LIBERTY BAY

TMDL IMPLEMENTATION PLAN

Prepared for:

City of Poulsbo
200 NE Moe Street
Poulsbo, WA 98370

City of Poulsbo

Prepared by:

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June 2016

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ACRONYMS

BMP	Best Management Practice
CIP	Capital Improvement Plan
City	City of Poulsbo
Ecology	Washington Department of Ecology
EMP	Effectiveness Monitoring Plan
FC	fecal coliform bacteria
GFC	General Facilities Charge
GIS	Geographic Information System
GMV	geometric mean value
IDDE	Illicit Discharge Detection and Elimination
ISU	impervious surface unit
KPHD	Kitsap Public Health District
LID	Low-Impact Development
NKSD	North Kitsap School District
NOA	Needs and Opportunities Assessment
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
O&M	Operation and Maintenance
OSS	on-site sewage system
OWS	oil/water separator
PIC	Pollutant Identification and Control
PTIP	City of Poulsbo Liberty Bay TMDL Implementation Plan
QAPP	Quality Assurance Project Plan
RSMP	Regional Stormwater Monitoring Program
SWCP	Stormwater Comprehensive Plan
SFDC	South Fork Dogfish Creek
SR	State Route
SWAMPPS	Stormwater Assessment and Monitoring Program for Puget Sound
TIA	Total Impervious Area

ACRONYMS (continued)

TMDL	Total Maximum Daily Load
UGA	Urban Growth Area
Utility	Poulsbo Storm Water Utility
WDOH	Washington State Department of Health
WSDOT	Washington State Department of Transportation

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EXECUTIVE SUMMARY

The City of Poulsbo (City) Liberty Bay Total Maximum Daily Load (TMDL) Implementation Plan (PTIP) has been prepared in response to the Department of Ecology's (Ecology's) *Liberty Bay Watershed Fecal Coliform Bacteria TMDL and Water Quality Implementation Plan* (2013). Ecology prepared this TMDL plan because there was evidence of bacterial contamination affecting beneficial uses in Liberty Bay, including shellfish harvesting and primary contact recreation.

The goal of Ecology's 2013 TMDL Plan is to ensure Liberty Bay will attain Washington State water quality standards. The goal of the PTIP is to identify the actions and projects that the City will implement to address the goals and requirements of Ecology's 2013 TMDL Plan. The purpose of the PTIP is to identify and prioritize actions that will help to preserve, protect, and restore water quality and natural systems, while at the same time providing infrastructure that supports both existing and future development. The PTIP covers the incorporated City area as it exists in 2016, including the urban growth area (UGA).

TMDL PURPOSE AND BACKGROUND

TMDL evaluations are required to identify the maximum amount of a pollutant that can be allowed into water bodies so as not to impair beneficial uses. Ecology's TMDL Plan includes an assessment of water quality problems and pollutant sources that cause the problem, and determines the amount of a given pollutant (Fecal coliform bacteria [FC] in this case) that can be discharged to the water body and still meet standards (the loading capacity). The TMDL Plan then allocates that load among the various sources such as specific streams and stormwater systems.

Ecology's TMDL Plan identifies specific tasks, responsible parties, and timelines for achieving water quality standards. Responsible parties include the City, Kitsap County, and the Kitsap Public Health District (KPHD). In response to Ecology's TMDL plan, the City initiated the PTIP project. The PTIP describe the actions that the City will take to implement actions associated with their responsibilities under Ecology's TMDL Plan. The PTIP is funded in part by a grant from Ecology.

PTIP SCOPE

Since the City's responsibilities under the TMDL are limited to a large extent on stormwater management, the PTIP also focuses on stormwater management. Elements of the PTIP include a watershed assessment, stormwater quality study, needs and opportunities assessment, capital improvement plan (CIP), financial plan and implementation plan.

POULSBO STORMWATER MANAGEMENT PROGRAM AND SYSTEM DESCRIPTION

The City established a Stormwater Utility (Utility) in 1981. The Utility manages, protects, and regulates the built (stormwater) and natural surface water systems in the City. The Utility funds and maintains stormwater facilities and helps assure compliance with applicable regulations. The City owns and operates an extensive system of drainage pipes, treatment facilities, and other assets that convey and treat stormwater runoff. The City's stormwater system serves an area of approximately 4.6 square miles and a population of approximately 9,915 (2015 Census data). The City is currently about 29 percent impervious surfaces, with 51 percent impervious estimated at full build out. Basins and sub-basins are shown in Figure ES-1.

WATERSHED ASSESSMENT

The Watershed Assessment provides an inventory and analysis of water quality conditions, the physical stormwater system and natural resources in the study area, and serves as the technical foundation for preparation of the PTIP. The purpose of the Watershed Assessment is to identify where and why water quality and selected ecological processes and habitats are impaired, and where corrective actions should be focused. The goal of the assessment is to understand where and why impairments occur, and to help target stormwater infrastructure planning to best mitigate existing and potential future impacts.

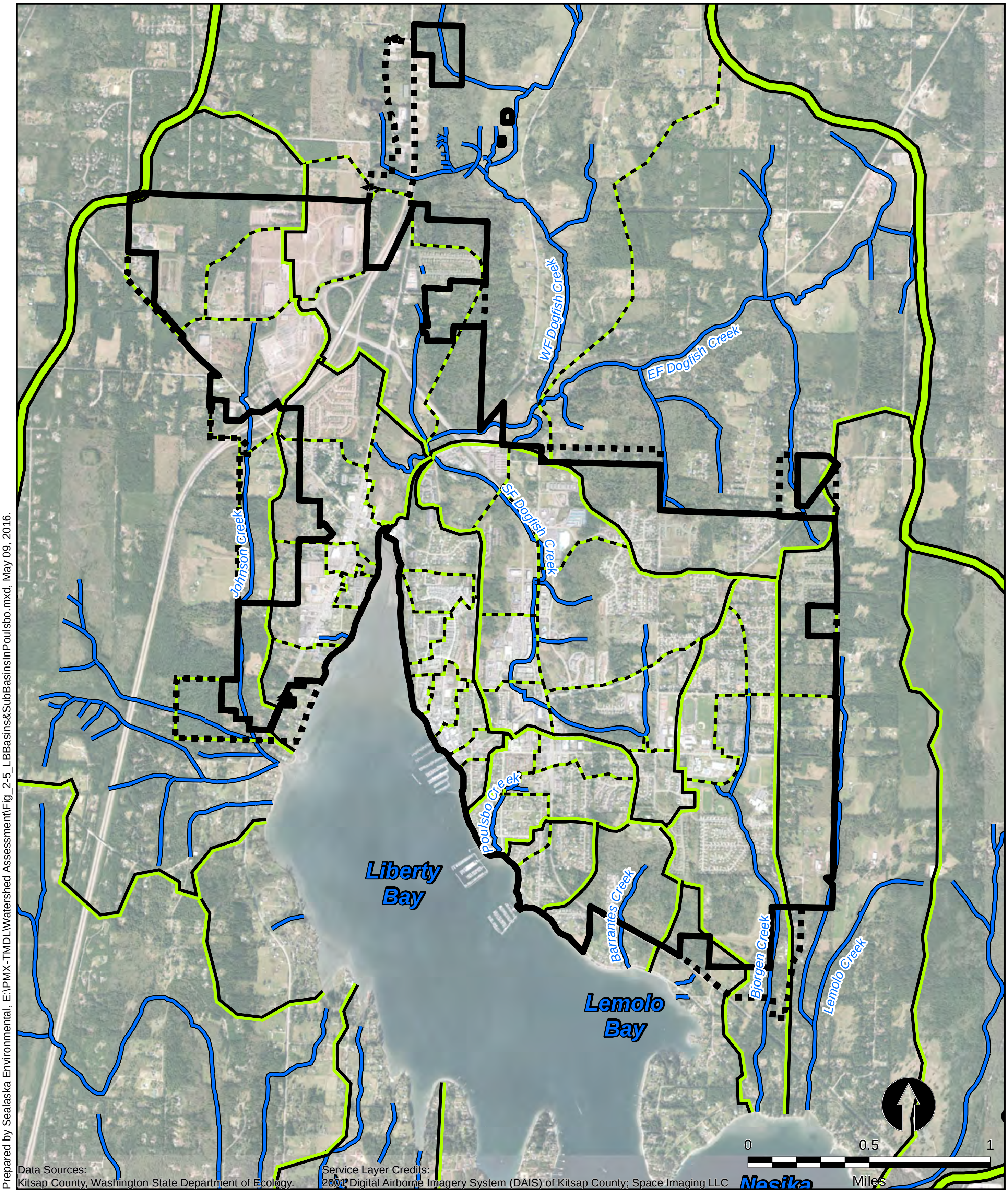
The Watershed Assessment characterized water quality, hydrology, and habitat components to identify specific basins, sub-basins, and stormwater system segments in the City that may warrant corrective action. The Watershed Assessment considers the entire Liberty Bay basin, with an emphasis on those areas within the City.

Water Quality Assessment

Liberty Bay FC water quality data is extensive; over the last 10 years over 1,000 FC samples have been collected. Liberty Bay marine water quality shows a significant long-term improving trend, with all 27 marine water monitoring stations meeting water quality standards in 2013, 2014, and 2015. Marine stations with highest FC concentrations are typically located near the head of Liberty Bay and are most influenced by Dogfish Creek.

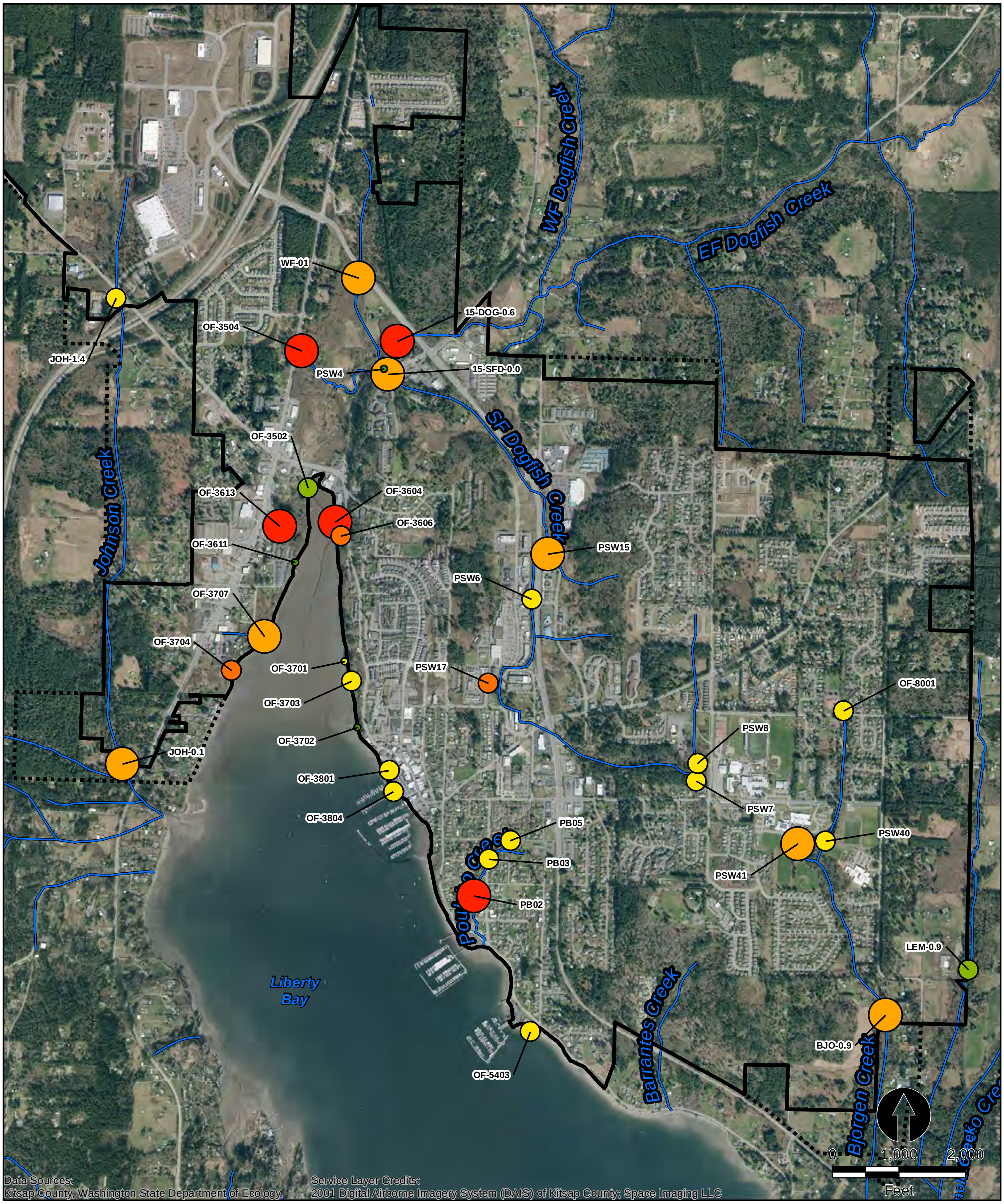
Stream water quality is also improving in all monitored stream basins except Bjorgen Creek, which is showing a slight declining trend. In general, stream water quality, although improving, periodically fails water quality standards.

Stormwater sampling results and basin analysis indicate that highest FC loading during wet weather conditions occurs from Dogfish Creek, South Fork Dogfish Creek (SFDC), and Johnson Creek. Highest FC concentrations are typically found in stormwater outfall discharges located in the middle segment of SFDC, the middle segment of Poulsbo Creek, the Torval Canyon area, and the central and south Viking Avenue basins (Figure ES-2). Poulsbo Creek has shown significant water quality improvement since Ecology’s TMDL study in 2008-09 (Ecology 2009). Overall, while stormwater from Poulsbo outfalls has elevated FC concentrations, values are typically well below the Puget Sound median concentration of 4,500 FC/100 ml (Ecology 2011).



Liberty Bay Watershed
Basin Boundary
Sub-Basin Boundary
Streams
City of Poulsbo
PUTA

Figure ES-1
Streams Basins and Sub-Basins In City of Pouslbo
TMDL Implementation Plan
City of Poulsbo



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Streams
City of Poulsbo
PUTA

FC Load
Low
Medium
High

FC Water Quality
Good
Moderate
Poor

Figure ES-2
2015 Water Quality Study Summary
TMDL Implementation Plan
City of Poulsbo

Approximately $6 million in water quality corrective actions have been implemented by local agencies in the Liberty Bay watershed over the past six years including stormwater retrofit by the City of over 25 acres of impervious area, 47 on-site sewage system (OSS) repairs, and 41 agricultural best management practices (BMPs). The location and time-frame for these corrective actions coincides with observed water quality improvements at many locations including the head of Liberty Bay, Poulsbo Creek, and City stormwater outfalls at Anderson Parkway, Front Street, and Nelson Park.

Habitat Assessment

Habitat impacts associated with stormwater are most prevalent in the SFDC and Bjorgen Creek basins where more dense urban development exists with little or no stormwater detention or treatment (Figure ES-3). Habitat impacts include both hydrologic alterations such as streambed scour and aggradation, as well as water quality impacts from sedimentation, toxics and low dissolved oxygen. Habitat impacts also result from fish passage barriers on Bjorgen Creek, Lemolo Creek, and SFDC, as well as shoreline armoring and erosion at Poulsbo Creek and several deteriorated stormwater outfalls along the Liberty Bay shoreline.

Potential habitat improvements include restoring degraded stream habitat on SFDC near 8th Avenue and Centennial Park, replacing barrier culverts on SFDC and Bjorgen Creeks, and improving stormwater quality and quantity control in the SFDC and Bjorgen Creek basins. Additionally, rehabilitation of deteriorated shoreline stormwater outfalls would improve nearshore habitat by reducing erosion and replacing riprap rock armoring with shoreline stabilization techniques that are more sustainable and provide greater habitat value.

BASIN AND STORMWATER INFRASTRUCTURE SUMMARY

The objective of the stormwater infrastructure assessment is to delineate catchment areas, evaluate type and extent of impervious surfaces, and characterize stormwater infrastructure conditions. Areas within the City where stormwater runoff is treated were delineated based on geographic information system (GIS) data, input from City staff, and limited field reconnaissance (Figure ES-4).

The City is currently about 29 percent impervious surfaces, with 51 percent impervious estimated at full build out. About 57 percent of the existing impervious surfaces are treated in accordance with 1992 or 1997 stormwater standards. About four percent of existing impervious surfaces are treated to 2005 stormwater standards. The relatively high percentage of treated impervious area is due to several factors, including the number of larger developments constructed in since the early 1990s, and the number of major roadway improvements and stormwater retrofits implemented by the City.

Although a significant portion of the City's TIA is served by treatment facilities, many of the treatment facilities were designed for oil and/or sediment removal, and are not particularly effective at FC treatment. Sampling results show that several basins that have large portions served by treatment facilities still have high FC discharges. An assessment of retrofit potential for existing facilities was done as part of the Needs and Opportunities Assessment.

Based on the infrastructure analysis, priority basins for potential corrective actions include portions of the SFDC basin near the Poulsbo Library and Poulsbo Village, the south Viking Avenue commercial area, portions of the Poulsbo Creek basin near SR305, the upper Bjorgen Creek basin including NKSD and the Ridgewood neighborhood, Torval Canyon, Poulsbo Place, and the Viking Heights/Fjord Drive neighborhoods.

CORRECTIVE ACTION PRIORITIES

Corrective action priorities were assessed by an integrated evaluation of Watershed Assessment results. Prioritization was performed using the combined results of the water quality, habitat, land-use and infrastructure assessment. The combined assessment results were sorted and ranked using a broad range of criteria and are shown in Figure ES-5.

CAPITAL IMPROVEMENT PLAN

The CIP identifies the specific facilities, relative priorities and costs of capital projects that address and implement TMDL priorities. The process used to develop and prioritize capital projects used an integrated evaluation of water quality, habitat, and infrastructure information for each of the high-priority sub-basins identified via the Watershed Assessment. The list of proposed PTIP priority projects were then screened, compared and rated relative to water quality, flood control, habitat and community development criteria. Projects were then programmed into a plan and schedule that considered the project cost, potential funding source, and project timing.

Conceptual designs were developed for 16 candidate CIP projects. The stormwater treatment BMPs selected for the high priority sites include bioretention, bioretention with underdrains, permeable pavement, treatment wetlands, and vault systems. Planning-level project costs were developed for each project including design, project management, construction management, and permitting. The resultant CIP is shown in Table ES-1, with project locations shown in Figure ES-6.

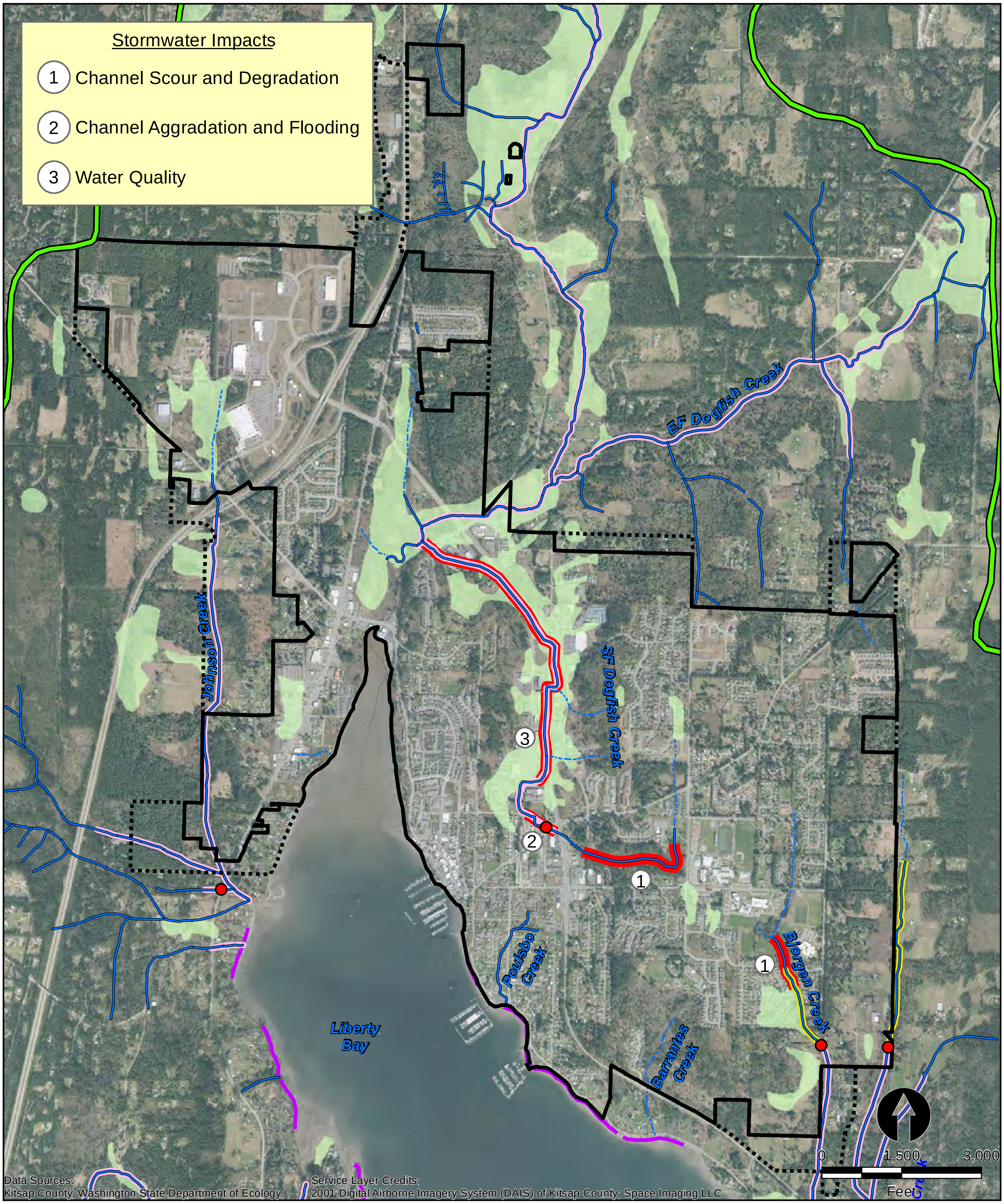

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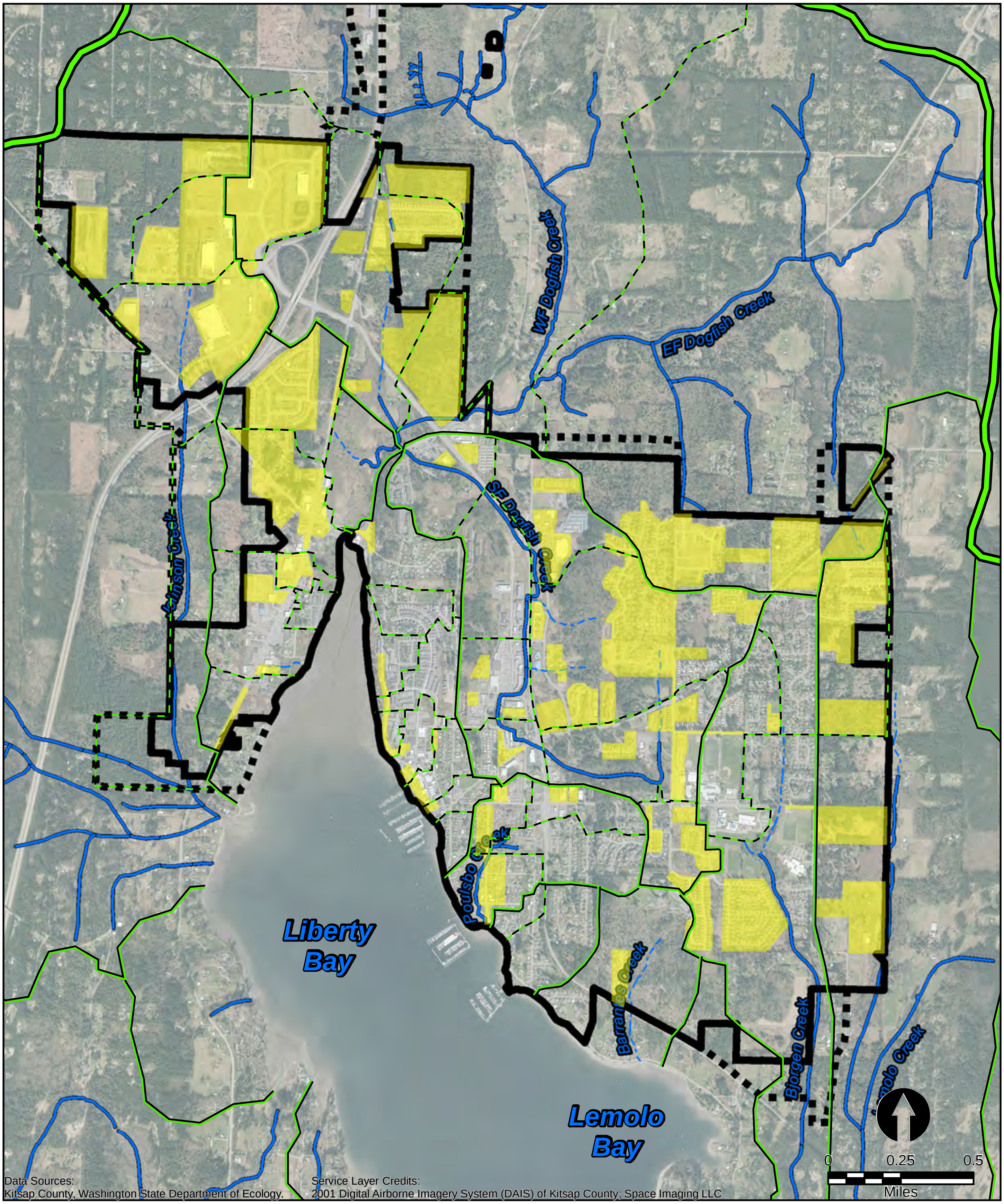
Figure ES-3
Fish and Wildlife Habitat

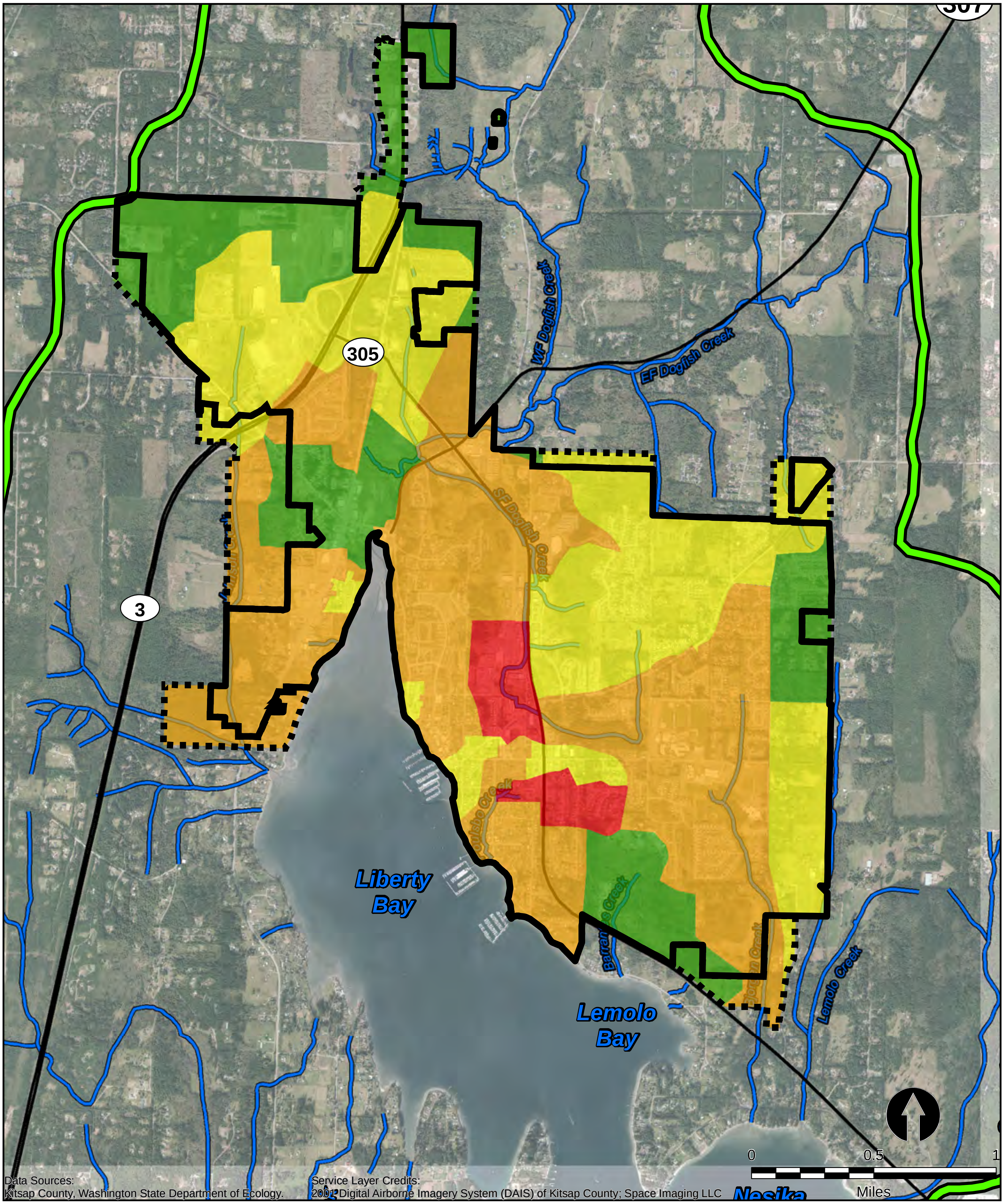
TMDL Implementation Plan
City of Poulsbo



Liberty Bay Watershed
Basin Boundary
Sub-Basin Boundary
Stream
Intermittent Stream
City of Poulsbo
PUTA
Areas with Stormwater Treatment

Figure ES-4
Stormwater Treatment Areas
TMDL Implementation Plan
City of Poulsbo

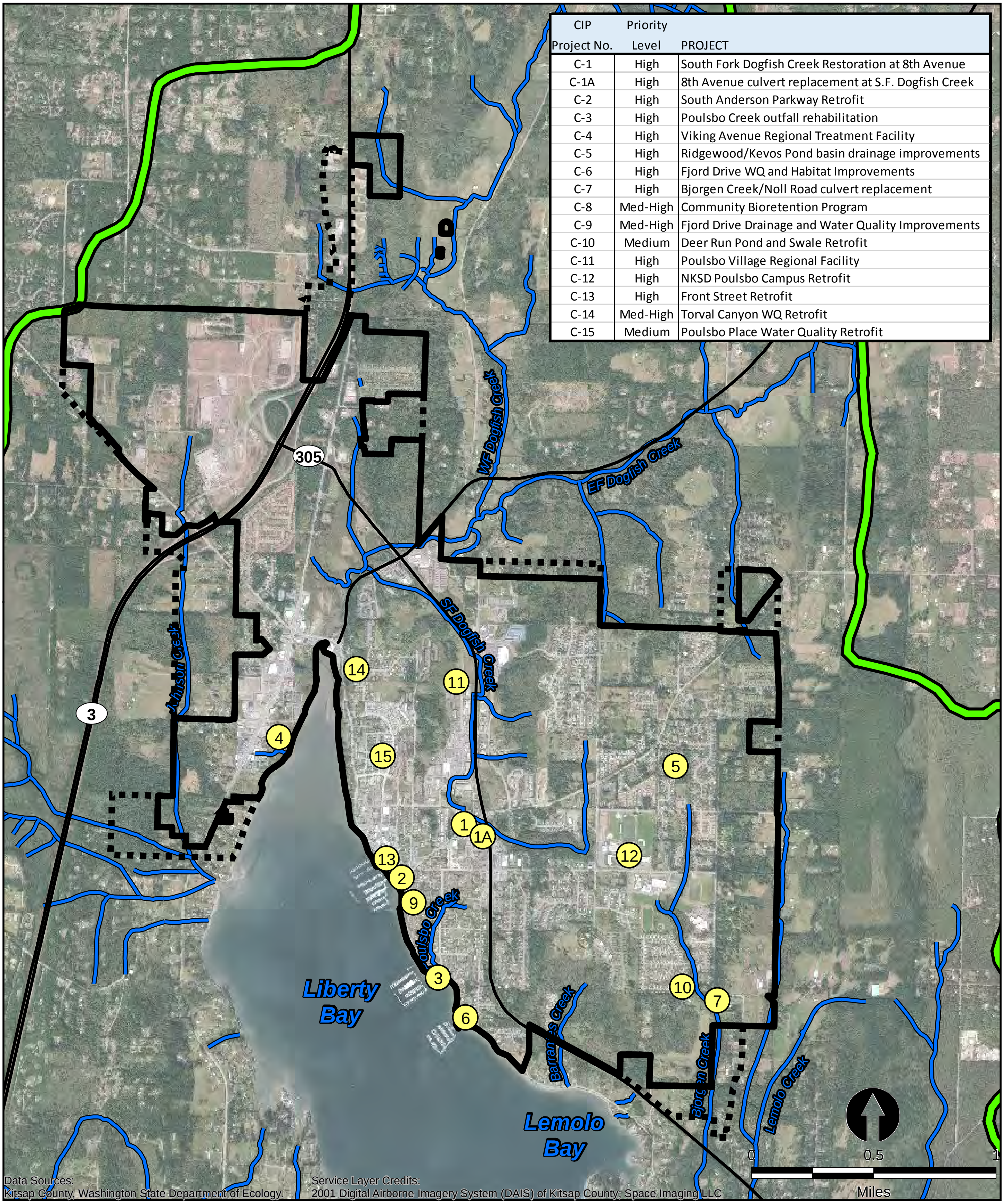
Prepared by Sealaska Environmental, E:\PMX-TMDL\Watershed Assessment\Fig6-1_PriorityAreasCombinedCriteria.mxd, June 02, 2016.



Liberty Bay Watershed
City of Poulsbo
PUTA
Highway

Sub Basin Ranking
- High
- Moderate-High
- Moderate
- Low

Figure ES-5
Priority Areas Based On Combined Criteria
TMDL Implementation Plan
City of Poulsbo



CIP Project No.	Priority Level	PROJECT
C-1	High	South Fork Dogfish Creek Restoration at 8th Avenue
C-1A	High	8th Avenue culvert replacement at S.F. Dogfish Creek
C-2	High	South Anderson Parkway Retrofit
C-3	High	Poulsbo Creek outfall rehabilitation
C-4	High	Viking Avenue Regional Treatment Facility
C-5	High	Ridgewood/Kevos Pond basin drainage improvements
C-6	High	Fjord Drive WQ and Habitat Improvements
C-7	High	Bjorgen Creek/Noll Road culvert replacement
C-8	Med-High	Community Bioretention Program
C-9	Med-High	Fjord Drive Drainage and Water Quality Improvements
C-10	Medium	Deer Run Pond and Swale Retrofit
C-11	High	Poulsbo Village Regional Facility
C-12	High	NKSD Poulsbo Campus Retrofit
C-13	High	Front Street Retrofit
C-14	Med-High	Torval Canyon WQ Retrofit
C-15	Medium	Poulsbo Place Water Quality Retrofit

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1 CIP Locations
Liberty Bay Watershed
City of Poulsbo
PUTA
Highway

Figure ES-6
Capital Project Locations
TMDL Implementation Plan
City of Poulsbo

Table ES-1. PTIP Capital Improvement Plan Financial Summary.

CIP Project No.	Priority Level	Project Score	Project	Project Type [1/]	Year 2016	2017	2018	2019	2020	2021	Total 6 Yr CIP	Not Scheduled
CAPITAL PROJECTS, 6 YEAR PLAN, 2016- 2022												
C-1	High	76	SF Dogfish Creek Culvert Replacement at 8th Avenue	WQ, H, FL	$25,000	$200,000	$500,000	$500,000	$400,000		$1,625,000	
C-1A	High	69	SF Dogfish Creek Culvert Replacement at 8th Avenue	H, FL	$25,000	$25,000		$400,000			$450,000	
C-2	High	69	South Anderson Parkway Retrofit	WQ	$380,000						$380,000	
C-3	High	69	Poulsbo Creek Outfall Rehabilitation	M/R, H		$25,000	$175,000				$200,000	
C-4	High	63	Viking Avenue Regional Treatment Facility	WQ, ED	$10,000	$700,000	$60,000	$600,000	$600,000		$1,970,000	
C-5	High	62	Ridgewood/Kevos Pond Basin Drainage Improvements	WQ, FL	$30,000	$230,000					$260,000	
C-6	High	62	Fjord Drive Water Quality and Habitat Improvements	WQ, H, M/R	$35,000	$255,000					$290,000	
C-7	High	58	Bjorgen Creek/Noll Road Culvert Replacement	H, FL	$30,000		$320,000				$350,000	
C-8	Med-High	46	Community Bioretention Program	WQ	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$150,000	
C-9	Med-High	43	Fjord Drive Drainage and Water Quality Improvements	WQ, M/R	$10,000	$210,000					$220,000	
C-10	Medium	37	Deer Run Pond and Swale Retrofit	WQ, M/R					$16,000	$184,000	$200,000	
C-11	High	61	Poulsbo Village Regional Facility	WQ, ED		$50,000	$130,000	$700,000	$960,000		$1,840,000	
			Subtotal 6-Year CIP, 2016 - 2021		**$570,000**	**$1,720,000**	**$1,210,000**	**$2,225,000**	**$2,001,000**	**$209,000**	**$7,935,000**	
CAPITAL PROJECTS - NOT SCHEDULED												
C-12	High	75	North Kitsap School District Campus Retrofit	WQ, H								$920,000
C-13	High	56	Front Street Retrofit	WQ, ED								$640,000
C-14	Med-High	44	Torval Canyon Water Quality Retrofit	WQ, FL								$470,000
C-15	Medium	39	Poulsbo Place Water Quality Retrofit	WQ								$810,000
			Subtotal Unscheduled CIP									**$2,840,000**
										TOTAL CIP	$10,775,000	

		2016	2017	2018	2019	2020	2021	Total 6 Yr CIP
EXISTING AND POTENTIAL FUNDING SOURCES - 6 YEAR CIP								
WDOE Stormwater Grants - Awarded		$350,000	$125,000					$475,000
WDOE Stormwater Grants - Future Applications			$300,000	$300,000	$600,000	$510,000		$1,710,000
NTA/PSP/RCO Grants - Future Applications			$162,500	$300,000	$550,000	$550,000		$1,562,500
Other (Developer, partner agencies, bonds)			$50,000	$130,000	$700,000	$960,000		$1,840,000
Subtotal Grants and Other Funding		**$350,000**	**$637,500**	**$730,000**	**$1,850,000**	**$2,020,000**		**$5,587,500**
Stormwater Utility		$294,493	$297,438	$300,412	$303,416	$306,450	$309,515	$1,811,724
TOTAL EXISTING 6-YEAR FUNDING, 2016 -2021		**$644,493**	**$934,938**	**$1,030,412**	**$2,153,416**	**$2,326,450**	**$309,515**	**$7,399,224**
REVENUE BALANCE - CAPITAL EXPENSES		**$74,493**	**-$785,062**	**-$179,588**	**-$71,584**	**$325,450**	**$100,515**	**-$535,776**
CAPITAL CONTRIBUTION FROM NEW REVENUE SOURCES								
Portion of Future General Facility Charge [2/]		$50,000	$50,500	$51,005	$51,515	$52,030	$52,551	$307,601
Portion of Future Traffic Impact Fees [2/]		$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$300,000
TOTAL 6-YEAR CITY NEW REVENUE CONTRIBUTION, 2016 - 2021		**$100,000**	**$100,500**	**$101,005**	**$101,515**	**$102,030**	**$102,551**	**$607,601**

Notes:

[1/] WQ – Water Quality, H – Habitat, FL – Flood Reduction or Flow Control, ED – Economic Development, M/R – Maintenance and Repair

[2/] General Facility Charge and Traffic Impact Fees expected to generate an estimated $150,000/year each in total.

IMPLEMENTATION AND FUNDING

Implementation of the projects identified in the PTIP will occur as an element of the City's overall stormwater program as described in the City's adopted 2016 Stormwater Comprehensive Plan (Sealaska 2016). The City's adopted stormwater CIP includes the projects described in this report, as well as a financial plan that would fund project construction. Table ES-2 summarizes implementation actions, priorities, and schedule.

Table ES-2. Summary of PTIP Implementation Actions

Priority	Description	Required by Regulation	Schedule
Critical	Adopt 2012 Ecology Stormwater Manual	Yes	By December 31, 2016
Critical	Update Poulsbo Municipal Code with LID Requirements	Yes	By December 31, 2016
High	Adopt Stormwater General Facility Charge	No	December 2016
High	Implement CIP including grant applications	No	On-going
High	Implement EMP	No	2017
Medium	Update and refine CIP	No	Annually
Medium	Add maintenance staff	No	2016 - 2018

Capital funding is expected to average about $1.5M per year, with approximately 50 percent funded via utility rates and 50 percent funded with grants. Table ES-1 summarizes expected CIP expenditures and revenues and as shown, existing revenues are not sufficient to fund the capital program. To address this funding gap, two new revenue sources are proposed; a stormwater General Facility Charge (GFC), and use of a portion of traffic impact fees. Each of these proposed revenue sources are described in more detail in the 2016 Stormwater Comprehensive Plan (SWCP).

EFFECTIVENESS MONITORING

An Effectiveness Monitoring Plan (EMP) and Quality Assurance Project Plan (QAPP) has been prepared to describe the objectives and methods for measuring performance and outcomes of the PTIP. Effectiveness monitoring helps to measure progress towards attainment of water quality standards and informs future management actions. The primary goal of this EMP is to provide data that supports adaptive management of the City's stormwater program so that the City can focus its limited financial and staff resources on activities that are likely to have the most potential to benefit water quality.

The EMP design builds on stormwater quality information collected as part of the Watershed Assessment and the City's on-going Illicit Discharge Detection and Elimination (IDDE) monitoring program. The design approach reflects the dual objectives of the EMP, which are to provide information that enhances and targets source control activities, as well as tracks progress toward TMDL goals.

EMP objectives will be met through characterizing wet and dry weather FC bacteria loads in stream tributaries and significant storm outfalls to Liberty Bay that are located within the City. These outfalls include those sampled as part of the City's IDDE program, as well as several additional locations that warrant on going monitoring based on Watershed Assessment results (Figure ES-7).

FC concentrations will be monitored at locations once during the dry season (August - September) and twice during wet season (January – April, October – December) periods of significant rainfall (storm event sampling). Sampling efforts will be coordinated with other monitoring programs including ambient marine and stream sampling conducted by the KPHD.

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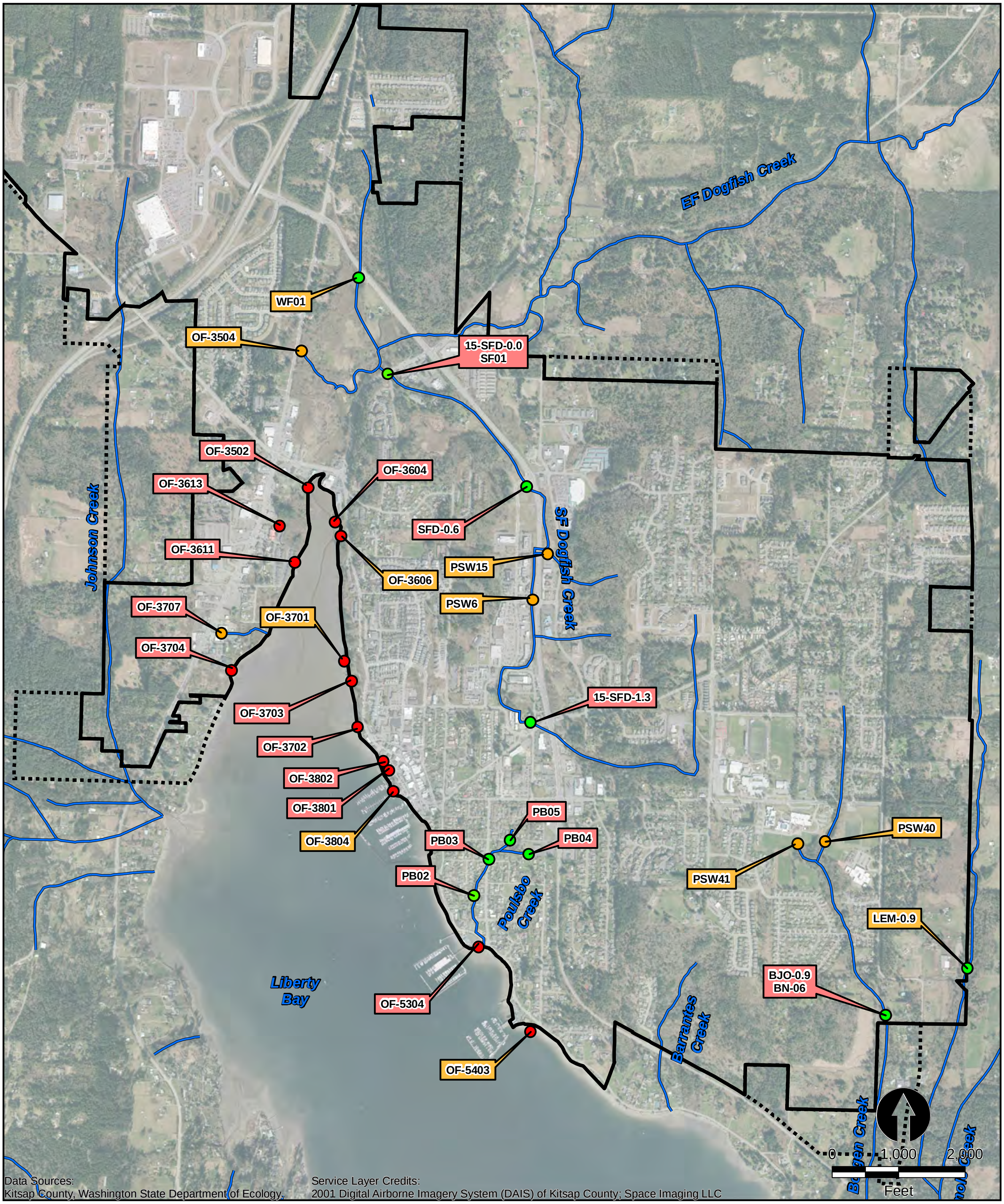

Streams
City of Poulsbo
PUTA
Stream Station
Marine Outfall
Freshwater Outfall
PB04 Existing IDDE/EMP Monitoring Station
PB04 Additional New IDDE/EMP Monitoring Station

Figure ES-7
EMP Sampling Locations
TMDL Implementation Plan
City of Poulsbo

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1 INTRODUCTION

The City of Poulsbo (City) Liberty Bay TMDL Implementation Plan (PTIP) has been prepared in response to the Ecology's *Liberty Bay Watershed Fecal Coliform Bacteria TMDL and Water Quality Implementation Plan* (2013). Ecology prepared this TMDL plan because there was evidence of bacterial contamination affecting beneficial uses in Liberty Bay, including shellfish harvesting and primary contact recreation.

The goal of Ecology's 2013 TMDL Plan is to ensure Liberty Bay will attain Washington State water quality standards. The goal of the PTIP is to identify the actions and projects that the City will implement to address the goals and requirements of Ecology's 2013 TMDL Plan. The intent of the PTIP is to identify and prioritize actions that help to preserve, protect, and restore water quality and natural systems, while at the same time providing infrastructure that supports both existing and future development.

1.1 PURPOSE AND SCOPE

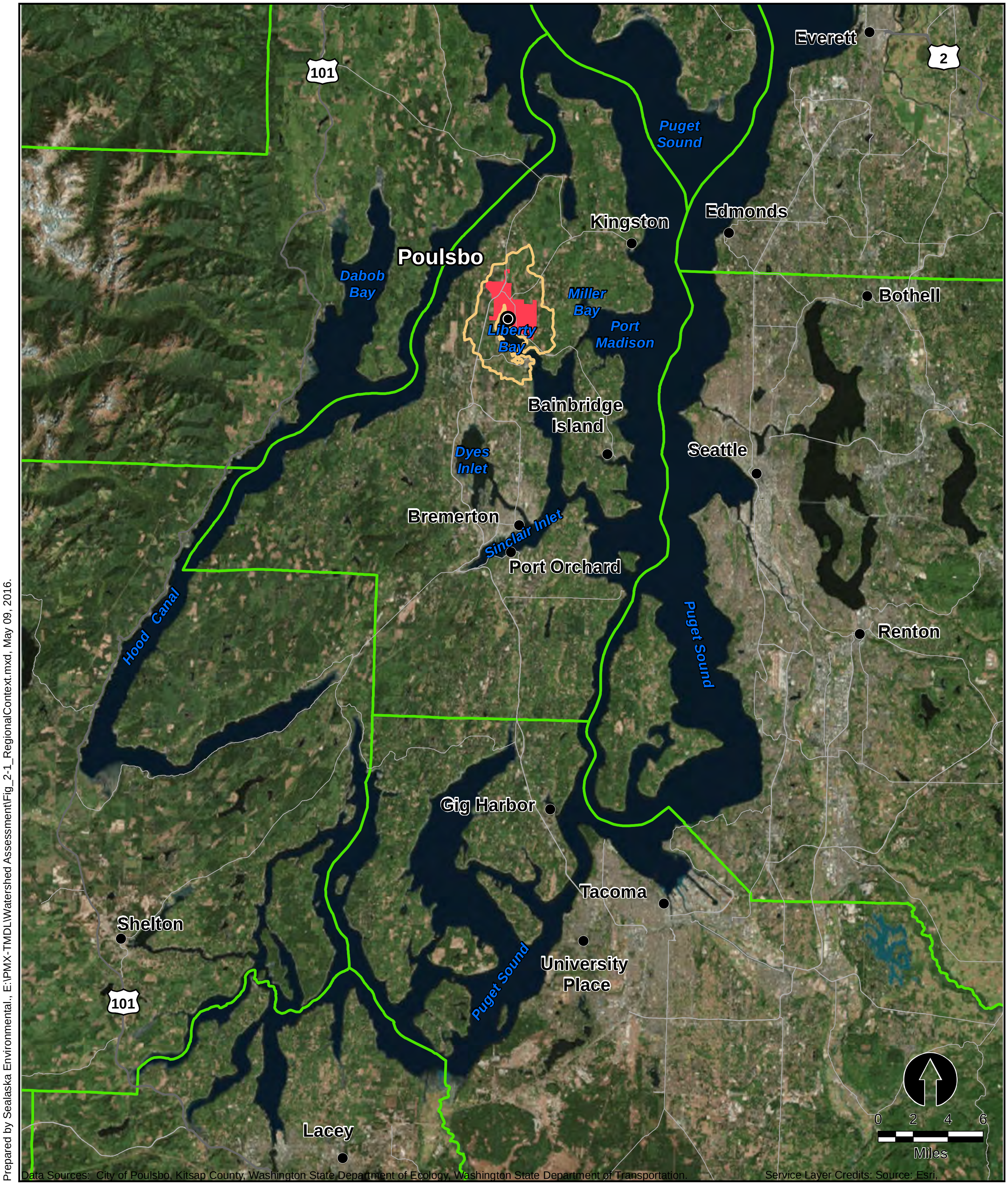
The purpose of the PTIP is to describe the actions the City will take to address TMDL Plan requirements during the 2016-2021 period including capital facilities, operation and maintenance, and financial elements. The PTIP covers the incorporated City area as it exists in 2016, including the UGA.

The PTIP is organized by the following sections:

1. Introduction
2. Watershed Assessment
3. Needs and Opportunities
4. Capital Improvement Plan
5. Non-Structural Actions
6. Financial Plan
7. Implementation Plan
8. Effectiveness Monitoring

Appendices include Appendix A - Water Quality and Basin Analysis Data; Appendix B - Capital Project Ranking Worksheets; Appendix C - Capital Project Schematic Designs; Appendix D - Individual Cost Estimates; and Appendix E - Effectiveness Monitoring Plan.

The project area consists of the City of Poulsbo and associated urban growth area (Figure 1-1).



Liberty Bay Watershed
U.S. Route
State Route
County Boundary
City of Pouslbo

Figure 1-1
City Location and Regional Context
TMDL Implementation Plan
City of Poulsbo

1.2 LIBERTY BAY TMDL PLAN – BACKGROUND INFORMATION

In 2008, Ecology initiated planning for the Liberty Bay Watershed Fecal Coliform Bacteria TMDL and Water Quality Implementation Plan (Ecology 2013). Ecology started this plan because there was evidence of bacterial contamination affecting beneficial uses in Liberty Bay, such as shellfish harvesting and primary contact recreation. The goal of Ecology's TMDL Plan is to ensure the impaired water will attain Washington State water quality standards. The Plan was completed in 2013.

TMDL evaluations are required to identify the maximum amount of each pollutant to be allowed into water bodies so as not to impair beneficial uses. The TMDL includes an assessment of water quality problems and of the pollutant sources that cause the problem, and determines the amount of a given pollutant (FC bacteria in this case) that can be discharged to the water body and still meet standards (the loading capacity), then allocates that load among the various sources.

Ecology's 2013 TMDL Plan develops FC bacteria TMDLs in the tributaries to Liberty Bay. The TMDLs set water quality targets to meet FC bacteria criteria, identify key reaches for source pollution reduction, and allocate pollutant loads to nonpoint sources. The TMDL Plan identifies specific tasks, responsible parties, and timelines for achieving water quality standards. Responsible parties include the City, Kitsap County, and the KPHD.

In response to Ecology's TMDL plan, the City initiated the PTIP project. The PTIP describe the actions that the City will take to implement actions associated with their responsibilities under Ecology's TMDL Plan.

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2 WATERSHED ASSESSMENT

The watershed assessment provides the basis for understanding the physical conditions and natural resources in the study area, and provides the technical foundation for identifying needs and opportunities. The watershed assessment considers the entire Liberty Bay basin, with an emphasis on those areas within the City. The assessment includes the following information:

- A description of the watershed and associated surface water resources;
- Analysis of existing water quality data including trends over the last 10 years;
- Results of the 2015 stormwater quality study;
- Review of water quality relative to development patterns and prior system retrofits;
- Summary of existing habitat conditions as related to potential stormwater impacts;
- Evaluation of the City's stormwater system; and
- Identification of potential corrective action priorities.

2.1 PURPOSE AND SCOPE OF WATERSHED ASSESSMENT

The general purpose of the watershed assessment is to identify where and why water quality and selected ecological processes and habitats are impaired, and where corrective actions should be focused. By understanding where and why these impairments occur, stormwater infrastructure planning can be targeted to best mitigate impacts - as well as help accommodate projected growth.

Liberty Bay water quality is influenced by broad watershed-scale processes that include land use and land cover, stream flows and hydrology, and infrastructure conditions. The intent of the watershed assessment is to evaluate these processes, and guide actions that can help restore watershed processes that are important to improving water quality and habitat. A watershed assessment can be performed for the entire Puget Sound, or it can also be scaled to subareas of interest, such as the Liberty Bay watershed. Utilizing a different scale allows focus on regionally significant issues (at the Puget Sound scale) or locally significant issues (at the subarea scale, such as the Liberty Bay and City of Poulsbo scale). While this assessment considers the broader Liberty Bay watershed scale, it focuses primarily on the City. The City is located entirely within the Liberty Bay watershed.

The watershed assessment characterizes water quality, hydrology, and habitat components to help identify specific basins, sub-basins, and stormwater system segments in the City that may warrant corrective action. The assessment is meant to provide the technical foundation for identifying problem locations, evaluating corrective action options, and prioritizing specific capital improvement projects.

2.2 PROJECT AREA DESCRIPTION

The Liberty Bay watershed encompasses all of the Poulsbo City Limits and UGA, and unincorporated Kitsap County on the western side of Puget Sound in Kitsap County, Washington. Additional watershed detail is provided below.

2.2.1 Liberty Bay Description

Liberty Bay is about 4 miles long and three-quarters of a mile wide. It is relatively shallow, with the deepest point (~39 feet) at its center. Extensive tide flats cover much of northern Liberty Bay at low tide. Marine water residence time in Liberty Bay is relatively short and water is frequently exchanged between Liberty Bay and Port Orchard Passage. The residence time estimated for most of Liberty Bay is on the order of one tidal cycle (Takesue 2011).

2.2.2 Watershed Description

The Liberty Bay watershed is about 22,000 acres in size. There are nine primary streams, five of which are all or partly located in the City (Figure 2-1). Table 2-1 summarizes major creeks in the watershed and their approximate lengths and sub-basin land-use patterns.

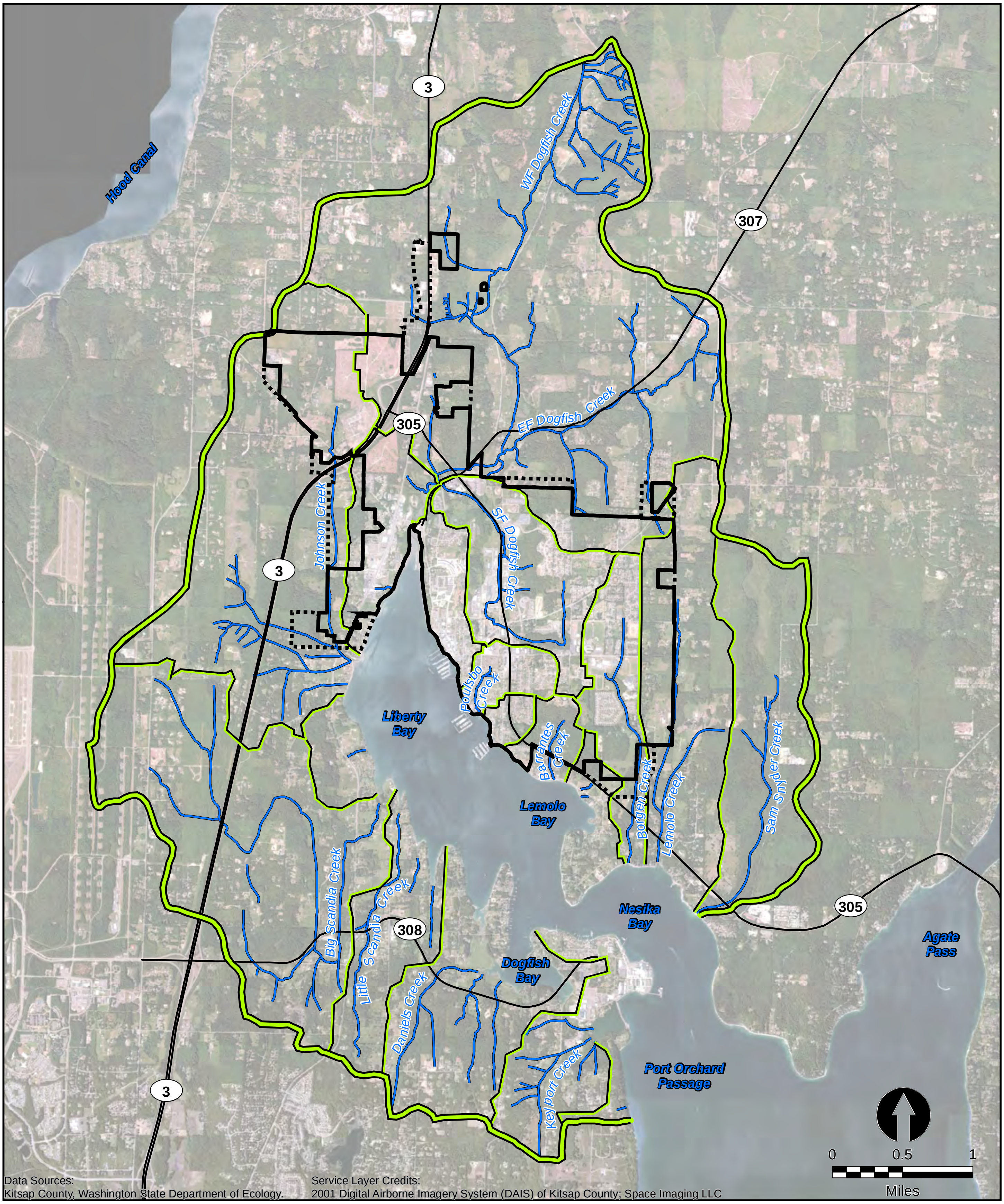
Table 2-1. Significant Drainages in Liberty Bay with Corresponding Sizes and Land-Use

Sub-watershed	Approximate Size (Mainstem River Miles)	Approximate Basin Size (acres)	Primary Land Use
Dogfish Creek (all major tributaries except South Fork)	7.0	4,100	Rural- and urban-residential/agricultural/ commercial and light industrial
South Fork Dogfish Creek	2.5	650	Rural- and urban-residential/agricultural/ commercial and light industrial
Poulsbo Creek	1.5	150	Urban-residential/commercial
Big Scandia Creek	3.0	1,700	Rural-residential/agricultural
Bjorgen Creek	1.5	420	City/rural-residential
Lemolo Creek	2.5	1,100	City/rural-residential
Johnson Creek	2.0	2,100	City/rural-residential/agricultural/urban commercial

At 4,100 acres, the largest drainage in the watershed is Dogfish Creek, which forms the head of Liberty Bay. Other significant stream drainages include Johnson, Big Scandia, Little Scandia, Bjorgen, Daniels, Sam Snyder, Lemolo, and Thompson Creeks (Figure 2-1).

About 80 percent of the watershed is drained by streams, and the remaining 20 percent discharges directly to marine waters.

Prepared by Sealaska Environmental, E:\PMX-TMDL\Watershed Assessment\Fig_2-2_LibertyBayWatershed&PrimaryBasins.mxd, May 09, 2016.



Liberty Bay Watershed
Basin Boundary
Streams
City of Poulsbo
PUTA
Highway

Figure 2-1
Liberty Bay Watershed, Streams and Primary Basins
TMDL Implmentation Plan
City of Poulsbo

2.2.3 Land Use and Development

Development of the Liberty Bay watershed began in the late 1880s with the logging industry. By the early 1900s, commercial fishing, shellfish, and agriculture industries flourished. About 200-acres of tidelands around Liberty Bay were used for oyster production. By 1967, water quality had deteriorated to the point that the oyster beds on the eastern shore of Liberty Bay were closed to harvesting. Oyster production ceased entirely with the closing of the Poulsbo oyster plant in 1983 (Takesue 2011).

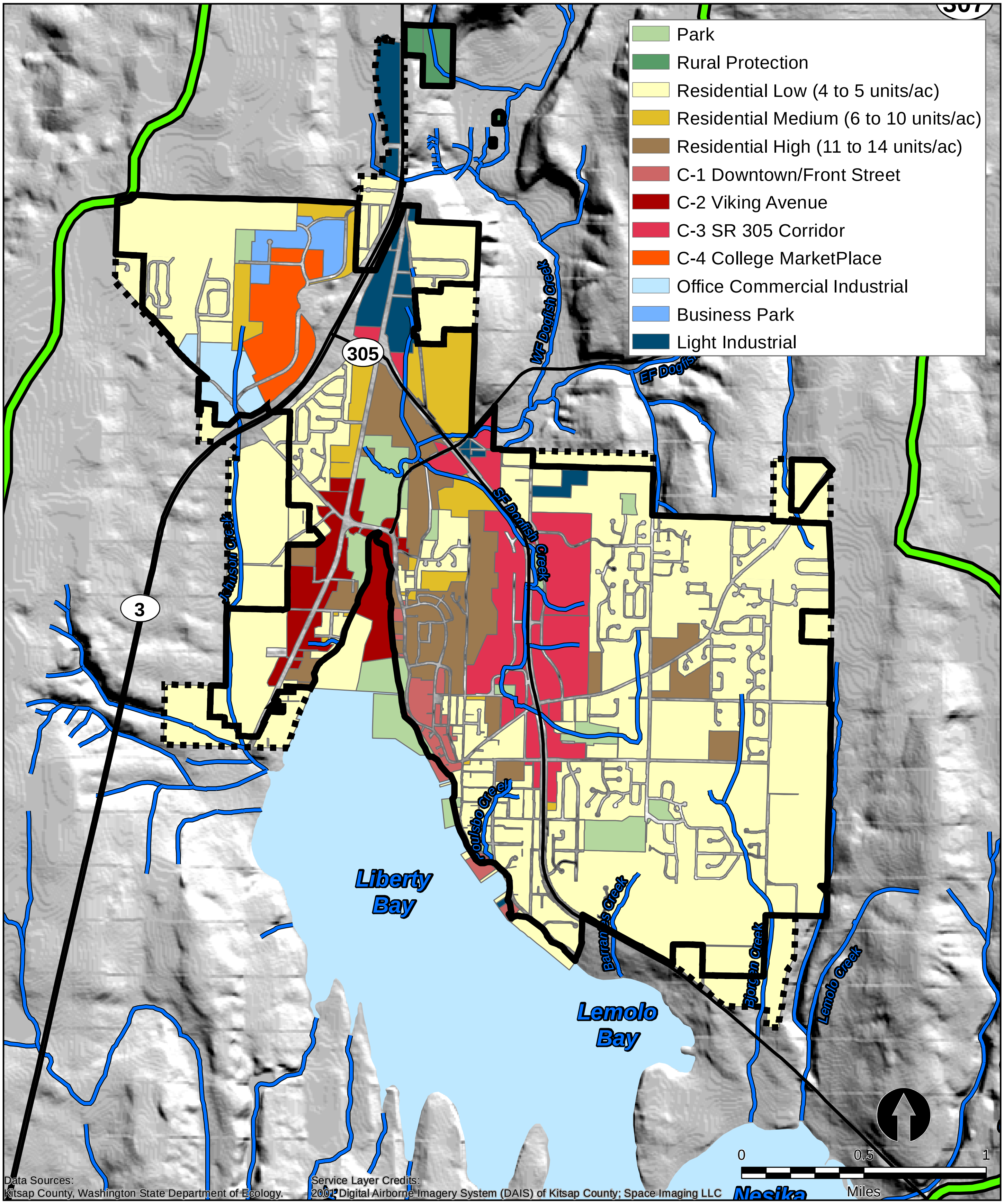
The population of the City was 9,950 in 2014. The City covers approximately 4.6 square miles, and includes about 4 miles of marine shoreline. Most of the highly developed areas are concentrated near Poulsbo and Keyport (Figure 2-2 and 2-3). Concentrated forests and small farms cover the rest of the watershed.

2.2.4 Basin and Stormwater Infrastructure Summary

A basin and stormwater infrastructure assessment was performed to delineate catchment areas, evaluate type and extent of impervious surfaces, and characterize stormwater infrastructure conditions. Over 50 percent of the historically forested watershed within the City is now developed, with about 30 percent classified as impervious (Figure 2-4). Basins and sub-basins are shown in Figure 2-5, and existing stormwater infrastructure is shown in Figures 2-6, 2-7, and 2-8.

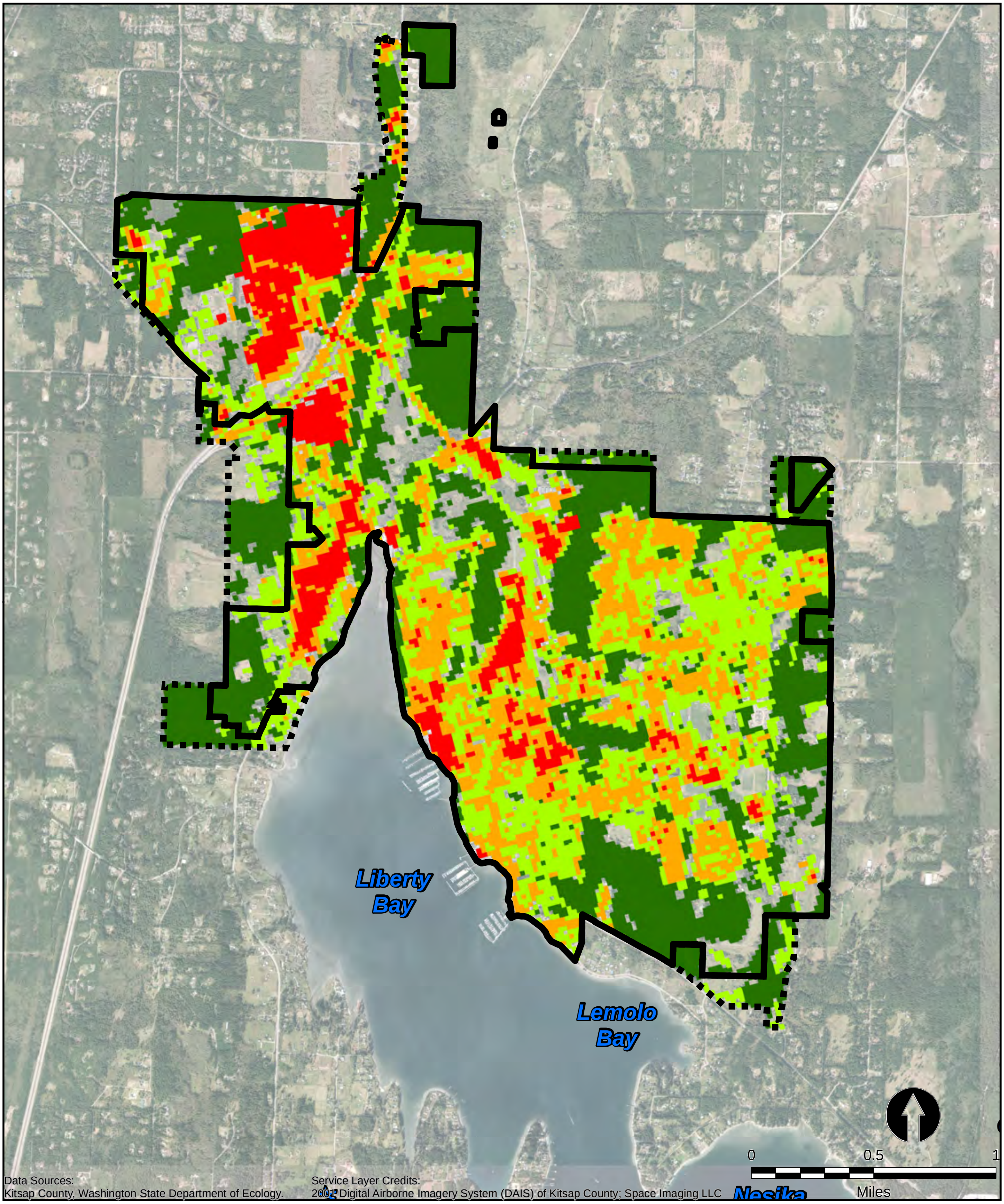
Additional basin and infrastructure analysis are presented in Sections 3 and 4.

Prepared by Sealaska Environmental, P:\Production\Fig\PMX-TMDL\New Maps\Watershed Assessment\Fig4_LandUseInPoulsbo.mxd, December 14, 2015.



Liberty Bay Watershed
Streams
Highway
City of Poulsbo
PUTA

Figure 2-2
Zoning In City of Poulsbo
TMDL Implementation Plan
City of Poulsbo



Prepared by Sealaska Environmental, E:\PMX-TMDL\Watershed Assessment\Fig_2-4_Gen_LandUsePoulsbo.mxd, May 09, 2016.

City of Poulsbo
PUTA
Forest
High Intensity Developed
Medium Intensity Developed
Low Intensity Developed
Cleared and Vacant Land

Figure 2-3
Generalized Land Use, City of Poulsbo
TMDL Implementation Plan
City of Poulsbo

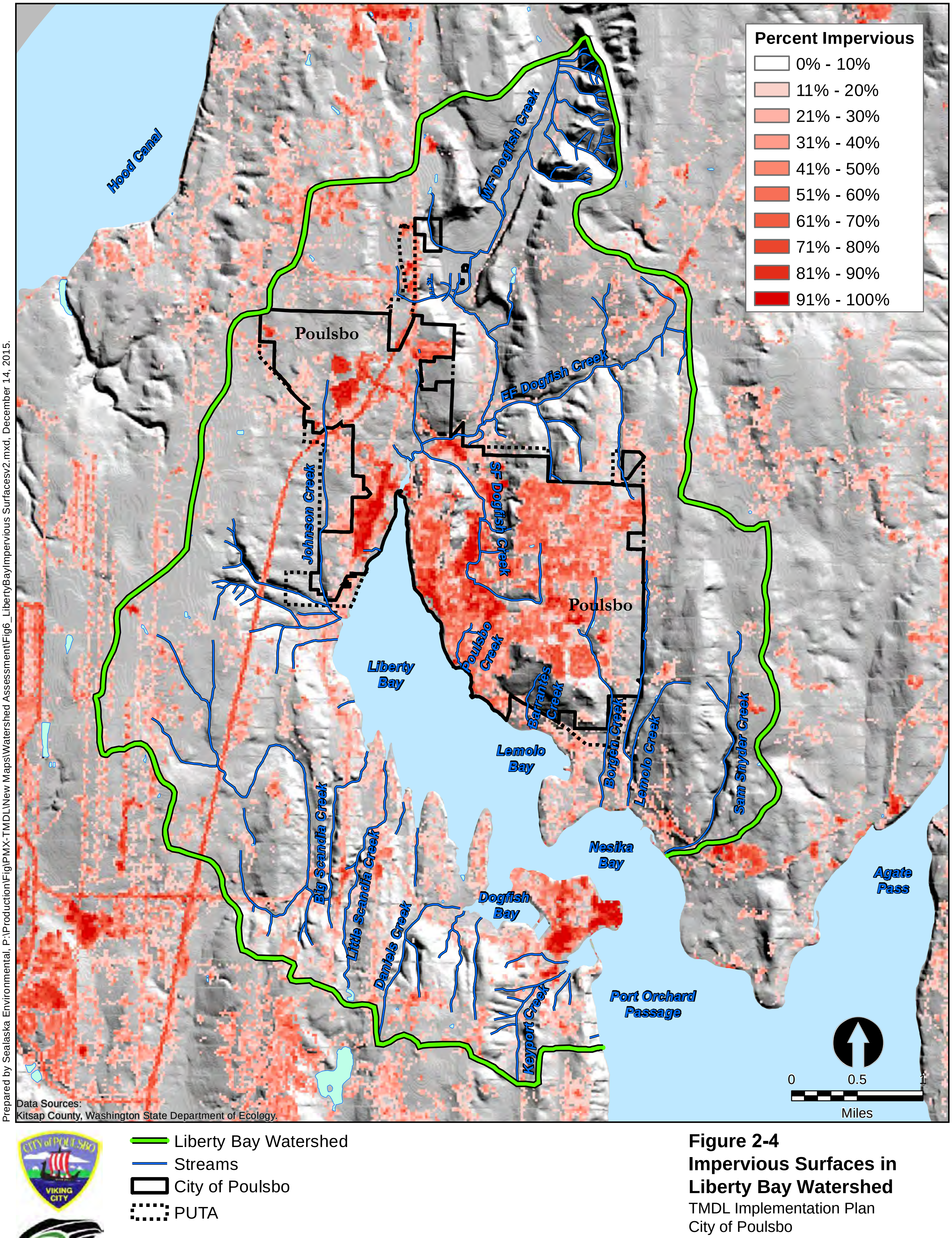


Figure 2-4
Impervious Surfaces in Liberty Bay Watershed
TMDL Implementation Plan
City of Poulsbo

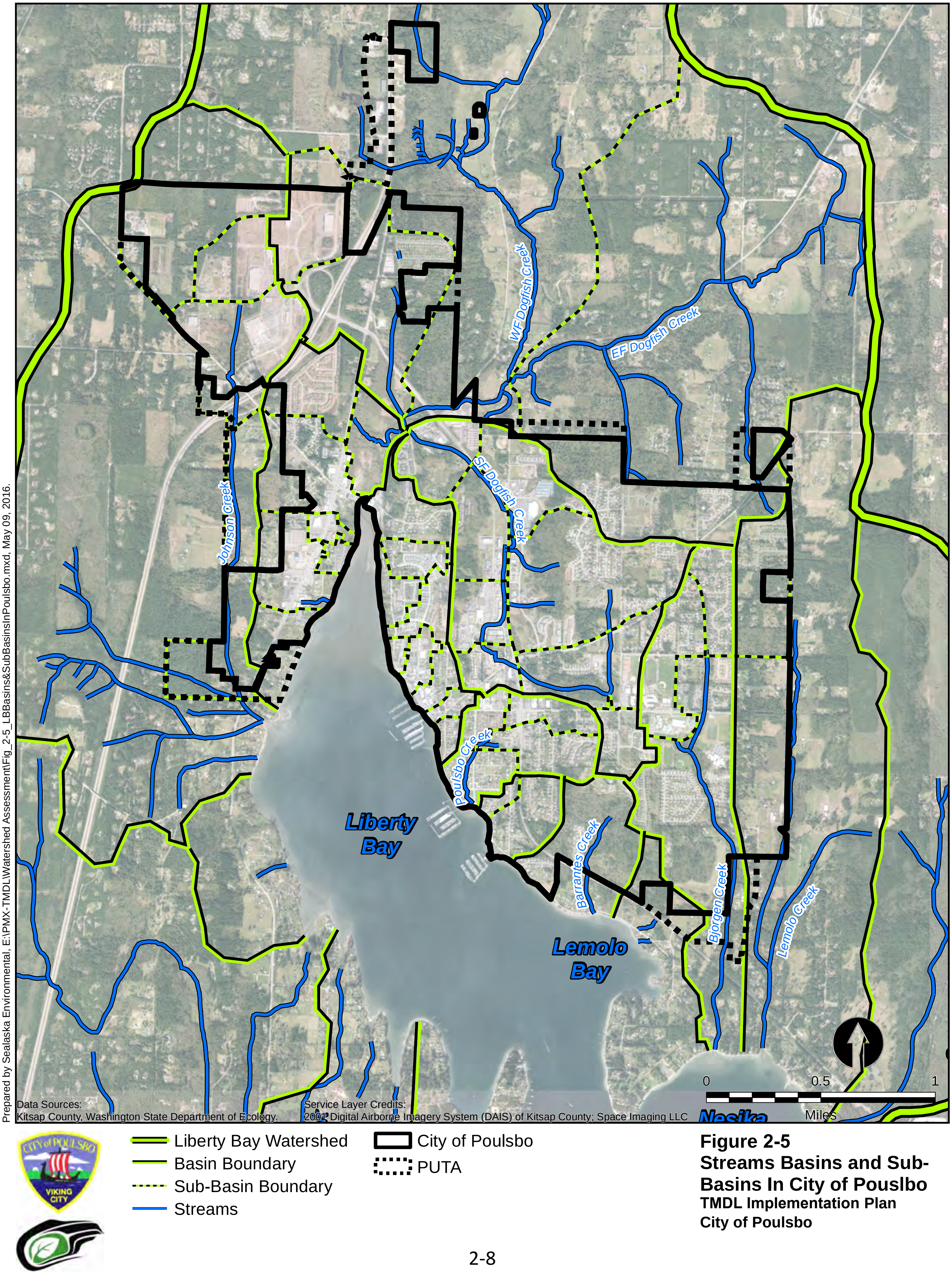
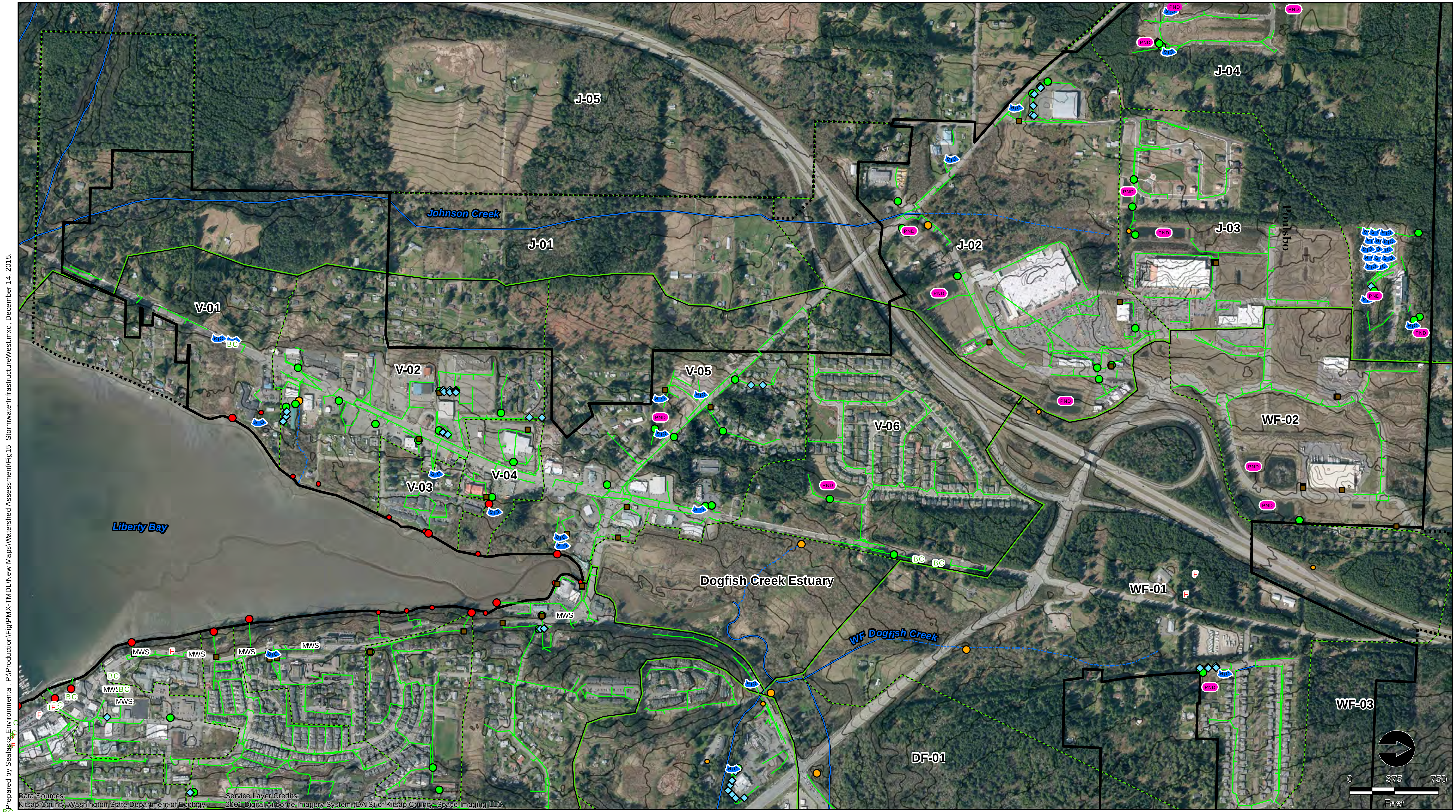
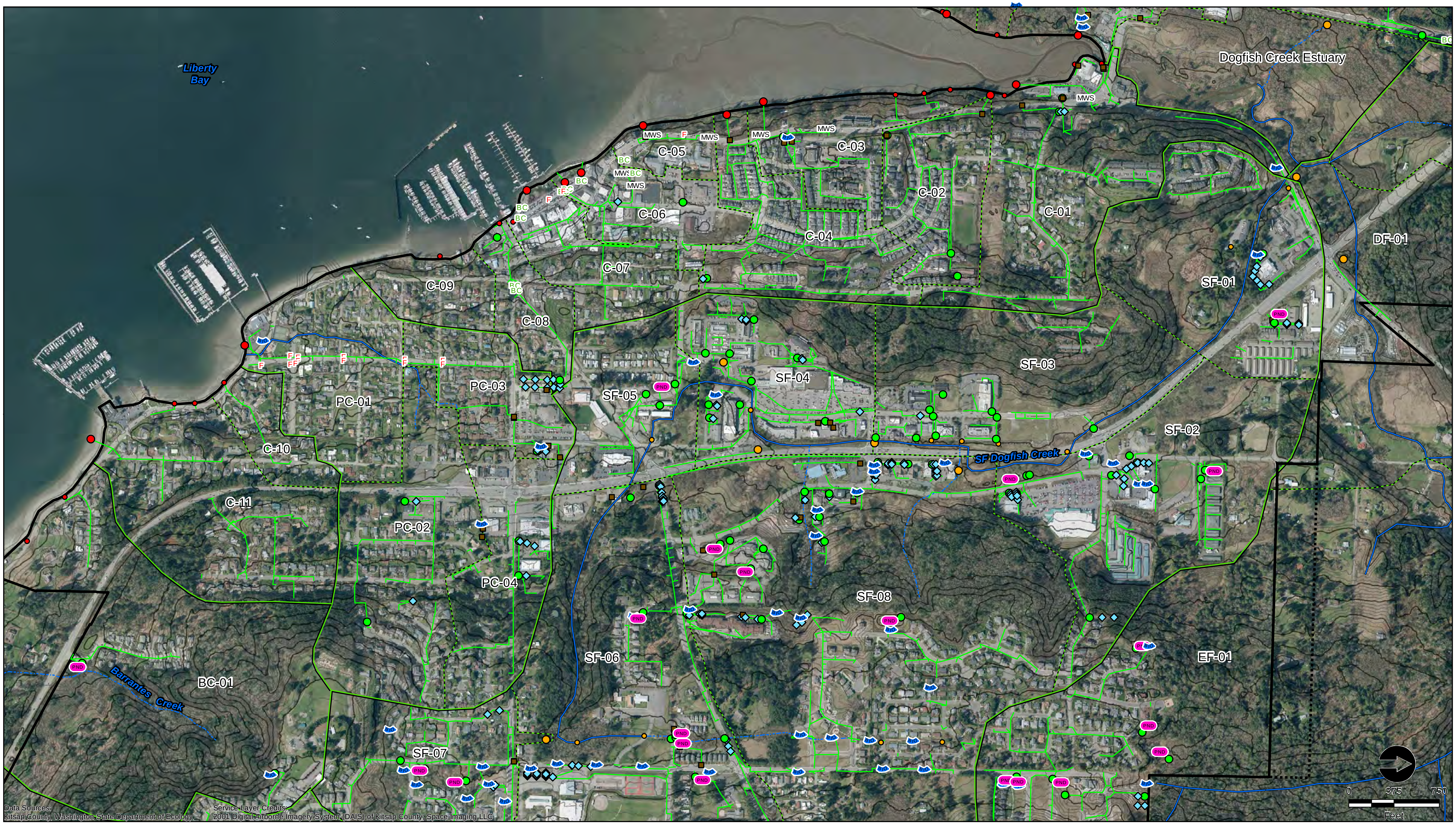


Figure 2-5
Streams Basins and Sub-Basins In City of Pouslbo
TMDL Implementation Plan
City of Poulsbo



Basin Boundary
Sub-Basin Boundary
City of Poulsbo
PUTA
Stormwater Pipe
Stream
Intermittent Stream
Control Structure
Oil Water Separator
Underground Detention Facility
Major Marine Outfall
Minor Marine Outfall
Major Freshwater Outfall
Minor Freshwater Outfall
F Filterra Vault
MWS Modular Wetland System
BC Bioretention Cell
PND Detention/Retention Pond
BIO Bioswale
WF-02 Sub-Basin I.D.

Figure 2-6.
Existing Stormwater Infrastructure and Sub-basins, Poulsbo West
TMDL Implementation Plan
City of Poulsbo



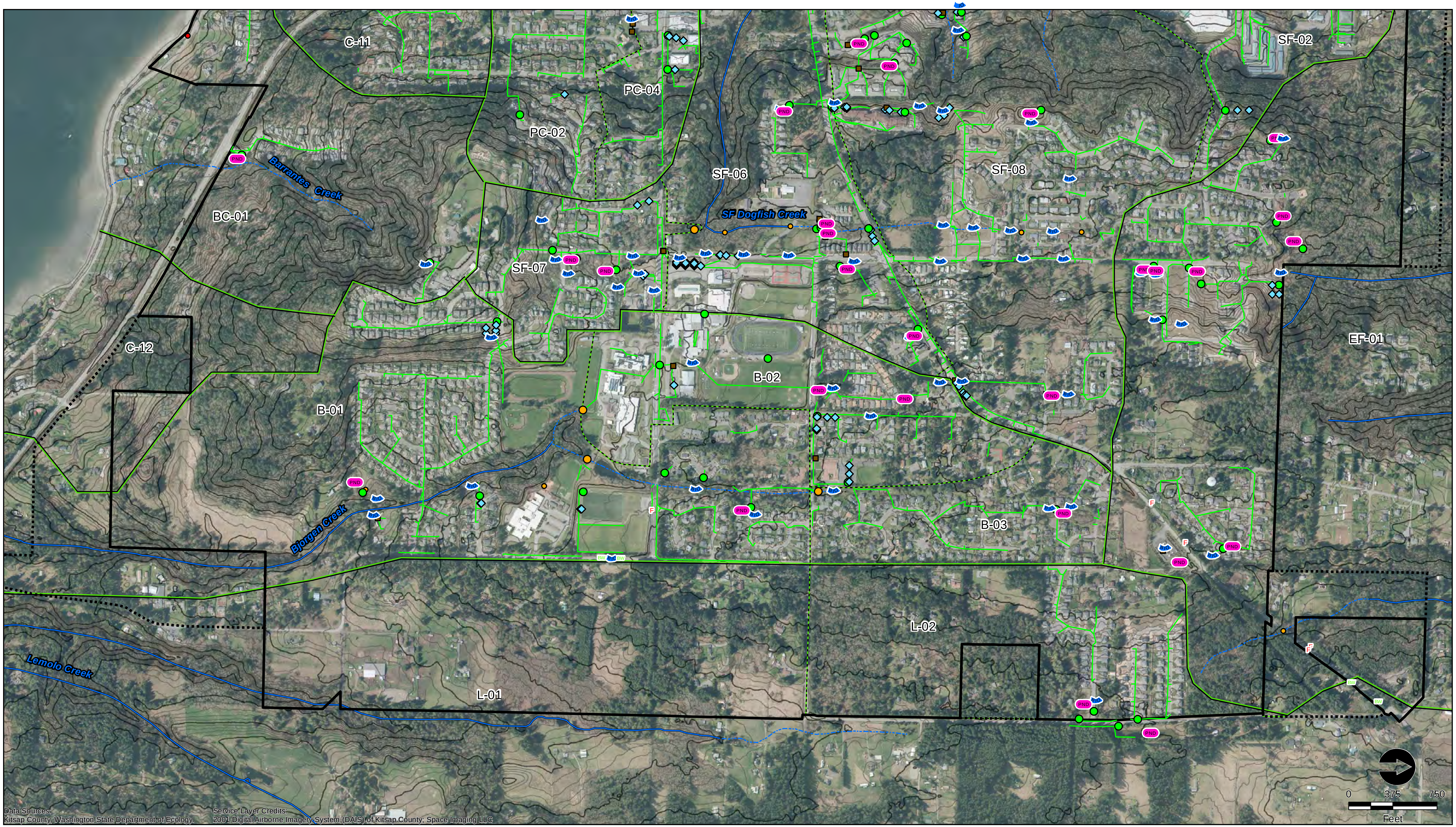
Prepared by Sealaska Environmental, P:\Production\Fig\PMX-TMDL\New Maps\Watershed Assessment\Fig16_StormwaterInfrastructureCore.mxd, December 14, 2015.

- Basin Boundary
- Sub-Basin Boundary
- City of Poulsbo
- PUTA
- Stormwater Pipe
- Stream
- Intermittent Stream
- Control Structure
- Oil Water Separator
- Underground Detention Facility
- Major Marine Outfall
- Minor Marine Outfall
- Major Freshwater Outfall
- Minor Freshwater Outfall
- Filterra Vault
- Modular Wetland System
- Bioretention Cell
- Detention/Retention Pond
- Bioswale
- SF-02 Sub-Basin I.D.

Figure 2-7. Existing Stormwater Infrastructure and Sub-basins, Poulsbo Central

TMDL Implementation Plan
City of Poulsbo

Prepared by Sealaska Environmental, P:\Production\Fig\PMX-TMDL\New Maps\Watershed Assessment\Fig17_StormwaterInfrastructureEast.mxd, December 14, 2015.



Basin Boundary
Sub-Basin Boundary
City of Poulsbo
PUTA
Stormwater Pipe
Stream
Intermittent Stream
Control Structure
Oil Water Separator
Underground Detention Facility
Major Marine Outfall
Minor Marine Outfall
Major Freshwater Outfall
Minor Freshwater Outfall
Filterra Vault
Modular Wetland System
Bioretention Cell
Detention/Retention Pond
Bioswale
BC-02 Sub-Basin I.D.

Figure 2-8.
Existing Stormwater Infrastructure and Sub-basins, Poulsbo East
TMDL Implementation Plan
City of Poulsbo

2.3 WATER QUALITY ASSESSMENT

The water quality assessment describes current and historical water quality conditions relative to FC bacteria. The goal of the water quality assessment is to summarize trends, describe the results of recent corrective actions and sampling efforts, and identify specific areas that may be priorities for future corrective action. Objectives of the water quality assessment include:

- Summarize existing water quality data including trends in marine waters and streams;
- Evaluate trends relative to corrective actions and land use;
- Summarize recent targeted stormwater sampling results; and
- Identify potential problem areas based on water quality data.

2.3.1 Standards and Beneficial Uses

The Washington State Water Quality Standards set forth in Chapter 173-201A of the Washington Administrative Code (WAC) include designated beneficial uses, waterbody classifications, and numeric and narrative water quality criteria for surface waters of the state.

Freshwater and marine waterbodies are required to meet water quality standards based on the beneficial uses of the waterbody. Numeric criteria for specific parameters are intended to protect designated uses. Liberty Bay is classified as Primary Contact Recreation water. All tributaries flowing into the bay are classified as *Extraordinary Primary Contact Recreation* waters. The *Extraordinary Primary Contact* use is intended for waters capable of "providing extraordinary protection against waterborne disease or that serve as tributaries to extraordinary quality shellfish harvesting areas." Water quality standards are summarized in Table 2-2.

Table 2-2. Fecal Coliform Water Quality Standard for Liberty Bay

Freshwater - Extraordinary Primary Contact	Marine Water - Extraordinary Aquatic, Primary Contact
Part 1: ≤50 FC/100 ml (geometric mean)	**Part 1:** ≤14 FC/100 ml (geometric mean)
Part 2: Not more than 10% of all samples obtained for calculating a geometric mean >100 FC/100 ml	**Part 2:** Not more than 10% of all samples obtained for calculating a geometric mean >43 FC/100 ml

FC criteria have two statistical components: a geometric mean and an upper limit value that 10 percent of the samples cannot exceed. The geometric mean value (GMV) for bacteria, measures the central tendency of a data set which is especially useful for groups of data that contain a broad range of values. Since sample results for bacterial concentrations tend to be highly variable, the geometric mean is more appropriate than an arithmetic mean or average.

2.3.2 Historical Source Control Summary

This section summarizes pollutant source control activities in the watershed conducted over the past 10 years. The type and location of source controls provides context for evaluation of water quality monitoring results, and helps to improve the understanding of causality between observed water quality conditions, trends, and pollutant control activities. Source control activities described in this section include stormwater, OSS, and agriculture. Source control activities are summarized in Table 2-3.

Table 2-3. Summary of Liberty Bay Source Control Activities

Source Control Element	Actions	Period Implemented	Total Estimated Cost	Lead Agency
Stormwater Retrofits, City of Poulsbo	Retrofitted over 25-acres of parking lot and major streets with bioretention, Filterra vaults, pervious pavement, and Modular Wetland Systems	2005 - 2016	$4,000,000	City of Poulsbo
Stormwater Retrofits, Kitsap County	Retrofitted Washington Avenue in Keyport (2-acres) with bioretention	2015 - 2016	$900,000	Kitsap County Public Works
OSS Repair	Inspected 850 systems, repaired 47	2009 - 2014	$700,000[1/]	Kitsap Public Health District
Agricultural BMPs	Implemented 98 BMPs at 41 locations in the watershed	2009 - 2014	Cost included as part of KPHD project[1/]	Kitsap Conservation District

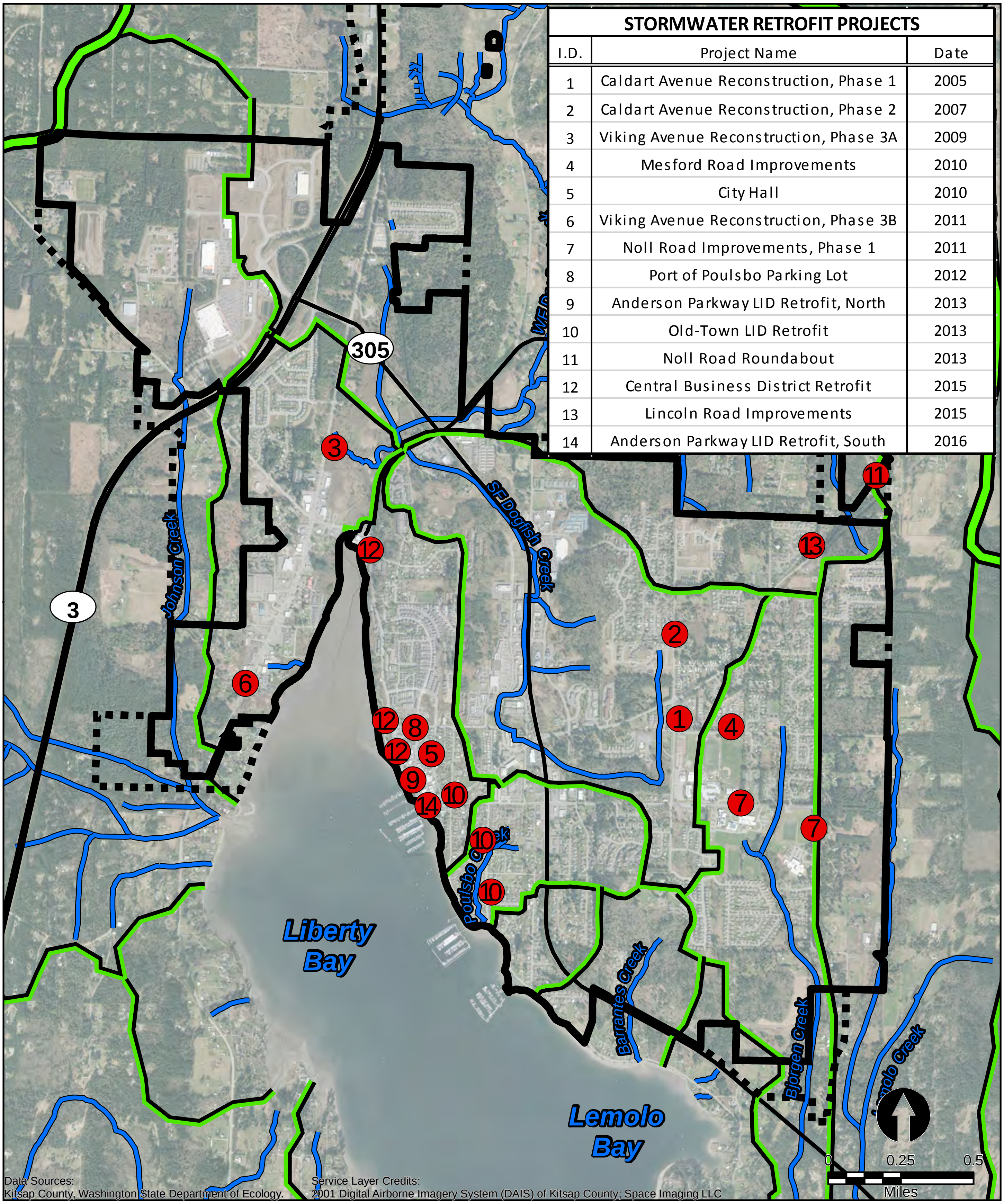
Notes:
[1/] Costs do not include actual OSS repair or agricultural BMP installation costs.

2.3.2.1 City of Poulsbo Stormwater Retrofits

The City has implemented a variety of stormwater retrofit projects designed to improve and protect water quality. These projects are summarized in Table 2-4 and shown in Figure 2-9.

Table 2-4. Summary of City Stormwater Retrofit Projects

Project	Date Completed	Approx. Area Treated (acres)	Basin	Pervious Pavements			Other Techniques			
				Pervious Parking	Pervious Sidewalk	Pervious Bike Lane	Bioretention	Filterra Vaults	Modular Wetlands	Green Roof
Caldart Avenue Reconstruction, Phase 1	2005	2	SF Dogfish Creek				X			
Caldart Avenue Reconstruction, Phase 2	2007	1	SF Dogfish Creek		X		X			
Viking Avenue Reconstruction, Phase 3A	2009	1.5	Liberty Bay		X	X	X			
Mesford Road Improvements	2010	1	SF Dogfish Creek	X		X				
City Hall	2010	0.25	Liberty Bay							X
Viking Avenue Reconstruction, Phase 3B	2011	2	Liberty Bay		X	X	X			
Noll Road Improvements, Phase 1	2011	1	Bjorgen Creek		X	X	X	X		
Port of Poulsbo Parking Lot	2012	0.5	Liberty Bay	X						
Anderson Parkway LID Retrofit, North	2013	3	Liberty Bay				X	X		
Old-Town LID Retrofit	2013	6	Poulsbo Creek				X	X		
Noll Road Roundabout	2013	1	Lemolo Creek		X		X			
Central Business District Retrofit	2015	3	Liberty Bay				X	X	X	
Lincoln Road Improvements	2015	2	SF Dogfish Creek		X		X	X		
Anderson Parkway LID Retrofit, South	2016	1	Liberty Bay	X					X	



STORMWATER RETROFIT PROJECTS

I.D.	Project Name	Date
1	Caldart Avenue Reconstruction, Phase 1	2005
2	Caldart Avenue Reconstruction, Phase 2	2007
3	Viking Avenue Reconstruction, Phase 3A	2009
4	Mesford Road Improvements	2010
5	City Hall	2010
6	Viking Avenue Reconstruction, Phase 3B	2011
7	Noll Road Improvements, Phase 1	2011
8	Port of Poulsbo Parking Lot	2012
9	Anderson Parkway LID Retrofit, North	2013
10	Old-Town LID Retrofit	2013
11	Noll Road Roundabout	2013
12	Central Business District Retrofit	2015
13	Lincoln Road Improvements	2015
14	Anderson Parkway LID Retrofit, South	2016

Liberty Bay Watershed
Basin Boundary
Streams
City of Poulsbo
Poulsbo Urban Transition Area
Highway
Stormwater Retrofit Locations

Figure 2-9
Stormwater Retrofit Locations in City of Poulsbo
TMDL Implementation Plan
City of Poulsbo

2.3.2.2 Agricultural Best Management Practices

Range and pastured livestock with direct access to streams can be a significant source of FC contamination. The most recent inventory of agricultural properties within the Liberty Bay watershed occurred in 2013-2014 as part of *the Liberty Bay Watershed Restoration Pollution Identification & Correction Program Project* completed by the KPHD and Kitsap Conservation District with funding from Ecology and Clean Water Kitsap.

Filterra vault used in Anderson Parkway retrofit.

A total of 227 agricultural sites were identified in the watershed, and of these, approximately 41 properties implemented agricultural BMPs including livestock access control, drainage improvements, and vegetation management. The agricultural BMP program reduced the “high” and “medium high” priority sites from 47 in 2009, to 9 in 2014. Table 2-5 summarizes agricultural BMP status in the watershed. Figure 2-10 shows approximate location of BMPs. As shown in Figure 2-10, agricultural practices within the City are minimal.

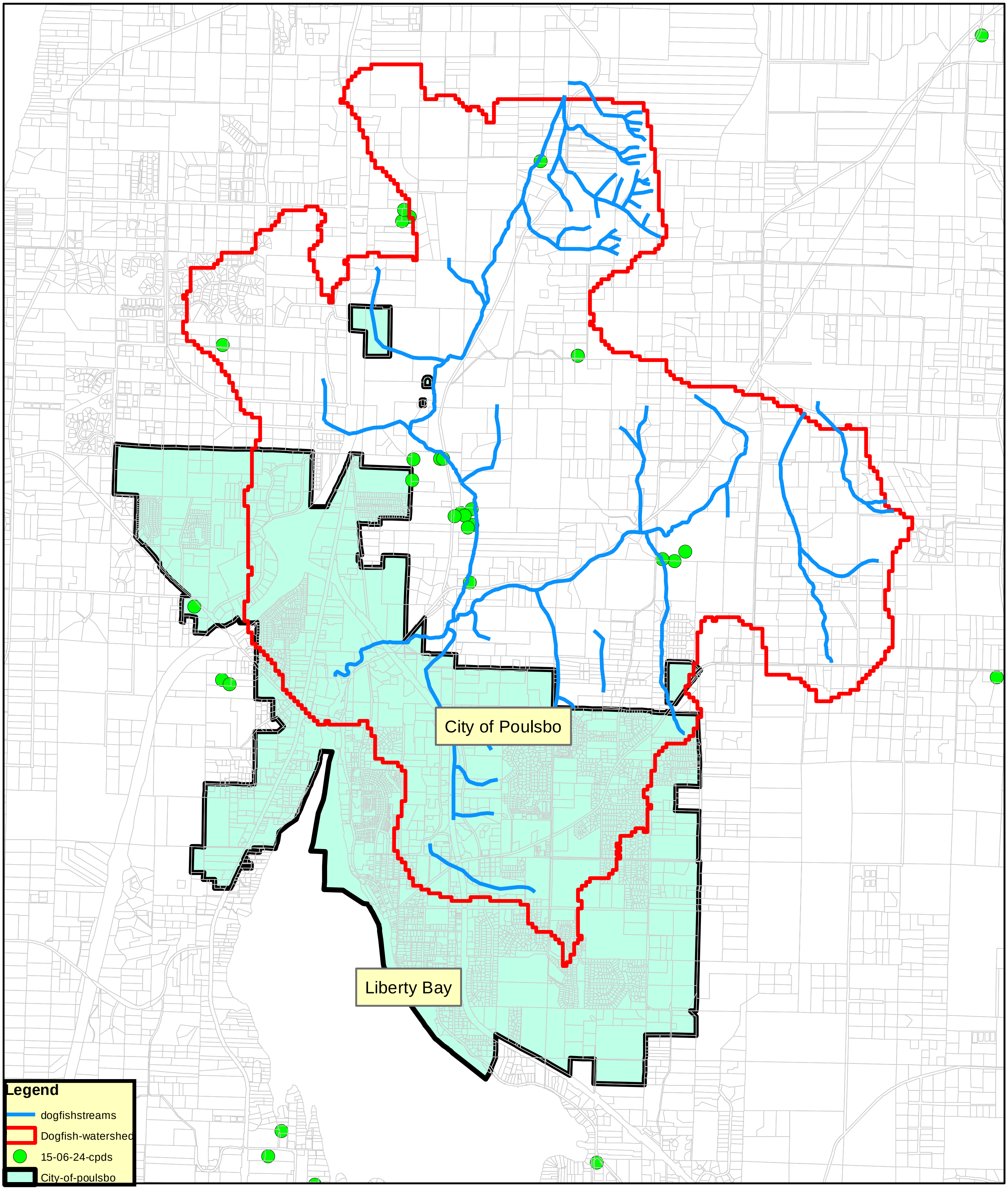
Table 2-5. Summary of Agricultural BMPs in the Liberty Bay Watershed

Sub-Basin	Number of Agricultural Properties with BMPs
Dogfish Creek	18
Johnson Creek	6
Scandia Creek	8
Lemolo/Bjorgen	3
Other	4

Source: KPHD 2014a

2.3.2.3 On-Site Septic Systems

The KPHD investigated 854 properties in the watershed as part of the 2014 Liberty Bay Watershed Restoration Pollution Identification & Correction Program Project and identified 51 failing OSS. Figure 2-11 shows the location of failing OSS and illustrates that most of the failing OSS were located within 200 feet of the shoreline (KPHD 2014b). As of April 2014, 47 of the 51 failing systems had been repaired (KPHD 2014). Within the City limits, OSS use is minimal with approximately 25 systems currently operating.



Map Created by:
Brian Stahl
July 2015

Figure 2-10. Kitsap Conservation District Best Management Practices, Dogfish Creek Basin

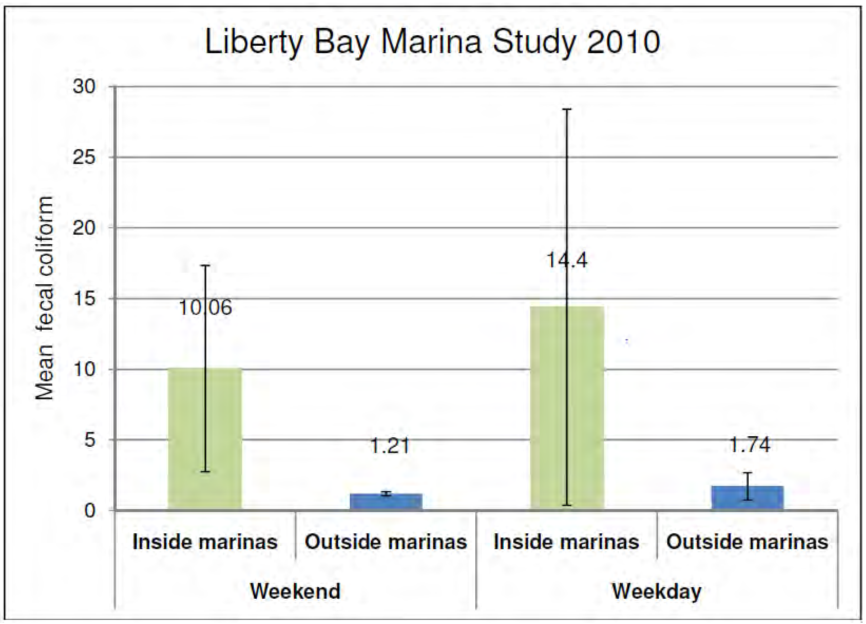
Prepared by Sealaska Environmental., E:\PMX-TMDL\Watershed Assessment\Fig_2-1_RegionalContext.mxd, May 09, 2016.

Source: KPHD 2014

Figure 2-11
On-site Sewage System Repairs
TMDL Implementation Plan
City of Poulsbo

2.3.2.4 Marinas

In 2010, the KPHD conducted a study to determine the potential contribution of FC from marinas in Liberty Bay. The results from this study showed that concentrations of FC were significantly higher inside the marinas compared to the waters external to the marinas. During both weekday and weekend sampling events the levels of fecal bacteria also remained higher inside the marinas versus outside the marinas (even during high boater use days) (KPHD 2011). Figure 2-12 summarizes results of the study.



Source: KPHD 2011

Figure 2-12. Mean FC Results Inside and Outside Marinas during Weekend and Weekday Sampling Events

2.3.3 Historical Water Quality Data Review

The historical water quality data review includes marine water, freshwater and stormwater elements. Each of these historical data sets is described in the following sections.

2.3.4 Marine Water

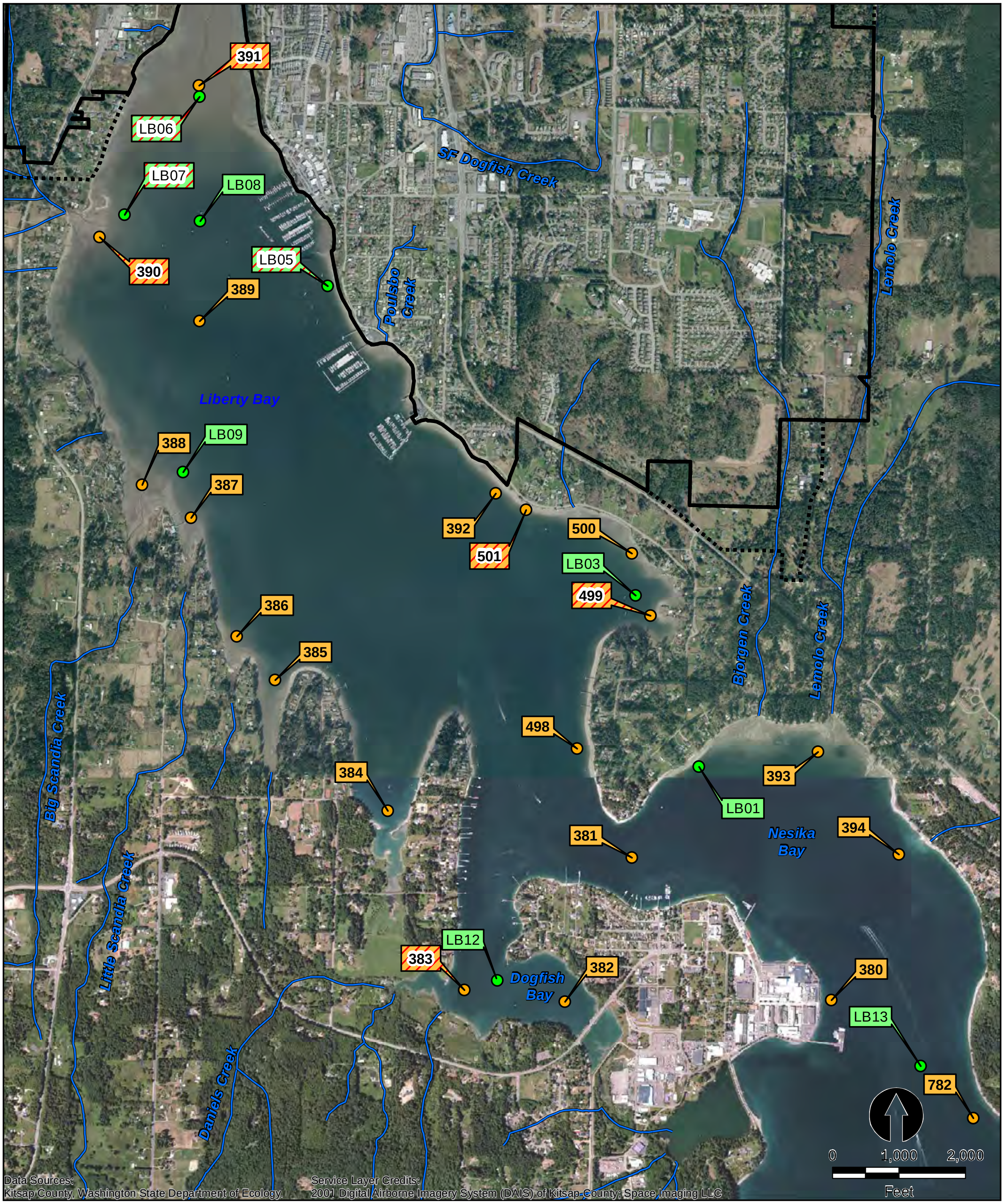
Liberty Bay marine water quality monitoring has been performed for more than 10 consecutive years by the KPHD as part of the County's ambient trend monitoring program and the Washington State Department of Health (WDOH) as part of the state Shellfish Sanitation Program (WDOH 2008). Sampling locations are shown in Figure 2-13.

The WDOH is currently conducting a 30-month monitoring study of Liberty Bay to determine whether portions of the bay may be approved for commercial shellfish harvest. Currently, the only approved portion of Liberty Bay is the area near the community of Lemolo known as Lemolo Bay (Figure 2-14). WDOH's current classification status for Lemolo Bay is "Meets standards but some concerns" (Ecology 2013). Table 2-6 lists WDOH sampling results for 30 sampling events conducted between 2013 and 2015.

Table 2-6. Summary of WDOH Water Quality Monitoring for Liberty Bay, 2013 to 2015

Station Number	Classification	Monitoring Period	No. of Samples	Range	Geometric Mean	Est. 90th Percentile	Meets Standard
380	Pending	2013 – 2015	32	2 – 23	2	5	Yes
381	Pending	2013 – 2015	30	2 – 8	2	3	Yes
382	Pending	2013 – 2015	30	2 – 14	3	9	Yes
383	Pending	2013 – 2015	31	2 – 540	4	17	Yes
384	Pending	2013 – 2015	31	2 – 49	4	16	Yes
385	Pending	2013 – 2015	31	2 – 8	2	6	Yes
386	Pending	2013 – 2015	31	2 – 23	3	8	Yes
387	Pending	2013 – 2015	31	2 – 130	4	18	Yes
388	Pending	2013 – 2015	31	2 – 49	4	13	Yes
389	Pending	2013 – 2015	30	2 – 8	2	4	Yes
390	Pending	2013 – 2015	31	2 – 350	4	16	Yes
391	Pending	2013 – 2015	31	2 – 49	5	19	Yes
392	Pending	2013 – 2015	31	2 – 130	3	9	Yes
393	Pending	2013 – 2015	31	2 – 33	2	6	Yes
394	Pending	2013 – 2015	31	2 – 46	2	6	Yes
498	Prohibited	2005 – 2015	59	1.7 – 49	2.6	7	Yes
499	Approved	2005 – 2015	61	1.7 – 130	4.1	17	Yes
500	Approved	2005 – 2015	60	1.7 – 11	2.4	4	Yes
501	Approved	2005 – 2015	60	1.7 – 1,600	4.3	23	Yes

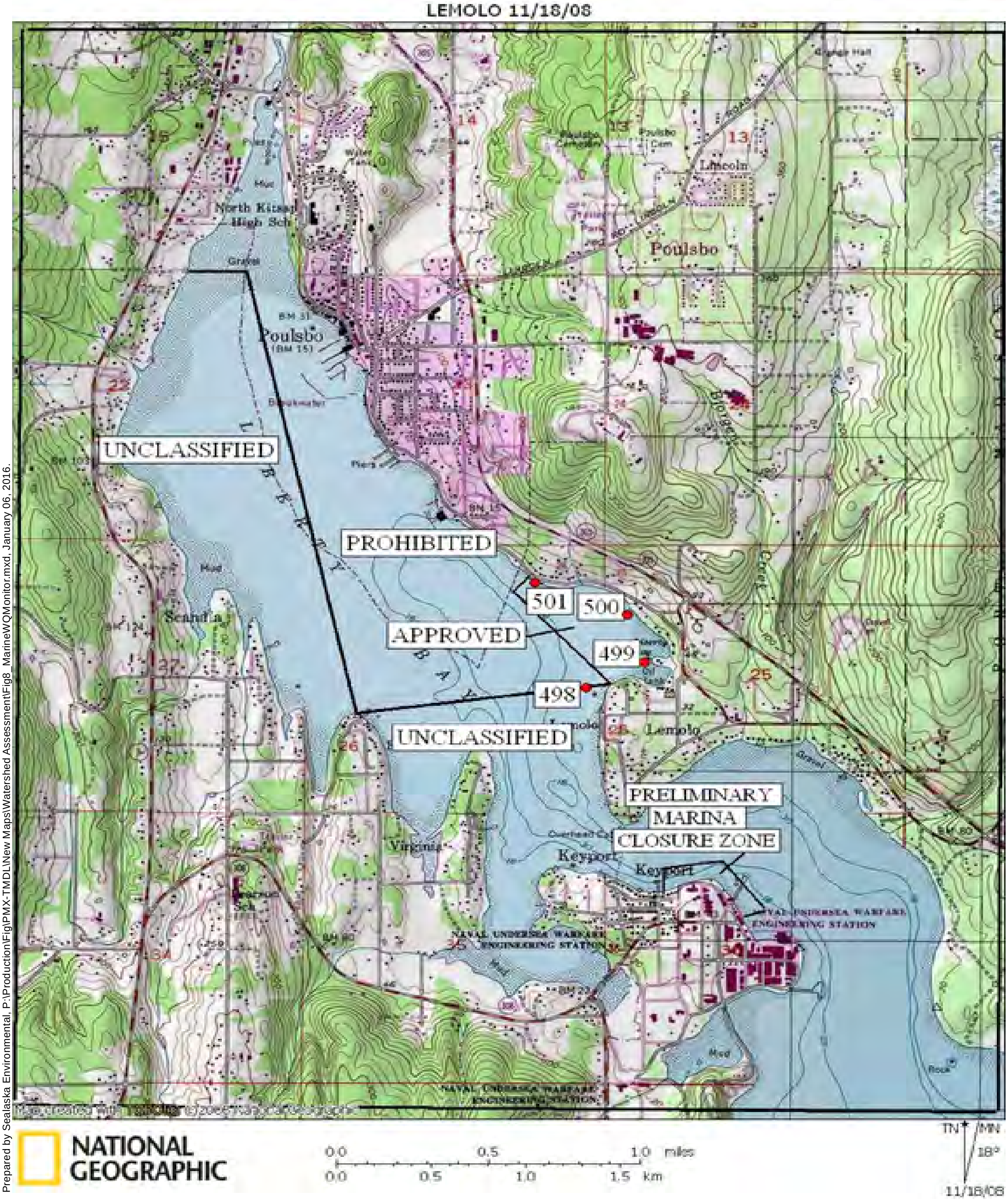
Source: WDOH 2015



Prepared by Sealaska Environmental, P:\Production\Fig\PMX-TMDL\New Maps\Watershed Assessment\Fig8_MarineWQMonitor.mxd, January 06, 2016.

Streams
City of Poulsbo
PUTA
123 Marine WQ Station - WDOH
LB00 Marine WQ Station - KPHD
LB00 Elevated Fecal Coliform

Figure 2-13
Marine Water Quality Monitoring Stations
TMDL Implementation Plan
City of Poulsbo



Prepared by Sealaska Environmental, P:\Production\Fig\PMX-TMDL\New Maps\Watershed Assessment\Fig8_MarineWQMonitor.mxd, January 06, 2016.

Source: WDOH

Figure 2-14
Commercial Shellfish Harvest Classifications
TMDL Implementation Plan
City of Poulsbo

2.3.4.1 Marine Water Quality Trends

Since 2012, over 800 marine water samples have been collected from 27 locations in Liberty Bay. As shown in Figure 2-13, all marine water stations currently meet FC standards, with highest FC concentrations typically at the head of Liberty Bay at stations LB05 and LB06.

Figures 2-15 and 2-16 depict FC trends for marine stations located at the head of Liberty Bay where highest FC concentrations have been historically observed. Trends are typically based on 10 samples per year from each location, for over 10 consecutive years. Trend analysis shows significant improvement, with both stations consistently meeting Part 1 of the FC standard for at least the past 10 years. Station LB05 has consistently met Part 2 of the FC standard since 2005, with station LB06 also meeting the Part 2 standard in both 2013 and 2014.

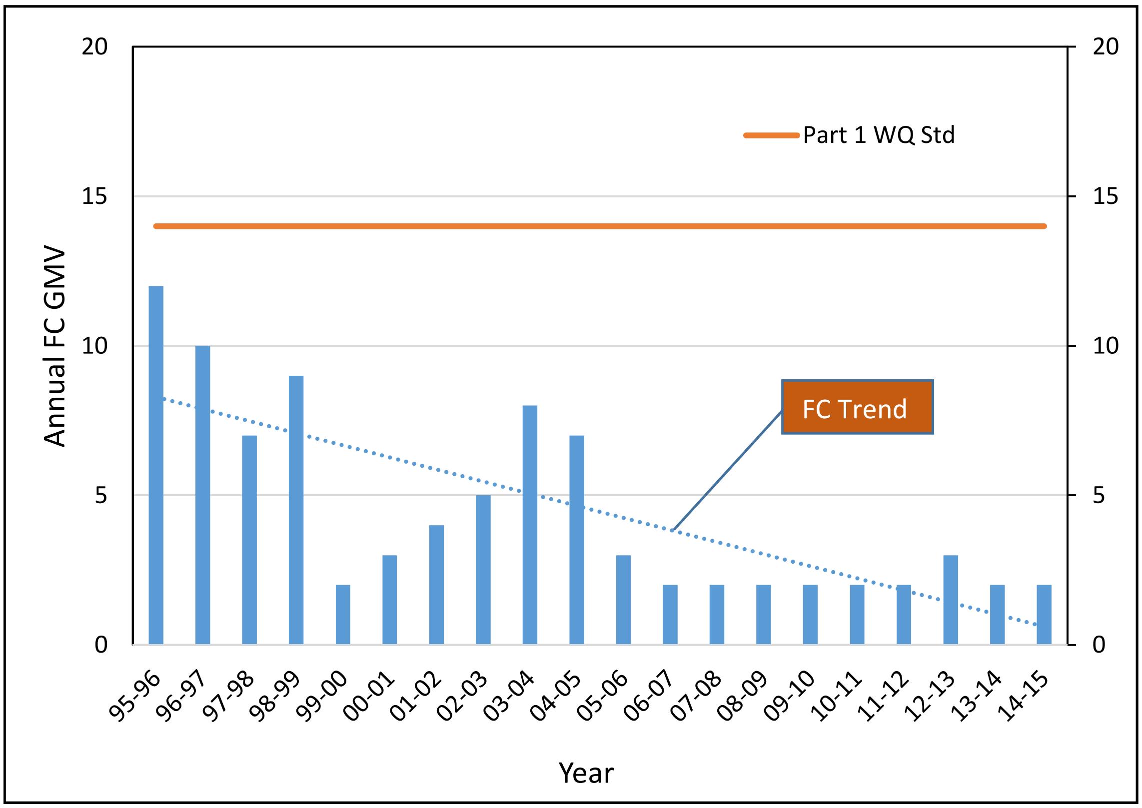


Figure 2-15. Trend for Liberty Bay Marine Station LB05

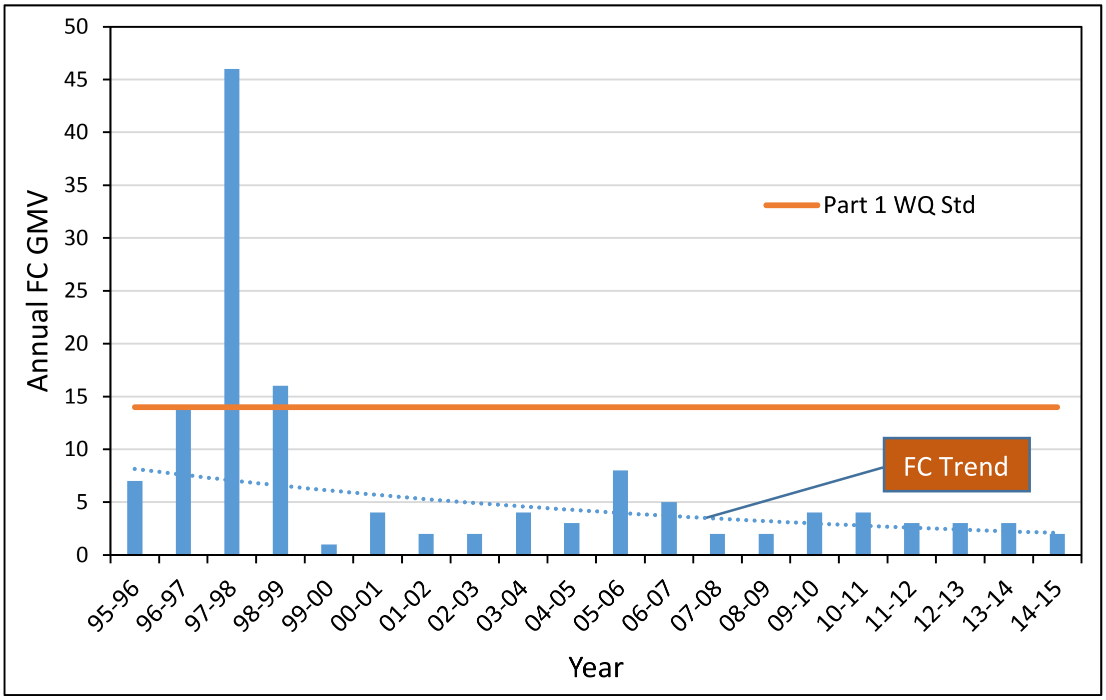


Figure 2-16. Trend for Liberty Bay Marine Station LB06

2.3.5 Freshwater Stream Water Quality

The KPHD has regularly sampled FC in freshwater streams in the Liberty Bay watershed since 1996. Freshwater sampling stations are shown in Figure 2-17. Table 2-7 provides a summary of stream sampling results at the mouths of major streams in the watershed.

Table 2-7. Liberty Bay Freshwater Stream Stations Summary Statistics, 2005 to 2015

Stream	Station Description	Year	No. of Samples	Range	Geometric Mean	Est. 90th Percentile	Meets Standard Pt 1	Meets Standard Pt 2
		SAMPLING STATIONS LOCATED WITHIN THE CITY						
Dogfish Creek Mainstem	Below SR305 at Bond Road upstream of confluence with SFDC	2005	12	7 – 900	53	358	No	No
		2006	12	14 – 300	82	398	No	No
		2007	11	7 – 1600	51	362	No	No
		2008	12	8 – 240	49	229	Yes	No
		2009	11	2 – 300	52	313	No	No
		2010	12	4 – 270	53	218	No	No
		2011	12	4 – 190	31	161	Yes	No
	KPHD ID: DF01	2012	12	4 – 160	45	204	Yes	No
	Ecology ID: 15-DOG-0.6	2013	12	4 – 680	36	309	Yes	No
		2014	12	4 – 170	29	131	Yes	No
		2015	4	4 – 50	12	46	Yes	Yes
	Totals		**123**	**2 – 1600**	**44**	**242**	**Yes**	**No**

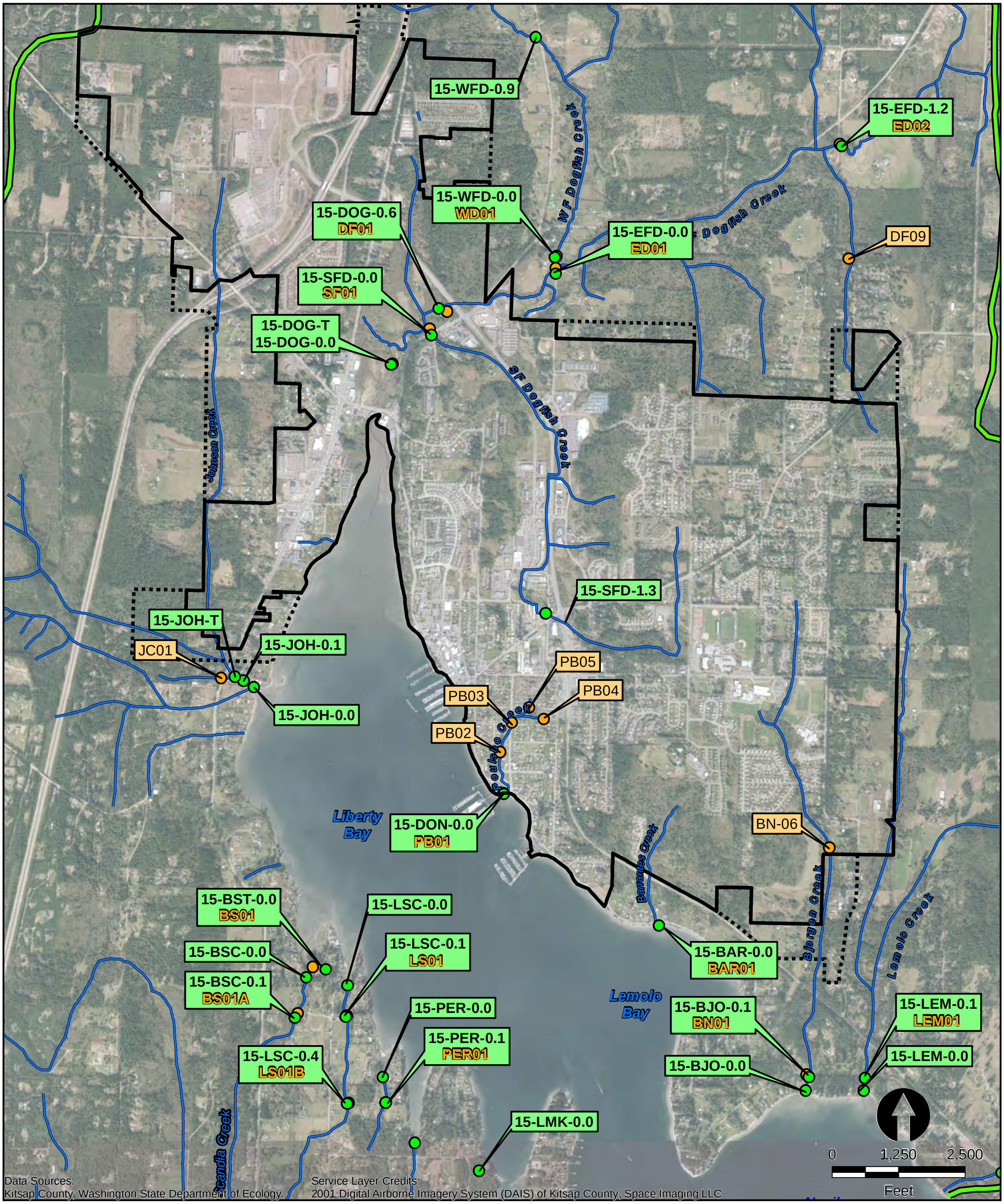
Table 2-7. Liberty Bay Freshwater Stream Stations Summary Statistics, 2005 to 2015 (continued)

Stream	Station Description	Year	No. of Samples	Range	Geometric Mean	Est. 90th Percentile	Meets Standard Pt 1	Meets Standard Pt 2
SAMPLING STATIONS LOCATED WITHIN THE CITY (CONTINUED)								
South Fork Dogfish Creek	Crossing at Bond Road	2005	12	4 – 220	25	145	Yes	No
		2006	12	21 – 900	35	239	Yes	No
		2007	11	4 – 240	40	382	Yes	No
		2008	12	4 – 1600	31	96	Yes	No
		2009	11	14 – 130	47	111	Yes	No
	KPHD ID: SF01	2010	12	4 – 210	27	123	Yes	No
	Ecology ID: 15-SFD-0.0	2011	12	4 – 610	26	149	Yes	No
		2012	12	4 – 520	36	289	Yes	No
		2013	12	4 – 120	35	226	Yes	No
		2014	12	20 – 40	20	93	Yes	Yes
		2015	4	4 – 90	16	88	Yes	Yes
	Totals		**123**	**4 – 2001**	**54**	**304**	**No**	**No**
Poulsbo Creek	Outfall at Poulsbo Yacht Club	2009	17	1 – 5200	74	206	No	No
		2011	1	4	4	NA	Yes	Yes
	KPHD ID: PB01	2012	1	170	170	NA	No	No
		2013	7	4 – 2001	70	1025	No	No
	Ecology ID: 15-DON-0.0	2014	12	4 – 930	37	358	Yes	No
		2015	4	10 – 70	19	63	Yes	Yes
	Totals		**25**	**4 – 2001**	**39**	**374**	**Yes**	**No**
SAMPLING STATIONS LOCATED OUTSIDE THE CITY WITH PORTIONS OF BASIN IN THE CITY								
Lemolo Creek	Crossing at Lemolo Sh. Rd	2011	2	10 – 300	55	1190	No	No
	KPHD ID: LEM01	2013	12	4 – 380	42	344	Yes	No
	Ecology ID: 15-LEM-0.1	2014	4	4 – 170	50	202	No	No
		2015	2	10 – 40	20	56	Yes	Yes
	Totals		**25**	**4 – 380**	**42**	**215**	**Yes**	**No**

Table 2-7. Liberty Bay Freshwater Stream Stations Summary Statistics, 2005 to 2015 (continued)

Stream	Station Description	Year	No. of Samples	Range	Geometric Mean	Est. 90th Percentile	Meets Standard Pt 1	Meets Standard Pt 2
SAMPLING STATIONS LOCATED OUTSIDE THE CITY WITH PORTIONS OF BASIN IN THE CITY (CONTINUED)								
Bjorgen Creek	Crossing at Lemolo Shore Road	2006	12	8 – 900	62	462	No	No
		2007	12	7 – 1600	85	670	No	No
		2008	12	7 – 500	58	335	No	No
		2009	11	2 – 1601	76	1,077	No	No
	KPHD ID: BN01	2010	12	4 – 900	60	485	No	No
	Ecology ID: 15-BJO-0.0	2011	12	4 – 410	49	508	Yes	No
		2012	12	4 – 330	48	231	Yes	No
		2013	12	4 – 2001	79	860	No	No
		2014	12	4 – 1410	82	1150	No	No
		2015	4	10 – 110	36	130	Yes	No
	Totals		**111**	**2 – 2001**	**64**	**520**	**No**	**No**
Johnson Creek	Crossing at Viking Avenue	2005	12	2 – 500	34	312	Yes	No
		2006	12	2 – 220	32	185	Yes	No
		2007	11	8 – 300	24	95	Yes	Yes
		2008	12	2 – 110	17	69	Yes	Yes
		2009	11	7 – 300	27	135	Yes	No
	KPHD ID: JC01	2010	12	4 – 130	18	71	Yes	Yes
	Ecology ID: 15-JOH-0.1	2011	12	4 – 140	10	43	Yes	Yes
		2012	12	1 – 93	13	75	Yes	Yes
		2013	12	4 – 790	28	196	Yes	No
		2014	12	4 – 120	18	66	Yes	Yes
		2015	4	10 – 240	54	334	No	No
	Totals		**123**	**1 – 790**	**21**	**113**	**Yes**	**No**

Overall stream water quality as characterized by the KPHD has been variable, with significant long-term improving trends in all major City streams except Bjorgen Creek. This trend generally coincides with the corrective action programs. Figures 2-18 through 2-21 show water quality trends in primary streams for the 1996 through 2015 period.



Prepared by Sealaska Environmental, E:\PMX-TMDL\Effectiveness Monitoring Plan\MXD\Fig_3-5_StreamWQMonitor.mxd, June 02, 2016.

Liberty Bay Watershed
City of Poulsbo
PUTA

Fresh WQ Station - WDOE
Fresh WQ Station - KPHD/CoP

Figure 2-17 Historical Stream Water Quality Monitoring Stations
TMDL Implementation Plan
City of Poulsbo

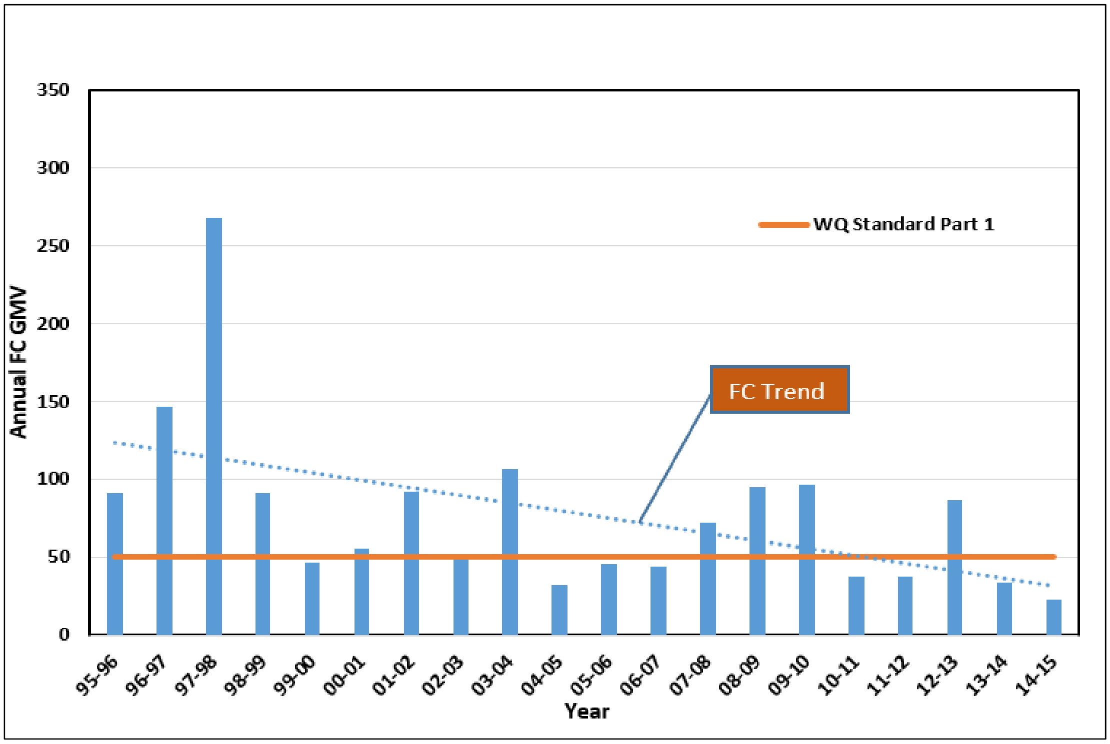


Figure 2-18. South Fork Dogfish Creek Fecal Coliform Trend, 1996-2015

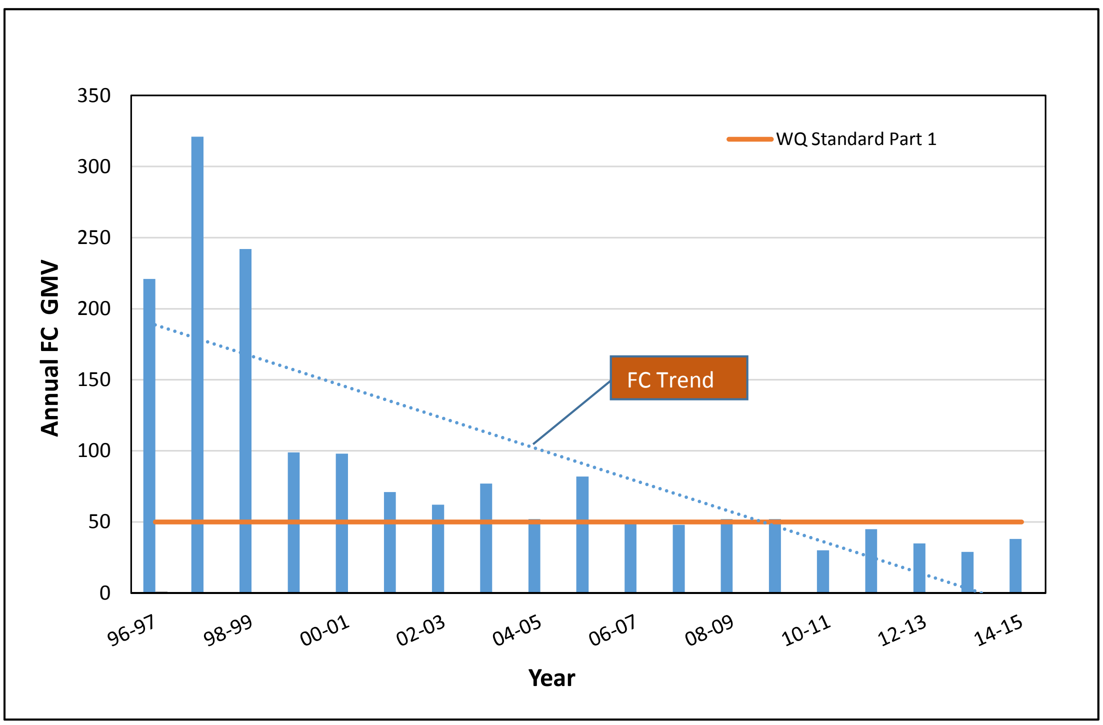


Figure 2-19. Dogfish Creek Fecal Coliform Trend, 1996-2015

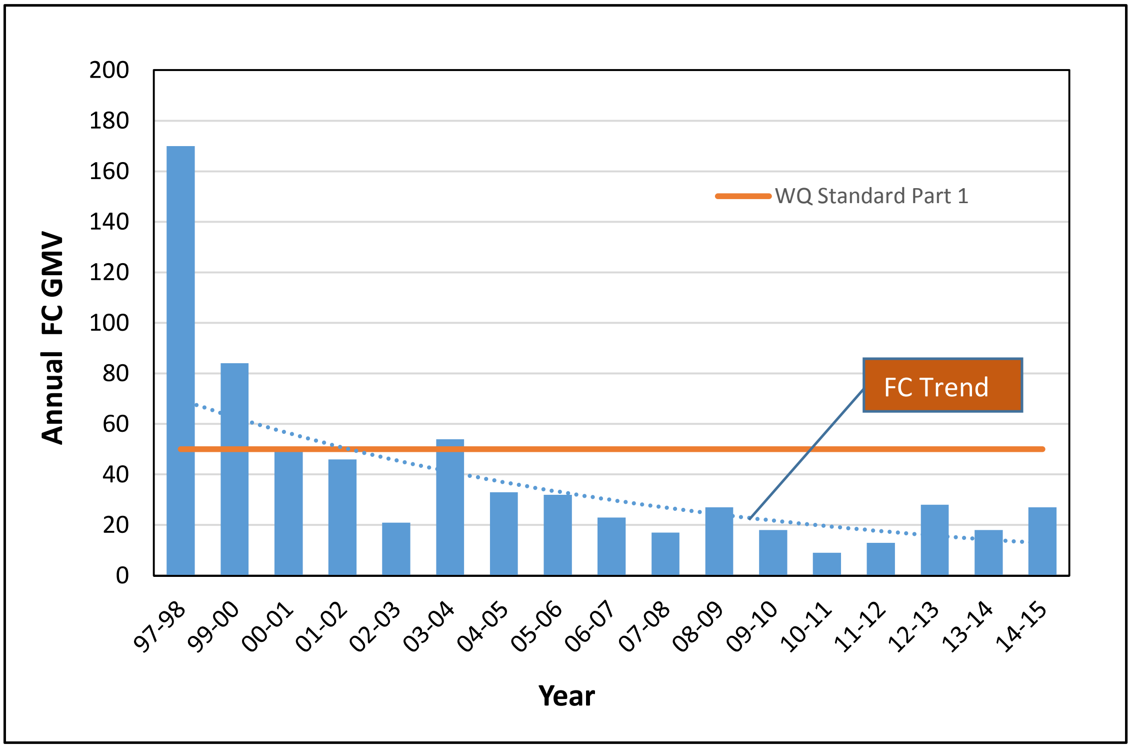


Figure 2-20. Johnson Creek Fecal Coliform Trend, 1997-2015

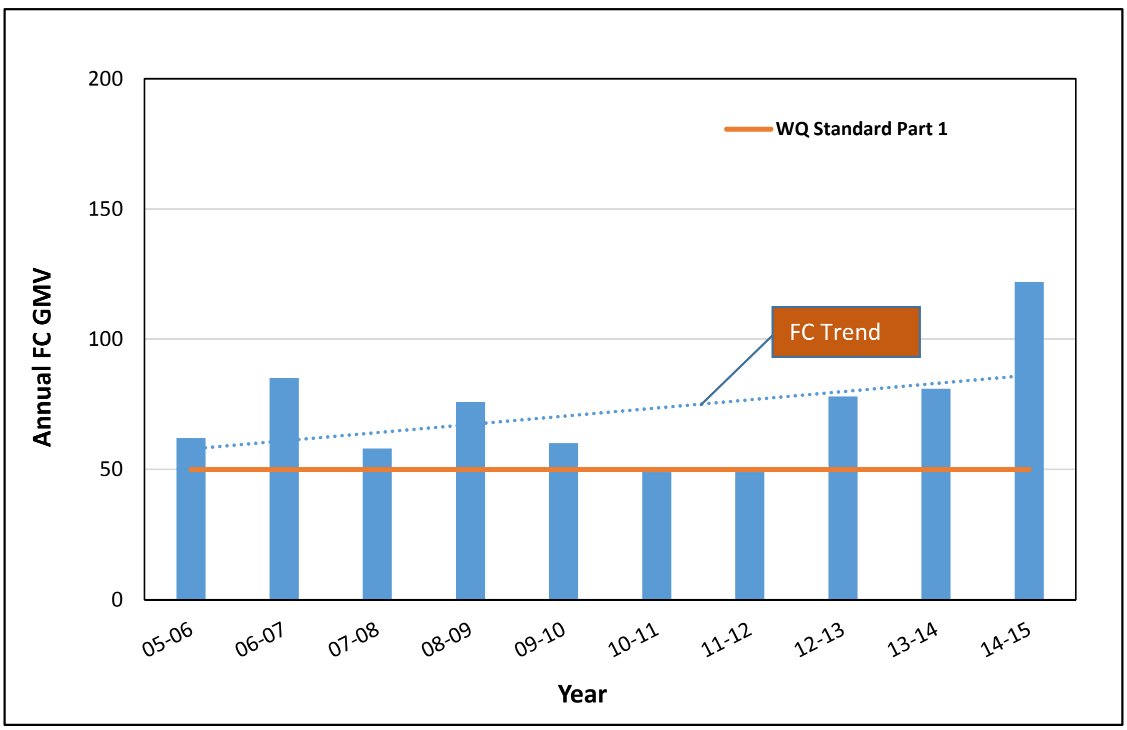


Figure 2-21. Bjorgen Creek Fecal Coliform Trend, 2006-2015

2.3.5.1 Stream and Stormwater Outfall FC Loading Trends

Load analysis uses flow volume and FC concentration to calculate total number of FC in a discharge per unit of time and is expressed as billions of colony forming units per day (bcfu/day). FC loading data was developed as part of the TMDL Plan (Ecology 2013), and is summarized in Table 2-8.

The load analysis prepared by Ecology indicated that within the City, the South Fork of Dogfish Creek (SFDC), Poulsbo Creek, Bjorgen Creek, and City stormwater outfalls were potential priority locations for FC reductions. Target reductions for each location are shown in Table 2-8 and represent how much improvement was estimated as necessary to meet water quality standards.

Comparing dry and wet weather data showed that FC concentrations and loading increased substantially in marine and freshwater during rain events at all locations.

Table 2-8. FC Load Analysis Summary, 2008-2009 Data

Sub-Basin	Location	Dry Season Load (bcfu/day)[1/]	Wet Season Load (bcfu/day)[1/]	Target FC Reduction[2/]
STATIONS LOCATED WITHIN THE CITY OF POULSBO				
Dogfish Creek	Above confluence with South Fork	12	30	38%
South Fork Dogfish Creek	Bond Road	0.81	20	87%
Johnson Creek	Viking Avenue	2.5	3.8	0
Poulsbo Creek	Outfall at Liberty Bay	2.2	26	84%
Stormwater outfall OF-3502	Nelson Park bioswale outfall	0.66	1.4	97%
Stormwater outfall OF-3707	North Viking Avenue	0.55	0.70	45%
Stormwater outfall OF-3704	Liberty Shores assisted living	0.13	2.5	95%
Stormwater outfall OF-3703	Outfall at American Legion Park	0.04	3.1	93%
STATIONS LOCATED OUTSIDE THE CITY				
Bjorgen Creek	Lemolo Shore Drive	1.2	7.8	61%
Lemolo Creek	Lemolo Shore Drive	0.32	3.1	66%
Big Scandia Creek	Scandia Road	1.7	12	55%
Little Scandia Creek	Scandia Road	0.9	0.89	85%
Daniels Creek	Hwy 308	1.5	1.4	46%
Barrantes Creek	Lemolo Shore Drive	0.09	0.24	25%

Notes:
[1/] bcfu = billions of colony forming units
[2/] Targets are for wet season reductions. Poulsbo stormwater outfalls are for informational purposes only (Ecology 2013). Data based on Ecology sampling from 2008 to 2009.

2.3.6 Stormwater Quality

Periodic monitoring of City stormwater has been performed by the KPHD since 2000. Stormwater sampling was also performed by Ecology as part of 2013 TMDL Plan. Historical stormwater sampling results are summarized in Table 2-9, and Figure 2-22 shows outfall locations. Locations shown reflect the City's outfall numbering scheme wherever applicable. For outfalls that do not have a City identifier, the KPHD outfall identifier is used. Stormwater outfall sample identifiers from both the KPHD and Ecology have been standardized to the City outfall number.

Table 2-9. City of Poulsbo Stormwater Outfall Sampling Results

Outfall I.D.	Name and Location	Land Use	Sample Date	Wet/Dry	E. Coli/100 ml [1/]
MARINE – STORMWATER OUTFALL MONITORING LOCATIONS					
OF-3502	Central Viking Ave. – Nelson Park Bioswale Outfall	Commercial and City street	2009	Dry	2
			2010	Dry	>2,419
			2011	Dry	5
			2012	Dry	34
			2014	Dry	8
			2015	Dry	26
OF-3604	North Front Street – South End of Parking Lot Liberty Bay Auto	Residential, commercial, and City street	2009	Dry	1,553
			2010	Dry	113
			2011	Wet	>2,419
			2012	Dry	27
			2014	Dry	167
			2015	Dry	770
OF-3606	Front Street between Torval Canyon & Jensen	Residential	2009	Dry	52
			2010	Dry	48
			2011	Dry	172
			2012	Dry	77
			2014	Dry	210
			2015	Dry	56
OF-3613	South central Viking Avenue outfall below Les Schwab	Commercial, parking, and City street	2011	Dry	921
			2012	Dry	291
			2015	Dry	125
OF-3611	3rd Avenue south of Windsong Apts.	Commercial, residential, and parking lot	2009	Dry	46
			2010	Dry	130
			2011	Dry	>2,419
			2012	Dry	17
			2014	Dry	34
			2015	Dry	147

Table 2-9. City of Poulsbo Stormwater Outfall Sampling Results (continued)

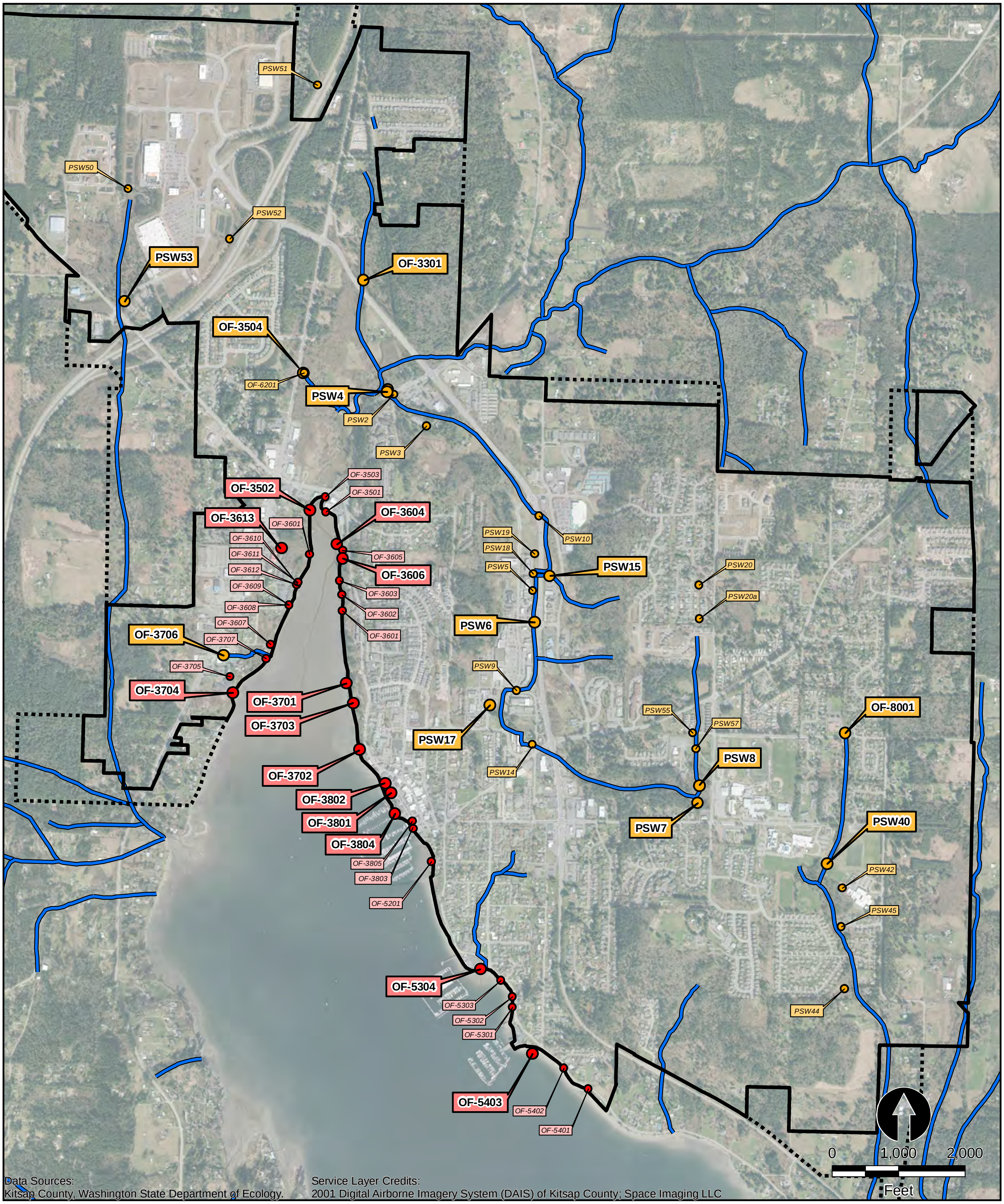
Outfall I.D.	Name and Location	Land Use	Sample Date	Wet/Dry	E. Coli/100 ml [1/]
MARINE – STORMWATER OUTFALL MONITORING LOCATIONS (continued)					
OF-3702	Cast iron outfall under the Gran Kirk Apts.	Commercial, residential, and City street	2010	Dry	37
			2011	Dry	>2,419
			2014	Dry	6
OF-3703	24” corrugated pipe located at north end of American Legion Park	Residential and City street	2009	Dry	345
			2010	Dry	219
			2011	Dry	1,203
			2012	Dry	155
			2014	Dry	32
			2015	Dry	16
OF-3704	Creek next to Liberty Shores Retirement Center	Residential and commercial	2009	Dry	36
			2010	Dry	20
			2011	Dry	517
			2012	Dry	120
			2014	Dry	130
			2015	Dry	1,986
OF-3707	Viking Avenue south outfall located behind NW Ken’s Auto, 650 Bovela	Commercial, parking lot, and City street	2009	Dry	240
			2010	Dry	488
			2011	Dry	66
			2014	Dry	24
			2015	Dry	14
OF-3801	Anderson Parkway near the restrooms (taken from catch basins)	Commercial, parking lot, and City street	2010	Dry	204
			2011	Wet	488
			2012	Dry	462
			2014	Dry	28
			2015	Dry	6
OF-3802	Anderson Parkway in front of Sons of Norway	Commercial, parking lot, and City street	2010	Dry	11
			2011	Wet	325
			2012	Dry	6
			2014	Dry	138
			2015	Dry	4
OF-3805	Anderson Parkway at Port boardwalk	Commercial, parking lot, and City street	2011	Wet	>2,419

Table 2-9. City of Poulsbo Stormwater Outfall Sampling Results (continued)

Outfall I.D.	Name and Location	Land Use	Sample Date	Wet/Dry	E. Coli/100 ml [1/]
MARINE – STORMWATER OUTFALL MONITORING LOCATIONS (continued)					
OF-5301	Fjord Drive	Residential	2011	Wet	649
OF-5302	Fjord Drive	Residential	2011	Wet	285
OF-5303	Fjord Drive and Shorewood Court	Residential	2010	Dry	<1
			2011	Wet	308
			2014	Dry	<1
			2015	Dry	<1
OF-5304	Poulsbo Creek outfall, Fjord Drive & 6th Avenue	Residential and commercial	2009	Dry	35
			2010	Dry	261
			2011	Wet	>2,419
			2012	Dry	185
			2014	Dry	186
			2015	Dry	>2,419
OF-5403	Outfall at end of 9th Avenue	Residential	2011	Wet	903
			2015	Dry	>2,419

Note:
[1/] All data is for E. Coli/100 ml.

Stormwater data for past years is generally limited in terms of frequency, location and runoff condition. Trend analysis for specific stormwater outfalls is therefore not possible. As indicated in Table 2-9, stormwater outfall monitoring has been conducted primarily during dry weather conditions and with a focus on IDDE. Historical stormwater monitoring shows that virtually all outfalls have exhibited elevated FC levels at some point in time.



Prepared by Sealaska Environmental, E:\PMX-TMDL\Effectiveness Monitoring Plan\MXD\Fig_3-6_StormwaterOutfallLoc.mxd, June 01, 2016.

Streams
City of Poulsbo
PUTA

Marine Outfalls
- Major/City System
- Minor/Private

Freshwater Outfalls
- Major/City System
- Minor/Private

Figure 2-22
Stormwater Outfall Locations
TMDL Implementation Plan
City of Poulsbo

2.3.7 2015 STORMWATER QUALITY MONITORING RESULTS

2.3.7.1 Goals and Objectives

The goal of the 2015 stormwater quality study was to generate FC data to help identify specific pollutant loading areas in the City, and support development of focused corrective action measures. Specific objectives of the monitoring consisted of:

- Characterize FC bacteria concentrations from major stormwater outfalls in the City under both wet and dry weather conditions;
- Compare data for freshwater tributaries in the City to past sampling results and TMDL load criteria; and
- Evaluate relative contributions of FC loading from streams and stormwater to help focus corrective actions on the highest priority areas.

2.3.7.2 Quality Assurance Project Plan

The *Quality Assurance Project Plan (QAPP), Stormwater Quality Study, Liberty Bay TMDL Implementation Plan* (Parametrix 2015) was prepared as required under the grant agreement between Ecology and the City. The goal of the QAPP is to describe how the City will conduct focused stormwater monitoring to characterize potential pollutant sources, and establish a baseline for future comparison.

2.3.7.3 Summary of Stormwater Sampling Approach

The study objectives were met through characterizing wet and dry weather FC bacteria loads in stream tributaries and significant storm outfalls to Liberty Bay that are located within the City. FC concentrations were monitored in November and December 2015. Flow was measured at selected stream stations pursuant to the QAPP.

The 2015 stormwater study consisted of two sampling events at 40 locations during both dry conditions and periods of significant rainfall (storm event sampling). These synoptic surveys include two “dry storm event” surveys and two “wet storm event” surveys to help characterize seasonal and rain event FC contributions from the City.

All major stormwater outfalls in the City were sampled as part of the study. A "major outfall" was defined as a pipe at least 12 inches in diameter that discharges from a significant basin area. Many of these outfalls have been sampled as part of prior investigations (refer to Section 2.3). Sampling locations consist of a combination of stormwater outfalls and freshwater tributaries as shown in Tables 2-10, 2-11, and 2-12, and Figure 2-23. Sampling sites were selected based on project objectives, as well as the information related to past corrective actions and historical sampling results.

Table 2-10. Stream Sampling Stations

Station	Site Description	Flow Msmt
	DOGFISH CREEK	
15-DOG-0.6	Mainstem behind dental office on Bond Road, downstream of SR305 crossing.	YES
15-SFD-0.0	South fork at Bond Rd. and 1st Avenue, 50 feet downstream of culvert below 36-in diameter storm outfall.	YES
15-SFD-0.6	South fork at 7th Ave. and Forest Rock Lane/SR305, upstream side of culvert.	NO
15-SFD-1.3	South fork at 8th Ave. and Iverson St., upstream side of culvert.	NO
WF-01	West fork, downstream of culvert under SR305.	NO
	JOHNSON CREEK	
JOH-0.1	Mainstem, inside City Limits above confluence with west fork, from property at 18931 Viking Avenue.	YES
JOH-1.4	Finn Hill Rd. at Olhava Way, downstream culvert at SE corner.	NO
	POULSBO CREEK	
PB-02	Downstream culvert at Sommerseth St.	YES
PB-03	Ryen St. culvert, upstream end.	NO
PB-04	East branch trib. behind Presbyterian Church, Harrison St.	NO
PB-05	Mainstem at culvert east of 700 Harrison St.	NO
	LEMOLO CREEK	
LEM-0.9	Lemolo Creek at culvert crossing Heron Pond Ln.	YES
	BJORGEN CREEK	
BJO-0.9	Bjorgen Creek at Storhoff Rd. culvert.	YES

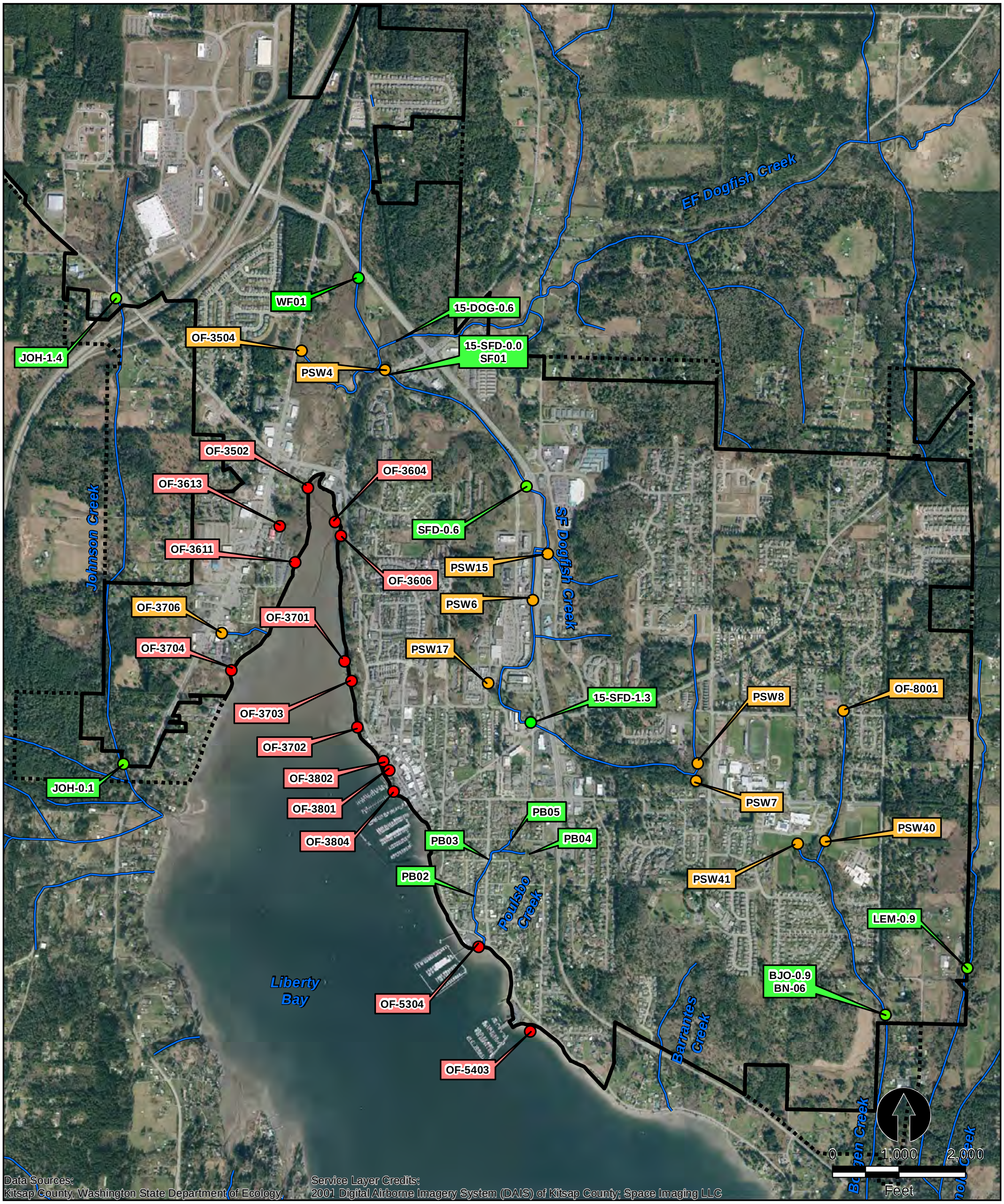
Table 2-11. Marine Outfall Sampling Locations

Outfall I.D.	Name and Location	Diam. (in.)
OF-3502	Central Viking Ave. – Nelson Park bioswale outfall	24
OF-3604	North Front St. – South end of parking lot at 20101 Front St. (auto glass/dance studio)	24
OF-3606	Front St. between Torval Canyon Rd. and Jensen Way	18
OF-3613	South central Viking Ave. outfall below Les Schwab Tire Center	24
OF-3701	24” corrugated pipe located at north end of American Legion Park	24
OF-3702	Cast iron outfall at south end of American Legion Park at beginning of boardwalk	18
OF-3703	24” corrugated pipe located in center of American Legion Park	24
OF-3704	Intermittent creek on south side of Liberty Shores Retirement Center	NA
OF-3707	Bioswale to bay, north side of Ken’s Auto, 650 Bovela Ln	24
OF-3801	Anderson Parkway at south side of gazebo	30
OF-3804	Anderson Parkway at north side of Port gangway	18
OF-3611	3rd Ave. at end of Edvard St. between Windsong Apartments & Liberty Bay Condos	18
OF-5304	Poulsbo Creek outfall, Fjord Dr. and 6th Ave.	48
OF-5403	Fjord Dr. at 9th Avenue	24

Table 2-12. Freshwater Upland Outfall Sampling Locations

Outfall I.D.	Name and Location	Diam. (in.)
PSW4	SR305 storm outfall at Bond Rd. & 1st Ave., downstream side of SFDC culvert under Bond Road	36
PSW6	Poulsbo Village outfall, SR305 at Liberty Rd., NW corner	36
PSW7	East Caldara Ave. basin from culvert east of 1508 Hostmark St.	30
PSW8	Culvert under Mesford Rd. below Caldara Cottages, headwaters of SFDC	24
PSW15	SR305, Liberty Road and 10th Avenue outfall, 50’ south of downstream end of SFDC culvert under SR305	24
PSW17	Iverson St. and 7th Ave. basin, ditch at drop inlet 75’ north of entrance to Centennial Park	30
PSW40	Bjorgen Creek headwaters in channel below 24” corrugated metal pipe (CMP) outfall (upper Bjorgen Creek basin) and 18” corrugated polyethylene pipe (CPE) outfall (portion of NKSD basin) below pond east of middle school	24, 18
PSW41	NKSD and portions of Ridgewood storm system outfall to Bjorgen Creek at spillway below middle school	48” spill way
OF-8001	Kevos Pond/Ridgewood basin, north side of Mesford Rd. at Glen Haven Ct. intersection, at east property line of LDS Church, 12138 Mesford Rd.	Ditch
OF-3504	North central Viking Avenue outfall to Fish Park, 24” corrugated pipe approx. 200’ north of trail entrance to Fish Park	24

Prepared by Sealaska Environmental, P:\Production\Fig\PMX-TMDL\New Maps\Watershed Assessment\Fig12_WaterQualityMonLoc.mxd, December 14, 2015.



Streams
City of Poulsbo
PUTA

Stream Station
Marine Outfall
Freshwater Outfall

Figure 2-23
2015 Water Quality Monitoring Locations
TMDL Implementation Plan
City of Poulsbo

2.3.7.4 Rain Event Criteria

Rain event sampling met the criteria for the preferred storm event on two occasions in December 2015 as defined in the QAPP; a minimum 0.3 inch of rainfall in a 24-hour period preceded by no more than trace rainfall in the previous 24 hours. Table 2-13 shows precipitation during sampling events.

Table 2-13. Summary of Precipitation during 2015 Stormwater Sampling

Sampling Date	24 Hour Rainfall	Prior 24 Hour Rainfall
November 04, 2015	0.0 in	0.01 in
November 20, 2015	0.0 in	0.05 in
December 03, 2015	1.32 in	0.07 in
December 10, 2015	0.82 in	0.0 in

Flow was measured at stream stations at their lowest location using a flow meter consistent with the QAPP.

2.3.7.5 Sampling Results

Sampling results are summarized in Table 2-14, with monitoring data provided in Appendix A. Note that "low," "medium," and "high" priority designations are based on relative concentration and are provided for descriptive purposes only.

Rain event conditions, SFDC

Table 2-14. Summary of 2015 Stormwater Sampling

Station ID Streams	Description	11/14/2015 Dry	11/25/2015 Dry	GMV Dry	12/3/2015 Wet	12/10/2015 Wet	GMV Wet
15-DOG-0.6	Mainstem Dogfish Creek	10	20	14	410	1,240	713
15-SFD-0.0	SFDC at Bond Rd. & 1st Ave., downstream of PSW4	140	<10	37	250	140	187
15-SFD-0.6	SFDC at Bond Rd. & 1st Avenue	130	40	72	50	1,040	228
15-SFD-1.3	SFDC at 8th Ave. and Iverson	20	<10	14	380	380	380
WF-01	West Fork of Dogfish Creek, downstream of culvert under SR305	<10	10	10	400	220	297
BJO-0.9	Bjorgen Creek at Storhoff Road culvert	40	10	20	400	180	268
LEM 0.9	Lemolo Creek at Heron Pond Lane	10	20	14	140	40	75
JOH-0.1	Johnson Creek, mainstem at 18931 Viking Avenue	10	10	10	360	240	294
JOH-1.4	Finn Hill Road at Olhava Way	60	10	24	90	160	120
PB-02	Poulsbo Creek, downstream culvert at Sommerseth	60	10	24	420	640	518
PB-02 R	Poulsbo Creek duplicate	70	70	70	340	940	565
PB03	Poulsbo Creek-corner of Ryen & 6th	60	10	24	340	1,460	705
PB03 R	Duplicate of PB03	70	60	65	370	460	413
PB04	Poulsbo Creek behind church	140	<10	37	70	80	75
PB05	Poulsbo Creek, Harrison St. culvert at 709 Harrison St.	<10	<10	<10	170	120	143
OF-5304	Poulsbo Creek outfall	100	60	77	40	60	49
Legend	Low: 0 – 100 Wet GMV						
	Medium: 101 – 499 Wet GMV						
	High: > 500 Wet GMV						

Table 2-14. Summary of 2015 Stormwater Sampling (continued)

Station ID Streams	Description	11/14/2015 Dry	11/25/2015 Dry	GMV Dry	12/3/2015 Wet	12/10/2015 Wet	GMV Wet
		MARINE OUTFALLS					
OF-3502	Nelson Park	<10	40	40	50	120	77
OF-3504	North Central Viking Ave. outfall to Fish Park	<10	90	10	>2,000	1,040	1,442
OF-3604	Liberty Bay Auto-24" CMP	60	10	24	>2,000	540	1,039
OF-3606	South of 20101 Front Street	<10	<10	<10	420	2,200	961
OF-3611	CMP at Windsong Apartments	<10	<10	<10	30	80	49
OF-3613	Nelson Park north of Hidden Cove Apts.	NA*	<10	<10	1,440	880	1,126
OF-3613 R	Duplicate sample of OF-3613	350	<10	59	1,420	280	631
OF-3701	24" CMP at north end of American Legion Park	50	10	22	730	40	171
OF-3702	Cast Iron outfall at south end of American Legion Park	No flow	<10	<10	<10	80	80
OF-3703	24" CMP at American Legion Park	70	<10	70	320	240	277
OF-3703 R	Duplicate sample of OF-3703	40	30	35	280	420	343
OF-3704	Liberty Shores Creek at retirement home	40	20	28	>2,000	180	600
OF-3707	East end of bioswale behind Ken's Auto	30	10	17	380	300	338
OF-3801	Anderson Parkway-south side of Gazebo on beach	<10	<10	<10	>2,000	<20	200
OF-3804	Port of Poulsbo main parking lot, landward of fuel dock gangway	60	<10	24	320	200	253
OF-5403	Outfall on beach near Fjord Drive at 9th Ave.	20	<10	14	240	200	219

Legend:
- Low: 0 – 100 Wet GMV
- Medium: 101 – 499 Wet GMV
- High: > 500 Wet GMV

Table 2-14. Summary of 2015 Stormwater Sampling (continued)

Station ID Streams	Description	11/14/2015 Dry	11/25/2015 Dry	GMV Dry	12/3/2015 Wet	12/10/2015 Wet	GMV Wet
			FRESHWATER OUTFALLS				
PSW4	SR305 stormwater outfall @ SFDC	<10	<10	<10	110	20	47
PSW6	Poulsbo Village outfall, SR305 at Liberty Rd., NW corner	10	10	10	380	340	359
PSW7	East Caldart Ave. basin, from culvert east of 1508 Hostmark St.	60	<10	24	160	120	139
PSW8	Photo of bank by high school - new location is on Mesford	No flow	50	50	310	500	394
PSW15	SR305 outfall near O'Reilly's	110	<10	33	550	360	445
PSW17	Ditch near Centennial Park	No flow	No flow	No flow	580	560	570
PSW40	Bjorgen Creek channel below 24" and 18" outfalls	20	<10	14	150	1,200	424
PSW41	Outfall to Bjorgen Creek at spillway below middle school	No flow	20	20	290	180	228
OF-8001	Kevos Pond / Ridgewood basin	No flow	20	20	300	800	490
Legend	Low: 0 – 100 Wet GMV						
	Medium: 101 – 499 Wet GMV						
	High: > 500 Wet GMV						

2.3.7.6 Stream Sampling Results

Stream sampling results are summarized in Table 2-14. Loading data for streams is presented in Table 2-15. Loading data shows that wet weather loads are typically 50 to 100 times dry weather loads, with Dogfish Creek and SFDC loads both exceeding all other streams combined.

Table 2-15. Stream Loading Summary, 2015 Stormwater Sampling

		Dry Weather Avg.			Wet Weather Avg.		
Station ID	**Description**	**FC/100 ml [1/]**	**Flow (cfs)**	**Load [2/]**	**FC/100 ml [1/]**	**Flow (cfs)**	**Load [2/]**
PB-02	Poulsbo Creek, downstream culvert at Sommerseth	24	0.49	0.29	440	1.4	15.5
LEM 0.9	Lemolo Creek at Heron Pond Lane	10	0.28	0.07	53	6.4	8.3
BJO-0.9	Bjorgen Creek at Storhoff Road culvert	40	0.07	0.07	175	8.7	37.4
15-DOG-0.6	Mainstem Dogfish Creek	20	11.12	5.44	100	75.5	184.8
15-SFD-0.0	SFDC at Bond Rd. & 1st Ave., downstream of PSW4	53	1.86	2.40	286	19.4	135.7
JOH-0.1	Johnson Creek mainstem at 18931 Viking Avenue	10	1.37	0.33	94	25.1	57.6

Notes:
[1/] Geometric mean
[2/] Loading data in billions of colony forming units per day (bcfu/day)

Stream sampling from 2015 was compared to data collected as part of Ecology's TMDL study in 2008-09 (Ecology 2009). A direct comparison for wet weather results was not possible due to the lack of rain event data in 2008-2009. Dry weather conditions are compared in Table 2-16 and Figure 2-24 and show that conditions in 2015 appear to be improved compared to 2009; however, this conclusion should be viewed with caution due to the relatively small 2015 data set.

Table 2-16. Comparison of Dry Weather Stream Sampling Results, 2009 to 2015

Station ID	Description	FC Concentration 2009 FC/100 ml GMV	FC Concentration 2009 Target Value	FC Concentration 2015 FC/100 ml GMV	Reduction Target Reduction	Reduction Actual Reduction
PB-02	Poulsbo Creek, downstream culvert at Sommerseth	302	27	24	91%	92%
LEM 0.9	Lemolo Creek at Heron Pond Lane	63	11	10	83%	84%
BJO-0.9	Bjorgen Creek at Storhoff Road culvert	276	13	40	95%	86%
15-DOG-0.6	Mainstem Dogfish Creek	93	43	20	53%	78%
15-SFD-0.6	SFDC at Bond Rd. & 1st Avenue	62	31	53	50%	15%
JOH-0.1	Johnson Creek, mainstem at 18931 Viking Avenue	36	15	10	57%	72%

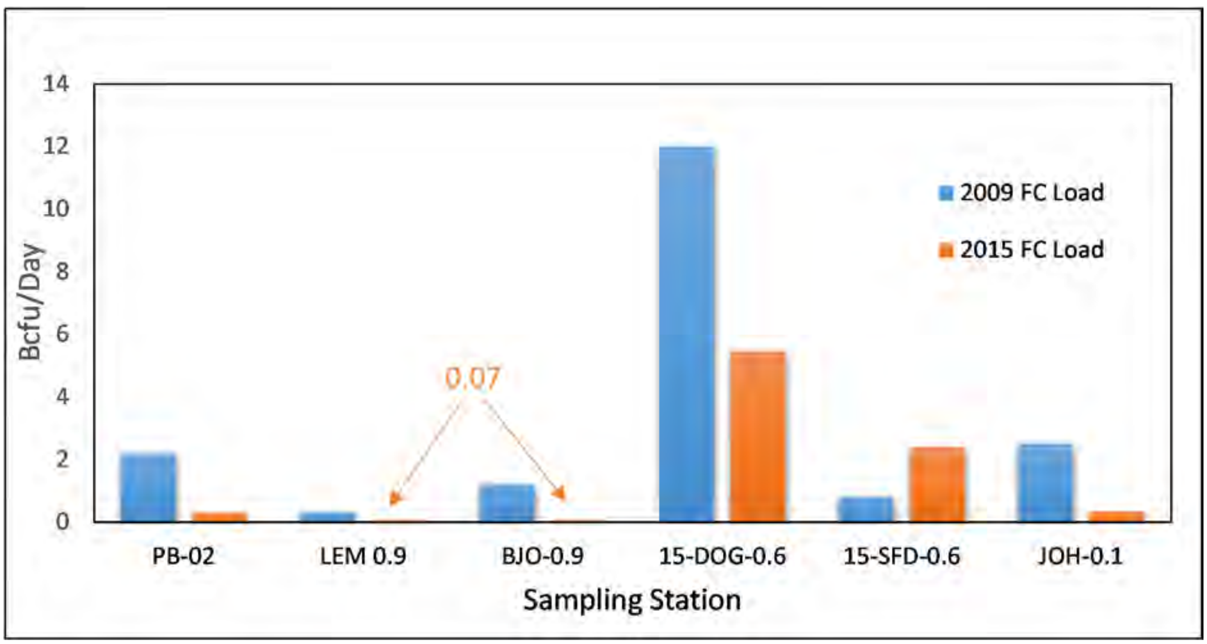


Figure 2-24. Dry Conditions Stream Loading Comparison, 2009 and 2015

Stream sampling observations are summarized as follows:

- Within the City, highest FC loading is from the SFDC with the largest contribution from the middle and upper basin located above the intersection of 7th Avenue and SR305.
- Wet weather loading within the Johnson Creek basin was relatively high, with the less developed stream segment between Finn Hill Road and Viking Avenue contributing higher FC loading. The majority of the contributing basin to this segment is located outside of the City.

- Bjorgen Creek loading is highest in the upper basin above the North Kitsap School District (NKSD). Loading decreases downstream from the stormwater outfalls below the NKSD.
- Poulsbo Creek water quality and loading is significantly improved compared to 2009 conditions. The middle and lower segment of Poulsbo Creek between SR305 and Sommerseth Street continues to have relatively high FC concentrations and loads.
- All streams showed significant improvement in FC concentration under dry weather conditions compared to 2009 data. Reductions in dry weather FC concentration were close to TMDL targets in all streams except SFDC.
- All streams except Bjorgen Creek show a significant long-term improving trend. Lack of improvement in Bjorgen Creek water quality is likely due to lack of treatment facilities in the upper basin including the NKSD campus and the Ridgewood/Kevos Pond neighborhood.

2.3.7.7 Stormwater Outfall Sampling Results

Stormwater outfall sampling results are summarized in Table 2-17. Stormwater outfall flow measurements were not performed as part of the 2015 sampling effort. In lieu of an actual flow measurement, a relative load index was calculated for each outfall based on wet weather FC concentration and total impervious area (TIA) within the outfall catchment area. Outfall loading information is provided in Table 2-18 and is shown graphically in Figure 2-25. Refer to Section 2.5 for detail on TIA sub-basin analysis.

Stormwater concentration and relative loading information is combined in Table 2-17 and shown graphically in Figure 2-17. Based on the combined concentration and loading data, the following basins warrant additional corrective action analysis:

- Basins SF-05 and SF-04 which include the Poulsbo Public Works Complex, Library, and Poulsbo Village.
- Basin V-02 which serves the south central segment of Viking Avenue and adjacent commercial areas.
- Basin V-04 which serves a portions of the central segment of Viking Avenue and adjacent commercial areas.
- Basin V-06 which serves north Viking Avenue and the Stendahl Ridge neighborhood.
- Basin C-01 which includes the Torval Canyon area and portions of Front Street.
- Basin PB-02 which includes portions of Old Town between 6th Avenue and SR305, as well as portions of the Viking Heights neighborhood.

Several basins that serve SR305 scored relatively high for potential corrective action. Basin SF-06 includes portions of Lincoln Road, 10th Avenue, and SR305 from Hostmark Street to Liberty Road. Basin WF-01 includes the SR305-Viking Avenue and SR305-SR3 intersections, as well as north Viking Avenue.

Table 2-17. Stormwater Outfall Relative Loading

Station ID	Basin ID	Description	Wet Weather GMV	Basin TIA (ac)	FC Load Index 1/
		MARINE OUTFALLS			
OF-3502	V-05	Nelson Park	77	28.9	2,242
OF-3504	V-06	North Central Viking Ave. outfall to Fish Park	1,442	40.9	58,931
OF-3604	C-01	Liberty Bay Auto-24" CMP	1,039	17.5	18,221
OF-3606	C-02	South of 20101 Front Street	961	8.1	7,808
OF-3611	V-03	CMP at Windsong Apartments	49	3.4	169
OF-3613	V-04	Nelson Park north of Hidden Cove Apts.	843	13.2	11,129
OF-3701	C-03	24" CMP at north end of American Legion Park	171	8.1	1,388
OF-3702	C-05	Cast Iron outfall at south end of American Legion Park	80	3.4	273
OF-3703	C-04	24" CMP at American Legion Park	308	11.9	3,675
OF-3704	V-01	Liberty Shores Creek at retirement home	600	8.3	4,988
OF-3707	V-02	East end of bioswale behind Ken's Auto	338	33.2	11,194
OF-3801	C-06	Anderson Parkway-south side of Gazebo on beach	200	12.8	2,553
OF-3804	C-07	Port of Poulsbo main parking lot, landward of fuel dock gangway	253	11.2	2,823
OF-5403	C-11	Outfall on beach near Fjord Drive at 9th Ave.	219	15.7	3,444
		FRESHWATER OUTFALLS			
WF-01	WF-01	West Fork of Dogfish Creek, downstream of culvert under SR305	297	57.6	17,093
PB-02	PC-01	Poulsbo Creek, downstream culvert at Sommerseth	604	19.2	11,633
PB-03	PC-02	Poulsbo Creek, corner of Ryen & 6th	317	11.1	3,505
PB05	PC-03, PC-04	Poulsbo Creek, Harrison St. culvert at 709 Harrison St.	143	24.0	3,432
PSW4	SF-01	SR305 Stormwater outfall @ SFDC	47	14.8	696
PSW6	SF-04	Poulsbo Village outfall, SR305 at Liberty Rd., NW corner	359	22.9	8,246
PSW7	SF-07	East Caldart Ave. basin, from culvert east of 1508 Hostmark St.	139	19.3	2,677

Table 2-17. Stormwater Outfall Relative Loading (continued)

Station ID	Basin ID	Description	Wet Weather GMV	Basin TIA (ac)	FC Load Index [1/]
		MARINE OUTFALLS			
PSW8	SF-08	Photo of bank by high school - new location is on Mesford	394	17.2	6,762
PSW15	SF-06	SR305 Outfall near O'Reilly's	445	32.4	14,401
PSW17	SF-05	Ditch near Centennial Park	570	16.6	9,486
PSW40	B-03	Bjorgen Creek channel below 24" and 18" outfalls	424	13.5	5,736
PSW41	B-02	Outfall to Bjorgen Creek at spillway below middle school	228	48.9	11,167
OF-8001	B-03	Kevos Pond / Ridgewood basin	490	6.8	3,312

Notes:

[1/] Load Index = TIA * GMV

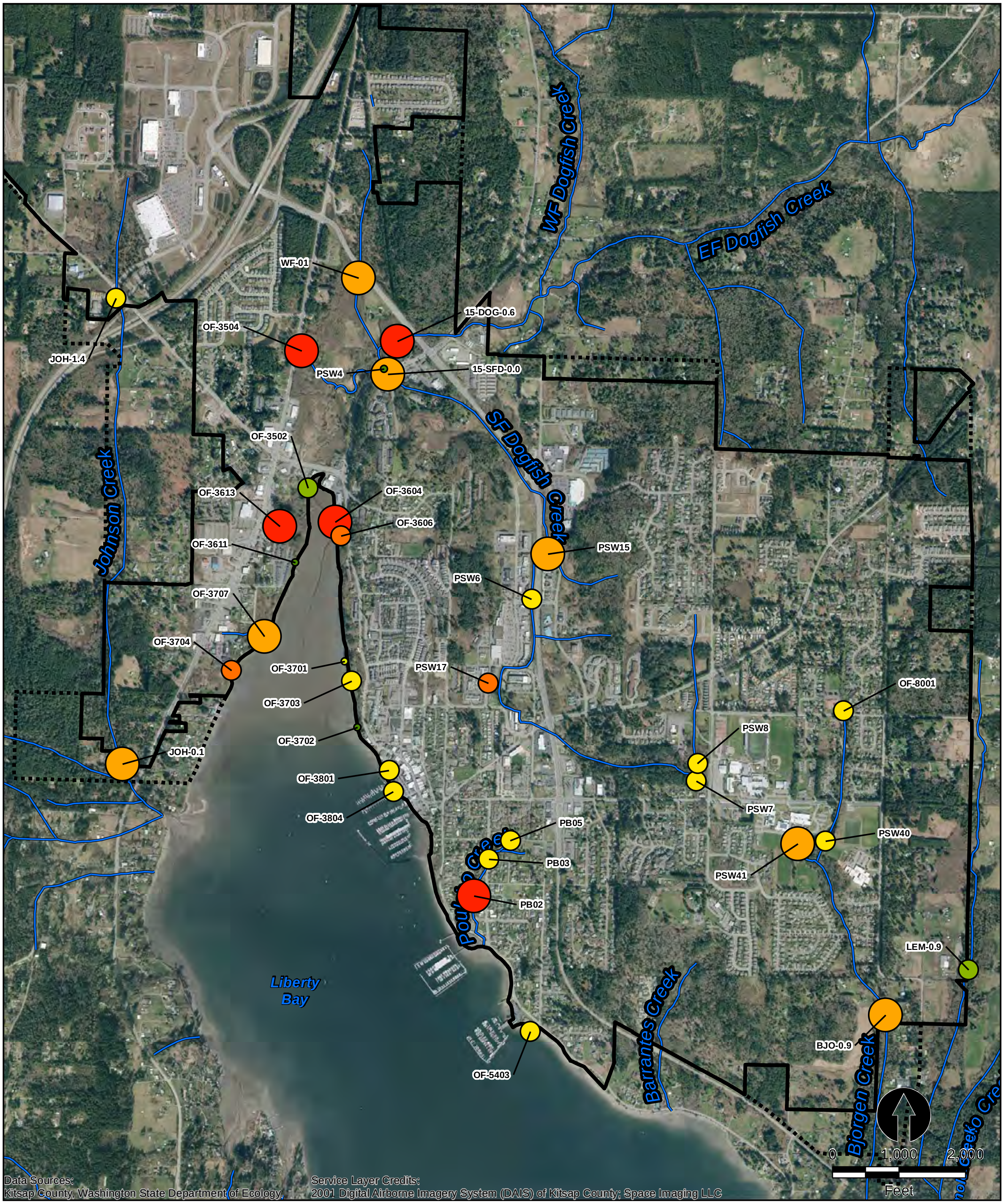
FC Load Index Relative Ranking

Legend	Low: 0 - 4000
	Medium: 4,000 - 8,000
	High: > 8,000

Table 2-18. Stormwater Outfall Water Quality Summary

Station ID	Description	FC GMV (2015) Dry Weather	FC GMV (2015) Wet Weather	FC Load Index
Marine Outfalls				
OF-3502	Nelson Park	40	77	2,242
OF-3504	North Central Viking Ave. outfall to Fish Park	10	1,442	58,931
OF-3604	Liberty Bay Auto-24" CMP	24	1,039	18,221
OF-3606	South of 20101 Front Street	<10	961	7,808
OF-3611	CMP at Windsong Apartments	<10	49	169
OF-3613	Nelson Park north of Hidden Cove Apts.	<10	1,126	11,129
OF-3701	24" CMP at north end of American Legion Park	22	171	1,388
OF-3702	Cast Iron outfall at south end of American Legion Park	<10	80	273
OF-3703	24" CMP at American Legion Park	70	277	3,675
OF-3704	Liberty Shores Creek at retirement home	28	600	4,988
OF-3707	East end of bioswale behind Ken's Auto	17	338	11,194
OF-3801	Anderson Parkway-south side of Gazebo on beach	<10	200	2,553
OF-3804	Port of Poulsbo main parking lot, landward of fuel dock gangway	24	253	2,823
OF-5403	Outfall on beach near Fjord Drive at 9th Ave.	14	219	3,444
Freshwater Outfalls				
WF-01	West Fork of Dogfish Creek, downstream of culvert under SR305	10	297	17,093
PB-02	Poulsbo Creek, downstream culvert at Sommerseth	24	604	11,633
PB-03	Poulsbo Creek, corner of Ryen & 6th	24	317	3,505
PB05	Poulsbo Creek, Harrison St. culvert at 709 Harrison St.	<10	143	3,432
PSW4	SR305 stormwater outfall @ SFDC	<10	47	696
PSW6	Poulsbo Village outfall, SR305 at Liberty Rd., NW corner	10	359	8,246
PSW7	East Caldart Ave. basin, from culvert east of 1508 Hostmark St.	24	139	2,677
PSW8	Photo of bank by high school - new location is on Mesford	50	394	6,762
PSW15	SR305 outfall near O'Reilly’s	33	445	14,401
PSW17	Ditch near Centennial Park	No flow	570	9,486
PSW40	Bjorgen Creek channel below 24" and 18" outfalls	14	424	5,736
PSW41	Outfall to Bjorgen Creek at spillway below middle school	20	228	11,167
OF-8001	Kevos Pond / Ridgewood basin	20	490	3,312

Prepared by Sealaska Environmental, P:\Production\Fig\PMX-TMDL\New Maps\Watershed Assessment\Fig3-17_WQandFC_Indexes.mxd, January 07, 2016.



Streams
City of Poulsbo
PUTA

FC Load
Low
Medium
High

FC Water Quality
Good
Moderate
Poor

Figure 2-25
2015 Water Quality Study Summary
TMDL Implementation Plan
City of Poulsbo

2.4 HABITAT ASSESSMENT

This section provides a summary of habitat conditions within the City including stream, wetland, shoreline, and riparian areas. The assessment is based primarily on the following studies, with emphasis on potential impacts due to stormwater runoff:

- South Fork Dogfish Creek Restoration Master Plan (ICF International 2010)
- City of Poulsbo Shoreline Master Program Update, Cumulative Impacts Analysis & No Net Loss Summary (City 2011)
- Hydrography of and Biochemical Inputs to Liberty Bay, a Small Urban Embayment in Puget Sound, Washington (Takesue 2011)
- Salmonid Habitat Limiting Factors, Water Resource Inventory Area 15 (East) Final Report (Haring 2000)
- East Kitsap County Nearshore Habitat Assessment and Restoration Prioritization Framework (Borde et al. 2009)
- Washington Department of Fish and Wildlife (WDFW) Priority Habitat and Species data (wildlife, forage fish, salmonids), Washington Department of Natural Resources (stream types), WDOH (shellfish harvest areas, beaches) GIS data sets.

2.4.1 Summary of Potential Habitat Impacts from Stormwater

Stormwater can effect fish and wildlife habitat by influencing the physical condition of streams and wetlands, as well as the quality of receiving waters. Numerous studies have linked increases in impervious surfaces such as roofs and parking lots to changes in stream flows and pollutant loading. Significant changes to stream habitat are generally observed when the effective impervious area (the area directly connected via pipes and conveyance systems) in a basin reaches 10 percent (Booth, Hartley, and Jackson 2002). Above the 10 percent impervious threshold, there are substantial increases in stream peak flow frequency and magnitude, channel degradation, and disruption to streambed sediment stability and composition.

All significant perennial stream basins in Poulsbo are over 10 percent TIA, with South Fork Dogfish Creek and Bjorgen Creek over 20 percent TIA. Figure 2-26 summarizes impervious surfaces in major Poulsbo stream basins under both existing and full build out conditions. Figure 2-27 summarizes existing habitat conditions.

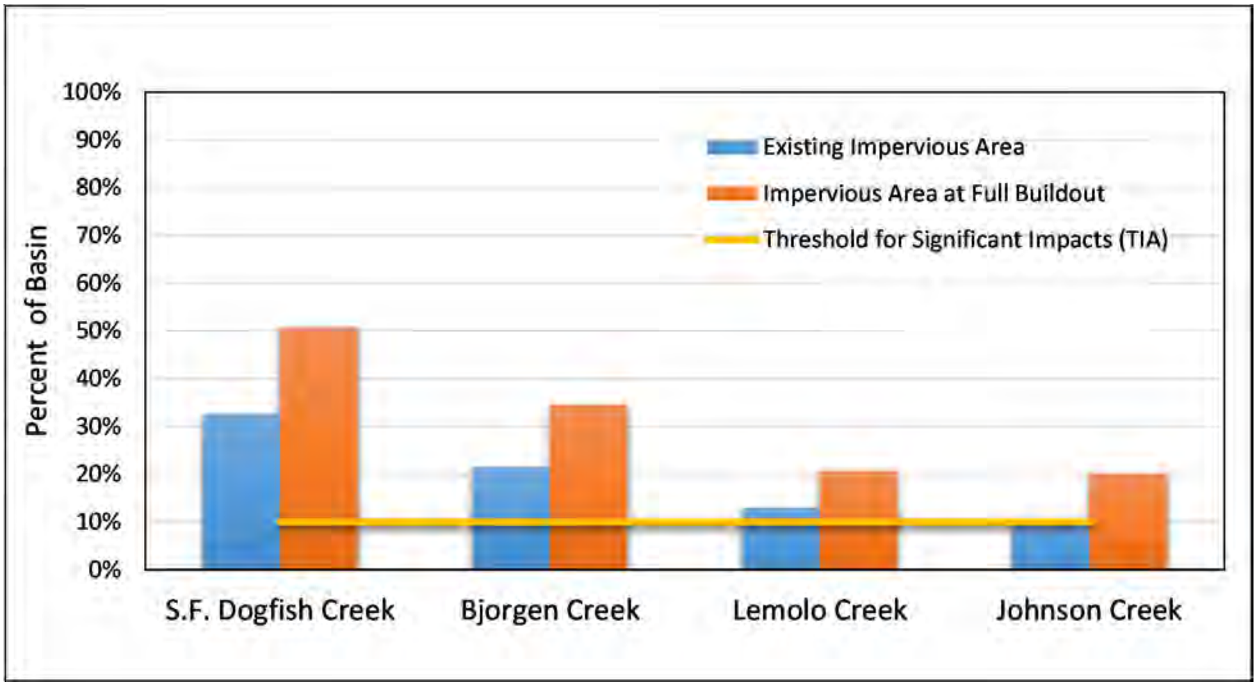


Figure 2-26. Impervious Surfaces in Fish Bearing Streams

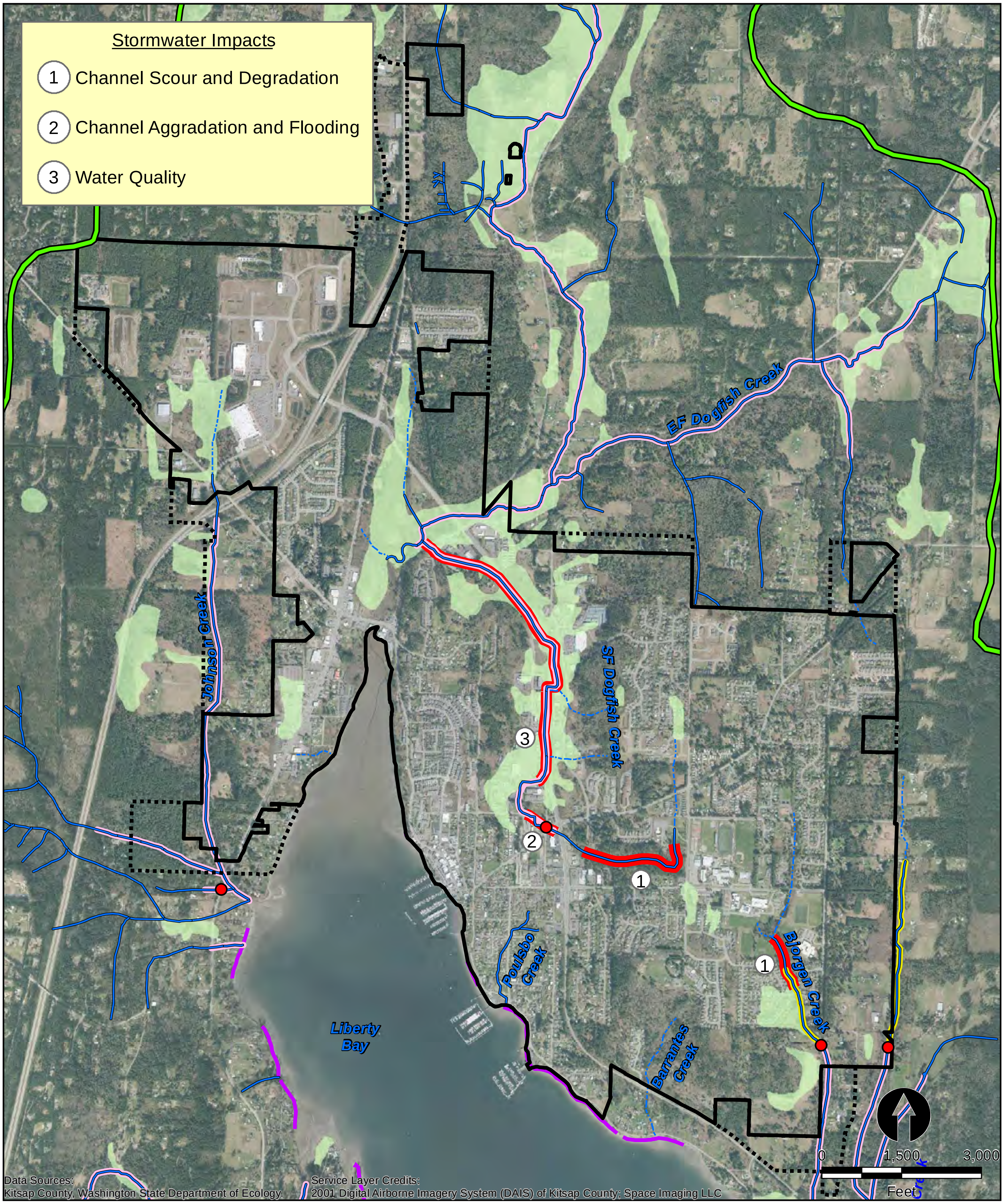
2.4.2 STREAM ASSESSMENT

Table 2-19 summarizes fish presence in perennial streams that are partially or entirely within the City and associated UGA.

Table 2-19. Poulsbo Area Streams and Fish Presence

Stream	Approximate Size (Mainstem River Miles)	Fish Present
Dogfish Creek	7.0	Resident cutthroat trout, chum salmon, coho salmon, Chinook salmon, steelhead
South Fork Dogfish Creek	2.5	Resident cutthroat trout, chum salmon, coho salmon
Bjorgen Creek	1.5	Resident cutthroat trout, chum salmon, coho salmon
Lemolo Creek	2.5	Resident cutthroat trout, chum salmon, coho salmon
Johnson Creek	2.0	Resident cutthroat trout, chum salmon, coho salmon
Poulsbo Creek	1.5	No fish present

Source: Haring 2000



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Liberty Bay Watershed
City of Poulsbo
PUTA
Wetlands & Hydric Soils
Intermittent Stream
Stream
Anadromous Salmonids & Resident Cutthroat
Resident Cutthroat Trout
Stormwater Impacts
Forage Fish Spawning Habitat
Fish Passage Barrier
Deteriorated Outfalls

Figure 2-27
Fish and Wildlife Habitat

TMDL Implementation Plan
City of Poulsbo

Stream habitat conditions are significantly influenced by a variety of factors other than stormwater including land conversion (e.g., forestland to residential), reduced instream flows due to reduced infiltration and groundwater recharge, and loss of natural floodplain processes due to dredging, bank armoring, and channelization. These factors reduce in-stream and riparian function due to alteration of natural vegetation, changed channel morphology, and lower large woody debris recruitment. Evaluation of these land use related habitat influences, while important, are outside of the scope of this report.

Dogfish Creek above Fish Park.

2.4.2.1 Dogfish Creek

The majority of the Dogfish Creek basin is located outside of the City. The lower section of Dogfish Creek that is within the City (vicinity of SR305 and Bond Road) is considered to be in poor condition due to high fine sediment load, untreated stormwater discharges, and encroachment into the riparian zone by roads, agriculture, and commercial and residential development. The Dogfish Creek estuary, in contrast, is in relatively good condition due in large part to the intact riparian buffers provided by the City's Fish Park.

2.4.2.2 South Fork Dogfish Creek

The 650-acre SFDC sub-basin is located entirely within the City of Poulsbo. Habitat in the SFDC has been degraded by historical development that includes commercial and residential development and roads. This development has confined the natural floodplain, eliminating virtually all floodplain function. Development has resulted in excessive peak flows, with stream channel scoured to hardpan in the upper reach, and extensive deposition of fine sediment in the lower gradient reach downstream. This has narrowed the natural floodplain in the upstream reach, and artificially widened the floodplain downstream. The channel scour has resulted in decreased floodplain connectivity. Sediment deposition has filled pools, created a wide, braided channel, and contributed to increased flooding in the lower basin (ICF International 2010).

Insufficient stormwater treatment is a significant contributing factor to degraded habitat conditions in the basin. It is estimated that the existing level of detention provided in the basin is only about eight percent of the detention storage volume that is recommended under current standards, while existing water quality treatment conditions provide treatment for only five percent of the area that would be required under current standards (ICF International 2010).

Incised and scoured channel, Wilderness Park in upper SFDC basin.

In summary, fish and wildlife habitat conditions within the basin have been degraded as a consequence of urbanization and development. Impacts noted throughout the basin include reduced riparian zone widths, reduced diversity of native plants, increased channel and bank erosion, restricted channel migration, disconnected floodplains and wetlands, and loss of adjacent wetlands and off-channel rearing habitat for juvenile salmonids. Additionally, an undersized culvert at 8th Avenue restricts fish passage during high flow conditions.

2.4.2.2.1 Summary of Prior Restoration Activities in SFDC Basin

Although habitat in the SFDC basin have been degraded by historical development, conditions are improving due to a variety of restoration projects implemented in the SFDC basin over the past 10 years, including:

- Removal of five fish passage barrier culverts by Washington State Department of Transportation (WSDOT) as part of the SR305 improvements project in 2006-2007;
- Restoration of 1,000 ft of stream channel and buffer by WSDOT as part of the SR305 project;
- Implementation by the City of critical area and buffer protection requirements in 2007;
- Construction of a regional detention facility in the basin headwaters by the City in 2008;
- Preparation of a Restoration Master Plan by the City in 2010;
- Planting and vegetation management of riparian habitat in the Poulsbo Village vicinity in 2010-2014 period; and
- Purchase of property by the City to support barrier culvert removal and stream channel restoration in 2015.

Collectively, these projects have resulted in significant habitat improvements.

SFDC north of Liberty Road, 2010.

SFDC north of Liberty Road, 2015.

2.4.2.2.2 SFDC Habitat Restoration Needs

Despite recent improvements, habitat impacts exist in much of the basin due to the combined effects of stormwater and development. Inadequate detention results in peak flows that continue to degrade channel conditions. Water quality conditions also remain relatively poor, with periods of elevated FC and low dissolved oxygen levels. Monitoring shows that while the SFDC appears to be following a trend of generally improving long-term water quality conditions, water quality continues to remain consistently below standards with the stream being the second largest source of FC loading to Liberty Bay after the mainstem of Dogfish Creek.

Habitat protection and restoration priorities in the SFDC basin include the following:

- Replacing the fish passage barrier culvert at 8th Street and restoring the channel between 8th Avenue and Centennial Park;
- Implementing bioretention, infiltration, and detention projects in the headwaters of the basin to reduce peak flow impacts and improve water quality and stream recharge; and
- Constructing additional detention and treatment facilities in the middle segment (Poulsbo Village area) to reduce channel and substrate impacts, and improve water quality.

2.4.2.3 Johnson Creek

Johnson Creek drains much of the west Poulsbo area. Habitat conditions in Johnson Creek are generally good but have been affected by a variety of factors including fish passage barriers, low flows, and riparian vegetation alteration. The natural floodplain is generally intact, as it is located within a confined ravine with no significant road impacts. Channel conditions are generally poor, however, with a lack of large woody debris and few pools (Haring 2000). Substrate conditions are typically good from Viking Avenue upstream to Cedar Lane. The majority of development within the headwaters of the basin uses infiltration for stormwater controls, which appear to be effective since there is no channel incision or scouring evident downstream of SR3. Based on existing conditions, no habitat restoration needs are identified in the portion of the Johnson Creek basin that is within the City.

2.4.2.4 Bjorgen Creek

Bjorgen Creek is a relatively low gradient stream the drains a portion of the east Poulsbo area. The upper watershed is fully developed and consists of the NKSD campus, the Ridgewood neighborhood, and portions of the Noll Road corridor. Much of this historical development was constructed without detention, and impacts due to altered hydrology (streambed scour and channel degradation) exist from the NKSD to the Deer Run development.

Bjorgen Creek fish habitat availability is affected by a barrier culvert at Storhoff Road (see Figure 2-27). The culvert at Lemolo Shore Drive also frequently gets blocked with debris and can restrict fish passage. This culvert is identified on the Kitsap County Capital Improvement Projects listing; however, no specific construction schedule has been determined. The culvert under SR305 was repaired by WSDOT in 2012, but prior to 2012 was a complete barrier to salmonids. The culvert under Storhoff Lane is scheduled for restoration by the City in 2018. A dam and associated pond at NKSD at RM 1.3 is also a total barrier, but is located upstream of the upper end of suitable salmonid habitat.

Overall, Bjorgen Creek habitat is affected primarily by fish passage barriers and altered hydrology in the developed basin headwaters. Future barrier removal by the City and Kitsap County will improve fish passage and extend salmonid presence.

2.4.2.4.1 Bjorgen Creek Habitat Restoration Projects

Habitat protection and restoration priorities in the Bjorgen Creek basin include the following:

- Replacement of the Storhoff Lane barrier culvert;
- Retrofit of the NKSD campus with water quality and quantity controls; and
- Improve detention, infiltration, and bioretention in the Ridgewood and Kevos Pond neighborhood.

2.4.2.5 Lemolo Creek

Lemolo Creek is similar to Bjorgen Creek in gradient and basin size. The watershed is currently moderately developed; however, residential development is rapidly increasing in the upper basin near Noll Road.

Lemolo Creek fish habitat availability is affected by several barrier culverts. The culvert at Lemolo Shore Drive is undersized and is subject to blocking. This culvert is identified on the Kitsap County Capital Improvement Projects listing; however, no specific construction schedule has been determined. The culvert under SR305 was repaired by WSDOT in 2012, but prior to 2012 was a complete barrier to salmonids. A private roadway embankment dam and associated pond at RM 1.3 is also a total barrier. Based on existing conditions, no stormwater related habitat restoration needs are identified in the Lemolo Creek basin.

2.4.3 Wetlands

Wetlands provide important fish and wildlife habitat as well as hydrologic functions that store water during wet periods and meter flows to streams during dry periods. Wetlands and hydric soils, which indicate areas where non-delineated wetlands may be present, are shown in Figure 2-27. As shown in Figure 2-27, significant wetland complexes in the City are located at the headwaters of Johnson Creek, SFDC, and Lemolo Creek.

In general, fish and wildlife habitat conditions within City wetlands have been degraded as a consequence of urbanization and development. Changes include reduced riparian zone widths, reduced diversity of native plants, increased channel and bank erosion, restricted channel migration, disconnected floodplains and wetlands, and loss of adjacent wetlands and off-channel rearing habitat for juvenile salmonids. Based on existing conditions, no stormwater related habitat restoration needs are identified for wetlands located in the City.

2.4.4 Shoreline Habitat

Shoreline habitat disturbances in urban areas are generally due to altered watershed hydrology or direct shoreline modification. These disturbances affect near-shore processes, with resulting affects to habitat and species occurrence and use. The Liberty Bay shoreline generally reflects the range of conditions encountered in Puget Sound, with typically moderate levels of impacts to nearshore resources, as well as areas of high and low impacts.

Overall, estuarine/marine nearshore function in the City is substantially impacted by physical alteration of natural estuaries, alteration of nearshore ecological function due to extensive shoreline armoring, loss of shoreline large woody debris, loss of shoreline riparian shade, and poor water/sediment quality (City 2011). Shoreline habitat conditions are generally summarized in Table 2-20.

Table 2-20. Summary of Shoreline Habitat within City of Poulsbo

Shoreline Segment	Habitat Quality	Primary Land Use Condition
Southeast (American Legion Park to South City Limits)	Low	Commercial and residential development, armoring, impervious surfaces
Northeast (American Legion Park to Lindvig Way)	Moderate	Residential development, parks, undeveloped
Dogfish Creek Estuary	Moderate-High	Park and open space
West (Lindvig Way to south City limits)	Low	Commercial and residential development, armoring, impervious surfaces

Source: City of Poulsbo 2011

Specific shoreline habitat includes surf smelt and Pacific Sand Lance intertidal spawning habitat along portions of east side of Liberty Bay within City Limits (Figure 2-27). Forage fish are the basis of Puget Sound food webs that include predatory fish, sea birds, and marine mammals, and life cycles of forage fish are closely tied to beach and nearshore habitats.

2.4.4.1 *Shoreline Habitat Restoration Projects*

Shoreline habitat protection and restoration priorities as they relate to surface and stormwater management include the following:

- Stormwater outfall restoration including Poulsbo Creek and outfalls OF-3604 (Liberty Bay Auto property) and OF-3703 (Poulsbo Place outfall at American Legion Park). These outfalls are in deteriorated condition and contribute to both nearshore substrate impacts via relic armoring, as well as nearshore erosion due to concentrated flow.
- Stormwater runoff and shoreline stabilization on Fjord Drive which is contributing to shoreline erosion and riparian buffer deterioration.
- Nearshore habitat restoration and beach supplementation at Muriel Williams Waterfront Park where extensive shoreline armoring and erosion are causing loss of nearshore substrate and erosion of riprap armoring.

2.4.4.2 *Shellfish Occurrence and Harvest*

Portions of Liberty Bay have been classified as a conditionally approved for shellfish harvest area since 1967. In 1994, 681 acres of shellfish beds within Liberty Bay were classified as restricted, with an additional 610 acres classified by the WDOH in 1991 as prohibited due to elevated FC contamination from animal wastes, nearby marinas, and other nonpoint sources.

The east side of Liberty Bay is closed to commercial shellfish harvest due to proximity to marinas and urban stormwater discharges. Lemolo Bay is open for commercial shellfish harvest at several commercial shellfish harvest sites along the shoreline just south of City Limits/Urban Growth Area. The west side of Liberty Bay currently being evaluated by WDOH for approval of commercial shellfish harvest.

2.5 STORMWATER INFRASTRUCTURE ASSESSMENT

The purpose of the stormwater infrastructure assessment is to identify areas where adequately functioning stormwater treatment facilities are generally present, and areas where there are minimal or no treatment facilities. The assessment was conducted by delineating specific catchment areas and evaluating treatment facilities and conditions within each catchment area. The assessment considers the age and type of developments, existing and future impervious surfaces, and type and location of existing treatment facilities.

The assessment used GIS to analyze the City stormwater system, impervious surface data collected by National Oceanic and Atmospheric Administration (NOAA), and approximate age of development. Information on pending and in-process development was added to account for impervious surfaces that are under construction, but are not included in the NOAA impervious surface data set. Treatment areas were determined by delineating specific areas based on the approximate age of development, and the corresponding stormwater management requirements that were in effect at the time the development occurred. Information was then tabulated and mapped to identify basins and sub-basins that may warrant corrective action based on extent of both impervious surfaces and treatment facilities.

Basin size and impervious area are summarized in Figure 2-28. Existing sub-basin, stormwater facility, and treatment areas are shown in Figures 2-29, 2-30, and 2-31. The complete set of basin assessment data is provided in Appendix A.

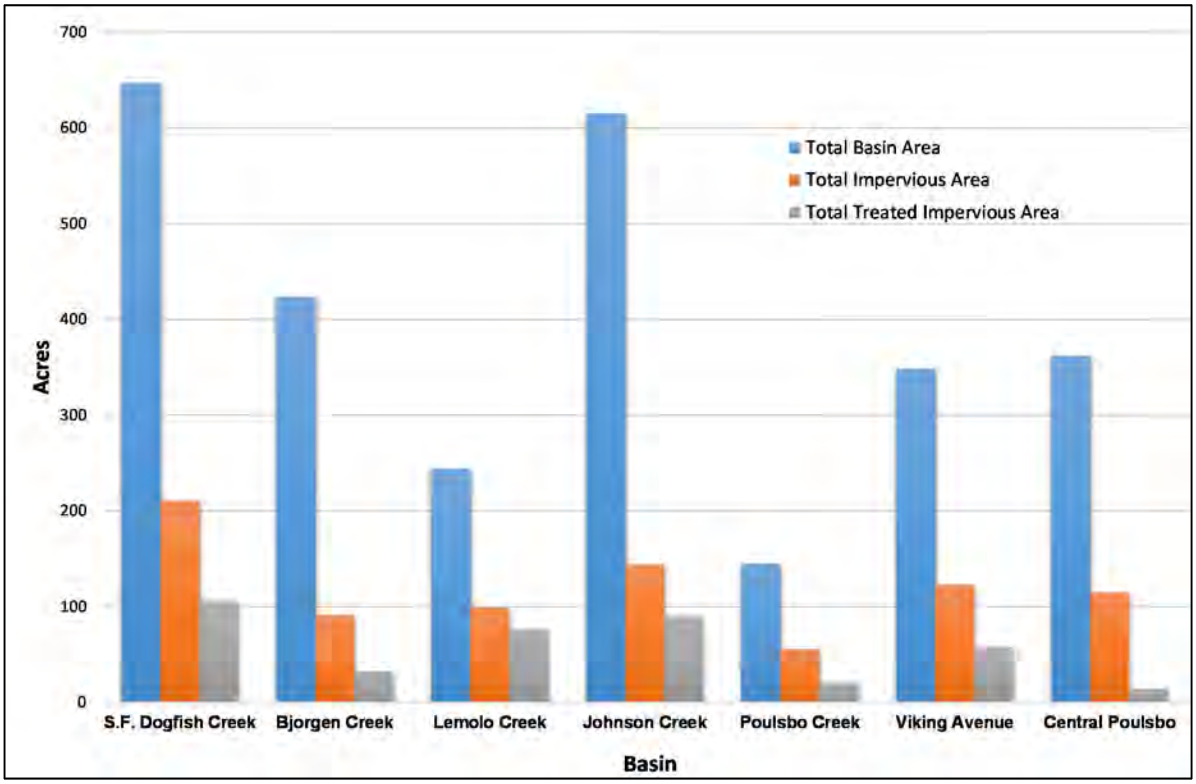


Figure 2-28. Basin Area and Impervious Surface Summary

The basin assessment shows that most of the City has TIA of between20 and 40 percent. Areas of the City that were developed prior to 1992 typically have a lower relative proportion of treated areas, including central Poulsbo (90 percent of TIA is untreated), Poulsbo Creek (70 percent of TIA is untreated), and upper Bjorgen Creek (90 percent of TIA is untreated). In contrast, basins with more recent development have a much higher proportion of treated TIA, including Lemolo Creek (90 percent of TIA is treated) and Johnson Creek (80 percent of TIA is treated).

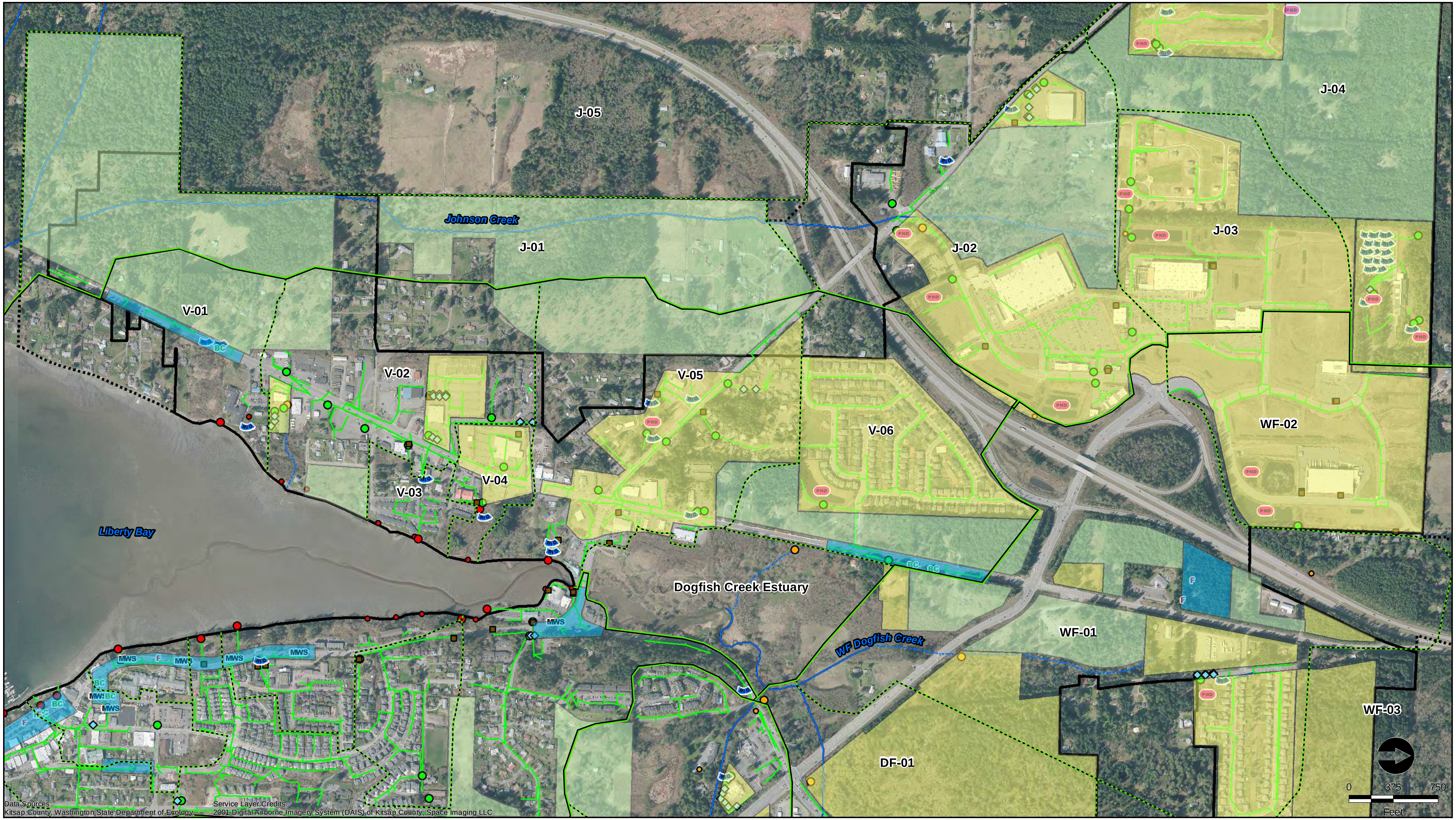
Treatment area delineation shows that overall, about 60 percent of existing TIA in the City is treated to standards associated with the either the 1992 Ecology Stormwater Management Manual, or the 1997 Kitsap County Stormwater Manual. Note that the treatment values are approximate and only cover the portion of the basin that is located within the City.

Both the 1992 and 1997 manuals were adopted by the City of Poulsbo in the 1996-1997 period. Prior to 1996, stormwater management was done pursuant to the City's Developer Guide, which focused primarily on quantity control. Water quality treatment for areas with direct marine discharge was typically oil/water separators (OWS) for commercial impervious surfaces and bioswales for residential development. Wet ponds were used for combined quantity and quality treatment in many areas that discharged to streams.

Treatment BMPs in the 1992 and 1997 Manuals were primarily wet ponds, biofiltration swales, and OWS. While these BMPs provide a basic level of treatment, they are not considered particularly effective for treatment of FC. Wet pond FC removal efficiency is typically in the range of 10 to 50 percent, and under the right conditions, wet pond BMPs can actually be sources of indicator bacteria due to both animal activity and indicator bacteria persistence (Hathaway 2009). Bioswale removal efficiency has been shown to be highly variable, and current stormwater manuals recommend using other treatment methods that provide more consistent performance. OWS systems provide little to no FC treatment. Therefore, areas of the City that are treated to 1992/1997 manual requirements may not be providing significant FC removal. This conclusion is supported by 2015 sampling data that shows several basins with relatively high percent TIA treatment continue to contribute significant FC loading.

Basins that are potential priorities for corrective actions were determined based on a combination of relatively high percentage of impervious surfaces, as well as relatively high quantities of untreated impervious. The highest priority sub-basins based on these criteria are as follows:

- Basins SF-04 and SF-05, consisting of the middle segment of SFDC including the Poulsbo Library and Poulsbo Village.
- Basins V-02 and V-06, consisting of North and South Viking Avenue.
- Basins PC-02, the middle segment of the Poulsbo Creek basin.
- Basin B-02, the upper Bjorgen Creek basin including NKSD and the Ridgewood neighborhood.
- Basins C-01, C-04, and C-11, consisting of the Torval Canyon, Poulsbo Place, and Viking Heights/Fjord Drive neighborhoods.



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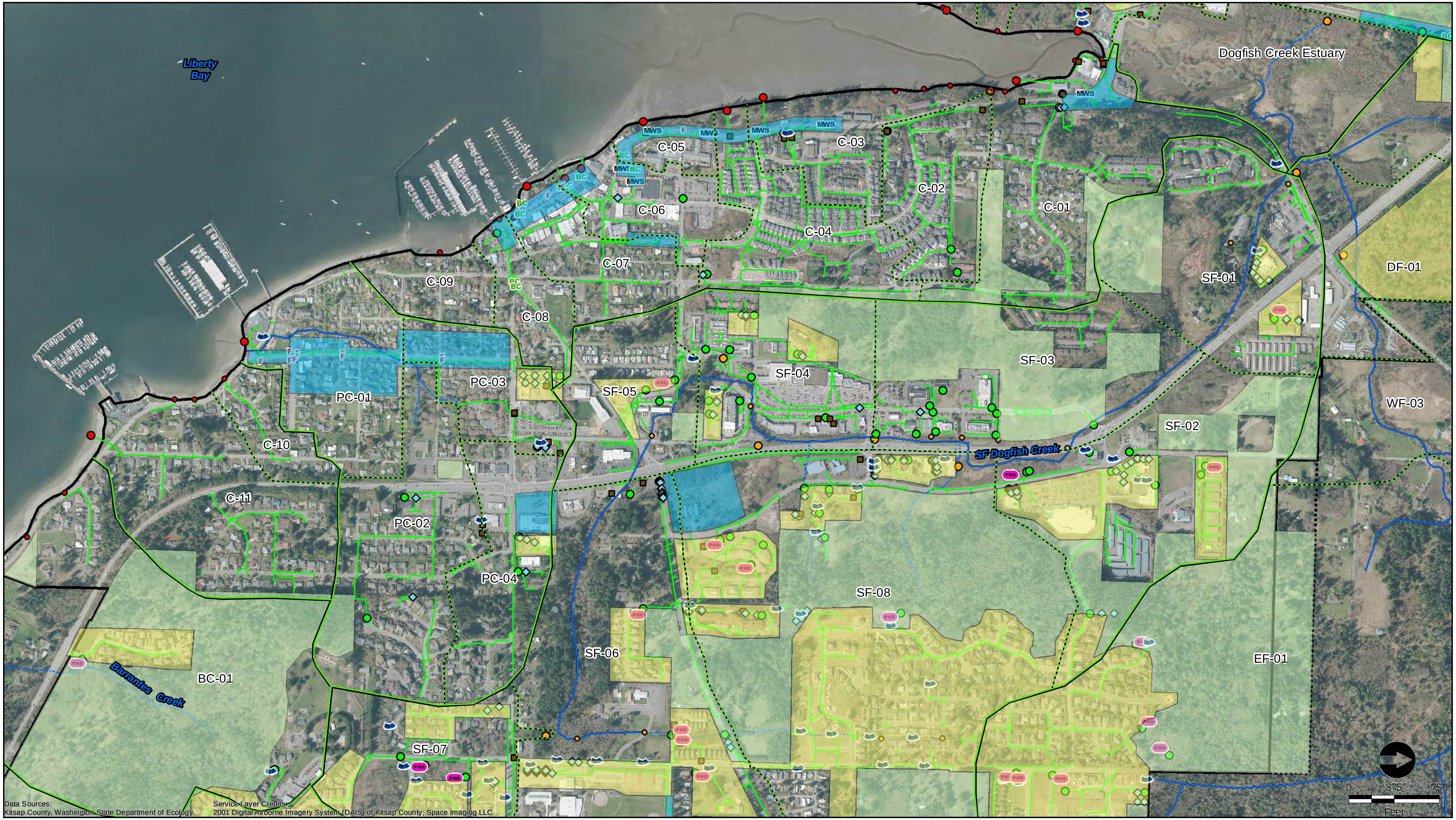
- Basin Boundary
- Sub-Basin Boundary
- City of Poulsbo
- PUTA
- Stormwater Pipe
- Stream
- Intermittent Stream
- Control Structure
- Oil Water Separator
- Underground Detention Facility
- Major Marine Outfall
- Minor Marine Outfall
- Major Freshwater Outfall
- Minor Freshwater Outfall
- Filterra Vault
- Modular Wetland System
- Bioretention Cell
- Detention/Retention Pond
- Bioswale
- Meets 1992/1997 SWM Manual Rqmts
- Meets 2005 SWM Manual Rqmts
- Future Developable
- WF-02 Sub-Basin I.D.

Figure 2-29
Stormwater Treatment Areas, Poulsbo West
TMDL Implementation Plan
City of Poulsbo



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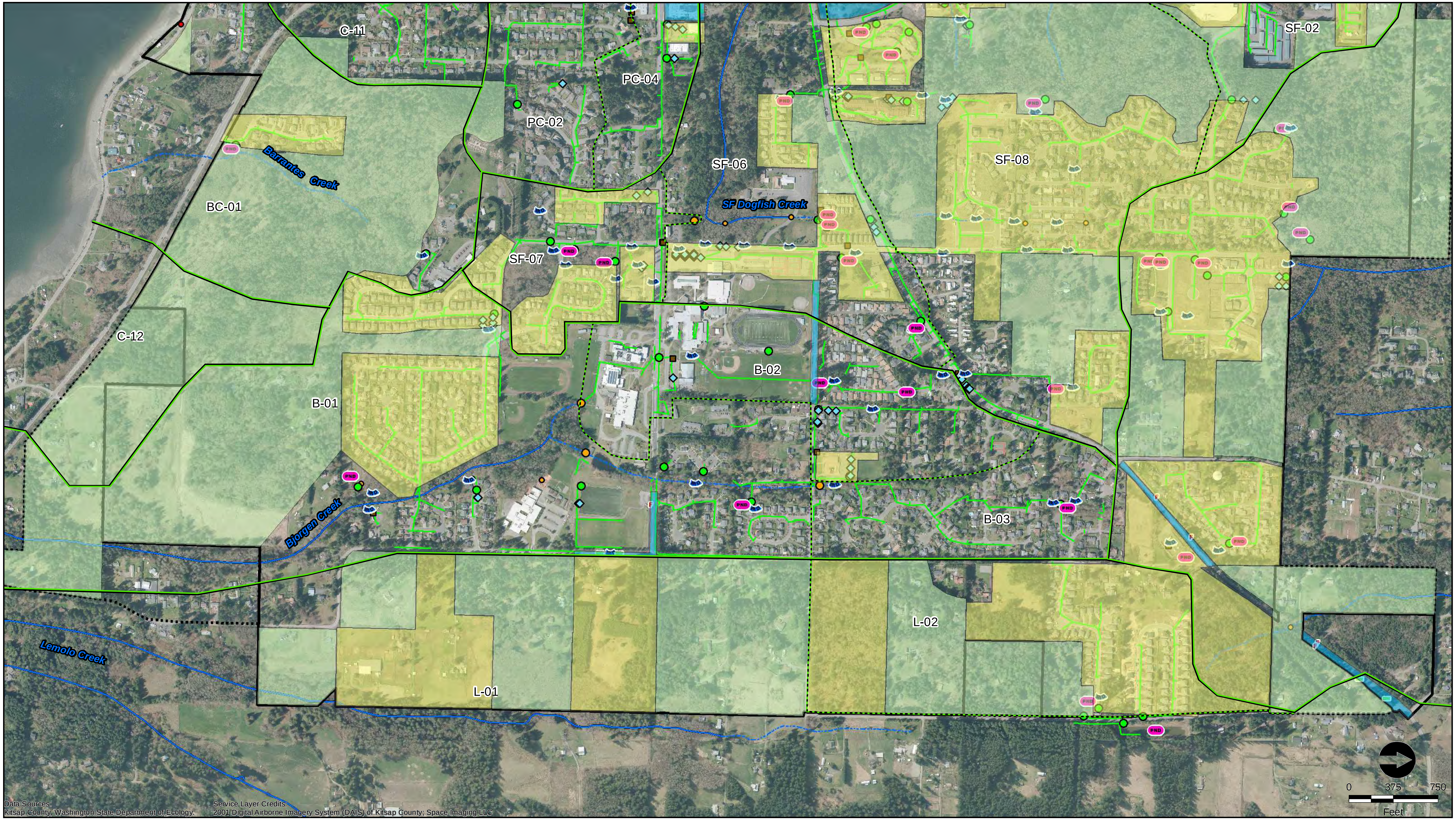
Basin Boundary
Sub-Basin Boundary
City of Poulsbo
PUTA
Stormwater Pipe
Stream
Intermittent Stream
Control Structure
Oil Water Separator
Underground Detention Facility
Major Marine Outfall
Minor Marine Outfall
Major Freshwater Outfall
Minor Freshwater Outfall
Filterra Vault
Modular Wetland System
Bioretention Cell
Detention/Retention Pond
Bioswale
Meets 1992/1997 SWM Manual Rqmts
Meets 2005 SWM Manual Rqmts
Future Developable
SF-02 Sub-Basin I.D.

Figure 2-30
Stormwater Treatment Areas, Central Poulsbo
TMDL Implementation Plan
City of Poulsbo



Prepared by Sealaska Environmental, H:\Active Projects\GIS\PMX-TMDL\New Maps\Fig10C_StormwaterTreatmentAreasEast.mxd, December 11, 2015.

Basin Boundary
Sub-Basin Boundary
City of Poulsbo
PUTA
Stormwater Pipe
Stream
Intermittent Stream
Control Structure
Oil Water Separator
Underground Detention Facility
Major Marine Outfall
Minor Marine Outfall
Major Freshwater Outfall
Minor Freshwater Outfall
Filterra Vault
Modular Wetland System
Bioretention Cell
Detention/Retention Pond
Bioswale
Meets 1992/1997 SWM Manual Rqmts
Meets 2005 SWM Manual Rqmts
Future Developable
EP-02 Sub-Basin I.D.

Figure 2-31
Stormwater Treatment Areas, Poulsbo East
TMDL Implementation Plan
City of Poulsbo

3 NEEDS AND OPPORTUNITIES

The goal of the Needs and Opportunities assessment (NOA) is to identify specific structural and non-structural projects and actions to improve water quality at prioritized locations in the City. The NOA uses the results of the Watershed Assessment to identify and prioritize specific basins and development areas that have been, are currently, or have potential in the future for water quality problems.

The NOA documents the process of identifying, developing and prioritizing retrofit projects in the City. Conceptual-level designs are also presented for the top priority retrofit projects to support capital project planning and pursuit of funding for implementation. This NOA also supports design of future projects, and coordinating potential project opportunities with public and private property owners.

3.1 PURPOSE AND SCOPE

The purpose of the NOA is to identify specific structural and non-structural actions, and resources that may be necessary to meet TMDL targets and milestones through the next 6 years, ending in 2021. These actions are targeted to specific priority basins and outfall locations (as determined from the Watershed Assessment), and include capital facilities, enhanced operation and maintenance practices, public information and education, or special facility or basin designations.

The NOA consists of the following scope:

- A summary of the corrective action priorities from the Watershed Assessment including prioritization of specific water quality and habitat problem locations.
- Development of project ranking criteria.
- For capital projects, preliminary site suitability analysis (physical features, critical areas, soil type, ownership, etc.) and feasibility analysis including schematic plans and costs for each of the potential projects.
- For non-structural projects, identification of potential actions.
- Summary ranking of projects and evaluation of funding and financing for implementation.

3.2 CORRECTIVE ACTION PRIORITIES

Corrective action priorities were assessed by an integrated evaluation of watershed assessment results. Prioritization was performed using the combined results of the water quality, habitat, and infrastructure assessment. The combined assessment results were sorted and ranked using the criteria shown in Table 3-1.

Table 3-1. Basin Ranking Criteria for Combined Assessment Results

Score	FC Load Index 1/	Wet Weather FC GMV	Total Impervious Area 1/	Untreated Impervious Area	Land Use	Resource Presence and Vulnerability
1	<4,000	0-100	<10%	<10 ac	Less than 20% high or medium density	No salmonids or forage fish present
2	4,000 - 10,000	101-499	10% to 25%	10 - 19 ac	20% to 50% high or medium density	Native trout or forage fish present
3	>10,000	>500	> 25%	>19 ac	More than 50% high or medium density	Anadromous salmonids present

Notes:
1/ FC Load Index = (TIA)*(GM FC Concentration)
TIA – Total Impervious Area
GM – geometric mean
GMV – geometric mean value

Sub-basin ranking is presented in Table 3-2. Ranking is presented sequentially (highest to lowest) and by category (high, moderate, and low priority). Basin priorities based on combined assessment results are shown in Figure 3-1. The highest priority basins for corrective action are summarized below.

3.2.1 South Fork Dogfish Creek Basin near 8th Avenue and Poulsbo Village

This 78-acre portion of the SFDC basin is located between the State Route (SR) 305-Lincoln Road intersection, and the 7th Avenue-SR305 intersection (sub-basins SF-04 and SF-05). This area includes the Poulsbo Public Works Complex, the Poulsbo Library, and the Poulsbo Village commercial zone. These basins have high FC concentrations, concentrated urban commercial development, and high proportion of untreated impervious surfaces. Stream habitat is degraded by barrier culverts, channel erosion, and channel aggradation. This area is the highest priority for action based on the Watershed Assessment.

3.2.2 South Central Viking Avenue

This 80-acre basin (sub-basin V-02) includes much of the south central Viking Avenue and adjacent commercial area. The basin in approximately 50 percent TIA, with large areas of parking and commercial land use. The majority of TIA in the basin is untreated, and discharges have both high FC concentration and load.

3.2.3 Middle Segment of Poulsbo Creek Upstream of 6th Avenue

The middle segment of Poulsbo Creek consists of a 54-acre area generally located between 6th Avenue and the Viking Heights development (sub-basin PB-02). It includes portions of SR305, urban commercial development, and high-density residential development. There is no significant stormwater treatment in this basin, and discharges have high FC concentration and load.

Table 3-2. Basin Rank Based on Water Quality, Land Use, Habitat, and Stormwater Infrastructure

Basin	Sub-Basin	Wet Weather FC GMV	FC Load Index	Total Imp Surface	Untreated Imp Surface	Land Use	Resource Presence & Vulnerability	Total Score	Sub-basin Rank All Criteria	Basin Rank All Criteria
South Fork Dogfish Creek	SF-01	2	2	2	3	2	3	14	**5**	
	SF-02	2	2	2	2	2	3	13	**6**	
	SF-03	2	2	2	3	2	3	14	**5**	
	SF-04	2	3	3	3	3	3	17	**2**	
	SF-05	3	3	3	3	3	3	18	**1**	
	SF-06	2	3	2	2	3	2	14	**5**	
	SF-07	2	1	3	3	3	1	13	**6**	
	SF-08	2	3	2	1	3	1	12	**7**	
	Average		2	2		3	2	14		**1**
Dogfish Creek	DF-01	3	1	3	2	3	3	15	**4**	
	WF-01	2	3	1	2	2	1	11	**8**	
	WF-02	2	1	2	3	1	1	10	**9**	
	WF-03	2	1	1	1	1	1	7	**10**	
	EF-01	3	1	1	1	1	3	10	**8**	
	Average		2	2		2	2	11		**3**
Bjorgen Creek	B-01	2	3	1	2	2	3	13	**6**	
	B-02	2	3	3	3	3	1	15	**4**	
	B-03	2	2	2	3	3	1	13	**6**	
	Average		3	3		2	1	14		**1**
Lemolo Creek	L-01	1	1	2	1	1	3	9	**8**	
	L-02	1	1	1	1	3	1	8	**9**	
	Average		2	2		2	1	9		**5**
Johnson Creek	J-01	2	3	1	3	1	3	13	**6**	
	J-02	2	1	1	1	3	1	9	**8**	
	J-03	2	1	3	1	3	1	11	**8**	
	J-04	2	1	1	1	2	1	8	**9**	
	J-05	2	1	1	1	1	1	7	**10**	
	Average		1	1		2	1	10		**4**
Poulsbo Creek	PB-01	3	1	2	2	3	2	13	**6**	
	PB-02	3	3	3	3	3	1	16	**3**	
	PB-03	2	1	3	3	3	1	13	**6**	
	PB-04	1	1	3	3	3	1	12	**7**	
	Average		1	2		2	1	14		**1**
Barrantes Creek	BC-01	1	1	1	2	1	1	7	**10**	
	Average			3			1	6		**6**
Viking Avenue	V-01	3	2	2	3	2	1	13	**6**	
	V-02	2	3	3	3	3	1	15	**4**	
	V-03	1	1	3	3	3	1	12	**7**	
	V-04	3	3	3	2	3	1	15	**4**	
	V-05	1	1	2	2	3	1	10	**9**	
	V-06	3	3	2	2	3	1	14	**5**	
	Dogfish Creek Estuary	1	1	1	3	1	3	10	**9**	
	Average		2	2		2	1	13		**2**
Central	C-01	3	3	3	3	2	1	15	**4**	
	C-02	3	2	3	3	3	1	15	**4**	
	C-03	2	1	3	3	3	1	13	**6**	
	C-04	2	1	3	3	3	1	13	**6**	
	C-05	1	1	2	3	3	1	11	**8**	
	C-06	2	1	3	3	3	1	13	**6**	
	C-07	2	1	3	3	3	1	13	**6**	
	C-08	1	1	3	3	3	1	12	**7**	
	C-09	1	1	3	3	3	1	12	**7**	
	C-10	1	1	3	3	3	2	13	**6**	
	C-11	2	1	3	3	3	2	14	**5**	
	C-12	1	1	1	3	2	2	10	**11**	
	Average		1	3		3	1	13		**2**
	High									
	Moderate-High									
	Moderate									
	Low									

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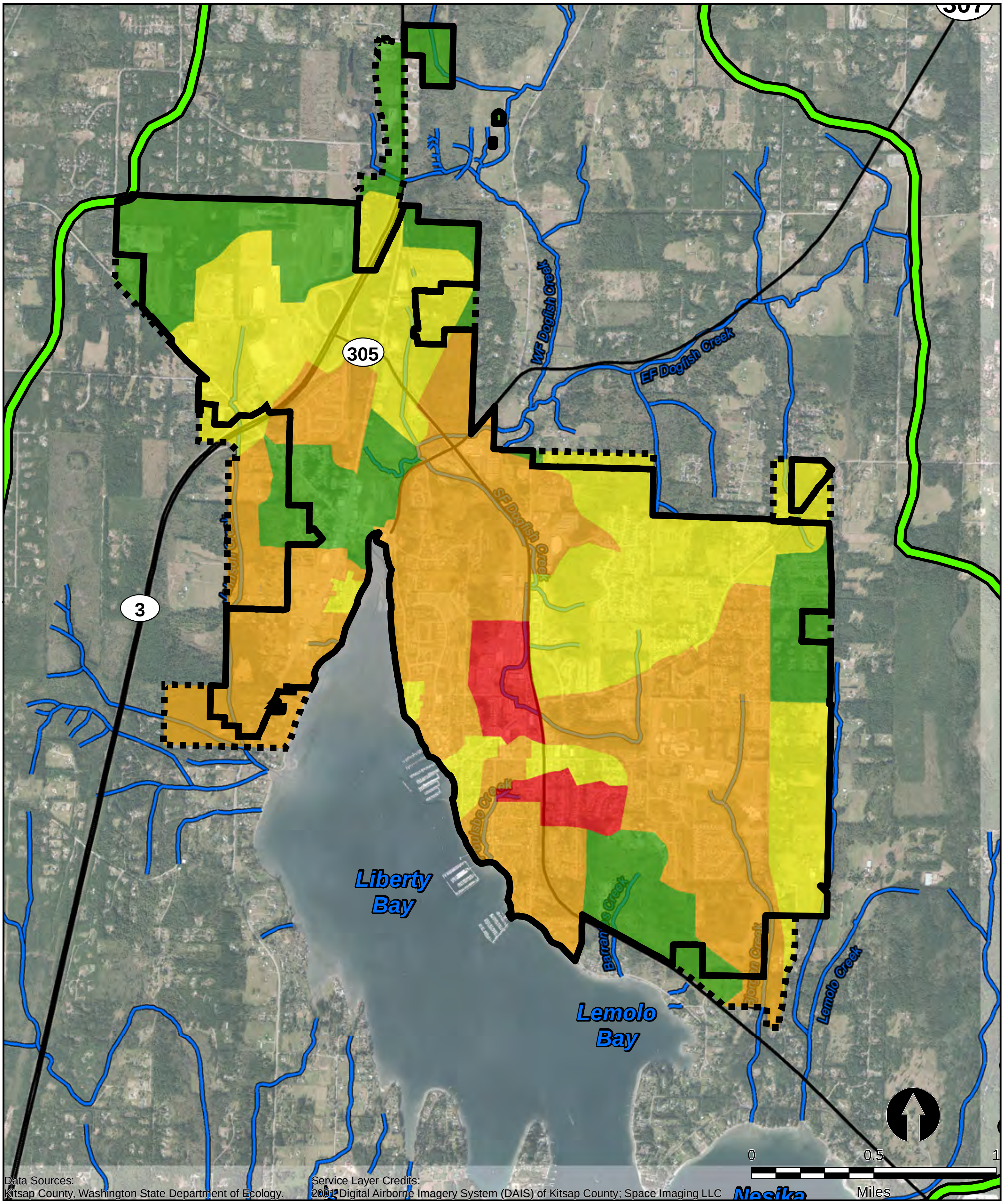

Liberty Bay Watershed
City of Poulsbo
PUTA
Highway

Sub Basin Ranking
High
Moderate-High
Moderate
Low

Figure 3-1
Priority Areas Based On Combined Criteria
TMDL Implementation Plan
City of Poulsbo

3.2.4 Upper Bjorgen Creek Basin above North Kitsap School District Campus

This 76-acre basin (sub-basin B-02) includes much of the NKSD campus, and the Ridgewood and Kevos Pond neighborhoods. There is no significant stormwater treatment in this basin, and discharges have high FC concentration and load. Stream habitat is degraded by channel erosion associated with high peak flows.

3.2.5 Lower Dogfish Creek Basin

The 62-acre lower Dogfish Creek basin (sub-basin DF-01) ranked as a high priority due to high loading in Dogfish Creek, as well as high levels of TIA associated with the future Edward Rose development. The ranking is skewed however, due to the Dogfish Creek loading that occurs upstream of the City, as well as the TIA associated with the approved but not yet constructed Edward Rose development. This sub-basin should therefore be considered a moderately high priority.

3.2.6 Other Moderate to High-Priority Basins

Other basins that are considered moderate to high priorities are central Viking Avenue (sub-basin V-04), Torval Canyon (sub-basin C-01), and north Viking Avenue near the Stendahl Ridge development (sub-basin V-06). Several of these basins are served by existing treatment facilities and may benefit from enhanced O&M actions.

4 CAPITAL PROJECT DEVELOPMENT AND PRIORITIZATION

Specific projects were developed to address each of the high-priority sub-basins identified via the Watershed Assessment. The process used to develop and prioritize capital projects is described below.

4.1 CAPITAL PROJECT DEVELOPMENT AND SELECTION

Capital projects were developed to address identified concerns using the following general process:

- Identify opportunity areas within priority basins based on existing stormwater infrastructure, available right-of-way, or availability of other City property.
- Develop a suite of potential treatment options with documented FC treatment performance as shown in Table 4-1.

Table 4-1. Relative Performance of Fecal Coliform Treatment Options

Treatment Source	FC % Removal
Treatment Wetlands	90%
Filterra and Modular Wetland Systems	80%
Permeable Pavement	90%
Standard Bioretention	50%+

Source: Kitsap County 2013

- Assess treatment options based on infiltration potential (Figure 4-1), existing stormwater infrastructure (collection and conveyance systems), and critical area constraints.
- Select candidate sites and determine potential feasibility and benefits of retrofit design options. The following criteria were used to evaluate specific sites:
  - Feasibility based on topography, available space, site drainage, cost, and specific site constraints including parking, buildings, and critical areas such as wetlands, streams, and steep slopes.
  - Size of contributing basin that could be routed to the site.
  - Expected water quality or flow control benefit based on type and intensity of existing impervious surfaces, and presence or absence of water quality treatment and/or flow control facilities.
  - Potential to mitigate multiple problems and/or sub-basins in an individual retrofit project location.
  - Extent and complexity of site challenges including connection to existing storm drain system, high water tables, and utility conflicts.

In addition to the above criteria, other potential project benefits were considered including public support, education, consistency with City Comprehensive and Parks/Open Space Plans, and opportunity for the City to partner with another agency or stakeholder to implement the project.

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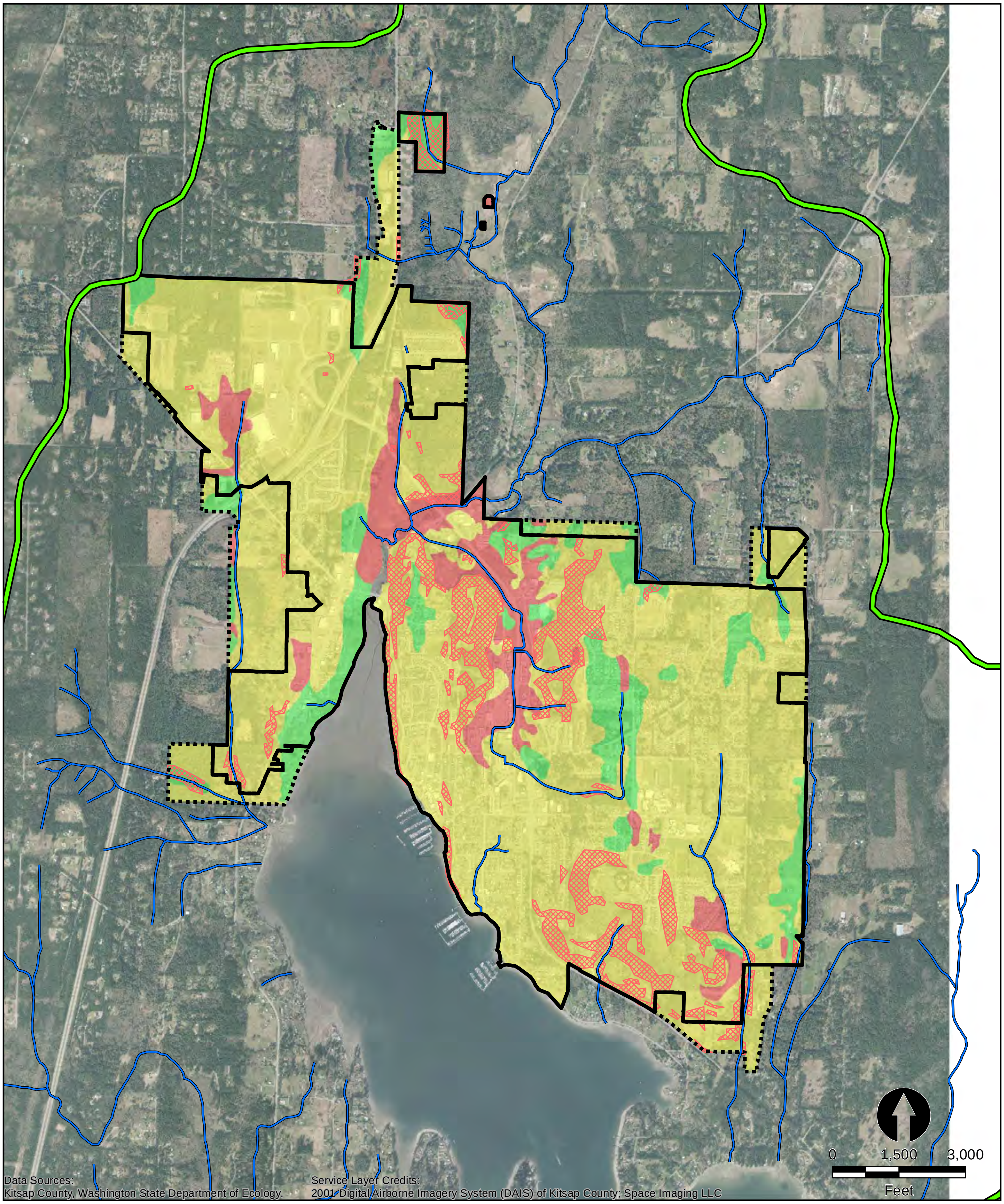


Figure 4-1
Infiltration Potential
TMDL Implementation Plan
City of Poulsbo

Based on this assessment, a total of 16 potential retrofit sites were identified and ranked.

4.2 CAPITAL PROJECT RANKING AND PRIORITIZATION

Candidate projects were screened, compared, and rated relative to a set of criteria that included water quality, flood control, habitat, and community development criteria. Table 4-2 summarizes scoring criteria, and Appendix B provides complete scoring details and ratings of individual projects.

Table 4-2. Summary of Project Rating Criteria

Criteria	Maximum Possible Score
Water Quality	21
Flow Control	18
Flood Reduction	20
Habitat	18
Economic Development and Partnerships	20
Puget Sound Partnership Strategic Initiatives	5
Public Complaints and Perceptions	5
Operation, Maintenance and Infrastructure Replacement	10
Maximum Potential Score	**127**

Projects were prioritized as either high, medium, or low based on scores. Project prioritization will be reviewed and revised annually by the City based on new information, funding availability, and specific project needs.

4.3 CAPITAL PROJECT DESIGN AND COST ESTIMATING

Conceptual designs were developed for 16 candidate projects. The stormwater BMPs selected for these sites include bioretention, bioretention with underdrains, permeable pavement, treatment wetlands, and vault systems. Preliminary facility sizing was performed for each project based on typical contributing basin ratios, summarized as follows:

- Bioretention cells using standard bioretention soil mix: 1 sq-ft bioretention per 10 sq-ft contributing basin area.
- Bioretention cells using Filterra media: 1 sq-ft bioretention per 500 sq-ft contributing basin area.
- Filterra and Modular Wetland System vaults: 1 sq-ft bioretention per 500 sq-ft contributing basin area.
- Stormwater Treatment Wetlands: 1 sq-ft wetland per 15 sq-ft contributing basin area.

Planning-level project costs were developed for each project including design, project management, construction management, and permitting. Construction costs were calculated using bid tabulations from similar projects in the Kitsap County area. Design, project management, construction management, and contingency costs were added based on typical percentage of construction costs.

5 CAPITAL IMPROVEMENT PLAN

The CIP identifies the specific facilities, relative priorities, and costs of capital projects that address and implement PTIP goals. A total of 16 specific projects were developed to address each of the high-priority sub-basins identified via the Watershed Assessment. Individual project concept designs are provided in Appendix C, and individual cost estimates are provided in Appendix D.

The list of CIP projects was screened, compared, and rated. Projects were then programmed into a plan and schedule that considered the project cost, potential funding source, and project timing. The resultant CIP is shown in Table 5-1, with project locations shown in Figure 5-1. Individual projects are summarized below.

SF Dogfish Creek Restoration at 8th Avenue

The South Fork of Dogfish Creek downstream of 8th Avenue frequently floods due to upstream erosion that has resulted in channel aggradation, which creates a shallow and flat channel that is not able to convey peak flows. This project will consist of restoring 525-ft of degraded stream and 36,750 sq-ft riparian buffer between 8th Avenue and Centennial Park. The project will construct bioretention facilities to treat run-off from the existing Public Works site and portions of Lincoln Road, 8th Avenue, 7th Avenue, and Iverson Street. The existing detention pond at the Poulsbo Library will be retrofit into a treatment wetland, and a new treatment wetland would be constructed for runoff from SR305 and portions of adjacent commercial development.

SF Dogfish Creek Culvert Replacement at 8th Avenue

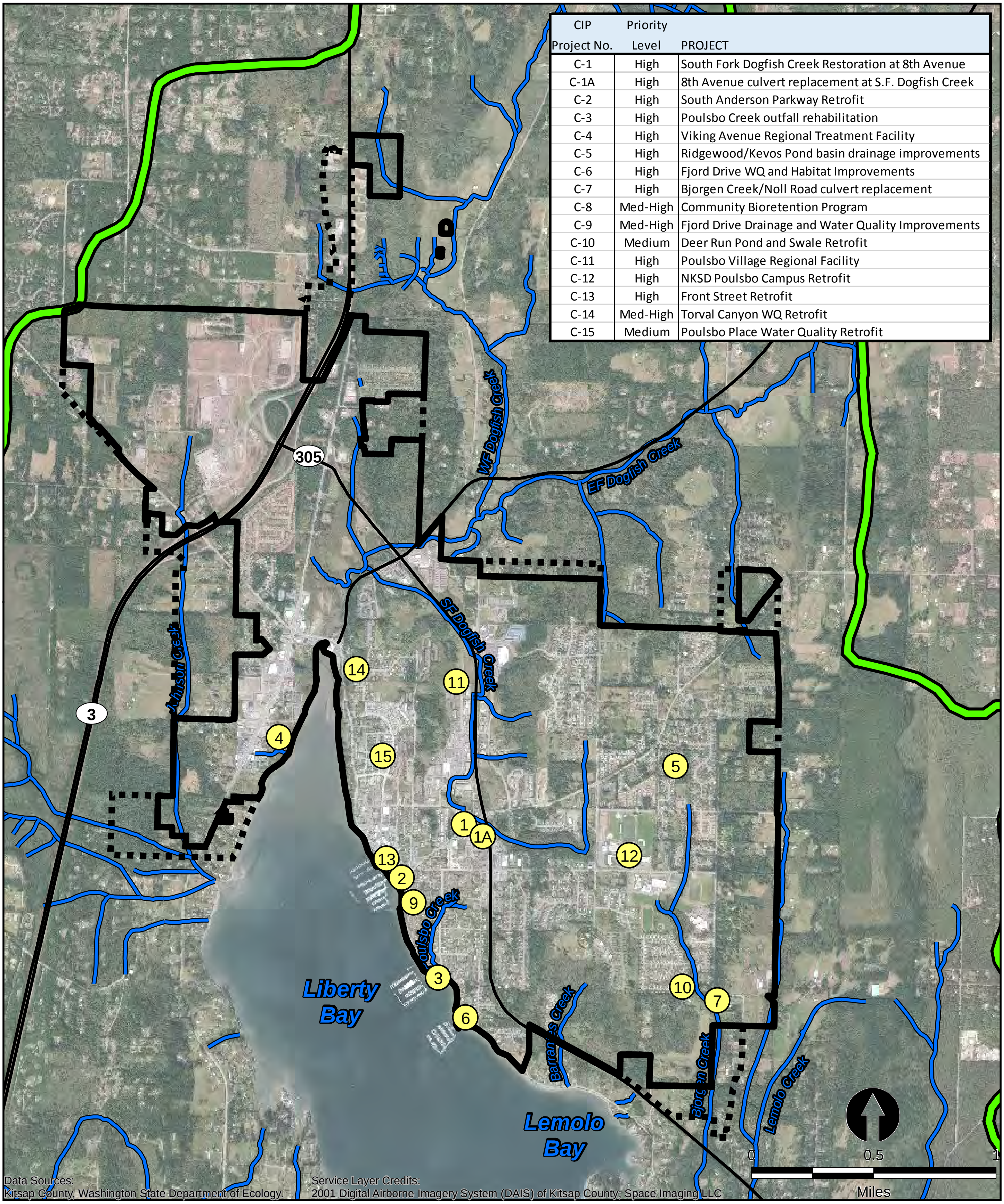
This project will replace the existing undersized 24-in diameter pipe under 8th Avenue with a new 12-ft wide concrete box culvert.

South Anderson Parkway Retrofit

The south Anderson Parkway retrofit will complement the retrofit of the main Anderson Parkway parking lot that occurred in 2010. The project will retrofit the existing 0.65-acre parking lot with pervious pavement and modular wetland system, and will replace an undersized 12-in diameter outfall conveyance pipe with new 18-in diameter pipe.

Poulsbo Creek Outfall Rehabilitation

The existing outfall pipe is corroded and has collapsed in places. This project will replace the corroded metal splash pad and outfall pipe with concrete splash pad and energy dissipater. The existing culvert will be lined from the outfall to Lions Park and new catch basin control structure will be installed. The project will also install habitat features at the outfall channel for mitigation, and will convert the existing ditch on Fjord Drive to a bioretention swale.



CIP Project No.	Priority Level	PROJECT
C-1	High	South Fork Dogfish Creek Restoration at 8th Avenue
C-1A	High	8th Avenue culvert replacement at S.F. Dogfish Creek
C-2	High	South Anderson Parkway Retrofit
C-3	High	Poulsbo Creek outfall rehabilitation
C-4	High	Viking Avenue Regional Treatment Facility
C-5	High	Ridgewood/Kevos Pond basin drainage improvements
C-6	High	Fjord Drive WQ and Habitat Improvements
C-7	High	Bjorgen Creek/Noll Road culvert replacement
C-8	Med-High	Community Bioretention Program
C-9	Med-High	Fjord Drive Drainage and Water Quality Improvements
C-10	Medium	Deer Run Pond and Swale Retrofit
C-11	High	Poulsbo Village Regional Facility
C-12	High	NKSD Poulsbo Campus Retrofit
C-13	High	Front Street Retrofit
C-14	Med-High	Torval Canyon WQ Retrofit
C-15	Medium	Poulsbo Place Water Quality Retrofit

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1 CIP Locations
Liberty Bay Watershed
City of Poulsbo
PUTA
Highway

Figure 5-1
Capital Project Locations
TMDL Implementation Plan
City of Poulsbo

Table 5-1. CIP Summary

CIP Project No.	Priority Level	Project Score	PROJECT	Project Type 1/	YEAR 2016	2017	2018	2019	2020	2021	Not Scheduled	Total
C-1	High	76	SF Dogfish Creek Restoration at 8th Avenue	WQ, H, FL	$25,000	$200,000	$500,000	$500,000	$400,000			$1,625,000
C-1A	High	69	SF Dogfish Creek Culvert Replacement at 8th Avenue	H, FL	$25,000	$25,000		$400,000				$450,000
C-2	High	69	South Anderson Parkway Retrofit	WQ	$380,000							$380,000
C-3	High	69	Poulsbo Creek Outfall Rehabilitation	M/R, H		$25,000	$175,000					$200,000
C-4	High	63	Viking Avenue Regional Treatment Facility	WQ, ED	$10,000	$700,000	$60,000	$600,000	$600,000			$1,970,000
C-5	High	62	Ridgewood/Kevos Pond Basin Drainage Improvements	WQ, FL	$30,000	$230,000						$260,000
C-6	High	62	Fjord Drive Water Quality and Habitat Improvements	WQ, H, M/R	$35,000	$255,000						$290,000
C-7	High	58	Bjorgen Creek/Noll Road Culvert Replacement	H, FL	$30,000		$320,000					$350,000
C-8	Med-High	46	Community Bioretention Program	WQ	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000		$150,000
C-9	Med-High	43	Fjord Drive Drainage and Water Quality Improvements	WQ, M/R	$10,000	$210,000						$220,000
C-10	Medium	37	Deer Run Pond and Swale Retrofit	WQ, M/R					$16,000	$184,000		$200,000
C-11	High	61	Poulsbo Village Regional Facility	WQ, ED		$50,000	$130,000	$700,000	$960,000			$1,840,000
C-12	High	75	North Kitsap School District Campus Retrofit	WQ, H							$920,000	$920,000
C-13	High	56	Front Street Retrofit	WQ, ED							$640,000	$640,000
C-14	Med-High	44	Torval Canyon Water Quality Retrofit	WQ, FL							$470,000	$470,000
C-15	Medium	39	Poulsbo Place Water Quality Retrofit	WQ							$810,000	$810,000
				Total	$570,000	$1,720,000	$1,210,000	$2,225,000	$2,001,000	$209,000	$2,840,000	**$10,775,000**

Notes:
1/ Project Type: WQ – Water Quality, H – Habitat, FL – Flood Reduction or Flow Control, ED – Economic Development, M/R – Maintenance and Repair

Viking Avenue Regional Treatment Facility

The south central Viking Avenue basin discharges untreated stormwater from a relatively large impervious area. This project will construct a regional treatment facility for the 60-acre urban basin consisting of bioretention, high-performance media filter, and a constructed wetland. It will also improve capacity of the conveyance system. The project includes acquisition of a 3-acre waterfront property for the site of a future stormwater park.

Ridgewood/Kevos Pond Basin Drainage Improvements

Undersized pipes and conveyance systems result in localized flooding and drainage problems. This project will replace undersized 12-inch diameter storm drains with 18-inch diameter storm drains and modify an existing control structure to improve conveyance and reduce flooding. It will also replace existing drainage ditch on Norrland Court with new 18-inch diameter storm drain, and construct bioretention cells to improve water quality.

Fjord Drive Water Quality and Habitat Improvements

Fjord Drive and associated shoreline areas experience water quality and erosion problems due to untreated stormwater discharges and deteriorated outfall structures. This project will consolidate three outfalls between 6th Avenue and Oyster Plant Park and install a new Modular Wetland System for treatment. It will also modify the storm collection system between 9th Street and east City limits and install a Modular Wetland System and Filterra vaults at the corner of Holm Court and Fjord Drive. The project will stabilize eroding shoreline and outfall energy dissipaters at multiple locations using soft armoring techniques.

Bjorgen Creek/Noll Road Culvert Replacement

The existing culvert under Storhoof Road is undersized and creates a fish passage barrier due to elevation drop at the downstream end of the culvert. This project would replace the existing 36-inch culvert with a 12-foot wide bottomless box culvert.

Community Bioretention Program

The community bioretention program is a collaborative partnership between the City and Kitsap Conservation District to site, design, and construct bioretention facilities in the City of Poulsbo. Projects would be constructed at multiple locations over a period of several years.

Fjord Drive Drainage and Water Quality Improvements

This project would replace 700-ft of deteriorated 8-inch diameter concrete pipe between Hostmark Street and Harrison Street, and would install a Modular Wetland System to treat 0.5-acres of City Street. The project would also replace the existing 12" diameter outfall with a concrete energy dissipater structure.

Deer Run Pond and Swale Retrofit

The existing stormwater treatment system for the Deer Run development is undersized and eroding. This project will retrofit the existing detention wet pond and bioswale to increase capacity, reduce erosion, and improve water quality treatment.

Poulsbo Village Regional Facility

The Poulsbo Village basin is largely developed and discharges untreated stormwater to the South Fork of Dogfish Creek. This project would construct a regional treatment facility for the basin consisting of a detention pond and high-performance media filter or constructed wetland. It would also modify the existing conveyance system and acquire property needed to support construction of the facility.

North Kitsap School District Campus Retrofit

The upper segment of Bjorgen Creek below the NKSD has been degraded due to untreated stormwater discharges. This project would construct regional treatment facilities on the NKSD property for a 76-acre urban basin that includes both the NKSD and residential areas. Treatment facilities may consist of a combination of bioretention, high-performance media filter, and a constructed wetland. The project will also improve capacity of conveyance system to alleviate localized flooding during high-intensity storm events.

Front Street Retrofit

This project would retrofit Front Street between 3rd Avenue to the south and King Olaf parking lot to the north by installing bioretention cells using Filterra media at crosswalk bulb outs and existing planting strips. The project would also realign the intersection of Front Street and Jensen Way and create an area to construct a small scale stormwater park.

Torval Canyon Water Quality Retrofit

This project would retrofit portions of Torval Canyon Road with Modular Wetland Systems and Filterra vaults. It would also modify the storm collection and conveyance system to direct flows to treatment devices.

Poulsbo Place Water Quality Retrofit

Stormwater runoff from Poulsbo Place is largely untreated. This project would retrofit the Poulsbo Place development with Modular Wetland Systems and Filterra vaults and modify the stormwater collection and conveyance system to direct flows to treatment devices.

6 NON-STRUCTURAL PROJECTS AND ACTIONS

Non-structural projects and actions that could potentially contribute to improved water quality consist of enhanced or expanded operation and maintenance (O&M) practices, increased education, and increased enforcement of codes and regulations.

6.1 OPERATION AND MAINTENANCE

The City operates and maintains an extensive system of storm drainage infrastructure that includes catch basins, manholes (junction and flow control), stormwater pipes, detention ponds, detention vaults, water quality facilities, ditches, and other infrastructure. The type and location of stormwater treatment facilities are shown graphically in Figures 2-6 through 2-8, and are summarized in Table 6-1.

Table 6-1. Summary of Operation and Maintenance Requirements

Stormwater Facility	Unit	No.	Maintenance Requirement
Conveyance System			
Catch Basins	Ea	2,500	Inspect 1x/yr, clean 25%/yr
Pipe	LF	324,034	Clean 5,000 LF/yr, Replace 1,500 LF/yr
Streets	SF	236,700	Clean 50%/yr
Detention, Infiltration, and Treatment Systems			
Detention and Infiltration Ponds	Ea	22	Inspect and maintain each 3x/yr
Bioswales	Ea	31	Mow and clean 3-5x/yr
Ditches	LF	15,000	Mow and clean 1x/yr
Bioinfiltration and Bioretention	Ea	11	Clean 3x/yr
Solids Removal Vaults	Ea	11	Inspect and clean 1x/yr
Tree Box Filterra Vaults	Ea	17	Inspect and clean 1x/yr
Underground Facilities	Ea	23	Inspect and clean 1x/yr
Oil/Water Separators	Ea	2	Inspect and clean 1x/yr

Note: LF = linear feet

O&M requirements and costs were reviewed as part of the Stormwater Operations and Rate Evaluation prepared by the City in 2014. This evaluation identified all City stormwater facilities, maintenance requirements and costs, as well as funding options.

Rates were adjusted in 2014 to reflect increased O&M requirements and needs, and no further O&M adjustments are necessary at this time. Over time, O&M needs will be influenced by growth in the City, as well as development of regional facilities and construction of Low-Impact Development (LID) facilities such as bioretention that tend to require more O&M resources. O&M costs will therefore be reviewed on a periodic basis to ensure that Level of Service criteria are being met, and that existing rates are sufficient to support needed O&M levels.

6.2 ENHANCED OPERATION AND MAINTENANCE RECOMMENDATIONS

System maintenance activities as specified under the City's National Pollutant Discharge Elimination System (NPDES) Phase II Stormwater General Permit are expected to be adequate to meet most TMDL requirements. Several enhanced O&M actions that exceed these minimum NPDES Permit requirements will be implemented by the City to improve water quality benefits.

6.2.1 State Route 305 Operation and Maintenance

The City has O&M responsibility for the SR305 stormwater system. This high volume roadway is located adjacent to SFDC and has little stormwater treatment infrastructure. Runoff from SR305 system is likely contributing to observed high pollutant loading in the SFDC, as well as observed salmonid pre-spawn mortality. Due to high contaminant loading and vulnerable receiving water, the following enhanced O&M measures are recommended for the SR305 stormwater system:

- Street sweeping of the SR305 twice per year; once in early summer, and once in early fall prior to fall rains.
- Catch basin cleaning once per year.
- Because the SR305 stormwater system is interconnected to the adjacent commercial system, monitoring of SR305 outfall PSW-15 will be done as part of annual IDDE screening.

6.2.2 Expanded IDDE Monitoring and Pollutant Identification and Control Measures

The City's IDDE monitoring program will be expanded to include basins and selected stream locations to provide on-going evaluation of existing stormwater treatment facilities or discharges that more frequently exhibit high FC loading. Depending on sample results, Pollutant Identification and Control (PIC) measures including sanitary surveys and more intensive monitoring could be more effective as source control measures as opposed to capital project implementation. Locations where more intensive monitoring and PIC measures may be implemented consist of:

- SFDC stations SFDC0.0, SFDC0.6, and SFDC1.3. The SFDC is the largest FC loading source in the City of Poulsbo.
- Poulsbo Creek stations OF-5304, PB-05, and PB-04. Poulsbo Creek has historically exhibited intermittent high FC concentrations given the high density residential and commercial setting.
- Contributing basins to outfall OF-3504 and OF-3604. Sample results from these basins were relatively high during wet weather conditions compared to other locations.

The EMP provides additional details on proposed on-going monitoring activities associated with the PTIP (Section 8 and Appendix E).

6.2.3 Detention Pond Water Quality Retrofits

There are over 50 City-owned stormwater vaults and ponds that collectively receive much of the runoff from developed areas and roadways. The effectiveness of these ponds in removing pollutants is likely highly variable. Most of the stormwater ponds in the City were not originally designed to serve a water quality function; rather they are detention ponds that reduce peak runoff flow rates and minimize local flooding. Retrofitting these ponds to improve pollutant removal without sacrificing runoff detention and flood-control functions would benefit water quality.

The Kitsap County Stormwater Pond Retrofit Design Guidance Manual (Kitsap County 2012) provides a systematic process to identify, prioritize, and retrofit existing stormwater facilities to improve water quality. This manual can serve as a tool to assist the City in converting existing detention ponds and vaults into combined water quantity and quality facilities.

6.3 EDUCATION

Public education elements include programs to reduce behaviors that result in adverse water quality impacts, and create stewardship and partnering opportunities. The City, in partnership with Kitsap County and other local agencies, is developing an education and outreach program that will distribute educational materials to homeowners and business. No additional education programs are recommended.

6.4 ENFORCEMENT

The City's enforcement program includes an IDDE program to detect and identify non-stormwater discharges and illicit connections into the stormwater system. The IDDE program was developed in 2009 in partnership with the Kitsap Public Health District to monitor, detect, and correct illicit connections including annual storm outfall monitoring. The City has also developed a private facility maintenance program and ordinance, and will be adopting the 2012 Ecology Stormwater Manual in 2016. No additional enforcement programs are recommended.

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7 IMPLEMENTATION

Implementation of the projects identified in this assessment will occur as an element of the City's overall stormwater CIP as described in the City's adopted 2016 Stormwater Comprehensive Plan (Sealaska 2016). The City's adopted stormwater CIP includes the projects described in Section 5 of this report, as well as a financial plan that would fund project construction.

7.1 FINANCIAL PLAN

This financial plan describes the costs, revenues, and funding sources associated with implementing the PTIP. The financial plan focuses on the following elements:

1. Overview of projected expenses and revenues,
2. Summary of existing rates and revenue sources, and
3. Options for addressing capital program funding gaps including GFCs and transportation impact fees.

The primary source of funds for the PTIP come from stormwater utility rate payers, who pay an annual fee based on the extent that their property is developed. Development is measured by ISU, which is equivalent to 3,000 square feet. The City's monthly stormwater rate was established in 2014 and is currently set at $16.43 per ISU.

In general, rate revenues first go to annual operating expenses and taxes, with revenues that exceed these annual expenses available to fund capital projects. In 2014, the Utility collected $1,030,000 in rate revenue. By 2021, based on assumed rate increases and growth, rate revenues are expected to be about $1.43 million.

The 2016 SWCP provides a financial analysis of the Utility's anticipated monthly rate revenues and projected operational and capital expenses over a 6-year period. The SWCP describes the costs, revenues, and funding sources associated with implementing the CIP. The primary source of funds for the Utility come from rate payers, who pay an annual fee based on the extent that their property is developed. Development is measured by impervious surface unit (ISU), which is equivalent to 3,000 square feet. The City's monthly stormwater rate was established in 2014 and is currently set at $16.43 per ISU.

Capital funding is expected to average about $1.5M per year, with approximately 50 percent funded via utility rates and 50 percent funded with grants. Table 7-1 summarizes expected CIP expenditures and revenues. As shown in Table 5-1, existing revenues are not sufficient to fund the capital program. This is a result of the capital improvement projects that are needed to help the City reach TMDL targets. To address this funding gap, two new revenue sources are proposed; a stormwater GFC, and use of a portion of traffic impact fees. Each of these proposed revenue sources are described in more detail in the 2016 SWCP.

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Table 7-1. PTIP Capital Improvement Plan Financial Summary.

CIP Project No.	Priority Level	Project Score	Project	Project Type [1/]	Year 2016	2017	2018	2019	2020	2021	Total 6 Yr CIP	Not Scheduled
CAPITAL PROJECTS, 6 YEAR PLAN, 2016- 2022												
C-1	High	76	SF Dogfish Creek Culvert Replacement at 8th Avenue	WQ, H, FL	$25,000	$200,000	$500,000	$500,000	$400,000		$1,625,000	
C-1A	High	69	SF Dogfish Creek Culvert Replacement at 8th Avenue	H, FL	$25,000	$25,000		$400,000			$450,000	
C-2	High	69	South Anderson Parkway Retrofit	WQ	$380,000						$380,000	
C-3	High	69	Poulsbo Creek Outfall Rehabilitation	M/R, H		$25,000	$175,000				$200,000	
C-4	High	63	Viking Avenue Regional Treatment Facility	WQ, ED	$10,000	$700,000	$60,000	$600,000	$600,000		$1,970,000	
C-5	High	62	Ridgewood/Kevos Pond Basin Drainage Improvements	WQ, FL	$30,000	$230,000					$260,000	
C-6	High	62	Fjord Drive Water Quality and Habitat Improvements	WQ, H, M/R	$35,000	$255,000					$290,000	
C-7	High	58	Bjorgen Creek/Noll Road Culvert Replacement	H, FL	$30,000		$320,000				$350,000	
C-8	Med-High	46	Community Bioretention Program	WQ	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$150,000	
C-9	Med-High	43	Fjord Drive Drainage and Water Quality Improvements	WQ, M/R	$10,000	$210,000					$220,000	
C-10	Medium	37	Deer Run Pond and Swale Retrofit	WQ, M/R					$16,000	$184,000	$200,000	
C-11	High	61	Poulsbo Village Regional Facility	WQ, ED		$50,000	$130,000	$700,000	$960,000		$1,840,000	
			Subtotal 6-Year CIP, 2016 - 2021		**$570,000**	**$1,720,000**	**$1,210,000**	**$2,225,000**	**$2,001,000**	**$209,000**	**$7,935,000**	
CAPITAL PROJECTS - NOT SCHEDULED												
C-12	High	75	North Kitsap School District Campus Retrofit	WQ, H								$920,000
C-13	High	56	Front Street Retrofit	WQ, ED								$640,000
C-14	Med-High	44	Torval Canyon Water Quality Retrofit	WQ, FL								$470,000
C-15	Medium	39	Poulsbo Place Water Quality Retrofit	WQ								$810,000
			Subtotal Unscheduled CIP									**$2,840,000**
										TOTAL CIP	$10,775,000	

	2016	2017	2018	2019	2020	2021	Total 6 Yr CIP
EXISTING AND POTENTIAL FUNDING SOURCES - 6 YEAR CIP							
WDOE Stormwater Grants - Awarded	$350,000	$125,000					$475,000
WDOE Stormwater Grants - Future Applications		$300,000	$300,000	$600,000	$510,000		$1,710,000
NTA/PSP/RCO Grants - Future Applications		$162,500	$300,000	$550,000	$550,000		$1,562,500
Other (Developer, partner agencies, bonds)		$50,000	$130,000	$700,000	$960,000		$1,840,000
Subtotal Grants and Other Funding	**$350,000**	**$637,500**	**$730,000**	**$1,850,000**	**$2,020,000**		**$5,587,500**
Stormwater Utility	$294,493	$297,438	$300,412	$303,416	$306,450	$309,515	$1,811,724
TOTAL EXISTING 6-YEAR FUNDING, 2016 -2021	**$644,493**	**$934,938**	**$1,030,412**	**$2,153,416**	**$2,326,450**	**$309,515**	**$7,399,224**
REVENUE BALANCE - CAPITAL EXPENSES	**$74,493**	**-$785,062**	**-$179,588**	**-$71,584**	**$325,450**	**$100,515**	**-$535,776**

	2016	2017	2018	2019	2020	2021	Total 6 Yr CIP
CAPITAL CONTRIBUTION FROM NEW REVENUE SOURCES							
Portion of Future General Facility Charge [2/]	$50,000	$50,500	$51,005	$51,515	$52,030	$52,551	$307,601
Portion of Future Traffic Impact Fees [2/]	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$300,000
TOTAL 6-YEAR CITY NEW REVENUE CONTRIBUTION, 2016 - 2021	**$100,000**	**$100,500**	**$101,005**	**$101,515**	**$102,030**	**$102,551**	**$607,601**

Notes:

[1/] WQ – Water Quality, H – Habitat, FL – Flood Reduction or Flow Control, ED – Economic Development, M/R – Maintenance and Repair

[2/] General Facility Charge and Traffic Impact Fees expected to generate an estimated $150,000/year each in total.

7.2 IMPLEMENTATION PLAN

This section describes the recommended actions for plan implementation, including operation and maintenance, staffing, and CIP elements. Table 7-2 summarizes implementation actions, priorities, and schedule.

Table 7-2. Summary of PTIP Implementation Actions

Priority	Description	Required by Regulation	Schedule
Critical	Adopt 2012 Ecology Stormwater Manual	Yes	By December 31, 2016
Critical	Update Poulsbo Municipal Code with LID Requirements	Yes	By December 31, 2016
High	Adopt Stormwater General Facility Charge	No	December 2016
High	Implement CIP including grant applications	No	On-going
High	Implement EMP	No	2017
Medium	Update and refine CIP	No	Annually
Medium	Add maintenance staff	No	2016 - 2018

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8 EFFECTIVENESS MONITORING

Effectiveness monitoring helps to measure progress towards attainment of TMDL water quality standards and informs future management actions. Documenting improvements in water quality is important because demonstrated success, or effectiveness, is tied to both NPDES Permit compliance and funding while a lack of demonstrated success can undermine the credibility and perceived benefit of the actions associated with TMDL implementation.

An EMP/QAPP has been prepared to describe the objectives and methods for measuring performance and outcomes of the PTIP. The complete EMP/QAPP is provided in Appendix E. This section provides a summary of the EMP/QAPP.

8.1 BACKGROUND AND PURPOSE OF EMP

Effectiveness monitoring is a critical component of an adaptive management approach to water quality improvement. Ecology describes the benefits of effectiveness monitoring as follows:

1. Provide a measure of progress toward implementation of recommendations (i.e., how much progress has been achieved, how much more effort is required);
2. Supports the decision-making process on more efficient allocation of funding and optimization in planning (i.e., identifying activities that worked, which restoration activity achieved the most success for the resources); and
3. Provide technical feedback that is useful for refinements of initial modeling analysis (e.g., for a TMDL) or refinements in the planning of BMPs, permits, and other pollutant reduction and watershed restoration strategies.

8.2 RELATIONSHIP OF LIBERTY BAY EMP TO EXISTING STATE AND LOCAL MONITORING PROGRAMS

Liberty Bay water quality monitoring programs exist at the state, regional and local level. These programs are generally designed to track trends in water quality, document impairments, and identify emerging, acute or chronic water quality issues that may require corrective action. The KPHD and the WDOH both conduct routine ambient water quality monitoring in Liberty Bay.

While these programs provide important information on water quality trends, and help to evaluate TMDL effectiveness on a watershed, embayment or regional scale, they are generally not designed to provide data on a targeted basin or sub-basin scale where multiple small-scale non-point source corrective actions typically occur. So although these existing monitoring programs provide important and useful information, they do not provide the more targeted collection of specific parameters and information necessary to support a local adaptive stormwater system management program that includes specific regulatory, capital and O&M components. The PTIP EMP is designed to address this information gap.

8.3 RELATIONSHIP OF EMP TO REGIONAL STORMWATER MONITORING PROGRAM (RSMP) AND NPDES PERMIT

The City is a participant in the Puget Sound Regional Stormwater Monitoring Program (RSMP) which is a collaborative monitoring program with western Washington municipal stormwater permittees and state agencies that is designed to meet NPDES permittee stormwater monitoring requirements. The RSMP is based on strategies and recommendations of the Stormwater Assessment and Monitoring Program for Puget Sound (SWAMPPS). The City contributes approximately $2,100 per year to the RSMP for status and trends monitoring, and $3,600 per year for RSMP effectiveness monitoring.

This PTIP EMP is not redundant with nor does it replace monitoring that is performed as part of the RSMP. The PTIP EMP is not intended to measure the City's compliance with TMDL goals, water quality standards or NPDES Permit conditions. Rather, this EMP is intended as a tool for the City to evaluate on-going progress toward improving stormwater management and prioritization of resources and actions. Specific objectives of the EMP are described below.

8.4 SPECIFIC OBJECTIVES OF THE PTIP EMP

There primary goal of the EMP is to provide quantitative data that supports adaptive management of the City's stormwater program so that the City can focus its limited financial and staff resources on activities that are likely to have the most potential to benefit water quality. As such, the EMP is intended to monitor performance of the City's stormwater system, as opposed to specific treatment or O&M BMPs.

A secondary goal of the EMP is to provide information to supplement local and regional ambient monitoring programs and to help support causal linkages between incremental improvements in receiving water quality and implementation of corrective actions.

Specific objectives of the PTIP EMP consist of the following:

- Provide information that allows adaptive management and on-going program refinement, performance assessment and measurement of progress toward improving water quality and habitat.
- Assess changes over time in TMDL targets related to urban runoff from the City;
- Support and enhance shared knowledge and feedback processes at a watershed level between tribes, agencies, and key stakeholder groups including the Suquamish Tribe, Kitsap County, KPHD, Kitsap Conservation District, WDOH, and Ecology.

The EMP incorporates a QAPP that reflects Ecology guidelines and includes specific sampling goals, objectives and performance measures; parameters, sampling locations, quality control measures and frequency; sampling and laboratory analytical methods and QA/QC criteria; roles and responsibilities; and reporting methods.

It is anticipated that the EMP/QAPP will be modified over time to reflect changes in water quality, BMP implementation, land use and development.

8.5 EMP DESIGN OBJECTIVES

The EMP design reflects the City's role in implementing the Liberty Bay TMDL Plan, which is limited to actions that occur within the City limits. Effectiveness monitoring for the City is therefore defined in terms of overall stormwater program effectiveness in contributing to meeting water quality goals. Broader scale effectiveness monitoring, which determines whether watershed-wide corrective actions (including stormwater management in the City) are effective at protecting and improving Liberty Bay water quality and are achieving targeted water quality outcome(s), would continue to be conducted by state or regional agencies including Ecology and the KPHD.

The objectives of the City's EMP are to focus on providing on-going information that enables the City to adapt stormwater manage actions, improve and maintain performance of BMPs, and the monitor the relative quality of stormwater runoff from areas within the City. The design of the City's EMP therefore focuses on measures that help to prioritize resources and sustain the effectiveness of a targeted action or relatively narrow suite of actions that are directly associated with the City's stormwater management program. Specifically, the City's EMP will be designed to provide information at the site and basin scale that includes:

- Source identification and diagnostic monitoring to provide sustained prioritization of problem areas, locate specific contaminant sources and support source removal/control actions.
- Monitor and track source controls associated with the City's IDDE program,
- Identify land use conditions that may be contributing elevated pollutant loading and may be subject to potential regulatory or O&M measures,
- Performance of City owned and maintained BMPs in treating stormwater discharges, and
- Inform O&M and capital project planning by providing on-going feedback information on relative improvements or declines in FC levels at specific locations.

8.6 COORDINATION WITH LOCAL AND STATE EMPS

The City's EMP design is intended to provide a cost-effective approach that is consistent with the functions and responsibilities of the Utility. The design also meshes with and compliments local and regional monitoring efforts, including the KPHD ambient monitoring program and monitoring being performed as part of the SWAMPPS.

8.7 EMP LIMITATIONS

The City's EMP will not replicate or be redundant with ambient monitoring of marine water or freshwater streams that is already performed by the KPHD or other agencies. The City's EMP will not measure compliance with water quality standards, or calculate statistics or perform trend analysis. Long term trend analysis in marine water and the mouths of primary freshwater tributaries will continue to be performed by the KPHD as part of their ambient monitoring program.

The EMP is also not intended for quantitative evaluation of individual BMP effectiveness. Specific BMP effectiveness is highly variable and general estimates of BMP effectiveness are already available from sources such as the International Stormwater BMP Database (www.bmpdatabase.org).

8.8 SAMPLING DESIGN

The EMP design builds on stormwater quality information collected as part of the Watershed Assessment and the City's on-going IDDE monitoring program. The design approach reflects the dual objectives of the EMP, which are to provide information that enhances and targets source control activities, as well as tracks progress toward TMDL goals.

The EMP design will build on and expand the City's existing IDDE monitoring program. The City's existing IDDE monitoring program consists of once/year dry weather monitoring at 22 outfalls for E. coli or FC. EMP elements that will be added to the IDDE monitoring will consist of:

- Additional outfalls or discharge points in priority basins as determined from the Watershed Assessment, and
- Wet weather FC bacteria monitoring at all locations twice per year.

These two modifications will help to ensure the EMP is addressing potential priority areas, as well as conditions under both wet and dry weather. This will enable the City to track sampling results, compare to TMDL criteria and identify relative contributions of FC loading so City sponsored corrective actions can focus on the apparent most significant sources.

A central goal of the EMP is to provide data that helps identify specific pollutant loading areas and sources in the City, and supports development and evaluation of focused corrective action measures over time. Specific objectives of the sampling design are as follows:

- Characterize and track FC bacteria concentrations from priority basins and outfalls in the City under both wet and dry weather conditions.
- Develop synoptic data for stormwater outfalls and freshwater tributaries in the City to compare to prior years sampling results, and TMDL load criteria.
- Identify relative contributions of FC loading to the bay so City sponsored corrective actions can be focused on the apparent most significant sources of contamination.

EMP objectives will be met through characterizing wet and dry weather FC bacteria loads in stream tributaries and significant storm outfalls to Liberty Bay that are located within the City. These outfalls include those sampled as part of the City's IDDE program, as well as several additional locations that warrant on going monitoring based on Watershed Assessment results.

FC concentrations will be monitored at locations once during the dry season (August - September) and twice during the wet season (January – April, October – December) periods of significant rainfall (storm event sampling). When possible, flow will be measured at stream sampling sites at the time of sampling.

Data from the monitoring will provide sub-basin/reach-specific and outfall-specific FC load and concentration comparisons to define areas of increased or decreased FC concentrations and loading.

8.9 SAMPLING LOCATIONS

Sampling locations consist of a combination of stormwater outfalls and freshwater tributaries (Figure 8-1). Sites have been identified based on project objectives, as well as the information presented in the Watershed Assessment. Sites may be added or removed from the sampling plan depending on access and new information provided during the annual plan review, field observations and data analysis.

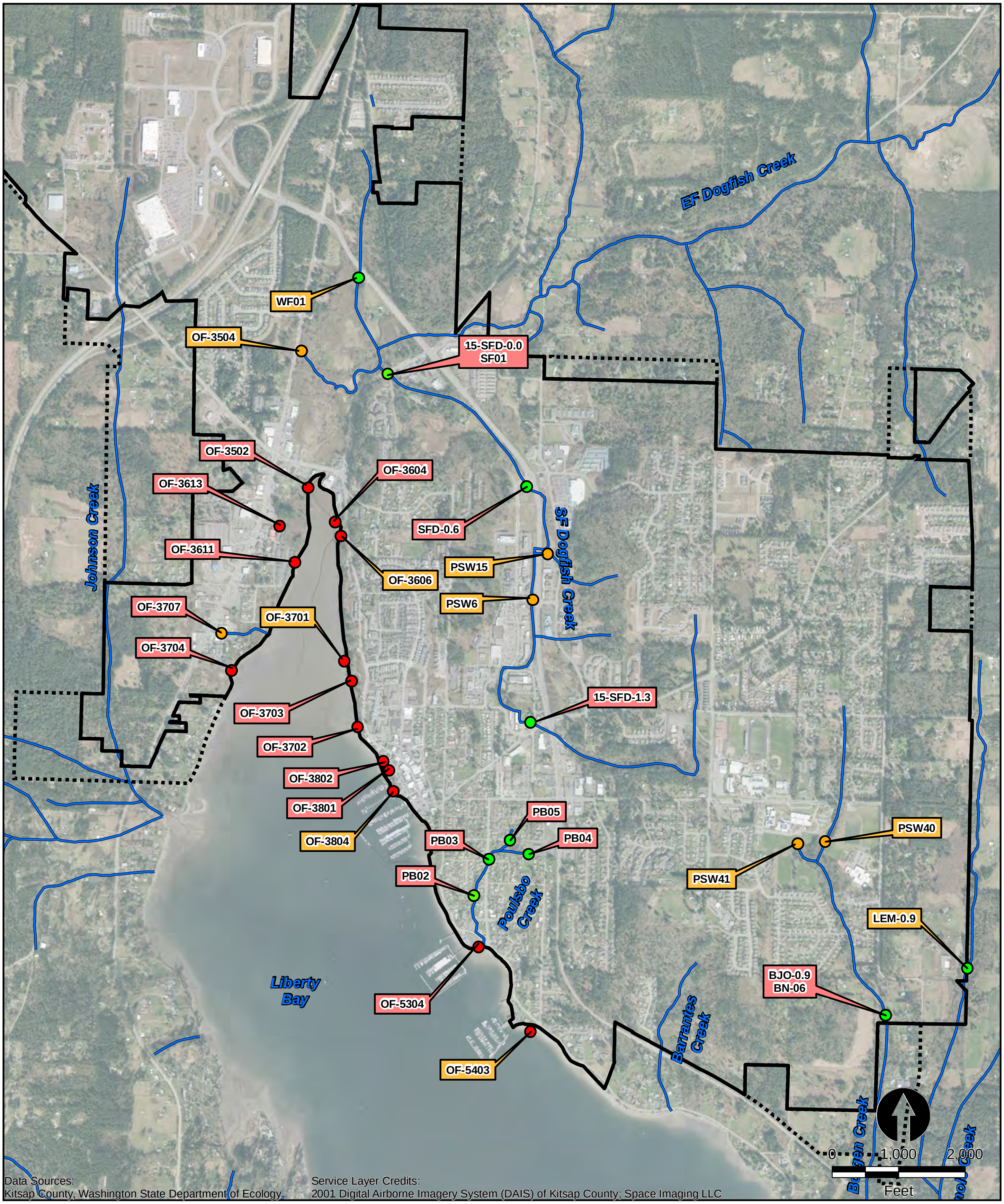
Freshwater tributary sampling locations are designed to monitor FC loading by stream segment, provide context for interpreting results from freshwater stormwater outfalls, and help further focus corrective action measures. Freshwater sampling locations are generally upstream of those used by Ecology and the KPHD in prior studies. Stormwater Outfall Monitoring

Outfall monitoring locations are shown in Figure 8-1. Marine outfall identification numbers match City of Poulsbo outfall inventory numbering system. Freshwater outfall numbers match prior numbering from the KPHD, and City outfall numbers where no KPHD identifier is available.

8.10 ANNUAL REPORTING

Pursuant to condition S8. Monitoring and Assessment of the NPDES Permit, the City will provide in each stormwater annual report a description of the stormwater monitoring or stormwater-related studies conducted during the reporting period. The report will include the following information:

- Summary of sampling results,
- Description of corrective action measures that were implemented during the prior reporting period,
- Discussion of corrective actions that will be implemented in the following year, and
- Any proposed modifications to the EMP.



Streams
City of Poulsbo
PUTA
Stream Station
Marine Outfall
Freshwater Outfall
PB04 Existing IDDE/EMP Monitoring Station
PB04 Additional New IDDE/EMP Monitoring Station

Figure 8-1
EMP Sampling Locations
TMDL Implementation Plan
City of Poulsbo

9 REFERENCES

Booth, D. B., D. Hartley, and R. Jackson. 2002. Forest Cover, Impervious-Surface Area, and the Mitigation of Stormwater Impacts. Journal of the American Water Resources Association, 38:835-845.

Borde, A. B., C. Judd, N. K. Sather, and R. M. Thom. 2009. East Kitsap County Nearshore Habitat Assessment and Restoration Prioritization Framework. Prepared by Battelle Marine Sciences Laboratory for Kitsap County Department of Community Development.

City (City of Poulsbo). 2011. City of Poulsbo Shoreline Master Program Update, Cumulative Impacts Analysis & No Net Loss Summary. Prepared by Grette Associates, 2011.

City. 2014. Stormwater Operations and Rate Evaluation. Internal Memorandum, August 2014.

City. 2016. 2016 Update Stormwater Management Program (SWMP). Permit # WAR 04-5537. Draft February 2016.

Ecology (Washing State Department of Ecology), 2011. Draft Western Washington Phase II Municipal Stormwater Permit Fact Sheet. November 2011.

Ecology. 2009. Liberty Bay Tributaries Fecal Coliform Bacteria Total Maximum Daily Load Water Quality Study Design (Quality Assurance Project Plan). Washington State Department of Ecology, Olympia, WA. Publication No. 09-03-102. January 2009.

Ecology. 2013. Liberty Bay Tributaries Fecal Coliform Bacteria Total Maximum Daily Load TMDL and Water Quality Implementation Plan. Washington State Department of Ecology, Olympia, WA. Publication No. 13-10-014. May 2013.

Ecology. 2015. Total Maximum Daily Load (TMDL) Requirements Western Washington Phase II Municipal Stormwater Permit – August 1, 2013, Modified January 16, 2015. APPENDIX 2 – TMDL Requirements.

Haring, D. 2000. Salmonid Habitat Limiting Factors, Water Resource Inventory Area 15 (East) Final Report. Washington State Conservation Commission.

Hathaway, J. M.; W. F. Hunt; and S. Jadlocki. 2009. Indicator Bacteria Removal in Storm-Water Best Management Practices in Charlotte, North Carolina. Journal of Environmental Engineering. December 2009.

ICF International. 2010. South Fork Dogfish Creek Restoration Master Plan. Phase 2 South Fork Dogfish Creek Restoration Master Plan. July. Prepared for the City of Poulsbo, Public Works Department.

Kitsap County 2012. Kitsap County Stormwater Pond Retrofit Design Guidance Manual. Prepared for Kitsap County Public Works Department by Herrera Environmental Consultants, Inc. June 2012.

Kitsap County 2013. Silverdale Low Impact Development Retrofit Plan. Prepared for Kitsap County Public Works Department by Herrera Environmental Consultants, Inc. January 2013.

KPHD (Kitsap Public Health District). 2011. Liberty Bay Marina Study 2010.

KPHD. 2014a. Liberty Bay Watershed Restoration Project Final Report. Kitsap Public Health District, Environmental Health Division, Water Pollution Identification & Correction Program. April 2014.

KPHD. 2014b. Water Pollution Identification & Correction Program 2013 Annual Water Quality Monitoring Report.

KPHD. 2015. Water Pollution Identification & Correction Program 2014 Annual Water Quality Monitoring Report.

Parametrix. 2015. Final Quality Assurance Project Plan, Stormwater Quality Study - Liberty Bay TMDL Implementation Plan. Prepared by Parametrix, Bremerton, Washington. September 2015.

Sealaska. 2016. Stormwater Comprehensive Plan. Prepared for City of Poulsbo. May 2016.

Takesue, R. K., editor. 2011. Hydrography of and Biogeochemical Inputs to Liberty Bay, a Small Urban Embayment in Puget Sound, Washington. U.S. Geological Survey Scientific Investigations Report 2011–5152, 98 p.

WDOH (Washington State Department of Health). 2008. Washington State Department of Health, Office of Shellfish and Water Protection: Annual Growing Area Review. www.doh.wa.gov/ehp/sf/Pubs/gareports/lemolo.pdf.

WDOH. 2015. Liberty Bay Commercial Shellfish Recertification Study Water Quality Monitoring Data. Personal Communication. 2015.

APPENDIX A
Water Quality and Basin Analysis Data

Table A-1. City of Poulsbo 2015 Stormwater Quality Study Sampling Results

	Dry		Wet		Dry		Wet		Dry		Wet		Dry		Wet		Dry		Wet		
	11-04	**11-20**	**12-03**	**12-10**	**11-04**	**11-20**	**12-03**	**12-10**	**11-04**	**11-20**	**12-03**	**12-10**	**11-04**	**11-20**	**12-03**	**12-10**	**11-04**	**11-20**	**12-03**	**12-10**	
Station ID	**FC/100ml**				**Turbidity NTU**				**pH**				**Conductivity µS**				**Flow/Discharge cfs**				**Notes**
15-DOG-0.6	10	40	50	200	3.90	3.90	8.8	13	7.21	7.68	7.35	6.92	138.3	156.7	59.8	97.4	8.35	11.12	52.52	46	Main Stem Dogfish Creek
15-SFD-0.0	140	20	410	200	3.20	3.60	22	17	7.85	7.72	7.49	7.43	192	201	84.4	93.4	1.16	1.39	12.94	12.87	S. Fork Dogfish Crk. at Bond Rd. & 1st Ave, 50' downstream of PSW4
15-SFD-0.6	130	10	400	240	3.00	3.70	21	16	7.09	7.47	7.64	7.59	177.4	195.4	88.8	92.5	0	0	0	0	South Fork Dogfish Creek at 7th Ave. and Forest Rock Ln.
15-SFD-1.3	20	10	380	80	0.75	0.80	16	4.4	7.7	7.6	7.25	6.98	257.6	195	88	107.1	0	0	0	0	South Fork Dogfish Creek at 8th Ave and Iverson
15-SFD-1.3 R	**	<10	380	120	**	**	**	**	**	-	-	-	**	-	-	-	**	0	0	0	Duplicate at South Fork Dogfish Creek at 8th Ave and Iverson
BJO-0.9	40	<10	170	180	1.50	0.83	4.6	32	7.74	7.19	7	7.32	162.5	167.7	100.4	75.8	0.07	0.48	4.11	9.27	Bjorgen Creek at Storhoff Road culvert
BJO-0.9 R	**	20	140	**	**	**	**	**	**	-	-	**	**	-	-	**	**	0	0	**	
JOH-0.1	10	<10	110	60	2.70	1.50	5	9.8	7.82	7.49	7.16	7.11	103.5	102.2	94.9	59.4	0.53	1.67	15.73	18.77	Johnson Crk. Mainstem at 18931 Viking Way
JOH-0.1 R	**	**	**	80	**	**	**	**	**	**	**	-	**	**	**	-	**	**	**	0	Duplicate at Johnson Crk. Mainstem at 18931 Viking Way
JOH-1.4	60	30	280	140	3.2	6.60	9	9	8	7.65	7.36	7.75	141.5	92.6	54.9	45.2	0	0	0	0	Finn Hill Road at Olhava Way
LEM 0.9	10	<10	70	40	0.96	2.00	5.2	4.6	7.32	7.74	7.56	7.4	151.5	128.8	107.7	71.1	0.11	0.343	1.813	9.28	Lemolo Creek at Heron Pond Lane
OF-3502	<10	<10	30	40	1.70	2.50	6.2	3.2	7.3	7.26	7.71	7.17	221.5	219	40.4	137.8	0.00	0	0	0	Nelson Park
OF-3502 R	**	**	50	**	**	**	**	**	**	**	-	**	**	**	-	**	**	**	0	**	
OF-3504	**	<10	1440	500	**	0.56	3.5	4.8	**	7.46	7.51	7.46	**	180	3.1	54.9	**	0	0	0	North Central Viking Ave outfall to Fish Park
OF-3604	60	40	>2000	1240	3.60	4.10	25	29	7.1	7.01	7.55	7.26	8017	2780	190.9	44.3	0.00	0	0	0	Liberty Bay Auto-24" CMP. Sampled CB 36-258-1 Front St-Torval Canyon.
OF-3606	<10	10	420	240	0.77	0.98	9.7	13	7.9	7.61	7.53	7.44	350.7	304	77.7	119.3	0.00	0	0	0	South of 20101 Front Street
OF-3606 R	**	<10	**	**		**	**	**		-	**	**		-	**	**		0	**	**	
OF-3611	<10	20	>2000	2200	5.00	3.60	5.5	8	7.3	7.34	7.83	7.15	320	241	36.2	75.7	0.00	0	0	0	CMP at Windsong Apartments
OF-3613	NA*	<10	1420	180	130.0	18.0	36	39	7.6	7.5	7.25	7.36	197.3	120	64.9	44	0.0	0	0	0	Nelson Park north of Windsong Apts
OF-3613R	350.0	**	**	**	0.0	**	**	**	0.0	**	**	**	0.0	**	**	**	0.0	**	**	**	
OF-3701	50	10	730	420	5.90	2.70	10	14	8	8.07	7.66	7.73	308.4	268	58.8	70.2	0.00	0	0	0	24" CMP at north end of American Legion Park
OF-3702	-	<10	<10	120	0.00	1.80	13	16	0	7.28	7.42	7.95	0	207.1	38.2	48.8	0.00	0	0	0	Cast Iron outfall at south end of American Legion Park
OF-3703	70	<10	320	160	2.20	2.20	8	7	7.8	7.81	7.07	7.55	478.3	400	107.1	124.2	0.00	0	0	0	24" CMP at American Legion Park
OF-3703 R	40	**	**	220	0.00	**	**	**	-	**	**	-	0	**	**	-	0	**	**	0	Duplicate of 24" CMP at American Legion Park
OF-3704	40	10	360	540	4.50	3.70	13	12	7.1	7.63	7.65	7.37	256.8	203	90.9	85.2	0.00	0	0	0	Liberty Shores Creek at retirement home
OF-3707	30	10	380	800	2.7	2.20	8.4	10	7.6	7.18	7.08	7.36	261	152	116.8	78.1	0.00	0	0	0	East end of bioswale behind Ken's Auto
OF-3801	<10	<10	>2000	640	0.64	0.44	62	21	7.41	7.98	6.82	7.3	2832	377.1	126.6	110.2	0.00	0	0	0	Anderson Parkway-south side of Gazeebo on beach
OF-3804	60	<10	320	940	1.50	1.50	10	10	7.37	7.56	6.74	7.57	3213	1632	1574	281.2	0.00	0	0	0	Port of Poulsbo main parking lot, landward of fuel dock gangway.
OF-5304	100	60	40	1460	0.60	1.20	2.2	11	7.25	7.16	7.08	6.95	470	424.8	2983	143	0.00	0	0	0	Poulsbo Creek outfall. Sampled at CB 54-8-2 on Fjord Ave on 12-9-15.

Table A-1. City of Poulsbo 2015 Stormwater Quality Study Sampling Results (continued)

	Dry		Wet		Dry		Wet		Dry		Wet		Dry		Wet		Dry		Wet		
	11-04	11-20	12-03	12-10	11-04	11-20	12-03	12-10	11-04	11-20	12-03	12-10	11-04	11-20	12-03	12-10	11-04	11-20	12-03	12-10	
Station ID	**FC/100ml**				**Turbidity NTU**				**pH**				**Conductivity µS**				**Flow/Discharge cfs**				**Notes**
OF-5403	20	<10	240	80	5.30	21.00	40	28	7.21	6.93	7.52	7.28	158700	155.3	105.4	72.3	0.00	0	0	0	Outfall on beach near Fjord Drive at 9th Ave., CMP half pipe at end of concrete pipe
OF-8001	0	20	300	880	0.00	0.44	6.8	7	0	7.9	7.22	7.29	0	94	44.4	41.6	0	0	0	0	Kevos Pond / Ridgewood basin
PB-02	60	10	420	460	1.10	3.20	11	7.4	7.47	7.35	7.7	7.43	262.3	258.6	106.1	120.3	0.31	0.358	0.835	1.2	Poulsbo Creek - Downstream culvert at Sommerseth
PB-02 R	70	**	**	**	0.00	**	**	**	-	**	**	**	0	**	**	**	0.00	**	**	**	
PB03	60	70	340	340	0.44	0.60	8	5.4	8.1	7.85	7.24	7.62	286.8	196	137.9	118.8	0.00	0	0	0	Poulsbo Creek-corner of Ryen & 6th
PB-03R	70	**	**	**	0.00	**	**	**	-	**	**	**	-	**	**	**	0.00	**	**	**	
PB04	140	10	340	380	0.42	0.34	4.3	3.5	7.9	7.85	7.25	7.29	206.6	210	108.1	97.9	0.00	0	0	0	Poulsbo Creek behind church
PB05	<10	60	370	1200	0.52	0.61	20	13	8.1	7.9	7.41	7.65	280.3	193	85.2	87.6	0.00	0	0	0	Poulsbo Creek-Harrison St. culvert at 709 Harrison St.
PSW15	110	10	400	180	14	9.10	24	15	7.9	7.18	7.2	7.49	230.4	110	93.1	95.2	0	0	0	0	SR 305 Outfall near O'Reilys
PSW17	0	-	580	360	0.00	-	41	40	0	-	7.26	8	0	-	63.4	33.9	0	0	0	0	Iverson & 7th Ave. Drop structure under plum tree
PSW4	<10	<10	250	<20	2.50	2.70	15	6	7.64	6.99	7.21	6.8	924	430.6	156.9	234.2	0.00	0	0	0	SR 305 Stormwater outfall @ S. Fk. Dogfish Crk.
PSW40	20	<10	150	120	7.4	3.10	6.5	4.1	7.9	7.63	7.25	7.47	111.3	98	50.2	79.2	0	0	0	0	Bjorgen Creek channel below 24" and 18" outfalls
PSW40 R	**	<10	160	**	**	**	**	**	**	0	-	**	**	0	-	**	**	0	0	**	
PSW41	0	20	290	1040	0.00	1.80	9.9	16	0	7.44	7.12	7.63	0	148	48.5	38.1	0.00	0	0	0	Outfall to Bjorgen Creek at spillway below Middle School
PSW6	10	<10	550	1040	2.4	10.20	28	26	7.7	7.19	7.79	7.63	133.5	245.8	65.3	21.1	0	0	0	0	SR305 & Liberty Rd, NW corner. Sampled CB at Liberty and 7th.
PSW7	60	90	>2000	560	2.4	5.00	12	16	7.4	7.53	7.45	7.52	214.2	118	61.2	38.2	0	0	0	0	East Caldart Ave basin, from culvert east of 1508 Hostmark St.
PSW8	0	50	310	280	0.00	2.00	16	9.8	7.84	7.56	7.19	7.32	176.7	132	72.4	72.9	0	0	0	0	Mesford Avenue west of Caldart
PSW8 R	**	**	**	300	**	**	**	**	**	**	**	7.32	**	**	**	72.9	**	**	**	0	Duplicate at Mesford Avenue west of Caldart
WF-01	<10	10	90	20	1.4	2.80	16	11	8.1	7.5	7.42	7.6	132.1	102	51.5	53.9	0	0	0	0	West Fork of Dogfish Crk, downstream of culvert under SR 305

Notes:

NA* Confluent growth, lab unable to report result

** No duplicate turbidity sample per contract

Table A-2. City of Poulsbo basin and stormwater treatment summary.

Basin Name and ID	Discharge Location (Outfall No.)	EXISTING CONDITIONS: Total Area (ac)	Total Exist. Impervious Area (ac)	Total Exist. Impervious Area %	Ex. Imp. Area Treated to 1992-97 Stdrd (ac) [1]	Ex. Imp. Area Treated to 1992-97 Stdrd %	Ex. Imp. Area Treated to 2005 Stdrd (ac)	Ex. Imp. Area Treated to 2005 Stdrd (%)	Total Exist. Imp. Area Treated (ac)	Total Exist. Imp. Area Treated (%)	Total Basin Area Treated (%)	FUTURE DEVELOPMENT CONDITION: Future Dev. Area at Full Build Out (ac)	Future Dev. Area at Full Build Out (%)	Future Imp. Area at Full Build Out (ac) [2]	Future Imp. Area at Full Build Out (%)	FULL BUILD OUT CONDITIONS: Total Imp. Area at Build Out (ac)	Total Imp. Area at Build Out (%)	TIA Treated At Full Build Out (ac)	TIA Treated At Full Build Out (%)	TIA Untreated At Full Build Out (ac)	TIA Untreated At Full Build Out (%)
South Fork Dogfish Creek																					
SF-01		61.4	14.8	24.2%	3.1	5.1%	0.0	0.0%	3.1	21.0%	5.1%	9.2	15.0%	6.4	10.5%	21.3	34.7%	9.6	44.9%	12.7	20.6%
SF-02		75.4	23.0	30.5%	15.0	20.0%	0.0	0.0%	15.0	65.3%	20.0%	20.0	26.5%	14.0	18.6%	37.0	49.1%	29.0	78.4%	12.5	16.6%
SF-03		65.6	13.0	19.9%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0%	32.9	50.2%	23.0	35.1%	36.1	55.0%	23.0	63.9%	13.0	19.9%
SF-04		46.0	22.9	49.9%	3.7	8.0%	0.0	0.0%	3.7	16.0%	8.0%	9.4	20.5%	6.6	14.3%	29.5	64.2%	10.3	34.8%	20.4	44.3%
SF-05		32.1	16.6	51.8%	2.1	6.7%	0.0	0.0%	2.1	12.9%	6.7%	1.1	3.4%	0.8	2.4%	17.4	54.2%	2.9	16.7%	15.1	47.2%
SF-06		105.5	32.4	30.7%	16.2	15.4%	1.8	1.7%	18.0	55.7%	17.1%	15.7	14.9%	11.0	10.4%	43.4	41.1%	29.0	67.0%	19.7	18.7%
SF-07		44.3	19.3	43.6%	8.0	18.1%	0.0	0.0%	8.0	41.4%	18.1%	0.0	0.0%	0.0	0.0%	19.3	43.6%	8.0	41.4%	13.7	31.0%
SF-08		217.0	68.7	31.7%	50.0	23.0%	4.2	1.9%	54.2	78.8%	25.0%	80.0	36.9%	56.0	25.8%	124.7	57.5%	110.2	88.3%	30.8	14.2%
Subtotal		647.2	210.9	32.6%	98.2	15.2%	6.0	0.9%	104.2	49.4%	16.1%	168.4	26.0%	117.9	18.2%	328.7	50.8%	222.0	67.5%	138.0	21.3%
Dogfish Creek																					
DF-01		62.7	56.9	90.8%	40.0	63.8%	0.0	0.0%	40.0	70.3%	63.8%	0.0	0.0%	0.0	0.0%	56.9	90.8%	40.0	70.3%	28.9	46.1%
WF-01		235.5	57.6	24.5%	39.4	16.7%	3.4	1.4%	42.8	74.3%	18.2%	70.1	29.8%	49.1	20.8%	106.7	45.3%	91.8	86.1%	27.7	11.7%
WF-02		98.2	12.7	12.9%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0%	68.2	69.5%	47.8	48.7%	60.5	61.6%	47.8	79.0%	12.7	12.9%
WF-03 [2]		100.7	10.9	10.8%	10.5	10.4%	0.0	0.0%	10.5	96.2%	10.4%	7.7	7.7%	5.4	5.4%	16.3	16.2%	15.9	97.5%	3.6	3.5%
EF-01 [2]		219.6	50.0	22.8%	44.1	20.1%	2.2	1.0%	46.3	92.6%	21.1%	108.1	49.2%	75.7	34.5%	125.7	57.2%	122.0	97.1%	17.6	8.0%
Subtotal		716.7	188.2	26.3%	134.0	18.7%	5.6	0.8%	139.6	74.2%	19.5%	254.2	35.5%	177.9	24.8%	366.1	51.1%	317.5	86.7%	90.4	12.6%
Bjorgen Creek																					
B-01 [2]		302.6	48.9	16.2%	28.7	9.5%	0.9	0.3%	29.6	60.5%	9.8%	79.2	26.2%	55.4	18.3%	104.3	34.5%	85.0	81.5%	28.2	9.3%
B-02		76.4	28.7	37.6%	1.6	2.1%	1.0	1.3%	2.6	9.1%	3.4%	0.0	0.0%	0.0	0.0%	28.7	37.6%	2.6	9.1%	26.9	35.2%
B-03		44.6	13.5	30.3%	0.0	0.1%	0.0	0.0%	0.0	0.3%	0.1%	0.0	0.0%	0.0	0.0%	13.5	30.3%	0.0	0.3%	13.5	30.2%
Subtotal		423.7	91.1	21.5%	30.4	7.2%	1.8	0.4%	32.2	35.3%	7.6%	79.2	18.7%	55.4	13.1%	146.5	34.6%	87.6	59.8%	68.6	16.2%
Lemolo Creek																					
L-01 [2]		146.4	56.7	38.7%	46.9	32.0%	0.7	0.5%	47.5	83.9%	32.5%	84.1	57.5%	58.9	40.2%	115.6	79.0%	106.4	92.1%	23.4	16.0%
L-02		97.8	42.3	43.3%	42.3	43.3%	0.0	0.0%	42.3	99.9%	43.3%	32.6	33.3%	22.8	23.3%	65.1	66.6%	65.1	100.0%	12.7	13.0%
Subtotal		244.2	99.0	40.6%	89.2	36.5%	0.7	0.3%	89.8	90.7%	36.8%	116.7	47.8%	81.7	33.5%	180.7	74.0%	171.5	94.9%	36.1	14.8%
Johnson Creek																					
J-01		144.2	6.3	4.4%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0%	130.5	90.5%	91.3	63.3%	97.6	67.7%	91.3	93.6%	6.3	4.4%
J-02		135.4	55.2	40.8%	55.1	40.7%	0.0	0.0%	55.1	99.8%	40.7%	41.0	30.3%	28.7	21.2%	83.9	62.0%	83.7	99.8%	0.1	0.1%
J-03		66.3	55.8	84.2%	48.6	73.3%	0.0	0.0%	48.6	87.1%	73.3%	10.5	15.9%	7.4	11.1%	63.2	95.3%	56.0	88.6%	21.8	32.9%
J-04		269.3	33.9	12.6%	26.6	9.9%	0.0	0.0%	26.6	78.7%	9.9%	104.1	38.7%	72.9	27.1%	106.7	39.6%	99.5	93.2%	15.2	5.6%
Subtotal		615.1	151.1	24.6%	130.3	21.2%	0.0	0.0%	130.3	86.2%	21.2%	286.1	46.5%	200.3	32.6%	351.4	57.1%	330.6	94.1%	43.4	7.1%
Poulsbo Creek																					
PC-01		37.6	12.6	33.5%	0.0	0.0%	7.1	19.0%	7.1	56.6%	19.0%	0.0	0.0%	0.0	0.0%	12.6	33.5%	7.1	56.6%	7.6	20.3%
PC-02		54.2	19.2	35.5%	0.1	0.1%	0.2	0.3%	0.2	1.1%	0.4%	3.6	6.7%	2.5	4.7%	21.8	40.2%	2.7	12.6%	19.1	35.2%
PC-03		21.7	11.1	50.8%	1.3	5.8%	4.1	18.9%	5.4	48.5%	24.7%	0.0	0.0%	0.0	0.0%	11.1	50.8%	5.4	48.5%	7.3	33.6%
PC-04		31.4	13.0	41.4%	0.9	2.7%	1.6	5.0%	2.4	18.7%	7.8%	0.0	0.0%	0.0	0.0%	13.0	41.4%	2.4	18.7%	11.3	35.9%
Subtotal		145.0	55.9	38.6%	2.2	1.5%	13.0	9.0%	15.1	27.1%	10.4%	3.6	2.5%	2.5	1.7%	58.4	40.3%	17.7	30.3%	45.3	31.2%
Barrantes Creek																					
BC-01 [2]		109.9	11.3	10.3%	5.9	5.3%	0.0	0.0%	5.9	51.7%	5.3%	76.5	69.6%	53.5	48.7%	64.8	59.0%	59.4	91.6%	7.2	6.6%
Subtotal		109.9	11.3	10.3%	5.9	5.3%	0.0	0.0%	5.9	51.7%	5.3%	76.5	69.6%	53.5	48.7%	64.8	59.0%	59.4	91.6%	7.2	6.6%
Viking Avenue																					
V-01		54.2	8.3	15.3%	0.0	0.1%	2.0	3.7%	2.1	24.7%	3.8%	17.9	33.0%	12.5	23.1%	20.8	38.4%	14.6	69.9%	6.9	12.7%
V-02		80.1	33.2	41.4%	6.4	8.0%	0.0	0.0%	6.4	19.3%	8.0%	14.1	17.6%	9.9	12.3%	43.0	53.7%	16.3	37.8%	28.7	35.8%
V-03		10.9	3.4	31.7%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0%	0.1	1.3%	0.1	0.9%	3.5	32.6%	0.1	2.8%	3.4	31.7%
V-04		13.2	8.3	62.9%	5.3	40.0%	0.0	0.0%	5.3	63.7%	40.0%	0.0	0.0%	0.0	0.0%	8.3	62.9%	5.3	63.7%	4.6	34.9%
V-05		104.9	28.9	27.6%	20.0	19.1%	0.0	0.0%	20.0	69.1%	19.1%	26.6	25.4%	18.6	17.8%	47.6	45.3%	38.6	81.2%	14.9	14.2%
V-06		85.5	40.9	47.8%	29.9	34.9%	2.4	2.8%	32.2	78.8%	37.7%	19.2	22.5%	13.5	15.8%	54.3	63.5%	45.7	84.1%	18.3	21.4%
Dogfish Creek Estuary		48.1	4.3	9.0%	0.2	0.4%	0.0	0.1%	0.2	5.7%	0.5%	0.0	0.0%	0.0	0.0%	4.3	9.0%	0.2	5.7%	4.2	8.6%
Subtotal		348.8	123.0	35.3%	61.6	17.7%	4.4	1.3%	66.0	53.6%	18.9%	77.9	22.3%	54.6	15.6%	177.6	50.9%	120.5	67.9%	81.0	23.2%
Central																					
C-01		61.5	17.5	28.5%	0.0	0.0%	1.8	2.8%	1.8	10.0%	2.8%	12.3	20.0%	8.6	14.0%	26.2	42.5%	10.4	39.7%	16.3	26.5%
C-02		25.8	9.5	36.9%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0%	0.9	3.4%	0.6	2.4%	10.1	39.3%	0.6	6.0%	9.5	36.9%
C-03		24.0	8.1	33.8%	0.0	0.0%	1.5	6.1%	1.5	18.0%	6.1%	0.0	0.0%	0.0	0.0%	8.1	33.8%	1.5	18.0%	7.1	29.5%
C-04		34.0	11.9	35.0%	0.0	0.0%	0.5	1.5%	0.5	4.3%	1.5%	2.1	6.2%	1.5	4.4%	13.4	39.4%	2.0	14.9%	11.6	34.0%
C-05		7.9	3.4	43.0%	0.0	0.0%	1.5	19.5%	1.5	45.3%	19.5%	0.0	0.0%	0.0	0.0%	3.4	43.0%	1.5	45.3%	2.3	29.4%
C-06		19.6	12.8	65.1%	0.0	0.0%	1.8	9.0%	1.8	13.8%	9.0%	0.0	0.0%	0.0	0.0%	12.8	65.1%	1.8	13.8%	11.5	58.8%
C-07		22.6	11.2	49.5%	0.0	0.0%	2.2	9.6%	2.2	19.4%	9.6%	0.0	0.0%	0.0	0.0%	11.2	49.5%	2.2	19.4%	9.6	42.7%
C-08		14.0	7.3	52.1%	0.2	1.7%	0.6	4.2%	0.8	11.5%	6.0%	0.0	0.0%	0.0	0.0%	7.3	52.1%	0.8	11.5%	6.7	47.9%
C-09		13.0	4.2	32.4%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0%	0.0	0.0%	0.0	0.0%	4.2	32.4%	0.0	0.0%	4.2	32.4%
C-10		11.6	4.7	40.2%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0%	0.0	0.0%	0.0	0.0%	4.7	40.2%	0.0	0.0%	4.7	40.2%
C-11		54.3	15.7	28.9%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0%	3.1	5.7%	2.2	4.0%	17.9	32.9%	2.2	12.1%	15.7	28.9%
C-12 [2]		45.5	2.8	6.2%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0%	45.5	99.9%	31.8	70.0%	34.7	76.2%	31.8	91.8%	2.8	6.2%
Subtotal		334.0	109.2	32.7%	0.2	0.1%	9.8	2.9%	10.0	9.2%	3.0%	63.9	19.1%	44.7	13.4%	153.9	46.1%	54.7	35.6%	102.2	30.6%
TOTALS		3,584.5	1,039.7	29.0%	551.8	53.1%	41.3	4.0%	593.1	57.0%	16.5%	1126.4	31.4%	788.5	22.0%	1,828.2	51.0%	1381.6	75.6%	612.2	17.1%

Notes: [1] Assumes 70% of existing treated development area is impervious.
[2] Assumes 70% of future development area will be impervious.
[3] Majority of basin located outside of City limits and UGA. Values are for portions of basin that are within the City.

APPENDIX B
Capital Project Ranking Worksheets

City of Poulsbo Stormwater Capital Improvement Project Prioritization

PROJECT: South Fork Dogfish Creek Restoration

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
1	***NPDES Permit Compliance***			
1a		Required by NPDES Permit	0 = not required 3 = required by 2016 5 = required by 2018	0
2	***Water Quality***			
2a		Required by Ecology TMDL Plan	0 = not required 3 = Load reduction is in basin with < 50% area within City 5 = Load reduction is in basin entirely within City	5
2b		Treatment Area	0 = no signficant treatment 2 = Low density residential 3 = High density residential 5 = treats dicharge from urban arterial and/or high density commercial	5
2c		Discharge Location	0 = project discharges to vegetated upland 2 = project discharges to wetland 5= project discharges directly to stream 10 = project is in priority basin and discharges directly to marine water	5
2d		Infiltration	0 = no infiltration 1 = minor infiltration 3 = infiltration is primary component of project	3
3	***Flow Control***			
3a		Improves detention	0 = no detetention increase 3 = addresses older area where localized flooding occurs 5 = increases detention upstream of known scour and channel degradation areas	3
3b		Improves conveyance capacity	0 = no increase in conveyance capacity	

PROJECT: South Fork Dogfish Creek Restoration

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
			3 = improves conveyance in sub-basin or localized area 5 = improves conveyance at known problem location	3
3c		Discharge Location	0 = project has direct marine discharge 1 = project discharges to low gradient stream 3 = discharge is to high gradient headwater stream	1
4	***Flood Reduction***			
4a		Flood Location	0 = no flood impact 5 = flood impacts to private property 10 = flood impacts to public infrastructure and/or safety	5
4b		Flood Source	0 = no flooding impact 3 = Private 5 = Public	3
4c		Flood Frequency	2 = 100-yr storm 3 = 25-yr storm 5 = 6-month storm	3
5	***Habitat***			
5a		Restoration or Habitat Plan priority	0 = not part of existing plan 3 = part of prior plan but City does not own property 5 = part of existing plan and City owns property	5
5b		Fish passage barrier removal	0 = No barrier 3 = Partial fish passage barrier removed 5 = complete fish passage barrier removed	0
5c		Habitat Degradation	0 = No degradation 3 = minor to moderate degradation 5= major degradation to habitat for priority species	5
			0 = no buffer impact	

PROJECT: South Fork Dogfish Creek Restoration

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
5d		Buffer Condition	1 = minor to moderate buffer improvement to smaller wetland or intermittent stream 3 = major buffer improvements to fish brearing stream, shoreline or wetland class III or IV	3
6	***Economic Development and Partnerships***			
6a		Supports economic development	0 = No signficant economic benefit 3 = Will contribute to redevelopment or neighborhood character 5 = high economic beneift such as regional facility or location in Viking way or Poulsbo Village redevelopment area	3
6b		Partnerships and funding leveraging	0 = no partnership or project leveraging opportunity 3 = partnership support and participation from other agencies 5 = partnership support and participation from other agencies and ability to leverage funding from other related or associated projects	5
6c		Recreation benefits	0 = Is not associated with any recreational site or use 3 = provides recreational opportunity or enhancement 5 = aligns with specific projects and goals associated with parks and recreation plan	5
6d		Aesthetic enhancement	0 = No aesthetic elements 3 = improvement in low to moderate visbility location 5 = signficant improvement at highly visible location	5
7	***Puget Sound Partnership Stragtegic Initatives***			

PROJECT: South Fork Dogfish Creek Restoration

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
7a	Meets Strategic Initatives (SI)	(1) prevent pollution from stormwater 2) protect and restore habitat 3) protect and recover shellfish beds	1 = consistent with one SI 3 = consistent with 2 SI 5 = consitent with all three SI	3
8	***Public Complaints and Perceptions***			
8a		Complaint History	0= No complaints 3= compliants form less than 2 parties over preceding 5 years or less 5 = complaints from multiple parties over extended period of time	3
9	***Operation, Maintenance and Infrastructure Replacement***			
9a		Maintenance requirements	0=high maintenance requiring mulitple events per year, both labor and equipment 3= moderate maintenance requirement 5=minimal maintenance requirement	0
9b		Infrastructure Replacement	0 = no replacement required 3 = replaces infrastructure > 30 years old 5 = replaces known deteriorated infrastructure based on prior inspection	3
			TOTAL SCORE	76

City of Poulsbo Stormwater Capital Improvement Project Prioritization

PROJECT: 8th Avenue Culvert Replacement at SF Dogfish Creek

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
1	***NPDES Permit Compliance***			
1a		Required by NPDES Permit	0 = not required 3 = required by 2016 5 = required by 2018	0
2	***Water Quality***			
2a		Required by Ecology TMDL Plan	0 = not required 3 = Load reduction is in basin with < 50% area within City 5 = Load reduction is in basin entirely within City	0
2b		Treatment Area	0 = no signficant treatment 2 = Low density residential 3 = High density residential 5 = treats dicharge from urban arterial and/or high density commercial	0
2c		Discharge Location	0 = project discharges to vegetated upland 2 = project discharges to wetland 5 = project discharges directly to stream 10 = project is in priority basin and discharges directly to marine water	0
2d		Infiltration	0 = no infiltration 1 = minor infiltration 3 = infiltration is primary component of project	0
3	***Flow Control***			
3a		Improves detention	0 = no detetention increase 3 = addresses older area where localized flooding occurs 5 = increases detention upstream of known scour and channel degradation areas	0
3b		Improves conveyance capacity	0 = no increase in conveyance capacity	

PROJECT: 8th Avenue Culvert Replacement at SF Dogfish Creek

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
			3 = improves conveyance in sub-basin or localized area 5 = improves conveyance at known problem location	5
3c		Discharge Location	0 = project has direct marine discharge 1 = project discharges to low gradient stream 3 = discharge is to high gradient headwater stream	3
4	***Flood Reduction***			
4a		Flood Location	0 = no flood impact 5 = flood impacts to private property 10 = flood impacts to public infrastructure and/or safety	10
4b		Flood Source	0 = no flooding impact 3 = Private 5 = Public	5
4c		Flood Frequency	2 = 100-yr storm 3 = 25-yr storm 5 = 6-month storm	5
5	***Habitat***			
5a		Restoration or Habitat Plan priority	0 = not part of existing plan 3 = part of prior plan but City does not own property 5 = part of existing plan and City owns property	5
5b		Fish passage barrier removal	0 = No barrier 3 = Partial fish passage barrier removed 5 = complete fish passage barrier removed	3
5c		Habitat Degradation	0 = No degradation 3 = minor to moderate degradation 5= major degradation to habitat for priority species	5
			0 = no buffer impact	

PROJECT: 8th Avenue Culvert Replacement at SF Dogfish Creek

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
5d		Buffer Condition	1 = minor to moderate buffer improvement to smaller wetland or intermittent stream 3 = major buffer improvements to fish brearing stream, shoreline or wetland class III or IV	3
6	***Economic Development and Partnerships***			
6a		Supports economic development	0 = No signficant economic benefit 3 = Will contribute to redevelopment or neighborhood character 5 = high economic beneift such as regional facility or location in Viking way or Poulsbo Village redevelopment area	3
6b		Partnerships and funding leveraging	0 = no partnership or project leveraging opportunity 3 = partnership support and participation from other agencies 5 = partnership support and participation from other agencies and ability to leverage funding from other related or associated projects	5
6c		Recreation benefits	0 = Is not associated with any recreational site or use 3 = provides recreational opportunity or enhancement 5 = aligns with specific projects and goals associated with parks and recreation plan	0
6d		Aesthetic enhancement	0 = No aesthetic elements 3 = improvement in low to moderate visbility location 5 = signficant improvement at highly visible location	3
7	***Puget Sound Partnership Stragtegic Initatives***			

PROJECT: 8th Avenue Culvert Replacement at SF Dogfish Creek

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
7a	Meets Strategic Initatives (SI)	(1) prevent pollution from stormwater 2) protect and restore habitat 3) protect and recover shellfish beds	1 = consistent with one SI 3 = consistent with 2 SI 5 = consitent with all three SI	1
8	***Public Complaints and Perceptions***			
8a		Complaint History	0= No complaints 3= compliants form less than 2 parties over preceding 5 years or less 5 = complaints from multiple parties over extended period of time	3
9	***Operation, Maintenance and Infrastructure Replacement***			
9a		Maintenance requirements	0=high maintenance requiring mulitple events per year, both labor and equipment 3= moderate maintenance requirement 5=minimal maintenance requirement	5
9b		Infrastructure Replacement	0 = no replacement required 3 = replaces infrastructure > 30 years old 5 = replaces known deteriorated infrastructure based on prior inspection	5
			TOTAL SCORE	69

City of Poulsbo Stormwater Capital Improvement Project Prioritization

PROJECT: Anderson Parkway Parknig Lot, Phase 2 Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
1	***NPDES Permit Compliance***			
1a		Required by NPDES Permit	0 = not required 3 = required by 2016 5 = required by 2018	0
2	***Water Quality***			
2a		Required by Ecology TMDL Plan	0 = not required 3 = Load reduction is in basin with < 50% area within City 5 = Load reduction is in basin entirely within City	5
2b		Treatment Area	0 = no signficant treatment 2 = Low density residential 3 = High density residential 5 = treats dicharge from urban arterial and/or high density commercial	5
2c		Discharge Location	0 = project discharges to vegetated upland 2 = project discharges to wetland 3 = project discharges directly to stream 10 = project is in priority basin and discharges directly to marine water	10
2d		Infiltration	0 = no infiltration 1 = minor infiltration 3 = infiltration is primary component of project	3
3	***Flow Control***			
3a		Improves detention	0 = no detetention increase 3 = addresses older area where localized flooding occurs 5 = increases detention upstream of known scour and channel degradation areas	0
3b		Improves conveyance capacity	0 = no increase in conveyance capacity	

PROJECT: Anderson Parkway Parknig Lot, Phase 2 Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
			3 = improves conveyance in sub-basin or localized area 5 = improves conveyance at known problem location	5
3c		Discharge Location	0 = project has direct marine discharge 1 = project discharges to low gradient stream 3 = discharge is to high gradient headwater stream	0
4	***Flood Reduction***			
4a		Flood Location	0 = no flood impact 5 = flood impacts to private property 10 = flood impacts to public infrastructure and/or safety	10
4b		Flood Source	0 = no flooding impact 3 = Private 5 = Public	5
4c		Flood Frequency	2 = 100-yr storm 3 = 25-yr storm 5 = 6-month storm	3
5	***Habitat***			
5a		Restoration or Habitat Plan priority	0 = not part of existing plan 3 = part of prior plan but City does not own property 5 = part of existing plan and City owns property	0
5b		Fish passage barrier removal	0 = No barrier 3 = Partial fish passage barrier removed 5 = complete fish passage barrier removed	0
5c		Habitat Degradation	0 = No degradation 3 = minor to moderate degradation 5= major degradation to habitat for priority species	0
			0 = no buffer impact	

PROJECT: Anderson Parkway Parknig Lot, Phase 2 Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
5d		Buffer Condition	1 = minor to moderate buffer improvement to smaller wetland or intermittent stream 3 = major buffer improvements to fish brearing stream, shoreline or wetland class III or IV	0
6	***Economic Development and Partnerships***			
6a		Supports economic development	0 = No signficant economic benefit 3 = Will contribute to redevelopment or neighborhood character 5 = high economic beneift such as regional facility or location in Viking way or Poulsbo Village redevelopment area	3
6b		Partnerships and funding leveraging	0 = no partnership or project leveraging opportunity 3 = partnership support and participation from other agencies 5 = partnership support and participation from other agencies and ability to leverage funding from other related or associated projects	5
6c		Recreation benefits	0 = Is not associated with any recreational site or use 3 = provides recreational opportunity or enhancement 5 = aligns with specific projects and goals associated with parks and recreation plan	0
6d		Aesthetic enhancement	0 = No aesthetic elements 3 = improvement in low to moderate visbility location 5 = signficant improvement at highly visible location	5
7	***Puget Sound Partnership Stragtegic Initatives***			

PROJECT: Anderson Parkway Parknig Lot, Phase 2 Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
7a	Meets Strategic Initatives (SI)	(1) prevent pollution from stormwater 2) protect and restore habitat 3) protect and recover shellfish beds	1 = consistent with one SI 3 = consistent with 2 SI 5 = consitent with all three SI	2
8	***Public Complaints and Perceptions***			
8a		Complaint History	0= No complaints 3= compliants form less than 2 parties over preceding 5 years or less 5 = complaints from multiple parties over extended period of time	0
9	***Operation, Maintenance and Infrastructure Replacement***			
9a		Maintenance requirements	0=high maintenance requiring mulitple events per year, both labor and equipment 3= moderate maintenance requirement 5=minimal maintenance requirement	3
9b		Infrastructure Replacement	0 = no replacement required 3 = replaces infrastructure > 30 years old 5 = replaces known deteriorated infrastructure based on prior inspection	5
			TOTAL SCORE	69

City of Poulsbo Stormwater Capital Improvement Project Prioritization

PROJECT: Poulsbo Creek Outfall Rehabilitation

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
1	***NPDES Permit Compliance***			
1a		Required by NPDES Permit	0 = not required 3 = required by 2016 5 = required by 2018	0
2	***Water Quality***			
2a		Required by Ecology TMDL Plan	0 = not required 3 = Load reduction is in basin with < 50% area within City 5 = Load reduction is in basin entirely within City	0
2b		Treatment Area	0 = no signficant treatment 2 = Low density residential 3 = High density residential 5 = treats dicharge from urban arterial and/or high density commercial	5
2c		Discharge Location	0 = project discharges to vegetated upland 2 = project discharges to wetland 5 = project discharges directly to stream or marine water 10 = project is in priority basin and discharges directly to marine water	5
2d		Infiltration	0 = no infiltration 1 = minor infiltration 3 = infiltration is primary component of project	1
3	***Flow Control***			
3a		Improves detention	0 = no detetention increase 3 = addresses older area where localized flooding occurs 5 = increases detention upstream of known scour and channel degradation areas	0
3b		Improves conveyance capacity	0 = no increase in conveyance capacity	

PROJECT: Poulsbo Creek Outfall Rehabilitation

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
			3 = improves conveyance in sub-basin or localized area 5 = improves conveyance at known problem location	5
3c		Discharge Location	0 = project has direct marine discharge 1 = project discharges to low gradient stream 3 = discharge is to high gradient headwater stream	0
4	***Flood Reduction***			
4a		Flood Location	0 = no flood impact 5 = flood impacts to private property 10 = flood impacts to public infrastructure and/or safety	10
4b		Flood Source	0 = no flooding impact 3 = Private 5 = Public	5
4c		Flood Frequency	2 = 100-yr storm 3 = 25-yr storm 5 = 6-month storm	5
5	***Habitat***			
5a		Restoration or Habitat Plan priority	0 = not part of existing plan 3 = part of prior plan but City does not own property 5 = part of existing plan and City owns property	5
5b		Fish passage barrier removal	0 = No barrier 3 = Partial fish passage barrier removed 5 = complete fish passage barrier removed	3
5c		Habitat Degradation	0 = No degradation 3 = minor to moderate degradation 5= major degradation to habitat for priority species	3
			0 = no buffer impact	

PROJECT: Poulsbo Creek Outfall Rehabilitation

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
5d		Buffer Condition	1 = minor to moderate buffer improvement to smaller wetland or intermittent stream 3 = major buffer improvements to fish brearing stream, shoreline or wetland class III or IV	1
6	***Economic Development and Partnerships***			
6a		Supports economic development	0 = No signficant economic benefit 3 = Will contribute to redevelopment or neighborhood character 5 = high economic beneift such as regional facility or location in Viking way or Poulsbo Village redevelopment area	3
6b		Partnerships and funding leveraging	0 = no partnership or project leveraging opportunity 3 = partnership support and participation from other agencies 5 = partnership support and participation from other agencies and ability to leverage funding from other related or associated projects	0
6c		Recreation benefits	0 = Is not associated with any recreational site or use 3 = provides recreational opportunity or enhancement 5 = aligns with specific projects and goals associated with parks and recreation plan	0
6d		Aesthetic enhancement	0 = No aesthetic elements 3 = improvement in low to moderate visbility location 5 = signficant improvement at highly visible location	3
7	***Puget Sound Partnership Stragtegic Initatives***			

PROJECT: Poulsbo Creek Outfall Rehabilitation

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
7a	Meets Strategic Initatives (SI)	(1) prevent pollution from stormwater 2) protect and restore habitat 3) protect and recover shellfish beds	1 = consistent with one SI 3 = consistent with 2 SI 5 = consitent with all three SI	5
8	***Public Complaints and Perceptions***			
8a		Complaint History	0= No complaints 3= compliants form less than 2 parties over preceding 5 years or less 10 = complaints from multiple parties over extended period of time	0
9	***Operation, Maintenance and Infrastructure Replacement***			
9a		Maintenance requirements	0=high maintenance requiring mulitple events per year, both labor and equipment 3= moderate maintenance requirement 5=minimal maintenance requirement	5
9b		Infrastructure Replacement	0 = no replacement required 3 = replaces infrastructure > 30 years old 5 = replaces known deteriorated infrastructure based on prior inspection	5
			TOTAL SCORE	69

City of Poulsbo Stormwater Capital Improvement Project Prioritization

PROJECT: Viking Avenue Regional Treatment Facility

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
1	***NPDES Permit Compliance***			
1a		Required by NPDES Permit	0 = not required 3 = required by 2016 5 = required by 2018	0
2	***Water Quality***			
2a		Required by Ecology TMDL Plan	0 = not required 3 = Load reduction is in basin with < 50% area within City 5 = Load reduction is in basin entirely within City	5
2b		Treatment Area	0 = no signficant treatment 2 = Low density residential 3 = High density residential 5 = treats dicharge from urban arterial and/or high density commercial	5
2c		Discharge Location	0 = project discharges to vegetated upland 2 = project discharges to wetland 3 = project discharges directly to stream 10 = project is in priority basin and discharges directly to marine water	10
2d		Infiltration	0 = no infiltration 1 = minor infiltration 3 = infiltration is primary component of project	3
3	***Flow Control***			
3a		Improves detention	0 = no detetention increase 3 = addresses older area where localized flooding occurs 5 = increases detention upstream of known scour and channel degradation areas	3
3b		Improves conveyance capacity	0 = no increase in conveyance capacity	

PROJECT: Viking Avenue Regional Treatment Facility

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
			3 = improves conveyance in sub-basin or localized area 5 = improves conveyance at known problem location	5
3c		Discharge Location	0 = project has direct marine discharge 1 = project discharges to low gradient stream 3 = discharge is to high gradient headwater stream	0
4	***Flood Reduction***			
4a		Flood Location	0 = no flood impact 5 = flood impacts to private property 10 = flood impacts to public infrastructure and/or safety	0
4b		Flood Source	0 = no flooding impact 3 = Private 5 = Public	0
4c		Flood Frequency	2 = 100-yr storm 3 = 25-yr storm 5 = 6-month storm	0
5	***Habitat***			
5a		Restoration or Habitat Plan priority	0 = not part of existing plan 3 = part of prior plan but City does not own property 5 = part of existing plan and City owns property	3
5b		Fish passage barrier removal	0 = No barrier 3 = Partial fish passage barrier removed 5 = complete fish passage barrier removed	0
5c		Habitat Degradation	0 = No degradation 3 = minor to moderate degradation 5= major degradation to habitat for priority species	3
			0 = no buffer impact	

PROJECT: Viking Avenue Regional Treatment Facility

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
5d		Buffer Condition	1 = minor to moderate buffer improvement to smaller wetland or intermittent stream 3 = major buffer improvements to fish brearing stream, shoreline or wetland class III or IV	1
6	***Economic Development and Partnerships***			
6a		Supports economic development	0 = No signficant economic benefit 3 = Will contribute to redevelopment or neighborhood character 5 = high economic beneift such as regional facility or location in Viking way or Poulsbo Village redevelopment area	5
6b		Partnerships and funding leveraging	0 = no partnership or project leveraging opportunity 3 = partnership support and participation from other agencies 5 = partnership support and participation from other agencies and ability to leverage funding from other related or associated projects	5
6c		Recreation benefits	0 = Is not associated with any recreational site or use 3 = provides recreational opportunity or enhancement 5 = aligns with specific projects and goals associated with parks and recreation plan	5
6d		Aesthetic enhancement	0 = No aesthetic elements 3 = improvement in low to moderate visbility location 5 = signficant improvement at highly visible location	5
7	***Puget Sound Partnership Stragtegic Initatives***			

PROJECT: Viking Avenue Regional Treatment Facility

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
7a	Meets Strategic Initatives (SI)	(1) prevent pollution from stormwater 2) protect and restore habitat 3) protect and recover shellfish beds	1 = consistent with one SI 3 = consistent with 2 SI 5 = consitent with all three SI	2
8	***Public Complaints and Perceptions***			
8a		Complaint History	0= No complaints 3= compliants form less than 2 parties over preceding 5 years or less 5 = complaints from multiple parties over extended period of time	0
9	***Operation, Maintenance and Infrastructure Replacement***			
9a		Maintenance requirements	0=high maintenance requiring mulitple events per year, both labor and equipment 3= moderate maintenance requirement 5=minimal maintenance requirement	0
9b		Infrastructure Replacement	0 = no replacement required 3 = replaces infrastructure > 30 years old 5 = replaces known deteriorated infrastructure based on prior inspection	3
			TOTAL SCORE	63

City of Poulsbo Stormwater Capital Improvement Project Prioritization

PROJECT: Kevos Pond-Ridgewood Neighborhood Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
1	***NPDES Permit Compliance***			
1a		Required by NPDES Permit	0 = not required 3 = required by 2016 5 = required by 2018	0
2	***Water Quality***			
2a		Required by Ecology TMDL Plan	0 = not required 3 = Load reduction is in basin with < 50% area within City 5 = Load reduction is in basin entirely within City	0
2b		Treatment Area	0 = no signficant treatment 2 = Low density residential 3 = High density residential 5 = treats dicharge from urban arterial and/or high density commercial	0
2c		Discharge Location	0 = project discharges to vegetated upland 2 = project discharges to wetland 5 = project discharges directly to stream 10 = project is in priority basin and discharges directly to marine water	2
2d		Infiltration	0 = no infiltration 1 = minor infiltration 3 = infiltration is primary component of project	0
3	***Flow Control***			
3a		Improves detention	0 = no detetention increase 3 = addresses older area where localized flooding occurs 5 = increases detention upstream of known scour and channel degradation areas	5
3b		Improves conveyance capacity	0 = no increase in conveyance capacity	

PROJECT: Kevos Pond-Ridgewood Neighborhood Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
			3 = improves conveyance in sub-basin or localized area 5 = improves conveyance at known problem location	5
3c		Discharge Location	0 = project has direct marine discharge 1 = project discharges to low gradient stream 3 = discharge is to high gradient headwater stream	3
4	***Flood Reduction***			
4a		Flood Location	0 = no flood impact 5 = flood impacts to private property 10 = flood impacts to public infrastructure and/or safety	10
4b		Flood Source	0 = no flooding impact 3 = Private 5 = Public	5
4c		Flood Frequency	2 = 100-yr storm 3 = 25-yr storm 5 = 6-month storm	3
5	***Habitat***			
5a		Restoration or Habitat Plan priority	0 = not part of existing plan 3 = part of prior plan but City does not own property 5 = part of existing plan and City owns property	0
5b		Fish passage barrier removal	0 = No barrier 3 = Partial fish passage barrier removed 5 = complete fish passage barrier removed	0
5c		Habitat Degradation	0 = No degradation 3 = minor to moderate degradation 5= major degradation to habitat for priority species	0
			0 = no buffer impact	

PROJECT: Kevos Pond-Ridgewood Neighborhood Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
5d		Buffer Condition	1 = minor to moderate buffer improvement to smaller wetland or intermittent stream 3 = major buffer improvements to fish brearing stream, shoreline or wetland class III or IV	0
6	***Economic Development and Partnerships***			
6a		Supports economic development	0 = No signficant economic benefit 3 = Will contribute to redevelopment or neighborhood character 5 = high economic beneift such as regional facility or location in Viking way or Poulsbo Village redevelopment area	3
6b		Partnerships and funding leveraging	0 = no partnership or project leveraging opportunity 3 = partnership support and participation from other agencies 5 = partnership support and participation from other agencies and ability to leverage funding from other related or associated projects	0
6c		Recreation benefits	0 = Is not associated with any recreational site or use 3 = provides recreational opportunity or enhancement 5 = aligns with specific projects and goals associated with parks and recreation plan	0
6d		Aesthetic enhancement	0 = No aesthetic elements 3 = improvement in low to moderate visbility location 5 = signficant improvement at highly visible location	5
7	***Puget Sound Partnership Stragtegic Initatives***			

PROJECT: Kevos Pond-Ridgewood Neighborhood Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
7a	Meets Strategic Initatives (SI)	(1) prevent pollution from stormwater 2) protect and restore habitat 3) protect and recover shellfish beds	1 = consistent with one SI 3 = consistent with 2 SI 5 = consitent with all three SI	1
8	***Public Complaints and Perceptions***			
8a		Complaint History	0= No complaints 3= compliants form less than 2 parties over preceding 5 years or less 10 = complaints from multiple parties over extended period of time	10
9	***Operation, Maintenance and Infrastructure Replacement***			
9a		Maintenance requirements	0=high maintenance requiring mulitple events per year, both labor and equipment 3= moderate maintenance requirement 5=minimal maintenance requirement	5
9b		Infrastructure Replacement	0 = no replacement required 3 = replaces infrastructure > 30 years old 5 = replaces known deteriorated infrastructure based on prior inspection	5
			TOTAL SCORE	62

City of Poulsbo Stormwater Capital Improvement Project Prioritization

PROJECT: Fjord Drive Water Quality and Habitat Improvements

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
1	***NPDES Permit Compliance***			
1a		Required by NPDES Permit	0 = not required 3 = required by 2016 5 = required by 2018	0
2	***Water Quality***			
2a		Required by Ecology TMDL Plan	0 = not required 3 = Load reduction is in basin with < 50% area within City 5 = Load reduction is in basin entirely within City	5
2b		Treatment Area	0 = no signficant treatment 2 = Low density residential 3 = High density residential 5 = treats dicharge from urban arterial and/or high density commercial	5
2c		Discharge Location	0 = project discharges to vegetated upland 2 = project discharges to wetland 5 = project discharges directly to stream or marine water 10 = project is in priority basin and discharges directly to marine water	10
2d		Infiltration	0 = no infiltration 1 = minor infiltration 3 = infiltration is primary component of project	1
3	***Flow Control***			
3a		Improves detention	0 = no detetention increase 3 = addresses older area where localized flooding occurs 5 = increases detention upstream of known scour and channel degradation areas	0
3b		Improves conveyance capacity	0 = no increase in conveyance capacity	

PROJECT: Fjord Drive Water Quality and Habitat Improvements

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
			3 = improves conveyance in sub-basin or localized area 5 = improves conveyance at known problem location	3
3c		Discharge Location	0 = project has direct marine discharge 1 = project discharges to low gradient stream 3 = discharge is to high gradient headwater stream	0
4	***Flood Reduction***			
4a		Flood Location	0 = no flood impact 5 = flood impacts to private property 10 = flood impacts to public infrastructure and/or safety	0
4b		Flood Source	0 = no flooding impact 3 = Private 5 = Public	0
4c		Flood Frequency	2 = 100-yr storm 3 = 25-yr storm 5 = 6-month storm	0
5	***Habitat***			
5a		Restoration or Habitat Plan priority	0 = not part of existing plan 3 = part of prior plan but City does not own property 5 = part of existing plan and City owns property	5
5b		Fish passage barrier removal	0 = No barrier 3 = Partial fish passage barrier removed 5 = complete fish passage barrier removed	0
5c		Habitat Degradation	0 = No degradation 3 = minor to moderate degradation 5= major degradation to habitat for priority species	5
			0 = no buffer impact	

PROJECT: Fjord Drive Water Quality and Habitat Improvements

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
5d		Buffer Condition	1 = minor to moderate buffer improvement to smaller wetland or intermittent stream 3 = major buffer improvements to fish brearing stream, shoreline or wetland class III or IV	3
6	***Economic Development and Partnerships***			
6a		Supports economic development	0 = No signficant economic benefit 3 = Will contribute to redevelopment or neighborhood character 5 = high economic beneift such as regional facility or location in Viking way or Poulsbo Village redevelopment area	3
6b		Partnerships and funding leveraging	0 = no partnership or project leveraging opportunity 3 = partnership support and participation from other agencies 5 = partnership support and participation from other agencies and ability to leverage funding from other related or associated projects	3
6c		Recreation benefits	0 = Is not associated with any recreational site or use 3 = provides recreational opportunity or enhancement 5 = aligns with specific projects and goals associated with parks and recreation plan	0
6d		Aesthetic enhancement	0 = No aesthetic elements 3 = improvement in low to moderate visbility location 5 = signficant improvement at highly visible location	5
7	***Puget Sound Partnership Stragtegic Initatives***			

PROJECT: Fjord Drive Water Quality and Habitat Improvements

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
7a	Meets Strategic Initatives (SI)	(1) prevent pollution from stormwater 2) protect and restore habitat 3) protect and recover shellfish beds	1 = consistent with one SI 3 = consistent with 2 SI 5 = consitent with all three SI	3
8	***Public Complaints and Perceptions***			
8a		Complaint History	0= No complaints 3= compliants form less than 2 parties over preceding 5 years or less 10 = complaints from multiple parties over extended period of time	3
9	***Operation, Maintenance and Infrastructure Replacement***			
9a		Maintenance requirements	0=high maintenance requiring mulitple events per year, both labor and equipment 3= moderate maintenance requirement 5=minimal maintenance requirement	3
9b		Infrastructure Replacement	0 = no replacement required 3 = replaces infrastructure > 30 years old 5 = replaces known deteriorated infrastructure based on prior inspection	5
			TOTAL SCORE	62

City of Poulsbo Stormwater Capital Improvement Project Prioritization

PROJECT: Bjorgen Creek Fish Passage Improvements

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
1	***NPDES Permit Compliance***			
1a		Required by NPDES Permit	0 = not required 3 = required by 2016 5 = required by 2018	0
2	***Water Quality***			
2a		Required by Ecology TMDL Plan	0 = not required 3 = Load reduction is in basin with < 50% area within City 5 = Load reduction is in basin entirely within City	0
2b		Treatment Area	0 = no signficant treatment 2 = Low density residential 3 = High density residential 5 = treats dicharge from urban arterial and/or high density commercial	0
2c		Discharge Location	0 = project discharges to vegetated upland 2 = project discharges to wetland 5 = project discharges directly to stream 10 = project is in priority basin and discharges directly to marine water	0
2d		Infiltration	0 = no infiltration 1 = minor infiltration 3 = infiltration is primary component of project	0
3	***Flow Control***			
3a		Improves detention	0 = no detetention increase 3 = addresses older area where localized flooding occurs 5 = increases detention upstream of known scour and channel degradation areas	0
3b		Improves conveyance capacity	0 = no increase in conveyance capacity	

PROJECT: Bjorgen Creek Fish Passage Improvements

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
			3 = improves conveyance in sub-basin or localized area 5 = improves conveyance at known problem location	5
3c		Discharge Location	0 = project has direct marine discharge 1 = project discharges to low gradient stream 3 = discharge is to high gradient headwater stream	3
4	***Flood Reduction***			
4a		Flood Location	0 = no flood impact 5 = flood impacts to private property 10 = flood impacts to public infrastructure and/or safety	5
4b		Flood Source	0 = no flooding impact 3 = Private 5 = Public	3
4c		Flood Frequency	2 = 100-yr storm 3 = 25-yr storm 5 = 6-month storm	2
5	***Habitat***			
5a		Restoration or Habitat Plan priority	0 = not part of existing plan 3 = part of prior plan but City does not own property 5 = part of existing plan and City owns property	5
5b		Fish passage barrier removal	0 = No barrier 3 = Partial fish passage barrier removed 5 = complete fish passage barrier removed	5
5c		Habitat Degradation	0 = No degradation 3 = minor to moderate degradation 5= major degradation to habitat for priority species	5
			0 = no buffer impact	

PROJECT: Bjorgen Creek Fish Passage Improvements

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
5d		Buffer Condition	1 = minor to moderate buffer improvement to smaller wetland or intermittent stream 3 = major buffer improvements to fish brearing stream, shoreline or wetland class III or IV	3
6	***Economic Development and Partnerships***			
6a		Supports economic development	0 = No signficant economic benefit 3 = Will contribute to redevelopment or neighborhood character 5 = high economic beneift such as regional facility or location in Viking way or Poulsbo Village redevelopment area	3
6b		Partnerships and funding leveraging	0 = no partnership or project leveraging opportunity 3 = partnership support and participation from other agencies 5 = partnership support and participation from other agencies and ability to leverage funding from other related or associated projects	5
6c		Recreation benefits	0 = Is not associated with any recreational site or use 3 = provides recreational opportunity or enhancement 5 = aligns with specific projects and goals associated with parks and recreation plan	0
6d		Aesthetic enhancement	0 = No aesthetic elements 3 = improvement in low to moderate visbility location 5 = signficant improvement at highly visible location	3
7	***Puget Sound Partnership Stragtegic Initatives***			

PROJECT: Bjorgen Creek Fish Passage Improvements

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
7a	Meets Strategic Initatives (SI)	(1) prevent pollution from stormwater 2) protect and restore habitat 3) protect and recover shellfish beds	1 = consistent with one SI 3 = consistent with 2 SI 5 = consitent with all three SI	1
8	***Public Complaints and Perceptions***			
8a		Complaint History	0= No complaints 3= compliants form less than 2 parties over preceding 5 years or less 5 = complaints from multiple parties over extended period of time	0
9	***Operation, Maintenance and Infrastructure Replacement***			
9a		Maintenance requirements	0=high maintenance requiring mulitple events per year, both labor and equipment 3= moderate maintenance requirement 5=minimal maintenance requirement	5
9b		Infrastructure Replacement	0 = no replacement required 3 = replaces infrastructure > 30 years old 5 = replaces known deteriorated infrastructure based on prior inspection	5
			TOTAL SCORE	58

City of Poulsbo Stormwater Capital Improvement Project Prioritization

PROJECT: Community Bioretention Program

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
1	***NPDES Permit Compliance***			
1a		Required by NPDES Permit	0 = not required 3 = required by 2016 5 = required by 2018	0
2	***Water Quality***			
2a		Required by Ecology TMDL Plan	0 = not required 3 = Load reduction is in basin with < 50% area within City 5 = Load reduction is in basin entirely within City	5
2b		Treatment Area	0 = no signficant treatment 2 = Low density residential 3 = High density residential 5 = treats dicharge from urban arterial and/or high density commercial	3
2c		Discharge Location	0 = project discharges to vegetated upland 2 = project discharges to wetland 5 = project discharges directly to stream 10 = project is in priority basin and discharges directly to marine water	10
2d		Infiltration	0 = no infiltration 1 = minor infiltration 3 = infiltration is primary component of project	3
3	***Flow Control***			
3a		Improves detention	0 = no detetention increase 3 = addresses older area where localized flooding occurs 5 = increases detention upstream of known scour and channel degradation areas	3
3b		Improves conveyance capacity	0 = no increase in conveyance capacity	

PROJECT: Community Bioretention Program

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
			3 = improves conveyance in sub-basin or localized area 5 = improves conveyance at known problem location	0
3c		Discharge Location	0 = project has direct marine discharge 1 = project discharges to low gradient stream 3 = discharge is to high gradient headwater stream	1
4	***Flood Reduction***			
4a		Flood Location	0 = no flood impact 5 = flood impacts to private property 10 = flood impacts to public infrastructure and/or safety	0
4b		Flood Source	0 = no flooding impact 3 = Private 5 = Public	0
4c		Flood Frequency	2 = 100-yr storm 3 = 25-yr storm 5 = 6-month storm	0
5	***Habitat***			
5a		Restoration or Habitat Plan priority	0 = not part of existing plan 3 = part of prior plan but City does not own property 5 = part of existing plan and City owns property	0
5b		Fish passage barrier removal	0 = No barrier 3 = Partial fish passage barrier removed 5 = complete fish passage barrier removed	0
5c		Habitat Degradation	0 = No degradation 3 = minor to moderate degradation 5= major degradation to habitat for priority species	3
			0 = no buffer impact	

PROJECT: Community Bioretention Program

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
5d		Buffer Condition	1 = minor to moderate buffer improvement to smaller wetland or intermittent stream 3 = major buffer improvements to fish brearing stream, shoreline or wetland class III or IV	0
6	***Economic Development and Partnerships***			
6a		Supports economic development	0 = No signficant economic benefit 3 = Will contribute to redevelopment or neighborhood character 5 = high economic beneift such as regional facility or location in Viking way or Poulsbo Village redevelopment area	3
6b		Partnerships and funding leveraging	0 = no partnership or project leveraging opportunity 3 = partnership support and participation from other agencies 5 = partnership support and participation from other agencies and ability to leverage funding from other related or associated projects	5
6c		Recreation benefits	0 = Is not associated with any recreational site or use 3 = provides recreational opportunity or enhancement 5 = aligns with specific projects and goals associated with parks and recreation plan	0
6d		Aesthetic enhancement	0 = No aesthetic elements 3 = improvement in low to moderate visbility location 5 = signficant improvement at highly visible location	5
7	***Puget Sound Partnership Stragtegic Initatives***			

PROJECT: Community Bioretention Program

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
7a	Meets Strategic Initatives (SI)	(1) prevent pollution from stormwater 2) protect and restore habitat 3) protect and recover shellfish beds	1 = consistent with one SI 3 = consistent with 2 SI 5 = consitent with all three SI	2
8	***Public Complaints and Perceptions***			
8a		Complaint History	0= No complaints 3= compliants form less than 2 parties over preceding 5 years or less 5 = complaints from multiple parties over extended period of time	0
9	***Operation, Maintenance and Infrastructure Replacement***			
9a		Maintenance requirements	0=high maintenance requiring mulitple events per year, both labor and equipment 3= moderate maintenance requirement 5=minimal maintenance requirement	3
9b		Infrastructure Replacement	0 = no replacement required 3 = replaces infrastructure > 30 years old 5 = replaces known deteriorated infrastructure based on prior inspection	0
			TOTAL SCORE	46

City of Poulsbo Stormwater Capital Improvement Project Prioritization

PROJECT: Fjord Drive Water Quality Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
1	***NPDES Permit Compliance***			
1a		Required by NPDES Permit	0 = not required 3 = required by 2016 5 = required by 2018	0
2	***Water Quality***			
2a		Required by Ecology TMDL Plan	0 = not required 3 = Load reduction is in basin with < 50% area within City 5 = Load reduction is in basin entirely within City	5
2b		Treatment Area	0 = no signficant treatment 2 = Low density residential 3 = High density residential 5 = treats dicharge from urban arterial and/or high density commercial	3
2c		Discharge Location	0 = project discharges to vegetated upland 2 = project discharges to wetland 5 = project discharges directly to stream or marine water 10 = project is in priority basin and discharges directly to marine water	10
2d		Infiltration	0 = no infiltration 1 = minor infiltration 3 = infiltration is primary component of project	0
3	***Flow Control***			
3a		Improves detention	0 = no detetention increase 3 = addresses older area where localized flooding occurs 5 = increases detention upstream of known scour and channel degradation areas	0
3b		Improves conveyance capacity	0 = no increase in conveyance capacity	

PROJECT: Fjord Drive Water Quality Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
			3 = improves conveyance in sub-basin or localized area 5 = improves conveyance at known problem location	5
3c		Discharge Location	0 = project has direct marine discharge 1 = project discharges to low gradient stream 3 = discharge is to high gradient headwater stream	0
4	***Flood Reduction***			
4a		Flood Location	0 = no flood impact 5 = flood impacts to private property 10 = flood impacts to public infrastructure and/or safety	0
4b		Flood Source	0 = no flooding impact 3 = Private 5 = Public	0
4c		Flood Frequency	2 = 100-yr storm 3 = 25-yr storm 5 = 6-month storm	0
5	***Habitat***			
5a		Restoration or Habitat Plan priority	0 = not part of existing plan 3 = part of prior plan but City does not own property 5 = part of existing plan and City owns property	0
5b		Fish passage barrier removal	0 = No barrier 3 = Partial fish passage barrier removed 5 = complete fish passage barrier removed	0
5c		Habitat Degradation	0 = No degradation 3 = minor to moderate degradation 5= major degradation to habitat for priority species	3
			0 = no buffer impact	

PROJECT: Fjord Drive Water Quality Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
5d		Buffer Condition	1 = minor to moderate buffer improvement to smaller wetland or intermittent stream 3 = major buffer improvements to fish brearing stream, shoreline or wetland class III or IV	0
6	***Economic Development and Partnerships***			
6a		Supports economic development	0 = No signficant economic benefit 3 = Will contribute to redevelopment or neighborhood character 5 = high economic beneift such as regional facility or location in Viking way or Poulsbo Village redevelopment area	3
6b		Partnerships and funding leveraging	0 = no partnership or project leveraging opportunity 3 = partnership support and participation from other agencies 5 = partnership support and participation from other agencies and ability to leverage funding from other related or associated projects	0
6c		Recreation benefits	0 = Is not associated with any recreational site or use 3 = provides recreational opportunity or enhancement 5 = aligns with specific projects and goals associated with parks and recreation plan	0
6d		Aesthetic enhancement	0 = No aesthetic elements 3 = improvement in low to moderate visbility location 5 = signficant improvement at highly visible location	3
7	***Puget Sound Partnership Stragtegic Initatives***			

PROJECT: Fjord Drive Water Quality Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
7a	Meets Strategic Initatives (SI)	(1) prevent pollution from stormwater 2) protect and restore habitat 3) protect and recover shellfish beds	1 = consistent with one SI 3 = consistent with 2 SI 5 = consitent with all three SI	3
8	***Public Complaints and Perceptions***			
8a		Complaint History	0= No complaints 3= compliants form less than 2 parties over preceding 5 years or less 10 = complaints from multiple parties over extended period of time	0
9	***Operation, Maintenance and Infrastructure Replacement***			
9a		Maintenance requirements	0=high maintenance requiring mulitple events per year, both labor and equipment 3= moderate maintenance requirement 5=minimal maintenance requirement	3
9b		Infrastructure Replacement	0 = no replacement required 3 = replaces infrastructure > 30 years old 5 = replaces known deteriorated infrastructure based on prior inspection	5
			TOTAL SCORE	43

City of Poulsbo Stormwater Capital Improvement Project Prioritization

PROJECT: Deer Run Detention and Bioswale Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
1	***NPDES Permit Compliance***			
1a		Required by NPDES Permit	0 = not required 3 = required by 2016 5 = required by 2018	0
2	***Water Quality***			
2a		Required by Ecology TMDL Plan	0 = not required 3 = Load reduction is in basin with < 50% area within City 5 = Load reduction is in basin entirely within City	0
2b		Treatment Area	0 = no signficant treatment 2 = Low density residential 3 = High density residential 5 = treats dicharge from urban arterial and/or high density commercial	2
2c		Discharge Location	0 = project discharges to vegetated upland 2 = project discharges to wetland 5 = project discharges directly to stream or marine water 10 = project is in priority basin and discharges directly to marine water	5
2d		Infiltration	0 = no infiltration 1 = minor infiltration 3 = infiltration is primary component of project	0
3	***Flow Control***			
3a		Improves detention	0 = no detetention increase 3 = addresses older area where localized flooding occurs 5 = increases detention upstream of known scour and channel degradation areas	3
3b		Improves conveyance capacity	0 = no increase in conveyance capacity	

PROJECT: Deer Run Detention and Bioswale Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
			3 = improves conveyance in sub-basin or localized area 5 = improves conveyance at known problem location	3
3c		Discharge Location	0 = project has direct marine discharge 1 = project discharges to low gradient stream 3 = discharge is to high gradient headwater stream	3
4	***Flood Reduction***			
4a		Flood Location	0 = no flood impact 5 = flood impacts to private property 10 = flood impacts to public infrastructure and/or safety	0
4b		Flood Source	0 = no flooding impact 3 = Private 5 = Public	0
4c		Flood Frequency	2 = 100-yr storm 3 = 25-yr storm 5 = 6-month storm	0
5	***Habitat***			
5a		Restoration or Habitat Plan priority	0 = not part of existing plan 3 = part of prior plan but City does not own property 5 = part of existing plan and City owns property	3
5b		Fish passage barrier removal	0 = No barrier 3 = Partial fish passage barrier removed 5 = complete fish passage barrier removed	0
5c		Habitat Degradation	0 = No degradation 3 = minor to moderate degradation 5= major degradation to habitat for priority species	3
			0 = no buffer impact	

PROJECT: Deer Run Detention and Bioswale Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
5d		Buffer Condition	1 = minor to moderate buffer improvement to smaller wetland or intermittent stream 3 = major buffer improvements to fish brearing stream, shoreline or wetland class III or IV	3
6	***Economic Development and Partnerships***			
6a		Supports economic development	0 = No signficant economic benefit 3 = Will contribute to redevelopment or neighborhood character 5 = high economic beneift such as regional facility or location in Viking way or Poulsbo Village redevelopment area	0
6b		Partnerships and funding leveraging	0 = no partnership or project leveraging opportunity 3 = partnership support and participation from other agencies 5 = partnership support and participation from other agencies and ability to leverage funding from other related or associated projects	0
6c		Recreation benefits	0 = Is not associated with any recreational site or use 3 = provides recreational opportunity or enhancement 5 = aligns with specific projects and goals associated with parks and recreation plan	0
6d		Aesthetic enhancement	0 = No aesthetic elements 3 = improvement in low to moderate visbility location 5 = signficant improvement at highly visible location	0
7	***Puget Sound Partnership Stragtegic Initatives***			

PROJECT: Deer Run Detention and Bioswale Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
7a	Meets Strategic Initatives (SI)	(1) prevent pollution from stormwater 2) protect and restore habitat 3) protect and recover shellfish beds	1 = consistent with one SI 3 = consistent with 2 SI 5 = consitent with all three SI	2
8	***Public Complaints and Perceptions***			
8a		Complaint History	0= No complaints 3= compliants form less than 2 parties over preceding 5 years or less 10 = complaints from multiple parties over extended period of time	0
9	***Operation, Maintenance and Infrastructure Replacement***			
9a		Maintenance requirements	0=high maintenance requiring mulitple events per year, both labor and equipment 3= moderate maintenance requirement 5=minimal maintenance requirement	5
9b		Infrastructure Replacement	0 = no replacement required 3 = replaces infrastructure > 30 years old 5 = replaces known deteriorated infrastructure based on prior inspection	5
			TOTAL SCORE	37

City of Poulsbo Stormwater Capital Improvement Project Prioritization

PROJECT: North Kitsap School District Poulsbo Campus Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
1	***NPDES Permit Compliance***			
1a		Required by NPDES Permit	0 = not required 3 = required by 2016 5 = required by 2018	0
2	***Water Quality***			
2a		Required by Ecology TMDL Plan	0 = not required 3 = Load reduction is in basin with < 50% area within City 5 = Load reduction is in basin entirely within City	5
2b		Treatment Area	0 = no signficant treatment 2 = Low density residential 3 = High density residential 5 = treats dicharge from urban arterial and/or high density commercial	5
2c		Discharge Location	0 = project discharges to vegetated upland 2 = project discharges to wetland 5 = project discharges directly to stream 10 = project is in priority basin and discharges directly to marine water	5
2d		Infiltration	0 = no infiltration 1 = minor infiltration 3 = infiltration is primary component of project	3
3	***Flow Control***			
3a		Improves detention	0 = no detetention increase 3 = addresses older area where localized flooding occurs 5 = increases detention upstream of known scour and channel degradation areas	5
3b		Improves conveyance capacity	0 = no increase in conveyance capacity	

PROJECT: North Kitsap School District Poulsbo Campus Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
			3 = improves conveyance in sub-basin or localized area 5 = improves conveyance at known problem location	3
3c		Discharge Location	0 = project has direct marine discharge 1 = project discharges to low gradient stream 3 = discharge is to high gradient headwater stream	3
4	***Flood Reduction***			
4a		Flood Location	0 = no flood impact 5 = flood impacts to private property 10 = flood impacts to public infrastructure and/or safety	5
4b		Flood Source	0 = no flooding impact 3 = Private 5 = Public	5
4c		Flood Frequency	2 = 100-yr storm 3 = 25-yr storm 5 = 6-month storm	3
5	***Habitat***			
5a		Restoration or Habitat Plan priority	0 = not part of existing plan 3 = part of prior plan but City does not own property 5 = part of existing plan and City owns property	0
5b		Fish passage barrier removal	0 = No barrier 3 = Partial fish passage barrier removed 5 = complete fish passage barrier removed	0
5c		Habitat Degradation	0 = No degradation 3 = minor to moderate degradation 5= major degradation to habitat for priority species	5
			0 = no buffer impact	

PROJECT: North Kitsap School District Poulsbo Campus Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
5d		Buffer Condition	1 = minor to moderate buffer improvement to smaller wetland or intermittent stream 3 = major buffer improvements to fish brearing stream, shoreline or wetland class III or IV	1
6	***Economic Development and Partnerships***			
6a		Supports economic development	0 = No signficant economic benefit 3 = Will contribute to redevelopment or neighborhood character 5 = high economic beneift such as regional facility or location in Viking way or Poulsbo Village redevelopment area	3
6b		Partnerships and funding leveraging	0 = no partnership or project leveraging opportunity 3 = partnership support and participation from other agencies 5 = partnership support and participation from other agencies and ability to leverage funding from other related or associated projects	5
6c		Recreation benefits	0 = Is not associated with any recreational site or use 3 = provides recreational opportunity or enhancement 5 = aligns with specific projects and goals associated with parks and recreation plan	3
6d		Aesthetic enhancement	0 = No aesthetic elements 3 = improvement in low to moderate visbility location 5 = signficant improvement at highly visible location	5
7	***Puget Sound Partnership Stragtegic Initatives***			

PROJECT: North Kitsap School District Poulsbo Campus Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
7a	Meets Strategic Initatives (SI)	(1) prevent pollution from stormwater 2) protect and restore habitat 3) protect and recover shellfish beds	1 = consistent with one SI 3 = consistent with 2 SI 5 = consitent with all three SI	3
8	***Public Complaints and Perceptions***			
8a		Complaint History	0= No complaints 3= compliants form less than 2 parties over preceding 5 years or less 10 = complaints from multiple parties over extended period of time	3
9	***Operation, Maintenance and Infrastructure Replacement***			
9a		Maintenance requirements	0=high maintenance requiring mulitple events per year, both labor and equipment 3= moderate maintenance requirement 5=minimal maintenance requirement	0
9b		Infrastructure Replacement	0 = no replacement required 3 = replaces infrastructure > 30 years old 5 = replaces known deteriorated infrastructure based on prior inspection	5
			TOTAL SCORE	75

City of Poulsbo Stormwater Capital Improvement Project Prioritization

PROJECT: Poulsbo Village Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
1	***NPDES Permit Compliance***			
1a		Required by NPDES Permit	0 = not required 3 = required by 2016 5 = required by 2018	0
2	***Water Quality***			
2a		Required by Ecology TMDL Plan	0 = not required 3 = Load reduction is in basin with < 50% area within City 5 = Load reduction is in basin entirely within City	5
2b		Treatment Area	0 = no signficant treatment 2 = Low density residential 3 = High density residential 5 = treats dicharge from urban arterial and/or high density commercial	5
2c		Discharge Location	0 = project discharges to vegetated upland 2 = project discharges to wetland 5 = project discharges directly to stream or marine water 10 = project is in priority basin and discharges directly to marine water	5
2d		Infiltration	0 = no infiltration 1 = minor infiltration 3 = infiltration is primary component of project	1
3	***Flow Control***			
3a		Improves detention	0 = no detetention increase 3 = addresses older area where localized flooding occurs 5 = increases detention upstream of known scour and channel degradation areas	3 5
3b		Improves conveyance capacity	0 = no increase in conveyance capacity	

PROJECT: Poulsbo Village Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
			3 = improves conveyance in sub-basin or localized area 5 = improves conveyance at known problem location	3
3c		Discharge Location	0 = project has direct marine discharge 1 = project discharges to low gradient stream 3 = discharge is to high gradient headwater stream	1
4	***Flood Reduction***			
4a		Flood Location	0 = no flood impact 5 = flood impacts to private property 10 = flood impacts to public infrastructure and/or safety	5
4b		Flood Source	0 = no flooding impact 3 = Private 5 = Public	3
4c		Flood Frequency	2 = 100-yr storm 3 = 25-yr storm 5 = 6-month storm	2
5	***Habitat***			
5a		Restoration or Habitat Plan priority	0 = not part of existing plan 3 = part of prior plan but City does not own property 5 = part of existing plan and City owns property	0
5b		Fish passage barrier removal	0 = No barrier 3 = Partial fish passage barrier removed 5 = complete fish passage barrier removed	0
5c		Habitat Degradation	0 = No degradation 3 = minor to moderate degradation 5= major degradation to habitat for priority species	3
			0 = no buffer impact	

PROJECT: Poulsbo Village Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
5d		Buffer Condition	1 = minor to moderate buffer improvement to smaller wetland or intermittent stream 3 = major buffer improvements to fish brearing stream, shoreline or wetland class III or IV	1
6	***Economic Development and Partnerships***			
6a		Supports economic development	0 = No signficant economic benefit 3 = Will contribute to redevelopment or neighborhood character 5 = high economic beneift such as regional facility or location in Viking way or Poulsbo Village redevelopment area	5
6b		Partnerships and funding leveraging	0 = no partnership or project leveraging opportunity 3 = partnership support and participation from other agencies 5 = partnership support and participation from other agencies and ability to leverage funding from other related or associated projects	3
6c		Recreation benefits	0 = Is not associated with any recreational site or use 3 = provides recreational opportunity or enhancement 5 = aligns with specific projects and goals associated with parks and recreation plan	0
6d		Aesthetic enhancement	0 = No aesthetic elements 3 = improvement in low to moderate visbility location 5 = signficant improvement at highly visible location	3
7	***Puget Sound Partnership Stragtegic Initatives***			

PROJECT: Poulsbo Village Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
7a	Meets Strategic Initatives (SI)	(1) prevent pollution from stormwater 2) protect and restore habitat 3) protect and recover shellfish beds	1 = consistent with one SI 3 = consistent with 2 SI 5 = consitent with all three SI	3
8	***Public Complaints and Perceptions***			
8a		Complaint History	0= No complaints 3= compliants form less than 2 parties over preceding 5 years or less 10 = complaints from multiple parties over extended period of time	0
9	***Operation, Maintenance and Infrastructure Replacement***			
9a		Maintenance requirements	0=high maintenance requiring mulitple events per year, both labor and equipment 3= moderate maintenance requirement 5=minimal maintenance requirement	0
9b		Infrastructure Replacement	0 = no replacement required 3 = replaces infrastructure > 30 years old 5 = replaces known deteriorated infrastructure based on prior inspection	5
			TOTAL SCORE	61

City of Poulsbo Stormwater Capital Improvement Project Prioritization

PROJECT: Front Street Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
1	***NPDES Permit Compliance***			
1a		Required by NPDES Permit	0 = not required 3 = required by 2016 5 = required by 2018	0
2	***Water Quality***			
2a		Required by Ecology TMDL Plan	0 = not required 3 = Load reduction is in basin with < 50% area within City 5 = Load reduction is in basin entirely within City	5
2b		Treatment Area	0 = no signficant treatment 2 = Low density residential 3 = High density residential 5 = treats dicharge from urban arterial and/or high density commercial	5
2c		Discharge Location	0 = project discharges to vegetated upland 2 = project discharges to wetland 3 = project discharges directly to stream or marine water 10 = project is in priority basin and discharges directly to marine water	10
2d		Infiltration	0 = no infiltration 1 = minor infiltration 3 = infiltration is primary component of project	1
3	***Flow Control***			
3a		Improves detention	0 = no detetention increase 3 = addresses older area where localized flooding occurs 5 = increases detention upstream of known scour and channel degradation areas	3
3b		Improves conveyance capacity	0 = no increase in conveyance capacity	

PROJECT: Front Street Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
			3 = improves conveyance in sub-basin or localized area 5 = improves conveyance at known problem location	3
3c		Discharge Location	0 = project has direct marine discharge 1 = project discharges to low gradient stream 3 = discharge is to high gradient headwater stream	0
4	***Flood Reduction***			
4a		Flood Location	0 = no flood impact 5 = flood impacts to private property 10 = flood impacts to public infrastructure and/or safety	0
4b		Flood Source	0 = no flooding impact 3 = Private 5 = Public	0
4c		Flood Frequency	2 = 100-yr storm 3 = 25-yr storm 5 = 6-month storm	0
5	***Habitat***			
5a		Restoration or Habitat Plan priority	0 = not part of existing plan 3 = part of prior plan but City does not own property 5 = part of existing plan and City owns property	0
5b		Fish passage barrier removal	0 = No barrier 3 = Partial fish passage barrier removed 5 = complete fish passage barrier removed	0
5c		Habitat Degradation	0 = No degradation 3 = minor to moderate degradation 5= major degradation to habitat for priority species	0
			0 = no buffer impact	

PROJECT: Front Street Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
5d		Buffer Condition	1 = minor to moderate buffer improvement to smaller wetland or intermittent stream 3 = major buffer improvements to fish brearing stream, shoreline or wetland class III or IV	0
6	***Economic Development and Partnerships***			
6a		Supports economic development	0 = No signficant economic benefit 3 = Will contribute to redevelopment or neighborhood character 5 = high economic beneift such as regional facility or location in Viking way or Poulsbo Village redevelopment area	5
6b		Partnerships and funding leveraging	0 = no partnership or project leveraging opportunity 3 = partnership support and participation from other agencies 5 = partnership support and participation from other agencies and ability to leverage funding from other related or associated projects	5
6c		Recreation benefits	0 = Is not associated with any recreational site or use 3 = provides recreational opportunity or enhancement 5 = aligns with specific projects and goals associated with parks and recreation plan	3
6d		Aesthetic enhancement	0 = No aesthetic elements 3 = improvement in low to moderate visbility location 5 = signficant improvement at highly visible location	5
7	***Puget Sound Partnership Stragtegic Initatives***			

PROJECT: Front Street Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
7a	Meets Strategic Initatives (SI)	(1) prevent pollution from stormwater 2) protect and restore habitat 3) protect and recover shellfish beds	1 = consistent with one SI 3 = consistent with 2 SI 5 = consitent with all three SI	3
8	***Public Complaints and Perceptions***			
8a		Complaint History	0= No complaints 3= compliants form less than 2 parties over preceding 5 years or less 10 = complaints from multiple parties over extended period of time	0
9	***Operation, Maintenance and Infrastructure Replacement***			
9a		Maintenance requirements	0=high maintenance requiring mulitple events per year, both labor and equipment 3= moderate maintenance requirement 5=minimal maintenance requirement	3
9b		Infrastructure Replacement	0 = no replacement required 3 = replaces infrastructure > 30 years old 5 = replaces known deteriorated infrastructure based on prior inspection	5
			TOTAL SCORE	56

City of Poulsbo Stormwater Capital Improvement Project Prioritization

PROJECT: Torval Canyon Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
1	***NPDES Permit Compliance***			
1a		Required by NPDES Permit	0 = not required 3 = required by 2016 5 = required by 2018	0
2	***Water Quality***			
2a		Required by Ecology TMDL Plan	0 = not required 3 = Load reduction is in basin with < 50% area within City 5 = Load reduction is in basin entirely within City	5
2b		Treatment Area	0 = no signficant treatment 2 = Low density residential 3 = High density residential 5 = treats dicharge from urban arterial and/or high density commercial	5
2c		Discharge Location	0 = project discharges to vegetated upland 2 = project discharges to wetland 3 = project discharges directly to stream or marine water 10 = project is in priority basin and discharges directly to marine water	10
2d		Infiltration	0 = no infiltration 1 = minor infiltration 3 = infiltration is primary component of project	1
3	***Flow Control***			
3a		Improves detention	0 = no detetention increase 3 = addresses older area where localized flooding occurs 5 = increases detention upstream of known scour and channel degradation areas	3
3b		Improves conveyance capacity	0 = no increase in conveyance capacity	

PROJECT: Torval Canyon Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
			3 = improves conveyance in sub-basin or localized area 5 = improves conveyance at known problem location	3
3c		Discharge Location	0 = project has direct marine discharge 1 = project discharges to low gradient stream 3 = discharge is to high gradient headwater stream	0
4	***Flood Reduction***			
4a		Flood Location	0 = no flood impact 5 = flood impacts to private property 10 = flood impacts to public infrastructure and/or safety	0
4b		Flood Source	0 = no flooding impact 3 = Private 5 = Public	0
4c		Flood Frequency	2 = 100-yr storm 3 = 25-yr storm 5 = 6-month storm	0
5	***Habitat***			
5a		Restoration or Habitat Plan priority	0 = not part of existing plan 3 = part of prior plan but City does not own property 5 = part of existing plan and City owns property	0
5b		Fish passage barrier removal	0 = No barrier 3 = Partial fish passage barrier removed 5 = complete fish passage barrier removed	0
5c		Habitat Degradation	0 = No degradation 3 = minor to moderate degradation 5= major degradation to habitat for priority species	0
			0 = no buffer impact	

PROJECT: Torval Canyon Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
5d		Buffer Condition	1 = minor to moderate buffer improvement to smaller wetland or intermittent stream 3 = major buffer improvements to fish brearing stream, shoreline or wetland class III or IV	0
6	***Economic Development and Partnerships***			
6a		Supports economic development	0 = No signficant economic benefit 3 = Will contribute to redevelopment or neighborhood character 5 = high economic beneift such as regional facility or location in Viking way or Poulsbo Village redevelopment area	3
6b		Partnerships and funding leveraging	0 = no partnership or project leveraging opportunity 3 = partnership support and participation from other agencies 5 = partnership support and participation from other agencies and ability to leverage funding from other related or associated projects	0
6c		Recreation benefits	0 = Is not associated with any recreational site or use 3 = provides recreational opportunity or enhancement 5 = aligns with specific projects and goals associated with parks and recreation plan	0
6d		Aesthetic enhancement	0 = No aesthetic elements 3 = improvement in low to moderate visbility location 5 = signficant improvement at highly visible location	3
7	***Puget Sound Partnership Stragtegic Initatives***			

PROJECT: Torval Canyon Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
7a	Meets Strategic Initatives (SI)	(1) prevent pollution from stormwater 2) protect and restore habitat 3) protect and recover shellfish beds	1 = consistent with one SI 3 = consistent with 2 SI 5 = consitent with all three SI	3
8	***Public Complaints and Perceptions***			
8a		Complaint History	0= No complaints 3= compliants form less than 2 parties over preceding 5 years or less 10 = complaints from multiple parties over extended period of time	0
9	***Operation, Maintenance and Infrastructure Replacement***			
9a		Maintenance requirements	0=high maintenance requiring mulitple events per year, both labor and equipment 3= moderate maintenance requirement 5=minimal maintenance requirement	3
9b		Infrastructure Replacement	0 = no replacement required 3 = replaces infrastructure > 30 years old 5 = replaces known deteriorated infrastructure based on prior inspection	5
			TOTAL SCORE	44

City of Poulsbo Stormwater Capital Improvement Project Prioritization

PROJECT: Poulsbo Place Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
1	***NPDES Permit Compliance***			
1a		Required by NPDES Permit	0 = not required 3 = required by 2016 5 = required by 2018	0
2	***Water Quality***			
2a		Required by Ecology TMDL Plan	0 = not required 3 = Load reduction is in basin with < 50% area within City 5 = Load reduction is in basin entirely within City	5
2b		Treatment Area	0 = no signficant treatment 2 = Low density residential 3 = High density residential 5 = treats dicharge from urban arterial and/or high density commercial	5
2c		Discharge Location	0 = project discharges to vegetated upland 2 = project discharges to wetland 3 = project discharges directly to stream or marine water 10 = project is in priority basin and discharges directly to marine water	10
2d		Infiltration	0 = no infiltration 1 = minor infiltration 3 = infiltration is primary component of project	1
3	***Flow Control***			
3a		Improves detention	0 = no detetention increase 3 = addresses older area where localized flooding occurs 5 = increases detention upstream of known scour and channel degradation areas	0
3b		Improves conveyance capacity	0 = no increase in conveyance capacity	

PROJECT: Poulsbo Place Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
			3 = improves conveyance in sub-basin or localized area 5 = improves conveyance at known problem location	3
3c		Discharge Location	0 = project has direct marine discharge 1 = project discharges to low gradient stream 3 = discharge is to high gradient headwater stream	0
4	***Flood Reduction***			
4a		Flood Location	0 = no flood impact 5 = flood impacts to private property 10 = flood impacts to public infrastructure and/or safety	0
4b		Flood Source	0 = no flooding impact 3 = Private 5 = Public	0
4c		Flood Frequency	2 = 100-yr storm 3 = 25-yr storm 5 = 6-month storm	0
5	***Habitat***			
5a		Restoration or Habitat Plan priority	0 = not part of existing plan 3 = part of prior plan but City does not own property 5 = part of existing plan and City owns property	0
5b		Fish passage barrier removal	0 = No barrier 3 = Partial fish passage barrier removed 5 = complete fish passage barrier removed	0
5c		Habitat Degradation	0 = No degradation 3 = minor to moderate degradation 5= major degradation to habitat for priority species	0
			0 = no buffer impact	

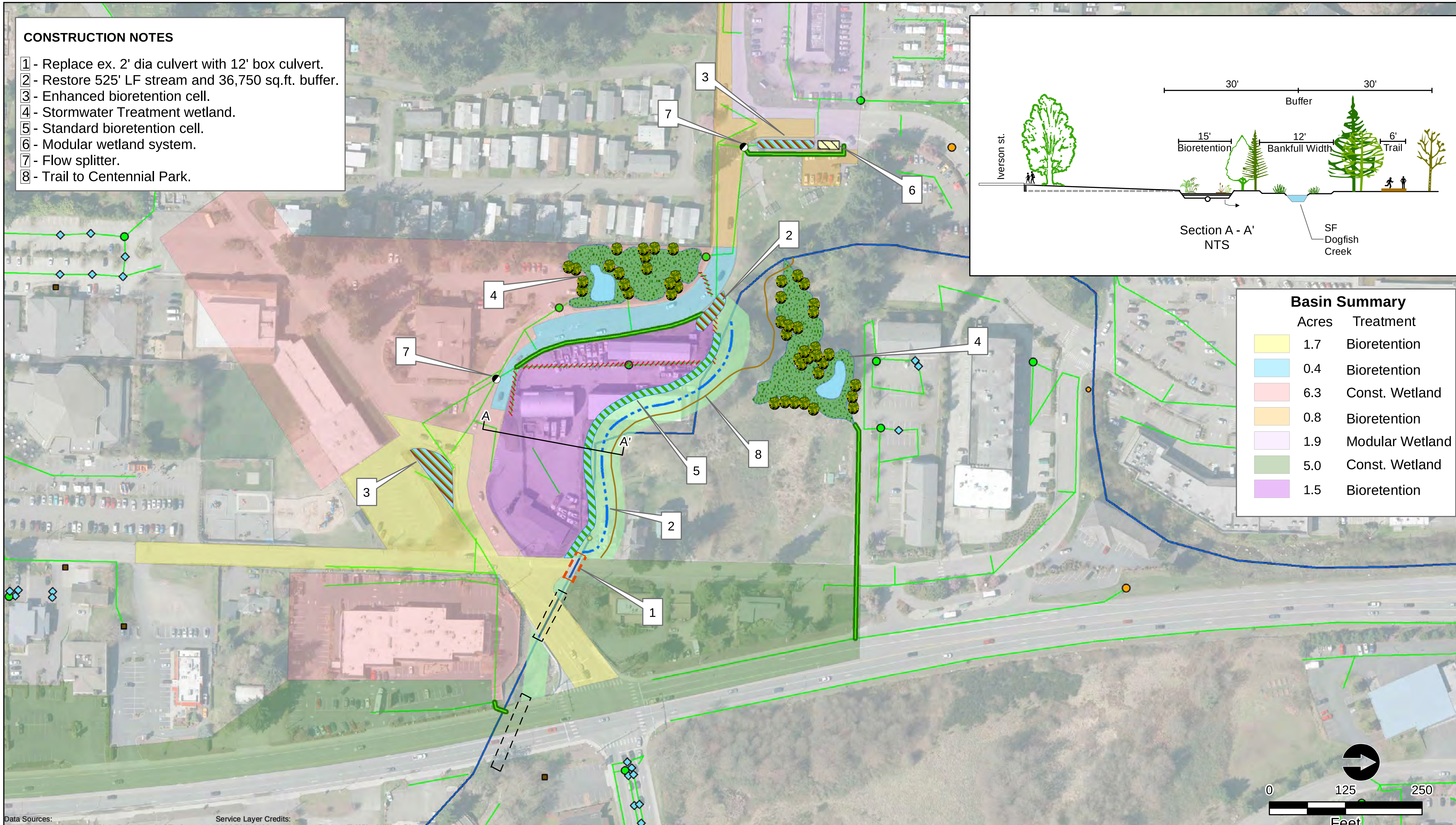
PROJECT: Poulsbo Place Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
5d		Buffer Condition	1 = minor to moderate buffer improvement to smaller wetland or intermittent stream 3 = major buffer improvements to fish brearing stream, shoreline or wetland class III or IV	0
6	***Economic Development and Partnerships***			
6a		Supports economic development	0 = No signficant economic benefit 3 = Will contribute to redevelopment or neighborhood character 5 = high economic beneift such as regional facility or location in Viking way or Poulsbo Village redevelopment area	3
6b		Partnerships and funding leveraging	0 = no partnership or project leveraging opportunity 3 = partnership support and participation from other agencies 5 = partnership support and participation from other agencies and ability to leverage funding from other related or associated projects	0
6c		Recreation benefits	0 = Is not associated with any recreational site or use 3 = provides recreational opportunity or enhancement 5 = aligns with specific projects and goals associated with parks and recreation plan	0
6d		Aesthetic enhancement	0 = No aesthetic elements 3 = improvement in low to moderate visbility location 5 = signficant improvement at highly visible location	3
7	***Puget Sound Partnership Stragtegic Initatives***			

PROJECT: Poulsbo Place Retrofit

Criteria No.	General Description	Specific Issue	Score Range Criteria	Score
7a	Meets Strategic Initatives (SI)	(1) prevent pollution from stormwater 2) protect and restore habitat 3) protect and recover shellfish beds	1 = consistent with one SI 3 = consistent with 2 SI 5 = consitent with all three SI	3
8	***Public Complaints and Perceptions***			
8a		Complaint History	0= No complaints 3= compliants form less than 2 parties over preceding 5 years or less 10 = complaints from multiple parties over extended period of time	0
9	***Operation, Maintenance and Infrastructure Replacement***			
9a		Maintenance requirements	0=high maintenance requiring mulitple events per year, both labor and equipment 3= moderate maintenance requirement 5=minimal maintenance requirement	3
9b		Infrastructure Replacement	0 = no replacement required 3 = replaces infrastructure > 30 years old 5 = replaces known deteriorated infrastructure based on prior inspection	3
			TOTAL SCORE	39

APPENDIX C
Capital Project Schematic Designs



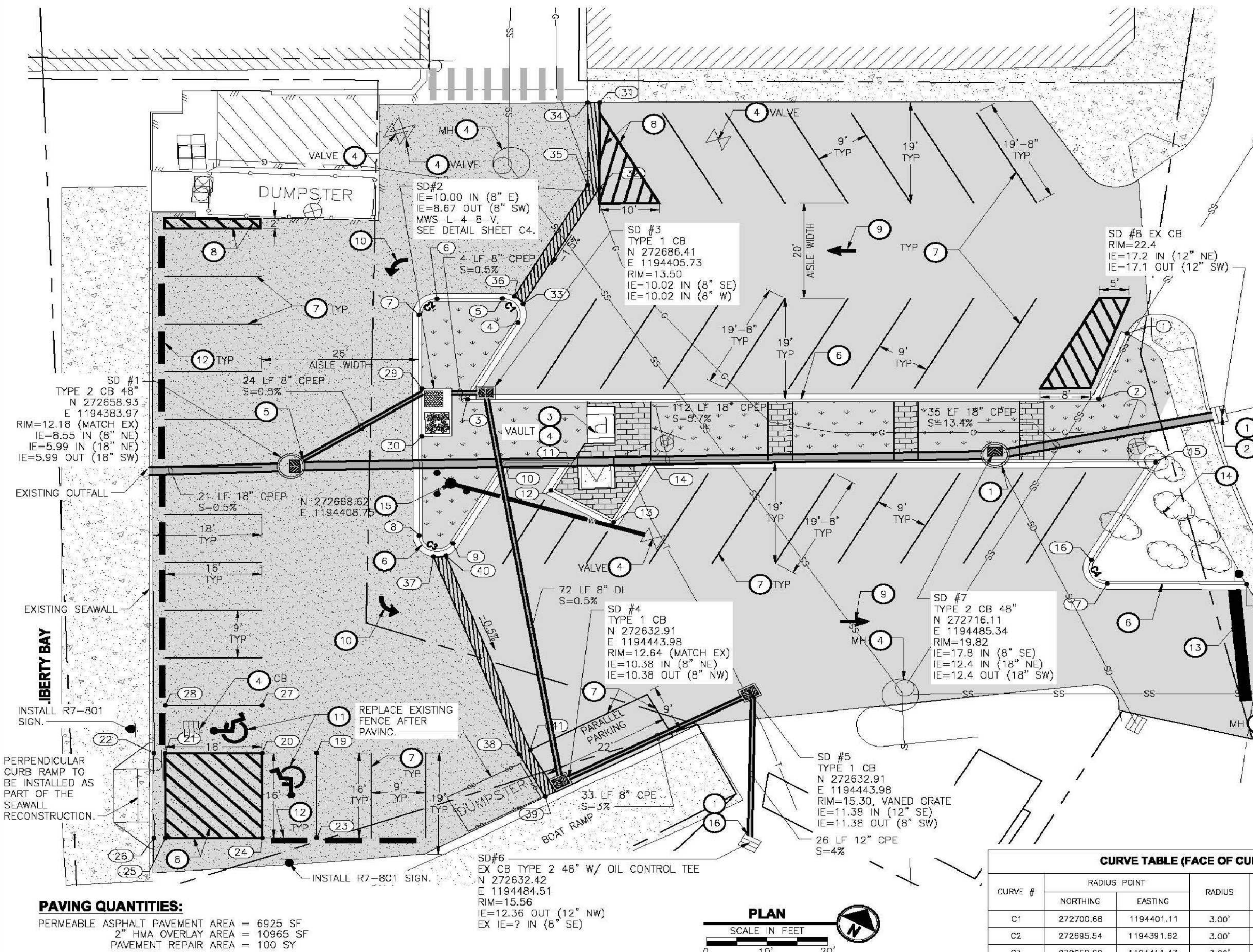
Prepared by Sealaska Environmental, E:\PMX-TMDL\Stormwater Management Plan\MXD\Fig_C-1_SF_DogfishCrk_at8th.mxd, February 10, 2016.

SEALASKA ENVIRONMENTAL

- Existing Stream
- New Stream Channel
- Existing Control Structure
- Existing Oil Water Separator
- Existing Underground Detention Facility
- Existing Stormwater Pipe
- New Stormwater Pipe
- Parcel Boundary
- Existing Culvert
- Proposed Culvert
- Features to be Removed
- Restored Stream Buffer
- Bioretention
- Enhanced Bioretention
- Constructed Wetland

Project C-1,C-1A
SF Dogfish Creek Restoration and Culvert Replacement at 8th Ave.
TMDL Implementation Plan
City of Poulsbo

Prepared by Sealaska Environmental, E:\PMX-TMDL\Stormwater Management Plan\MXD\Fig_C-2_SoAnderson_Parkway_Retrofit.mxd, February 10, 2016.



PAVING QUANTITIES:

PERMEABLE ASPHALT PAVEMENT AREA = 6925 SF
2" HMA OVERLAY AREA = 10965 SF
PAVEMENT REPAIR AREA = 100 SY

Point Table

Point #	Northing	Easting	Elevation	Description
1	272746.62	1194493.63	21.18	MATCH EX CURB, FL
2	272733.58	1194495.38	21.70	AP, FL
3	272683.86	1194403.66	13.38	AP, FL
4	272700.60	1194404.11	13.60	PC, FL
5	272703.32	1194399.68	13.48	PT, FL
6	272698.18	1194390.19	13.23	PC, FL
7	272694.11	1194388.98	13.15	PT, FL
8	272657.48	1194408.83	12.96	PC, FL
9	272658.82	1194414.47	13.18	PT, FL
10	272676.35	1194414.94	13.69	AP, FL
11	272681.30	1194424.08	14.21	AP, FL
12	272675.29	1194423.92	14.06	AP, FL
13	272674.97	1194435.91	15.08	AP, FL
14	272687.90	1194436.26	15.21	AP, FL
15	272727.52	1194509.35	24.47	AP, FL
16	272706.28	1194508.78	22.83	PC, FL
17	272703.56	1194513.19	23.19	PT, FL
18	272714.38	1194533.51	24.70	AP, FL
19	272613.33	1194413.42	12.87	ADA STALL, GRADE BREAK
20	272609.04	1194405.51	12.86	ADA STALL, GRADE BREAK
21	272601.42	1194391.44	12.94	LANDING, GRADE BREAK
22	272600.52	1194389.80	13.19	MATCH EX FL
23	272599.26	1194421.04	13.33	ADA STALL, GRADE BREAK
24	272594.97	1194413.13	13.15	ADA STALL, GRADE BREAK
25	272587.35	1194399.06	13.27	LANDING, GRADE BREAK
26	272586.44	1194397.40	13.28	MATCH EX FL
27	272616.95	1194401.22	12.70	ADA STALL, GRADE BREAK
28	272609.33	1194387.15	12.78	ADA STALL, GRADE BREAK
29	272682.10	1194396.06	13.57	TOP BACK OF CURB/MWS
30	272674.19	1194400.35	13.53	TOP BACK OF CURB/MWS

GENERAL CONSTRUCTION NOTES:

1. AT NO TIME SHALL CONCRETE, CONCRETE BY-PRODUCTS, VEHICLE FLUIDS, PAINT, CHEMICALS, OR OTHER POLLUTING MATTER BE PERMITTED TO DISCHARGE TO THE TEMPORARY OR PERMANENT DRAINAGE SYSTEM, OR TO DISCHARGE FROM THE PROJECT SITE.
2. CONTRACTOR TO VERIFY LOCATION OF ALL UTILITIES PRIOR TO CONSTRUCTION.
3. PAVEMENT REPAIR TO BE DELINEATED BY ENGINEER. SEE DETAIL 6/C3
4. PIPE TRENCHING BEDDING AND BACKFILL AND ASPHALT PAVEMENT RESTORATION, SEE DETAILS 3/C3 5/C3

KEYNOTES:

1. CONNECTION TO DRAINAGE STRUCTURE.
2. VERIFY EXISTING CB LOCATION.
3. REPLACE WITH WATERTIGHT LID (BY OTHERS).
4. ADJUST TO FINISHED GRADE.
5. 8" TIDEFLEX CHECKMATE INLINE CHECK VALVE ON INLET PIPE.
6. CONCRETE TRAFFIC CURB & GUTTER PER WSDOT STANDARD PLANS F-10.12-03.
7. WHITE PAINT LINE FOR 60d PARKING STALL ARRANGEMENT PER WSDOT STD PLAN M-17.10-02
8. YELLOW PAINT LINE (HATCH AREA) FOR 60d PARKING STALL ARRANGEMENT PER WSDOT STD PLAN M-17.10-02
9. WHITE PAINTED TRAFFIC ARROW, TYPE 1S, PER WSDOT STD PLAN M-24.40-01.
10. WHITE PAINTED TRAFFIC ARROW, TYPE 2SL (LEFT), PER WSDOT STD PLAN M-24.40-01.
11. PAINTED ACCESS PARKING SPACE SYMBOL PER WSDOT STD PLAN M-24.60-04.
12. MANUFACTURED WHEEL STOP, PLACEMENT PER WSDOT STD PLAN M-17.10-02.
13. PAINTED STOP LINE, 18" WIDE PER WSDOT STD PLAN M-24.60-04.
14. PROTECT EXISTING LANDSCAPING.
15. MOVE EXISTING HYDRANT AND BOLLARDS PER COP STD DETAIL 4-07.
16. REMOVE AND REINSTALL EXISTING OIL CONTROL TEE ON NEW PIPE IN EX CB.

CURVE TABLE (FACE OF CURB)

CURVE #	RADIUS POINT		RADIUS	LENGTH	DELTA
	NORTHING	EASTING			
C1	272700.68	1194401.11	3.00'	6.28'	120°00'00"
C2	272695.54	1194391.62	3.00'	4.71'	89°59'30"
C3	272658.90	1194411.47	3.00'	7.85'	150°00'30"
C4	272706.20	1194511.78	3.00'	6.26'	119°35'02"

Point Table

Point #	Northing	Easting	Elevation	Description
31	272743.53	1194396.23	14.07	BERM, FL
32	272729.40	1194403.89	13.99	BERM, FL
33	272704.09	1194403.20	13.57	BERM, FL
34	272742.56	1194394.48	13.67	BERM, FL
35	272728.92	1194401.88	13.59	BERM, FL
36	272704.68	1194401.22	13.57	BERM, FL
37	272655.13	1194412.79	13.04	BERM, FL
38	272629.02	1194442.99	12.92	BERM, FL
39	272624.05	1194450.58	12.74	BERM, FL
40	272656.29	1194414.50	13.13	BERM, FL
41	272630.62	1194444.20	12.92	BERM, FL

HATCH LEGEND:

- 2" HMA OVERLAY
- PERMEABLE ASPHALT PAVEMENT, SEE DETAIL 2/C3
- STORMWATER CONTROL BERM, SEE DETAIL 4/C3
- LANDSCAPE AREA, SEE SHEET LS1.
- RED BRICK PAVER WALKWAYS, SEE SHEET LS1.

100 % REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

REVISIONS	DATE	BY	
			DESIGNED T. SMITH
			DRAWN J. CERALDE
			CHECKED D. DINKUHN
			APPROVED

ONE INCH AT FULL SCALE. IF NOT, SCALE ACCORDINGLY
FILE NAME PS02332237077-C2
JOB No. 233-2237-077
DATE FEBRUARY 2015

MARIA THERESA CAYETANO SMITH, STATE OF WASHINGTON, 37935, REGISTERED PROFESSIONAL ENGINEER

Parametrix
ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES
1019 39TH AVENUE SE, SUITE 100
PUYALLUP, WASHINGTON 98374
T. 253.604.6600 F. 253.604.6799
www.parametrix.com

PROJECT NAME
CITY OF POULSBO
ANDERSON PARKWAY PHASE 2
STORMWATER RETROFIT
POULSBO, WASHINGTON

LID RETROFIT, PAVING CHANNELIZATION, SIGNING PLAN

DRAWING NO. 4 OF 7
C2

SEALASKA ENVIRONMENTAL

Project C-2.
South Anderson Parkway Retrofit
TMDL Implementation Plan
City of Poulsbo

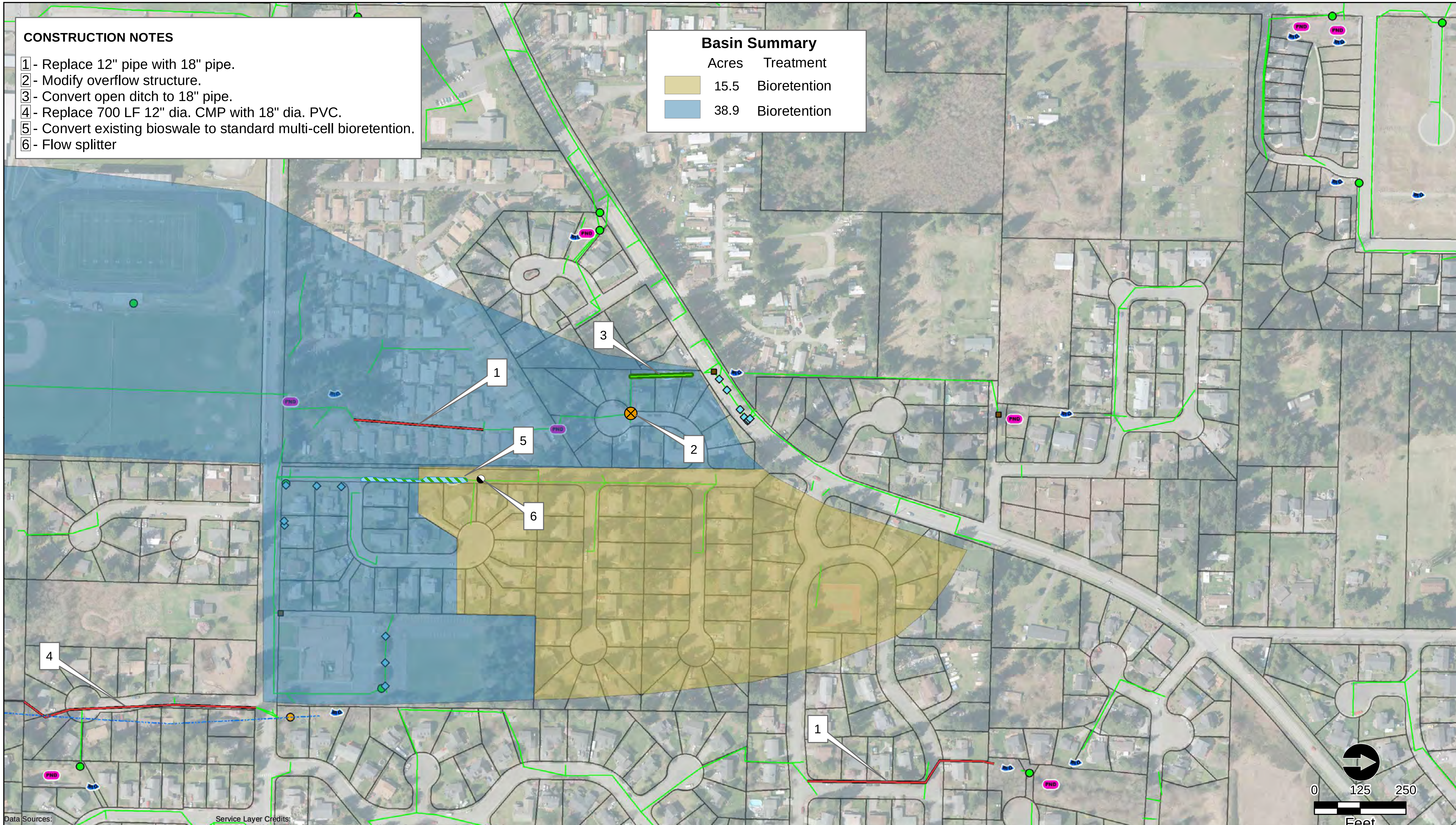
Prepared by Sealaska Environmental, E:\PMX-TMDL\Stormwater Management Plan\MXD\Fig._C-3_Poulsbo_Creek_Outfall_Improvements.mxd, February 25, 2016.

Existing Stream
Intermittent
Existing Control Structure
Existing Oil Water Separator
Existing Underground Detention Facility
Existing Stormwater Pipe
New Stormwater Pipe
Manhole
New Outfall
Parcel Boundary
Standard Bioretention
Enhanced Bioretention

Figure C-3.
Poulsbo Creek Outfall Rehabilitation
TMDL Implementation Plan
City of Poulsbo

5' Contours
25' Contours
Parcel Line
Stormwater Pipe
Ditch
Catch Basin
Control Structure
Proposed Flow Splitter
O/W Separator
Underground Detention
Proposed Stormwater Pipe
Project Site Limits

Project C-4.
Viking Avenue Regional Treatment Facility
TMDL Implementation Plan
City of Poulsbo



Prepared by Sealaska Environmental, E:\PMX-TMDL\Stormwater Management Plan\MXD\Fig._C-4_Kevos_Pond_Ridgewood_Retrofit.mxd, February 16, 2016.

- Existing Stream
- Intermittent
- Existing Control Structure
- Existing Oil Water Separator
- Existing Underground Detention Facility
- Existing Stormwater Pipe
- New Stormwater Pipe
- Pipe Replacement
- Overflow Structure
- Flow Splitter
- Parcel Boundary
- Standard Bioretention
- Enhanced Bioretention
- Constructed Wetland

Project C-5.
Ridgewood/Kevos Pond Basin Drainage Improvements
TMDL Implementation Plan
City of Poulsbo

Prepared by Sealaska Environmental, E:\PMX-TMDL\Stormwater Management Plan\MXD\Fig_C-8a_Fjord_Drive_Retrofit.mxd, February 25, 2016.

- Stream
- Intermittent
- Existing Control Structure
- Existing Oil Water Separator
- Existing Underground Detention Facility
- New Stormwater Pipe
- Existing Stormwater Pipe
- Feature to be Removed
- Marine Outfall
- Filterra Vault
- Modular Wetland System
- Parcel Boundary
- Standard Bioretention
- Enhanced Bioretention
- Constructed Wetland

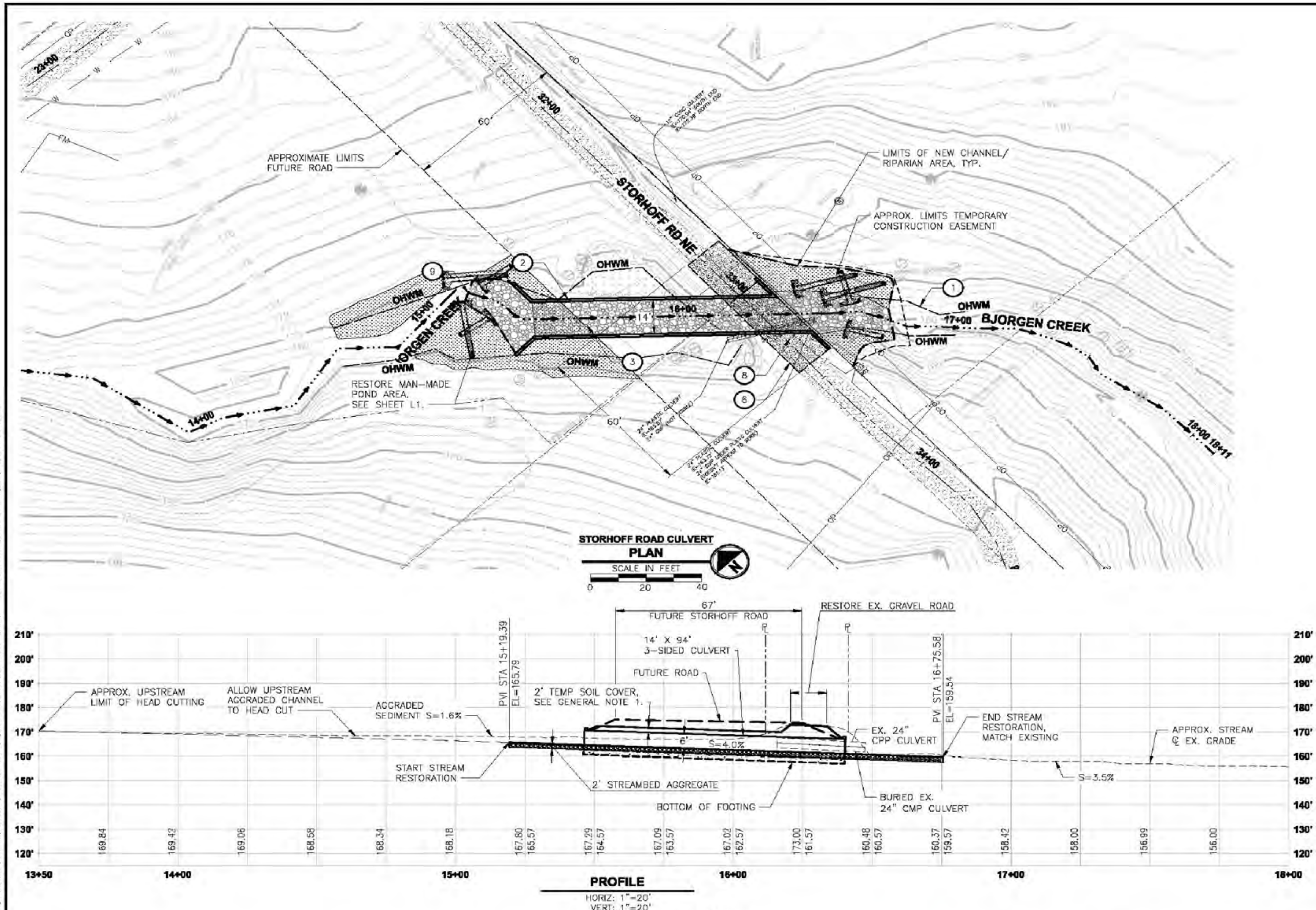
SEALASKA ENVIRONMENTAL

Figure C-6a.
Fjord Drive Water Quality and Habitat Improvements
TMDL Implementation Plan
City of Poulsbo

Prepared by Sealaska Environmental, E:\PMX-TMDL\Stormwater Management Plan\MXD\Fig._C-6b_Fjord_Drive_Retrofit.mxd, February 25, 2016.

- Stream
- Intermittent
- Existing Control Structure
- Existing Oil Water Separator
- Existing Underground Detention Facility
- New Stormwater Pipe
- Existing Stormwater Pipe
- Marine Outfall
- Filterra Vault
- Modular Wetland System
- Parcel Boundary
- Standard Bioretention
- Enhanced Bioretention
- Constructed Wetland

Figure C-6b.
Fjord Drive Water Quality and Habitat Improvements
TMDL Implementation Plan
City of Poulsbo



KEYNOTES:

1. ANCHORED ROUGHNESS LOG, TYP. SEE DETAIL 2/C3
2. 14' SPAN X 94' X 6' RISE PRECAST CONCRETE CULVERT
3. STREAMBED AGGREGATE, SEE DETAIL 1/C3
4. PIN LOGS WITH NO. 6 REBAR, FULL DEPTH.
5. BURY LOG ENDS 5' USING SMALL EXCAVATOR OR HAND TOOLS. MINIMIZE TREE ROOT DAMAGE. BACKFILL WITH NATIVE STREAMBED SOIL AND 3" COMPOST. SEED WITH RIPARIAN SEED MIX.
6. MATCH EDGE OF EXISTING SHOULDER, TYP.
7. MATCH EXISTING.
8. 15' WIDE 6" CSTC GRAVEL RESTORATION.
9. BYPASS CREEK IN ACCORDANCE WITH HPA PROVISIONS.
10. LANDSCAPE AREA, SEE SHEET L1.

LEGEND

RESTORATION AND MITIGATION AREA, SEE SHEET L1.

GENERAL NOTES:

1. CULVERT OUTSIDE OF EXISTING LIMITS OF STORHOFF ROAD TO BE COVERED WITH 2-FT SOIL AND HYDRO SEEDED. EMBANKMENT FOR FUTURE ROAD IMPROVEMENTS TO BE CONSTRUCTED AT A LATER DATE. CURRENTLY EST. AT 2017.

JARPA SET

REVISIONS	DATE	BY	
			DESIGNED D. DINKUHN
			DRAWN J. CERALDE
			CHECKED P. STRUCK
			APPROVED

ONE INCH AT FULL SCALE. IF NOT, SCALE ACCORDINGLY
FILE NAME PS0223703O-C02-C03
JOB No. 233-2237-030
DATE MAY 2015

DAVID L. DINKUHN, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER

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P 360.377.0014
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PROJECT NAME
CITY OF POULSBO
BJORGEN CREEK AT STORHOFF ROAD
FISH PASSAGE CULVERT IMPROVEMENTS
POULSBO, WASHINGTON

STORHOFF ROAD CULVERT PLAN AND PROFILE

DRAWING NO. 4 OF 6
C2

Prepared by Sealaska Environmental, E:\PMX-TMDL\Stormwater Management Plan\MXD\Fig_C-6_Bjorgen_Creek_Fish_Passage.mxd, February 10, 2016.

CITY of POULSBO VIKING CITY

SEALASKA ENVIRONMENTAL

Project C-7.
Bjorgen Creek/Noll Road Culvert Replacement
TMDL Implementation Plan
City of Poulsbo

Stream
Intermittent
Existing Control Structure
Existing Oil Water Separator
Existing Underground Detention Facility
New Stormwater Pipe
Existing Stormwater Pipe
Feature to be Removed
Marine Outfall
Filterra Vault
Modular Wetland System
Parcel Boundary
Standard Bioretention
Enhanced Bioretention
Constructed Wetland

SEALASKA ENVIRONMENTAL

Figure C-8a.
Community Bioretention Program
TMDL Implementation Plan
City of Poulsbo

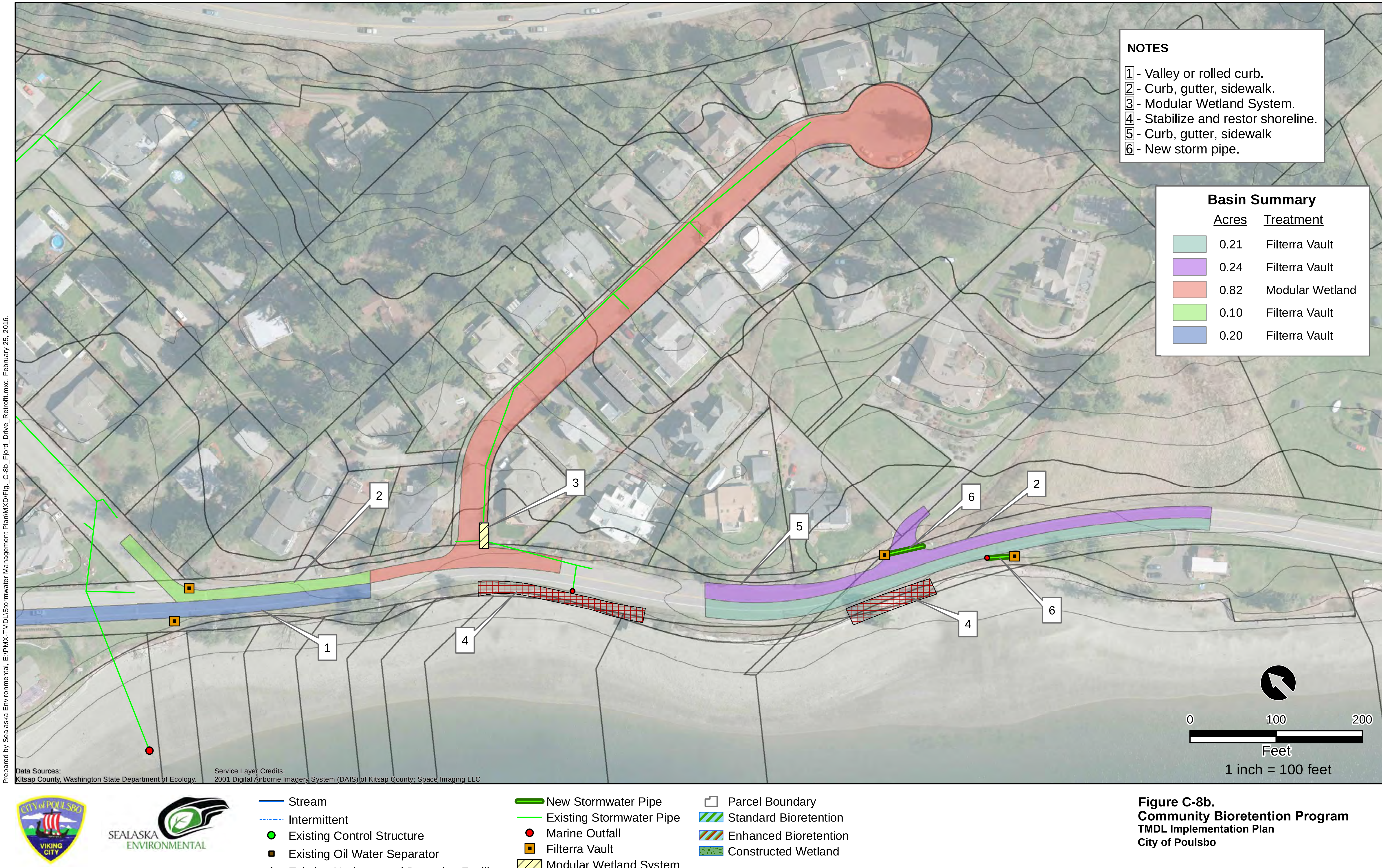
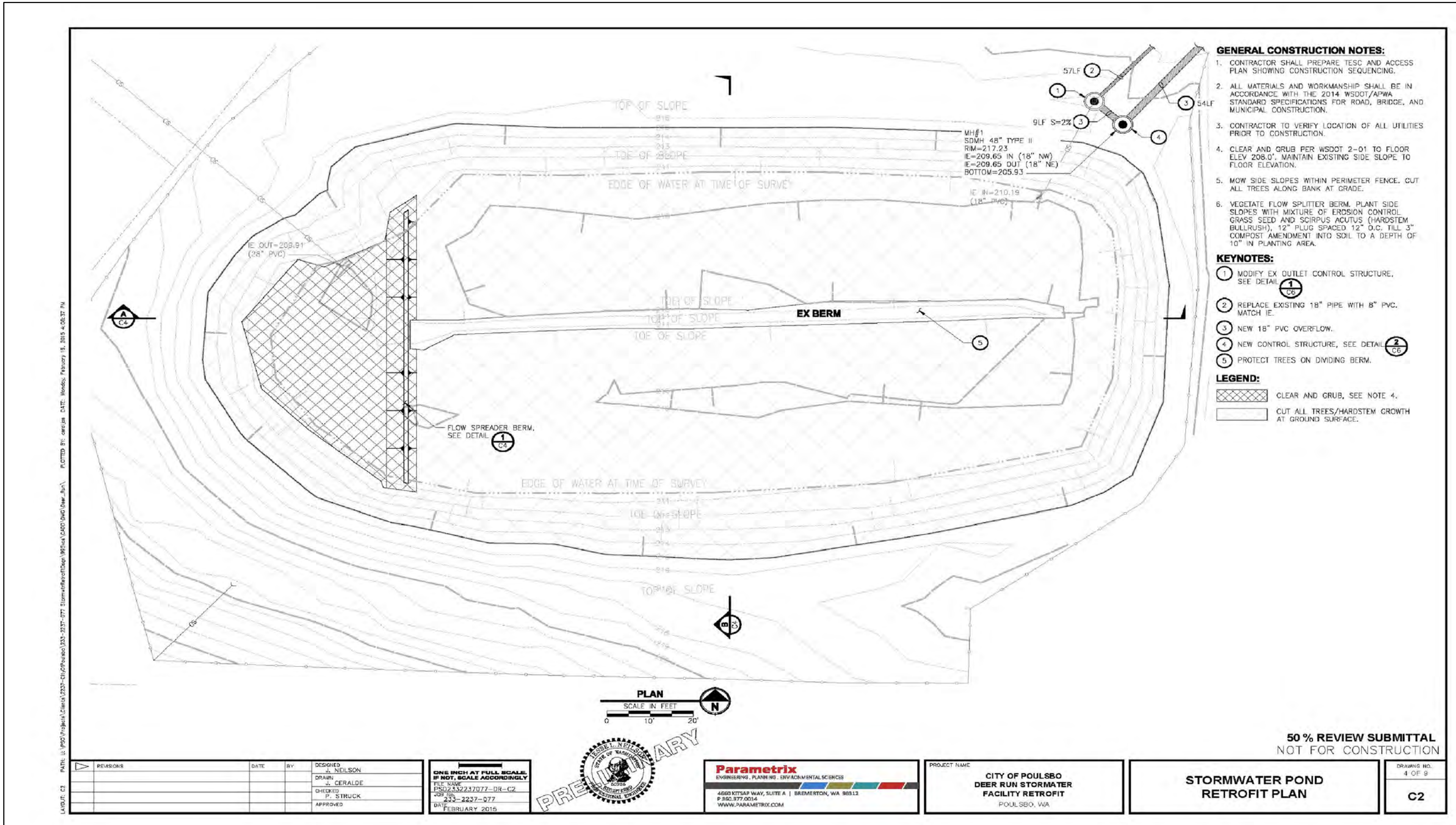


Figure C-8b.
Community Bioretention Program
TMDL Implementation Plan
City of Poulsbo

Stream
Intermittent
Existing Control Structure
Existing Oil Water Separator
Existing Underground Detention Facility
Existing Stormwater Pipe
New Stormwater Pipe
Modular Wetland System
New Outfall
Parcel Boundary
Major Marine Outfall
Minor Marine Outfall
Major Freshwater Outfall
Minor Freshwater Outfall

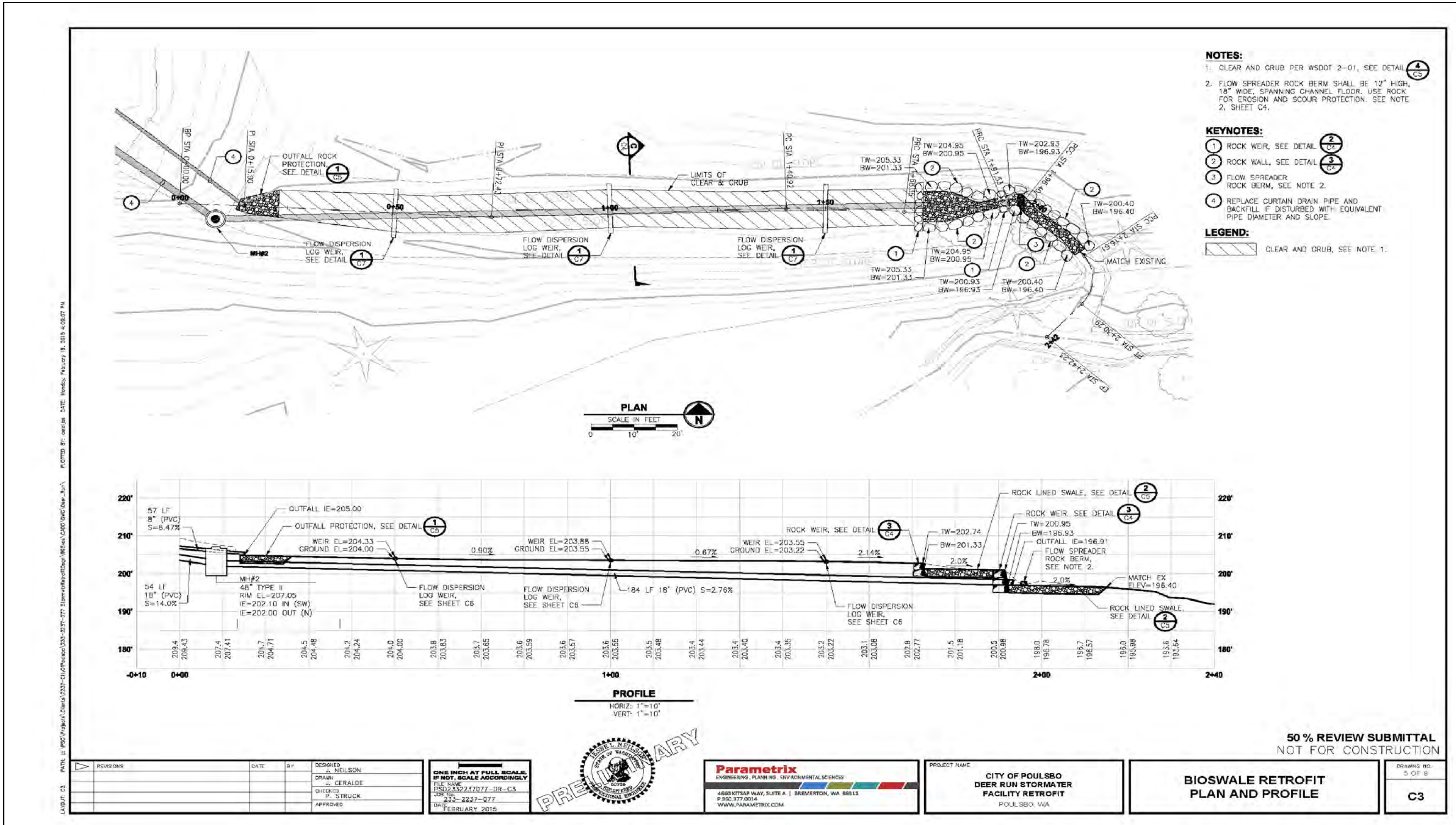
Figure C-9.
Fjord Drive Drainage and Water Quality Improvements
TMDL Implementation Plan
City of Poulsbo



Prepared by Sealaska Environmental, E:\PMX-TMDL\Stormwater Management Plan\MXD\Fig._C-11a_Deer_Run_Retrofit.mxd, February 10, 2016.

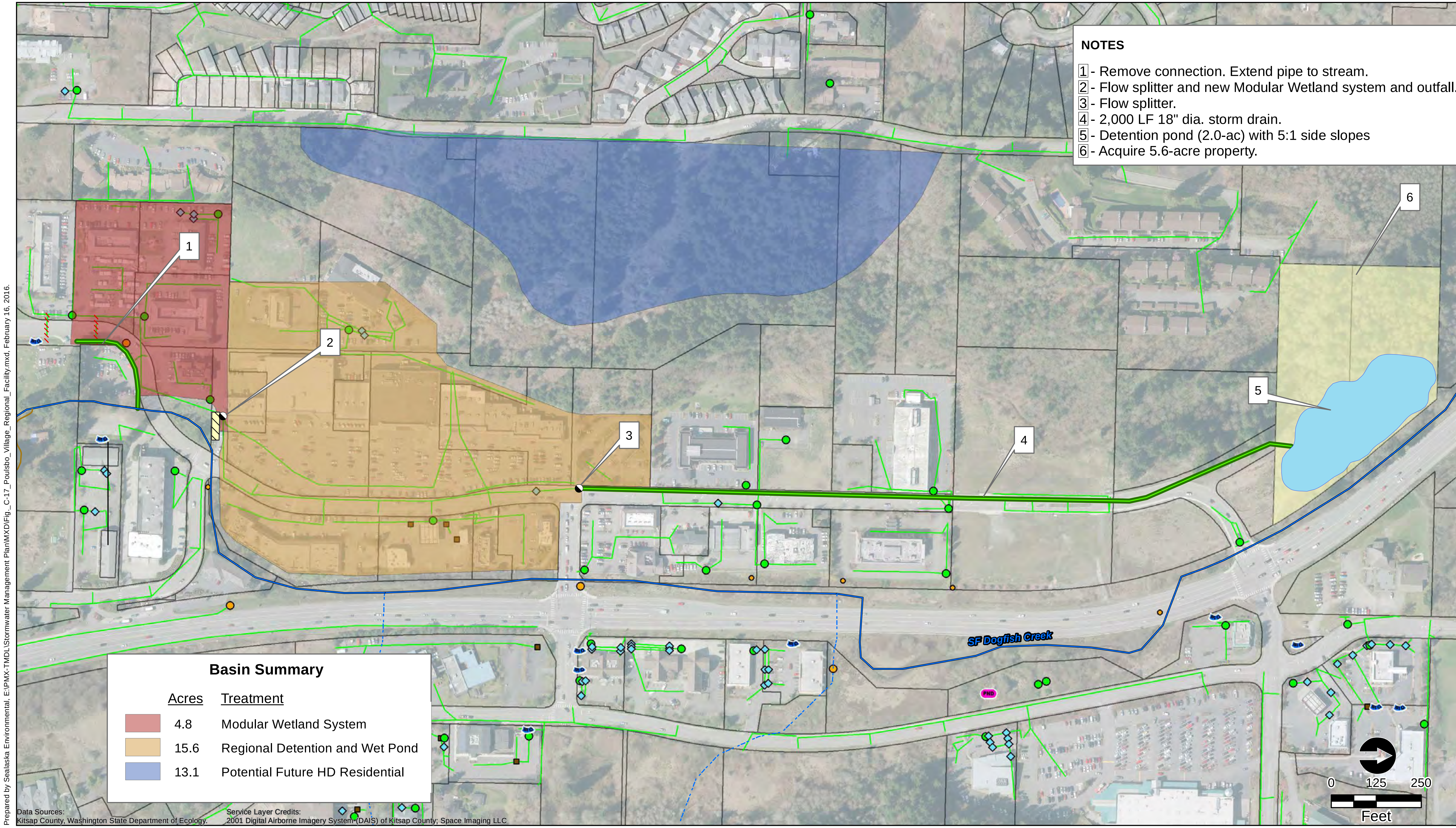
SEALASKA ENVIRONMENTAL

Project C-10a.
Deer Run Pond and Swale Retrofit
TMDL Implementation Plan
City of Poulsbo



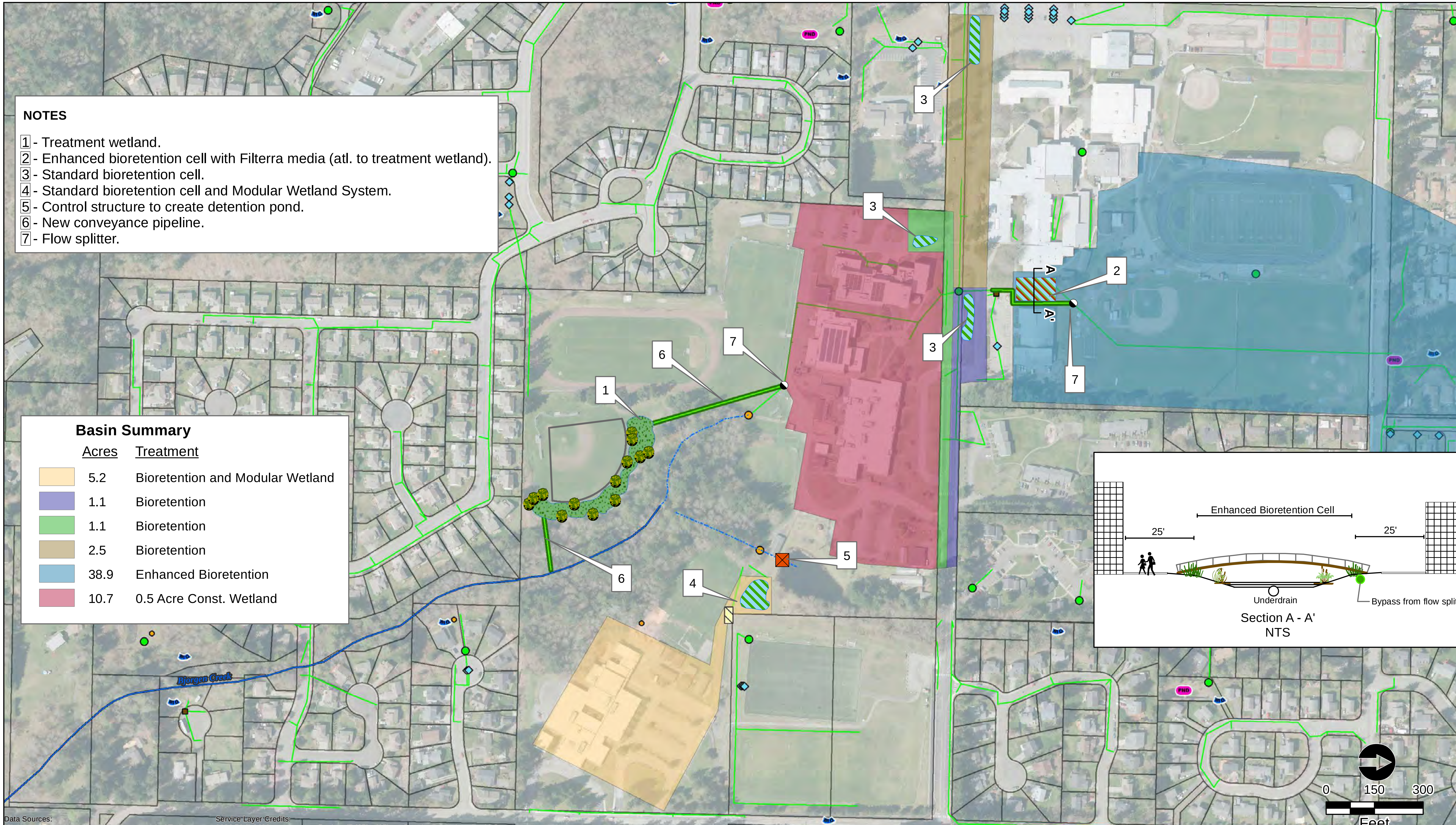
Prepared by Sealaska Environmental, E:\PMX-TMDL\Stormwater Management Plan\MXD\Fig_C-11b_Deer_Run_Retrofit_Details.mxd, February 10, 2016.

Project C-10b.
Deer Run Pond and Swale Retrofit Details
TMDL Implementation Plan
City of Poulsbo



Existing Control Structure
Existing Oil Water Separator
Existing Underground Detention Facility
Outfall
Existing Stormwater Pipe
New Stormwater Pipe
Parcel Boundary
Existing Stream
Intermittent Stream
Standard Bioretention
Enhanced Bioretention
Constructed Wetland

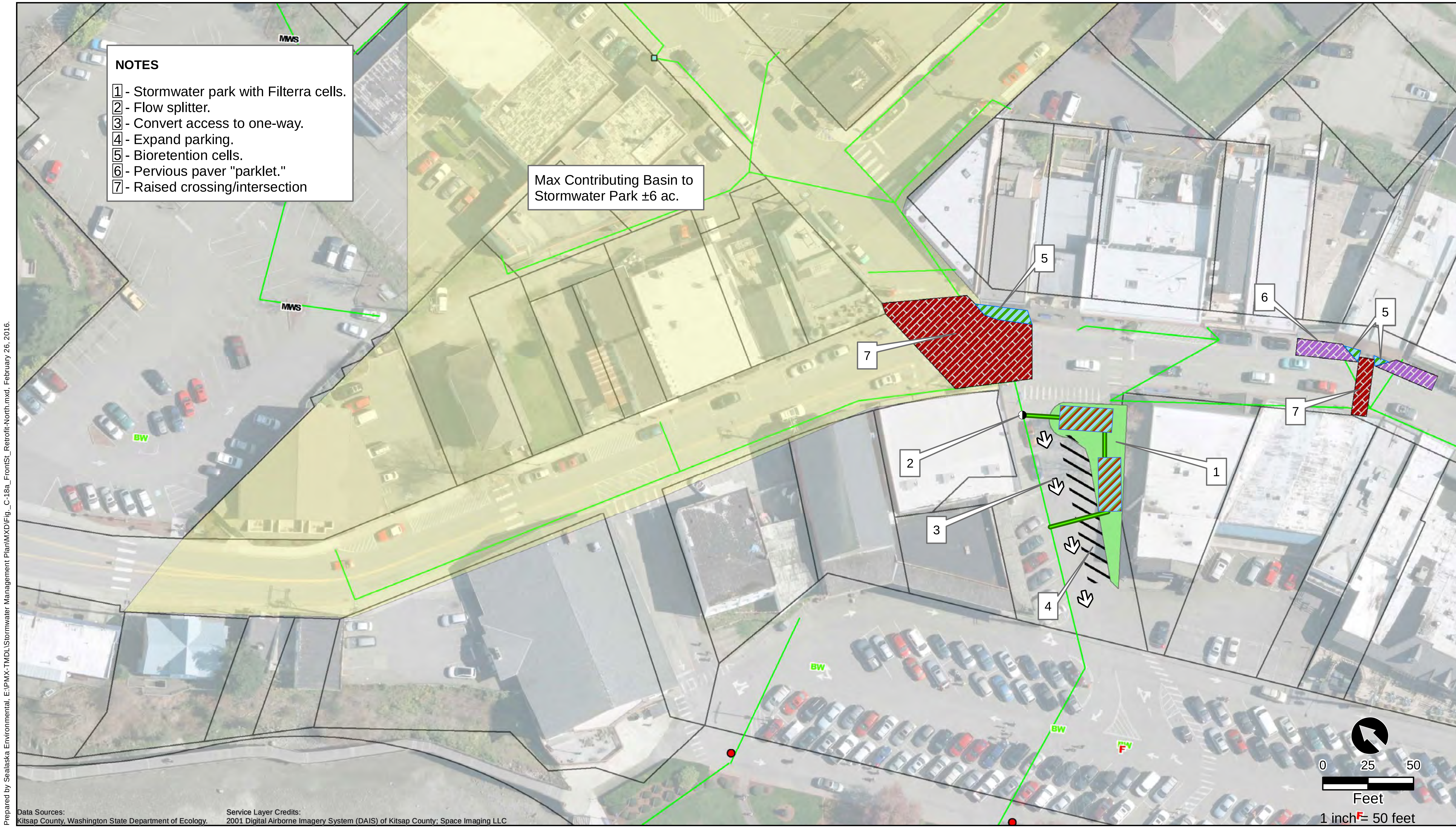
Project C-11.
Poulsbo Village Regional Facility
TMDL Implementation Plan
City of Poulsbo



Prepared by Sealaska Environmental, E:\PMX-TMDL\Stormwater Management Plan\MXD\Fig_C-14_NKSD_Campus_Retrofit.mxd, February 16, 2016.

- Existing Control Structure
- Existing Oil Water Separator
- Existing Underground Detention Facility
- Outfall
- Existing Stormwater Pipe
- New Stormwater Pipe
- Parcel Boundary
- Existing Stream
- Intermittent Stream
- Standard Bioretention
- Enhanced Bioretention
- Constructed Wetland
- Modular Wetland System

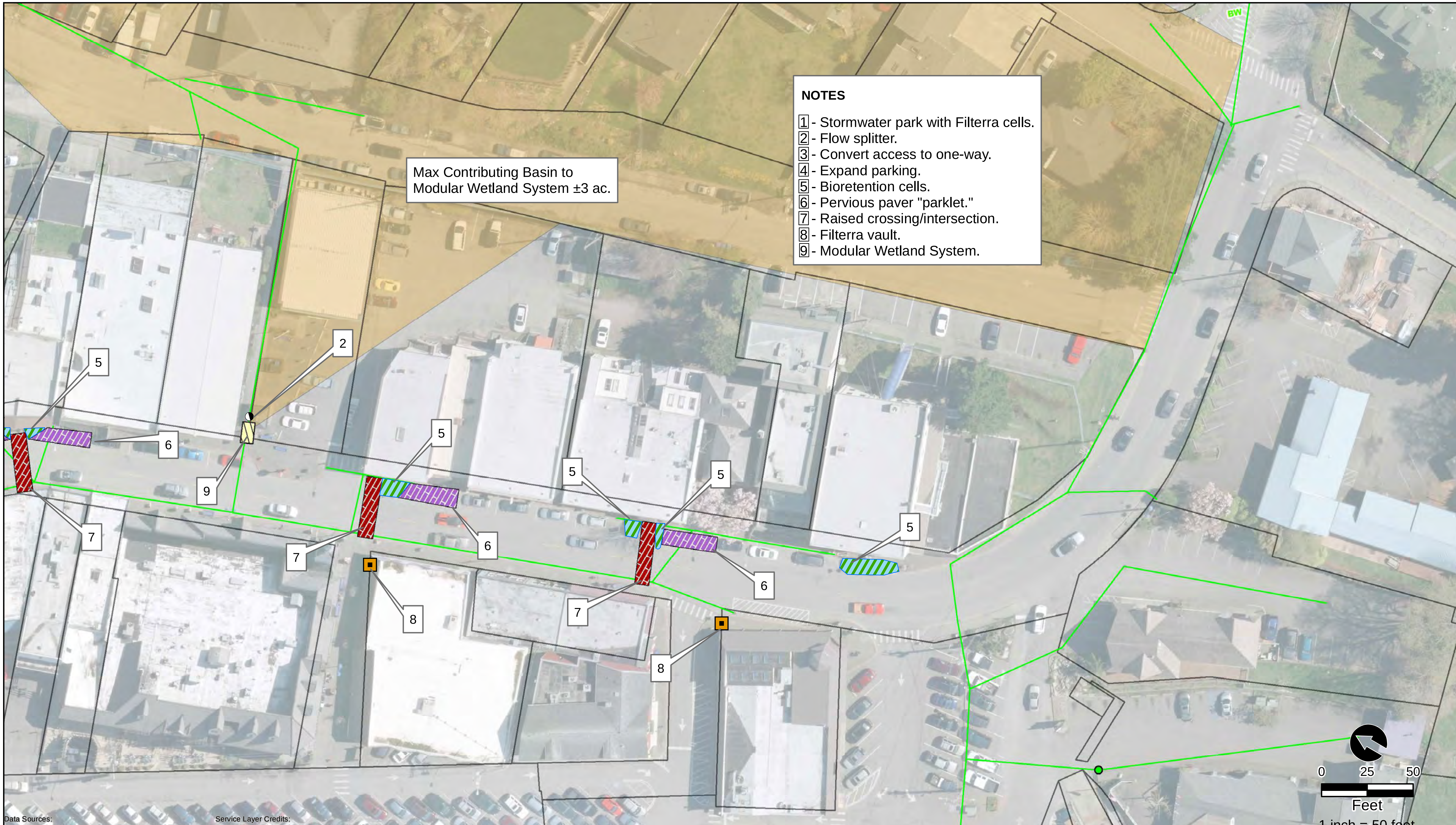
Figure C-12.
NKSD Campus Retrofit
TMDL Implementation Plan
City of Poulsbo



Existing Control Structure
Existing Oil Water Separator
Existing Underground Detention Facility
New Stormwater Pipe
Existing Stormwater Pipe
Filterra Vault
Modular Wetland System
Bioretention Well
Parcel Boundary
Standard Bioretention
Enhanced Bioretention

SEALASKA ENVIRONMENTAL

Figure C-13a.
Front Street Retrofit - North
TMDL Implementation Plan
City of Poulsbo



Prepared by Sealaska Environmental, E:\PMX-TMDL\Stormwater Management Plan\MXD\Fig._C-18b_FrontSt_Retrofit-South.mxd, February 26, 2016.

CITY of POULSBO VIKING CITY

SEALASKA ENVIRONMENTAL

- Existing Control Structure
- Existing Oil Water Separator
- Existing Underground Detention Facility
- Existing Stormwater Pipe
- Filterra Vault
- Modular Wetland System
- Bioretention Well
- Filterra Vault
- Parcel Boundary
- Standard Bioretention
- Enhanced Bioretention

Figure C-13b.
Front Street Retrofit - South
TMDL Implementation Plan
City of Poulsbo

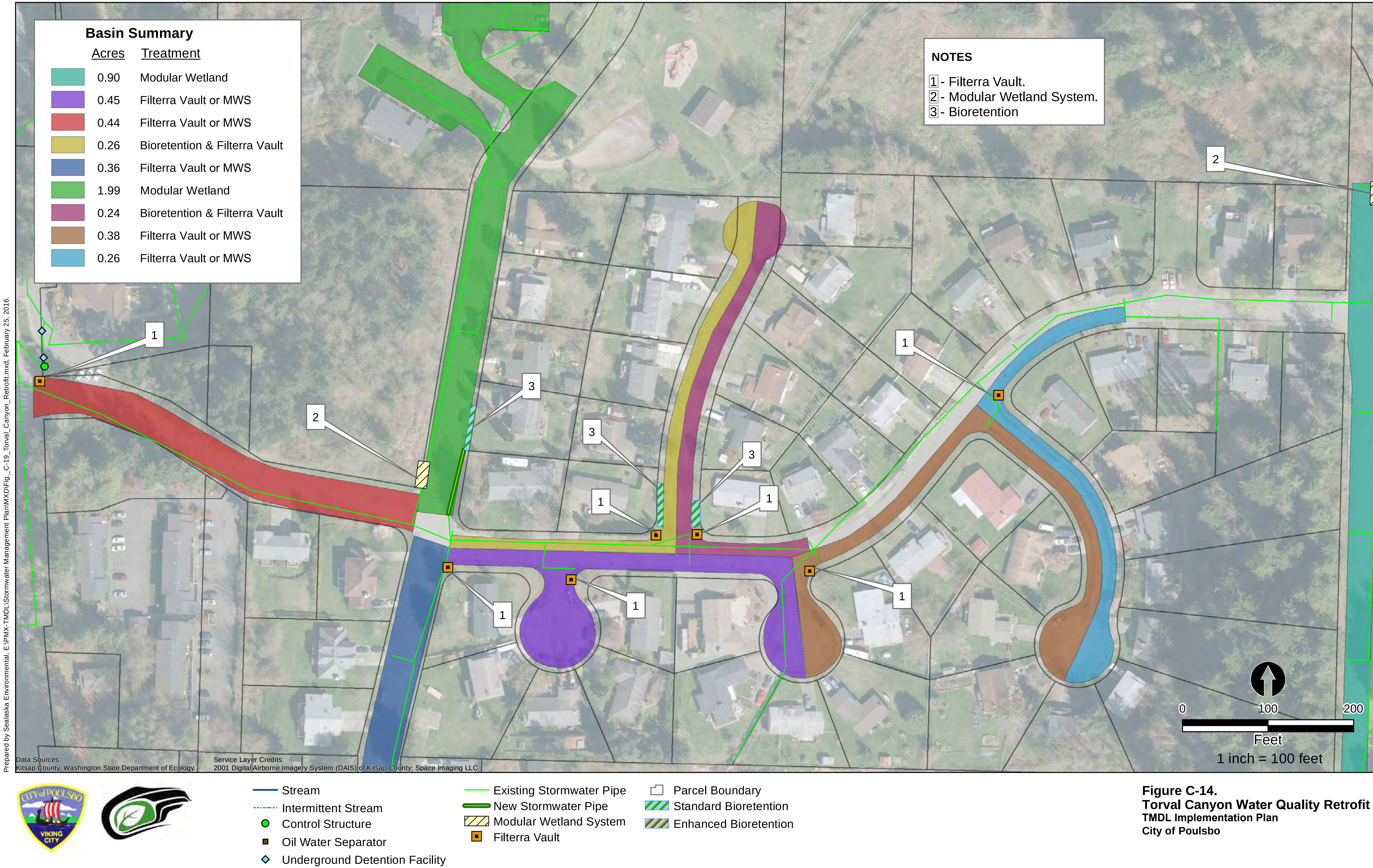
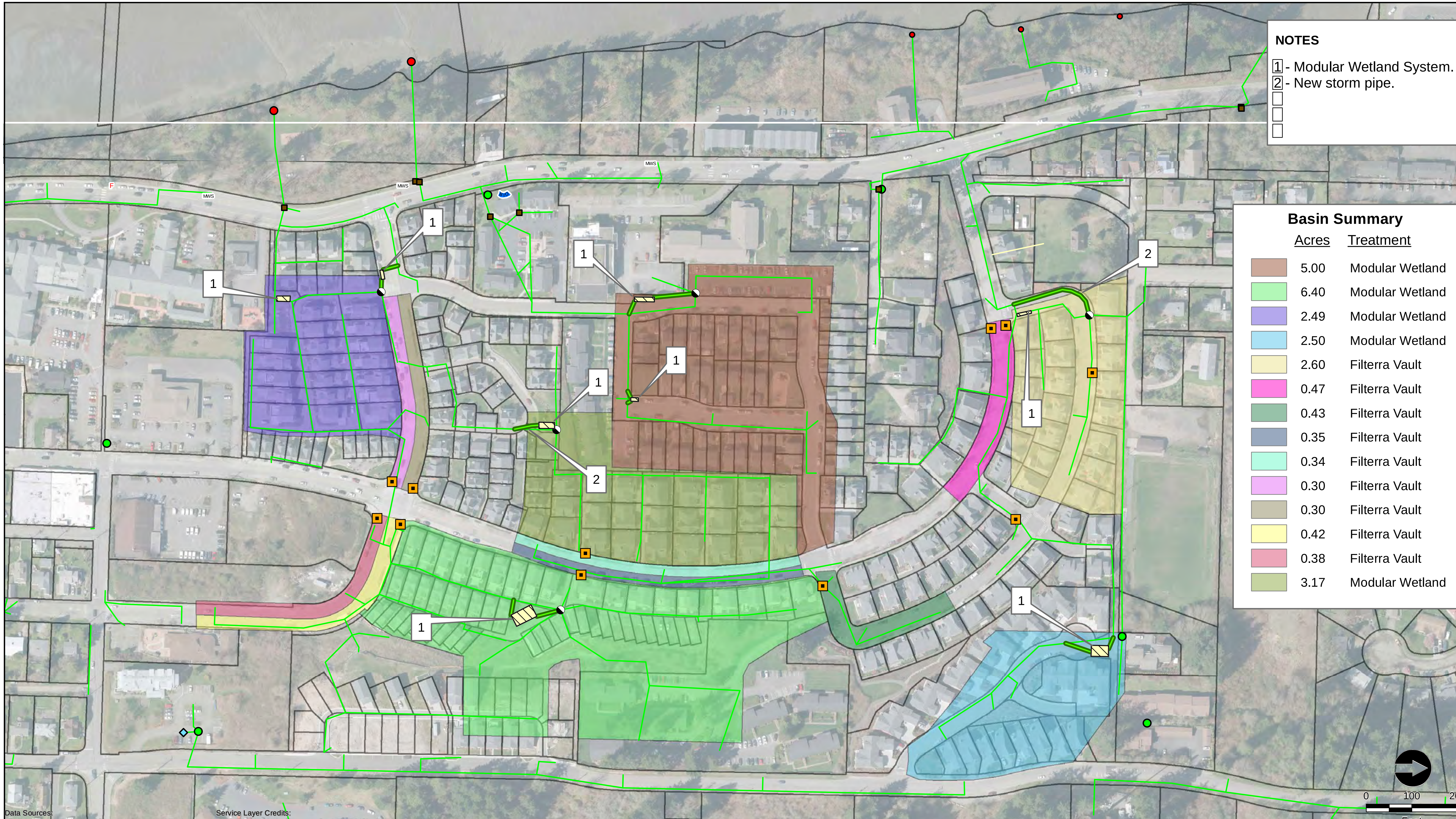


Figure C-14.
Torval Canyon Water Quality Retrofit
TMDL Implementation Plan
City of Poulsbo



Prepared by Sealaska Environmental, E:\PMX-TMDL\Stormwater Management Plan\MXD\Fig_C-20-Poulsbo_Place.mxd, February 25, 2016.

Stream
Intermittent Stream
Control Structure
Oil Water Separator
Underground Detention Facility
Existing Stormwater Pipe
New Stormwater Pipe
Marine Outfall
Freshwater Outfall
Filterra Vault
Modular Wetland System
Bioretention Well
Modular Wetland System
Flow Splitters
Filterra Vault

Figure C-15.
Poulsbo Place Water Quality Retrofit
TMDL Implementation Plan
City of Poulsbo

APPENDIX D
Individual Cost Estimates

CITY OF POULSBO
Stormwater Capital Project Cost Estimate

Project: **C-1, SOUTH FORK DOGFISH CREEK RESTORATION AT 8TH AVENUE**

Description: Restore 525-ft of stream channel and 36,750 sf riparian buffer between 8th Avenue and Centennial Park. Construct bioretention facilities to treat run-off from existing Public Works site and portions of Lincoln Road, 8th Avenue, 7th Avenue and Iverson Street. Retrofit existing detention pond at Poulsbo Library to treatment wetland. Construct new treatment wetland for runoff from SR305 and portions of adjacent development.

Item	Description	Unit	Quantity	Unit Price	Total
1	Mobilization	LS	1	$90,000	$90,000
2	TESC	LS	1	$15,000	$15,000
3	Stream channel restoration	LF	525	$100	$52,500
4	Stream and wetland buffer restoration	SF	30000	$3	$90,000
5	Bioretention on Public Works site	SF	8000	$10	$80,000
6	Bioretention cell on Lincoln Road	SF	2000	$15	$30,000
7	Bioretention cell on Iverson St	SF	1000	$15	$15,000
8	Bioretention cell on 7th Ave	SF	1500	$15	$22,500
9	Modular Wetland System on 7th Avenue	LS	1	$50,000	$50,000
10	Convert Ex. Det. Pond to Tmt. Wetland	SF	15000	$10	$150,000
11	New Tmt. Wetland	SF	15000	$20	$300,000
12	Conveyance Pipe, 18-in diameter	LF	500	$60	$30,000
13	Other conveyance improvements	LS	1	$20,000	$20,000
14	Connector Trail, 6-ft width gravel	LS	1	$20,000	$20,000
15	Miscellaneous Unlisted (5%)	LS	1	$45,000	$45,000
			Subtotal Construction		$1,010,000
			Construction Contingency	20%	$202,000
			Sales Tax	8.7%	$87,900
			Total Construction		$1,299,900
			Final Design	15%	$195,000
			Project Management	5%	$65,000
			Construction Management	5%	$65,000
			TOTAL PROJECT		**$1,625,000**

CITY OF POULSBO
Stormwater Capital Project Cost Estimate

Project:	**C-1a, 8th AVENUE CULVERT REPLACEMENT**				

Description: Replace existing undersized 24-in diameter concrete pipe pipe with 12-ft wide 3-sided concrete box culvert. Relocate existing underground utilities and reconstruct roadway.

Item	Description	Unit	Quantity	Unit Price	Total
1	Mobilization	LS	1	$25,000	$25,000
2	Site preparation	LS	1	$20,000	$20,000
3	12' x 50' box culvert, complete	LS	1	$90,000	$90,000
4	Roadway restoration	LS	1	$50,000	$50,000
5	Utility Relocation	LS	1	$20,000	$20,000
6	Traffic Control	LS	1	$20,000	$20,000
7	Miscellaneous Unlisted (10%)	LS	1	$25,000	$25,000
			Subtotal Construction		$300,000
			Construction Contingency	20%	$60,000
			Total Construction		$360,000
			Final Design	15%	$54,000
			Project Management	5%	$18,000
			Construction Management	5%	$18,000
			TOTAL PROJECT		**$450,000**

CITY OF POULSBO

Stormwater Capital Project Cost Estimate

Project:	**C-2, ANDERSON PARKWAY PHASE 2 RETROFIT**				
Description: Retrofit existing 0.65 acre parking lot with pervious pavement and Modular Wetland System. Replace undersized 12-in diameter conveyance pipe and outfall with new 18-in diameter pipe. Construction cost estimate based on final design (Feb. 2016).					
Item	Description	Unit	Quantity	Unit Price	Total
1	Mobilization	LS	1	$27,000	$27,000
2	Preparation and Demolition	LS	1	$14,000	$14,000
3	Grading and paving	LS	1	$91,000	$91,000
4	Stormwater retrofit	LS	1	$74,000	$74,000
5	TESC and Landscaping	LS	1	$20,000	$20,000
6	Striping, signing and traffic	LS	1	$22,000	$22,000
7	Water utility relocation	LS	1	$9,000	$9,000
			Subtotal Construction		$257,000
			Construction Contingency	10%	$25,700
			Sales Tax	8.7%	$22,400
			Total Construction		$305,100
			Project Management	10%	$30,500
			PSE Utility relation		$10,000
			Construction Management	10%	$30,500
			TOTAL PROJECT		**$380,000**

CITY OF POULSBO
Stormwater Capital Project Cost Estimate

Project:	**C-3, POULSBO CREEK OUTFALL REHABILITATION**				

Description: Line existing corroded CMP under Fjord Drive with new HDPE or PVC pipe. Replace deterioriated manhole structure on north side of Fjord Drive. Replace corroded metal splash pad at creek outfall with concrete splash pad and energy dissipater. Install habitat features at outfall channel and provide mitigation. Convert existing ditch bioswale adjacdent to Fjord Drive to a bioretention swale. Install biortention swale in southeast corner of Yacht Club parking lot.

Item	Description	Unit	Quantity	Unit Price	Total
1	Mobilization and Site Preparation	LS	1	$20,000	$20,000
2	48-in diameter HDPE liner for existing CMP	LF	160	$200	$32,000
3	Concrete Energy Dissipater and Splash Pad	LS	1	$30,000	$30,000
4	84 in diameter manhole structure	LS	1	$20,000	$20,000
5	Convert 250-ft bioswale to bioretention	SF	1000	$10	$10,000
6	Bioretention cell at SE corner YC parking lot	SF	400	$10	$4,000
7	Mitigation and habitat enhancements	LS	1	$10,000	$10,000
8	Seawall and parking lot restoration	LS	1	$10,000	$10,000
			Subtotal Construction		$136,000
			Construction Contingency	20%	$27,200
			Sales Tax	8.7%	$2,366
			Total Construction		$163,200
			Final Design and Permits	15%	$24,500
			Project Management	5%	$8,200
			Construction Management	5%	$8,200
			TOTAL PROJECT		**$200,000**

CITY OF POULSBO
Stormwater Capital Project Cost Estimate

Project: C-4, VIKING AVENUE REGIONAL WATER QUALITY TREATMENT FACILITY

Description: Construct regional treatment facility for 80-acre urban basin consisting of bioretention, high performance media filter and a constructed wetland. Improve capacity of conveyance system. Acquire 3-acre property. Construction cost estimate based on Preliminary Design Report, February 2015.

Item	Description	Unit	Quantity	Unit Price	Total
1	Mobilization and Site Preparation	LS	1	$85,000	$85,000
2	Constructed Treatment Wetland	LS	1	$212,000	$212,000
3	High Performance Media Filter	LS	1	$248,000	$248,000
4	Bioretention Cell	LS	1	$30,000	$30,000
5	Stormwater Conveyance	LS	1	$274,000	$274,000
			Subtotal Construction		$849,000
			Construction Contingency	20%	$169,800
			Sales Tax	8.7%	$73,900
			Total Construction		$1,092,700
			Land Acquisition		$600,000
			Final Design	15%	$163,900
			Project Management	5%	$54,600
			Construction Management	5%	$54,600
			TOTAL PROJECT		**$1,970,000**

CITY OF POULSBO
Stormwater Capital Project Cost Estimate

Project:	**C-5, RIDGEWOOD/KEVOS POND DRAINAGE IMPROVEMENTS**				

Description: Replace undersized 12-inch diameter storm drains with 18-inch diameter storm drains and modify existing control structure to improve conveyance and reduce flooding. Replace existing drainage ditch on Norrland Court with new 18-inch diameter storm drain. Construct bioretention cells to replace existing bioswale. Construction cost estimate based on Kevos Pond Basin Plan, May 2013, increased to account for inflation.

Item	Description	Unit	Quantity	Unit Price	Total
1	23rd Avenue storm drain capacity improvements	LS	1	$108,000	$108,000
2	Wendy Way storm drain capacity improvements	LS	1	$52,000	$52,000
3	Noorland Court control structure modifications	LS	1	$2,000	$2,000
4	Noorland Court ditch replacement	SF	2000	$3	$6,000
5	Bioretention swale near trail on 20th Avenue extension	LS	1	$20,000	$20,000
		Subtotal Construction			$188,000
		Construction Contingency		10%	$18,800
		Total Construction			$206,800
		Final Design		15%	$31,000
		Project Management		5%	$10,300
		Construction Management		5%	$10,300
		TOTAL PROJECT			**$260,000**

CITY OF POULSBO

Stormwater Capital Project Cost Estimate

Project:	**C-6, FJORD DRIVE WATER QUALITY AND HABITAT IMPROVEMENTS**				

Description: Consolidate 3 storm outfalls between 6th Avenue and Oyster Plant Park and install new Modular Wetland System for treatment. Modify storm collection system between 9th Street and east City limits and install Modular Wetland System for treatment. Install Filterra vaults at corner of Holm Court and Fjord Drive. Stabilize eroding shoreline and outfall energy dissipators at multiple locations using soft armoring techniques.

Item	Description	Unit	Quantity	Unit Price	Total
1	Mobilization and Site Preparation	LS	1	$10,000	$20,000
2	6th Ave to Oyster Plant Park collection system	LF	500	$70	$35,000
8	Outfall retrofits, 6th to Oyster Plant Park	EA	2	$2,000	$4,000
3	Modular Wetland System, 6th Ave to Oyster Plant Park	LS	1	$30,000	$30,000
6	Sidewalk, curb/gutter, 9th to Holm Court	LF	300	$50	$15,000
7	Filterra retrofit, Fjord and Holm Crt	EA	1	$25,000	$25,000
6	Sidewalk, curb/gutter, Holm Court to Whitford	LF	100	$50	$5,000
7	Filterra curb bulb retrofit, shared drive and Fjord	EA	1	$25,000	$25,000
8	Outfall retrofits, 9th to City limits	EA	2	$2,000	$4,000
9	Shoreline stabilization and habitat improvements	EA	2	$15,000	$30,000
			Subtotal Construction		$193,000
			Construction Contingency	20%	$38,600
			Total Construction		$231,600
			Final Design and Permits	15%	$34,700
			Project Management	5%	$11,600
			Construction Management	5%	$11,600
			TOTAL PROJECT		**$290,000**

CITY OF POULSBO
Stormwater Capital Project Cost Estimate

Project:	**C-7, BJORGEN CREEK CULVERT REPLACEMENT**				

Description: Replace existing undersized 24-in diameter CPE pipe that is a complete fish passage barrier with 12-ft wide 3-sided concrete box culvert. Relocate utilities and reconstruct roadway. Construction cost estimate based on preliminary design (Feb. 2015).

Item	Description	Unit	Quantity	Unit Price	Total
1	Mobilization	LS	1	$25,000	$25,000
2	Site preparation	LS	1	$20,000	$20,000
3	14' x 94' box culvert, complete	LS	1	$120,000	$120,000
4	Roadway restoration	LS	1	$50,000	$50,000
5	Mitigation and restoration	LS	1	$50,000	$50,000
	Subtotal Construction				$265,000
	Construction Contingency			10%	$26,500
	Total Construction				$291,500
	Final Design			10%	$29,200
	Project Management			5%	$14,600
	Construction Management			5%	$14,600
	TOTAL PROJECT				**$350,000**

CITY OF POULSBO
Stormwater Capital Project Cost Estimate

Project:	**C-8, COMMUNITY BIORETENTION PROJECT**				
Description: Collaborative partnership between City and Kitsap Conservation District to site, design and construct bioretention facilities in the City of Poulsbo. Cost are per year.					
Item	Description	Unit	Quantity	Unit Price	Total
1	Construction allowance	LS	1	$25,000	$25,000
		Subtotal Construction			$25,000
		Construction Contingency			$0
		Sales Tax			$0
		Total Construction			$25,000
		Final Design			$0
		Project Management			$0
		Construction Management			$0
		TOTAL PROJECT			**$25,000**

CITY OF POULSBO
Stormwater Capital Project Cost Estimate

Project:	**C-9, FJORD DRIVE DRAINAGE AND WATER QUALITY IMPROVEMENTS**				
Description: Replace 700-ft of old 8" diameter CP between Hostmark Street and Harrison Street. Install Modular Wetland System to treat 0.5-acre of City Street. Replace existing 12" diameter CMP outfall with concrete energy dissipater.					
Item	Description	Unit	Quantity	Unit Price	Total
1	Mobilization and Site Preparation	LS	1	$20,000	$20,000
2	Replace 8" dia CP with 18"' dia CPEP	LF	700	$100	$70,000
3	Type II catch basins	EA	4	$1,500	$6,000
4	Modular Wetland System	EA	1	$30,000	$30,000
5	Outfall retrofit	LS	1	$20,000	$20,000
	Subtotal Construction				$146,000
	Construction Contingency			20%	$29,200
	Total Construction				$175,200
	Final Design			15%	$26,300
	Project Management			5%	$8,800
	Construction Management			5%	$8,800
	TOTAL PROJECT				**$220,000**

CITY OF POULSBO
Stormwater Capital Project Cost Estimate

Project: C-10, DEER RUN STORMWATER RETROFIT

Description: Retrofit existing detention wet pond and bioswale to increase capacity, reduce erosion and improve water quality treatment. Construction cost estimate based on Preliminary Design Report, February 2015.

Item	Description	Unit	Quantity	Unit Price	Total
1	Mobilization	LS	1	$11,000	$11,000
2	TESC	LS	1	$12,000	$12,000
3	Detention Pond Modifications	LS	1	$29,000	$29,000
4	Bioswale Modifications	LS	1	$66,000	$66,000
		Subtotal Construction			$118,000
		Construction Contingency		20%	$23,600
		Sales Tax		8.7%	$10,300
		Total Construction			$151,900
		Final Design		15%	$22,800
		Project Management		10%	$15,200
		Construction Management		7%	$10,600
		TOTAL PROJECT			**$200,000**

CITY OF POULSBO
Stormwater Capital Project Cost Estimate

Project:	**C-11, POULSBO VILLAGE REGIONAL FACILITY**				

Description: Construct regional treatment facility for 112-acre urban basin consisting of a detnetion pond and high performance media filter or constructed wetland. Modify existing conveyance system. Acquire 3-acre property.

Item	Description	Unit	Quantity	Unit Price	Total
1	Mobilization and Site Preparation	LS	1	$85,000	$85,000
2	Regional detention pond	LS	1	$300,000	$300,000
2	Modular Wetland System	EA	1	$50,000	$50,000
4	Flow splitters	EA	2	$15,000	$30,000
5	Buffer mitigation	LS	1	$50,000	$50,000
6	18-in stormwater conveyance pipe	LF	2300	$70	$161,000
			Subtotal Construction		$676,000
			Construction Contingency	20%	$135,200
			Sales Tax	8.7%	$58,800
			Total Construction		$870,000
			Land Acquisition		$700,000
			Design Report	LS	$50,000
			Final Design	15%	$130,500
			Project Management	5%	$43,500
			Construction Management	5%	$43,500
			TOTAL PROJECT		**$1,840,000**

CITY OF POULSBO
Stormwater Capital Project Cost Estimate

Project:	**C-12, NORTH KITSAP SCHOOL DISTRICT CAMPUS RETROFIT**				

Description: Construct regional treatment facilities for 76-acre urban basin consisting of bioretention, high performance media filter and a constructed wetland. Improve capacity of conveyance system.

Item	Description	Unit	Quantity	Unit Price	Total
1	Mobilization and Site Preparation	LS	1	$85,000	$50,000
2	Constructed Treatment Wetland	SF	25000	$10	$250,000
3	High Performance Media Filter	SF	3000	$50	$150,000
4	Bioretention Cell	EA	3	$10,000	$30,000
5	Flow Splitter	EA	2	$10,000	$20,000
6	Outlet control structure for ex pond	EA	1	$20,000	$20,000
7	Stormwater Conveyance	LS	1	$50,000	$50,000
			Subtotal Construction		$570,000
			Construction Contingency	20%	$114,000
			Sales Tax	8.7%	$49,600
			Total Construction		$733,600
			Final Design	15%	$110,000
			Project Management	5%	$36,700
			Construction Management	5%	$36,700
			TOTAL PROJECT		**$920,000**

CITY OF POULSBO
Stormwater Capital Project Cost Estimate

Project:	**C-13, FRONT STREET RETROFIT**				
Description: Retrofit Front Street between 3rd Avenue to the south and King Olaf parking lot to the north. Install bioretention cells using Filterra media at crosswalk bulb outs and existing planting strips. Realign intersection of Front Street and Jensen and construct small scale stormwater park. Install 3 parklets using pervious pavers.					
Item	Description	Unit	Quantity	Unit Price	Total
1	Mobilization and Site Preparation	LS	1	$10,000	$25,000
2	High capacity bioretention cells	EA	6	$5,000	$30,000
3	Curb, sidewalk and cross walk modifications	EA	5	$10,000	$50,000
4	Filterra retrofit, north Front Street	EA	1	$25,000	$25,000
5	Pervious paver parklets	EA	3	$15,000	$45,000
6	Realign and raise Front-Jensen intersection	LS	1	$100,000	$100,000
7	Small scale stormwater park, Front-Jensen intersection	LS	1	$100,000	$100,000
8	Stormwater conveyance modifications	LS	1	$50,000	$50,000
	Subtotal Construction				$425,000
	Construction Contingency			20%	$85,000
	Total Construction				$510,000
	Final Design and Permits			15%	$76,500
	Project Management			5%	$25,500
	Construction Management			5%	$25,500
	TOTAL PROJECT				**$640,000**

CITY OF POULSBO
Stormwater Capital Project Cost Estimate

Project:	**C-14, TORVAL CANYON RETROFIT**				

Description: Retrofit portions of Torval Canyon Road with Modular Wetland Systems and Filterra vaults. Modify storm collection and conveyance system to direct flows to treatment devices.

Item	Description	Unit	Quantity	Unit Price	Total
1	Mobilization and Site Preparation	LS	1	$10,000	$20,000
2	Storm system modifications	LS	1	$20,000	$20,000
3	Modular Wetland System	EA	2	$50,000	$100,000
4	Filterra vaults	EA	7	$25,000	$175,000
		Subtotal Construction			$315,000
		Construction Contingency		20%	$63,000
		Total Construction			$378,000
		Final Design and Permits		15%	$56,700
		Project Management		5%	$18,900
		Construction Management		5%	$18,900
		TOTAL PROJECT			**$470,000**

CITY OF POULSBO
Stormwater Capital Project Cost Estimate

Project:	**C-15, POULBSO PLACE RETROFIT**				
Description: Retrofit the Poulsbo Place development with Modular Wetland Systems and Filterra vaults. Modify storm collection and conveyance system to direct flows to treatment devices.					
Item	Description	Unit	Quantity	Unit Price	Total
1	Mobilization and Site Preparation	LS	1	$10,000	$35,000
2	Storm system modifications	LS	1	$50,000	$20,000
3	Modular Wetland System	EA	5	$50,000	$250,000
4	Filterra vaults	EA	9	$25,000	$225,000
5	Traffic Control	LS	1	$10,000	$10,000
		Subtotal Construction			$540,000
		Construction Contingency		20%	$108,000
		Total Construction			$648,000
		Final Design and Permits		15%	$97,200
		Project Management		5%	$32,400
		Construction Management		5%	$32,400
		TOTAL PROJECT			**$810,000**

APPENDIX E
Effectiveness Monitoring Plan

Effectiveness Monitoring Plan and Quality Assurance Project Plan

City of Poulsbo

Liberty Bay TMDL Implementation Plan

Prepared for:

City of Poulsbo
200 NE Moe Street
Poulsbo, WA 98370

June 2016

SEALASKA ENVIRONMENTAL

Prepared by:

Sealaska Environmental Services, LLC
18743 Front St NE
Poulsbo, WA 98370

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ACRONYMS

BMPs	best management practices
City	City of Poulsbo
DOH	Department of Health
Ecology	Department of Ecology
EIM	Environmental Information Management System
EMP	Effectiveness Monitoring Plan
FC	fecal coliform bacteria
IDDE	Illicit Discharge Detection and Elimination
KCD	Kitsap Conservation District
KPHD	Kitsap Public Health District
MQO	Measurement quality objective
O&M	operation and maintenance
PTIP	City of Poulsbo TMDL Implementation Plan
QAPP	Quality Assurance Project Plan
QC	quality control
RSD	relative standard deviation
RSMP	Regional Stormwater Monitoring Program
SOPs	standard operating procedures
SWAMPPS	Stormwater Assessment and Monitoring Program for Puget Sound
TIA	total impervious area
TMDL	Total Maximum Daily Load
UGA	Urban Growth Area
WAC	Washington Administrative Code

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1 INTRODUCTION

The Liberty Bay Total Maximum Daily Load (TMDL) Plan prepared by the Department of Ecology (Ecology 2015) describes a process and actions that are intended to lead to sustained attainment of water quality standards in Liberty Bay and its freshwater tributaries. Implementation of portions of Ecology's TMDL Plan are being addressed by the City of Poulsbo (City) through the projects and actions described in the Poulsbo TMDL Implementation Plan (PTIP) (SES 2016a, in development).

The PTIP implementation plan includes a variety of capital facility, operation and maintenance (O&M), regulatory and management BMPs intended to attain Liberty Bay water quality standards. This Effectiveness Monitoring Plan (EMP) has been prepared to describe the objectives and methods for measuring performance and outcomes of the PTIP.

1.1 BACKGROUND AND PURPOSE OF EMP

TMDL effectiveness monitoring helps to measure progress towards attainment of water quality standards and informs future management actions. Documenting improvements in water quality is important because demonstrated success, or effectiveness, is tied to both NPDES Permit compliance and funding while a lack of demonstrated success can undermine the credibility and perceived benefit of the actions associated with TMDL implementation.

Effectiveness monitoring is a critical component of an adaptive management approach to water quality improvement. Ecology describes the benefits of effectiveness monitoring as follows:

1. Provide a measure of progress toward implementation of recommendations (i.e., how much progress has been achieved, how much more effort is required);
2. Supports the decision-making process on more efficient allocation of funding and optimization in planning (i.e., identifying activities that worked, which restoration activity achieved the most success for the resources); and
3. Provide technical feedback that is useful for refinements of initial modeling analysis (e.g., for a TMDL) or refinements in the planning of best management practices (BMPs), permits, and other pollutant reduction and watershed restoration strategies.

1.2 RELATIONSHIP TO EXISTING STATE AND LOCAL MONITORING PROGRAMS

Ambient water quality monitoring programs exist at the state, regional and local level. These programs are generally designed to track trends in water quality, document impairments, and identify emerging, acute or chronic water quality issues that may require corrective action. The Kitsap Public Health District (KPHD) and the state Department of Health (DOH) both conduct routine ambient water quality monitoring in Liberty Bay. A summary of historical water quality monitoring results is provided in the Liberty Bay Watershed Assessment (SES 2016b).

While these programs provide important information on water quality trends, and help to evaluate TMDL effectiveness on a watershed, embayment or regional scale, they are generally not designed to provide data on a targeted basin or sub-basin scale where multiple small-scale non-point source corrective actions occur. Although these existing monitoring programs provide important and useful information, they do not provide the more targeted collection of specific parameters and information necessary to support a local adaptive stormwater system management program that includes specific regulatory, capital and O&M components. The PTIP EMP is designed to address this information gap.

1.2.1 Relationship to Regional Stormwater Monitoring Program (RSMP) and NPDES Permit

The City is a participant in the Puget Sound Regional Stormwater Monitoring Program (RSMP) which is a collaborative monitoring program with western Washington municipal stormwater permittees and state agencies that is designed to meet NPDES permittee stormwater monitoring requirements. The RSMP is based on strategies and recommendations of the Stormwater Assessment and Monitoring Program for Puget Sound (SWAMPPS). The City contributes approximately $2,100 per year to the RSMP for status and trends monitoring, and $3,600 per year for RSMP effectiveness monitoring.

This PTIP EMP is not redundant with nor does it replace monitoring that is performed as part of the RSMP. The PTIP EMP is not intended to measure the City's compliance with TMDL goals, water quality standards or NPDES Permit conditions. Rather, this EMP is intended as a tool for the City to evaluate on-going progress toward improving stormwater management and prioritization of resources and actions. Specific objectives of the EMP are described below.

1.3 SPECIFIC OBJECTIVES OF THE PTIP EMP

There primary goal of this EMP is to provide quantitative data that supports adaptive management of the City's stormwater program so that the City can focus its limited financial and staff resources on activities that are likely to have the most potential to benefit water quality. As such, the EMP is intended to monitor performance of the City's stormwater system, as opposed to specific treatment or O&M BMPs.

A secondary goal of the EMP is to provide information to supplement local and regional ambient monitoring programs and to help support causal linkages between incremental improvements in receiving water quality and implementation of corrective actions.

Specific objectives of the PTIP EMP consist of the following:

- Provide information that allows adaptive management and on-going program refinement, performance assessment and measurement of progress toward improving water quality and habitat.
- Assess changes over time in TMDL targets related to urban runoff from the City;
- Support and enhance shared knowledge and feedback processes at a watershed level between monitoring agencies and key stakeholder groups including the Suquamish Tribe, Kitsap County, KPHD, Kitsap Conservation District (KCD), DOH, and Ecology.

1.4 EMP SCOPE AND ORGANIZATION

The EMP incorporates a Quality Assurance Project Plan (QAPP) that reflects Ecology guidelines and includes specific sampling goals, objectives and performance measures; parameters, sampling locations, quality control measures and frequency; sampling and laboratory analytical methods and QA/QC criteria; roles and responsibilities; and reporting methods.

It is anticipated that the EMP/QAPP will be modified over time to reflect changes in water quality, BMP implementation, land use and development.

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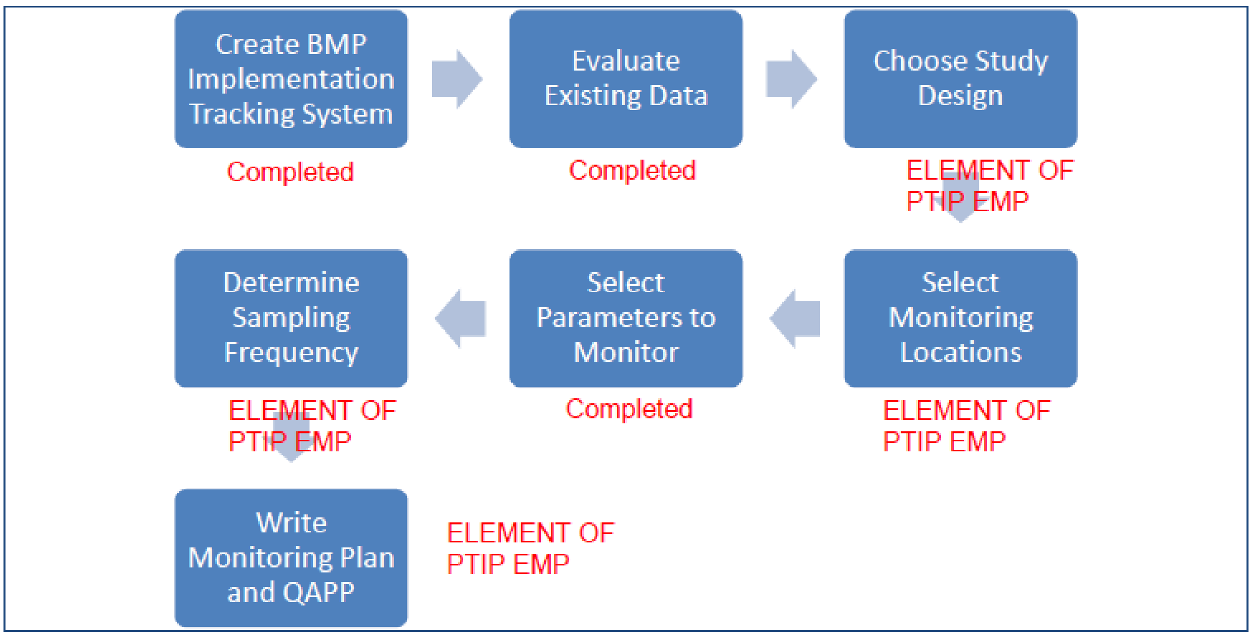
2 EMP DEVELOPMENT AND DESIGN

The City's EMP has been developed consistent with a watershed approach which focuses on hydrologically defined areas (basins and sub-basins) in conjunction with an adaptive management process to address issues and priorities. The Watershed Assessment Liberty Bay TMDL Plan (SES 2016b) and Needs and Opportunities Assessment (SES 2016c) provides the technical foundation for the EMP including evaluation of existing data, BMP documentation, basin analysis and corrective action prioritization.

2.1 EMP DEVELOPMENT PROCESS

The general steps that are typically common to all EMPs are shown in Figure 2-1, which also depicts the status of each step with respect to the City' PTIP (red text).



(*Note:* Modified from EPA 2010.)

Figure 2-1. Development of a TMDL Effectiveness Monitoring Plan

Each step in the EMP development process is generally described in Table 2-1 below, with additional detail provided in Chapters 3 through 9.

Table 2-1. Summary of EMP Development Process

Element	Status	Additional Notes
Create BMP Implementation Tracking System	Completed	Refer to *Watershed Assessment* and *Needs and Opportunities Assessment* for facility types and locations
Evaluate Existing Data	Completed	Refer to *Watershed Assessment* and *Needs and Opportunities Assessment* for analysis and summary
Choose Study Design	Element of PTIP	Refer to Chapter 3-4 of this EMP
Determine Sampling Frequency	Element of PTIP	Refer to Chapter 3-4 of this EMP
Select Parameters to Monitor	Completed	Fecal coliform
Select Monitoring Locations	Element of PTIP	Refer to Chapter 3-4 of this EMP
Write Monitoring Plan and QAPP	Completed	

2.2 EMP DESIGN OBJECTIVES

The EMP design reflects the City's role in implementing the Liberty Bay TMDL Plan, which is limited to actions that occur within the City limits. Effectiveness monitoring for the City is therefore defined in terms of overall stormwater program effectiveness in contributing to meeting water quality goals. Broader scale effectiveness monitoring, which determines whether watershed-wide corrective actions (including stormwater management in the City) are effective at protecting and improving Liberty Bay water quality and are achieving targeted water quality outcome(s), would continue to be conducted by state or regional agencies including Ecology and the KPHD.

The objectives of the City's EMP are to focus on providing on-going information that enables the City to adapt stormwater manage actions, improve and maintain performance of BMPs, and the monitor the relative quality of stormwater runoff from areas within the City. The design of the City's EMP therefore focuses on measures that help to prioritize resources and sustain the effectiveness of a targeted action or relatively narrow suite of actions that are directly associated with the City's stormwater management program. Specifically, the City's EMP will be designed to provide information at the site and basin scale that includes:

- Source identification and diagnostic monitoring to provide sustained prioritization of problem areas, locate specific contaminant sources and support source removal/control actions.
- Monitor and track source controls associated with the City's Illicit Discharge Detection and Elimination (IDDE) program,
- Identify land use conditions that may be contributing elevated pollutant loading and may be subject to potential regulatory or O&M measures,
- Performance of City owned and maintained BMPs in treating stormwater discharges, and
- Inform O&M and capital project planning by providing on-going feedback information on relative improvements or declines in FC levels at specific locations.

2.3 COORDINATION WITH LOCAL AND STATE EMPS

The City's EMP design is intended to provide a cost-effective approach that is consistent with the functions and responsibilities of the City's stormwater utility. The design also meshes with and compliments local and regional monitoring efforts, including the KPHD ambient monitoring program and monitoring being performed as part of the SWAMPPS.

2.4 EMP DESIGN ELEMENTS

The EMP design builds on stormwater quality information collected as part of the Watershed Assessment and the City's on-going IDDE monitoring program. The design approach reflects the dual objectives of the EMP, which are to provide information that enhances and targets source control activities, as well as tracks progress toward TMDL goals.

The EMP design will build on and expand the City's existing IDDE monitoring program. The City's existing IDDE monitoring program consists of once/year dry weather monitoring at 22 outfalls for E. coli or FC. EMP elements that will be added to the IDDE monitoring will consist of:

- Additional outfalls or discharge points in priority basins as determined from the Watershed Assessment, and
- Wet weather FC bacteria monitoring at all locations twice per year.

These two modifications will help to ensure the EMP is addressing potential priority areas, as well as conditions under both wet and dry weather. This will enable the City to track sampling results, compare to TMDL criteria and identify relative contributions of FC loading so City sponsored corrective actions can focus on the apparent most significant sources.

The QAPP provided in the following chapters describes the specific elements associated with the City's EMP, including Sampling Design.

2.5 EMP LIMITATIONS

The City's EMP will not replicate or be redundant with ambient monitoring of marine water or freshwater streams that is already performed by the KPHD or other agencies. The City's EMP will not measure compliance with water quality standards, or calculate statistics or perform trend analysis. Long term trend analysis in marine water and the mouths of primary freshwater tributaries will continue to be performed by the KPHD as part of their ambient monitoring program.

The EMP is also not intended for quantitative evaluation of individual BMP effectiveness. Specific BMP effectiveness is highly variable and general estimates of BMP effectiveness are already available from sources such as the International Stormwater BMP Database (www.bmpdatabase.org).

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3 QAPP OVERVIEW AND BACKGROUND

This EMP focuses on stormwater discharges and selected freshwater stream locations in the City, and will be coordinated with monitoring conducted by the KPHD. The EMP is in QAPP format pursuant to Ecology guidelines and includes specific sampling goals, objectives and performance measures; parameters, sampling locations, quality control measures and frequency; sampling and laboratory analytical methods and QA/QC criteria; roles and responsibilities; and reporting methods.

This QAPP is modeled after the QAPP prepared for the City's 2015 stormwater sampling study (Parametrix 2015). This QAPP is intended as a general guide and description of the goals, parameters, methods and locations where sampling will be performed. Sampling results, field conditions and changes in land use all have potential to generate information or create conditions that warrant modification to sample location, number and frequency. As sampling efforts are implemented, adjustments to this QAPP will therefore be likely and will be documented as described in later sections.

This QAPP is a guide for the City and stakeholder agency monitoring staff and will be reviewed and amended in response to changes in monitoring objectives, sampling results and practices as needed.

3.1 STUDY AREA

The study area is the City of Poulsbo (Figure 3-1 and 3-2). The City is approximately 4.5 square miles in size, and supports a population of just under 10,000. The City of Poulsbo and the Poulsbo Urban Growth Area (UGA) are within the Liberty Bay watershed.

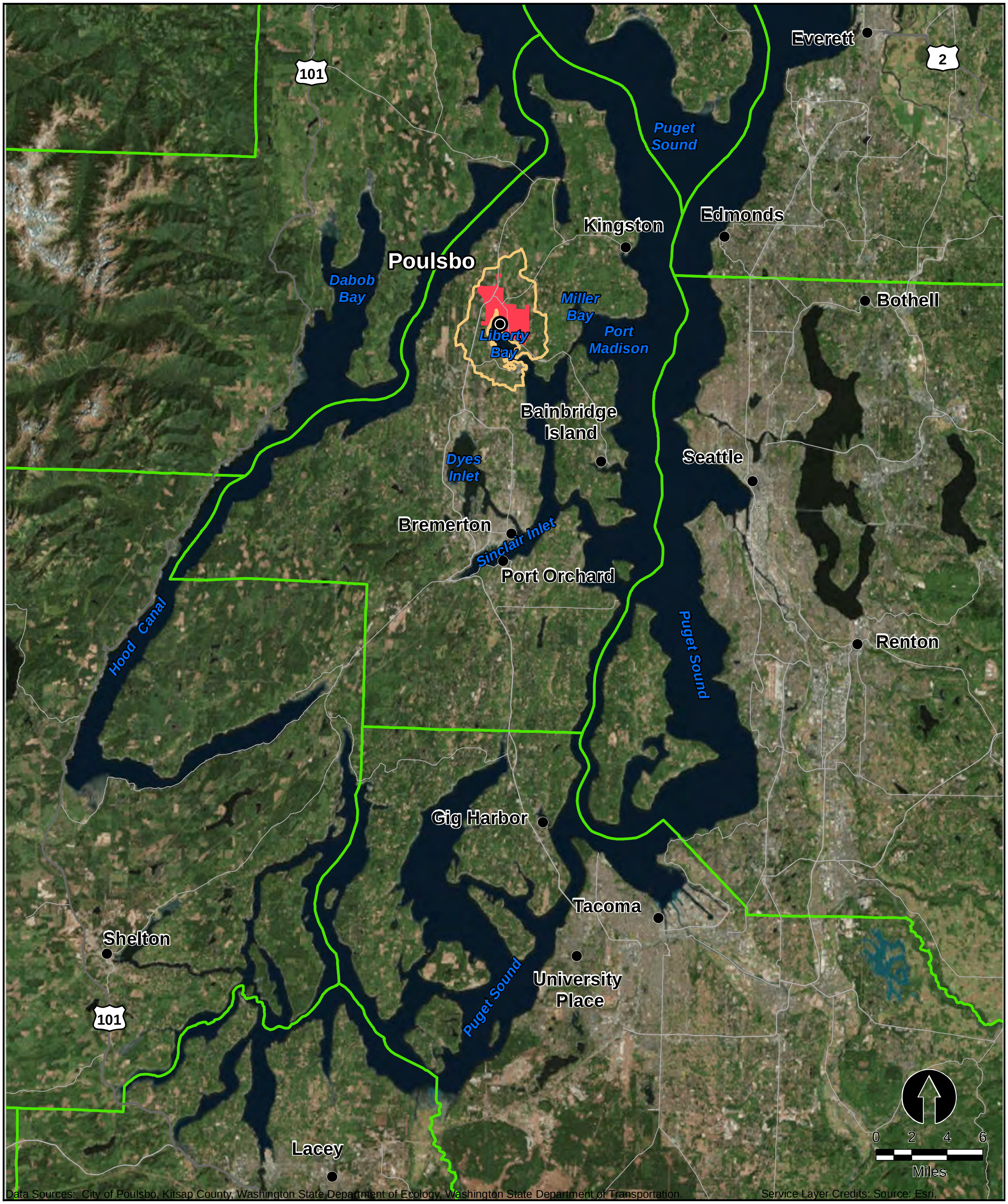
The study area includes a combination of stormwater and freshwater discharges. The watershed area and primary streams and basins in the study area are shown in Figure 3-2. Dogfish Creek is the largest tributary to Liberty Bay, but other creeks and storm drains also contribute freshwater to the bay, including Lemolo, Bjorgen, and Sam Snyder Creeks in Nesika Bay. The Watershed Assessment (SES 2016b) provides a detailed description of the study area.

3.2 FECAL COLIFORM WATER QUALITY STANDARDS AND BENEFICIAL USES

The Washington State Water Quality Standards, Chapter 173-201A of the Washington Administrative Code (WAC), include designated beneficial uses, waterbody classifications, and numeric and narrative water quality criteria for surface waters of the state.

The Fecal coliform bacteria (FC) criteria have two statistical components: a geometric mean and an upper limit value that 10% of the samples cannot exceed. Fecal coliform samples collected randomly follow a lognormal distribution. In Washington State FC TMDL studies, the upper limit statistic (i.e., not more than 10% of the samples shall exceed) has been interpreted as a 90th percentile value of the log-normalized values (Ecology 2009).

Prepared by Sealaska Environmental., E:\PMX-TMDL\Watershed Assessment\Fig_2-1_RegionalContext.mxd, May 09, 2016.



Liberty Bay Watershed

U.S. Route

State Route

County Boundary

City of Pouslbo

Figure 3-1.
City Location and Regional Context
Liberty Bay TMDL Implementation Plan, City of Poulsbo

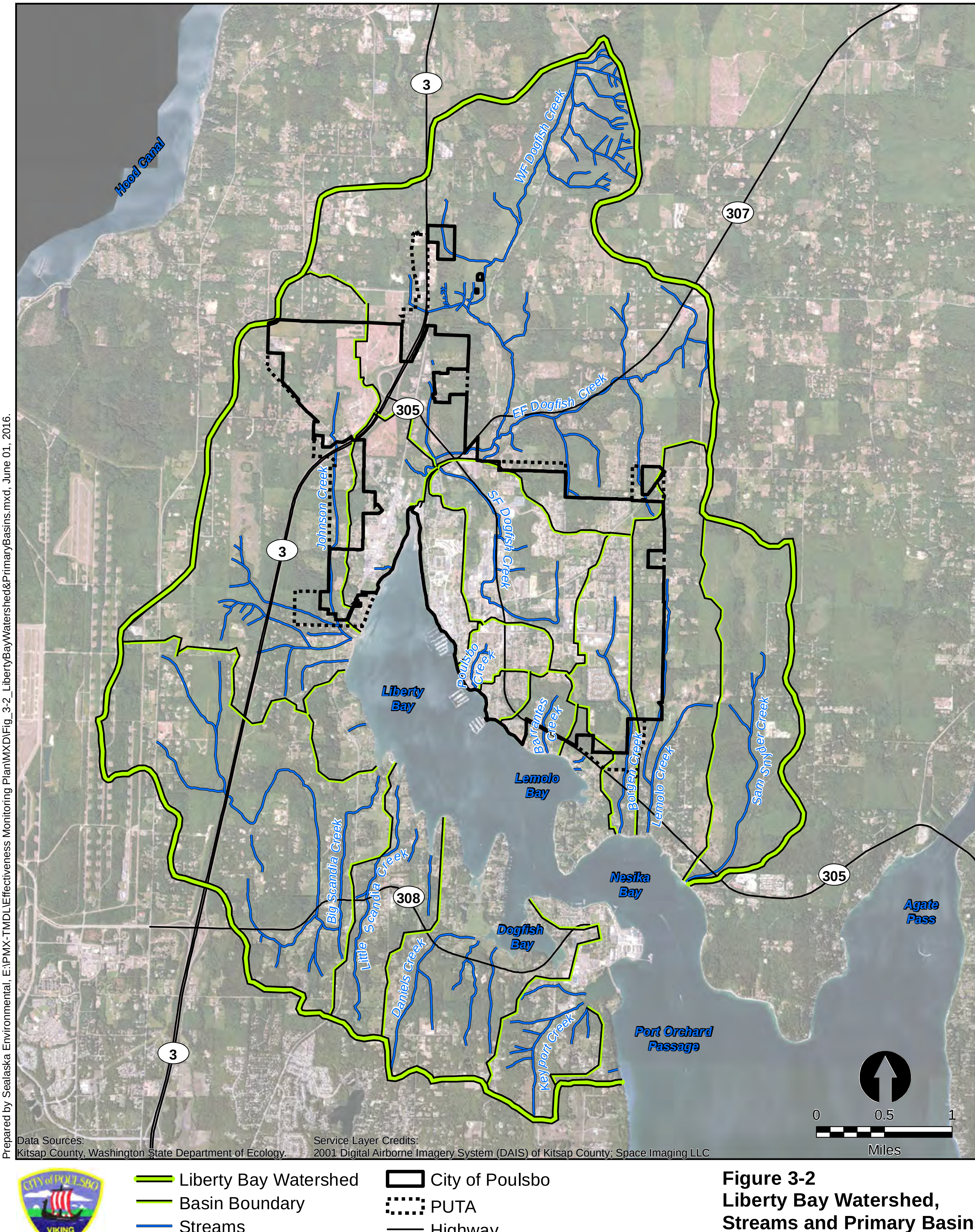


Figure 3-2
Liberty Bay Watershed, Streams and Primary Basins
Liberty Bay TMDL Implementation Plan, City of Poulsbo

3.2.1 Freshwaters

The Extraordinary Primary Contact use is intended for waters capable of "providing extraordinary protection against waterborne disease or that serve as tributaries to extraordinary quality shellfish harvesting areas." To protect this use category: "Fecal coliform organism levels must not exceed a geometric mean value of 50 colonies/100 mL, with not more than 10% of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value exceeding 100 colonies/100 mL" [WAC 173-201A-200(2)(b), 2003 edition]. Compliance is based on meeting both the geometric mean criterion and the 10% of samples (or single sample if less than ten total samples) limit.

3.2.2 Marine Waters

No marine water monitoring is proposed as part of this QAPP so marine water quality standards are not applicable. However, the marine standard is provided below for context.

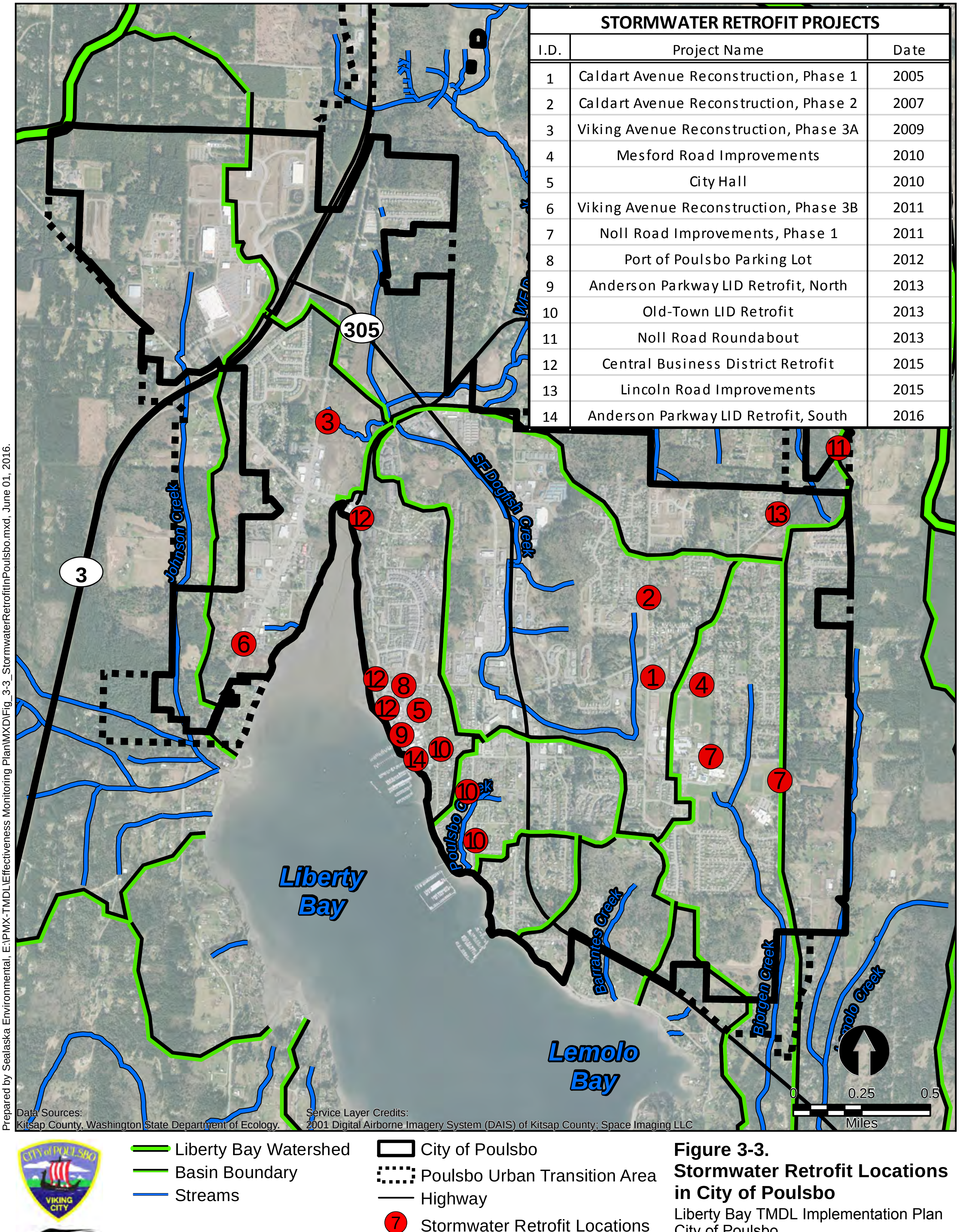
To protect either Shellfish Harvesting or Primary Contact Recreation (swimming or water play): "Fecal coliform organism levels must not exceed a geometric mean value of 14 colonies/100 mL, with not more than 10% of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value exceeding 43 colonies/100 mL" [WAC 173-201A-210(3)(b), 2003 edition].

Compliance is based on meeting both the geometric mean criterion and the 10% of samples (or single sample if less than ten total samples) limit. These two measures are used in combination to ensure that the bacterial pollution in a waterbody will be maintained at levels that will not cause a greater risk to human health.

3.2.3 Stormwater BMP Inventory

Recent non-point pollutant source control activities in the Liberty Bay watershed are described in detail in the Watershed Assessment. Because this EMP/QAPP focuses on the City's stormwater management program, the following BMP inventory discussion focuses on stormwater facilities and management activities within the City.

The City has implemented a variety of source control and retrofit projects designed to improve and protect water quality. These projects are summarized in Table 3-1 and are shown in Figure 3-3.



STORMWATER RETROFIT PROJECTS

I.D.	Project Name	Date
1	Caldart Avenue Reconstruction, Phase 1	2005
2	Caldart Avenue Reconstruction, Phase 2	2007
3	Viking Avenue Reconstruction, Phase 3A	2009
4	Mesford Road Improvements	2010
5	City Hall	2010
6	Viking Avenue Reconstruction, Phase 3B	2011
7	Noll Road Improvements, Phase 1	2011
8	Port of Poulsbo Parking Lot	2012
9	Anderson Parkway LID Retrofit, North	2013
10	Old-Town LID Retrofit	2013
11	Noll Road Roundabout	2013
12	Central Business District Retrofit	2015
13	Lincoln Road Improvements	2015
14	Anderson Parkway LID Retrofit, South	2016

Figure 3-3.
Stormwater Retrofit Locations in City of Poulsbo
Liberty Bay TMDL Implementation Plan
City of Poulsbo

Table 3-1. Summary of City Stormwater Retrofit Projects

Project	Date Completed	Approx. Area Treated (acres)	Basin	Pervious Pavements			Other Techniques			
				Pervious Parking	Pervious Sidewalk	Pervious Bike Lane	Bioretention	Filterra Vaults	Modular Wetlands	Green Roof
Caldart Avenue Reconstruction, Phase 1	2005	2	SF Dogfish Creek				X			
Caldart Avenue Reconstruction, Phase 2	2007	1	SF Dogfish Creek		X		X			
Viking Avenue Reconstruction, Phase 3A	2009	1.5	Liberty Bay		X	X	X			
Mesford Road Improvements	2010	1	SF Dogfish Creek	X		X				
City Hall	2010	0.25	Liberty Bay							X
Viking Avenue Reconstruction, Phase 3B	2011	2	Liberty Bay		X	X	X			
Noll Road Improvements, Phase 1	2011	1	Bjorgen Creek		X	X	X	X		
Port of Poulsbo Parking Lot	2012	0.5	Liberty Bay	X						
Anderson Parkway LID Retrofit, North	2013	3	Liberty Bay				X	X		
Old-Town LID Retrofit	2013	6	Poulsbo Creek				X	X		
Noll Road Roundabout	2013	1	Lemolo Creek		X		X			
Central Business District Retrofit	2015	3	Liberty Bay				X	X	X	
Lincoln Road Improvements	2015	2	SF Dogfish Creek		X		X	X		
Anderson Parkway LID Retrofit, South	2016	1	Liberty Bay	X					X	

3.3 WATER QUALITY DATA REVIEW

Water quality data is discussed in detail in the Watershed Assessment. Historical data and results of the 2015 focused stormwater sampling are briefly summarized below.

3.3.1 Historical Marine and Freshwater Monitoring Results

Marine water quality monitoring has been performed for more than 10 consecutive years in Liberty Bay by the KPHD as part of the County's ambient monitoring program, and the State DOH as part of the state Shellfish Sanitation Program (DOH 2008). Currently all marine sampling stations meet the FC standard. Since 2012, over 500 marine water samples have been collected from 27 locations in Liberty Bay. Only one station, LB06 at the head of the bay, has routinely shown elevated FC levels. Marine sampling locations are shown in Figure 3-4.

The KPHD has been regularly sampling FC in freshwaters of the Liberty Bay watershed since 1996. Stream water quality is improving in all monitored stream basins except Bjorgen Creek, which is showing a slight declining trend. In general, stream water quality, although improving, periodically fails water quality standards. Table 3-2 lists the primary streams and their respective FC trends as determined by the KPHD. Freshwater sampling stations are shown in Figure 3-5.

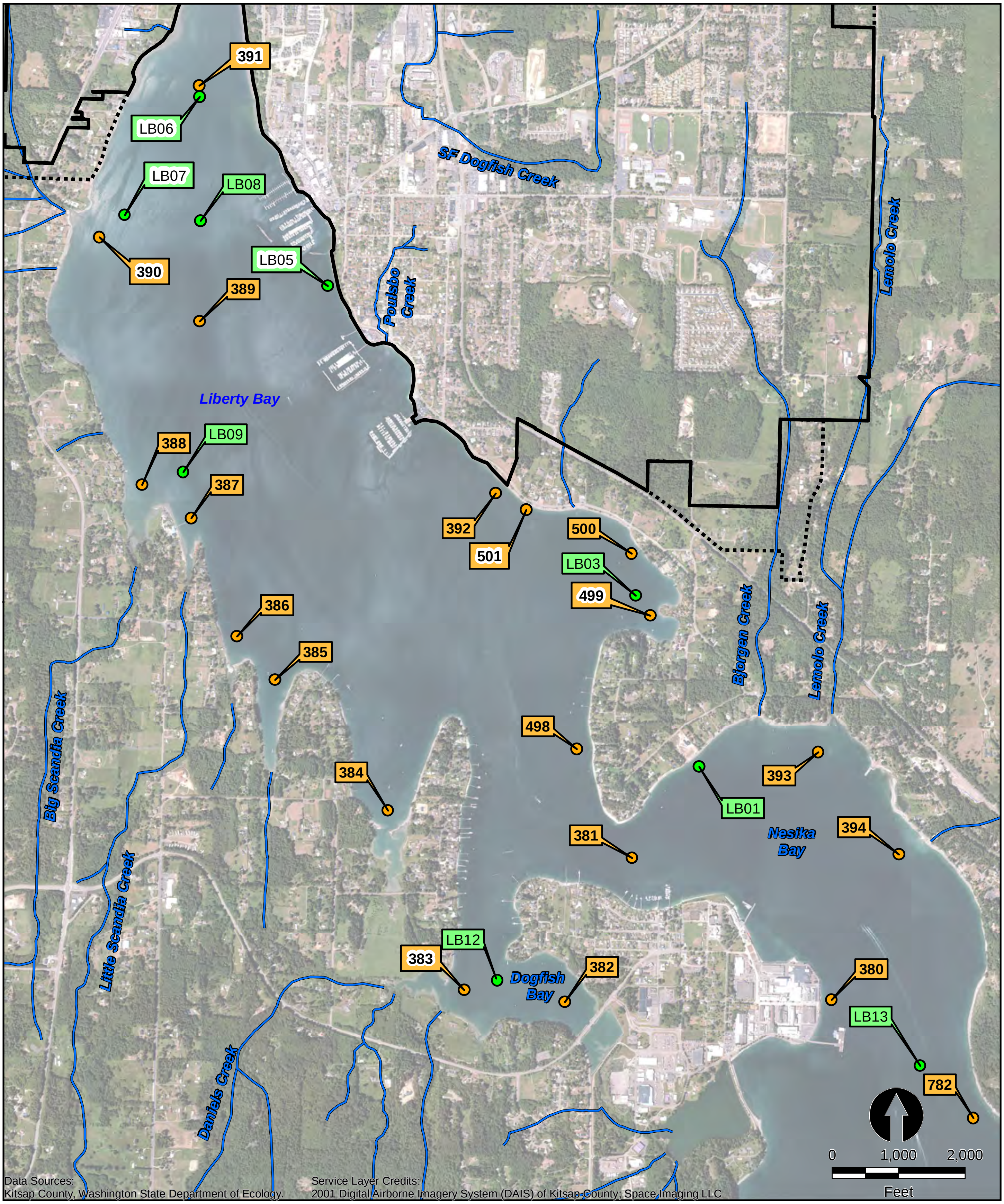
Table 3-2. Freshwater Stream Drainages to Liberty Bay with Corresponding Fecal Coliform Trends

Subwatershed	3-Year Trend	Long-Term Trend	Overall Water Quality
Little Scandia Creek	Stationary	Stationary	Very poor
Big Scandia Creek	Stationary	Stationary	Moderate
Bjorgen Creek	Stationary	Stationary	Poor
Daniels Creek	Improving	Stationary	Good
Dogfish Creek (all tributaries included)	Improving	Stationary	Good
Dogfish Creek, South Fork	Improving	Stationary	Poor
Johnson Creek	Improving	Stationary	Good

Source: KPHD 2013, 2014. Data based on KPHD monthly sampling from 1996 through 2014.

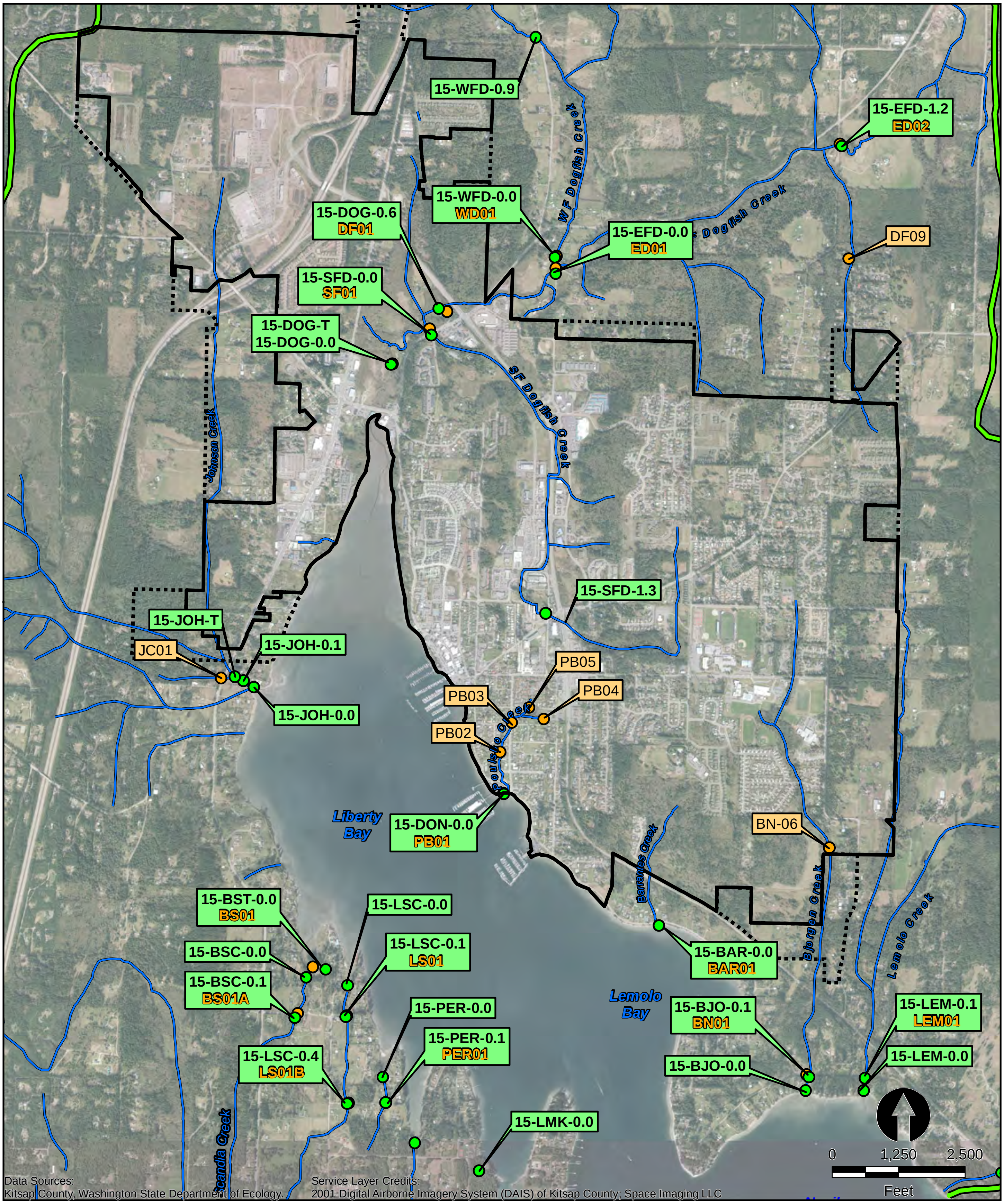
Stream sampling results from 2015 monitoring are summarized in Table 3-3. Loading data for streams is presented in Table 3-4. Loading data shows that wet weather loads are typically 50 to 100 times dry weather loads, with Dogfish Creek and SF Dogfish Creek loads both exceeding all other streams combined.

Prepared by Sealaska Environmental, E:\PMX-TMDL\Effectiveness Monitoring Plan\MXD\Fig_3-4_MarineWQMonitor.mxd, June 01, 2016.



Streams
City of Poulsbo
PUTA
123 Marine WQ Station - WDOH
LB00 Marine WQ Station - KPHD

Figure 3-4.
Marine Water Quality Monitoring Stations
Liberty Bay TMDL Implementation Plan
City of Poulsbo



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Liberty Bay Watershed
City of Poulsbo
PUTA

Fresh WQ Station - WDOE
Fresh WQ Station - KPHD/CoP

Figure 3-5
Historical Stream Water Quality Monitoring Stations
Liberty Bay TMDL Implementation Plan
City of Poulsbo

Table 3-3. Stream Loading Summary, 2015 Sampling

		Dry Weather Avg.			Wet Weather Avg.		
Station ID	**Description**	**FC/100 ml [1/]**	**Flow (cfs)**	**Load [2/]**	**FC/100 ml [1/]**	**Flow (cfs)**	**Load [2/]**
PB-02	Poulsbo Creek, downstream culvert at Sommerseth	24	0.49	0.29	440	1.4	15.5
LEM 0.9	Lemolo Creek at Heron Pond Lane	10	0.28	0.07	53	6.4	8.3
BJO-0.9	Bjorgen Creek at Storhoff Road culvert	40	0.07	0.07	175	8.7	37.4
15-DOG-0.6	Mainstem Dogfish Creek	20	11.12	5.44	100	75.5	184.8
15-SFD-0.0	SF Dogfish Creek at Bond Rd. & 1st Ave., downstream of PSW4	53	1.86	2.40	286	19.4	135.7
JOH-0.1	Johnson Creek mainstem at 18931 Viking Avenue	10	1.37	0.33	94	25.1	57.6

Notes:
[1/] Geometric mean
[2/] Loading data in billions of colony forming units per day (bcfu/day)

Stream sampling from 2015 was compared to data collected as part of Ecology's TMDL study in 2008-09. A direct comparison for wet weather results was not possible due to the lack of rain event data in 2008-2009. Dry weather conditions are compared in Table 3-4 and show that conditions in 2015 appear to be improved compared to 2009; however, this conclusion should be viewed with caution due to the relatively small 2015 data set.

Table 3-4. Comparison of Dry Weather Stream Sampling Results, 2009 to 2015

		FC Concentration			Reduction	
Station ID	**Description**	**2009 FC/100 ml GMV**	**2009 Target Value**	**2015 FC/100 ml GMV**	**Target Reduction**	**Actual Reduction**
PB-02	Poulsbo Creek, downstream culvert at Sommerseth	302	27	24	91%	92%
LEM 0.9	Lemolo Creek at Heron Pond Lane	63	11	10	83%	84%
BJO-0.9	Bjorgen Creek at Storhoff Road culvert	276	13	40	95%	86%
15-DOG-0.6	Mainstem Dogfish Creek	93	43	20	53%	78%
15-SFD-0.6	SF Dogfish Creek at Bond Rd. & 1st Avenue	62	31	53	50%	15%
JOH-0.1	Johnson Creek, mainstem at 18931 Viking Avenue	36	15	10	57%	72%

3.3.2 Stormwater Quality

Stormwater monitoring in the City has been performed by the KPHD since 2000, and was also performed by Ecology as part of 2013 TMDL Plan. Stormwater data for past years is generally limited in terms of frequency, location and runoff condition and trend analysis for specific stormwater outfalls is not possible. Stormwater outfall monitoring has been conducted primarily during dry weather conditions and with a focus on IDDE activities. Historical stormwater monitoring shows that virtually all outfalls have exhibited elevated FC levels at some point in time. Stormwater outfall locations are shown in Figure 3-6 and location of existing IDDE sampling sites is shown in Figure 3-7.

In 2015, a limited stormwater study was conducted as part of the Watershed Assessment consisting of two sampling events at 40 locations during both dry conditions and periods of significant rainfall (storm event sampling). The goal of the 2015 stormwater quality study was to provide FC data to help identify specific pollutant loading areas in the City, and support development of focused corrective action measures.

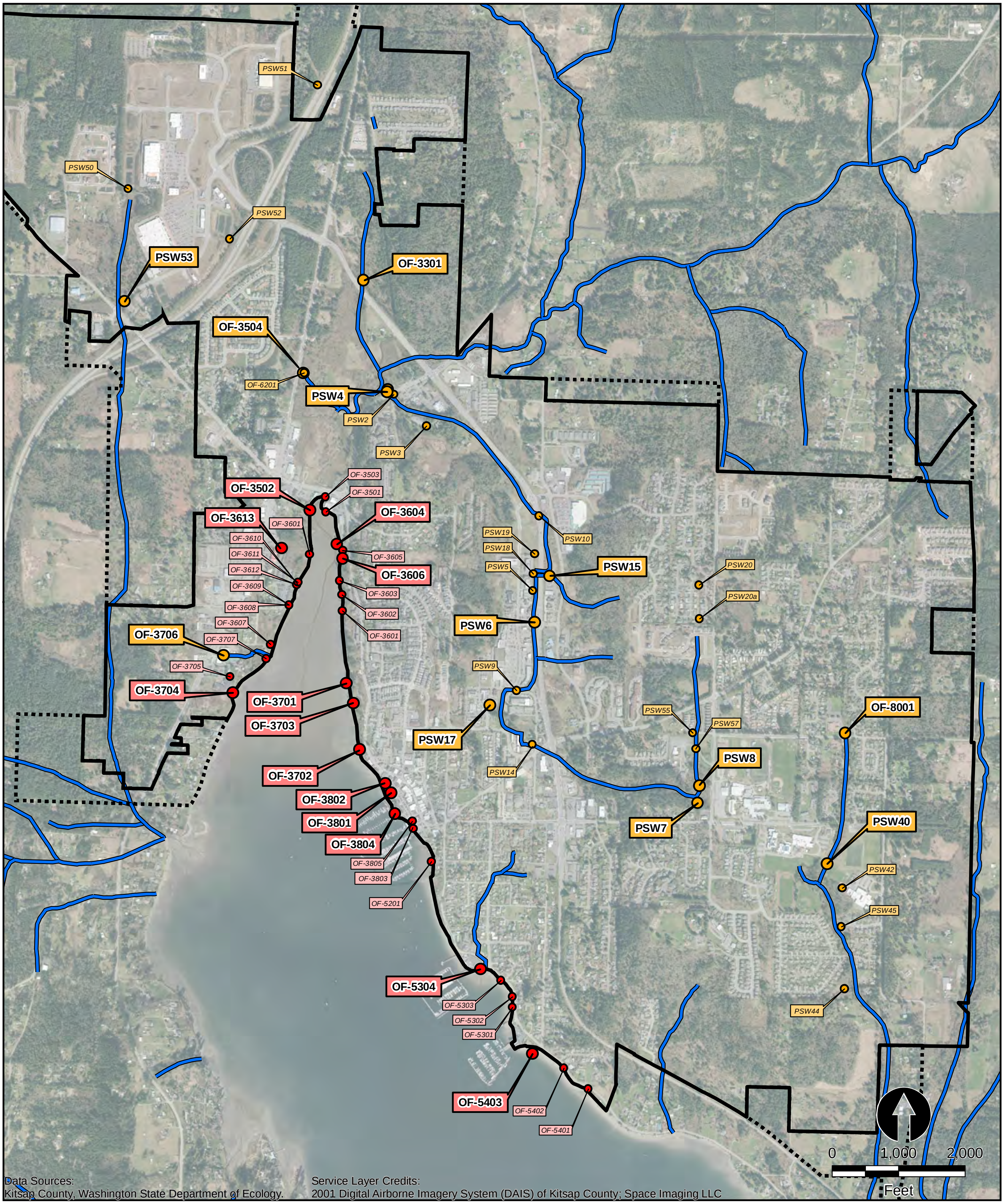
Stormwater outfall sampling stations are shown in Figure 3-8 and wet weather results are summarized in Table 3-5. Stormwater outfall flow measurements were not performed as part of the 2015 sampling effort. In lieu of an actual flow measurement, a relative load index was calculated for each outfall based on wet weather FC concentration and total impervious area (TIA) within the outfall catchment area. Outfall loading information is provided in Table 3 5 and is shown graphically in Figure 3-9. Refer to the Watershed Assessment for detail on TIA sub-basin analysis.

3.4 STORMWATER INFRASTRUCTURE ASSESSMENT

The purpose of the stormwater infrastructure assessment was to identify areas where adequately functioning stormwater treatment facilities are generally present, and areas where there are minimal or no treatment facilities. The assessment was conducted by delineating specific catchment areas and evaluating treatment facilities and conditions within each catchment area. The assessment considers the age and type of developments, existing and future impervious surfaces, and type and location of existing treatment facilities. Existing sub-basin, stormwater facility, and treatment areas are shown in Figure 3-10. The complete set of basin assessment data is provided in the *Watershed Assessment.*

3.5 SUMMARY OF PRIORITY AREAS

Basins that were potential priorities for corrective actions were determined through the *Watershed Assessment* based on a combination of monitoring results and basin characteristics (land use, impervious surfaces, area treated). Corrective action strategies and projects for these areas were developed in the Needs and Opportunities Assessment (SES 2016c). Priority sub-basins based on these criteria are shown in Figure 3-11 and are summarized in Table 3-6.



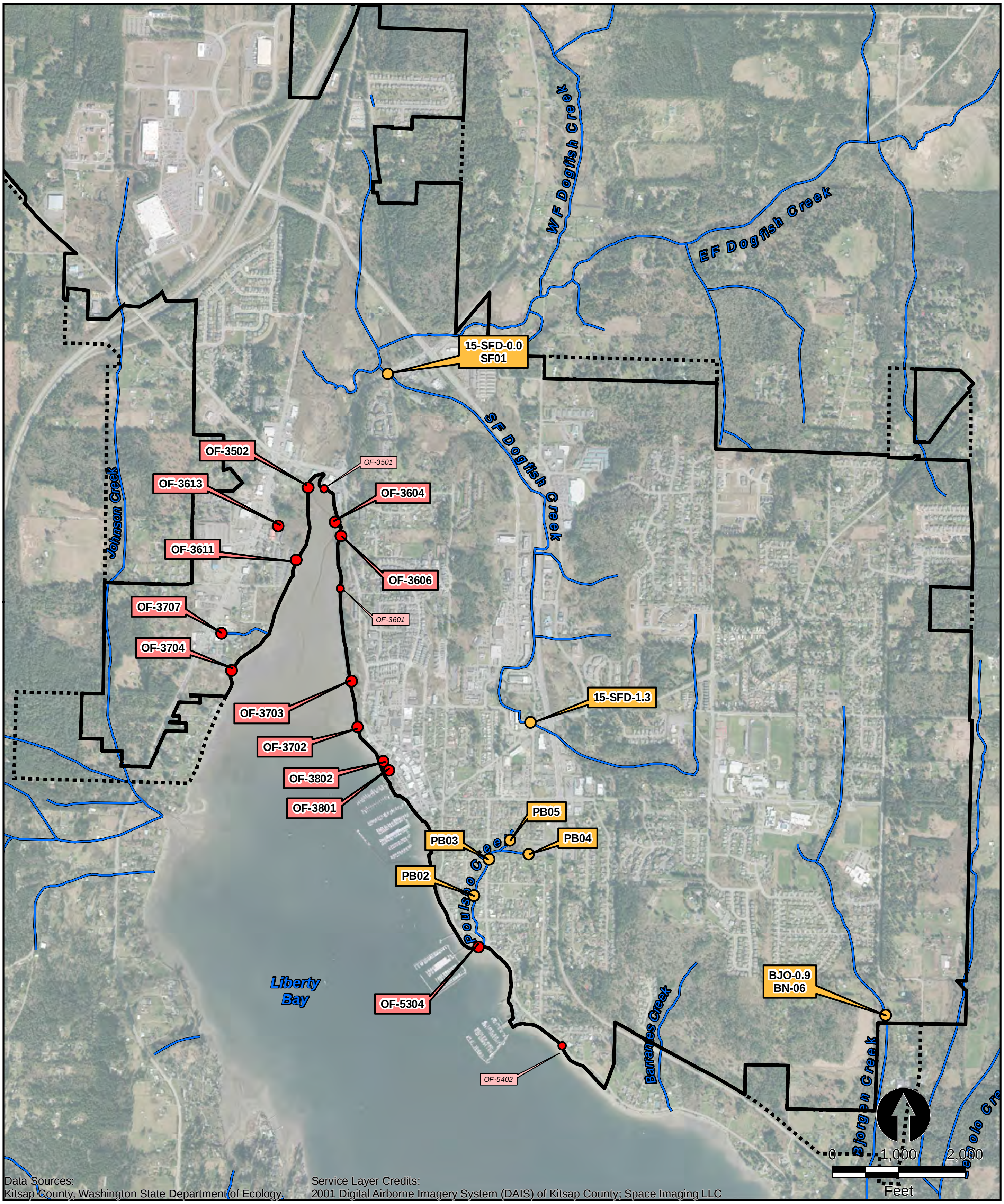
Prepared by Sealaska Environmental, E:\PMX-TMDL\Effectiveness Monitoring Plan\MXD\Fig_3-6_StormwaterOutfallLoc.mxd, June 01, 2016.

Streams
City of Poulsbo
PUTA

Marine Outfalls
- Major/City System
- Minor/Private

Freshwater Outfalls
- Major/City System
- Minor/Private

Figure 3-6.
Stormwater Outfall Locations
Liberty Bay TMDL Implementation Plan, City of Poulsbo

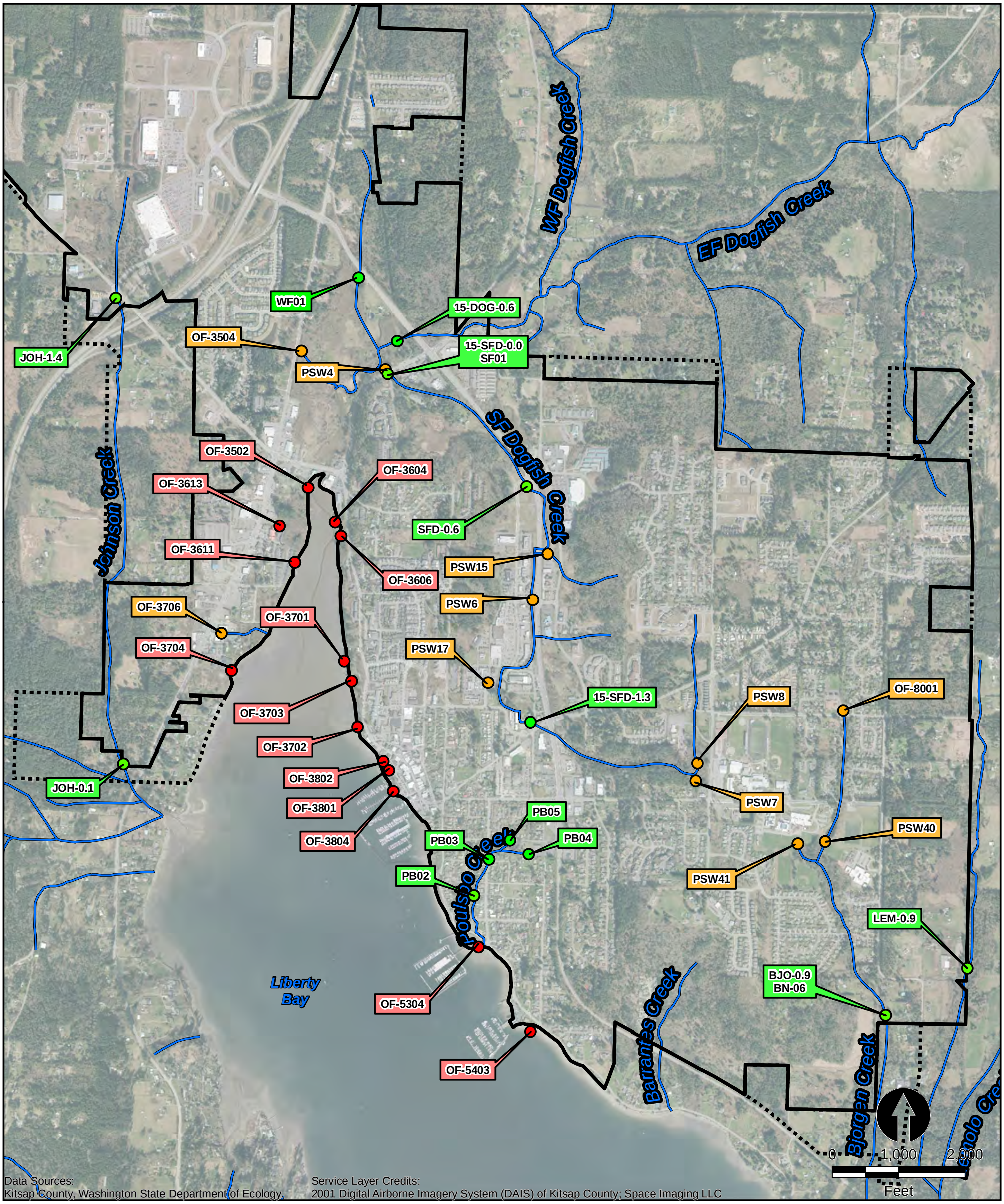


Prepared by Sealaska Environmental, E:\PMX-TMDL\Effectiveness Monitoring Plan\MXD\Fig_3-7_IDDE_Loc.mxd, June 02, 2016.

Streams
City of Poulsbo
PUTA
Stormwater Outfalls
Freshwater Stream

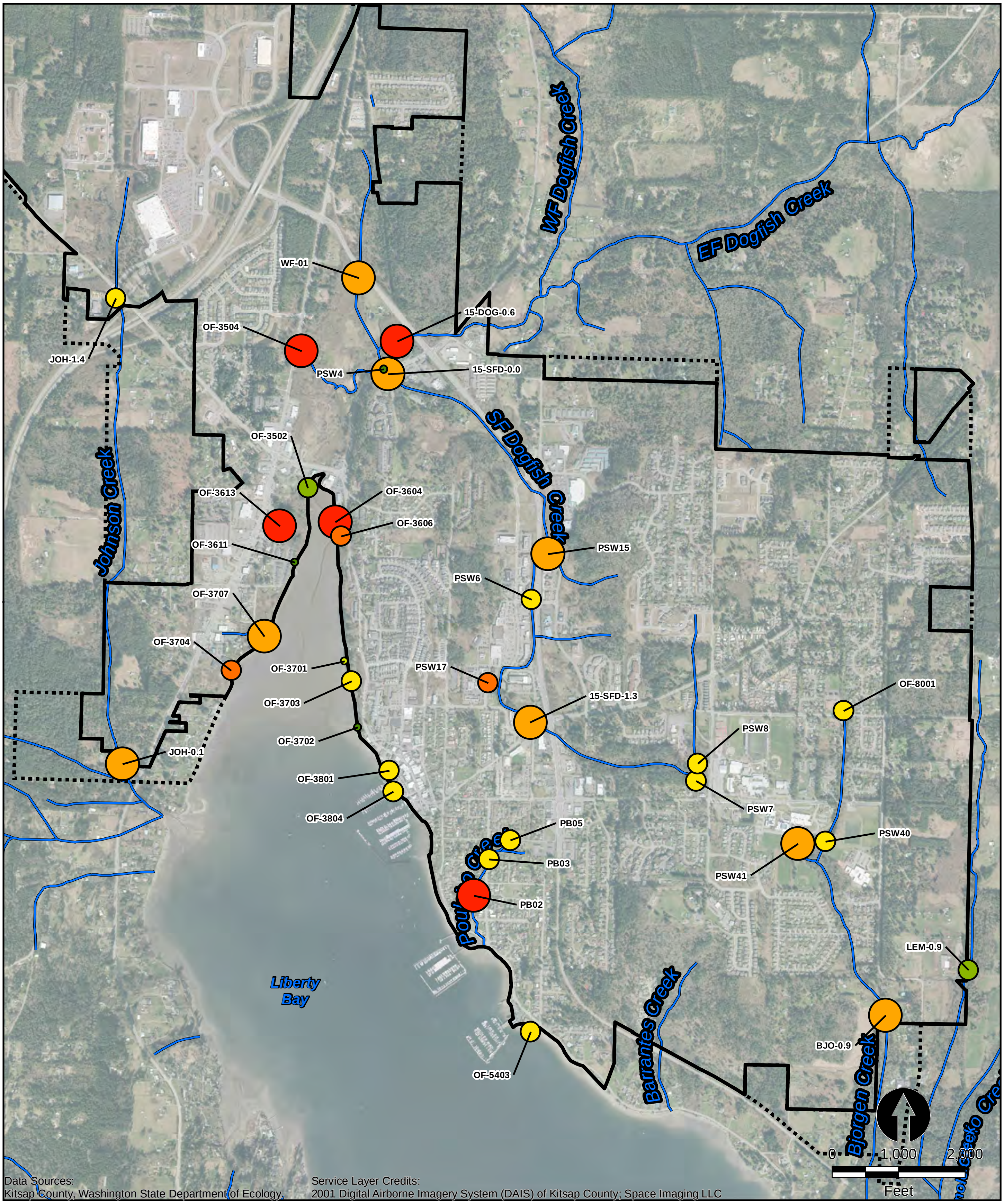
Figure 3-7
Existing IDDE Monitoring Locations
Liberty Bay TMDL ImplementationPlan
City of Poulsbo

Prepared by Sealaska Environmental, E:\PMX-TMDL\Effectiveness Monitoring Plan\MXD\Fig_3-8_WaterQualityMonLoc.mxd, June 01, 2016.



Streams
City of Poulsbo
PUTA
Stream Station
Marine Outfall
Freshwater Outfall

Figure 3-8.
2015 Water Quality Monitoring Locations
Liberty Bay TMDL Implementation Plan
City of Poulsbo



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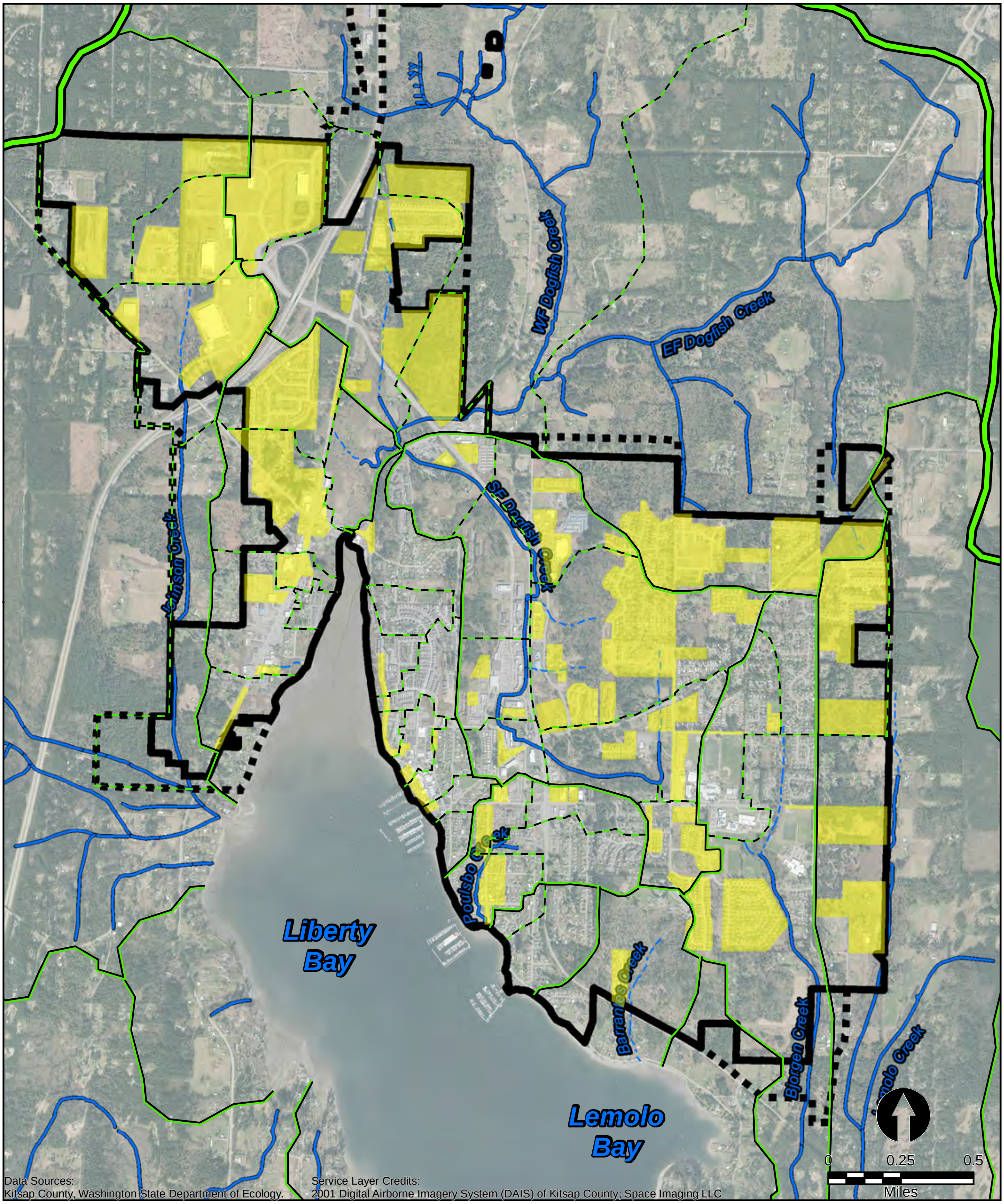
Streams
City of Poulsbo
PUTA

FC Load
Low
Medium
High

FC Water Quality
Good
Moderate
Poor

Figure 3-9
2015 Water Quality Study Summary
Liberty Bay TMDL Implementation Plan
City of Poulsbo



Prepared by Sealaska Environmental, E:\PMX-TMDL\Effectiveness Monitoring Plan\MXD\Fig_3-10_StormwaterRetrofitInPoulsbo.mxd, June 01, 2016.

Liberty Bay Watershed
Basin Boundary
Sub-Basin Boundary
Stream
Intermittent Stream
City of Poulsbo
PUTA
Areas with Stormwater Treatment

Figure 3-10.
Stormwater Treatment Areas
Liberty Bay TMDL Implementation Plan, City of Poulsbo

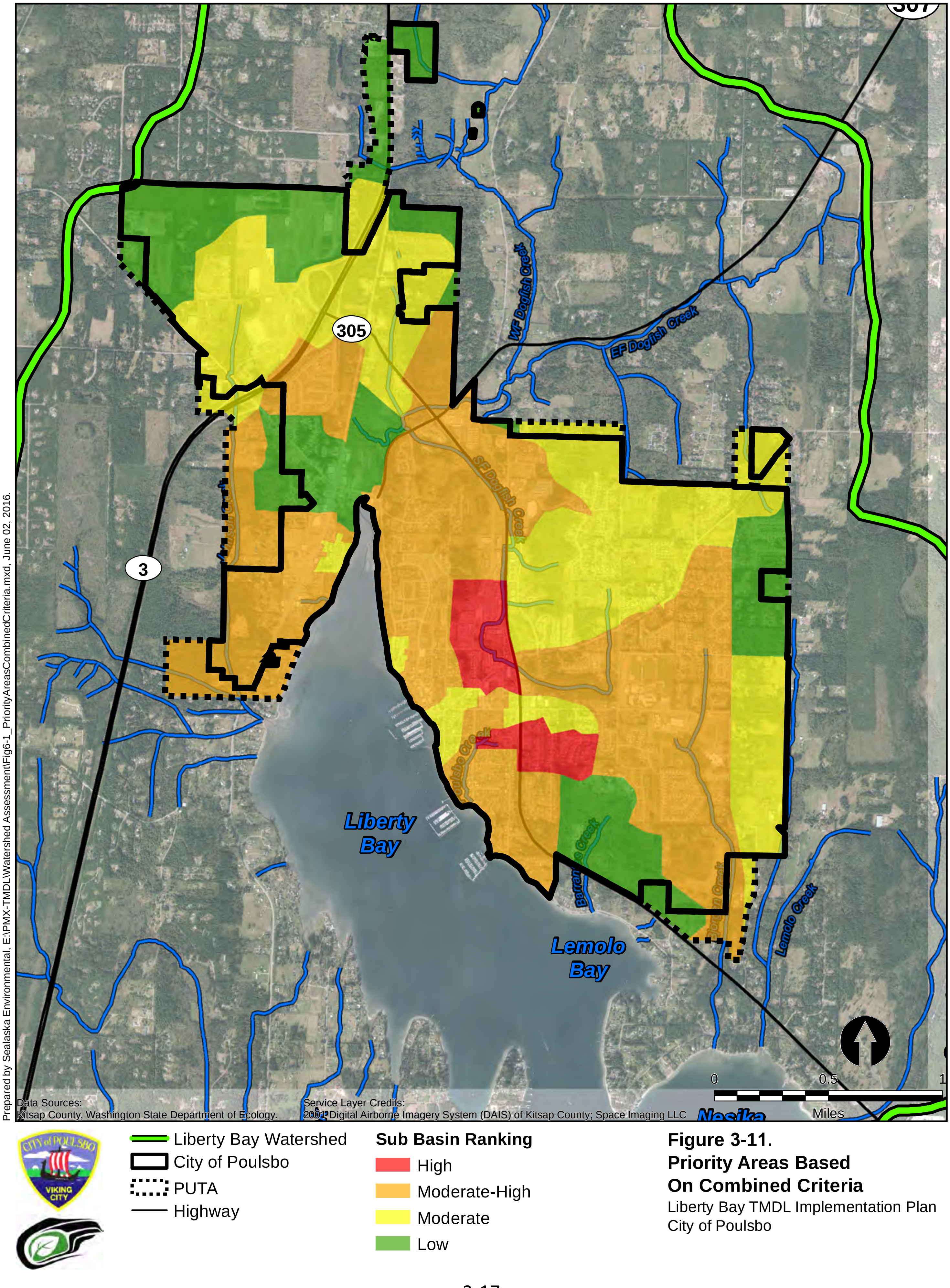


Figure 3-11.
Priority Areas Based
On Combined Criteria
Liberty Bay TMDL Implementation Plan
City of Poulsbo

Table 3-5. Stormwater Outfall Sampling Results

Station ID	Basin ID	Description	Wet Weather GMV	Basin TIA (ac)	FC Load Index 1/
MARINE OUTFALLS					
OF-3502	V-05	Nelson Park	77	28.9	2,242
OF-3504	V-06	North Central Viking Ave. outfall to Fish Park	1,442	40.9	58,931
OF-3604	C-01	Liberty Bay Auto-24" CMP	1,039	17.5	18,221
OF-3606	C-02	South of 20101 Front Street	961	8.1	7,808
OF-3611	V-03	CMP at Windsong Apartments	49	3.4	169
OF-3613	V-04	Nelson Park north of Hidden Cove Apts.	843	13.2	11,129
OF-3701	C-03	24" CMP at north end of American Legion Park	171	8.1	1,388
OF-3702	C-05	Cast Iron outfall at south end of American Legion Park	80	3.4	273
OF-3703	C-04	24" CMP at American Legion Park	308	11.9	3,675
OF-3704	V-01	Liberty Shores Creek at retirement home	600	8.3	4,988
OF-3707	V-02	East end of bioswale behind Ken's Auto	338	33.2	11,194
OF-3801	C-06	Anderson Parkway-south side of Gazebo on beach	200	12.8	2,553
OF-3804	C-07	Port of Poulsbo main parking lot, landward of fuel dock gangway	253	11.2	2,823
OF-5403	C-11	Outfall on beach near Fjord Drive at 9th Ave.	219	15.7	3,444
FRESHWATER OUTFALLS					
WF-01	WF-01	West Fork of Dogfish Creek, downstream of culvert under SR305	297	57.6	17,093
PB-02	PC-01	Poulsbo Creek, downstream culvert at Sommerseth	604	19.2	11,633
PB-03	PC-02	Poulsbo Creek, corner of Ryen & 6th	317	11.1	3,505
PB05	PC-03, PC-04	Poulsbo Creek, Harrison St. culvert at 709 Harrison St.	143	24.0	3,432
PSW4	SF-01	SR305 Stormwater outfall @ SF Dogfish Creek	47	14.8	696
PSW6	SF-04	Poulsbo Village outfall, SR305 at Liberty Rd., NW corner	359	22.9	8,246

Table 3-5. Stormwater Outfall Sampling Results (continued)

Station ID	Basin ID	Description	Wet Weather GMV	Basin TIA (ac)	FC Load Index [1/]
		FRESHWATER OUTFALLS (continued)			
PSW7	SF-07	East Caldart Ave. basin, from culvert east of 1508 Hostmark St.	139	19.3	2,677
PSW8	SF-08	Photo of bank by high school - new location is on Mesford	394	17.2	6,762
PSW15	SF-06	SR305 Outfall near O'Reilly's	445	32.4	14,401
PSW17	SF-05	Ditch near Centennial Park	570	16.6	9,486
PSW40	B-03	Bjorgen Creek channel below 24" and 18" outfalls	424	13.5	5,736
PSW41	B-02	Outfall to Bjorgen Creek at spillway below middle school	228	48.9	11,167
OF-8001	B-03	Kevos Pond / Ridgewood basin	490	6.8	3,312

Notes:
[1/] Load Index = TIA * GMV
FC Load Index Relative Ranking
GMV – geometric mean value
Legend:
Low: 0 - 4000
Medium: 4,000 - 8,000
High: > 8,000

As shown in Figure 3-9, the 62-acre lower Dogfish Creek basin (sub-basin DF-01) ranked as a high priority due to high loading in Dogfish Creek, as well as high levels of TIA associated with the future Edward Rose development. The ranking is skewed however, due to the Dogfish Creek loading that occurs upstream of the City, as well as the TIA associated with the approved but not yet constructed Edward Rose development. For these reasons, this sub-basin should only be considered a moderately high priority

Table 3-6. Summary of Priority Areas and Corrective Actions

Basin ID	Description	Basin Size and Status	Corrective Action Strategy
SF-05	Middle segment of SF Dogfish Creek including the Poulsbo Library, City Public Works complex and SR305	32-acres Fully developed Not treated	Capital Facility Retrofit
PB-02	Portions of Old Town neighborhood between 6th Avenue and SR305, as well as portions of the Viking Heights neighborhood	54-acres Fully developed Not treated	Monitoring and PIC [1]
V-02	Central segment of Viking Avenue and adjacent commercial areas	80-acres Fully developed Not treated	Capital Facility Retrofit
V-06	North Viking Avenue and the Stendahl Ridge neighborhood	XX acres Fully developed Mostly treated	Enhanced O&M, PIC [1/]
B-02	Upper Bjorgen Creek basin including NKSD and the Ridgewood neighborhood	76-acres Fully developed Not treated	Capital Facility Retrofit
SF-04 & SF-03	Middle segment of SF Dogfish Creek include Poulsbo Village and 7th Avenue commercial zone	112-acres Fully developed Not treated	Capital Facility Retrofit
SF-06 & SF-08	Upper segment of SF Dogfish Creek including Lincoln Road, 10th Avenue, and SR305 from Hostmark Street to Liberty Road	322-acres Mostly developed Mostly treated	Monitoring
WF-01	Intermittent tributary to Dogfish Creek that drains the north Viking Avenue basin	235-acres Part developed Part treated	Monitoring

Notes:

[1/] Pollution Identification and Control Survey.

4 SAMPLING DESIGN

A central goal of the EMP is to provide data that helps identify specific pollutant loading areas and sources in the City, and supports development and evaluation of focused corrective action measures over time. Specific objectives of the sampling design are as follows:

- Characterize and track FC bacteria concentrations from priority basins and outfalls in the City under both wet and dry weather conditions.
- Develop synoptic data for stormwater outfalls and freshwater tributaries in the City to compare to prior years sampling results, and TMDL load criteria.
- Identify relative contributions of FC loading to the bay so City sponsored corrective actions can be focused on the apparent most significant sources of contamination.

EMP objectives will be met through characterizing wet and dry weather FC bacteria loads in stream tributaries and significant storm outfalls to Liberty Bay that are located within the City. These outfalls include those sampled as part of the City's IDDE program, as well as several additional locations that warrant on going monitoring based on Watershed Assessment results.

FC concentrations will be monitored at locations once during the dry season (August - September) and twice during the wet season (January – April, October – December) periods of significant rainfall (storm event sampling). When possible, flow will be measured at stream sampling sites at the time of sampling.

Data from the monitoring will provide sub-basin/reach-specific and outfall-specific FC load and concentration comparisons to define areas of increased or decreased FC concentrations and loading.

4.1 RAIN EVENT SAMPLING

Storm sampling will occur between January and April, or between October and December. Two storm events will be sampled, with a preferred storm event defined as a minimum 0.3 inch of rainfall in a 24-hour period preceded by no more than trace rainfall in the previous 24 hours.

One "dry" sampling event would occur in August-September time period as part of the City's IDDE program. Each event will include a synoptic (performed in one day) survey of all monitoring sites. Flow measurements and FC samples will be collected from stream sites at this time.

Open channel flow will be measured using a Marsh McBirney flow meter (or similar), or estimated using stage and rating curves and tables, or relationships with other monitoring locations when grab samples are collected.

If flows cannot be measured directly, they will be estimated, qualified as "estimates" in Ecology's Environmental Information Management System (EIM), and used appropriately during data analysis. Daily rainfall data will be obtained from local sources.

Monitoring sites will be sampled a total of three times per year. Storm sampling will consist of two teams of one or two people sampling all sites one time over the duration of the event.

4.2 SAMPLING LOCATIONS

Sampling locations consist of a combination of stormwater outfalls and freshwater tributaries (Figure 4-1). Sites have been identified based on project objectives, as well as the information presented in the Watershed Assessment. Sites may be added or removed from the sampling plan depending on access and new information provided during the annual plan review, field observations and data analysis. The locations of the water quality stations are listed in Table 4-1.

Freshwater tributary sampling locations are designed to monitor FC loading by stream segment, provide context for interpreting results from freshwater stormwater outfalls, and help further focus corrective action measures. Freshwater sampling locations are generally upstream of those used by Ecology and the KPHD in prior studies.

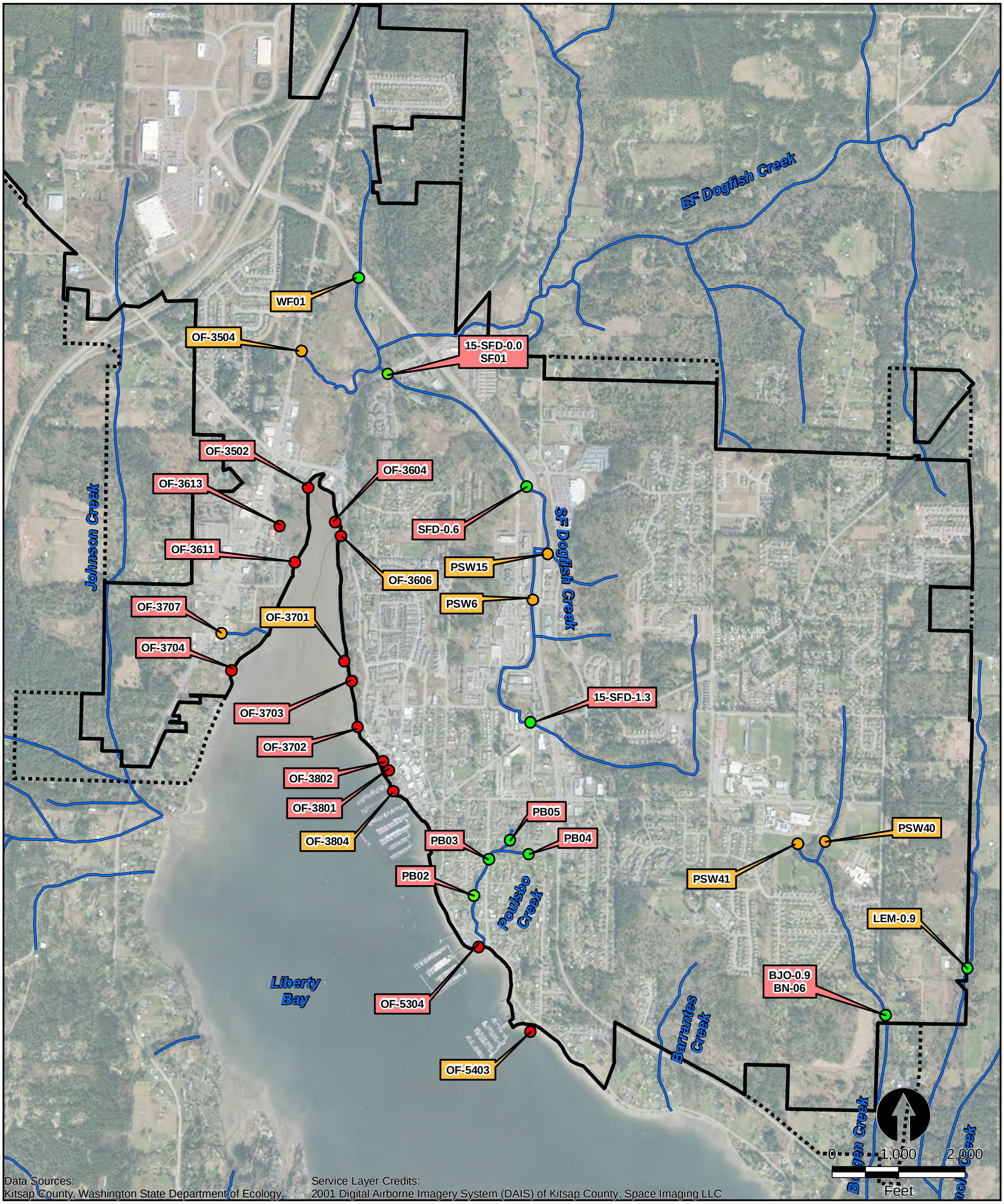
Table 4-1. Freshwater Stream Sampling Locations

Field ID w/ River Mile	Site Description
Dogfish Creek	
15-SFD-0.0	South fork at Bond Rd and 1st Avenue, 50 feet downstream of culvert.
15-SFD-0.6	South fork at Forest Rock Hills, upstream side of culvert.
15-SFD-1.3	South fork at 8th Avenue and Iverson, upstream side of culvert.
WF-01	West fork, upstream of confluence with main stem.
Poulsbo Creek	
OF5304	Outfall at mouth.
PB02	Culvert at Sommerseth Street
PB03	Ryen Street culvert, upstream end.
PB04	East branch tributary behind church.
PB05	Mainstem at Harrison Street.
Lemolo Creek	
LEM0.9	Lemolo Creek at city limits.
Bjorgen Creek	
BJO-0.9	Bjorgen Creek at Storhoff Road culvert.

4.2.1 Stormwater Outfall Monitoring

Outfall monitoring locations are shown in Table 4-2 and Figure 4-1. Marine outfall identification numbers match City of Poulsbo outfall inventory numbering system. Freshwater outfall numbers match prior numbering from the KPHD, and City outfall numbers where no KPHD identifier is available.

Prepared by Sealaska Environmental, E:\PMX-TMDL\Effectiveness Monitoring Plan\MXD\Fig_4-1_EMP_SamplingLoc.mxd, June 01, 2016.



Streams
City of Poulsbo
PUTA
Stream Station
Marine Outfall
Freshwater Outfall
PB04 Existing IDDE/EMP Monitoring Station
PB04 Additional New IDDE/EMP Monitoring Station

Figure 4-1
EMP Sampling Locations
Liberty Bay TMDL Implementation Plan
City of Poulsbo

Table 4-2. City of Poulsbo Stormwater Outfall Sampling Locations

Outfall ID	Name and Location	Land Use	Diameter (inch)
Marine Outfall Monitoring Locations			
OF-3502	Central Viking Avenue – Nelson Park bioswale outfall	Commercial and City Street	24
OF-3604	North Front Street – South end of parking lot Liberty Bay Auto	Residential, commercial and City Street	24
OF-3606	Front Street between Torval Canyon and Jensen	Residential	18
OF-3613	South central Viking Avenue outfall below Les Schwab	Commercial, parking lot and City street	24
OF-3701	24-inch corrugated pipe located at north end of American Legion park	Residential and City street	24
OF-3702	Cast iron outfall under the Gran Kirk Apartments	Commercial, residential and City Street	18
OF-3703	24-inch corrugated pipe located in center of American Legion park	Residential and City street	24
OF-3704	Creek next to Liberty Shores Retirement Center	Residential and commercial	NA
OF-3707	Viking Avenue south outfall located behind NW Kens Auto 650 Bovela	Commercial/parking lot/City Street	24
OF-3801	Anderson Parkway near the restrooms (taken from catch basins)	Commercial/parking lot/City Street	30
OF-3802	Anderson Parkway in front of Sons of Norway	Commercial/parking lot/City Street	30
OF-3804	Anderson Parkway at Port gangway	Commercial/parking lot/City Street	18
OF-3611	3rd Avenue Apartments at end of Edvard Street	Residential	18
OF-5304	Poulsbo Creek outfall, Fjord Drive, and 6th Avenue	Residential and Commercial	48

Table 4-2. City of Poulsbo Stormwater Outfall Sampling Locations (continued)

Outfall ID	Name and Location	Land Use	Diameter (inch)
FRESHWATER OUTFALL MONITORING LOCATIONS			
PSW6	Poulsbo Village outfall	State Highway, commercial, City Street	36
PSW15	Liberty Road and 10th Avenue outfall	Commercial/City Street	24
PSW17	Iverson and 7th Avenue basin	Commercial/parking lot/City Street	30
PSW40	Upper Bjorgen Creek and NKSD pond outfall to Bjorgen Creek	Residential, Institutional/parking lots	20 (2)
PSW41	Kevos/Ridgewood Neighborhood and NKSD storm system outfall	Residential/Institutional/ parking lots	24
OF-3504	North central Viking Avenue outfall to Fish Park	Commercial/parking lot/City Street	Ditch

Over time, adjustments to the storm monitoring locations will likely be necessary to reflect changes in land use, capital facility construction or other factor. Adjustments to monitoring locations will be documented in the annual report that is prepared as described in Chapter 8.

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5 SAMPLING AND MEASUREMENT PROCEDURES

Field sampling and measurement protocols will follow standard operating procedures (SOPs) developed as part of the 2015 Stormwater Quality Study (Parametrix 2015). Grab samples will be collected directly into pre-cleaned containers supplied by and Ecology accredited laboratory. Sample parameters, containers, volumes, preservation requirements, and holding times are listed in Table 5-1. FC samples will be tagged, stored on ice, delivered to the laboratory via courier, and analyzed within 24 hours of collection.

Table 5-1. Containers, Preservation Requirements, and Holding Times for Samples Collected

Parameter	Sample Matrix	Container	Preservative	Holding Time
Fecal coliform	Surface water, stormwater runoff	250 or 500 mL glass/poly autoclaved	Cool to 4°C	24 hours

Grab samples will be collected using the SOPs for FC grab sampling provided in Appendix A. Ten percent of FC samples will be replicated in the field in a side-by side manner to assess field and laboratory variability. Samples from streams will be collected in the thalweg and just under the water's surface. Samples from stormwater will be collected from the outfall prior to discharge to receiving water. No marine water samples will be collected. Field protocols are provided in Appendix A.

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6 DATA QUALITY OBJECTIVES

Measurement quality objectives (MQOs) state the level of acceptable error in the measurement process. This includes error inherently associated with field sampling and laboratory analysis. Field and laboratory errors are minimized by adhering to protocols for sampling and analysis. Precision for replicates will be expressed as percent relative standard deviation (%RSD) (Ecology 2009).

Analytical methods, precision targets, and method resolution or reporting limits are listed in Table 6-1. The reporting limits of the methods listed in the table meet the expected range of results and the required level of sensitivity to meet project objectives.

Table 6-1. Targets for Precision and Reporting Limits for the Measurement Systems

Analysis	Method/Equipment	Field Replicate MQO	Lab Duplicate MQO	Reporting Limits and Resolution
Field Measurements				
Discharge Volume, Streams	Marsh McBirney Flowmeter	10% RSD	n/a	0.01 ft/s
Laboratory Analyses				
Fecal Coliform – MF (membrane filtered)[1/]	SM 9222D	50% of replicate pairs < 20% RSD 90% of replicate pairs <50% RSD[2/]	40% RPD	1 cfu/100 mL

Notes:
[1/] As units of measurement, not percentages.
[2/] Replicate results with a mean of less than or equal to 20 cfu/100 mL will be evaluated separately.
SM – Standard Methods for the Examination of Water and Wastewater, 20th Edition (APHA et al., 1998).

The targets for analytical precision of laboratory analyses in Table 6-1 are based on the 2009 QAPP prepared by Ecology for the Liberty Bay TMDL Plan.

6.1 REPRESENTATIVE SAMPLING

The study is designed to have enough sampling sites and sufficient sampling frequency to meet study objectives. Fecal coliform values are known to be highly variable over time and space. Sampling variability can be somewhat controlled by strictly following standard procedures and collecting quality control samples, but natural spatial and temporal variability can contribute greatly to the overall variability in the parameter value. Resources limit the number of samples that can be taken at one site spatially or over various intervals of time. Laboratory and field errors are further expanded by estimate errors in seasonal loading calculations.

6.1.1 Comparability

The City will sample many of the same sites sampled as part of the 2015 Stormwater Study, as well as sites sampled by Ecology and the KPHD. Datasets from both agencies will be compared with sample results to evaluate both FC concentrations and trends.

6.1.2 Completeness

The goal for the sampling is to correctly collect and analyze 100% of the FC samples for each of the sampling sites. However, problems occasionally arise during sample collection that cannot be controlled which can interfere with this goal. Example problems are flooding, inadequate rain for storm sampling, site access problems, or sample container shortages.

A lower limit of five samples per site is typically required for comparison to Washington State criteria, which will not be met with the current sampling design. WAC 173-201A states:

"When averaging bacteria sample data for comparison to the geometric mean criteria, it is preferable to average by season and include five or more data collection events within each period….and [the period of averaging] should have sample collection dates well distributed throughout the reporting period."

Sampling does not meet the lower limit criteria of five samples per season (wet or dry) per site, but will still be useful for source location identification, adaptive management planning and other analyses.

7 QUALITY CONTROL

Total variation for field sampling and laboratory analysis will be assessed by collecting replicate samples. Bacteria samples tend to have a high relative standard deviation (RSD) between replicates compared to other water quality parameters. Bacteria sample precision will be assessed by collecting replicates for approximately 10% of samples in each survey.

All samples will be analyzed by a laboratory accredited by Ecology. Field sampling will follow quality control protocols described in the individual SOPs provided in Appendix A. If any of these quality control procedures are not met, the associated results may be qualified by the project manager and used with caution, or not used at all.

Standard Methods (APHA et al., 1998) recommends a maximum holding time of eight hours for microbiological samples (six hours transit and two hours laboratory processing) for non-potable water tested for compliance purposes. Standard Methods recommends a holding time of less than 30 hours for drinking water samples and less than 24 hours for other types of water tested when compliance is not an issue. Microbiological samples analyzed beyond the 24-hour holding time will be qualified with a “J” qualifier code, indicating the sample result is an estimate.

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8 DATA MANAGEMENT PROCEDURES

Laboratory-generated data reduction, review, and reporting will follow the procedures associated with the contract laboratory. Lab results will be checked for missing and/or improbable data and variability in lab duplicates. Any estimated results will be qualified and their use restricted as appropriate. A standard case narrative of laboratory QA/QC results will be provided by the laboratory to the project manager for each set of samples.

Field notebooks will be checked for missing or improbable measurements before leaving each site. Field-generated data will be entered into EXCEL® spreadsheets as soon as practical after returning from the field. The EXCEL® Workbook file will be labeled “DRAFT” until data verification and validation are completed. Data entry will be checked by the project manager against the field notebook data for errors and omissions. Valid data will be moved to a separate file labeled “FINAL.”

Field replicate sample results will be compared to quality objectives. Data requiring additional qualifiers will be reviewed by the project manager. After data verification and data entry tasks are completed, all field and laboratory data will be copied into a file labeled “FINAL,” and then submitted to Ecology for entry into the EIM system. At the end of the field collection phase of the study, the data will be compiled in a data summary.

8.1 ANNUAL REPORTING

The City’s project manager will be responsible for submitting the annual report. Tabular data summaries will be prepared after each sampling event.

Pursuant to condition S8. Monitoring and Assessment of the NPDES Permit, the City will provide in each stormwater annual report a description of the stormwater monitoring or stormwater-related studies conducted during the reporting period. The report will include the following information:

- Summary of sampling results,
- Description of corrective action measures that were implemented during the prior reporting period,
- Discussion of corrective actions that will be implemented in the following year, and
- Any proposed modifications to the EMP.

8.2 DATA VERIFICATION

Data verification requires adequate documentation of the process. Data verification involves examining the data for errors, omissions, and compliance with quality control (QC) acceptance criteria. Laboratory staff is responsible for performing laboratory data verification. Field measurements will be verified by field staff before leaving the site.

A detailed examination of the data package using professional judgment to determine whether the MQOs have been met will follow data verification. The project manager examines the complete data package to determine compliance with procedures outlined in the QAPP. The project manager will also ensure that the MQOs for precision, bias, and sensitivity are met.

8.3 DATA USABILITY ASSESSMENT

The field lead or project manager will verify that all measurement and data quality objectives have been met for each monitoring station. The field lead or project manager will make this determination by examining the data and all of the associated QC information. If the objectives have not been met, the field lead and project manager will decide how to qualify the data and whether or not it can be used in the technical analysis.

8.4 DATA ANALYSIS

Data analysis will consist of comparison to water quality standards where applicable, and calculation of load. Results will be compared to TMDL targets.

Due to the relatively small data set from each station (three samples), statistical analysis will not be conducted. Ideally, at least 20 data points are needed from a broad range of hydrologic conditions to determine an annual FC distribution (Ecology 2013). While fewer data will provide less confidence in FC reduction targets, the data is expected to be sufficient to support on-going planning and evaluation of implementation measures.

9 PROJECT TEAM AND SCHEDULE

Table 9-1 outlines staff involved in this monitoring project.

Table 9-1. Organization of Project Staff and Responsibilities

Staff	Title	Responsibilities
Diane Lenius, City of Poulsbo 360-394-9750	Asst. City Engineer, City Project Lead	Acts as point of contact between City, consultant and stakeholders. Coordinates information exchange. Reviews and approves the QAPP and annual technical reports.
Anja Hart, City of Poulsbo 360-394-9753	Stormwater Program Manager	Reviews and approves the QAPP. Coordinates sampling with field staff, and oversees field sampling and transportation of samples to the laboratory. Conducts QA review of data, analyzes and interprets data, and enters data into EIM. Writes the annual report.
Phil Struck Sealaska Environmental 360-850-5340	Project Manager	Writes the QAPP.

9.1 PROJECT SCHEDULE

Table 9-2 shows the proposed project schedule.

Table 9-2. Proposed Schedule for Completing Field and Laboratory Work, Data Entry into EIM, and Reports

Field and Laboratory Work	
Field Work Completed	December annually
Laboratory Analyses Completed	December annually
Environmental Information System (EIM) System	March annually
EIM User Study ID	TBD
EIM Study Name	Liberty Bay Fecal Coliform PTIP
Data Due in EIM	December 2015
Annual Report	
Author Lead	Anya Hart
Internal Draft	February annually
Final Report Due to Ecology	March annually

Notes:
EIM – Environmental Information Management System

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10 REFERENCES

APHA, AWWA, and WEF. 1998. Standard Methods for the Examination of Water and Wastewater 20th Edition. American Public Health Association, Washington, D.C.

DOH, 2008. Washington State Department of Health, Office of Shellfish and Water Protection: Annual Growing Area Review. www.doh.wa.gov/ehp/sf/Pubs/gareports/lemolo.pdf.

Ecology. 2009. Liberty Bay Tributaries Fecal Coliform Bacteria Total Maximum Daily Load Water Quality Study Design (Quality Assurance Project Plan). Washington State Department of Ecology, Olympia, WA. Publication No. 09-03-102. January 2009.

Ecology. 2013. Liberty Bay Tributaries Fecal Coliform Bacteria Total Maximum Daily Load TMDL and Water Quality Implementation Plan. Washington State Department of Ecology, Olympia, WA. Publication No. 13-10-014. May 2013.

Ecology. 2015. Total Maximum Daily Load (TMDL) Requirements Western Washington Phase II Municipal Stormwater Permit – August 1, 2013, Modified January 16, 2015. APPENDIX 2 – Total Maximum Daily Load (TMDL) Requirements.

EPA. 2010. Recommendations for Developing TMDL Effectiveness Monitoring Plans. Prepared by The Cadmus Group, Inc. for U.S. EPA Region 10 (Contract EP-C-08-002) 1.

Parametrix. 2015. Final Quality Assurance Project Plan, Stormwater Quality Study - Liberty Bay TMDL Implementation Plan. Prepared by Parametrix, Bremerton, Washington. September 2015.

KPHD 2013. Silverdale Low Impact Development Retrofit Plan. Prepared for Kitsap County Public Works Department by Herrera Environmental Consultants, Inc. January 2013.

KPHD, 2014. Water Pollution Identification & Correction Program 2013 Annual Water Quality Monitoring Report. Kitsap Public Health District.

SES (Sealaska Environmental Services, LLC). 2016a. Poulsbo TMDL Implementation Plan. Prepared for City of Poulsbo. 2016.

SES. 2016b. Watershed Assessment for the Poulsbo TMDL Implementation Plan. Prepared for City of Poulsbo. February 2016.

SES. 2016c. Needs and Opportunities Assessment. Prepared for City of Poulsbo. 2016.

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APPENDIX A
Field SOPs

Washington State Department of Ecology

Environmental Assessment Program

Standard Operating Procedures for the Collection of Fecal Coliform Bacteria Samples in Surface water

Version 2.1

Author - William J. Ward and Nuri Mathieu
Date -

Reviewer - Mike Anderson and Trevor Swanson
Date -

QA Approval - William R. Kammin, Ecology Quality Assurance Officer
Date - February 9, 2011

EAP030

V1.3 Recertified 10/15/10.
V2.1 Recertified 5/1/14.

APPROVED: 02/09/2011

Signatures on File.

This is a harmonized version combining SOP EAP030 and EAP012, which were both sample collection SOPs for fecal coliform bacteria.

Please note that the Washington State Department of Ecology's Standard Operating Procedures (SOPs) are adapted from published methods, or developed by in-house technical and administrative experts. Their primary purpose is for internal Ecology use, although sampling and administrative SOPs may have a wider utility. Our SOPs do not supplant official published methods. Distribution of these SOPs does not constitute an endorsement of a particular procedure or method.

Any reference to specific equipment, manufacturer, or supplies is for descriptive purposes only and does not constitute an endorsement of a particular product or service by the author or by the Department of Ecology.

Although Ecology follows the SOP in most instances, there may be instances in which Ecology uses an alternative methodology, procedure, or process.

SOP Revision History

Revision Date	Rev	Summary of changes	Sections	Reviser(s)
2/2/2007	1.0	Editorial; formatting	all	Bill Ward
2/9/2007		Internal Review	all	Dave Hallock
3/21/2007	1.1	Incorporate Comments, More Edits	all	Bill Ward
4/2/2007		QAO Review	all	Bill Kammin
4/5/2007	1.2	Incorporate Comments, More Edits	all	Bill Ward
4/18/2007		Final Review	all	Maggie Bell-McKinnon
4/22/2007	1.3	Minor Edits	all	Bill Ward
10/15/10	1.3	Recertified	All	Kammin
11/10/10	2.0	Harmonized with EAP SOP#012	all	Bill Ward; Nuri Mathieu
2/2/11	2.1	Incorporated comments from technical reviewers	all	Bill Ward; Nuri Mathieu
5/1/14		Recertified	all	Bill Kammin

1.0 Purpose and Scope

1.1 This document is the Environmental Assessment Program (EAP) Standard Operating Procedure (SOP) for the collection of freshwater samples for laboratory analysis of fecal coliform bacteria. The typical methods for fecal coliform analysis are: Standard Methods (SM) 9222D – a membrane filtration method and SM9221E 1 a most-probable number method using an EC medium. The procedures in this SOP may also be used to collect other bacteria samples such as E. coli, Enterococci, etc. Standard Methods contains alternative analytical procedures for these bacteria parameters.

1.2 This SOP includes the procedures for sample collection by hand, using a bacteria sampler, or with an extension pole. The SOP also covers sample collection from waters with high residual chlorine (treated effluent or receiving waters) or metals contamination.

1.3 Surface water can contain pathogenic (disease-causing) microorganisms. Testing water samples for the presence of all pathogenic microorganisms is expensive. Due to this high cost, Ecology tests water samples for fecal coliform bacteria, an organism used as an indicator of the potential presence of other pathogenic microorganisms.

2.0 Applicability

2.1 This SOP applies to the collection of bacteria samples in surface water.

3.0 Definitions

3.1 Ecology – Washington State Department of Ecology.

3.2 EAP – Environmental Assessment Program.

3.3 EIM – Environmental Information Management System. A searchable database developed and maintained by the Washington State Department of Ecology

3.4 Fecal coliform – A group of bacteria that inhabit the intestinal tract of warm-blooded animals and remain viable (alive and capable of infecting another organism) in freshwater for a variable period of time. The presence of fecal coliform bacteria in water indicates fecal contamination of the water by a warm-blooded animal; harmful bacteria and viruses associated with fecal contamination may also be present.

3.5 Field Logbook – A weather resistant logbook containing "Rite in the Rain" ® writing paper used to document any and all field activities, sample data, methods and observations for each and all collection sites.

3.6 MEL- Manchester Environmental Laboratory.

3.7 QA – Quality Assurance

4.0 Personnel Qualifications/Responsibilities

4.1 Field operations require training specified in EAP's Field Safety Manual (Ecology, 2006) such as First Aid, CPR, and Defensive Driving.

4.2 Boat operations require that staff meet specific training requirements as described in EAP's Field Safety Manual, such as an EAP Boating Course and an approved Boating Safety Course.

5.0 Equipment, Reagents, and Supplies

5.1 Supplies

5.1.1 Bacteria bridge sampler (Figure 1 – left)
5.1.2 Sampling ropes 1 @ 10 ft., 1 @ 35 ft. and 2 @ 55 ft.
5.1.3 Extension pole with bottle clamp (Figure 1 – right)
5.1.4 Cooler containing ice
5.1.5 250 or 500 mL autoclaved bacteria sample bottles[1] (Figure 1 – center)
5.1.6 Field Logbook or Field Data Report Form (see Attachment A for form)
5.1.7 Gloves (for sites where bacteria levels are known or are suspected to be high)
5.1.8 Antibacterial hand sanitizer
5.1.9 Pre-Sampling Notification (PSN) form
5.1.10 Lab Analysis Request (LAR) forms
5.1.11 Sample tags with pre-assigned sample numbers from the lab

[1] 500 ml sample bottles may be necessary if both fecal coliform and other bacteria tests are conducted.

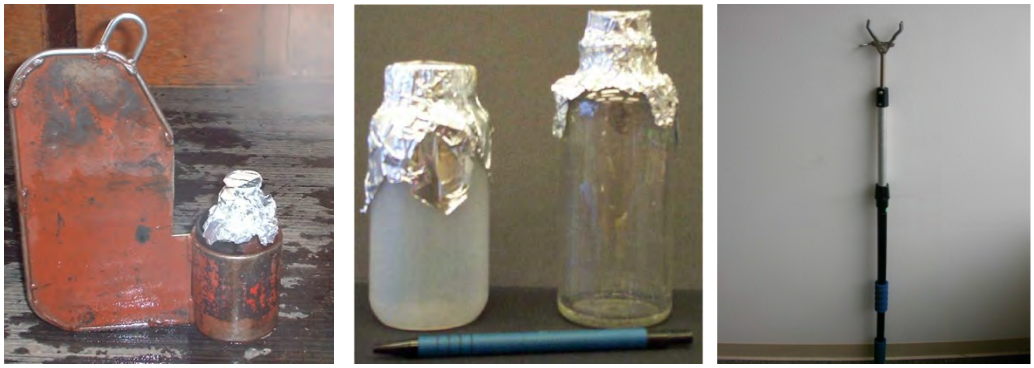

Figure 1. Left: Bacteria bridge sampler with bottle. Center: 250 mL polypropylene and glass bottles. Right: Sampling extension pole.

5.2 <u>Sample Containers</u>

5.2.1 The typical bacteria sample containers are 250-mL or 500mL pre-autoclaved polypropylene bottles with aluminum foil wrapped caps used to preserve sterility near the bottle opening (Figure 1-center). *Note: Masking tape with black lines on the foil mean the bottle was autoclaved. These bottles should not be used after 6 months.*

5.2.2 When chlorine is suspected to be present in the sample water, bottles with sodium thiosulfate (thiosulfate) added should be requested from the laboratory. The bottles will be marked with yellow stickers on top to indicate the thiosulfate addition. Thiosulfate will not affect samples if chlorine is not present.

5.2.3 If heavy metal contamination (>1.0 mg/L of Copper or Zinc) is suspected, bottles must have EDTA added. This is a special request and must be set up through the laboratory.

6.0 Summary of Procedure

6.1 <u>Field Preparation</u>

6.1.1 Before the start of a new project, the lab must review and approve the project specific Quality Assurance Project Plan (QAPP). Before each sampling run, a Pre-Sampling Notification form must be submitted to the lab at least two weeks prior to any sampling. This ensures the lab has adequate time to prepare the medium for bacterial analysis. *Note: Avoid bacteria sample collection between Thursday and Sunday. Sample collection on these days must be pre-approved with the lab, but is possible under some special circumstances.*

6.1.2 If the range of bacteria concentrations can be estimated before sampling, let the lab microbiologist know so that a set of dilutions that bracket the expected concentration range can be prepared.

6.1.3 Under certain conditions the most probable number (MPN) method is recommended: 1) if the sample is collected from extremely turbid water (<25 mL can be filtered); or 2) if the sample is collected in or near a WA Department of Health (DOH) shellfish growing area. The lab needs additional time to prepare for the MPN method, so sample notification should be provided at least one month in advance.

6.1.4 Prior to collecting samples prepare sample tags prepared containing the project name, sample number, site, date, and space for time.

6.2 General Sampling Techniques

6.2.1 Care should be used at all times to avoid contamination of the inside of the sample bottle, or the foil-covered silicon stopper or bottle cap. Also, the sample needs to be placed in ice in a cooler as soon as possible after collection. *Note: Non-drinking water bacteria samples have a maximum holding time of 24 hours (APHA, 2000).*

6.2.2 Do not rinse the bottle and do not pour water into a bacteria bottle from another non-sterilized container.

6.2.3 Be careful not to disturb sediment from the stream bed, particularly in slower moving waters. For slow moving streams with easily disturbed sediment, collect the sample from the stream bank using a sampling extension pole (Figure 1) or from a bridge with a bacteria bridge sampler

6.2.4 Always: 1) Collect samples from the active part of the stream (thalweg) to ensure the sample is representative of the waterbody; and 2) Face the opening of the bottle upstream (or into the tidal flow in marine water).

6.2.5 Avoid sample collection: 1) from the surface layer (top inch of water); 2) near the streambed; and 3) from back eddies and side channels. *Note: In extremely shallow depths, collect the sample from the surface if unavoidable and record in field notes.*

6.2.6 When filling the sample bottle, be careful to pull the bottle out of the water as it reaches the point where it is filled to at or near the shoulder of the bottle. If the bottle becomes filled above this level, then immediately pour out excess sample downstream of sampler. *Note: This step allows air space for proper mixing at the lab.*

6.2.7 If on a boat, then collect samples upstream of the engine cooling system to avoid any potential gas and oil contamination.

6.2.8 If the samples need to be collected in slow moving waters with stratified velocity, then collect a depth-integrated bacteria sample. To collect a depth-integrated sample, first submerge the bottle (mouth facing down) to roughly 25 percent of the water's depth. Next, invert the bottle slightly until it begins to fill and then slowly move the bottle up through the water column as it fills. Quickly remove the bottle from beneath the water when the bottle reaches roughly 75 percent of the water's depth and the water level inside the bottle is at or near the shoulder. *Note: Depth integrated bacteria sampling is performed in TMDL or other special studies.*

6.2.9 Avoid sample collection in stagnant waters. If unsure whether or not water is stagnant (generally less than 0.1 ft/s), then use a flow meter to measure velocity. *Note: TMDL or other special studies may require sample collection in stagnant water under certain conditions (e.g. sampling behind a pump station or tide gate).*

6.2.10 If sample bottles contain an additive (thiosulfate or EDTA), then either: 1) collect sample with a sterile bottle without additive and pour mixed sample into bottle with additive; or 2) follow instructions for Hand Dip Method for Waters with High Chlorine Content or Metals Contamination (6.3.3).

6.2.11 If sample bottles with additive are accidentally overfilled pour the excess out. Manchester Environmental Laboratory (MEL) adds the additive to the bottles in excess. MEL qualifies the sample results for overfilled bottles as "bottle overfill."

6.2.12 If sampling wastewater or industrial effluent, then locate an appropriate sampling location representative of water being discharged to the receiving water body. In particular, the location should be below any chlorination or ultra-violet (UV) application and as close to the discharge outfall as possible. Wear gloves and use a sampling extension pole to collect samples without contacting the effluent with your hands

6.3 Sample Collection

6.3.1 Bridge Sampler Method. This method is typically used to collect samples when standing on a bridge or boat.

6.3.1.1 Secure the bacteria sample bottle into the bacteria sampler and attach the sampling rope.

6.3.1.2 Move to a well mixed, representative location such as the deepest part of the active channel.

6.3.1.3 Remove the aluminum foil covered stopper or lid, taking care not to touch the inside or bottom of the lid, and either 1) hold onto it with a freehand or 2) set it upside down where contamination to the inside of the lid can be avoided (such as on the road surface or on top of other field equipment). *Note: In windy conditions, set the lid down somewhere shielded from the wind so that it doesn't blow over (such as on the leeward side of sampling equipment.)*

6.3.1.4 Carefully lower the sampler to the water surface, taking care to not dislodge bridge debris onto it. Allow the bottom of the sampler to touch the water surface, then raise the sampler off the water for a few moments to allow any debris from the bottom of the sampler to drop off and float away. *Note: This step is intended to prevent sample contamination from anything attached to bottom of the sampler.*

6.3.1.5 Without submerging the bottle mouth, lower the sampler about 15 cm (6 inches) into the water. Allow the current to re-orient the sampler so the sample bottle is on the upstream side of the sampler. Then rapidly lower the sampler about 0.5 meters to completely submerge it. *Note: This minimizes the sampling of surface film.*

6.3.1.6 Retrieve the filled bottle taking care to not dislodge bridge debris onto it or the sampler.

6.3.1.7 If the bottle is filled above the shoulder, then immediately pour out enough excess sample to ensure that the sample volume is at or near the shoulder.

6.3.1.8 Carefully replace the aluminum foil covered stopper or lid. Make sure the foil is open wide enough to avoid touching it to the top or inside of the bottle. Also, do not touch the lower part of the stopper or inside of the cap with your hand.

6.3.2 Hand Dip Method. This method is typically used to collect samples within reach of the water surface (when standing in or near the waterbody or from small boat).

6.3.2.1 Move to a well mixed location such as the deepest part of the active channel or another location where a representative sample may be collected. Do not contaminate the sample location by wading upstream. If collecting from an eddy, then do not wade anywhere in the eddy prior to sample collection. *Note: The Extension Pole Method (see 6.3.4 below) should always be used to collect lake samples.*

6.3.2.2 Remove the lid and set it upside down following section 6.3.1.3.

6.3.2.3 Grab the base of the sample bottle with one hand and remove the bottle cap. Then invert the bottle, reach upstream, and plunge the bottle into the water about 15 cm (6 inches), and then tip the bottle mouth up toward the water surface. Allow the bottle to fill and then take it out of the water. *Note: If sampling from a boat, then plunge the bottle into the water upstream of the engine, and move it away from the boat while and tipping the bottle mouth up toward the water surface.*

6.3.2.4 If the bottle is filled above the shoulder, then immediately pour out enough excess sample to ensure that the sample volume is at or near the shoulder.

6.3.2.5 Replace the lid as described in section 6.3.1.8.

6.3.3 Hand Dip Method for Waters with High Chlorine Content or Metals Contamination. This method is used when the sample container contains thiosulfate (for chlorine) or EDTA (for metals) preservative. In lieu of this method, the sample may be collected in a sterile container without preservative, using any other method described in this SOP, and then immediately transferred to the container with preservative.

6.3.3.1 Remove the stopper/lid from the bottle just before sampling and set the aluminum foil down following section 6.3.1.3

6.3.3.2 Place the lid over the mouth leaving a small opening on one side.

6.3.3.3 Place one hand around the bottle with a finger holding the lid in place.

6.3.3.4 Quickly plunge bottle (mouth facing up) through the surface layer with the top of the bottle tilted forward and the opening facing upstream.

6.3.3.5 Keep the bottle submerged long enough for the bottle to fill to at or near the shoulder of the bottle. Try to avoid overfilling the bottle.

6.3.3.6 Quickly remove bottle from water to avoid the surface layer

6.3.3.7 If the bottle is filled above the shoulder, then immediately pour out enough excess sample to ensure that the sample volume is at or near the shoulder.

6.3.2.6 Replace the lid as described in section 6.3.1.8.

6.3.4 **Extension Pole Method.** This method is typically used to reach a more representative or undisturbed sample location from the stream bank, or when sampling a lake or slow moving stream.

6.3.4.1 Secure the bacteria sample bottle in the extension pole clamp.

6.3.4.2 Move to a location where a representative sample may be reached with the pole.

6.3.4.3 Remove the lid and set it upside down following section 6.3.1.3

6.3.4.4 Position the bottle over the desired sample location.

6.3.4.5 Invert the bottle and in one quick motion plunge the mouth of the bottle into the water about 15 cm (6 inches). Then slowly move the bottle upstream with the bottle mouth tipped toward the water surface until the bottle fills. If sampling a lake, then slowly move the tipped bottle away from the bottle entry point until it completely fills.

6.3.4.6 Take the bottle out of the water. If the bottle is filled above the shoulder, then immediately pour out enough excess sample to ensure that the sample volume is at or near the shoulder.

6.3.2.7 Replace the lid as described in section 6.3.1.8.

6.3.5 **Bathing Beach Method.** This method is used when collecting samples from bathing beaches. Section 6.3.5 was taken from the Beach Environmental Assessment, Communication and Health (BEACH) program guidance. More beach sampling information is available from the: Quality Assurance Project Plan: BEACH Program (Schneider, 2004).

6.3.5.1 Wade into roughly 2.5 feet of water.

6.3.5.2 Fill a bottle at each of the three sampling sites by wading into knee deep water, unscrewing the cap and inserting the bottle and cap into the water at a 45 degree angle (with the bottle opening facing down). Turn the bottle upright a few inches below the surface and allow it to fill. Remove the cap and bottle from the water and pour off enough water to leave an air space. Cap the bottle. Use a sampling extension pole to avoid collecting disturbed sediment.

6.3.5.3 Deliver to laboratory within six hours of sample collection.

6.4 <u>Field Processing</u>

6.4.1 Label the collected sample bottle with the appropriate tag and place it in ice in a cooler to preserve the sample during shipment to the laboratory.

6.4.2 Record the date, time, and sampling location on a Field Logbook or Field Data Report Form.

7.0 Records Management

7.1 All hardcopy documentation of the data, such as completed Field Logbook and Field Data Report Forms are kept and maintained by the project lead. These documents are organized in binders or in expanding files. After about six years, hardcopies are boxed and moved to EAP archives.

7.2 Data collected for Ecology's Ambient River and Stream Monitoring Program will be entered into an Access-based database, reviewed and verified following the Quality Control and Quality Assurance procedures (see 8.1 below), uploaded into EIM, and posted on this web page http://www.ecy.wa.gov/programs/eap/fw_riv/rv_main.html.

7.3 Data collected for special project or Total Maximum Daily Load (TMDL) studies will be reviewed, verified, and stored based on the QAPP for the project.

8.0 Quality Control and Quality Assurance

8.1 Freshwater Ambient Monitoring Program

8.1.1 The data QA program for field sampling consists of two parts: (1) adherence to the SOP procedures for sample/data collection and periodic evaluation of sampling personnel and (2) the collection of a field quality control (QC) sample during each sampling run. The Freshwater Ambient Monitoring QA program is described in detail in www.ecy.wa.gov/biblio/0303200.html (Hallock and Ehinger 2003).

8.1.2 Each run one field QC sample is collected as a duplicate sequential field sample and one 500mL sample is collected for a laboratory split sample. The duplicate sample consists of the collection of an additional sample approximately 15-20 minutes after the initial collection at a station. This sample represents the total variability due to short-term, in-stream dynamics, sample collection and processing, and laboratory analysis.

8.1.3 A two-tiered system will be used to evaluate data quality of individual results based on field QC. The first tier consists of an evaluation of the variability in field duplicates and the reasonableness of the result. Results exceeding pre-set limits are flagged. The second tier QC evaluation is a manual review of the data flagged in the first tier. Data are then coded from 1 through 9 (1 = data meets all QA requirements, 9 = data are unusable). Criteria for assigning codes are discussed in more detail in Hallock and Ehinger (2003). Do not routinely use or distribute data with quality codes greater than 4. *Note: results from highly turbid samples are estimated.*

8.2 Total Maximum Daily Load (TMDL) Studies

8.2.1 The QA process for TMDL field samples consists of two parts: (1) adherence to the SOP procedures for sample/data collection and periodic evaluation of sampling personnel and (2) the collection of a field QC sample for twenty percent of the samples collected for a given study. The TMDL QA process is described in greater detail in Lombard and Kirchimer (2004).

8.2.2 The field QC sample is collected as a duplicate sample in either a side by side manner or immediately following the initial sample. This sample represents the total variability due to sample collection and laboratory analysis.

8.2.3 Recommendations for evaluating precision from bacteria duplicate results can be found in Mathieu (2006).

8.2.4 QA/QC procedures are addressed on a project-by-project basis in the QAPP for the project.

9.0 Safety

9.1 Safety is the primary concern when collecting samples. Since many sample sites are located near roads and bridges, road and pass conditions should always be checked before departure (especially in winter). If roadside hazards, weather, accidents, construction, etc. make sample collection dangerous, then skip that station or sampling run if necessary. Note the reason on the Field Data Report Form and notify your supervisor of the hazard when you return to the office. If the hazard is a permanent condition, relocation of the station may be necessary. Review Ecology's Safety Program Manual periodically to assist with these safety determinations (Ecology, 2010).

9.2 Gloves should be worn to avoid exposure. If gloves are not worn, hands should be cleaned using anti-bacterial soap or hand sanitizer after completing work at each sampling station or, at a minimum, after completing work at sampling stations with known high bacteria counts and before ingesting food or drink.

9.3 After sampling assume your hands and anything they touch are contaminated with bacteria and use care accordingly.

10.0 References

10.1 APHA (American Public Health Association), 2005. Standard Methods for the Examination of Water and Wastewater-. No: 4500-O C. Winkler Method, Azide Modification, American Public Health Association, 21st Edition. Washington D.C.

10.2 Ecology, 2006. Chemical hygiene plan and hazardous materials management plan. Washington State Department of Ecology. Olympia, WA. http://aww.ecology/services/es/Safety/ChemicalHygiene.pdf

10.3 Ecology, 2010. Environmental Assessment Program Safety Manual. Washington State Department of Ecology. Olympia, WA. http://aww.ecology/programs/eap/Safety/Safety1.html

10.4 Hallock, D. and W. Ehinger, 2003. Quality Assurance Monitoring Plan: Stream Ambient Water Quality Monitoring. Washington State Department of Ecology, Olympia, WA. 27pp. Publication No. 03-03-200. www.ecy.wa.gov/biblio/0303200.html

10.5 Lombard, S. and C. Kirchimer, 2004. Guidelines for preparing Quality Assurance Project Plans for Environmental Studies. Washington State Department of Ecology, Olympia, WA. 48pp.+ app.(100 total). Publication No. 04-03-030. http://www.ecy.wa.gov/biblio/0403030.html

10.6 Mathieu, N., 2006. Replicate Precision for 12 TMDL Studies and Recommendations for Precision Measurement Quality Objectives for Water Quality Parameters. Washington State Department of Ecology, Olympia, WA. 15pp. Publication No. 06-03-044. http://www.ecy.wa.gov/biblio/0603044.html

10.7 Schneider, L., 2004. Quality Assurance Project Plan: BEACH Program. Washington State Department of Ecology, Olympia, WA. 21pp. Publication No. 04-03-205. http://www.ecy.wa.gov/biblio/0403205.html

ATTACHMENT A

FIELD DATA REPORT FORM

WASHINGTON STATE DEPARTMENT OF ECOLOGY

FIELD DATA REPORT FORM

Y	M	M	D	D
0				

SURVEY .... SAMPLER .... PAGE ....OF..................

STATION NO.	STATION NAME	TIME	TEMP °C	DO mg/L	DO #	TEMP pH	TRUE pH METER	COND µMHOS/CM	BARO. PRESS. in. Hg	*	STAGE HEIGHT	CHK BAR/ WT LNGTH ADDTN	COMMENTS

WEATHER, etc.:

Relinquished By:	Received By:	Da	Hr	Mn	Comments

ECY 040-2-41 (Rev. 8/04)

* 1 = WWG 2 = Staff 3 = GH 4= Tape Down 5 = Other (Specify above

Washington State Department of Ecology

Environmental Assessment Program

Standard Operating Procedure for Manually Obtaining Surface Water Samples

Version 1.2

Author – Joe Joy (retired)
Date - 10/24/2006

Reviewer – Trevor Swanson
Date - 6/26/2013

QA Approval – Bill Kammin, Ecology QA Officer
Date - 6/26/2013

EAP015

APPROVED: October 24, 2006

Three-Year Review: July 1, 2010
Three-Year Review: June 26, 2013

Signatures on File

Please note that the Washington State Department of Ecology's Standard Operating Procedures (SOPs) are adapted from published methods, or developed by in-house technical and administrative experts. Their primary purpose is for internal Ecology use, although sampling and administrative SOPs may have a wider utility. Our SOPs do not supplant official published methods. Distribution of these SOPs does not constitute an endorsement of a particular procedure or method.

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SOP Revision History

Revision Date	Rev number	Summary of changes	Sections	Reviser(s)
10/10/2006	1.0	Formatting; signatories	all	Bill Kammin
7/1/2010	1.1	Three year review	All	Kammin
6/26/2013	1.2	Three year review	All	Trevor Swanson

1.0 Purpose and Scope

1.1 This document is the Environmental Assessment Program (EAP) Standard Operating Procedure (SOP) for manually obtaining surface water samples. It includes procedures for collecting samples from lotic and lentic waterbodies, wastewater treatment plant access points, and outfalls, pipes, and drains. It also describes procedures for sampling while wading on beaches and from boats and bridges. This SOP does not describe the operation of unattended automated sampling devices, nor does it cover pelagic marine or groundwater sampling.

2.0 Applicability

2.1 This SOP should be followed when manually collecting samples from surface waters as described in section 1.1.

3.0 Definitions

3.1 Composite sample: A sample in one container comprised of discrete sub-samples collected spatially or temporally or both.

3.2 EDTA: An acronym for the chemical compound ethylene diamine tetraacetic acid. EDTA is a chelating agent Manchester Environmental Laboratory (MEL) adds to microbiological sample bottles to remove any metals that may be present in the sample.

3.3 Grab sample: A sample collected during a very short time period at a single location.

3.4 Halocline: The depth where salinity increases rapidly over a relatively short depth interval in a manner similar to temperature in a thermocline.

3.5 Integrated sample: A sample comprised of continuously collected sub-samples from a water column or across a cross section of a waterbody - differentiated from a composite sample by the term ‘continuously collected.’

3.6 Intermediate sampling container: A temporary sampling container used to directly sample water and transfer it to the primary container. Often, 500 or 1000 mL polypropylene containers are used as intermediate containers to collect samples for transfer to smaller bottles, which often contain acids or other preservatives.

3.7 LAR: Laboratory Analysis Request form.

3.8 Lotic: Flowing water systems such as rivers and streams.

3.9 Lentic: Still water systems such as lakes and ponds.

3.10 MEL: Manchester Environmental Laboratory

3.11 Pelagic: Waters of open seas, oceans, or lakes that are not near the shore.

3.12 Thalweg**:** The line defining the points along the length of a river bed with the greatest volume of moving water.

3.13 Thermocline: A distinct layer in a waterbody in which temperature changes more rapidly with depth than it does in the layers above or below, usually at a rate of 1º C or more for each 1 meter of depth.

3.14 Thiosulfate: A chemical MEL puts into sampling containers to rapidly dechlorinate water samples, especially those taken at wastewater treatment facilities.

4.0 Personnel Qualifications/Responsibilities

4.1 This SOP pertains to all Natural Resource Scientists, Environmental Engineers, Environmental Specialists, Hydrogeologists, and Interns and Technicians in Ecology's EA Program.

4.2 All field staff must comply with the requirements of the EA Safety Manual (Ecology, 2012). A full working knowledge of the procedures in Chapter 1 'General Field Work,' especially the sections 'Working in Rivers and Streams,' 'Working near Traffic and from Bridges,' and 'Fall Protection,' is expected. Sampling from a boat requires one person onboard to be a qualified boat operator and all persons onboard must be familiar with Chapter 3 of the EA Safety Manual, 'Boating.'

4.2 All field staff must be familiar with other standard procedures for sampling water quality parameters described in this SOP. Several water quality parameters have special sample pre-treatment, filtering, post-treatment, and collection procedures applicable to this SOP. If a vertically integrated sampler is to be used, field staff should read Isokinetic Depth-Integrated Sampling Methods, Chapter A4, section 4.1.3 (USGS, 2006).

4.3 The field lead directing sample collection must be knowledgeable of all aspects of the project's Quality Assurance Project Plan (QAPP) to ensure that credible and useable data are collected. All field staff should be briefed by the field lead or project manager on the sampling goals and objectives prior to arriving to the site.

4.4 All field staff must comply with EAP Policy 1-15 'Minimizing the Spread of Invasive Species' to the level described in the QAPP.

5.0 Equipment, Reagents, and Supplies

5.1 <u>General Equipment and Supplies</u>

5.1.1 Intermediate sampling containers and devices (e.g., 500 or 1000 mL bottles, syringe for field filtering, stainless or Teflon dipper, DH-76 integrated sampler, Van Dorn or Kemmerer sampler, appropriate ropes/cables/rods, mobile bridge crane or davit) (Figure 1).

5.1.2 Sampling extension pole.

5.1.3 Glass or polypropylene bottle supplied by the laboratory with appropriate preservatives and filtering devices (Figure 2).

5.1.4 Safety equipment appropriate for the sampling sites: safety vests and lines, bridge traffic control signs and cones, or boating safety equipment.

5.1.5 Latex gloves for hygienic protection; leather gloves for handling ropes and cables.

5.1.6 Anti-bacterial hand sanitizer or soap.

5.1.7 Coolers.

5.1.8 Ice (Regular, blue, or dry –depending on shipping method).

5.1.9 Tap water.

5.1.10 Sample tags with sample numbers assigned by MEL.

5.1.11 LAR forms.

5.1.12 Field notebook and pens.

5.1.13 Disinfection solutions, brushes, or other equipment necessary to minimize the spread of invasive species from site to site. See EAP Policy 1-15 for more information.

Figure 1. Top: DH-76 integrated sampler with bottle; Kemmerer bottle, weighted bottles and DO bucket for bridge sampling. Bottom: Van Dorn sampler.

5.2 <u>Sample Containers</u>

5.2.1 The most common containers for sampling surface waters in EAP are made of polypropylene or glass. The MEL manual (MEL, 2008) describes the type of bottle and volume of sample necessary to complete the laboratory analysis. The containers usually come directly from MEL and some may have chemicals to stabilize or neutralize the sample.

Figure 2. Sample containers commonly used for water samples.

5.2.2 Check bottles for loose lids. Damaged or leaking containers should be recycled or discarded.

5.2.3 Containers left over from previous projects should be closely inspected before using. Bottles with old or discolored preservative should be sent back to MEL for proper disposal. Fecal coliform sampling bottles, 500 and 1000 mL polypropylene bottles, and 500 mL Teflon metal sampling bottles (and associated Teflon vials with nitric acid preservative) should also be sent back to MEL for reuse. Most other bottles can be recycled or discarded as necessary. Check with MEL if there is a question on whether a bottle can be reused.

5.2.4 Holding times for sterilized microbiological sample bottles are:

5.2.4.1 3 months without thiosulfate/EDTA

5.2.4.2 1 month with thiosulfate/EDTA

5.2.5 For efficiency, some parameters can be combined into one container. See MEL, 2008.

6.0 Summary of Procedure

6.1 Pre-sampling Preparation

6.1.1 File a 'Field Work Plan & Contact Person Form.' In addition, an 'Ecology Float Plan' must be filed if a boat will be used. Forms are available and should be posted on the EA Program SharePoint site at: http://teams/sites/EAP/Pages/Default.aspx.

6.1.2 Obtain proper sample bottles from the laboratory and arrange for sample analyses. MEL's sample container request and pre-sampling notification forms are available at: http://aww.ecologydev/programs/eap/manlabindex.htm. MEL will provide lab sample numbers after forms are submitted.

6.1.3 Obtain ropes, extension poles, meters, and intermediate sampling devices through equipment check-out procedures.

6.1.4 Notify the laboratory at least two weeks prior to sampling, especially if special preparations are needed for your samples or the parameters have a short holding time.

6.1.5 Sampling on Thursday through Sunday must be pre-approved with the laboratory for bacteria and other analyses with short holding times.

6.1.6 If the range of concentrations can be estimated before sampling (from past samples or otherwise), inform the lab beforehand or write it on the sample tags so the proper set of dilutions can bracket the range.

6.1.7 If the water is extremely turbid (<25 mL can be filtered) the laboratory may need to modify its analytical method. Call the lab as soon as possible so they can prepare for adjustments.

6.1.8 Prior to collecting sample, have sample tags prepared containing the project name, sample number, site, date, parameter, and space for time. Also have field lab book or page prepared with similar information. EAP's SharePoint site contains several example sample tag and field sheet forms: [http://teams/sites/EAP/infostream/default.aspx.](http://teams/sites/EAP/infostream/default.aspx)

6.1.9 Pre-book air transportation for sample coolers if possible.

6.2 <u>General Considerations and Cautions</u>

6.2.1 Never compromise your personal safety or that of a field partner to collect a water sample. Always plan ahead to avoid falling and drowning hazards.

6.2.2 If only one sample is taken from a site in a lotic system, collect it in, or as close as safely possible, to the thalweg or predominant downstream current. Avoid back eddies and side channels that would not be representative of the water quality affecting downstream sites. If stratification is present, consider sampling the strata individually.

6.2.3 If collecting samples along a transect while wading, set-up a tag line for safety and to help keep a straight transect.

6.2.4 If only one sample is taken from a site in a lentic or estuarine system, determine the most representative site to safely sample and achieve the goal of the project. Determine if stratification is present with a thermistor, salinometer, or by other means. If stratification is present, consider sampling the strata individually. Note the depth of the halocline or thermocline in the field notebook and the depth where the sample(s) were collected.

6.2.5 Do not rinse a sterilized sample container or one that contains preservative.

6.2.6 Collect water samples after performing other field tasks if they cannot immediately be stored in a cool, dark place.

6.2.7 Be careful not to disturb sediment from the stream bed, particularly in slower moving waters. If sample contamination from stirred sediment is an issue, collect samples from the bank using a sampling extension pole while avoiding touching the stream bottom.

6.2.8 If sampling from a bridge, find the thalweg and determine if the current is too strong for a weighted sampling device to sink and obtain a representative sample.

6.2.9 If sampling from a boat, avoid gas and oil contamination. Collect the sample from near the bow while the boat moves upstream or upwind.

6.2.10 Before leaving the sampling site, inspect and clean all equipment (sampling devices, ropes, boots, etc.) to the level required by the invasive species prevention policy described in the QAPP.

6.3 Direct Sampling

6.3.1 Remove stopper/lid from container just before sampling. Be careful not to contaminate the cap, neck, or the inside of the bottle with your fingers, wind-blown particles, or dripping water from your clothes, body, or overhanging structures.

6.3.2 If no preservative is present in the container, face upstream in lotic waters and upwind in lentic waters and proceed as follows:

6.3.3 Hold the container near its base, reach out in front of your body, and plunge it (mouth down) below the surface to about mid-water column. If the water is so shallow that this technique will disturb sediment and contaminate the sample, it may be necessary to collect a surface water sample. Make sure to note your change of methods, if any.

6.3.4 Fill the bottle to the appropriate level depending on the analyte to be tested.

6.3.5 Pour out a small volume if needed to create a headspace for mixing in the lab. Do not create a headspace for some analytes like volatile organics and alkalinity.

6.3.6 If an extension pole is used from a pier, dock, or from shore, securely attach the sample container (with its lid in place) to the holder with the clamps or bands. Remove the container lid, being careful not to contaminate the container, and follow the above procedure. Do not use this method for samples that already have preservative in the container; use methods outlined in 6.4 - Sampling with Intermediate Fevices and Containers.

6.3.7 If preservative is present in the container and you can reach the water with your hand, use the following procedure:

6.3.8 Hold the container upright and place the lid over the mouth so that only a small area forms an opening (Figure 3).

6.3.9 Immerse the bottle about 15 cm (6 inches) under the water surface while holding the cap in position with your fingers as far away from the opening as possible.

6.3.10 Carefully observe the rate the container is filling and remove it from the water before the headspace area is reached. If overfilling occurs, get a new sample container and repeat.

6.3.11 This procedure does not work well in fast moving, shallow water. Use procedures in section 6.4 if this is the case.

6.3.12 Sample free-falling water from drains, pipes, and outfalls by using an intermediate sampling device if necessary.

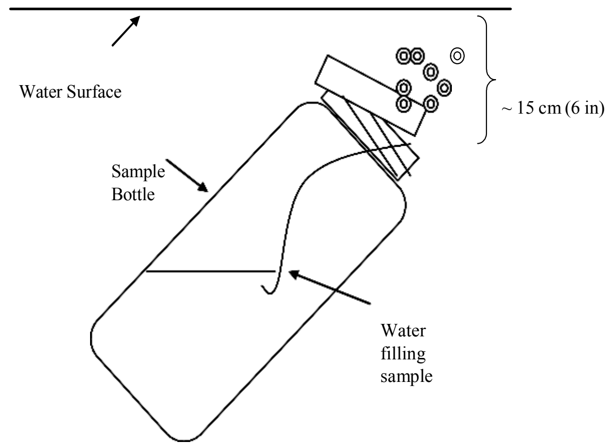

Figure 3. Illustration of the cap position on a sample container being filled that already contains a preservative.

6.3.13 Securely replace the lid of the container. Invert it several times to evenly mix any preservative with the sample.

6.3.14 Rinse any large amount of dirt or debris from the outside of the container.

6.3.15 Attach the ID tag. Place in appropriate storage.

6.4 Sampling with Intermediate Devices and Containers

a)  b) 

Figure 4. a) Syringe and filter used for dissolved nutrient samples. b) Dipper and extension pole used from a streambank.

6.4.1 Rinse an intermediate container (Figure 1) with site water and pour the rinsate away from or downstream of the sampling location. If used in a contaminated environment (e.g. wastewater treatment plant, stormwater drain), it should be washed with soap and water and rinsed off-site before use. Some organic and micronutrient sampling procedures require acid and distilled water rinses as well. For especially turbid sites, be sure to inspect and rinse out any sediment or organic debris that may have collected at the bottom of the container.

6.4.2 Fill the intermediate container with water following the technique described in 6.4.1 as closely as possible. Submerge the container to a depth that does not disturb bottom sediments, but also avoids sampling the surface layer.

6.4.3 For vertically integrated samples, raise and lower the sampler at a constant rate and avoid disturbing bottom sediments. If the sample container is overfilled or underfilled, dump the sample and adjust the transit rate or try a different nozzle size (USGS, 2006).

6.4.4 Kemmerer or Van Dorn bottles should be lowered to an appropriate depth and triggered with a messenger. Be aware that messengers may not work if the messenger is too light for the transit depth to the bottle.

6.4.5 Sticks and leaves can be removed from the bucket or dipper if contamination of the sample can be avoided. Gently mix the water in the intermediate container by swirling before pouring it into the sample containers if using an open-top container, or slowly inverting three times if using a closed-top container. From the intermediate container, carefully fill the sample containers, leaving adequate headspace as needed. Do not overfill. Put a note in the field notebook if you suspect that sand or other heterogeneous materials were not adequately represented in the sample.

6.4.6 Release the first 50 - 100 mL from the Kemmerer or Van Dorn sampler outlet before beginning to fill sample containers. Avoid contaminating the sample with your hands or with the outlet extension tube.

6.4.7 Securely replace the stopper/lid of each sample container. Invert several times to evenly mix preservative with the sample.

6.4.8 Rinse any large amount of dirt or debris from the outside of the container.

6.4.9 Attach the ID tag. Place in appropriate storage.

6.5 <u>Samples Collected from Bridges</u>

6.5.1 Follow the guidelines in the Safety Manual chapter, 'Working near Traffic and from Bridges'. Sample from the bridge only if all safety precautions are taken and the risk of injury is negligible.

6.5.2 Pick a spot on the downstream side of the bridge and observe the following:

6.5.3 Make sure you are you over the thalweg of the water body.

6.5.4 Is the current too swift for the weight of your sampler? Do you have enough rope/rods/cables to break the water's surface and overcome the downstream current velocity? Will you be able to pull a weighted bucket up against the force of the current?

6.5.5 Are debris moving downstream or is there boat traffic moving upstream or downstream? If conditions warrant, post an observer with a clear view of upstream and downstream conditions.

6.5.6 If you do not know the depth of water at the site, roughly measure it so the sampling device will not disturb bottom sediments when deployed.

6.5.7 Clear any loose debris from the bridge railing and make sure the path from the railing to the water's surface is clear of obstructions.

6.5.8 If the DH-76 or other vertical integrated sampling device is being used, measure both depth and velocity at the transect points on the bridge. Mark transect points or stretch a tape along the bridge for easier reference.

6.5.9 Assemble, secure, and untangle the sampler with ropes/rods/cables and keep feet and legs clear of all ropes/rods/cables. Be aware of bridge traffic.

6.5.10 If the DH-76 or other integrated sampling device is being used, install the correct nozzle size for the depth and velocities at the site.

6.5.11 Place a clean intermediate container or sterilized bottle into the sampler and secure carefully.

6.5.12 Remove the stopper/lid just before lowering the sampler-with-bottle down on the rope, and set it somewhere free of dirt or other sources of contamination.

6.5.13 Wear canvass or leather gloves to protect your hands from rope burns. Lower the sampler in such a manner so as not to contaminate the open bottle with dirt or dripping water.

6.5.14 When approaching the water surface, drop the sampler quickly through the surface to avoid the micro-layer to a depth of 15 cm (6 in) or more unless contact will be made with the substrate.

Figure 5. Various methods of collecting water samples from bridges**.**

6.5.15 Keep the bottle submerged long enough for the container or bucket to fill.

6.5.16 For vertically integrated samples, raise and lower the sampler at a constant rate and avoid disturbing bottom sediments. If the sample container is overfilled or underfilled, dump the sample and adjust the transit rate or try a different nozzle size (USGS, 2006).

6.5.17 Be aware that if Kemmerer and Van Dorn bottles are being used from bridges and the river current is swift, the messenger may not be able to trigger the closing mechanism.

6.5.18 Pull up the sampler and bottle; be careful not to contaminate the sample with dirt or water from either the rope or bridge, or other sources of contamination.

6.5.19 Pour out sample to allow for the air space needed for proper mixing at the lab (unless bottle contains preservative).

6.5.20 Securely replace the aluminum covered stopper/lid.

6.5.21 Rinse any large amount of dirt or debris from the outside of the container.

6.6 <u>Samples collected from wastewater/point source effluent</u>

6.6.1 Conduct a reconnaissance of potential sampling sites with assistance from facility personnel. Attend to all safety precautions. Avoid confined spaces.

6.6.2 Locate an appropriate sampling location representative of water being discharged to the receiving water body. In particular, the location should be below any chlorination or ultra-violet (UV) application.

6.6.3 Use a sampling extension pole or dipper (Figure 4) to collect samples without contacting the effluent with your hands. Wear protective clothing and gloves if necessary.

6.6.4 Note residual chlorine concentrations on lab sample tags.

6.6.5 If sampling bacteria at a facility that uses chlorine for disinfecting its effluent, order bottles with thiosulfate from MEL, to neutralize the chlorine.

6.7 <u>Samples collected from marine water bathing beaches</u>

6.7.1 (Taken from the Beach Environmental Assessment, Communication and Health (BEACH) program guidance). More beach sampling information is available from the Quality Assurance Project Plan: BEACH Program (Schneider, 2004).

6.7.2 Wade into roughly 2.5 feet of water.

6.7.3 Fill a water bottle at sampling sites by .
following procedures 6.3 or 6.4, as appropriate. If possible use a sampling extension pole (Figure 4) to avoid collecting disturbed sediment.

6.8 <u>Sample Labeling and Storage</u>

6.8.1 After collecting the sample, immediately loop the string attached to the proper sample tag over stopper/lid until secure. Make sure to attach sample tag beneath, not on top of, the aluminum foil cover of microbiology bottles, as the covers can be easily separated from the sample during transport and handling.

6.8.2 Check the tag to ensure accurate location and analytical information. Record the time the sample was collected on the tag and enter relevant data into the field notes. Use waterproof ink or pencil.

6.8.3 Place labeled sample bottle in a cooler with ice. It is important to cool most samples to 4˚C immediately and store them in the dark.

6.9 <u>Sample Transport</u>

6.9.1 Samples transported from the EAP Operations Center (OC) by MEL courier.

6.9.1.1 Pack samples in regular cubed or crushed ice. Deliver samples to walk-in cooler at EAP OC and leave Lab Analysis Requested (LAR) forms in the "Out" box near the walk-in cooler. Make sure the LAR form contains the project name, station names, sample numbers, date, times, and parameters. The LAR form is available at: http://aww.ecologydev/programs/eap/manlabindex.htm (PDF file; print and fill out), http://teams/sites/EAP/infostream/default.aspx (Excel spreadsheet version), or carbon copy forms can be requested from the MEL courier.

6.9.2 Samples shipped via air or ground freight service

6.9.2.1 Samples must be collected in polypropylene containers, not glass. Pack samples using blue or dry ice (check with airline for restrictions on dry ice). Cool to 4˚C and store in dark cooler. In warmer weather (80˚F and above) use ten to twelve blue ice packs per cooler. In cooler weather (below 80˚F) use six to eight blue ice packs, to avoid freezing samples. Put LAR form in a waterproof bag or tape it to the inside of the cooler lid and tape coolers shut after inspection.

6.9.2.2 For dry ice transport, make sure there is an air buffer space (minimum of 3 inches) between the dry ice and any samples to avoid freezing samples. Empty sample bottles, newspaper, packing peanuts, etc. can be placed around the dry ice to create a buffer

7.0 Records Management

7.1 Each sample collection will be fully described in the field notebook with waterproof ink, e.g., date, time, location identification, sample laboratory identification number, sample type, analyses to be performed, and ancillary data. Entries will be kept neat and concise. Measures will be taken to avoid losing the field notebook.

7.2 Sample locations will be described in enough detail to find on a USGS 7.5 minute map or an Environmental Information Management (EIM) System map cover. Otherwise, a global positioning system (GPS) unit will be used to record an accurate location. Coordinates will be recorded as per EIM requirements.

7.3 Information for each laboratory sample will be entered onto a Request for Analysis form when the samples are submitted to MELor other analytical facility.

8.0 Quality Control and Quality Assurance

8.1 QA/QC procedures will be addressed thoroughly on a project-by-project basis in the QAPP for the project.

9.0 Safety

9.1 All field staff must comply with the requirements of the EA Safety Manual, especially Chapter 1 ‘General Field Work,’ which includes special circumstances like fall protection, working on bridges, and working in rivers and streams. Sampling from a boat requires one person onboard to be a qualified boat operator and all persons onboard must be familiar with Chapter 3 of the EA Safety Manual, ‘Boating.’

9.2 For further field health and safety measures refer to the Environmental Assessment Program (EAP) Safety Manual

9.3 Canvass or leather gloves will protect hands from rope burns when lowering intermediate sampling equipment from bridges. Care is necessary on bridges to keep lines, ropes, and cables clear of other equipment, legs, and traffic.

9.4 Preferably, latex gloves should be worn to avoid bacterial or chemical exposure while performing direct sampling. If gloves are not worn, hands should be cleaned using anti-bacterial soap or hand sanitizer after each sampling station. Before ingesting food or drink, dirty over-clothes should be changed and hands should be washed.

10.0 References

10.2 Ecology, 2012. Environmental Assessment Program Safety Manual. Washington State Department of Ecology. Olympia, WA. http://aww.ecology/programs/eap/Safety/safety.html

10.3 MEL, 2008. Manchester Environmental Laboratory Lab Users Manual Ninth Edition. Environmental Assessment Program. Washington State Department of Ecology. Manchester, WA.

10.4 Schneider, Lynn, 2004. Quality Assurance Project Plan: BEACH Program. Environmental Assessment Program of the Washington State Department of Ecology. Olympia, Washington.

10.5 USGS, 2006. National Field Manual for the Collection of Water-Quality Data. U S Geological Survey, Water Resources Office of Water Quality. Chapter 4.1 Surface Water Sampling: Collection methods at flowing-water and still-water sites. http://water.usgs.gov/owq/FieldManual/chapter4/pdf/Chap4_v2.pdf