DEPARTMENT OF ECOLOGY
State of Washington

Quality Assurance Project Plan

Sequim-Dungeness Clean Water District (CWD) Pollution Identification & Correction (PIC), Trends and Project Monitoring: Phase V

September 2025

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Cover photo: Dungeness Delta. Photo by Sequim Daily Gazette.

Quality Assurance Project Plan
Sequim-Dungeness Clean Water District (CWD) Pollution Identification & Correction (PIC), Trends and Project Monitoring

September 2025

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EAP: Environmental Assessment Program

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2.0 Abstract

The Sequim Bay-Dungeness Watershed Clean Water District (CWD) Pollution Identification and Correction (PIC) program began in 2014 as a collaborative effort among Clallam County Environmental Health (CCEH), the Jamestown S'Klallam Tribe (JS'KT), the Clallam Conservation District (CCD), the Dungeness River Management Team (DRMT), and Streamkeepers of Clallam County (SK). The purpose is to identify and correct non-point pollution sources within the CWD, with the goal of reducing bacterial pollution in Sequim and Dungeness Bays, toward upgrades of commercial shellfish acreage. The area of focus, the CWD, is a shellfish protection district created by Clallam County in 2000 following closures of commercial shellfish beds due to impaired water quality.

This Quality assurance project plan (QAPP) outlines sample collection, analyses, and quality assurance (QA) procedures and objectives for surface water monitoring and reporting performed under the CWD PIC Phase V project, coordinated by CCEH. The complete Pollution Identification and Correction Plan is detailed in Clallam Conservation District (2014). The purpose of this document is to ensure that high quality, verifiable data are collected – to ensure cost-effective surveillance of water quality and detection of impairments.

The surface water sampling in this QAPP consists of Trends monitoring and Segmented monitoring for bacteria and nutrient concentrations and loads. Trends stations were established in 2014 and are sampled monthly or quarterly (based on tiered priority designations). These stations are at the mouths of streams in the CWD, providing temporal surveillance of the health of the watershed and an early alert to spatial changes in nonpoint source pollution. Segmented monitoring is conducted monthly in current PIC Focus Areas. These stations are in upstream areas selected after review of Trends data and can include all surface waters draining to a targeted stream. This approach is for detection of hotspots, which trigger additional focused sampling to narrow pollution sources and enable corrections.

3.0 Background

3.1 Introduction and problem statement

The Sequim Bay-Dungeness CWD is in the eastern portion of Clallam County, Washington, on the northeast coast of the Olympic Peninsula, and includes the City of Sequim. The western edge of the CWD is defined by land draining to Bagley Creek and the eastern edge extends to the area draining to Sequim Bay on the Miller Peninsula (Figure 1). All waterways in the CWD drain to the Strait of Juan de Fuca, either directly or through Dungeness Bay or Sequim Bay. These marine receiving zones traditionally support commercial and recreational shellfish, salmon, and bottom fish harvests.

In 1997, the Washington State Department of Health (WDOH) reported increasing levels of fecal coliform (FC) bacteria in Dungeness Bay near the mouth of the Dungeness River. Bacteria levels continued to increase during subsequent monitoring and as a result, in 2000 WDOH closed 300 acres near the mouth of the Dungeness River to shellfish harvest. In 2001, 100 more acres were added to the closure area. Then, in 2003, based on a continuing decline in water quality, 1150 acres from the inner portion of Dungeness Bay were reclassified from Approved to Conditionally Approved and an additional 250 acres from the outer bay were reclassified from Approved to Prohibited. Shellfish harvest is allowed in the Conditionally Approved area from February to October.

Following these downgrades, there have been incremental upgrades. Since 2003, WDOH has gradually upgraded the classification of several stations in Dungeness Bay from Prohibited to Conditionally Approved, meaning that shellfish harvest is open from February through October but closed in the rainy season—from November through January. In 2011, 500 acres in the bay were upgraded from Prohibited to Conditionally Approved. Four sites that are near or relatively close to the mouth of the river remain closed year-round (WDOH 2012). In 2015, 688 acres in the bay were upgraded from Conditionally Approved to Approved, and 40 acres were upgraded from Prohibited to Conditionally Approved. In 2016, 272 acres of shellfish growing area just offshore from the Dungeness River mouth were upgraded from Conditionally Approved to Approved. However, 80 acres in proximity to the river mouth remain closed year-round. In 2020, 23 acres of shellfish growing area at the mouth of Golden Sands Slough and Cassalery Creek upgraded from Prohibited to Approved.

While downgrades in Dungeness Bay are from nonpoint source loading, major Sequim Bay downgrades are linked primarily to wastewater treatment plant (WWTP) design and marina pollution. In 1992, 200 acres of shellfish growing were closed, and 2830 acres downgraded from Approved to Conditionally Approved due to failure to meet Washington State standards for fecal coliform. After WWTP upgrades and discharge relocation in 1998, 2800 acres were reclassified from Conditionally Approved to Approved and in 2000 750 acres were upgraded from Prohibited to Approved. Between 2008 and 2018, another 94 acres were reclassified as Approved.

Figure 2 through 5 depict WDOH sampling locations and current classifications in CWD Growing Areas.

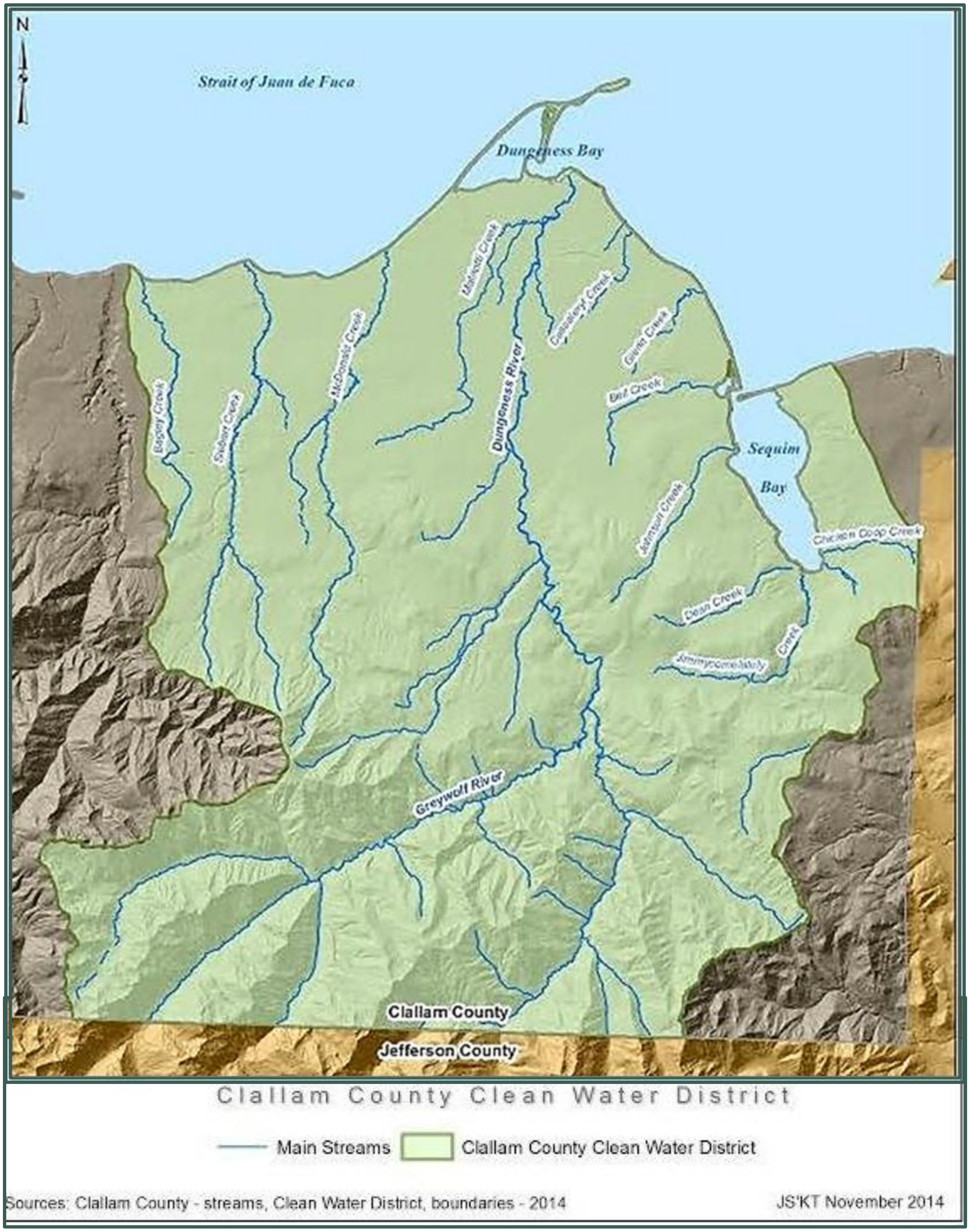


Figure 1. Sequim-Dungeness Clean Water District and Streams.

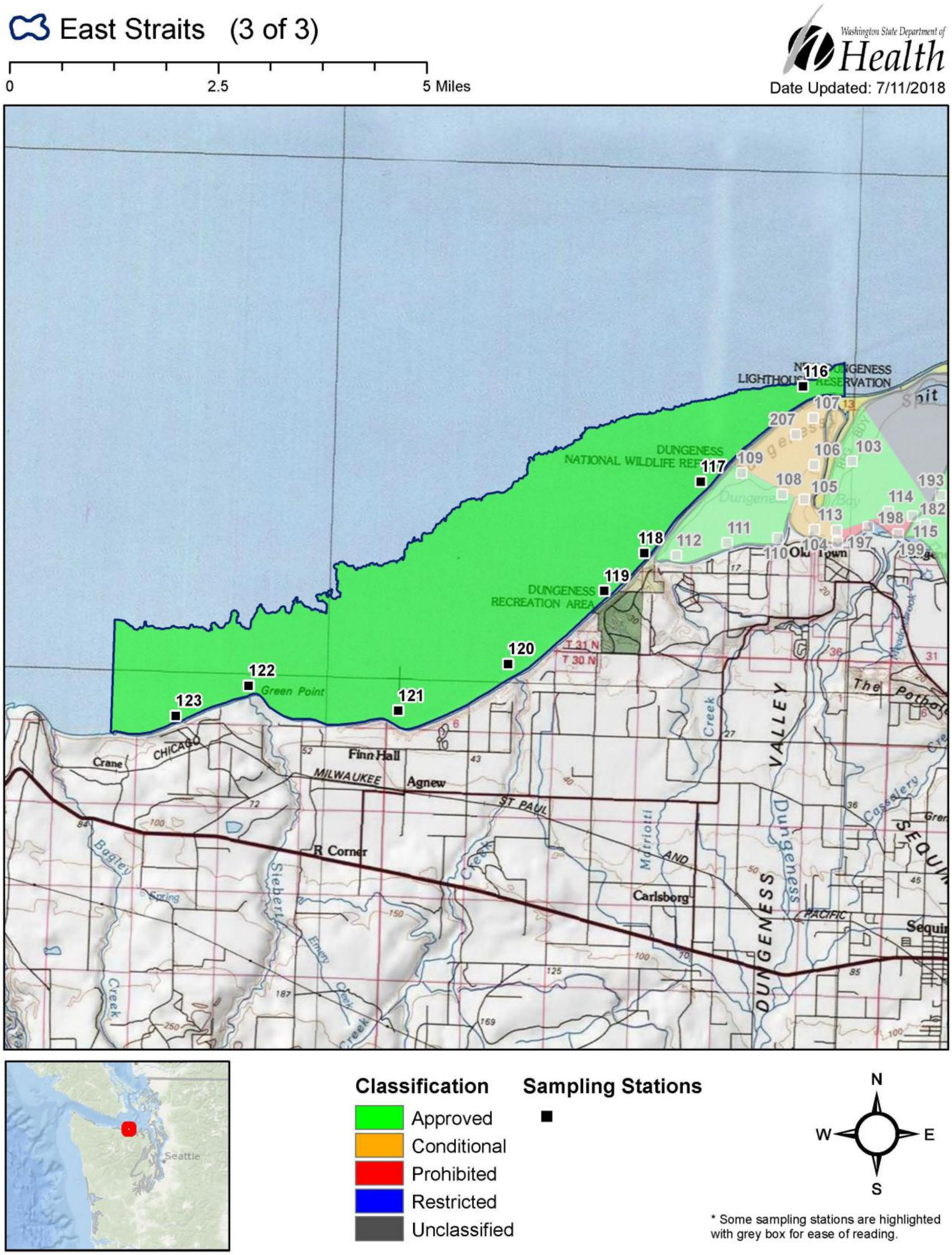


Figure 2. East Straits marine monitoring stations and current shellfish growing area classification (Washington State Department of Health, Dec. 31, 2024).

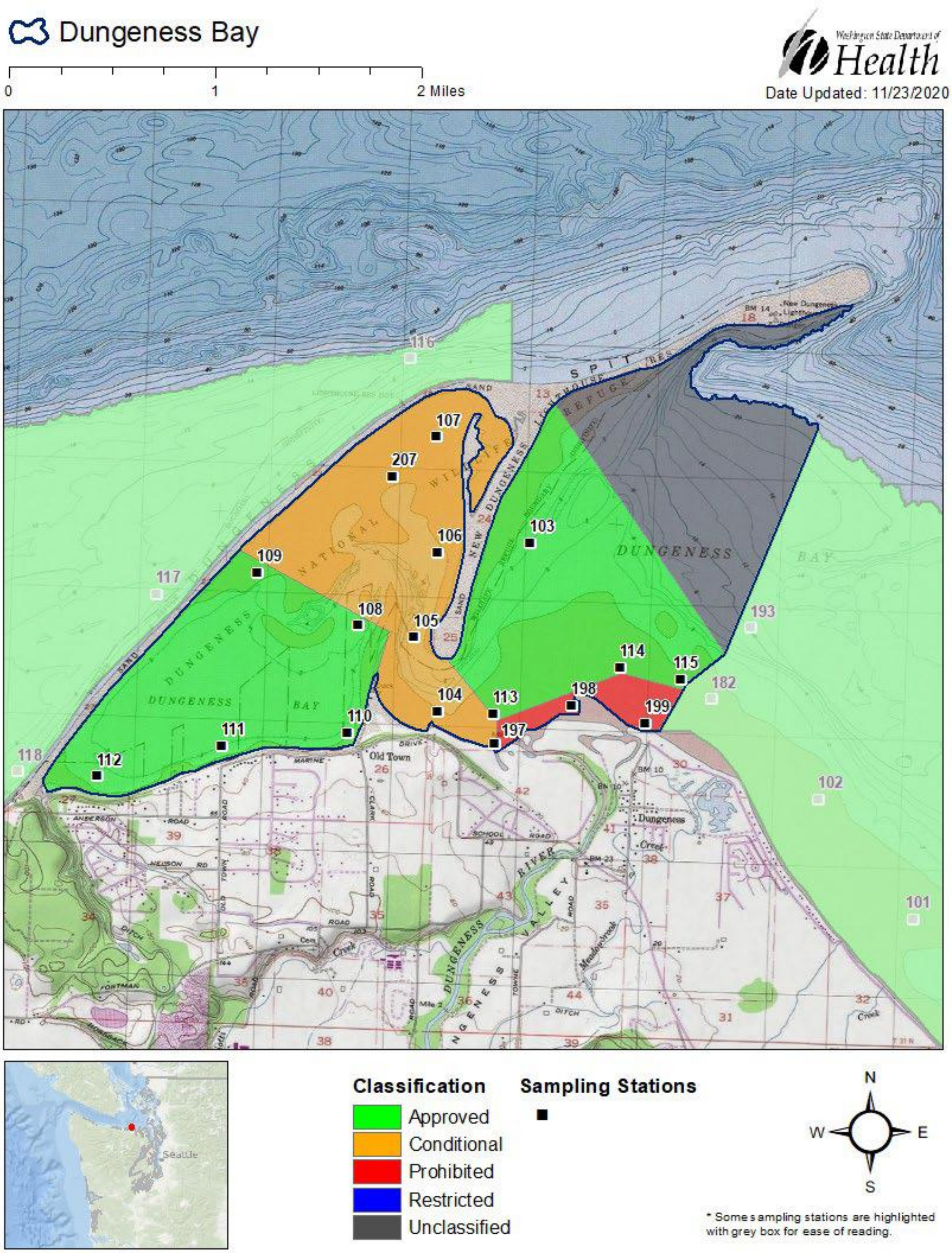


Figure 3. Dungeness Bay marine monitoring stations and current shellfish growing area classification (Washington State Department of Health, Dec. 31, 2024).

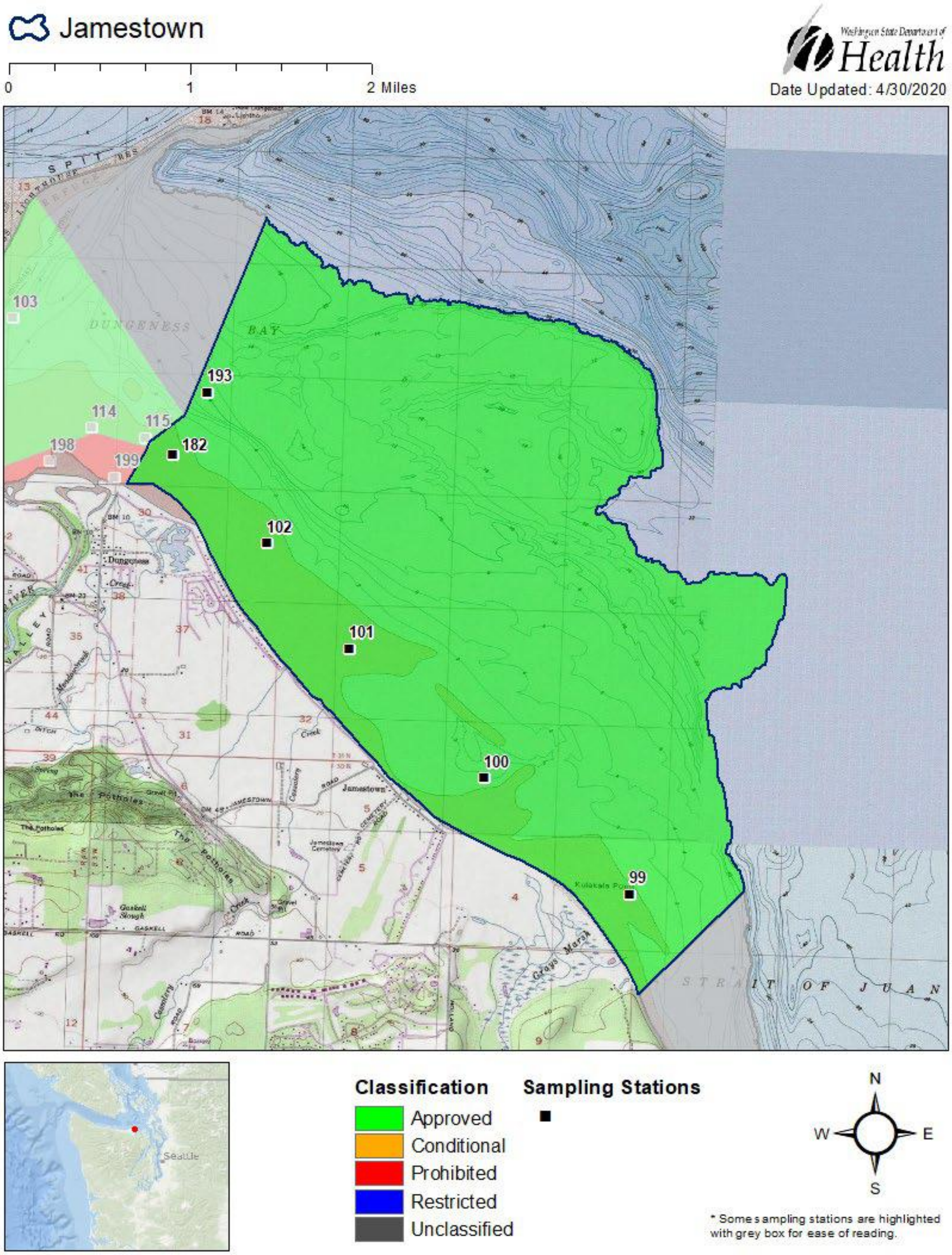


Figure 4. Jamestown marine monitoring stations and current shellfish growing area classification (Washington State Department of Health, Dec. 31, 2024).

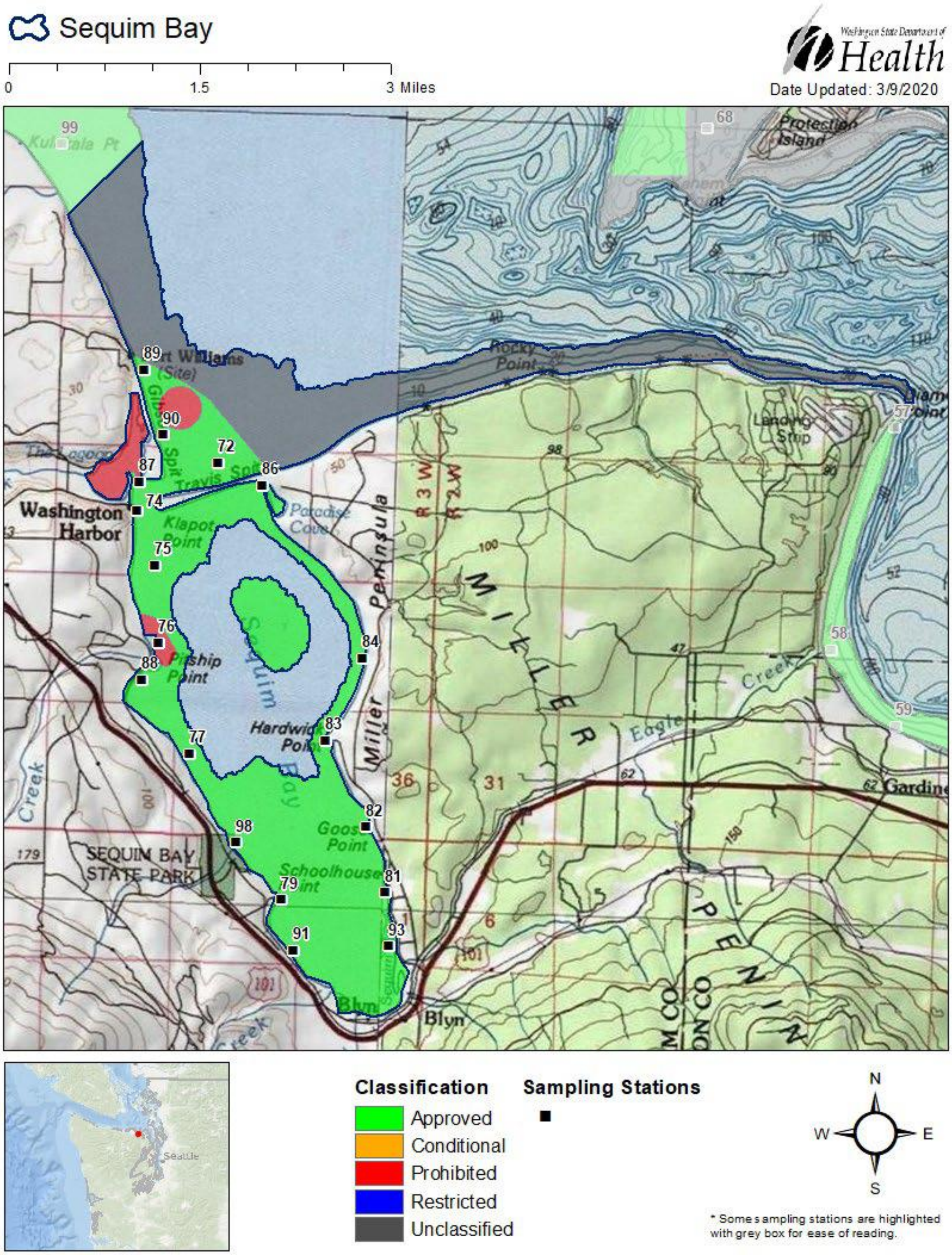


Figure 5. Sequim Bay marine monitoring stations and current shellfish growing area classification (Washington State Department of Health, Dec. 31, 2024).

While water quality improvements have been made within the CWD, areas of Dungeness and Sequim bays remain closed to shellfish harvesting due to high bacteria levels. Toward continued improvements, Clallam County's current phase of the PIC project will continue the PIC Trends Monitoring Program, which began in 2014, on 18–21 CWD streams to collect data on fecal indicator bacteria, nutrients, and other standard physical and chemical parameters at locations just upstream of marine waters. These data guide selection of prioritized waterways for targeted assessments and improvement. Continued Segmented sampling will target 12–15 sites within Focus Areas, to identify pollution hot spots and sources for corrective actions. The Phase V PIC Focus Area, selected by the CWWG, is an area covering the upper Dungeness watershed, the Cassalery Creek watershed, and Dungeness Irrigation network feeding the head of Meadowbrook Creek.

The goal of this project is to assist those living within the CWD areas to make decisions that protect water quality and correct pollution sources, toward increasing the quality of the surface water flowing into the bays and ultimately to the upgrade of shellfish growing areas.

3.2 Study area and surroundings

3.2.1 History of study area

Dungeness Bay and Sequim Bay have traditionally been rich in littleneck clams. Native people harvested shellfish there throughout tribal memory. In the 1900s, commercially farmed oysters provided local jobs. Recreational harvest has been popular with residents and tourists and contributes to the image of Sequim as a beautiful and pristine area (Streeter and Hempleman 2004).

The climate in this region of the Olympic Peninsula is considerably drier than elsewhere in western Washington because it lies in the rain shadow of the Olympic Mountains. Precipitation varies from 15 inches near Sequim to 80 inches in the headwaters of the Dungeness River. Due to the low rainfall, the lower Dungeness valley contains about 170 miles of irrigation water conveyance to support approximately 6,000 acres in agricultural production.

Land use within the study area is mostly rural residential and agricultural. Historically, most of the study area outside of the city of Sequim was farmland. A population increase during the past 30 years has resulted in a significant amount of farmland being converted to residential use. Commercial uses are mostly located within the city of Sequim and the Carlsborg urban growth area (UGA). The city of Sequim and the Carlsborg UGA are both served by sewer systems, while residential and commercial businesses in the rural areas use on-site septic systems (OSS).

Existing data is recent and plentiful for core study sites as well as optional sites. This is thanks to the Washington State Department of Ecology (Ecology) Total Maximum Daily Load (TMDL) studies and efforts of CWD members, including the Jamestown S'Klallam Tribe (JS'KT), Streamkeepers of Clallam County (SK), and Clallam County Environmental Health (CCEH). This project addresses previously defined need to upgrade water quality conditions in the lower Dungeness.

3.2.2 Summary of previous studies and existing data

Background information presented in this QAPP is based on the following select reports:

1. Sargeant 2002: A Dungeness River and Matriotti Creek fecal coliform TMDL study were conducted, toward protection of shellfish harvest use in Dungeness Bay. The TMDL study

measured fecal coliform concentrations in several freshwater tributaries to Dungeness Bay, in 1999 and 2000, and determined necessary reductions to meet marine water quality standards. The TMDL evaluation proposed a fecal coliform bacteria target for the Dungeness River at a geometric mean of 13 cfu/100mL and a 90th percentile not to exceed 43 cfu/100mL. Tributaries targets were determined to be 50 cfu/100mL and a 90th percentile of 100 cfu/100mL for Meadowbrook Creek, Cooper Creek, and Golden Sands Slough, and 60 cfu/100mL and a 90th percentile not to exceed 170 cfu/100mL for Matriotti and Hurd creeks.

2. Sargeant 2004a: Following the Dungeness River and Matriotti Creek TMDL study, a Dungeness Bay fecal coliform TMDL study was conducted and included 7 irrigation ditches. The study confirmed the 13 cfu/100mL target set for the Dungeness River and set a target for irrigation ditches at mean of 50 cfu/100mL and a 90th percentile of 100 cfu/100mL.
3. Streeter and Hempleman 2004: In response to TMDL findings, as required by the U.S. Environmental Protection Agency's Water Clean-up Process, a water Cleanup Implementation Plan was developed by the CWWG. Status reports on its implementation are submitted annually by Clallam County to the WDOH. Clallam County's PIC projects contribute to the monitoring and enforcement actions in this plan.
4. Sargeant 2004b: A post-TMDL review, using data from 2002 – 2004, found some improvements toward attaining TMDL targets in Matriotti Creek (40% improvement), but further degradation of water quality in Meadowbrook Creek.
5. Woodruff et al. 2009a: This study conducted microbial source tracking. Phase 1 ribotyping analyses targeted the mouths of Matriotti Creek, Meadowbrook Creek, Golden Sands Slough, and an irrigation ditch at the center of inner Dungeness Bay, as well as marine stations within the Bay. Matriotti Creek had the highest frequency of occurrence of human sources (9 out of 13 sampling events), while Meadowbrook Creek and the ditch station had human-derived sources present at least half of the time. Game farm source types were present 46% of the time in Matriotti, below the Game Farm. Avian sources were found to be the largest contributor in the watershed. Phase 2, Bacteroides (human and ruminant), covered an expanded set of stations within the same area to demonstrate a quicker source classification test. Meadowbrook Creek and Meadowbrook Slough tested positive for human sourced bacteria.
6. Woodruff et al. 2009b: A TMDL Effectiveness Monitoring Study, summarized trends of fecal coliform from 1998 – 2008, characterized nutrients in the watershed from (1959 and 1970 vs 2005 – 2008), and evaluated effectiveness of BMPs. There was no significant increase or decrease in the annual mean fecal coliform concentration during the period examined. Matriotti creek and irrigation ditches were observed to be the most significant contributors of fecal coliform to the Dungeness River. Recent nutrient levels were not significantly higher, but waters with elevated levels signified a variety of nonpoint sources. BMP analyses showed 1) little benefit to piping irrigation waters if ditches are left in place for stormwater conveyance and 2) no detectable benefit downstream from current magnitude of septic repairs.
7. Cadmus Group 2010: Ecology published an additional FC TMDL Effectiveness Monitoring Report. It concluded that, between 1999 and 2009, fecal coliform concentrations decreased 24% in marine stations, however stations in the inner bay did not meet water quality standards during the November to February period. The Dungeness River and Hurd Creek were in compliance with TMDL fecal coliform targets, however 9 of 13 Dungeness Bay tributaries did not meet water quality criteria and TMDL targets during the 2008 – 2009 sampling period. Cassalery, Cooper, and Meadowbrook Creeks were also found to be in violation of their dissolved oxygen criterion.

3.2.3 Parameters of interest and potential sources

The parameters of interest for this project are:

- **Bacteria loading**: Fecal coliform was used to set the 2004 TMDL for shellfish growing area protections and this project continues to monitor against those benchmarks at Trends Monitoring stations. At the end of 2020, Ecology transitioned bacterial water quality primary contact criteria for freshwater to E. coli. In response, this project incorporated E. coli analysis into Focus Area monitoring (in addition to FC), to assess performance of hotspot detection. In addition to tracking nonpoint source TMDL goals, bacteria are used to locate OSS failures and agricultural runoff in the CWD. Corrective actions, prescribed in the PIC Plan (Clallam Conservation District 2014), are then discussed with landowners. Other potential sources of bacteria include pets/wildlife.

- **Nutrient loading**: The Trend Monitoring section of this project samples for ammonia as N, nitrate as N, nitrite as N, and phosphate as P. Trends in nutrient loads indicate changes in water quality that affect the limiting conditions for algal blooms in receiving water shellfish growing areas. In addition to domestic OSS failures, nitrogen and phosphorus sources include fertilizers and combustion products. This dataset is a component of Focus Area selection.

- **Standard water quality indicators**: Temperature, pH, salinity, dissolved oxygen, and turbidity are recorded at Trends stations. Temperature dissolved oxygen and salinity are recorded at Segmented stations. These measurements are used for data interpretation and water quality classifications.

3.2.4 Regulatory criteria or standards

Chapter 173-201A of the Washington Administrative Code (WAC) establishes water quality standards for surface waters of the state “consistent with public health and public enjoyment of the waters and the propagation and protection of fish, shellfish, and wildlife”. These waters are “protected by numeric and narrative criteria, designated uses, and an antidegradation policy”.

Primary tributaries in the project area are identified in Table 602 of this WAC with the varying criteria for the project’s parameters of interest, including spawning and incubation protection.

3.3 Water quality impairment studies

Water quality classifications for the marine receiving waters of the CWD are summarized in Table 1. Classifications of individual streams can be accessed in the Department of Ecology's Water Atlas and are comprehensively detailed in Clallam County (2025).

Table 1. Water quality classifications in Sequim-Dungeness shellfish harvest areas, with respect to analytes reported herein. Assessment units are listed from west to east.

Waterbody	Assessment Unit ID	Category 4A	Parameter	Category 4C	Parameter	Category 5	Parameter
Dungeness B.	48123B1F5_01_01			2004-**current**	Macroalgae	2018-**current**	Enterococci
Dungeness B.	48123B1G4_01_01	2008-**current**	Fecal coliform	2004-**current**	Macroalgae	2004-2008	Fecal coliform
Dungeness B.	48123B1F4_01_01	2008-**current**	Fecal coliform			2004-2008	Fecal coliform
Juan de Fuca	48123B1F3_01_01	2010-**current**	Fecal coliform			2004-2008	Fecal coliform
Juan de Fuca	48123B1F2_01_02	2004-2008, 2018-**current**	Fecal coliform				
Juan de Fuca	48123B1F1_01_01					2018-**current**	Fecal coliform
Juan de Fuca	48123B0C7_01_01					2018-**current**	Fecal coliform, Enterococci
Juan de Fuca	48123A0J4_01_01					2018-**current**	Fecal coliform, Enterococci
Sequim Bay	48123A0I4_01_02			2004-**current**	Macroalgae		
Sequim Bay	48123A0E2_01_01					1996-1998, 2010-**current**	Enterococci
Sequim Bay	48123A0E0_01_01					2010-**current**	Dissolved oxygen

3.4 Effectiveness monitoring studies

In addition to the Effectiveness Monitoring studies summarized in Section 3.2.2, the Trends data from this Clallam County PIC project and routine DOH monitoring of shellfish growing areas provides a means of assessing current effectiveness of BMPs and corrective actions initiated under the PIC Focus Area Segmented efforts. PIC Phase I Focus Areas were Golden Sands and Meadowbrook Sloughs (2015 – 2017), Phase II were Matriotti and Lotzgesell Creeks (2017 – 2019), Phase III were Upper Matriotti Creek and Lower Bell Creek (2020 – 2022), and Phase V were Upper Matriotti Creek and the Highland Irrigation system (2023 – 2025). Table 2 provides a summary of FC monitoring at the mouth of the Dungeness River and other tributaries within the CWD.

Table 2. Trends in bacterial pollution in PIC monitored surface waters, 2015-2024.

Growing Area	Site/mile	Geometric Means and 90th Percentiles by Water Year[b,c]										Criteria	Priority tier		Focus Area
		2000[a]	2016	2017	2018	2019	2020	2021	2022	2023	2024		2015-2023	2024	
East Straits	Bagley 0.7	--	33(390)	6(22)	20(28)	11(61)	21(101)	27(107)	54(93)	12(109)	31(226)	50(100)[d]	2	2	--
	Siebert 1.0	--	8(81)	2(6)	5(20)	8(60)	12(29)	28(175)	14(45)	17(85)	13(61)	50(100)[d]	2	2	--
	Agnew ditch 0.3	--	120(621)	56(93)	27(87)	36(293)	100(299)	38(174)	66(285)	45(202)	53(141)	50(100)[d]	2	1	--
	McDonald 1.6	--	22(373)	3(8)	7(22)	6(47)	33(122)	58(563)	43(146)	60(485)	82(317)	50(100)[d]	2	1	--
Dungeness Bay	Lotzgesell 0.1	--	39(149)	25(61)	25(198)	43(403)	49(368)	94(514)	51(343)	31(350)	112(556)	50(100)[d,e]	1	1	Phase II
	Matriotti 0.3	279(783)	116(402)	81(312)	96(479)	138(1046)	198(730)	296(1303)	95(660)	110(966)	202(759)	60(170)[f]	1	1	Phase II-IV
	Meadowbrook 0.1/0.2	33(243)	12(59)	6(21)	6(17)	17(102)	55(206)	75(219)	86(357)	68(238)	62(520)	50(100)[f,h]	1	1	Phase I
	Meadowbr. Sl. 0.23	20(1/18>100)	30(322)	23(190)	86(460)	182(1375)	160(737)	--	--	--	--	50(100)[f]	1	1	Phase I
	Hurd 0.2	12(100)	9(77)	4(13)	4(9)	3(13)	10(43)	8(46)	5(25)	9(73)	12(127)	60(170)[f,h]	2	2	--
	Dungeness River 0.7	17(81)	5(24)	3(4)	5(14)	7(34)	16(45)	13(59)	12(37)	20(96)	34(91)	13(43)[f,g]	1	1	--
Jamestown	Golden Sands Sl. 0.0	109(565)	75(513)	25(100)	18(128)	41(206)	44(367)	28(206)	36(347)	18(102)	35(143)	50(100)[f,h]	1	1	Phase I
	Cooper 0.1	49(140)	14(112)	11(41)	11(45)	21(89)	32(178)	31(220)	29(120)	25(83)	40(153)	50(100)[f,h]	1	2	--
	Cassalery 0.0/0.6	--	71(304)	11(71)	15(107)	41(144)	57(246)	35(169)	52(593)	108(684)	117(258)	50(100)[d]	1	1	--
	Gierin 1.8	--	46(122)	10(53)	15(154)	14(100)	17(42)	*n* < 3	83(210)	27(96)	71(236)	50(100)[d]	2	1	--
Sequim Bay	Bell 0.2	--	84(518)	12(57)	35(172)	67(686)	103(258)	150(1023)	140(1250)	150(957)	105(663)	50(100)[d,e]	1	1	Phase III, IV
	Johnson 0.0	--	24(114)	5(19)	16(104)	13(118)	11(73)	35(356)	20(84)	36(337)	31(91)	50(100)[d,e]	1	2	--
	Sequim Bay SP 0.0/0.1	--	5(15)	20(192)	16(162)	12(56)	10(54)	6(36)	13(75)	4(27)	44(955)	50(100)[d,e]	1	2	--
	Dean 0.17	--	24(411)	4(16)	*n* < 3	--	*n* < 3	*n* < 3	53(140)	6(18)	27(39)	50(100)[d,e]	2	2	--
	Jimmycomelately 0.15	--	6(29)	6(29)	8(36)	18(176)	8(25)	20(168)	15(94)	12(68)	41(255)	50(100)[d,e]	1	2	--
	No Name 0.03	--	4(17)	7(41)	10(108)	10(75)	20(190)	15(150)	22(270)	8(49)	36(69)	50(100)[d,e]	2	2	--
	Chicken Coop 0.24	--	6(16)	11(57)	11(80)	8(81)	12(95)	77(410)	47(83)	13(196)	*n* < 3	50(100)[d,e]	2	2	--

[a] November 1999 through October 2000 geometric means and 90th percentiles taken from the Dungeness River and Matriotti Creek Fecal Coliform Bacteria Total Maximum Daily Load Study (Sargeant 2002)—the baseline prior to cleanup implementation.

[b] Fecal coliform concentrations (cfu/100mL) are given as geometric means, followed by 90th percentiles in parenthesis. Boxes are coded green when both values meet the referenced criteria, orange when one criterion is not met, or red when neither criterion are met.

[c] CWD Water years begin September 15th to statistically separate irrigation season from wet season.

[d] Clallam County Department of Community Development. 2004. State of the waters of Clallam County, 2004. Clallam County. Available at: https://www.clallamcountywa.gov/1028/State-of-the-Waters-of-Clallam-County

[e] Washington Administrative Code, Title 173 - Ecology, Department of (1995 - 2003). Office of the Code Reviser, Washington State Legislature, Olympia, WA. Available at: https://leg.wa.gov/state-laws-and-rules/state-rules-wac/past-versions-of-state-rules/

[f] Sargeant D. 2002. Dungeness River and Matriotti Creek fecal coliform bacteria total maximum daily load study. Olympia (WA): Washington State Department of Ecology (US). Available at https://fortress.wa.gov/Ecology/publications/summarypages/0203014.html

[g] Sargeant D. 2004. Dungeness Bay fecal coliform bacteria total maximum daily load study. Olympia (WA): Washington State Department of Ecology (US). Available at https://fortress.wa.gov/Ecology/publications/summarypages/0403012.html

[h] Site has a TMDL calculated rollback or mass balance target which is lower than the criteria used for PIC water quality assessments: Meadowbrook 14(100); Hurd 12(100); Golden Sands Slough 19(100); Cooper 35(100) cfu/100mL (Streeter and Hempleman 2004).

4.0 Project Description

4.1 Project goals

The goal of this project is to reduce bacterial and nutrient pollution loading from the Sequim-Dungeness watershed, leading to the upgrade of shellfish growing areas in Dungeness and Sequim bays. Multiple growing areas are currently closed due to unsafe levels of fecal coliform, enterococci, and macroalgae.

4.2 Project objectives

This monitoring project has three objectives:

1. Trends Monitoring Program
   - A. Monitor trends in the physical and chemical properties of water quality, along with fecal coliform and nutrient loading, within the CWD through monthly sampling.
   - B. Identify waterways that are being impacted by FC and nutrient pollution.
   - C. Prioritize waterways for PIC Project implementation.
2. Segmented Monitoring Program
   - A. Identify sources of bacterial pollution through segmented sampling.
   - B. Trigger correction efforts, e.g. septic system violation abatement, agriculture BMPs, etc.
   - C. Evaluate effectiveness of pollution correction efforts with follow up water quality sampling.
3. Pollution Correction
   - A. Apply the PIC plan in priority sub-watersheds within the CWD.
   - B. Identify sources of bacterial pollution through segmented sampling in priority sub-watersheds within the CWD. Other investigative tools include property/OSS evaluation by CCEH field staff, creek “walks”, beach “walks”, and when practical, dye testing.
   - C. Use available means to correct suspected sources of pollution within the project area. Examples include public education and outreach, enforcement of State and County Codes, CCEH technical assistance for OSS, and CCD technical assistance for poor agricultural practices.

4.3 Information needed and sources

This monitoring plan relies on collaboration between the members of the Sequim Bay-Dungeness CWWG to select Focus Areas. All other information needs are obtained through tasks detailed in Section 4.4.

4.4 Tasks required

<u>Trends Monitoring Program Tasks</u>

- Tier 1 waterways (12) will be sampled monthly for FC and bimonthly for nutrients (nitrate, nitrite, ammonia, and orthophosphate). Temperature, pH, salinity/conductivity, dissolved oxygen, turbidity, and flow will be recorded for all sampling sites, using a YSI water quality multiparameter meter and flow meter/stream gauge.

- Lower priority Tier 2 waterways (9) will be sampled quarterly.
- Tiers and sampling parameters/periodicity may change in response to data. For example, a Tier 1 waterway may drop to Tier 2 if State water quality standards are consistently met, and vice versa, following consensus of the CWWG.
- Select polluted waterways for PIC Focus Areas, in collaboration with the CWWG, DRMT and the Clallam County Board of Health.
- Submit data to Ecology's Environmental Information Management (EIM) database (and, in turn, to EPA's STOrage and RETrieval Database [WQX]).

<u>PIC Segmented Monitoring Program Tasks</u>

- Conduct segmented FC and E. coli sampling on selected waterways to identify sources of bacterial pollution. Temperature, salinity/conductivity, and dissolved oxygen will be recorded for all sampling sites, using a YSI water quality multiparameter meter.
- Include E. coli testing at least 4x/year.
- Compile results, assess data, and involve CWWG in preliminary analysis.
- Identify "hot spots" from segmented sampling results.
- Implement additional investigative tools such as OSS inspections and dye testing if practical.
- Conduct proper corrective actions based on surrounding anthropogenic activity (OSS vs. agriculture).
- Conduct post-remediation activity sampling to evaluate effectiveness.
- Submit data to Ecology's Environmental Information Management (EIM) database (and, in turn, to EPA's STOrage and RETrieval Database [WQX]).

4.5 Systematic planning process

The CWWG is tasked with ongoing water quality monitoring and clean-up activities. This group has been meeting regularly since 2014 to develop the PIC plan, as described above. The PIC plan builds local capacity to adaptively and comprehensively manage pollution by better coordinating water quality monitoring, outreach and clean-up efforts (Figure 6).

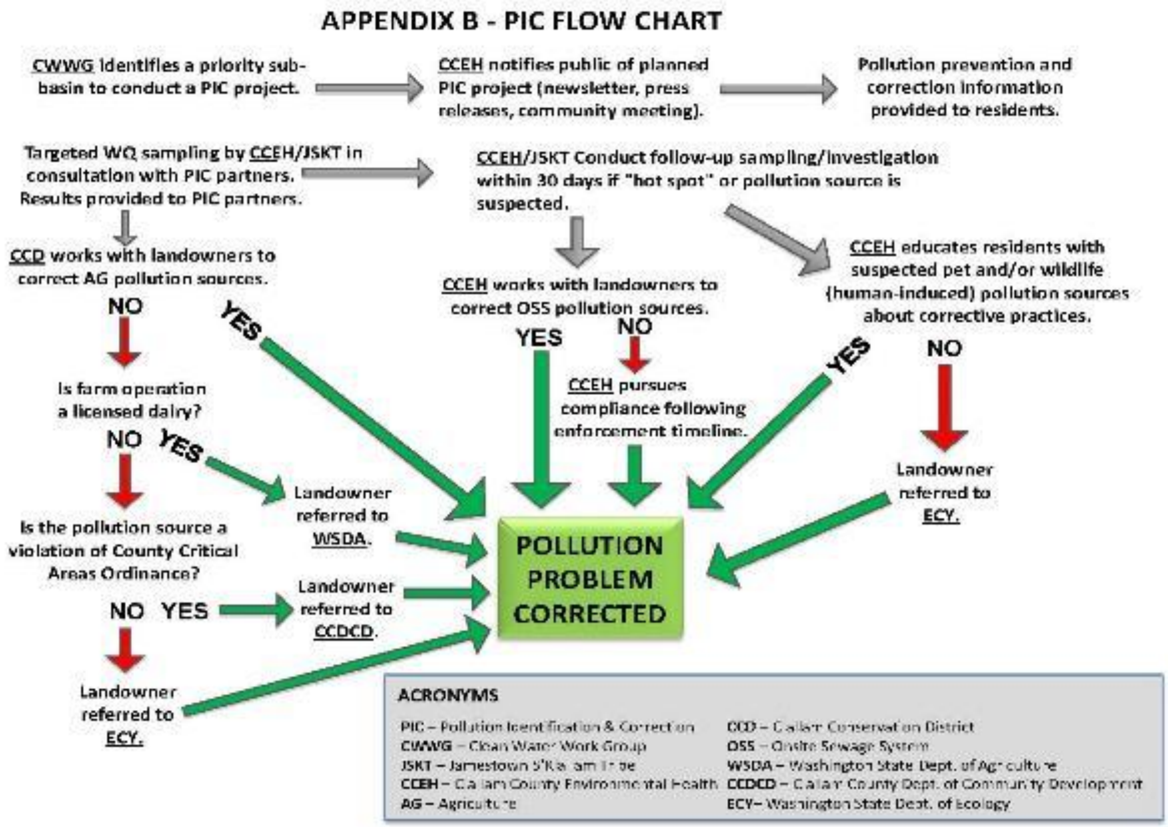


Figure 6. PIC Flow Chart

5.0 Organization and Schedule

5.1 Key individuals and their responsibilities

Table 3 shows the responsibilities of those who will be involved in this project.

Table 3. Organization of project staff and responsibilities.

Staff	Title	Responsibilities
JE Strivens Clallam County Environmental Health Phone: 360-417-2415	Water Quality Specialist/PIC Coordinator	Authors the QAPP. Directs sampling strategy. Conducts project reviews. Manages budget. Authors the final report.
Lori DeLorm Jamestown S'Klallam Tribe, Natural Resources Phone: 360-681-4619	Natural Resource Technician	Assist with writing QAPP. Conducts segmented sampling and transports samples to the laboratory. Conducts QA review of data, analyzes and interprets data.
Joel Green Clallam County Dept. of Community Development Phone: 360-417-2281	Streamkeepers Coordinator	Coordinates trends and segmented monitoring activities, including sample collection, shipping samples to UW Lab or transport to CCEH lab, data QA/QC, and uploading of all data to EIM. Writes annual trends reports analyzing the data.
Abbey Blair Clallam County Environmental Health Phone: 360-417-2334	CCEH Water Laboratory Manager	Analyze water samples for fecal coliform and E. coli as directed.
Loren Tuttle University of Washington Marine Chemistry Lab Phone: 425-463-6899	Marine Chemistry Laboratory Manager	Analyze water samples for nutrients as directed.
Christina Frans Phone: 360-519-2067	Ecology Quality Assurance Officer	Reviews and approves the draft QAPP and the final QAPP.

5.2 Special training and certifications

Streamkeepers volunteers are trained on the Streamkeepers' QAPP (Chadd 2019, Chadd 2016), by their coordinator, for Trends monitoring.

5.3 Organization chart

Not Applicable – See Table 3.

5.4 Proposed project schedule

Table 4 –Table 6 list key activities, due dates, and lead staff for this project.

Table 4. Schedule for completing field and laboratory work

Task	Frequency	Lead staff
Segmented Field work	Monthly (beginning Feb. 2026), or more often as needed	Joel Green, Lori DeLorm
Trends Field work	Monthly, or more often as needed	Joel Green
Laboratory Fecal coliform analyses	Monthly, or more often as needed	Abbey Blair
Contract lab Nutrient analyses	Monthly	Loren Tuttle

Table 5. Schedule for data entry

Task	Due date	Lead staff
EIM data loaded* [1]	Annually by December 31st	Joel Green/SK Volunteer
EIM QA [2]	Annually by January 15th	Joel Green/SK Volunteer
EIM complete [3]	Annually by January 31st	Joel Green

*EIM Project ID: WQC-2026-00371
[1] All data entered into EIM by the lead person for this task.
[2] Data verified to be entered correctly by a different person; any data entry issues identified.
3 All data entry issues identified in the previous step are fixed.

Table 6. Schedule for reporting

Task	Due date	Lead staff
Annual report draft to PIC coordinator	November 15 annually	Joel Green
Annual report draft to Ecology PM	November 31 annually	JE Strivens
Upload annual report to EAGL	December 31 annually	JE Strivens
Final report draft to Ecology PM	December 31 of final year	JE Strivens
Upload final report to EAGL	January 31	JE Strivens

5.5 Budget and funding

The project activities described in this QAPP are being funded under a grant provided by Ecology for 2.25 years.

6.0 Quality Objectives

6.1 Data quality objectives

The main data quality objective (DQO) for this project is to collect an adequate number of samples to accurately characterize possible sources of bacteria and nutrients in the project area. The samples will be analyzed using EPA and Standard Methods.

6.2 Measurement quality objectives

Field sampling procedures and laboratory analyses inherently have associated error. Measurement quality objectives (MQOs) establish the allowable error for a project. Precision and bias provide measures of data quality and are used to assess agreement with MQOs.

6.2.1 Targets for precision, bias, and sensitivity

The MQOs for project results, expressed in terms of acceptable precision, bias, and sensitivity, are described in this Section and summarized in Table 7.

Table 7. Measurement quality objectives (e.g., for laboratory analyses of water samples).

Parameter	Laboratory Duplicate (RPD)	Field Duplicate (RSD)	Matrix Spike Duplicate (RPD)	Lab Control Standard (%Recovery)	Matrix Spike (%Recovery)	Reference Material (%Recovery)	Lowest Concentrations of Interest	Method
Fecal coliform	≤ 20%	≤ 20% & 90% of replicate pairs ≤ 50%*	n/a	n/a	n/a	n/a	1 cfu / 100 mL	SM 9222 D
E. coli	≤ 20%		n/a	n/a	n/a	n/a	24 cfu / 100 mL	SM 9223B
NO_3 - N	≤ 10%	≤ 10%	≤ 20%	90-110%	90-110%	85-115%	0.0028 mg/L	EPA 353.4
NO_2 - N	≤ 10%	≤ 10%	≤ 20%	90-110%	90-110%	80-120%	0.0003 mg/L	
NH_4 - N	≤ 15%	≤ 15%	≤ 20%	90-110%	90-110%	80-120%	0.0006 mg/L	EPA 349
PO_4 - P	≤ 10%	≤ 10%	≤ 20%	90-110%	90-110%	80-120%	0.0006 mg/L	EPA 365.5

*Mathieu 2006.

6.2.1.1 Precision

Precision is defined as the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves. Precision is achieved through both field and laboratory replication to assess the field variability as well as the laboratory method precision. Replicate samples will be collected at a minimum of 5% of sampling sites, and at least one set of replicate samples will be taken by each field team each day. The site for the replicate sample will be decided at random prior to conducting sampling. For laboratory analyses, laboratory duplicates will be made at random for a minimum of 5% of samples analyzed.

Precision DQOs are listed in Table 7 and Table 8.

6.2.1.2 Bias (accuracy)

Accuracy is defined as the degree of agreement between an average observed value and an accepted reference value. Accuracy is achieved through the use of laboratory control samples, matrix spikes, and reference materials. Frequency of these QC samples will adhere to the accredited method.

Project staff will assess bias in field samples by submitting field blanks. Field staff will prepare blanks in the field by filling the bottles directly with deionized water, and handling and transporting the samples to the labs in the same manner that the rest of the samples are processed.

For field measurements, project staff will minimize bias by calibrating and/or checking equipment using NIST-traceable standards before and after each run. More detailed information is found in Section 10.0 Quality Control Procedures on Quality Control Procedures.

Accuracy DQOs are listed in Table 7 and Table 8.

Table 8. Measurement quality objectives for field measurements.

Parameter	Bias*	Field Precision**	Sensitivity	Expected Range of Results
Temperature (thermistor)	0.2 °C (two-point)	0.2 °C	-5 °C - 50 °C	0 °C - 30 °C
Salinity (YSI)	5% RPD	0.02 PSS or 5% RSD	0 - 70 PSS	0 - 35 PSS
Dissolved Oxygen (YSI)	± 2%	± 0.5%	0 – 500%	85% - 100%
pH (YSI)	± 0.2	± 0.2	0 - 14	6.5 – 9
Turbidity (YSI)	± 7%	± 7%	0 - 50 NTU	1 - 30 NTU

* Deviation from NIST standard or spiked blank.
** Per-pair variation.

6.2.1.3 Sensitivity

Sensitivity is the capability of a test method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. Sensitivity is addressed primarily through the selection of appropriate analytical methods, equipment, and instrumentation. The methods selected for this PIC study were chosen to provide the sensitivity required for the end use of the data. This is a quantitative assessment and is monitored through the instrument calibrations and calibration verification samples and the analyses of procedural blanks with every analytical batch. Sensitivity MQOs are discussed in Section 9.1.

6.2.2 Targets for comparability, representativeness, and completeness

6.2.2.1 Comparability

To help ensure comparability with previous projects in the Dungeness watershed, standardized sampling techniques and methods, and analysis and data reduction, are being used. In addition, analytical laboratories were chosen to be consistent with those used for the EPA Targeted Watershed Grant (Streeter 2005; Woodruff et al. 2009b), the Clallam Marine Recovery Area Septic Solutions (Soule 2013), and prior PIC Phases. The same analytical methods are available and will be used.

6.2.2.2 Representativeness

Representativeness will be addressed through choice of sampling sites and frequency and timing of sampling. Sites will be as close as possible to discharge points of freshwater bodies into marine waters, in order to reflect as accurately as possible, the pollutant concentrations upon entry into marine waters. Trends monitoring sampling will be collected monthly for tier 1 sites, and quarterly for tier 2 sites throughout the year, and in general, stream flow status and weather will not deter going into the field. Samples will be collected during low tide periods whenever possible, and samples having appreciable salinity (e.g., > 1 ppt) will be highlighted in field logs. Segmented sampling will be addressed by selecting appropriate spatial representation of the stream or creek in question, with one sample site close to the terminus of the project area, and one sample site as far upstream as possible within the project area. If/when hotspots are identified, sample sites will be established upstream and downstream of the hotspot. Grab sample protocol follows the *Standard operating procedure for manually obtaining surface water samples* (Joy, 2006).

6.2.2.3 Completeness

The goal set for this project is 95% of planned sampling to be conducted and analyzed.

Reasons for missing sampling activities in a monitoring program include: (1) inclement weather or flooding, (2) hazardous driving or monitoring conditions, (3) unavailability of monitoring staff, laboratories, equipment, or supplies, and (4) dry creek beds.

Routinely missed samples could impart bias in expressions generated from final data. Every effort will be made to sample within each target month. Field monitoring data loss due to equipment failure will be minimized by having backup equipment available. Apart from weather, unforeseen occurrences are random relative to water quality conditions. These occurrences will not affect long-term data analyses, except for effects from potential reduction in sample size.

6.3 Acceptance criteria for quality of existing data

Existing data consists of data collected during PIC Phases I – IV. Existing data have been through QA/QC review under approved QAPPs for their respective Phases. These data will be retrieved from EIM and used in the Final Report for Trends Program analyses. QA/QC requirements of Phase I – IV QAPPs meet project acceptance criteria for this use.

6.4 Model quality objectives

Not Applicable, no modeling will be conducted during this project.

7.0 Study Design

7.1 Study boundaries

The study area is the Sequim Bay-Dungeness Watershed CWD, which is bounded on the west by the Bagley Creek drainage area and on the east by the Sequim Bay drainage area (Figure 7).

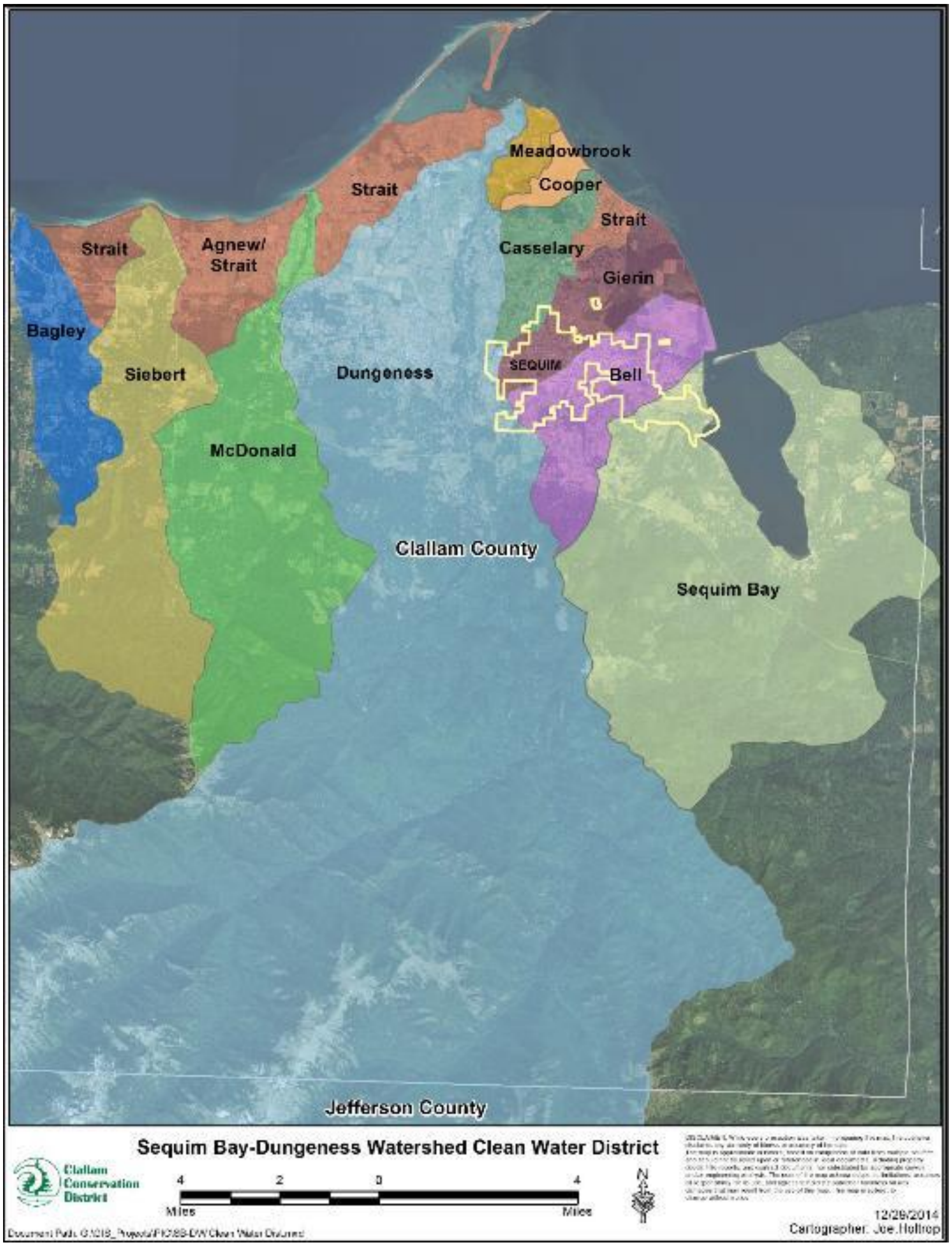


Figure 7. Sequim Bay-Dungeness Watershed Clean Water District.

The Phase V Focus Area, selected by the CWWG, is mapped in Figure 8.

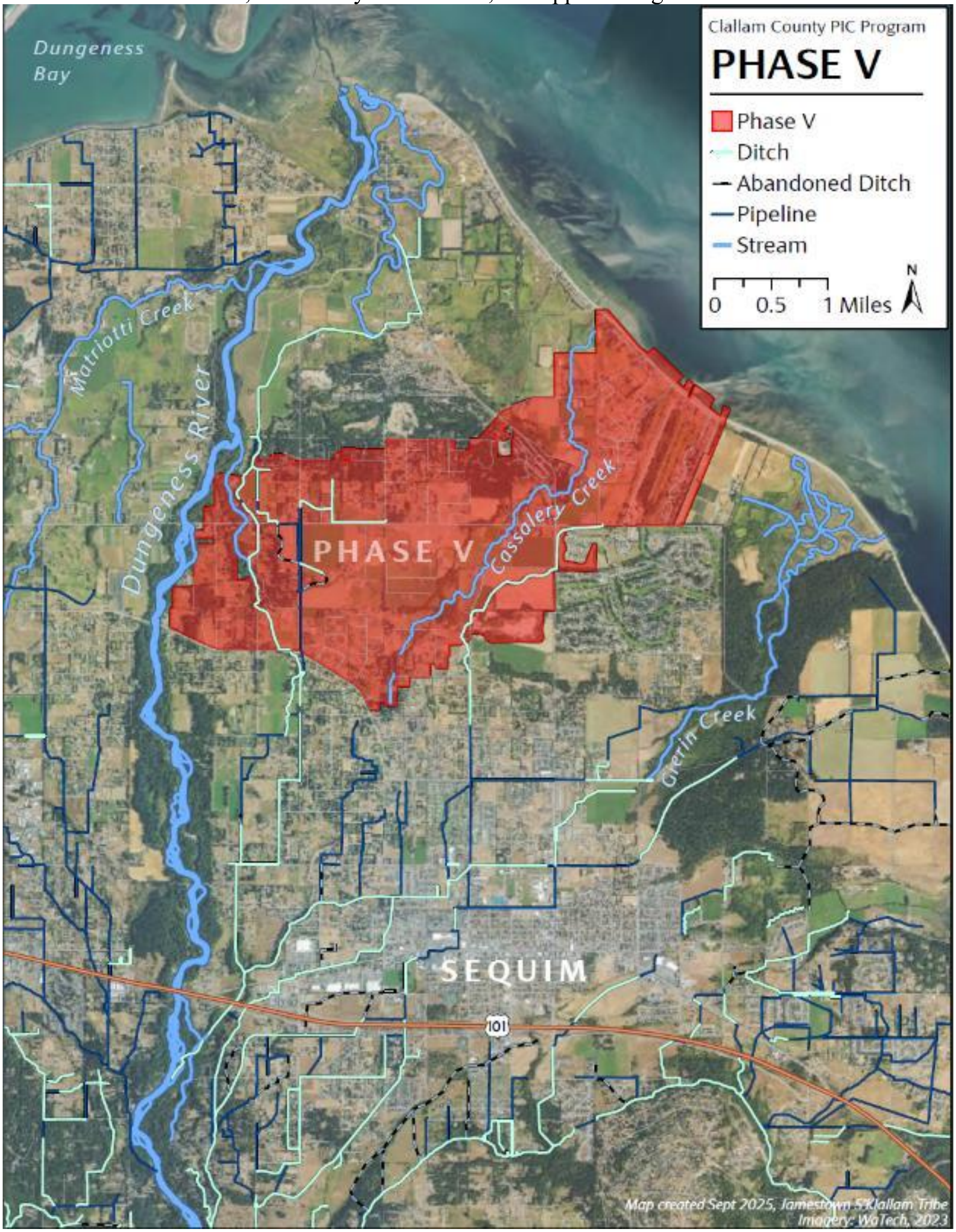


Figure 8. PIC Focus Areas 2026-2028.

7.2 Field data collection

7.2.1 Sampling locations and frequency

<u>Trends Monitoring</u>

Trends monitoring is currently underway under a previous QAPP (Strivens et al. 2025). Sampling will continue once a month on Tier I waterways and quarterly on Tier II waterways from February 2026 through May 2028 (Table 9, Table 10, Figure 9). Tier assignments are subject to change as situations change, and data informs adaptation. When changes are made, they will be reported in the following annual report. General criteria for choosing sites and parameters are discussed below.

Sampling site selections include the following considerations:

- Attempt to sample all freshwater discharges to marine waters in the study area, plus major tributaries to those discharges.
- Sample each discharge downstream of as many possible point or non-point inputs as possible.
- If possible:
    - Avoid tidal influence so samples will represent freshwater concentrations and sources. Where there is tidal influence, sample from the uppermost, least saline, layer of water.
    - Sample at sites with the greatest ease of access, such as public access.

When possible, all monthly or quarterly samples will be collected on the same date. When not practical to do so, sites will be split such that all drainages to specific receiving waters will be sampled on the same day.

Windows for quarterly sampling will be the months of January, April, August, and November. These months correspond to seasonal spikes observed in past sampling.

Descriptions of each steam can be found in Appendix 2. CWD Stream Descriptions.

Table 9. Tier 1 Trends sites (FC monthly/ FC + nutrients)

Stream Name	Receiving Waters	Monitoring Station (CCWR/EIM)	Description
Agnew Creek	Strait of Juan de Fuca	Agnew Creek/Ditch 0.3	At 1079 Finn Hall Road
McDonald Creek		McDonald Creek 1.6	Downstream of Old Olympic Hwy bridge
Dungeness River	Dungeness Bay	Dungeness 0.7	0.3 miles downstream of Schoolhouse Bridge, access from Rivers End Rd.
Meadowbrook Creek		Meadowbrook 0.2	Near mouth, upstream of Sequim-Dungeness Way, near Three Crabs Rd.
Meadowbrook Slough		Meadowbrook Slough 0.23	Upstream of the Dungeness Farm Bridge at the end of Abernathy St.
Golden Sands Slough		Golden Sands Slough 0.0	At outlet on south side of Three Crabs Rd.
Cassalery Creek		Cassalery 0.0 (or 0.6 if tide is high)	At mouth; private but can be accessed via neighbor & beach
Gierin Creek		Gierin 1.8	At upper end of Grays Marsh property, below tributary

Stream Name	Receiving Waters	Monitoring Station (CCWR/EIM)	Description
Matriotti Creek	Dungeness River	Matriotti 0.3a	Downstream of Ward Rd.
Lotzgesell Creek		Lotzgesell 0.1	Upstream of confluence with Matriotti Cr., on Game Farm property
Bell Creek	Sequim Bay	Bell 0.2	About 30' above Schmuck Rd.

Table 10. Tier 2 Trends sites (FC quarterly)

Stream Name	Receiving Waters	Monitoring Station (CCWR/EIM)	Description
Bagley Creek	Strait of Juan de Fuca	Bagley Creek 0.7a	Downstream of Olympic Discovery Trail bridge
Siebert Creek		Siebert Creek 1.0	At Olympic Discovery Trail parking area
Hurd Creek	Dungeness River	Hurd Creek 0.2	At Moore property
Dean Creek	Sequim Bay	Dean Creek 0.17	At Olympic Discovery Bridge
No Name Creek		No Name Creek 0.03	Next to Jamestown Tribe Admin. Bridge
Chicken Coop Creek		Chicken Coop 0.24	About 50 feet upstream of culvert at Old Blyn Hwy.
Cooper Creek		Cooper 0.1	Access from Three Crabs Rd.
Jimmycomelately Cr.		Jimmycomelately 0.15	Upstream of Hwy 101, Ecology gage
Johnson Creek		Johnson Creek 0.0	Downstream of culvert, SE end of Marina parking lot.
Sequim Bay State Park Creek		Sequim Bay State Park Creek 0.0 (or 0.1 if tidal influence is present)	Sequim Bay State Park, near mouth of creek

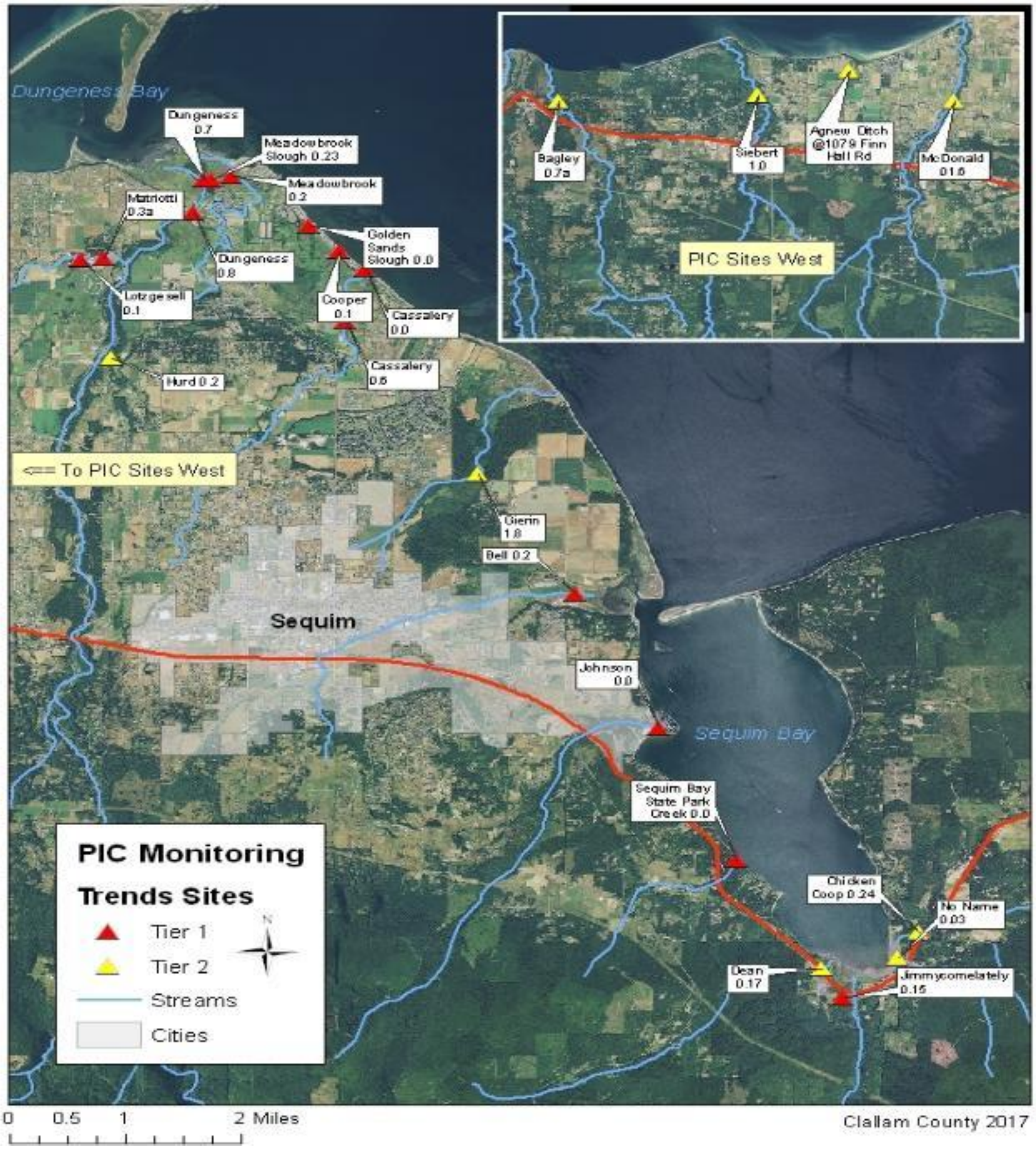


Figure 9. Trends Monitoring Program Sampling Sites

<u>Segmented Monitoring</u>

PIC project monitoring will include segmented sampling of targeted sub-basins that have been prioritized for cleanup. The current PIC focus area has been adopted by the Clean Water Work Group from the prioritization process described the PIC Plan (Clallam Conservation District 2014).

Segmented sampling will be conducted once a month at all sites referenced Table 11, from February 2026 through May 2028. Sites were chosen based on accessibility, and roughly evenly distributed from one another to capture an accurate representation within the focus area, as well as support more effective "hot spot" sampling. If possible, all monthly samples will be collected on the same date. When it is not practical to do so, sites will be split such that all samples in a drainage area will be collected on the same day.

Table 11. Segmented Monitoring sites (FC monthly)

Stream Name	Receiving Waters	Monitoring Station (CCWR/EIM)	GIS Coordinates (Latitude | Longitude)	
Dungeness River	Dungeness Bay	Dungeness RM3.2	48.116219	123.149840
		Dungeness RM4.0	48.107678	123.153259
Dung. Irr. Ditch	Meadowbrook Creek	Dungeness Irrigation DM0.0	48.140898	123.123101
		Dungeness Irrigation DM2.4	48.119400	123.142156
		Dungeness Irrigation DM2.65	48.116290	123.140385
		Dungeness Irrigation DM2.8	48.113805	123.140167
		Dungeness Irrigation DM3.6	48.105427	123.136154
		Dungeness Irrigation Pond	48.116237	123.124119
Cassalery Creek	Jamestown Growing Area	Cassalery CM0.0	48.134272	123.097013
		Cassalery CM0.6	48.126931	123.100647
		Cassalery CM1.1	48.120642	123.098357
		Cassalery CM1.85	48.116106	123.108796
		Cassalery CM2.2	48.112434	123.112534
		Cassalery CM2.8	48.107167	123.118133

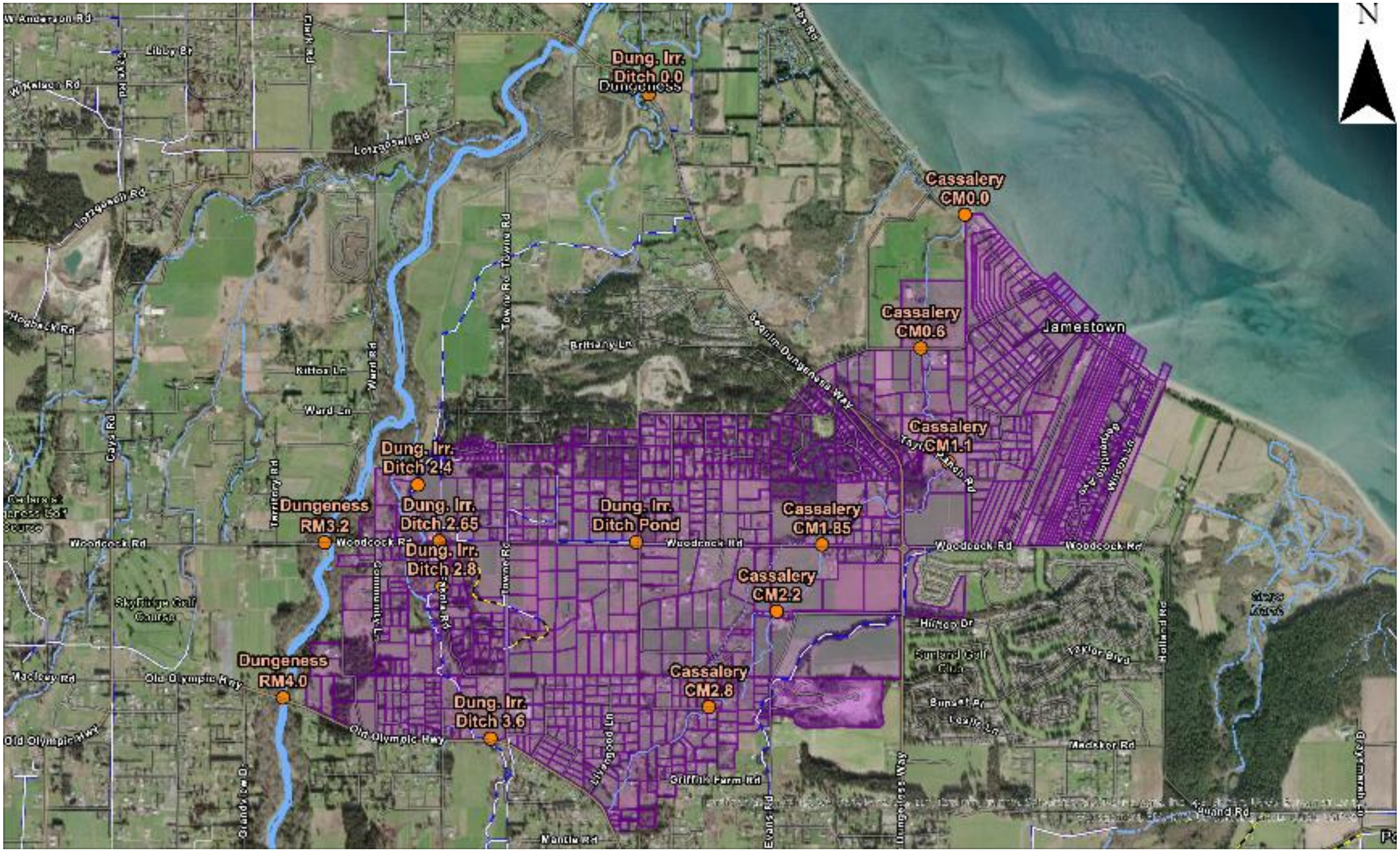


Figure 10. Maps showing sampling locations for Segmented monitoring.

The goal of segmented sampling is to locate contamination "hot spots" within a priority sub-basin. "Hot spots" will be defined as locations where the geometric mean of three water quality samples exceeds the "Extraordinary" water quality standard set by Washington State (i.e., 50 fecal coliform colony-forming units per 100 mL for freshwater). Selection of the hot-spot sampling sites is based on a review of available records (e.g., OSSs of concern, poorly drained soils) and visual assessments of potential pollution sources (e.g., poorly managed farms or homes with questionable septic systems).

All samples with FC results exceeding 50 cfu/100mL will be re-sampled to confirm that they are indeed hot spots. Re-sampling will occur as soon as possible, ideally within a few days of the initial collection date. When the geometric mean from samples taken exceeds 50 cfu/100mL, the hot spot will be designated, warranting further investigation. All hot spots should be investigated. However, when multiple hot spots are identified, additional investigations will be prioritized using the criteria shown in Table 12.

Table 12. Scheme for prioritizing hot spot investigation

Indicator Organism	**High Priority**	**Medium Priority**	**Low Priority**
Fecal Coliform (FC)	> 400 FC / 100mL	100 to 399 FC / 100mL	50 to 99 cfu/100mL

After a hot spot has been identified, additional sampling may occur if needed to further identify the source or sources of pollution. Additional sampling is needed when multiple discharges such as stormwater ditches, drainage pipes, irrigation ditches and other drains come to a focal point upstream of the identified hot spot.

7.2.2 Field parameters and laboratory analytes to be measured

A. Trends Monitoring: Both Tier I & Tier II sampling will include the following parameters:

- Fecal coliform (cfu/100 mL)
- Water temperature (°C)
- pH
- Salinity (ppt or PSS)
- Dissolved Oxygen (mg/L)
- Conductivity (µs/cm)
- Turbidity (FNU)
- Flow (flow meter, cu ft/sec or stream gage, ft)

Tier I sampling will also include the following parameters:

- Dissolved nutrients: NO_3, NO_2, NH_4, PO_4 (µg/L).

B. PIC Segmented monitoring will include the following parameters:

- Fecal coliform (cfu/100 mL)
- E. coli (cfu/100 mL) – as needed for source identification
- Water temperature (°C)
- Salinity (ppt or PSS)
- Flow (flow meter, cu ft/sec) - quarterly

C. PIC Project monitoring (hotspot or property sampling) will include the following parameters:

- Fecal coliform (cfu/100 mL)
- Water temperature (°C)
- Salinity (ppt or PSS)

7.3 Modeling and analysis design

Not applicable.

7.4 Assumptions underlying design

The study area has been the target of several water quality investigations in the past two decades, both of surface and ground water. These prior investigations inform the selection of Tier I & II sites and the parameters to be measured, based on existing data and potential impact to public health and shellfish harvest. Tier II sites are assumed to contribute a smaller load of pollutants to receiving waters based on historic data, land use, or size of discharge.

This QAPP identifies analytical methods that will be used to measure nutrients in Trends Monitoring program samples (see Section 9.0). In choosing these methods, we assume that the same laboratory and methods as have been used previously will provide comparable results helpful in identifying water quality trends and pollution sources.

7.5 Possible challenges and contingencies

Primary sampling site locations are easily accessible from County easements or pre-arranged permission to access private property. Sampling is always conducted with a minimum of two staff or volunteers in the event an issue arises in the field, with a contact in the office aware of field samplers' whereabouts and expected time of arrival back.

7.5.1 Logistical problems

Logistical problems should be minimal as the project sampling sites are easily accessed, and Trends sites have been sampled routinely for over 20 years. Segmented sampling may find issues with low or no flow in creeks and ditches, depending on low snowpack, low rainfall, or low irrigation water levels at time of sampling.

7.5.2 Practical constraints

Practical constraints regarding the field aspect of this project are having adequate volunteer support for sampling.

7.5.3 Schedule limitations

Limitations on schedule include the time required to complete and finalize the QAPP, availability of staff, field samplers, calibrated equipment, supplies, laboratories, weather, tides, and funding. Also, field days are limited by the need to submit FC samples to the CCEH Lab by 12:00 pm on Thursdays.

8.0 Field Procedures

8.1 Invasive species evaluation

To avoid cross-contamination of invasive species between sites, samplers will follow the Streamkeepers of Clallam County Anti-Contamination Protocol (Chadd 2016), which is compliant with Ecology Standard Operating Procedures (SOP) EAP070 and EAP071.

8.2 Measurement and sampling procedures

SK maintains rigorous protocols for all steps in the process of monitoring area streams, from documentation to calibration to SOPs to training. Details from their QAPP are referenced below (Chadd 2019). The SK QAPP draws from several WA Dept. of Ecology's published SOP's, including, EPA042, Measuring Gage Height of Streams, and EAP030, Collection of Fecal Coliform Bacteria Samples in Surface Water. SK protocols are also followed by CCEH and JS'KT staff.

Training:

SK offers training to volunteers, based on the procedures in the Volunteer Handbook (Chadd 2016). Volunteers see the procedures demonstrated and have the opportunity to practice them, under supervision of staff or experienced volunteers. Training participation is recorded in SK database. New volunteers are then assigned to teams with experienced volunteers guiding them through procedures. Usually, several outings are required before new volunteers feel comfortable performing procedures on their own. Only volunteers trained in a given procedure will be allowed to attach their initials to data gathered under that procedure. The SK database connects all data with a sampler, whose training history is recorded in a separate table in that database.

Qualifiers Based on QC Controls:

For each QC check performed, qualifiers indicated by a QC test will be applied to all data governed by that test. In general, instruments will be calibrated (or checked if not able to be calibrated) prior to the sampling session and then checked subsequent to the sampling session. Both pre- and post-sampling checks must meet QC criteria in order for data gathered in between to be considered acceptable.

Accuracy Tests:

Accuracy of water quality measurements is assessed by performance evaluation measurements of the equipment; see Table 7 and Table 8 for criteria.

Precision Tests:

Precision of water quality measurements is assessed by analysis of replicate samples taken in the field at one site per team per sampling period. The variation between these sample and replicate values is a measure of variability due to short-term environmental factors, instrument operation, and sampling procedure. See Table 7 and Table 8 for acceptance criteria and control limits based on comparing replicates with their paired samples.

QC qualifiers are then applied to all samples in the grouping covered by that replicate/sample pair—for example, the entire group of samples taken by that team during that sampling period. These qualifiers are only applied if they downgrade already-applied QC qualifiers; for example, if program managers have already applied a "REJ" qualifier to a result, a downgrade value of "EST" based on replicate/sample comparison will not change the "REJ" designation for that result.

Special note for QC of fecal coliform samples:
Both field and lab replicates are taken with ≥ 5% of samples. The acceptance criteria and control limits in Table 7 are based on comparing field replicates with their paired samples (Mathieu 2006).

Side-by-Side Sampling—External:
Separate from Ecology monitoring activities, as possible, SK volunteers or staff will participate in Ecology's Side-by-Side Sampling program, whereby water-quality monitors test water bodies at the same time Ecology tests them as part of their monthly Ambient Monitoring Program. This program affords both parties the opportunity for additional confirmation of their data.

In-Situ Sampling Procedures:
A basic schema of sampling and measurement procedures is presented in Section 8.2 Measurement and sampling procedures, above. The cited method sources, hereby incorporated by reference into this document, give full explanations relating to:

- collection of samples and associated field QC samples
- analytical methods for measurements/analyses done in the field as well as the laboratory
- required equipment and in-situ calibration and maintenance procedures
- required content and format of field log entries
- sampling equipment and methods for its preparation and decontamination

8.3 Containers, preservation methods, holding times

Table 13 describes appropriate containers, preservation techniques, and holding times as per 40CFR 136.

Table 13. Sample containers, preservation, and holding times.

Parameter	Matrix	Minimum Quantity Required	Container	Preservative	Holding Time
Fecal coliform [CCEH Lab]	Water	100 ml	Sterilized poly ≥125 mL	1-4°C, dark	6 hr
Nutrients (dissolved) [UW][1]	Water	40 ml	60 mL HDPE narrow mouth acid washed	Field filter with surfactant-free cellulose acetate filter; 4°± 2°C, dark	24 hr

1. Containers will be supplied by the accredited laboratory.

8.4 Equipment decontamination

Refer to Section 8.1 Invasive species evaluation.

8.5 Sample ID

Bottles will be labeled either with numbers, referenced on the field data sheet, or with the name of the site, date, and QC type (primary sample, field replicate, blank). Bottles intended for different analyses can be distinguished by size and shape, so no further labeling is necessary. Each bottle sent to a lab will be entered into the Clallam County Water Resources (CCWR) database with a unique ID, and each result from each Batch will also have a unique ID.

8.6 Chain of custody

Samples will be sent to the appropriate lab accompanied by a copy of the relevant field sampling log and a chain of custody form, obtained from the labs, that has been signed and dated. Please refer to Figure 11 for a sample chain-of-custody form.

PIC Trends Monitoring **Date:** ___/___/___ Clallam County Env. Health Lab / Other: ______________________ *Tour ID:* ______ ***Rev. 2/8/17***

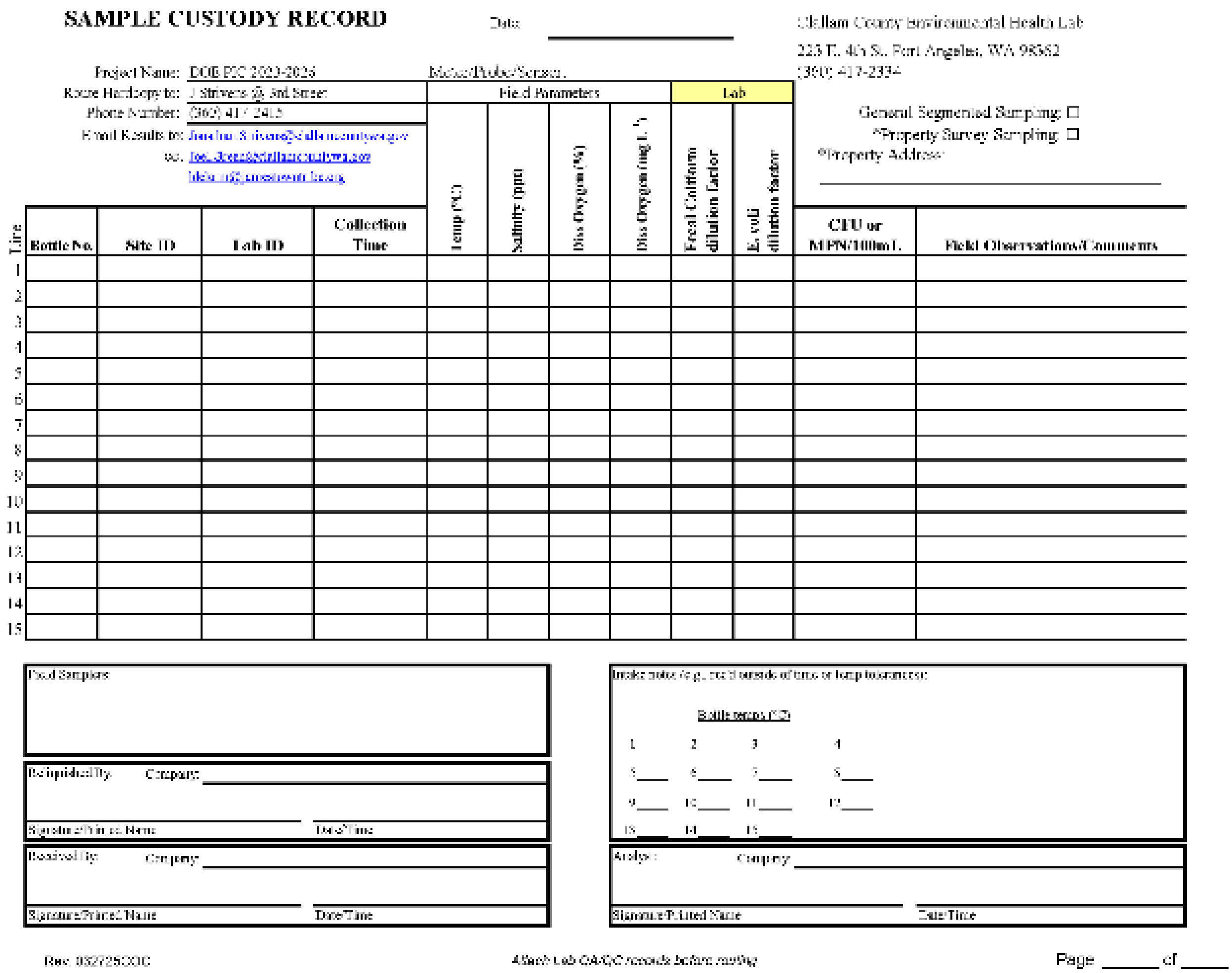
Tier 1 monthly **Samplers' initials: Stage/Flow: WQ: Bacteria: Nutrients: Turbidity grabs:**

Field ID (fecal bottle #)	Station Name, Code, or Description (Label nutrients bottles with the same number as on the corresponding bacterial sample bottle, and send a copy of this field sheet to the nutrients lab.)	Temperature control at lab, °C	Time (military)	Gage height /Water-level/Top-down (ft)	Samples taken with ProDSS / YSI-85 (circle) #____ Wtr Temp to 0.1 °C	Barometric Pressure to 0.01 in Hg	Dissolved Oxygen to whole % Local	Dissolved Oxygen to 0.1 mg/L	Specific Cond SpC to whole µS/cm	Salinity to 0.1 PSU (ppt)	pH to 0.1	Turbidity to whole FNU	Fecal/ lab rep counts per 100 mL factor	Fecal qualifier (U=<; G=>)	Clallam County lab #	Comments **Stream conditions: -turbid? -smelly? **Ebb or Flood Tide? (Cassalery mouth) **Problems sampling **Unusual situations *(Continue on back if needed; indicate stream & location.)*
	Jimmycomelately 0.15			GH												
	Sequim Bay State Pk 0.0	X		TD -												
	Johnson 0.0	X		GH												
	Bell 0.2	X		GH												
	Cassalery 0.0	X		EST												
	Cassalery 0.6 *(if 0.0 tidal influence; ALWAYS read gage)*	X		GH												
	Meadowbrook Slough .23	X		TD -												
	Cooper 0.1	X		TD -												
	Golden Sands Slough 0.0	X		TD -												
	Meadowbrook 0.2	X		TD -												
	Meadowbrook 0.2 blanks	X		X	X	X	X	X	X	X	X					
	Dungeness 0.7	X		X												*Flow @ECY gage Dung 0.8:* _____ *cfs @* ___:___ /_____
	Lotzgesell 0.1	X		TD -												
	Matriotti 0.3a	X		TD -												
	Matriotti 0.3a replicates	X		X												

GH = gage height; TD = measure top-down (record as a negative number); EST=floating-object flow estimate—see other side for calculation

Fecal lab samples submitted by (incl. initials): _____________ Date: ________ Time: _______ Rec'd by: _______________ Date: ________ Time: _______

Nutrients samples submitted by (incl. initials): _____________ Date: ________ Time: _______ Rec'd by: _______________ Date: ________ Time: _______



SAMPLE CUSTODY RECORD

Date:

Clallam County Environmental Health Lab
223 E. 4th St., Port Angeles, WA 98362
(360) 417-2334

Project Name: DOE PIC 2023-2026
Route Hardcopy to:
Phone Number:
Email Results to:

General Segmented Sampling: ☐
*Property Survey Sampling: ☐
*Property Address:

Line	Bottle No.	Site ID	Lab ID	Collection Time	Temp (°C)	Salinity (ppt)	Diss Oxygen (%)	Diss Oxygen (mg L⁻¹)	Fecal Coliform dilution factor	E. coli dilution factor	CFU or MPN/100mL	Field Observations/Comments
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												

Field Samplers:

Relinquished By: Company:
Signature/Printed Name Date/Time

Received By: Company:
Signature/Printed Name Date/Time

Bottle temps (°C)

Analyst: Company:
Signature/Printed Name Date/Time

Attach Lab QA/QC records before routing

Page ____ of ____

Figure 11. Chain of custody form examples.

8.7 Field log requirements

The field log for this project will consist of the field sampling log sheet containing the primary data, plus the additional log sheets listed below, describing the overall sampling event and calibration/drift check results. Any corrections will use strikeouts and be initialed and dated.

- Episode/Tour cover sheet—one per sampling team per sampling day
  - https://www.clallamcountywa.gov/DocumentCenter/View/6045/Episode-Tour-Cover-Sheet-PDF
  - Weather comment section on Tour cover sheet will include a record of precipitation from previous 24 and 48 hours from the National Weather Service.
- Instrument calibration activity & pre/post checks:
  - https://clallamcountywa.gov/ArchiveCenter/ViewFile/Item/424

8.8 Other activities

Stream Gages

At sites with stream gages, samplers will be asked to record stage height. Sites without gages will be measured for stage from a top-down reference point where possible.

Flow measurements

Flow measurements will be recorded, based on staff availability. Measurements will be taken by a Sontec FlowTracker2, User manual 1.0, Software 1.0 and Firmware 1.0. The PIC sampling team follows the U.S. Geological Survey streamflow protocol for stream discharge measurements (Turnipseed and Sauer 2010).

Flow Measurement Procedure

Prior to sampling the equipment from the following list will be assembled.

Equipment List

1. Handheld FlowTracker2 with mounting brackets and hard carrying case
2. Eight AA batteries installed in FlowTracker2 and extra batteries stored in case
3. Top-setting wading rod, assembled
4. Field tape measure
5. 2 stakes, 2 clamps and hammer or mallet
6. Calculator or cell phone
7. Field sheet, clipboard, pencils/pens

Site Selection

Flow sites will be selected and prioritized by the following criteria:

1. Safety and accessibility of the site.
2. Ideal physical characteristics of the stream bed include small cobble or small gravel substrate, straight channel, no large obstructions and little vegetation causing flow obstruction.
3. Preferably at least six inches deep during lowest flow time of the year, and ideally at least five feet wide.

Taking the Measurement

1. Arrive at flow sampling site and collect gear.
2. Install stakes on each side of the stream directly across from each other, and high enough above the wetted area so that the tape does not touch the water.
3. Stretch tape across the creek perpendicular to the direction of the flow. Secure tape with clamps.
4. The wetted area of the creek is measured and divided by 10 to provide the interval number.
5. Once interval is set, power on the FlowTracker2 and perform the Automated Beam Check. Automated Beam Check collects data for 30 seconds, and if passed, press start to begin collecting data following the FlowTracker 2 Velocity Method of 0.6. Any depth over 1.0 feet will follow the 0.2/0.8 method.

Field assistant will record data on a field sheet while data is simultaneously recorded in the FlowTracker 2 equipment.

Data Transfer

Once back at the office, data will be transferred from the handheld FlowTracker2 to the Sontec software via blue tooth. Data will then be stored in an excel spreadsheet and shared with PIC partners.

Other General QC Measures:

- Clear, user-friendly, and detailed instructions for all procedures, minimizing judgment calls
- Equipment checked for damage prior to sampling
- Multiple observers when possible
- Each sampling team has an experienced leader
- Staff review of data, including comparing values year-to-year
- Values compared to external data from other agencies, such as stream gage data

9.0 Laboratory Procedures

9.1 Lab procedures table

The matrix for all analyses will be non-potable water. Analytical methods are listed in Table 14. All bacteria samples will be delivered the same day to the CCEH Water Lab in Port Angeles, WA (accreditation # H421) to be analyzed.

Nutrient analyses of water samples will be performed by the UW School of Oceanography Marine Chemistry Laboratory in Seattle, WA. All nutrient samples will be shipped to the UW Lab on the day of sampling. The UW Lab will batch the dissolved nutrients NO_3, NO_2, NH_4, for PO_4 for analyses.

Table 14. Measurement methods (laboratory).

Analyte	Sample Matrix	Samples (Number/ Arrival Date)	Expected Range of Results	Detection Limit	Sample Prep Method	Analytical (Instrumental) Method
Fecal coliform	Water	12-15 samples monthly, additional samples as needed	1 - >2000 cfu / 100 mL	1 cfu * 100 mL /volume used in the analysis	Two to ten-fold dilution	SM 9222 D
E. coli		12-15 samples quarterly, additional samples as needed	100-10000 MPN / 100 mL	1 MPN * 100 mL /volume used in the analysis	Two to ten-fold dilution	SM 9223B
NO_3 - N		12-15 samples every 2 months	0.0134 - >13.0 mg/L	0.0028 mg/L	Field filter with surfactant-free cellulose acetate filter	EPA 353.4
NO_2 - N			0.0010 - >13.0 mg/L	0.0003 mg/L		
NH_4 - N			0.0049 - >200.0 mg/L	0.0006 mg/L		EPA 349
PO_4 - P			0.0113 - >218.0 mg/L	0.0006 mg/L		EPA 365.5

Reporting Limits (RLs): For nutrient RLs, Field Blank data (without qualifiers) will be used to calculate synthesized RLs for the various parameters, with this procedure developed in consultation with EPA: The synthesized RL will be the larger of 3.18 * MDL or the mean +1 standard deviation of the non-OUT field blanks. For bacteria, RLs are equivalent to DLs, which are based on dilution factors.

9.2 Sample preparation method(s)

Please refer to Table 14 above.

9.3 Special method requirements

Not Applicable.

9.4 Laboratories accredited for methods

This PIC project will contract with CCEH Water Lab (accreditation # H421) for monthly trends analysis and segmented analysis of FC or E. coli samples and UW Marine Chemistry Lab for monthly analyses of nutrient samples.

This project obtained a Washington State Department of Ecology laboratory accreditation waiver for the analysis of nutrient parameters: nitrate-nitrogen (NO_3-N) and nitrite-nitrogen (NO_2-N) by EPA Method 353.4_2_1997, ammonium-nitrogen (NH_4-N) by EPA Method 349, and orthophosphate (PO_4-P) by EPA Method 365.5_1.4_1997. There are no laboratories currently accredited by the Washington State Department of Ecology to perform these specific methods. The selected methods are necessary to conduct accurate salinity corrections critical to the integrity of the dataset and to meet project reporting limit DQOs. This waiver supports the project's goal to ensure scientifically valid and defensible data while adhering to practical and regulatory constraints.

10.0 Quality Control Procedures

10.1 Table of field and laboratory quality control

Table 15. Quality control samples, types, and frequency.

<table>
<tr><th>Parameter</th><th>Field Blanks</th><th>Field Replicates</th><th>Laboratory Check Standards</th><th>Laboratory Method Blanks</th><th>Analytical Duplicates</th><th>Laboratory Matrix Spikes</th></tr>
<tr><td>Bacteria</td><td colspan="2" rowspan="2">≥ 1 per tour and 5% of sites</td><td>n/a</td><td>2 per ≤ 10 samples</td><td>1 per ≤ 10 samples</td><td>n/a</td></tr>
<tr><td>Dissolved Nutrients</td><td>2 per run</td><td>2 per run</td><td>1 per ≤ 20 samples</td><td>1 per ≤ 20 samples</td></tr>
<tr><td>Water temperature</td><td rowspan="5">n/a</td><td rowspan="5">≥ 1 per tour & 5% of sites</td><td rowspan="5">n/a</td><td rowspan="5">n/a</td><td rowspan="5">n/a</td><td rowspan="5">n/a</td></tr>
<tr><td>Salinity</td></tr>
<tr><td>Dissolved Oxygen</td></tr>
<tr><td>pH</td></tr>
<tr><td>Turbidity</td></tr>
</table>

Each type of QC sample listed above will have MQOs associated with it (Section 6.2) that will be used to evaluate the quality and usability of the results. A "tour" is a round of sampling conducted on a given day by a given field team. A "run" is a batch of samples processed by the lab. Laboratory QC samples results will be obtained by Streamkeepers for documentation purposes.

10.2 Corrective action processes

If data fall outside the specified accuracy or precision criteria defined in Table 7, or if problems affecting comparability are identified, the laboratory leader must contact the PIC coordinator to discuss options available for rectifying the issue. All QC sample failures and associated corrective actions must be documented in the data report narratives. If data must be reported with failing QC results, then data qualifiers shall be assigned. Data shall be reviewed by the laboratory and project quality control officers or designees to assure that it is complete. Data review will include data verification, validation, and oversight for level II reporting. An assessment of overall data quality will be provided in the final project report. Any departures from this QAPP will be documented in the final report.

Qualifiers will be assigned to data as appropriate, based on qualifier codes developed by the EIM. To be unqualified (i.e., acceptable without qualification for submission for the State Water Quality Report), data must be gathered in accordance with established monitoring procedures, be fully documented, and pass all QC requirements. The most common data qualifiers are:

- **J-variants** (laboratory-data estimate[JG, JK, JL]): Apply if laboratory identifies sample as an estimate, or if established QC procedures have not been followed or documented (for example, lab duplicates were not run), or one or more QC control limits have not passed (for example, lab duplicates were outside precision targets), but the QA officer determines the data to be reasonably trustworthy for general water-quality assessments.

- **J** (Estimated: The analyte was positively identified, and the associated numerical value is the approximate concentration of the analyte in the sample): Apply if established procedures have not been followed or documented, or one or more QC screens have not passed, but QA officer believes the data to be reasonably trustworthy for general water-quality assessments.
- **OUT** (outlier within dataset): Apply to Field Blanks that fail Tukey fence analysis with k = 1.5.
- **REJ** (rejected): Apply if established procedures have not been followed and/or documented, or one or more QC screens have not passed, and QA officer believes the data to be untrustworthy for any purpose.

If data are flagged by the laboratory or adjusted due to blanks, replicates, spikes, or standards, these adjustments will be documented along with the data and flagged appropriately.

Field blank and sample results for each parameter for each day will be processed using the following steps, developed in consultation with state and federal scientists (N Mathieu, personal communication, 2014; D Matheny, personal communication, 2014; T Gries, personal communication, 2018; APHA, 2012):

- If, after procedural QC and outlier analysis, Field Blank (FB) has not been qualified and FB ≤ Reporting Limit (RL), no qualifier for the field samples.
- If FB has been qualified, qualify all field samples as J or REJ per judgment of the QA officer, and record a comment alongside the data explaining why that qualifier was applied; for example, "FB is OUT but data deemed reasonable."
- Else, if FB > RL, qualify the FB as J with the comment ">RL". Designate (FB – RL) as the absolute bias for that day, in which case the relative bias for a given measurement would be (absolute bias) / (sample value). Then apply qualifiers per the MQOs for bias:
  - If (relative bias) ≤ (target bias) for that parameter, no qualifier for field samples.
  - If (relative bias) > (target bias) but field sample value ≤ RL, qualify it as B, defined by EIM as "Analyte detected in sample and method blank. Reported result is sample concentration without blank correction" (Ecology, 2019); the rationale is that field data with a value < the RL (and also < the FB) is indicative of a truly low value that should not be rejected, regardless of potential contamination issues evidenced by the high FB.
  - Else, qualify all field samples as J, or REJ when relative bias is >20%, and record a comment alongside the data explaining why that qualifier was applied; for example, "FB > RL and rel bias > 20%."

For in-situ measurements, see Additional QC notes in Section 8.2 Measurement and sampling procedures.

11.0 Data Management Procedures

11.1 Data recording and reporting requirements

The Environmental Information System (EIM) Study ID for this project is WQC-2026-00371.

Trends and Segmented data collection, quality control, management, and reporting will be coordinated by Streamkeepers and CCEH, respectively. See Section 5.0 Organization and Schedule, for more details.

Recording Field Data
Field data will be collected on custom-designed data sheets. The primary field data sheet, as well as ancillary data sheets (Episode and Tour cover sheets, calibration/check sheets), are on the SK website at https://www.clallamcountywa.gov/904/Data-Sheets-Forms-Tools. Field samplers will record data and enter their initials on these sheets. When all data have been collected at a site, the team leader looks over the sheets for completeness, legibility, and obvious errors, and gets further information from team members as appropriate. Any problems with data collection are noted in a "Comments" section of the data sheet. The team leader initials and dates this review, then initials and dates again when turning the sheets in to the office. Then staff initials and dates receipt and QC review of the data. This latter review is a thorough process that includes troubleshooting for decimal and rounding errors, data entered into the wrong field, incomplete data, etc.

Transferring Data to Electronic Form
Once field data sheets have been received and reviewed at the Streamkeepers office, volunteers will enter the Trends Monitoring data into the CCWR database. Detailed procedures will be provided to the volunteers, both in written form and in one-on-one training, and staff will be available to volunteers as they perform data entry. Volunteers subsequently will check database entries against field sheets.

Laboratory Data Upload
When laboratories report data in a standard electronic format, SK staff and volunteers will devise database queries to upload the data.

Automated Data Checks
Our intention is to program the CCWR database to automatically perform some of the statistical checks described in the "Quality Control" section above, and in some cases to downgrade data automatically as appropriate (leaving a record of the downgrade). In other cases, the database will display a message instructing program managers to examine data and apply downgrades as appropriate. These automated routines will ensure compliance with QC procedures. In the absence of automation, data qualifiers will be applied manually by the QC officer. If Streamkeepers completes coding for an automated QC review process, an addendum to the QAPP will be approved prior to use.

Final Sign-Off of Data
Once all of the above checks have been performed, the QA officer will do a final review of data, including examination of outliers, and sign off that the data are ready for publication.

Management and Storage of Database
The CCWR database is managed by SK. It is stored on Clallam County's network drive, which is backed up daily. The database itself is two files: CCWR_Data consists exclusively of data tables,

while CCWR_User comprises data-entry forms, database queries, reports, lookup tables, metadata, and other database objects. This structure provides stable storage for data.

Retrieval of Data
Data can be retrieved from the CCWR database in a variety of ways. Several custom-made reports and queries have been designed to portray the environmental data in the database. Data can also be retrieved via user queries. A variety of CCWR data is also available on the Streamkeepers website: https://www.clallamcountywa.gov/901/Streamkeepers.

11.2 Laboratory data package requirements

Lab documentation should always include all QC results associated with the data, a case narrative discussing any problems with the analyses, corrective actions taken, changes to the referenced method, and an explanation of data qualifiers.

The CCEH Water Lab reports results directly on data sheets provided for the project. Outside laboratories will report results and QC information on their standard forms via email.

Laboratories are required to keep a backup of all records for a minimum of five years.

11.3 Electronic transfer requirements

Any electronic data transfer will be requested in readable format.

11.4 EIM/STORET data upload procedures

All new data will be uploaded from the CCWR database to Ecology's EIM database for subsequent transfer by Ecology to EPA's WQX database. Upon upload of data to EIM, the data manager will request confirmation that the data have, in turn, been sent to EPA's WQX.

11.5 Model information management

Not applicable.

12.0 Audits and Reports

12.1 Field, laboratory, and other audits

Formal field and laboratory audits are not planned at this time. "Spot-checks" will be performed as needed, through either testing of triplicate field samples or triplicate laboratory analysis of individual samples.

12.2 Responsible personnel

Formal program audits are not planned at this time but the need for a program audit may be considered in the future. In lieu of such an audit, the QA officer will be responsible for day-to-day compliance with this document, including assuring that quality of the data is acceptable and that corrective actions are implemented in a timely manner. QC review and signoff will be conducted after each sampling period. In addition, the project manager will review the data and metadata in consultation with the QA officer at some point early in the project and at the end of the project, to assure that procedures have been followed as outlined in this document.

Laboratories participate in performance and system audits of their own procedures; these are available on request.

12.3 Frequency and distribution of reports

Data will be submitted annually to Ecology through EIM. Ecology, when able, will forward data on to EPA's WQX's database. A report documenting Trends work will be written annually, and a Final Report encompassing Trends and Segmented results will be written at the conclusion of the grant period.

12.4 Responsibility for reports

The annual Trends report will be written by the Streamkeepers Coordinator and Streamkeepers volunteers. The Final report will be written by the PIC Program Coordinator, with input and/or review from the Streamkeepers Coordinator and Jamestown S'Klallam Tribe Natural Resources staff.

13.0 Data Verification

EPA defines data verification as “the process of evaluating the completeness, correctness, and conformance/compliance of a specific data set against the method, procedural, or contractual requirements.”

13.1 Field data verification, requirements, and responsibilities

Field team leaders will verify data before turning in data sheets. The QA officer will examine the data and metadata for errors or omissions as well as completeness and compliance with QC acceptance criteria and will apply data qualifiers as needed.

13.2 Laboratory data verification

Laboratory results are reviewed and verified by qualified and experienced lab staff, with findings documented in a case narrative.

13.3 Validation requirements, if necessary

The complete data package, along with the laboratories’ written reports, will be assessed by the QA officer and project manager for completeness and reasonableness. There will be no independent data validation.

13.4 Model quality assessment

Not applicable.

14.0 Data Quality (Usability) Assessment

14.1 Process for determining project objectives were met

The process for determining whether project objectives were met will involve a comprehensive evaluation of data quality, completeness, and relevance in relation to the goals and objectives outlined in Section 4.0. The project manager, in consultation with the QA officer, laboratory managers, and project partners, will assess data quality at annual intervals and at project completion. Verified and validated data will be reviewed against the established data quality objectives (DQOs) and measurement quality objectives (MQOs) described in Sections 6.1 and 6.2. Completeness will be determined as the proportion of planned samples successfully collected and analyzed, with a target of at least 95%. Precision, bias, and sensitivity metrics will be evaluated to ensure compliance with acceptance criteria, and any data exclusions or qualifications will be fully documented and justified.

Each project objective described in Section 4.2 will be evaluated using specific performance indicators. For the Trends Monitoring Program, analyses will determine whether long-term data were sufficient to identify statistically significant spatial or temporal changes in fecal coliform and nutrient concentrations. For the Segmented Monitoring Program, the assessment will determine the success of sampling in identifying bacterial "hot spots" and whether subsequent corrective actions resulted in measurable improvements in water quality. For Pollution Correction objectives, pre- and post-remediation data will be compared to evaluate the effectiveness of implemented measures, with attention given to any observed upgrades in shellfish growing area classifications or reductions in fecal coliform concentrations in priority waterways.

Results will be analyzed in comparison with historical PIC program data (Phases I–IV), applicable Washington State Water Quality Standards (WAC 173-201A), and established Total Maximum Daily Load (TMDL) targets. Where data are sufficient, statistical methods such as Mann-Kendall trend analysis or nonparametric before-and-after tests may be used to determine measurable progress toward water quality improvement. Findings will be summarized in annual and final reports, including explicit statements on whether data quality and quantity were adequate to support project conclusions and assess progress toward the overall goal of reducing bacterial and nutrient loading in the Sequim-Dungeness Clean Water District.

Finally, this evaluation process supports adaptive management by informing refinement of sampling design, prioritization of future Focus Areas, and improvement of QA/QC procedures in subsequent phases. If objectives are not fully achieved, the final report will identify limiting factors and recommend corrective actions or methodological adjustments to strengthen future monitoring and implementation efforts.

14.2 Treatment of non-detects

Sample results with U qualifiers will be reported at the MDL and included in environmental assessments.

14.3 Data analysis and presentation methods

All data generated by the activities described in this QAPP, as per the Ecology grant requirements, will be uploaded to Ecology's EIM database. Ecology, when possible, will forward this data on to EPA's WQX database.

14.4 Sampling design evaluation

The sampling design of PIC has a track record of success. The project coordinator will routinely consult the CWWG on progress and Focus Area adjustments.

14.5 Documentation of assessment

The project coordinator, in consultation with others working on this project, will comment in the project final report on the adequacy of the sampling design and whether changes should be made in further efforts.

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16.0 Appendices

Appendix 1. Glossaries, Acronyms, and Abbreviations

Glossary of General Terms

Ambient: Background or away from point sources of contamination. Surrounding environmental condition.

Anthropogenic: Human-caused.

Clean Water Act: A federal act passed in 1972 that contains provisions to restore and maintain the quality of the nation's waters. Section 303(d) of the Clean Water Act establishes the TMDL program.

Conductivity: A measure of water's ability to conduct an electrical current. Conductivity is related to the concentration and charge of dissolved ions in water.

Designated uses: Those uses specified in Chapter 173-201A WAC (Water Quality Standards for Surface Waters of the State of Washington) for each water body or segment, regardless of whether or not the uses are currently attained.

Dissolved oxygen (DO): A measure of the amount of oxygen dissolved in water.

Dilution factor: The relative proportion of effluent to stream (receiving water) flows occurring at the edge of a mixing zone during critical discharge conditions as authorized in accordance with the state's mixing zone regulations at WAC 173-201A-100. http://apps.leg.wa.gov/WAC/default.aspx?cite=173-201A-020

Effluent: An outflowing of water from a natural body of water or from a human-made structure. For example, the treated outflow from a wastewater treatment plant.

Fecal coliform (FC): That portion of the coliform group of bacteria which is present in intestinal tracts and feces of warm-blooded animals as detected by the product of acid or gas from lactose in a suitable culture medium within 24 hours at 44.5 plus or minus 0.2 degrees Celsius. Fecal coliform bacteria are "indicator" organisms that suggest the possible presence of disease-causing organisms. Concentrations are measured in colony forming units per 100 milliliters of water (cfu/100 mL).

Geometric mean: A mathematical expression of the central tendency (an average) of multiple sample values. A geometric mean, unlike an arithmetic mean, tends to dampen the effect of very high or low values, which might bias the mean if a straight average (arithmetic mean) were calculated. This is helpful when analyzing bacteria concentrations, because levels may vary anywhere from 10 to 10,000 fold over a given period. The calculation is performed by either: (1) taking the nth root of a product of n factors, or (2) taking the antilogarithm of the arithmetic mean of the logarithms of the individual values.

Load allocation: The portion of a receiving water's loading capacity attributed to one or more of its existing or future sources of nonpoint pollution or to natural background sources.

Loading capacity: The greatest amount of a substance that a water body can receive and still meet water quality standards.

Nonpoint source: Pollution that enters any waters of the state from any dispersed land-based or water-based activities, including but not limited to atmospheric deposition, surface-water runoff from agricultural lands, urban areas, or forest lands, subsurface or underground sources, or discharges from boats or marine vessels not otherwise regulated under the NPDES program. Generally, any unconfined and diffuse source of contamination. Legally, any source of water pollution that does not meet the legal definition of "point source" in section 502(14) of the Clean Water Act.

Nutrient: Substance such as carbon, nitrogen, and phosphorus used by organisms to live and grow. Too many nutrients in the water can promote algal blooms and rob the water of oxygen vital to aquatic organisms.

Pathogen: Disease-causing microorganisms such as bacteria, protozoa, viruses.

pH: A measure of the acidity or alkalinity of water. A low pH value (0 to 7) indicates that an acidic condition is present, while a high pH (7 to 14) indicates a basic or alkaline condition. A pH of 7 is considered to be neutral. Since the pH scale is logarithmic, a water sample with a pH of 8 is ten times more basic than one with a pH of 7.

Point source: Sources of pollution that discharge at a specific location from pipes, outfalls, and conveyance channels to a surface water. Examples of point source discharges include municipal wastewater treatment plants, municipal stormwater systems, industrial wastewater treatment facilities, and construction sites where one or more acres of land are disturbed.

Pollution: Contamination or other alteration of the physical, chemical, or biological properties of any waters of the state. This includes change in temperature, taste, color, turbidity, or odor of the waters. It also includes discharge of any liquid, gaseous, solid, radioactive, or other substance into any waters of the state. This definition assumes that these changes will, or are likely to, create a nuisance or render such waters harmful, detrimental, or injurious to (1) public health, safety, or welfare, or (2) domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or (3) livestock, wild animals, birds, fish, or other aquatic life.

Primary contact recreation: Activities where a person would have direct contact with water to the point of complete submergence including, but not limited to, skin diving, swimming, and water skiing.

Riparian: Relating to the banks along a natural course of water.

Salmonid: Fish that belong to the family *Salmonidae*. Species of salmon, trout, or char.

Sediment: Soil and organic matter that is covered with water (for example, river or lake bottom).

Stormwater: The portion of precipitation that does not naturally percolate into the ground or evaporate but instead runs off roads, pavement, and roofs during rainfall or snow melt.

Stormwater can also come from hard or saturated grass surfaces such as lawns, pastures, playfields, and from gravel roads and parking lots.

Streamflow: Discharge of water in a surface stream (river or creek).

Surface waters of the state: Lakes, rivers, ponds, streams, inland waters, salt waters, wetlands and all other surface waters and water courses within the jurisdiction of Washington State.

Total Maximum Daily Load (TMDL): A distribution of a substance in a water body designed to protect it from not meeting (exceeding) water quality standards. A TMDL is equal to the sum of all of the following: (1) individual wasteload allocations for point sources, (2) the load allocations for nonpoint sources, (3) the contribution of natural sources, and (4) a margin of safety to allow for uncertainty in the wasteload determination. A reserve for future growth is also generally provided.

Total suspended solids (TSS): Portion of solids retained by a filter.

Turbidity: A measure of water clarity. High levels of turbidity can have a negative impact on aquatic life.

Watershed: A drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

303(d) list: Section 303(d) of the federal Clean Water Act, requiring Washington State to periodically prepare a list of all surface waters in the state for which beneficial uses of the water – such as for drinking, recreation, aquatic habitat, and industrial use – are impaired by pollutants. These are water quality-limited estuaries, lakes, and streams that fall short of state surface water quality standards and are not expected to improve within the next two years.

90^{th} percentile: An estimated portion of a sample population based on a statistical determination of distribution characteristics. The 90^{th} percentile value is a statistically derived estimate of the division between 90% of samples, which should be less than the value, and 10% of samples, which are expected to exceed the value.

Acronyms and Abbreviations

BMP	Best management practice
CCD	Clallam Conservation District
CCC	Clallam County Code
CCEH	Clallam County Environmental Health
CCWR	Clallam County Water Resources Database
CWD	Sequim-Dungeness Clean Water District
CWWG	Clean Water Work Group
DCD	Clallam County Department of Community Development
DO	(see Glossary above)
DQO	Data quality objective
e.g.	For example
Ecology	Washington State Department of Ecology
EIM	Environmental Information Management database

EPA	U.S. Environmental Protection Agency
et al.	And others
FB	Field Blank
FC	(see Glossary above)
GIS	Geographic Information System software
GPS	Global Positioning System
i.e.	In other words
JS'KT	Jamestown S'Klallam Tribe
MDL	Method detection limits
MQOs	Measurement quality objectives
MRA	Marine recovery area
NEP	National Estuary Project
NH3	Ammonia
NH4	Ammonium
NIST	National Institute of Standards and Technology
NO2	Nitrite
NO3	Nitrate
NTA	Near term action
NTR	National Toxics Rule
OSS	Onsite septic system
PIC	Pollution Identification & Correction
PO4	Phosphate
QA	Quality assurance
QAPP	Quality assurance project plan
QC	Quality control
RL	Reporting limit
RM	River mile or Reference material
RPD	Relative percent difference
RSD	Relative standard deviation
SK	Streamkeepers of Clallam County
SOP	Standard operating procedures
SBDW	Sequim Bay-Dungeness Watershed
WQX	EPA's storage and retrieval water quality database
SQRT	Square root
TIN	Total inorganic nitrogen
TMDL	(See Glossary above)
TN	Total Nitrogen
TP	Total phosphorus
TSS	(See Glossary above)
UGA	Urban growth area
UW	University of Washington Marine Chemistry Lab
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WDOH	Washington Department of Health
WQA	Water Quality Assessment
WRIA	Water Resource Inventory Area

WSU	Washington State University

Units of Measurement

°C	degrees centigrade
cfs	cubic feet per second
cfu	colony forming units
Cms	cubic meters per second, a unit of flow
Ft	feet
G	gram, a unit of mass
Kg	kilograms, a unit of mass equal to 1,000 grams
m	meter
mg	milligram
mg/d	milligrams per day
mg/L	milligrams per liter (parts per million)
mg/L/hr	milligrams per liter per hour
mL	milliliter
s.u.	standard units
µg/kg	micrograms per kilogram (parts per billion)
µg/L	micrograms per liter (parts per billion)

Quality Assurance Glossary

Accreditation: A certification process for laboratories, designed to evaluate and document a lab's ability to perform analytical methods and produce acceptable data. For Ecology, it is "Formal recognition by (Ecology)…that an environmental laboratory is capable of producing accurate analytical data." [WAC 173-50-040] (Kammin, 2010)

Accuracy: The degree to which a measured value agrees with the true value of the measured property. USEPA recommends that this term not be used, and that the terms *precision* and *bias* be used to convey the information associated with the term *accuracy* (USGS, 1998).

Analyte: An element, ion, compound, or chemical moiety (pH, alkalinity) which is to be determined. The definition can be expanded to include organisms, e.g., fecal coliform, Klebsiella (Kammin, 2010).

Bias: The difference between the sample mean and the true value. Bias usually describes a systematic difference reproducible over time and is characteristic of both the measurement system and the analyte(s) being measured. Bias is a commonly used data quality indicator (DQI) (Kammin, 2010; Ecology, 2004).

Blank: A synthetic sample, free of the analyte(s) of interest. For example, in water analysis, pure water is used for the blank. In chemical analysis, a blank is used to estimate the analytical response to all factors other than the analyte in the sample. In general, blanks are used to assess possible contamination or inadvertent introduction of analyte during various stages of the sampling and analytical process (USGS, 1998).

Calibration: The process of establishing the relationship between the response of a measurement system and the concentration of the parameter being measured (Ecology, 2004).

Check standard: A substance or reference material obtained from a source independent from the source of the calibration standard; used to assess bias for an analytical method. This is an obsolete term, and its use is highly discouraged. See Calibration Verification Standards, Lab Control Samples (LCS), Certified Reference Materials (CRM), and/or spiked blanks. These are all check standards but should be referred to by their actual designator, e.g., CRM, LCS (Kammin, 2010; Ecology, 2004).

Comparability: The degree to which different methods, data sets and/or decisions agree or can be represented as similar; a data quality indicator (USEPA, 1997).

Completeness: The amount of valid data obtained from a project compared to the planned amount. Usually expressed as a percentage. A data quality indicator (USEPA, 1997).

Continuing Calibration Verification Standard (CCV): A quality control (QC) sample analyzed with samples to check for acceptable bias in the measurement system. The CCV is usually a midpoint calibration standard that is re-run at an established frequency during the course of an analytical run (Kammin, 2010).

Control chart: A graphical representation of quality control results demonstrating the performance of an aspect of a measurement system (Kammin, 2010; Ecology 2004).

Control limits: Statistical warning and action limits calculated based on control charts. Warning limits are generally set at +/- 2 standard deviations from the mean, action limits at +/- 3 standard deviations from the mean (Kammin, 2010).

Data integrity: A qualitative DQI that evaluates the extent to which a data set contains data that is misrepresented, falsified, or deliberately misleading (Kammin, 2010).

Data quality indicators (DQI): Commonly used measures of acceptability for environmental data. The principal DQIs are precision, bias, representativeness, comparability, completeness, sensitivity, and integrity (USEPA, 2006).

Data quality objectives (DQO): Qualitative and quantitative statements derived from systematic planning processes that clarify study objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions (USEPA, 2006).

Data set: A grouping of samples organized by date, time, analyte, etc. (Kammin, 2010).

Data validation: An analyte-specific and sample-specific process that extends the evaluation of data beyond data verification to determine the usability of a specific data set. It involves a detailed examination of the data package, using both professional judgment and objective criteria, to determine whether the MQOs for precision, bias, and sensitivity have been met. It may also include an assessment of completeness, representativeness, comparability, and integrity, as these criteria relate to the usability of the data set. Ecology considers four key criteria to determine if data validation has actually occurred. These are:

- Use of raw or instrument data for evaluation.
- Use of third-party assessors.
- Data set is complex.

- Use of EPA Functional Guidelines or equivalent for review.

Examples of data types commonly validated would be:

- Gas Chromatography (GC).
- Gas Chromatography-Mass Spectrometry (GC-MS).
- Inductively Coupled Plasma (ICP).

The end result of a formal validation process is a determination of usability that assigns qualifiers to indicate usability status for every measurement result. These qualifiers include:

- No qualifier – data are usable for intended purposes.
- J (or a J variant) – data are estimated, may be usable, may be biased high or low.
- REJ – data are rejected, cannot be used for intended purposes.
  (Kammin, 2010; Ecology, 2004).

Data verification: Examination of a data set for errors or omissions, and assessment of the Data Quality Indicators related to that data set for compliance with acceptance criteria (MQOs). Verification is a detailed quality review of a data set (Ecology, 2004).

Detection limit (limit of detection)**:** The concentration or amount of an analyte which can be determined to a specified level of certainty to be greater than zero (Ecology, 2004).

Duplicate samples: Two samples taken from and representative of the same population, and carried through and steps of the sampling and analytical procedures in an identical manner. Duplicate samples are used to assess variability of all method activities including sampling and analysis (USEPA, 1997).

Field blank: A blank used to obtain information on contamination introduced during sample collection, storage, and transport (Ecology, 2004).

Initial Calibration Verification Standard (ICV): A QC sample prepared independently of calibration standards and analyzed along with the samples to check for acceptable bias in the measurement system. The ICV is analyzed prior to the analysis of any samples (Kammin, 2010).

Laboratory Control Sample (LCS): A sample of known composition prepared using contaminant-free water or an inert solid that is spiked with analytes of interest at the midpoint of the calibration curve or at the level of concern. It is prepared and analyzed in the same batch of regular samples using the same sample preparation method, reagents, and analytical methods employed for regular samples (USEPA, 1997).

Matrix spike: A QC sample prepared by adding a known amount of the target analyte(s) to an aliquot of a sample to check for bias due to interference or matrix effects (Ecology, 2004).

Measurement Quality Objectives (MQOs)**:** Performance or acceptance criteria for individual data quality indicators, usually including precision, bias, sensitivity, completeness, comparability, and representativeness (USEPA, 2006).

Measurement result: A value obtained by performing the procedure described in a method (Ecology, 2004).

Method: A formalized group of procedures and techniques for performing an activity (e.g., sampling, chemical analysis, data analysis), systematically presented in the order in which they are to be executed (EPA, 1997).

Method blank: A blank prepared to represent the sample matrix, prepared and analyzed with a batch of samples. A method blank will contain all reagents used in the preparation of a sample, and the same preparation process is used for the method blank and samples (Ecology, 2004; Kammin, 2010).

Method Detection Limit (MDL): This definition for detection was first formally advanced in 40CFR 136, October 26, 1984 edition. MDL is defined there as the minimum concentration of an analyte that, in a given matrix and with a specific method, has a 99% probability of being identified, and reported to be greater than zero (Federal Register, October 26, 1984).

Percent Relative Standard Deviation (%RSD): A statistic used to evaluate precision in environmental analysis. It is determined in the following manner:

$$\%RSD = (100 * s)/x$$

where s is the sample standard deviation and x is the mean of results from more than two replicate samples (Kammin, 2010).

Parameter: A specified characteristic of a population or sample. Also, an analyte or grouping of analytes. Benzene and nitrate + nitrite are all parameters (Kammin, 2010; Ecology, 2004).

Population: The hypothetical set of all possible observations of the type being investigated (Ecology, 2004).

Precision: The extent of random variability among replicate measurements of the same property; a data quality indicator (USGS, 1998).

Quality assurance (QA): A set of activities designed to establish and document the reliability and usability of measurement data (Kammin, 2010).

Quality Assurance Project Plan (QAPP): A document that describes the objectives of a project, and the processes and activities necessary to develop data that will support those objectives (Kammin, 2010; Ecology, 2004).

Quality control (QC): The routine application of measurement and statistical procedures to assess the accuracy of measurement data (Ecology, 2004).

Relative Percent Difference (RPD): RPD is commonly used to evaluate precision. The following formula is used:

$$[Abs(a-b)/((a + b)/2)] * 100$$

where “Abs()” is absolute value and a and b are results for the two replicate samples. RPD can be used only with 2 values. Percent Relative Standard Deviation is (%RSD) is used if there are results for more than 2 replicate samples (Ecology, 2004).

Replicate samples: Two or more samples taken from the environment at the same time and place, using the same protocols. Replicates are used to estimate the random variability of the material sampled (USGS, 1998).

Representativeness: The degree to which a sample reflects the population from which it is taken; a data quality indicator (USGS, 1998).

Sample (field): A portion of a population (environmental entity) that is measured and assumed to represent the entire population (USGS, 1998).

Sample (statistical): A finite part or subset of a statistical population (USEPA, 1997).

Sensitivity: In general, denotes the rate at which the analytical response (e.g., absorbance, volume, meter reading) varies with the concentration of the parameter being determined. In a specialized sense, it has the same meaning as the detection limit (Ecology, 2004).

Spiked blank: A specified amount of reagent blank fortified with a known mass of the target analyte(s); usually used to assess the recovery efficiency of the method (USEPA, 1997).

Spiked sample: A sample prepared by adding a known mass of target analyte(s) to a specified amount of matrix sample for which an independent estimate of target analyte(s) concentration is available. Spiked samples can be used to determine the effect of the matrix on a method's recovery efficiency (USEPA, 1997).

Split sample: A discrete sample subdivided into portions, usually duplicates (Kammin, 2010).

Standard Operating Procedure (SOP): A document which describes in detail a reproducible and repeatable organized activity (Kammin, 2010).

Surrogate: For environmental chemistry, a surrogate is a substance with properties similar to those of the target analyte(s). Surrogates are unlikely to be native to environmental samples. They are added to environmental samples for quality control purposes, to track extraction efficiency and/or measure analyte recovery. Deuterated organic compounds are examples of surrogates commonly used in organic compound analysis (Kammin, 2010).

Systematic planning: A step-wise process which develops a clear description of the goals and objectives of a project, and produces decisions on the type, quantity, and quality of data that will be needed to meet those goals and objectives. The DQO process is a specialized type of systematic planning (USEPA, 2006).

References for QA Glossary

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Appendix 2. CWD Stream Descriptions

The following list describes streams within the CWD with descriptions sourced from the Elwha-Dungeness Watershed Plan (Elwha-Dungeness Planning Unit 2005).

Tributaries to Dungeness Bay:

- **Dungeness River** flows north into the outer Dungeness Bay just east of the opening between Graveyard and Cline Spits. The river is 32 miles long and drains 172,517 acres. The upper two-thirds of the watershed are within national forest and national park areas. The river contributes the vast majority of freshwater to the Bay (Soule 2013).
- **Matriotti Creek** is 9.3 miles long and is the largest low-elevation tributary to the Dungeness River, flowing into it on the left bank at RM 1.9.
- **Lotzgesell Creek** is a tributary to Matriotti Creek that encompasses similar land uses.
- **Hurd Creek** is a small, low-elevation tributary approximately one mile long that flows into the Dungeness River on the right bank at RM 2.7.
- **Meadowbrook Creek** flows north toward Dungeness Bay approximately 0.4 miles east of the Dungeness River mouth. Meadowbrook Slough (also referred to as Dungeness Slough, by neighbors) is approximately 0.5 miles long and parallels a dike along the lower reaches of the Dungeness River. The points of discharge of the Dungeness River, Meadowbrook Slough, and Meadowbrook Creek are dynamic—occasionally the lesser waterways discharge directly into the bay, while other times they first join the Dungeness River which in turn discharges into the bay.
- **Golden Sands Slough** discharges into outer Dungeness Bay southeast of Meadowbrook Creek. The slough is a series of constructed channels in an estuarine wetland area. Water in the slough tends to be saline and stagnate (Sargeant 2002).
- **Cooper Creek** discharges into Dungeness Bay just southeast of Golden Sands Slough. The creek is fed by wetlands, and the upland area is undeveloped. The lower portion of the stream channel has been straightened, and the mouth is controlled by a tide gate.
- Cassalery Creek is approximately 4.2 miles long and discharges to Dungeness Bay just southeast of Cooper Creek.
- **Gierin Creek** discharges into Dungeness Bay just southeast of Cassalery Creek. It is fed by steep-gradient groundwater discharge from the north slopes of the Olympic Mountains. There are 8.3 miles of streams and tributaries in the 3.1 square-mile watershed.
- An **un-named** intermittent stream periodically discharges to inner Dungeness Bay at the base of Dungeness Spit. Roadside ditches act as stormwater conveyance and may also be used for occasional flushing of irrigation pipelines under the control of the Cline Irrigation District.

Tributaries to Sequim Bay:

- **Chicken Coop Creek** enters the southeast corner of Sequim Bay to the northeast of Jimmycomelately Creek. The mainstem is 3.1 miles in length with an additional 3.1 miles in tributaries.
- **No Name Creek**, draining to Sequim Bay just south of Chicken Coop Creek, is a generally forested, short, steep creek, relatively undeveloped and minimally impacted by nonpoint sources of pollution.

- **Dean Creek** is an intermittent stream draining ~3 square miles, flowing ~4 miles from headwaters at an elevation of ~1900' into the southwest corner of Sequim Bay.
- **State Park Creek** is the largest of several small drainages emptying into the western side of Sequim Bay north of Dean Creek, comprising mixed land uses, including forestry, small farms, and residences.
- Jimmycomelately Creek is the largest stream in the Sequim Bay watershed, draining an extended interior foothill watershed of ~16 square miles, with a vertical drop of 2500' in less than 9 miles, emptying at the south end of Sequim Bay.
- **Johnson Creek** is the third largest stream within the Sequim Bay watershed (~6.2 square miles), flowing northeast from the foothills of the Olympic Mountains into the west side of Sequim Bay at Pitship Point (near the John Wayne Marina). The total length of Johnson Creek is ~7.4 miles. Five river miles (RM) are attributed to the mainstem, while two miles consist of tributaries. The upper creek flows through a substantial ravine, while the lower two miles are low gradient.
- **Bell Creek** is a relatively small drainage entering Washington Harbor on the marine shoreline just north of the mouth of Sequim Bay. It is 3.8 miles long and drains a watershed of over 8.9 square miles. Bell Creek has served historically as a conveyance for irrigation water, and much of the creek has been heavily altered by rural and urban development.

<u>Tributaries to the Strait of Juan de Fuca west of Dungeness Bay:</u>

- **McDonald Creek** is a significant independent drainage, entering the Strait of Juan de Fuca between the western end of Dungeness Spit and Green Point. It's 13.6 miles drain ~23.0 square miles of the northeast flank of Blue Mountain, with headwaters originating at ~4,700'. The creek flows through a deeply incised coastal upland and marine bluff.
- **Agnew Ditch** is part of Sequim's irrigation ditch system, originating from the Dungeness River. It is conveyed for several miles via McDonald Creek before irrigating the Agnew area—where it is sometimes known as Agnew Creek—and emptying to the Strait.
- **Siebert Creek**, 12.4 miles long, drains 19.5 square miles of the northwest flank of Blue Mountain and is a significant independent drainage, entering the Strait at Green Point. The watershed includes 31.2 miles of mainstem stream and tributaries, much of which is well incised, with its upper watershed reaching an elevation of 3,800'. It is the westernmost stream influenced directly by Dungeness area irrigation flows.
- **Bagley Creek** is a medium-sized independent drainage, entering the Strait ~2 miles west of Green Point. It is the westernmost watershed of the CWD. The drainage has approximately 9.5 miles of streams and tributaries.