HERRERA

TECHNICAL MEMORANDUM

Date: March 21, 2022

To: Zack Holt, City of Port Orchard

Copy to: Matt Fontaine, Herrera Environmental Consultants, Inc.

From: Mindy Fohn and Katie Wingrove, Herrera Environmental Consultants, Inc.

Subject: City of Port Orchard Watershed Inventory and Assessment

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BACKGROUND

The purpose of this technical memorandum is to document the process used to prepare a receiving water conditions assessment and identify candidate watersheds for prioritization for the City of Port Orchard (City). This is a requirement of S5.C.1.d.i of the Western Washington Phase II National Pollutant Discharge Elimination System Municipal Stormwater Permit (NPDES Phase II permit). The approach taken to complete this inventory and preliminary assessment generally follows Ecology's Stormwater Management Action Plan (SMAP) guidance (Ecology 2019) with modifications that reflect the specific needs of the City, water resources and the landscape.

The receiving water conditions assessment presents the watershed inventory for three major categories:

1. Watershed Delineation and Jurisdiction Control
2. Receiving Water Conditions and Water Resource Uses
3. Stormwater Management Influence

Watershed metrics are described, and selected metrics are used for assessment. The assessment identifies candidate watersheds to carry forward to SMAP prioritization.

Appendix A is the Detailed Watershed Inventory. Appendix B is the Nearshore and Salmonid Habitat Conditions Life History Support Methodology and Results.

This technical memorandum along with Appendix A Excel file, will be submitted to Ecology with the City's annual report on March 31, 2022, as required by the NPDES Phase II permit.

WATERSHED INVENTORY

Watershed Delineation and Jurisdiction Control

The number of watersheds delineated is dependent upon the scale used and needs appropriate for supporting the inventory and planning effort. Ecology's Stormwater Management Action Plan (SMAP) guidance (Ecology 2019) recommends a scale of 1 to 20 square miles. The City's watersheds were delineated by receiving waters and the basin boundaries adjusted as described below, and watershed jurisdiction control was calculated.

Receiving waters were identified upon review of available stream and water body mapping from the National Hydrography Dataset (NHD), Department of Natural Resources (DNR) mapping, and Wild Fish Conservancy (WFC) web tool. To maintain available stream type designations, the DNR stream layer was used as the base layer for receiving water identification. In the Lower

Blackjack watershed more detailed WFC mapping was used to supplement the DNR mapping to improve accuracy of stream alignment. In areas where stream names were missing from the GIS data, City staff supplied historical information to assign names.

A topographic basin delineation was provided by the City in feature class format (file name: Water_Shed_by_Creek) and used to identify watersheds containing lands located entirely or partly within the city limits.

A high-level review of watershed boundaries was conducted to adjust boundaries where warranted based on the City's stormwater infrastructure, contour data, and discussions with City staff. As a result, some watershed boundaries were adjusted:

- The City's shoreline areas, which are flow-control exempt and discharge directly to Sinclair Inlet, were excluded from the original topographic stream watersheds. These areas were reviewed individually and folded into adjacent stream watersheds based on topography and stormwater infrastructure.

- The Downtown-County Campus watershed was subdivided from the Johnson Creek watershed to coordinate with the ongoing analysis and planning study for the downtown area.

- The Blackjack Creek watershed was subdivided into five subbasins to align with the "Blackjack Creek Restoration Plan" (Lower Blackjack, Middle Blackjack, Upper Blackjack, Ruby Creek, and Square Creek).

- Minor topographic adjustments based on City contours (applies to several watersheds)

Table 1 lists the 18 watersheds. Detailed information regarding each watershed is provided in Table A-1 of Appendix A.

Seven of the eighteen watersheds are less than the 1 square mile recommended size for SMAP evaluation: Annapolis Creek, Johnson Creek, Sacco/Sullivan Creek, Downtown-County Campus, Melcher Creek, Caseco Creek, and Stream 270.

Table 1. City of Port Orchard Watersheds, Area and Receiving Waters.

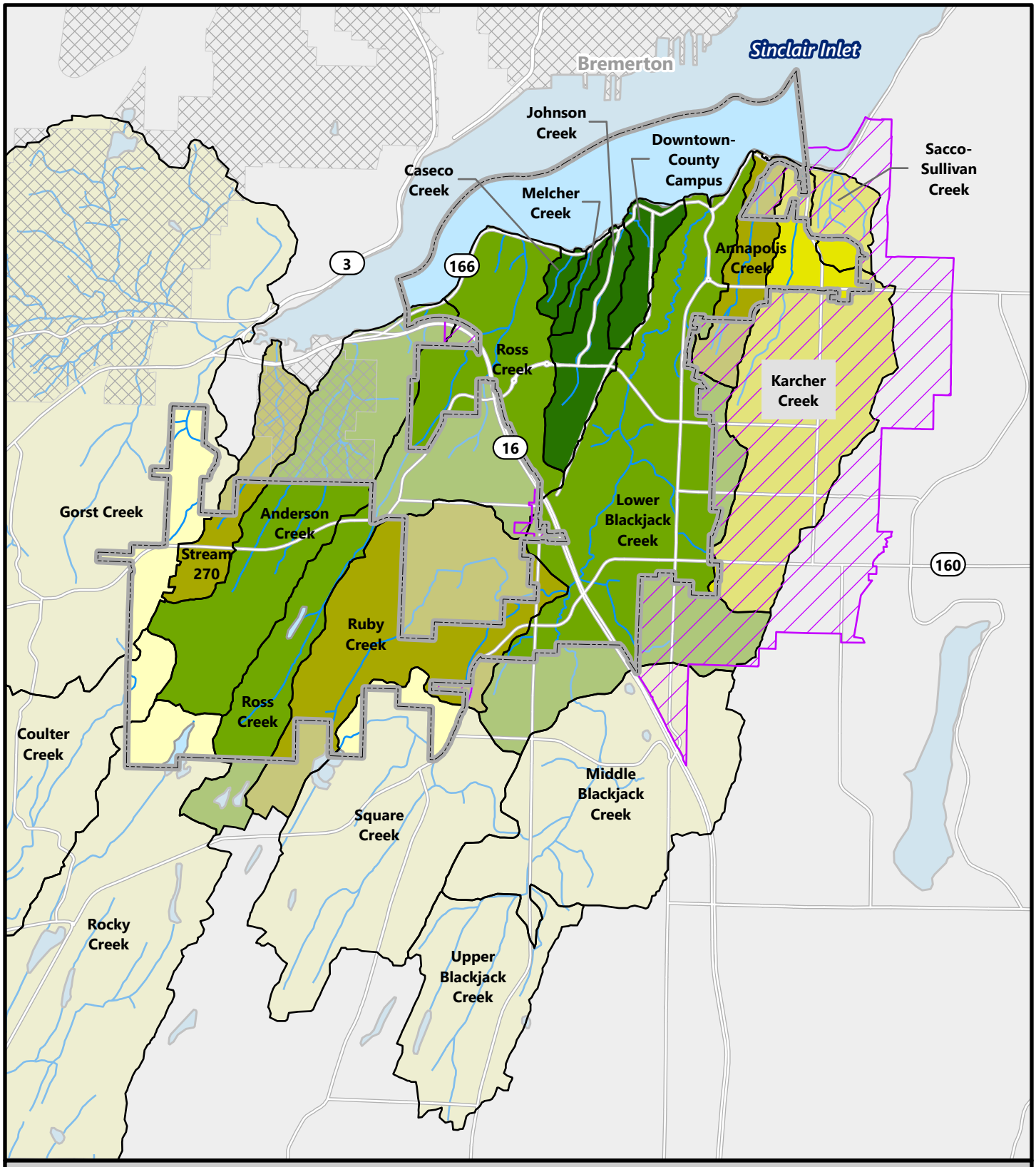
Watershed Name	Area (square miles)	Receiving Waters
Annapolis Creek	0.50	Annapolis Creek, Sinclair Inlet
Johnson Creek	0.51	Johnson Creek, Sinclair Inlet
Karcher Creek	2.24	Karcher Creek, Sinclair Inlet
Ross Creek	2.75	Ross Creek, PO_Strm2, Sinclair Inlet
Anderson Creek (Gorst)	2.01	Anderson Creek, Sinclair Inlet
Lower Blackjack	3.87	Lower Blackjack Creek, Silver Creek, Sinclair Inlet
Middle Blackjack	2.46	Middle Blackjack Creek, Lower Blackjack Creek, Sinclair Inlet
Upper Blackjack	1.33	Upper Blackjack Creek, Middle Blackjack Creek, Lower Blackjack Creek, Sinclair Inlet
Ruby Creek	2.20	Ruby Creek, Blackjack Creek, Lower Blackjack Creek, Sinclair Inlet
Square Creek	2.64	Square Creek, Ruby Creek, Lower Blackjack Creek, Sinclair Inlet
Coulter Creek	13.11	Coulter Creek, North Bay
Rocky Creek	18.32	Rocky Creek, Rocky Bay
Gorst Creek (Parish Creek in City portion)	9.58	Parish Creek, Gorst Creek, Sinclair Inlet
Sacco/Sullivan Creek	0.29	Sullivan Creek, Sinclair Inlet
Downtown-County Campus	0.28	PO_Strm1, Sinclair Inlet
Melcher Creek	0.10	Melcher, Creek, Sinclair Inlet
Caseco Creek	0.09	Caseco Creek, Sinclair Inlet
Stream 270	0.56	Stream 270, Sinclair Inlet

Watersheds extend beyond the city limits, and therefore multiple jurisdictions may have influence over the watershed. Other jurisdictions with influence over the City's watersheds include the City of Bremerton, unincorporated Kitsap County, Mason County, and Pierce County (Figure 1). No areas from Mason or Pierce Counties would be annexed by the City, so these counties are not included in the watershed calculations. In Table 2, watershed areas are expressed as percentage of basin within the different jurisdictions. Additionally, a separate basin calculation was performed including Urban Growth Areas (UGAs) that could be annexed into the City. The calculations estimate the potential future percentage of City control of these areas. The City currently has 30 percent or greater control in Annapolis Creek, Johnson Creek, Ross Creek, Anderson Creek, Lower Blackjack, Ruby Creek, Downtown-County Campus, Melcher Creek, Caseco Creek, and Stream 270.

Jurisdictional control by the City is increased substantially (see far right column in Table 2, Percent City + UGA) in the following watersheds if annexation is completed: Annapolis Creek, Karcher Creek, and Sacco/Sullivan Creek.

Table 2. Percent of Watershed in Key Jurisdictions and Within UGA.

Watershed Name	Percent City	Percent City UGA	Percent Kitsap County	Percent City of Bremerton	Percent City + UGA
Annapolis Creek	54.6%	45.4%	0.0%	0.0%	100.0%
Johnson Creek	100.0%	0.0%	0.0%	0.0%	100.0%
Karcher Creek	11.4%	88.6%	0.0%	0.0%	100.0%
Ross Creek	64.7%	1.7%	33.6%	0.0%	66.4%
Anderson Creek (Gorst)	59.4%	0.4%	18.0%	22.1%	59.9%
Lower Blackjack	67.9%	18.7%	13.4%	0.0%	86.6%
Middle Blackjack	0.0%	5.8%	94.2%	0.0%	5.8%
Upper Blackjack	0.0%	0.0%	100.0%	0.0%	0.0%
Ruby Creek	53.5%	1.0%	45.5%	0.0%	54.5%
Square Creek	7.4%	0.002%	92.6%	0.0%	7.4%
Coulter Creek	1.2%	0.0%	86.0%	12.8%	1.2%
Rocky Creek	1.3%	0.0%	98.7%	0.0%	1.3%
Gorst Creek (Parish Creek in City portion)	5.0%	0.0%	36.7%	58.3%	5.0%
Sacco/Sullivan Creek	21.8%	78.2%	0.0%	0.0%	100.0%
Downtown-County Campus	100.0%	0.0%	0.0%	0.0%	100.0%
Melcher Creek	100.0%	0.0%	0.0%	0.0%	100.0%
Caseco Creek	100.0%	0.0%	0.0%	0.0%	100.0%
Stream 270	44.9%	0.0%	20.7%	34.4%	44.9%



Legend

- Port Orchard City Limits
- Port Orchard UGA
- Watersheds
- Bremerton
- Waterbodies
- Streams
- Roads

Percent PO Control

- 0% - 10%
- >10% - 30%
- >30% - 55%
- >55% - 75%
- >75% - 100%

Figure 1.
City of Port Orchard Watersheds and Jurisdiction Control.

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0 0.5 1 2 Miles

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Receiving Water Conditions and Water Resource Uses

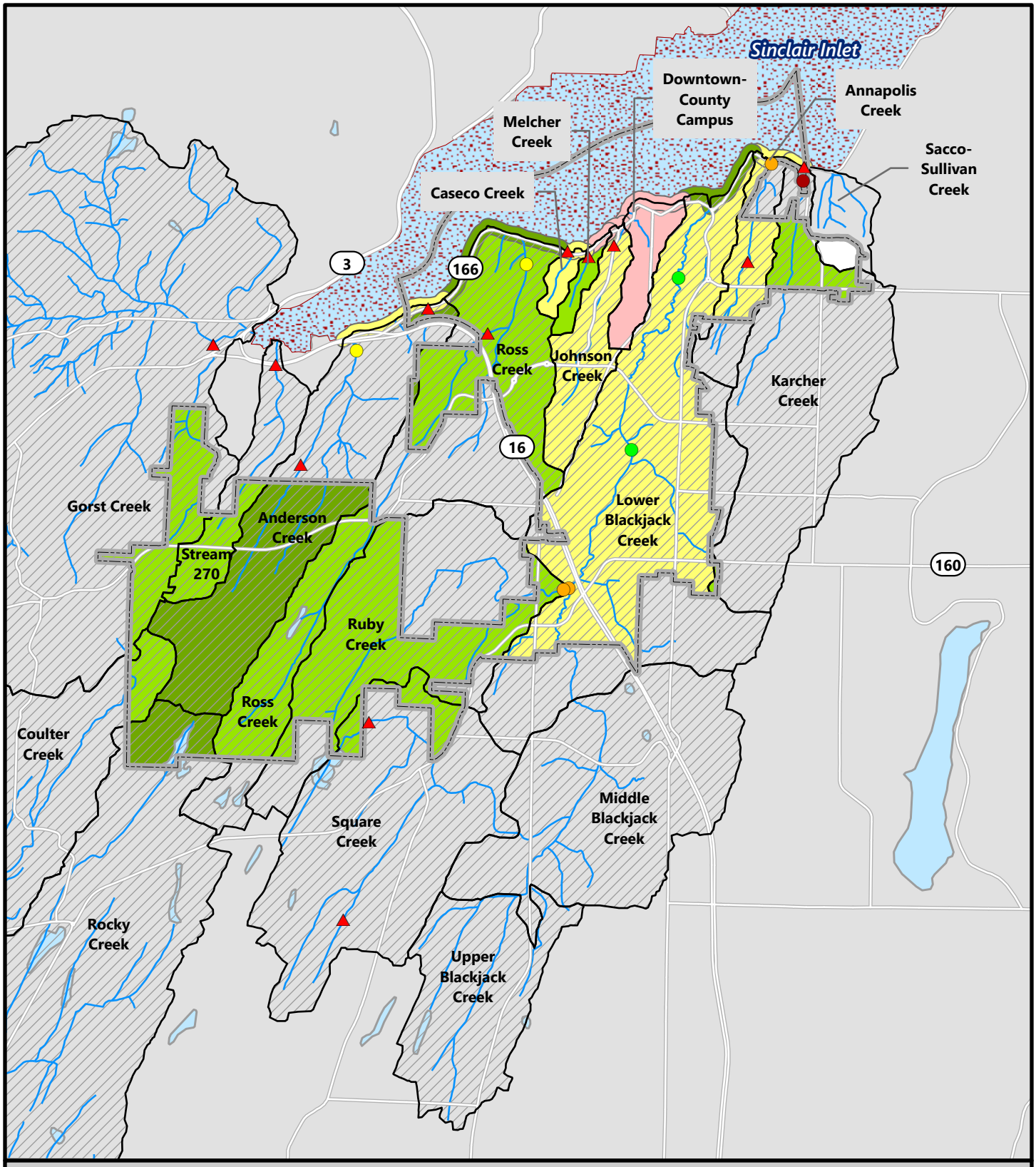
Water quality, habitat conditions, and water resource uses were inventoried. City watersheds are categorized as either freshwater streams only, or a combination of freshwater streams and nearshore marine areas. The six watersheds categorized as freshwater streams only are: Middle Blackjack, Ruby Creek, Upper Blackjack, Coulter Creek, and Rocky Creek. The remaining 12 watersheds have a nearshore marine component. One challenge during SMAP prioritization will be balancing scoring and ranking criteria between these two different watershed types.

Not all watersheds have water quality data; therefore, a balanced and non-biased approach for criteria, scoring, and ranking will be considered during the prioritization phase of SMAP. Water quality data was available for benthic index of biotic integrity (B-IBI) for 10 of 18 watersheds, nearshore bacteria marine water quality for 11 of 12 watersheds that have a marine component, stream bacteria water quality for 8 of 18 watersheds, and 303(d) listed waters were present in 8 of 18 watersheds.

Due to the extensive use of City watersheds by salmonids, a detailed assessment of marine nearshore and freshwater system habitat conditions was conducted and is summarized in Appendix B. Current habitat conditions were assessed using existing data and only for areas within city limits. For freshwater stream systems, rearing, spawning, migration, and refuge/riparian function were each scored separately. For both marine nearshore and freshwater system scores, the higher the points, the better condition of habitat.

City water resource uses by people and wildlife vary from nearshore marine areas to upland freshwater streams. Water resource use characterization metrics included forage fish and shoreline habitat, marine nearshore pocket estuary habitat, public recreation, salmonids, and shellfish. Shellfish harvest is not an identified use in any of the nearshore marine watersheds since they are closed to harvest due to the presence of multiple wastewater treatment plant outfalls.

Figure 2 shows results for selected water conditions and water resource use metrics: B-IBI score, shellfish closure zones, first total fish passage barrier, ESA listed species presence, salmonid refuge-riparian habitat rating by watershed, and marine nearshore habitat rating. Results, data sources, and notes are shown in Table A-2 of Appendix A.



Legend

- Port Orchard City Limits
- Watersheds
- Waterbodies
- Shellfish Harvest Closure Zone (WSDOH)
- Presence of ESA listed salmon habitat
- First Total Fish Passage Barrier
- Streams
- Roads

Refuge-Riparian Rating

- 0 - 0.1 (poor)
- >0.1 - 0.4 (moderate)
- >0.4 - 0.75 (good)
- >0.75 - 1 (excellent)

Nearshore Rating

- 0 - 1 (poor)
- >1 - 5 (moderate)
- >5 - 10 (good)
- >10 (excellent)

B-IBI Samples

- Very Poor
- Poor
- Fair
- Good

Figure 2.
Selected Metrics of Water Conditions and Water Resource Uses.

N

0 0.5 1 2 Miles

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Stormwater Management Influence

Metrics describing the City MS4 (municipal separate storm sewer system) impacts to marine nearshore and freshwater ecosystems were developed. Also, metrics describing equity related to overburdened communities were developed. Detailed data sources, results, and notes included in Tables A-3 and A-4 of Appendix A.

Metrics specific to marine nearshore ecosystems are percent flow control exempt areas and number of outfalls to marine shoreline. Metrics specific to stream ecosystems are percent impervious surface, road density, fish passage barriers, feet of stream to first full barrier, percent impervious in riparian zone, and number of outfalls to streams.

Future growth was considered in the assessment. Two metrics assess future growth: percent of basin area with vacant/partially utilized/underutilized lands, and percent of basin area with projected population growth.

Five equity metrics were calculated: combined environmental health disparities rank, environmental exposures, environmental effects, socioeconomic factors, and sensitive populations. The results will be incorporated into the criteria, scoring, and ranking prioritization process.

Selected metrics were evaluated for stormwater management influence during this initial SMAP inventory phase, while others will be utilized during SMAP prioritization. Summarizing key metrics shows that 12 of the 18 watersheds contribute high or moderate stormwater impacts to nearshore and/or stream receiving waters from the City MS4 (Table 3). Impacts of City stormwater and infrastructure include contribution of pollutants, uncontrolled flows, and fragmented stream habitat. Six watersheds have low or no levels of City MS4 outfalls to surface waters. Detailed data sources, results, and notes are in Table A-3 of Appendix A.

Table 3. Selected Metrics for City Stormwater Influence on Receiving Waters.

Watershed	Percent Impervious Area	Road Crossings Per Stream Mile	Outfalls to Stream	Outfalls to Marine	Level of Stormwater Impact
Annapolis Creek	30.1%	5.3	1	4	High
Johnson Creek	28.8%	9.5	2	2	High
Karcher Creek	27.7%	3.7	3	0	High
Ross Creek	13.3%	2.1	10	13	Moderate
Anderson Creek (Gorst)	8.9%	3.7	4	5	Moderate
Lower Blackjack	22.3%	1.9	10	12	Moderate
Ruby Creek	5.3%	1.1	6	Not applicable	Moderate
Sacco/Sullivan Creek	18.1%	1.2	0	0	High
Downtown-County Campus	50.2%	8.8	0	10	High
Melcher Creek	12.2%	4.4	0	3	Moderate

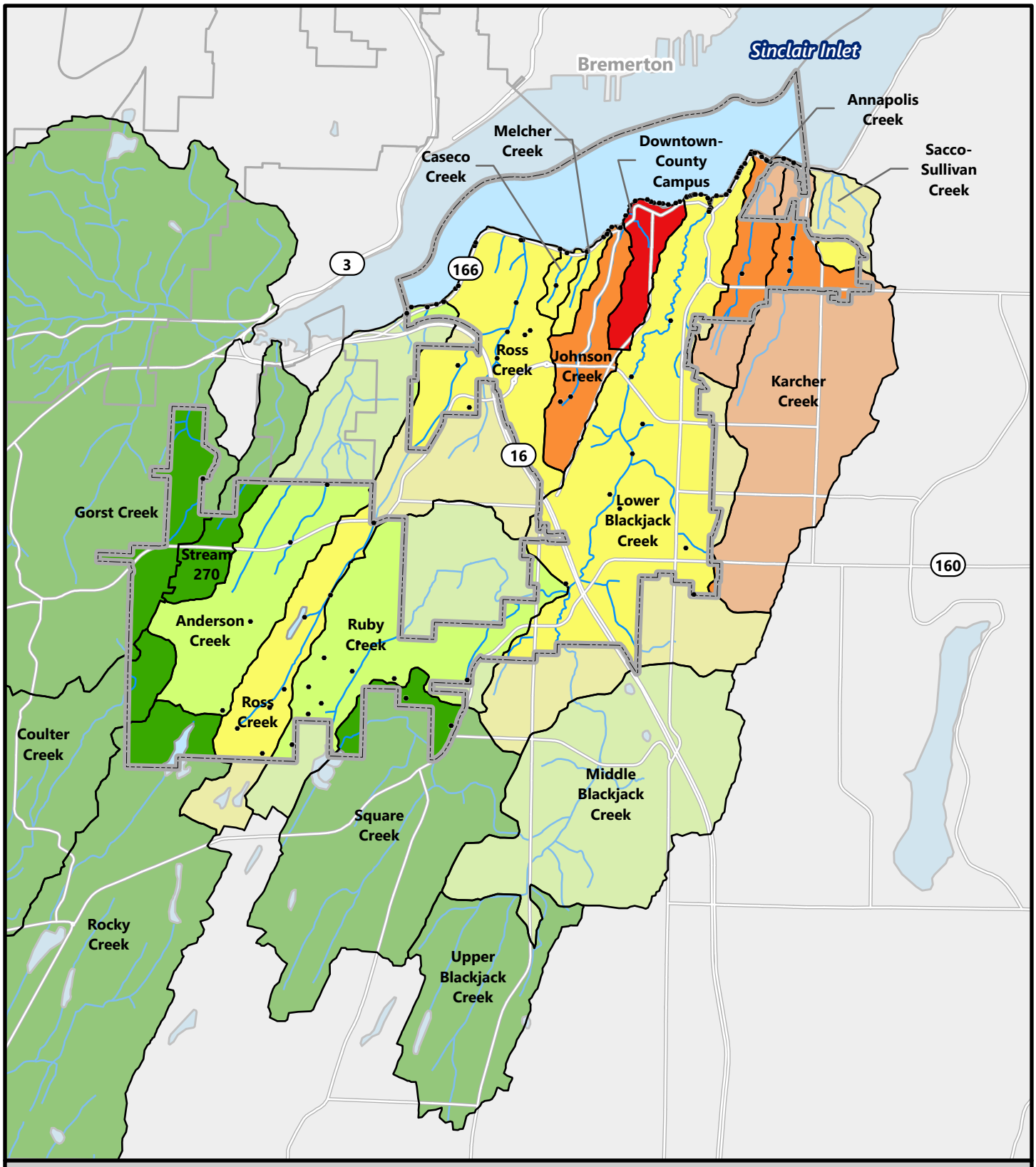
Table 3 (continued). Selected Metrics for City Stormwater Influence on Receiving Waters.

Watershed	Percent Impervious Area	Road Crossings Per Stream Mile	Outfalls to Stream	Outfalls to Marine	Level of Stormwater Impact
Caseco Creek	11.9%	4.7	1	1	Moderate
Stream 270	44.9%	1.1	0	Not applicable	Moderate
Middle Blackjack	9.2%	0.7	0	Not applicable	Low
Upper Blackjack	3.8%	1.6	0	Not applicable	Low
Square Creek	3.6%	1.2	1	Not applicable	Low
Coulter Creek	0.4%	0.3	0	Not applicable	Low
Rocky Creek	1.7%	0.6	0	Not applicable	Low
Gorst Creek	4.1%	1.2	1	Not applicable	Low

Watersheds with 5 percent or less current or future potential City jurisdictional control are also designated as "low stormwater management influence." Watersheds with 5 percent or less City jurisdictional control are Middle Blackjack, Upper Blackjack, Square Creek, Coulter Creek, Rocky Creek, and Gorst Creek. These six watersheds will not be considered for further analysis.

A summary of major stormwater impacts, potential restoration/protection goals, potential management actions, and existing plans or projects were inventoried. Existing projects or plans are present in 7 of the 12 candidate watersheds: Annapolis Creek, Johnson Creek, Ross Creek, Anderson Creek, Lower Blackjack, Ruby Creek, and Downtown-County Campus. The inventory and assessment results are in Table A-5 of Appendix A.

Figure 3 shows results from three key metrics used for stormwater influence: percent watershed impervious and stream and marine city stormwater outfalls.



Legend

- MS4 Outfalls to Stream, Lake, Wetland or Marine Shoreline
- Port Orchard (PO) City Limits
- Watersheds
- Bremerton
- Waterbodies
- Streams
- Roads

Total Watershed Percentage Impervious Surface Area

- 0% - 5%
- >5% - 10%
- >10% - 25%
- >25% - 50%
- >50% - 100%

Figure 3.
Selected Metrics of Stormwater Influence.

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0 0.5 1 2 Miles

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CANDIDATE WATERSHEDS FOR PRIORITIZATION

Twelve of the eighteen watersheds will be moved forward for SMAP prioritization. Key characteristics of the watersheds retained for the prioritization phase along with a description of current storm and stream improvement projects from the City draft Capital Stormwater Improvements Project list are provided below.

Anderson Creek

Summary: Anderson Creek watershed is 2.01 square miles (1,285 acres); 59 percent of the basin is located within the city limits. The watershed is 9 percent impervious surface; that includes 6 percent impervious surface in the riparian zone. The watershed has 59 linear feet (lf) of roads per acre. Documented aquatic species habitat is present for coho, fall chum, winter steelhead, and resident trout. No habitat is present for forage fish in the marine shoreline area of this watershed. There are 4.1 fish passage barriers per stream mile. The City MS4 includes four outfalls to the stream and five outfalls to the marine shoreline.

Projects: Potential projects are the Anderson Creek Culvert Retrofits and McCormick Woods Drive Culvert Barrier Replacement.

Annapolis Creek

Summary: Annapolis Creek watershed is 0.50 square mile (318 acres), and 55 percent of the basin is located within the city limits. The watershed is 30 percent impervious surface; that includes 20 percent impervious surfaces in the riparian zone. The watershed has 59 lf of roads per acre. Documented aquatic species habitat is present for coho, fall chum, and resident trout. No habitat is identified for forage fish in the marine shoreline area of this watershed. There are 4.9 fish passage barriers per stream mile. The City MS4 includes one outfall to the stream and four outfalls to the marine shoreline.

Projects: One potential project is the Annapolis Creek Culvert Replacement.

Downtown-County Campus

Summary: Downtown County Campus watershed is 0.28 square mile (178 acres); 100 percent of the basin is located within the city limits. The watershed is 50 percent impervious surface; that includes 56 percent impervious surfaces in the riparian zone. The watershed has 201 lf of roads per acre. There are no documented salmonid or forage fish species habitat. There are no fish passage barriers. The City MS4 has no outfalls to the stream and 10 outfalls to the marine shoreline.

Projects: Potential projects are the Central Sidney Stormwater Improvements and Downtown Basin Stormwater Upgrades.

Johnson Creek

Summary: Johnson Creek watershed is 0.51 square mile (326 acres); 100 percent of the basin is located within the city limits. The watershed is 29 percent impervious surface; that includes 19 percent impervious surface in the riparian zone. The watershed has 111 lf of roads per acre. Documented aquatic species habitat is present for resident trout, and surf smelt. There are 12.3 fish passage barriers per stream mile. The City MS4 has two outfalls to the stream and two outfalls to the marine shoreline.

Projects: Potential projects are the Johnson Creek Stream Realignment and Johnson Creek Estuary Restoration.

Karcher Creek

Summary: Karcher Creek watershed is 2.24 square miles (1,433 acres); 11 percent of the basin is located within the city limits. If all UGA is annexed, City control would increase to 100 percent of the watershed area. The watershed is 28 percent impervious surface; that includes 13 percent impervious surface in the riparian zone. The watershed has 107 lf of roads per acre. Documented aquatic species habitat is present for coho, resident trout, fall chum, sand lance, and surf smelt. There are 3.7 fish passage barriers per stream mile. The City MS4 has three outfalls to the stream and no outfalls to the marine shoreline.

Projects: No projects are currently identified in the Karcher Creek watershed.

Lower Blackjack

Summary: Lower Blackjack Creek watershed is 3.87 square miles (2,479 acres); 68 percent of the basin located within the city limits. If all UGA is annexed, City control would increase to 88 percent of the watershed area. The watershed is 22 percent impervious surface; that includes 15 percent impervious surfaces in the riparian zone. The watershed has 81 lf of roads per acre. Documented aquatic species habitat is present for coho, fall chum, winter steelhead, resident trout, fall Chinook, summer chum, sand lance, and surf smelt. There are 2.0 fish passage barriers per stream mile. The City MS4 has 10 outfalls to the stream and 12 outfalls to the marine shoreline.

Projects: Potential projects and plans are the South East Salmonberry Road Lower Blackjack Creek Culvert Replacement, Blackjack Creek Floodplain Restoration and Stormwater Management Plan, Port Orchard East Shoreline Acquisition and Easement Right, Rockwell Area Stormwater Improvements, Silver Creek Rehabilitation, South Blackjack Creek Culvert Removal and Bridge Installation, Blackjack Creek Storm Outfall Assessment and Retrofit Analysis, South Sidney Regional Facility, and Westbay Stormwater Improvements.

Ross Creek

Summary: Ross Creek watershed is 2.75 square miles (1,759 acres); 59 percent of the basin is located within the city limits. The watershed is 13 percent impervious surface; that includes 10 percent impervious surfaces in the riparian zone. The watershed has 66 lf of roads per acre. Documented aquatic species habitat is present for coho, fall chum, winter steelhead, resident trout, sand lance, and surf smelt. There are 3.6 fish passage barriers per stream mile. The City MS4 has 10 outfalls to the stream and 13 outfalls to the marine shoreline.

Projects: Potential projects are Ross Creek Beaver Dam Analogs Installation and Ross Creek Estuary Restoration and Beach Recreation Area.

Ruby Creek

Summary: Ruby Creek watershed flows into Lower Blackjack watershed and is 2.20 square miles (1,405 acres); 54 percent of the basin is located within the city limits. The watershed is 5 percent impervious surface; that includes 6 percent impervious surfaces in the riparian zone. The watershed has 41 lf of roads per acre. Documented aquatic species habitat is present for coho, fall chum, resident trout, and summer chum. There are 9.2 fish passage barriers per stream mile. The City MS4 has six outfalls to the stream and no marine nearshore area.

Projects: One potential project is the Glenwood Road Ruby Creek Culvert Replacement.

Sacco/Sullivan Creek

Summary: Sacco/Sullivan Creek watershed is 0.29 square mile (186 acres); 22 percent of the basin is located within the city limits. If all UGA is annexed, City control would increase to 100 percent of the watershed area. The watershed is 18 percent impervious surface; that includes 4 percent impervious surfaces in the riparian zone. The watershed has 92 lf of roads per acre. Documented aquatic species habitat is present for resident trout, fall chum, and surf smelt. There are no fish passage barriers. The City MS4 has no outfalls to the stream or marine shoreline.

Projects: No projects have been identified in the Sacco/Sullivan Creek watershed.

Stream 270

Summary: Stream 270 watershed is 0.56 square mile (361 acres); 45 percent of the basin is located within the city limits. The watershed is 3 percent impervious surface; that includes 4 percent impervious surfaces in the riparian zone. The watershed has 35 lf of roads per acre. Documented aquatic species habitat is present for coho, fall chum, and resident trout. There are 3.0 fish passage barriers. The City MS4 has no outfalls to the stream or marine shoreline.

Projects: No projects have been identified in the Stream 270 watershed.

SUMMARY

All watersheds were characterized for basin size, jurisdictional control, water conditions, water resource uses, stormwater management influence, future growth, and equity. Watersheds were assessed for major stormwater impacts, potential management actions, and existing plans or projects documented. All inventory results, data sources, and notes are in Appendix A, Tables A-1 through A-5.

Table 4 summarizes watershed level of stormwater influence and rationale for either retaining for SMAP prioritization and or setting aside from the prioritization process.

Table 4. Stormwater Management Influence and Candidate Watersheds for Prioritization.

Watershed	Level of Stormwater Influence	Rationale for Retaining or Setting Aside for Prioritization	Result
Downtown-County Campus	High	50 percent watershed impervious surface, highest riparian impervious (56 percent)	Retain for prioritization
Annapolis Creek	High	30 percent watershed impervious, second highest riparian impervious (20 percent), increased City control if annexation occurs	
Johnson Creek	High	29 percent watershed impervious, highest stream barriers per mile (12.3)	
Karcher Creek	High	28 percent watershed impervious, increased City control if annexation occurs	
Sacco/Sullivan Creek	High	18 percent watershed impervious surface, increased City control if annexation occurs	
Ross Creek	Moderate	13 percent watershed impervious surface	
Melcher Creek	Moderate	12 percent watershed impervious surface	
Caseco Creek	Moderate	12 percent watershed impervious surface	
Lower Blackjack	Moderate	11 percent watershed impervious surface	
Anderson Creek (Gorst)	Moderate	9 percent watershed impervious surface	
Ruby Creek	Moderate	5 percent watershed impervious surface,	
Stream 270	Moderate	3 percent watershed impervious surface	
Gorst Creek	Low	5 percent City control	Set aside from prioritization process
Square Creek	Low	4 percent City control	
Rocky Creek	Low	1 percent City control	
Coulter Creek	Low	1 percent City control	
Upper Blackjack	Low	0 percent City control	
Middle Blackjack	Low	0 percent City control	

The next steps are to conduct the SMAP prioritization phase. Candidate watersheds will be further evaluated following the Ecology Guidance.

REFERENCES

Ecology. 2019. Stormwater Management Action Planning Guidance. Washington Department of Ecology-Water Quality Program. Publication Number 19-10-010.

ESA. 2017. Blackjack Creek Watershed Restoration Assessment and Protection and Restoration Plan. Prepared for Suquamish Tribe and Washington Department of Ecology, by ESA Consultants, Seattle, Washington.

APPENDIX A

Detailed Watershed Inventory

Table A-1. Delineate Basins and Identify Receiving Waters.

Metric Name	Basin Identification	Basin Area		Receiving Waters			Basin Jurisdiction Control					
	Basin	AREA (SQ MI)	AREA (Acres)	Streams	Lakes	Marine	% In City	% Outside City only	% in City UGA	% Kitsap County	% City of Bremerton	% in City Jurisdiction + Port Orchard UGA
	Annapolis Creek	0.50	318	Annapolis Creek	None	Sinclair Inlet	54.6%	45.4%	45.4%	0.0%	0.0%	100.0%
	Johnson Creek	0.51	326	Johnson Creek	None	Sinclair Inlet	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	Karcher Creek	2.24	1,433	Karcher Creek	None	Sinclair Inlet	11.4%	88.6%	88.6%	0.0%	0.0%	100.0%
	Ross Creek	2.75	1,759	Ross Creek, PO_Strm2	Berry Lakes, Nels Johnson Lakes, North Lake	Sinclair Inlet	64.7%	35.3%	1.7%	33.6%	0.0%	66.4%
	Anderson Creek (Gorst)	2.01	1,285	Anderson Creek	None	Sinclair Inlet	59.4%	40.6%	0.4%	18.0%	22.1%	59.9%
	Blackjack Creek all subwatersheds [1]	12.51	8,005	Blackjack Creek, Silver Creek	None	Sinclair Inlet	32.0%	68.0%	7.1%	60.9%	0.0%	39.1%
	Lower Blackjack	3.87	2,479	Lower Blackjack Creek, Silver Creek	None	Sinclair Inlet	67.9%	32.1%	18.7%	13.4%	0.0%	86.6%
	Middle Blackjack	2.46	1,576	Middle Blackjack Creek	Deep Lake	Not applicable	0.0%	100.0%	5.8%	94.2%	0.0%	5.8%
	Upper Blackjack	1.33	854	Upper Blackjack Creek	None	Not applicable	0.0%	100.0%	0.0%	100.0%	0.0%	0.0%
	Ruby Creek	2.20	1,405	Ruby Creek (Blackjack Creek)	Honey Lake, Square Lake; wetland complex with outfalls	Not applicable	53.5%	46.5%	1.0%	45.5%	0.0%	54.5%
	Square Creek	2.64	1,691	Square Creek (Blackjack Creek)	Matthews Lake, Square Lake	Not applicable	7.4%	92.6%	0.002%	92.6%	0.0%	7.4%
	Coulter Creek	13.11	8,388	Coulter Creek	Kriegler Lake	North Bay	1.2%	98.8%	0.0%	86.0%	12.8%	1.2%
	Rocky Creek	18.32	11,727	Rocky Creek	Bear Lake, Carney Lake, Fairview Lake, Helena Lake, Hidden Lake, Lake Koeneman, Sailor Lake, Wye Lake	Rocky Bay	1.3%	98.7%	0.0%	98.7%	0.0%	1.3%
	Gorst Creek (Parish in City portion)	9.58	6,133	Gorst Creek, Parish Creek, Heins Creek	Heins Lake, Jarstad Lake, Twin Lakes	Sinclair Inlet	5.0%	95.0%	0.0%	36.7%	58.3%	5.0%
	Sacco/Sullivan Creek	0.29	186	Sullivan Creek	None	Sinclair Inlet	21.8%	78.2%	78.2%	0.0%	0.0%	100.0%
	Downtown-County Campus	0.28	178	PO_Strm1	None	Sinclair Inlet	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	Melcher Creek	0.10	61	Melcher Creek	None	Sinclair Inlet	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	Caseco Creek	0.09	56	Caseco Creek	None	Sinclair Inlet	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	Stream 270	0.56	361	Strm270	None	Sinclair Inlet	44.9%	55.1%	0.0%	20.7%	34.4%	44.9%
Data Availability: City or Basin-wide?	Basin wide	Basin wide	Basin wide	Basin wide	Basin wide	Basin wide	Basin wide	Basin wide	Basin wide	Basin wide	Basin wide	Basin wide

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	Table A-1. Delineate Basins and Identify Receiving Waters.											
	Basin Identification	**Basin Area**		**Receiving Waters**			**Basin Jurisdiction Control**					
Metric Name	**Basin**	**AREA (SQ MI)**	**AREA (Acres)**	**Streams**	**Lakes**	**Marine**	**% In City**	**% Outside City only**	**% in City UGA**	**% Kitsap County**	**% City of Bremerton**	**% in City Jurisdiction + Port Orchard UGA**
Data Sources	Compiled from DNR stream layer, supplemented with Wild Fish Conservancy (WFC) water typing data for Blackjack Watershed	GIS Calculation	GIS Calculation	Department of Natural Resources (DNR) stream layer and National Hydrography Dataset (NHD), supplemented with Wild Fish Conservancy (WFC) alignment and water typing for Lower Blackjack Basin	GIS (NHD layer)	GIS, Documents	"CityUGA2019Updated" layer from the Washington State Geospatial Open Data Portal					
Other Notes	1-20 square miles size recommended in Ecology Guidance. [1]Blackjack Creek watershed is subdivided into 5 subwatersheds. Common name, create name if no name, or use stream number						Exclude UGA Exclude County Exclude tribal lands; U&A lands Exclude federal lands		UGA Only, exclude City, county, tribal, federal	Includes other unincorporated UGAs (Bremerton, Belfair, Gorst, South Kitsap)		

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Table A-2. Assess Receiving Water Conditions.

Metric	Water Quality Conditions					Habitat Conditions				
	Stream Bacteria Quality	Nearshore Bacteria Marine Water Quality	Benthic Index of Biotic Integrity (B-IBI)		303(d) Listing – Water	Nearshore Marine Habitat Conditions	Salmonid Habitat – Life History Support			
	Result/Creek	Result/Station Identification	Result	Year(s) of Data Used	Parameter	Relative Acre Points Based on HEA Rapid Assessment	Rearing	Spawning	Migration	Refuge and Riparian Function
Annapolis Creek	Meets Part 1 and 2/ Annapolis Creek	Meets Part 1 and 2/ SN22	34	2003	Dissolved oxygen	4.2	0.67	1.00	0.26	0.27
Johnson Creek	No data	Meets Part 1 and Fails Part 2/ SN23	No data	Not applicable	No 303(d) Cat 5 Listing	0.2	0.73	0.97	0.03	0.34
Karcher Creek	Meets Part 1 and 2/ Karcher Creek	Meets Part 1 and Fails Part 2/ SN13	No data	Not applicable	No 303(d) Cat 5 Listing	2.4	1.00	1.00	Total barrier at mouth	0.42
Ross Creek	Meets Part 1 and 2/ Ross Creek	Meets Part 1 and 2/ SN24	49	2003	Dissolved oxygen	20.6	0.67	0.67	0.64	0.53
Anderson Creek (Gorst)	Meets Part 1 and 2/ Anderson Creek	Meets Part 1 and Fails Part 2/ SN05	58	Average 2017–2019	No 303(d) Cat 5 Listing	1.2	1.00	0.97	0.98	0.77
Lower Blackjack	Meets Part 1 and 2/ Blackjack Creek	Meets Part 1 and 2/ SN12	63	Average 2017–2019	Dissolved oxygen	Not applicable	0.88	1.00	2.31	0.38
Middle Blackjack	No data	Not applicable	61	Average 2017–2019	Dissolved oxygen	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Upper Blackjack	No data	Not applicable	No data	Not applicable	Dissolved oxygen	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Ruby Creek	No data	Not applicable	No data	Not applicable	Dissolved oxygen	Not applicable	0.15	0.67	0.83	0.53
Square Creek	No data	Not applicable	82	Average 2017–2019	No 303(d) Cat 5 Listing	Not applicable	0.17	1.00	0.39	0.69
Coulter Creek	Meets Part 1 and 2/ Coulter Creek	Not applicable	49	2003	Dissolved oxygen, pH	Not applicable	1.00	1.00	0.20	0.50
Rocky Creek	No data	Not applicable	74	2019	No 303(d) Cat 5 Listing	Not applicable	0.00	1.00	0.39	0.77
Gorst Creek	Meets Parts 1, Fails Part 2/ Gorst Creek	Meets Part 1 and Fails Part 2/ SN05	73	Average 2017–2019	Dissolved oxygen	Not applicable	0.81	0.95	0.62	0.46
Sacco/Sullivan Creek	Meets Part 1 and 2/ Sacco/Sullivan Creek	Meets Part 1 and 2/ SN15	10	2003	No 303(d) Cat 5 Listing	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

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	Table A-2. Assess Receiving Water Conditions.									
	Water Quality Conditions					**Habitat Conditions**				
Metric	**Stream Bacteria Quality**	**Nearshore Bacteria Marine Water Quality**	**Benthic Index of Biotic Integrity (B-IBI)**		**303(d) Listing – Water**	**Nearshore Marine Habitat Conditions**	**Salmonid Habitat – Life History Support**			
	Result/Creek	**Result/Station Identification**	**Result**	**Year(s) of Data Used**	**Parameter**	**Relative Acre Points Based on HEA Rapid Assessment**	**Rearing**	**Spawning**	**Migration**	**Refuge and Riparian Function**
Downtown-County Campus	No data	No data	No data	Not applicable	No 303(d) Cat 5 Listing	0.7	No data	No data	Total barrier at mouth	0.05
Melcher Creek	No data	Meets Part 1 and 2/ SN10	No data	Not applicable	No 303(d) Cat 5 Listing	0.3	1	1	0.02	0.45
Caseco Creek	No data	Meets Part 1 and 2/ SN10	No data	Not applicable	No 303(d) Cat 5 Listing	1.5	0.22	0.67	Total barrier at mouth	0.38
Strm270	No data	Meets Part 1 and Fails Part 2/ SN05	No data	Not applicable	No 303(d) Cat 5 Listing	Not applicable	1	0.67	0.32	0.50
GIS or Document Review, Other	**Document**	Document	Puget Sound Benthos Database	Puget Sound Benthos Database	Ecology Database	See Appendix B Methods and Results	See Appendix B Methods and Results	See Appendix B Methods and Results	See Appendix B Methods and Results	See Appendix B Methods and Results
Data Sources	Kitsap Public Health District, Annual Water Quality Report, 2020	Kitsap Public Health District, Annual Water Quality Report, 2017	Puget Sound Benthos Database	Puget Sound Benthos Database	*Washington State Department of Ecology Water Quality Assessment 303(d) List 2014. https://apps.ecology.wa.gov/ApprovedWQA/ApprovedPages/ApprovedSearch.aspx*	NOAA Nearshore Habitat Value Model	WDFW Habitat Survey Summary Files	WDFW Habitat Survey Summary Files	WDFW Barrier Database, Mapped Hydrology	Mapped Hydrology/Water Types, Kitsap Wetlands, ESRI Clarity Aerial Photography
Other Notes	Standard is WAC 173-201A, Most recent year of freshwater sampling	Standard is WAC 173-201A, Most recent year of nearshore marine water sampling	Standard rating applied to scores: Excellent (80–100), Good (60–80), Fair (40–60), Poor (20–40), Very Poor (<20);	Notation of BIBI date age and result	No 303(d) Cat 5 Listing is due to lack of data or data that meets standards.	NOAA Nearshore Habitat Value Model/Calculations	Average of Per–Reach WDFW Rearing Habitat Assessment Quality Modifier (0–1)	Average of Per–Reach WDFW Spawning Habitat Assessment Quality Modifier (0–1)	Length of Accessible Habitat Compared to Length of Potential Habitat (mile points)	Acre-points (unimpacted buffers and adjacent wetlands) per total buffer area
City or basin wide metric?	City	City	City	City	Basin	City	City	City	City	City

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Table A-2 (continued). Assess Receiving Water Conditions.

	Water Resource Uses									
Metric	**Forage Fish Habitat**	**Shoreline Habitat**	**Marine Nearshore Pocket Estuary**	**Public Health/ Recreation Contact**	**ESA Listed Salmon**	**Salmonid Use**			**Non-ESA Listed Salmon and Resident Fish**	**Shellfish**
				Public Health/ Recreation Contact	**Yes/No for Presence of Habitat**	**Presence**	**Rearing**	**Spawning**	**Coho, Chum, Resident Trout—Yes/No if any species habitat present**	**Approved, Conditionally Approved, Prohibited**
Annapolis Creek	None	None	None	None	Yes	Coho, fall chum, resident trout	None	None	Yes	Prohibited
Johnson Creek	Surf smelt spawning	None	None	None	Yes	Resident trout	None	None	Yes	Prohibited
Karcher Creek	Surf smelt spawning Sand lance spawning	None	None	Retsil Boat Launch	Yes	Coho, fall chum, resident trout	None	Coho	Yes	Prohibited
Ross Creek	Surf smelt spawning Sand lance spawning	Salt marsh	Pocket Estuary, PM13	Ross Creek Tidelands	Yes	Coho, fall chum, winter steelhead, resident trout	None	Coho, fall chum	Yes	Prohibited
Anderson Creek (Gorst)	None	Salt marsh	None	None	Yes	Coho, fall chum, winter steelhead, resident trout	None	Coho	Yes	Prohibited
Lower Blackjack	Surf smelt spawning Sand lance spawning	None	Pocket Estuary, PM 12	Park/beach next to Marlee Apts	Yes	Coho, fall chum, winter steelhead, resident trout, fall chinook, summer chum	Coho	Coho, fall chinook, fall chum, summer chum, winter steelhead	Yes	Prohibited
Middle Blackjack	Not applicable	Not applicable	Not applicable	None	Yes	Resident trout, winter steelhead	Coho	Fall chum, summer chum	Yes	Not applicable
Upper Blackjack	Not applicable	Not applicable	Not applicable	None	Yes	Resident trout, winter steelhead	Coho	None	Yes	Not applicable
Ruby Creek	Not applicable	Not applicable	Not applicable	None	Yes	Coho, fall chum, resident trout, summer chum	Coho	None	Yes	Not applicable
Square Creek	Not applicable	Not applicable	Not applicable	None	Yes	Coho, resident trout	Coho	Fall chum, summer chum	Yes	Not applicable
Coulter Creek	Not applicable	Not applicable	Not applicable	None	Yes	Coho, fall chum, winter steelhead, resident trout, fall chinook, largemouth bass, summer chum	None	Coho, fall chum, summer chum	Yes	Conditionally Approved
Rocky Creek	Not applicable	Not applicable	Not applicable	None	Yes	Coho, fall chum, winter steelhead, resident trout, summer chum, fall chinook	None	Coho, fall chum, summer chum	Yes	Conditionally Approved
Gorst Creek	None	Salt marsh	None	None	Yes	Coho, fall chum, winter steelhead, resident trout	Fall chinook	Coho, fall chinook, fall chum, winter steelhead	Yes	Prohibited
Sacco/Sullivan Creek	Surf smelt spawning	None	None	None	No	Fall chum, resident trout	None	None	Yes	Prohibited

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	Table A-2 (continued). Assess Receiving Water Conditions.									
	Water Resource Uses									
Metric	**Forage Fish Habitat**	**Shoreline Habitat**	**Marine Nearshore Pocket Estuary**	**Public Health/ Recreation Contact**	**ESA Listed Salmon**	**Salmonid Use**			**Non-ESA Listed Salmon and Resident Fish**	**Shellfish**
				Public Health/ Recreation Contact	**Yes/No for Presence of Habitat**	**Presence**	**Rearing**	**Spawning**	**Coho, Chum, Resident Trout—Yes/No if any species habitat present**	**Approved, Conditionally Approved, Prohibited**
~~**Downtown-County Campus**~~	None	None	None	Port Orchard Waterfront Park Boat Launch/Marina	No	None	None	None	No	Prohibited
Melcher Creek	Surf smelt spawning	None	None	Boat Launch/Marina	Yes	None	None	None	Yes	Prohibited
Caseco Creek	Surf smelt spawning	None	None	None	Yes	None	None	None	Yes	Prohibited
Strm270	None	None	None	None	Yes	Coho, fall chum, resident trout	None	None	Yes	Prohibited
GIS or Document Review, Other				Database	Database	Database	Database	Database	Database	GIS
Data Sources	*WDFW Forage Fish Habitat Mapping https://wdfw.maps.arcgis.com/home/webmap*	*Washington State Ecology Coastal Atlas Map https://apps.ecology.wa.gov/coastalatlas/tools/Map.aspx*	*Washington State Ecology Coastal Atlas Map https://apps.ecology.wa.gov/coastalatlas/tools/Map.aspx*	*Washington State Ecology Coastal Atlas Map https://apps.ecology.wa.gov/coastalatlas/tools/Map.aspx*	Statewide Integrated Fish Distribution (Northwest Indian Fisheries Commission & WDFW), NMFS West Coast Region Endangered Species Act critical habitat geodatabase (NOAA Fisheries), WA Dept of Fish and Wildlife Open Data downloaded from Washington Geospatial Open Data Portal (dated 5/21/2018)	Statewide Integrated Fish Distribution (Northwest Indian Fisheries Commission & WDFW)	Statewide Integrated Fish Distribution (Northwest Indian Fisheries Commission & WDFW)	Statewide Integrated Fish Distribution (Northwest Indian Fisheries Commission & WDFW)	Statewide Integrated Fish Distribution (Northwest Indian Fisheries Commission & WDFW), Wild Fish Conservancy, NMFS West Coast Region Endangered Species Act critical habitat geodatabase (NOAA Fisheries)	*WSDOH Commercial Growing Classification and Sanitary Survey Program*
Other Notes										
City or basin wide metric?	City	City	City	City	Basin	Basin	Basin	Basin	Basin	Basin

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Table A-3. Assess Stormwater Management Influence.

	Infrastructure								
	Percent TIA	**Road Density**	**Road Crossings**		**Mapped WDFW Fish Barriers Related to Road Crossings**		**Linear Feet of Stream Prior to First Upstream Full Barrier**	**Linear Feet of Stream Prior to First Upstream Full Barrier (data only)**	**Percent TIA in Riparian**
Metric Detail	**Percent Impervious Surface**	**Linear Feet of Road/Acre**	**Road Crossings per Stream Mile**	***Road Crossings in Watershed Used for Calculation***	**Barriers per Stream Mile**	***Barriers in Watershed used for Calculation***	**Identify First Full Barrier and Measure Downstream Linear Feet**	**Identify First Full Barrier and Measure Downstream Linear Feet**	**Percent TIA in Extended Riparian Zone (streams, lakes/ponds, wetlands)**
Annapolis Creek	30.1%	107.4	5.3	11	4.9	10	4,316	4,316	19.7%
Johnson Creek	28.8%	110.6	9.5	14	12.3	18	859	859	19.0%
Karcher Creek	27.7%	107.0	3.7	7	3.7	7	1	Full barrier at mouth	12.7%
Ross Creek	13.3%	66.0	2.1	15	3.6	25	4,502	4,502	9.6%
Anderson Creek (Gorst)	8.9%	58.6	3.7	18	4.1	20	5,797	5,797	5.8%
Blackjack Creek – Aggregate	10.8%	53.0	1.4	42	2.8	81	44,703	44,703	6.8%
Lower Blackjack	22.3%	81.1	1.9	19	2.0	20	Not applicable	Not applicable	15.3%
Middle Blackjack	9.2%	49.3	0.7	3	2.4	10	Not applicable	Not applicable	2.9%
Upper Blackjack	3.8%	33.2	1.6	8	1.2	6	Not applicable	Not applicable	2.3%
Ruby Creek	5.3%	41.4	1.1	4	9.2	33	16,203	16,203	6.1%
Square Creek	3.6%	34.6	1.2	8	1.8	12	4,609	4,609	2.0%
Coulter Creek	0.4%	4.1	0.3	11	0.6	27	Not applicable	Not applicable	0.4%
Rocky Creek	1.7%	12.1	0.6	32	0.6	34	Not applicable	Not applicable	1.5%
Gorst Creek (Parish in City portion)	4.1%	23.4	1.2	38	1.3	42	1,835	1,835	3.6%
Sacco/Sullivan Creek	18.1%	92.0	1.2	2	0.0	0	1,761	No full barriers mapped	3.5%
Downtown-County Campus	50.2%	200.8	8.8	3	0.0	0	1,798	No full barriers mapped	55.6%
Melcher Creek	12.2%	90.0	4.4	2	4.4	2	1	285	9.5%
Caseco Creek	11.9%	108.7	4.7	2	9.5	4	1	Full barrier at mouth	13.3%
Strm270	2.8%	35.0	1.1	2	1.7	3	949	949	3.7%
GIS or Document Review, Other	GIS Analysis	GIS Analysis	GIS Analysis	GIS Analysis	GIS Analysis	GIS Analysis	GIS Analysis	GIS Analysis	GIS Analysis
Data Sources	2016 NLCD Impervious	Kitsap County GIS – Roads	Kitsap County GIS – Roads; DNR streams	Kitsap County GIS – Roads; DNR streams	WDFW Web Map Tool, extracted data; Kitsap County GIS – Roads	WDFW Web Map Tool, extracted data; Kitsap County GIS – Roads	WDFW Web Map Tool, extracted data; DNR streams	WDFW Web Map Tool, extracted data; DNR streams	2016 NLCD; Kitsap wetlands; DNR and NHD streams/water bodies
Purpose	TIA is most correlated with BIBI scores	Highly correlated with BIBI (MacNeale, 2019)	Measure of disconnected habitat and correlation with BIBI (MacNeale, 2019)	*Supporting information for Road Crossings per Stream Mile*	Check against road crossing data for comparison	*Supporting information for Road Crossings per Stream Mile*	Measure of stream habitat availability	Measure of stream habitat availability	Riparian condition measurement used previously for Port Angeles study, and modified.

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	Table A-3. Assess Stormwater Management Influence.								
	Infrastructure								
	Percent TIA	**Road Density**	**Road Crossings**		**Mapped WDFW Fish Barriers Related to Road Crossings**		**Linear Feet of Stream Prior to First Upstream Full Barrier**	**Linear Feet of Stream Prior to First Upstream Full Barrier (data only)**	**Percent TIA in Riparian**
Metric Detail	**Percent Impervious Surface**	**Linear Feet of Road/Acre**	**Road Crossings per Stream Mile**	***Road Crossings in Watershed Used for Calculation***	**Barriers per Stream Mile**	***Barriers in Watershed used for Calculation***	**Identify First Full Barrier and Measure Downstream Linear Feet**	**Identify First Full Barrier and Measure Downstream Linear Feet**	**Percent TIA in Extended Riparian Zone (streams, lakes/ponds, wetlands)**
Data Gaps	Lack of detailed impervious layer.		Stream lines do not exactly align with topography/ hillshade. Road crossings do not all correspond directly with mapped barriers. Mapping gaps may include forest roads, military roads, private roads, railroad crossings. Crossings may be overestimated in dense areas and underestimated in less dense areas.						Measuring % impervious in the buffer is a good approximation of disturbed areas, but may not account for other types of disruption. Would be valuable to compare to a canopy layer, if one becomes available.
Notes/Comments	See comment regarding %pollutant potential PGIS		Conducted high-level data review to remove immediate duplicates and re-add major WDFW mapped culvert barriers not otherwise captured.		Excluded barriers mapped as dams, diversion, natural, unknown – focused on road crossings	Excluded barriers mapped as dams, diversion, natural, unknown – focused on road crossings	Mainstem linear distance only to first full barrier, not a total inventory of currently accessible fish habitat	Mainstem linear distance only to first full barrier, not a total inventory of currently accessible fish habitat	Note – This may be skewing towards non-fish creeks; they have a smaller buffer so their % impervious of the riparian is higher. Keep in mind when comparing %s.
City or Basinwide Metric?	**Basin**	**Basin**	**Basin**	**Basin**	**Basin**	**Basin**	**Basin**	**Basin**	**Basin**

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Table A-3 (continued). Assess Stormwater Management Influence.

	Infrastructure (continued)					Future Development			
	Percent Flow Control Exempt Areas	Discharge to Lake or Wetland inside City Limits?	Outfalls to Streams	Discharge to marine shoreline?	Outfalls to Shoreline	Percent of Watershed Within City Limits that is Vacant, Under Utilized, or Partially Utilized (Buildable Lands Report)			Percent of Basin Area with Projected Population Growth Greater Than 1.9%
Metric Detail	**Acres of FC Exempt/Total Acres**	**Yes/No**	**Port Orchard MS4 Outfalls (or Mapped Discharge) in Extended Riparian Zone of Stream, Lake, or Wetland**	**Yes/No**	**Port Orchard MS4 Outfalls (or Mapped Discharge) to Shoreline**	**Partially Utilized**	**Under Utilized**	**Vacant**	**Area by Census Block Group with Projected Population Growth Greater than 1.9% from 2021–2026**
Annapolis Creek	3.3%	No	1	Yes	4	4.63%	2.89%	14.40%	0.00%
Johnson Creek	0.9%	Yes	2	Yes	2	11.52%	0.56%	11.18%	0.00%
Karcher Creek	0.5%	No	3	Yes	0	1.04%	6.24%	5.41%	0.00%
Ross Creek	4.7%	Yes	10	Yes	13	2.36%	0.96%	28.39%	61.19%
Anderson Creek (Gorst)	7.5%	Yes	4	Yes	5	4.69%	0.00%	35.19%	63.49%
Blackjack Creek – Aggregate	N/A	Yes	17	Yes	12	6.81%	6.66%	40.29%	24.65%
Lower Blackjack	2.0%	Yes	10	Yes	12	10.01%	8.91%	29.44%	20.76%
Middle Blackjack	0.0%	No	0	No	Not applicable (upstream basin)	Not applicable	Not applicable	Not applicable	14.98%
Upper Blackjack	0.0%	No	0	No	Not applicable (upstream basin)	Not applicable	Not applicable	Not applicable	0.00%
Ruby Creek	0.0%	Yes	6	No	Not applicable (upstream basin)	0.75%	2.74%	55.46%	82.83%
Square Creek	0.0%	Yes	1	No	Not applicable (upstream basin)	0.00%	0.00%	95.30%	3.46%
Coulter Creek	0.0%	No	0	No	Not applicable (no City shoreline)	0.00%	0.00%	100.00%	0.00%
Rocky Creek	0.0%	No	0	No	Not applicable (no City shoreline)	0.00%	0.00%	64.85%	0.00%
Gorst Creek (Parish in City portion)	0.0%	Yes	1	Yes	Not applicable (no City shoreline)	2.70%	0.00%	57.20%	42.12%
Sacco/Sullivan Creek	3.6%	No	0	Yes	Not applicable (no City shoreline)	10.40%	0.00%	8.21%	0.00%
Downtown-County Campus	10.1%	No	0	Yes	10	2.71%	5.02%	3.08%	0.00%
Melcher Creek	12.4%	No	0	Yes	3	25.34%	1.37%	26.03%	0.00%
Caseco Creek	12.4%	No	1	Yes	1	15.32%	0.00%	26.45%	0.00%
Strm270	0.0%	No	0	Yes	Not applicable (no City shoreline)	28.28%	0.00%	60.37%	74.38%
GIS or Document Review, Other	GIS Analysis	GIS	GIS Analysis	GIS	GIS Analysis	GIS Analysis	GIS Analysis	GIS Analysis	GIS Analysis
Data Sources	City of Port Orchard "Watershed by Creek" topographic delineation		City of Port Orchard Outfalls; Kitsap wetlands; DNR and NHD streams/water bodies		City of Port Orchard Outfalls; Kitsap wetlands; DNR and NHD streams/water bodies	Kitsap County GIS – Port Orchard LCA Parcels			ESRI 2021–2026 USA Population Growth, accessed via hosted online service in February 2022 (Block group scale)
Purpose	Describes how much of the basin is WQ treatment only.		Storm						Population growth indicates future development or redevelopment pressure. All new impervious development will be constructed under current codes, but may still have negative influence on water bodies.

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	Table A-3 (continued). Assess Stormwater Management Influence.								
	Infrastructure (continued)					Future Development			
	Percent Flow Control Exempt Areas	**Discharge to Lake or Wetland inside City Limits?**	**Outfalls to Streams**	**Discharge to marine shoreline?**	**Outfalls to Shoreline**	**Percent of Watershed Within City Limits that is Vacant, Under Utilized, or Partially Utilized (Buildable Lands Report)**			**Percent of Basin Area with Projected Population Growth Greater Than 1.9%**
Metric Detail	**Acres of FC Exempt/Total Acres**	**Yes/No**	**Port Orchard MS4 Outfalls (or Mapped Discharge) in Extended Riparian Zone of Stream, Lake, or Wetland**	**Yes/No**	**Port Orchard MS4 Outfalls (or Mapped Discharge) to Shoreline**	**Partially Utilized**	**Under Utilized**	**Vacant**	**Area by Census Block Group with Projected Population Growth Greater than 1.9% from 2021–2026**
Data Gaps	Calculated using the original Kitsap topo stream basin boundaries, which exclude areas draining directly to Puget Sound. Does not include upstream piped areas with outfalls to the Sound. Does not include any lake drainage areas (lakes are too small, not listed in Appendix I-A: Flow Control Exempt Receiving Waters of the SWMMWW).	Outfall ownership data is not available. Count of outfalls may include private outfalls in outfall mapping layer. Available only inside City limits.	Lack of outfalls mapped outside the city, only including PO MS4 stream outfalls (excludes direct outfalls to Puget Sound)	Outfall ownership data is not available. Count of outfalls may include private outfalls in outfall mapping layer. Available only inside City limits.		LCA parcels only available for basin area inside Port Orchard City Limits. Reported percent does not reflect entire basin area. Calculations are likely to be skewed for basins with a large percentage of area outside the City.			Data is at coarse block group scale. Block group polygons do not align with watershed boundaries. Population growth estimate is high-level; detailed population data not available.
Notes/Comments		"Yes" indicates mapped outfall within extended riparian zone of mapped wetland or lake/pond. No major outfalls mapped at named lakes (some located near unnamed water bodies and wetlands).	Some outfalls outside the riparian zone were excluded with a few are quite close to the boundary. These can be added to the count if preferred. May want to map and verify approach during prioritization step.	Sinclair Inlet Only		Calculations method: 1. Clip basins to Port Orchard City Limits 2. Set definition query on LCA Parcels: LCA_CLASS IN ('PARTIALLY UTILIZED', 'UNDERUTILIZED', 'VACANT') 3. Dissolve LCA Parcels by LCA_CLASS to remove any overlapping parcels 4. Intersect the dissolved LCA Parcels with the clipped basins. 5. Aggregate via pivot table, generating areas per basin for Partially Utilized, Under Utilized and Vacant 6. Per basin, divide the area of the Partially Utilized Under Utilized and Vacant by the area of the clipped basin to generate percentage 7. For Blackjack Creek Aggregate, follow this method: For the included basins, sum the areas of each LCA class and divide by the sum of area of basins.			Assigned % to each block group based on hosted ESRI service layer, then intersected with watershed boundaries to calculate area for each growth category. Summarized as % of watershed area in only the highest growth category (>1.9%). Note – 0% in this column does NOT indicate zero growth. Watershed may still have projected growth in the lower range (e.g., 1.25%)
City or Basinwide Metric?	**Basin**	**City**	**City**	**City**	**City**	**City**	**City**	**City**	**Basinwide**

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	Table A-4. Equity.				
	Combined	**Environmental Exposures**	**Environmental Effects**	**Socioeconoic Factors**	**Sensitive Populations**
	Basinwide	**Basinwide**	**Basinwide**	**Basinwide**	**Basinwide**
Annapolis Creek	7.00	6.00	5.00	6.00	8.00
Johnson Creek	8.00	7.00	7.00	7.00	6.00
Karcher Creek	6.22	5.24	4.58	6.13	6.17
Ross Creek	4.75	5.38	4.56	4.56	3.56
Anderson Creek (Gorst)	4.00	5.00	4.00	4.00	3.00
Blackjack Creek – Aggregate	Not Available	Not Available	Not Available	Not Available	Not Available
Lower Blackjack	5.91	6.14	4.70	5.35	5.38
Middle Blackjack	3.86	5.63	2.51	4.79	2.65
Upper Blackjack	3.20	3.60	2.00	5.80	2.20
Ruby Creek	4.00	5.00	4.00	4.00	3.00
Square Creek	3.30	3.59	2.59	5.41	2.30
Coulter Creek	3.85	3.59	2.81	5.41	3.29
Rocky Creek	2.69	4.03	4.59	4.42	5.45
Gorst Creek (Parish Creek in City portion)	4.59	3.12	1.74	4.76	3.18
Sacco/Sullivan Creek	7.00	6.00	5.00	6.00	8.00
Downtown-County Campus	8.00	7.00	7.00	7.00	6.00
Melcher Creek	8.00	7.00	7.00	7.00	6.00
Caseco Creek	8.00	7.00	7.00	7.00	6.00
Strm270	4.00	5.00	4.00	4.00	3.00
GIS or Document Review, Other	GIS Analysis	GIS Analysis	GIS Analysis	GIS Analysis	GIS Analysis

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	Table A-4. Equity.				
	Combined	**Environmental Exposures**	**Environmental Effects**	**Socioeconoic Factors**	**Sensitive Populations**
	Basinwide	**Basinwide**	**Basinwide**	**Basinwide**	**Basinwide**
Data Sources	Kitsap Overburdened Communities Assessment, WA Environmental Health Disparities Map	Kitsap Overburdened Communities Assessment, WA Environmental Health Disparities Map	Kitsap Overburdened Communities Assessment, WA Environmental Health Disparities Map	Kitsap Overburdened Communities Assessment, WA Environmental Health Disparities Map	Kitsap Overburdened Communities Assessment, WA Environmental Health Disparities Map
Purpose	Composite score evaluating threat to and vulnerability of populations	Indicators in the environmental exposures theme use data from measured environmental concentrations and releases of contaminants from pollution sources as a way to quantify pollution burden from exposure to pollutants.	Indicators in the environmental effects theme illustrate the potential risk of the environmental hazard on communities nearby. However, as proximity to a potential exposure does not necessarily reflect actual exposure.	Indicators in this theme are often found to be associated with environmental justice conditions, such as poverty or unemployment, which modify the effects of environmental exposures on health.	Indicators in this theme relate to biological susceptibility. People with pre-existing cardiovascular disease or low-birth-weight infants may be more vulnerable to environmental risk factors.
Data Gaps	Data is available at the Census Tract scale, which does not align with watershed delineations; data processing involved area-weighting to assign watershed values	Data is available at the Census Tract scale, which does not align with watershed delineations; data processing involved area-weighting to assign watershed values	Data is available at the Census Tract scale, which does not align with watershed delineations; data processing involved area-weighting to assign watershed values	Data is available at the Census Tract scale, which does not align with watershed delineations; data processing involved area-weighting to assign watershed values	Data is available at the Census Tract scale, which does not align with watershed delineations; data processing involved area-weighting to assign watershed values
Notes/Comments		Higher numbers indicate higher threat from environmental exposures.		Higher numbers indicate greater vulnerability of populations within the watershed	

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	Table A-5. Assess Watershed Stormwater Impacts, Restoration/Protection Goals, and Potential Management Actions.			
	Major Stormwater Impacts	**Potential Restoration/Protection Goals**	**Potential Management Actions**	**Existing Plan or Project**
Annapolis Creek	Pollutant export to stream and marine waters Uncontrolled flows to stream and shoreline Fragmented stream habitat	Reduce stormwater pollutants Reduce uncontrolled flows Remove fish passage barriers	High priority basin for business source control inspections High priority basin for storm system maintenance Identify flow control retrofit projects Identify fish passage barrier removal projects Identify riparian improvement projects	Annapolis Creek Culvert Replacement
Johnson Creek	Pollutant export to stream and marine waters Uncontrolled flows to stream and shoreline Fragmented stream habitat	Reduce stormwater pollutants Reduce uncontrolled flows Remove fish passage barriers	High priority basin for business source control inspections High priority basin for storm system maintenance Identify flow control retrofit projects Identify fish passage barrier removal projects Identify riparian improvement projects	Johnson Creek Stream Realignment Johnson Creek Estuary Restoration
Karcher Creek	Pollutant export to stream and marine waters Uncontrolled flows to stream and shoreline Fragmented stream habitat 11% City control, increases to %100 if Annexed	Reduce stormwater pollutants Reduce uncontrolled flows Remove fish passage barriers		No projects identified
Ross Creek	Uncontrolled flows to stream and shoreline Fragmented stream habitat Future growth	Reduce uncontrolled flows Remove fish passage barriers	Identify flow control retrofit projects Identify fish passage barrier removal projects Identify riparian improvement projects	Ross Creek Beaver Dam Analogs Installation Ross Creek Estuary Restoration and Beach Recreation Area
Anderson Creek (Gorst)	Fragmented stream habitat Future growth	Remove fish passage barriers	Identify fish passage barrier removal projects Identify riparian improvement projects	Anderson Creek Culvert Retrofits McCormick Woods Drive Culvert Barrier Replacement
Lower Blackjack	Pollutant export to stream and marine waters Uncontrolled flows to stream and shoreline Fragmented stream habitat Future growth	Reduce stormwater pollutants Reduce uncontrolled flows Remove fish passage barriers	High priority basin for business source control inspections High priority basin for storm system maintenance Identify flow control retrofit projects Identify fish passage barrier removal projects Identify riparian improvement projects	SE Salmonberry Road Lower Blackjack Creek Culvert Replacement Blackjack Creek Floodplain Restoration and Stormwater Plan Management Port Orchard East Shoreline Acquisition and Easement Right Rockwell Area Stormwater Improvements Silver Creek Rehabilitation South Blackjack Creek Culvert Removal and Bridge Installation Blackjack Creek Storm Outfall Assessment and Retrofits South Sidney Regional Facility Westbay Stormwater Improvements

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	Table A-5. Assess Watershed Stormwater Impacts, Restoration/Protection Goals, and Potential Management Actions.			
	Major Stormwater Impacts	**Potential Restoration/Protection Goals**	**Potential Management Actions**	**Existing Plan or Project**
Middle Blackjack	Fragmented stream habitat 0% City Control/Contribution No MS4 outfalls to stream	Not Applicable	None	Watershed not moved forward to prioritization
Upper Blackjack	Low level of stormwater impacts 0% City Control/Contribution No MS4 outfalls to stream	Not Applicable	None	Watershed not moved forward to prioritization
Ruby Creek	Fragmented stream habitat Future growth	Remove fish passage barriers	Identify fish passage barrier removal projects Identify riparian improvement projects	Glenwood Road Ruby Creek Culvert Replacement
Square Creek	Low level of stormwater impacts 7% City Control/Contribution	Not Applicable	None	Watershed not moved forward to prioritization
Coulter Creek	Low level of stormwater impacts 1% City Control/Contribution No MS4 outfalls to stream	Not Applicable	None	Watershed not moved forward to prioritization
Rocky Creek	Low level of stormwater impacts 1% City Control/Contribution No MS4 outfalls to stream	Not Applicable	None	Watershed not moved forward to prioritization
Gorst Creek (Parish Creek in City portion)	Low level of stormwater impacts 5% City Control/Contribution	Not Applicable	None	Watershed not moved forward to prioritization
Sacco/Sullivan Creek	Pollutant export to stream and marine waters Uncontrolled flows to stream and shoreline 21% City control, increases to %100 if Annexed	Reduce stormwater pollutants Reduce uncontrolled flows		No projects identified
Downtown-County Campus	Pollutant export to stream and marine waters Uncontrolled flows to stream and shoreline Fragmented stream habitat	Reduce stormwater pollutants Reduce uncontrolled flows Remove fish passage barriers	High priority basin for business source control inspections High priority basin for storm system maintenance Identify flow control retrofit projects Identify fish passage barrier removal projects Identify riparian improvement projects	Central Sidney Stormwater Improvements Downtown Basin Stormwater Upgrades
Melcher Creek	Pollutant export to stream and marine waters Uncontrolled flows to stream and shoreline Fragmented stream habitat Future growth	Reduce stormwater pollutants Reduce uncontrolled flows Remove fish passage barriers	High priority basin for business source control inspections High priority basin for storm system maintenance Identify flow control retrofit projects Identify fish passage barrier removal projects Identify riparian improvement projects	No projects identified

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	Table A-5. Assess Watershed Stormwater Impacts, Restoration/Protection Goals, and Potential Management Actions.			
	Major Stormwater Impacts	**Potential Restoration/Protection Goals**	**Potential Management Actions**	**Existing Plan or Project**
Caseco Creek	Pollutant export to stream and marine waters Uncontrolled flows to stream and shoreline Fragmented stream habitat Future growth	Reduce stormwater pollutants Reduce uncontrolled flows Remove fish passage barriers	High priority basin for business source control inspections High priority basin for storm system maintenance Identify flow control retrofit projects Identify fish passage barrier removal projects Identify riparian improvement projects	No projects identified
Stream 270	Fragmented stream habitat Minimal stormwater influence	Remove fish passage barriers	Identify fish passage barrier removal projects	No projects identified

Rationale:	**Rationale:**
Pollutant export : Presence of outfalls to stream, presence of outfalls to marine nearshore	Goals are related to identified stormwater impacts
Uncontrolled flows to stream and shoreline: >10% TIA, or >10% TIA in Riparian **and** Presence of outfalls to stream, presence of outfalls to marine,	
Fragmented stream habitat: > 3 WDFW Fish Barriers related to road crossings per mile	
Future Development: >20 of City watershed vacant lands	

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APPENDIX B

Nearshore and Stream Habitat Conditions Scoring Methods and Results

APPENDIX B

SALMONID HABITAT LIFE HISTORY SUPPORT METHODOLOGY AND RESULTS

Prepared by GeoEngineers for Herrera Environmental Consultants, Inc., April 2021.

1.0 RELATIVE NEARSHORE HABITAT EVALUATION

A rapid assessment of nearshore habitat conditions was performed for the nine basins that contain nearshore habitat within City limits to generate relative nearshore habitat scores for each basin. The assessment utilized available geospatial data from the sources listed below. Nearshore habitat zones and relative nearshore habitat values were established based on review of existing Habitat Equivalency Analysis (HEA) publications listed below. The following sections identify the data and methods used to conduct the relative nearshore habitat evaluation for the basins within the study area and the results of this assessment.

1.1 Data Review

Geospatial data obtained for this assessment included:

- DNR Shorezone Inventory – Shoreline Modification (DNR 2019)
- Forage Fish Spawning Map (WDFW 2021)
- World Imagery (ESRI 2021a)
- World Topographic Map (ESRI 2021b)

The following HEA publications were reviewed for this assessment:

- *Use of The Puget Sound Nearshore Habitat Values Model with Habitat Equivalency Analysis for Characterizing Impacts and Avoidance Measures for Projects that Adversely Affect Critical Habitat of ESA-Listed Chinook and Chum Salmon* (Ehinger et al. 2015)
- *Hylebos Waterway Natural Resource Damage Settlement Proposal Report* (NOAA 2002)
- *Determining Habitat Value and Time to Sustained Function* (Iadanza 2001)
- *Puget Sound Nearshore Habitat Conversion Calculator 2021 V1.3* (NOAA 2021)

1.2 Methodology

Establishment of Nearshore Habitat Zones

Each basin was divided into up to three nearshore habitat zones:

- Riparian
- Intertidal
- Estuarine

The riparian zone was established by extending a line 40 meters (130 feet) from the DNR Shorezone Inventory shapefile (DNR 2019) landward based on the size of the riparian zone assessed in current NOAA HEA guidance (NOAA 2021). Although current HEA NOAA guidance for assessing nearshore habitat divides intertidal habitat into two zones (upper shore zone and lower shore zone), intertidal habitat was assessed as one zone in this assessment because site specific information regarding tidal elevations and submerged aquatic vegetation were not available at the time of this assessment. Intertidal habitat was mapped from the edge of the DNR Shorezone Inventory shapefile waterward to a low tide line created through visual interpretation of satellite and aerial imagery (ESRI 2021a) of the study area during a low tide. Estuarine zones were estimated using the waterbody polygons available on World Topographic Map (ESRI 2021b).

1.2.1 Relative Nearshore Habitat Values

The relative nearshore habitat values for this assessment were established based on published HEA values from the following sources: DNR Shorezone Inventory – Shoreline Modification (DNR 2019), Forage Fish Spawning Map (WDFW 2021a), World Imagery (ESRI 2021a).

World Topographic Map (ESRI 2021b)Using the HEA concept, habitat values range between 0 and 1 with a value of 1 being the best available habitat. Modifiers were applied to the maximum value of each habitat zone based on the level of modification present in that basin. These modifiers range from fully functioning habitat, which retains the total value for that habitat zone, to developed, which provides no habitat function and receives a habitat value of 0.

Estuarine habitat zone habitat has been assigned a value of 1, which reflects the local importance of habitat in this zone for salmonid species that utilize the City nearshore environment. This value is generally consistent with the habitat value of 1 assigned to estuarine marsh habitat (Iadanza 2001 and NOAA 2002). The intertidal zone was assigned a maximum habitat value of 0.8 which is within the range of previously established maximum habitat values of 0.75 (Iadanza 2001) and 0.9 (NOAA 2002). Riparian habitat was assigned a maximum habitat value of 0.5, which is consistent with maximum habitat value documented by Iadanza (2001). Table 1 shows the relative nearshore habitat values used in this assessment.

Table 1. Relative Nearshore Habitat Values

Nearshore Habitat Zone	Developed	Degraded	Partially Functioning	Fully Functioning
Riparian Zone	0	0.1	0.25	0.5
Intertidal Zone	0	0.1	0.4	0.8
Estuarine Zone	N/A	N/A	N/A	1

For the purposes of this relative nearshore habitat assessment, the following definitions were applied for each modifier for each habitat zone:

Riparian Zone

- Developed: Impervious surface
- Degraded: Invasive vegetation dominant

- Partially Functioning: Mix of native and invasive vegetation or native vegetation disconnected from intertidal zone by roadway or bulkhead.
- Fully Functioning: Native vegetation connected to intertidal zone

Intertidal Zone

- Developed: Covered by overwater structures
- Degraded: Adjacent to filled intertidal and/or shoreward of overwater structures
- Partially Functioning: Debris present, located between structures and/or adjacent to bulkheads.
- Fully Functioning: No disturbance

Estuarine Zone

For the estuarine zone, only two estuarine zones were mapped in the City with minimal disturbance (Blackjack and Ross creeks). Therefore, modifiers were not assigned to the estuarine zone.

Nearshore multipliers

Nearshore multipliers were assigned based on two mapped conditions: 1) documented forage fish spawning and 2) shoreline modification. In basins with documented forage fish spawning (WDFW 2021), a multiplier of 1.5 was assigned to intertidal and estuarine zones. In basins with shoreline armoring (DNR 2019), a multiplier of 0.5 was applied to the percentage of each nearshore habitat zone containing shoreline armoring.

1.2.2 Nearshore Habitat Condition Assessment

The nearshore habitat assessment was completed through visual estimation of the amount of each zone that met each of the definitions described previously. These percentages were then multiplied by the overall size of each zone and the applicable habitat value. Multipliers were then applied to each zone to generate a relative nearshore habitat score for each zone within each basin. The sum of the scores represents the relative nearshore habitat score for each basin in "acre-points." Because this assessment method uses size of the zone as a factor, scores for larger basins were generally larger. To provide a second metric that reflects habitat value independent of basin size, size was factored out of each score to generate a second score in "relative nearshore habitat points-per-acre."

1.3 Results

Nearshore habitat within the City basins have been historically impacted through the placement of fill, construction of bulkheads and overwater structures and upland development within the riparian zone. However, intact intertidal, estuarine and riparian areas are present within the City that provide quality habitat for salmonids. The results of the nearshore habitat condition assessment for each habitat zone are presented for each basin in Table 2.

Table 2. Nearshore Habitat Condition Assessment

Basin	Zone	Size (Acres)	Percentage of Zone					Forage Fish Spawning
			Bulkhead	Developed	Degraded	Partially Functioning	Fully Functioning	
Annapolis	Riparian	4.7	100	95	2	3	0	N/A
Annapolis	Intertidal	16.0	100	5	10	85	0	Yes
Anderson	Riparian	5.0	100	95	5	0	0	N/A
Anderson	Intertidal	5.3	100	25	0	75	0	Yes
Caseco	Riparian	3.6	100	95	5	0	0	N/A
Caseco	Intertidal	7.5	100	10	30	60	0	Yes
Downtown	Riparian	9.1	100	95	5	0	0	N/A
Downtown	Intertidal	7.3	100	40	40	20	0	Yes
Johnson	Riparian	2.3	100	95	2	3	0	N/A
Johnson	Intertidal	3.3	100	10	90	0	0	No
Karcher	Riparian	2.1	100	90	5	5	0	N/A
Karcher	Intertidal	7.9	100	0	0	100	0	Yes
Blackjack	Riparian	18.2	90	85	5	0	10	N/A
Blackjack	Intertidal	75.5	99	5	10	85	0	Yes
Blackjack	Estuarine	0.5	0	0	0	0	100	Yes
Melcher	Riparian	3.7	100	75	10	15	0	N/A
Melcher	Intertidal	3.9	100	20	80	0	0	Yes
Ross	Riparian	22.4	55	35	20	30	15	N/A
Ross	Intertidal	27.6	55	5	5	45	45	Yes
Ross	Estuarine	1.1	10	0	0	10	90	Yes

The HEA metrics described in Section 2.2.1 were applied to the nearshore habitat condition assessment data shown in Table 2 to generate relative nearshore habitat scores in both “acre-points” and “relative nearshore habitat points-per-acre.” The results of the relative nearshore habitat assessment are shown in Table 3.

Table 3. Relative Nearshore Habitat Scores by Basin

Shoreline	Acre-Points	Points/Acre
Annapolis	4.2	0.20
Anderson	1.2	0.12
Caseco	1.5	0.14
Downtown	0.7	0.04
Johnson	0.2	0.03
Karcher	2.4	0.24
Blackjack	20.9	0.22
Melcher	0.3	0.04
Ross	20.6	0.40

The results of the assessment indicate that nearshore habitat in the Blackjack Creek basin generated the highest score of 20.9 acre-points, which resulted from the high quantity of intertidal habitat available at the Blackjack Creek delta. Nearshore habitat within the Ross Creek basin received a similar score of 20.6 are-points and is roughly half the size of the nearshore habitat evaluated for the Blackjack Creek basin. Thus, when evaluated on a points-per-acre basis, nearshore habitat in the Ross Creek basin has a value of 0.40, which is nearly double that of the Blackjack Creek basin or any other basin in the City. This reflects the quality of the available intertidal and riparian habitat and the relatively low amount of shoreline armoring in the Ross Creek Basin. Nearshore habitat in the Annapolis Creek, Blackjack Creek and Karcher Creek basins generated scores between 0.20 and 0.24 when evaluated on a points-per-acre basis indicating comparatively moderate nearshore habitat values. While the nearshore habitats in the remaining basins received points-per-acre scores below 0.20, indicating comparatively low nearshore habitat values with high levels of disturbance.

This relative nearshore habitat assessment represents a high-level evaluation of existing conditions of the nearshore environment within City limits using readily available information and does not include field evaluation of habitat conditions. The framework established for this assessment is scalable and can be modified and/or expanded in the future to refine the results of the assessment.

2.0 FRESHWATER HABITAT EVALUATION

Four freshwater habitat metrics were used to compare salmonid habitat potential among basins located within the City of Port Orchard: spawning, rearing, migration, and riparian refuge. An overall summary of each metric's calculation method is provided followed by a basin-by-basin summary.

2.1 Data Review

Geospatial data was provided by Herrera and is described in previous sections. Additional data acquired by for this assessment includes detailed habitat assessment result spreadsheets provided by WDFW. Methods used to collect this information are described in the *Fish Passage Inventory, Assessment, and Prioritization Manual* (WDFW 2019).

2.2 Methodology

2.2.1 Spawning and Rearing

WDFW habitat assessments conducted as part of their barrier assessment, inventory, and prioritization work was utilized for two metrics: spawning and rearing potential. During this work, fish biologists walk the stream, break down the drainage into reaches (by physical parameters or the influence of road crossings), and assign each reach a spawning and rearing 'habitat quality modifier' (HQM) from 0 to 1 (WDFW 2019). For each basin these HQMs are averaged across each reach located within the City. Occasional assumptions were made where data was not available.

Table 10.2. Spawning habitat quality modifiers and criteria.

Spawning Habitat Quality Modifier		
Habitat Condition	**HQM Value**	**Habitat Criteria**
Good to Excellent	1	Spawning gravel patches have ≤ 16% fine particles.
Fair	0.67	Spawning gravel patches show moderate to widespread signs of instability (scour/filling), and/or > 16% to 21% fine particles.
Poor	0.33	Spawning gravel patches show widespread to major signs of instability (scour/filling), and/or 21% to 26% fine particles.
No Value	0	Spawning gravel patches have > 26% fine particles.

Table 10.3. Rearing habitat quality modifiers and criteria.

Rearing Habitat Quality Modifier		
Habitat Condition	**HQM Value**	**Habitat Criteria**
Good to Excellent	1	Rearing habitat is stable, and in a normal productive state, without features that negatively influence rearing conditions. Barring the presence of features that negatively influence rearing conditions, ponds and wetlands always have an HQM value of 1.
Fair	0.67	Rearing habitat shows signs of moderate to widespread instability and/or disturbances known to reduce productive capacity. A few of the features that positively influence rearing conditions are present, but only within ≤ 67% of the reach.
Poor	0.33	Rearing habitat shows signs of widespread to major instability and/or disturbances known to reduce productive capacity. A few of the features that positively influence rearing conditions are present, but only within ≤ 33% of the reach.
No Value	0	Habitat is severely disturbed and provides no rearing value to salmonids at this time.

Table 4. Spawning and Rearing Metric Results Summary

Basin	Spawning HQM	Rearing HQM
Annapolis Creek	0.67	1.00
Johnson Creek	0.73	0.97
Karcher Creek	1.00	1.00
Ross Creek	0.67	0.67
Anderson Creek (Gorst)	1.00	0.97
Lower Blackjack	0.88	1.00
Ruby Creek	0.15	0.67
Square Creek	0.17	1.00
Coulter Creek	Assumed 1.00	Assumed 1.00
Rocky Creek	Assumed 0.00	Assumed 1.00
Gorst Creek (Parish in City portion)	0.81	0.95
Sacco/Sullivan Creek	No data	No data
Downtown-County Campus	Assumed 0.50	Assumed 0.50
Melcher Creek	1.00	1.00
Caseco Creek	0.22	0.67
Strm270	1.00	0.67

2.2.2 Migration

Migration was assessed specifically for the portions of basins located within City limits, independent of impacts to migration caused by fish passage barriers located outside City jurisdiction. The goal of this assessment is to create a planning tool for potential City capital improvement projects.

A GIS-based assessment was conducted to quantify the impact of fish passage barriers on fish migration within each basin. First, linear feet of stream length were calculated for DNR type-F streams within each basin. This layer was then modified in Johnson, Melcher, and Caseco Creek basins according to on-the-ground observations from WDFW regarding length of potential fish habitat in each basin. Second, the

mainstem length downstream from the lowest total blockage was calculated, representing the quantity of currently accessible salmonid habitat. Finally, the number of partial barriers within each basin were tallied.

Basins with no total blockages received 1 'foot-point' per linear foot of stream habitat. Each partial barrier within the basin was assigned a multiplier of 0.75. In basins with total passage barriers only the accessible habitat downstream from a total passage barrier was used for this metric. Foot-points were converted to miles for readability.

No attempt was made to normalize scores between basins based on size or stream length. For this metric, large basins with multiple tributaries and a lack of total barriers did and should score higher for fish migration potential due to the increased quantity of habitat available. Potential refinements to this metric could include adding a reduction modifier for basins with a downstream (total and/or partial) passage barrier outside City limits. Additionally, further refinement of hydrography mapping and determining the limits of potential fish habitat would provide a more realistic picture of habitat resources and migration opportunity within each basin. Table 5 is the migration metrics results summary.

Table 5. Migration Metric Results Summary

Basin	Within City of Port Orchard					Feet-Points	**Mile-Points**
	Potential Fish Habitat Stream Length (Feet)	No barriers (T/F)	Partial Barriers (Count)	Total Barrier (Yes/No)	Stream Length Downstream of Total Blockage (Feet)		
Annapolis Creek	5158	F	1	Y	1851	1388.25	**0.26**
Johnson Creek	9606	F	6	Y	850	151.28	**0.03**
Karcher Creek	3876	F	0	Y	0	0.00	**0.00**
Ross Creek	20160	F	1	Y	4502	3376.50	**0.64**
Anderson Creek (Gorst)	9229	F	2	N	N/A	5191.31	**0.98**
Lower Blackjack	28963	F	3	N	N/A	12218.77	**2.31**
Ruby Creek	10439	F	3	N	N/A	4403.95	**0.83**
Square Creek	2036	T	0	N	N/A	2036.00	**0.39**
Coulter Creek	1042	T	0	N	N/A	1042.00	**0.20**
Rocky Creek	2060	T	0	N	N/A	2060.00	**0.39**

Gorst Creek (Parish in City portion)	5828	F	2	N	N/A	3278.25	**0.62**
Sacco/Sullivan Creek	0	T	0	N	N/A	0.00	**0.00**
Downtown-County Campus	1798	F	0	Y	0	0.00	**0.00**
Melcher Creek	2421	F	1	Y	115	86.25	**0.02**
Caseco Creek	1201	F	0	Y	0	0.00	**0.00**
Strm270	1679	T	0	N	N/A	1679.00	**0.32**

2.2.3 Riparian and Refuge

The riparian and refuge function metric assesses the influence of development on riparian processes as an indicator for LWD recruitment and off-channel refuge. A 150-foot buffer was applied to fish-bearing streams to calculate a total riparian buffer area within each basin. Adjacent wetlands mapped within 50 feet of the stream were considered potentially accessible off-channel refuge areas and were included as part of the metric. Esri World Imagery (ESRI 2021a) polygons were digitized around areas of visible disturbance within each buffer.

To calculate this metric, wetland area and disturbance area were subtracted from the total buffer area, resulting in an area of undisturbed upland riparian buffer. This upland acreage was assigned a multiplier of 0.5. Total wetland area was assigned a multiplier of 1. These multipliers differ in order to recognize the typically greater value off-channel wetlands provide compared to upland riparian buffers. These values approximate those developed in the HEA document *Relative Chinook Salmon Lower Willamette Habitat Values* (USFWS 2012), where off-channel aquatic habitats typically have habitat values of 0.9 to 1.0 while riparian forest habitat values are between 0.5 to 0.65. The sum of the scores represents the relative riparian and refuge habitat score for each basin in "acre-points." Because this assessment method uses size of the basin as a factor, scores for larger basins were generally larger. To provide a second metric that reflects value independent of basin size, size was factored out of each score to generate a second score in "relative riparian/refuge points-per-acre." Generally, this caused smaller, less developed basins, particularly those with large wetland complexes, to score highest while scores for basins closer to dense development were moderate and less variable. Riparian and refuge metrics results summary are in Table 6.

Table 6. Riparian and Refuge Metric Results Summary

NAME	Total Buffer Area (acre)	Disturbed Buffer Area (acre)	Total Adjacent Wetland Area (acre)	Undisturbed Upland Buffer (acre)	total acre points	acre points per total buffer area
Annapolis Creek	33.02	15.47	0.00	17.55	8.77	0.27
Anderson Creek (Gorst)	61.08	4.45	22.22	49.33	46.89	0.77
Caseco Creek	19.73	6.75	2.13	10.85	7.55	0.38
Downtown-City Campus	13.12	11.89	0.00	1.22	0.00	0.05
Coulter Creek	3.28	0.00	0.00	3.28	1.64	0.50
Gorst Creek	21.64	2.17	0.40	19.07	9.93	0.46
Johnson Creek	45.13	14.58	0.00	30.55	15.28	0.34
Karcher Creek	26.54	4.28	0.00	22.26	11.13	0.42
Lower Blackjack Creek	223.19	62.85	6.90	157.02	85.42	0.38
Melcher Creek	17.06	2.84	0.97	13.25	7.60	0.45
Rocky Creek	34.00	0.00	18.48	15.52	26.24	0.77
Ross Creek	148.18	31.20	28.71	100.49	78.96	0.53
Ruby Creek	61.68	9.59	11.86	41.80	32.76	0.53
Square Creek	12.51	0.00	3.20	10.86	8.63	0.69
Stream 270	12.18	0.00	0.00	12.18	6.09	0.50

2.3 Results

Annapolis Creek

Annapolis Creek is mapped as a type-N (non-fish) stream per DNR hydrography, however this is a known error as adult salmonids have been documented along Arnold Ave E. WDFW barrier assessment at site 920412, which spans Mile Hill Drive and several commercial buildings, lists 2,349 feet of potential habitat upstream and 6,319 feet downstream to the mouth. Portions of this distance just upstream of Sinclair Inlet flow through County land.

Herrera measured 4,316 feet from the mouth to the first total passage barrier (Site 920484), located on South Kitsap High School grounds. Assessment of mapped hydrology included 5,158 feet of stream habitat within the City limits, 1,851 feet of which are located downstream of total passage barriers.

Spawning and Rearing HQM

WDFW data only includes the area upstream of Mile Hill Drive. Two reaches were documented, however the 2nd reach was outside City limits, so only the HQM's from Reach 1 were included. Field assessment of downstream reaches could further refine this metric.

Migration

Three total passage barriers are mapped within the basin, two of which are located on City property. One partial barrier is also mapped within the City limits, located at the mouth of the creek discharging to Sinclair Inlet.

Riparian and Refuge

Buffers and disturbance quantity has not yet been calculated for this basin. An approved distance of fish-bearing stream channel is needed to perform the assessment. No wetlands are mapped near the creek and the landscape is highly developed so this basin will likely score low for this metric. WDFW did note several areas of undefined channel that appeared more like wetland habitat during their upstream assessment, which combined with the type-N stream designation, provides a good reminder of the limitations of public-mapped hydrology and wetland layers.

Anderson Creek

Within City limits Anderson Creek provides two fish-bearing channels with a strong wetland/beaver influence. Comparing aerial imagery to mapped wetland boundaries, the potential refugia may be underestimated. Downstream of City limits the creek flows through relatively undeveloped forestland however multiple relic crossings impede upstream fish passage. WSDOT has recently completed barrier corrections at the SR-16 crossing located at the mouth of the creek.

Herrera measured 5,797 feet from the mouth to the first total passage barrier (Site 998901) located outside City limits. Another total passage barrier (Site 998905) is located on a separate fork of the creek, also outside the City. Assessment of mapped hydrology included 9,229 feet of stream habitat within the City, a distance which discounts a small unmapped tributary documented by WDFW located within McCormick Village Park.

Spawning and Rearing HQM

Reaches 1 through 3 from WDFW data were discounted as they are located outside City limits. A total of ten reaches located within the City were averaged for this basin, which featured only 1 reach with a value less than 1.

Migration

Two partial and no total fish passage barriers were included in this assessment. The unmapped McCormick Village Park tributary features an additional one total and one partial passage barrier not included in this metric. This basin would be a good candidate for refining this metric to include a points reduction element for downstream passage barriers outside the City limits.

Riparian and Refuge

Only a small portion of the riparian buffer is impacted by a dense residential community and the road crossing on SW Old Clifton Road. Several large wetland complexes are associated with the upstream limits of the creek, causing this basin to provide one of the highest riparian/refuge scores within the City.

Caseco Creek

Similar to Annapolis Creek, Caseco Creek is mapped as a non-fish bearing channel located entirely within City limits. A total passage barrier drains the creek to Sinclair Inlet, above which WDFW documents 1,201 linear feet of potential fish habitat. This distance ends at crossing 934392, which drains retention ponds down a steep slope.

Spawning and Rearing HQM

WDFW identified 3 reaches within Caseco Creek, each with limited spawning and rearing habitat potential.

Migration

Due to the passage barrier located at the mouth, Caseco Creek scored 0 points for migration.

Riparian and Refuge

This metric features moderate disturbance near the mouth of the creek and several small associated wetlands.

Downtown-City Campus

Salmonid habitat assessment of this basin was not conducted. No WDFW habitat or barrier assessment data was identified, and no fish-bearing channel is mapped. Based on the degree of development in this basin it can be presumed that no anadromous access is possible into the greenbelt with mapped drainage between City Hall and the Kitsap County administration building.

Spawning and Rearing HQM

N/A – no data.

Migration

N/A – presumed 0.

Riparian and Refuge

Extremely limited riparian habitat is located surrounding this drainage. There is a small greenbelt surrounding the channel that shows signs of disturbance throughout most of its width.

Coulter Creek

The Coulter Creek basin is located in the far southwest portion of the City, and only includes a short section of channelized habitat draining a relatively small headwater wetland. Besides a few dirt roads visible on aerial photography the entire basin is undeveloped within City limits.

Spawning and Rearing HQM

WDFW habitat data was not collected for this site. Given the lack of human development in the area, spawning and rearing habitat modifiers are assumed to be 1 for this basin.

Migration

No passage barriers are mapped on the short section of creek within the City. There are several partial barriers on mainstem Coulter Creek as well as total barriers on several tributaries. This relatively large system drains south towards Allyn and features a fish hatchery near the mouth.

Riparian and Refuge

Coulter Creek received a moderate score for riparian and refuge function as no disturbance to the buffer nor adjacent wetlands were identified, in this scenario (no associated wetlands or buffer impacts) the metric will score 0.50 acre-points per buffer area regardless of buffer size.

Gorst Creek

A relatively small portion of this tributary to Gorst Creek (Parish Creek) is located within City limits, along Feigley Road north of Old Clifton Road. The stream crosses SR-3 in Gorst, meeting the mainstem Gorst Creek just upstream of its confluence with the western tip of Sinclair Inlet. The upstream portion of Parish Creek appears impacted by residential development along Lone Bear Lane, including a stormwater standpipe in the channel straightened ditch like segments of the Creek.

Spawning and Rearing HQM

Seven total reaches were included from WDFW's assessment, resulting in an average 0.83 HQM for spawning and 0.95 for rearing.

Migration

A total of 5,828 feet of fish-bearing channel is mapped within the City in this basin. No total barriers and two partial barriers are located along this length, resulting in a score of 0.62. A total downstream barrier is mapped outside the City, currently precluding anadromous access.

Riparian and Refuge

Generally small areas of disturbance and associated wetlands are mapped within this drainage.

Johnson Creek

Johnson Creek roughly parallels Port Orchard Boulevard from Sinclair Inlet to Tremont Street then extends further to its headwaters near Cedar Heights Junior High. The stream crosses Port Orchard Blvd several times, exacerbating passage issues.

Herrera measured 859 feet from the mouth to the first total passage barriers (Site 996960) based on mapped hydrology. WDFW assessment of this stream measured 637 feet between the creek's mouth and the first total barrier. The stream is entirely within City limits and mapped fish bearing for its full mapped length of 7,743 feet. Including tributaries, WDFW lists 9,606 linear feet of potential habitat gain upstream of the Bay Street culvert discharging to Sinclair Inlet.

Spawning and Rearing HQM

A total of 10 WDFW reaches were assessed, with spawning HQMs occasionally limited by substrate condition. Despite the number of road crossings along Port Orchard Blvd the stream appears to remain potentially functional as salmonid habitat.

Migration

Migration is severely impacted in this basin. Less than 10% of the creek is accessible to anadromous fish, and passage of resident fish throughout the basin is also severely impacted by the frequency of partial and total passage barriers.

Riparian and Refuge

No wetlands are mapped adjacent to Johnson Creek, and the drainage pathway parallel to a relatively major roadway limits buffer function.

Karcher Creek

Karcher Creek flows along the eastern boundary of Port Orchard, with only two relatively short stretches within City limits, one near the mouth and the other further upstream within the Veterans Memorial Park. Most of the drainage flows through relatively undeveloped parks, with increased residential and utility infrastructure encroachment near the mouth.

There is a total passage barrier (Site 995350) mapped at the mouth, however WDFW notes the culvert backwaters at high tide and salmonid juveniles were observed upstream of the crossing. For this assessment we presumed this crossing is a total passage barrier (as mapped by WDFW), precluding anadromous access to the creek.

WDFW habitat assessment was conducted surrounding the Mile Hill Drive crossing. They measured 5,449 feet of channel during their downstream check, and list 8,255 feet of potential habitat gain upstream of Mile Hill Drive. GIS assessment measured approximately 3,876 feet of channel located within City limits.

Spawning and Rearing HQM

WDFW habitat assessment data was only available for portions of the creek upstream of Mile Hill Drive, outside the City boundary. Seven reaches were mapped about this location, all with spawning and rearing HQM values of 1. For this assessment we assumed similar conditions downstream.

Migration

For the purposes of this study we followed WDFW's assessment of the Beach Drive culvert being a total barrier, scoring 0 points for migration. There is an additional total barrier (Site 999570) located at the downstream end of the City boundary. The Mile Hill Drive crossing (Site 15.0201 0.90) is also a total passage barrier.

Riparian and Refuge

Karcher Creek scored moderately low for this metric due to the lack of mapped wetlands and frequency of buffer impacts, particularly at the downstream end of the creek.

Lower Blackjack Creek

Blackjack Creek is the largest and most productive watershed in Port Orchard, with most of the lower basin located within City limits. Downstream of SR-16 the mainstem (approximately 18,600 feet) features a relatively intact riparian zone upstream of its bridge outlet to Sinclair Inlet (Site 931350). An additional tributary (also known as Silver Creek) paralleling the Bethel Road corridor is mapped joining the mainstem just upstream of this outlet crossing that appears to provide limited fish habitat opportunity due to the amount of surrounding development.

Upstream of the partial-barrier SR-16 highway crossings (Sites 996755, 990038, and 996756), cleared fields and residential lots encroaching upon the creek become more common. Much of the upper watershed is outside City limits except for portions of two tributaries (Ruby Creek and Square Creek).

Approximately 28,963 linear feet of fish-bearing channel is mapped within City portions of Lower Blackjack Creek. No total passage barriers are mapped along this length however total barriers are present on smaller tributaries that provide the physical parameters required to support fish life (Sites 935527 and 935492).

Spawning and Rearing HQM

WDFW habitat assessment data is not available downstream of SR-16. Notes from their downstream check conducted in late October 2010 include frequent observations of adult chum and active redds. Spawning HQM was assessed at 0.33 on the reach upstream of SR-16 due to the lack of riffle habitat, a distance of 4,157 feet. Assuming a value of 1.0 for the 18,600 feet downstream of SR-16 and including the 4,157 feet upstream with a 0.33 spawning HQM, the Lower Blackjack Creek spawning HQM is 0.88. Rearing HQM is presumed 1.0 for the entire basin, as listed in the two reaches formally assessed and qualitatively documented in the downstream check.

Migration

Three partial barriers are mapped within City limits on Lower Blackjack Creek, all in quick sequence at the SR-16 crossing. Two total barriers are also mapped but were discounted from this assessment:

- Site 935492, located along the Sedgewick Road/SR-16 interchange, is not listed as a significant reach that supports at least 200 meters of potential fish habitat. No apparent hydrography is mapped draining through this site.

- Site 935527, located on the intersection of SE Rose Road and SE Cedar Road, does convey a significant reach of stream however this site is located at the very upstream end of City jurisdiction, and its inclusion would not impact the reported metric.

Given 28,963 linear feet of type-F channel and 3 partial barriers to fish passage Lower Blackjack Creek scored 2.31 “mile points” for migration.

Riparian and Refuge

Riparian and refuge scores for Lower Blackjack Creek were largely impacted by the tributary flowing adjacent to Bethel Road. A relatively high proportion of the riparian zone at and upstream of SR-16 is also impacted.

Melcher Creek

Melcher Creek is a small tributary to Sinclair Inlet located entirely within the City. The outlet culvert (Site 996957) is relatively degraded along the tideflats and is mapped as a partial passage barrier. There is a total barrier (Site 934601), measured via hydrology at 285 feet upstream. WDFW survey notes measure this distance at 115 feet. WDFW ended their “Threshold Determination” 715 feet upstream of the mouth, confirming a significant reach of habitat within this basin. Additional potential fish habitat could exist above this distance as a detailed, full survey was not conducted.

Spawning and Rearing HQM

WDFW did not perform a detailed habitat survey at this crossing. Spawning and rearing metrics were presumed to be 1.0 given the lack of data to the contrary. This assumption could be refined in later phases with field verification.

Migration

Migration is severely limited in this basin due to the degraded outlet culvert at the mouth and total passage barrier not far upstream. Distances measured by WDFW to the nearest total barrier combined with the full 2,421 feet of mapped channel were used to calculate this metric. Melcher Creek scored 0.03 “mile points” for migration.

Riparian and Refuge

Riparian buffer impacts are largely limited to the lower portion of the creek. Further upstream the drainage flows through a relatively steep valley with limited development apparent on aerial imagery. Impacts within this valley due to landscaping or other debris dumping are unknown but not uncommon in this setting. Additionally, Melcher Creek is mapped terminating downstream of W Melcher Street, above which headwater wetlands could connect to the creek and provide additional off-channel refuge habitat.

Rocky Creek

A small portion of the Rocky Creek basin extends into the far southwest corner of City limits. Aquatic habitat within the City is entirely ponded, consisting of the northern half of Nels Johnson Lakes. Smaller wetland and ponded areas as well as dirt/gravel roads are visible on aerial imagery. A few houses along McCormick Woods Drive are located in the northeastern portion of the basin.

WDFW does not map total passage barriers downstream of the lake however there are several partial barriers and wetland complexes that could limit passage during certain portions of the year. Mapped hydrography includes 2,060 feet of ‘channel,’ which is roughly centered around the lake. Within the City and basin the lake measures roughly 18.5 acres (mapped NWI wetland) and appears to extend slightly north into the Anderson Creek basin.

Spawning and Rearing HQM

For the purposes of this assessment spawning activity was not considered viable in this basin due to the lack of channelized habitat available. Rearing potential was assumed to be 1.0 as the lake likely provides year-round rearing habitat for coho, cutthroat, and steelhead as well as warm-water fish such as bass and bluegill.

Migration

No known limitations to migration exist within the City, however seasonal fluctuations in water level could limit access to portions of the lake. Using the mapped centerline of 2,060 feet the basin scored 0.39 points for migration.

Riparian and Refuge

No development is evident within 150 feet of the mapped channel line or the visible lake boundary. The houses along McCormick Woods Drive are just over 150 feet from the mapped wetland boundary. Buffer areas used for this metric were calculated using the NWI-mapped wetland boundary rather than the DNR channel to more accurately reflect riparian and buffer conditions within the basin.

Ross Creek

Ross Creek is a relatively large basin that includes portions within and outside City limits. The creek outlet features a small pocket estuary that drains through a box culvert under SW Bay Street that is presumed to be a velocity barrier during certain periods of tidal exchange. Relatively unimpacted conditions exist between Bay Street and SR-16. Upstream of the highway habitat conditions are more highly impacted as the creek flows through the Port Orchard Industrial Park and then the McCormick Woods Golf Course.

Herrera measured 4,502 feet from the mouth to the first total passage barriers (Site 15.0210 0.17), located on an abandoned road approximately 423 feet downstream of SR-16. 20,160 feet of potential type-F stream was calculated within City limits and this basin.

Spawning and Rearing HQM

WDFW habitat assessment data was not available for the Ross Creek basin. Surveys were conducted in 1997 however this data utilized an obsolete spreadsheet program and is considered too dated for relevancy. A basin-wide metric of 0.67 was assumed given the disparity between relatively natural conditions downstream of SR-16 versus highly impacted conditions upstream of the highway. Upstream habitat survey notes available in the inventory summary report for site 990270 indicate that upstream reaches go dry during summer and offer limited rearing habitat, with the exception of several lakes. Electroshocking in 1997 did not encounter salmonids.

Migration

Herrera measured 4,502 feet of mainstem stream habitat available downstream of the first total passage barrier. We considered the outlet culvert a partial barrier, resulting in a migration score of 0.64.

Riparian and Refuge

Ross Creek received a moderate riparian and refuge function score of 0.53 due to the frequency of wetland and lake habitat, primarily upstream of SR-16, as well as the relatively unimpacted conditions downstream of the highway.

Ruby Creek

Ruby Creek is a tributary to Blackjack Creek with a confluence near SR-16 and Sedgewick Road. It flows through a mix of residences, cleared fields, and native forest from its headwaters. Several small tributaries and maintained ponds enter the creek near Glenwood Road SW and SW Harper Road, providing minor supplements to available fish habitat resources (located outside City limits).

There are no total fish passage barriers mapped on the mainstem drainage. Total barriers are mapped on several of the small tributaries, blocking access to relatively small quantities of potential fish habitat. A total length of 10,439 feet of type-F channel is mapped within City limits, a length that likely underestimates available habitat due to the limitations of existing hydrology maps. Updating hydrology to match 2013 Wild Fish Conservancy assessments would provide a more accurate representation of conditions within the basin, both within and outside the City.

Spawning and Rearing HQM

WDFW assessed a total of 13 reaches within City limits, including the mainstem and three tributaries. Nine of these reaches provided no spawning habitat, while the majority featured minor to moderate impacts to potential rearing capacity. Averaging scores across the basin resulted in an average spawning HQM of 0.15 and a rearing HQM of 0.67.

Migration

Three partial and no total fish passage barriers were included in this assessment resulting in a migration score of 0.83 "mile points." One total barrier and one partial barrier located within the City were not included due to inaccurate hydrology west of development surrounding the Sedgewick and Sydney Road intersection. An additional 8 partial and 3 total barriers are mapped outside City limits within this basin.

Riparian and Refuge

Riparian health and potential refuge habitat are variable throughout the basin, with impacts more frequently encountered near the confluence with Blackjack Creek. Portions of a large wetland complex adjacent to SW Harper Road increases the potential refuge value.

Square Creek

Square Creek is the 2nd major tributary to Blackjack Creek located partially within City limits. It flows roughly 6,300 feet from the north end of Square Lake across Glenwood Road to its confluence with Blackjack Creek, generally west of the residential community along Vern Vista Place SW. Roughly 2,036 feet of this length is located within the City. WDFW maps a total passage barrier located outside the City at approximately 1,580 feet downstream from Square Lake.

Spawning and Rearing HQM

Reaches 1 and 6 from WDFW data covered portions of the creek within the City. No spawning habitat is located in lower sections of the creek while occasional marginal spawning grounds were observed near the lake, resulting in a low spawning score of 0.17. No impacts to rearing habitat conditions were identified in either reach, with both receiving a 1.0 score.

Migration

No passage barriers are mapped on the 2,036 feet of City-owned stream channel, resulting in a migration score of 0.39 "mile points." One total and two partial barriers are located outside the City.

Riparian and Refuge

No development or other signs of riparian impact are visible on aerial photography within the City. Square Lake is the only mapped non-channelized aquatic habitat within City portions of the basin. Roads, buildings, and fields are common adjacent to the creek outside City limits.

Stream 270

Headwater portions of the Stream 270 drainage are located within the City, originating near active residential construction west of McCormick Village Park. Approximately 1,679 feet of potential fish habitat was measured, which is currently inaccessible to anadromous fish due to a total passage barrier located outside City limits on SR-3 (Site 991670). This length includes a section of mapped type-N channel which was included in WDFW's assessment as potential fish habitat. No other passage barriers are mapped within the system – previous barrier site 996761 was replaced in 2018 with a 16-foot span bridge.

Spawning and Rearing HQM

WDFW comments on barrier inventory reports indicate quality habitat upstream of SR-3. The assessed reach within the City received a 1.0 HQM for spawning and a 0.67 HQM for rearing.

Migration

No barriers are mapped within City portions of this system. Upon replacement of the downstream highway culvert, fish will have unimpeded access to all potential habitat within the basin. Stream 270 scored 0.32 "mile points" for the relatively short length of unimpeded habitat located within the City.

Riparian and Refuge

No buffer impacts or adjacent wetlands were identified within City portions of the creek, resulting in a score of 0.50 for this basin.

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