



# RIPARIAN VEGETATION INVENTORY AND FUNCTION ASSESSMENT OF TRIBUTARIES AND MARINE SHORELINE

## SOUTHWEST WHATCOM COUNTY

### **Prepared for**

Whatcom County Water Resources  
322 N. Commercial Street, Suite 110  
Bellingham, Washington 98225

### **Prepared by**

Anchor QEA, LLC  
720 Olive Way, Suite 1900  
Seattle, Washington 98101

**October 2012**

# PHASE 2 RIPARIAN VEGETATION INVENTORY AND FUNCTION ASSESSMENT OF TRIBUTARIES AND MARINE SHORELINE SOUTHWEST WHATCOM COUNTY

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## LIST OF ACRONYMS AND ABBREVIATIONS

CREP	Conservation Reserve Enhancement Program
Ecology	Washington State Department of Ecology
LiDAR	Light Detection and Ranging
LWD	large woody debris
NOAA	National Oceanic and Atmospheric Association
NRCS	U.S. National Resources Conservation Service
PSLC	Puget Sound LiDAR Consortium
SMA	Shoreline Management Act
SMP	Shoreline Master Plan
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources

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## 1 INTRODUCTION

Anchor QEA, LLC (Anchor QEA), conducted a riparian vegetation inventory and function assessment in 2010 to address data gaps on riparian conditions in areas of Northwest Whatcom County. The 2010 inventory and function assessment was conducted in Dakota, California, and Terrell creeks, as well as along the coastal marine shoreline between the U.S.-Canadian border and Point Whitehorn. A report similar to this one (Anchor QEA 2012) describes the results of a 2010 investigation conducted in portions of the Jordan, Silver, Squalicum, Chuckanut, and Padden creek basins, as well as along the coastal marine shoreline from Point Whitehorn south to the Whatcom County boundary, including Point Roberts and Lummi and Eliza Islands.

This riparian vegetation inventory fills data gaps in the project area. The riparian function assessment characterizes existing conditions for fish habitat and wildlife corridors. Existing riparian function and the identification of restoration priorities focused on three specific functions of riparian vegetation:

- A source of large woody debris (LWD) to the water bodies in order to form and maintain complex aquatic habitat structure
- Corridors for wildlife to live in and move through
- Buffers promoting water quality by allowing stormwater to percolate into the soil and cast shade over the water

This assessment uses the methodology developed for the previous riparian function assessment and relies on much of the same data that was used to conduct the assessment in the northwest portion of the county in 2010 (Anchor QEA 2010).

This report describes the methods and findings of the inventory and the riparian function assessment. The main geodatabase product for the project accompanies this report. This report highlights selected example maps and results of what the data in the geodatabase can support. The inventory and assessment methods applied in this study were established to be efficient and transferrable, so they can be applied in other parts of Whatcom County as funding allows.

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## 2 METHODS

The 2010 assessment methodology was based on a literature review of studies conducted in Whatcom County involving the collection and assessment of riparian data, including studies of the Nooksack River basin (Duck Creek Associates 2000; Coe 2001; Hyatt et al. 2004) and along shorelines within the Birch Bay watershed (ESA Adolfson 2007). Using the same methodology and geodatabase design from the 2010 report provided consistency with this assessment. That methodology is described below.

### 2.1 Project Area and Assessment Reaches

The project area included portions of five creeks: Jordan, Silver, Squalicum, Chuckanut, and Padden, as well as the coastal marine shoreline between Point Whitehorn and the southern boundary of Whatcom County, including Point Roberts and Lummi and Eliza Islands. Tributaries included all reaches within the designated creek basins that are outside of Bellingham city limits, with the exception of Chuckanut Creek. All reaches were approved by Whatcom County prior to assessment (Map 1).

All data were collected in assessment reaches. The initial reaches were determined using a stream layer approach provided by Whatcom County (SSHIAP\_HydroEdit\_Line); these reaches were divided according to Washington Department of Fish and Wildlife (WDFW) SalmonScape hydrology data according to their attributes for geomorphology (confinement and gradient class). To be consistent with the Whatcom County Shoreline Master Plan (SMP), reaches were also split according to their intersections with other creek lines. Freshwater reaches were also split at Conservation Reserve Enhancement Program (CREP) boundaries. Initial coastal marine reaches were created from the shoreline geometry developed for the Whatcom County SMP (PLN\_wcpds\_smp\_Marine\_shoreline). Coastal reaches were split again using shoretype landform data developed for the WRIA 1 Nearshore & Estuarine Assessment and Restoration Prioritization (Coastal Geologic Services 2012). In addition, during the data collection process, reaches were refined to shorter lengths by assessing the riparian condition in each reach and dividing the reaches accordingly at places where distinct changes in riparian vegetation occurred.

Along all shorelines, riparian vegetation data were collected in the 30- and 100-foot buffers. Along the coastal marine shoreline, data were also collected in a 200-foot buffer, which is consistent with the Shoreline Management Act (SMA) jurisdictional width. In the creeks, separate data were collected for left bank and right bank conditions. To facilitate data collection, buffers were created on either side of the hydrology data layer in ArcGIS using predetermined distances of 30 and 100 feet for tributary reaches and 30, 100, and 200 feet for coastal reaches (only buffered upland). In the tributaries, buffers were created from the hydrology data layer. The resulting polygons were then used to identify the data collection zone for each reach. In areas where the hydrology line or shoreline did not match up with conditions in the aerial imagery, the interpretation of riparian conditions was adjusted so that the correct buffer area was evaluated.

## 2.2 Riparian Vegetation Inventory Methods

Using the created buffers as visual guides, riparian vegetation data were collected for each reach at each buffer level and stored on the fly in a geodatabase feature class. Data for 30- and 100-foot buffers were collected separately. The primary aerial imagery used in the riparian vegetation inventory was 2010 color aerial imagery with 8-inch resolution provided by Whatcom County, and aerial oblique photographs from the Washington State Department of Ecology (Ecology) and the Bing website ([www.bing.com/maps](http://www.bing.com/maps)).

In each buffer width and along each bank, riparian vegetation data were collected through aerial interpretation. The data collected was vegetation type, vegetation density, and percentage of shade over the body of water. Any relevant notes pertaining to the confidence of the reach data collection or for informative purposes were also recorded. Table 1 describes the categories used for each of the data sets.

**Table 1**  
**Vegetation Type, Density, and Shading Categories**

Category	Description
<b>Vegetation Type</b>	
Coniferous	Forested areas, with 70% or more tree coverage coniferous
Deciduous	Forested areas, with 70% or more tree coverage deciduous
Mixed	Forested areas, with no dominance



Category	Description
Shrub	Areas with vegetation less than 15 feet tall at maturity
Agricultural	Areas of pasture or crops; no planted riparian area
Lawn/Landscaped	Cleared, grass lawn, or landscaped areas
Urban	More than 50% impervious or non-vegetated surfaces
<b>Vegetation Density</b>	
Sparse	Less than two-thirds forested
Dense	More than two-thirds forested
<b>Percent Shade</b>	
0% to 20%	Stream and both banks visible
20% to 40%	Banks partially visible
40% to 70%	Stream surface visible, banks not visible
70% to 90%	Stream visible in patches
More than 90%	Stream not visible more than 10% of length

The height of the riparian vegetation was estimated using USGS 2006, Puget Sound LiDAR Consortium (PSLC) 2005, and Lummi/San Juan Islands 2009 Light Detection and Ranging (LiDAR) data from the PSLC. Both highest-hit and bare-earth data for the assessment area were available in multiple tiles; the data were imported into ArcMap, where a spatial analyst was used to create mosaic datasets for each return type. Using the raster calculator in ArcMap, the bare-earth LiDAR was subtracted from the highest-hit LiDAR, resulting in an estimated canopy height data set. The LiDAR was then reclassified into three elevation ranges: 0 to 10 feet, 10 to 50 feet, and greater than 50 feet. Using the buffer polygon dataset for buffer distances of 30 feet and 100 feet, zonal statistics for riparian vegetation were calculated for the LiDAR elevation ranges, and the “majority” attribute was then stored in the corresponding reach feature as the estimated canopy height. Table 2 describes the vegetation height categories.

**Table 2**  
**Vegetation Height Categories**

Category	Description
Small	Majority of stand height less than 10 feet
Medium	Majority of stand height between 10 and 50 feet
Large	Majority of stand height more than 50 feet

### **2.2.1 Quality Assurance and Quality Control of Riparian Vegetation Inventory**

Throughout the data collection process, a variety of quality assurance and quality control methods were used. In the initial reach data collection process, data were collected in a personal geodatabase feature class. In this feature class, domains were set up to expedite the collection process and ensure that data were classified uniformly. Domains allow the creator of the geodatabase to predetermine what can be stored in an attribute table and allow for the use of drop-down menus during data collection, which increases the rate and accuracy of the data collected. After approximately 25 percent of the reach data were collected, a second geographic information system (GIS) operator assessed reaches previously assessed by the first operator, and any differences in classifications were reconciled. This process ensured both that the assessment methodology was understood and that the operators' eyes were properly trained. The assessment confidence for each reach was also noted during the data collection process, including any reason for a degraded confidence (Table 3). There were some occurrences of low confidence, and most of those incidences result from the operator not being able to see the stream channel in the aerial imagery or poor registry between the stream reach layer and the aerial photo.

**Table 3**  
**Assessment Confidence Categories**

<b>Category</b>	<b>Description</b>
High	No difficulty in assessing reach
Medium	Some difficulty in assessing reach
Low	Difficulty in assessing reach

LiDAR data were also checked during data processing to ensure that elevation values were not altered during the import and mosaic process. Spot checks were conducted to compare the original data with the mosaic data. A visual comparison was also made between the reclassified elevation-range LiDAR and the aerial photograph to qualitatively review the classification scheme for spatial correctness. In the previous phase of this project, completed for northwest Whatcom County, it was necessary to reassess reaches classified as "mixed" vegetation type due to the large number that had been classified as such. Two factors contributed to this not being necessary for this assessment in this phase: the interpreters'

eyes were more trained for discerning between vegetation types; and the aerial photograph was temporally sufficient to make the determination between coniferous and deciduous vegetation.

## 2.3 Riparian Function Assessment

The functional assessment to characterize riparian conditions and support the identification of priority areas for restoration was based on riparian conditions as they relate to:

- LWD recruitment potential
- Wildlife corridor connectivity
- Water quality

Table 4 shows the riparian vegetation data parameters used to assess the existing conditions and future restoration needs of each aspect of riparian vegetation function. The methods for evaluating each of the riparian functions are described in the subsequent sections.

**Table 4**  
**Riparian Vegetation Parameters Used to Assess Riparian Function**

<b>Riparian Parameter</b>	<b>LWD Recruitment Potential</b>	<b>Wildlife Corridor Connectivity</b>	<b>Water Quality</b>
Vegetation Type	✓	✓	✓
Percent Shade			✓
Stand Height	✓		
Vegetation Density	✓	✓	✓

For each component of riparian function evaluated, the existing conditions were assessed and assigned to a category (e.g., high, medium, or low). Next, a restoration need category was assigned based on the existing conditions; if the existing conditions were highly functioning, then the restoration need was low and vice versa. The restoration need categories for the individual restoration functions evaluated were also high, medium, or low.

Reaches including lands that have been enrolled in the CREP program were identified separately and separated into unique reaches. These reaches are assumed to be “In Restoration” with some amount of riparian vegetation restoration having already occurred

and currently providing some direct benefit. Riparian buffers provide benefits to water quality, fish, and wildlife. Riparian buffers keep water temperatures cool by shading and reduce erosion by providing stream bank stabilization. They also act to intercept sediment, nutrients, pesticides, and other materials in surface runoff and reduce nutrients and other pollutants in shallow subsurface water flow (NRCS 2006). Additionally, riparian buffers provide habitat and wildlife corridors in primarily agricultural areas. However, due to the temporal constraint of the aerial photography data being used, it is difficult to determine the current benefit being provided due to the immaturity of the CREP activities. In order to maintain consistency in the assessment, the prioritization of CREP reaches was completed based on the same parameters as non-CREP reaches. This may result in a higher than necessary restoration priority being assigned. The restoration need scores for all CREP reaches have been assigned “In Restoration” to ensure that CREP reaches are not inappropriately prioritized over other sites. It is recommended that site-specific analysis or site visits be conducted at the CREP sites to accurately determine the current ground condition. It is important to note that reaches more recently put into restoration may have limited existing function, but are on a trajectory to have significantly increased function over time. Lands identified as having agricultural vegetation were separated from other vegetation types, because agricultural lands provide different constraints and opportunities for restoration.

To accurately assess the coastal marine shorelines, shoretype landform data acquired from the Puget Sound Nearshore Partnership (Shipman 2008) and refined by Coastal Geologic Services (2012) was used to determine if the reach riparian functions were part of the properly functioning condition of the shoretype (Table 5). Landform types were grouped into two categories: riparian function for shoretypes that are naturally associated with forest cover and non-riparian function for shoretypes that are naturally disassociated with forest cover). Coastal marine shorelines that are categorized into the non-riparian function category were not reported in the restoration needs summary data or maps for the coastal marine shoreline assessment, as they would not naturally provide this function (Map 6).

**Table 5**  
**Natural Riparian Function of Coastal Marine Shoretypes**

Shoreline Category	Shoretype Landform
Riparian function (Naturally associated with forest cover)	Pocket beach, plunging, rocky platform, bluff
Non-riparian function (naturally disassociated with forest cover)	Barrier Beach, Barrier Estuary, Bluff Back Beach, Delta, Artificial

Note:

The adjacency of riparian forest along undisturbed marine shorelines varies by shoretype, but also by several other factors, including slope, soil, substrate, exposure, high winds, waves, and salt spray. Shoretype was used as it is generally a good indicator and recent data was available.

### **2.3.1 Large Woody Debris Recruitment Potential**

The LWD recruitment potential component provides an indication of the riparian buffer contribution to the instream habitat and channel complexity conditions of the tributary. Existing LWD recruitment potential was evaluated in a manner similar to the Washington Department of Natural Resources (WDNR) Watershed Analysis Manual, as applied in the Nooksack River Basin by Coe (2001). This approach results in a qualitative indicator of the potential for trees to fall into and become lodged in the stream. One refinement to this method was to differentiate between areas with dense or sparse vegetation in the medium and low categories. Existing LWD recruitment potential was assigned to each bank of each reach, based on the riparian vegetation conditions in the 100-foot buffer. The 100-foot buffer was used instead of the 30-foot buffer because it provides a better indication of the long-term potential for LWD, whereas the 30-foot buffer may be a single tree wide, which would leave no replacement tree vegetation when that tree falls. Dense and sparse vegetation were grouped into different categories because the categories lead to different restoration priorities.

Restoration need was assigned based on the existing conditions, such that low existing potential led to a high restoration potential and vice versa. Reaches with medium or low existing LWD potential but dense tree vegetation were assigned to the low restoration potential category because either the LWD recruitment potential will emerge as the trees

continue to grow or the need to add conifers to a stand of dense deciduous trees is less than other restoration needs. The existing and restoration need category assignments for each bank of each reach used the assignments shown in Table 6.

**Table 6**  
**Category Assignments for Existing Large Woody Debris Recruitment Potential and Restoration Need**

<b>Vegetation Type/Height/Stand Density</b>	<b>Existing LWD Recruitment Potential Category<sup>a</sup></b>	<b>Restoration Need</b>
Coniferous/large/dense Coniferous/medium/dense Mixed/large/dense Mixed/medium/dense	High	Low
Deciduous/large/dense Deciduous/medium/dense	Medium – D	Low
Coniferous/large/sparse Coniferous/medium/sparse Mixed/large/sparse Mixed/medium/sparse	Medium – S	Medium
Coniferous/small/dense Mixed/small/dense Deciduous/small/dense	Low – D	Low
Coniferous/small/sparse Mixed/small/sparse Deciduous/large/sparse Deciduous/medium/sparse Deciduous/small/sparse	Low – S	High
All shrub, lawn, and urban categories	None	High
Agriculture	None – ag	High – ag

Note:

a. The existing LWD recruitment potential for the medium and low categories includes whether the existing vegetation density is sparse (S) or dense (D).

ag = agriculture

D = dense

S = sparse

### 2.3.2 Wildlife Corridor Connectivity

Terrestrial wildlife corridors are typically managed at a scale wider than the 30- and 100-foot buffers assessed in this riparian inventory. However, the data collected indicate the wildlife corridor conditions. The evaluation of wildlife corridor connectivity was primarily based on conditions in the 100-foot buffer, with secondary consideration of vegetation conditions in the 30-foot buffer, which provide connectivity between areas with wildlife corridor vegetation in the 100-foot buffer. Suitable vegetation to provide wildlife corridor functions was considered to be any of the tree categories with dense rather than sparse vegetation. Table 7 describes the category assignments made to the 30- and 100-foot buffers on each side of the creek or along the coastal marine shoreline. Table 8 describes the combination of the 30- and 100-foot buffer vegetation conditions for an overall categorization of wildlife corridor connectivity in the reach. As described above, this categorization emphasizes the 100-foot buffer conditions over the 30-foot buffer conditions.

**Table 7**  
**Category Assignments for Existing Wildlife Corridor Connectivity**  
**Applied to 30- and 100-foot Buffers**

<b>Vegetation Type/Stand Density</b>	<b>Existing Wildlife Corridor Connectivity Category<sup>a</sup></b>
Coniferous/deciduous/mixed/dense	High
Coniferous/deciduous/mixed/sparse	Medium
Shrub/dense	Medium
Shrub/sparse	Low
Agriculture/dense	Low – ag
Agriculture/sparse	Low – ag
Lawn/dense	Low
Lawn/sparse	Low
Urban/dense	Low
Urban/sparse	None

Note:

a. Those reaches with agriculture include “-ag” in the existing wildlife corridor connectivity category.

ag = agriculture

**Table 8**  
**Category Assignments for Wildlife Corridor Connectivity Restoration Need**

<b>Existing Corridor Habitat Connectivity Category in 100-foot and 30-foot buffers</b>	<b>Wildlife Corridor Restoration Need<sup>a</sup></b>
High-High	Low
High-Medium	Medium
High-Low	Medium
High-None	Medium
Medium-High	High
Medium-Medium	Medium
Medium-Low	Medium
Medium-None	Low
Low-High	Medium
Low-Medium	Medium
Low-Low	High
Low-None	Low
None-High	Low
None-Medium	Low
None-Low	Low
None-None	Low

Note:

a. CREP reaches were not assigned a restoration need and are designated in the data tables as "In Restoration."

The landscape setting of the wildlife corridor was also investigated. An analysis was conducted to determine the total length of the corridor that would be created by filling a 1,000-foot or smaller gap in the presence of tree vegetation. The reaches in the top 20 longest resulting reaches were moved into the next highest restoration need category.

### **2.3.3 Water Quality**

Contributions of the riparian vegetation to unimpaired water quality were assessed based on vegetation type, density, and percent shade. Table 9 presents the system used to categorize the existing conditions and restoration need.



**Table 9**  
**Category Assignments for Existing Water Quality Conditions**  
**Based on Riparian Vegetation and Restoration Need**

<b>Vegetation Type/Stand Density/Percent Shade</b>	<b>Existing Water Quality Category<sup>a</sup></b>	<b>Restoration Potential/Need<sup>b</sup></b>
Coniferous/dense/shade between 40% and 100% Coniferous/sparse/shade between 70% and 100% Deciduous/dense/shade between 40% and 100% Deciduous/sparse/shade between 70% and 100% Mixed/dense/shade between 40% and 100% Mixed/sparse/shade between 70% and 100% Shrub/dense/shade between 90% and 100%	High	Low
Coniferous/dense/shade between 0% and 40% Deciduous/dense/shade between 0% and 40% Mixed/dense/shade between 0% and 40% Shrub/dense/shade between 20% and 90%	Medium – D	Low
Coniferous/sparse/shade between 40% and 70% Deciduous/sparse/shade between 40% and 70% Mixed/sparse/shade between 40% and 70% Shrub/sparse/shade between 70% and 100%	Medium – S	Medium
Shrub/dense/shade between 0% and 20%	Low – D	Low
Coniferous/sparse/shade between 0% and 40% Deciduous/sparse/shade between 0% and 40% Mixed/sparse/shade between 0% and 40% Shrub/sparse/shade between 0% and 70%	Low – S	High
All lawn and urban categories	None	High
Agriculture	None – ag	High – ag

Notes:

a. The existing water quality conditions for the medium and low categories includes whether the existing vegetation density is sparse (S) or dense (D).

b. CREP reaches were not assigned a restoration need and are designated in the data tables as “In restoration.”

The reaches with agriculture include “-ag” in the restoration need category.

ag = agriculture

D = dense

S = sparse

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### 3 RIPARIAN VEGETATION INVENTORY RESULTS

The photograph interpretation of riparian vegetation conditions identifies the vegetation type, density, height, and waterbody shade by stream reach in Jordan, Silver, Squalicum, Chuckanut, and Padden Creek basins, as well as along the coastal marine shoreline between Point Whitehorn and the boundary between Whatcom and Skagit counties. In total, 456 reaches were delineated and characterized along 194.6 stream and shoreline miles. Average reach length was shorter in the tributaries (less than 2,800 feet) than along the coastal marine shoreline (nearly 4,000 feet), as shown in Table 10. Of the 322 freshwater tributary reaches, 16 were unable to be assessed due to an inability to see the stream channel or poor spatial registry between the stream layer and the aerial photo. The 16 unassessed reaches have been excluded from the data analysis tables and figures to prevent misrepresentation of the assessed data. However, they are included in Table 10 to be consistent with the GIS database, which includes all reaches regardless of their assessment status.

**Table 10**  
**Number of Reaches and Reach Lengths**

<b>Tributary</b>	<b>Number of Reaches</b>	<b>Length (miles)</b>	<b>Average Reach Length (feet)</b>
Chuckanut	45	19.3	2,265
Jordan	71	17.7	1,316
Padden	4	1.3	1,716
Silver	156	31.8	1,076
Squalicum	46	24.1	2,766
Coastal marine	134	100.4	3,956
Total	456	194.6	2,253

The GIS database accompanying this report includes data for the 30- and 100-foot corridors on the left and right banks of the tributaries. For the purposes of summarizing and displaying the data, the inventory results in this section present the 30-foot corridor data along the left bank of the tributaries. The data presented are also available for the right bank of tributaries and in the 100-foot corridor. To evaluate the representativeness of the 30-foot left bank data for the right bank and 100-foot corridor data, vegetation type data were compared. In the tributaries, the 30-foot left bank vegetation type was highly similar to the

30-foot right bank vegetation type. Among 92 percent of the tributary reaches by count and 91 percent by length, the 30-foot left bank and right bank vegetation type was identical (Table 11). This high degree of similarity in vegetation type for the left bank compared to the right bank was also documented in the 100-foot buffer; 86 percent of the reaches by count and 85 percent by length had the same vegetation type. Comparing vegetation type in the left bank 30-foot buffer with that in the 100-foot buffer, the same vegetation type was observed in 78 percent of the reaches; this corresponded to 81 percent of the stream length. The apparent changes in vegetation type between 30 and 100 feet appears to reflect the presence of relatively narrow buffers (i.e., less than 100 feet wide) of trees beyond which other land uses occur, such as agricultural fields. Along the coastal shorelines, more differences in vegetation type between the 30- and 100-foot buffers were documented (Table 12). In fact, only 44 percent of the reaches, representing 45 percent of the shoreline length, had the same vegetation type in both the 30- and 100-foot buffer.

**Table 11**  
**Similarity of Vegetation Type in Riparian Buffers Inventoried in Tributaries**

	<b>30-foot Buffer in Left Bank versus Right Bank</b>	<b>100-foot Buffer in Left Bank versus Right Bank</b>	<b>Left Bank 30- foot Buffer versus 100-foot Buffer</b>	<b>Right Bank 30- foot Buffer versus 100-foot Buffer</b>
Total Number of Reaches	306	306	306	306
Number of Reaches with Same Vegetation Type	282	263	239	245
Percent of Reaches with Same Vegetation Type	92%	86%	78%	80%
Total Shoreline Length Inventoried	91.6 miles	91.6 miles	91.6 miles	91.6 miles
Shoreline Length with Same Vegetation Type	83.4 miles	77.9 miles	74.8 miles	74.7 miles
Percent of Shoreline Length with Same Vegetation Type	91%	85%	81%	82%

**Table 12**  
**Similarity of Vegetation Type in Riparian Buffers Inventoried along Coastal Shoreline**

	<b>30-foot Buffer versus 100-foot Buffer</b>	<b>30-foot Buffer versus 200-foot Buffer</b>	<b>100-foot Buffer versus 200-foot Buffer</b>
Total Number of Reaches	134	134	134
Number of Reaches with Same Vegetation Type	59	60	94
Percent of Reaches with Same Vegetation Type	44%	45%	70%
Total Shoreline Length Inventoried	100.4 miles	100.4 miles	100.4 miles
Shoreline Length with Same Vegetation Type	45 miles	54.7 miles	77 miles
Percent of Shoreline Length with Same Vegetation Type	45%	54%	77%

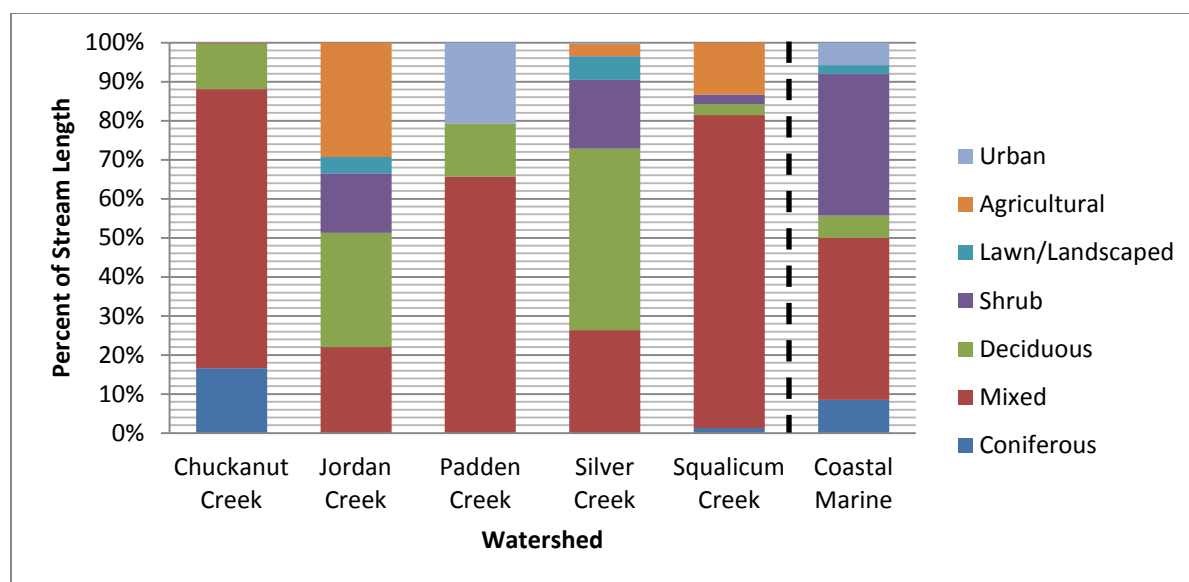
Table 13 presents the stream length of each vegetation type by watershed; Figure 1 presents the data as a percentage of total stream length, and Maps 2 and 3 present the vegetation type distributions for the tributaries and coastal marine shoreline, respectively. Along four of the five creeks and coastal shoreline, the three tree categories (deciduous/coniferous/mixed) were the dominant vegetation type, consisting of 56 percent (coastal marine) and 100 percent (Chuckanut Creek) of the total shoreline length. In Jordan Creek, mixed, deciduous, and agricultural categories were dominant (81 percent). In three of the five creeks, the mixed tree category (i.e., mix of deciduous and coniferous trees) was the tree category distributed along the longest length of creek shoreline. Jordan and Silver creeks had a greater length of deciduous tree shoreline than mixed tree. In terms of the most widely observed vegetation type, mixed trees were longest in Chuckanut, Padden, and Squalicum creeks and coastal shoreline (72, 62, 80, and 42 percent, respectively), and deciduous trees were longest in Silver and Jordan creeks (47 and 29 percent respectively). Agricultural lands extended along 29 percent of the stream length in Jordan Creek. Only the Padden Creek, Silver Creek, and coastal marine shorelines had urban categories (23, less than 1, and less than 6 percent, respectively). Coniferous trees were the dominant vegetation type only along short portions of the streams and coastal shoreline. In Jordan, Padden, and Silver Creeks, no stream reaches had coniferous trees as the dominant vegetation type.

**Table 13**  
**Stream Length (Miles) in Each Vegetation Category**

<b>Vegetation Category</b>	<b>Chuckanut Creek</b>	<b>Jordan Creek</b>	<b>Padden Creek</b>	<b>Silver Creek</b>	<b>Squalicum Creek</b>	<b>Coastal Marine</b>
Coniferous	3.2	0.0	0.0	0.0	0.3	8.5
Mixed	13.8	3.9	0.8	7.7	19.3	41.7
Deciduous	2.2	5.2	0.2	13.6	0.7	5.7
Shrub	0.0	2.7	0.0	5.1	0.6	36.4
Lawn/Landscaped	0.0	0.7	0.0	1.8	0.0	2.3
Agricultural	0.0	5.2	0.0	0.9	3.2	0.0
Urban	0.0	0.0	0.3	0.1	0.0	5.8

The differences between tributaries in the extent of “agriculture” riparian vegetation appear to reflect the degree to which vegetated riparian buffers are present in the agricultural areas of each watershed. Based on land cover data from the National Oceanic and Atmospheric Administration’s (NOAA) 2006 Coastal Change Analysis Program, the tributary corridors in Jordan, Silver, and Squalicum creeks are 46, 9, and 20 percent agriculture<sup>1</sup>, respectively; whereas, Chuckanut and Padden creeks are 0 percent agriculture. This information appears to indicate that the establishment of vegetated riparian buffers is more widespread in Chuckanut and Padden creeks than in Jordan, Silver, and Squalicum creeks.

<sup>1</sup> This percentage is the sum of the pasture/hay and cultivated crop categories in the NOAA Coastal Change Analysis Program database.



**Figure 1**  
**Percent of Stream Length Composed of Each Vegetation Type**

In the creeks, the vast majority of stream length with one of the three tree categories was densely vegetated. In fact, the percentages of shorelines with tree vegetation that were densely vegetated (30-foot buffer, left bank) were 71.5 percent (15.2 miles) in Silver Creek, 81.0 percent (6.9 miles) in Jordan Creek, 80.7 percent (16.2 miles) in Squalicum Creek, 95.2 percent (18.3 miles) in Chuckanut Creek, and 100 percent (1.0 miles) in Padden Creek. In terms of the percentage of the entire tributary lengths, Silver Creek had dense tree vegetation along 47 percent of its shoreline, Jordan Creek had 37 percent, Squalicum had 66.8 percent, Chuckanut had 94.7 percent, and Padden Creek had 77.5 percent.

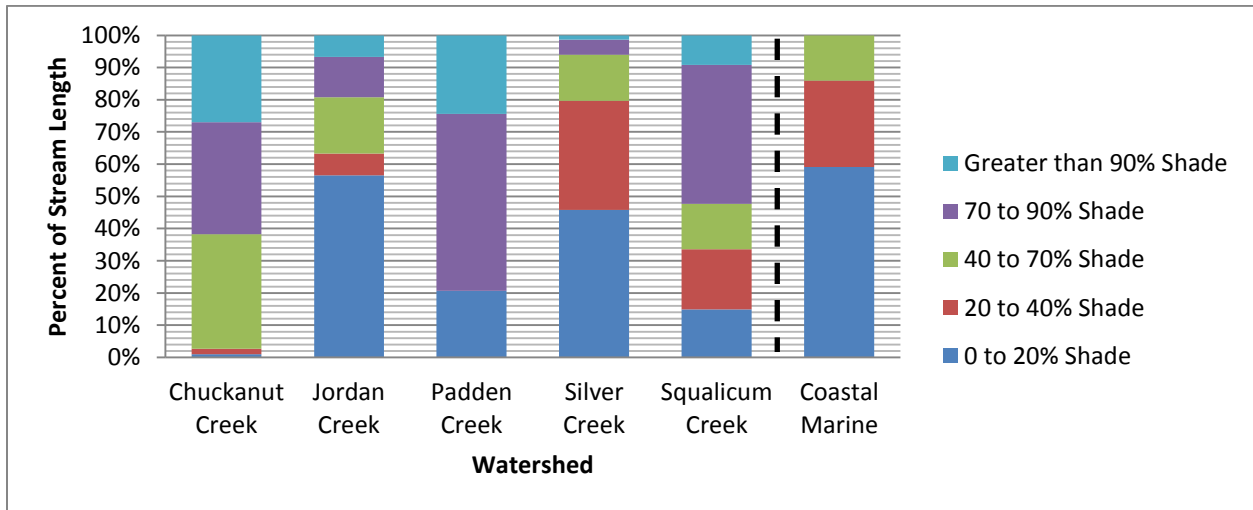
Along the coast, only 44 percent of the shoreline with trees (3.9 of 8.7 miles) was categorized as densely vegetated. Considering the entire shoreline length, 16 percent had dense tree vegetation (3.9 of 24.8 miles). This low percentage of dense vegetation is likely due to a combination of natural factors limiting dense tree growth along marine coastal shorelines and the removal of vegetation to support other land uses. Marine coastal shoreline types that may not naturally support dense vegetation within 30 feet of ordinary high water include beach spits, backshore beaches, and actively eroding bluffs where erosion may have naturally exposed bare substrate. Human alterations to the shoreline that result in loss of vegetation include removing vegetation for views; shoreline development of residential, industrial, or

other buildings; and roads along the shoreline. Along the marine coastal shoreline inventoried, 8.4 miles does not necessarily reflect removal of vegetation for views, development, or other land uses. Another 1.1 miles of the lower tributaries included within the SMP jurisdiction also had roads running along the shoreline. These shoreline roads result in removal of riparian vegetation along the shorelines.

In terms of the percent shade cast over the creeks by the adjacent vegetation, nearly 50 percent of the coastal marine, Jordan Creek, and Silver Creek shorelines have 0 to 20 percent shade (Table 14, Figure 2, Maps 4 and 5). In Padden Creek, only 23 percent of the stream length had 0 to 20 percent shade, and the remainder of the creeks had higher amounts of shade. More than 70 percent shade was observed along 61 percent of the Chuckanut Creek shoreline; in Squalicum Creek, this number was 53 percent, and in Padden Creek, it was 77 percent. It should be noted that some natural shorelines and natural vegetation types do not cast shade; therefore, 100 percent shade is not a natural target for all shorelines. For example, shrub vegetation in a wetland may not cast shade over the creek, depending on stream width.

**Table 14**  
**Stream Length (Miles) in Each Shade Category**

<b>Shade Category</b>	<b>Chuckanut Creek</b>	<b>Jordan Creek</b>	<b>Padden Creek</b>	<b>Silver Creek</b>	<b>Squalicum Creek</b>	<b>Coastal Marine</b>
0% to 20% Shade	0.2	10.0	0.3	13.4	3.6	59.3
20% to 40% Shade	0.3	1.2	0.0	9.9	4.5	27.0
40% to 70% Shade	6.8	3.1	0.0	4.2	3.4	14.1
70% to 90% Shade	6.7	2.2	0.7	1.3	10.4	0.0
Greater than 90% Shade	5.2	1.2	0.3	0.4	2.2	0.0



**Figure 2**  
**Percent Shade Cast over Waterbody**



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## 4 RESTORATION ASSESSMENT

### 4.1 Large Woody Debris Existing Recruitment Potential and Restoration Need

The shoreline length for which existing LWD recruitment potential was characterized as high along at least one bank of the shoreline ranged from 6 percent (1.1 miles) along Jordan Creek to 83 percent (16.0 miles) in Chuckanut Creek (Maps 7 and 8), based on existing vegetation conditions in the watersheds. Padden Creek and Squalicum Creek were intermediate, with 66 and 61 percent, respectively (0.8 and 14.5 miles, respectively), and were characterized as high function for existing LWD recruitment potential.

In the creeks, restoration potential was categorized based on the conditions observed on both banks. In this way, the restoration potential categories described two bank conditions (e.g., high – high). An exception to this categorization system was stream reaches, with agriculture along at least one bank categorized as high priority for restoration. Due to the different restoration opportunities and constraints associated with agriculture, these stream reaches were categorized separately as “high with at least one bank agriculture.” Another exception was the separate categorization of reaches with land in the CREP program as "In Restoration."

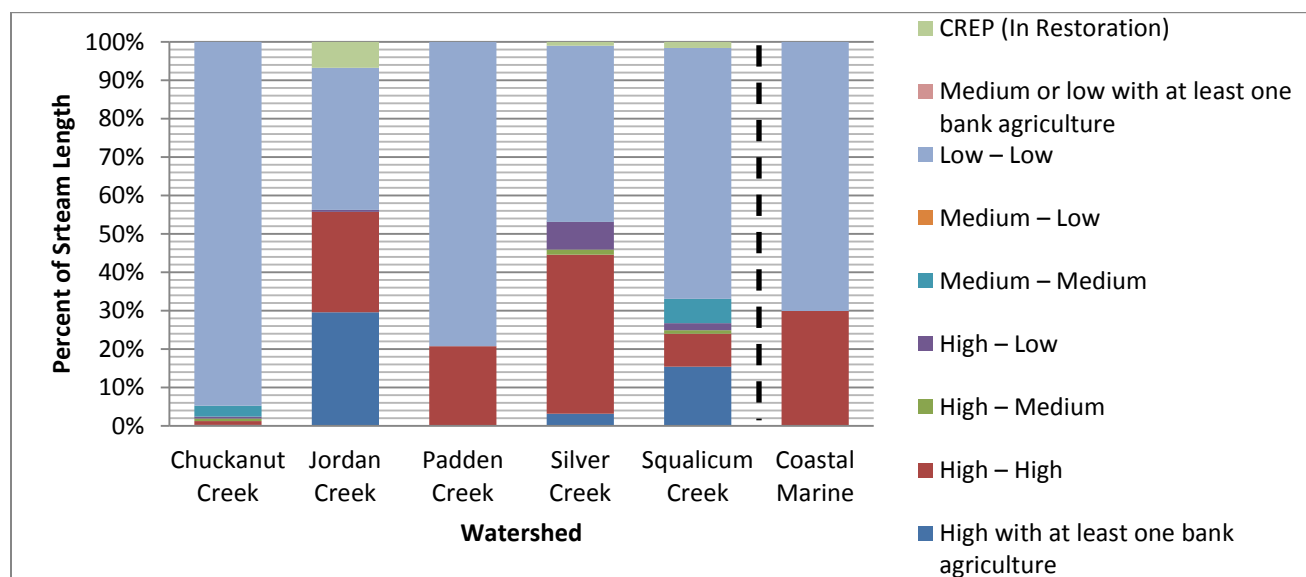
There is a more widespread need for restoration of LWD recruitment potential in Jordan Creek, Silver Creek, and Squalicum Creek than in Chuckanut and Padden creeks (Table 15, Figure 3, Map 9). In fact, at least one bank was identified as having a high restoration need along 50 percent of the shoreline in Silver Creek. The coastal marine shoreline had 30 percent (7.6 miles) of the shoreline length categorized as high priority for LWD recruitment restoration in reaches designated as appropriate for natural riparian function (Map 10). In Chuckanut and Padden creeks, 92 and 77 percent of the stream lengths, respectively (17.6 and 1.0 miles) were categorized as low restoration need on both banks.

**Table 15**  
**Stream Length (Miles) in Each Large Woody Debris Recruitment Restoration Need Category**

LWD Recruitment Restoration Need Category	Chuckanut Creek	Jordan Creek	Padden Creek	Silver Creek	Squalicum Creek	Coastal <sup>a</sup> Marine
High with at least One Bank Agriculture	0.0	5.2	0.0	0.9	3.7	0.0
High – High	0.2	4.6	0.3	12.1	2.1	7.6
High – Medium	0.1	0.0	0.0	0.4	0.2	-
High – Low	0.1	0.1	0.0	2.1	0.4	-
Medium – Medium	0.5	0.0	0.0	0.0	1.5	0.0
Medium – Low	0.0	0.0	0.0	0.0	0.0	-
Low – Low	17.6	6.5	1.0	13.4	15.7	17.8
Medium or Low with at least One Bank Agriculture	0.0	0.0	0.0	0.0	0.0	0.0
CREP (In Restoration)	0.0	1.2	0.0	0.3	0.4	0.0

Note:

a. Coastal marine shoreline reaches that have been classified as “Non-Riparian Function” have been omitted from the summary table and figure due to natural conditions not being conducive to riparian function.



**Figure 3**  
**Percent of Watershed Stream Length in Each Large Woody Debris Recruitment Restoration Need Category**

## **4.2 Wildlife Corridor Existing Conditions and Restoration Need**

Wildlife corridor conditions were categorized as providing high function in Chuckanut and Padden creeks. In Chuckanut Creek, 96 percent (18.3 miles) of the stream length was categorized as having at least one bank with high function for wildlife corridor conditions. In Padden Creek, 79 percent (1.0 miles) was categorized as having at least one bank with high function for wildlife corridor conditions. Lower percentages of high function were observed in Jordan, Silver, and Squalicum creeks and along the coastal marine areas, where 41, 54, 68, and 19 percent, respectively (7.3, 15.8, 16.4, and 19.0 miles) of high existing function for wildlife corridor conditions occurred (Maps 11 and 12). Map 13 shows the location of the reaches where restoration to fill wildlife corridor gaps would create the longest continuous reaches with suitable habitat for wildlife connectivity.

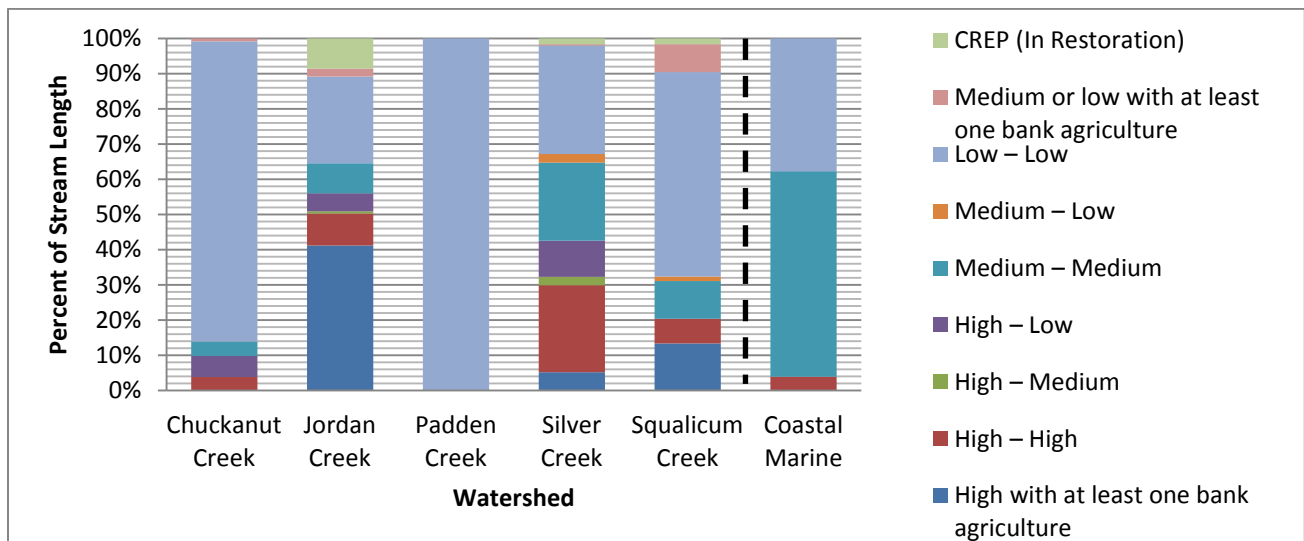
For restoration of wildlife corridors, 43 percent (7.6 miles) of the stream length of Jordan Creek had agriculture on at least one bank and a high or medium restoration need for wildlife habitat connectivity. Four percent (0.7 miles) of Chuckanut Creek, 9 percent (1.6 miles) of Jordan Creek, 23 percent (7.2 miles) of Silver Creek, and 0 percent of Padden Creek had high – high need for wildlife corridor restoration. Along the coast, 4 percent (1.0 mile) of the shoreline had a high need for wildlife corridor restoration, 58 percent (14.8 miles) had a medium need, and 38 percent (9.6 miles) had a low need (Table 16, Figure 4, Map 14). As discussed previously, these percentages for the marine shoreline represent online shorelines where the geomorphic shoretype is considered conducive to natural association with adjacent forest cover. Shoretype landforms that are considered to be frequently spatially disassociated from forest cover under natural or undisturbed conditions have been omitted.

**Table 16**  
**Stream Length (Miles) in Each Wildlife Corridor Restoration Need Category**

Wildlife Corridor Restoration Need Category	Chuckanut Creek	Jordan Creek	Padden Creek	Silver Creek	Squalicum Creek	Coastal <sup>a</sup> Marine
High With at least One Bank Agriculture	0.0	7.2	0.0	1.5	3.2	0.0
High – High	0.7	1.6	0.0	7.2	1.7	1.0
High – Medium	0.0	0.1	0.0	0.7	0.0	-
High – Low	1.2	0.9	0.0	3.0	0.0	-
Medium – Medium	0.8	1.5	0.0	6.5	2.6	14.8
Medium – Low	0.0	0.0	0.0	0.7	0.3	-
Low – Low	16.4	4.3	1.3	9.0	13.9	9.6
Medium or Low With at least One Bank Agriculture	0.2	0.4	0.0	0.1	1.9	0.0
CREP (In Restoration)	0.0	1.5	0.0	0.5	0.4	0.0

Note:

a. Coastal marine shoreline reaches that have been classified as “Non-Riparian Function” have been omitted from the summary table and figure due to natural conditions not being conducive to riparian function.



**Figure 4**  
**Percent of Watershed Stream Length in Each Wildlife Corridor Restoration Need Category**

### 4.3 Water Quality Existing Conditions and Restoration Need

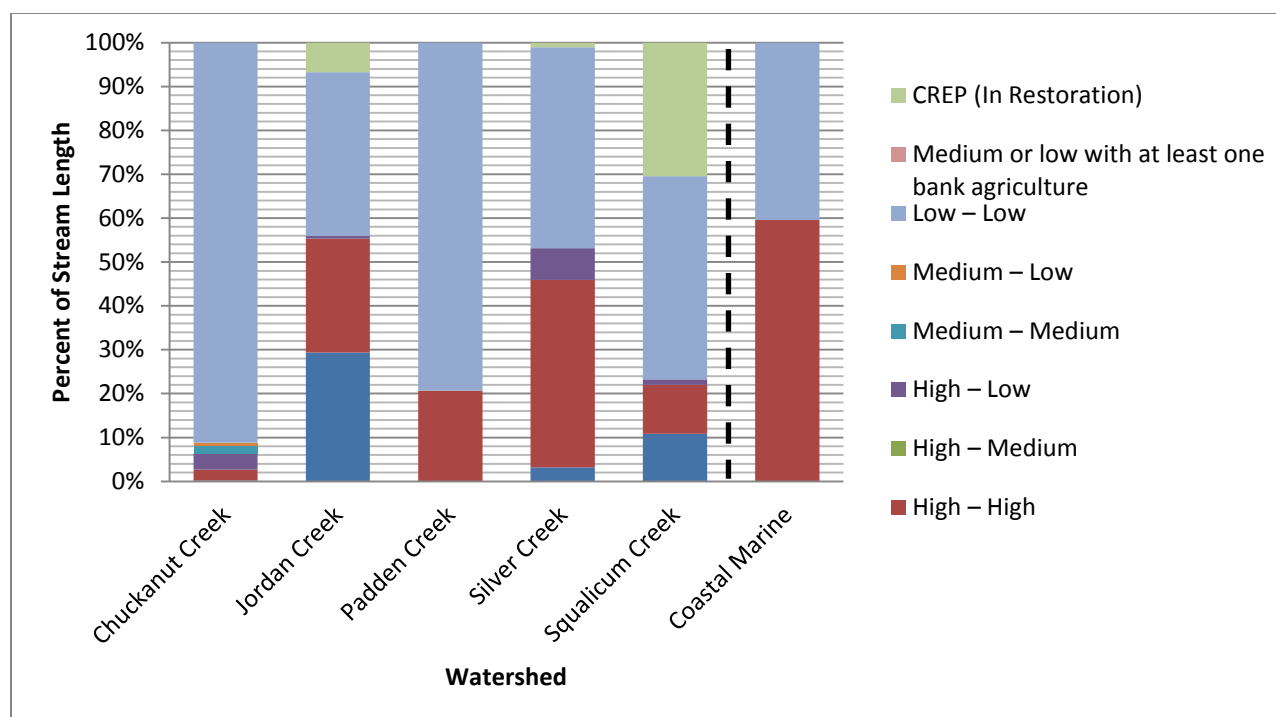
Larger portions of stream length in Chuckanut and Padden creeks were classified as more highly functioning for water quality than the other creeks and coastal marine shoreline. In Chuckanut Creek and Padden Creek, 96 percent (18.4 miles) and 79 percent (1.0 miles), respectively, of the stream length was classified as providing at least one bank with high function for water quality (Map 16). In Jordan Creek, only 41 percent (7.3 miles) was categorized as providing high function for water quality. Forty percent of the coastal marine shoreline (Map 17), 54 percent (15.8 miles) of Silver Creek, and 68 percent (16.4 miles) of Squalicum Creek was categorized as providing high function conditions for water quality. The percentages of the watersheds in the categories of low – low and high with at least one bank of agriculture for water quality restoration need are similar to those reported for LWD recruitment restoration. In the five creeks, between 3 percent (Chuckanut Creek) and 42 percent (Silver Creek) of the total stream lengths were categorized as high – high for water quality restoration need (i.e., both banks high) (Table 17, Figure 5, Maps 18 and 19).

**Table 17**  
**Stream Length (Miles) in Each Water Quality Restoration Need Category**

<b>Water Quality Restoration Need Category</b>	<b>Chuckanut Creek</b>	<b>Jordan Creek</b>	<b>Padden Creek</b>	<b>Silver Creek</b>	<b>Squalicum Creek</b>	<b>Coastal<sup>a</sup> Marine</b>
High with at least One Bank Agriculture	0.0	5.2	0.0	0.9	3.7	0.0
High – High	0.5	4.6	0.3	12.5	3.8	15.6
High – Medium	0.0	0.0	0.0	0.0	0.0	-
High – Low	0.7	0.1	0.0	2.1	0.4	-
Medium – Medium	0.3	0.0	0.0	0.0	0.0	0.0
Medium – Low	0.1	0.0	0.0	0.0	0.0	-
Low – Low	17.6	6.6	1.0	13.4	15.8	10.6
Medium or Low with at least One Bank Agriculture	0.0	0.0	0.0	0.0	0.0	0.0
CREP (In Restoration)	0.0	1.2	0.0	0.3	0.4	0.0

Note:

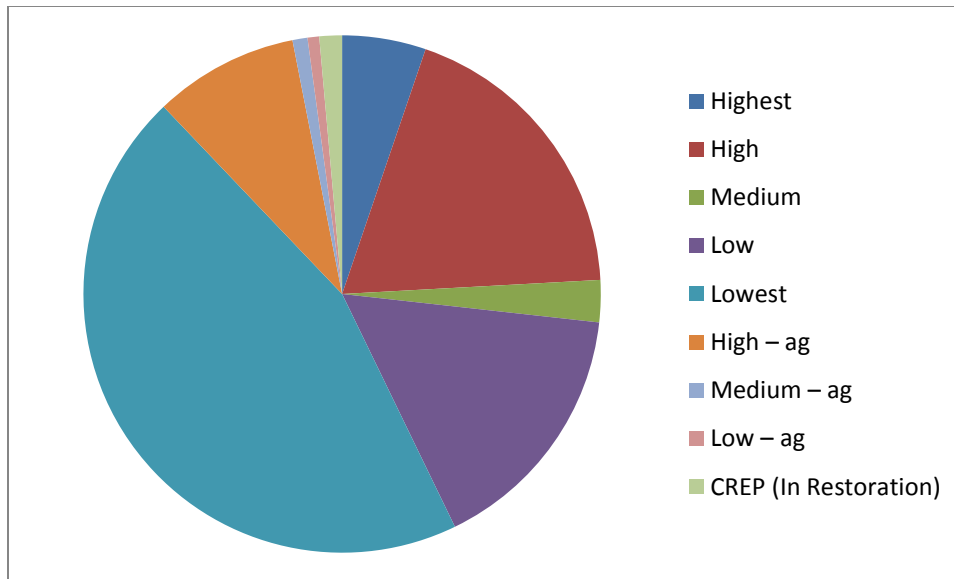
a. Coastal marine shoreline reaches that have been classified as “Non-Riparian Function” have been omitted from the summary table and figure due to natural conditions not being conducive to riparian function.



**Figure 5**  
**Percent of Watershed Stream Length in Each Water Quality Restoration Need Category**

#### 4.4 Combined Restoration Needs

Across the entire tributary project area, 87 percent (79 miles) of the shoreline did not have agriculture or CREP activities along the stream. Agriculture occurred on at least one bank for 10 percent (9.8 miles) of the shoreline. A total of 13 percent (12.25 miles) of the shoreline was assigned to either the highest or the high combined restoration need categories (i.e., aggregate restoration need for LWD, water quality, and wildlife connectivity) and had agriculture along at least one bank (Figure 6). A total of 48 percent (43.6 miles) of the tributary project area was assigned to the lowest restoration need category. A total of 36 percent (9.4 miles) of the coastal marine project area was assigned the lowest restoration need category (this includes only those reaches designated to be conducive to natural riparian function based on shoretype landform).



**Figure 6**  
**Combined Restoration Need Category Proportions in the Project Area**

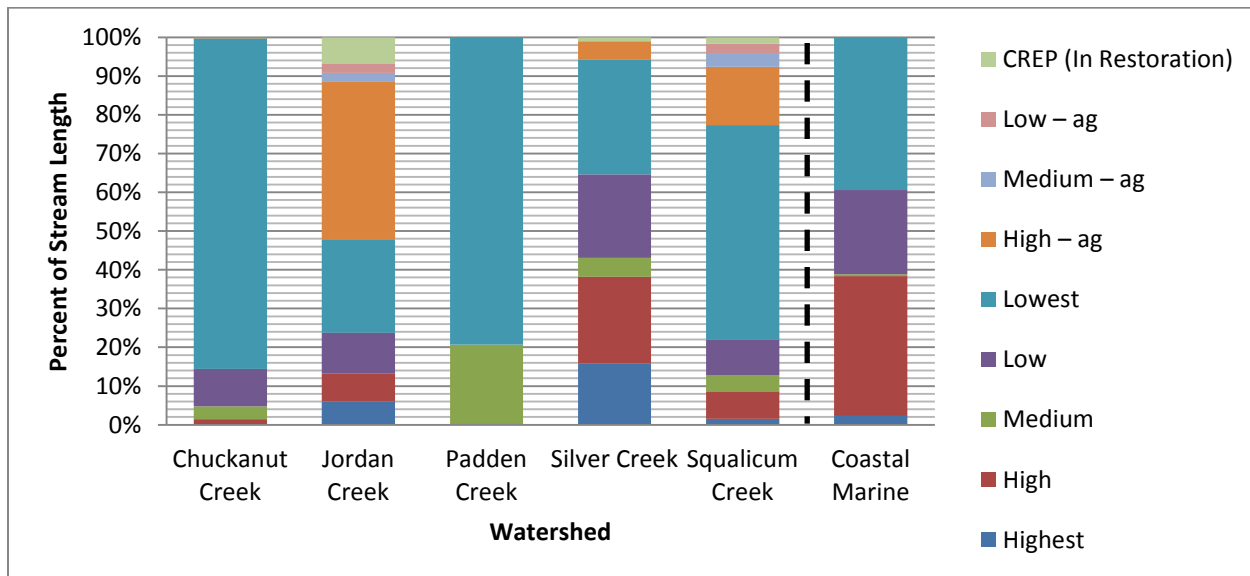
In Chuckanut, Padden, Silver, and Squalicum Creeks, the largest percentages of stream length were in the lowest combined restoration category (88, 77, 35, and 63 percent, respectively) (Table 18 and Figure 7). In Jordan Creek, high restoration need with at least one bank agriculture was the most widespread restoration category (32 percent of stream length). Along the marine coast, the high need category comprised the longest percentage of shoreline length (65 percent).

**Table 18**  
**Stream Length (Miles) in Each Combined Restoration Need Category**

Combined Restoration Need Category	Chuckanut Creek	Jordan Creek	Padden Creek	Silver Creek	Squalicum Creek	Coastal <sup>a</sup> Marine
Highest	0.0	1.0	0.0	4.6	0.4	1.0
High	0.3	1.2	0.0	6.6	1.7	15.6
Medium	0.6	0.0	0.3	1.4	1.0	0.2
Low	1.9	1.8	0.0	6.3	2.2	0.0
Lowest	16.4	4.2	1.0	8.7	13.3	9.4
High – ag	0.1	7.1	0.0	1.4	3.6	0.0
Medium – ag	0.0	0.4	0.0	0.0	0.9	0.0
Low – ag	0.0	0.4	0.0	0.0	0.6	0.0
CREP (In Restoration)	0.0	1.2	0.0	0.3	0.4	0.0

Note:

a. Coastal marine shoreline reaches that have been classified as “Non-Riparian Function” have been omitted from the summary table and figure due to natural conditions not being conducive to riparian function.



**Figure 7**  
**Percent of Watershed Stream Length in Each Combined Restoration Need Category**



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## 5 CONCLUSIONS

The photo-interpretation-based riparian inventory methods and restoration framework provide riparian vegetation data and a science-based assessment technique to support restoration activities in the Chuckanut, Jordan, Padden, Silver, and Squalicum Creek watersheds, as well as along the coastal marine shoreline. These techniques can be applied to other creek systems and marine shorelines to provide consistently collected and interpreted riparian data. It is suggested that, prior to embarking on any restoration activities at an identified site, a more thorough site-specific analysis should be conducted.

Of the five creek watersheds, Chuckanut Creek has the highest functioning riparian vegetation conditions. Jordan Creek has the lowest functioning riparian vegetation conditions and has extensive agriculture operations along its riparian corridor. The coastal marine shoreline presents challenges in determining restoration need due to the varied shoreline types. Restoration priorities are identified in each watershed and can be coupled with other considerations, such as landowner willingness and watershed location, to develop projects in areas lacking mature native trees.

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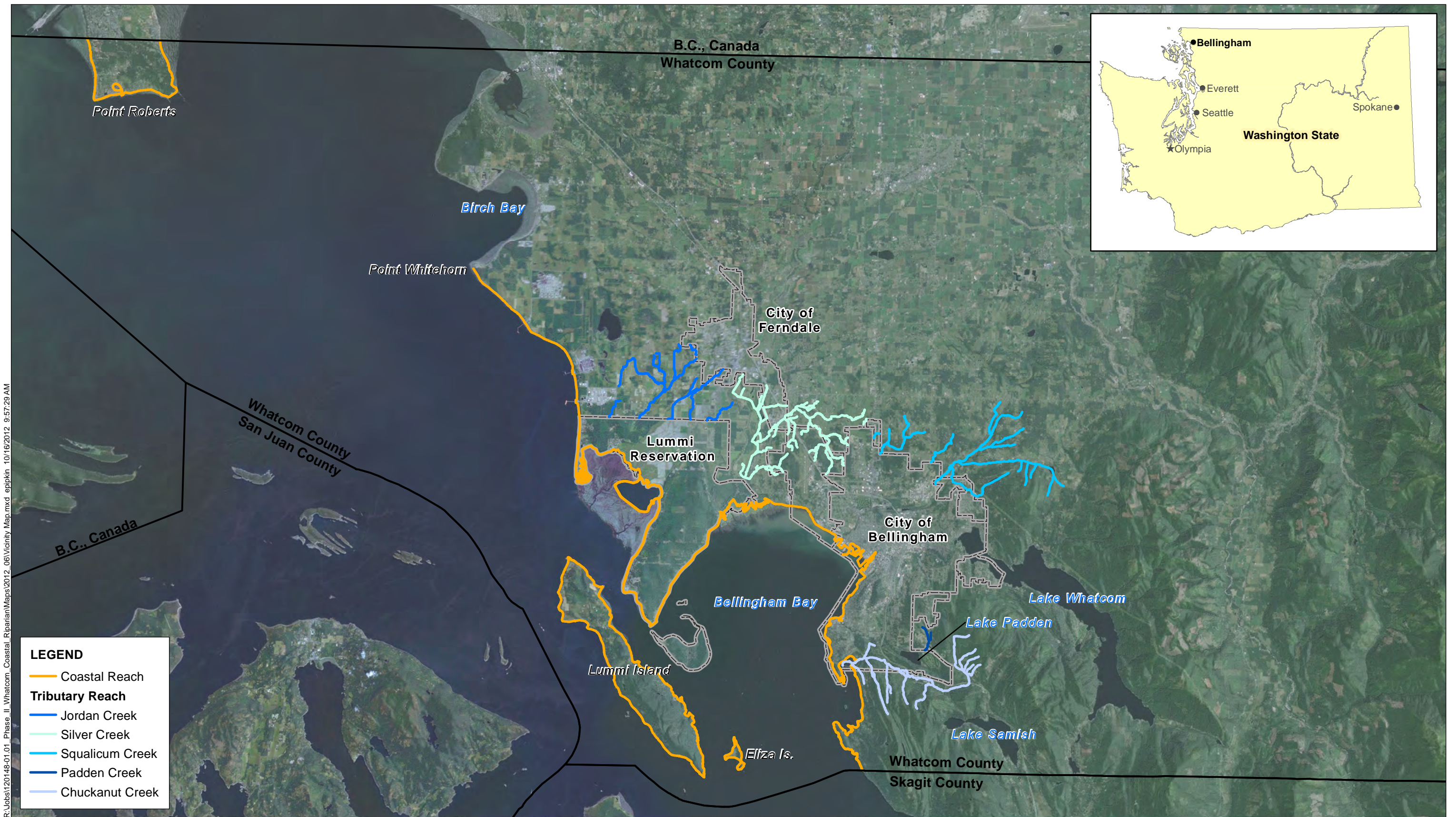
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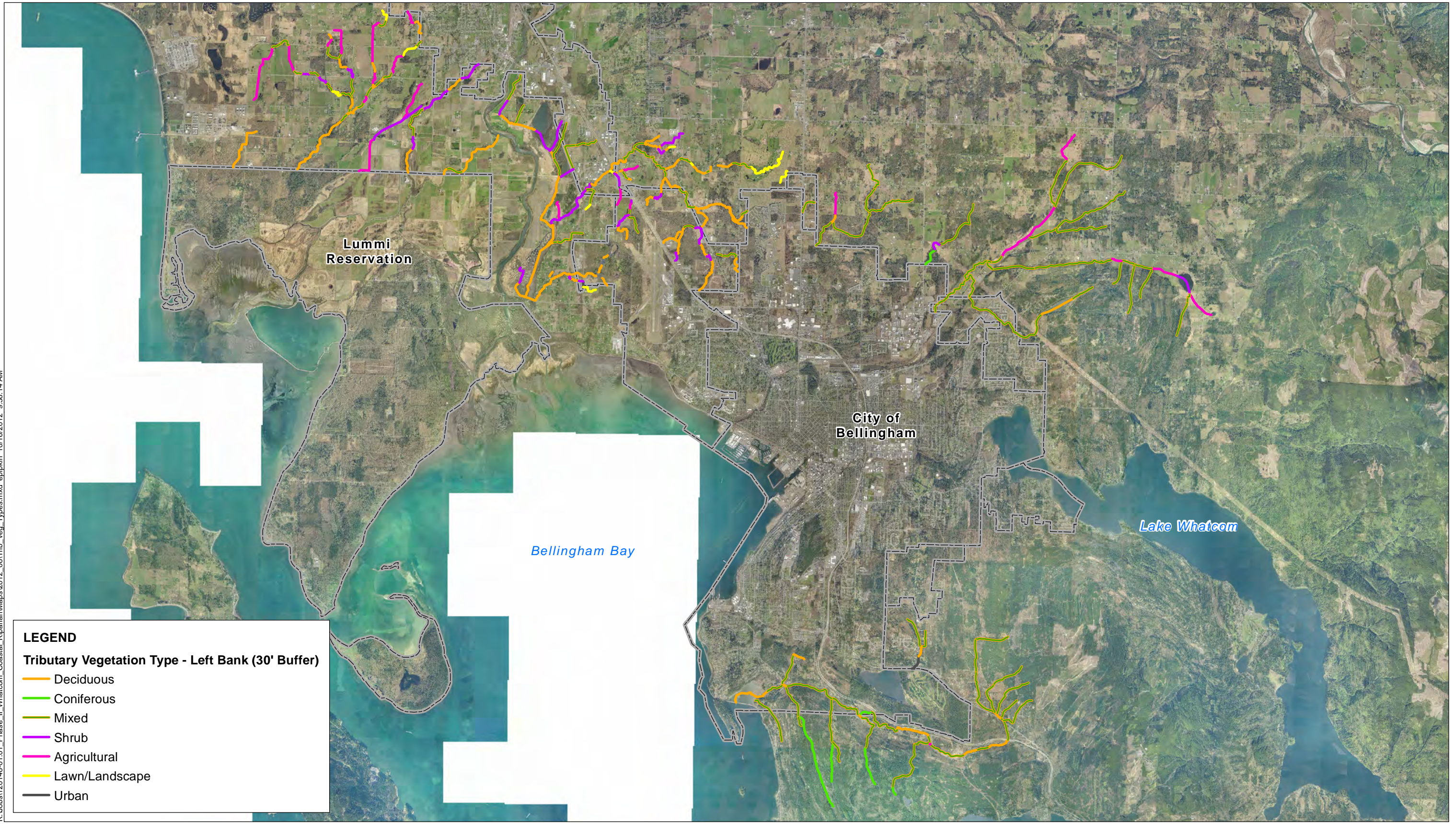


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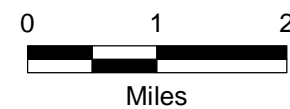


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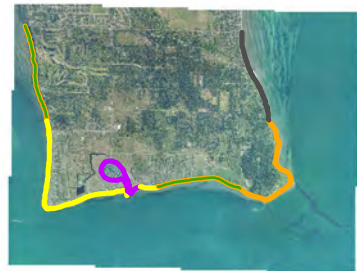
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2. Aerial photo and stream layer provided by Whatcom County.





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#### LEGEND

##### Coastal Vegetation Type - (30' Buffer)

- Deciduous
- Coniferous
- Mixed
- Shrub
- Agricultural
- Lawn/Landscape
- Urban

Point Whitehorn

City of  
Ferndale

Lummi  
Reservation

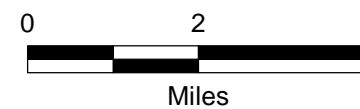
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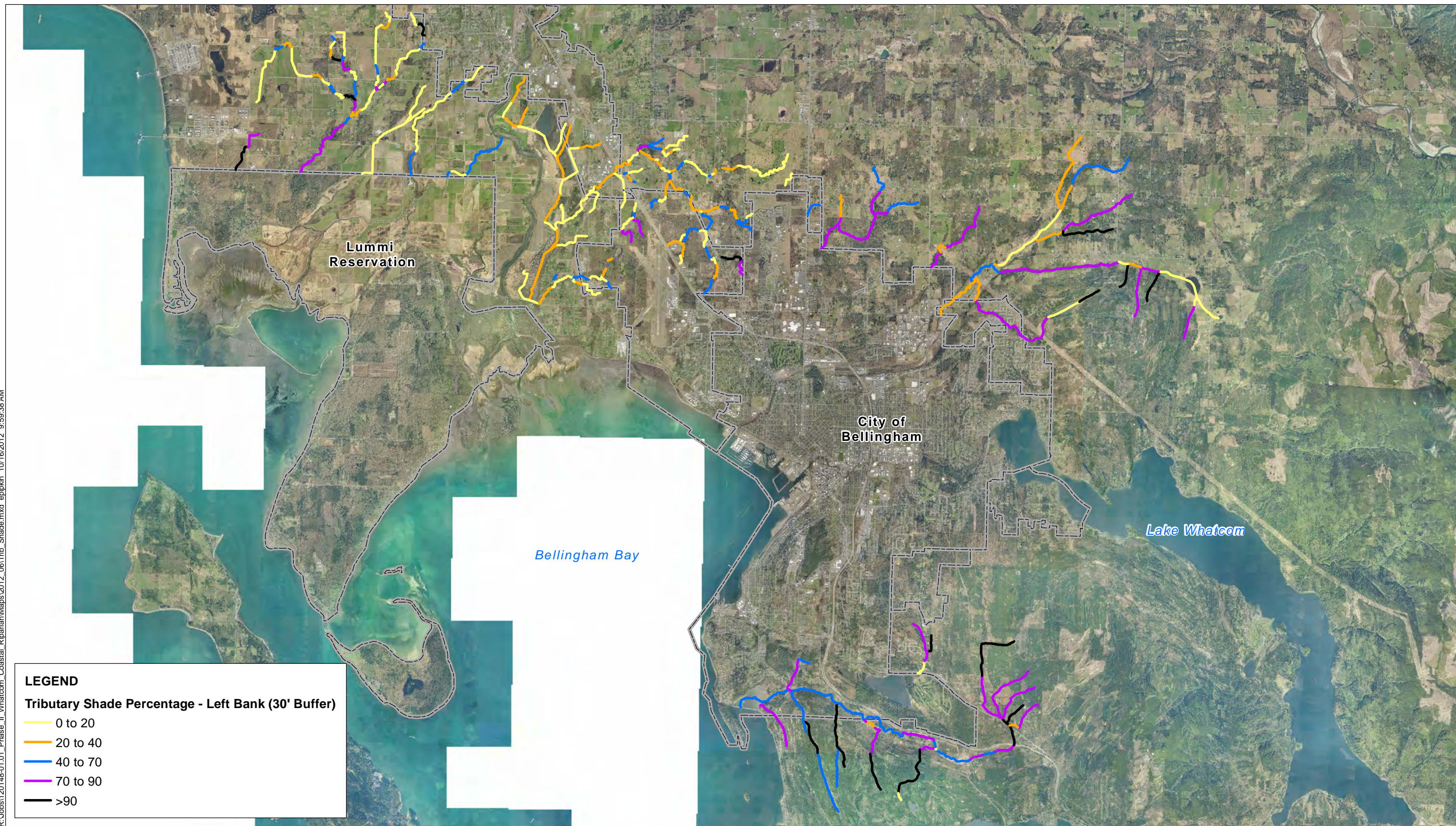
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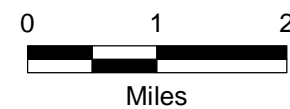


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Point Whitehorn

City of  
Ferndale

Lummi  
Reservation

City of  
Bellingham

Bellingham Bay

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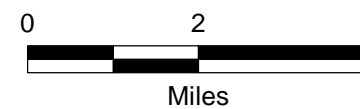
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##### Coastal Shade Percentage - (30' Buffer)

- 0 to 20
- 20 to 40
- 40 to 70
- 70 to 90
- >90

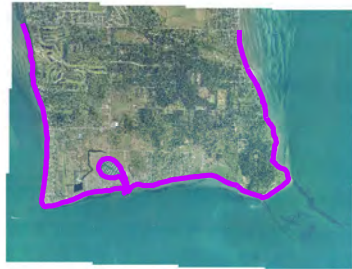
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Point Whitehorn

City of  
Ferndale

Lummi  
Reservation

City of  
Bellingham

Bellingham Bay

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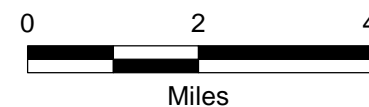
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##### Natural Riparian Function based on Shoretype

- Naturally Disassociated with Forest Cover
- Naturally Associated with Forest Cover

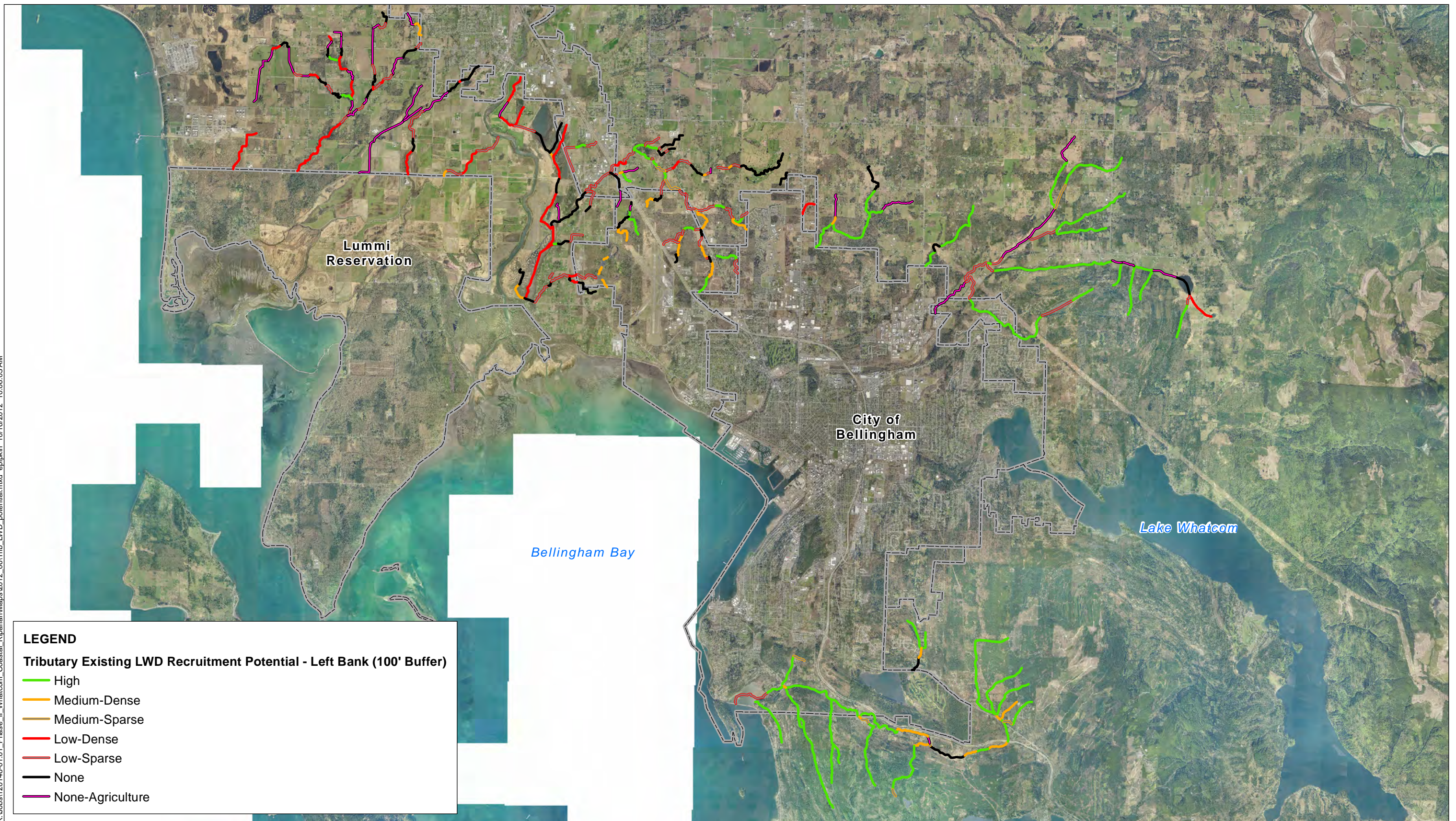
#### NOTES:

- Horizontal datum: WA State Plane North, NAD83, Feet.
- Aerial photo and stream layer provided by Whatcom County.
- Shoretype data provided by Puget Sound Nearshore Partnership and modified by Coastal Geologic Services.



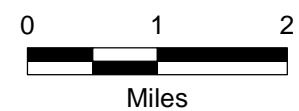


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**NOTES:**

1. Horizontal datum: WA State Plane North, NAD83, Feet.
2. Aerial photo and stream layer provided by Whatcom County.





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Point Roberts Inset

#### LEGEND

##### Coastal Existing LWD Recruitment Potential - (100' Buffer)

- High
- Medium-Dense
- Medium-Sparse
- Low-Dense
- Low-Sparse
- None
- None-Agriculture

Point Whitehorn

City of  
Ferndale

Lummi  
Reservation

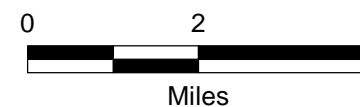
City of  
Bellingham

Bellingham Bay

Lake Whatcom

#### NOTES:

1. Horizontal datum: WA State Plane North, NAD83, Feet.
2. Aerial photo and stream layer provided by Whatcom County.

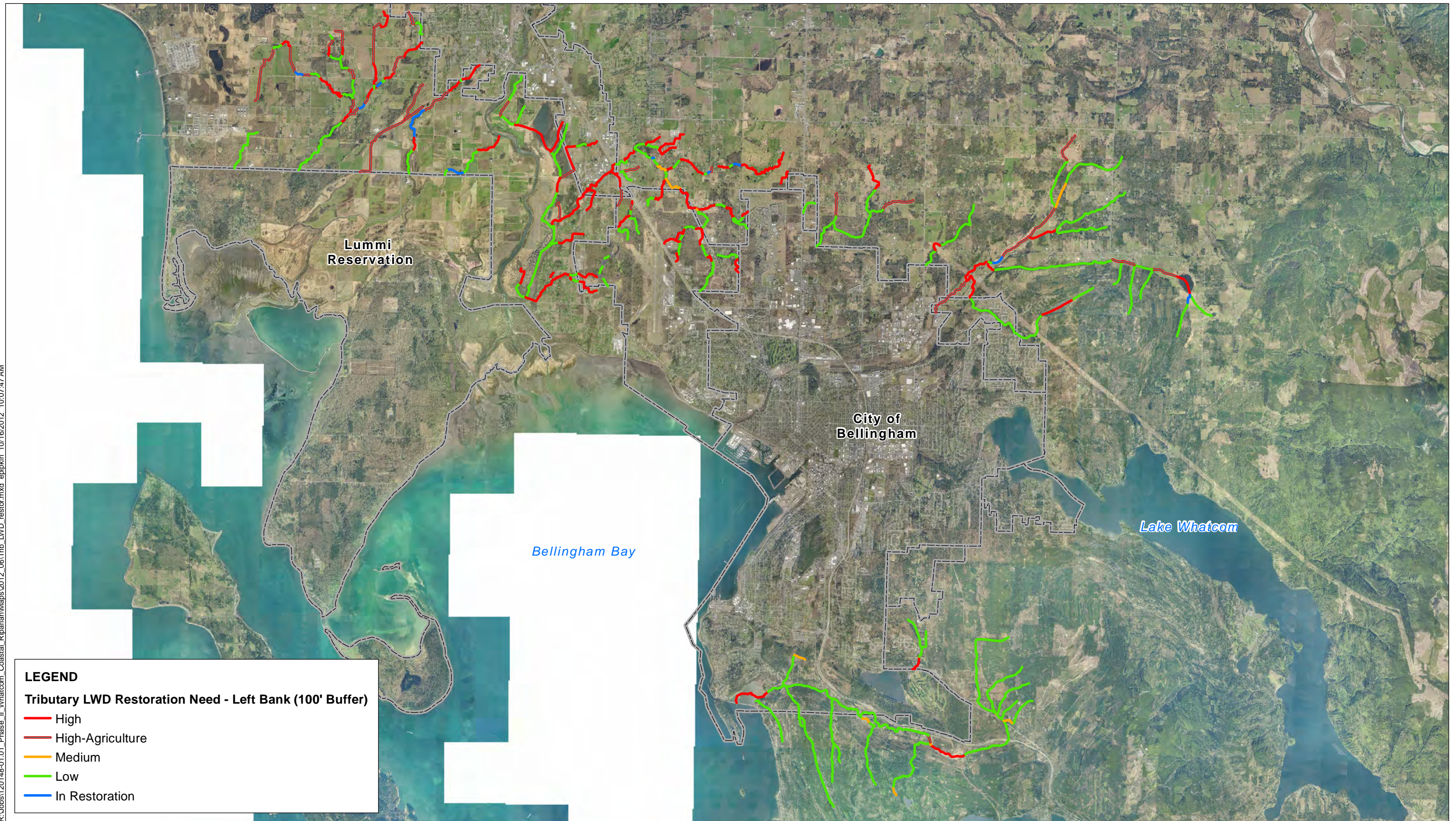


Coastal Existing Large Woody Debris Recruitment Potential - (100' Buffer)  
Phase 2 Whatcom County Riparian Function Assessment  
Whatcom County, WA

Map 8

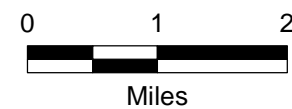


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**NOTES:**

1. Horizontal datum: WA State Plane North, NAD83, Feet.
2. Aerial photo and stream layer provided by Whatcom County.





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Point Roberts Inset

**LEGEND**

**Coastal LWD Restoration Need - (100' Buffer)**

- High
- Low

Point Whitehorn

City of  
Ferndale

Lummi  
Reservation

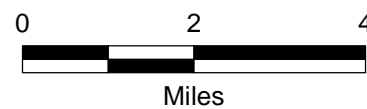
City of  
Bellingham

Bellingham Bay

Lake Whatcom

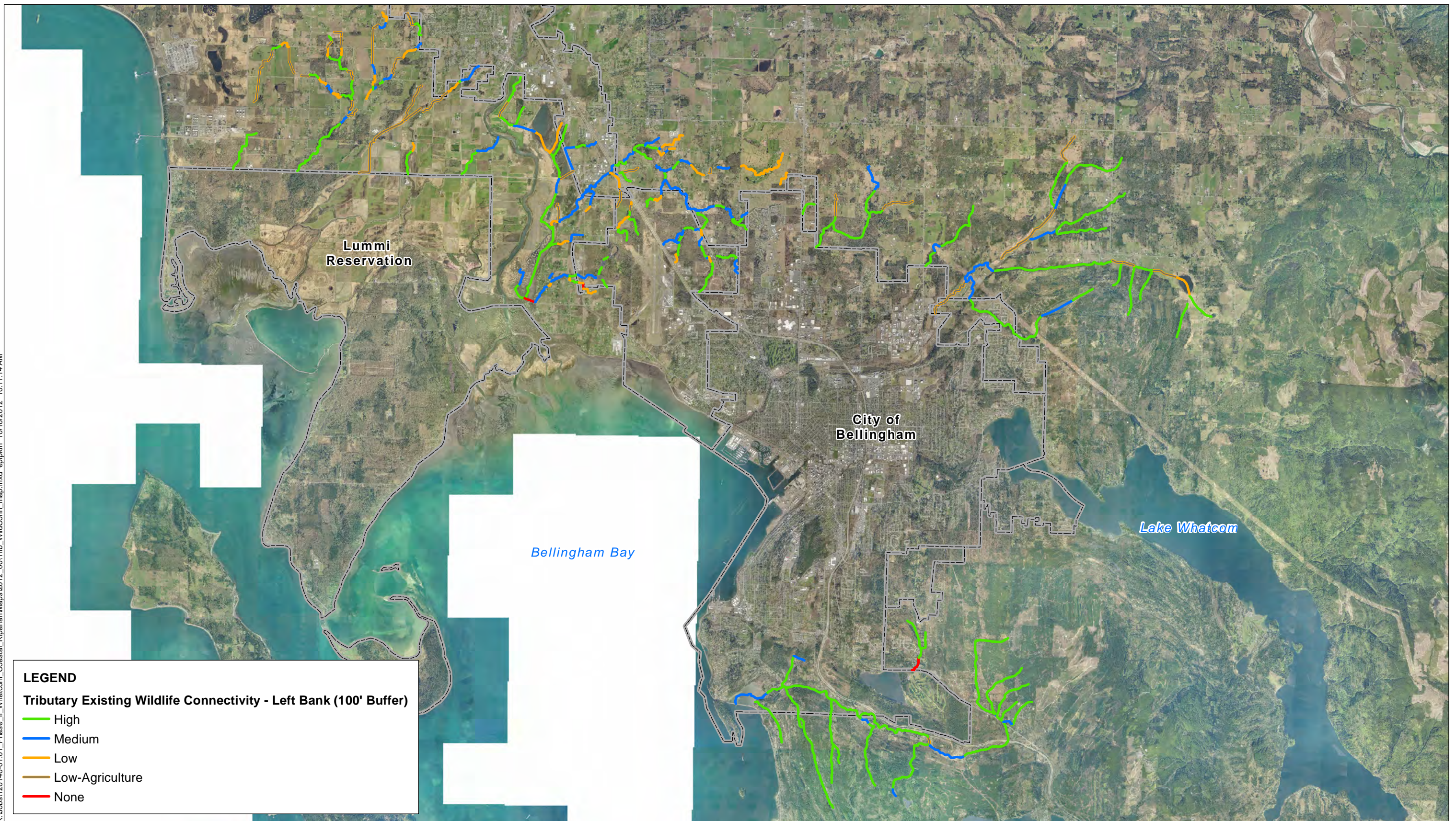
**NOTES:**

1. Horizontal datum: WA State Plane North, NAD83, Feet.
2. Aerial photo and stream layer provided by Whatcom County.
3. Results shown only for coastal reaches classified as naturally associated with forest cover.



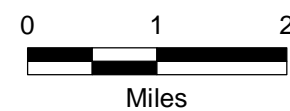


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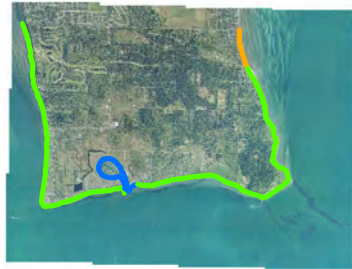
**NOTES:**

1. Horizontal datum: WA State Plane North, NAD83, Feet.
2. Aerial photo and stream layer provided by Whatcom County.





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Point Roberts Inset

#### LEGEND

##### Coastal Existing Wildlife Connectivity - (100' Buffer)

- High
- Medium
- Low
- None

Point Whitehorn

City of  
Ferndale

Lummi  
Reservation

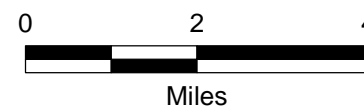
City of  
Bellingham

Bellingham Bay

Lake Whatcom

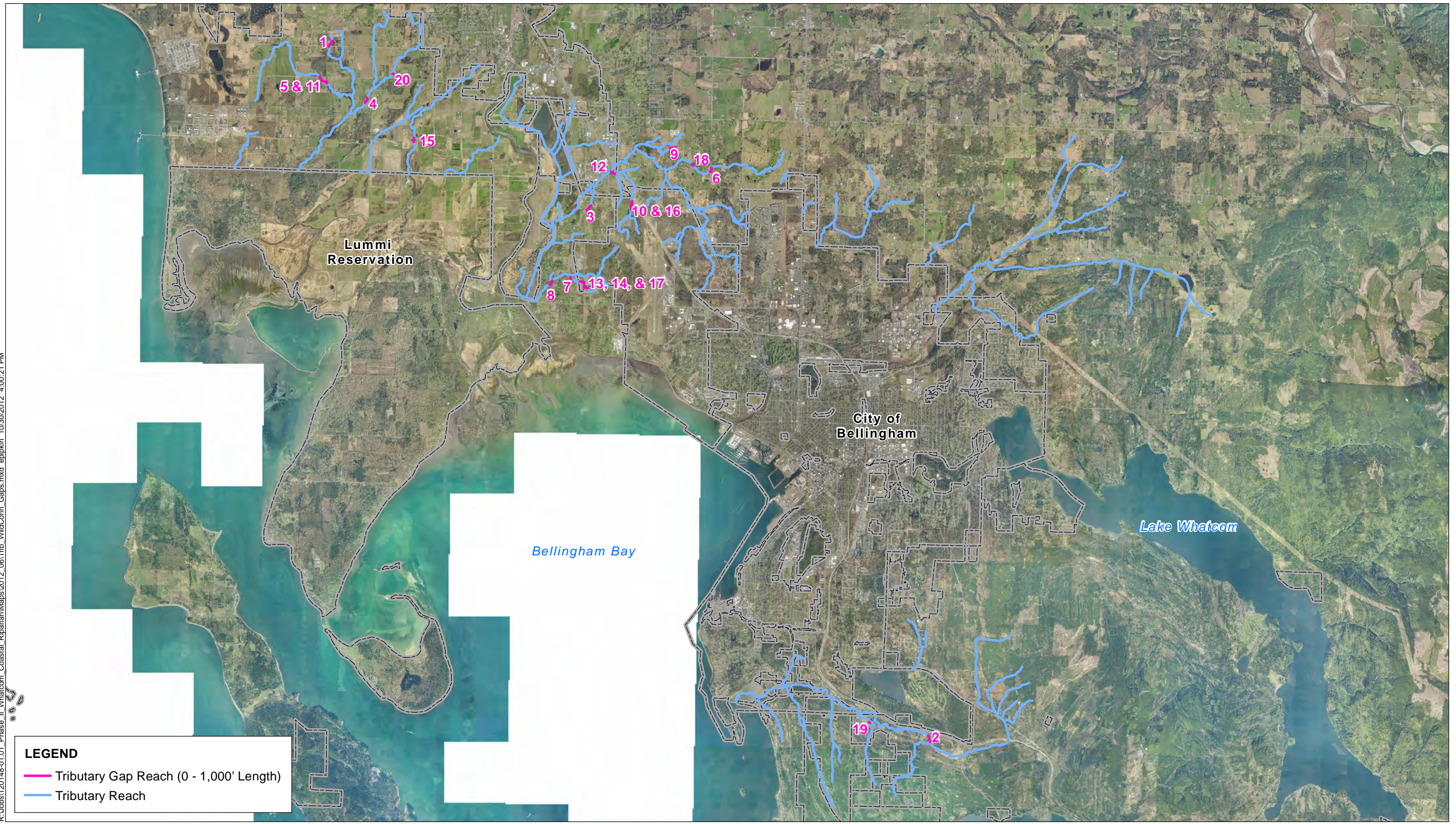
#### NOTES:

1. Horizontal datum: WA State Plane North, NAD83, Feet.
2. Aerial photo and stream layer provided by Whatcom County.





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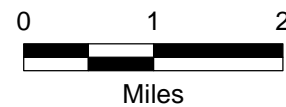


**LEGEND**

- Tributary Gap Reach (0 - 1,000' Length)
- Tributary Reach

**NOTES:**

- Horizontal datum: WA State Plane North, NAD83, Feet.
- Aerial photo and stream layer provided by Whatcom County.

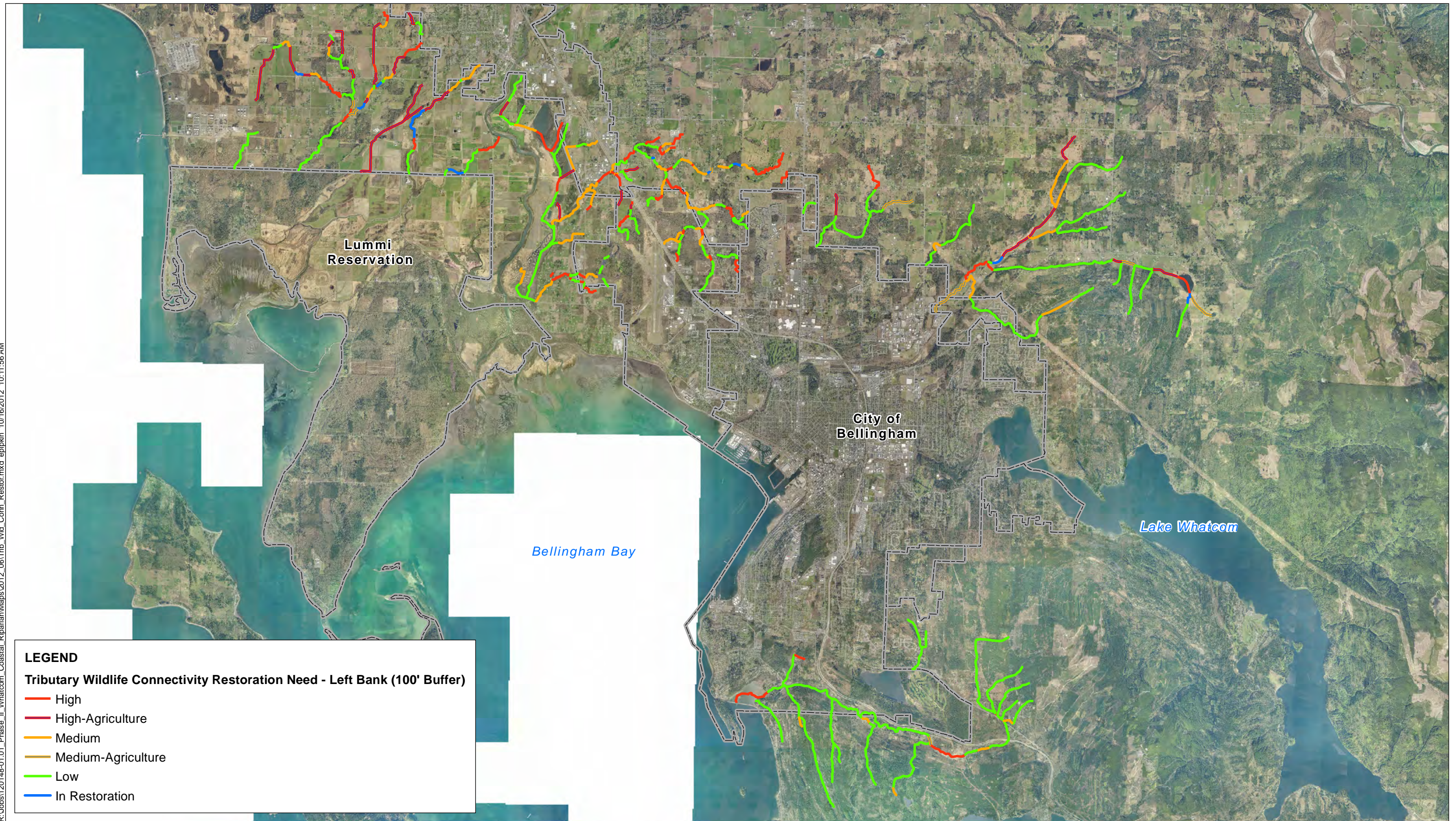


**Map 13**

Tributary Wildlife Connectivity Gaps  
between 0 and 1,000 feet Ranked by Length - Left Bank (100' Buffer)  
Phase 2 Whatcom County Riparian Function Assessment  
Whatcom County, WA

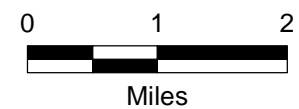


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**NOTES:**

1. Horizontal datum: WA State Plane North, NAD83, Feet.
2. Aerial photo and stream layer provided by Whatcom County.





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Point Roberts Inset

#### LEGEND

##### Coastal Wildlife Connectivity Restoration Need - (100' Buffer)

- High
- Medium
- Low

Point Whitehorn

City of  
Ferndale

Lummi  
Reservation

City of  
Bellingham

Bellingham Bay

Lake Whatcom

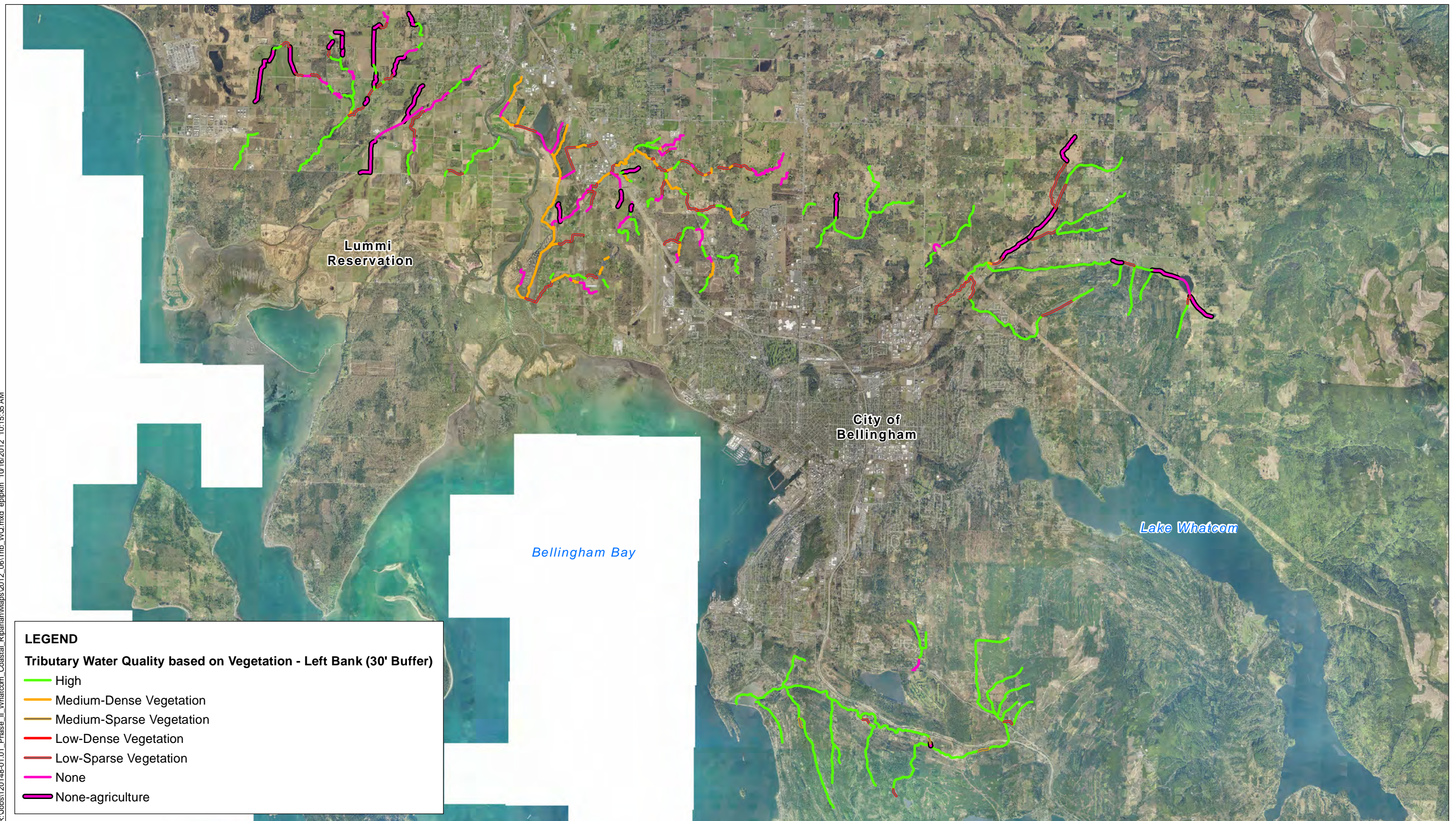
#### NOTES:

1. Horizontal datum: WA State Plane North, NAD83, Feet.
2. Aerial photo and stream layer provided by Whatcom County.



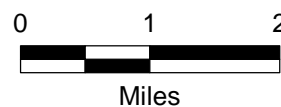


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**NOTES:**

1. Horizontal datum: WA State Plane North, NAD83, Feet.
2. Aerial photo and stream layer provided by Whatcom County.

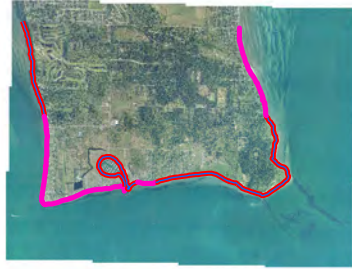


**Map 16**  
Tributary Existing Water Quality Conditions based on Riparian Vegetation - Left Bank (30' Buffer)  
Phase 2 Whatcom County Riparian Function Assessment  
Whatcom County, WA





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Point Roberts Inset

**LEGEND**

**Coastal Water Quality based on Vegetation**

- High
- Medium-Dense Vegetation
- Low-Dense Vegetation
- Low-Sparse Vegetation
- None

Point Whitehorn

City of  
Ferndale

Lummi  
Reservation

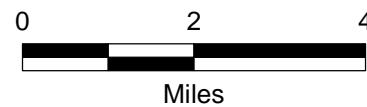
City of  
Bellingham

Bellingham Bay

Lake Whatcom

**NOTES:**

1. Horizontal datum: WA State Plane North, NAD83, Feet.
2. Aerial photo and stream layer provided by Whatcom County.



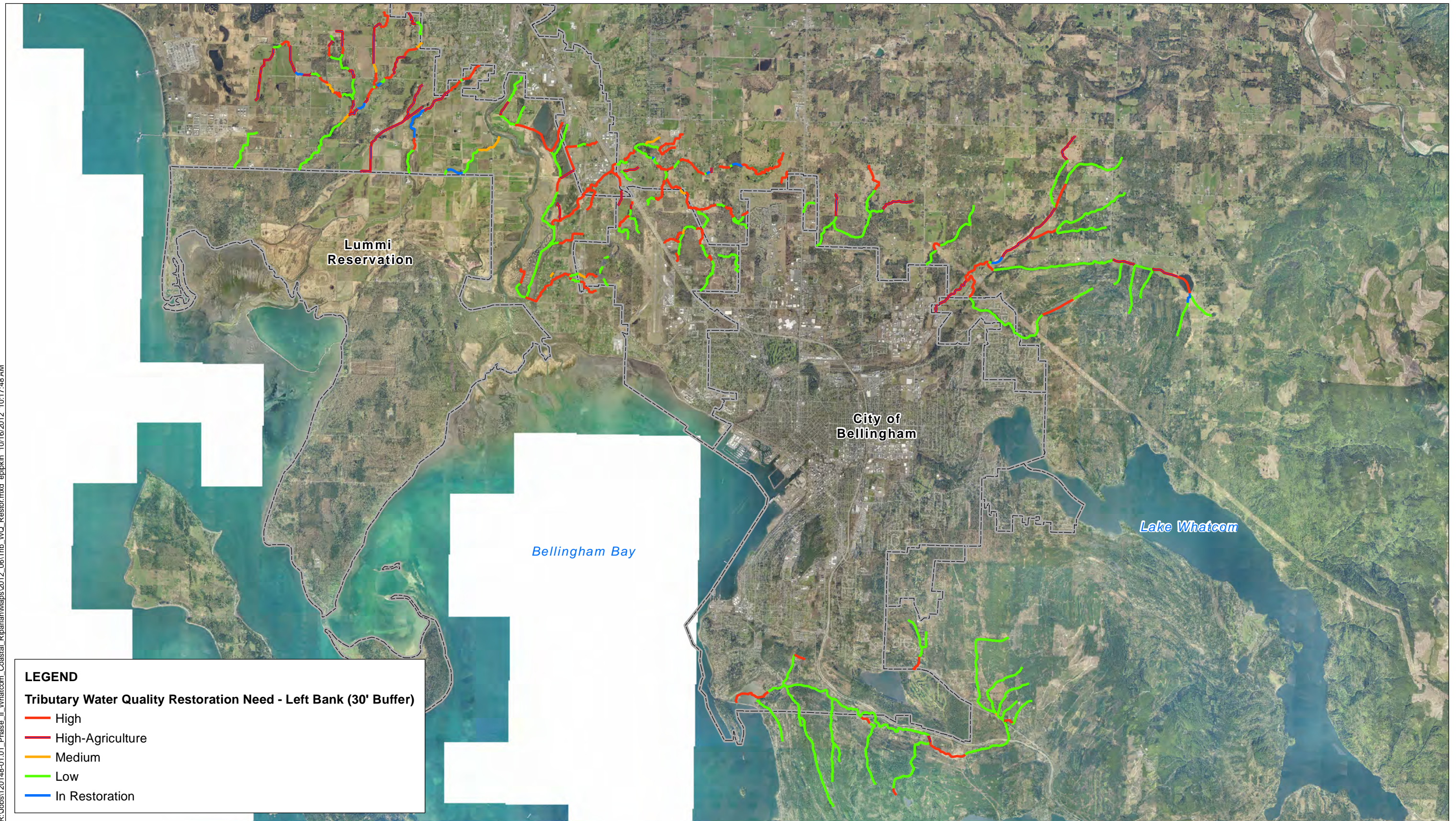
Coastal Existing Water Quality Conditions based on Vegetation - (30' Buffer)  
Phase 2 Whatcom County Riparian Function Assessment  
Whatcom County, WA

**Map 17**



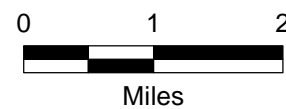


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**NOTES:**

1. Horizontal datum: WA State Plane North, NAD83, Feet.
2. Aerial photo and stream layer provided by Whatcom County.





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Point Roberts Inset

**LEGEND**

**Coastal Water Quality Restoration Need - (30' Buffer)**

- high
- low

Point Whitehorn

City of  
Ferndale

Lummi  
Reservation

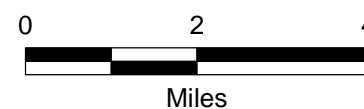
City of  
Bellingham

Bellingham Bay

Lake Whatcom

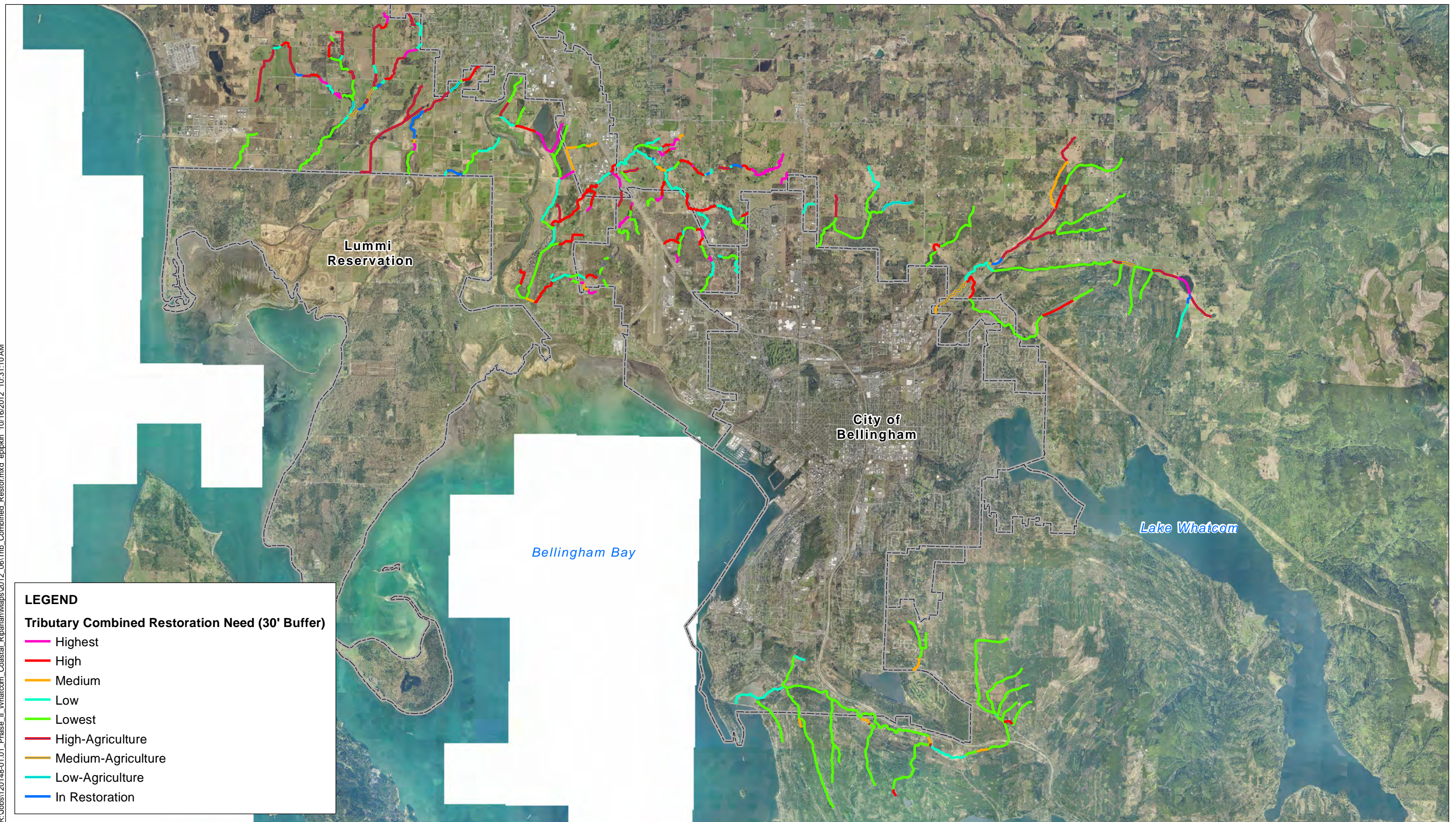
**NOTES:**

1. Horizontal datum: WA State Plane North, NAD83, Feet.
2. Aerial photo and stream layer provided by Whatcom County.



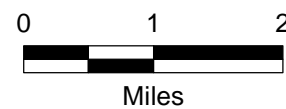


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**NOTES:**

1. Horizontal datum: WA State Plane North, NAD83, Feet.
2. Aerial photo and stream layer provided by Whatcom County.





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Point Roberts Inset

#### LEGEND

##### Coastal Combined Restoration Need

- Highest
- High
- Medium
- Low
- Lowest

Point Whitehorn

City of  
Ferndale

Lummi  
Reservation

City of  
Bellingham

Bellingham Bay

Lake Whatcom

#### NOTES:

1. Horizontal datum: WA State Plane North, NAD83, Feet.
2. Aerial photo and stream layer provided by Whatcom County.

