

Laurel Watershed Improvement District  
Agriculture-Watershed Characterization and Mapping Report  
August 2016



Whatcom County Ag-Watershed Project



PROJECT PARTNERS



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For more information on the Ag-Watershed Project, please contact the project leads:

Karin Beringer

Whatcom County Planning &  
Development Services  
Bellingham, Washington 98226  
[kberinge@co.whatcom.wa.us](mailto:kberinge@co.whatcom.wa.us)

Heather MacKay

FHB Consulting Services Inc.  
Lynden WA 98264  
[heather@fhb3.com](mailto:heather@fhb3.com)

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## Abbreviations used in this document

AU	Assessment Unit/Analysis Unit (Puget Sound Watershed Characterization Project) <sup>1</sup>
AWCA	Agriculture-Watershed Characterization Area
CDID	Consolidated Drainage Improvement District
DID	Drainage Improvement District
DO	Dissolved oxygen
NRCS	Natural Resource Conservation Service
PDR	Purchase of Development Rights
PSWC	Puget Sound Watershed Characterization
RSA	Rural Study Area
USDA	United States Department of Agriculture
WCD	Whatcom Conservation District
WCPDS	Whatcom County Planning & Development Services
WCPW	Whatcom County Public Works
WDFW	Washington Department of Fish & Wildlife
WID	Watershed Improvement District
WRIA 1	Water Resource Inventory Area 1

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<sup>1</sup> In earlier pilot documents, AUs were also referred to as "Analysis Units"

# 1 Introduction

## 1.1 Background and purpose of agriculture-watershed characterization and mapping

Agricultural operations and watershed features have long been key components of Whatcom County's distinct landscape. Both are critical for our community's economy and health. While it may seem that agriculture and watershed functions are at odds with one another after decades of regulations and planning, there are in fact many locations where protection of agricultural lands and enhancement of watershed functions can result in mutual benefits.

Healthy watersheds provide a wide range of watershed ecosystem services. These include: surface and ground water supply and recharge; water storage and flood protection; production of food, fish, fiber and building materials; soil processes and sediments; cycling of nutrients, transport of pollutants; and protection against natural hazards such as floods, droughts and landslides.

These many watershed services rely on processes involving water flow and storage, water quality, plants and animals.

Farming relies on watershed services as part of the "natural infrastructure" for production. Agricultural production requires enough water of suitable quality for irrigation, livestock and processing; healthy high-quality soils; drainage of fields and protection from flooding. In addition, agricultural systems require: a large enough land base to sustain a vibrant agricultural economy; access to labor, markets and additional "built infrastructure".

However, farms are also providers of watershed services, the most obvious being food production. The preservation of open space, wildlife corridors, protection of soils and flood water storage are other watershed services that can be provided on actively farmed

land. Landowners and farmers who participate in strategic actions to maintain, repair or protect larger-scale watershed processes can help to improve watershed health and enhance critical watershed services.

Definitions: for the purposes of the Ag-Watershed Project,

- *agricultural enhancement* entails maintaining the land base, soil, water, air, plants, animals, production capacity and natural infrastructure necessary to keep farmers farming over the long term as land uses and economic situations change over time. Thus "agricultural enhancement" and "agricultural protection" include but are not limited to agricultural land protection alone.
- *watershed enhancement* actions are those actions which improve the ability of the watershed to provide its natural benefits and services to communities. Watershed enhancement includes the idea of "repairing" major landscape processes related to hydrology and ecosystems, in order to maintain, protect or improve the delivery of watershed services.

The ag-watershed characterization maps and tables combine existing spatial data with field experience and farmers' local knowledge to identify agricultural priorities and needs in the in the lowland areas of Whatcom County and to bring those into the planning conversation with watershed priorities and needs. The results of this work are intended to support integrated land and water planning at watershed scale, and to support the identification and prioritization of agricultural and watershed enhancement actions at farm and reach scale. These products will be provided to the Watershed Improvement Districts and Special Districts to inform and complement their current comprehensive planning work.

The characterization and mapping results presented in this report have been derived from multiple information sources. The information is provided for planning purposes only, is not for use in regulatory actions, and is intended to contribute to ongoing Whatcom County Planning and Development Services efforts to improve agricultural and watershed conditions.



## 1.2 About the Ag-Watershed Project

The Ag-Watershed Project is examining ways to reward the good things that farmers already do - those beneficial actions that go beyond existing regulation to maintain, repair or protect large-scale watershed processes, while also strengthening agriculture in Whatcom County.

The Ag-Watershed Project is a research and development project funded by a National Estuary Program Watershed Protection and Restoration Grant (June 2012 to June 2016) to Whatcom County Planning & Development Services, administered by the Washington Department of Commerce. Project partners include: Whatcom Farm Friends–Community Education, Whatcom Conservation District and Washington State Department of Fish & Wildlife.

Project fact sheets and links to all previous work, including technical reports and reference documents can be found at <http://whatcomcounty.us/2260/Agricultural-Watershed-Pilot-Project>

## 1.3 What is in this document

This document contains the reference information, work session information and results of the agriculture-watershed characterization and analysis conducted in 2016. The document is arranged into sections that allow easy access to specific categories of information. An overview of the document contents is also provided in the color-coded table in the front of this document.

Sections 1 and 2 provide background information about the Ag-Watershed Project, the characterization and mapping task, and the Laurel Watershed Improvement District.

Section 3 is a summary of the overall methodology and results. It can be read as a stand-alone resource to obtain an overview of the process and the outcomes.

Section 4 contains a detailed description of the agricultural characterization methodology, and includes the agricultural prioritization maps and the detailed tables of information about agricultural priorities.

Section 5 contains a detailed description of the watershed characterization methodology, and includes the watershed prioritization maps and the detailed tables of information about watershed priorities.

Section 6 contains the set of agricultural and watershed reference maps that were used in generating the agriculture-watershed characterization results.

Sections 7 and 8 contain the bibliography and glossary of key terms. Sources of information cited in the text of the report are included in the bibliography but are also provided in footnotes for easy reference.

Appendices contain additional supporting information for future reference by the WID.

This document is one of a series of six reports. A customized report has been prepared for each of the Watershed Improvement Districts in Whatcom County. Reports for other Watershed Improvement Districts can be accessed through the WID websites<sup>2</sup> or through the Ag-Watershed Project page.<sup>3</sup> The results of the characterization and mapping have also been incorporated into an online story map at <http://arcg.is/29MYdYu>.<sup>4</sup>

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<sup>2</sup> Links to each WID website can be found at <http://www.agwaterboard.com/>

<sup>3</sup> See <http://www.co.whatcom.wa.us/2260/Agricultural-Watershed-Pilot-Project>

<sup>4</sup> Whatcom County Agriculture-Watershed Project (2016). *Agriculture-Watershed Characterization & Mapping, Whatcom County*. Story map

## 2 Overview of the Laurel Watershed Improvement District

The Nooksack River watershed and certain adjacent basins (including Lake Whatcom) which discharge to the marine waters of Georgia Strait and Puget Sound and to the Fraser River system in Canada are included in Water Resource Inventory Area 1 (WRIA 1), as designated by the State of Washington. The majority of Whatcom County is in WRIA 1 with a portion of the WRIA 1 extending into neighboring Skagit County (see Figure 1 and Figure 2).

Each Watershed Improvement District (WID) is a unique agricultural neighborhood in Whatcom County's broader farming community. Natural characteristics of the soil, locations of surface and ground waters and topography of the area help to delineate viable areas for the many types of agricultural production taking place. The boundaries of the WIDs have been selected not only to reflect the characteristics and interests of different agricultural neighborhoods, but also to align where possible with the geographic boundaries of water management areas used in mapping and planning of water resources by local and state governments and the agricultural land classifications used by local land use planners and agricultural specialists.

The Laurel Watershed Improvement District (see Figure 3) is located in the central lowland area of Whatcom County, adjacent to the main Nooksack River within WRIA 1. Land use in the local area is diverse, including agricultural, rural, commercial and low-density

residential areas. Agriculture includes a mix of dairies, berry crops and potato crops in the northern part of the WID and small scale agriculture in the southern portion. The City of Ferndale (pop. 12,700) lies across the Nooksack River to the west of the WID area, while the City of Bellingham (pop. 83,600) is located to the south. A significant proportion of the soils in the Laurel WID have been classified by the USDA Natural Resources Conservation Service as Prime or Prime if managed<sup>5</sup> (see Prime Soils reference map).

The WID area encompasses 8,307 acres in total. The WID area includes portions of the Ten Mile Creek, Four Mile Creek and Deer Creek drainages, all of which are included in Water Resource Inventory Area 1 (WRIA 1). Flow through these creeks is generally east to west, entering the Barrett Lake reservoir near Ferndale which then drains into the Nooksack River.

The WID contains two other special purpose districts within its boundaries, whose primary purpose is to improve and maintain drainage of agricultural land within those portions of the WID. These are Diking District #3 and Drainage Improvement District #4 (see Special Districts reference map).

More information about the Laurel WID can be found at their website <http://www.laurelwid.com/>

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prepared for the Whatcom County Agriculture-Watershed Pilot Project, Whatcom County Planning & Development Services, Bellingham, using ArcGIS® software by Esri. <http://arcg.is/29MYdYu>

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<sup>5</sup> U.S. Department of Agriculture, Natural Resources Conservation Service. *National soil survey handbook, title 430-VI*. [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2\\_054242](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_054242)

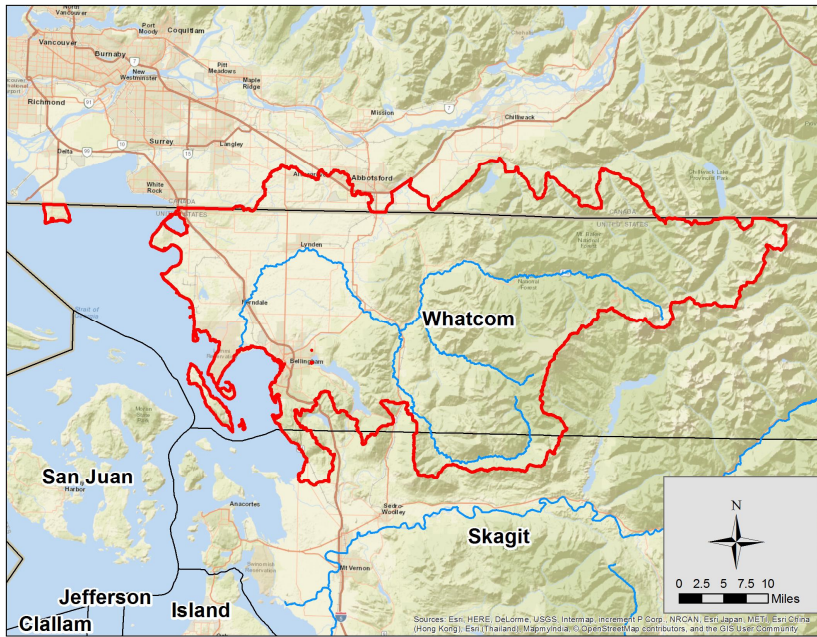


Figure 1. Regional map showing general location of Whatcom County and Water Resource Inventory Area 1 (red boundary)

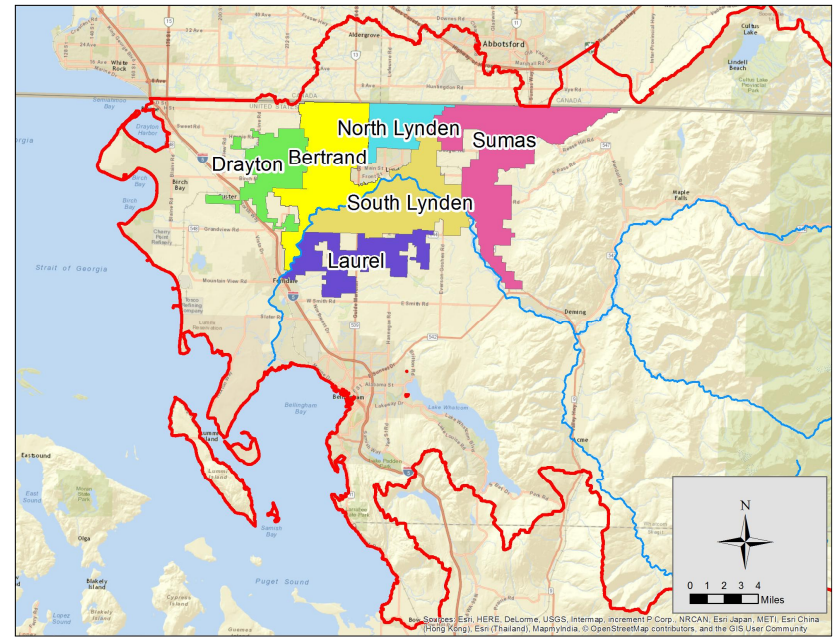


Figure 2. Map showing Water Resource Inventory Area 1 and the Laurel Watershed Improvement District



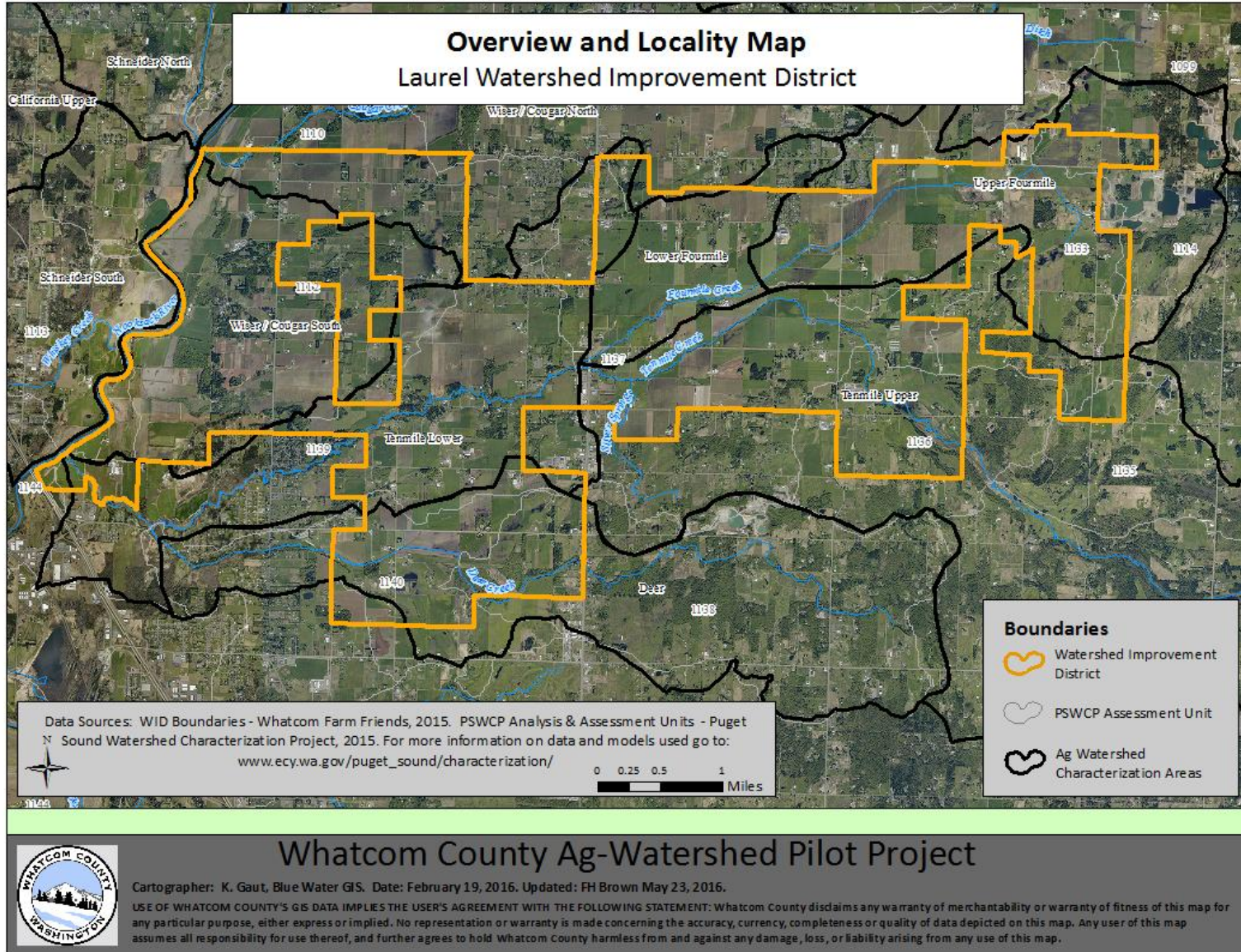


Figure 3. Laurel WID: Overview and locality map

### 3 Summary results and approach used for agriculture-watershed characterization

#### 3.1 Pilot characterization and mapping (2012)

The methodology for agriculture-watershed characterization and mapping was developed and pilot-tested during Phase 1 of the Ag-Watershed Project. The pilot focus area covered the Bertrand, Fishtrap and Kamm watersheds. The pilot results are reported in the Phase 1 report on mapping and characterization (Gill, 2013).<sup>6</sup> Project Fact Sheet 2 provides additional background information on the agriculture-watershed characterization and mapping process.<sup>7</sup>

Information that was gathered during the pilot study in 2012 was reviewed and updated and has been incorporated into the 2016 agriculture-watershed characterization reports for the Bertrand, North Lynden and South Lynden Watershed Improvement Districts.

#### 3.2 Methodology used for the 2016 WID characterization and mapping

Areas within the Laurel Watershed Improvement District (WID) have been prioritized for both watershed and agricultural enhancement. This work has used an approach of structured combination and integration of local field knowledge and experience with a series of reference maps and tables, all of which draw on existing information and data.

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<sup>6</sup> Gill P (2013). *Agriculture-Watershed Characterization and Mapping Report for the North Lynden watersheds*. Prepared for the Whatcom County Agriculture-Watershed Pilot Project, Whatcom County Planning & Development Services, Bellingham. <http://www.co.whatcom.wa.us/2260/Agricultural-Watershed-Pilot-Project>

<sup>7</sup> Ag-Watershed Project fact sheets can be downloaded from <http://whatcomcounty.us/2260/Agricultural-Watershed-Pilot-Project>

A work session was held with Laurel WID members and technical staff of local agencies in February 2016, during which participants used maps to identify and prioritize the type and location of agricultural and watershed services that could potentially be enhanced on agricultural land where there is potential for mutual benefit to both agricultural and watershed systems.

#### 3.2.1 Watershed analysis

The results of the watershed characterization and mapping for the Laurel WID include tables and summary maps which describe the watershed services that are most needed for a healthy watershed (including the restoration of salmon populations) and where they could be enhanced in the watershed.

In order to generate these tables and summary maps for the Laurel WID, the information contained in the watershed reference maps (see section 6.2 of this report) was combined with the results of watershed characterization<sup>8</sup> (water flow assessments for WRIA 1, provided by the Department of Ecology in a series of maps showing the areas which are most in need of either restoration or protection of larger-scale water flow processes). The work session participants reviewed this information, provided additional local field knowledge on site-specific watershed priorities, and identified potential actions or projects that could help to achieve watershed priorities.

A more detailed description of the watershed characterization methodology is provided in section 5.1 of this report.

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<sup>8</sup> Watershed 'characterization' is a set of water and habitat assessments that compare areas within a watershed for restoration and protection value. It is a coarse-scale tool that supports decisions regarding where on the landscape should efforts be focused first, and what types of actions are most appropriate to that place." See [http://www.ecy.wa.gov/puget\\_sound/characterization/index.html](http://www.ecy.wa.gov/puget_sound/characterization/index.html)

### 3.2.2 Agricultural analysis

The results of the agricultural characterization and mapping for the Laurel WID include tables and summary maps which describe the agricultural services that are most needed for the long term success of agriculture, and where they could be enhanced in the watershed. The primary focus was on the “natural infrastructure” for agriculture: soils, water, adequate drainage and flood protection, and long-term protection of the agricultural land base.

Methods used to prioritize agricultural needs are based on a combination of: information from (i) existing agricultural protection programs in Whatcom County, (ii) available GIS data contained in the agricultural reference maps (see section 5.1 of this report) and (iii) local knowledge provided at the WID work session.

At the WID work session, participants assisted the project team to collate and evaluate information on agricultural system needs and priorities in the WID area, and to locate the different agricultural system needs and priorities on base maps of the WID area. A more detailed description of the methodology is provided in section 3.1 of this report.

### 3.3 Application: How to use the results of the agriculture-watershed characterization and mapping

The WID can use the characterization maps and tables of agricultural and watershed priorities to support their land and water planning, management, and project funding.

The characterization maps and tables should help the WID to identify, prioritize, and strategically locate practical beneficial projects and actions at the farm or reach-scale, and to enhance agricultural operations and watershed functions in the WID area.

The characterization maps and tables should also help the WID identify project opportunities that enhance watershed processes while strengthening agriculture where agricultural and watershed priorities are complementary, and to find acceptable trade-offs where they compete.

These results, which incorporate local knowledge and farmer insights, may also be used to communicate the WIDs’ priority enhancement needs to planners for consideration in broad scale planning such as Whatcom County’s Comprehensive Planning Process. More information on how to use these results in planning can be found in the Ag-Watershed Project Fact Sheet 5, included as Appendix D of this report.

### 3.4 Summarized results for the Laurel Watershed Improvement District

The summary table below (Table 1) and the summary maps in Figure 4 highlight the most significant watershed and agricultural enhancement opportunities within the Laurel WID area. Check marks in Table 1 indicate where a specific enhancement priority was identified during the characterization and mapping process.

Detailed descriptions of priorities, the sources of data or information on priorities, and descriptions of each priority and the opportunities for enhancement through specific actions can be found in Table 3 and Table 5.



Table 1. Summary results of agriculture-watershed characterization and mapping for the Laurel WID  
(See locality map in Figure 3 for locations of agriculture-watershed characterization areas)

	Tenmile Creek Upper	Tenmile Creek Lower	Fourmile Creek Upper	Fourmile Creek Lower	Deer Creek	Wiser/Cougar North	Wiser/Cougar South
Agricultural Enhancement Priority (See Table YY for details)							
Prime agricultural soils	Ü	Ü	Ü	Ü	Ü	Ü	Ü
Water quality for crops and livestock	Ü	-	-	-	-	-	-
Water quantity	Ü	Ü	Ü	Ü	Ü	-	Ü
Agricultural drainage	Ü	-	Ü	Ü	Ü	-	-
Flood protection	Ü	-	-	-	-	-	-
Agricultural land base: Important agricultural land	Ü	Ü	Ü	Ü	Ü	Ü	Ü
Protection from development pressure	Ü	Ü	Ü	Ü	Ü	Ü	Ü
Other:							
Watershed Enhancement Priority (See Table YY for details)							
Water Quality							
Nutrients, Ammonia-N	-	-	-	-	Ü (Ammonia-N)	-	-
Bacteria	Ü	Ü	-	-	Ü	Ü	-
Temperature	-	-	-	-	-	-	-
Dissolved oxygen	Ü	Ü	-	-	Ü	Ü	-
Other:					Ü(pH)		
Habitat							
Salmon spawning (current, documented)	-	-	-	-	Ü	-	-
Anadromous fish	Ü	Ü	Ü	Ü	Ü	Ü	Ü
Wildlife	-	-	Ü	-	Ü	Ü	-
Wetland	Ü	Ü	Ü	Ü	Ü	Ü	Ü
Water Flow Processes <sup>9</sup>							
Delivery	-	-	Ü	-	-	-	-
Discharge	-	Ü	-	-	Ü	-	Ü
Recharge	-	-	Ü	-	-	-	-
Storage	Ü	Ü	Ü	Ü	Ü	Ü	Ü
Other	-	-	-	-	-	-	-

<sup>9</sup> Check marks are shown in the summary table if the recommendation for any water flow process is indicated as highest restoration/restoration/highest protection/protection.

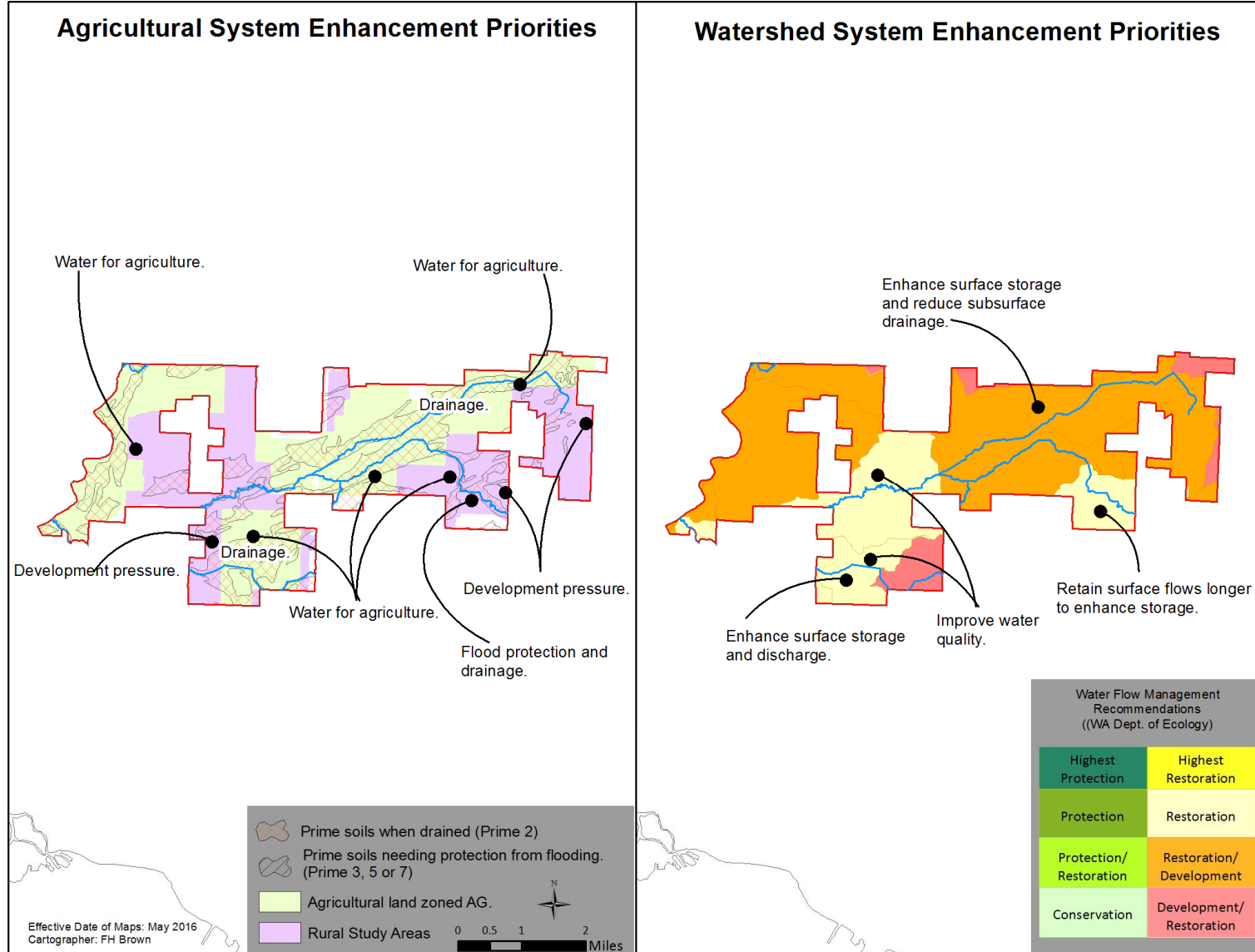


Figure 4. Summary maps: Agricultural and watershed system enhancement priorities

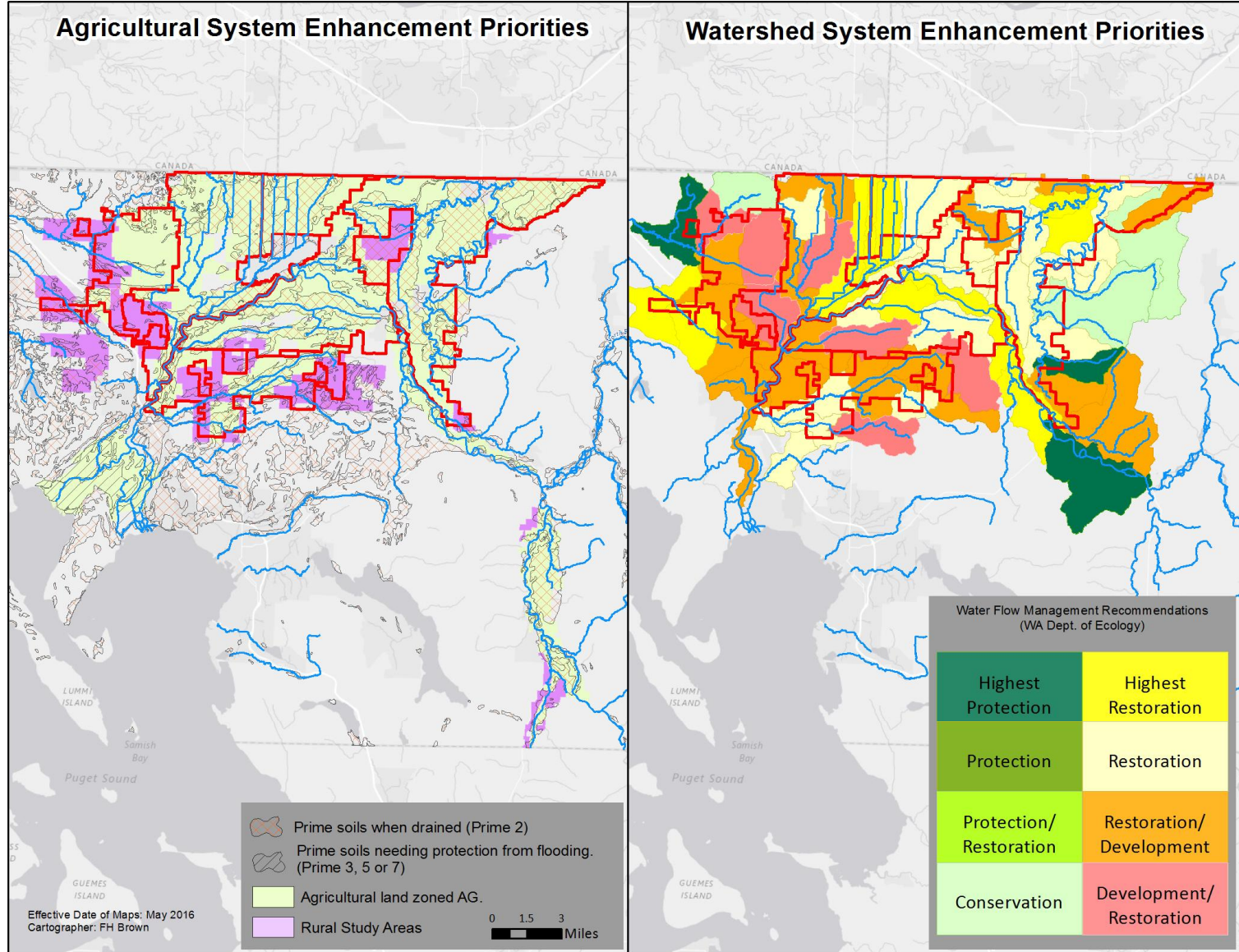


Figure 5. General agricultural and watershed enhancement priorities for the lowland areas of Whatcom County

### 3.5 Possible future challenges and priorities

Future challenges (1- 10 years) may include issues listed below. See Table 1 for the full summary results of agriculture-watershed characterization and mapping for the Laurel WID.

- Water quantity: Access to legal irrigation water is a key priority (39 new applications have been filed in the WID area over the past five years). Barrett Lake, Deer Creek, Fourmile Creek, and Tenmile Creek are closed year-round to further appropriations unless mitigated. Restrictions on irrigation from creeks, tributaries, and other surface water sources are in place until instream flows levels are met during critical periods for fish per the existing Nooksack Instream Flow Rule.<sup>10</sup> Limited access to water rights may impact water quantity accessibility in some areas of the WID, as major Group A public suppliers do not have adequate water rights in proper locations to meet projected future demand.<sup>11</sup>
- Protection of agricultural land from development pressure: All sub-basins within the Laurel WID area contain prime agricultural soils that are considered important to Whatcom County's agricultural land base. Pressures from residential and commercial development are found in sub-basin areas that contain major arterials.
- Water quality: Tenmile and Fourmile Creeks are actively monitored for water quality parameters (dissolved oxygen, bacteria, and fecal coliform). Groundwater quality (nitrates)

is of concern in large areas of the Sumas-Blaine Aquifer located within the WID area.

- Drainage: Much of the Laurel WID area includes woodlots and riparian plantings along major creeks and tributaries of the Nooksack River. Regular management of beaver and removal of other impediments to agricultural drainage infrastructure is needed, in order to access fields at critical times during the growing season.

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<sup>10</sup> [WAC 173-501](#) (1985), Instream Resources Protection Program – Nooksack Water Resource Inventory Area 1.

<sup>11</sup> *Whatcom County Coordinated Water System Plan Update* (2016), <http://www.whatcomcounty.us/1035/Coordinated-Water-System-Plan-Update>

## 4 Agricultural characterization and mapping for the Laurel Watershed Improvement District

### 4.1 Methodology

#### 4.1.1 General approach

The general approach used in this work has been to identify and characterize

- what the priority agricultural needs are in the WID area, and why these are priorities for farming,
- where these are most needed in the WID area for the long term success of agriculture,
- what are the potential opportunities for agricultural enhancements that can address these needs, and
- which specific actions at reach-scale or farm-scale might be most effective in meeting agricultural enhancement needs in the WID.

The method used to characterize, prioritize, and map agricultural enhancement needs within the area of the Watershed Improvement District (WID) was developed and used in the pilot study,<sup>12</sup> and has since been adapted and refined as described here. The methodology relies on the structured combination of information derived from

- (i) existing agricultural land protection programs in Whatcom County,
- (ii) available GIS data used to prepare the agricultural reference maps, and
- (iii) local knowledge provided by participants in the WID work session.

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<sup>12</sup> Gill P (2013). *Agriculture-Watershed Characterization and Mapping Report for the North Lynden watersheds*. Prepared for the Whatcom County Agriculture-Watershed Pilot Project, Whatcom County Planning & Development Services, Bellingham.  
<http://www.co.whatcom.wa.us/2260/Agricultural-Watershed-Pilot-Project>

#### 4.1.2 What are the priorities for agriculture and why are these needed?

A viable agricultural system relies on three kinds of infrastructure:

- Natural infrastructure including available land, soils, water, air, plants and animals;
- Built infrastructure including product packing and processing facilities, livestock shelter and management facilities, transportation and water conveyance systems for irrigation, land drainage and flood protection; and
- Supporting socio-cultural-economic infrastructure including research capacity, cultural value, knowledge and information transfer, labor, regulations and governance, business structures, access to markets.

The agricultural characterization has been focused on those aspects of agricultural infrastructure that are considered to be priorities for maintaining a viable agricultural industry in Whatcom County, and that are suited to mapping. These general priorities were initially identified in the pilot agricultural characterization and mapping workshop held in Lynden in October 2012<sup>13</sup> with farmers, agriculture professionals, planning and conservation agency staff:

- Availability of prime agricultural soils for all crop types and rotations;
- Water quantity for agricultural activities (irrigation, livestock and agricultural processing);
- Water quality for agriculture (livestock, crops, processing);
- Land drainage including timing of drainage for soil preparation, crop growth and harvesting;
- Protection of fields from flooding at critical times in the growing season;

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<sup>13</sup> Gill, P. (2013). *Ibid.*



- Protection of the agricultural land base from conversion for non-farming land uses; and
- Protection from development pressure and agricultural-residential conflicts.

#### 4.1.3 Detailed description of process for characterizing and mapping agricultural enhancement priorities

Step 1: Delineation of Agriculture-Watershed Characterization Areas. The WID area was divided into several smaller “Agriculture-Watershed Characterization Areas” (AWCAs), based on a combination of the WRIA 1 water management areas<sup>14</sup> and the Puget Sound Watershed Characterization Project Assessment Units (see section 5 in this report for explanation of the assessment units). The AWCAs reflect hydrological and agricultural characteristics in the landscape, are recognizable for WID members, and are of a size that is practical for the WIDs to utilize in their planning processes. Importantly, the AWCAs represent common areas within which to characterize and map both agricultural and watershed enhancement priorities.

Step 2: Agriculture priority maps. The project team assembled a series of agriculture priority maps based on analysis of GIS data from Whatcom County’s existing Agriculture Program and other relevant sources. The agriculture priority maps included, for each agriculture-watershed characterization area (AWCA) associated with the WID:

- Proportion of prime soils (Figure 6);
- Drainage needs for agricultural land (Figure 7);

- Flood protection needs for agricultural land (Figure 8);
- Important agricultural land and needs for protection of the agricultural land base (Figure 9);
- Water quantity needs for agricultural activities (Figure 10).

Step 3: Agriculture reference maps. The project team prepared a series of agriculture reference maps to provide background information for the characterization and mapping process, using GIS data from Whatcom County and other relevant sources. The agriculture reference maps included:

- Agriculture priority areas identified in the County’s Agriculture program as important agricultural land,<sup>15</sup> including land within the Agriculture District (AG), land in the Rural Study Areas, and land on which agricultural conservation easements have been placed through the Purchase of Development Rights program (Figure 17);
- Agricultural land use inventory,<sup>16</sup> showing current land cover on agricultural lands in the WID (Figure 18);
- Location of Prime farmland soils as defined by the USDA (Figure 19);
- Potential residential development rights on agricultural land (Figure 20);
- Water right points of diversion – existing water rights and new applications (Figure 21);
- Special Districts that are wholly or partially within the WID area, including drainage, diking and flood control districts (Figure 22);
- Surface water quality impairments (Figure 27).

<sup>14</sup> *Surface Water Delineation Boundaries in WRIA 1* (November 2002). [http://wria1project.whatcomcounty.org/uploads/PDF/Maps/WRIA%201%20Watersheds%20&%20Streams%20V3\\_draftscreen.pdf](http://wria1project.whatcomcounty.org/uploads/PDF/Maps/WRIA%201%20Watersheds%20&%20Streams%20V3_draftscreen.pdf)

<sup>15</sup> *Whatcom County Agricultural Strategic Plan*. (2011), Planning & Development Services (Published May 17, 2011; Re-Published July 27, 2011) <http://www.whatcomcounty.us/DocumentCenter/View/3630>

<sup>16</sup> *Whatcom County Agricultural Land Cover Analysis* (2013), Whatcom County Planning & Development Services: Agricultural Program, May 2013 <http://www.co.whatcom.wa.us/DocumentCenter/View/3989>



Step 4: WID work session. The WID commissioners hosted a work session to bring together participants with local knowledge of agriculture in the WID area, including farmers and residents, agency staff and agriculture professionals. At the work session, participants gathered around several large printed maps of the WID area and discussed the agricultural and watershed priorities in the WID. Participants were provided with a set of the reference maps to use in the discussion as needed. Participants' inputs on agricultural priorities and specific actions were compiled by the project team as notes in a series of tables (see Table 3 in this report) and as notes on the large desk-top maps.

Step 5: Characterization and determination of agricultural enhancement priorities and specific actions. The project team added information from the agricultural priority maps and other reference documents to the detailed agricultural enhancement tables, along with the information provided by the work session participants (see Table 4). Agricultural priorities were determined for each Agriculture-Watershed Characterization Area (AWCA) by combining the reference information and the work session information as shown in Table 2 below. Where specific actions at specific locations were suggested by work session participants, these were included in the Agricultural Priority Actions Map (Figure 11

Step 6: Mapping of agricultural enhancement priorities. A summary agricultural enhancement map was prepared (Figure 4) to show, as far as possible in a single map, the locations of agricultural priorities including prime farmland soils, important agricultural land, flood protection and agricultural drainage.

Table 2. Methodology for determination of agricultural enhancement priorities in the Laurel WID.

1. Primary indicator of priority: Refer to the reference maps and reference documents for a substantiated agricultural priority in each agriculture-watershed characterization area according to the criteria below. If a criterion is met for indicating an agricultural priority, then add this in yellow highlight to the detailed agricultural characterization tables, and put a check mark in the summary table of agricultural and watershed enhancement priorities (Table 1).		
2. Modifiers: Refer to the work session participants' comments for this area to see whether their comments might modify the indicator of a priority or would support a priority being added to the table, as explained below. Modify the agricultural priority indicators in summary Table 1 and detailed Table 3 as needed.		
3. Specific actions/opportunities: If the participants recommended specific actions to address priority needs, then record these in the "possible actions" column in the detailed agricultural characterization tables. Specific actions that can be tied to a specific location should be placed on the agricultural priority actions map. Specific actions that are more general can be listed in the possible actions column of the detailed agricultural characterization tables.		
Priority	Criteria for indicating priority	Modifiers
<i>Prime agricultural soils</i>	>50% of the area is Prime farmland (any prime soils category 1-10 according to USDA definitions for prime farmland)	-
<i>Water quality for crops and livestock</i>	Note WA Dept. of Ecology water quality impairments in category 5, 4a or 4b where these might affect use of the water for agricultural activities.	If work session participants noted a specific agricultural water quality issue that could affect the use of water for agricultural purposes (e.g. iron causes blockage of irrigation pipes; nitrate can be a problem for livestock), then indicate as "priority for agriculture" and crosscheck with reference documents or reference maps to substantiate if possible.
<i>Water quantity for agricultural activities</i>	More than 1 new application for water right in the area.	Refer to participants' comments and reference maps. If number of new applications is <3 and participants stated, with supporting evidence, that water quantity for agriculture is currently sufficient, then the priority indicator can be removed.
<i>Agricultural drainage</i>	>50% of the area contains Prime 2 soils (Prime if drained) Note presence of drainage district – not a modifier but indicates that drainage needs ongoing maintenance to remain effective.	Refer to participants' comments to see whether they consider drainage to be a priority (if they do not, that does not necessarily mean that drainage is not needed in the areas, but probably means that if drainage infrastructure is present then it is adequately maintained). If specific actions were recommended at specific locations, then add those to the actions column.
<i>Flood protection</i>	Contains >5% soils that are Prime if protected from flooding, OR Contains 1 in 100-year flood area, OR Contains floodway	If only a small portion of the area contains one of the 3 criteria at left, then refer to participants' comments and if they did not consider flood protection to be a general need for the area, then the priority indicator can be removed.
<i>Agricultural land base:</i> <ul style="list-style-type: none"> <li><i>Important agricultural land</i></li> <li><i>Protection from development pressure</i></li> </ul>	>50% of the area is any combination of AG zoned, Rural Study Area or PDR easement.	-
	Reference maps: If a Rural Study Area is present (see agricultural priority areas reference map), OR If the area contains parcels with more than 2 potential additional dwelling units (development rights reference map)	Refer to participants' comments to see if they are experiencing residential-agriculture conflicts or pressure for conversion of agricultural land in the area and consider this to be a priority.
<i>Other:</i>	Refer to participants' comments. Crosscheck with reference documents or reference maps to substantiate if possible.	-

## 4.2 Agricultural characterization tables

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Table 3. Agriculture characterization tables for the Laurel WID.

NOTE: Possible actions include: Specific actions identified by WID Actions Map # and location (e.g. L17) and Assessment Unit (AU); and general actions which do not have locations specified. Some of these actions do not appear on the WID Actions Map due to: (i) action is general in description, no location is noted; (ii) action is specific in description, but no location noted; (iii) action is general in description, but location is outside the WID area; or (iv) action is specific in description, location outside the WID. AUs are provided when known.

3A. Agricultural Enhancement Priorities: Upper Tenmile Creek							
	Water quantity: Irrigation, stock and processing	Water quality	Drainage	Flood protection	Land	Other	Possible actions
Upper Tenmile Creek AU1137 AU1136  Notes from reference maps and other documents:	10-25 new applications for water rights in Upper Tenmile – See Ag Priorities maps: Water Quantity <b>Water quantity priority</b>	Sections of Tenmile Creek in Upper Tenmile are in category 5 <sup>17</sup> for DO. One section is in category 4a <sup>18</sup> for bacteria. <sup>19</sup>  Iron (natural origin) found in most areas of Sumas aquifer in the Lynden-Everson- Nooksack-Sumas study area. <sup>20</sup>	25-50% of soil in Upper Tenmile is prime if drained. – See Ag Priorities map: Drainage.	<5% of soil is prime if protected from flooding in Upper Tenmile – See Ag Priorities maps: Flooding.	41% of land is in Ag Zoning and RSA. An RSA occupies a substantial portion of Upper Tenmile. – See Ag Priorities map: Ag Land Base. <b>Ag land base priority in section of Upper Tenmile that is within Laurel WID</b>  >85% of area is prime 1-10 in Upper Tenmile. – See Ag Priorities map: Prime Soils. <b>Ag prime soils priority</b>		
Upper Tenmile Creek AU1137 AU1136  Notes from work session February 2016	Silver Spring Creek is very important - supports irrigation use and maintains Tenmile Creek flow. Upper Silver Spring Creek goes dry (possibly due to gravel pit at headwater of Silver Spring Creek). A deep ditch below Ten Mile road goes dry from July through September	Problems with DO and fecal coliforms in main creek. There is increased sediment in Silver Springs Creek, possibly in runoff from Laurel Rd and upstream development.  AU 1136: Some iron issues in water in this area. <b>Ag water quality priority</b>	Important to maintain drainage. Beaver control is needed. Sediment accumulates in channel (channel not specified by participants). AU 1136: Flow is not good by the Old Guide and Hemmi Rd area. After silage was harvested out of Hemmi/Tenmile area the ground became wet year round. <b>Ag drainage priority</b>	AU 1136: Regular flooding after installation of log jams in channel of Tenmile. <b>Ag flood protection priority</b>	AU 1136: Development causing some increased sediment and storm water flow. <b>Development pressure</b>	Historically, water quality has been good.	(L17/30) AU 1137 Fish passage problem. (L3/31) AU 1137: Clean out Tenmile Creek channel west of Chasteen Rd for 0.5 miles downstream. (L1/32) AU 1137: Consider purchase of development rights in upper Silver Springs Creek.  AU 1136: Remove old dam at the school.

<sup>17</sup> Category 5 - Polluted waters that require a TMDL (total maximum daily load) or other WQI (water quality Improvement) project: the traditional list of impaired water bodies traditionally known as the 303(d) list. Starting with the 2008 Water Quality Assessment, Washington's 303(d) list of polluted waters were placed under Category 5 in the approved assessment. Placement in this category means that Ecology has data showing that the water quality standards have been violated for one or more pollutants, and there is no TMDL or pollution control plan. WA Department of Ecology, 2015. *Water Quality Assessment Categories*. <http://www.ecy.wa.gov/programs/wq/303d/WQAssessmentCats.html> (Accessed March 28, 2016)

<sup>18</sup> Category 4a - has a TMDL: water bodies that have an approved TMDL in place and are actively being implemented. WA Department of Ecology, 2015. *Water Quality Assessment Categories*. <http://www.ecy.wa.gov/programs/wq/303d/WQAssessmentCats.html> (Accessed March 28, 2016)

<sup>19</sup> Ecology (2012), *Water Quality Assessment for Washington*. <http://www.ecy.wa.gov/programs/wq/303d/index.html>

<sup>20</sup> Cox, S. E., and Kahle, S. C. (1999), Hydrogeology, Ground-Water Quality, and Sources of Nitrate in Lowland Glacial Aquifers of Whatcom County, Washington, and British Columbia, Canada; Water-Resources Investigations Report 98-4195. USGS. <<http://pubs.usgs.gov/wri/1998/4195/report.pdf>> (last accessed 4/4/2016)

3B. Agricultural Enhancement Priorities: Lower Tenmile Creek							
	Water quantity: Irrigation, stock and processing	Water quality	Drainage	Flood protection	Land	Other	Possible actions
<p>Lower Tenmile AU1140</p> <p>Notes from reference maps and other documents:</p>	<p>1-10 new applications for water rights in Lower Tenmile. See Ag Priorities maps: Water Quantity (map shows 6 applications)</p> <p>Water quantity priority</p>	<p>A section of Tenmile Creek in Lower Tenmile is in category 5 for DO, and category 4a for bacteria.<sup>21</sup></p> <p>Iron (natural origin) found in most areas of Sumas aquifer in the Lynden-Everson-Nooksack-Sumas study area.<sup>22</sup></p>	<p>25-50% of soil in Tenmile Lower is prime if drained. – See Ag Priorities maps: Drainage.</p>	<p>&lt;5% of soil is prime if protected from flooding in Lower Tenmile. A small area along the Nooksack River lies in floodway and 100-year flood zone – See Ag Priorities maps: Flooding.</p>	<p>71% of land in Lower Tenmile is in Ag Zoning and RSA.</p> <p>Ag land base priority</p> <p>A Rural Study Area occupies a substantial portion of this subbasin. – See Ag Priorities map: Ag Land Base.</p> <p>Development pressure</p> <p>92% of soils in Lower Tenmile are Prime. See Ag Priorities map: Prime Soils.</p> <p>Ag prime soils priority</p>		
<p>Lower Tenmile AU1140</p> <p>Notes from work session February 2016</p>		<p>West of Guide Meridian work is being done on creek.</p> <p>Participants noted water temperature concerns for the creek.</p> <p>Iron in groundwater can clog berry irrigation equipment.</p>					

<sup>21</sup> Ecology (2012), *Water Quality Assessment for Washington*. <http://www.ecy.wa.gov/programs/Wq/303d/index.html>

<sup>22</sup> Cox, S. E., and Kahle, S. C. (1999), Hydrogeology, Ground-Water Quality, and Sources of Nitrate in Lowland Glacial Aquifers of Whatcom County, Washington, and British Columbia, Canada; Water-Resources Investigations Report 98-4195. USGS. <<http://pubs.usgs.gov/wri/1998/4195/report.pdf>> (last accessed 4/4/2016)

3C. Agricultural Enhancement Priorities: Upper Fourmile Creek							
	Water quantity: Irrigation, stock and processing	Water quality	Drainage	Flood protection	Land	Other	Possible actions
Upper Fourmile Creek AU1133 AU1114  Notes from reference maps and other documents:	1-10 new applications for water rights in Upper Fourmile – See Ag Priorities maps: Water Quantity (map shows 4 applications). <b>Water quantity priority</b>		25-50% of soil in Upper Fourmile is prime if drained. – See Ag Priorities map: Drainage.  Drainage District # 3 is located within the Fourmile subbasin. <sup>23</sup>	<5% of soil is prime if protected from flooding in Upper Fourmile. – See Ag Priorities maps: Flooding.	81% of land in Upper Fourmile is in Ag Zoning & RSA. <b>Ag land base priority</b> A Rural Study Area occupies a portion of this subbasin. – See Ag Priorities map: Ag Land Base. <b>Development pressure</b> >85% of area is prime 1-10 in Upper Fourmile – See Ag Priorities map: Prime Soils. <b>Ag prime soils priority</b>		
Upper Fourmile Creek AU1133 AU1114  Notes from work session February 2016	Water Rights are available. There is plenty of surface water. There are lots of springs in the area. More groundwater irrigation rights are needed.	Green Lake has water quality problems May-Oct (low DO, high temperature)	Drainage is an issue in this area. Peat soils around Noon and Lunde Rds need drainage; new blueberries on Pole Rd are adding drainage water to the creek; Guide Meridian runoff.  Green Lake Slough was dredged 10 years ago and this helped drainage in area.  AU1114: The Drainage District used to dredge Fourmile and this helped drainage. (36)  A comment was made that the elevation of Fourmile drops 1' from Green Lake to Hannegan Rd.  Loss of ag lands in area at the edge of the gravel pit - 5 years ago it was dry, where it is now chronically wet. <b>Ag drainage priority</b>	Beaver dams are creating localized flood problems and keeping land out of agriculture between Green Lake and the gravel pit. (L9/39)  Beaver dam removal and buffer planting maintenance is needed to prevent channel blockage by bridge.  Flood protection is not currently a priority in this area – however, see beaver maintenance item L18.	5-acre development has brought increased stormwater runoff flowing toward Fourmile Creek.  Land can be used for residential between Central and Ten Mile Rds.	Noon Rd and Hemmi Road are built on peat and are settling  Fourmile to Guide has less reed canary grass and good shade.	(L4/33) AU1133: Potential sediment trap in Fourmile Creek  (L5/34) AU1133: Maintenance required on Fourmile Creek to keep channel flowing.  (L7/36) AU 1133: Bypass around lake needs to be cleaned.  (L18/37) AU1114: Beaver management needed to prevent flooding.  (L8/38) AU1114: Maintenance needed to clear willows out of waterway.  (L9/39) AU1114: More ag land would be available if this area drained.  (L11/41) AU1133: Maintenance needed to clear willows that have fallen into water.

<sup>23</sup> WCD (2014), *Agricultural Drainage for Drainage Districts*. Whatcom Conservation District. <http://www.whatcomcd.org/ag-drainage-districts>



3D. Agricultural Enhancement Priorities: Lower Fourmile Creek							
	Water quantity: Irrigation, stock and processing	Water quality	Drainage	Flood protection	Land	Other	Possible actions
<p>Lower Fourmile Creek AU1137</p> <p>Notes from reference maps and other documents:</p>	<p>1-10 new applications for water rights in Lower Fourmile. See Ag Priorities maps: Water Quantity (map shows 4 applications). <b>Water quantity priority</b></p>		<p>25-50% of soil in Lower Fourmile is prime if drained. See Ag Priorities map: Drainage.</p> <p>Drainage District #3 is located within the Fourmile subbasin. <sup>24</sup></p>	<p>&lt;5% of soil is prime if protected from flooding in Lower Fourmile – See Ag Priorities maps: Flooding.</p>	<p>84% of land in Lower Fourmile is in Ag Zoning &amp; RSA. <b>Ag land base priority</b></p> <p>A Rural Study Area occupies a small portion of this subbasin. – See Ag Priorities map: Ag Land Base. <b>Development pressure</b></p> <p>&gt;85% of area is prime 1-10 in Lower Fourmile. – See Ag Priorities map: Prime Soils. <b>Ag prime soils priority</b></p>		
<p>Lower Fourmile Creek AU1137</p> <p>Notes from work session February 2016</p>	<p>Summer flow is low. Need more groundwater irrigation rights.</p>	<p>Participants mentioned fecal coliforms, DO as concerns, particularly for Tenmile downstream of Fourmile confluence. Low DO is possibly associated with peat soils in the area.</p>	<p>Fourmile channel grade is flat and requires periodic maintenance to maintain drainage. There are peat soils in the area which require drainage. Drainage below old Guide is very bad. Land is 4-5" under water and drainage for whole Tenmile system is impaired. Flow gets slow by the school. <b>Ag drainage priority</b></p>				<p>Need to check if old rip rap is possibly adding to channel failures. (lii)</p> <p>Allow for more fall to the creek to increase outflow. (iv)</p>

<sup>24</sup> WCD (2014), *Agricultural Drainage for Drainage Districts*. Whatcom Conservation District. <http://www.whatcomcd.org/ag-drainage-districts>

3E. Agricultural Enhancement Priorities: Deer Creek							
	Water quantity: Irrigation, stock and processing	Water quality	Drainage	Flood protection	Land	Other	Possible actions
Deer Creek AU1140 and AU1138  Notes from reference maps and other documents:	1-10 new applications for water rights in Deer Creek – See Ag Priorities maps: Water Quantity (map shows 3 applications within the WID area of Deer Creek). <b>Water quantity priority</b>	A sections of Deer Creek is in category 5 for pH, and category 4a for bacteria. <sup>25</sup>  Iron (natural origin) found in most areas of Sumas aquifer in the Lynden-Everson-Nooksack-Sumas study area. <sup>26</sup>	25-50% of soil in Deer is prime if drained. See Ag Priorities map: Drainage.  Drainage Improvement District #30A includes the south fork of Deer Creek _ <i>Agricultural Drainage for Drainage Districts</i> . <a href="http://www.whatcomcd.org/ag-drainage-districts">http://www.whatcomcd.org/ag-drainage-districts</a>	<5% of soil is prime if protected from flooding in Deer Creek. See Ag Priorities maps: Flooding.	The portion of Deer Creek that is within the Laurel WID is in Ag Zoning & RSA. See Ag Reference map: Agriculture Priority Areas. <b>Ag land base priority</b>  84% of soils are prime 1-10 in Deer Creek – See Ag Priorities map: Prime Soils. <b>Prime soils priority</b>		
Deer Creek AU1140 and AU1138  Notes from work session February 2016	Deer Creek goes dry in summer. Need to use water from community water association for stock watering. The summer of 2015 was very dry, the normally high quality hay production was reduced.  One participant tried to install a 600 ft well in the area but the well yielded white sand & salt water. Lake in the area now drains neighboring landowner's spring (location detail not provided).	Iron levels are high in some areas. There are high fecal coliform counts in the area, participants had questions about possible sources of fecal coliforms. Crystal Springs development is a possible source of sediment entering the stream.	There were beaver issues in the lower areas (lower lands), but repeated dam removal over several years has controlled them.  It is too wet to grow corn or grass in fields between Deer Creek and Axton, also wet through area along Guide and above Hemmi near woodlot. <b>Ag drainage priority</b>	Beaver dams cause flooding around backside of Wiser Lake.  Flood protection is not currently a priority in this area but see beaver maintenance action item #L14.	Hay and beef cows in the area. Dairy farmers are leaving and selling land for berries. The land is good for growing lots of things. There are lots of residential conflicts: smells, noise, pesticide concerns. <b>Development pressure</b>  The headwater is in jeopardy due to development - reduced streamflow.		(L13/44) AU1140: This area needs better drainage.  (L20/45) Groundwater quantity is limited here, not enough for cows and lots of iron.  (L14/46) AU1140: Problems with drainage and beaver management needed.  (L15/47) AU1140: Wet field, would benefit from cleaning culvert.  (L16/48) AU1140: Keeping this ditch clear is key to drainage to east. Creek runs slowly.

<sup>25</sup> Ecology (2012), *Water Quality Assessment for Washington* <http://www.ecy.wa.gov/programs/Wq/303d/index.html>

<sup>26</sup> Cox, S. E., and Kahle, S. C. (1999), Hydrogeology, Ground-Water Quality, and Sources of Nitrate in Lowland Glacial Aquifers of Whatcom County, Washington, and British Columbia, Canada; Water-Resources Investigations Report 98-4195. USGS. <<http://pubs.usgs.gov/wri/1998/4195/report.pdf>> (last accessed 4/4/2016)

3F. Agricultural Enhancement Priorities: Wiser Lake/Cougar Creek (South)							
	Water quantity: Irrigation, stock and processing	Water quality	Drainage	Flood protection	Land	Other	Possible actions
<p>Wiser Lake/Cougar Creek (South) AU1112</p> <p>Notes from reference maps and other documents:</p>	<p>1-10 new applications for water rights in Wiser/Cougar South – See Ag Priorities maps: Water Quantity (map shows 5 applications). <b>Water quantity priority</b></p>	<p>Iron (natural origin) found in most areas of Sumas aquifer in the Lynden-Everson-Nooksack-Sumas study area.<sup>27</sup></p>	<p>&lt;25% of soil in Wiser/Cougar South is prime if drained. See Ag Priorities map: Drainage.</p>	<p>&lt;5% of soil is prime if protected from flooding in Wiser/Cougar South. A small area along the Nooksack River lies in floodway and 100 year flood zone. See Ag Priorities maps: Flooding.</p>	<p>97% of land in Wiser/Cougar South is in AG Zoning &amp; RSA. <b>Ag land base priority</b></p> <p>A Rural Study Area occupies a substantial portion of this sub-basin. See Ag Priorities map: Ag Land Base, and Ag reference map: Agriculture Priority Areas. <b>Development pressure</b></p> <p>80% of soils are prime 1-10 in Wiser/Cougar S. – See Ag Priorities map: Prime Soils. <b>Ag prime soils priority</b></p>		
<p>Wiser Lake/Cougar Creek (South) AU1112</p> <p>Notes from work session February 2016</p>	<p>Irrigation is critical by Piper and Northwest Rds.</p> <p>Groundwater is ample.</p> <p>There is a good well by Pole Rd.</p>	<p>Water is clean. Iron levels vary greatly, high in some places, not present in others.</p>	<p>The Sandy soils drain well here. Drainage District takes care of flooding well.</p>	<p>AU1112: Flood waters recede pretty quickly, but there is increasing spring and fall flooding. If trend continues it will impact farming operations, e.g. corn harvest.</p>		<p>Fish passage barrier between Chasteen and Guide Meridian Rds.</p>	<p>[L12] AU1112: Drainage - improve drainage functions along Neevel Rd and Nooksack River.</p> <p>[L19] AU1112: Drainage - Confluence of Tenmile and Nooksack River would be a good place for floodgate. (iv)</p>

<sup>27</sup> Cox, S. E., and Kahle, S. C. (1999), Hydrogeology, Ground-Water Quality, and Sources of Nitrate in Lowland Glacial Aquifers of Whatcom County, Washington, and British Columbia, Canada; Water-Resources Investigations Report 98-4195. USGS. <<http://pubs.usgs.gov/wri/1998/4195/report.pdf>> (last accessed 4/4/2016)

3G. Agricultural Enhancement Priorities: Wiser Lake/Cougar Creek (North) – only a small portion is within the Laurel WID							
	Water quantity: Irrigation, stock and processing	Water quality	Drainage	Flood protection	Land	Other	Possible actions
<p>Wiser Lake/Cougar Creek (North) AU1110</p> <p>Notes from reference maps and other documents:</p>	<p>1 new application for a water right in the portion of Wiser/Cougar North that is within the Laurel WID, but there are more applications in this area outside the WID boundary.</p> <p>See Ag Priorities maps: Water Quantity and Ag reference map: Water right points of diversion.</p>	<p>A section of Wiser Creek in Wiser/Cougar North are in category 5 for DO, and category 4a for bacteria.<sup>28</sup></p>	<p>25-50% of soil in Wiser/Cougar North is prime if drained. – See Ag Priorities map: Drainage.</p> <p>Drainage Improvement District #5 is located within the Wiser/Cougar North sub-basin.<sup>29</sup></p>	<p>&lt;5% of soil is prime if protected from flooding in Wiser/Cougar North. A small area along the Nooksack River lies in floodway and 100-year flood zone – See Ag Priorities maps: Flooding.</p>	<p>83% of land in Wiser/Cougar North is in AG Zoning &amp; RSA.</p> <p>Ag land base priority</p> <p>A Rural Study Area occupies a portion of this sub-basin. – See Ag Priorities map: Ag Land Base.</p> <p>Development pressure</p> <p>94% of area is prime 1-10 in Wiser/Cougar North. – See Ag Priorities map: Prime Soils.</p> <p>Ag prime soils priority</p>		
<p>Wiser Lake/Cougar Creek (North) AU1110</p> <p>Notes from work session February 2016</p>	<p>Sufficient water from Tenmile.</p>		<p>Drainage is sufficient.</p>				

<sup>28</sup> Ecology (2012), *Water Quality Assessment for Washington* <http://www.ecy.wa.gov/programs/Wq/303d/index.html>

<sup>29</sup> *Agricultural Drainage for Drainage Districts*. Whatcom Conservation District. <http://www.whatcomcd.org/ag-drainage-districts>

#### 4.3 Agricultural priorities: Summary maps

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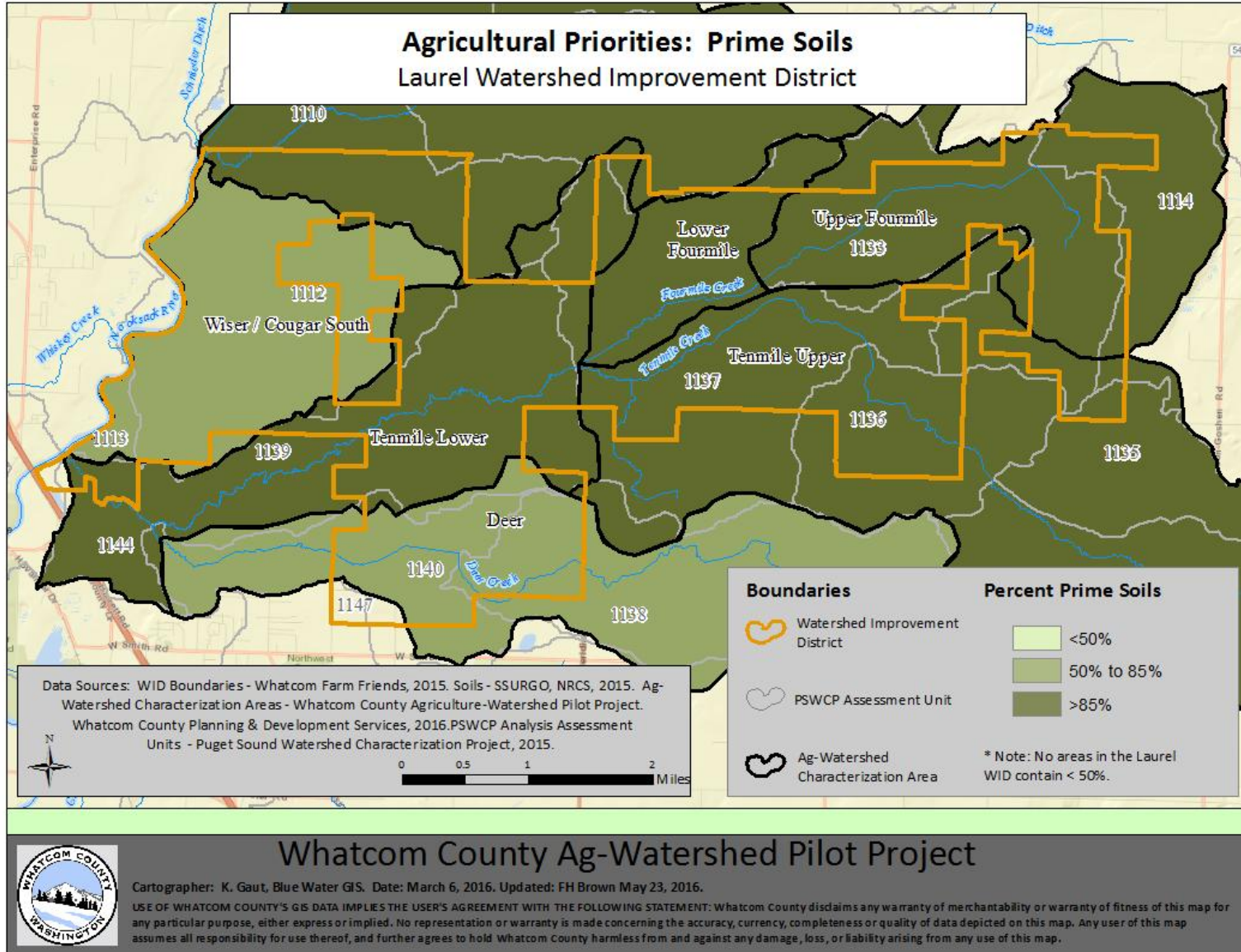


Figure 6. Laurel WID agricultural priorities: Proportion of prime soils. Data from reference map of prime soils



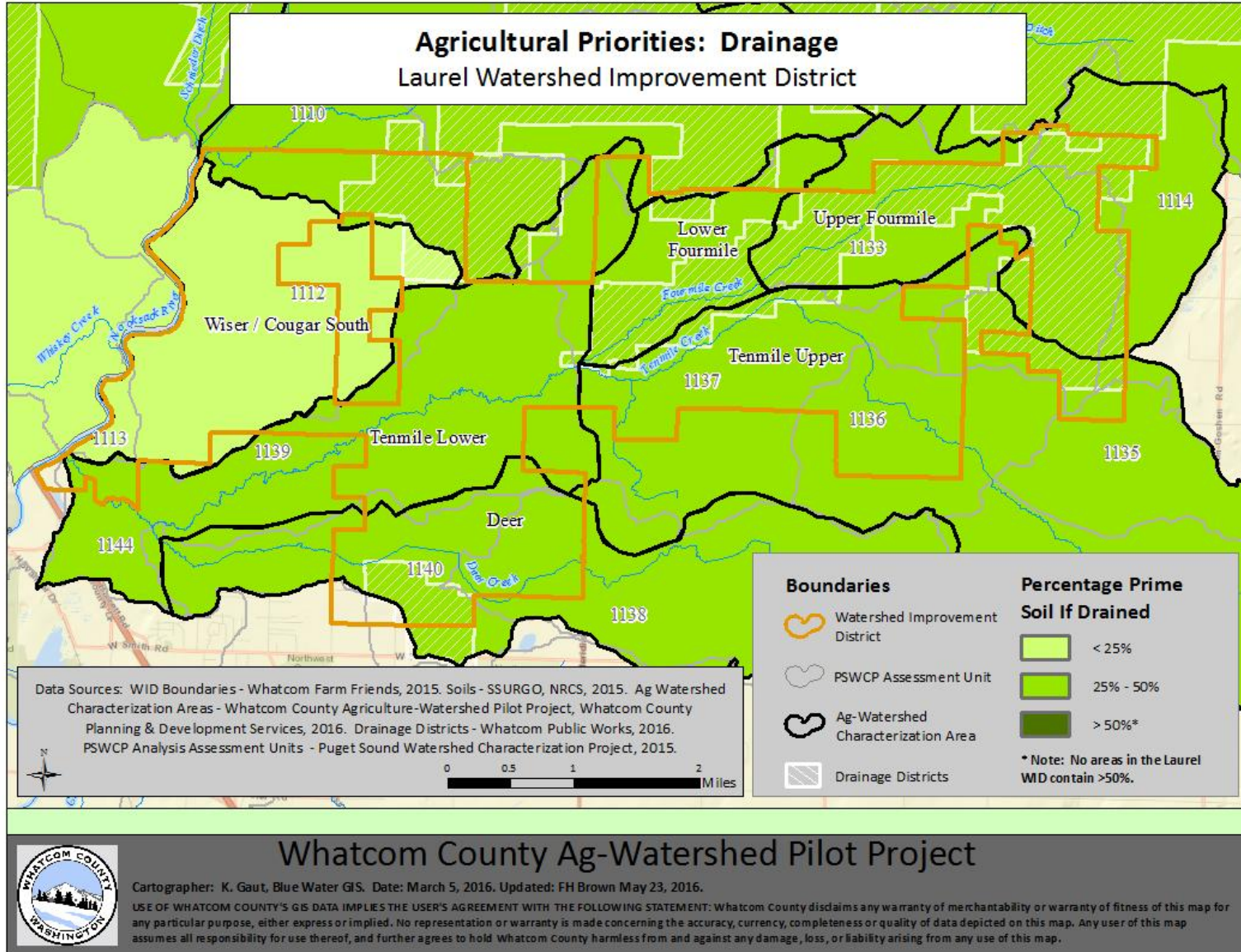


Figure 7. Laurel WID agricultural priorities: Drainage of agricultural land. Data from reference maps of prime soils and special districts

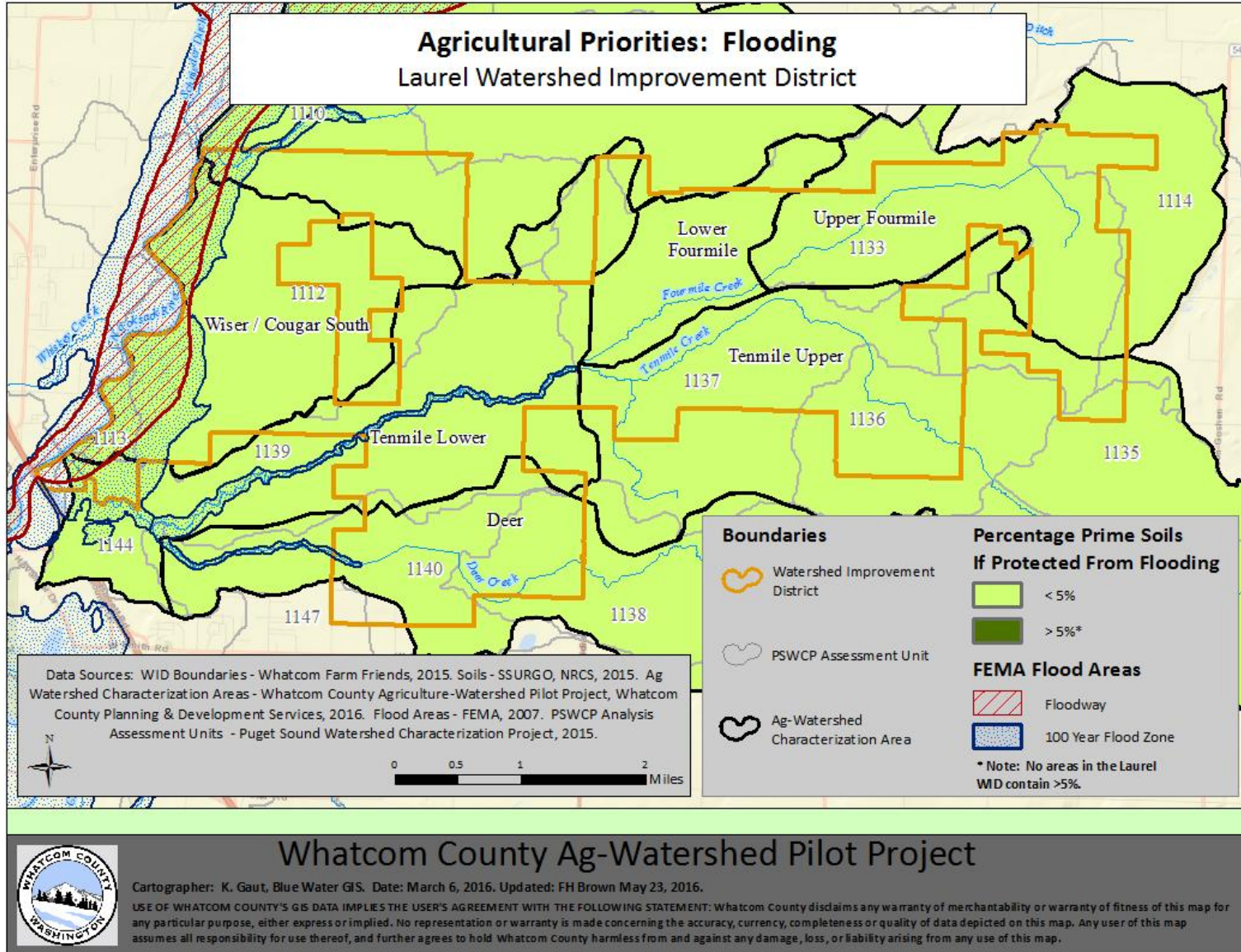


Figure 8. Laurel WID agricultural priorities: Protection from flooding. Data from reference maps on prime soils and special districts.



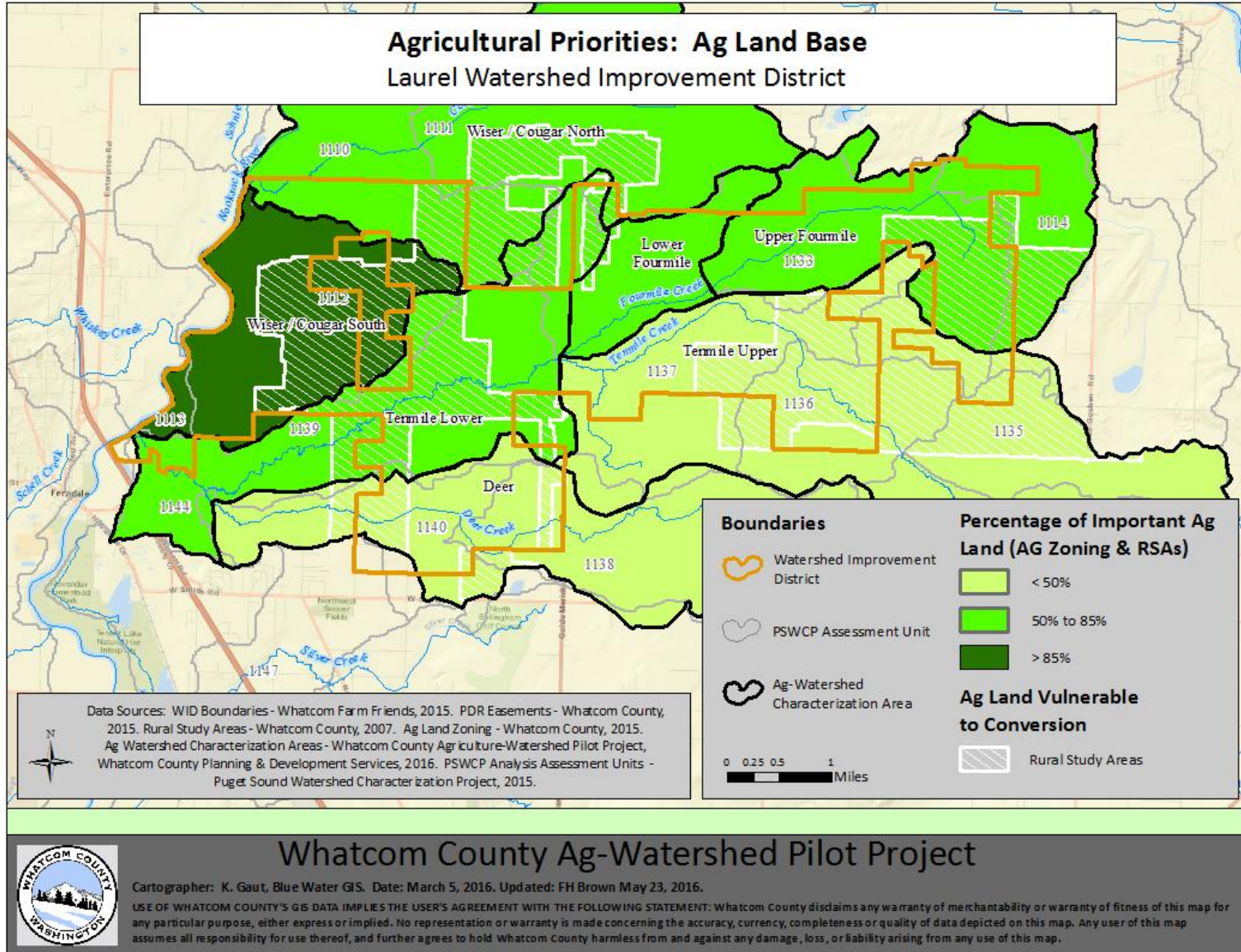


Figure 9. Laurel WID agricultural priorities: Protection of the agricultural land base. Data from reference map of agricultural priority areas

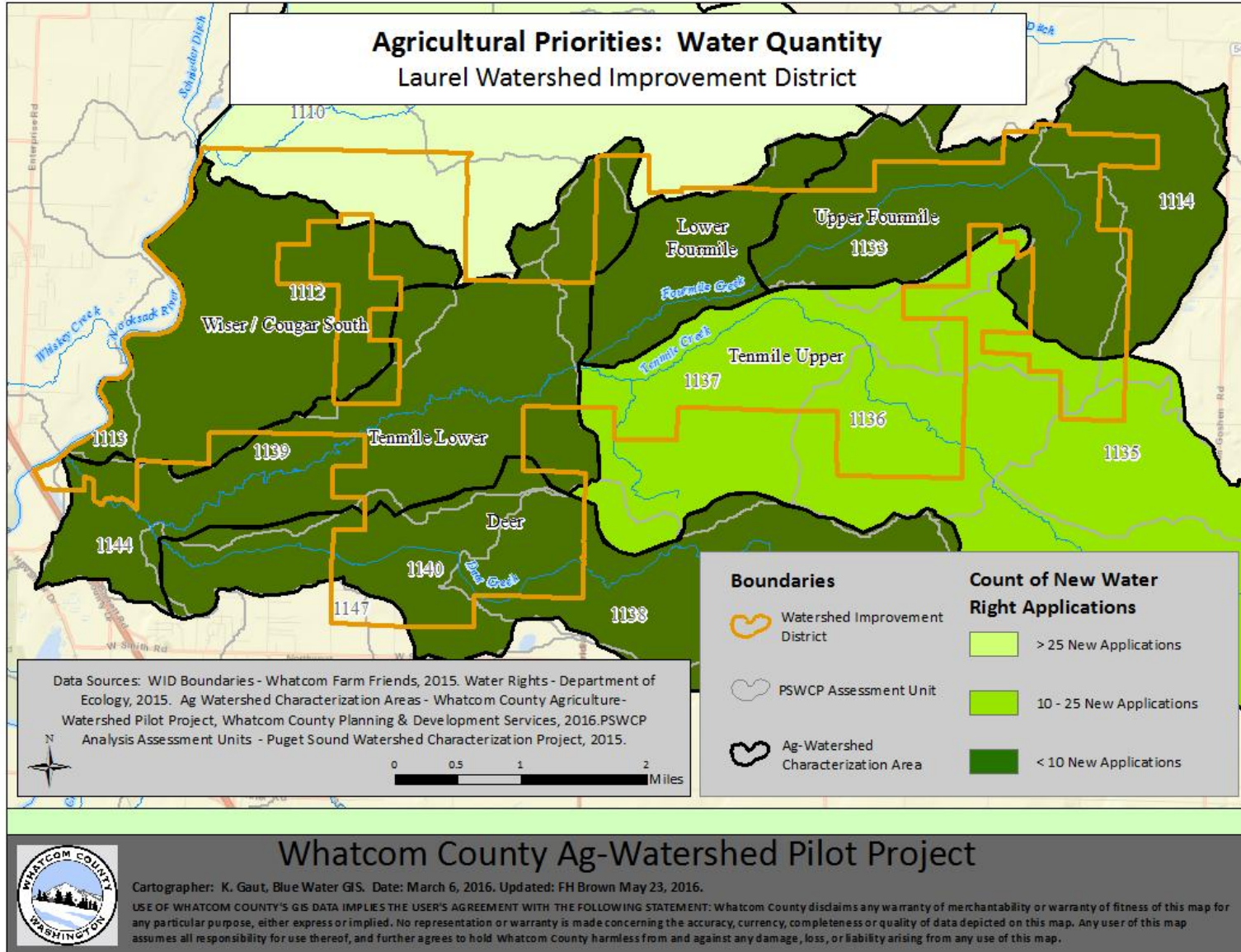


Figure 10. Laurel WID agricultural priorities: Water for agricultural activities. Data from reference map on water right points of diversion



#### 4.4 Agricultural priorities: Specific actions map

Table 4. Key for actions on agricultural priorities specific actions map

Action # on map	AU #	Priority	Notes
1	1137	Development	Purchase development rights in upper Silver Springs Creek.
2	1112	Development	There are lots of residential / development conflicts here.
3	1137	Drainage	Clean out Tenmile Creek channel west of Chasteen Rd for 0.5 miles downstream.
4	1133	Drainage	Potential sediment trap in Fourmile Creek.
5	1133	Drainage	Maintenance required on Fourmile Creek to keep channel flow.
6	1133	Drainage	Clean out of Green Lake Slough to Hannegan Rd. needed to improve drainage of boggy area.
7	1133	Drainage	Bypass around lake needs to be cleaned.
8	1114	Drainage	Maintenance needed to clear willows out of waterway.
9	1133	Drainage	More agricultural land would be available if this area drained.
10	1133	Drainage	Beaver dam removal by bridge necessary.
11	1133	Drainage	Maintenance needed to clear willows that have fallen into water.
12	1112	Drainage	This area has poor drainage.
13	1139	Drainage	This area needs better drainage.
14	1138	Drainage	Problems with drainage and beaver management needed.
15	1140	Drainage	Wet field, would benefit from cleaning culvert.
16	1140	Drainage	Keeping this ditch clear is key to drainage to east. Creek runs slowly.
17	1137	Fisheries	Fish passage problem.
18	1133	Flooding	Beaver management needed to prevent flooding.
19	1139	Flooding	Potential good location for flood gate.
20	1139	Water Quantity	Groundwater quantity is limited here, not enough for cows and high iron levels.



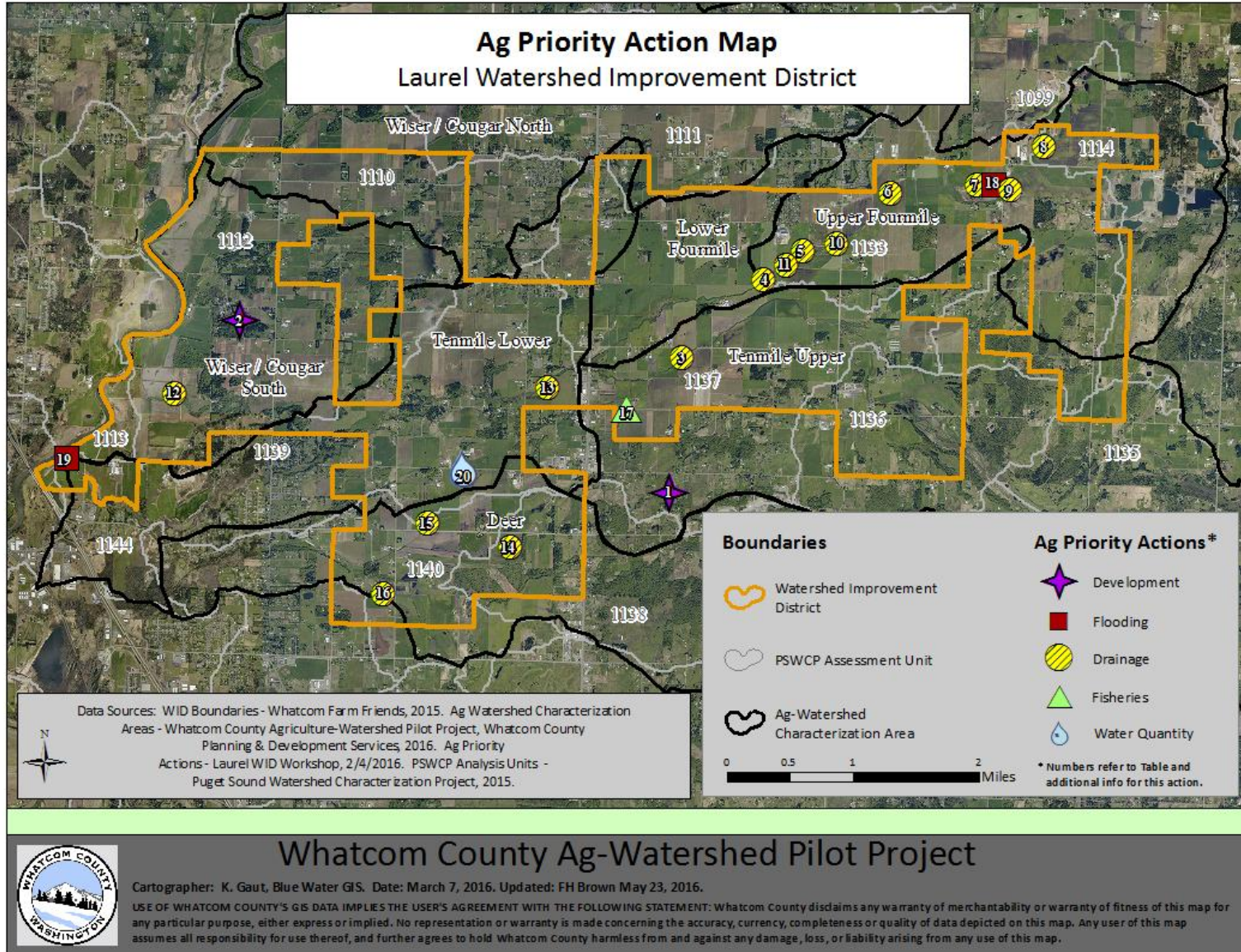


Figure 11. Laurel WID map of specific actions for agricultural priorities. Information on this map is from the WID work session in February 2016.

## 5 Watershed characterization and mapping for the Laurel Watershed Improvement District

### 5.1 Methodology

The description of the watershed characterization methodology has been adapted from that provided in the Appendix to the pilot Agriculture-Watershed Characterization and Mapping Report.<sup>30</sup>

#### 5.1.1 General approach

The watershed characterization assessment uses methods developed by the Puget Sound Watershed Characterization Watershed Project.<sup>31</sup> The results of the watershed characterization assessment are intended to assist the WIDs in identifying high priority opportunities for watershed enhancement projects on agricultural land in the lowland areas of Whatcom County, with a focus in areas where watershed and agricultural priorities could be mutually reinforcing.

The *Puget Sound Watershed Characterization (PSWC)* is a set of water and habitat assessments that compare areas within a watershed for relative restoration and protection value. It is a coarse-scale decision-support tool that provides information for regional, county, and watershed-based planning. The information it provides allows local and regional governments, as well as NGOs, to base their land use decisions on a systematic analytic framework. It prioritizes specific geographic areas for protection, restoration, and

conservation of our region's natural resources, and identifies where best to focus new development. Application of this method should result in future land-use patterns that protect the health of terrestrial and aquatic resources while directing limited financial resources to the highest priority areas for restoration and protection.

The objective of the PSWC assessment is to “characterize” the watershed in a way that helps to identify priority enhancement opportunities. The relative comparison of assessment units (AUs) for water flow processes across the lowland watersheds allows for a coarse-level snapshot of which areas are relatively important or degraded for water flow. From this snapshot we suggest possible enhancement actions that could contribute to improving or protecting water flow processes at the AU scale. Actual site location of those actions within an assessment unit would require different analyses not described here.

The assessment results in this document address the following primary questions for the Whatcom County lowland watersheds:

- (1) *Where on the landscape* should management efforts be focused first to benefit water flow processes in the watersheds that are part of the Watershed Improvement District?
- (2) *What types of activities and actions* are most appropriate to that place based on the assessment results?

The assessment results therefore address both the “where” and the “what” to focus on, in terms of water flow processes. This integrated approach offers a systematic framework for identifying more important areas within the lowland watersheds and those which are more degraded for water flow processes and water quality, with the intent of identifying areas that offer the most potential for enhancement.

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<sup>30</sup> Hume C & Stanley S (2013). *Summary of water flow assessment results for Bertrand, Fishtrap and Kamm watersheds*. Appendix A in Gill P (2013). *Agriculture-Watershed Characterization and Mapping Report for the North Lynden watersheds*. Prepared for the Whatcom County Agriculture-Watershed Pilot Project by the Washington Department of Ecology Shorelands and Environmental Assistance Program.

<http://www.co.whatcom.wa.us/2260/Agricultural-Watershed-Pilot-Project>

<sup>31</sup> See [http://www.ecy.wa.gov/puget\\_sound/characterization/index.html](http://www.ecy.wa.gov/puget_sound/characterization/index.html)

### 5.1.2 Limitations

Care should be taken to use the Puget Sound Watershed Characterization as intended. It is a coarse-scale assessment and is not intended for site-specific application or decision-making at the site scale. Finer scale data, local information and technical expertise is needed for those decisions. In addition:

- The Puget Sound Watershed Characterization is for planning purposes only. This does not affect or alter existing land use/environmental regulations although it may be used to help inform future land use and regulatory decisions.
- For the water flow assessment, the rankings for any single AU are relative only to other AUs in the area of analysis. This means it is only appropriate to compare the WID results with results in other AUs in the lowland area of WRIA 1.
- Results at the AU scale represent land-use planning-level information. At the project- or site scale, each AU will have a combination of on-the-ground challenges and opportunities. Just because an AU is rated as a low priority for restoration does not mean there are no suitable restoration sites or opportunities in that AU. Similarly, not every site in an AU that is a high priority for restoration will be suitable for restoration.
- The assessments are landscape-scale and consequently do not address site-specific issues. These are best addressed through finer-scale studies, which will remain essential to the success of local conservation efforts. When developing site-level plans, the WID should evaluate the need for finer-scale information and collect it where needed.
- The watershed characterization assessment is not intended to address compliance with state or federal water quality law, nor describe the actions necessary to achieve compliance with those laws. It is a violation of state law when activities are shown to cause or have the substantial potential to cause nonpoint source pollution. If the reader has questions about

the water quality laws, they can contact Whatcom County Public Works or the WA Department of Ecology for additional information.

### 5.1.3 Fundamental concepts of watershed characterization

Watershed processes are defined as the dynamic physical and chemical interactions that form and maintain the landscape and ecosystems on a geographic scale of watershed to basins. This includes the movement of water, sediment, nutrients, pathogens, chemicals and wood. Watershed process are controlled and influenced by natural attributes and human actions. Natural controls on watershed processes include physical attributes of the ecosystem such as geomorphology, geology, and soils. Many human actions influence watershed processes. For example, timber harvest may reduce the amount of wood entering streams. Shoreline armoring can reduce sediment input from bluffs and alter the erosion, movement, and deposition of sediments along beaches. Urban development can increase the amount and amplitude of stormwater runoff. Watershed characterization attempts to model these watershed processes such that areas of the landscape can be identified which are relatively more important (presence of natural controls) or degraded (due to human impacts).

### 5.1.4 Understanding the water flow assessment results

The water flow assessment uses two models to compare the *importance* and *degradation* of water flow processes in a watershed. Together, they identify areas that are relatively more suitable for protection or restoration of water flow processes. Each model provides a ranking from low to high for how important and how degraded each assessment unit is *relative* to the other units in the watershed.



### Water flow importance

The *importance* model evaluates the watershed in its “unaltered” state. This model combines the delivery, surface storage, recharge, and discharge components to compare the relative *importance* of assessment units in maintaining overall water flow processes in a non-degraded setting. When precipitation is “delivered” as either rain or snow, there are physical features that control the surface and subsurface movement of that precipitation within an assessment unit. These physical features include land cover, storage areas such as wetlands and floodplains, areas of higher infiltration and recharge, and areas that discharge groundwater. These areas are considered “important” to the overall water flow processes.

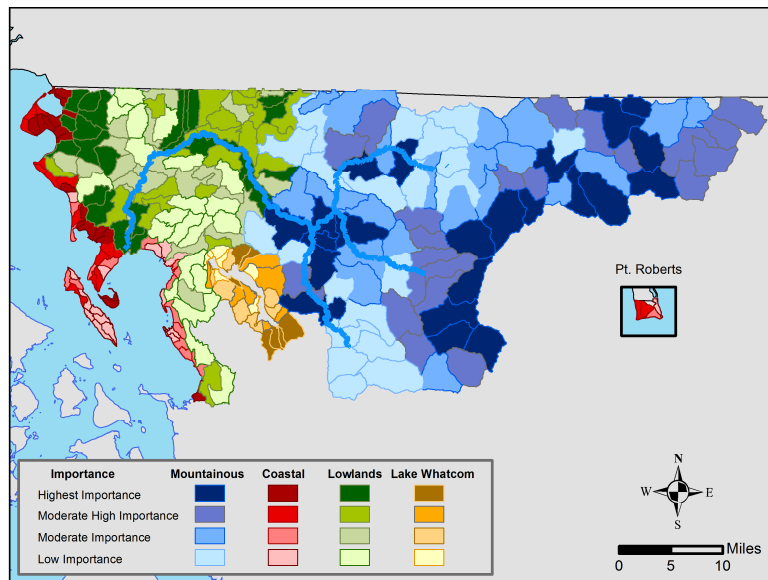


Figure. Overall importance to water flow processes: Results of Puget Sound Watershed Characterization assessment for WRIA 1. Darkest colored assessment units are considered highest *importance* relative to other assessment units in the same landscape group of WRIA 1.

In the figure to the left, each landscape group is displayed in a different color gradient (i.e. shades of blue, green, red or tan), which allows for direct comparison within the extent of that landscape group only. Dark green assessment units would be considered *highly important* for overall water flow processes *only* within the lowland area of WRIA 1, and are not comparable to AUs outside of that extent. However, this does allow one to determine which AUs throughout the lowland areas of WRIA 1 are *relatively more important* than others in that same extent.

### Water flow degradation

In the water flow *degradation* model the watershed is evaluated in its “altered” state to consider the impact of human actions on water flow processes. The *degradation* model calculates the degree of alteration to those controls that regulate the delivery, movement and loss of water, such as forest clearing and impervious surfaces. This model combines the delivery, surface storage, recharge, and discharge components to compare the relative *degradation* to overall water flow processes in assessment units. Degradation to these processes generally accelerates the movement of surface flows downstream. This accelerated delivery increases downstream flooding and erosion and subsequently degrades aquatic habitat over time.

The figure below displays the results of the *degradation* to water flow processes for all of WRIA 1. Since degradation is not controlled by landscape, we compare assessment units within the entire extent of the WRIA. A dark pink unit along the coast is comparable in level of degradation to a unit in the lowland area.



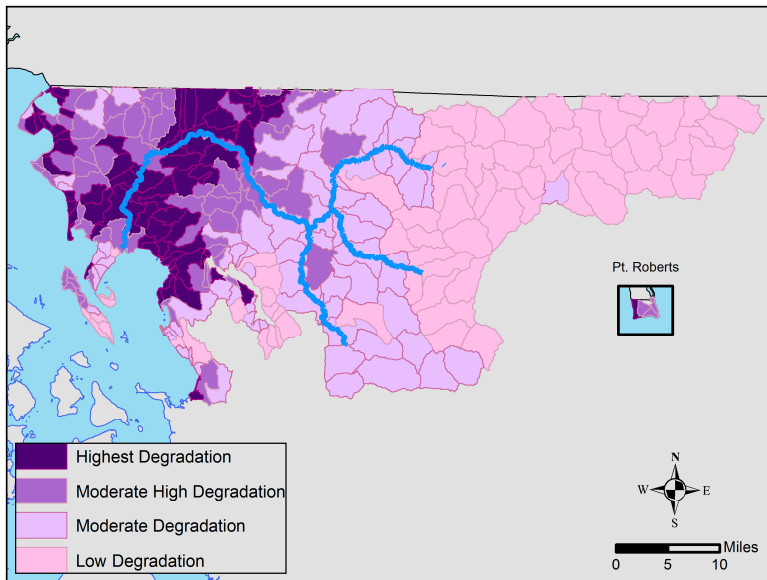


Figure. Overall degradation of water flow processes: Results of Puget Sound Watershed Characterization assessment for WRIA 1. Dark pink assessment units are considered to have the highest *degradation* relative to other assessment units in WRIA 1.

#### Management matrix for water flow

Combining the results of the *importance* and *degradation* models yields a simple categorical matrix that planners can use, along with other science-based information, to inform land management strategies and actions. At its simplest, this management matrix conveys which areas are relatively important and/or degraded, and what actions might be most appropriate there:

- Highly important – low degradation = protect
- Highly important – high degradation = restore
- Low importance – low degradation = conserve
- Low importance – high degradation = develop

The Puget Sound Watershed Characterization project generally prioritizes restoration or enhancement actions in watersheds which are both highly important and are relatively more degraded for watershed processes (yellow boxes in the Management Matrix Figure below; yellow assessment units in the map below). This does not mean that there are not important areas or necessary restoration actions in assessment units that are not highly important and highly degraded. Rather, given limited funding these might be the first places to focus on in order to increase the likelihood of improving watershed processes.

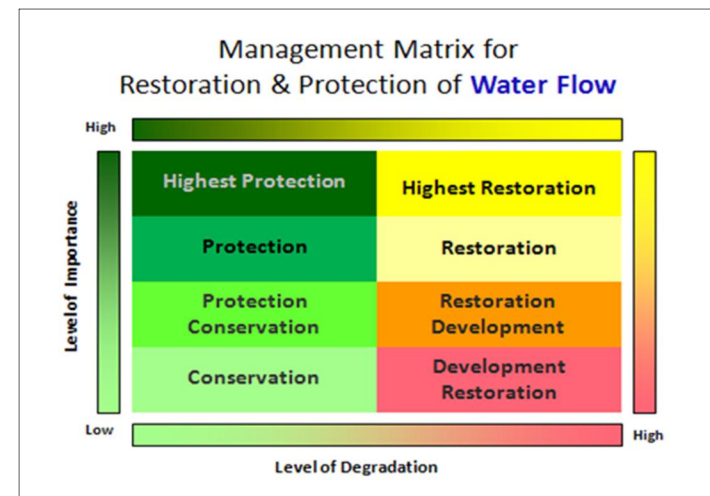


Figure: Management matrix for water flow, indicating relative priorities for restoration and protection of processes. By accounting for both the relative level of *importance* and the relative level of *degradation* of an Assessment Unit one can begin to prioritize which areas of a watershed to apply management strategies which protect water flow processes, and which areas to prioritize restoration of water flow processes.

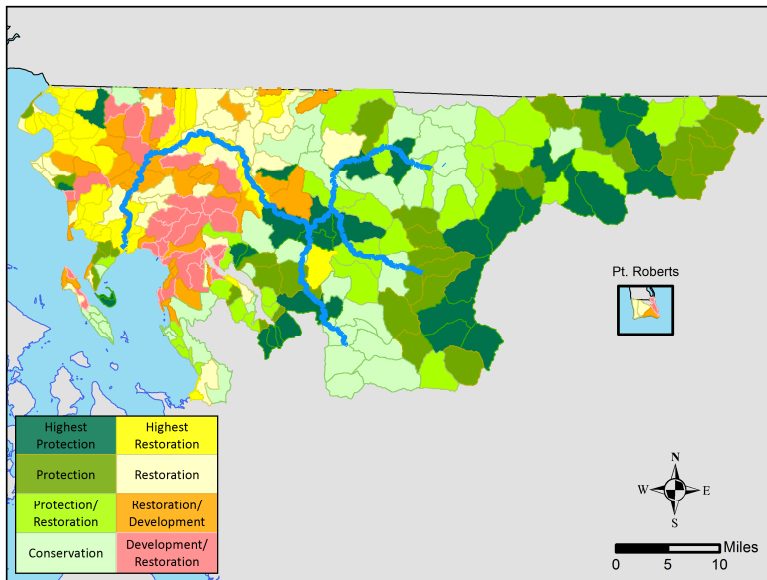


Figure. Overall priorities for restoration and protection of water flow processes in WRIA 1: Results of Puget Sound Watershed Characterization assessment.

#### 5.1.5 Using the results of the water flow assessment

For water flow process enhancement or restoration, actions should be directed towards reducing the degradation to controls that regulate the delivery and movement of water through the watershed. These controls include forest cover, areas of surface storage, areas of permeable deposits, areas of slope wetlands and areas of floodplains with permeable deposits.

The terms “restoration” and “protection” as used in this document do not mean a return to historic land cover conditions or retaining 100% forested land cover. Restoration and protection actions should be done in a manner that recognizes and works within the constraints of the existing land use activities. For example,

restoration in agricultural areas could mean consideration of measures that enhance a critical portion of water flow processes such as surface storage. This could involve the retention of water on fields for a longer period to avoid harmful peak flows within streams during the winter months. Restoration and protection measures are, therefore, always proposed here in the context of both the landscape setting and the current land use activities.

There are actions which can offer mutual benefits to both water flow and water quality. For example, there are some areas where wetland restoration or enhancement to surface storage processes could provide some improvements for both. The potential enhancement actions suggested in Table 5 may have additional benefits to other watershed processes and functions particularly in the area of riparian habitat and structure which are critical to salmonid habitats throughout the Whatcom County lowland watersheds.

## 5.2 Watershed characterization tables

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Table 5. Watershed characterization tables for the Laurel WID

NOTE: Possible actions include: Specific actions identified by WID Actions Map # location and Assessment Unit (AUs), and General actions which do not have locations specified. Some of these actions do not appear on the WID Priority Actions Map due to: (i) action is general in description no location is noted; (ii) action is specific in description but no location noted; (iii) action is general in description, located outside the WID area; (iv) action is specific in description, located outside the WID.

5A. Watershed Enhancement Priorities: Upper Tenmile Creek				
	Wildlife habitat	Salmonid habitat	Water quality	Summary & potential for enhancement
Upper Tenmile AU1137 AU1136 + small portion of AU1135  Notes from reference maps and other documents	Critical Habitat: Wetland (See Watershed reference map: Priority Species & Habitats)	Chinook, chum, coho, cutthroat, & steelhead <sup>32</sup>  (See Watershed reference map: Fish presence & fish barriers)	Sections of Tenmile Creek in Upper Tenmile (AU1137 and AU1136) are in category 5 <sup>33</sup> for DO, and in category 4a <sup>34</sup> for bacteria. <sup>35</sup>	<u>Results of PSWC water flow assessment:</u> AU1137: An area of moderate importance for all flow processes, especially surface storage. Overall water flow processes are highly degraded. AU1136: An area of high importance for discharge and moderately high importance for surface storage. Overall water flow processes are highly degraded, especially discharge and surface storage. AU1135: An area of moderately high importance for discharge and delivery processes. Overall water flow processes are moderately to highly degraded, especially discharge.  <u>Summary:</u> This area is of moderate to moderate-high importance for water flow processes overall, but is moderately to highly degraded, particularly for surface storage processes. Category 5 for dissolved oxygen and Category 4a for bacteria in Ten Mile Creek. Enhancement actions should focus on increasing surface storage in order to retain surface flows for longer, particularly in the upper portion (AU1136). Decreasing the rate and quantity of drainage of subsurface waters will help to improve discharge to surface streams.
Upper Tenmile AU1137 AU1136 + small portion of AU1135 Notes from February 2016 work session		Good fish habitat in Silver Springs Creek (comment from WID work session.)		

<sup>32</sup> Fish Habitat Technical Team (2004), WRIA 1 Watershed Management Project. Data provided by Sarah Watts, Whatcom County Planning & Development Services.

<sup>33</sup> Category 5 - Polluted waters that require a TMDL (total maximum daily load) or other WQI (water quality Improvement) project: the traditional list of impaired water bodies traditionally known as the 303(d) list. Starting with the 2008 Water Quality Assessment, Washington's 303(d) list of polluted waters were placed under Category 5 in the approved assessment. Placement in this category means that Ecology has data showing that the water quality standards have been violated for one or more pollutants, and there is no TMDL or pollution control plan. WA Department of Ecology, 2015. *Water Quality Assessment Categories*. <http://www.ecy.wa.gov/programs/wq/303d/WQAssessmentCats.html> (Accessed March 28, 2016)

<sup>34</sup> Category 4a - has a TMDL: water bodies that have an approved TMDL in place and are actively being implemented. WA Department of Ecology, 2015. *Water Quality Assessment Categories*. <http://www.ecy.wa.gov/programs/wq/303d/WQAssessmentCats.html> (Accessed March 28, 2016)

<sup>35</sup> Ecology, (2012), *Water Quality Assessment for Washington*. <http://www.ecy.wa.gov/programs/wq/303d/index.html>

5B. Watershed Enhancement Priorities: Lower Tenmile Creek

	Wildlife habitat	Salmonid habitat	Water quality	Summary & potential for enhancement
<p>Lower Tenmile AU1139 + small portion of AU1137</p> <p>Notes from reference maps and other documents</p>	<p>-Critical Habitat: Wetland</p> <p>-Rare Plant: Canadian St. John's-wort<sup>36</sup></p> <p>(See Watershed reference map: Priority Habitats &amp; Species)</p>	<p>Chinook, chum, coho, cutthroat, &amp; steelhead<sup>37</sup></p> <p>(See Watershed reference map: Fish presence &amp; fish barriers)</p>	<p>A section of Tenmile Creek in Lower Tenmile is in category 5 for DO, and category 4a for bacteria.<sup>38</sup></p>	<p><u>Results of PSWC water flow assessment:</u></p> <p>AU1139: An area of moderately high importance for discharge and surface storage processes. Overall water flow processes are highly degraded.</p> <p>AU1137: An area of moderate importance for all flow processes, especially surface storage. Overall water flow processes are highly degraded.</p> <p><u>Summary:</u></p> <p>This area is of moderate to moderate-high importance for water flow processes, but overall water flow processes are highly degraded. Category 5 for dissolved oxygen category 4a for bacteria. Enhancement actions should focus on increasing surface storage in order to retain surface flows for longer. Decreasing the rate and quantity of drainage of subsurface waters will help to improve discharge to surface streams.</p>
<p>Lower Tenmile AU1139 + small portion of AU1137</p> <p>Notes from February 2016 work session</p>		<p>Salmon in Deer Creek (upstream of confluence with Tenmile Creek). In summer, pools will have fish in them.</p>		

<sup>36</sup> WA Department of Natural Resources (2015), *Washington Natural Heritage Program*. <http://www1.dnr.wa.gov/nhp/refdesk/gis/index.html>

<sup>37</sup> Fish Habitat Technical Team (2004), WRIA 1 Watershed Management Project. Data provided by Sarah Watts, Whatcom County Planning & Development Services.

<sup>38</sup> Ecology (2012), *Water Quality Assessment for Washington*. <http://www.ecy.wa.gov/programs/wq/303d/index.html>

5C. Watershed Enhancement Priorities: Upper Fourmile Creek

	Wildlife habitat	Salmonid habitat	Water quality	Summary & potential for enhancement
<p>Upper Fourmile AU1133 + AU1114</p> <p>Notes from reference maps and other documents</p>	<p>AU1114: Critical Habitat: Trumpeter swan (1) and wetland (1)</p> <p>AU1133: Rare plant: bristly sedge.<sup>39</sup></p> <p>(See Watershed reference map: Priority Habitats &amp; Species)</p>	<p>AU1133: Chum, coho &amp; cutthroat<sup>40</sup></p> <p>AU1114: Coho &amp; cutthroat<sup>41</sup></p> <p>Documented presence of coho<sup>42</sup></p>	<p>No water quality impairments listed for Fourmile Creek, but there are listings for dissolved oxygen and bacteria in Tenmile Creek downstream of the confluence with Fourmile.<sup>43</sup></p>	<p><u>Results of PSWC water flow assessment:</u></p> <p>AU1133: An area of moderate high importance for recharge, surface storage and delivery processes. Overall water flow processes are highly degraded.</p> <p>AU1114: An area of moderate high importance for recharge and delivery processes. Overall water flow processes are moderately to highly degraded.</p> <p><u>Summary:</u></p> <p>This area is of moderately high importance for water flow processes, but water flow processes are moderately to highly degraded, particularly surface storage, delivery and discharge. No water quality impairments are listed for this area, but there are listings for dissolved oxygen and bacteria in Tenmile Creek downstream of the confluence with Fourmile Creek. Enhancement actions should focus on increasing surface storage in order to retain surface flows for longer. Preventing additional impervious cover and reducing existing impervious cover will help to enhance recharge. Enhancing forest/riparian cover will help to improve delivery of water to streams.</p>
<p>Upper Fourmile AU1133 + AU1114</p> <p>Notes from February 2016 work session</p>		<p>Fourmile Creek to Guide Meridian Road has less reed canary grass and good shade, since the riparian vegetation was planted.</p>	<p>Green Lake has water quality problems May-Oct (low DO, high temperature)</p>	

<sup>39</sup> WA Department of Natural Resources (2015), *Washington Natural Heritage Program*. <http://www1.dnr.wa.gov/nhp/refdesk/gis/index.html>

<sup>40</sup> Fish Habitat Technical Team (2004), WRIA 1 Watershed Management Project. Data provided by Sarah Watts, Whatcom County Planning & Development Services.

<sup>41</sup> Fish Habitat Technical Team (2004), WRIA 1 Watershed Management Project. Data provided by Sarah Watts, Whatcom County Planning & Development Services.

<sup>42</sup> WDFW *SalmonScape* [website] <http://apps.wdfw.wa.gov/salmonscape/>

<sup>43</sup> Ecology (2012), *Water Quality Assessment for Washington*. <http://www.ecy.wa.gov/programs/wq/303d/index.html>



5D. Watershed Enhancement Priorities: Lower Fourmile Creek				
	Wildlife habitat	Salmonid habitat	Water quality	Summary & potential for enhancement
<p>Lower Fourmile AU1137</p> <p>Notes from reference maps and other documents</p>	<p>Critical Habitat: Wetland (1)</p> <p>(See Watershed reference map: Priority Habitats &amp; Species)</p>	<p>Chinook, chum, coho, cutthroat,<sup>44</sup> &amp; steelhead<sup>45</sup></p> <p>Documented presence of coho and fall chum<sup>46</sup></p>	<p>No water quality impairments listed for Fourmile Creek, but there are listings for dissolved oxygen and bacteria in Tenmile Creek downstream of the confluence with Fourmile.<sup>47</sup></p>	<p><u>Results of PSWC water flow assessment:</u></p> <p>An area of moderate importance for all flow processes, especially surface storage. Delivery, surface storage and discharge processes are highly degraded.</p> <p><u>Summary:</u></p> <p>The area is of moderate importance overall for water flow processes, but water flow processes are highly degraded. No water quality impairments are listed for this area, but there are listings for dissolved oxygen and bacteria in Tenmile Creek downstream of the confluence with Fourmile Creek. Enhancement actions should focus on increasing surface storage in order to retain surface flows for longer. Decreasing the rate and quantity of subsurface water drainage will help to improve discharge to surface streams.</p>
<p>Lower Fourmile AU1137</p> <p>Notes from February 2016 work session</p>		<p>WDFW did a survey in 2009 for steelhead.</p> <p>Fourmile Creek to Guide Meridian Road has less reed canary grass and good shade, since the riparian vegetation was planted.</p> <p>Used to be 30 years ago you could see fish in the Creek in this area, but they are no longer evident (comment from WID work session).</p> <p>Fish (species not known) have been observed in the lowermost reach of Fourmile Creek between the Fourmile/Tenmile confluence and Guide Meridian Road (comment from WID resident, who was not present at the work session).</p>	<p>Participants mentioned fecal coliforms, dissolved oxygen as concerns, particularly for Tenmile downstream of Fourmile confluence.</p> <p>Low dissolved oxygen in Fourmile Creek is possibly also associated with peat soils in the area.</p>	

<sup>44</sup> WDFW *SalmonScape* [website] <http://apps.wdfw.wa.gov/salmonscape/>

<sup>45</sup> Fish Habitat Technical Team (2004), WRIA 1 Watershed Management Project. Data provided by Sarah Watts, Whatcom County Planning & Development Services.

<sup>46</sup> WDFW *SalmonScape* [website] <http://apps.wdfw.wa.gov/salmonscape/>

<sup>47</sup> Ecology (2012), *Water Quality Assessment for Washington*. <http://www.ecy.wa.gov/programs/wq/303d/index.html>

5E. Watershed Enhancement Priorities: Deer Creek				
	Wildlife habitat	Salmonid habitat	Water quality	Summary & potential for enhancement
Deer Creek AU1140 AU1138  Notes from reference maps and other documents	Critical Habitat: Shorebird concentration, wetland  (See Watershed reference map: Priority Habitats & Species)	Coho, cutthroat, & steelhead; chum also in AU1140. <sup>48</sup>  Documented spawning: coho and winter steelhead. <sup>49</sup>	Sections of Deer Creek are in category 5 for DO, pH, Ammonia-N and category 4a for bacteria. <sup>50</sup>	<u>Results of PSWC water flow assessment:</u> An area of high importance for surface storage and moderately high importance for discharge. Delivery, surface storage and discharge processes are highly degraded.  <u>Summary:</u> Overall water flow processes are moderately to highly degraded. The lower portion of Deer Creek is of moderate-high importance for overall water flow processes. Water quality listings for dissolved oxygen, pH, ammonia-N and bacteria. Enhancement actions should focus on increasing surface storage in order to retain surface flows for longer. Decreasing the rate and quantity of drainage of subsurface waters will help to improve discharge to surface streams.
Deer Creek AU1140 AU1138  Notes from February 2016 work session		NSEA surveys in Deer Creek and Silver Springs, tributary to Tenmile. Found coho presence in Deer and Silver Springs in 2013 and 2012. <sup>51</sup> WDFW did survey in 2009 for steelhead.  Salmon in Deer Creek. In summer, pools will have fish in them.  Coho have been sighted in Deer Creek (reported by others not present at the work session). Fish presence was not observed by those present. The individuals present in the work session group do not claim ability to distinguish between species.		

<sup>48</sup> Fish Habitat Technical Team (2004), WRIA 1 Watershed Management Project. Data provided by Sarah Watts, Whatcom County Planning & Development Services.

<sup>49</sup> WDFW *SalmonScape* [website] <http://apps.wdfw.wa.gov/salmonscape/>

<sup>50</sup> Ecology (2012), *Water Quality Assessment for Washington*. <http://www.ecy.wa.gov/programs/wq/303d/index.html>

<sup>51</sup> NSEA (2012 & 2013), *Salmon Spawning Grounds Surveys 2012 and Salmon Spawning Grounds Surveys 2013* <<http://www.n-sea.org/archived-publications>>

5F. Watershed Enhancement Priorities: Wiser Lake/Cougar Creek North

	Wildlife habitat	Salmonid habitat	Water quality	Summary & potential for enhancement
<p>Wiser/Cougar North AU1110</p> <p>Notes from reference maps and other documents</p>	<p>Critical Habitat: Shorebird concentrations (1) and wetland (1)</p> <p>(See Watershed reference map: Priority Habitats &amp; Species)</p>	<p>Char, Chinook, chum, coho, cutthroat, pink, sockeye, steelhead.<sup>52</sup></p>	<p>A section of Wiser Creek in Wiser/Cougar North AU1110 is in category 5 for DO, and category 4a for bacteria and a section of Unnamed Creek (Tributary to Nooksack River) in AU1110 is in category 5 for DO.<sup>53</sup></p>	<p><u>Results of PSWC water flow assessment:</u> An area of moderately high importance for surface storage and moderate importance for recharge. Delivery, surface storage and discharge processes are highly degraded.</p> <p><u>Summary:</u> Overall water flow processes are highly degraded, but this area is of only moderate importance overall for water flow processes. There are water quality listings for dissolved oxygen and bacteria in this area. Enhancement actions should focus on increasing surface storage in order to retain surface flows for longer.</p>
<p>Wiser/Cougar North AU1110</p> <p>Notes from February 2016 work session</p>		<p>Fish presence noted in Elder Ditch (comment from WID work session).</p>		

<sup>52</sup> Fish Habitat Technical Team (2004), WRIA 1 Watershed Management Project. Data provided by Sarah Watts, Whatcom County Planning & Development Services.

<sup>53</sup> Ecology (2012), *Water Quality Assessment for Washington*. <http://www.ecy.wa.gov/programs/wq/303d/index.html>

5G. Watershed Enhancement Priorities: Wiser Lake/Cougar Creek South				
	Wildlife habitat	Salmonid habitat	Water quality	Summary & potential for enhancement
Wiser/Cougar South AU1112  Notes from reference maps and other documents	Critical Habitat: Wetland (1)  Rare Plant: Canadian St. John's-wort <sup>54</sup>  (See Watershed reference map: Priority Habitats & Species)	Char, Chinook, chum, coho, cutthroat, pink, sockeye & steelhead. <sup>55</sup>	No water quality impairments listed in Wiser/Cougar South AU1112. <sup>56</sup>	<u>Results of PSWC water flow assessment:</u> An area of moderate-high importance for surface storage and discharge and moderate importance for recharge. Delivery, surface storage and discharge processes are highly degraded.  <u>Summary:</u> Overall water flow processes are highly degraded, but this area is of only moderate importance overall for water flow processes. Enhancement actions should focus on increasing surface storage in order to retain surface flows for longer. Decreasing the rate and quantity of subsurface water drainage will help to improve discharge to surface streams. Enhancing forest/riparian cover will help to improve delivery of water to streams.
Wiser/Cougar South AU1112  Notes from February 2016 work session	St. John's Wort present in Wiser/Cougar South (reported by others not present. No observation of it by those present). Discussion as to whether this plant could be poisonous to cows.	Fish passage barrier between Chasteen and Guide Meridian Rds (comment from WID work session)		Potential action: Remove fish passage barrier between Chasteen and Guide Meridian Rds.

<sup>54</sup> WA Department of Natural Resources (2015), *Washington Natural Heritage Program*. <http://www1.dnr.wa.gov/nhp/refdesk/gis/index.html>

<sup>55</sup> Fish Habitat Technical Team (2004), WRIA 1 Watershed Management Project. Data provided by Sarah Watts, Whatcom County Planning & Development Services.

<sup>56</sup> Ecology, (2012), *Water Quality Assessment for Washington*. <http://www.ecy.wa.gov/programs/wq/303d/index.html>

### 5.3 Watershed priorities: Summary maps

The water flow assessment maps contained in this section were prepared using data from the Puget Sound Watershed Characterization Project, provided by the WA Department of Ecology. See [http://www.ecy.wa.gov/puget\\_sound/characterization/index.html](http://www.ecy.wa.gov/puget_sound/characterization/index.html)

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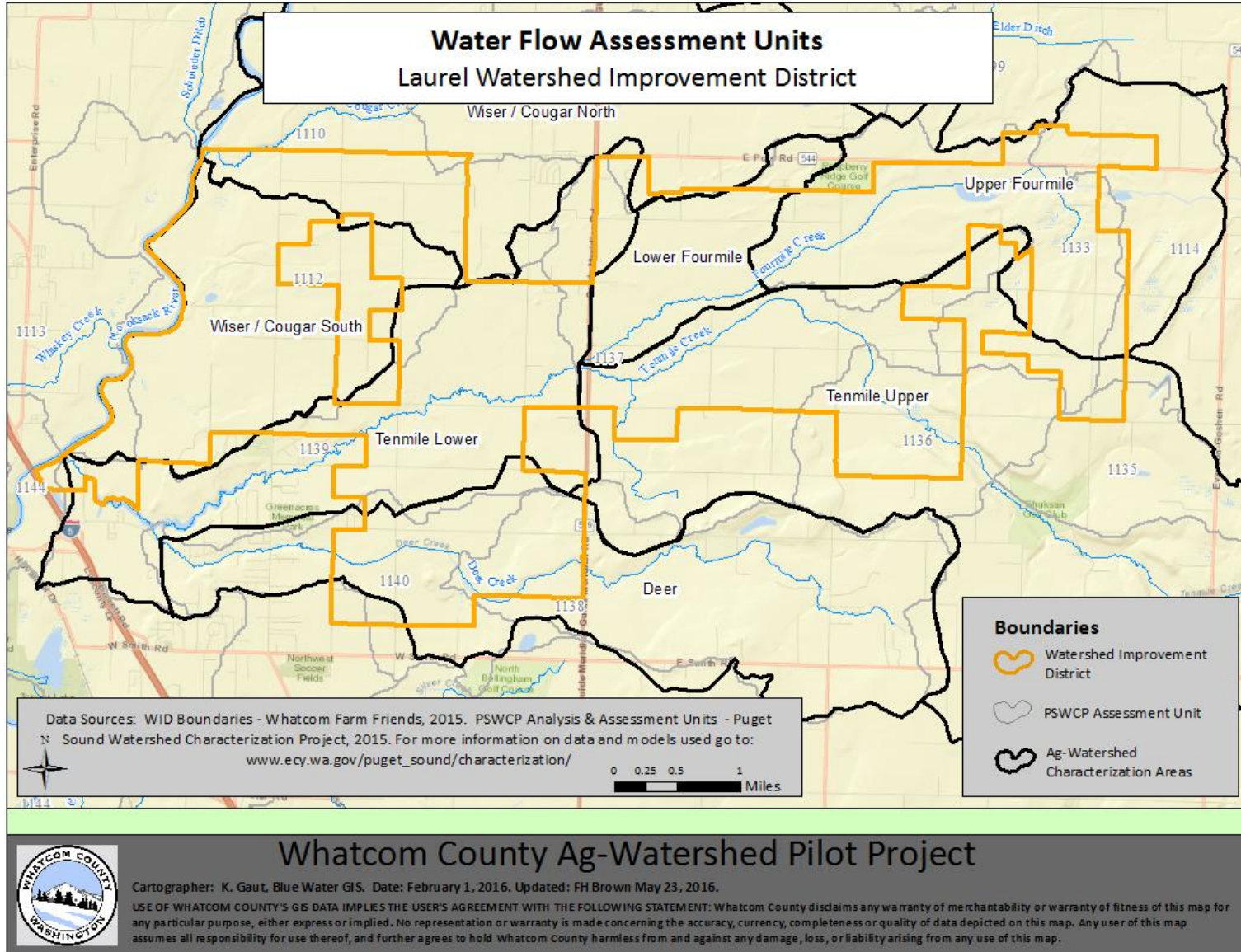


Figure 12. Laurel WID: Water flow assessment units in relation to the WID area



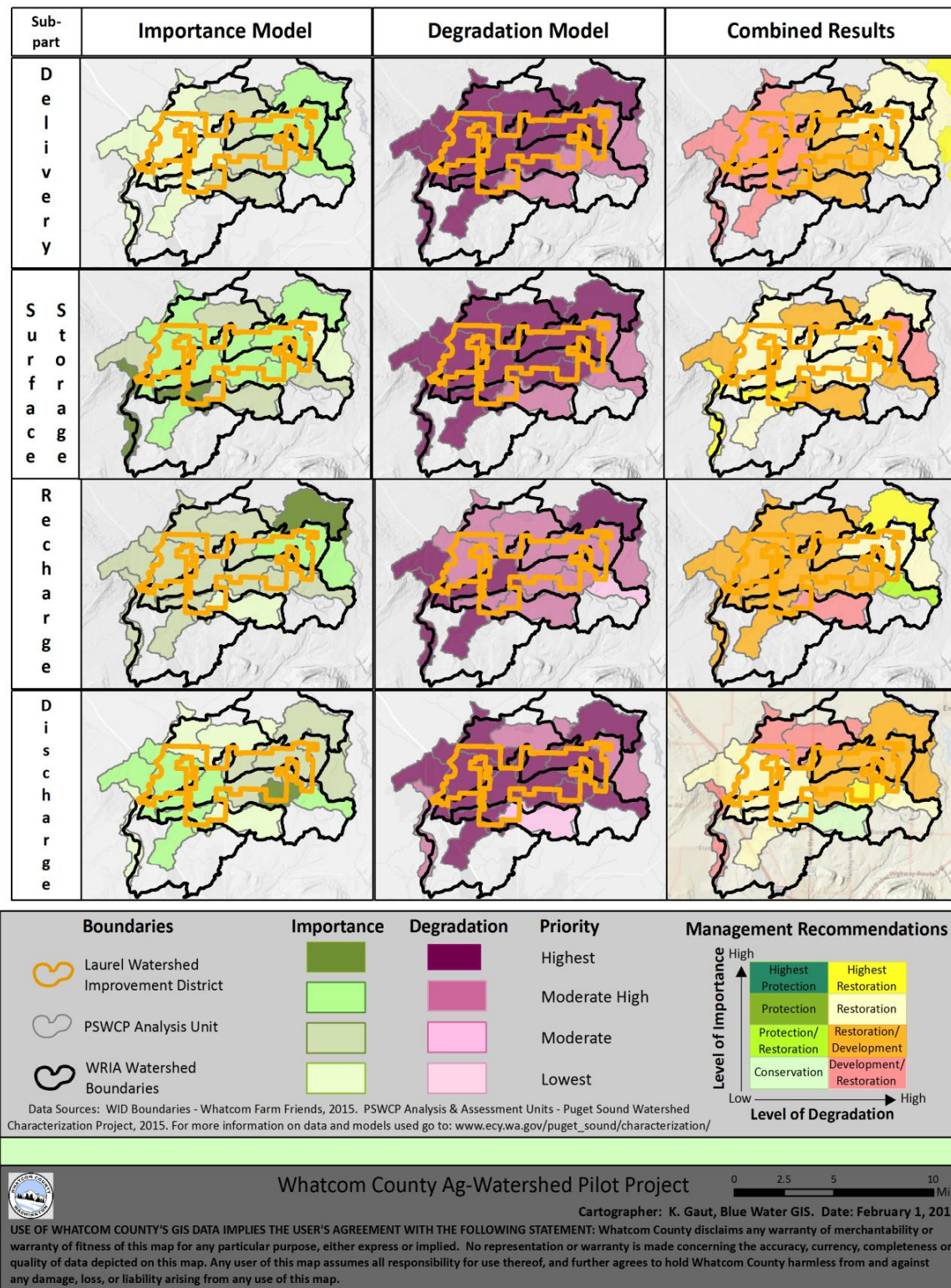


Figure 13. Laurel WID: Water flow process assessment results



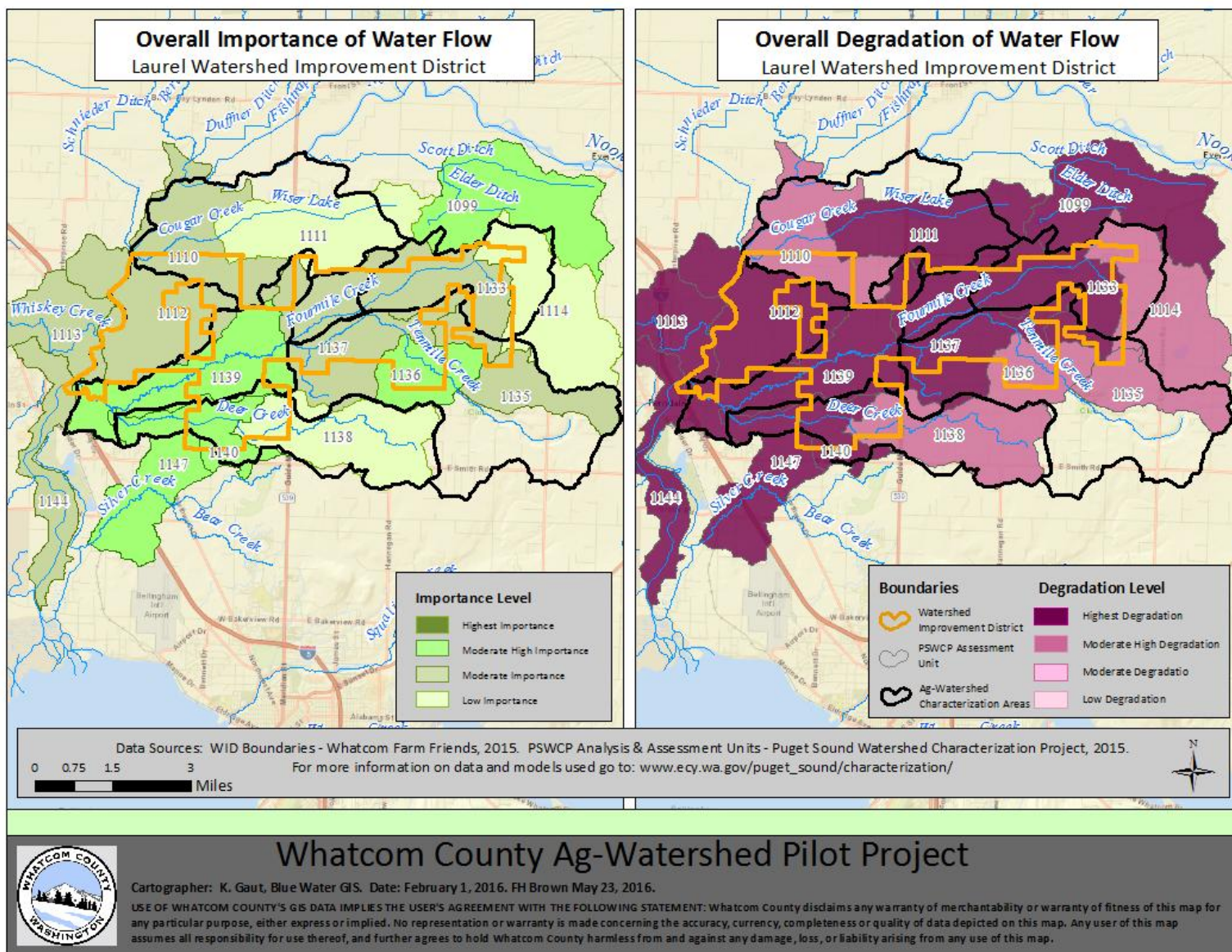


Figure 14. Laurel WID: Overall importance and degradation of water flow processes

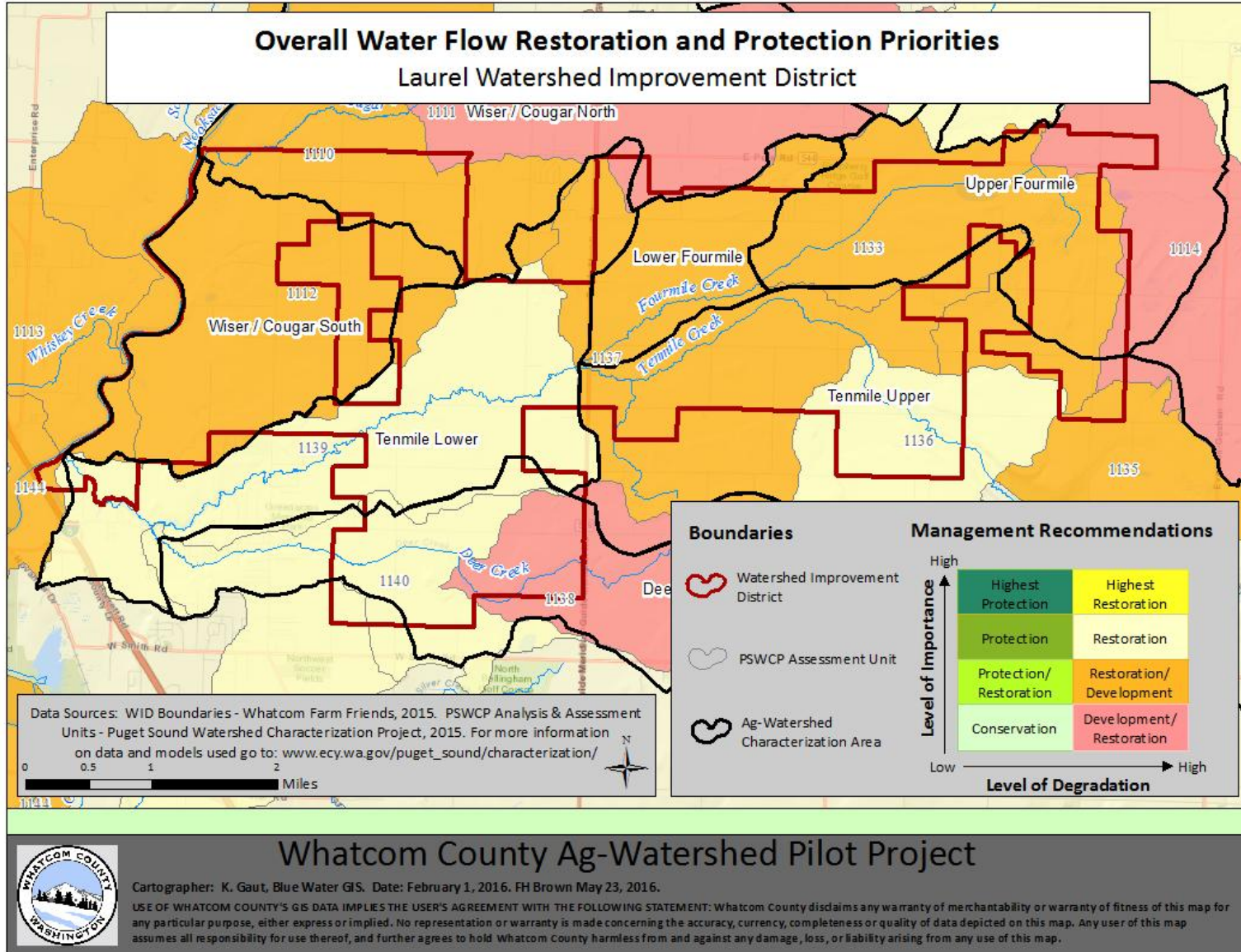


Figure 15. Laurel WID: Overall water flow restoration and protection priorities

#### 5.4 Watershed priorities: Specific actions map

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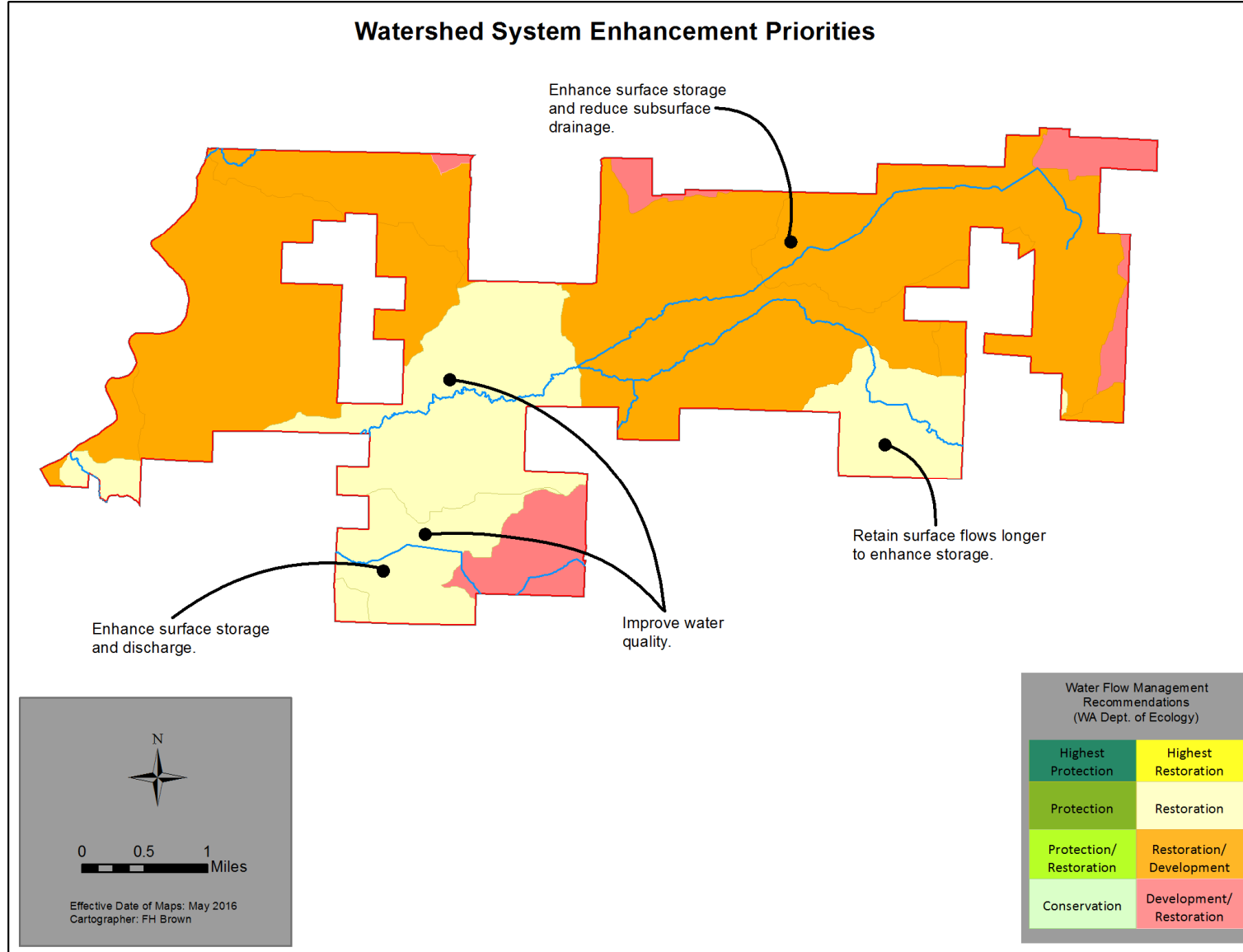


Figure 16. Laurel WID: Summary watershed enhancement priorities and specific actions

## 6 Reference maps for the Laurel Watershed Improvement District

### 6.1 Agriculture reference maps

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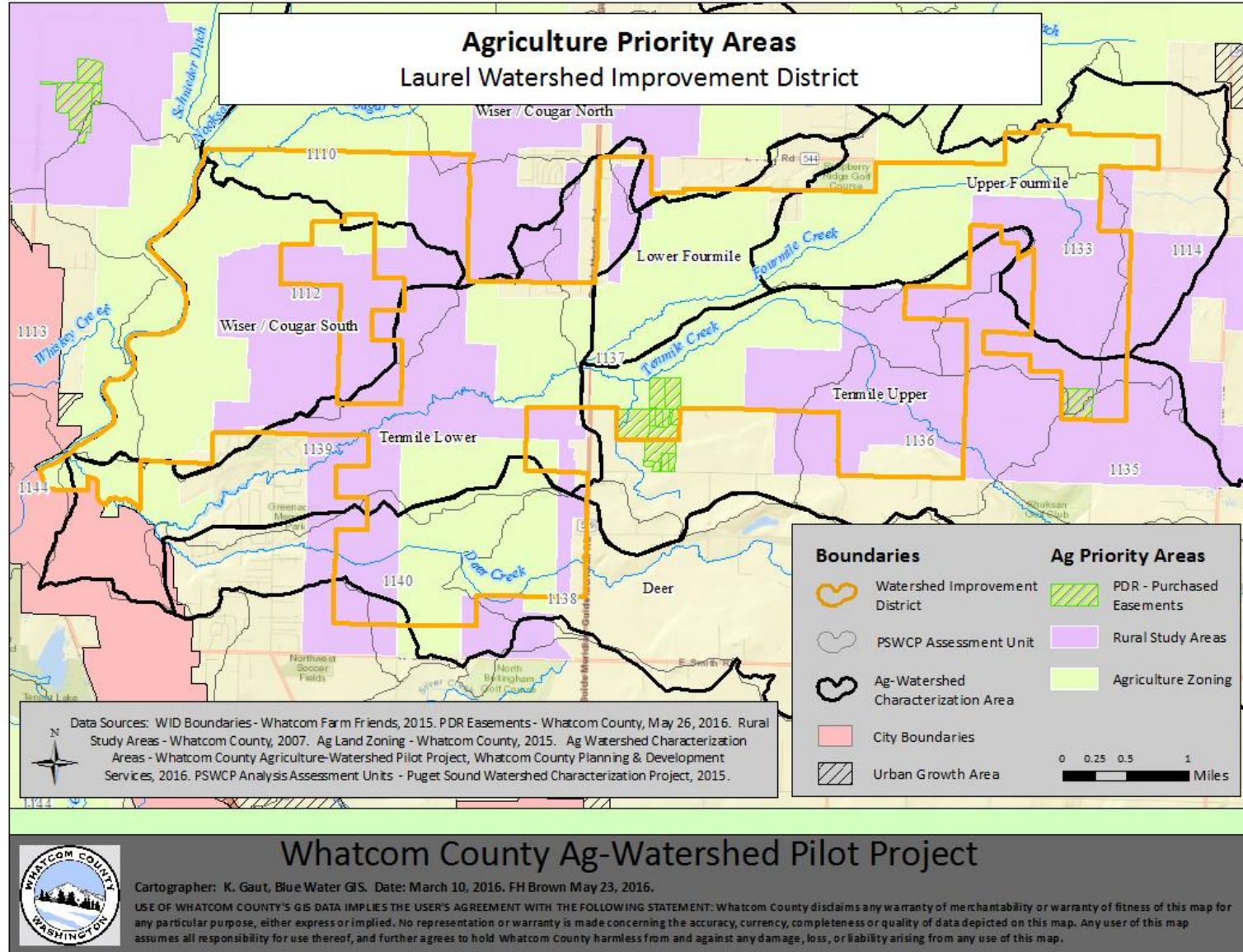


Figure 17. Laurel WID Reference map: Agriculture priority areas



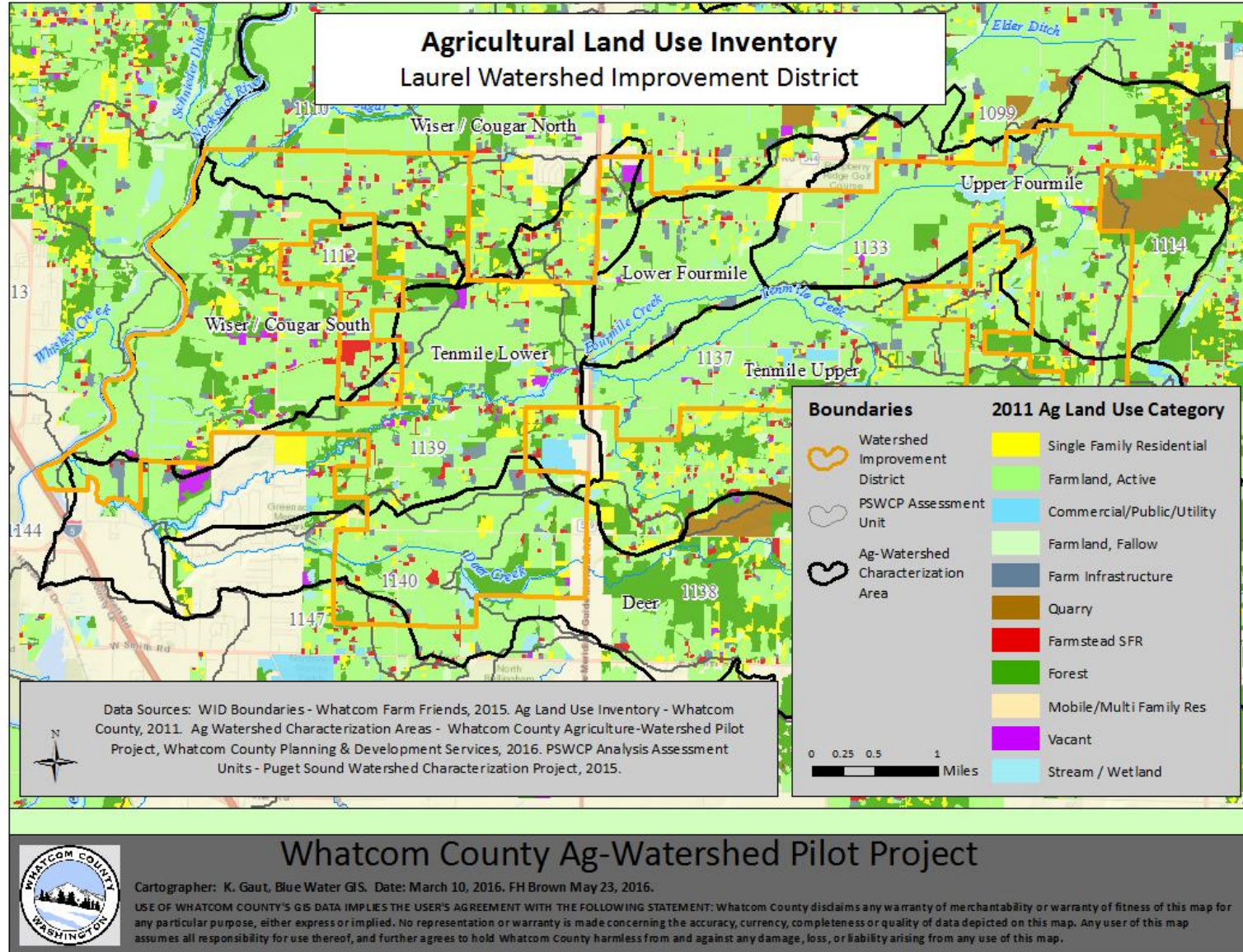


Figure 18. Laurel WID Reference map: Agricultural land use inventory



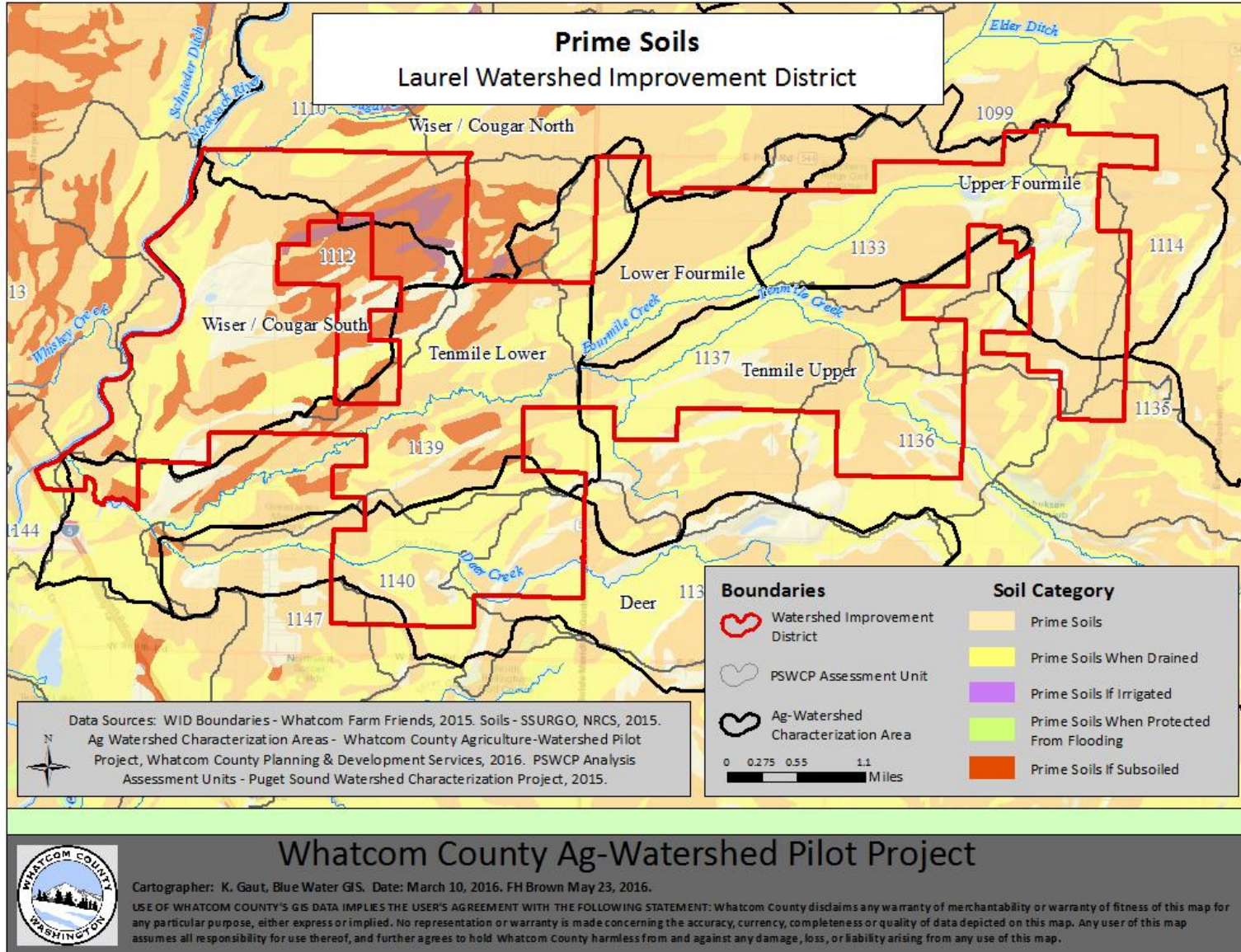


Figure 19. Laurel WID Reference map: Prime soils



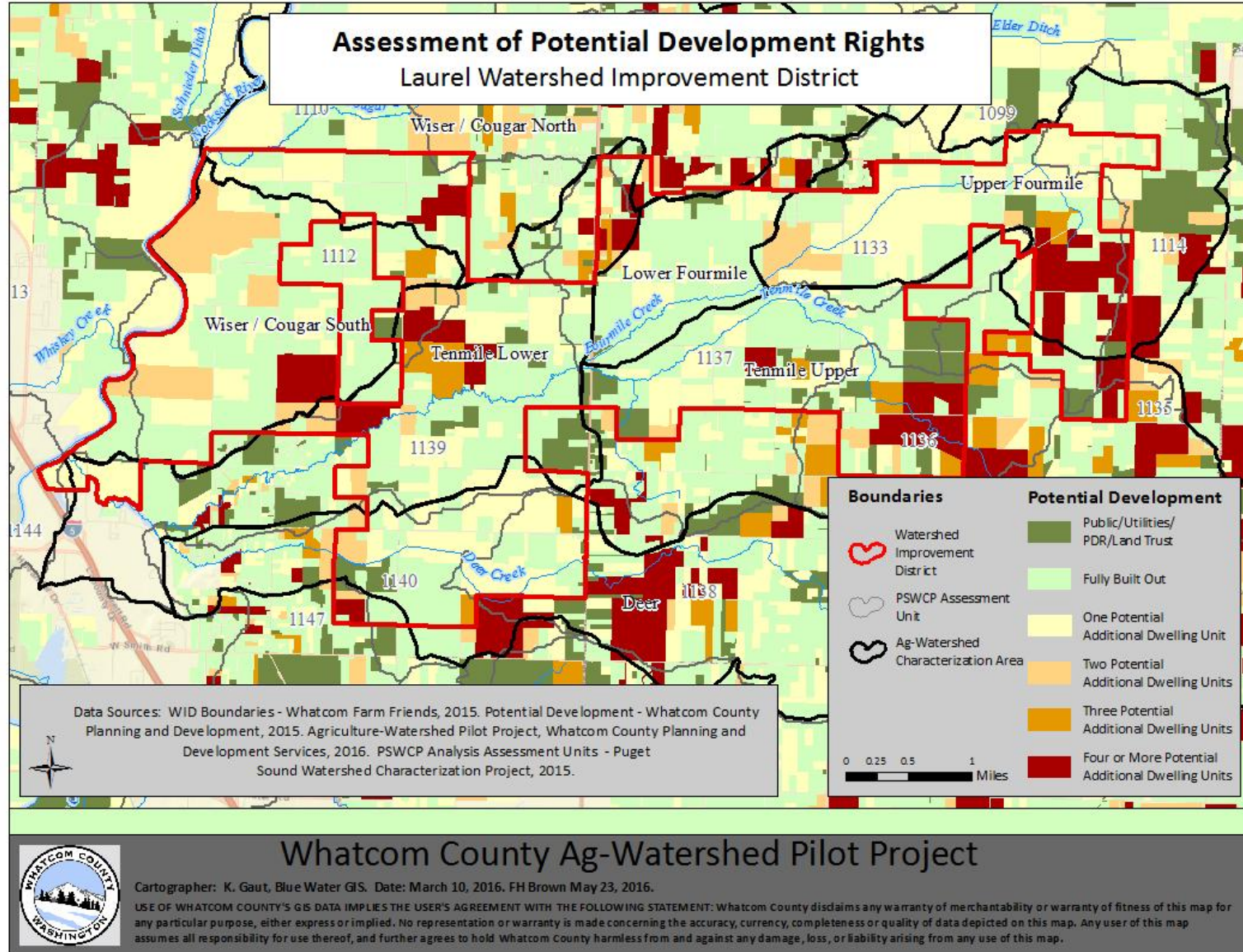


Figure 20. Laurel WID Reference map: Assessment of potential development rights



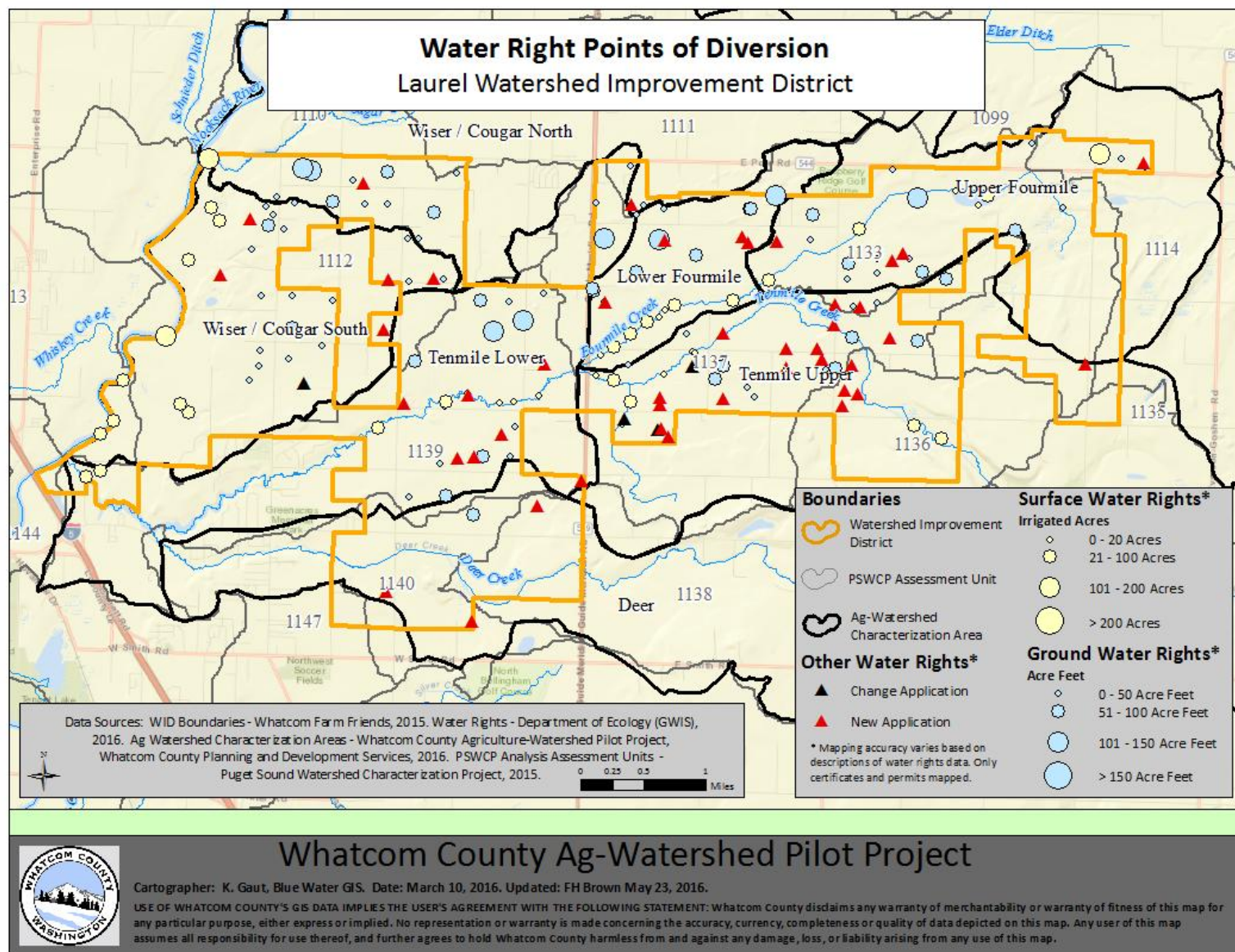


Figure 21. Laurel WID Reference map: Water right points of diversion



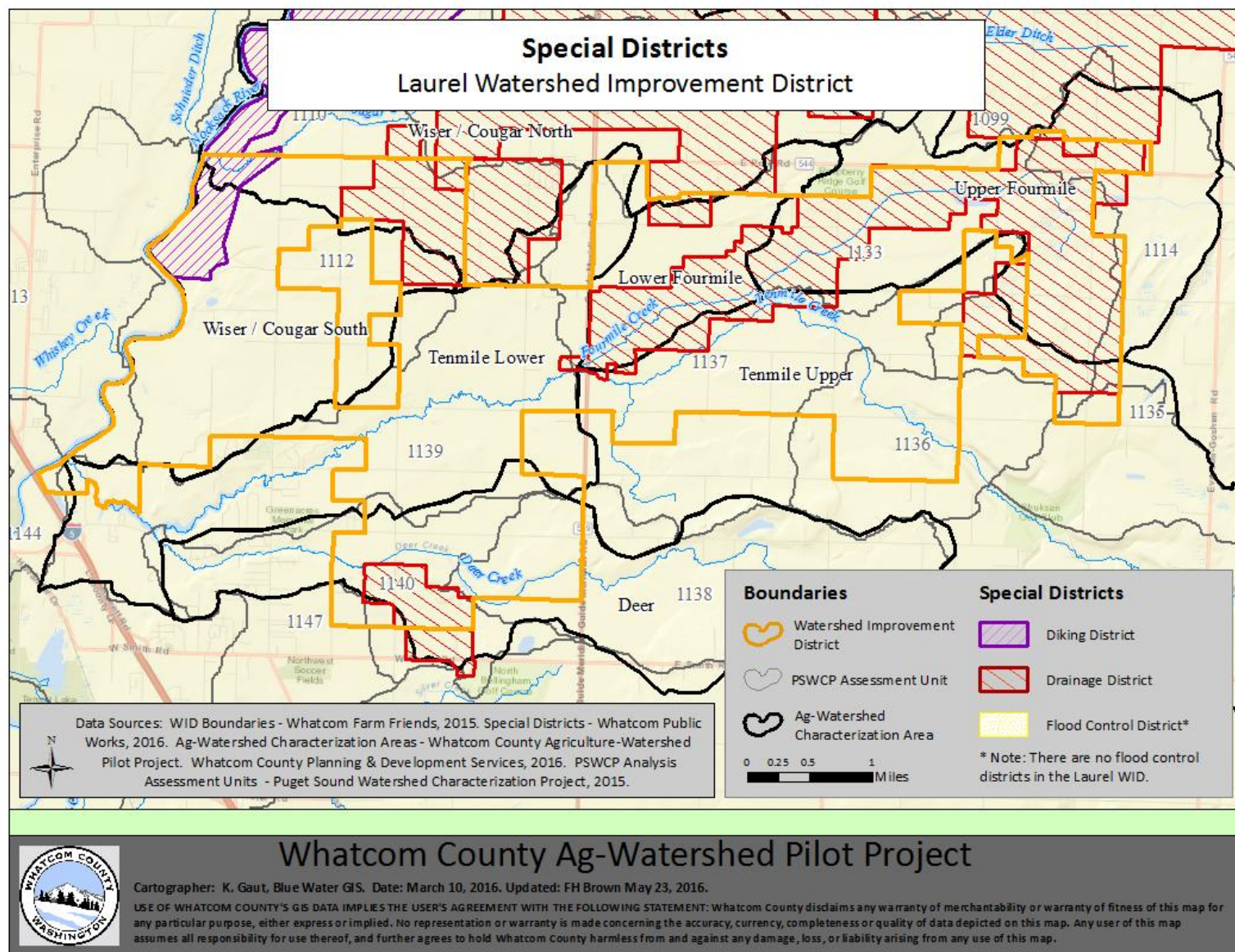


Figure 22. Laurel WID Reference map: Special districts

## 6.2 Watershed reference maps

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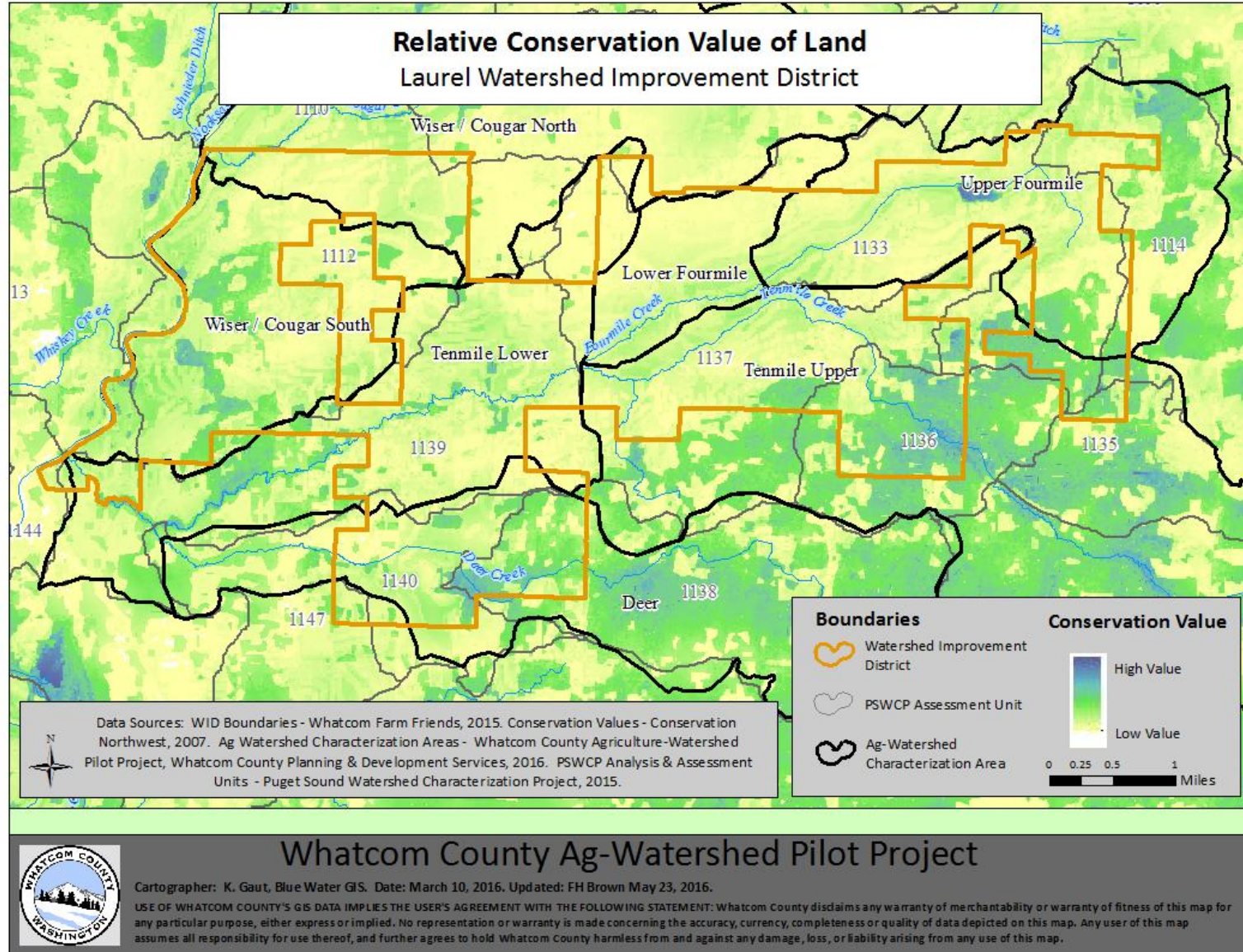


Figure 23. Laurel WID Reference map: Relative conservation value of land



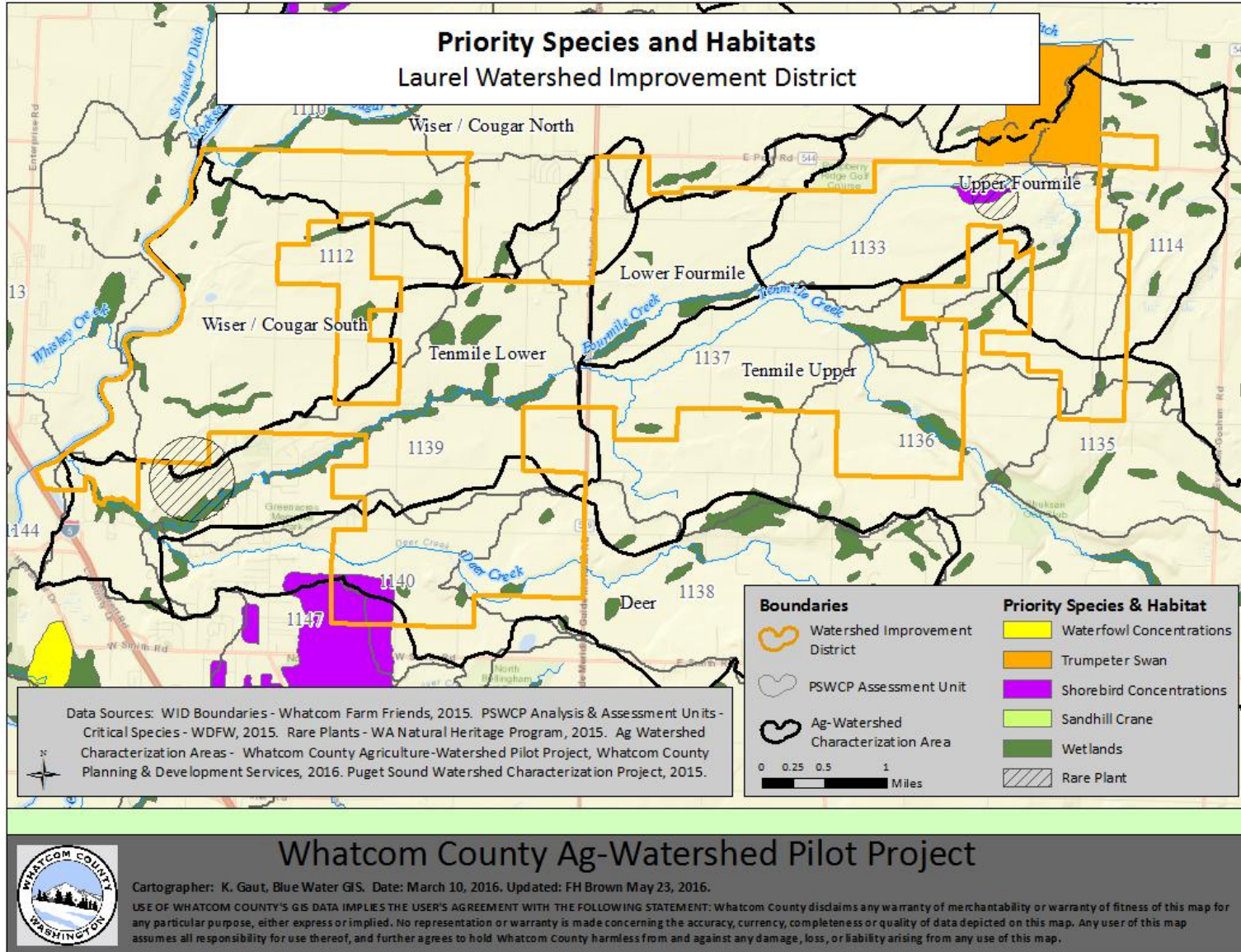


Figure 24. Laurel WID Reference map: Priority species and habitat

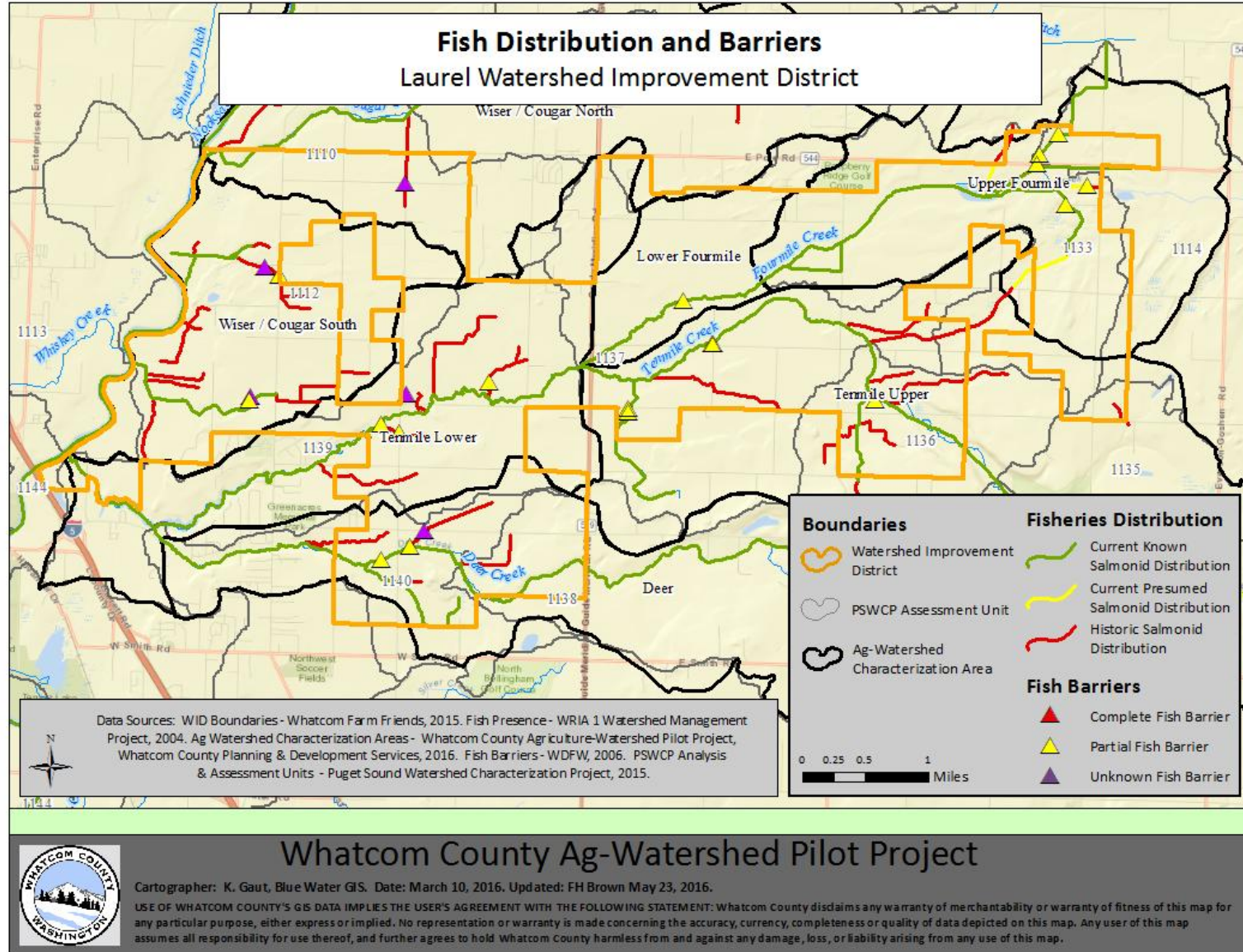


Figure 25. Laurel WID Reference map: Fish distribution and fish barriers



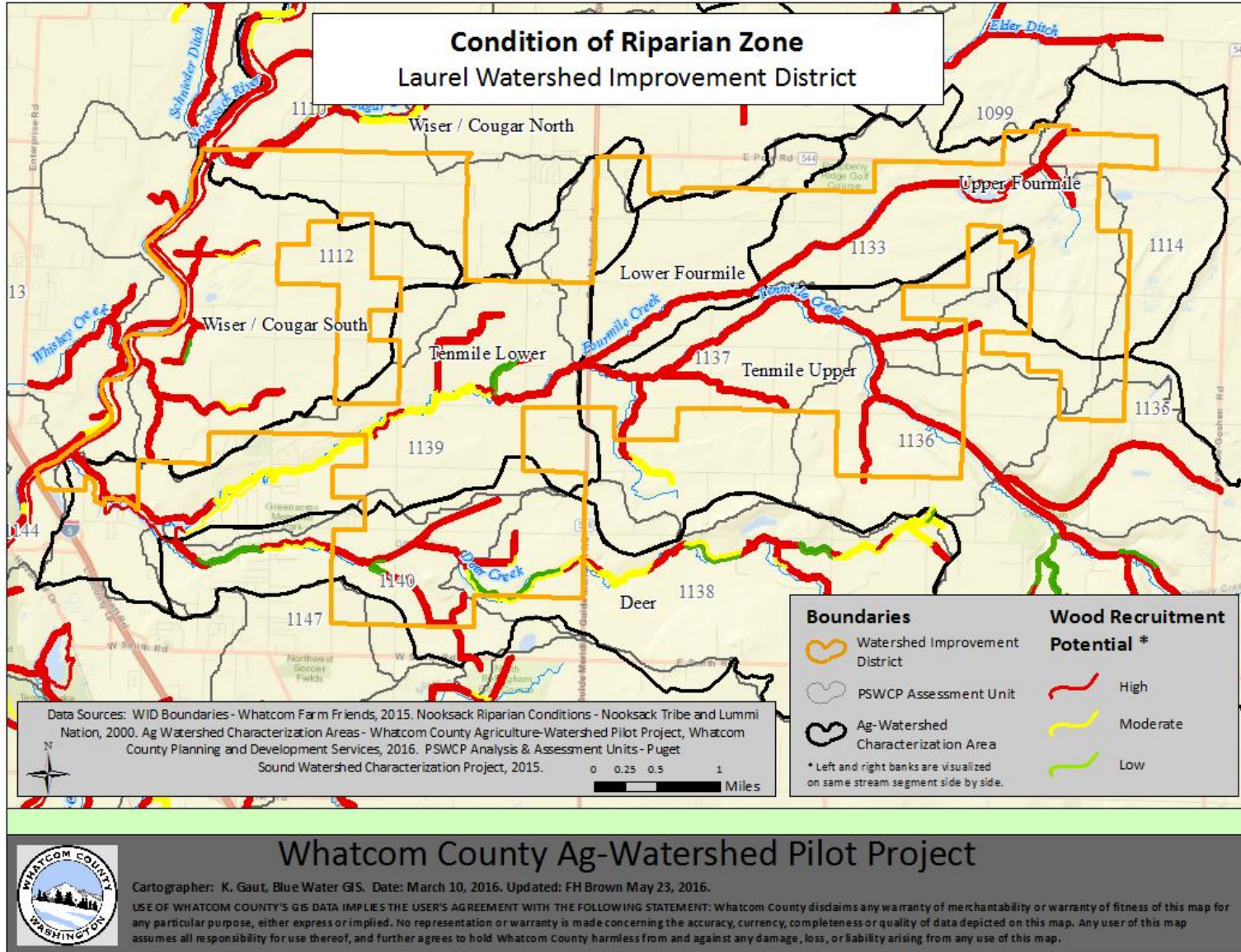


Figure 26. Laurel WID Reference map: Condition of riparian zone

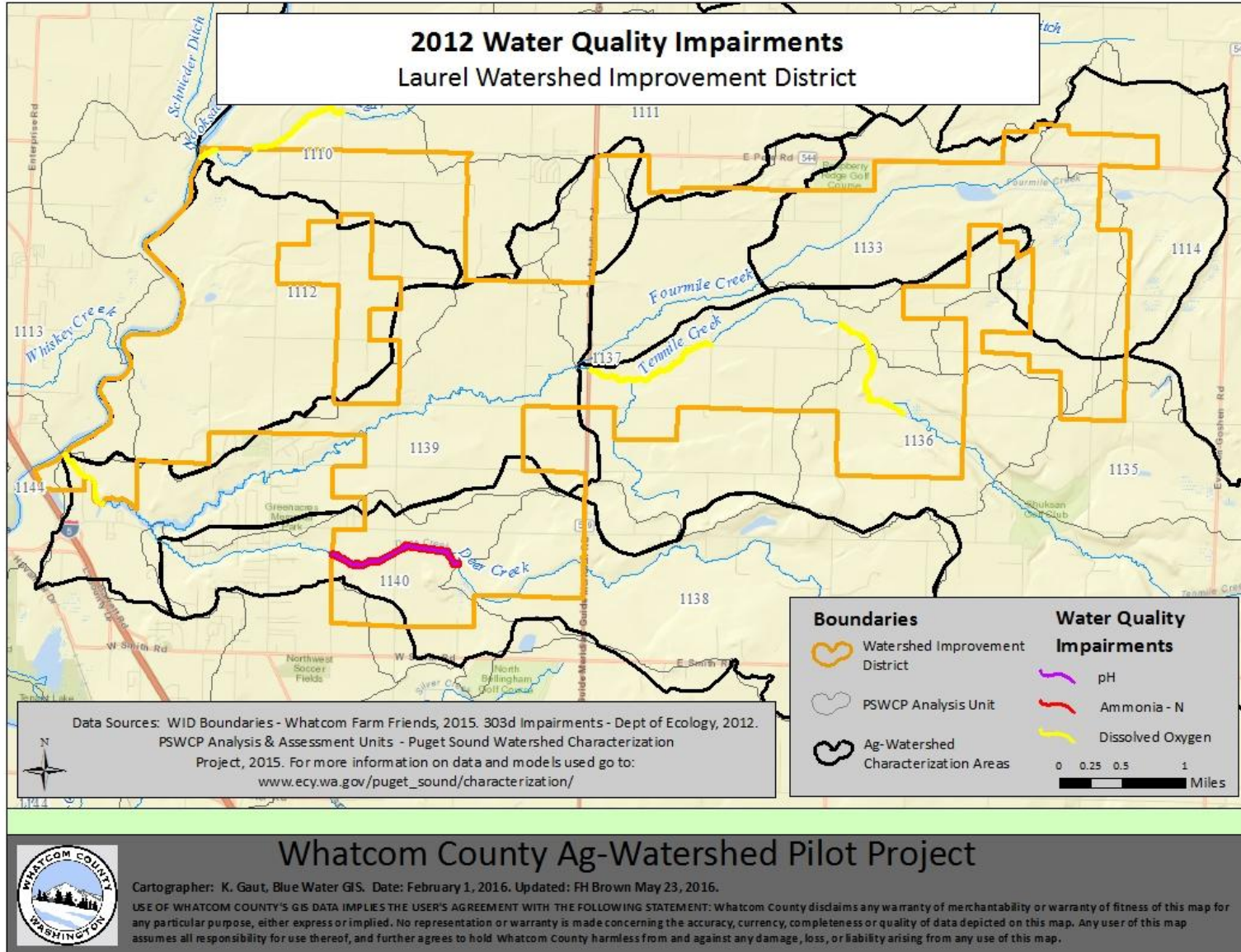
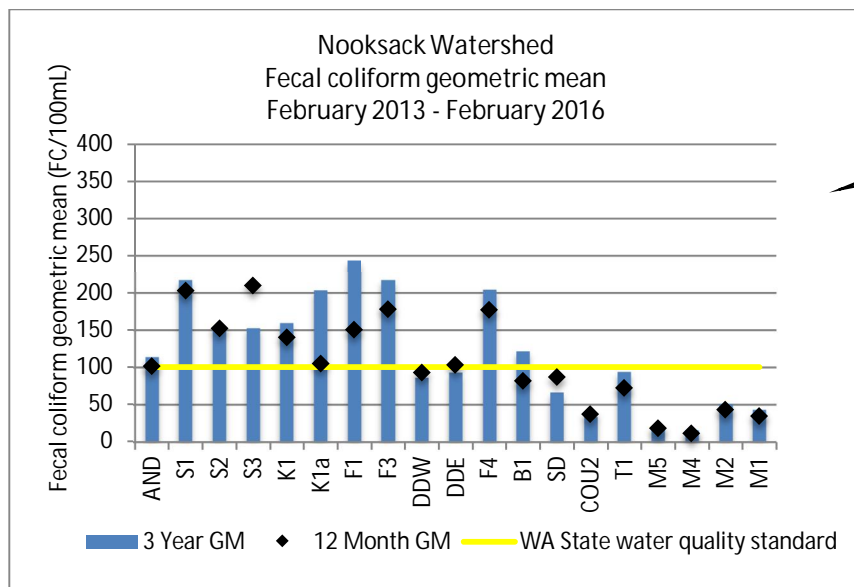
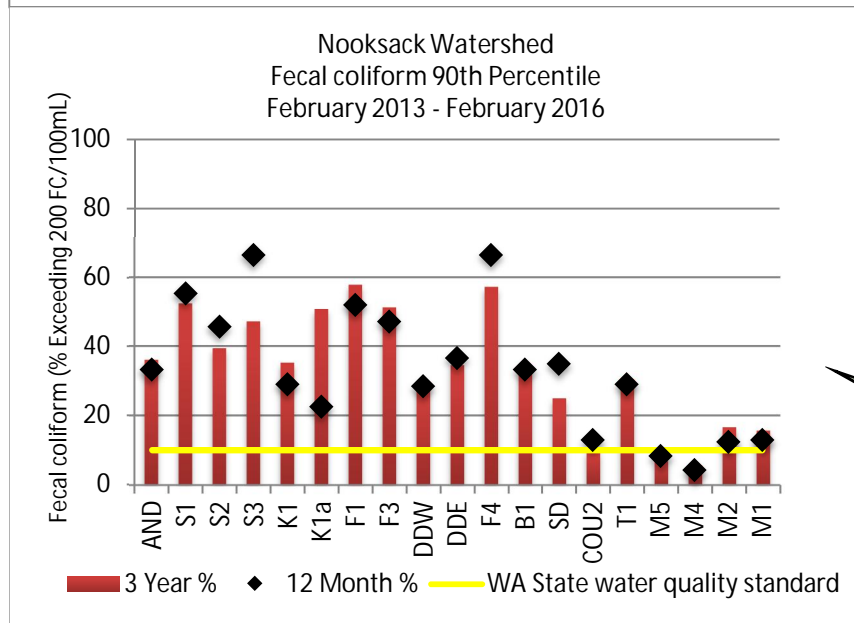


Figure 27. Laurel WID Reference map: Water quality impairments (2012)





This graph illustrates fecal coliform geometric means at routine stations. A black dot located above the blue bar indicates that bacteria levels have been increasing in the past twelve months at that site. Data from Whatcom County Public Works.



This graph illustrates the percent of samples exceeding 200 FC/100mL at routine monitoring stations. A black dot above the red bar indicates that bacteria levels have been increasing in the past twelve months at that site. Data from Whatcom County Public Works.

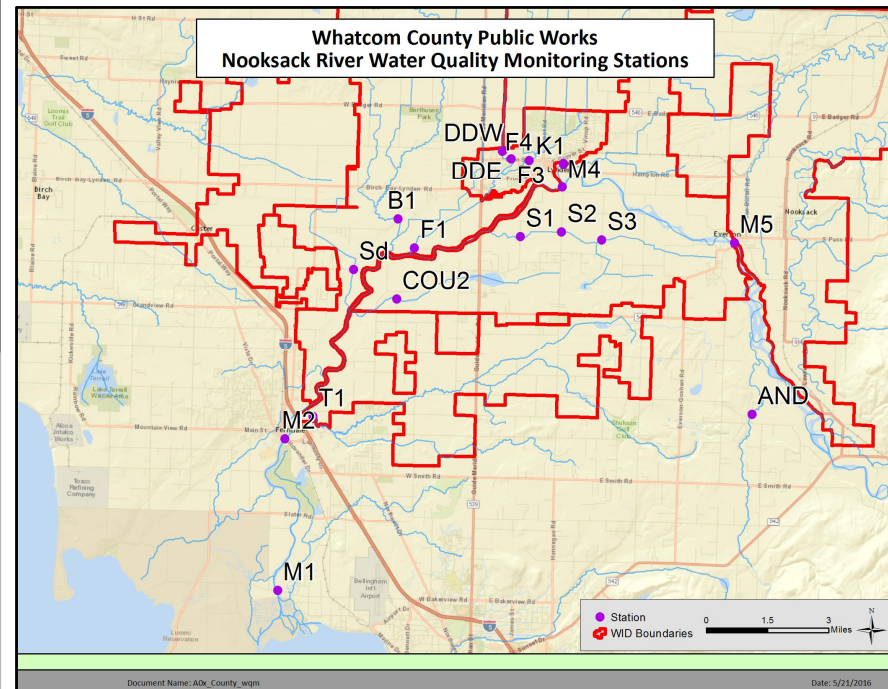


Figure 28. Laurel WID Reference map: Routine water quality monitoring results

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## GIS data sources

Agricultural Conservation Easements	Whatcom County Planning & Development Services. <a href="http://wa-whatcomcounty.civicplus.com/DocumentCenter/View/10821">http://wa-whatcomcounty.civicplus.com/DocumentCenter/View/10821</a> Most recent update received from Chris Elder 2 May 2016.
Agricultural land use inventory	Whatcom County Planning & Development Services, 2011. Received from Sarah Watts December 2015.
Agricultural Priority Actions	Generated at WID work sessions in January-February 2016.
Ag-Watershed Characterization Areas	Generated for the Whatcom County Agriculture-Watershed Pilot Project, January 2016.
Cropland	Cropland Data Layers, United States Department of Agriculture, National Agricultural Statistics Service, 2015. <a href="http://nassgeodata.gmu.edu/CropScape/">http://nassgeodata.gmu.edu/CropScape/</a>
Fish Barriers	Washington Department of Fish & Wildlife, 2006 <a href="http://wdfw.wa.gov/conservation/habitat/fish_passage/data_maps.html">http://wdfw.wa.gov/conservation/habitat/fish_passage/data_maps.html</a>
Fish Presence	Fish Habitat Technical Team, WRIA 1 Watershed Management Project, 2004. Received from Sarah Watts, Whatcom County Planning & Development Services, December 2015.
Floodzones, floodways & Levees	FEMA, 2007. Latest received from Chris Elder, Whatcom County Planning & Development Services, 22 February 2016.
Hydrography	Washington State Department of Natural Resources. <a href="https://fortress.wa.gov/dnr/adminsa/DataWeb/dmmatrix.html">https://fortress.wa.gov/dnr/adminsa/DataWeb/dmmatrix.html</a>
Riparian Conditions	Nooksack Indian Tribe, 2001. Nooksack River Watershed Riparian Function Assessment. Data received from Treva Coe, January 2016.
Potential Development Rights	Whatcom County Planning and Development Services, 2015. Received from Sarah Watts, December 2015.
Prime soils	Soil Survey Geographic Database (SSURGO), Natural Resources Conservation Service, United States Department of Agriculture. Available online at <a href="http://websoilsurvey.nrcs.usda.gov/">http://websoilsurvey.nrcs.usda.gov/</a> (Last accessed December 2015)
Priority Species and Habitats	Washington Department of Fish & Wildlife, 2015. <a href="http://wdfw.wa.gov/mapping/phs/">http://wdfw.wa.gov/mapping/phs/</a>
Rare Plants	Washington Natural Heritage Program, 2015. Washington Department of Natural Resources, 2015. <a href="http://www1.dnr.wa.gov/nhp/refdesk/gis/index.html">http://www1.dnr.wa.gov/nhp/refdesk/gis/index.html</a>

Relative Conservation Values	Data received from Sarah Watts, Whatcom County Planning & Development Services, January 2016. Source: Nelson, R (2007) <i>Mapping Biodiversity in Whatcom County: Data and Methods</i> . Prepared for the Whatcom Legacy Project, 2007. <a href="http://wa-whatcomcounty.civicplus.com/DocumentCenter/View/15493">http://wa-whatcomcounty.civicplus.com/DocumentCenter/View/15493</a> (Last accessed 25 September 2016)
Rural Study Areas	Whatcom County Planning & Development Services. Received from Sarah Watts, December 2015.
Special Districts boundaries	Whatcom County Public Works, 2016. Received from Travis Bouma 7 March 2016.
Water Quality Impairments	Washington Department of Ecology, 2012. <i>Water Quality Assessment for Washington</i> . <a href="http://www.ecy.wa.gov/programs/Wq/303d/index.html">http://www.ecy.wa.gov/programs/Wq/303d/index.html</a>
Water Quality Monitoring Stations	Whatcom County Department of Public Works. <a href="http://www.co.whatcom.wa.us/2170/Water-Quality-Monitoring-Results#stations">http://www.co.whatcom.wa.us/2170/Water-Quality-Monitoring-Results#stations</a>
Water Resource Inventory Area 1 (WRIA1) boundary	Whatcom County Planning & Development Services, 2015.
Water Rights	Washington Department of Ecology, Geographic Water-right Information System (GWIS) 2016. <a href="http://www.ecy.wa.gov/2016Water.html">http://www.ecy.wa.gov/2016Water.html</a>
Watershed characterization	Landscape groups, water flow assessment results from the Puget Sound Watershed Characterization Project <a href="http://www.ecy.wa.gov/puget_sound/characterization/index.html">http://www.ecy.wa.gov/puget_sound/characterization/index.html</a> (Last accessed April 2016)
Watershed Improvement District boundaries	Received from Ag Water Board, 2015. <a href="http://www.agwaterboard.com">www.agwaterboard.com</a>
Whatcom County Tax Parcels	Dated October 6, 2015. Received from Sarah Watts, Whatcom County Planning & Development Services.
Zoning	Whatcom County Title 20 Zoning, Whatcom County Planning & Development Services. <a href="http://www.whatcomcounty.us/716/Data/">http://www.whatcomcounty.us/716/Data/</a>

## 8 Glossary of key terms used in this report

Agricultural enhancement [protection]	Agricultural enhancement entails maintaining the land base, soil, water, air, plants, animals, production capacity and natural infrastructure necessary to keep farmers farming over the long term as land uses and economic situations change over time. Thus “agricultural enhancement” and “agricultural protection” include but are not limited to agricultural land protection alone.
Agriculture-Watershed Characterization Area (AWCA)	Each WID area has been divided into several smaller “Agriculture-Watershed Characterization Areas”, based on a combination of the WRIA 1 water management areas and the PSWC Project Assessment Units. The AWCAs reflect hydrological and agricultural characteristics in the landscape; are recognizable for WID members and are of a size that is practical for the WIDs to utilize in their planning processes. Importantly, the AWCAs represent common areas within which to characterize and map both agricultural and watershed enhancement priorities.
Assessment Unit (AU)	The assessment units (AUs) used in the Puget Sound Watershed Characterization (PSWC) represent the minimum spatial scale over which the characterization results are meaningful. The AUs were derived from reach-scale catchments delineated by the Salmon and Steelhead Habitat Inventory and Assessment Program (SSHIAP; NWIFC 2009). The SSHIAP catchments were aggregated into larger units with a mean size 4.7 square miles. See: Stanley et al. (2011) <a href="https://fortress.wa.gov/ecy/publications/documents/1106016.pdf">https://fortress.wa.gov/ecy/publications/documents/1106016.pdf</a> Wilhere et al. (2013) <a href="ftp://www.ecy.wa.gov/gis_a/inlandWaters/ps_project/Docs/Watershed_Characterization_WDFW_Report_Final_Dec2013.pdf">ftp://www.ecy.wa.gov/gis_a/inlandWaters/ps_project/Docs/Watershed_Characterization_WDFW_Report_Final_Dec2013.pdf</a>
Landscape Group	A group of AU's within the analysis area that each have similar environmental characteristics, such as precipitation, landform, and/or geology. In the current version of the Characterization models, landscape groups are identified strictly on geographical position (coastal, lowland, and mountain, plus a subset of lowland assessment units that drain to one of four large lakes).
Watershed characterization	Watershed 'characterization' is a set of water and habitat assessments that compare areas within a watershed for restoration and protection value. It is a coarse-scale tool that supports decisions regarding where on the landscape should efforts be focused first, and what types of actions are most appropriate to that place. See <a href="http://www.ecy.wa.gov/puget_sound/characterization/index.html">http://www.ecy.wa.gov/puget_sound/characterization/index.html</a>
Watershed enhancement	Watershed enhancement actions are those actions which improve the ability of the watershed to provide its natural benefits and services to communities. Watershed enhancement includes the idea of “repairing” major landscape processes related to hydrology and ecosystems, in order to maintain, protect or improve the delivery of watershed services.
Water Resource Inventory Area	Water Resource Inventory Area (WRIA): Administrative watershed boundaries designated by the State of Washington's natural resource agencies.

## Appendices

Appendix A: Data sources for the Laurel Watershed Improvement District

Appendix B: WID work session information

Appendix C: Water flow assessment results for Water Resource Inventory Area 1

Appendix D: Fact sheet 5 (Planning, designing and implementing beneficial actions for agricultural & watershed enhancement)







## Appendix A: Sources of Available Data for Laurel WID

### July 2016

Prepared by Cheryl Lovato Niles & Heather MacKay

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## Whatcom County Ag-Watershed Project

### Purpose of this document

The purpose of this document is to collate relevant sources of data, particularly sources for data sets generated through longer-term routine monitoring programs. These data sets are potentially useful for field and desk work in the Laurel Watershed Improvement District (WID).

Sources for the following data types have been collated for the Fourmile, Tenmile, Deer, and Wiser/Cougar South watersheds:

- Water quality measures (fecal coliform, temperature, dissolved oxygen, turbidity, nitrogen, and phosphorous) from 2000 to the present,
- Hydrography,
- Stream flow from 2000 to the present,
- Erosion and avulsion hazard in the Nooksack River channel migration zone,
- Ground water measurements from 2000 to the present,
- Water rights,
- Fish presence and habitat evaluations from 1990 to the present,
- Salmon and steelhead population boundaries,
- Aquatic nuisance species,
- Instream and streambank vegetation from 1990 to the present,
- Land use and land cover from 2000 to the present,
- Wildlife, and
- Soils.

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Table 1: Fecal coliform monitoring maps and reports

Area	Watershed	Parameter	Source	Description	URL
Laurel	Ten Mile Lower	Fecal coliform	Whatcom County	Map of routine monitoring sites and reports of sampling results updated monthly	<a href="http://www.whatcomcounty.us/2170/Water-Quality-Monitoring-Results">http://www.whatcomcounty.us/2170/Water-Quality-Monitoring-Results</a> [last accessed February 1, 2016] (see note below for information on how to download FC data)
Laurel	Fourmile, Tenmile Upper, Tenmile Lower, Wiser/Cougar South	Fecal coliform	Conservation District	Watershed Health Assessment (November 2015)	<a href="http://www.whatcomcounty.us/2170/Water-Quality-Monitoring-Results">http://www.whatcomcounty.us/2170/Water-Quality-Monitoring-Results</a> [last accessed February 1, 2016]
all	All (Department of Agriculture tests numerous stations routinely and also in response to high FC counts – station locations vary)	Fecal coliform	Washington State Departments of Agriculture and Ecology (only WSDA results shown as of 2/9/16). Data is available upon request from WSDA Dairy Nutrient Management group - Michael Isensee 360-961-7412	Map of preliminary source tracking results	<a href="http://www.whatcomcounty.us/2170/Water-Quality-Monitoring-Results">http://www.whatcomcounty.us/2170/Water-Quality-Monitoring-Results</a> [last accessed February 1, 2016]

Accessing water quality data from routine monitoring sites: Figure 1 shows the locations of routine water quality monitoring sites that are within the Laurel Watershed Improvement District.

Whatcom County, the Tribes, Washington State Department of Ecology, and Washington Department of Agriculture coordinate their water quality monitoring efforts. To see the most recent couple of months of data from the map of routine water quality monitoring online at the County's website <http://www.whatcomcounty.us/2170/Water-Quality-Monitoring-Results>, open the map at <http://wacds.maps.arcgis.com/apps/webappviewer/index.html?id=71fa677503c949c8847066178a531099>, and click on the layers symbol in the upper right hand corner. This opens a box titled Layer List. Select the box to the left of "Preliminary WQ Data Results (All)", and then click on the arrow to the right to open up the drop down menu. Select "Open Attribute Table". A detailed table will open up. Under "Options" in the upper left corner of the table, you can choose to export the data and it will automatically populate an Excel spreadsheet. The purple dots indicate station locations; the blue squares indicate that there is data associated with that station in this system. To find earlier data see the table below.

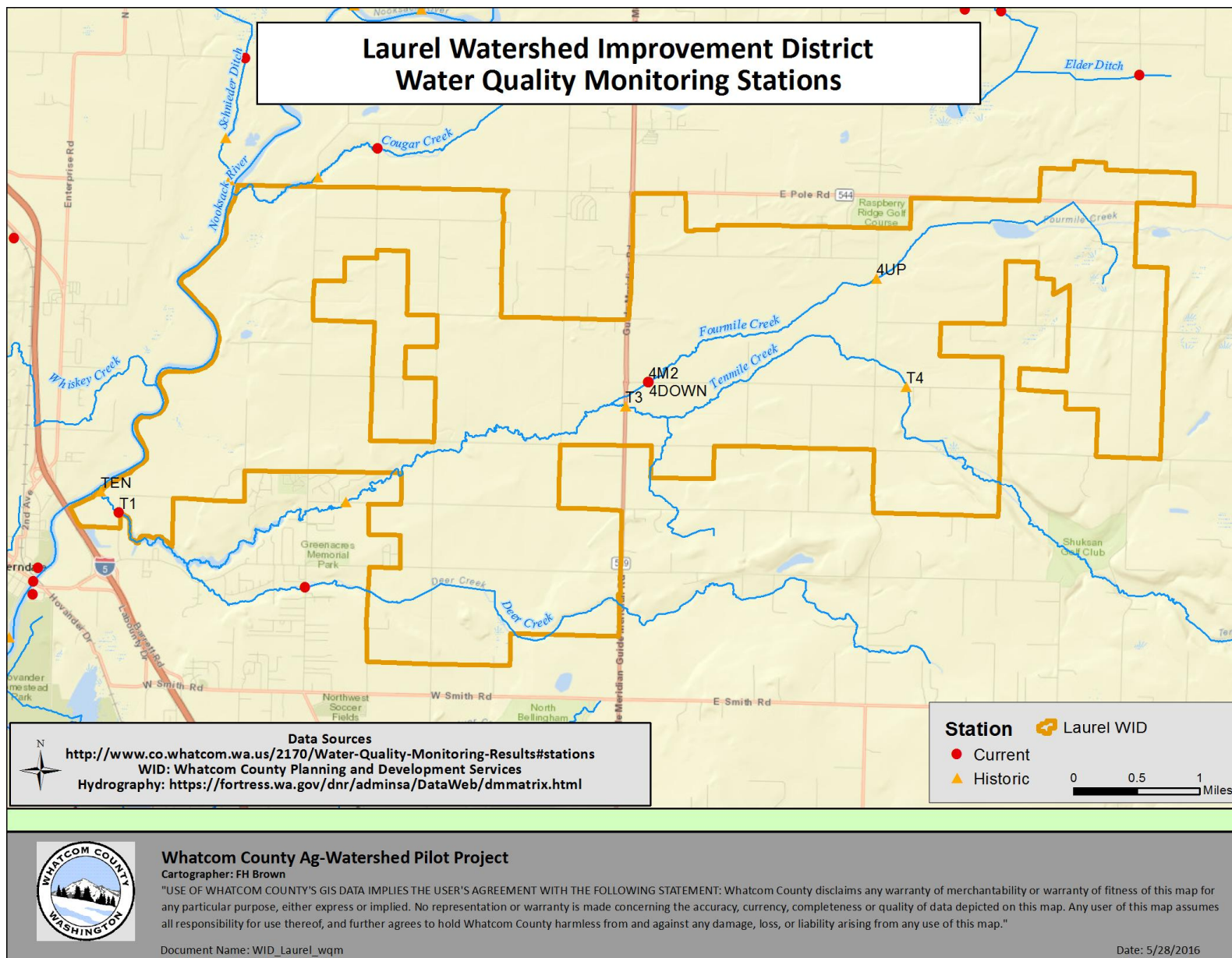


Figure 1: Laurel Watershed Improvement District water quality monitoring stations. See Tables 1 and 2 for more information.



Table 2: Where to find earlier water quality data from monitoring stations on Whatcom County Water Quality Monitoring Results for the Laurel WID area.

*Data for the County Health Department are not included here because their monitoring focuses entirely on marine water.*

Who	Department of Ecology	Whatcom County Public Works	Washington State Department of Agriculture	Nooksack Tribe
What	Data generally includes FC, pH, T, Conductivity, and DO. Occasionally flow and wetted width are recorded.	Focused on fecal coliform	Focused on fecal coliform	Fecal coliform, E.coli, T, pH, DO, Conductivity, Turbidity,
How	You may request the data from the Department of Ecology Bellingham Field office. Details below.	Annual reports for 2011 through 2013 are available online at URL below.	Data is available upon request from WSDA Dairy Nutrient Management group - Michael Isensee 360-961-7412	Available by request
Details	You may request data for a watershed subbasin from Jessica Kirkpatrick, Steve Hood, or Chris Luerkens at 360-715-5200.	< <a href="http://www.co.whatcom.wa.us/2172/Resource-Library">http://www.co.whatcom.wa.us/2172/Resource-Library</a> >	Station locations are shown on Whatcom County's map of routine monitoring sites but results are available on the Preliminary Source ID Results map (both maps at < <a href="http://www.whatcomcounty.us/2170/Water-Quality-Monitoring-Results">http://www.whatcomcounty.us/2170/Water-Quality-Monitoring-Results</a> > ) and by request – contact information above.	Jezra Belieau, Water Resources Specialist Nooksack Indian Tribe <a href="mailto:jbeaulieu@nooksack-nsn.gov">jbeaulieu@nooksack-nsn.gov</a>
Station Names	DRC T1 T2 T3 T4 NWIC-4UP NWIC-4DOWN	CA14c COU2	4M2	SW15

Table 3: Streamflow

WID/Area	Watershed	Ongoing/ Completed	Station ID	Description	Lat	Long	Collected by	Source	URL
Laurel	Tenmile Lower	Ongoing	12212900	Tenmile Creek near Laurel	485149	1222945	USGS	USGS "Summary Information for Continuous Streamflow Gages in and near the WRIA 1 Study Area"	<a href="http://wa.water.usgs.gov/projects/wria01/sw.htm">http://wa.water.usgs.gov/projects/wria01/sw.htm</a> [last accessed October 1, 2015]
Laurel	Tenmile Lower	Ongoing	12213000	Tenmile Creek near Ferndale	485115	1223225	USGS	USGS "Summary Information for Continuous Streamflow Gages in and near the WRIA 1 Study Area"	<a href="http://wa.water.usgs.gov/projects/wria01/sw.htm">http://wa.water.usgs.gov/projects/wria01/sw.htm</a> [last accessed October 1, 2015]

Table 4: Streamflow plus additional measures

WID/Area	Watershed	Additn'l parameters	Station ID	Station location	Ongoing/ Completed	Collected by	Source	URL	notes
South of Laurel	Mainstem	FC, T, NH3, NO2 NO3, TPN, TPP, OP, DO, pH,	01A050	Nooksack River @Brennan	ongoing	Ecology	River & Stream Water Quality Monitoring	<a href="https://fortress.wa.gov/ecy/eap/riverwq/regions/state.asp">https://fortress.wa.gov/ecy/eap/riverwq/regions/state.asp</a> [last accessed October 1, 2015]	Oxygen is monitored "continuously" - 15 to 30 minute intervals

Table 5: Additional streamflow reports

WID/Area	Title	Published	URL
Bertrand, N. Lynden, S. Lynden, Laurel	USGS Estimating low-flow frequency statistics and hydrologic analysis of selected stream-flow gaging stations, Nooksack River basin, report 2009-5170	USGS Scientific Investigations Report, 2009.	<a href="http://wria1project.whatcomcounty.org/uploads/PDF/WaterQN/2009_USGS%20Report%20for%20Selected%20WRIA%20%20Gage%20Stations.pdf">http://wria1project.whatcomcounty.org/uploads/PDF/WaterQN/2009_USGS%20Report%20for%20Selected%20WRIA%20%20Gage%20Stations.pdf</a>

Table 6: Hydrography

Area	Parameter	Source	URL
US	Hydrography	USGS. The National Map, Hydrography	<a href="http://viewer.nationalmap.gov/viewer/nhd.html?p=nhd">http://viewer.nationalmap.gov/viewer/nhd.html?p=nhd</a> [last accessed September 30, 2015]

Table 7: Erosion and avulsion in Nooksack River channel migration zone

Area	Parameter	Document Title	Author	Date	URL
Sumas, S. Lynden, N. Lynden, Bertrand, Laurel	Erosion and Avulsion	Erosion and Avulsion Hazard Mapping and Methodologies for use in the Nooksack River Channel Migration Zone Mapping	Paul Pittman, LEG Whatcom County Public Works and Peter Gill, Whatcom County Planning and Development Services,	2009	<a href="http://wa-whatcomcounty.civicplus.com/DocumentCenter/View/15492">http://wa-whatcomcounty.civicplus.com/DocumentCenter/View/15492</a> [last accessed February 29, 2016]

Table 8: Groundwater Data

WID/Area	Water-shed	Parameter	Title of Table/Source	Station ID	Source	URL	Notes
all	all	Well location, use, depth, installation date, open interval	Summary Information for Wells in the WRIA 1 Study Area	1297 wells listed. Latitude and Longitude provided for all.	USGS	<a href="http://wa.water.usgs.gov/projects/wria01/data/well_info.htm">http://wa.water.usgs.gov/projects/wria01/data/well_info.htm</a> via <a href="http://wa.water.usgs.gov/projects/wria01/gw.htm">http://wa.water.usgs.gov/projects/wria01/gw.htm</a> [both last accessed October 1, 2015]	This table contains data for all wells in the WRIA 1 study area that were in the USGS database as of December 14, 1999. There are many wells in the WRIA 1 study area that are not in the database. Additional information regarding wells in this table can be obtained by contacting Luis Fuste, the Information Officer of the USGS Washington Water Science Center of the USGS, at (253) 428-3600 x2653. Information in this table may overlap with information in the database of the Whatcom County Health and Human Services Department See Summary Information for Whatcom County Health and Human Services Department Wells in the WRIA 1 Study Area).

WID/ Area	Water- shed	Parameter	Title of Table/Source	Station ID	Source	URL	Notes
all	all	Well location, use, depth, installation date, open interval	Summary Information for Wells in the WRIA 1 Study Area, Downloaded from the Whatcom County Health and Human Services Department Database	Numerous wells listed. Township, range, section, and quarter section listed for all.	Whatcom County Health and Human Services	<a href="http://wa.water.usgs.gov/projects/wria01/data/tableGW2.htm">http://wa.water.usgs.gov/projects/wria01/data/tableGW2.htm</a> [last accessed October 1, 2015]	This table contains selected data for all wells in the WRIA 1 study area that were in the Whatcom County Health and Human Services Department database as of January 7, 2000. There are many wells in the WRIA 1 study area that are not in the database. Additional information regarding wells in this table can be obtained by contacting Anne Marie Karlberg at the Whatcom County Health and Human Services Department, at (360) 738-2504 x50819. Information in this table may overlap with information in the database of the USGS (see Summary Information for Wells in the WRIA 1 Area, Downloaded from the USGS National Water Information System). Disclaimer: The locations of these wells have not been field checked. Construction information was gathered from driller's logs and may contain errors.
all	all	Well location, use, depth, installation date, open interval	Wells with Sufficient Information to Compute Hydraulic Conductivities, Downloaded from the USGS National Water Information System (NWIS)	Numerous wells listed. Lat. and long. listed for all.	USGS	<a href="http://wa.water.usgs.gov/projects/wria01/data/tableGW4.htm">http://wa.water.usgs.gov/projects/wria01/data/tableGW4.htm</a> [last accessed October 1, 2015]	All information in this table is provisional and subject to revision. The data in the database were collected and entered for a wide variety of projects and purposes over a long period of time and the resulting dataset varies in quality and detail. Although many wells have accurate information (especially those checked and used in recent studies), some problems are known to exist for older entries. Examples of known problems include, but are not limited to, inaccurate well locations, old information regarding the primary use of the well, incorrect installation dates, and erroneous labeling of well locations as having been field-checked. No checks were performed to assure consistency between the latitude and longitude of a well and its assigned local name
all	all	Water level below surface, date of measurement, method	Historical Ground-Water Levels in the WRIA 1 Study Area	Numerous wells listed. USGS ID is lat long.	USGS	<a href="http://wa.water.usgs.gov/projects/wria01/data/water_levels.htm">http://wa.water.usgs.gov/projects/wria01/data/water_levels.htm</a> [last accessed October 1, 2015]	Table contains historical water-level information for wells in the WRIA 1 study area that were in the USGS National Water Information System (NWIS) on December 14, 1999, and for which water-level information was available. Additional information regarding wells in this table can be obtained by contacting Luis Fuste, the Information Officer of the USGS Washington Water Science Center of the USGS, at (253) 428-3600 x2653.



WID/ Area	Water- shed	Parameter	Title of Table/Source	Station ID	Source	URL	Notes
Laurel	Tenmile lower?	Hydraulic conductivity	Summary Information for Aquifer Tests in the WRIA 1 Study Area	Ferndale	USGS, Ecology, Cascades Env. Services and Water Resources Cons. Team	<a href="http://wa.water.usgs.gov/projects/wria01/gw.htm">http://wa.water.usgs.gov/projects/wria01/gw.htm</a> [last accessed October 1, 2015]	The published source of the data may be found by cross-referencing the code in the column labeled "Catalogue Number" with information in a Microsoft Access* database developed by Greenberg and others (1996) and expanded by the USGS as part of the current (January, 2000) study.

Table 9: Additional reports on groundwater

Watershed	Title	Published	Authors	URL
all	Nitrate Contamination in the Sumas-Blaine Aquifer, Whatcom County, Washington	Publication No. 11-03-027, May 2011	Melanie Redding, Barbara Carey, and Kirk Sinclair, Washington State Department of Ecology	<a href="https://fortress.wa.gov/ecy/publications/documents/1103027.pdf">https://fortress.wa.gov/ecy/publications/documents/1103027.pdf</a> [last accessed February 1, 2016]
all	Sumas-Blaine Aquifer Nitrate Contamination Summary	Department of Ecology Pub. No. 12-03-026, June 2012	Barbara Carey	<a href="http://www.ecy.wa.gov/biblio/1203026.html">www.ecy.wa.gov/biblio/1203026.html</a> [last accessed February 1, 2016]
all	Hydrogeology, ground water quality, and sources of nitrate in lowland glacial aquifers of Whatcom County, Washington, and British Columbia, Canada	US Geological Survey Water-Resources Investigations Report 98-4195. 1999. 251 pages, 5 plates.	Cox, S. E., and S. C. Kahle	
WRIA1	WRIA 1 Groundwater Data Assessment: Overview. In Bandaragoda, C., C. Lindsay, J. Greenberg, and M. Dumas, editors. WRIA 1 Groundwater Data Assessment	Whatcom County PUD #1, Whatcom County, WA. WRIA 1 Joint Board, 2013.	Lindsay, C. and C. Bandaragoda,	<a href="http://wria1project.whatcomcounty.org/">http://wria1project.whatcomcounty.org/</a> [last accessed 2/1/16]

Table 10: Groundwater maps

WID/ Area	Parameter	Title	Last modified	Source	URL	Notes
all	Ground- water movement	Generalized Pattern of Ground -Water Movement for the Puget Sound Aquifer System in the WRIA 1 Study Area	2000	USGS	<a href="http://wa.water.usgs.gov/projects/wria01/maps/mapGW2.pdf">http://wa.water.usgs.gov/projects/wria01/maps/mapGW2.pdf</a> [last accessed October 1, 2015]	Modified from Vaccaro, J.J., Hasen, A.J. and Jones, M.A., 1998. Hydrogeologic Framework of the Puget Sound Aquifer System, Washington and British Columbia; US Geological Survey Professional Paper 1424-D.
all	Selected well locations	Locations of Selected Wells in the WRIA 1 Study Area by Primary Water Use	2000	USGS	<a href="http://wa.water.usgs.gov/projects/wria01/maps/mapGW4.pdf">http://wa.water.usgs.gov/projects/wria01/maps/mapGW4.pdf</a> [last accessed October 1, 2015]	USGS National Water Information System (NWIS), downloaded December 14, 1999. Not all well locations have been verified and therefore they may plot in the wrong locations.
all	Ground- water levels	Water-Level Contours in the Uppermost Aquifer of the Lynden-Everson-Nooksack-Sumas (LENS) Study Area	2000	USGS	<a href="http://wa.water.usgs.gov/projects/wria01/maps/mapGW3.pdf">http://wa.water.usgs.gov/projects/wria01/maps/mapGW3.pdf</a> [last accessed October 1, 2015]	From: Cox, S.E., and Kahle, S.C., 1999, Hydrogeology, Ground-Water Quality, and Sources of Nitrate in Lowland Glacial Aquifers of Whatcom County, Washington, and British Columbia, Canada: U.S. Geological Survey Water-Resources Investigations Report 98-4195, 5 plates, 251 p.
all	Aquifer tests	Approximate Locations of Aquifer Tests in the WRIA 1 Study Area	2000	USGS	<a href="http://wa.water.usgs.gov/projects/wria01/maps/mapGW5.pdf">http://wa.water.usgs.gov/projects/wria01/maps/mapGW5.pdf</a> [last accessed October 1, 2015]	From: Various Hydrogeologic Studies in the WRIA 1 Study Area
all	Selected well locations	Locations of Selected Wells in the WRIA 1 Study Area with Sufficient Information to Compute Hydraulic Conductivities	2000	USGS	<a href="http://wa.water.usgs.gov/projects/wria01/maps/mapGW6.pdf">http://wa.water.usgs.gov/projects/wria01/maps/mapGW6.pdf</a> [last accessed October 1, 2015]	From: USGS National Water Information System (NWIS), downloaded December 14, 1999. Not all well locations have been verified, therefore they may plot in the wrong locations.
all	Selected well locations	Locations of Selected Wells in the WRIA 1 Study Area with Five or More Historical Water Levels	2000	USGS	<a href="http://wa.water.usgs.gov/projects/wria01/maps/mapGW7.pdf">http://wa.water.usgs.gov/projects/wria01/maps/mapGW7.pdf</a> [last accessed October 1, 2015]	From: USGS National Water Information System (NWIS), downloaded December 14, 1999. Not all well locations have been verified and therefore they may plot in the wrong locations

all	Soil types	Distribution of Soil Map Units in the WRIA 1 Study Area	2000	USGS	<a href="http://wa.water.usgs.gov/projects/wria01/maps/mapGW8.pdf">http://wa.water.usgs.gov/projects/wria01/maps/mapGW8.pdf</a> [last accessed October 1, 2015]	From: U.S. Department of Agriculture, 1994, State Soil Geographic (STATSGO) Data Base: Data use information, Soil Conservation Service, National Cartography and GIS Center, Fort Worth, Texas, accessed January 28, 2000, at URL <a href="http://www.ftw.nrcs.usda.gov/stat_data.html">http://www.ftw.nrcs.usda.gov/stat_data.html</a> . Note: The soil information for this map was Natural Resources Conservation Service 1994 STATSGO data. STATSGO was compiled at 1:250,000 and designed to be used primarily for regional, multi-state, state, and river-basin resource planning, management, and monitoring.
all	Soil permeability	Soil Permeability in Parts of the WRIA 1 Study Area	2000	USGS	<a href="http://wa.water.usgs.gov/projects/wria01/maps/mapGW9.pdf">http://wa.water.usgs.gov/projects/wria01/maps/mapGW9.pdf</a> [last accessed October 1, 2015]	Modified from: U.S. Department of Agriculture-Soil Conservation Service, 1992, Soil Survey of Whatcom County Area, Washington, 54 sheets, 481 p.

Table 11: Water rights

Area	Parameter	Title	Source	URL	Notes
all	Quantity, place of use, source, purpose, all documents associated with water rights, and well logs	Water Resources Explorer	Washington State Department of Ecology	<a href="http://www.ecy.wa.gov/programs/wr/info/webmap.html">http://www.ecy.wa.gov/programs/wr/info/webmap.html</a> [last accessed October 1, 2015]	You can search with an interactive map, or using information such as address, township and range, or latitude and longitude.
all	Water rights	WRIA 1 Water Rights Atlas, 2003	Public Utility District No. 1	<a href="http://wria1project.whatcomcounty.org/Resource-Library/Studies-And-Reports/Water-Rights/65.aspx">http://wria1project.whatcomcounty.org/Resource-Library/Studies-And-Reports/Water-Rights/65.aspx</a> [last accessed February 1, 2016]	

Table 12: Land use/Land cover

WID/Area	Watershed	Parameter	Document	URL
Whatcom County		Agricultural Land Cover Analysis	Whatcom County Agricultural Land Cover Analysis version 2.3. 2013. Whatcom County Planning and Development Services	<a href="http://www.whatcomcounty.us/documentcenter/view/3989">http://www.whatcomcounty.us/documentcenter/view/3989</a> [last accessed October 1, 2015]
Whatcom County		Critical Areas Ordinance Maps	Whatcom County's Critical Areas (CAO) are environmentally sensitive natural resources that have been designated for protection and management in accordance with the requirements of the Growth Management Act.	<a href="http://www.whatcomcounty.us/811/County-Wide-Critical-Area-Ordinance-Maps">http://www.whatcomcounty.us/811/County-Wide-Critical-Area-Ordinance-Maps</a> [last accessed February 26, 2016]
Whatcom County		Land Cover Change	WDFW High Resolution Change Detection Project; Whatcom County: Land Cover Change by Sub-Basin	<a href="http://wa-whatcomcounty.civicplus.com/DocumentCenter/View/15805">http://wa-whatcomcounty.civicplus.com/DocumentCenter/View/15805</a> [last accessed February 26, 2016]



Table 13: Land use/Land cover map and charts from Lower Nooksack Water Budget Overview

*Report covers Tenmile, Four Mile, Fazon, Deer, and Wiser Lake/Cougar Creek*

From: Bandaragoda, C., J. Greenberg, M. Dumas and P. Gill. (2012). Lower Nooksack Water Budget (Chapter 5, Land Cover). Whatcom County, WA: WRIA 1 Joint Board. Retrieved from <a href="http://wria1project.whatcomcounty.org/">http://wria1project.whatcomcounty.org/</a> [last accessed October 1, 2015 ]	Figure
WRIA 1 map of existing land cover	Figure 1
WRIA 1 map of historic land cover classes, produced by Utah State University (Winkelaar 2004).	Figure 2
Areal distribution of existing and historical land cover classes in the Lower Nooksack watershed (top) and the Nooksack Forks watershed (bottom).	Figure 7
Final land cover classification, original data source class, and Lower Nooksack Water Budget land cover parameters.	Table 1
Crop types in the Lower Nooksack Subbasin.	Table 2

Table 14: Land use/Land cover electronic data from Lower Nooksack Water Budget Overview

*Report covers Tenmile, Four Mile, Fazon, Deer, and Wiser Lake/Cougar Creek*

From: Bandaragoda, C., J. Greenberg, M. Dumas and P. Gill. (2012). Lower Nooksack Water Budget (Chapter 5, Land Cover). Whatcom County, WA: WRIA 1 Joint Board. Retrieved from <a href="http://wria1project.whatcomcounty.org/">http://wria1project.whatcomcounty.org/</a> [last accessed October 1, 2015].	Title
Tables of crop type summarized by the 16 drainages of the Lower Nooksack Subbasin	Appendix Chap5A_LN_AgLandUse.pdf
Classes and descriptions of original NOAA CCAP dataset	Appendix Chap5B_LandCoverClass.pdf
Classes and descriptions of original Whatcom County Agricultural Land Cover Analysis	Appendix Chap5C_WhatcomCountyLandCover.pdf
GIS data, Whatcom County Agricultural Land Cover Analysis	Agrural-use-pds2011.shp
Parameter grids (ascii files) and Excel spreadsheets of parameter values by land cover class	Land Cover Model Parameter Lookup Tables (Folder: Ascii grids/ see lulc_existing.xls and lulc_historic.xls
Matlabcode to convert raster, lookup tables, and shapefile data to area averaged parameter values	Topnet-WM Preprocessing Program files
ArcGIS 10 Files Geodatabase Raster Grids 30 Meter Pixel resolution; Metadata xml	wria1_lulc_water_budget.gdb, 1. Existing Land Cover GIS data (<Lulc_exist>) 2. Historical Land Cover GIS data (<Lulc_hist>)
Lower Nooksack Subbasin Land cover tables and charts from GIS data	Lulc_charts_lowerNookonly.xlsx
WRIA 1 Land cover codes, tables, and charts from GIS data	Lulc_charts_wria1.xlsx

Table 15: NSEA spawner surveys

*NSEA has spawner survey reports from 1998 to the present. This table includes every relevant reach surveyed since 2005. Some reaches were not surveyed every year.*

Watershed	Creek	Station Location	Collected by	Source	Notes
Ten Mile Upper	Silver Springs Creek	RM 0.0 – 0.5	trained NSEA staff and volunteers	Nooksack Salmon Enhancement Spawning Grounds data and reports. <a href="http://www.n-sea.org/archived-publications">http://www.n-sea.org/archived-publications</a> [last accessed Feb 1, 2016]	Live salmon, carcasses and redds are recorded. The reports include brief descriptions of the reach. The monitored reaches have changed somewhat over time.
Ten Mile Upper	Starry Creek	RM 0 – 0.75	trained NSEA staff and volunteers	Nooksack Salmon Enhancement Spawning Grounds data and reports. <a href="http://www.n-sea.org/archived-publications">http://www.n-sea.org/archived-publications</a> [last accessed Feb 1, 2016]	Live salmon, carcasses and redds are recorded. The reports include brief descriptions of the reach. The monitored reaches have changed somewhat over time.
Ten Mile Upper	Ten Mile	RM 9-9.2	trained NSEA staff and volunteers	Nooksack Salmon Enhancement Spawning Grounds data and reports. <a href="http://www.n-sea.org/archived-publications">http://www.n-sea.org/archived-publications</a> [last accessed Feb 1, 2016]	Live salmon, carcasses and redds are recorded. The reports include brief descriptions of the reach. The monitored reaches have changed somewhat over time.
Deer Creek	Deer Creek Upper	RM 3.2-3.7	trained NSEA staff and volunteers	Nooksack Salmon Enhancement Spawning Grounds data and reports. <a href="http://www.n-sea.org/archived-publications">http://www.n-sea.org/archived-publications</a> [last accessed Feb 1, 2016]	Live salmon, carcasses and redds are recorded. The reports include brief descriptions of the reach. The monitored reaches have changed somewhat over time.
Deer Creek	Deer Creek Lower	RM 0.5-1.1	trained NSEA staff and volunteers	Nooksack Salmon Enhancement Spawning Grounds data and reports. <a href="http://www.n-sea.org/archived-publications">http://www.n-sea.org/archived-publications</a> [last accessed Feb 1, 2016]	Live salmon, carcasses and redds are recorded. The reports include brief descriptions of the reach. The monitored reaches have changed somewhat over time.

Table 16: WDFW spawner surveys

Watershed	Parameter	Creek	Station location	Frequency	Date	Ongoing/ completed	Collected by	Source
Wiser Lake/Cougar Creek, Fourmile and Ten Mile Creeks	Limited field data from a one year survey to assess adult Steelhead spawning habitat: Steelhead redds or suitable gravel for Steelhead spawning.	Specifics are available upon request	Specifics are available upon request	One-time	2009	Completed	WDFW and NSEA field crews	WDFW Tasha Geiger Nooksack River Stock Assessment 360-305-2023 Natasha.geiger@df w.wa.gov

Table 17: Aquatic nuisance species

Area	Title - Parameter	Notes	Frequency	Date		Source
Washington State	Aquatic invasive species	Description of aquatic nuisance species with distribution maps. Organized by organism.	ongoing		<a href="http://wdfw.wa.gov/ais">http://wdfw.wa.gov/ais</a> [last accessed October 1, 2015]	WDFW
Washington State	Washington Herp Atlas		unknown	Maps updated 2013	<a href="http://www1.dnr.wa.gov/nhp/refdesk/herp/herpmain.html">http://www1.dnr.wa.gov/nhp/refdesk/herp/herpmain.html</a> [last accessed October 1, 2015]	DNR
Washington State	Washington Nature Mapping Program – wildlife distribution maps		unknown	unknown	<a href="http://naturemappingfoundation.org/natmap/maps/">http://naturemappingfoundation.org/natmap/maps/</a> [last accessed October 1, 2015]	NatureMapping Program
US	USGS NAS – Nonindigenous Aquatic Species – presence and distribution	Searchable database/maps of nonindigenous aquatic species sightings organized by group, i.e. amphibians, fish, mammals.	unknown	Date of info varies	<a href="http://nas.er.usgs.gov/queries/default.aspx">http://nas.er.usgs.gov/queries/default.aspx</a> [last accessed October 1, 2015]	USGS
Washington State	Washington Department of Ecology Environmental Assessment Aquatic Plant Monitoring	Description of aquatic nuisance plants with distribution maps, searchable survey results by county, lake, or plant name, and downloadable survey data.	ongoing	Date of info varies	<a href="http://www.ecy.wa.gov/programs/wq/plants/weeds/index.html">http://www.ecy.wa.gov/programs/wq/plants/weeds/index.html</a> [last accessed October 1, 2015]	WA Department of Ecology
Whatcom County	Whatcom County Noxious Weeds webpages	Distribution map of some noxious weeds. Field guides and information about noxious weeds.	unknown	Map date is 2008. Website date is 2007. Other material is undated.	<a href="http://www.whatcomcounty.us/DocumentCenter/View/2506">http://www.whatcomcounty.us/DocumentCenter/View/2506</a> [last accessed October 1, 2015]	Whatcom County
Pacific Northwest	Aquatic and Riparian Effectiveness Monitoring Program Invasive Species Report	Description of monitoring program and presence of invasive species in surveyed areas.	2010	2011	<a href="http://www.reo.gov/monitoring/reports/watershed/AREMP%20Aquatic%20Invasive%20Species%20Report%202010.pdf">http://www.reo.gov/monitoring/reports/watershed/AREMP%20Aquatic%20Invasive%20Species%20Report%202010.pdf</a> [last accessed October 1, 2015]	UW Forest Service and Bureau of Land Management

Table 18: Additional habitat/wildlife documents

Watershed/area	Parameter	Document
Does not include Dakota, California, or Sumas River watersheds	Riparian function	Coe, T. 2001. Nooksack River Watershed Riparian Function Assessment. Nooksack Indian Tribe Natural Resources Department. < <a href="http://salmon.wria1.org/resources/documents">http://salmon.wria1.org/resources/documents</a> > [last accessed January 4, 2016]
Whatcom County	Fish barriers	Whatcom County Public Works, 2006. Whatcom County Fish Passage Barrier Inventory Final Report - IAC Project Number: 01-1258 N. January, 2006. < <a href="http://salmon.wria1.org/resources/documents">http://salmon.wria1.org/resources/documents</a> > [last accessed January 4, 2016]
WRIA 1	Fish habitat	Smith, C.J. 2002. Salmon and steelhead habitat limiting factors in WRIA 1, the Nooksack basin. Washington State Conservation Commission, Lacey, Washington. 325 pp.
Ten Mile	2013 Data Integration of WRIA 1 Hydraulic, Fish Habitat, and Hydrology Models	Bandaragoda, C. Joanne Greenberg, and Mary Dumas (2013). Data integration of WRIA 1 Hydraulic, Fish Habitat, and Hydrology Models. 134 pp. Nooksack Indian Tribe, Whatcom County, WA. WRIA 1 Joint Board. Retrieved [Date], from <a href="http://wria1project.whatcomcounty.org/">http://wria1project.whatcomcounty.org/</a> [last accessed February 1, 2016]
Nooksack	Fish presence	Nooksack Tribe, 2004. Referenced in North Lynden Watershed Improvement District Management Plan for Drainage, flooding, Irrigation and Fish Issues, 2009. Bibliography entry is unclear.
WRIA 1	Fish presence	Anchor Environmental, LLC. 2003. Fish periodicity in WRIA 1. Prepared for City of Bellingham Public Works Department. Seattle, Washington. 43 pp+ Appendices
Deer Creek	Juvenile salmonids (salmon, steelhead, trout)	This data was collected by Bob Vadas (WDFW) and is not an official report but it does speak to juvenile population numbers found in Bertrand Cr, Fishtrap Cr and Deer Cr sampling locations where also sampled for comparison. This data has not been fully analyzed at this time and should only be used as an initial look into juvenile populations. Sampling was conducted from 2006-2010.
Whatcom County	Biodiversity	Nelson, R., 2007. Mapping Biodiversity in Whatcom County: Data and Methods. Submitted to the Whatcom Legacy Project, August 2007. < <a href="http://wa-whatcomcounty.civicplus.com/DocumentCenter/View/15493">http://wa-whatcomcounty.civicplus.com/DocumentCenter/View/15493</a> > [last accessed February 29, 2016]
Whatcom County	Wildlife	Eissinger, A., 1994. Significant Wildlife Areas. (Available through the public library)



Table 19: Additional habitat/wildlife maps and databases

Watershed/ Area	Parameter	Document/Website	URL	Source
Whatcom County	Fish Presence Char, Chinook, Chum, Coho, Cutthroat, Pink, Steelhead, Bull Trout/Dolly Varden	Maps: Fish Presence by species available on Whatcom County Critical Areas Ordinance Maps page	<a href="http://www.co.whatcom.wa.us/811/County-Wide-Critical-Area-Ordinance-Maps">http://www.co.whatcom.wa.us/811/County-Wide-Critical-Area-Ordinance-Maps</a> [last accessed February 24, 2016]	Whatcom County
Whatcom County	Wildlife	The Whatcom County mappings were completed in 2007, as part of a project to characterize ecosystem processes and wildlife habitat in the Birch Bay Watershed.	<a href="http://wdfw.wa.gov/conservation/habitat/planning/lha/whatcom.html">http://wdfw.wa.gov/conservation/habitat/planning/lha/whatcom.html</a> [last accessed February 1, 2016]	Washington Department of Ecology and Washington Department of Fish and Wildlife
Washington State	Priority Habitats and Species on the Web	PHS on the Web is a Washington Department of Fish and Wildlife web-based, interactive map for citizens, landowners, cities and counties, tribal governments, other agencies, developers, conservation groups, and interested parties to find basic information about the known location of Priority Habitats and Species (PHS) in Washington State.	<a href="http://wdfw.wa.gov/mapping/phs/">http://wdfw.wa.gov/mapping/phs/</a> [last accessed October 1, 2015]	Washington Department of Fish and Wildlife
Washington State	Salmon distribution, status, and habitats	SalmonScape is an interactive mapping application designed to display and report a wide range of data related to salmon distribution, status, and habitats. The data sources used by SalmonScape include stream specific fish and habitat data, and information about stock status and recovery evaluations.	<a href="http://apps.wdfw.wa.gov/salmonscape/">http://apps.wdfw.wa.gov/salmonscape/</a> [last accessed October 1, 2015]	Washington Department of Fish and Wildlife
West Coast	Salmon	Maps of salmon and steelhead population boundaries	<a href="http://www.westcoast.fisheries.noaa.gov/maps_data/maps_and_gis_data.html">http://www.westcoast.fisheries.noaa.gov/maps_data/maps_and_gis_data.html</a> [last accessed October 1, 2015]	NOAA Fisheries, West Coast Region
Whatcom County	Marine species and Habitats	Whatcom County Marine Resources maps of marine species and habitats	<a href="http://www.mrc.whatcomcounty.org/library">http://www.mrc.whatcomcounty.org/library</a> [last accessed October 1, 2015]	Whatcom County Marine Resources Committee Library
US	Critical habitat maps for marine and	Website links to data and maps. The critical habitat maps provided here are for illustrative purposes only. Textual descriptions of critical habitats, which are provided in the	<a href="http://www.nmfs.noaa.gov/pr/species/criticalhabitat.htm">http://www.nmfs.noaa.gov/pr/species/criticalhabitat.htm</a> [last accessed January 21, 2016]	NMFS NOAA

Watershed/ Area	Parameter	Document/Website	URL	Source
	anadromous fishes	associated <i>Federal Register</i> notices (see links below), are the definitive sources for determining critical habitat boundaries. Map and <i>Federal Register</i> notice links are PDF files.		
US	Threatened and Endangered Species	Environmental Conservation Online System, data and maps.	<a href="http://ecos.fws.gov/ecp/">http://ecos.fws.gov/ecp/</a> [last accessed February 18, 2016]	US FWS
Washington State	Rare plants, animals, ecological communities	Reference Desk of the Washington Natural Heritage Program. Includes searchable databases	<a href="http://www1.dnr.wa.gov/nhp/refdesk/gis/index.html">http://www1.dnr.wa.gov/nhp/refdesk/gis/index.html</a> [last accessed October 1, 2015]	Washington State Department of Natural Resources
Puget Sound Region	Wetlands	National Wetlands Inventory, data and maps	<a href="http://www.fws.gov/wetlands/">http://www.fws.gov/wetlands/</a> [last accessed February 1, 2016]	US FWS

Table 20: Soils

WID/Area	Parameter	Document	URL	Source
US	Soils	Web Soil Survey	< <a href="http://websoilsurvey.nrcs.usda.gov/app/">http://websoilsurvey.nrcs.usda.gov/app/</a> > last accessed October 1, 2015	USDA Natural Resource Conservation Service

Table 21: WRIA 1 materials online

*In addition to the WRIA 1 materials included in this memo, there are many additional resources available on the WRIA1 Resource Library webpages*

Watersheds	Type of Resource	Topics or Titles	URL
all	Studies	Water rights, Water Quantity, Water Quality, and Habitat and Instream Flow; The 2010 State of the Watershed Report, 2013 WRIA Groundwater Data Assessment, 2013 Data Integration of WRIA 1 Hydraulic, Fish Habitat and Hydrology Models, The Whatcom County Coordinated Water System Plan (2000), and 2005 Numerical Groundwater Flow Model of the Abbotsford-Sumas Aquifer	< <a href="http://wria1project.whatcomcounty.org/Resource-Library/8.aspx">http://wria1project.whatcomcounty.org/Resource-Library/8.aspx</a> > [last accessed February 1, 2016]
all	Maps	WRIA 1 Watersheds Map V3 Historic Land Cover Map - USU Existing Land Cover Future Land Cover – USGS Impervious Surfaces – NOAA Population Density – WA DOE Approximate Depth to Water Combined Hydrology Mechanisms, Draft – 11 Precipitation – PRISM Surface Water Storage Alterations Water Right Watershed Status Long Term Monitoring Adopted Map, and Interactive WRIA Monitoring Stations.	< <a href="http://wria1project.whatcomcounty.org/Resource-Library/Maps/38.aspx">http://wria1project.whatcomcounty.org/Resource-Library/Maps/38.aspx</a> > [last accessed February 1, 2016]

## Appendix B: WID Work session information Laurel Watershed Improvement District

1. Overview of Laurel WID characterization and mapping work  
Laurel Watershed Improvement District (Laurel WID) hosted a work session with the ag-watershed project team to prepare agricultural-watershed characterization and mapping work products for use in the Laurel WID's ongoing comprehensive planning. Some of the final work products will also be used as part of the Ag-Watershed Project final report to the Whatcom County Planning & Development Services (WCPDS) Agriculture Program and to the Washington Department of Commerce.<sup>1</sup>

This appendix provides documentation of the February 2016 WID work session, a summary of materials used to gather and document input both before and after the work session, and a list of participants engaged in developing and reviewing the agricultural-watershed characterization and mapping work.

The Laurel WID Board reviewed and approved:

- the scope of work for Task 6 (extended ag-watershed characterization and mapping: December 2015),
- draft characterization tables from the work session and preliminary draft maps (February-March 2016),
- the draft summary report documenting methods and results (April-May 2016), and

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<sup>1</sup> The Ag-Watershed Project is a research and development project funded by a National Estuary Program Watershed Protection and Restoration Grant (June 2012 to June 2016) to Whatcom County Planning & Development Services, administered by the Washington Department of Commerce. Project partners include: Whatcom Farm Friends–Community Education, Whatcom Conservation District, and Washington State Department of Fish & Wildlife. Project fact sheets and links to all previous work, including technical reports and reference documents can be found at <http://whatcomcounty.us/2260/Agricultural-Watershed-Pilot-Project>

- the full draft report on the WID characterization and mapping (this document: May-June 2016).

### 2. Laurel WID work session

The February 4, 2016 work session participants included Laurel WID members and guests who contributed local knowledge and expertise to identify agriculture and watershed priorities and enhancement opportunities within in the WID area.

Participants were introduced to a structured process to identify specific characteristics of the agricultural and watershed systems and locate these on maps of the WID area. Small groups of participants then worked together to identify, characterize and locate agricultural system characteristics and enhancement opportunities in the WID area.

The February 2016 work session orientation included an overview of the Laurel WID area and instruction on the method used for the characterization and mapping activities.

### Background information provided at the work session:

- February 4, 2016 Agenda and work session overview.
- Summary of the Agricultural Analysis Method, included in an excerpt from the 2013 Ag-Watershed Characterization & Mapping Report.
- Fact sheet #2 "Identifying Opportunities to Strengthen Agriculture & Watershed Systems in Whatcom County."
- "About the Laurel WID" website excerpt describing the WID boundary locations, primary watershed assessment units (AU), and list of WID priorities for agriculture and watershed services.

### Reference information provided at the work session:

Prior to the WID work session, the Ag-Watershed Project team compiled information from existing planning and reference documents describing agricultural and watershed systems and enhancement priorities in the Laurel WID area. Background maps and materials were prepared for use in table-top mapping activities (see complete list of work session maps and supporting materials below).

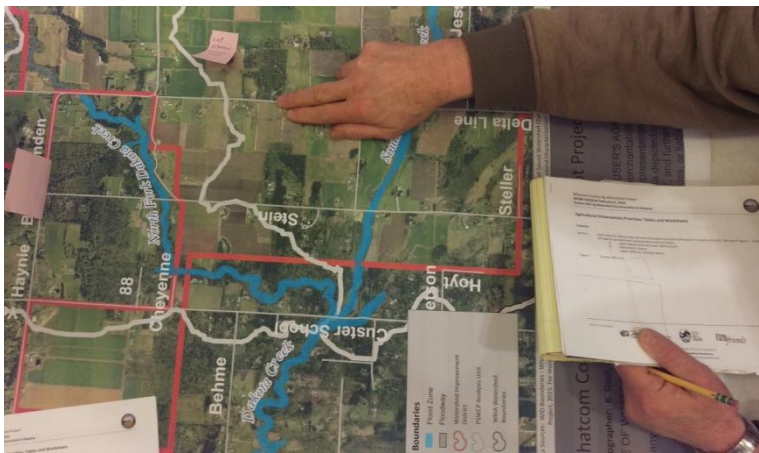


Figure 1. 2016 WID Work session table-top materials.

### Work session materials:

- Laurel WID large-scale locality maps for table-top discussion and note-taking purposes.
- Laurel WID Agricultural Enhancement Priorities: Tables & Worksheets.
- Laurel WID Watershed Enhancement Priorities: Tables & Worksheets.
- Laurel WID Background Maps featuring Water Flow Assessments:
  - Water Flow Assessment Unit (AU) map.

- Water Flow Characterization Results (All) from Puget Sound Watershed Characterization Project (PSWCP) 2015 management recommendations.
- Importance and Degradation of Water Flow from PSWCP 2015 analysis.
- Overall Water Flow Restoration & Protection Management Recommendations from PSWCP 2015 analysis.

### Reference maps provided at the work session:

- Overview and Locality Map: Preliminary showing PSWCP 2015 Area Units & Laurel WID sub-area names, locations.
- Agricultural Priority Areas: Preliminary Draft from Whatcom County Planning & Development Services (WCPDS), 2015 Purchase of Development Rights (PDR) Easements.
- Agriculture Priority Areas and Zoning from WCPDS, 2015.
- Actively Farmed Land from WCPDS, 2015.
- Fish Presence from WRIA 1 Watershed Management Project, 2004.
- Relative Conservation Value of Land from Conservation Northwest, 2007.
- Agricultural Land Use Classes from WCPDS, 2011.
- Priority Habitats and Species from WA Department of Fish & Wildlife 2014 and WA Natural Heritage Program, 2015.
- Prime Soils from SSURGO, NRCS, 2015.
- Water Rights: Points of Diversion from WA Department of Ecology, 2016.
- Condition of Riparian Zone from Nooksack Tribe and Lummi Nation Nooksack Riparian Conditions, 2000.
- Potential Development Rights from WCPDS, 2015.
- 303d Water Quality Impairments (2012) from WA Department of Ecology.
- Watershed health assessment results from Whatcom Conservation District, 2015.





Figure 2. Laurel WID 2016 work Session in action.

### Work session participants:

The objective of the February 2016 Laurel WID work session was to gather input on agricultural system characteristics and enhancement opportunities from a representative mix of agricultural producers and landowners, with the goal of 51% of participants who are active farmers and/or landowners and Laurel WID members.

The WID Board invited a mix of participants considering: (i) location within the WID sub-basins; (ii) type of agricultural operation; (iii) size of agricultural operation; and (iv) parcel size. The WID Board identified additional guests to assist with and advise the work session participants, to provide additional technical inputs at the work sessions, and to review work products for accuracy. See Table 1 for a summary of Laurel WID work session invitees and attending participants\*.

Table 1. Laurel WID Work Session Invitees and Participants.

WID Invitees & Participants*	WID Area	Ag Type
Si Eldred*	Ten Mile Lower	Cattle
Jack Morgan	Ten Mile Upper	Cattle
Art Zawicki	Ten Mile Lower	Cattle
Bradley Sangha	Ten Mile Central	Berry
Dorie Belisle	Ten Mile Central	Fruit
Paul Chudek	Ten Mile Upper	Cattle
Ken Sidhu	Ten Mile Lower	Berry
Ten Mile Group	-	
Bob Kratzig*	Four Mile	Cattle
Eric Sundstrom*	Ten Mile Central	Dairy
Walker Sundstrom*	Ten Mile Central	Dairy
Veen Huizen Farm*	Four Mile	Dairy
Ken Schilke Farm	Four Mile	Berry
Kevin Sterk *	Four Mile	Dairy
Melvin & Joyce Hayes	Four Mile	
Roger Blok*	Four Mile/Cougar	Dairy
Rich Appel	Wiser Cougar South	Dairy
Leroy Plagerman*	Ten Mile Lower	Dairy
Jon Maberry	Ten Mile Central	Berry
Troy Kortus	-	
Mike Boxx*	Ten Mile Lower	Mixed
Dave Keetzig*	-	
WID Guests	Expertise	Agency
Karin Beringer*	Ag land priorities,	Ag Land
Chris Elder*	enhancements	Program,
Mark Personius		WCPDS
Paula Harris	Flood, drainage	River & Flood,
Gary Stoyka*	enhancements	WCPW

### 3. Record of meetings

During WID Board meetings, WID Commissioners reviewed the proposed scope of the ag-watershed characterization and mapping work products, the draft work session materials, and preliminary draft work products prior to the completion of the final project deliverables. Meetings included:

December 14, 2015 - Laurel WID Board reviewed project scope of work (SOW) and proposed Memorandum of Understanding (MOU) with Whatcom County Planning and Development Services.

January 11, 2016 - Laurel WID Board reviewed and approved proposed SOW, MOU, and work session agenda and invitees.

February 4, 2016 - Laurel WID work session participants provided input on agricultural characteristics and enhancements in the WID area.

March 14, 2016 - Laurel WID Board reviewed summary of work session input and preliminary draft report contents.

May-June 2016 - Laurel WID Board reviewed and confirmed the final Laurel WID Agriculture-Watershed Characterization and Mapping Report.

### 4. Record of documents

The Laurel WID Board worked with Ag-Watershed Project staff to conduct work session outreach and proceedings. This record of documents includes administrative documents used to guide the project work and documentation of Ag-Watershed Project team and participant contributions to the final work products and analysis (maps, tables and summary report).

Administrative materials included:

- December 2015 SOW for Laurel WID agricultural and watershed characterization and mapping project (see Table 2 on page 4 with excerpt on the Agricultural Analysis Method).
- December 2015 draft MOU with WCPDS.

- February 2016 Laurel WID work session invitation and RSVP tracking list.
- February 4, 2016 Laurel WID Work Session Agenda and materials.

Information materials provided for preliminary review included:

#### Tables

- Table 1. Summary of results of ag-watershed characterization mapping for the Laurel WID.
- Table 2. Agricultural characterization tables for Laurel WID characterization mapping for the Laurel WID.
- Table 3. Key actions on agricultural priorities specific actions map.
- Table 4. Watershed characterization tables for the Laurel WID.

#### Maps

- Map showing WRIA 1 and Laurel WID.
- Laurel WID overview and locality.
- Laurel WID agricultural priorities: Proportion of prime soils. Data from reference map of prime soils.
- Laurel WID agricultural priorities: Drainage of agricultural land. Data from reference maps of prime soils and special districts.
- Laurel WID agricultural priorities: Protection of agricultural land from flooding. Data from reference maps of prime soils and special districts plus WCPDS GIS data on FEMA flood areas.
- Laurel WID agricultural priorities: Protection of the agricultural land base. Data from reference map of agriculture priority areas.
- Laurel WID agricultural priorities: Water for agricultural activities. Data from reference map on water right points of diversion.
- Laurel WID map of specific actions for agricultural priorities (generated at February 4, 2016 work session).
- Laurel WID: Overall water flow restoration & protection priorities.
- Laurel WID: Water flow assessment units in relation to WID area.
- Laurel WID: Water flow process assessment results.
- Laurel WID: Overall water flow restoration & protection priorities.

Table 2. Excerpt: Ag-Watershed Project Agricultural Analysis Method<sup>2</sup>

<i>Priority What?</i>	<i>Where?</i>	<i>Related Background Info.</i>
Soils	Primary, secondary, tertiary soils for all crop types and rotations. Selection Criteria: Prime Agricultural soils are present in the watershed.	Map: Ag Priority Areas Map: Ag Land Use Map: Prime soils
Water Quantity	Water for irrigation, livestock and agricultural processing. Selection Criteria: One or more applications for new water rights are present, and identified in the Ag Mapping Workshop.	Map: Water Rights
Land Drainage	Includes timing of field drainage for agricultural crops and storage opportunities. Selection Criteria: Over 50% of area contains Prime Ag soils only if drained, or identified in the Ag Mapping Workshop.	Map: Prime soils
Flood Protection	Relief from high flashy flows and sustained flooding events. Selection Criteria: Contains prime Ag soils only if protected from flooding, or identified in the Ag Mapping Workshop.	Map: Ag Land Use Map: Prime soils
Protection of the Ag Land Base	Use of purchase or transfer of unrealized development rights in order to protect working ag land from conversion pressures. Selection Criteria: over 50% the area includes any combination of land zoned Agriculture, "Rural Study Area", or in PDR easements.	Map: Ag Priority Areas Map: Ag Land Use Map: Potential Development Rights

<sup>2</sup> Agricultural Analysis Method from the Agriculture-Watershed Characterization & Mapping Report combines information on existing agricultural protection programs, local knowledge and available GIS data. Gill P (2013). *Agriculture-Watershed Characterization and Mapping Report for the North Lynden watersheds*. Prepared for the Whatcom County Agriculture-Watershed Pilot Project, Whatcom County Planning & Development Services, Bellingham. <http://www.co.whatcom.wa.us/2260/Agricultural-Watershed-Pilot-Project>



## Appendix C: Water Flow Assessment Results for Water Resource Inventory Area 1

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# 1 Methodology

The description of the watershed characterization methodology has been adapted from that provided in the Appendix to the pilot agriculture-watershed characterization and mapping report.<sup>1</sup>

## 1.1 General approach

The watershed characterization assessment uses methods developed by the Puget Sound Watershed Characterization Project.<sup>2</sup> The results of the watershed characterization assessment are intended to assist the WIDs in identifying high priority opportunities for watershed enhancement projects on agricultural land in the lowland areas of Whatcom County, with a focus in areas where watershed and agricultural priorities could be mutually reinforcing.

The *Puget Sound Watershed Characterization (PSWC)* is a set of water and habitat assessments that compare areas within a watershed for relative restoration and protection value. It is a coarse-scale decision-support tool that provides information for regional, county, and watershed-based planning. The information it provides allows local and regional governments, as well as NGOs, to base their land use decisions on a systematic analytic framework. It prioritizes specific geographic areas for protection, restoration, and conservation of our region's natural resources, and identifies where best to focus new development. Application of this method should result in future land-

use patterns that protect the health of terrestrial and aquatic resources while directing limited financial resources to the highest priority areas for restoration and protection.

The objective of the PSWC assessment is to “characterize” the watershed in a way that helps to identify priority enhancement opportunities. The relative comparison of assessment units (AUs) for water flow processes across the lowland watersheds allows for a coarse-level snapshot of which areas are relatively important or degraded for water flow. From this snapshot we suggest possible enhancement actions that could contribute to improving or protecting water flow processes at the AU scale. Actual site location of those actions within an assessment unit would require different analyses not described here.

The assessment results in this document address the following primary questions for the Whatcom County lowland watersheds:

(1) *Where on the landscape* should management efforts be focused first to benefit water flow processes in the watersheds that are part of the Watershed Improvement District?

(2) *What types of activities and actions* are most appropriate to that place based on the assessment results?

The assessment results therefore address both the “where” and the “what” to focus on, in terms of water flow processes. This integrated approach offers a systematic framework for identifying more important areas within the lowland watersheds and those which are more degraded for water flow processes and water quality, with the intent of identifying areas that offer the most potential for enhancement.

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<sup>1</sup> Hume C & Stanley S (2013). *Summary of Water Flow Assessment Results for Bertrand, Fishtrap and Kamm Watersheds*. Appendix A in Gill P (2013). *Agriculture-Watershed Characterization and Mapping Report for the North Lynden watersheds*. Prepared for the Whatcom County Agriculture-Watershed Pilot Project by the Washington Department of Ecology Shorelands and Environmental Assistance Program.

<http://www.co.whatcom.wa.us/2260/Agricultural-Watershed-Pilot-Project>

<sup>2</sup> See [http://www.ecy.wa.gov/puget\\_sound/characterization/index.html](http://www.ecy.wa.gov/puget_sound/characterization/index.html)

## 1.2 Limitations

Care should be taken to use the Puget Sound Watershed Characterization as intended. It is a coarse-scale assessment and is not intended for site-specific application or decision-making at the site scale. Finer scale data, local information and technical expertise is needed for those decisions. In addition:

- The Puget Sound Watershed Characterization is for planning purposes only. This does not affect or alter existing land use/environmental regulations although it may be used to help inform future land use and regulatory decisions.
- For the water flow assessment, the rankings for any single AU are relative only to other AUs in the area of analysis. This means it is only appropriate to compare the Watershed Improvement District (WID) results with results in other AUs in the lowland area of WRIA 1.
- Results at the AU scale represent land-use planning-level information. At the project- or site scale, each AU will have a combination of on-the-ground challenges and opportunities. Just because an AU is rated as a low priority for restoration does not mean there are no suitable restoration sites or opportunities in that AU. Similarly, not every site in an AU that is a high priority for restoration will be suitable for restoration.
- The assessments are landscape-scale and consequently do not address site-specific issues. These are best addressed through finer-scale studies, which will remain essential to the success of local conservation efforts. When developing site-level plans, the WID should evaluate the need for finer-scale information and collect it where needed.
- The watershed characterization assessment is not intended to address compliance with state or federal water quality law, nor describe the actions necessary to achieve compliance with those laws. It is a violation of state law when activities are shown to cause or have the substantial potential to cause nonpoint source

pollution. If the reader has questions about the water quality laws, they can contact Whatcom County Public Works or the WA Department of Ecology for additional information.

## 1.3 Fundamental Concepts of Watershed Characterization

Watershed processes are defined as the dynamic physical and chemical interactions that form and maintain the landscape and ecosystems on a geographic scale of watershed to basins. This includes the movement of water, sediment, nutrients, pathogens, chemicals and wood. Watershed processes are controlled and influenced by natural attributes and human actions. Natural controls on watershed processes include physical attributes of the ecosystem such as geomorphology, geology, and soils. Many human actions influence watershed processes. For example, timber harvest may reduce the amount of wood entering streams. Shoreline armoring can reduce sediment input from bluffs and alter the erosion, movement, and deposition of sediments along beaches. Urban development can increase the amount and amplitude of stormwater runoff. Watershed characterization attempts to model these watershed processes such that areas of the landscape can be identified which are relatively more important (presence of natural controls) or degraded (due to human impacts).

## 1.4 Understanding the Water Flow Assessment results

The Water Flow Assessment uses two models to compare the *importance* and *degradation* of water flow processes in a watershed. Together, they identify areas that are relatively more suitable for protection or restoration of water flow processes. Each model provides a ranking from low to high for how important and how degraded each assessment unit is *relative* to the other units in the watershed.

### Water Flow importance

The *importance* model evaluates the watershed in its “unaltered” state. This model combines the delivery, surface storage, recharge, and discharge components to compare the relative *importance* of assessment units in maintaining overall water flow processes in a non-degraded setting. When precipitation is “delivered” as either rain or snow, there are physical features that control the surface and subsurface movement of that precipitation within an assessment unit. These physical features include land cover, storage areas such as wetlands and floodplains, areas of higher infiltration and recharge, and areas that discharge groundwater. These areas are considered “important” to the overall water flow processes.

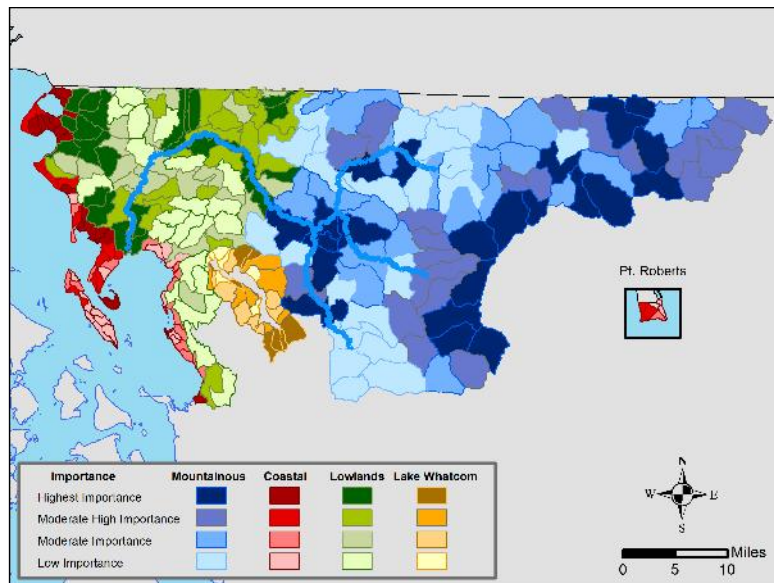


Figure. Overall importance to water flow processes: Results of Puget Sound Watershed Characterization assessment for WRIA 1. Darkest colored assessment units are considered highest *importance* relative to other assessment units in the same landscape group of WRIA 1.

In the figure to the left, each landscape group is displayed in a different color gradient (i.e. blue, green, red or tan), which allows for direct comparison within the extent of that landscape group only. Dark green assessment units would be considered *highly important* for overall water flow processes *only* within the lowland area of WRIA 1, and are not comparable to AUs outside of that extent. However, this does allow one to determine which AUs throughout the lowland areas of WRIA 1 are *relatively more important* than others in that same extent.

### Water flow degradation

In the water flow *degradation* model the watershed is evaluated in its “altered” state to consider the impact of human actions on water flow processes. The *degradation* model calculates the degree of alteration to those controls that regulate the delivery, movement and loss of water, such as forest clearing and impervious surfaces. This model combines the delivery, surface storage, recharge, and discharge components to compare the relative *degradation* to overall water flow processes in assessment units. Degradation to these processes generally accelerates the movement of surface flows downstream. This accelerated delivery increases downstream flooding and erosion and subsequently degrades aquatic habitat over time.

The figure below displays the results of the *degradation* to water flow processes for all of WRIA 1. Since degradation is not controlled by landscape, we compare assessment units within the entire extent of the WRIA. A dark pink unit along the coast is comparable in level of degradation to a unit in the lowland area.

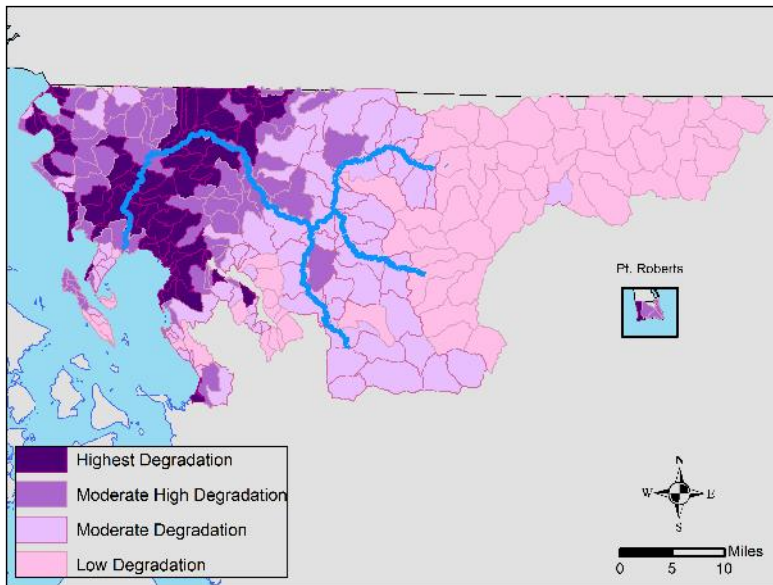


Figure. Overall degradation of water flow processes: Results of Puget Sound Watershed Characterization assessment for WRIA1. Dark pink assessment units are considered to have the highest *degradation* relative to other assessment units in WRIA1.

#### Management matrix for water flow

Combining the results of the *importance* and *degradation* models yields a simple categorical matrix that planners can use, along with other science-based information, to inform land management strategies and actions. At its simplest, this management matrix conveys which areas are relatively important and/or degraded, and what actions might be most appropriate there:

Highly important – low degradation = protect  
 Highly important – high degradation = restore  
 Low importance – low degradation = conserve  
 Low importance – high degradation = develop

The Puget Sound Watershed Characterization project generally prioritizes restoration or enhancement actions in watersheds which

are both highly important and are relatively more degraded for watershed processes (yellow boxes in the Management Matrix Figure below). This does not mean that there are not important areas or necessary restoration actions in assessment units that are not highly important and highly degraded. Rather, given limited funding these might be the first places to focus on in order to increase the likelihood of improving watershed processes.

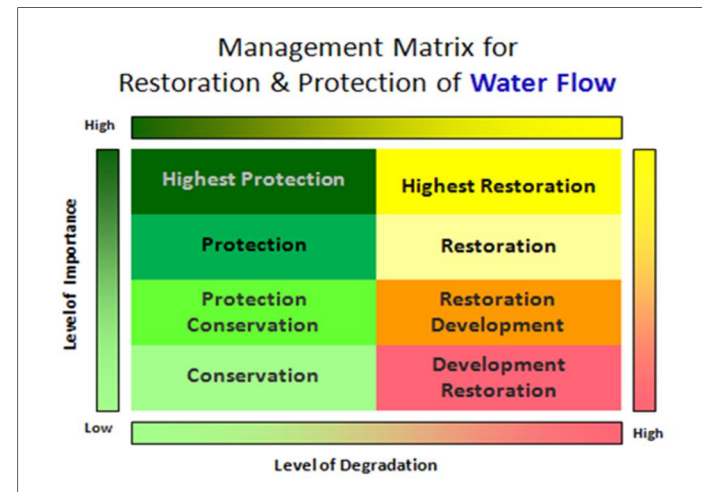


Figure: Management Matrix for Water Flow, indicating relative priorities for restoration and protection of processes. By accounting for both the relative level of *importance* and the relative level of *degradation* of an Assessment Unit one can begin to prioritize which areas of a watershed to apply management strategies which protect water flow processes, and which areas to prioritize restoration of water flow processes.

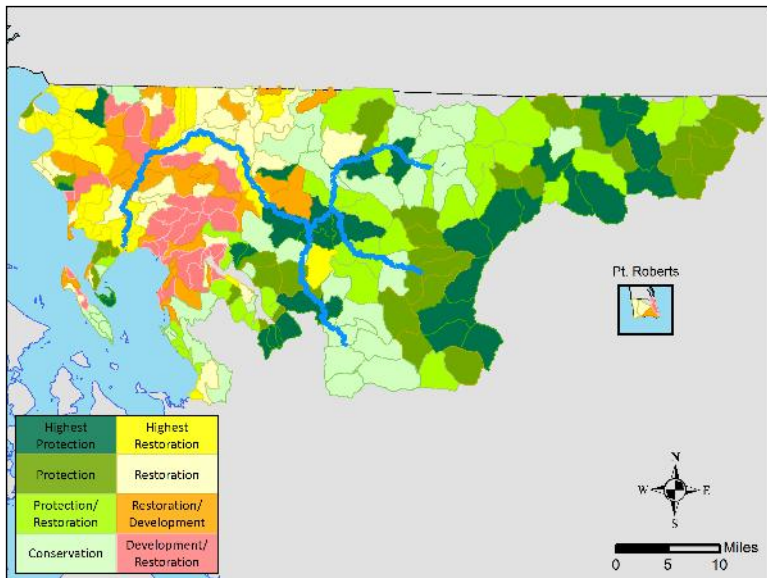


Figure. Overall priorities for restoration and protection of water flow processes in WRIA 1: Results of Puget Sound Watershed Characterization assessment.

## 2 Using the results of the water flow assessment

For water flow process enhancement or restoration, actions should be directed towards reducing the degradation to controls that regulate the delivery and movement of water through the watershed. These controls include forest cover, areas of surface storage, areas of permeable deposits, areas of slope wetlands and areas of floodplains with permeable deposits.

The terms “restoration” and “protection” as used in this document do not mean a return to historic land cover conditions or retaining 100% forested land cover. Restoration and protection actions should be done in a manner that recognizes and works within the constraints of the existing land use activities. For example, restoration in agricultural areas could mean consideration of measures that enhance

a critical portion of water flow processes such as surface storage. This could involve the retention of water on fields for a longer period to avoid harmful peak flows within streams during the winter months. Restoration and protection measures are, therefore, always proposed here in the context of both the landscape setting and the current land use activities.

There are actions which can offer mutual benefits to both water flow and water quality. For example, there are some areas where wetland restoration or enhancement to surface storage processes could provide some improvements for both. Enhancement actions for water flow processes may have additional benefits to other watershed processes and functions particularly in the area of riparian habitat and structure which are critical to salmonid habitats throughout the Whatcom County lowland watersheds.



### 3 Water flow assessment results for WRIA1

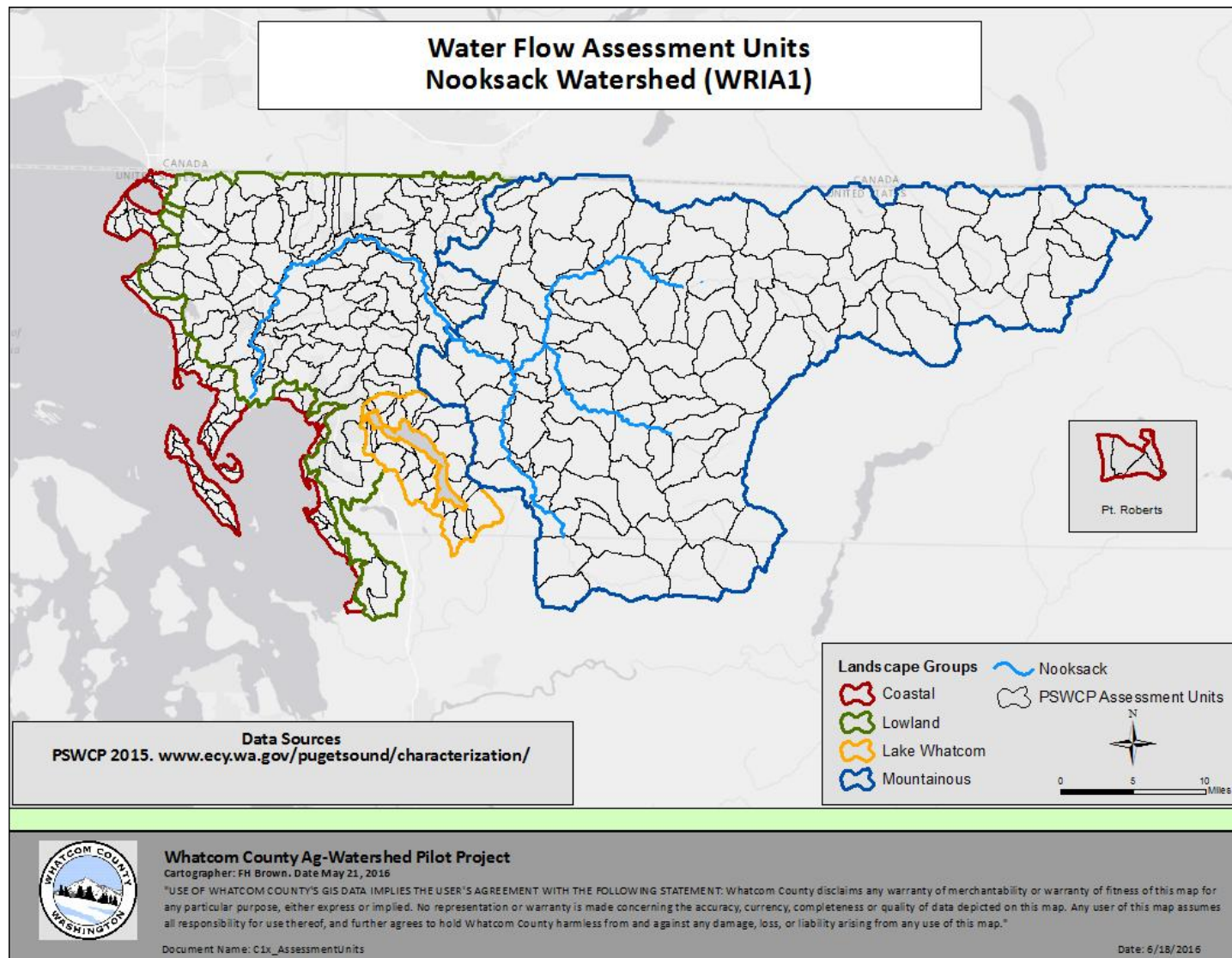


Figure 1. Water flow assessment units used in the Puget Sound Watershed Characterization.

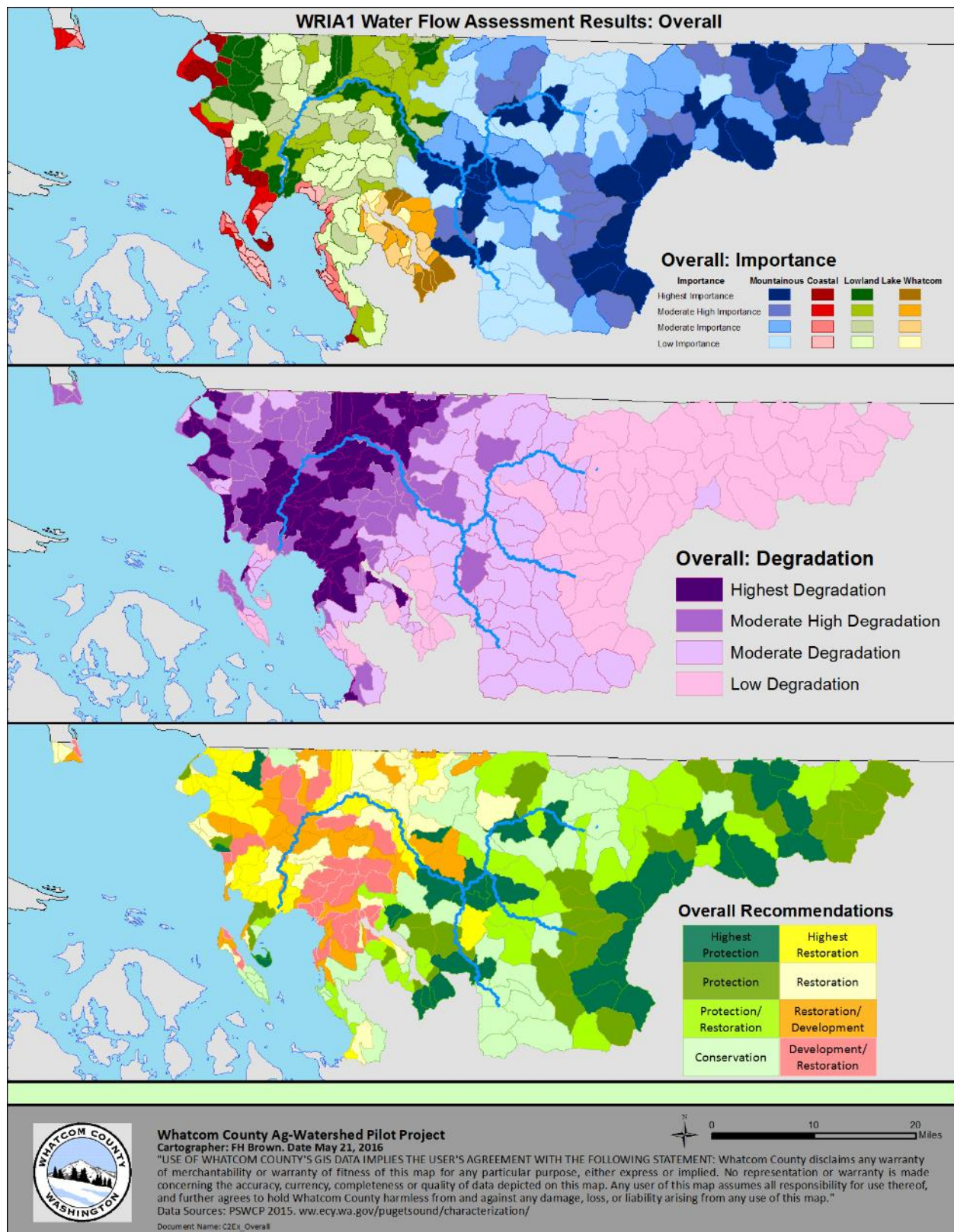


Figure 2. Overall water flow assessment results for WRIA1.



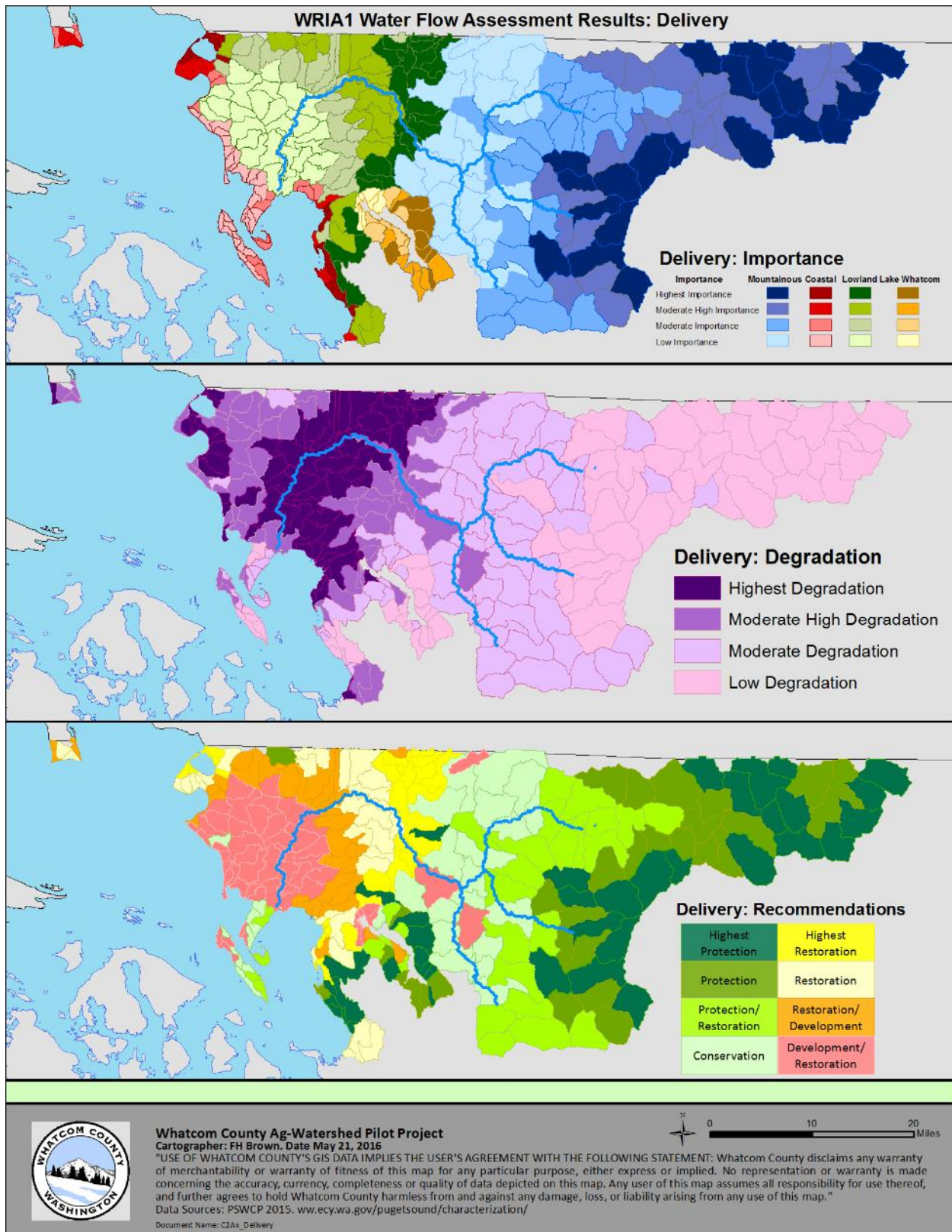


Figure 3. Delivery processes: Assessment results for WRIA1.

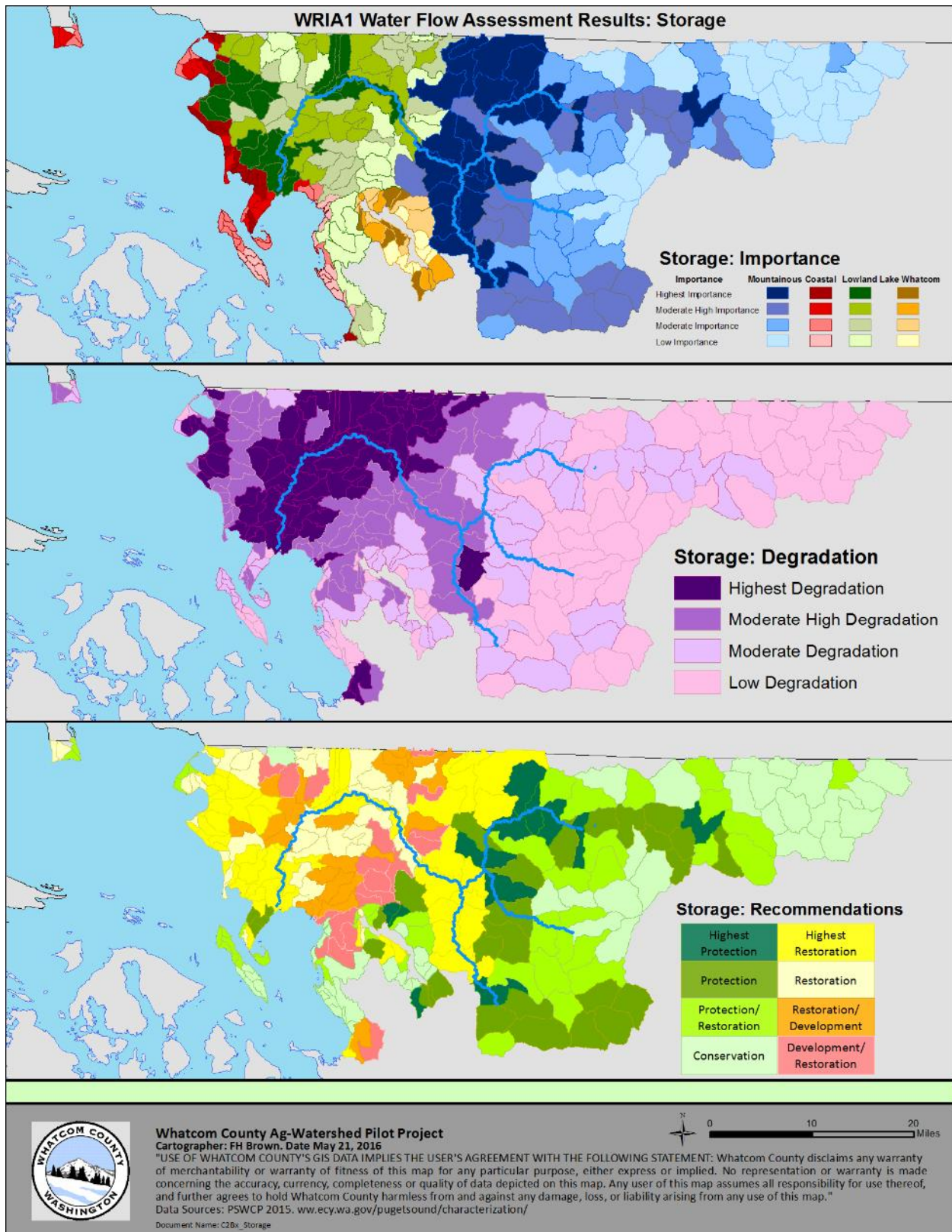


Figure 4. Storage processes: Assessment results for WRIA1.



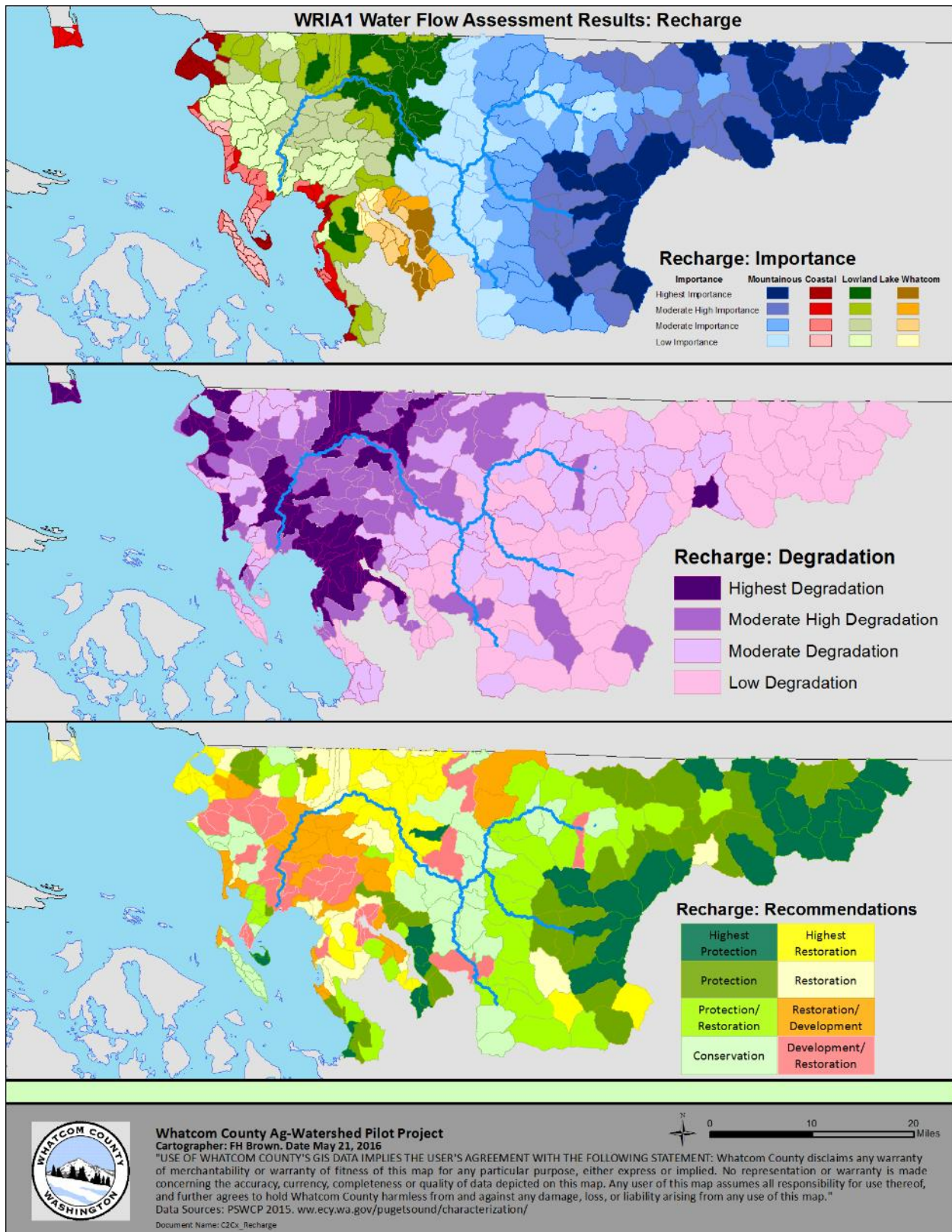


Figure 5. Recharge processes: Assessment results for WRIA1.



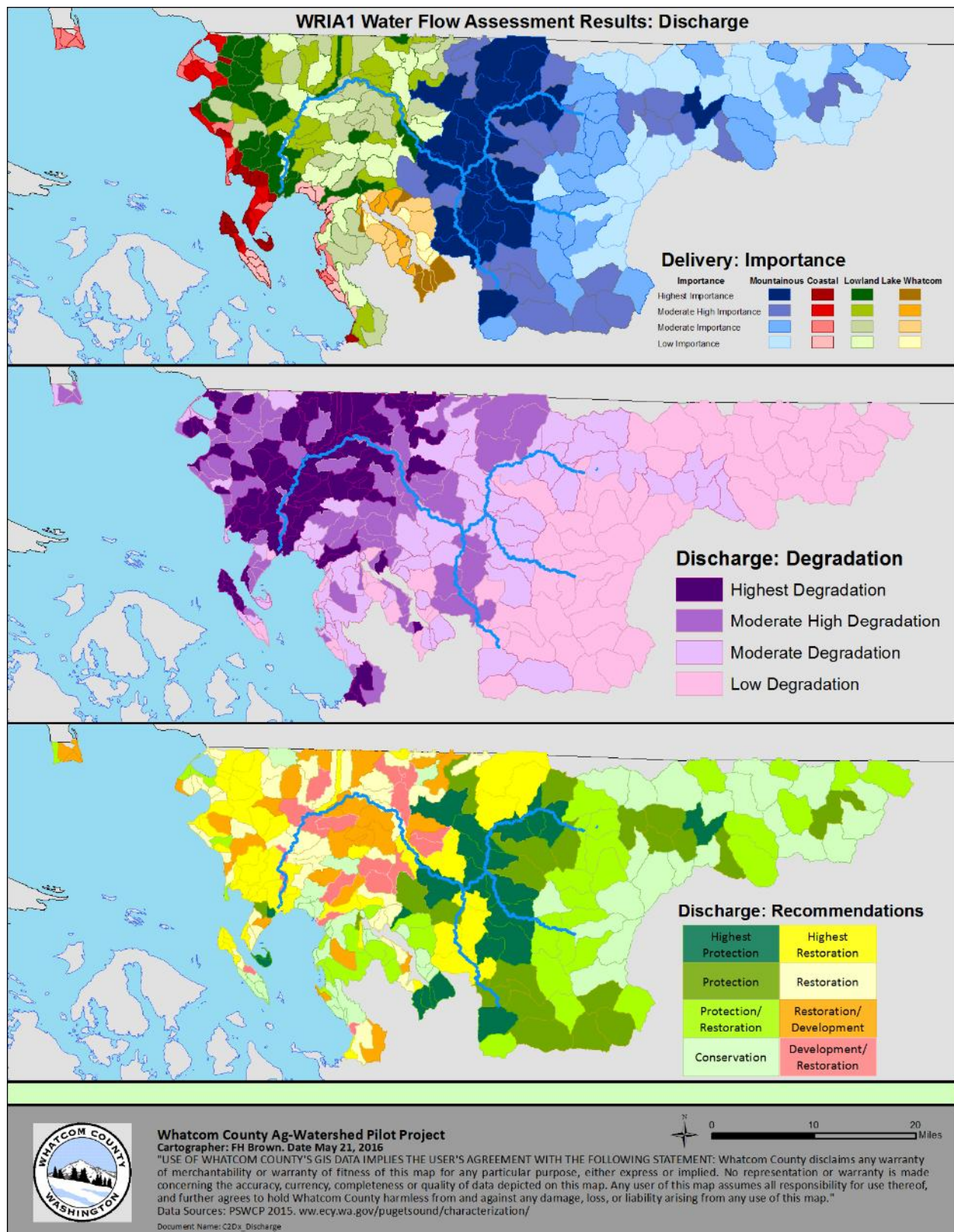


Figure 6. Discharge processes: Assessment results for WRIA1.

Appendix D. Ag-Watershed Project Fact Sheet #5:

Planning, designing and implementing beneficial actions for agricultural & watershed enhancement



## Whatcom County Ag-Watershed Project Fact Sheet #5

Planning, designing and implementing beneficial actions for agricultural & watershed enhancement

The Whatcom County Agriculture-Watershed Pilot Project (the "Ag-Watershed Project") has examined ways to reward beneficial actions by farmers and landowners who voluntarily go beyond existing regulation to maintain, restore or enhance large-scale watershed processes, while also strengthening agriculture in Whatcom County (see [Fact Sheet #1](#)).

Agricultural landowners and farmers have worked with the Project Partners (Whatcom County, Whatcom Conservation District, Whatcom Farm Friends and Washington Department of Fish & Wildlife) to test ways to better integrate agriculture and watershed planning and to design, select and implement effective local enhancement projects.

The project has used pilot studies on agricultural land in Whatcom County to test

- planning tools to identify high-priority, high-value opportunities to take actions for agricultural and watershed enhancement and/or protection,
- scientific measurement tools that connect specific beneficial actions on working farmland to measurable outcomes for agriculture and watersheds, and
- administrative tools to verify, track and account for the benefits of these actions over time.

Fact sheet #5 shows how Agriculture-Watershed Characterization and Mapping can be used as a planning tool to:

- integrate local agricultural priorities into routine planning for consideration alongside adopted watershed priorities in Whatcom County and the Puget Sound region, and
- design local projects on a single farm or group of farms that help to achieve both agricultural and watershed enhancement priorities.

### STEP1: CHARACTERIZE AND MAP AGRICULTURAL AND WATERSHED ENHANCEMENT PRIORITIES

The characterization and mapping process combines information from current agriculture and watershed plans with existing spatial data, field experience and farmers' local knowledge to identify agricultural priorities and needs in the area alongside watershed priorities and needs, as shown below in the example maps for a Watershed Improvement District. (See [Fact Sheet #2](#) for more detailed information on the characterization and mapping process.)

Farmers, planners and landowners identify, characterize & map enhancement priorities, using local field knowledge, existing data and reference maps.



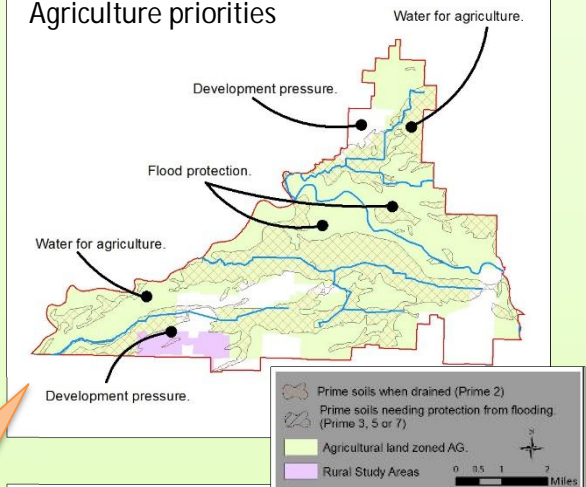
#### Working agricultural lands. Needs and enhancement priorities:

- Water quantity for out of stream uses
- Water quality for agricultural use
- Drainage of fields
- Flood protection
- Protection of agricultural land base and soils
- Pollination

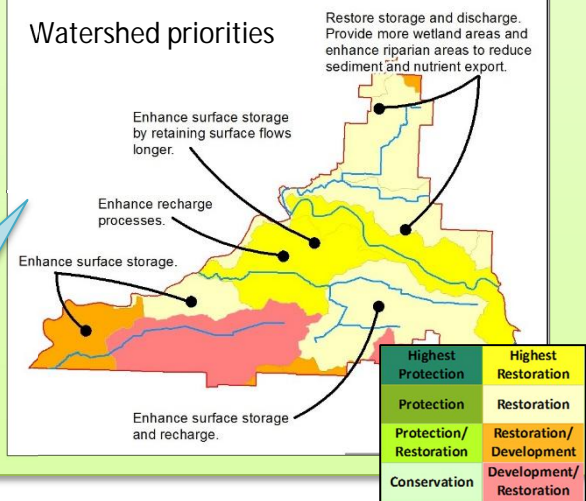
#### Watershed systems. Protection, restoration and enhancement priorities:

- Water quality
- Habitat (riparian, instream, fish, wildlife, wetlands)
- Water quantity
- Water flow processes (recharge, discharge, surface water storage, water delivery)

#### Agriculture priorities



#### Watershed priorities



See Ag-Watershed Project website <http://www.co.whatcom.wa.us/2260/Agricultural-Watershed-Pilot-Project>

for Fact Sheets 1-5 and links to the Watershed Characterization and Mapping Reports for the Watershed Improvement Districts



## STEP 2: IDENTIFY PLACES WHERE AGRICULTURAL AND WATERSHED PRIORITIES COINCIDE

In some locations, agricultural and watershed priorities may be in competition; in other locations they may be complementary. Ideally, projects should enhance watershed processes while also strengthening agriculture. Sometimes, however, acceptable tradeoffs must be found between agricultural and watershed priorities. Mapping these priorities concurrently allows farmers and planners to identify the places in the landscape that offer opportunities to address both watershed and agricultural needs most efficiently and effectively.

## STEP 3: SELECT SPECIFIC ACTIONS FOR AGRICULTURAL AND WATERSHED ENHANCEMENT

Watershed Improvement Districts (WIDs) and other special districts, planners and landowners can use the maps and characterization reports to determine which agricultural enhancements or conservation actions might be most appropriate at a site, given current regulation. Scientific measurement tools (metrics) allow planners and WIDs to develop potential scenarios for optimizing agricultural and watershed enhancements before pursuing project design, verification and implementation (see [Fact Sheet #3](#)).

## STEP 4: INTEGRATE ACTIONS INTO WATERSHED & LAND USE PLANS AND INVESTMENT STRATEGIES

Priority actions and projects can be integrated into farmers' business plans, ongoing WID planning, land and watershed management efforts and funding programs (see [Fact Sheet #4](#)). Tracking progress against longer-term goals helps to quantify the benefits of investing in actions for watershed and agricultural enhancement on working farmland.

## AG-WATERSHED PROJECT PILOTS & CASE STUDIES: EXAMPLES OF BENEFICIAL ACTIONS & PROJECTS

### Pilot 1 (single landowner)

Proposed enhancement: Avoided conversion of wetland habitat resulting from beaver activity in the headwaters of an important salmon bearing stream, on a site that could be returned to active farming at the end of the Conservation Reserve Enhancement Program (CREP) lease.

Agricultural benefits: diversification of revenue from payment for permanent wetland conservation easement on marginal farmland.

Watershed benefits: wetland habitat and surface water storage capacity in the upper watershed are permanently protected.



### Pilot 2 (multiple landowners):

Improve flood protection and field drainage for low-lying farmland, while concurrently increasing stream width and channel complexity, improving stream-floodplain connectivity and restoring riparian vegetation in a highly channelized reach. Agricultural benefits: improved flood protection and drainage for fields on prime farmland [proposed project design addresses faster removal of flood waters from fields & improved efficiency of drainage ditches].

Watershed benefits: stream function and habitat condition in the reach are enhanced in exchange for a small amount of agricultural land taken out of production to accommodate channel widening.

Case study (land use planning): Measuring the potential agricultural benefits of different land use options. The demonstration site is an undeveloped property located in the Nooksack basin lowlands, within the floodway. Soils are mostly agricultural, but prone to flooding. Surrounding land use is mixed urban and agricultural.

### Future option 1 (agricultural use)

- Entire site actively farmed, except for creek buffer
- Permanent Agricultural Conservation Easement protects

- land for farming

- Maintain soil drainage for fields

### Future option 2 (mixed use)

- NE portion actively farmed, SW portion converted to recreation/open space

- Watershed enhancement along creek & floodway

