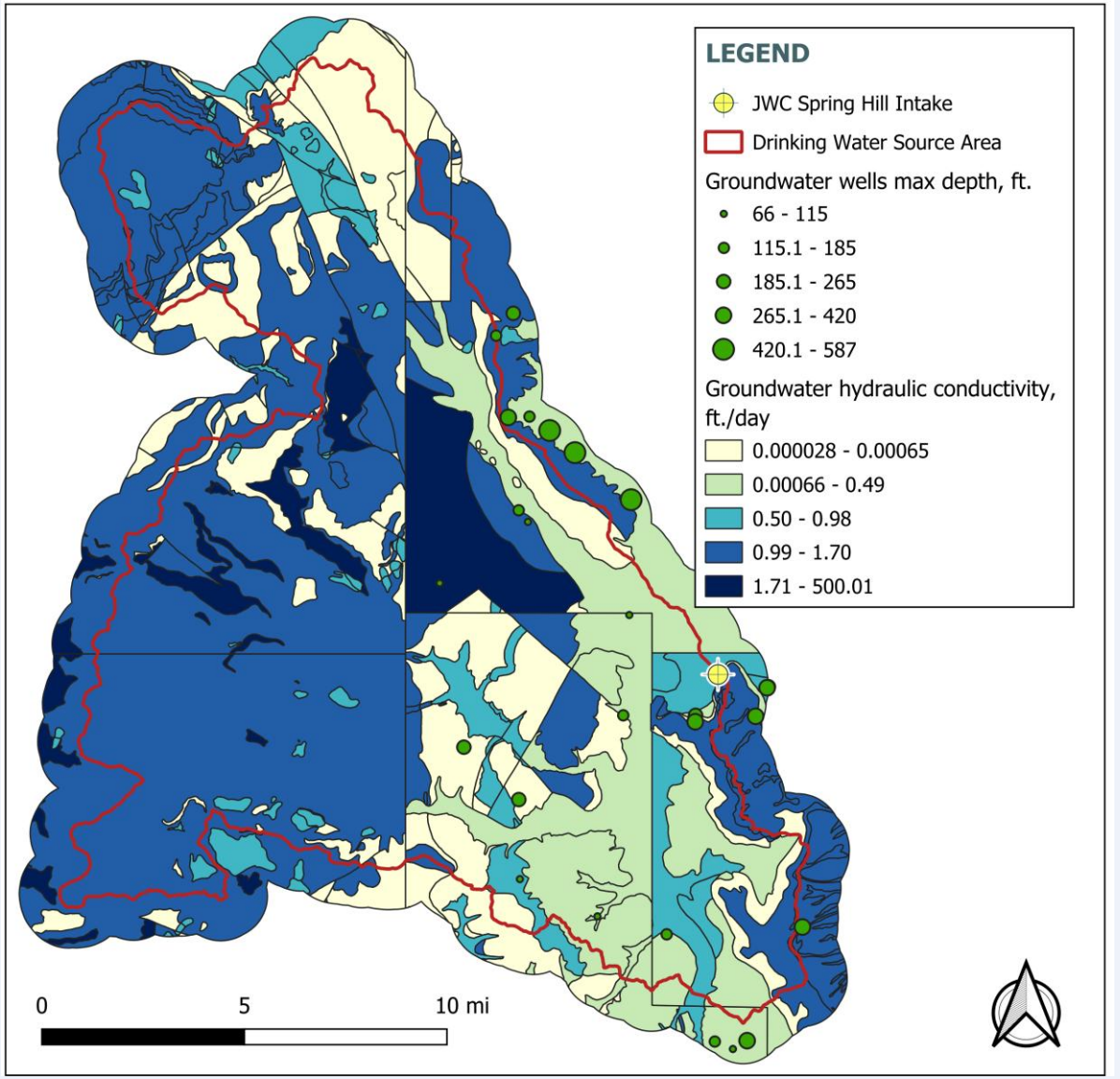
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Key Takeaways – GW and Hydrogeology

Phase II: Hydrologic and Water Quality Characterization

- Large variations in hydraulic conductivity – influences subsurface transport
- Perched, shallow soils in the vadose zone may be a source of high Pollutants of Concern (POC) mobility
- GW flow is from the coastal range toward the Willamette
- Aquifer permeability is mostly low with some areas of moderate to high permeability

***Result:** Subsurface flows at shallower depths could be susceptible to transporting POCs to surface waters.

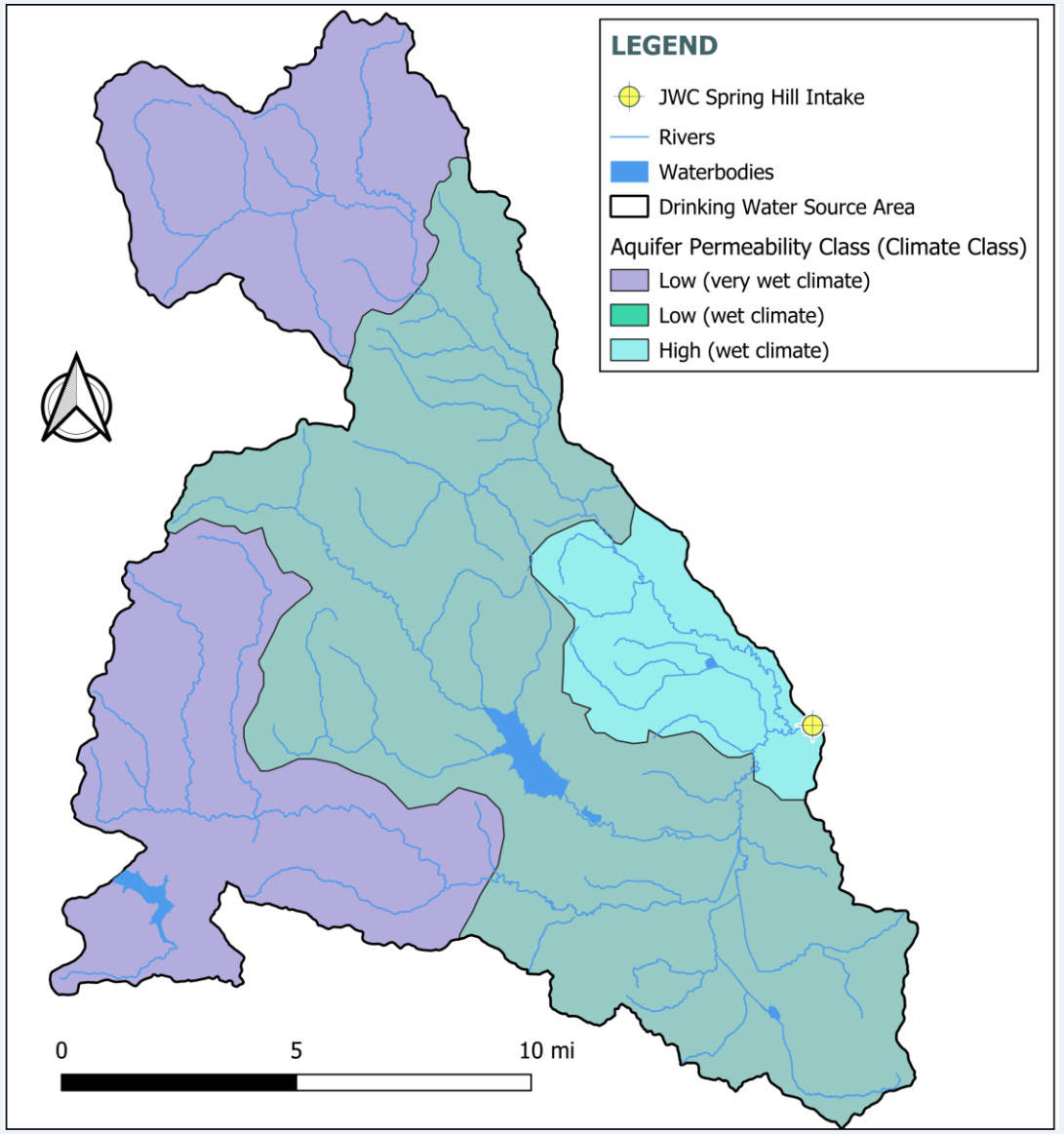


Key Takeaways – GW and Hydrogeology

Phase II: Hydrologic and Water Quality Characterization

- Groundwater moves relatively rapidly in the headwaters, and decreases in velocity in the lowland and flatter areas
- Groundwater recharge varies from 7 to 25 inches per year with higher recharge at higher elevations.
- The Tualatin River is a gaining river reach, supporting the concept that there is wide-spread baseflow accretion.
- Groundwater pumping is distributed throughout the DWSA except at the highest elevations.

***Result**: For POCs that infiltrate into the subsurface and recharge groundwater, the potential exists for them to be adequately mobile and return to surface water.



Water Quality – Pollutants of Concern (POCs)

Phase II: Hydrologic and Water Quality Characterization

Total Maximum Daily Loads (TMDLs):

- Ammonia
- Dissolved Oxygen
- Total Phosphorous
- Water Temperature
- E. Coli
- pH
- Turbidity
- Chlorophyll a

Organic compounds detected (non-exhaustive list):

- Metolachlor
- Hexachlorocyclopentadiene (HEX)
- Diquat
- Simazine
- 2,4-D

Many of these can be tied to agricultural produces (and other activities) in the watershed.

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Water Quality – POC Priority List

Phase II: Hydrologic and Water Quality Characterization

Over 256 analytes detected by the JWC between 2016 and 2023.

- 96 of 256 chemicals have agricultural relevance
- 44 chemicals had thresholds of contamination concern

POC threshold analysis conducted to develop POC priority list.

- Sources and application rates of priority POCs identified.

POC Priority List and Source

POCs\Source	Berry Growers	Christmas Tree Farms	Hazelnut Growers	Nursery & Greenhouse	Pasture/Hay	Vegetable Growers	Veg Seed Growers	CAFOs/Stables/Kennels	Fish Hatcheries	Forestry	Home Landscapes	Turfgrass	Right of Way/Roads	Urban Development	Chem/Mech Facilities	Septic Systems
TSS*	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
Nitrogen*	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Ammonia*	X	X	X	X	X	X	X		X		X	X				X
2,4-D*,†	X	X	X		X	X										
Diuron†	X		X	X		X										
Hexachlorocyclopentadiene (HEX)			X	X		X										
Metolachlor		X		X	X	X				X	X	X	X			
Simazine†	X	X	X	X		X										

* Schmidt (2012)

† Kilders and Cloutier (2021)

Phase III

Resource Analysis and Source Assessment

Bayesian Belief Network (BBN)

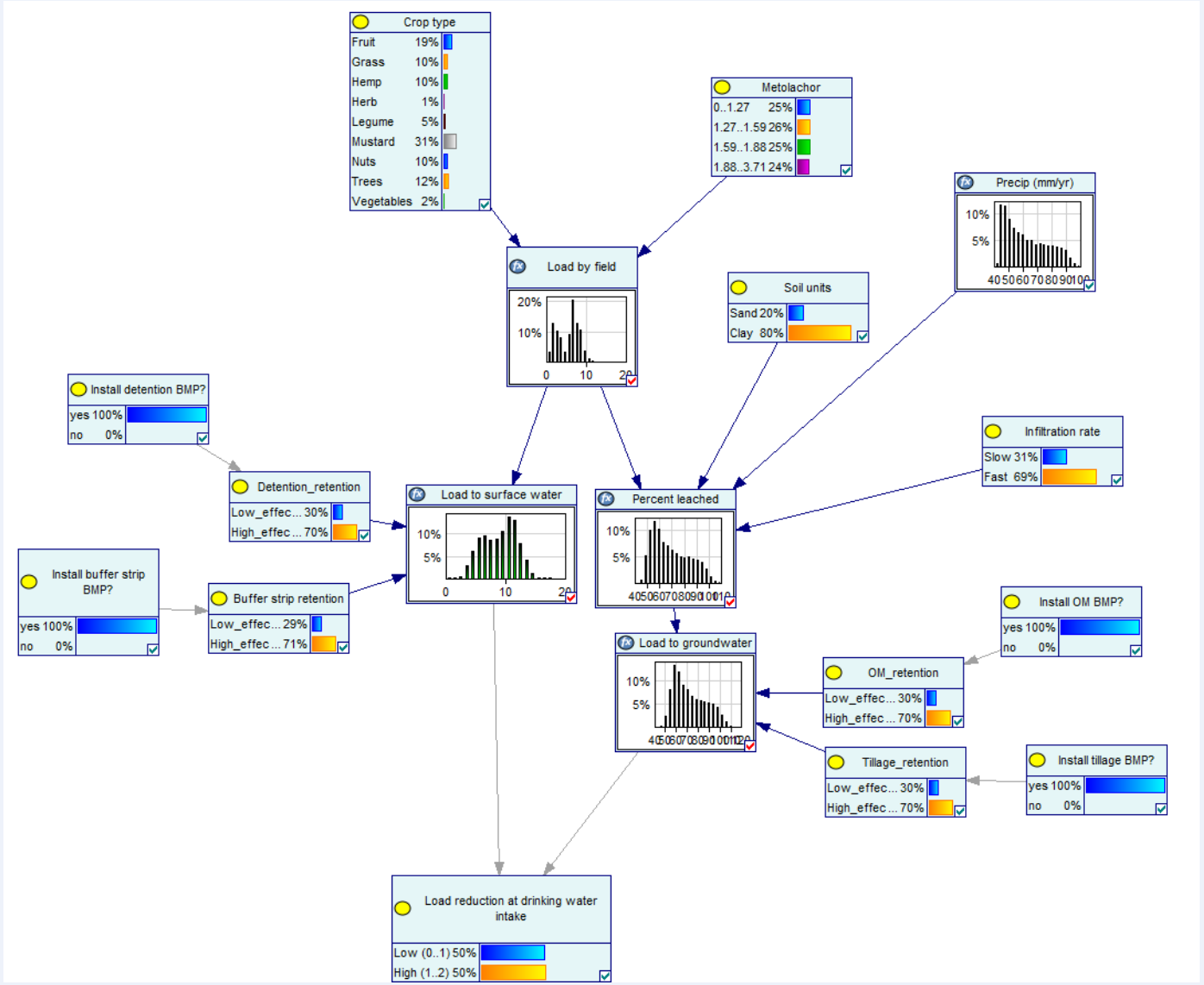
Phase III: Resource Analysis and Source Assessment

BBN provides a probabilistic, visual framework to integrate expert opinion and diverse spatial and biophysical data in casual relationships that influence pollution risk uncertainty.

Pollution risk uncertainty can be used to evaluate the impacts of multiple BMP strategies and identify critical source areas.

Inputs

- Soil characteristics
- Climate data
- Topography
- Chemical characteristics
- Land use
- BMP Performance



Bayesian Belief Network (BBN)

Phase III: Resource Analysis and Source Assessment

6 BMPs evaluated:

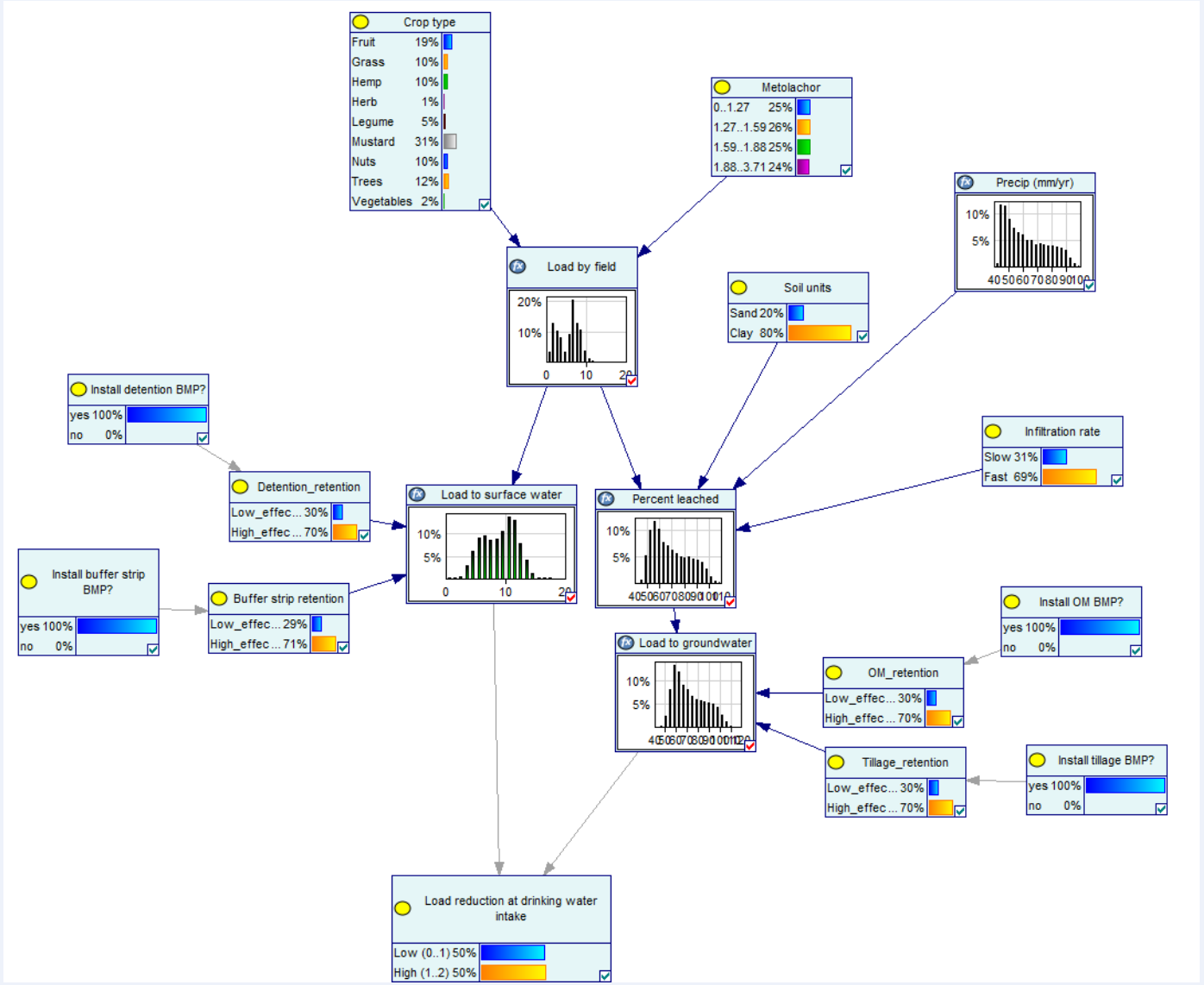
- Detention Basin, Retention Pond, Wetland Basin, Wetland Channel, Grass Swale, and Grass Strip

6 Crops evaluated:

- Fruit, grass, hemp, herb, legume, mustard, nuts, trees, and vegetable.
- Not all crops evaluated for all POCs.

3 BMP effectiveness levels evaluated:

- Low (10%)
- Medium (20%)
- High (30%)



BBN Example Set-up – Nitrate

Phase III: Resource Analysis and Source Assessment

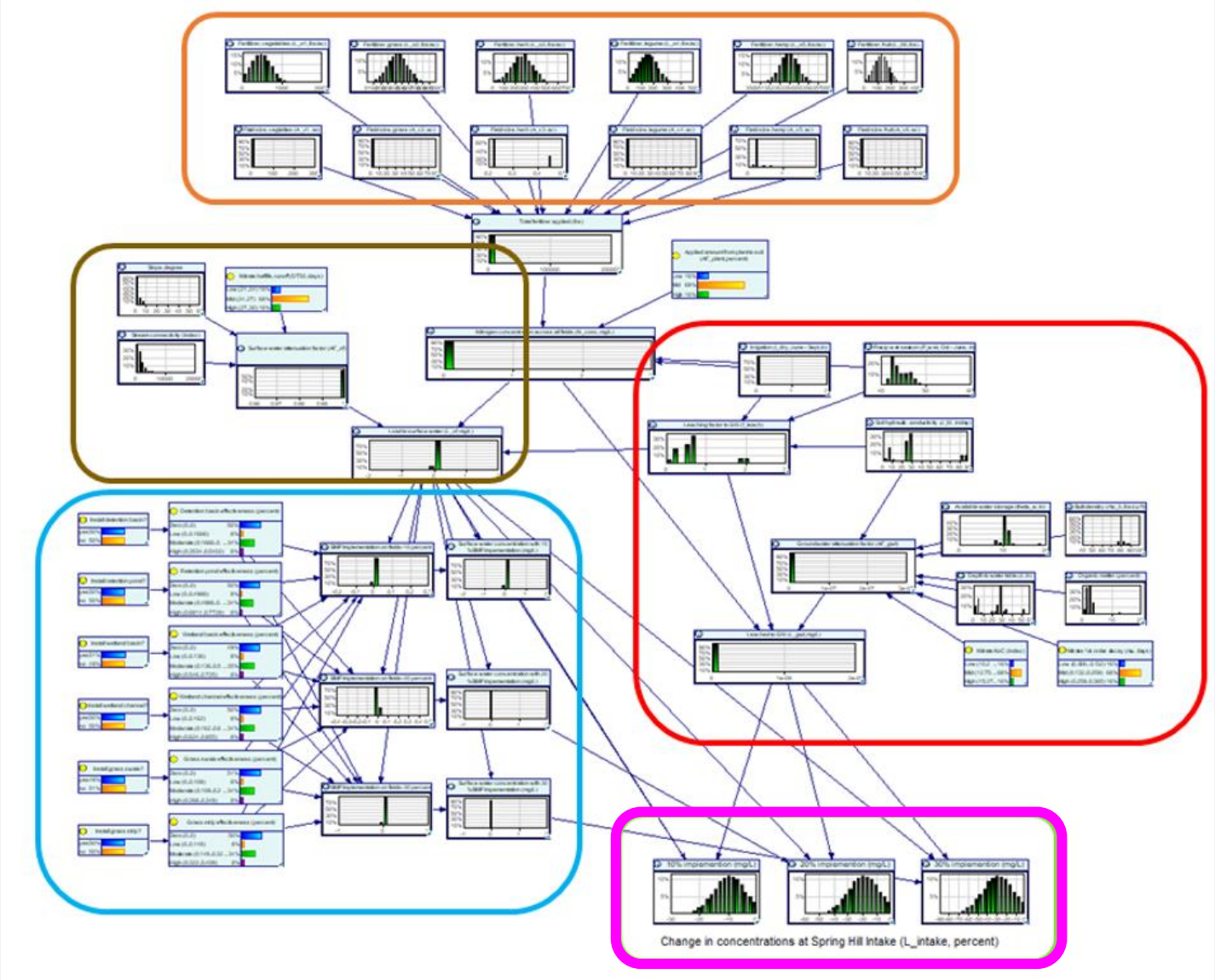
Light blue is BMP types and effectiveness

Orange is nitrate application to field types

Brown is surface hydrology

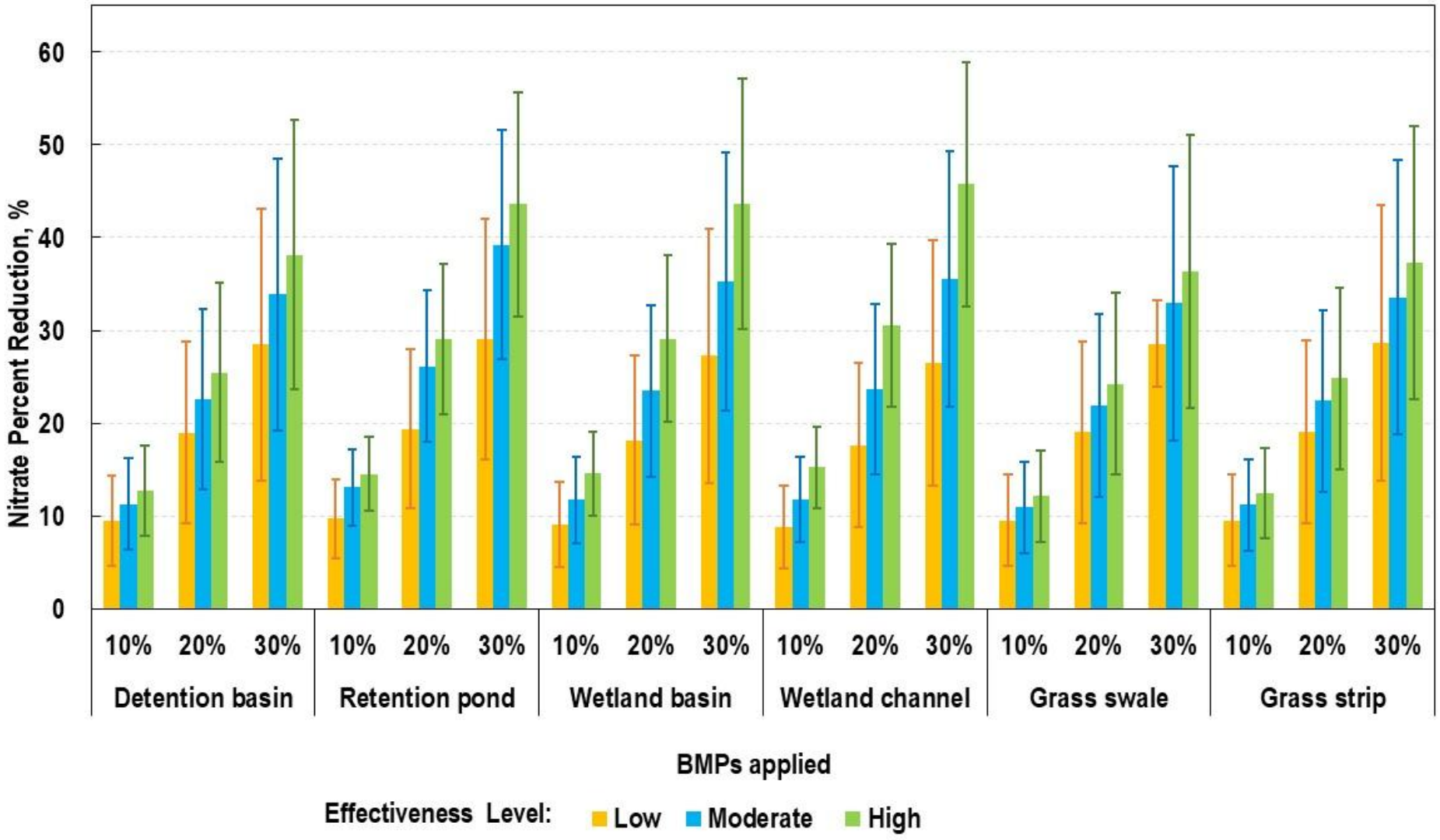
Red is groundwater hydrology

Pink is BMPs results



BBN Example Output - Nitrate

Phase III: Resource Analysis and Source Assessment



Key Takeaways – BBN Results

Phase III: Resource Analysis and Source Assessment

- Groundwater leaching and mobilization does not seem to be a-significant biophysical driver.
- Not all crops receive all POCs.
- For the 4-6 BMPs in each BBN model, each BMP showed differences in their effectiveness across the POCs.
- Certain, individual BMPs provide water quality improvements for multiple POCs.
- Bundling BMPs together in a scenario will tend to provide a higher degree of confidence of reducing POC concentrations across the DWSA, but as modeled it may not lead to a greater improvement than just doing one BMP.

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Phase IV
Recommendations

Focus Areas

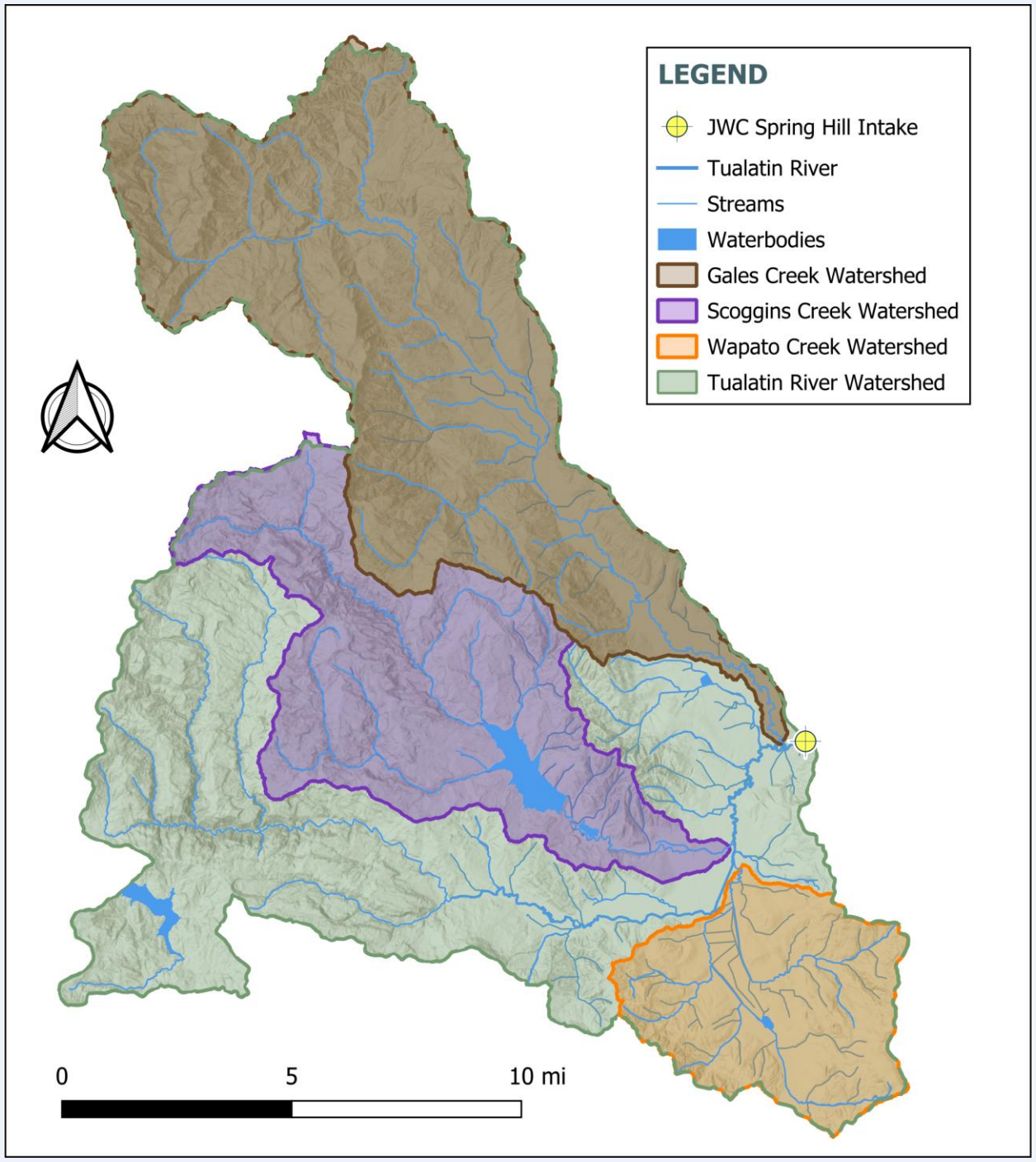
Phase IV: Recommendations

Four focus areas for BMP implementation (100 ft. buffer around major stream):

- Lower Gales Creek
- Lower Wapato Creek
- Lower Scoggins Creek
- Tualatin River upstream of JWC Intake

Focus area recommendations based on:

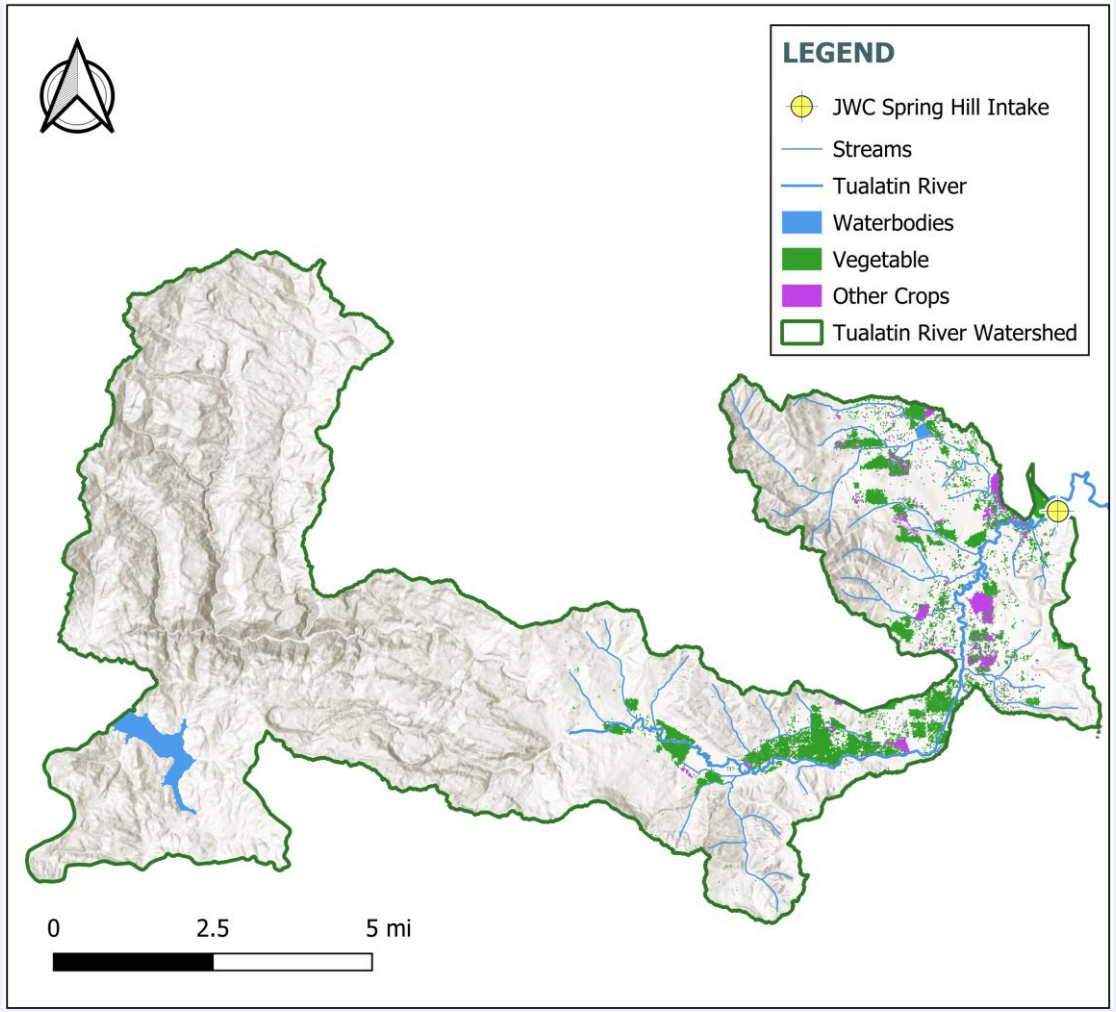
- BBN analysis results (concentration reductions from BMP implementation)
- GIS analysis identifying high priority agricultural areas to target.
- BMP cost for implementation.



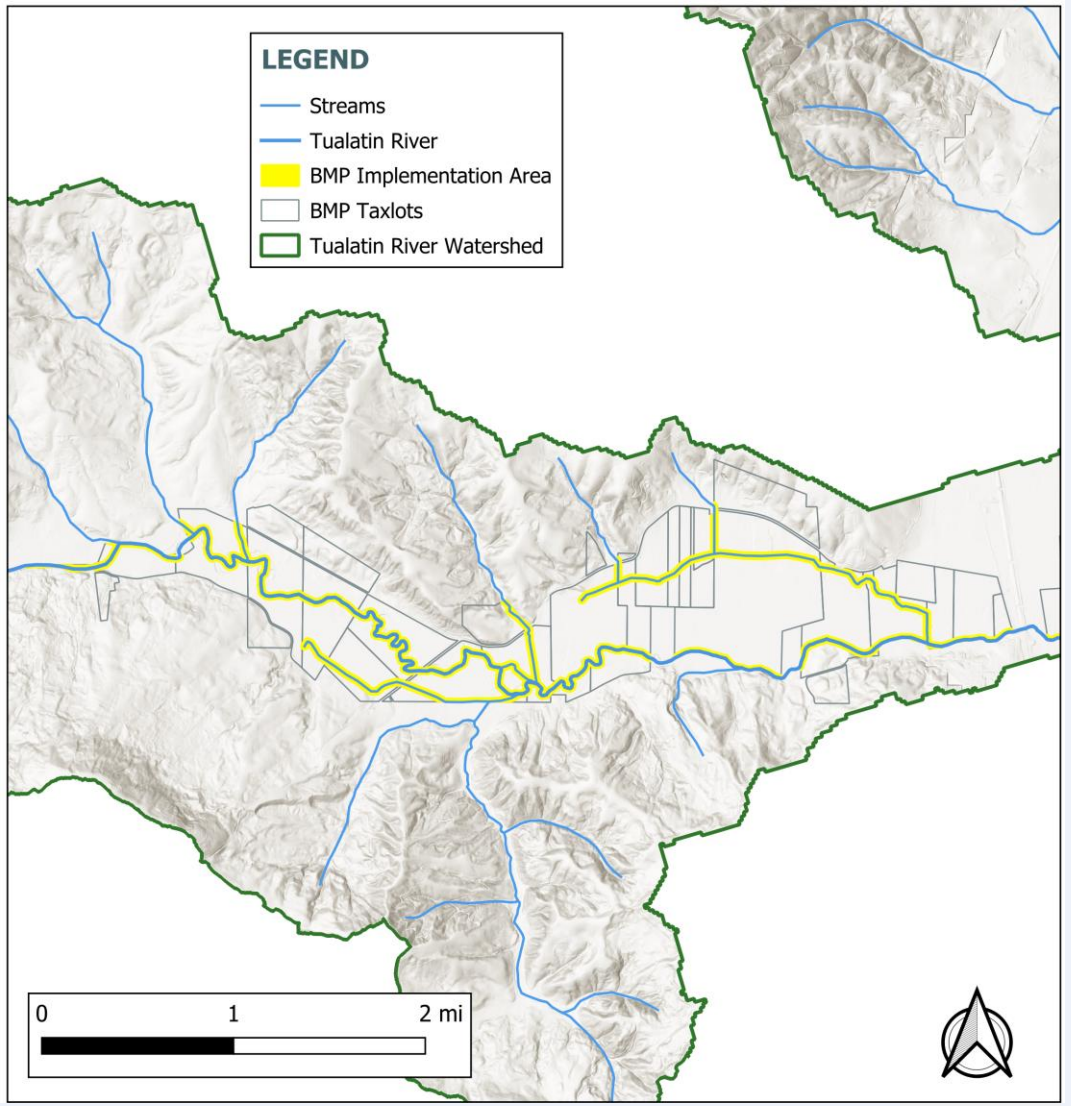
Focus Areas – Example, Tualatin River

Phase IV: Recommendations

Area of direct runoff to the Tualatin River.



Tualatin River agricultural producer focus area



Cost of BMP Implementation

Phase IV: Recommendations

Costs based on NRCS – Washington County data, QA/QC'd by cost engineer.

Each BMP is assumed to have 20% participation and moderate BMP effectiveness.

BBN analysis showed diminishing returns with multiple BMPs.

If assume each of the 8 BMPs was equally implemented in each focus area, the total cost would be $2.5M.

BMP	Description	EQIP Code	Average Cost per Unit	Units
Nutrient Management Plans	Tailor timing, rate, placement, and method of fertilizer application by crop type and field characteristics	102	$5,398	N/A
		157	$3,620	N/A
		590	$51	Ac
Integrated Pest Management/Pesticide Management	Biological, cultural, physical, and chemical tools to minimize economic, health, and environmental risks	161	$5,281	N/A
		595	$238	Ac
No-Till or Reduced Till	Soil not disturbed by tillage – reduce erosion and runoff, suppress weeds	329	$36	Ac
Buffer/Filter Strips	Planted along field borders, contours within field, and steep slopes – reduce erosion and runoff	393	$259	Ac
Conservation Cover	Permanent vegetation in orchards, vineyards, berry farms, and nurseries – reduce erosion and runoff	327	$182	Ac
Critical Area Planting	Seed areas that were bare and without another purpose – reduce erosion and runoff	342	$392	Ac
Grassy Borders	Borders around fields, may be harvested – reduce erosion and runoff	386	$308	Ac
			$83	k-SqFt
Riparian Buffers/Streamside Man. Areas	Restored riparian vegetation – reduce erosion and runoff, nutrient uptake	390	$12,349	Ac
			$24,199	Ac
Water Quality Basins/Pond	Storage of stormwater runoff in a detention pond, retention pond, or wetland	378	$21	CuYd
		636	$20	SqYd
Media Filter	Bed of particles which filter influent	N/A	$283	CuFt
	Filter socks	N/A	$190	Unit
Organic Farming	No synthetic fertilizers or pesticides used	N/A	$1,100	N/A
Drinking Water Protection Zones	Restriction of activities or facilities around a source water intake	N/A	$10,000	N/A
Constructed Wetland	An artificial wetland ecosystem with hydrophytic vegetation for biological treatment of water	656	$14,440	Ac
			$1	SqFt
Sediment Basin	A basin constructed with an engineered outlet, formed by constructing an embankment, excavating a dugout, or a combination of both	350	$5	CuYd
Denitrifying Bioreactor	A structure that uses a carbon source to reduce the concentration of nitrate nitrogen in subsurface agricultural drainage flow through enhanced denitrification	605	$24,000	N/A
Grass Waterway	A shaped or graded channel that is established with suitable vegetation to convey surface water at a nonerosive velocity	412	$2,187	Ac
			$0	SqFt
Cover Crop	Crops grown for soil protection and enrichment – reduce erosion and runoff, suppress weeds	340	$211	Ac
Riparian Forest Buffer	A buffer that includes an area predominantly covered by trees and/or shrubs located adjacent to a water body	391	$4,993	Ac

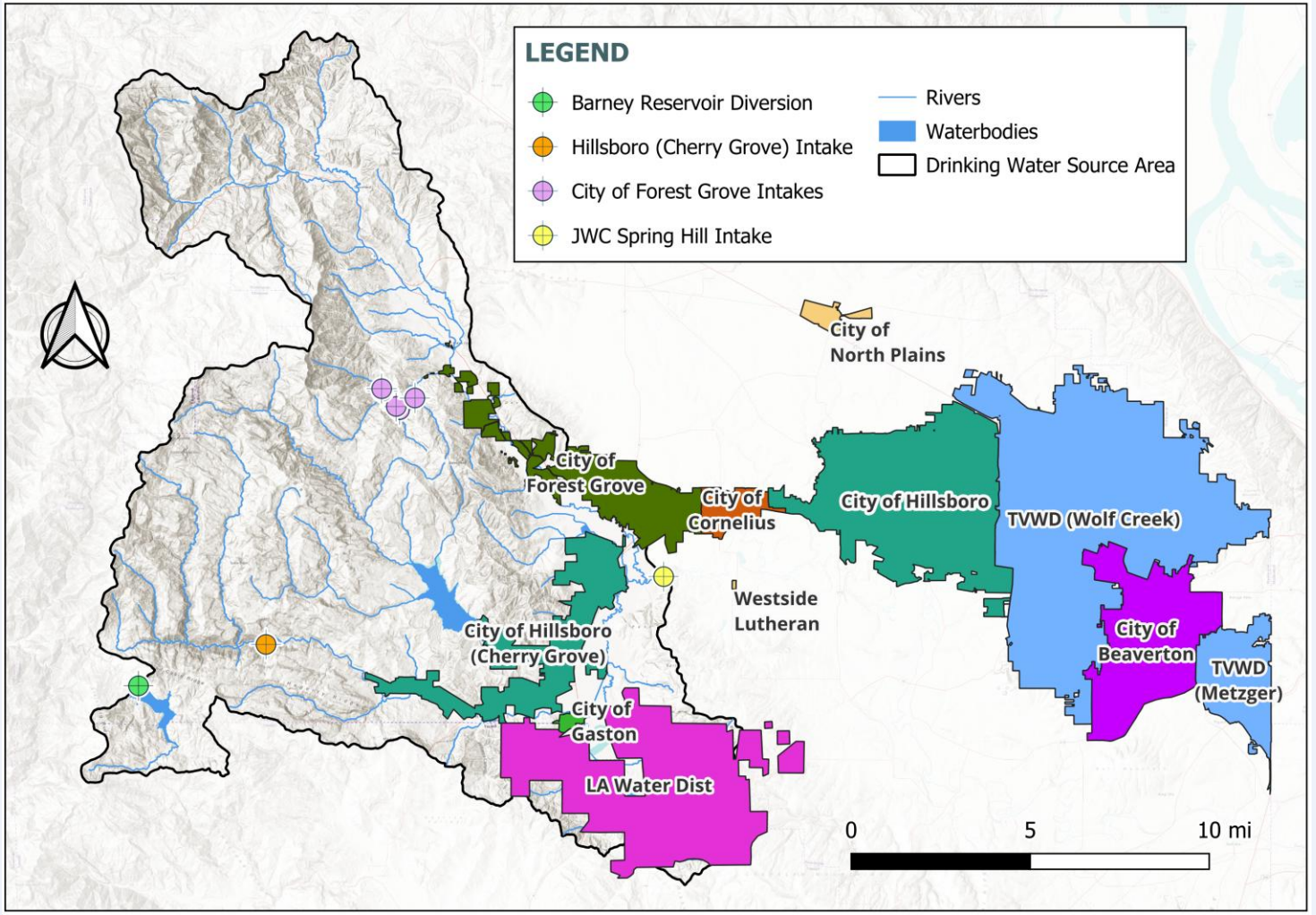
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Next Steps

Work with watershed partners and agricultural producers in each focus area to build partnerships, implement BMPs, and identify additional strategies and opportunities to reduce pollutant loading.

Pursue identified funding opportunities to support BMP implementation.



Thank you!

Please email us with your questions or comments.

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