Supporting Information for 2018 Water Quality Assessment

Supplemental methods, citations, and data sources

Water Quality Program

Washington State Department of Ecology
Olympia, Washington

August 2021, Publication XX-XX-XXX[1]

[1] This Supporting Information document has been submitted to EPA as part of the 2018 Water Quality Assessment. The final document will be published after EPA approves the submittal, anticipated in September 2021.

Publication Information

This document is available on the Department of Ecology's website at:
https://apps.ecology.wa.gov/publications/summarypages/XXXXXXX.html

(The publication link will be available after EPA approval, anticipated September 2021).

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Document Purpose

The Washington State Department of Ecology (Ecology) prepared this document during completion of Washington's 2014/2016/2018 Water Quality Assessment (further referred to as 2018 WQA) to meet requirements of the Clean Water Act. The primary purposes of this document are to:

- Provide numeric and narrative data sources that were considered for use in making water quality determinations for the Water Quality Assessment categories
- Provide citation information associated with Washington's 2018 WQA in order to satisfy the U.S. Environmental Protection Agency (EPA) submittal requirements and to meet the requirements of RCW 34.05.272[3]
- Document additional assessment methodologies and policy decisions used to support water quality determinations and further supplement Water Quality Program Policy 1-11[4]

This document was submitted to EPA with the associated 2018 WQA water quality category determinations, also known as the Integrated Report of the 305(b) report and 303(d) list, in August 2021. The full 2018 WQA can be accessed through Ecology's website[5].

This document is structured into several sections containing the following information:

- Supplemental Methodologies –additional assessment methods used to support water quality determinations for parameters that may or may not have a defined methodology in Policy 1-11.
- Numeric Data Sources – citations of numeric-based datasets analyzed to support water quality determinations.
- Narrative Data and Information –narrative data and information submitted for consideration in the WQA and Ecology's use determinations.
- TMDL and Alternative Pollution Control Project Information –information and analyses supporting Category 4A and 4B determinations.

[3] https://app.leg.wa.gov/RCW/default.aspx?cite=34.05.272
[4] https://apps.ecology.wa.gov/publications/SummaryPages/1810035.html
[5] http://www.ecology.wa.gov/303d

Background Information on the WQA Process

The federal Clean Water Act at sections 303(d) and 305(b) require Washington State to assess the water quality status of Washington state waters and periodically report on the status to EPA Region 10. Ecology develops the Water Quality Assessment (WQA) to fulfill this requirement. The purpose of the WQA is to determine if readily available data demonstrates that the water quality for the given waterbody supports the designated uses described in the water quality standards and begin prioritizing clean-up. Ecology accomplishes this by applying methodologies to compare available data and information to water quality standards for surface waters and sediments, following credible data protocols and requirements.

Credible Data Laws and Policies

Washington State law (Water Quality Data Act codified in RCW 90.48.570[6] through 90.48.590, also referred to as "Credible Data Act") requires Ecology to use credible data to determine whether any water of the state is to be placed on or removed from the 303(d) list and whether any surface water of the state is supporting its designated use or other classification. Ecology's Credible Data Policy (Policy 1-11, Chapter 2[7]) describes the Quality Assurance (QA) measures, guidance, regulations, and existing policies that help ensure the credibility of data and other information used in agency actions relating to surface water quality. This policy applies when evaluating data and information for use in agency decisions when the quality of a surface water of the state is at issue. It is also intended as guidance for all parties interested in submitting data for consideration in decisions related to water quality.

Data are considered credible data if:

- Appropriate quality assurance and quality control procedures were followed and documented in collecting and analyzing water quality samples;
- The samples or measurements are representative of water quality conditions at the time the data were collected;
- The data consist of an adequate number of samples based on the objectives of the sampling, the nature of the water in question, and the parameters being analyzed; and
- Sampling and laboratory analysis conform to methods and protocols generally acceptable in the scientific community as appropriate for use in assessing the condition of the water.

Ecology encourages any party considering submitting numeric or narrative data for consideration in the WQA review both chapters of Policy 1-11 to understand submittal requirements.

[6] https://app.leg.wa.gov/RCW/default.aspx?cite=90.48.570
[7] https://ecology.wa.gov/DOE/files/3b/3bf2eaab-090b-49d1-8ff4-fd8c82960f7a.pdf

Water Quality Assessment Methodology

Washington's assessment protocols are described in "Washington's Water Quality Assessment Listing Methodology to Meet Clean Water Act Requirements" (Policy 1-11, Chapter 1). This policy describes the methodologies for how waterbody segments are assessed for determining the status of water quality, using the state's water quality standards as the basis. Ecology applies this policy when evaluating data and information for the Assessment to meet the federal Clean Water Act reporting requirements. The policy is also intended as guidance for all parties that submit data for the Assessment process or are planning data collection efforts for use in future assessments. This policy provides guidance for both numeric data submittals and submittals based on narrative standards.

Data Citations to meet RCW 34.05.272

Ecology's Water Quality Program (WQ) is required to identify the information sources relied upon in support of certain agency actions defined by RCW 34.05.272. One of the purposes of this document is to meet the requirements of RCW 34.05.272 to provide citation information associated with Washington's 2018 Water Quality Assessment.

RCW 34.05.272 describes eleven categories of information sources that need to be identified with citations used to support the WQA. They include:

1. Peer review overseen by an independent third party.
2. Review by staff internal to Ecology.
3. Review by persons that are external to and selected by Ecology.
4. Documented open public review process that is not limited to invited organizations or individuals.
5. Federal and state statutes.
6. Court and hearings board decisions.
7. Federal and state administrative rules and regulations.
8. Policy and regulatory documents adopted by local governments.
9. Data from primary research, monitoring activities, or other sources, but that has not been incorporated as part of documents reviewed under other processes.
10. Records of best professional judgment of Ecology employees or other individuals.
11. Sources of information that do not fit into one of the other categories listed.

This document contains the primary citation lists associated with the development of the 2018 Water Quality Assessment and the data sources used or examined as the basis for individual water quality listings. Citations noted in this document include numbers in brackets, following the citation, that identify which of the eleven citation categories relate to the specific citation. In cases where a group of source listings all have the same citation category, the category number is included within the descriptive text above the group of source listings.

State and Federal Guidance Documents

The following are citations for state and federal laws and policies supporting Ecology's WQA determination process:

Washington Administrative Code. Chapter 173-201A WAC. Water Quality Standards for Surface Waters of the State of Washington.[8] [7]

Washington State Department of Ecology. 2018. Water Quality Program Policy, WQP Policy 1-11 Chapter 1. Assessment of Water Quality for the Clean Water Act Section 303(d) and the 305(b) Integrated Report. Washington State Department of Ecology. Revised July 2020, Publication No. 06-10-091.[9] [2, 3, 4]

Washington State Department of Ecology. 2006. Water Quality Program Policy, WQP Policy 1-11 Chapter 2. Ensuring Credible Data for Water Quality Management. Washington State Department of Ecology. Established September 2006.[10] [2, 3, 4]

Washington State Department of Ecology. 2011. Waters Requiring Supplemental Spawning and Incubation Protection for Salmonid Species. Washington State Department of Ecology. Revised January 2011. Publication No. 06-10-038.[11] [2, 3, 4]

Federal Water Pollution Control Act (the "Clean Water Act") 33 U.S.C. 1251 et seq.[12] [5]

Revised Code of Washington. Chapter 90.48 RCW. Water Pollution Control.[13] [5]

2018 WQA Public and Tribal Involvement

Ecology followed several key steps to develop and submit the final 2018 WQA to EPA for approval, including:

- Updates to the listing methodologies in Policy 1-11, Chapter 1
- Gathering and assembling credible water quality data
- Technical assessment of data to make category determinations
- Tribal and public review of the WQA results
- Final WQA and Candidate 303(d) list submitted to EPA for approval.

Individuals and organizations participated in developing the 2018 WQA by reviewing and commenting on Policy 1-11, submitting readily available data, and reviewing and commenting on the draft 2018 WQA.

[8] https://apps.leg.wa.gov/WAC/default.aspx?cite=173-201A
[9] https://apps.ecology.wa.gov/publications/SummaryPages/0610038.html
[10] https://ecology.wa.gov/DOE/files/3b/3bf2eaab-090b-49d1-8ff4-fd8c82960f7a.pdf
[11] https://apps.ecology.wa.gov/publications/SummaryPages/0610038.html
[12] https://www.govinfo.gov/content/pkg/USCODE-2018-title33/pdf/USCODE-2018-title33-chap26.pdf
[13] https://app.leg.wa.gov/Rcw/default.aspx?cite=90.48

Updates to Policy 1-11, Chapter 1

Policy 1-11 Chapter 1 had two updates in preparation for the 2018 WQA, one in 2018 and one in 2020.

After EPA approved the last Assessment in 2016, one of the first steps was to conduct a comprehensive public process to update key parts of the listing methodology policy. Highlights of this update included:

- provisions to ensure the use of credible data and to minimize errors in under- and over-listing impaired waters
- revisions to parameter-specific data analysis methods for all parameters
- clarifying information on application of narrative water quality standards in the WQA and data submittal requirements
- improving Ecology's TMDL prioritization process
- and other relevant WQA information

Ecology held a public review on the proposed revisions from February - April, 2018. Revisions to Policy 1-11, Chapter 1 were finalized in November 2018. A response to comments[14] was prepared as part of the process.

The 2020 revisions to Policy 1-11, Chapter 1 updated the methodology for assessing bacteria data for water contact recreation use due to an update in surface water quality standards in 2019. Ecology held a public review on the proposed revisions from April 1 – 30, 2020. Revisions to the bacteria methodologies were finalized in July 2020. A response to comments[15] was prepared as part of the process.

Call for Data

Each WQA begins with a "Call for Data", where Ecology invites tribes, governments, stakeholders, and any other interested parties to submit data and information for consideration in the upcoming WQA. Ecology issued two calls, one in 2016[16]and one in 2018[17] to commence Washington's 2018 WQA. Ecology requested that submitters upload numeric data to either Ecology's Environmental Information Management[18] (EIM) database or databases associated with the federal Water Quality Portal[19] (Portal). Ecology also received data and narrative submittals outside of EIM to consider for use in the WQA that were evaluated against narrative water quality standards. The target data window for the 2018 WQA was data collected between January 2006 and December 2017.

[14] https://apps.ecology.wa.gov/publications/SummaryPages/1810036.html
[15] https://apps.ecology.wa.gov/publications/documents/2010028.pdf
[16] http://lawfilesext.leg.wa.gov/law/wsr/2016/03/16-03-088.htm
[17] http://lawfilesext.leg.wa.gov/law/wsr/2018/05/18-05-036.htm
[18] https://ecology.wa.gov/Research-Data/Data-resources/Environmental-Information-Management-database
[19] https://www.waterqualitydata.us/

Tribal Review

Ecology offered all tribes within Washington an opportunity to review and provide input on updates to Policy 1-11 and the draft WQA prior to public review. These tribal reviews were in accordance with the 1997 agreement between Ecology, tribes and EPA, described in the *Cooperative Management of the Clean Water Act 303(d) Program for the Tribes in Washington State, the Washington State Department of Ecology, and the U.S. Environmental Protection Agency Region 10*. Washington does not have Clean Water Act authority on tribal reservation boundaries; the EPA or governing tribe implements Clean Water Act programs on tribal lands. However, Ecology does utilize readily available tribal data and makes water quality determinations on waterbodies draining into or out of tribal reservation boundaries.

Preceding public comment periods for the two Policy 1-11 Chapter 1 revisions, tribal previews were held in 2017 and 2020.

Prior to public review of the draft WQA, Ecology worked directly with Washington tribes and EPA to address concerns regarding the draft WQA results and corrected any errors found. The 2018 WQA tribal review ran from February - March 2021. We received positive feedback from tribes on our efforts to promote an open consultation process this assessment cycle and we look forward to building on these efforts in future assessments.

Public Review of Draft 2018 WQA

Ecology held a 60-day public comment period on the draft 2018 WQA from April 8 to June 4, 2021. Ecology held an online webinar/workshop during the comment period and met directly with several parties to address comments and questions that came up during the comment period. All comments received during the public comment period and Ecology's responses are summarized in the Response to Comments 2018 Water Quality Assessment[20]. The response to comments publication link was included in Ecology's submittal to EPA, posted on our website, and uploaded into the EPA ATTAINS database.

[20] https://apps.ecology.wa.gov/publications/summarypages/XXXXXXX.html

Supplemental Methodologies

Dissolved Oxygen Salish Sea Model

The Salish Sea Model (SSM) was developed by Pacific Northwest National Laboratory (PNNL) in collaboration with scientists within Ecology's Environmental Assessment Program. The model is a powerful computer tool that can simulate several physical and water quality processes. More specifically, the model can evaluate changes in marine dissolved oxygen levels due to discharges from wastewater plants. For more information on the development, outputs and limitations of the Salish Sea Dissolved Oxygen Model, reference Puget Sound Nutrient Source Reduce Project. Volume 1: Model Updates and Bounding Scenarios (Ecology Publication No. 19-03-001)[21].

In general, the model was used to "ground-truth" category determinations in marine waters where we found exceedances of the dissolved oxygen numeric criteria based on observational data. While the general WQA process for analyzing dissolved oxygen simply identifies exceedances of the numeric biological criteria, the dissolved oxygen model is actually calculating the potential that human activities are exceeding the 0.2 mg/L natural conditions pieces of the criteria. The application of the model allows Ecology to assess for both components of the criteria and produce a more accurate reflection of water quality conditions. No water quality determinations were made without observational data present, meaning no determinations were made based on model predictions alone.

Using ArcMap GIS application, we plotted portions of Puget Sound that had observational exceedances of the numeric water quality criteria found through the WQA analysis with the extents of the 2006 and 2014 SSM runs. Categories were assigned as follows:

- Areas where WQA analysis found exceedances of the criteria and the model found human actions are impacting dissolved oxygen were placed in Category 5, impaired.
- Areas where data demonstrated no exceedances of the criteria but were collected in human impacted regions were placed into Category 3, or not enough information.
- Areas where WQA analysis found exceedances but the model predicted humans are not impacting dissolved oxygen were placed in Category 2, or waters of concerns.
- If there were no exceedances of criteria in non-impacted areas, the standard Policy 1-11 dissolved oxygen methodology was applied.

In areas of model uncertainty, also referred to as "masked" areas of the model, we made a best professional judgement call based on the proximity to areas of human influence. If exceedances occurred in a portion of Puget Sound directly adjacent to an area of anthropogenic influence, that area was treated in the same fashion as a human-impacted area. For masked areas that are isolated from areas of Puget Sound identified as impaired, those areas were treated under

[21] https://apps.ecology.wa.gov/publications/SummaryPages/1903001.html

the methodology outlined in Policy 1-11. A remark is attached to all listings that were subject to this analysis to indicate the outcome of application of the model. For previous category determinations that did not have more recent data during the assessment window (2006-2017), our policy is to carry forward those category determinations. For these type of listings, we applied the same logic above to refine our category determinations for the 2018 list.

Polybrominated Diphenyl Ethers (PBDEs): Use of Fish Consumption Advisories

We reviewed the Washington Department of Health (DOH) Fish Consumption Advisories website[22] for non-priority pollutant based advisories. Non-priority pollutants do not have numeric criteria in Washington's Water Quality Standards. As of February 2021, there were only three fish consumption advisories in the state for a non-priority pollutant. Three different segments of the Spokane River were issued a fish consumption advisory for polybrominated diphenyl ethers (PBDEs). Within the extent of each fish consumption advisory segment, we found PBDE fish tissue datasets in EIM and noted the locations where data were collected. Within the gathered PBDE tissue dataset, we looked for data that met the three main data usability requirements outlined in Policy 1-11:

- Tissue data had to be collected within the assessment window, which was 1/1/2006 to 12/31/2017 for this assessment cycle.
- The tissue data had to be collected from edible species.
- The data needed to come from an assessable tissue type. For fin-fish, fillet samples are assessed because fillet is the most common edible portion of fish as compared to the whole body.

If a sampling location had data that met the three assessment usability requirements, a Category 5 listing was created for the assessment unit that contained the location.

Total Mercury Tissue Data

The numeric human health criterion for methylmercury (0.03 mg/kg) is expressed as a fish tissue concentration. In the 2018 Assessment Cycle, Ecology used methylmercury, as well as mercury, fish tissue data to evaluate human health. The mercury tissue data used in the assessment met the data requirements outlined in Policy 1-11.

In aquatic environments, microorganisms convert mercury into methylmercury. Fish absorb methylmercury through their gills from the water and from the food they consume. Methylmercury is the bioaccumulative and toxic form of mercury in fish tissue. More than 95% of the total mercury in fish fillet tissue is methylmercury where it is associated with muscle proteins (Bloom, 1995; Driscoll et al., 1994). More recent studies (Lescord et al., 2018) indicate

[22] https://www.doh.wa.gov/CommunityandEnvironment/Food/Fish/Advisories

that the percent of methylmercury may be lower than the 95% previously reported, particularly in younger and smaller fish. Ecology's assessment of fish tissue centers on fish tissue collected from non-juvenile fish and on fillet (muscle) tissue, where we assume that methylmercury generally makes up more than 95% of the total mercury.

References

Bloom, N.S. (1992). On the chemical form of mercury in edible fish and marine invertebrate tissue. *Can J Fish Aquat Sci,* 49, 1010– 1017. [9]

Driscoll, C., Yan, C., Schofield, C., Munson, R., and Holsapple, J. (1994). The Mercury Cycle and Fish in the Adirondack Lakes. *Environment Science and Technology*, 28 (3), 136A-143A. [9]

Lescord, G.L., Johnston, T.A., Branfireun, B.A., and Gunn, J.M. (2018). Percentage of methylmercury in the muscle tissue of freshwater fish varies with body size and age and among species. *Environmental Toxicology and Chemistry*, 37 (10), 2682-2691. [9]

Non-Native Aquatic Plants

Ecology's Washington State Lake Database was accessed in February 2020 to assess for the presence of non-native aquatic plants. Data was downloaded that included lake monitoring data from 1/1/2006 to 12/31/2017 on Class A and Class B weed lists of submersed and floating plants. Any waterbody with documented presence of non-native aquatic plants during the assessment window were placed in Category 4C. Any waterbody that was previously in Category 4C for non-native aquatic plants but had information in the database indicating the listed plants have been "eradicated", were moved to Category 3. Ecology defines eradication as the absence of that plant for at least five years. Private ponds, mitigation ponds, and stormwater ponds were not assessed.

Temperature: Natural Conditions

Ecology's Environmental Assessment Program first began evaluating the potential for natural exceedances of the temperature criteria in marine waters in the 2004 WQA. Since then, staff have built on their knowledge of ocean upwelling, circulation, thermal warming, shoreline modifications, and sedimentation rates in Washington's bays and applied this knowledge within the context of the WQA to improve our water quality determinations. In 2011 staff conducted an analysis evaluating temperature natural conditions in Washington State marine waters, which identified several marine waterbodies where exceedances of the temperature numeric criteria could not be attributed to natural phenomena alone (referred to as Albertson memo, available upon request). The Albertson memo was also used in the 2018 WQA as a basis for determining whether or not natural physical processes in marine waters were driving temperature exceedances.

Using ArcMap GIS application, temperature water quality determinations developed through application of Policy 1-11 were plotted with marine areas where temperature levels cannot be

entirely attributed to natural conditions, as defined by the Albertson memo. Categories were assigned as follows:

- Marine waters with observed exceedances of the temperature numeric criteria within likely human impaired areas were placed in Category 2, water of concern. Ecology decided further site specific analysis would be needed to confirm anthropogenic influences before placing the waterbody on the 303(d) list.
- Waters where data demonstrated no exceedances of the criteria in likely human impaired areas were placed in Category 3, not enough information.
- All temperature determinations outside of the likely human impaired areas were placed in Category 1, meets tested criteria, since it is assumed that the sole driver of temperature would be thermal heating by sunlight.

A remark is attached to all listings that were subject to this analysis to indicate the outcome. For previous category determinations that did not have more recent data during the assessment window (2006-2017), our policy is to carry forward those category determinations. For these type of listings, we applied the same logic above to refine our category determinations for the 2018 list.

Numeric Data Sources

The following sections contains citations of numeric-based datasets analyzed to support WQA category determinations. Ecology's primary data sources for the WQA are Ecology's Environmental Information Management (EIM) database and the Water Quality Portal database. However, additional readily available datasets meeting Washington's Credible Data Act requirements (RCW 90.48.50) and Ecology Policy 1-11 quality assurance requirements were also considered. A portion of the studies below may have data collected from waters both within and outside of tribal lands. However, only data from non-tribal and non-treaty tribal waters were used in the assessment. Additionally, this section only documents sources with data during the 2018 WQA data collection window (2006-2017). Data sources used in the last WQA are documented in Ecology Publication No. 16-03-002[23]. Citations and data sources for other past assessments are available upon request.

EIM

Ecology's EIM database contains environmental monitoring data collected by Ecology and other parties. EIM includes data for groundwater, watershed habitat health, marine sediments, river and stream water quality, and more. The tables below list studies from Ecology's EIM database that Ecology considered and subsequently used in the development of the 2018 WQA. The first table details studies with surface water quality data. The second table contains studies with contaminated sediments data analyzed by Ecology's Toxics Cleanup Program.

The following EIM studies apply RCW 34.05.272 data source category #9: Data from primary research, monitoring activities, or other sources, but that has not been incorporated as part of documents reviewed under other processes.

Table 1. Studies from EIM with surface water data included in development of the 2018 WQA

Study ID	Study Name
17274-01	Abandoned Mine Lands Initial Investigations
AAHM0003	Fecal Coliform Bacteria TMDL for Oakland Bay-Hammersley Inlet
AAHM0004	TMDL Analysis for Temperature in tribs to Oakland Bay-Hammer
aalb0001	Colville River Tributaries - Fecal Coliform
AJOH0048	PBT Monitoring: Measuring PBDE Levels in Washington Rivers and Lakes
AJOH0050	Yakima River 2006 Fish Tissue Survey for Chlorinated Pesticides, PCBs, and Dioxins.
AJOH0051	Marina Copper Study
AJOH0053	Endosulfan and Dieldrin in Wide Hollow Creek
AJOH0055	Yakima River Pesticides and PCBs TMDL: Evaluation of Water Quality Study Findings

[23] https://apps.ecology.wa.gov/publications/documents/1603002.pdf

Study ID	Study Name
AJOH0057	Puget Sound Boatyard Receiving Water Study
AJOH0059	Mercury & Small-Scale Mining
AJOH0060	Mercury and Copper in Leach Creek
AJOH0061	Microcystins and Saxitoxin in Western Washington Lakes
AJOH0063	Background Assessment for Chemical Contaminants in Northeastern Washington Area Lakes.
AJOH0065	Analyzing Chlorinated Pesticide Residues in Fish from Washington Background Lakes and Emerging PBTs in Fish Tissue
AMB_WQ_Bothell	Annual Stream Water Quality Monitoring
Ambient Monitoring	King County Ambient Macroinvertebrate Monitoring Program
AMS001	Statewide River and Stream Ambient Monitoring-WY2010 to present (Transitional data that has not yet been QA'd will be found in 'Statewide River and Stream Ambient Monitoring-WY 2010 to present-2;' User Study ID AMS001-2)
AMS001E	Statewide River and Stream Ambient Monitoring-WY 2000 through WY 2009
AMS002B	Lake Mini-Monitoring TP and Secchi
AMS004	Continuous Stream Monitoring
AMS005	Continuous Stream Temperature Monitoring
AO6557	Heglar Kronquist Landfill RI/FS, Mead, WA
AODE11237	Port of Tacoma Parcel 15 RI/FS
AODE12803	Gig Harbor Sportman's Club RI/FS
AODE8258	Douglas Management Dock (Alaska Marine Lines), Seattle, WA
AODE8979	Weyerhaeuser Mill A Former, Everett, WA
AODE9000	Blaine Marina Inc Remedial Investigation, Blaine, WA
AQ_Kenmore2012	Kenmore Sediment and Water Investigation
AQCD092002472	Alcoa Vancouver - Sediment Cleanup Site
ASTO0001	Upper Yakima Basin Temperature TMDL
BBCWQ	Burnt Bridge Creek - 2016 Water Quality Monitoring
BBCWQ06	Burnt Bridge Creek - 2006 Water Quality Monitoring
BBCWQ07	Burnt Bridge Creek - 2007 Water Quality Monitoring
BBCWQ11	Burnt Bridge Creek - 2011 Water Quality Monitoring
BCAR006	Edison large on-site sewage system (LOSS) - Groundwater study
BEDI0007	Water Quality Monitoring for Fecal Coliform Bacteria in Pierre Creek and Burns Creek
BEDI0008	Medicine Creek Fecal Coliform Investigation Summer 2009
BEDI0009	Medicine Creek Water Quality Monitoring for Fecal Coliform Bacteria and Nitrate+Nitrite-Nitrogen
BEDI0010	McAllister Creek Fecal Coliform Bacteria Monitoring Summer 2009
BEDI0011	Dobbs Creek Water Quality Monitoring for Fecal Coliform Bacteria
BEDI0012	Kennedy Creek Fecal Coliform Bacteria Water Quality Monitoring Study
BEDI0013	Upper Kennedy Fecal Coliform Bacteria Investigation, 2008-2009
BEDI0014	South Prairie Creek; Inglin Creek Drain Tile T4DT

Study ID	Study Name
BEDI0016	Black Creek Temperature Monitoring (06/24/2010 - 09/02/2010)
BEDI0017	Humptulips River Temperature Monitoring
BEDI0018	Dungeness Seep Study for Fecal Coliform Bacteria
BEDI0019	Bowman Creek Fecal Coliform Characterization
BEDI0020	Pussyfoot Creek Fecal Coliform Bacteria Characterization Monitoring
BEDI0021	Second Creek Fecal Coliform Characterization
BEDI0022	Lower Salmon Creek Watershed Fecal Coliform Bacteria Monitoring
BERA0003	South Puget Sound Fish and Shellfish Tissue Verification of 303(d) Listings
BERA0004	Similkameen River and Palmer Lake Investigation of Arsenic in Fish Tissue
BERA0005	Potholes Reservoir: Screening Survey for Dieldrin, other Chlorinated Pesticides, and PCBs in Fish, Water, and Sediments
BERA0007	Assessment of Toxicity in North Creek, Gig Harbor
BERA0008	Integrated Ambient Monitoring Pilot - Potential Causes for Impairment of Rainbow Trout Early Lifestages and Loss of Benthic Biodiversity in Indian Creek
BERA0009	Spokane River Toxics Preliminary Monitoring 2012 through 2013 - In Support of the Long-term Toxics Monitoring Strategy
BERA0010	Integrated Ambient Monitoring Follow-up Study in Indian Creek - Phase II Study
BERA0011	Lake Spokane PCBs in Carp
BERA0012	Spokane River PCBs and other Toxics: Long-Term Monitoring at the Spokane Tribal Boundary
BlackCr	Black Creek Temperature Monitoring (06/01/2006 - 10/01/2006)
Boise Ambient	King County Boise Creek Ambient Monitoring Project
Brwa0007	Squalicum Creek Stormwater Pilot Total Maximum Daily Load
BSAC0001	Continuous Nitrate Monitoring in the Deschutes River during the 2010 Water Year
BUDD07	Budd Inlet Sediment Characterization
C0500017	Little Spokane River Bacteria, Phosphorus, and Temperature TMDL Surveys
C0500079	Hood Canal Salmon Enhancement Group Molluscan Study
C0800174	Fidalgo Bay Nearshore Non-Point Watershed Assesement
C0900063	Investigation of fecal coliform sources in Juanita Creek basin
C1100043	Burnt Bridge Creek Bacteria Source Reduction Project
C1200226	WDFW Puget Sound Ecosystem Monitoring Program (PSEMP) Toxics in Biota Study- Toxic Contaminants in Dungeness Crab and Spot Prawn from Puget Sound, Washington, USA
CamasBKGRM121	Camas WWTP Receiving Water Study
CAME001	Brominated Flame Retardants, Chlorinated Paraffins, and Hexabromocyclododecane in WA Rivers and Lakes
CAME002	Statewide Survey of Per- and Poly-fluoroalkyl Substances in Washington State Rivers and Lakes

Study ID	Study Name
CAME003	Flame Retardants in Ten Washington State Waterbodies
CampBRAU2C	US ARMY Camp Bonneville RAU-2C
CBRO0001	Dungeness Watershed Fecal Coliform TMDL Effectiveness Monitoring
CBUR0002	Pesticides in Salmonid-Bearing Streams, Year 3
CBUR0003	Pesticides in Salmonid-Bearing Streams, Year 4
CBUR0004	Pesticides in Salmonid-Bearing Streams, Year 5
CBUR0006	Pesticides in Salmonid-Bearing Streams, Year 6
CBUR0007	A Study of Copper Discharge from Irrigation Canals
CC-LISP	Long-term Index Site Project (LISP), Clark County
CC-SCMP	Clark County NPDES Salmon Creek Monitoring Project
CC-SNAPBACT	Stormwater Needs Assessment Program; Focused Assessment
CC-SNAPCHAR	Stormwater Needs Assessment Program subwatershed characterization
CC-TEMP	Clark County Continuous Stream Temperature
CC-VOLMGIB	Clark County Volunteer Monitoring Ambient Stream Monitoring
CC-VOLMONAM	Clark County Volunteer Monitoring, Ambient Stream Monitoring
CCC1-06	Volunteer Water Quality Monitoring: Baseline Monitoring of the Upper Columbia River Shoreline
CCHL46954465	Cowlitz County Headquarters Landfill (aka Weyerhaeuser Regional Landfill) Groundwater Monitoring
CCOF0003	Lower Okanogan River Basin DDT and PCB TMDL Effectiveness Monitoring, 2008
CCOF0004	2007 Lake Chelan Wapato Basin TMDL Effectiveness Monitoring for Total Phosphorus
CCTWLDM1079	Cowlitz County Tennant Way Landfill Detection Monitoring
CCWR_002	City of Port Angeles (PA-fecal)
CCWR_003	Streamkeepers monitoring (SK_suite)
CCWR_004	SK_fecal
CCWR_034	Clallam County Environmental Health
CCWR_049	Quileute Tribe monitoring
CCWR_053	Lincoln HS Monitoring
CCWR_055	Storm surface water EPA Grant 2008-2009
CCWR_058	Clean Water District monitoring
CCWR_061	Storm surface water EPA Grant 2010-2011
CCWR_062	WRIA 19 stormwater sediment study
CFA_WQ14	Chehalis Flood Authority Water Quality Monitoring
cfur0003	PBT Monitoring: Measuring PFC Levels in Washington
CFUR0005	PBDE Flame Retardants in Spokane River Fish Tissues and Osprey Eggs.
CFUR0006	Speciated Mercury in the Lake Ozette Drainage.
cfur0008	Mercury Screening in Lake Ozette Sockeye
CHPI004	Waitsburg WWTP Groundwater Study - Evaluation of Nutrient Loading to the Touchet River
Clarks Creek DO	Clarks Creek Dissolved Oxygen Study

Study ID	Study Name
CNF WQ TMDL	Colville National Forest Water Quality TMDL Monitoring
COS_WQ	City of Shoreline Ambient Stream Monitoring 2007-2015
CRBHHRA12	Columbia River Component Risk Assessment: Baseline Human Health Risk Assessment
CRK-06	Volunteer Water Quality Monitoring: Baseline Monitoring of Columbia River Tributaries
DBAT0004	Skokomish River Basin Fecal Coliform TMDL Attainment Monitoring
DCWA2018-CRMonit	Columbia River Water Quality Monitoring 2018
DCWA2019-CRMonit	Columbia River Water Quality Monitoring 2019
DCWA2019-ExtCRMonit	Extended Columbia River Water Quality Monitoring 2019
ddug0001	Nason Creek Oxbow Reconnection Monitoring
DDUG0002	Yakima Area Creeks Temperature Assessment
DGRA0001	Walla Walla River Chlorinated Pesticides Source Characterization
DMMP_Dioxin_2005-07	DNR Dioxin Study
DryForkCreek	City of Pullman Fecal Coliform Bacteria Monitoring of Dry Fork Creek
DSAR0004	Pesticides in Salmonid-Bearing Streams, Year 7
DSAR0005	Pesticides in Salmonid-Bearing Streams, Skagit-Samish Intensive Sampling
DSAR0006	Pesticides in Salmonid-Bearing Streams, Year 8
DSAR0007	Pesticides in Salmonid-Bearing Streams, Year 9
DSAR0008	Pesticides in Salmonid-Bearing Streams, Comparison of Grab vs Depth Integration
DSAR0009	Pesticides in Salmonid-Bearing Streams, Year 10
DSAR0010	Pesticides in Salmonid-Bearing Streams, Year 11
DSAR0011	Pesticides in Salmonid-Bearing Streams, Copper Assessment
DSER0016	PCBs, PBDEs, and Selected Metals in Spokane River Fish, 2005
EFLewisSA	East Fork Lewis Fecal Coliform Bacteria and Temperature Source Assessment
EFLRTMDL	East Fork Lewis River TMDL technical study for Temperature and Bacteria (WRIA27)
EG150077	Hood Canal Priority Basins
EG160640	Quilcene-Dabob Bay Pollution Identification and Correction
EKCDAmbientWQ	WRIA 31 TMDL
EPABEACH	WA State BEACH (Beach Environmental Assessment, Communication, and Health) Program
EPALR05B	USEPA 2005 Phase 1 Fish Tissue Sampling: RI/FS Upper Columbia River/ Lake Roosevelt
Ephrata Landfill_592	Ephrata Landfill, Ephrata, Grant County WA
EURM0001	Tieton and Lower Naches Temperature Study
FBCPDX48	Supplementary Fidalgo Bay and Custom Plywood Mill Sediment Dioxin Study, Anacortes, WA: Data Report
FCCD 1_WQ	WRIA 44/50 stream monitoring
Fecal_TMDL_Bothell	North and Swamp Creeks TMDL Fecal Bacteria Results

Study ID	Study Name
FFCMP13	Freshwater Fish Contaminant Monitoring Program 2013
FFCMP14	Freshwater Fish Contaminant Monitoring Program 2014
FFCMP15	Freshwater Fish Contaminant Monitoring Program 2015
FFCMP16	Freshwater Fish Contaminant Monitoring Program 2016
FIDALG08	Fidalgo Bay Sediment Investigation
FS1203	B&L Wood Waste Landfill, Fife Way and Puget Power Rd, Tacoma, WA
FS1554858	Van Stone Mine Site, CS461, Colville, WA
FS2018	The Boeing Company, Auburn Fabrication Division Plant
FS2699	Sisco Landfill Site
FS53481373	Kaiser Trentwood Remedial Investigation, Spokane, WA
FS787	Palouse Producers, Palouse, WA
FS84531356	USG Interiors Highway 99 Cleanup Site, Tacoma, WA
FS9	Kimberly-Clark Worldwide Site, Everett, WA
G0100038	Local Involvement in Resource Issues
G0200280	Chehalis River Council Volunteer Monitoring Project
G0200377	Fecal Coliform Baseline Study
G0300021	Water Quality Monitoring Implementation
G0300037	Lower Palouse River Scoping Project
G0300114	Garfield County Riparian Restoration
G0300181	Water Resources Protection Program (Burnt Bridge Creek)
G0300201	Newman Lake Watershed Monitoring & Education
G0300233	West Branch Hylebos Creek Restoration
G0400133	Skagit County Monitoring Program (Grant: G0400133, 12/22/2003 - 12/31/2008)
G0400199	Deschutes River/Budd Inlet TMDL
G0400200	Urban Streams Riparian Restoration, Cleanup and TMDL Action Plan
G0400264	French Creek BMP Monitoring and Implementation
G0400274	DDT Concentrations in Lake Chelan Water Measured Using Semipermeable Membrane Devices (SPMDs) and a Large-Volume Solid-Phase Extraction Device. Sediment Organochlorine Pesticide Concentrations near Tributary and Irrigation Drain Discharges to Lake Chelan
G0500025	Clallam County-Wide Monitoring CCWF Task 3
G0500033	Riparian Enhancement and Monitoring
G0500076	Ten Mile Creek Watershed Restoration Project- 4Mile Creek Focus Area Monitoring
G0500118	South Prairie Creek Restoration Project
G0500122	Colville River TMDL Implementation Project
G0500140	Bellingham Salmon Habitat Restoration and TMDL
G0500151	Bainbridge Island Water Quality Monitoring Program
G0500173	Dyes Inlet Restoration Project
G0500175	Snoqualmie Watershed Agricultural Assistance Team Project
G0600071	Cottage Lake Phosphorus Reduction Project

Study ID	Study Name
G0600178	Long Lake Integrated Management Plan
G0600241	Pend Oreille TMDL Data Gathering Project
G0600283	Little Klickitat TMDL Implementation Project, Task 2 Monitoring
G0600323	Stillaguamish Sub-Basin TMDL
G0600332	Skokomish Annas Bay Restoration Study
G0600345	Totten/Eld Inlet TMDL Response
G0600378	Mason County's Hood Canal Septic System Surveys and Database Enhancement
G0700093	Chimacum Creek Clean Water Project
G0700116	WRIA 22-23 Water Quality Monitoring
G0700126	Little Bear Pollution Identification/Correction
G0700145	Livestock Implementation Project
G0700165	Pine Creek Enhancement Phase 2, Task 5 Water Quality Monitoring
G0700167	Palouse River Implementation Project B
G0700243	Hansen Creek / Red Creek Restoration Project
G0700316	Swamp Creek Water Pollution Prevention
G0800014	Loon Lake Water Quality Monitoring Program
G0800055	Hood Canal Clean Water Project
G0800056	Discovery Bay Clean Water Project
G0800097	NF Palouse River TMDL Implementaiton Project
G0800099	Achieving Environmental Compliance- AEC
G0800113	Jump Off Joe Creek Restoration Project
G0800132a	Whatcom Creek Watershed Bacteria TMDL CCWF Grant No G0800132
G0800132b	Bellingham Water Quality and Habitat Improvement: Long-term Temperature and Shade Monitoring of Whatcom Creek
G0800327	Holmes Harbor Bacteria Source Identification/Remedy
G0800328	Lincoln County Implementation Project
G0800355	Little Pend Oreille River Watershed Water Quality Monitoring
G0800396	Little Klickitat Temperature TMDL Implementation Project
G0800398	WRIA 31 Water Quality Remediation and Evaluation, Task 4 Water Quality Monitoring
G0800469	South Fork Stillaguamish Tributaries Restoration
G0800516	Lake Steilacoom Calcium Hydroxide Treatment Routine Monitoring
G0800611	Lake Assessment and Toxic Cyanobacteria Monitoring Project
G0800616	Miller Creek Sub-basin Investigative Water Quality Monitoring; Grant G0800616 Miller-Pilchuck Creeks TMDL Improvement
G0800618	Juanita Creek Basin Stormwater Retrofitting Analysis Project
G0900050	Sinclair Inlet Restoration/Protection Project
G0900051	Kittitas Multi-TMDL Compliance Project
G0900067	Mats Mats Bay Water Quality Improvement Program
G0900073	Day Creek Habitat Restoration: temperature effectiveness monitoring for introduced large in-channel wood.
G0900074	Hansen Creek Alluvial fan

Study ID	Study Name
G0900076	Lone Lake Restoration and Implementation Project
G0900201	Hammonds Lake Nutrient Source Study
G1000099	WRIA 44/50 Long Term Monitoring Program
G1000122	Northshore Hood Canal Pollution Identification and Correction
G1000151	Water Quality Improvement Through Beaver Restoration in the Methow River Watershed
G1000282	Methow Subbasin Water Quality Restoration and Monitoring Program
G1000301	Liberty Bay Watershed Restoration Project
G1000342	Chamokane Creek Watershed Implementation Plan
G1000349	Stillaguamish Temperature TMDL Adaptive Assessment and Implementation Project
G1000530	South Sound GREEN Fecal Coliform Bacteria Monitoring in Dobbs Creek
G1000531	Washington State University Puyallup Research and Extension Center Clarks Creek Water Quality, Science, Restoration, and Implementation Program
G1100174	Clean Water District 2013-14
G1100177	Little Klickitat TMDL
G1100189	Hood Canal Watershed Clean Water Project
G1100202	pierce county shellfish project
G1100251	Jefferson County Lakes Toxic Algae Project
G1200001a	Lake Ketchum Algae Control Plan (Water Quality Data)
G1200017 B-IBI	B-IBI Monitoring, North Fork West Hylebos Creek
G1200127	Northeast Jefferson Clean Water Project
G1200280	Maxwelton Bacteria Source Identification
G1200337	Little Klickitat TMDL Implementation
G1200408	Bear Creek Livestock BMP Continuation
G1300059	Walla Walla Conservation District Water Monitoring, 2015-2016
G1300075	Ebey's Prairie Watershed Stormwater Remediation Project
G1300080	Squalicum Creek Water Quality and Biotic Integrity Improvements
G1300080 & G1400398	Squalicum Creek Water Quality and Biotic Integrity Improvements, Phase 2
G1300083	WDFW Puget Sound Ecosystem Monitoring Program (PSEMP) Toxics in Biota Study - Toxic contaminants in juvenile Chinook salmon (Oncorhynchus tshawytscha) migrating through estuary, nearshore and offshore habitats of Puget Sound
G1300102	White Salmon River Fecal Coliform Bacteria Monitoring
G1400003	Jefferson County Toxic Cyanobacteria Project
G1400004	Lake Ketchum Algae Control Implementation
G1400400	Squalicum Creek Watershed Monitoring and Social Marketing Clean Water Project
G1400424	Little Klickitat TMDL Implementation Project 6
G1400428	Swale Creek Implementation Project
G1400435	Drayton Harbor/Semiahmoo Bay Water Quality Enhancement Project

Study ID	Study Name
G1400458	Strait Water Quality Partnership Task 2 - Pillar Point Shellfish Downgrade Response
G1400475	Waughop Lake Management Plan
G1400501	Shade Monitoring for the Wenatchee Basin Water Quality Restoration Project
G1400520	WRIA 31 Implementation & Monitoring
G1400530	Hood Canal Clean Streams Initiative
G1400543	Skagit Flats South Water Quality Monitoring
G1400575	Spanaway Lake Management Plan
G1400587	2014 Pierce County Shellfish Project
G1500046	Penrose Point Nutrient Reduction Project
GMER0004	Union River FC TMDL Attainment Monitoring
GPEL0008	Old Stillaguamish River TMDL
GPEL0010	Lower White River pH TMDL
Green RivEquipBlank	Green River PCB Equipment Blank Study Data Report
Green RivSurfWater1	Lower Duwamish Waterway Source Control: Green River Watershed Surface Water Data Report
GRNRVLD13	Green River Loading Study - Phase 1
GRNRVLD14	Green River Loading Study - Phase 2
GRNRVLD16	Green River Loading Study - Phase 3
GTUT0001	Pesticides in Salmonid-Bearing Streams, Year 12
GTUT0002	Pesticides in Salmonid-Bearing Streams, Year 13
GTUT0003	Pesticides in Salmonid-Bearing Streams, Year 14
HANSVLGS	Hansville General Store, Hansville, WA
HgFish05	Mercury Trends in Fresh Water Fish 2005
HgFish06	Mercury Trends in Freshwater Fish 2006
HgFish07	Mercury Trends in Freshwater Fish 2007
HgFish08	Mercury Trends in Freshwater Fish 2008
HgFish09	Mercury Trends in Freshwater Fish 2009
HgFish10	Mercury Trends in Freshwater Fish 2010
HgFish11	Measuring Mercury Trends in Freshwater Fish in Washington State, 2011 Sampling Results
HgFish12	Measuring Mercury Trends in Freshwater Fish in Washington State, 2012 Sampling Results
HgFish13	Measuring Mercury Trends in Freshwater Fish in Washington State, 2013 Sampling Results
HgFish14	Measuring Mercury Trends in Freshwater Fish in Washington State, 2014 Sampling Results
HgFish15	Measuring Mercury Trends in Freshwater Fish in Washington State, 2015 Sampling Results
HgFish16	Measuring Mercury Trends in Freshwater Fish in Washington State, 2016 Sampling Results
HgFish17	Measuring Mercury Trends in Freshwater Fish in Washington State, 2017 Sampling Results

Study ID	Study Name
HoldMine	Holden Mine Remediation, Holden, WA
Island_County_AEC_WQ	Island County Water Quality Monitoring Program
IslandCountyPIC	Island County Pollution Identification and Correction Study
IslandCoWQ	Island County Water Quality Program
JCRE0001	Crystal Creek Multi-Parameter TMDL Effectiveness Monitoring
JDURK0001	Wilson Creek Sub-Basin Fecal Coliform Monitoring
JeldWen12	Jeld Wen Former Nord Door Site - Sediments
jfie0001	Padilla Bay Tributaries Fecal Coliform Bacteria Total Maximum Daily Load
JICA0000	South Fork Palouse River TMDL*please see Study Comment field below*
JICA0001	Palouse River TMDL*please see Study Comment field below*
JICA0002	Wide Hollow Creek Water Quality Study for Aquatic Life Use
JICA0003	Okanogan River Tributaries 303(d) pH Listings Verification Study
JJOY0005	Hangman Creek Dissolved Oxygen and pH TMDL
jjoy0006	Upper Crab Creek TMDL Study
jjoy0007	Little Spokane River Dissolved Oxygen & pH TMDL
jjoy0009	Little Spokane Fish Hatchery Characterization
JKAR0001	Fecal coliform bacteria monitoring: South Prairie Creek tributaries assessment including Inglin Creek and Spiketon Ditch.
JKAR0002	Skagit Bay Fecal Coliform Bacteria Loading Assessment
JKAR0003	Cherry and Ames Creeks (Snoqualmie River Tributaries) Dissolved Oxygen Study
JKAR0004	Clover Creek multiple parameter TMDL
jkar0005	North River Temperature and Bacteria Verification Study
jros0001	Goosmus Creek
jros0003	Little Spokane River Fish Hatchery
JROS0009	Colfax Floodworks Fecal Coliform Study
jros0011	Crab Creek Alternate Feed Route Study
JROS0020	Lake Spokane Nutrient Monitoring
JROS0021	Asotin Creek FC Study
JROS0022	Inland Empire Paper Company Source Water Study
JROS0023	New Spokane WWTP Monitoring
JROS0024	Deep Lake Monitoring
JROS0025	Walla Walla Multiple DO, pH and Bacteria TMDL Effectiveness Monitoring
JROSL001	Rocky Ford Creek Monitoring 2006
JROSL004	Pataha Creek Effectiveness Monitoring 2005
JROSL007	Garfield County Implementation Monitoring
JROSL008	Asotin County Implementation Monitoring
KC-marine-tissue	King County MarineTissue Monitoring
KC_Minor_Lakes	King County Minor Lakes Monitoring Program
KClake-1	King County Routine Major Lakes Ambient Monitoring

Study ID	Study Name
KCmar-1	King County Routine Marine Ambient Monitoring
KCPIC_Quartermaster	Quartermaster Harbor Pathogens Reduction Project - National Estuary Program Grant
KCsb-1	King County Swimming Beach Monitoring Program
KCstrm-1	King County Routine Ambient and Wet Weather Streams Monitoring
KITSAPWQ	Kitsap Public Health District Surface Water Trend Monitoring
KNRD TS Temperature	KNRD Time Series Temperature Monitoring Network
KTWQ	Kalispel Tribe Water Quality Monitoring Network
LDW-KC-Waters	King County Water sampling (Lower Duwamish River)
LDWAOC3	Lower Duwamish Waterway Administrative Order on Consent (third amendment)
LDWEnglishSole2007	2007 PSAMP Groundfish Contaminant Survey
LDWFishCrabClam2007	FISH, CRAB, AND CLAM TISSUE COLLECTION AND CHEMICAL ANALYSES FOR ADDITIONAL FISH, CRAB, AND CLAM SAMPLING IN THE LOWER DUWAMISH WATERWAY IN 2007
LDWGSW0717	Lower Duwamish Waterway, Groundwater Sampling for PCB Congeners and Aroclors
LKFenwick_WQ	Water Quality for Lake Fenwick
LKMeridian_WQ	Water Quality for Lake Meridian
LKSpokaneNutrient_WQ	Lake Spokane Nutrients Monitoring
LoonLake WQ	Loon Lake Water Quality Monitoring Program, Continuous
LSP3	Little Squalicum Park Remedial Investigation/Feasibility Study (data collected by Integral and the City of Bellingham during the LSP RI/FS phase)
LSUL0001	Puyallup River Fecal Coliform Bacteria TMDL
LVDITCH-2010	Fecal Coliform in Longview Ditches and Lake Sacajawea 2010
Lynnwood_TMDL	Swamp Creek Watershed, Fecal Coliform Bacteria TMDL, Lynnwood, WA
MarineWater	Long-term marine water column monitoring 1999-present. (Transitional data that has not yet been through a documented Data Entry Review process can be found in EIM Study ID â€œMarineWater-Pâ€).
MasonHCPIC_WQ	Mason County's Hood Canal Septic System Surveys and Database Enhancement â€“ stage 1
MBEL0002	Lake Ballinger Monitoring Project
mifr0001	Status Monitoring for the Upper Yakima River Suspended Sediment and Organochlorine Pesticide TMDL
MIFR0002	Little Spokane River PCBs in Fish Tissue Verification Study
mifr0003	Spokane Fish Hatchery PCB Evaluation
MIKA0001	Giffin Lake, Yakima County Phosphorus Verification Monitoring
MIKA0002	Myron Lake, Yakima County Ammonia Verification Monitoring
MIT_SCWQ	Muckleshoot Indian Tribe Fisheries Department Lake Washington Ship Canal Water Quality Project

Study ID	Study Name
MonroeWQ	City of Monroe TMDL water quality monitoring for fecal coliform bacteria
Monte Cristo	Monte Cristo Mining Area Remedial Investigation
MRED0002	Hangman Hills Sewage Treatment Plant Nutrient Loading and Groundwater Study
MROB0001	Deschutes River Watershed (WRIA 13), multi-parameter TMDL
MROB0004	South Puget Sound Dissolved Oxygen Study, Phase 2
MROB002	Bear Evans Temperature and DO TMDL
MROB003	Green River and Newaukum Creek Temperature and Dissolved Oxygen Study
MSVL_MUNSONCREEK2017	Munson Creek TMDL 2017
MVON001	Stillaguamish River-Dissolved OxygenAdditional Study for Low Dissovled Oxygen Levels Below The City of Arlington.
MVP003	Additional Study of Low Dissolved Oxygen Levels In The Upper Stillaguamish River Main Stem
MVP004	Gibbons Creek Effectiveness Monitoring
NCRI0001	Snoqualmie River Temperature TMDL
NFPR	North Fork Palouse River BMP effectiveness monitoring
NFTOUTLE	North Fork Toutle River Water Temperature Study
NMat0001	Drayton Harbor Watershed Fecal Coliform TMDL
NMat0002	Lower White River Nutrients and pH Study
NMat0003	Phase 2: High Summer Bacteria Concentrations in Streams
NMat0004	Salmon Creek Low DO and pH Study
NMat0005	Fecal Coliform MPN method comparison study
NMat0006	Chehalis River Tributaries Supplemental Temperature and Flow Monitoring 2017
NSEA_TerrellCr_WQ	NSEA Water Quality on Terrell Creek
OCCSED16	Occidental Chemical Corporation (OCC), Data Summary Report Hylebos Sediment and Porewater Sampling Program 2016
OGEO0001	Willapa River Fecal Coliform Bacteria Verification Study
PAND0002	OP Pesticides in Grayland Ditch
PAND0004	Henderson Inlet Fecal Coliform Effectiveness Monitoring
PASED08	Port Angeles Harbor Sediment Investigation.
PbTrends09	PBT Trend Monitoring: Lead in Suspended Particulate Matter, 2009
PbTrends10	PBT Trend Monitoring: Lead in Suspended Particulate Matter 2010
PbTrends11	PBT Trend Monitoring: Lead in Suspended Particulate Matter 2011
PbTrends12	PBT Trend Monitoring: Measuring Lead in Suspended Particulate Matter from Washington State Rivers and Lakes, 2012 Results.
PbTrends13	PBT Trend Monitoring: Measuring Lead in Suspended Particulate Matter from Washington State Rivers and Lakes, 2013 Results.
PbTrends14	PBT Trend Monitoring: Measuring Lead in Suspended Particulate Matter from Washington State Rivers and Lakes, 2014 Results.
PbTrends15	PBT Trend Monitoring: Measuring Lead in Suspended Particulate Matter from Washington State Rivers and Lakes, 2015 Results.

Study ID	Study Name
PbTrends16	PBT Trend Monitoring: Measuring Lead in Suspended Particulate Matter from Washington State Rivers and Lakes, 2016 Results.
PCSWQD	Pierce County Surface Water Quality Upland Sampling
PeabodySID2012	Peabody Creek Stressor Identification Study 2012
PipersFC001	Piper's Creek Microbial Source Tracking Study
PlumcreekWQ	Lookout Creek Temperature monitoring
PortGamble09	Port Gamble Bay Remedial Investigation and Feasibility Study
PORTGAMBLE2011	Port Gamble Bay Supplemental Remedial Investigation 2011
PortGardner_08	Sediment Characterization Study in Port Gardner and Lower Snohomish Estuary, Port Gardner, WA. Reload 4/10/2010. Revised by Jonathan Newer of SAIC - Bothell WA
PSTox001	Toxics in Surface Runoff to Puget Sound
RCOO0004	Lake Chelan DDT and PCBs in Fish TMDL
RCOO0006	Vancouver Lake PCBs, Chlorinated Pesticides, and Dioxins in Fish Tissue and Sediment Investigation
RCOO0008	West Medical Lake PCBs, Dioxins and Furans in Fish, Sediment, and Wastewater Treatment Plant Effluent
RCOO0009	Copper and Zinc Levels in Des Moines, Massey, and McSorley Creeks, King County
RCOO0010	Puget Sound Toxics Loading Analysis: Characterization of Toxic Chemicals in Puget Sound and Major Tributaries, 2009-10
RCOO0016	Puget Sound Basin Railroad Track PAH and Metals Baseline Study
RESources_LNKSK_WQ	TMDL fecal coliform monitoring in the lower Nooksack River.
Rivers	Rivers B-IBI sampling
RSM_EFS1	Redmond Paired Watershed Study _ Final
RSMP_PC_PMNM2015	Regional Stormwater Monitoring Program Puget Marine Nearshore Mussels (Pierce)
RSMP_PC_PMSB2015	Regional Stormwater Monitoring Program Puget Marine Shoreline Bacteria (Pierce)
S356THST_SAM_STUDY	Effectiveness Monitoring of the South 356th Street Retrofit and Expansion Project, Federal Way, WA
SAM_MNM	Stormwater Action Monitoring Program Puget Nearshore Mussels
SAM_PC_MNM2017	Stormwater Action Monitoring Program â€“ Pierce County â€“ Puget Nearshore Mussels
SAM_PLES	Stormwater Action Monitoring Program Puget Lowland Ecoregion Streams
SCBIDWQD	Routine monthly monitoring of water quality in canals and return flows of the South Columbia Basin Irrigation District
SCL_BWQS	Water Quality Monitoring Program, Boundary Hydroelectric Project (FERC No. 2144)
SCMP_WQ	Skagit County Monitoring Program (01/01/2009 -)
SCOL0001	Weaver Creek (Mason County) Fecal Coliform TMDL Attainment Monitoring
scol0002	White Salmon River Watershed Fecal Coliform Bacteria Attainment Monitoring Study

Study ID	Study Name
SCOL0003	Deschutes River Multi-parameter Total Maximum Daily Load Effectiveness Monitoring Pilot Project
SCTA0001	Dayton and Waitsburg TMDL Fine-Tuning
SCTPWQCR	Columbia River Background Water Quality near the SCTP
SGOL008	Zinc and Copper Concentrations in an Industrial Area Creek during Storm Events.
SGOL009	Lead and Copper Concentrations in North Creek, Gig Harbor
Skok_Estuary_Monitor	Skokomish Estuary monitoring
SLIP4_RAC	Slip 4 Removal Action Construction 2012
SNOCO_TMDLMONITORING	Snohomish County Surface Water Management Fecal Coliform Bacteria TMDL Monitoring
SNOCOPIC_LowerStilly	Lower Stillaguamish Pollution Identification and Correction Program
SnohomishSTRMWTR_WQ	City of Snohomish QAPP
SnoLakes	Snohomish County Lake Management Program
SPC_TMDL_WQ	South Prairie Creek Restoration Monitoring
SPILDW06	Sediment Profile Imaging Feasibility Study - Lower Duwamish Waterway
SPU_stream_bact	SPU Urban Stream Bacteria Study
SRRTTF-2014	Spokane River Regional Toxics Task Force 2014 Synoptic Dry Weather Survey and Confidence Testing for PCBs in Surface Water
SRRTTF-2015	Spokane River Regional Toxics Task Force 2015 Synoptic Dry Weather Survey
SRRTTF-2016	Spokane River Regional Toxics task Force 2016 Monthly Monitoring
SRRTTF-GW2016	Spokane River Regional Toxics Task Force 2016 Groundwater Sampling for PCBs in the Spokane Valley-Rathdrum Prairie Aquifer
STEB0002	Burnt Bridge Creek Fecal Coliform Bacteria, Dissolved Oxygen, and Temperature Total Maximum Daily Load Technical Study
SuqTribeStreamTemps	Water Temperatures in Selected Streams of Kitsap County
ThorntonMatthewsFC01	Thornton Creek and Matthews Beach Microbial Source Tracking Study
tist0000	West Medical Lake verification monitoring
tist0001	Deadman/Meadow/Alpowa FC, DO, pH, and Temp STI monitoring
tist0002	Hangman Creek dissolved oxygen, pH, and nutrients pollutant source assessment
TMDL2017SC	NPDES required monthly TMDL Swamp Creek monitoring
TNC 1_WQ	Groundwater level monitoring WRIA 44/50
TSWA0001	Samish Bay Fecal Coliform Bacteria TMDL
TSWA0002	Liberty Bay Fecal Coliform TMDL
TSWA0003	Lacamas Creek Fecal Coliform, Temperature, Dissolved Oxygen, and pH Total Maximum Daily Load
TSWA0004	French Creek and Pilchuck River Temperature, Dissolved Oxygen, and pH Total Maximum Daily Load
TSWA0005	North Ocean Beaches Fecal Coliform TMDL and Source ID Study
TUWS35TM	Tucannon River Watershed Temperature TMDL
UCR_FS05	Phase I Upper Columbia River Site CERCLA RI/FS - Fish Tissue Data

Study ID	Study Name
Upper GreenSurfWater	Lower Duwamish Waterway Source Control: Upper and Middle Green River Surface Water Data Report
USNKPLTM	Keyport Area 8 Biological Evaluation
USNKPLTM16	Keyport Area 8 Tissue/Sediment Evaluation
USNSILTM2003-07	US Navy Bremerton Naval Complex Operable Unit B Marine Monitoring, Bremerton, WA. Combined 3 years of data from 2003 2005 and 2007 into one study.
USNSILTM2014-15	US Navy NBK Bremertion Operable Unit B Marine 2014-15 Sinclair Inlet Marine Monitoring, Bremerton, WA
UWI_EB07	Surface Sediment and Fish Tissue Chemistry in Greater Elliott Bay (Seattle) -Urban Waters Initiative
Vashon	King County Vashon Island Macroinvertebrate Monitoring Project
VCNW1264	Des Moines Creek Regional Retention/Detention Facility Arsenic Issues Investigation by Des Moines Creek Basin Committee
VCSW0889	Pacific Northwest Salmon Center Brownfields Cleanup, Belfair, WA
WA0001317	Pend Oreille Mine Ground & Surface water
WA0032182	Carnation Wastewater Treatment Plant - Temperature Monitoring Study for NPDES Permit #WA0032182
WADOH_Marine_Fecal	Shellfish Growing Area Program - Marine Water Quality Monitoring
WAR044001_S8B	Clark County Phase I Municipal Stormwater Permit (2013 - 2018)
WAR044001_S8D	Clark County Phase I Municipal Stormwater Permit
WAR044002_S8D	Pierce County Phase I Municipal Stormwater Permit
WB1577RIFS	Solid Wood Inc. (West Bay Park) RI/FS, Olympia, WA. Agreed Order # DE-08-TCP SR-5415
WDFW 11-1916	WDFW Mussel Watch Pilot Expansion project - toxic contaminants in Puget Sound nearshore biota: a large-scale synoptic survey using transplanted mussels (Mytilus trossulus)
WDFW_TBiOS_Chinook	Contaminants Reveal Spatial Segregation of Sub-adult Chinook Salmon Residing and Feeding in Puget Sound
WDFW_TBiOS_EngSole	Contaminants in Puget Sound English Sole Muscle tissues
WEHI0001	Type N Experimental Buffer Treatment Study--Competent Lithologies
WEHI0002	Extensive Riparian Status and Trends
WEHI0003	Type N Experimental Buffer Treatment Study--Incompetent Lithologies
WHM_EFF0	Watershed Health data for Monitoring the Effectiveness of Pollution Control Activities on Agricultural Lands, Bertrand Creek
WHM_EFF2	Watershed Health data for Henderson Inlet Fecal Coliform TMDL Effectiveness Monitoring
WHM_EFF3	Effectiveness Monitoring of TMDL and Salmon Recovery Activities on Newaukum River
WHM_EPA	Status and Trends Puget Sound Region Sentinel Site Monitoring
WHM_WHB	Wide Hollow Creek Water Quality Study for Aquatic Life Use (Bioassessment and Habitat Component)
WHOB001	Pine Creek Toxaphene Source Assessment
WHOB002	Wenatchee River PCB Source Assessment

Study ID	Study Name
WHOB003	Assessment of Methods for Sampling Low-Level Toxics in Surface Waters
WHOB004	Copper, Zinc, and Lead in Select Marinas of Puget Sound
WillBacT	Riverdale Creek Verification Study
WJW00002	Puyallup and White Rivers Dissolved Oxygen and Temperature Data Summary Report
WPAH13	2013 Western Port Angeles Harbor RI/FS Sediment Sampling
WQALWAND	Lake Whatcom Tributary Monitoring Project
WQAMFNWT	City of Bellingham Nooksack River Middle Fork Water Temperature Monitoring Program
WQASCAMB	Snohomish County Surface Water Ambient Monitoring
WQC-2016-00082	Improving Water Quality: Riparian Restoration on Lower Yellowhawk Creek
WQC-2016-0014	Monitoring the Effectiveness of Riparian Buffers on the South Fork of the Palouse River
WQC-2016-00371	Douglas County Water Quality Improvement Program
WQC-2016-CHCoNR-0247	Lake Chelan Long Term Monitoring
WQC-2017-00167	Strait Priority Areas Project
WQC-2017-00168	Central Hood Canal Pollution Identification and Correction
WQC2015CwCoHH00129	Water Quality Testing & Improvement at Two Cowlitz County Lakes
WQC2016MCFEG00215	Yakima River Side Channels Project
WQC2016OkHiAl00126	Monitoring Program for the Triple Creek Wetland Restoration Project
WSTMP05	Washington State Toxics Monitoring Program: Exploratory Monitoring 2005.
WSTMP06	Washington State Toxics Monitoring Program: Exploratory Monitoring 2006.
WSTMP07	Washington State Toxics Monitoring Program: Exploratory Monitoring 2007.
WSTMP08	Washington State Toxics Monitoring Program: Exploratory Monitoring 2008.
WSTMP09	Washington State Toxics Monitoring Program: Exploratory Monitoring 2009.
WSTMP10	Washington State Toxics Monitoring Program: Exploratory Monitoring 2010
WSTMP12	Washington State Toxics Monitoring Program: Exploratory Monitoring 2012
WWP1Y0	Whatcom Waterway Phase 1 Cleanup Year 0
WWP1Y1	Whatcom Waterway Phase 1 Compliance Monitoring Year 1
YUTTMDL	Yakima Urban Tributaries Fecal Coliform TMDL

Table 2. Studies from EIM with contaminated sediment data included in development of the 2018 WQA

Study ID	Study Name
53ACSO96	King County's NPDES CSO Subtidal Sed
63ACSO97	NPDES 63rd Ave CSO Baseline Study, 1997
AGS_NPDES_2007	American Gold Seafoods 2007 NPDES Sampling at Puget Sound salmon net pens
AGS_NPDES_2010	NPDES Sampling during 2010: American Gold Seafoods Net-Pen Sites in Puget Sound
AJOH0005	Spokane River PCBs, 1993-1994
AJOH0049	Toxics in stormwater runoff from PS boatyards.
AK_CSO97	NPDES Alaska CSO Baseline Study
ALCOA90	ALCOA Aluminum - Class 2 Inspection
ALDRWD04	Sediment Sampling Results, Walderwood Picnic Point Wastewater Treatment Facility. Original name: ALDRWD04
ALKI01	NPDES Alki Subtidal Monitoring 2001
ALKI9497	NPDES Alki Subtidal Monitoring 1994-1997
ANCHOR90	Anchor Cove Condominium Marina Project.
AODE5095	Jeld Wen Inc., Former Nord Door Site Groundwater, Soil and 2009 Sediments, Everett, WA
AODE5272	West Bay Marina Remedial Investigation, Olympia, WA
AODE5572	Port of Everett North Marina West End Site, Soil, Groundwater and Sediment Characterization, Everett, WA.
AODE8979	Weyerhaeuser Mill A Former, Everett, WA
AODE9001	Westman Marine Remedial Investigation, Blaine, WA
AQKeyport2011	Keyport Lagoon Sediment Characterization - 2011
AQMauryIsland2008	Glacier Northwest, Inc., Maury Island Dock Reconstruction
AR-94-02	NRDA Sed. Svy of Comm & Elliott Bays
ARCOCP00	Arco Cherry Point NPDES Characterization
ARCOCP01	BP ARCO Cherry Point NPDES Sed Rechar
ARCOCPC2	ARCO Cherry Point Refinery Class 2 Insp.
BB_RB	Bellingham Bay Regional Background Characterization
BCECW11	Bay Center Marina Entrance Channel, DY12
BCWTAC95	Boise Cascades West Tacoma Mill Baseline
BCWTACC2	Boise Cascade's West Tacoma Mill Class 2
BERA0001	Verification of 303(d) Listed Sites in NWRO, CRO and ERO
BHPSED19	Blakely Harbor Park Sediment Investigation 2019
BLAKEISL	WSPRC BLAKE ISLAND MD DY89
BLGM_91A	Maint./other dredging of Bellingham Bay.
BLGMMETL	Metals Results from Bellingham Bay
BN_SF_HV	BN_SF RR Harborview Park Investigation
BOISECAS	Boise Cascade Mill - Class 2 Inspection

Study ID	Study Name
BOLD 2008	Puget Sound Sediment PCB and Dioxin 2008 Survey. Also known as BOLD STUDY
BPCP06	RETEC BP Cherry Point 2006
BPCP16	BP Cherry Point 2016 NPDES Sampling
BPFERNC2	BP Oil Refinery Class II Inspection
BremSed2015	City of Bremerton Sediment Monitoring 2015
BREMTP98	'98 Bremerton WTP NPDES Sed. Mon. Report
BRTCSO97	NPDES Barton CSO Baseline Study
Budd Inlet Hardel 07	C396_Hardel EIM Results. Original User Study ID was C396. Updated 10/21/08 per Sharon R. Brown.
BUDD07	Budd Inlet Sediment Characterization
BUDD98	BUDD INLET
BUDINLET	Budd Inlet Sediment Survey Project
CAPSM07	Cap Sante Boat Haven - West Basin Redevelopment Project, Recency Extension, DY08
CARKEK00	Carkeek Park Outfall Monitoring 2000
CBMSQS	Commencement Bay RI Main Sed. Qual. Sur.
CBSDSM17	Commencement Bay Dredged Material Disposal Site Monitoring, 2017
CENKIT10	Central Kitsap Wastewater Treatment Facility (NPDES Permit Renewal -2010). GeoEngineers original name: NPDES-WA-003052-0.
CENKIT99	Central Kitsap WWTP NPDES monitoring
CG36P05	US Coast Guard Pier 36 - Post Dredge Characterization, DY06
CHAMBR95	Chambers Creek WWTP Marine Sediment Mon.
CHEVPW04	Chevron Point Wells Supplemental Study
CHEVPW95	Chevron Point Wells Terminal 95
CHNC0606	Baker Bay - Chinook Channel Sediment June 2006
CHNK0787	Chinook Channel 1987
CNKTSPC2	Central Kitsap WTP 1988 Class II Inspec.
CoEvOutf17	2017 City of Everett Deep Water Outfall DNR Easement Sampling
COLM0900	Columbia River Mouth- O & M
CONOCO04	ConocoPhillips NPDES Permit Support
CPRESS02	Cypress Island 2002 NPDES
CPSD9497	Ambient Subtidal Monitoring 1994-1997
CSFSED17	Cosmo Specialty Fibers Baseline Sediment Sampling
DAC-HY94	Commencement Bay Nat.Res. Assessment
DAISPA99	Daishowa-Port Angeles NPDES Monitoring
DENN9496	Denny Way Cap Monitoring 1994-96
DKC0605	Driftwood Key Community Club, DY06

Study ID	Study Name
DSER0008	Lake Roosevelt Sediment Toxicity (duplicate study LKROOS01 deleted on 12-26-2012)
DSER0014	Screening San Juan Harbor sediments for toxicants
DUWSU12	Duwamish Waterway, East Waterway and West Waterway Subsurface Sediment Characterization
EBCHEM	1985 Elliott Bay sediment survey
EDMDUNOC	City of Edmonds Unocal Study
EDMDWTC2	Edmonds WTP Class II Inspection
EDMOND08	City of Edmonds NPDES Sediment Analysis
EDMOND95	Edmonds WWTP Baseline
EEWSed13	Everett East Waterway - Sediment Characterization
EHCHEM94	Eagle Harbor PreDesign Sediment Sampling
EIGHTBAY	1985 Puget Sound Eight-Bay survey.
EVCHEM	1985 Everett Hbr. chem. & biota data.
EVEOM11	Corps of Engineers Snohomish River Navigation Channel Maintenance Dredging, DY12
EVEOM17	Snohomish River Federal Navigation Channel Dredged Material Characterization DY2018
EVRT10TH	Everett Harbor 10th St. boat ramp expan.
EVTWE494	Weyerhauser Everett, WA
EVWEYCII	Weyerhaeuser, Everett Class II Inspectio
EWST298	USACE/Port of Seattle East Waterway Stage 2, DY00
FERNDALE	Ferndale WWTP - Class 2 Inspection
FIDALG08	Fidalgo Bay Sediment Investigation
FIDLGO97	Survey of Fidalgo Bay
FS1206878	Grit contamination in Blair Waterway.
FS1385	Cascade Pole Long-term Groundwater Compliance Monitoring and Sediment Sampling, Olympia, WA
FS95275518	Former Irondale Iron and Steel Plant, Irondale, WA
FWLKUN01	Lake Union Sediment Quality Study
FWSPOR00	Chemical Analysis and Toxicity Testing of Spokane River Sediments Collected in October 2000
FWUPCR05	USEPA Phase I Sediment Sampling Upper Columbia River/Lake Roosevelt Site CERCLA RI/FS
G1300053	Budd Inlet Sediment Site Surface and Subsurface Sediment Investigation
GAMBLE06	Port Gamble Dredging 2006
GEI006	Ecology Tier 1 Site Investigation - Former Port Blakely Mill Bainbridge Island, Washington
GEI024	Ecology Tier 2 Site Investigation - Guemes Channel
GHSED18	Gig Harbor Sediment Study 2018

Study ID	Study Name
GHSI	Grays Harbor Sediment Screening Study. Duplicate study found in EIM GRAYH_99 was erased on 03-25-2013.
GPBASE93	GP Baseline Sed. Character., '93 NPDES
GPCAM17	Sediment Monitoring at Georgia-Pacific (Camas) for NPDES Permit No. WA0000256
GRAYS_08	Dredged Material Characterization for Grays Harbor Navigational Channel Maintenance Dredging, Grays Harbor, WA 2008-2009
GRAYS00	USACE Grays Harbor O&M, DY01
GRAYS04	USACE Grays Harbor O&M, DY05
GRAYS06	USACE Grays Harbor Navigation Channel Maintenance Dredging, DY08
GRAYS11	USACE Grays Harbor Navigation Channel O&M - DY 12
GRAYS177	USACE Grays Harbor O&M, DY02
GRAYS297	Army Corps of Engineers - Grays Harbor dredged material characterization - 2010
GRAYS98	USACE Grays Harbor O&M, DY99
HANSEN12	Hansen Boat Company, 30Aug2012 Surface Sediment Sampling, NPDES Permit WA0031909
HARIS03A	Harris Ave Shipyard Supp Invest7-24-2003
HIRIPH2	Harbor Island Phase II RI
HYLE9496	Hylebos Waterway PRD Event 1A, 1B & 1C
IJW05	RETEC I&J Waterway Surface Sampling 2005
ILWA0787	Ilwaco Channel 1987
ILWC0606	Baker Bay - West Ilwaco Channel Sediment June 2006
INTLCO15	2015 Alcoa Intalco NPDES Sediment Characterization
INTLCO88	DOE 88 Intalco C2 Monitoring Inspection
INTLCO93	1993 WDNR Impact Zone Study at Intalco
INTLCO99	Intalco Sediment Investigation
ITT_94	ITTRAYONIER,PLANTCLOSUREMONITORING
JCKSON94	Jackson Park Housing Complex OU2
JeldWen12	Jeld Wen Former Nord Door Site - Sediments
JeldWen13	Jeld Wen Former Nord Door Site - 2013 Sediments
KC_CSO_2011	King County CSO Sediment Quality Characterization 2011 - NPDES Permit No. WA-002918-1
KC_CSO_2013	King County CSO Sediment Quality Characterization 2013 - NPDES Permit No. WA-002918-1
KC_CSO_2018	King County CSO Sediment Characterization 2018 for NPDES Permit No. WA-002918-1
KCintertidal-sed	King County Ambient Intertidal Sediment sampling
KCmar-1	King County Routine Marine Ambient Monitoring
KCOutf12	2012 Kimberly Clark Deep Water Outfall NPDES Sampling
KEYPORT	The Navy's Keyport RI Report

Study ID	Study Name
KEYPRT92	Navy/Keyport Final RI Report of 10/25/93
KIMCLK04	Kimberly-Clark Outfall 100 Baseline Sediment Samp
KINGST02	Kitsap County Outfall
KINGST19	2019 Kingston Waste Water Treatment Plant, Surface Sediment Sampling, NPDES Permit WA0032077
KITSAP03	Kitsap Transit/Sidney Landing Investigat
KTSPMON2	Sinclair and Dyes Inlet monitoring 91-92
LAK99	Lakehaven Utility District NPDES 1999 Lakehaven
LAKEROOS	Review of L. Roosevelt Synoptic Data
LAKOTA05	Lakota Sediment Sampling
LAKOTA16	Lakota Wastewater Treatment Plant Sediment Monitoring Study
LCBWRS93	Lower Columbia Backwater Recon. Survey
LKUNDRDK	Lake Union Drydock Sediment Monitoring
LKUNION	Survey of Contaminants in Lake Union
LKWA00	Lake Washington Baseline Sed Study 2000
LONGVW90	Longview Fibre Co. - Class 2 Inspection
LOTT_96	Budd Inlet - LOTT 1996 NPDES Sed. Monitoring Report
LSAMM99	Lake Sammamish Baseline Sediment Stdy 99
Lucca's Landing	Lucca's Landing sediment sampling for DNR Lease
LUUCSO00	King County Lake Union University Regulator CSO
LYNNWD09	City of Lynnwood WWTP Baseline Sediment Monitoring 2009
LYNNWD95	Lynnwood WWTP Baseline
MAGCSO96	NPDES Magnolia CSO Baseline Study, 1996
MALINS	1980 NOAA OMPA-19 survey of Elliott Bay.
MBTL12	2012 NPDES Sediment Characterization for Outfalls 001S and 002A - Millennium Bulk Terminals, Longview, WA. NPDES Permit WA0000086.
MCPLC_2012	McFarland Cascade 2012. NPDES Permit No. WA00379563.
MCRNH0917	Mouth of the Columbia River North Head Baseline Survey
MESHOU16	MHCC Outfall Sediment Sampling and Analysis
MIDWAY02	Midway Sewer Outfall #1 Baseline
MIDWAY06	Midway Sewer District Sed Sampling
MIDWAY07	Midway WWTP 2007 Supplemental Sediment Sampling
MIDWAY95	MIDWAY BASELINE
MONAK05	Anderson/Ketron DMMP Dredged Material Disposal Site - 2005 Full Monitoring
MONCB03	2003 Tiered-Full Monitoring of the DMMP Commencement Bay Dredged Material Disposal Site
MONCB04	2004 Tiered-Full Monitoring at Commencement Bay
MONCB05	2005 Commencement Bay Site Physical Monitoring and Phenol Study

Study ID	Study Name
MONCB191	2003 Tiered-Full Monitoring in Com Bay
MONEB13	Elliott Bay DMMP Monitoring, Partial, 2013
MURCSO97	NPDES CSO Subtidal sediments, 1997
NAVYHPFC	Everett Homeport (full characterization)
NAVYHPII	U.S. Navy Homeport Element II Full Char.
NAVYMANC	US Navy Manchester Fuel Pier Replacement
NB_CSO96	Magnolia, North Beach, 53rd Street CSO's
NBLA0002	Ostrich Bay Sediment Monitoring
NBLA0006	Evaluation of Candidate Freshwater Sediment Reference Sites
NOP_RB	North Olympic Peninsula Regional Background Characterization
NPI_PA_001_002_2010	Sediment Sampling for Nippon Paper Industries
NPI_PA_002_2010	National Parks Service Sediment Sampling for Nippon Paper Industries outfall 002 replacement.
OAKHAR04	Crescent Harbor WWTP
OAKHBR06	Oak Harbor Sediment Sampling
OAKSED08	2008 Oakland Bay Sediment Characterization of intertidal and subtidal areas from Hammersley Inlet to upper Oakland Bay, Mason County, Washington.
OBCLAM97	Jackson Park/Erlands Point Clam and Sediment Samples near Ostrich Bay in Dyes Inlet (former Study Name Clam study, Ostrich Bay). Samples Analyzed Independently by Navy. See also Study AJOH0027.
OLYHAR88	USACE Olympia Harbor Navigation Improvement FC, DY 89
OLYTERC2	Olympus Terrace WTP Class II Inspection
OU2CON97	Confirmatory Study OU 2, JPHC/NHB site
P53MON92	Pier 53-55 Sed Cap & ENR Remed Project
P66CAP	PIER66 SEDIMENT CAP/CENTRAL WATERFRONT
PA_STP04	Port Angeles NPDES Sediment Analysis
PA_STP96	1996City of Port Angeles NPDES Report
PADDE00	Port of Bellingham, Padden Creek, DY01
PAINEFLD	Survey for Contaminants at Paine Field
PASED08	Port Angeles Harbor Sediment Investigation.
PGB-HERRING-SED2014	Port Gamble Bay Sediment Sampling in 2014 for Herring Embryo Mortality Study
PGHO&M94	USACE Grays Harbor O&M, DY94'
PGHO&M96	USACE Grays Harbor O&M, DY96
PGHT294	Grays Harbor, Port of, Terminal 2, DY94
PGM1010	Port Gardner Dredged Material Disposal Site Monitoring, 2010
Phillips66_2015	Phillips 66 Ferndale NPDES Sediment Sampling 2015
Phillips66_2017	Phillips 66 Ferndale NPDES Sediment Sampling 2017
Phillips66_2019	Phillips 66 Ferndale Refinery Wharf Causeway Replacement Sediment Characterization

Study ID	Study Name
POGHT07-1	Port of Grays Harbor - Terminal 1, 2 and 4, DY08
POGHT07-2	Port of Grays Harbor - Terminal 3 Maintenance Dredging, DY09
POLARIS	Crowley Marine Services Base Sed Samp
PortGamble09	Port Gamble Bay Remedial Investigation and Feasibility Study
PORTGAMBLE2011	Port Gamble Bay Supplemental Remedial Investigation 2011
PortGardner_08	Sediment Characterization Study in Port Gardner and Lower Snohomish Estuary, Port Gardner, WA. Reload 4/10/2010. Revised by Jonathan Newer of SAIC - Bothell WA
PortGardner_RB	Port Gardner Regional Background Characterization
POS2R03	Port of Seattle - East Waterway Stage II Recency Testing, DY04
POSDMC16	Des Moines Creek Basin Outfall Surface Sediment Sampling
POSTPT03	Post Point NPDES Sediment Sampling, 2003
POSTPT87	Post Point Treatm Plant, B'ham Cty, 1987
POSTPT96	Post Point Treatm Plant, B'ham Cty, 1996
POTBD98	USACE Blair Waterway Deepening, DY99
POTP413	Port of Tacoma Pier 4 Reconfiguration Project, DY14
POV89_EI	Port of Vancouver Bioassays for Copper
PPTox07	Sediment toxicity study near Post Point wastewater treatment plant outfalls (Bellingham Bay, Washington)
PSAMP_HP	Puget Sound Assessment and Monitoring Program’s historical sediment monitoring program 1989-1995
PSAMP_LT	The Puget Sound Assessment and Monitoring Program’s Long-Term Temporal Monitoring
PSAMP_SP	The Puget Sound Assessment and Monitoring Program's (PSAMP) Spatial/Temporal Monitoring
PSAMPNOA	A Cooperative Agreement with the Puget Sound Assessment and Monitoring Program and the National Oceanic and Atmospheric Administration(NOAA) National Status and Trends (NS&T) Program to jointly examine measures of sediment quality throughout Puget Sound.
PSDDA_00	Elliott Bay Full Monitoring
PSDDA_01	Full monitoring of Commencement Bay
PSDDA_02	Tiered-Partial Monitoring of Elliott Bay
PSDDA1	PSDDA Phase I Survey of Disposal Sites
PSDDA2	PSDDA Phase 2 Survey of Disposal Sites
PSDDAM90	1990 PSDDA Post-Disposal Site Monitoring
PSEMP_LT	Puget Sound Ecosystem Monitoring Program Long Term Sediment Component
PSNS90	Puget Snd Naval Shipyard Site Inspec. 90
PSREF90	Puget Sound Reference Areas Survey
PST18_P2	Port of Seattle, T18 Phase 2, DY97

Study ID	Study Name
PST9117	Port of Seattle T-91 Submerged Lands Preliminary Investigation Sediment Characterization Results Phase 1
PST9118	Port of Seattle T-91 Submerged Lands Preliminary Investigation Sediment Characterization Results Phase 2
PSYSEA98	Portland Shipyard Sed. Inv.
PT_2001	Pope & Talbot Landfill 2&3
PT_PG1	Pope and Talbot - Port Gamble 1
PTORCHC2	Port Orchard WTP Class II Inspection
PTPC2014	Port Townsend Paper Corporation NPDES Sediment Data - 2014
PTWNPCC2	Pt. Townsend Paper Company Class 2
PTWNPENR	Port Townsend Pen-Reared Salmon Mortal.
QUEBAX1	PAH's in L. Wash. at Quen/Baxter Phase 1
QUEDAL00	Quendall Terminals
QUILL17	Quillayute River Federal Navigation Channel and Boat Basin Dredged Material Characterization
QUILL301	Army Corps of Engineers - Quillayute dredged material characterization - 2010
RAYON98	Rayonier, DY98
RAYONR05	Former Rayonier Mill Site
RAYSED09	Former Rayonier WWTP Outfall Sediment Baseline Monitoring,Port Angeles, Washington
RED99	Lakehaven Utility District NPDES 1999 Redondo
REDONDO	Redondo Sediment Sampling
REDONDO09	Redondo Poverty Bay - Lakehaven Utility District Wastewater Treatment Outfall -- DNR lease and NPDES requirements. Name changed from LUD09.
REDONDO16	Redondo Wastewater Treatment Plant Sediment Monitoring Study
RENT01	NPDES Renton (South Plant) Subtidal 2001
RENT9497	NPDES Renton Subtidal Monitoring 1994-97
RENT99	NPDES Renton Subtidal Monitoring 1999
REYNOLDS	Reynolds Aluminum - Class 2 Inspection
RICH9496	Richmond Beach IT Monitoring 1994-96
RILEY001	South Puget Sound toxicants in sediments
RPMESI97	Rayonier Pulp Mill Expanded Site Inspection 1997, TDD:97-06-0010
RSMP_PC_MNS2016	Regional Stormwater Monitoring Program Puget Marine Nearshore Sediments (Pierce)
RTTAC14	RockTenn NPDES Sediment Analysis 2014
RUSTWY15	Marine Sediment Sampling along Ruston Way, Commencement Bay
SCDMET03	Sinclair-Dyes Metals Verification Study

Study ID	Study Name
SCLAIR94	Sinclair Inlet monitoring, 1994
SCOTT95	Scott Paper Co. Baseline Sediment Survey
SEACRE97	Seacrest Preliminary Study '97
SEQUIM97	City of Sequim Outfall Sampling
SHANPT95	Shannon Point Seafoods Phase I SAP
SHEBA20	Shelter Bay Marina sediment characterization DY20
SHELL04	Shell Puget Sound Refinery
SHELL92	Shell Oil Sediment Baseline
SHELTON WWTP	Shelton WWTP Outfall Baseline Sediment Monitoring Study by City of Shelton
SIMILK00	Similkameen River Sediments
SIMPSN87	Baseline Monitoring Simpson Tacoma
SIMPSON	Simpson NPDES Sediment Analysis 2004
SINCLET	Lower Sinclair Inlet Sediment PCB Study
SITCUMRI	Port of Tacoma RI/NRDA (Sitc/Mlwk/Blair)
South_Plant_2017	2017 South Plant WWTP NPDES Outfall Study - Sediment Sampling Events
South_Plant_2018	2018 South Plant WWTP NPDES Outfall Study - Sediment Sampling Event
SPILDW06	Sediment Profile Imaging Feasibility Study - Lower Duwamish Waterway
SPOK2000	Spokane River Sediments October 2000
SPUCSO062WQ	CSO Outfall 62 Post Construction Compliance Report
SPUCSO095WQ	Seattle Public Utilities CSO Outfall 95 Post Construction Monitoring Compliance Report
SQMMON91	91 Pt. of Port Angeles Sediment Monitori
SQMMON92	92 Pt. of Port Angeles Sediment Monitori
SQUAL95	Squalicum Waterway Sediment Characterizn
STEILLK2	Copper in Steilacoom Lake - Phase 2
SWINC09	USACE Swinomish Channel O&M, DY10
SWINC17	Swinomish Channel Federal Navigation Channel Dredged Material Characterization DY2018
SWINR02	USACE Swinomish Channel O&M, DY03
SWSSD10SEDS	SW Suburban Sewer District Salmon Creek Burien WTTP Sediment Monitoring by Michael A. Kyte, Nisqually Aquatic Technologies.
SWSSD96	Southwest Suburban Sewer District
TACCENC2	Tacoma Central WTP Class II Inspection
TERM5_91	Terminal 5 W. Waterway maint. dredging
TERMNL91	Terminal 91, W. side apron construction
TESORO01	TESORO SEDIMENT CHEMISTRY 2001 Sampling
TEXACO95	Texaco Class 2

Study ID	Study Name
TODD05_Y5	Todd Shipyards Sediment Operable Unit Year 5
TPETM06	USACE Willapa Bay, Toke Point Entrance Channel and Tokeland Marina, DY07
TPPS3AB	TPPS Phase III A & B
TXNPDS92	Texaco Anacortes NPDES Sediment Studies
USNSILTM2003-07	US Navy Bremerton Naval Complex Operable Unit B Marine Monitoring, Bremerton, WA. Combined 3 years of data from 2003 2005 and 2007 into one study.
USNSILTM2018	US Navy NBK Bremerton Operable Unit B Marine 2018 Sinclair Inlet Marine Monitoring, Bremerton WA
UWI	Urban Waters Initiative
UWI_EB07	Surface Sediment and Fish Tissue Chemistry in Greater Elliott Bay (Seattle) -Urban Waters Initiative
WB1577RIFS	Solid Wood Inc. (West Bay Park) RI/FS, Olympia, WA. Agreed Order # DE-08-TCP SR-5415
West_Point_2011	2011 West Point WWTP Outfall Study Sediment Sampling Event
WEYLONG	Weyerhaeuser Co. - Class 2 Inspection
WHAPRD02	Whatcom WW Pre-Remedial Design Eval
WHOB004	Copper, Zinc, and Lead in Select Marinas of Puget Sound
WP1&2_96	West Point EBO Baseline Study Phase 1
WPNT00	NPDES West Pt Subtidal Monitoring 2000
WPNT06	West Point, King County, NPDES Sediment Monitoring
WPNT9497	West Point Subtidal NPDES Monit. 1994-97
WWP1Y0	Whatcom Waterway Phase 1 Cleanup Year 0
WWP1Y1	Whatcom Waterway Phase 1 Compliance Monitoring Year 1
WWPRDI08	Whatcom Waterway Pre-Remedial Design Investigation

Water Quality Portal

The Water Quality Portal is a publicly accessible database supported by the U.S. Geological Survey (USGS), Environmental Protection Agency (EPA), and the National Water Quality Monitoring Council (NWQMC). The Portal houses data from the USGS National Water Information System (NWIS), EPA Storage and Retrieval (STORET) data warehouse, and U.S. Department of Agriculture Sustaining the Earth's Watersheds – Agricultural Research Database (STEWARDS). The following tables list studies and USGS monitoring locations from the Portal database that Ecology considered and subsequently used in the development of the 2018 WQA. Monitoring locations from USGS stations are not directly linked to StudyID's within the Portal. Therefore, USGS locations included in the 2018 WQA are listed in a separate table.

The following Water Quality Portal studies apply RCW 34.05.272 data source category #9: Data from primary research, monitoring activities, or other sources, but that has not been incorporated as part of documents reviewed under other processes.

Table 3. Studies from the Water Quality Portal included in development of the 2018 WQA

Study ID	Organization ID	Study Name	Organization Name
106 CWA	JSKTRIBE_WQX	Sequim Bay Basin Fresh Water Stream Nutrient and Bacteria Sampling Program	Jamestown SKlallam Tribe
2009_summer_stream_temp	PGSTNATR_WQX	Summer Stream Temperature	Port Gamble S'Klallam Tribe
4	CTUIR_WQX	Temperature Monitoring Program	Confederated Tribes of the Umatilla Indian Reservation
61	CLALLAMCODCD	Storm surface water EPA Grant 2010-2011	Clallam County-DCD
BBMONIT	WHATCOM_WQX	Birch Bay FC Monitoring	Whatcom County Public Works
BBMONIT;EPABEACH	WHATCOM_WQX	NA	Whatcom County Public Works
CDAWAT_Streams_2005	CDATWATRES	CDATstreams	Coeur D'Alene Tribe
CDAWAT_Streams_2006	CDATWATRES	CDATstreams	Coeur D'Alene Tribe
CDAWAT_Streams_2007	CDATWATRES	CDATstreams	Coeur D'Alene Tribe
CONTAMB	PUYALLUP_WQX	Continuous Ambient Monitoring	Puyallup Tribe of Indians
CONTMON	PUYALLUP_WQX	Continuous Temperature Monitoring	Puyallup Tribe of Indians
CWA_2562	QUILEUTE_WQX	Quileute Water Quality	Quileute Natural Resources (Washington)
CWDA	JCPH_WQX	Clean Water District Activities	Jefferson County Public Health
Cypress Island	SAMISHINDIAN_WQX	Cypress Island	Samish Indian Nation
DOH Contract No. N22580-1	SKAGITCOUNTY_WQX	Skagit County Pollution Identification and Correction Program	Skagit County
Drayton_Harbor_WQ	NOOKSACK_WQX	Drayton Harbor Watershed Water Quality Monitoring	Nooksack Indian Tribe
DWQMON	PUYALLUP_WQX	Discrete Water Quality Monitoring	Puyallup Tribe of Indians
ELDPICSAMPLES	THURSTONCOUNTY	ELD SHORELINE SAMPLING P.I.C. GRANT	Thurston County Health Department
EMAP/REMAP/CEMAP	OREGONDEQ	EMAP/REMAP/CEMAP	State of Oregon Dept. of Environmental Quality
EPA_REG_EFF	KINGCOUNTY	EPA Regulatory Effectiveness	King County (Washington)
EPABEACH;SWQMP	SWINOMISH	NA	Swinomish Indian Tribal Community

Study ID	Organization ID	Study Name	Organization Name
EPABEACH;TRTUL_WQ_AMB	TRTUL_WQX	NA	Tulalip Tribes of Washington
ESD 253A	R10OEA	2012 NLA Lake Fish Tissue Hg	EPA Region 10 Office of Environmental Assessment
Fidalgo Bay	SAMISHINDIAN_WQX	Fidalgo Bay	Samish Indian Nation
GriffinCk	SNOQUALM_WQX	GriffinCk	Snoqualmie Tribe
Hansen	UPPERSKAGIT	Hansen Creek Restoration Project	Upper Skagit Indian Tribe
Hood Canal Regional Pollution	KITSAPCHD_WQX	The Hood Canal Regional Pollution Identification and Correction (PIC) Program	Kitsap County Health District
IDEQ LEW SW	IDEQ_WQX	IDEQ Lewiston Office Surface Water Program Sampling	Idaho Department Of Environmental Quality DEQ
JSKTRIBE	JSKTRIBE	JAMESTOWN WQ PROGRAM	Jamestown SKlallam Tribe
KC_QUARTERMASTER	KINGCOUNTY	Quartermaster Harbor Marine Water Quality	King County (Washington)
KimCkWQ	SNOQUALM_WQX	KimCkWQ	Snoqualmie Tribe
KINGCO_422027	KINGCOUNTY	King County 2014 Lake WA PCB/PBDE Loadings Study	King County (Washington)
KNRD FT-2009	KNRD_WQX	KNRD 2009 Fish Tissue Analysis	Kalispel Indian Community of the Kalispel Reservation
KNRD FT-2011	KNRD_WQX	KNRD 2011 Fish Tissue Analysis	Kalispel Indian Community of the Kalispel Reservation
KNRD FT-2017	KNRD_WQX	KNRD 2017 Fish Tissue Analysis	Kalispel Indian Community of the Kalispel Reservation
KNRD Inorganics and Metals	KNRD_WQX	Inorganics and Metals Sampling Project	Kalispel Indian Community of the Kalispel Reservation
KNRD Water Quality Monitoring	KNRD_WQX	Water Quality Monitoring Project	Kalispel Indian Community of the Kalispel Reservation
KNRD-Timeseries Daily-Min Max Mean	KNRD_WQX	KNRD Temperature Daily Summary Data Project (Min, Max, Mean, 7DADM)	Kalispel Indian Community of the Kalispel Reservation
KPH_EPA_ShellfishProt_2010thru2014	KITSAPCHD_WQX	Kitsap County Shellfish Restoration Protection	Kitsap County Health District

Study ID	Organization ID	Study Name	Organization Name
Lake Campbell	SAMISHINDIAN_WQX	Lake Campbell	Samish Indian Nation
Lake Symington Nutrient Grant	KITSAPCHD_WQX	Lake Symington Nutrient Reduction Project	Kitsap County Health District
LC_WQ	SAMISHINDIAN_WQX	Lake Campbell Water Quality Monitoring	Samish Indian Nation
LUMMI001	LUMMINSN	Lummi Nation Water Quality Monitoring Program	LummiNation (Washington)
LUMMI002	LUMMINSN_WQX	Surface Water - Incident Response	LummiNation (Washington)
LUMMI004	LUMMINSN_WQX	Surface Water - DOH Support	LummiNation (Washington)
LUMMI006	LUMMINSN_WQX	Marietta Channel Study	LummiNation (Washington)
LUMMI017	LUMMINSN_WQX	Surface Water - Nutrient Monitoring	LummiNation (Washington)
LUMMI018	LUMMINSN_WQX	Surface Water - Regular Monitoring	LummiNation (Washington)
LUMMI019	LUMMINSN_WQX	Surface Water - First Flush WQ Monitoring	LummiNation (Washington)
LUMMI021	LUMMINSN_WQX	Surface Water - Investigation	LummiNation (Washington)
LUMMI023	LUMMINSN_WQX	ZAPS	LummiNation (Washington)
LUMMI024	LUMMINSN_WQX	SW - DOH Support Special Sampling	LummiNation (Washington)
MKWQ	MAKAH	makah water quality	Makah Tribe (Washington)
MM_PDDN	MIDNITE_2	Midnite Mine Pre-Design Data Needs	Midnite Mine Environmental Data
NALMS_SECCHI_DIPIN	NALMS	Secchi Dip In	North American Lake Management Society
NARS_NLA2007;NARS_NLA2007_ECOREGION_WMT	NARS_WQX	NA	EPA National Aquatic Resources Survey (NARS)
NARS_NLA2007;NARS_NLA2007_ECOREGION_XER	NARS_WQX	NA	EPA National Aquatic Resources Survey (NARS)
National Water Quality Assessment Program (NAWQA)	USGS-WA	NA	USGS Oregon Water Science Center
National Water Quality Assessment Program (NAWQA)	USGS-OR	NA	USGS Washington Water Science Center

Study ID	Organization ID	Study Name	Organization Name
NCCA_NCA199706;NCCA_WEMAP200506	NARS_WQX	NA	EPA National Aquatic Resources Survey (NARS)
NEP_2016_WSDA	WSDA_WQX	NEP_2016_WSDA	Washington State Department of Agriculture, Dairy Nutrient Management Program
Nooksack_Temp	NOOKSACK_WQX	Nooksack River Watershed Temperature Monitoring	Nooksack Indian Tribe
NooksackWaterQuality	NOOKSACK_WQX	Nooksack River Watershed Sampling	Nooksack Indian Tribe
Nov08Waters	SBITENV_WQX	Shoalwater Tribe Water Monitoring	Shoaltwater Bay Tribe (Washington)
NRSA0809	OST_SHPD	USEPA National Aquatic Resource Assessment - National Rivers and Streams Assessment 2008-2009	USEPA, Office of Water, Office of Science and Technology, Standards and Health Protection Division
NRSA1314	OST_SHPD	USEPA National Aquatic Resource Assessment - National Rivers and Streams Assessment 2013-2014	USEPA, Office of Water, Office of Science and Technology, Standards and Health Protection Division
Off_Res	UPPERSKAGIT	Off_Reservation	Upper Skagit Indian Tribe
OZETTERIVER	MAKAH_WQX	OZETTE RIVER PROJECTS	Makah Indian Tribe of the Makah Indian Reservation
PC-00J326-01	TPCHD_WQX	Pierce County Pollution Identification and Correction Project	Tacoma-Pierce County Health Department (Washington)
PC-00J888-01	TPCHD_WQX	Tacoma-Pierce PIC Round 6 C17128	Tacoma-Pierce County Health Department (Washington)
Pesticide Stewardship Partnerships	OREGONDEQ	Pesticide Stewardship Partnerships	State of Oregon Dept. of Environmental Quality
PGST_RESWQ	PGSTNATR_WQX	Port Gamble S'Klallam Tribe Reservation Monitoring	Port Gamble S'Klallam Tribe
PGST_WQ	PGSTNATR_WQX	Port Gamble SKlallam Tribe Water Quality	Port Gamble S'Klallam Tribe
PICPILOT2015	CLALLAMCOUNTYEH_WQX	Pollution Identification and Correction Pilot Area 2015	Clallam County Environmental Health Services
PICPILOT2016	CLALLAMCOUNTYEH_WQX	Pollution Identification and Correction Pilot Area 2016	Clallam County Environmental Health Services

Study ID	Organization ID	Study Name	Organization Name
PICPILOT2017	CLALLAMCOUNTYEH_WQX	Pollution Identification and Correction Pilot Area 2017	Clallam County Environmental Health Services
PO-00J12301	TPCHD_WQX	Pierce County Shellfish Watersheds Project	Tacoma-Pierce County Health Department (Washington)
PRWM	PUYALLUP_WQX	Puyallup River Watershed Monitoring	Puyallup Tribe of Indians
QINNRSA16	QIN_WQX	Quinault Rivers and Streams Assessment using EPA's NRSA Protocol	Quinault Indian Nation
QuendallTerminals	ASPECT_WQX	Quendall Terminals	Aspect Consulting
QWRIA21P3	QIN_WQX	Ambient Water Quality	Quinault Indian Nation
QWRIA21P5	QIN_WQX	2011 Queets River Watershed Peak Water Temperature	Quinault Indian Nation
QWRIA21P8	QIN_WQX	2011 Queets River Watershed Thermal Infrared Radiometry Flight	Quinault Indian Nation
ResWQ	SNOQUALM_WQX	106	Snoqualmie Tribe
SCMP	SKAGITCOUNTY_WQX	Skagit County Monitoring Program	Skagit County
SemiahmooWatershed	NOOKSACK_WQX	Semiahmoo Spit Water Quality Monitoring	Nooksack Indian Tribe
SFEW	SQUAXIN	Shellfish - Early Warning and intensive water quality monitoring	Squaxin Island Tribe
SFPS	SQUAXIN	Shellfish - Pathogens in marine sediment	Squaxin Island Tribe
SITRIPAQ	SQUAXIN	On-reservation - riparian and aquatic habitat	Squaxin Island Tribe
SNOWQ	SNOQUALM	Surface Water Quality Monitoring	Snoqualmie Tribe Environmental & Natural Res Dep(Washington)
SNOWQ	SNOQUALM_WQX	106 Water Quality Sampling	Snoqualmie Tribe
SoosCreek	MIT_WQX	2015_Soos Creek Stormwater Monitoring	Muckleshoot Indian Tribe
SRWWQM	SKAGITWG_WQX	Skagit River Watershed Water Quality Monitoring	Skagit River Watershed Grant (TNC, SRSC, WWAA) - Washington
Statewide Toxics	OREGONDEQ	Statewide Toxics Monitoring	State of Oregon Dept. of Environmental Quality

Study ID	Organization ID	Study Name	Organization Name
SumasMountain200905	R10SUMASMOUNTAIN	Sumas Mountain Asbestos Site - Soil, Sediment and Water Sampling, May 12-13, 2009	EPA Region 10 Superfund Sumas Mountain Asbestos Site
SUQ_WQMD	SUQUAMISH	Suquamish Tribe Monitoring	Suquamish Tribe
Surface Water Ambient	OREGONDEQ	Surface Water Ambient Monitoring	State of Oregon Dept. of Environmental Quality
SW Network	BUNKER_USGS	USGS Project SW Network	Bunker Hill Mining and Metallurgical Complex (Region 10) USGS
SWQM	ELWHAWQ1_WQX	Surface Water Quality Monitoring	Lower Elwha Klallam Tribe
SWQM	SBITENV_WQX	Water Quality Monitoring	Shoaltwater Bay Tribe (Washington)
SWQM	SKOKDATA_WQX	Skokomish Surface Water Quality Monitoring Program	Shoaltwater Bay Tribe (Washington)
SWQM	SBITENV	Water Quality Monitoring	Skokomish Indian Tribe of the Skokomish Reservation, Washington
SWQMP	SWINOMISH	Swinomish Water Quality Monitoring Program	Swinomish Indian Tribal Community
TCFCMP2012-2013	NSEA	Terrell Creek Fecal Coliform Monitoring Project	Nooksack Salmon Enhancement Association
TMDL	OREGONDEQ	Total Maximum Daily Load Sampling	State of Oregon Dept. of Environmental Quality
TWG	JSKTRIBE_WQX	Targeted Watershed Grant	Jamestown SKlallam Tribe
USGS 100	R10BUNKER	USGS CDA Sampling Locations	EPA Region 10 Superfund Bunker Hill Mining and Metallurgical Complex
Water Quality Response	OREGONDEQ	Water Quality Response Monitoring	State of Oregon Dept. of Environmental Quality
WCOAST	EMAP_CS_WQX	EMAP-West 1999-2006 Coastal Monitoring	Environmental Monitoring and Assessment Program EPA
WhiteandGreenRiver	MIT_WQX	White and Green River Water Quality Monitoring Project	Muckleshoot Indian Tribe
WhiteRiver	MIT_WQX	White River Water Quality Monitoring Project	Muckleshoot Indian Tribe

Study ID	Organization ID	Study Name	Organization Name
WhiteRiverCTemp	MIT_WQX	White River Continuous Temperature Monitoring	Muckleshoot Indian Tribe
WS-96073601	THCOENVHWA_WQX	Thurston County Targeted Watershed Project-Nisqually	Thurston County Environmental Health
YAKAMA_NATION_WQD	YAKAMA_WQX	2016_Water_Quality_Data	Confederated Tribes and Bands of the Yakama Nation

Table 4 USGS monitoring locations from the Portal included in development of the 2018 WQA.

USGS Station ID	Location Description
12040680	LAKE HOH NEAR FORKS, WA
12043454	LAPOEL CREEK NEAR FAIRHOLM, WA
12043467	SMITH CREEK NEAR FAIRHOLM, WA
12043530	BARNES CREEK NEAR PIEDMONT, WA
12043950	PIEDMONT CREEK AT PIEDMONT, WA
12044000	LYRE RIVER AT PIEDMONT, WA
12046506	ELWHA RIVER AT STRATTON RD, NR PORT ANGELES, WA
12046690	TUMWATER CREEK NEAR PORT ANGELES, WA
12047013	WHITE CREEK DS OF WABASH ST NR PORT ANGELES, WA
12047305	SURVEYOR CREEK NEAR LITTLE OKLAHOMA, WA
12047440	BAGLEY CREEK NEAR LITTLE OKLAHOMA, WA
12047660	HEATHER LAKE NEAR SEQUIM, WA
12048050	CANYON CREEK NEAR SEQUIM, WA
12050245	SNOW CREEK ABOVE NF-2814 ROAD NEAR MAYNARD, WA
12051995	UNNAMED TRIB TO LITTLE QUILCENE R NR QUILCENE, WA
12053810	MILK LAKE NEAR ELDON, WA
12058495	DOW CREEK BLW N LAKE CUSHMAN RD NR HOODSPORT, WA
12062580	UNNAMED TRIBUTARY TO LYNCH COVE NEAR BELFAIR, WA
12063050	TRIBUTARY TO UNION RIVER NEAR BELFAIR, WA
12063280	BEAR CREEK NEAR SUNNYSLOPE, WA
12070220	STEEL CREEK NEAR GLUDS POND NEAR BROWNSVILLE, WA
12072160	GORST CREEK BELOW HEINS CREEK NEAR GORST, WA
12072370	GORST CREEK AT W BELFAIR VALLEY RD AT GORST, WA
12072430	ANDERSON CREEK NEAR ANDERSON ROAD NEAR GORST, WA
12072480	BLACKJACK CREEK DS OF HWY 16 NEAR FERNWOOD, WA
12072510	BLACKJACK CREEK AT MOUTH AT PORT ORCHARD, WA
12072520	ANNAPOLIS CREEK AT ARNOLD AVENUE AT ANNAPOLIS, WA
12072530	OLNEY CREEK NEAR MOUTH AT ANNAPOLIS, WA
12073905	UNNAMED TRIBUTARY TO COULTER CREEK NEAR ALLYN, WA
12076530	GOLDSBOROUGH CREEK NR GRAVEL PITS NR SHELTON, WA
12077565	MILL CREEK NEAR SE TRILLIUM LN NEAR SHELTON, WA
12078210	UNNAMED TRIBUTARY TO SKOOKUM CR NR KAMILCHE, WA
12078920	DESCHUTES RIVER NR SHELL ROCK RIDGE NEAR VAIL, WA
12078930	DESCHUTES RIVER NEAR VAIL, WA
12080750	WOODLAND CREEK AT DRAHAM ROAD NEAR OLYMPIA, WA
12081516	MCALLISTER CREEK ESTUARY NEAR OLYMPIA, WA
12088490	POWELL CREEK NEAR MCKENNA, WA
12089710	YELM CREEK DOWNSTREAM FM 123RD AVE SE NR YELM, WA
12089970	NISQUALLY RIVER NEAR YELM, WA
12091956	EUNICE LAKE NEAR CARBONADO, WA

USGS Station ID	Location Description
12096700	HIDDEN LAKE NEAR GREENWATER, WA
12098700	WHITE RIVER AT HEADWORKS AB FLUME NR BUCKLEY, WA
12099060	WHITE RIVER CANAL ABV LAKE TAPPS NEAR BUCKLEY, WA
12101100	LAKE TAPPS DIVERSION AT DIERINGER, WA
12113390	DUWAMISH RIVER AT GOLF COURSE AT TUKWILA, WA
12113400	DUWAMISH RIVER AT TUKWILLA, WA
12113406	DUWAMISH R AT 42ND AVE BRIDGE AT DUWAMISH, WA
12113415	DUWAMISH R AT E MARGINAL WAY BR AT DUWAMISH, WA
12113425	DUWAMISH R AT 102ND ST BRIDGE AT DUWAMISH, WA
12156395	MUNSON CREEK NEAR 73RD DR NE NEAR MARYSVILLE, WA
12156950	UNNAMED TRIB TO MF QUILCEDA CR NR MARYSVILLE, WA
12162980	JIM CREEK BELOW LITTLE JIM CREEK NEAR OSO, WA
12163020	JIM CREEK ABOVE HATCHERY CREEK NEAR OSO, WA
12163990	JIM CREEK BELOW NICKS ROAD NEAR ARLINGTON, WA
12164050	JIM CREEK AT JORDAN ROAD NEAR ARLINGTON, WA
12165000	SQUIRE CREEK NEAR DARRINGTON, WA
12166300	NF STILLAGUAMISH RIVER NEAR OSO, WA
12167500	ARMSTRONG CREEK NEAR ARLINGTON, WA
12167650	STILLAGUAMISH RIVER AT RM 12.2 NEAR ARLINGTON, WA
12168650	PILCHUCK CREEK NEAR MOUTH NEAR SILVANA, WA
121689962	PRAIRIE CRREK NEAR 74TH AVE NE NEAR ARLINGTON, WA
12169990	CHURCH CREEK AT JENSEN ROAD NEAR STANWOOD, WA
12170050	STILLAGUAMISH RIVER NR THOMLE ROAD NR STANWOOD, WA
12170300	STILLAGUAMISH RIVER NEAR STANWOOD, WA
12178080	NEWHALEM CREEK ABOVE EAST FORK NEAR NEWHALEM, WA
12178700	LOWER THORNTON LAKE NEAR NEWHALEM, WA
12178730	THORNTON CREEK NEAR NEWHALEM, WA
12181090	SOUTH CASCADE MIDDLE TARN NEAR MARBLEMOUNT, WA
12181095	SOUTH CASCADE LAKE NEAR MARBLEMOUNT, WA
12181100	SF CASCADE R AT S CASCADE GL NR MARBLEMOUNT, WA
12181200	SALIX CREEK AT S CASCADE GL NEAR MARBLEMOUNT, WA
12181450	HIDDEN LAKE NEAR MARBLEMOUNT, WA
1220070110	UNNAMED TRIB TO FISHER C NR MILLTOWN RD NR CONWAY
12203542	WHATCOM CREEK UPS OF MEADOR AVE AT BELLINGHAM, WA
12210700	NOOKSACK RIVER AT NORTH CEDARVILLE, WA
12213100	NOOKSACK RIVER AT FERNDALE, WA
12213505	CALIFORNIA CREEK NEAR PLEASANT VALLEY, WA
12214350	SUMAS RIVER AT SOUTH PASS ROAD AT NOOKSACK, WA
12215000	JOHNSON CREEK AT SUMAS, WA
12215650	COPPER LAKE NEAR GLACIER, WA
12419495	SPOKANE RIVER AT STATELINE BR NR GREENACRES, WA
12450880	STILLETO LAKE NEAR STEHEKIN, WA

USGS Station ID	Location Description
12472900	COLUMBIA R AT VERNITA BR NR PRIEST RAPIDS DAM, WA
12473520	COLUMBIA RIVER AT RICHLAND, WA
12494450	NACHES RIVER AT RM 12.2 NEAR NACHES, WA
12498690	NACHES RIVER ABOVE DIVERSION DAM NEAR YAKIMA, WA
12498990	NACHES RIVER AT 40TH AVENUE NEAR YAKIMA, WA
12504490	SUNNYSIDE CANAL AT DIVERSION NEAR PARKER, WA
12504509	JOINT DRAIN 32 AT OUTLOOK RD NEAR SUNNYSIDE, WA
12505040	YAKIMA RIVER AT RM 103 NEAR WAPATO, WA
12505045	YAKIMA RIVER AT RM 102.8 NEAR PARKER, WA
12505060	YAKIMA RIVER AT RM 102.6 NEAR PARKER, WA
12505085	YAKIMA RIVER AT RM 100.8 NEAR DONALD, WA
12505090	YAKIMA RIVER AT RM 100.7 NEAR DONALD, WA
12505150	ROZA CANAL WASTEWAY NUMBER 3 NEAR SAWYER, WA
12505180	ROZA CANAL WASTEWAY NO 3 BLW HWY 12 NR SAWYER, WA
12505270	YAKIMA RIVER AT RM 94.4 NEAR BUENA, WA
12505300	YAKIMA RIVER NEAR TOPPENISH, WA
12505310	YAKIMA RIVER BELOW HIGHWAY 22 NEAR TOPPENISH, WA
12505315	BUENA DRAIN AT WESTBOUND I-82 NEAR BUENA, WA
1250532100	YAKIMA RIVER BLW N MYERS RD BRIDGE RB NR ZILLAH
1250532110	YAKIMA RIVER BLW N MYERS RD BRIDGE LB NR ZILLAH
1250532200	YAKIMA RIVER AT RM 90.4 NEAR ZILLAH, WA
1250532210	YAKIMA RIVER AT RM 90.3 NEAR ZILLAH, WA
1250532400	YAKIMA RIVER 3 FT FROM RB AT RM 89 NR ZILLAH, WA
1250532410	YAKIMA RIVER 20 FT FROM RB AT RM 89 NR ZILLAH, WA
12505325	YAKIMA RIVER AT RM 88.1 NEAR TOPPENISH, WA
12505330	YAKIMA RIVER AB E TOPPENISH DRAIN NR GRANGER, WA
12505445	JOINT DRAIN AT YAKIMA VALLEY HWY AT GRANGER, WA
12505448	JOINT DRAIN 28 NEAR GRANGER, WA
12508670	DID 7 DRAIN NEAR MABTON, WA
12508785	JOINT DRAIN NEAR S 1ST STREET AT SUNNYSIDE, WA
12508788	SULPHUR CR WASTEWAY AT SHELLER RD AT SUNNYSIDE WA
12508790	DID 18 DRAIN AT SUNNYSIDE, WA
12508810	WASHOUT DRAIN AT SUNNYSIDE, WA
12508825	JOINT DRAIN 40.2 NR TEAR RD NEAR SUNNYSIDE, WA
12508835	JOINT DRAIN FROM ROUGK LN NEAR SUNNYSIDE, WA
12508840	DID 3 DRAIN NEAR SUNNYSIDE, WA
12508988	DRAIN 31 AT WEST CHARVET RD AT MABTON, WA
12508997	GRANDVIEW DRAIN AT CHASE ROAD NEAR GRANDVIEW, WA
12509057	JOINT DRAIN 1 AT BUS RD NEAR GRANDVIEW, WA
13334000	GRANDE RONDE RIVER AT ZINDEL, WA
13334300	SNAKE RIVER NEAR ANATONE, WA
13351000	PALOUSE RIVER AT HOOPER, WA

USGS Station ID	Location Description
14144700	COLUMBIA RIVER AT VANCOUVER, WA
14144805	FLUSHING CHANNEL AT VANCOUVER LK AT VANCOUVER, WA
14211920	BURNT BRIDGE CR AT VANCOUVER LK NR VANCOUVER, WA
14211925	VANCOUVER LAKE SITE 2 NEAR VANCOUVER, WA
14211930	VANCOUVER LAKE SITE 3 NEAR VANCOUVER, WA
14211935	VANCOUVER LAKE SITE 4 NEAR VANCOUVER, WA
14211940	VANCOUVER LAKE SITE 1 NEAR VANCOUVER, WA
14211949	VANCOUVER LAKE SITE 5 NEAR VANCOUVER, WA
14211955	LAKE RIVER AT FELIDA, WA
14213050	SALMON CREEK AT LAKE RIVER NR VANCOUVER
14216000	LEWIS RIVER ABOVE MUDDY RIVER NEAR COUGAR, WA
14216500	MUDDY RIVER BELOW CLEAR CREEK NEAR COUGAR, WA
14224570	LAKE LOUISE OUTLET NEAR PARADISE, WA
14224590	SNOW LAKE NEAR PACKWOOD, WA
14240525	NF TOUTLE RIVER BELOW SRS NEAR KID VALLEY, WA
14241500	SOUTH FORK TOUTLE RIVER AT TOUTLE, WA
14242580	TOUTLE RIVER AT TOWER ROAD NEAR SILVER LAKE, WA
14243000	COWLITZ RIVER AT CASTLE ROCK, WA
453604122060000	FRANZ LAKE SLOUGH ENTRANCE, COLUMBIA RIVER, WA
454705122451400	CAMPBELL SLOUGH, RIDGEFIELD NWR, ROTH UNIT, WA
460939123201600	BIRNIE SLOUGH, WHITE'S ISLAND, COLUMBIA RIVER, WA
461802124024400	COLUMBIA R AT PORT OF ILWACO MARINA AT ILWACO, WA
471142122094701	EPILIMNION-LAKE TAPPS NR BONNEY LAKE, WA SITE 2
471142122094702	HYPOLIMNION-LAKE TAPPS NR BONNEY LAKE, WA SITE 2
471223122091201	EPILIMNION-LAKE TAPPS NR BONNEY LAKE, WA SITE 6
471223122091202	HYPOLIMNION-LAKE TAPPS NR BONNEY LAKE, WA SITE 6
471241122084401	EPILIMNION-LAKE TAPPS NR BONNEY LAKE, WA SITE 7
471241122084402	HYPOLIMNION-LAKE TAPPS NR BONNEY LAKE, WA SITE 7
471324122093901	EPILIMNION-LAKE TAPPS NR SUMNER, WA SITE 5
471324122093902	HYPOLIMNION-LAKE TAPPS NR SUMNER, WA SITE 5
471358122085201	EPILIMNION-LAKE TAPPS NR SUMNER, WA SITE 3
471358122085202	HYPOLIMNION-LAKE TAPPS NR SUMNER, WA SITE 3
471405122093301	EPILIMNION-LAKE TAPPS NR SUMNER, WA SITE 4
471405122093302	HYPOLIMNION-LAKE TAPPS NR SUMNER, WA SITE 4
471418122121101	EPILIMNION-LAKE TAPPS NR SUMNER,WA SITE 1
471418122121102	HYPOLIMNION-LAKE TAPPS NR SUMNER, WA SITE 1
471423122115001	EPILIMNION-LAKE TAPPS NR SUMNER, WA SITE 8
471423122115002	HYPOLIMNION-LAKE TAPPS NR SUMNER, WA SITE 8
471456122110801	EPILIMNION-LAKE TAPPS NR SUMNER, WA SITE 9
471456122110802	HYPOLIMNION-LAKE TAPPS NR SUMNER, WA SITE 9
475004117453000	LK SPOKANE NR LK SPOKANE CAMPGROUND
480333123503210	LAKE CRESCENT STATION LS04

USGS Station ID	Location Description
480508123455710	LAKE CRESCENT STATION LS02
481903122301001	SKAGIT DELTA (SITE 3)
481915122225501	WHILEY SLOUGH
481917122293901	SKAGIT DELTA (SITE 1)
481958122294301	SKAGIT DELTA (SITE 2)
482027122262401	HALL SLOUGH
482106122283401	SKAGIT DELTA (SITE 5)
482109122282501	SKAGIT DELTA (CRAFT ISLAND)
482125122293501	SKAGIT DELTA (OLD DIST)
482132122283401	SKAGIT DELTA (NEW DIST MID)
482136122282601	SKAGIT DELTA (NF AT NEW DIST)
482510117393701	BAYLEY LAKE (LITTLE PEND OREILLE NWR) NR ADDY, WA
485631117431010	FRANKLIN D ROOSEVELT LAKE DEADMANS EDDY RADB-DGT
485632117430810	FRANKLIN D ROOSEVELT LAKE DEADMANS EDDY RAD7-DGT
485646117430210	FRANKLIN D ROOSEVEL LAKE DEADMANS EDDY (UPSTRM-DGT

Other Data Sources

- University of Washington Applied Physicals Laboratory (UW/APL), Northwest Association of Networked Ocean Observing Systems (NANOOS), and Washington Ocean Acidification Center (WOAC) cruise data. Submitted to Ecology June 30, 2016. [9]
- Washington State Lakes Environmental Data Database. Washington State Department of Ecology.[24] Accessed February 2020. [9]

[24] https://apps.ecology.wa.gov/coastalatlas/tools/LakeDetail.aspx

Narrative Data and Information

Ecology considered all narrative data and information that were submitted during the public call-for-data periods in development of the 2018 WQA. Policy 1-11, Chapter 1, section "1E. Data and Information Submittals" states that information and data provided in the narrative submittal must meet the following two conditions:

1. Documentation of a designated use impairment in the waterbody, AND
2. Documentation that impairment of the existing or designated use is related to the environmental alteration on that same waterbody segment or grid.

Any numeric water quality data associated with the specific study being considered that was already in EIM or the federal Water Quality Portal would have been accessed directly, regardless of whether or not the narrative submittal met the above two conditions.

The "Ocean Acidification" and "Microplastics" sections below contain Ecology's evaluation and use determinations for data and information submitted on these topics. The "Other Narrative Data and Information" section details all other technical reports, studies, and other information considered in development of the WQA.

Ocean Acidification

During the public call-for-data, Ecology received two submittals related to ocean acidification (OA):

1. Correspondence from Valdivia, Center for Biological Diversity (CBD) to Lizon, Department of Ecology, 6/24/2016. The CBD letter provides two types of information relevant to ocean acidification to be considered for the Water Quality Assessment:
   - Information on the affects that ocean acidification is having on marine life, and
   - Specific requests for ten waterbody locations to be listed as threatened or impaired under its 303(d) list
2. Joint correspondence from Alin, et al, NOAA/PMEL and UW to Kleinknecht and Lizon, Department of Ecology, 6/30/2016. The NOAA/UW letter provides three type of information relevant to impacts to aquatic life uses in Washington coastal waters:
   - Two files containing pH measurements from multiple research surveys spanning 2007 to 2014.
   - Information on data that can be used to estimate pH values for a large number of additional data sets containing surface carbon dioxide data.
   - Information on biological impacts on pteropods related to Washington State's pH narrative biological quality criteria.

Both the CBD and NOAA/UW submittals have overlapping OA information and data sources provided for Ecology to consider for use in the WQA. Therefore, we reviewed the types of

information provided as a whole to determine if the information meets Ecology's credible data requirements to be considered for listing in the Assessment. We reviewed the data and information from both CBD and NOAA/UW based on five types of data submittals:

1. Narrative information submittals to determine if the data credibility requirements are met
2. pH data to determine if standards were met
3. Surface seawater CO_2 data and proposed methodology to estimate in-situ pH values
4. Pteropod and aragonite saturation data to determine if aquatic life are impacted by low pH
5. Analysis of pH and surface seawater CO_2 data from ten mooring buoy locations to determine if listing requirements were met based on a combination of narrative information and numeric data

Each of the sections below provide Ecology's review and determinations of whether the information and data submittals for ocean acidification can be used for Assessment.

Narrative Information

Submittal

The CBD correspondence presents information and studies supporting concerns that ocean acidification is impacting Washington's coastal and estuarine waters and that its negative effects will only grow more severe with business as usual greenhouse emission scenarios.

Ecology Determination

We do not dispute CBD's overall concerns about ocean acidification and climate change. In fact, our state has embraced efforts to cut greenhouse gas emissions. Washington's Governor Jay Inslee is a national leader in efforts to cut greenhouse gas emissions to prevent climate change. Governor Inslee and the Washington Legislature have adopted a variety of laws, programs, and initiatives designed to reduce greenhouse gas emissions.

Most recently, the Washington legislature passed a comprehensive climate law called the Climate Commitment Act that was signed the Governor on May 17, 2021. The Climate Commitment Act establishes a "cap and invest" program that sets a limit on the amount of greenhouse gases that can be emitted in Washington (the cap) and then auctions off allowances for companies and facilities that emit greenhouse gases until that cap is reached.

Further, Washington recognizes that vehicle emissions are Washington's largest contributor to greenhouse gases and has taken numerous actions to curb emissions, including:

- Under regulations adopted in 2021 per the Clean Car Law, vehicles manufactured after 2005 must meet strict emission standards to be registered, leased, rented, licensed, or sold in Washington.

- In 2020 Governor Inslee signed the Zero Emissions Vehicle (ZEV) standard and Ecology will complete rulemaking for the new regulations by the end of 2021. The ZEV standard requires automakers to deliver a certain number of zero emission vehicles each year, and earn credits based on the number of vehicles produced and delivered for sale.
- In 2021, Governor Inslee signed the Clean Fuel Standard, which will require fuel suppliers to reduce the carbon intensity of their fuels 20% by 2038. The standard is expected to reduce statewide greenhouse gas emissions by 1.8 million metric tons of carbon dioxide equivalent by 2030.

Ecology has and will continue to be a leader in carrying out efforts to curb greenhouse gas emissions in order to address climate change and ocean acidification issues. To get more information on what the department is doing to address greenhouse gas emissions, go to: Reducing greenhouse gases - Washington State Department of Ecology[25].

Submittal

CBD provided information to emphasize that ocean acidification already affects marine life, including assertions that:

- Ocean acidification reduces calcium carbonate saturation
- Washington's coastal and estuarine waters are affected by ocean acidification
- Empirical and field studies show that marine calcifiers are highly vulnerable
- Shellfish fisheries in Washington State are already harmed by ocean acidification
- Ocean acidification affects crucial zooplankton groups such as pteropods
- Ocean acidification affects a variety of other marine organisms
- Local stressors magnify anthropogenic ocean acidification
- Ocean acidification is a multi-stressor problem that can be partially addressed locally

Ecology Determination

We appreciate the concerns expressed by CBD with regard to ocean acidification and potential effects on aquatic life, and the dedication CBD has in its campaign to combat effects from ocean acidification. Likewise, Washington takes the issue of ocean acidification very seriously. Understanding the effects of ocean acidification is an evolving science. The state continues to work along with California, Oregon, federal agencies, and academic institutions to identify science and data gaps in understanding ocean acidification and what steps the state can take to curb effects from ocean acidification at the regional and local level.

Washington was one of the first states to take a leadership role in addressing ocean acidification, when then Governor Gregoire convened a Blue Ribbon Panel (Panel) on Ocean Acidification in February 2012. The Panel, which included scientific experts, relevant

[25] https://ecology.wa.gov/Air-Climate/Climate-change/Greenhouse-gases/Reducing-greenhouse-gases

agencies, and stakeholders, developed recommendations[26] on understanding, monitoring, adapting, and mitigating ocean acidification in Puget Sound and Washington waters. Five years later, the Marine Resources Advisory Council (MRAC)[27] convened Washington's leading ocean acidification experts to evaluate progress, next steps, and potential revisions to the recommended actions identified in 2012. The 2017 Addendum[28] updates the comprehensive strategy based on emerging science, management practices, and the new global network of partners working on this challenge.

The Blue Ribbon Panel recommendations have been embraced and enhanced by similar, more recent efforts to understand and curb effects from ocean acidification due to human sources. To get more information on what the department is doing to address climate change, go to Ecology website[29].

Numeric Data

pH values from research surveys

NOAA/PMEL-led West Coast Ocean Acidification cruise data

Submittal

Data were collected by National Ocean and Atmosphere Administration's Pacific Marine Laboratory (NOAA/PMEL) West Coast Ocean Acidification cruises. Cruises spanned the Pacific Coast from British Columbia, Canada to the southern Baja California Penninsula, Mexico in 2007, 2011, 2012, 2013. Samples were collected at 129 unique monitoring stations. Parameters reported include temperature, salinity, nutrients, dissolved oxygen, various dissolved inorganic carbon species, and different forms of measured or calculated pH.

Ecology Determination

None of the 129 monitoring locations are located within Washington State waters. Ecology's authority to make water quality determinations for purposes of the Water Quality Assessment is limited to Waters of the State, which extends three miles off of the Pacific Coast shoreline, as consistent with the provisions in the federal Clean Water Act Section 502. All of the submitted monitoring locations were greater than 10 miles off of the Pacific Coast shoreline, well outside Washington's jurisdiction for Clean Water Act actions. Our Credible Data Act requires that data used for the WQA is representative of the conditions of the waterbody we are making a water quality determination. This is to ensure that we are accurately characterizing ambient water quality conditions when we are making regulatory determinations under the Clean Water Act.

For Ecology to use these data, we would need to have data or information to support that aquatic life conditions at locations greater than 10 miles offshore are representative to

[26] https://apps.ecology.wa.gov/publications/documents/1201015.pdf
[27] http://oainwa.org/mrac/
[28] http://oainwa.org/assets/docs/2017_Addendum_BRP_Report_fullreport.pdf
[29] https://ecology.wa.gov/Air-Climate/Climate-change

those nearshore Waters of the State. In this case, we do not have former information to accurately apply these data within Waters of the State. Utilizing data collected well offshore to represent near shore conditions would not accurately represent water conditions, as it would not take into account local point and non-point source pollution sources or coastal currents/upwelling. As a result, none of these data could be used for purposes of the Assessment.

UW/APL, NANOOS, WOAC Puget Sound, Strait of Juan de Fuca, and coastal cruise data

Submittal

Data were collected jointly by University of Washington Applied Physicals Laboratory (UW/APL), Northwest Association of Networked Ocean Observing Systems (NANOOS), and Washington Ocean Acidification Center (WOAC) cruises. Cruises spanned Puget Sound, the Strait of Juan de Fuca, and off the coast of Washington's northwest peninsula in 2008-2014. Samples were collected at 61 unique monitoring stations. Parameters reported include temperature, salinity, nutrients, dissolved oxygen, various dissolved inorganic carbon species, and different forms of measured or calculated pH.

Ecology Determination

Of the 3,944 data points submitted, 1,764 had pH records collected within Washington State waters. These data are summarized below in Table 5 and were incorporated into the WQA. Ecology's review of pH data found that no sample exceeded the lower range of Washington's marine pH criteria for protection of aquatic life (7.0–8.5 pH). However, it is worth nothing **two samples exceeded the upper range of the pH criteria**.

- Station P3 recorded an instantaneous maximum pH value of 8.556 in 2014. This monitoring station corresponds with Assessment Unit (AU) 48122B4A8_01_01, which is currently proposed as Category 5 due to several exceedances of the upper range of the pH criteria based on Ecology long-term marine monitoring data.
- Station P1 recorded an instantaneous maximum pH value of 8.541 in 2014. This monitoring station corresponds with Assessment Unit (AU) 48122A2B9_01_01, which is currently proposed as Category 2 due to exceedances of the upper range of the pH criteria based on Ecology long-term marine monitoring data. However, there were not enough exceedances across multiple years to support a Category 5 listings based on our Policy 1-11 methodology.

The UW/APL pH data appear to support these two category determinations for exceeding the upper range of pH criteria. All other pH records fell within the pH range protective of Aquatic Life. All data collected outside of State waters were not used for the WQA because 1) Ecology does not have jurisdiction of waters outside of the state; and 2) there is no information to support these offshore monitoring locations are representative of nearshore Waters of the State. See Ecology Determination in NOAA/PMEL cruise data section above

for more information on how data collected outside State Waters are not appropriate for the WQA.

Table 5 Summary of UW/APL pH records collected in Washington State waters.

Station	Assessment Unit	Sample Count	Minimum (pH)	Maximum (pH)
P1	48122A3B0_01_01	28	7.519	*8.541
P10	47122I7A1_01_01	36	7.707	8.167
P11	47123D1H3_01_01	41	7.355	8.264
P12	47123E1C0_01_01	56	7.335	8.332
P122	48124E6H8_01_01	12	7.632	7.938
P123	48124D4J2_01_01	42	7.605	8.166
P128	48124D2F6_01_01	23	7.643	7.903
P13	47123F0E0_01_01	49	7.423	8.308
P131	48124C0J9_01_01	18	7.542	7.892
P132	48123C9H8_01_01	52	7.652	8.093
P133	48123C7E2_01_01	16	7.649	8.008
P136	48123C4C7_01_01	43	7.674	8.089
P14	47122G9A3_01_01	56	7.469	8.277
P15	47122G8G5_01_01	48	7.408	8.298
P16	47122G7J6_01_01	44	7.526	8.284
P17	47122H7D6_01_01	44	7.603	8.3
P18	48122A6D1_01_01	47	7.744	8.023
P19	48122A6J2_01_01	47	7.738	8.05
P2	48122B3D9_01_01	14	7.529	8.338
P20	48122B6E8_01_01	41	7.572	8.002
P21	48122B8I4_01_01	59	7.691	8.098
P22	48123C0H1_01_01	66	7.65	8.024
P23	48123C2E2_01_01	23	7.682	7.915
P24	48123D1D2_01_01	29	7.689	7.942
P25	48123D0J0_01_01	24	7.724	7.897
P26	48122D7H1_01_01	27	7.589	7.934
P27	47122I4B5_01_01	51	7.676	8.194
P28	47122H4A5_01_01	51	7.645	8.217
P29	47122F4F4_01_01	38	7.317	8.128
P3	48122B4A8_01_01	32	7.58	*8.556
P30	47122E4F0_01_01	38	7.522	8.212
P31	47122D3J5_01_01	40	7.57	8.121
P32	47122D4D4_01_01	36	7.533	8.217
P33	47122D4C9_01_01	32	7.536	8.376
P34	47122C5I3_01_01	5	7.815	7.83

Station	Assessment Unit	Sample Count	Minimum (pH)	Maximum (pH)
P35	47122B6I3_01_01	34	7.489	8.155
P36	47122B7G8_01_01	28	7.69	8.138
P37	47122C8G5_01_01	20	7.563	8.173
P38	47122C7H0_01_01	36	7.515	8.422
P39	47122E5B2_01_01	20	7.609	8.009
P4	48122C5E5_01_01	31	7.581	8.433
P401	47123E0J5_01_01	54	7.296	8.321
P402	47123D0F2_01_01	24	7.266	8.321
P403	47122G8J6_01_01	9	7.568	7.846
P404	47123B0D1_01_01	4	7.606	7.671
P5	47122I3I6_01_01	34	7.615	8.465
P500	47122G3A6_01_01	10	7.73	8.088
P6	47122J4C6_01_01	12	7.859	8.296
P7	47122J6I1_01_01	46	7.737	8.038
P8	47122I6J0_01_01	54	7.664	8.186
P9	47122I6D6_01_01	40	7.71	8.136

*exceedances of the marine pH criteria of 7.0 – 8.5.

Surface seawater CO_2 data to estimate pH

Moored time-series carbon dioxide observations

Submittal

Time-series data of surface seawater carbon dioxide levels (pCO_2 or fCO_2) and other physical and chemical parameters collected from NOAA moorings as part of their Ocean Carbon Data Systems (OCADS) project are available on the OCADS website. Data submitters provide an equation for estimating total alkalinity using salinity measurements, based on a Fassbender and others research publication in review at time of data submittal. Theoretically, pCO_2/fCO_2, estimated alkalinity, temperature, and pressure data can be used to estimate pH. Four moorings were submitted for consideration:

- La Push – 47.97°N, 124.95°W
- Cape Elizabeth – 47.35°N, 124.73°W
- Twanoh – 47.37°N, 123.01°W
- Dabob – 47.80°N, 122.80°W

Ecology Determination

Staff determined that these data are not appropriate for the WQA.

First, it is worth noting that the La Push and Cape Elizabeth moorings are well outside Washington State waters and are thus not suitable for use in Washington's WQA (see

Ecology Determination to NOAA/PMEL data section above). Therefore, only the Twanoh and Dabob data would be considered for the WQA.

Second, Ecology does not have approved numeric criteria for determining impairment to aquatic life utilizing surface water pCO_2 measurements. Ecology also does not have an established method for the conversion of salinity measurements to total alkalinity (TA) or conversion of pCO_2 to infer pH for purposes of the WQA. While the submittal provided a theoretical method for estimating alkalinity based on CO_2, then estimating pH based on CO_2 estimates, there are multiple concerns with this method.

- The Fassbender and others publication referenced was in review at time of submittal and not provided with the data submittal. Our Credible Data Act deems data credible when it is considered "generally acceptable in the scientific community as appropriate for use in assessing the conditions of the water." While Ecology staff located what appears to be the final publication by searching academic journals, it is unclear what changes may have been made to methods or calculations in the review process, as the version of the publication used to support the methods presented in the submittal was not provided.
- Based on what is presumed the final publication, the data used to develop the TA/salinity relationship were collected solely in Washington's offshore coastal waters However, the Twanoh and Dabob buoys are located in nearshore bays of Puget Sound. The environmental conditions influencing water chemistry differ drastically between offshore Pacific Coast waters and inland Puget Sound waters, meaning the relationship developed by Fassbender and others is very likely not representative of these two monitoring locations. The authors themselves cite several studies indicating that carbonate chemistry can be unique to specific regions, vary seasonally and interannually, and be influenced by local landuses and climates. Further the authors go so far to say "…this poses challenges for the empirical TA-S approach in nearshore environments". This information supports that this relationship is not suitable for use these monitoring locations.

Third, under the circumstances that the proposed methodology was appropriate for the WQA, the Twanoh mooring does not have available salinity measurements within the data window and thus total alkalinity could not be estimated under the methods provided. The Dabob mooring had few salinity measurements available, with many measurements outside the salinity range appropriate for the equation provided (25-30 ppt), meaning most available measurements would not be estimating TA with the proposed equation. It is also worth noting that the data submitters later in their submittal highlight that Dabob and Twanoh OA moorings had no temperature or salinity data to calculate pH (See Section Ten mooring buoys: Dabob OA mooring). This questions the purpose of including this monitoring location in this section of the data submittal.

Due to data credibility concerns with extrapolating offshore data to represent nearshore Waters of the State and lack of well-established methodology for estimating pH in Washington State waters, these data are not appropriate for the WQA.

Surface seawater carbon dioxide observations from ships

Submittal

Data consists of surface ocean fCO_2 levels, salinity, and other chemical and physical parameters collected from various research vessel cruises around the world, stored in the Surface Ocean CO_2 Atlas. Data are collected by several different organizations, including NOAA/PMEL Carbon Group cruises spanning 2009-2011. Data submitters suggest that Ecology follow the recommended calculations to estimate total alkalinity and pH.

Ecology Determination

Staff determined that these data are not appropriate for use in the WQA. Our Credible Data act requires we use data representative of water quality conditions and methods generally acceptable in the scientific community. See Ecology Determination on Moored time-series carbon dioxide observations above for a more detailed explanation of how these data do not meet credible data requirements.

Additionally, our Policy 1-11 details that third part data submittals should include documentation from the original data submitter indicating that the required QA objectives were met. This requirement is to ensure that we are using appropriately quality assured and controlled water quality samples when the data submitter is a different organization than the data collector. The only information provided with this data submittal was a link to the general database website. No quality assurance information or documents, such as a quality assurance project plan (QAPP) or field/laboratory calibration records, were provided.

Pteropod Data

WCOA Cruises

Submittal

Data consists of pteropod shell damage characterization and calculated aragonite saturation based on samples collected from 2011 and 2013 NOAA/PMEL cruises of Pacific Coast waters. Pteropod samples were collected from 17 stations in 2011 and 19 stations in 2013. Organisms were washed with distilled water, dehydrated, plasma etched for removal of organics, then analyzed for shell dissolution severity using a scanning electron microscope (SEM). The percentage of organisms with Type II and Type III damage (more severe shell dissolution) and depth integrated abundance of organisms was summarized by year and sampling station, along with the average aragonite saturation state at that station.

Ecology Determination

None of the pteropod monitoring locations are located within Washington State waters. All data collected outside of State waters were not used for the WQA because 1) Ecology does

not have jurisdiction of waters outside of the state; and 2) there is no information to support these offshore monitoring locations are representative of nearshore Waters of the State. See Ecology Determination in NOAA/PMEL cruise data section above for more information on how data collected outside State Waters are not appropriate for the WQA.

WOAC and NANOOS Cruises

Submittal

Data consists of pteropod shell damage characterization and calculated aragonite saturation based on samples collected from a 2014 WOAC and NANOOS cruise of Puget Sound. Between 2 to 3 pteropod sampling events occurred at 7 stations between July and October 2014. Organisms were processed using the method outlined in the submittal, with the exception of using 1% KOH to remove organic matter, rather than plasma etching. The percentage of organisms with Type II and Type III damage (more severe shell dissolution) and depth integrated abundance of organisms was summarized for each sample, along with the average aragonite saturation state at that station.

Ecology Determination

Data are summarized below in Table 6. The percentage of organisms with Type II-III shell damage ranged from 22% to 100% at sampling sites, while aragonite saturation ranged from 0.48 to 1.26. It should be noted that Ecology currently does not have numeric criteria for aragonite saturation or an approved standard methodology for analyzing marine biological organism data for purposes of the WQA. While data demonstrate a range of severity in pteropod shell damage, there are no reference conditions or sites with which to compare these data. Without reference conditions, it is unclear whether or not these data represent the natural conditions of aquatic life in Washington's waters. Additionally, the three samples are not likely to capture the potential variability in pteropod shell development. Ecology recognizes the relationships between pH, aragonite saturation, and pteropod shell dissolution as documented by Bednarsek and others (2012, 2014). However, there is not sufficient data collected in Washington's waters for purposes of the WQA at this time. These types of data could likely be utilized in future WQAs, if paired with a robust statistical analysis including reference sites, which could then be used to document clear impacts to aquatic life uses in Washington waters.

Table 6 Summary of WOCA pteropod Type II+III shell damage (D) data and average water column average aragonite saturation (Ω) data by sampling station

STATION	SAMPLES	D MIN (%)	D MAX (%)	Ω MIN	Ω MAX
P12	3	68	100	0.51	0.62
P22	2	35	70	0.84	1.00
P28	3	84	100	0.86	1.02
P38	3	22	100	0.96	1.28
P4	3	39	78	0.62	0.68
P402	2	62	81	0.48	0.70

STATION	SAMPLES	D MIN (%)	D MAX (%)	Ω MIN	Ω MAX
P8	2	38	80	0.95	1.26

Mooring buoy data submitted by CBD

Ecology analyzed each of the ten waterbody locations that CBD provided data and information to support their request that these waterbodies be included on the 303(d) List as Category 5 waters.

Tatoosh Island (48.3933ºN, 124.7384ºW)

Submittal

Coastal waters around Tatoosh Island should be listed as impaired with respect to ocean acidification because the rate of pH decline is higher than natural fluctuating conditions with a human caused variation of more than 0.2 pH units (standard deviation criteria). The data clearly shows that it violates water quality standards based on the Washington methodology. It also violates the antidegradation and aquatic life standard. In addition, pH decline over the year has impacted the benthic community.

Ecology Determination

No action. The monitoring site where the Wootton study was conducted is located within the boundaries of the Makah Indian reservation. The monitoring site is not subject to Washington State's authority because it is located within a tribal boundary. Tribes have independent authority for setting water quality standards and implementing regulations for waters on reservation lands under the Clean Water Act.

The monitoring site where the Wootton study was conducted is located within the boundaries of the Makah Indian reservation and is unique in that it is where oceanic waters mix with outgoing water from the Strait of Juan de Fuca. Data and information from the Wootton et al, 2008 study were previously considered by Ecology during the Assessment listing process that resulted in the EPA-approved 2010 Marine Water Quality Assessment. Ecology reviewed the Wooten (2008) study to determine if the pH and biology data collected as part of the study could be used as a basis for listing on Category 5 in the 2010 Marine Assessment. While the Wootten study may be valid for Tatoosh Island, a spatial extrapolation of long-term trends from the study area to a larger regional change would exhibit high uncertainty since the data are from only one sampling location. Also, the study does not provide conclusive evidence that the cause of the pH change is due to human sources. For instance, the change could be caused by natural sources related to inputs from river discharges, long-shore shelf transport and planktonic specifies composition (i.e., the pH changes could be related to changes in physical conditions due to the location and changes in the patterns of primary productivity and species composition).

The dataset was also reviewed by Ecology's marine monitoring unit as part of the 2010 Water Quality Assessment. This dataset does not provide any pH data showing impairments

of Washington waters, nor does it provide conclusive evidence that Washington's coastal aquatic life in the natural environment are being impaired by ocean acidification. Therefore, the dataset does not provide a basis for waterbody listings in Category 5 for violations of either pH or narrative standards for aquatic life. In summary, this study does not provide any pH data showing impairments of Washington waters, nor does it provide conclusive evidence that Washington's coastal aquatic life in the natural environment are being impaired by ocean acidification. Therefore, the study does not provide a basis for waterbody listings in Category 5 for violations of either pH or narrative standards for aquatic life.

Cape Elizabeth OA mooring (47.35ºN, 124.73ºW)

Submittal

Coastal waters around Cape Elizabeth mooring should be listed as threatened with respect to ocean acidification because the average rate of pH decline is higher than natural fluctuating conditions with a human caused variation of about 0.183 pH units. It is likely that these waters will surpass the 0.2 pH change standard before the next assessment. The average (± standard deviation) sea surface pH at the Cape Elizabeth mooring was 8.153±0.08 units significantly ($p<0.001$) lower than preindustrial levels of 8.339±0.14 units. Since preindustrial time pH has declined 0.183 units at this site which is higher than the global average of 0.1 units.

Ecology Determination:

A response to the applicability of the Cape Elizabeth OA mooring data in the WQA is provided earlier in document (See Ecology Determination Moored time-series carbon dioxide observations). Due to data credibility concerns with extrapolating offshore data to represent nearshore Waters of the State and lack of established methodology for estimating pH in Puget Sound waters, these data are not appropriate for the WQA.

Further, even if the mooring were within the jurisdiction of state waters, CBD misinterprets the sea surface pH measurements at the Cape Elizabeth mooring by stating that the human caused variation of 0.2 units within the acceptable range of 7.0 – 8.5 units are being violated. These CBD inferences are based on numerous assumptions that are neither scientific nor credible for determining that the 0.2 unit pH variation is being violated based on current pH data at the mooring site. A comparison of estimated pre-industrial pH values based on assumed temporal trends to estimated current pH values is not a analysis properly vetted by the scientific community and would not meet our Credible Data Act requirements for the WQA.

La Push OA mooring (47.97ºN, -124.95ºW)

Submittal

Coastal waters around La Push mooring should be listed as impaired with respect to ocean acidification because the rate of pH decline is higher than natural fluctuating conditions with a human caused variation of more than 0.2 pH units (standard deviation criteria). This violates

the Washington State water quality standard for pH. The average (± standard deviation) sea surface pH at La Push OA mooring over the past ten years was 8.181±0.09 units significantly lower ($p<0.001$) than preindustrial levels of 8.389±0.185 units (Fig. 10). Since preindustrial time pH has declined 0.207 units at this site which is higher than the global average of 0.1 units.

Ecology Determination

A response to the applicability of the La Push OA mooring data in the WQA is provided earlier in document (See Ecology Determination for Moored time-series carbon dioxide observations). Due to data credibility concerns with extrapolating offshore data to represent nearshore Waters of the State and lack of established methodology for estimating pH in Puget Sound waters, these data are not appropriate for the WQA.

Further, even if the mooring were within the jurisdiction of state waters, CBD inferences are based on numerous assumptions that are neither scientific nor credible for determining that the 0.2 unit pH variation is being violated based on current salinity and pCO_2 data at the mooring site. CBD misinterprets the sea surface pH measurements at the La Push mooring by stating that the human caused variation of 0.2 units within the acceptable range of 7.0 – 8.5 units are being violated. CBD asserts that "the average (± standard deviation) sea surface pH at the Cape Elizabeth mooring was 8.153±0.08 units significantly ($p<0.001$) lower than preindustrial levels of 8.339±0.14 units. Since preindustrial time pH has declined 0.183 units at this site which is higher than the global average of 0.1 units." A comparison of estimated pre-industrial pH values based on assumed temporal trends to estimated current pH values is not a analysis properly vetted by the scientific community and would not meet our Credible Data Act requirements for the WQA.

Dabob OA mooring (47.97ºN, -124.95ºW)

Submittal

The lack of salinity and temperature at this station inhibits calculating pH from pCO_2 data. However, Washington may have other sources, including the state water quality monitoring stations and the shellfish hatchery that could be analyzed. Nonetheless, it is important to highlight that pCO_2 in this station can reach levels well above 500 ppm which represents relative low pH. Salinity, temperature, and pH data from this mooring is not available.

Ecology Determination

No action. The request to list this buoy site for ocean acidification is based on pCO_2 data from this station, which can reach levels well above 500 ppm. The submitter asserts that these levels would correlate with relatively low pH. Ecology determined that using pCO_2 data trends alone are not appropriate for the WQA. Ecology does not have approved numeric criteria for determining impairment to aquatic life utilizing surface water pCO_2 measurements. For assessment of waters under Washington's narrative water quality criteria, Ecology must have information that clearly documents the connection between sources, causes, and effects on designated uses in order to meet credible data requirements

in Washington. While Ecology understands the chemical equilibrium between pCO_2 and pH in aquatic systems, there are no additional information or data paired with the CO_2 data to suggest aquatic life is impaired in Dabob Bay and that elevated CO_2 is either directly or indirectly impacting that use. Due to lack of established criteria and lack of information supporting impacts under Ecology's narrative criteria, it was determined that these pCO_2 data are not appropriate for use in the WQA. (Note: This monitoring location was also included in the submittal from NOAA/U)

Twanoh (NANOOS ORCA buoy at Twanoh (47.37°N, 123.01°W)

Submittal

The lack of salinity and temperature at this station inhibits calculating pH from pCO2 data. However, Washington may have other sources, including the state water quality monitoring and the shellfish hatchery, for such data in this area that it should analyze. Nonetheless, it is important to highlight that pCO2 in this station can reach levels well above 500 ppm which represents relative low pH. Salinity, temperature, and pH data from this mooring is not available.

Ecology Determination

No action. The request to list this buoy site for ocean acidification is based on pCO_2 data from this station, which can reach levels well above 500 ppm. The submitter asserts that these levels would correlate with relatively low pH. Ecology determined that using pCO_2 data trends alone are not appropriate for the WQA. Ecology does not have approved numeric criteria for determining impairment to aquatic life utilizing surface water pCO_2 measurements. For assessment of waters under Washington's narrative water quality criteria, Ecology must have information that clearly documents the connection between sources, causes, and effects on designated uses in order to meet credible data requirements in Washington. While Ecology understands the chemical equilibrium between pCO2 and pH in aquatic systems, there are no additional information or data paired with the CO_2 data to suggest aquatic life is impaired in Dabob Bay and that elevated CO_2 is either directly or indirectly impacting that use. Due to lack of established criteria and lack of information supporting impacts under Ecology's narrative criteria, it was determined that these pCO_2 data are not appropriate for use in the WQA. (Note: This monitoring location was also included in the submittal from NOAA/U.)

Taylor Shellfish Farm (Dabob Bay, 47.8199ºN, -122.8215ºW)

Submittal

Although we only obtained 60-day worth of data, these include 41,062 pH measurements. Approximately 37% of data points were below 7.8 pH units between February and April 2016 (Fig. 14), a pH value that is harmful to the growth of oyster larvae and pteropods (see above). This clearly violates the antidegradation and aquatic life standard.

Ecology Determination

No action. Upon review of the data, Ecology determined there is not sufficient information provided with the data to demonstrate that quality assurance practices appropriate for the WQA were used. Per Policy 1-11, data submittals must include "documentation addressing the accuracy and completeness of the information submitted" and "documentation from the original data submitter indicating that the required QA objectives were met". The data submitter provided only a link to a .csv file stored on dropbox.com containing pH values and date/time of collection. There is no information documenting the method by which data were collected, whether a quality assurance project plan exists for these data, or whether any data collection or quality control procedures were followed.

However, even if data were deemed appropriate for the WQA, Ecology does not agree with the assertion that there was nonattainment of Washington's aquatic life standard. It appears from our review that all pH monitoring data were within the acceptable range of 7.0 to 8.5 units based on application of Policy 1-11, and there was no accompanying analysis demonstrating that there was a human-caused variation within the range of less than 0.2 units. It does not appear that any biology data was collected as part of this monitoring site that supports the statements that a pH of less than 7.8 represents harm to oyster larvae and pteropods in Dabob Bay, and would lead to conclusions the use is being impaired at this site. CBD did cite laboratory studies suggesting negative impacts to calcifying organisms and highlighted the need for further research on the impacts of ocean acidification to aquatic life under field conditions. Since this information was for discussion purposes, and the study did not report any observed impairments to aquatic life in the field, it is not appropriate to use in assessing the narrative standards for aquatic life. In summary, due to lack of quality assurance documentation and lack of information supporting impacts under Ecology's narrative criteria requirements, it was determined that these pH data are not appropriate for use in the WQA.

Dockton Park Station (Outer Quartermaster Harbor, 47.371618º N, -122.454097ºW)

Submittal

Waters around Dockton Park in the Outer Quartermaster Harbor should be designed as impaired due to ocean acidification because in ~47% of 194,283 measurements (from 2009 to 2016) pH have fallen below a threshold that is considered harmful for marine organisms such as oysters and pteropods (Fig 15). Washington's listing policy states that waters should be placed on the impaired waters list when a minimum of three excursions exist from all data considered and at least ten percent of values in a given year do not meet the criterion. (WA-001399-40). This also clearly violates the antidegradation and aquatic life standard. The average pH from 2009 to 2016 was 7.83 ± 0.32 (± standard deviation) with approximately 47% of measurements (92,253 out of 194,283) were below 7.8 units. The average aragonite saturation state during the same period was 1.36 ± 0.78 with 60% of estimates were below 1.3. Studies have demonstrated

that organisms such as oysters and pteropods in water conditions below these thresholds show signs of negative impacts from ocean acidification.

Ecology Determination

No action. Upon review of this submittal, there is not sufficient information provided with the data to demonstrate that quality assurance practices appropriate for the WQA were used. Per Policy 1-11, data submittals must include "documentation addressing the accuracy and completeness of the information submitted" and "documentation from the original data submitter indicating that the required QA objectives were met". For example, King County's Marine Monitoring website indicates that all pH data records should be paired with a quality control descriptor, which was missing from this submittal. Upon review of the data, we note that pH values ranged from 3.59 to 8.76, which is a highly unrealistic range for pH in a heavily studied marine environment. This calls into question quality assurance concerns that are not adequately addressed by the third party submittal.

Additionally, there is no presentation of biological data collected at this location that supports the statements that the presented aragonite saturation levels at this location are impacting oysters or pteropods in Quartermaster Harbor. It was determined that these data are not appropriate for use in the WQA due to: lack of quality assurance documentation, discrepancies between data provided and data represented in figures, lack of established aragonite criteria, and lack of information supporting impacts under Ecology's narrative criteria.

Quarter Master Yacht Club

Submittal

Waters around Quarter Master Yacht Club should be designed as impaired due to ocean acidification because in ~14% of 122,277 measurements (from 2009 to 2016), pH was below 7.8 unit, a critical threshold that is considered harmful for marine organisms such as oysters and pteropods (Fig 16). Washington's listing policy states that waters should be placed on the impaired waters list when a minimum of three excursions exist from all data considered and at least ten percent of values in a given year do not meet the criterion. (WA-001399-40). This clearly violates the antidegradation and aquatic life standard. The average pH from 2009 to 2016 was 8.15 ± 0.29 (± standard deviation) with approximately 14% of measurements (16,685 out of 122,277) were below 7.8 units (Fig. 16). The average aragonite saturation state during the same period was 2.63 ± 1.42 with 23% of estimates below 1.3. Studies have demonstrated that organisms such as oysters and pteropods in water conditions below these thresholds show signs of negative impacts from ocean acidification

Ecology Determination

No action. Upon review of this submittal, there is not sufficient information provided with the data to demonstrate that quality assurance practices appropriate for the WQA were used. Per Policy 1-11, data submittals must include "documentation addressing the

accuracy and completeness of the information submitted" and "documentation from the original data submitter indicating that the required QA objectives were met". For example, King County's Marine Monitoring website indicates that all pH data records should be paired with a quality control descriptor, which was missing from this submittal.

Additionally, the data provided were the exact same data as those provided from the Dockton Park monitoring station listed above, which calls into question whether the data provided are actually the data presented in Figure 16 of the submittal.

Nonetheless, pH values in data provided ranged from 3.59 to 8.76, which is a highly unrealistic range for pH in a heavily studied marine environment. This calls into question quality assurance concerns that are not adequately addressed by the third party submittal. There is also no presentation of biological data collected at this location that supports the statements that the presented aragonite saturation levels at this location are impacting oysters or pteropods in Quartermaster Harbor.

It was determined that these data are not appropriate for use in the WQA due to: lack of a quality assurance documentation, discrepancies between data provided and data represented in figures, lack of established aragonite criteria, and lack of information supporting impacts under Ecology's narrative criteria.

Point Williams

Submittal

Waters around Point Williams should be designed as impaired due to ocean acidification because in ~49% of 20,247pH measurements (from 2009 to 2016) have fallen below a threshold that is considered harmful for marine organisms such as oysters and pteropods (Fig 17). Washington's listing policy states that waters should be placed on the impaired waters list when a minimum of three excursions exist from all data considered and at least ten percent of values in a given year do not meet the criterion (WA-001399-40). Water quality in this site clearly violates the numerical and antidegradation standard for pH and aquatic life standard. The average pH from 2009 to 2016 was 7.89 ± 0.25 (± standard deviation) with approximately 49% of measurements (9,825 out of 20,247) were below 7.8 units. The average aragonite saturation state during the same period was 1.58 ± 1.24 with 60% of estimates were below 1.3. Studies have demonstrated that organisms such as oysters and pteropods in water conditions below these thresholds show signs of negative impacts from ocean acidification.

Ecology Determination

No action. Upon review of this submittal, there is not sufficient information provided with the data to demonstrate that quality assurance practices appropriate for the WQA were used. Per Policy 1-11, data submittals must include "documentation addressing the accuracy and completeness of the information submitted" and "documentation from the original data submitter indicating that the required QA objectives were met". For example,

King County's Marine Monitoring website indicates that all pH data records should be paired with a quality control descriptor, which was missing from this submittal.

Additionally, the data provided were the exact same data as those provided from the Dockton Park monitoring station listed above, which calls into question whether the data provided are actually the data presented in Figure 17. Nonetheless, pH values in data provided ranged from 3.59 to 8.76, which is a highly unrealistic range for pH in a heavily studied marine environment. This calls into question quality assurance concerns that are not adequately addressed by the third party submittal. Additionally, there is no presentation of biological data collected at this location that supports the statements that the presented aragonite saturation levels at this location are impacting oysters or pteropods in Point Williams.

In summary, it was determined that these data are not appropriate for use in the WQA due to: lack of quality assurance documentation, discrepancies between data provided and data represented in figures, lack of established aragonite criteria, and lack of information supporting impacts under Ecology's narrative criteria.

Seattle Aquarium

Submittal

Waters around the Seattle Aquarium should be designated as impaired due to ocean acidification because in ~49% of 275,747 measurements (from 2009 to 2016), pH has fallen below a threshold that is considered harmful for marine organisms such as oysters and pteropods (Fig 18). Washington's listing policy states that waters should be placed on the impaired waters list when a minimum of three excursions exist from all data considered and at least ten percent of values in a given year do not meet the criterion (WA-001399-40). This also clearly violates the aquatic, numerical and antidegradation standards. The average pH from 2009 to 2016 at 1 m of depth was 7.77 ± 0.29 (± standard deviation) with approximately 49% of measurements (135,025 out of 275,747) were below 7.8 units. The average aragonite saturation state during the same period was 1.10 ± 0.53 with 72% of estimates were below 1.3. Studies have demonstrated that organisms such as oysters and pteropods in water conditions below these thresholds show signs of negative impacts from ocean acidification.

Ecology Determination

No action. Upon review of this submittal, there is not sufficient information provided with the data to demonstrate that quality assurance practices appropriate for the WQA were used. Per Policy 1-11, data submittals must include "documentation addressing the accuracy and completeness of the information submitted" and "documentation from the original data submitter indicating that the required QA objectives were met". For example, King County's Marine Monitoring website indicates that all pH data records should be paired with a quality control descriptor, which was missing from this submittal.

Additionally, the data provided were the exact same data as those provided from the Dockton Park monitoring station listed above, which calls into question whether the data provided are actually the data presented in Figure 18. Nonetheless, pH values in data provided ranged from 3.59 to 8.76, which is a highly unrealistic range for pH in a heavily studied marine environment. This calls into question quality assurance concerns that are not adequately addressed by the third party submittal. Additionally, there is no presentation of biological data collected at this location that supports the statements that the presented aragonite saturation levels at this location are impacting oysters or pteropods in Elliott Bay.

In summary, it was determined that these data are not appropriate for use in the WQA due to: lack of quality assurance documentation, discrepancies between data provided and data represented in figures, lack of established aragonite criteria, and lack of information supporting impacts under Ecology's narrative criteria.

Listing Determination for Ocean Acidification

Upon review of information and data submitted to support listing based on ocean acidification, Ecology did not find any basis for listing waterbody segments in Category 5, as noted in the determinations above.

Ecology has determined that Washington's Puget Sound waters should continue to be listed in Category 2 (waters of concern) for potential impacts to fish and shellfish habitat from human activities, including conditions that makes the waters more vulnerable, such as climate change, urbanization, and ocean acidification. Listing ID #36169 is based on narrative criteria (WAC 173-201A-260(2)) intended to protect existing and designated uses and is intended to be representative of the full extent of Puget Sound. Category 2 is the appropriate category because it applies when some credible data create concerns of possible impact to designated uses, but fall short of demonstrating that there is a persistent problem. Category 2 listings are intended to help Ecology and the public be aware of, track, and investigate these water quality concerns.

Microplastics

Microplastics are generally defined as plastic debris less than 5 mm in length. While microplastics are found in many cosmetic supplies and clothing, they can also be sourced from the breakdown of larger plastic materials. Common pathways for microplastics to enter our environment include littering, ineffective solid waste management practices, wastewater treatment plants, wind, and even some fishing activates (EPA, 2016). Field surveys have found microplastics in surface waters all over the world (Thompson et al., 2009). However, their impacts on the environment is still an emerging field of study.

Data and Supporting Studies Considered

As part of our Water Quality Assessment, Ecology reviewed microplastic data and supporting studies submitted by the Center for Biological Diversity on June 30, 2016 during the Call for Data period to evaluate the potential impacts of microplastics on Washington's surface waters. The following section details Ecology's evaluation and response to the data and information submittal.

Sound Experience Microplastic Citizen Science Program

Data collected by the Sound Experience Microplastic Citizen Science Program (SEMCSP) at several locations in Puget Sound in 2012 and 2013 wanted to document microplastic concentrations. Samples were collected during multiple cruises using manta nets equipped with 0.33mm plankton net in the upper 0.2m of the water column. Samples were then rinsed over 5 mm and 0.33mm sieves. Methods and data were summarized in an undergraduate research thesis at the University of Washington, Tacoma (Reetz, 2014). However, the study states that no quality assurance or quality control methods were in places for sample collection or lab processing. Additionally, the data records from SEMCSP did not correspond with the data presented in the study results section. For these reasons, this information would not meet Washington's Credible Data Act requirements (RCW 90.48.585) and was not further considered.

Gilman unpublished thesis

Ecology reviewed results from Gilman (2014), which quantified mean microplastic concentrations on twelve beach sites spanning Budd, Eld, and Totten Inlets in 2013. For each location, one sample event occurred along the high-tide mark following the highest high tide event of the year. The study found the presence of microplastics on the shores of all three inlets, with Budd Inlet containing microplastic concentrations two orders of magnitude larger than Eld and Totten Inlets. However, it is currently unclear how reported concentrations of microplastics along these beaches may "adversely affect characteristic water uses, cause acute or chronic conditions to the most sensitive biota dependent upon those waters, or adversely affect public health", as defined in WAC 173-201A-260(2)(a). While the submitters presented a study of sediment cores from Hawaii beaches found that adding plastic can significantly alter soil permeability and temperature conduction (Carson et al., 2011), it not clear how plastic concentrations on the beaches in Carson and others' study compare to those on Washington's

beaches in Gilman's study. The direct link between these physical changes and potential impacts to organisms in Washington's waters is also uncertain. Additionally, the visible presence of microplastics on beaches does not suggest an impairment to aesthetic uses as defined in WA 173-201A-260(2)(b). Therefore, due to the lack of a coherent connection between environmental alteration and a documented designated use impairment, these data do not meet our criteria for listing under our narrative standards.

Davis and Murphy study (2015)

Ecology reviewed results and supporting data from Davis III and Murphy (2015), which summarized results of anthropogenic debris on 37 beaches in Washington State collected 2008 to 2011 and surface water debris collected from Salish Sea to Skagway, Alaska in 2011. The study found considerably higher concentrations of anthropogenic marine debris on beaches in Washington than those reported in beaches outside of Washington State and the United States. The authors also concluded that plastic on Washington's beaches is largely sourced from surface water. While the presence of microplastics in Puget Sound's urbanized areas and Washington beaches is clear, we currently do not have enough information to determine how current levels of microplastics may "adversely affect characteristic water uses, cause acute or chronic conditions to the most sensitive biota dependent upon those waters, or adversely affect public health", as defined in WAC 173-201A-260(2)(a), or impact Washington's aquatic organisms. Due to the lack of a coherent connection between environmental alteration and a documented designated use impairment, these data do not meet our criteria for listing under our narrative standards.

Adventurers and Scientists for Conservation Global Microplastics Initiative

Data collected by Adventurers and Scientists for Conservation (ASC) Global Microplastics Initiative in multiple fresh waters and marine waters were also considered for the assessment. All grab samples were collected in one liter bottles by citizen scientist volunteers. Data collected in Washington's waters 2014-2015 ranged from 0 to 32 microplastics/L. Based on current research, it's unclear whether the levels reported can impact local aquatic life. Data submitters cited a study by Lonnstead and Eklov (2016) which found impacts to development, growth, and behaviors of European Perch exposed to varying levels of microplastics. However, European Perch are not resident species in Washington's marine waters. Also, the difference in impacts to fish between the control group and the average microplastic concentration group (10 microplastics/L) were not statistically significant for nearly all factors analyzed. Most impacts were noted in the high exposure group (80 microplastics/L). No waterbodies provided in the ASC dataset had levels above the 80 microplastics/L threshold. Therefore, it is not clear whether microplastic concentrations ASC documented in Washington State are causing impacts to aquatic life. These data do not meet Ecology's criteria for listing under our narrative standards.

Determination of listing for Microplastics

Ecology recognizes the presence of microplastics in Washington's surface waters. However, at this time there is not sufficient research directly correlating levels of microplastics in our waters to impacts to aquatic life or public health. Ecology is committed to continue researching microplastics and their potential role in our WQA. Our future research plans include but are not limited to:

- Tracking development of water quality standards for microplastics
- Identifying standardized sampling methods, laboratory methods, and quality control procedures microplastics as they become available
- Locating microplastics data that meets credible data requirements
- Tracking research demonstrating the impacts of microplastic levels of public health and/or organisms relevant to Washington's surface waters

References

Carson, H. S., Colbert, S. L., Kaylor, M. J., & McDermid, K. J. (2011). Small plastic debris changes water movement and heat transfer through beach sediments. *Marine Pollution Bulletin*, *62*(8), 1708–1713. http://doi.org/10.1016/j.marpolbul.2011.05.032 [11]

Davis, W., & Murphy, A. G. (2015). Plastic in surface waters of the Inside Passage and beaches of the Salish Sea in Washington State. *Marine Pollution Bulletin*, *97*(1-2), 169–177. http://doi.org/10.1016/j.marpolbul.2015.06.019 [11]

Environmental Protection Agency. (2016). State of the Science White Paper: A Summary of Literature on the Chemical Toxicity of Plastics Pollution to Aquatic Life and Aquatic Dependent Wildlife. *EPA-82-R-16-009*. [11]

Gilman, N. E. (2013). Examining spatial concentrations of marine micro-plastics on shorelines in south Puget Sound, Washington. *Unpublished Thesis*. [11]

Lonnstedt, O. M., & Eklov, P. (2016). Environmentally relevant concentrations of microplastic particles influence larval fish ecology. *Science*, *352*(6290), 1213 – 1216. http://doi.org/10.1126/science.aad8828 [11]

Reetz, L. R. (2014). Characterizing microplastics of surface waters in the Puget Sound, WA. *Unpublished Undergraduate Research.* [11]

Thompson, R.C., Moore, C.J., vom Saal, F.S. & Swan, S.H. (2009). Plastics, the environment and human health: current consensus and future trends. *Philosophical Transactions of the Royal Society B, 364*(1526.: 2153-2166. http://doig.org/10.1098/rstb.2009.0053 [11]

Other Narrative Submittals

In addition to the ocean acidification and microplastics submittals described above, other studies and information submitted for consideration under the narrative water quality standards were reviewed to determine if they meet narrative listing requirements in Policy 1-11, Chapter 1.

Narrative Submittals Used in the WQA

The following is a list of narrative submittals that were determined to meet credible data statutes and Policy 1-11 listing requirements and were included in the WQA.

It is important to note that if a narrative submittal was considered for use in the WQA and numeric data associated with the narrative submittal has already resulted in a listing based on the numeric data, then the numeric listing will prevail as the primary reason for the listing (in other words, we would not create an additional listing based on narrative criteria). It is also important to note that any numeric water quality data associated with, or related to, a specific study that was already in EIM or the federal Water Quality Portal would have been accessed and analyzed directly, regardless of whether or not the narrative submittal was used.

The following submittals were used in the WQA:

Albertson, Skip, Environmental Assessment Program, Memo to Mike Herold, Water Quality Program. 2011. 303(d) Natural Condition Calls for Temperature in Washington State Waters. Memo dated April 5, 2011. [2, 10]

Ecology Notes

This memo from Ecology Environmental Assessment Program Marine Monitoring Unit staff details regions of Puget Sound were exceedances of the temperature numeric criteria could not be entirely attributed to natural conditions. Methodology for how this information was incorporated in the 2018 WQA is included in the Supplemental Methodology section of this document.

Carey, A.J., L.A. Niewolny, J.A. Lanksbury, and J.E. West. 2014. Toxic Contaminants in Dungeness crab (Metacarcinus magister) and Spot Prawn (Pandalusplatyceros) from Puget Sound, Washington, USA. Washington Department of Fish and Wildlife; WDFW Report Number FPT 14-06. Olympia, Washington. 121pp.[30] [9]

Ecology Notes

This study was included in the 2018 WQA under the EIM Study ID C1200226. Data included toxics in shellfish tissue data from 2011-2012.

Clark Regional Wastewater District, Discovery Clean Water Alliance, and City of Vancouver. Review of Water Quality Documentation Provided by Ecology for 303(d) listings #49044 and

[30] https://wdfw.wa.gov/publications/01608

#49047 for Dissolved Oxygen in the Columbia River. Request for Listing Reassessment Based on Additional Information. Letter dated October 15, 2018. [11]

Ecology Notes

This letter contained detailed analysis describing data applicability and quality assurance concerns with a Columbia River dataset that was used in the previous WQA. Ecology staff reviewed the analysis and met with the data collector to discuss concerns. Ecology decided to remove the dataset from the WQA process based on the analysis and discussions with data submitter.

Clark Regional Wastewater District, Discovery Clean Water Alliance, and City of Vancouver. Request to Update Columbia River Dissolved Oxygen Listings #49044 and #49047. Letter dated November 1, 2019. [11]

Ecology Notes

This letter documents requests to include EIM Study ID's DCWA2018-CRMonit and DCWA2019-CRMonit in the 2018 WQA. These studies contain dissolved oxygen verification monitoring data collected between 2018-2019 to update Listing IDs 49044 and 49047, which were 303(d) listed last cycle based on data that does not meet our quality assurance requirements (See Clark Regional Water District letter above). The data submitters coordinated with Ecology early in the WQA process to design a monitoring program that would comprehensively capture ambient dissolved oxygen conditions at specific sections of the Columbia River. While the data collected is outside the data window for the 2018 WQA (2006-2017), Ecology granted the use of these data, paired with the analysis documented in the Clark Regional Wastewater Direct letter formerly mentioned, to update the erroneous 303(d) lists based on questionable data.

Lanksbury, J.A., A.J. Carey, L.A. Niewolny, and West, J.E. 2013. Mussel Watch Pilot Expansion 2012/2013: a study of toxic contaminants in blue mussels (Mytilus trossulus) from Puget Sound Washington, USA. Washington Department of Fish and Wildlife. 55pp.[31] [9]

Ecology Notes

This study was included in the 2018 WQ Assessment under the EIM Study ID WDFW 11-1916.

Marshalonis, D. and Larson, C. 2018. Flow Pulses and Fine Sediments Degrade Stream Macroinvertebrate Communities in King County, Washington, USA. Ecological Indicators, 93: 365-378.[32] [1]

Ecology Notes

[31] http://wdfw.wa.gov/publications/01597/
[32] https://doi.org/10.1016/j.ecolind.2018.04.060

This study identified flow alterations, fine sediment, and habitat degradation as the main sources causing macroinvertebrate community impairments in the Big Soos Creek watershed. The study was completed by Washington Department of Ecology and Environmental Protection Agency scientists, as part of the TMDL development process.

Tanner, D.Q., Bragg, H.M., and Johnston, M.W., U.S. Geological Survey Open-File Report 2012-1256: Total dissolved gas and water temperature in the lower Columbia River, Oregon and Washington, water year 2012-Quality-assurance data and comparison to water-quality standards (2013).[33] [9]

Ecology Notes

Data from the USGS Columbia River monitoring locations associated with this study were included in the 2018 WQA. 303(d) listings on the Washington side of the Columbia are in Category 4A because total dissolved gas and temperature TMDLs exist for the Columbia River. Read the TMDL for Temperature in the Columbia and Lower Snake Rivers[34]and TMDL for the Lower Columbia River Total Dissolved Gas.[35]

U.S. Geological Survey. NASQAN National Stream Quality Accounting Network – Data Portal.[36] [9]

Ecology Notes

This data was accessed through the federal water quality portal. See StudyID: National Water Quality Assessment Program (NAWQA) in the Water Quality Portal section of this document.

Washington State Department of Ecology. 2004. Sediment Quality Assessment of Puget Sound's Hood Canal Region. Publication No. 10-03-0006.[37] [2, 9]

Ecology Notes

This report is associated with EIM Study ID PSAMP_SP. Data is from 1997-2014 and contains both sediment chemical and bioassay data.

Washington State Department of Ecology. 2011. Control of Toxic Chemicals in Puget Sound: Assessment of Selected Toxic Chemicals in the Puget Sound Basin, 2007-2011. Publication No. 11-03-055. [38] [2,3,9]

Ecology Notes

[33] https://pubs.usgs.gov/of/2012/1256/pdf/ofr20121256.pdf
[34] https://www.epa.gov/sites/production/files/2020-05/documents/r10-tmdl-columbia-snake-temperature-final-05182020-web.pdf
[35] https://apps.ecology.wa.gov/publications/SummaryPages/0203004.html
[36] https://nrtwq.usgs.gov/nwqn/#/
[37] https://apps.ecology.wa.gov/publications/publications/1003006.pdf
[38] https://apps.ecology.wa.gov/publications/publications/1103055.pdf

This report is a synthesis of all 3 phases of the Puget Sound Toxics Loading Assessment (PSTLA) program which existed from 2007-2011. Projects where data were collected/created were only included in Phase 3. Other studies were not included in the assessment because they didn't meet data requirements.

Washington State Department of Ecology. 2011. Control of Toxic Chemicals in Puget Sound: Characterization of Toxic Chemicals in Puget Sound and Major Tributaries. Publication No. 11-03-008.[39] [2,3,9]

Ecology Notes

Data collected under this study were included in the 2018 WQA under the EIM Study ID RCOO0010.

Washington State Department of Ecology. 2018. Crystal Creek Multi-Parameter Total Maximum Daily Load: Water Quality Effectiveness Monitoring Report. Publication No. 18-10-007.[40] [2, 3, 4]

Ecology Notes

This study found chlorine and ammonia levels in Crystal Creek have dropped below water quality standards due to the decommissioning of the Roslyn POTW in 2005, which was the only source of these pollutants identified by the TMDL. Study findings were used as a justification to remove 303(d) listings for ammonia and chlorine on Crystal Creek. Data collected as part of this study were included in the 2018 WQA under EIM Study ID JCRE0001.

Washington State Department of Ecology. 2014. Myron Lake (Yakima County) Verification Monitoring. Publication No. 14-03-032.[41] [2, 3, 4]

Ecology Notes

This study found implementation of a siphon in hypolimnion of the lake has reduced ammonia concentrations in all thermo-layers well-below the chronic criteria during the critical period of late summer and after autumnal turnovers. Study was provided with a de-listing justification memo from Eastern Regional Office TMDL staff to support removing Myron lake off the 303(d) for ammonia.

Washington State Department of Ecology. 2016. Okanogan River Tributaries pH 303(d) Listing Verification Study. Publication No 16-03-036.[42] [2, 3]

Ecology Notes

[39] https://apps.ecology.wa.gov/publications/publications/1103008.pdf
[40] https://apps.ecology.wa.gov/publications/documents/1810007.pdf
[41] https://apps.ecology.wa.gov/publications/SummaryPages/1403032.html
[42] https://apps.ecology.wa.gov/publications/documents/1603036.pdf

This verification monitoring and modeling study found pH in the Okanogan River Basin was often naturally higher than pH criteria, due to high alkalinity levels driven by carbonate geology. Study also found biological activity, natural or human-influenced, has minimal impact on pH and dissolved oxygen levels in the basin. Study findings were used to justify removal of several 303(d) listings for pH and dissolved oxygen in the Okanogan River Basin.

Washington State Department of Ecology. 2019. Puget Sound Nutrient Source Reduction Project. Volume 1: Model Updates and Bounding Scenarios. Publication No. 19-03-001.[43] [2, 3, 4]

Ecology Notes

This document details information background, methods, and results of the most recent runs of Ecology's Salish Sea Model. Methodology for how this information was incorporated in the can be found the Supplemental Methodologies section of this document.

Washington State Department of Ecology. 2010. Sediment Quality Assessment of the Hood Canal Region of Puget Sound: Spatial/Temporal Sediment Monitoring Element of the Puget Sound Assessment and Monitoring Program. Publication No. 10-03-005.[44] [2,3]

Ecology Notes

This study was from the same data set as the study above (Ecology Publication #10-03-006). Data is associated with EIM Study ID PSAMP_SP.

Washington State Department of Ecology. 2011. South Puget Sound Dissolved Oxygen Study: Interim Nutrient Load Summary for 2006-2007. Publication No. 11-03-001.[45] [2,3]

Ecology Notes

There are over 500 listings from numerous water quality studies related to the Salish Sea Dissolved Oxygen Model, the South Puget Sound Dissolved Oxygen Study, and other studies related to The Puget Sound Nutrient Reduction Project. Ambient monitoring data collected as part of this study for ammonia, dissolved oxygen, temperature, and pH were used in the WQA in accordance with Policy 1-11 (StudyID MROB0004). See Puget Sound Reduction Project webpage[46]

Washington State Department of Ecology. 2008. South Puget Sound Dissolved Oxygen Study: Key Findings on Nitrogen Sources from the Data Report. Publication No. 08-10-099.[47] [2,3]

Ecology Notes

[43] https://apps.ecology.wa.gov/publications/documents/1903001.pdf
[44] https://apps.ecology.wa.gov/publications/publications/1003005.pdf
[45] https://apps.ecology.wa.gov/publications/publications/1103001.pdf
[46] https://ecology.wa.gov/Water-Shorelines/Puget-Sound/Helping-Puget-Sound/Reducing-Puget-Sound-nutrients/Puget-Sound-Nutrient-Reduction-Project
[47] https://apps.ecology.wa.gov/publications/publications/0810099.pdf

This is a fact sheet associated with the South Puget Sound Dissolved Oxygen Study listed above (StudyID MROB0004).

Washington State Department of Ecology. 2014. South Puget Sound Dissolved Oxygen Study: Water Quality Model Calibration and Scenarios. Publication No. 14-03-004.[48] [2,3]

Ecology Notes

Ambient monitoring data collected as part of this study for ammonia, dissolved oxygen, temperature, and pH were used in the WQA in accordance with Policy 1-11 (StudyID MROB0004).

Washington State Department of Ecology. 2011. Toxics in Surface Runoff to Puget Sound Phase 3 Data and Load Estimates. Publication No. 11-03-010.[49] [2,3,9]

Ecology Notes

Data collected under this study were included in the 2018 WQA under the EIM Study ID PSTox001.

Washington Department of Fish and Wildlife. English Sole Species Monitored: Toxic Contaminants in Puget Sound Fish and Shellfish.[50] [9, 11]

Ecology Notes

This submittal is a website that provides information on their salmon monitoring program Data from this program (2007-2017 data) was included in the 2018 WQ Assessment under the EIM Study ID WDFW_TBiOS_EngSole.

Washington Department of Fish and Wildlife. Salmon Species Monitored: Toxic Contaminants in Puget Sound Fish and Shellfish.[51] [9, 11]

Ecology Notes

This submittal is a website that provides information on their salmon monitoring program. For the 2018 WQ Assessment, Resident Blackmouth Chinook Salmon data collected 2016-2017 by WDFW was used. See EIM Study ID: WDFW_TBIOS_Chinook.

Washington State Department of Health. 2021. Fish Consumption Advisories in Washington State. Accessed online as of 2/28/2021.[52] [11]

Ecology Notes

In accordance with our Policy 1-11 methodology for assessing the human health criteria harvesting use, Ecology reviewed Washington State Department of Health fish consumption advisories for any information documenting impairments of the fish/shellfish harvesting

[48] https://apps.ecology.wa.gov/publications/publications/1403004.pdf
[49] https://apps.ecology.wa.gov/publications/publications/1103010.pdf
[50] https://wdfw.wa.gov/species-habitats/science/marine-toxics/species-monitored
[51] https://wdfw.wa.gov/species-habitats/science/marine-toxics/species-monitored
[52] https://www.doh.wa.gov/CommunityandEnvironment/Food/Fish/Advisories

uses. Review the advisories and the accompanying data resulted in placing four sections of the Spokane River and one section of Lake Spokane on the 303(d) for Polybrominated Diphenyl Ethers (PBDEs). Methodology for how this information was incorporated in the 2018 WQA is included in the section Supplemental Methodology section of this document.

Narrative Submittals Not Used in the WQA

Ecology's review of narrative submittals identified numerous submittals that were determined to not meet the listing requirements for WQA purposes because, for one or more reasons, the submittal did not meet credible data requirements described in statutes (RCW 90.48.570-590) and WQP Policy 1-11, Chapter 1: *Washington's Water Quality Assessment Listing Methodology to Meet Clean Water Act Requirements* and Chapter 2: *Ensuring Credible Data for Water Quality Management*.

It is important to note that submittals that were not used to make a listing based on narrative criteria may have numeric data associated with the submittal. If numeric water quality data associated with, or related to, the study was already in EIM or the federal Water Quality Portal, it would have been accessed directly, regardless of whether or not the narrative submittal was used.

The following tables provide a list of submittals, including ocean acidification and microplastics submittals, that were determined to not meet the listing requirements for use for the WQA, along with the reason for not being used:

Table 7: Studies where location was not within, near or representative of Washington waters and/or study includes organisms not found in Washington waters (examples: study located in another state or country, study uses species not found in Washington, study is on a global scale).

Table 8: Studies where the study intent does not demonstrate designated use impairment to ambient water conditions (examples: aquatic population comparison studies, wildlife health studies, lab studies).

Table 9: Modeled results not appropriate for determining whether water quality standards in Washington are being met in specific waters (Note: any numeric data on specific waterbody segments associated with the model would be used if accessible in EIM or federal WQ portal).

Table 10: Submittals from third parties that did not include documentation addressing the accuracy and completeness of the information submitted to Ecology, and/or study methods and data were not documented or readily available (examples: news articles, fact sheets, websites).

Table 11: Study submittals that fell outside the WQA cycle window of 2006 – 2017.

Table 12: Data associated with a submittal was considered for listing, but did not show exceedances of the standards, or did not meet data or quality assurance requirements in

accordance with credible data statutes and policies (examples: quality assurance of data not provided, study does not validate exceedance of numeric or violation of narrative standards).

Table 13: Study submittals that are not a water quality study, and are not related to determining ambient water conditions (examples: vessel traffic study, fish growth comparisons, species descriptions, efficacy of research methods, endangered species declarations).

Table 7. Studies where location was not within, near or representative of Washington waters and/or study includes organisms not found in Washington waters

Narrative Data Submittal	Reasons(s) for not using Submittal
NMFS, Lower Columbia River Conservation and Recovery Plan for Oregon Populations of Salmon and Steelhead (2010) https://www.fisheries.noaa.gov/resource/document/recovery-plan-lower-columbia-river-coho-salmon-lower-columbia-river-chinook	Focus of website, in Oregon, is unrelated to determining water quality or ambient conditions of specific waterbodies in Washington.
Incardona, J. et al. 2015. Very low embryonic crude oil exposures cause lasting cardiac defects in salmon and herring. Scientific Reports. 5:13499. DOI: 10.1038/srep13499. https://ui.adsabs.harvard.edu/abs/2015NatSR...513499I/abstract	This study was not specific to Washington waters. It reviews data and information from the Exxon Valdez oil spill and long term effects on salmon and herring.
Graham and Brun, Determining Lamprey Species Composition, Larval Distribution, and Adult Abundance in the Deschutes River, Oregon, Subbasin (2007);NMFS, Columbia River Estuary Recovery Plan Module for Salmon and Steelhead (2011) https://www.osti.gov/biblio/897845	Focus of study, in Oregon, is unrelated to determining water quality or ambient conditions of specific waterbodies in Washington.
NMFS, Conservation and Recovery Plan for Oregon Steelhead Populations in the Middle Columbia River Steelhead Distinct Population Segment (2009) https://www.fisheries.noaa.gov/resource/document/recovery-plan-middle-columbia-river-steelhead-distinct-population-segment	Focus of the plan, in Oregon, is unrelated to determining water quality or ambient conditions of specific waterbodies in Washington.

Narrative Data Submittal	Reasons(s) for not using Submittal
COSEWIC. 2008. COSEWIC assessment and update status report on the Killer Whale Orcinus orca, Southern Resident population, Northern Resident population, West Coast Transient population, Offshore population and Northwest Atlantic / Eastern Arctic population, in Canada. https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-assessments-status-reports/killer-whale-2008.html	This report from Canada is not specific to Washington waters.
Garrett, C., and Ross, P.S. 2010. Recovering resident killer whales: A guide to contaminant sources, mitigation, and regulations in British Columbia. Can. Tech. Rep. Fish. Aquat. Sci. 2894: xiii + 224 p. https://www.arlis.org/docs/vol1/D/690987332.pdf	This report from Canada is not specific to Washington waters. Intent of the study was not to demonstrate ambient water conditions at specific locations in Washington. This study looks at the source, transport and fate features of contaminants in the British Columbia marine environment.
Alonso, M. et al. 2014. Anthropogenic (PBDE) and naturally-produced (MeO-PBDE) brominated compounds in cetaceans — A review. Science of The Total Environment. Volume 481, 15 May 2014, Pages 619-634. https://www.sciencedirect.com/science/article/abs/pii/S0048969714001843	This is a global comparison study that focuses on brominated compounds in cetaceans. Focus of study was unrelated to determining water quality or ambient conditions of specific waterbodies in Washington.
U.S.G.S., Woods Hole Coastal and Marine Science Center, Didemnum vexillum, Triangle, Umpqua River mouth, Oregon, Images https://www.usgs.gov/centers/whcmsc	The reference to the Oregon coast is outside of Washington waters. Focus of website is unrelated to determining water quality or ambient conditions of specific waterbodies.
Brette, F. et al. 2016. A Novel Cardiotoxic Mechanism for a Pervasive Global Pollutant. Scientific Reports. 7:41476. DOI: 10.1038/srep41476. https://www.nature.com/articles/srep41476	This global study based on the Deepwater Horizon disaster in the Gulf of Mexico is not specific to Washington waters. Focus of study was unrelated to determining water quality or ambient conditions of specific waterbodies.
Kidd, K. et al. 2007. Collapse of a fish population after exposure to a synthetic estrogen. PNAS. May 22, 2007. vol. 104 No. 21, 8897–8901. https://www.pnas.org/content/104/21/8897	This study was located off of northwestern Ontario, Canada in the Experimental Lakes Area, and is not specific to Washington waters.

Narrative Data Submittal	Reasons(s) for not using Submittal
U.S.G.S., Woods Hole Coastal and Marine Science Center, Didemnum vexillum - Oregon Coast Occurrences and Images https://www.usgs.gov/centers/whcmsc	The reference to the Oregon coast is outside of Washington waters. Focus of website is unrelated to determining water quality or ambient conditions of specific waterbodies.
National Ocean and Atmosphere Administration's Pacific Marine Laboratory (NOAA/PMEL) West Coast Ocean Acidification monitoring pH data values from research surveys, submitted via 6/30/2016 correspondence to Ecology. Submittal includes pH data collected on NOAA/PMEL-led West Coast Ocean Acidification cruises in 2007, 2011, 2012 and 2013.	None of the 129 monitoring locations were located within Washington State waters. All monitoring locations were several miles off the Pacific Coast, spanning from British Columbia, Canada to the southern Baja California Peninsula, Mexico.
National Ocean and Atmosphere Administration's Pacific Marine Laboratory (NOAA/PMEL) West Coast Ocean Acidification (WCOA) cruise, information on biological impacts on pteropods on the WOAC cruises, 2011 and 2013, submitted via 6/30/2016 correspondence to Ecology.	None of the pteropod monitoring locations from this submittal were located within Washington State waters. All monitoring locations were several miles off the Pacific Coast.
Center for Biological Diversity, data and information submittal to list Tatoosh Island (48.3933ºN, 124.7384ºW) as impaired for ocean acidification, submitted via 6/24/2016 correspondence to Ecology.	The monitoring site where the Wootton study was conducted is located within the boundaries of the Makah Indian reservation. The monitoring site is not subject to Washington State's authority because it is located within a tribal boundary.
Center for Biological Diversity, data and information submittal to list Cape Elizabeth OA mooring (47.35ºN, 124.73ºW) as impaired for ocean acidification, submitted via 6/24/2016 correspondence to Ecology.	The Cape Elizabeth station is a NOAA National Data Buoy Center Buoy off the Washington coast. This mooring location is located 45 nautical miles northwest of Aberdeen, Washington and is well outside of Washington coastal waters.
Center for Biological Diversity, data and information submittal to list La Push OA mooring (47.97ºN, -124.95ºW) as impaired for ocean acidification, submitted via 6/24/2016 correspondence to Ecology.	The La Push station is a permanent ocean observing array off the outer coast of Washington near La Push. The La Push OA mooring location is well outside of Washington coastal waters.

Table 8. Studies where the study intent does not demonstrate designated use impairment to ambient water conditions at specific locations in Washington; study does not document that impairment of the existing or designated use is related to the environmental alteration on that same waterbody segment or grid.

Narrative Data Submittal	Reasons(s) for not using Submittal
Columbia Basin Bulletin, Study Details Toxic Accumulation in Puget Sound Seabirds Eating Fish, Including Columbia Chinook (Oct. 31, 2014) citing study by Northwest Fisheries Science Center https://www.cbbulletin.com/study-details-toxic-accumulation-in-puget-sound-seabirds-eating-fish-including-columbia-chinook/	The article is on comparison of seabirds that consume fish on the outer Washington coast compared with seabirds nesting in Puget Sound.
Ecology, A Toxics-Focused Biological Observing System for Puget Sound; Developed by the Washington Department of Fish and Wildlife and NOAA Fisheries for the Puget Sound Partnership (Jan. 2010) https://apps.ecology.wa.gov/publications/publications/1010004.pdf	This study looks at biologically-based monitoring as an important component of efforts to protect estuaries from toxic chemicals.
Ecology, Control of Toxic Chemicals in Puget Sound Phase 2: Sediment Flux/Puget Sound Sediments Bioaccumulation Model – Derived Concentrations for Toxics Final Summary Technical Report (May 2009) https://apps.ecology.wa.gov/publications/publications/0909069.pdf	The goal of the project was to inform a source control strategy to reduce the loading of toxics into Puget Sound.
Ecology, Phase 1: Initial Estimate of Toxic Chemical Loadings to Puget Sound (Oct. 2007) https://apps.ecology.wa.gov/publications/publications/0710079.pdf	This effort was initiated by a team of toxic contamination experts from various governmental entities around Puget Sound to assess toxic contaminant loading to Puget Sound so that agencies can select how and where to target toxics reduction efforts to provide the most benefit for Puget Sound.

Narrative Data Submittal	Reasons(s) for not using Submittal
Ecology, Persistent Organic Pollutants in Marine Plankton from Puget Sound (March 2011) https://apps.ecology.wa.gov/publications/publications/1110002.pdf	This project was designed to evaluate the extent and magnitude of Persistent Organic Pollutant (POP) exposure in organisms that occupy the lowest trophic levels in the pelagic ecosystem of Puget Sound, and to gain a better understanding of the pathways of contaminants within this food web.
O'Neill, S., et. al. 2015. Toxic contaminants in juvenile Chinook salmon (Oncorhynchus tshawytscha) migrating through estuary, nearshore and offshore habitats of Puget Sound. Washington Department of Fish and Wildlife, Report FPT 16-02. https://wdfw.wa.gov/publications/01796	The study addresses the general hypothesis that chemicals released into Puget Sound from human activities and development reduces the health and productivity of salmon and their food supply. Data associated with this study was considered for use in the WQA.
Ecology, Control of Toxic Chemicals in Puget Sound Evaluation of Loading of Toxic Chemicals to Puget Sound by Direct Groundwater Discharge (April 2011) https://apps.ecology.wa.gov/publications/publications/1103023.pdf	This project relates to work done from 2010-2011, when the Washington State Department of Ecology developed quantitative estimates of the annual toxic chemical load delivered to Puget Sound by direct groundwater discharge.
Puget Sound Ecosystem Monitoring Program Toxics Work Group. 2017. 2016 Salish Sea Toxics Monitoring Review: A Selection of Research. C.A. James, J. Lanksbury, D. Lester, S. O'Neill, T. Roberts, C. Sullivan, J. West, eds. Puget Sound Ecosystem Monitoring Program. Tacoma, WA. https://pspwa.app.box.com/s/0luxyi979sz3d9cx90ovlr4ot6axqwk8/file/391719053529	This work group review provided a summary of toxics research in the Salish Sea.

Narrative Data Submittal	Reasons(s) for not using Submittal
USFWS, Impacts of Stormwater Runoff on Coho Salmon in Restored Urban Streams (2007) https://your.kingcounty.gov/dnrp/library/water-and-land/science/seminars/October-2007/Pre-Spawn-Mortality-of-Coho-Salmon-in-Restored-Urban-Streams.pdf	This study focused on impacts to coho salmon in restored urban streams.
USFWS, Information Sheet, Summary of Kootenai River White Sturgeon Studies Upper Columbia Fish and Wildlife Office (2007/2008) https://www.fws.gov/idaho/promo.cfm?id=177175835	The studies focus specifically on white sturgeon, and evaluate potential effects to the fish from chlorine and copper in the Kootenai and Columbia Rivers, as well as three herbicides proposed for control of Eurasian watermilfoil in the Kootenai River.
NMFS, Landscape Ecotoxicology of Coho Salmon Spawner Mortality in Urban Streams (Aug. 17, 2011) https://www.fws.gov/wafwo/documents/PR_LandscapeEcotoxofCohoSalmonSpawner.pdf	This study found that spawner mortality was most closely and positively correlated with the relative proportion of local roads, impervious surfaces, and commercial property within a basin.
Ecology, Relationships Between Sediment Quality, Dissolved Oxygen, and Benthic Invertebrates in Hood Canal (Dec. 2007) https://apps.ecology.wa.gov/publications/documents/0703048.pdf	Any D.O. and sediment data in EIM was considered and used for the WQA. As part of the Hood Canal Dissolved Oxygen Program, scientists analyzed data from Hood Canal studies conducted from 1932 to 2005. These data were examined to evaluate their relationship to each other and to respond to the question “How do low dissolved oxygen levels affect the benthic infauna in Hood Canal?”

Narrative Data Submittal	Reasons(s) for not using Submittal
Ecology, Relationships between the Composition of the Benthos and Sediment and Water Quality Parameters in Hood Canal Task IV – Hood Canal Dissolved Oxygen Program (Dec. 2007) https://apps.ecology.wa.gov/publications/documents/0703040.pdf	Any D.O. and sediment data in EIM was considered and used for the WQA.
Ecology, Chemical Contamination and Toxicity in Sediments from Hood Canal, WA (1952 – 2005) https://apps.ecology.wa.gov/publications/documents/1003006.pdf	Any D.O. and sediment data in EIM was considered and used for the WQA. This document is a summary for scientists of the findings of the study "Relationships between the Composition of the Benthos and Sediment and Water Quality Parameters in Hood Canal". Analysis of Hood Canal data collected from 1932 to 2005 revealed that sediment texture was the most important factor controlling invertebrate community composition, followed by dissolved oxygen, organic carbon content of the sediments, and station depth.
Ecology, Relationships between Dissolved Oxygen Levels and Benthos in Hood Canal https://apps.ecology.wa.gov/publications/documents/0703040.pdf	Any D.O. and sediment data in EIM was considered and used for the WQA. This document is a summary for the general public of the findings of the study "Relationships between the Composition of the Benthos and Sediment and Water Quality Parameters in Hood Canal". Steps were taken in this report to develop initial critical dissolved oxygen thresholds used to determine when benthic infauna are at risk.

Narrative Data Submittal	Reasons(s) for not using Submittal
NMFS, Recurrent Die-Offs of Adult Coho Salmon Returning to Spawn in Puget Sound Lowland Urban Streams (Dec. 14, 2011) https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0028013	Several Seattle-area streams in Puget Sound were the focus of habitat restoration projects in the 1990s. Post-project effectiveness monitoring surveys revealed anomalous behaviors among adult coho salmon returning to spawn in restored reaches.
O'Neill, S.M., A.J. Carey, J.A. Lanksbury, L.A. Niewolny, G.M. Ylitalo, L.L. Johnson, J.E. West. 2015. Toxic contaminants in juvenile Chinook salmon (Oncorhynchus tshawytscha) migrating through estuary, nearshore and offshore habitats of Puget Sound. Washington Department of Fish and Wildlife; WDFW Report Number FPT 16-02. Olympia, Washington. 132pp. https://wdfw.wa.gov/publications/01796	This study was designed to provide a synoptic WQA of contaminant exposure for major populations of juvenile Chinook salmon from Puget Sound as the fish migrate from their freshwater to marine habitats.
West, J.E., J.A. Lanksbury, and S.M. O'Neill. 2011. Control of Toxic Chemicals in Puget Sound Phase 3: Persistent Organic Pollutants in Marine Plankton from Puget Sound. Washington Department of Fish and Wildlife. Olympia, Washington. 70pp https://wdfw.wa.gov/publications/01363	This project was designed to evaluate the extent and magnitude of Persistent Organic Pollutant (POP) exposure in organisms that occupy the lowest trophic levels in the pelagic ecosystem of Puget Sound, and to gain a better understanding of the pathways of contaminants within this food web.
O'Neill, S.M. and J.E. West. 2007. Persistent Bioaccumulative Toxics in the Food Web. Pages 140-148; 151-156 in Puget Sound Action Team, editors. 2007 Puget Sound Update: Ninth Report of the Puget Sound Assessment and Monitoring Program. Washington Department of Fish and Wildlife; Publication Number PSAT 07-02. Olympia, Washington. 276pp. https://wdfw.wa.gov/publications/01038	This is a summary technical report of the conditions of Puget Sounds as measured by ongoing monitoring and research activities of the Puget Sound Assessment and Monitoring Program (PSAMP).

Narrative Data Submittal	Reasons(s) for not using Submittal
West, J.E., and S.M. O'Neill. 2007. Thirty years of persistent bioaccumulative toxics in Puget Sound: time trends of PCBs and PBDE flame retardants in three fish species. 2007 Research in the Georgia Basin and Puget Sound Conference. Puget Sound Action Team. Vancouver, B.C. Washington Department of Fish and Wildlife, Olympia, Washington https://wdfw.wa.gov/publications/01038	This report was put together In order to better understand the fate and transport of PCBs in the Puget Sound ecosystem, and to assess the recent trends this project observed PSAMP monitoring within a larger historical context. Combined and analyzed PSAMP monitoring data with a number of previously published studies and unpublished data dating back to 1975.
O'Neill, S.M., G.M. Ylitalo, J.E. West., J. Bolton, C.A. Sloan, and M.M. Krahn. 2006. Regional patterns of persistent organic pollutants in five Pacific salmon species (Oncorhynchus spp.) and their contributions to contaminant levels in northern and southern resident killer whales (Orcinus orca). Presentation at 2006 Southern Resident Killer Whale Symposium. Seattle, Washington. Washington Department of Fish and Wildlife, Olympia, Washington. https://wdfw.wa.gov/publications/01034	The main objective of this study was to determine if Pacific salmon had species specific regional body burdens of contaminants that could differentially affect contaminant levels is northern and southern residents.
Meador, J. 2013. Perspective: Do chemically contaminated river estuaries in Puget Sound (Washington, USA) affect the survival rate of hatchery-reared Chinook salmon? Can. J. Fish. Aquat. Sci. 71: 162–180 (2014) dx.doi.org/10.1139/cjfas-2013-0130. https://cdnsciencepub.com/doi/10.1139/cjfas-2013-0130	This was a comparative study of hatchery-reared, ocean-type juvenile Chinook salmon with coho salmon from the same hatcheries.

Narrative Data Submittal	Reasons(s) for not using Submittal
Meador, J., A. Yeh, G. Young, and E. Gallagher. 2016. Contaminants of emerging concern in a large temperate estuary. Environ Pollut. 2016 June; 213: 254–267. doi:10.1016/j.envpol.2016.01.088. https://www.sciencedirect.com/science/article/abs/pii/S0269749116300884	This study focused on studying contaminants of emerging concern (CECs) in effluent from two wastewater treatment plants and whole-body juvenile Chinook salmon (Oncorhynchus tshawytscha) and Pacific staghorn sculpin (Leptocottus armatus) in estuaries receiving effluent, to gain information on detection of CECs.
Meador, J, A. Yeh, and E. Gallagher. 2018. Adverse metabolic effects in fish exposed to contaminants of emerging concern in the field and laboratory. Environmental Pollution, Volume 236, May 2018, Pages 850-861. https://pubmed.ncbi.nlm.nih.gov/29471284/	This study focused on studying contaminants of emerging concern (CECs) in effluent from two wastewater treatment plants and whole-body juvenile Chinook salmon (Oncorhynchus tshawytscha) and Pacific staghorn sculpin (Leptocottus armatus) in estuaries receiving effluent, to gain information on detection of CECs.
Gockel, C. and T. Mongillo. 2013. Potential Effects of PBDEs on Puget Sound and Southern Resident Killer Whales: A Report on the Technical Workgroups and Policy Forum. https://www.eopugetsound.org/sites/default/files/features/resources/PBDEs_Puget_Sound_Report.pdf	In coordination with NMFS, EPA Region 10's Office of Water and Watersheds hosted a series of technical workgroups during spring 2013 to study potential effects of PBDEs on Puget Sound and Southern Resident Killer Whales.
NOAA Fisheries. 2014. Southern Resident Killer Whales: 10 Years of Research and Conservation. https://www.noaa.gov/media-release/noaa-fisheries-10-year-study-highlights-threats-to-southern-resident-killer-whales	NOAA Fisheries used new findings to increase protections for killer whales. These include developing new rules for boat operations in the vicinity of the whales, evaluating how fishing and habitat loss affects whales through changes in prey abundance, and developing proactive plans to protect whales in the event of a major oil spill.

Narrative Data Submittal	Reasons(s) for not using Submittal
NMFS, PBDEs and Killer Whales in Puget Sound (July 23, 2013) https://www.eopugetsound.org/articles/report-potential-effects-pbdes-puget-sound-and-southern-resident-killer-whales	The report is on the pathways and effects of PBDEs on Killer Whales in Puget Sound.
EPA, Potential Effects of PBDEs on Puget Sound and Southern Resident Killer Whales: A Report on the Technical Workgroups and Policy Forum (July 24, 2013) https://www.eopugetsound.org/articles/report-potential-effects-pbdes-puget-sound-and-southern-resident-killer-whales	In coordination with NMFS, EPA Region 10's Office of Water and Watersheds hosted a series of technical workgroups during spring 2013 to study potential effects of PBDEs on Puget Sound and Southern Resident Killer Whales.
NMFS, Puget Sound Ecosystem Monitoring Program (PSEMP) Puget Sound Marine Waters: 2013 Overview (2013) https://repository.library.noaa.gov/view/noaa/28038	The objective of this report is to collate and distribute the valuable physical, chemical, and biological information obtained from various marine monitoring and observing programs in Puget Sound.
NMFS, Puget Sound Ecosystem Monitoring Program (PSEMP) Puget Sound Marine Waters: 2011 Overview (2011) https://www.psp.wa.gov/downloads/psemp/PSmarinewaters_2011_overview.pdf	The report reveals patterns and trends in numerous environmental parameters, including plankton, water quality, climate, and marine life.
Puget Sound Ecosystem Monitoring Program, Monitoring Priorities and Gaps: Puget Sound Ecosystem Monitoring Program Toxics Workgroup (Jan. 15, 2014) https://pspwa.app.box.com/s/0luxyi979sz3d9cx90ovlr4ot6axqwk8/file/425859476728	In this project, PSEMP aimed to use a risk-based approach to identify those CECs which might be most likely to harm fish and other aquatic species.

Narrative Data Submittal	Reasons(s) for not using Submittal
Rayne, S. et al. 2004. PBDEs, PBBs, and PCNs in Three Communities of Free-Ranging Killer Whales (Orcinus orca) from the Northeastern Pacific Ocean. Environ. Sci. Technol. 2004, 38, 4293-4299. https://www.zoology.ubc.ca/~barrett/documents/PBDEsPBBsandPCNsEnviron.Sci.Technol2004_000.pdf	Polybrominated diphenyl ethers (PBDEs), polybrominated biphenyls (PBBs), and polychlorinated naphthalenes (PCNs) were quantified in blubber biopsy samples collected from free-ranging male and female killer whales (Orcinus orca) belonging to three distinct communities (southern residents, northern residents, and transients) from the northeastern Pacific Ocean.
Ecology and King County, 2011. Control of Toxic Chemicals in Puget Sound: Assessment of Selected Toxic Chemicals in the Puget Sound Basin, 2007-2011. Washington State Department of Ecology, Olympia, WA and King County Department of Natural Resources, Seattle, WA. Ecology Publication No. 11-03-055. https://apps.ecology.wa.gov/publications/documents/1103055.pdf	The study included an assessment of major delivery pathways such as surface water runoff, groundwater, publicly owned treatment works (POTWs), and direct air deposition. An assessment of the relative hazards posed by target chemicals was also performed. Any water quality data associated with the study that is in EIM or the federal Water Quality Portal would be used in the assessment of data.
Johnson, L. et al. 2008.The Effects of Polycyclic Aromatic Hydrocarbons in Fish from Puget Sound, Washington. The Toxicology of Fishes, Chapter 22, 878 – 912. https://www.researchgate.net/publication/279723988_The_Effects_of_Polycyclic_Aromatic_Hydrocarbons_in_Fish_from_Puget_Sound_Washington	This article reviewed field and laboratory data on flatfish in Puget Sound that indicate that exposure to PAHs is associated with increases in disease and alterations in growth and reproductive function that could potentially reduce the productivity of fish subpopulations residing at contaminated sites. Any water quality data associated with the study that is in EIM or the federal Water Quality Portal would be used in the assessment of data.

Narrative Data Submittal	Reasons(s) for not using Submittal
Scholtz NL, Myers MS, McCarthy SG, Labenia JS, McIntyre JK, et al. (2011) Recurrent Die-Offs of Adult Coho Salmon Returning to Spawn in Puget Sound Lowland Urban Streams. PLoS ONE 6(12): e28013. doi:10.1371/journal.pone.0028013 https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0028013	This study focused on restoration projects in urban watersheds to improve salmon abundance and survival, and their successes or challenges. It does not in fact demonstrate impaired watersheds but looks at improvements based on restoration, and challenges that are present.
McIntyre, J. et al. 2012. Low-level copper exposures increase visibility and vulnerability of juvenile coho salmon to cutthroat trout predators. Ecological Applications, 22(5), 2012, pp. 1460–1471. https://pubmed.ncbi.nlm.nih.gov/22908706/	This is a laboratory study that involved capturing wild salmon and exposing them to elevated copper, then observing effects.
Sloan, C. et al. 2009. Polybrominated Diphenyl Ethers in Outmigrant Juvenile Chinook Salmon from the Lower Columbia River and Estuary and Puget Sound, Washington. Arch Environ Contam Toxicol (2010) 58:403–414. DOI 10.1007/s00244-009-9391-y. https://link.springer.com/article/10.1007/s00244-009-9391-y	This article presents the concentrations of PBDEs measured in gutted bodies and stomach contents of outmigrant juvenile Chinook salmon.
Cullon, D. et al. 2009. PERSISTENT ORGANIC POLLUTANTS IN CHINOOK SALMON (ONCORHYNCHUS TSHAWYTSCHA): IMPLICATIONS FOR RESIDENT KILLER WHALES OF BRITISH COLUMBIA AND ADJACENT WATERS. Environmental Toxicology and Chemistry, Vol. 28, No. 1, pp. 148–161, 2009. https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/docs/exhibits/sfwc/spprt_docs/sfwc_exh3_cullon.pdf	This is a study focused on the relationship of chinook salmon POP levels to those in killer whales who prey on them.

Narrative Data Submittal	Reasons(s) for not using Submittal
Krahn, et al. 2007. Persistent organic pollutants and stable isotopes in biopsy samples (2004/2006) from Southern Resident killer whales. Marine Pollution Bulletin 54 (2007) 1903–1911. https://pubmed.ncbi.nlm.nih.gov/17931664/	Intent of the study was not to demonstrate ambient water conditions at specific locations in Washington in Washington; study does not document that impairment of the existing or designated use is related to the environmental alteration on that same waterbody segment or grid. This study, using blubber/epidermis biopsy samples, contributes contemporary information about potential factors (i.e., levels of pollutants or changes in diet) that could adversely affect Southern Residents.
Cullon, D.L., M.B. Yunker, C. Alleyne, N.J. Dangerfield, S. O'Neill, M.J. Whiticar, and P.S. Ross. 2009. Persistent organic pollutants (POPs) in Chinook salmon (Oncorhynchus tshawytscha): Implications for resident killer whales of British Columbia and adjacent waters. Environ. Toxicol. Chem. 28:148-161. https://setac.onlinelibrary.wiley.com/doi/full/10.1897/08-125.1	The study measured persistent organic pollutant (POP) concentrations in chinook salmon (*Oncorhynchus tshawytscha*) in order to characterize dietary exposure in the highly contaminated, salmon-eating northeastern Pacific resident killer whales.
Johnson, L.L., D.P. Lomax, M.S. Myers, O.P. Olson, S.Y. Sol, S.M. O'Neill, J.E. West, and T. K. Collier. 2008. Xenoestrogen exposure and effects in English sole (Parophrys vetulus) from Puget Sound, WA. Aquatic Toxicology 88(1):29-38. https://wdfw.wa.gov/publications/01042	In 1997-2001, as part of the Washington State's Puget Sound Assessment and Monitoring Program, this study surveyed English sole from a number of sites for evidence of xenoestrogen exposure, using vitellogenin production in males as an indicator.
USFWS, Migratory Birds and Contaminants along the Lower Columbia River Estuary https://www.fws.gov/oregonfwo/Contaminants/FieldStudies/BaldEagle/LCR-BaldEagleFactSheet.pdf	This is a fact sheet on bald eagles in the lower Columbia River and indications that they have rebounded since the 1970s.

Narrative Data Submittal	Reasons(s) for not using Submittal
USFWS, FY13 - Environmental Contaminants Program Off-Refuge Investigations Sub-Activity WA - Investigation of Contaminants in Feeds and Fish at FWS Pacific Region National Fish Hatcheries and the Ramifications to Human and Ecological Health (Aug. 2012) https://www.fws.gov/wafwo/pdf/fish feed final report.pdf	For this project, returning adult salmon and steelhead were sampled at three National Fish Hatcheries for contaminants. The levels of the contaminants varied by fish species and could be a result of migration route, diet, taxa-specific physiology and age at return. Feeds were collected throughout the rearing period for each species sampled and analyzed for the same contaminants as those in the fish.
NMFS, Chemical Contaminants, Pathogen Exposure and General Health Status of Live and Beach-Cast Washington Sea Otters (Enhydra lutris kenyoni) (Feb. 2009) https://www.fws.gov/wafwo/pdf/ONMS_Final Sea Otter Report.pdf	Analyses of blood and liver samples from live captured sea otters and liver samples from beach-cast sea otter carcasses off the remote Washington coast indicate relatively low exposure to contaminants, but suggest that even at the low levels measured, exposure may be indicated by biomarker response.
USGS, Assessment of Contaminant Exposure and Effects on Ospreys Nesting along the Lower Duwamish River, Washington, 2006–07 (2009) https://www.fws.gov/wafwo/pdf/Final Report 2009_1255.pdf	This study assessed contaminant exposure effect on ospreys nesting.
USGS, Assessing reproductive and endocrine parameters in male largescale suckers (Catostomus macrocheilus) along a contaminant gradient in the lower Columbia River, USA (2014) https://www.sciencedirect.com/science/article/abs/pii/S0048969713011352	This study evaluated the effects of contaminants on osprey (Pandion haliaetus) nesting along the lower Duwamish River (LDR), Washington, and used the upper reach of the Willamette River (WR), Oregon, as a reference site. Further investigations are necessary to determine the key factors driving the observed cellular differences and to assess the biological significance of these determinations.

Narrative Data Submittal	Reasons(s) for not using Submittal
USGS, Contaminants of legacy and emerging concern in largescale suckers (*Catostomus macrocheilus*) and the foodweb in the lower Columbia River, Oregon and Washington, USA (2014) https://www.sciencedirect.com/science/article/abs/pii/S0048969713004336	This study investigated occurrence, transport pathways, and effects of polybrominated diphenyl ether (PBDE) flame retardants and other endocrine disrupting chemicals (EDCs) in aquatic media and the food web in the lower Columbia River.
USGS, Health status of Largescale Sucker (*Catostomus macrocheilus*) collected along an organic contaminant gradient in the lower Columbia River, Oregon and Washington, USA (2014) https://www.sciencedirect.com/science/article/abs/pii/S0048969713008966	For this study the health of Largescale Sucker (Catostomus macrocheilus) in the lower Columbia River (USA) was evaluated using morphometric and histopathological approaches, and its association with organic contaminants accumulated in liver was evaluated in males.
C Benson, A. J. New Zealand mudsnail sightings distribution (2014) https://www.fws.gov/columbiariver/publications/2014 NZMS progress report.pdf	The Columbia River Fisheries Program Office has been intermittently monitoring the New Zealand mudsnail at six lower Columbia River Basin National Fish Hatcheries since 2006.
NMFS, 10 Years of Research & Conservation: Southern Resident Killer Whales (June 2014) https://www.noaa.gov/media-release/noaa-fisheries-10-year-study-highlights-threats-to-southern-resident-killer-whales	This paper is a culmination of research into recovery of the killer whale populations and steps that need to be taken.
NMFS, Recovery Plan for Southern Resident Killer Whales (Orcinus orca) (Jan. 17, 2008) https://www.fisheries.noaa.gov/resource/document/recovery-plan-southern-resident-killer-whales-orcinus-orca	This paper is a recovery plan for the killer whale populations and steps that need to be taken.

Narrative Data Submittal	Reasons(s) for not using Submittal
EPA, Recommendations on a Monitoring Scheme for Polybrominated Diphenyl Ethers (PBDEs) in Puget Sound https://www.eopugetsound.org/sites/default/files/PBDE Recommendations.pdf	EPA provides forward thinking recommendations for monitoring PBDEs in Puget Sound.
Lanksbury, J.A., and B. Lubliner. 2015. Quality Assurance Project Plan for Status and Trends Monitoring of Marine Nearshore Mussels for the Regional Stormwater Monitoring Program and Pierce County. Washington Department of Fish and Wildlife; WDFW Publication Number FPT 15-04. Olympia, Washington. 76pp. https://wdfw.wa.gov/publications/01760	The QAPP submittal does not represent study results that demonstrate ambient water conditions at specific locations in Washington; we do note that WDFW submitted all relevant tissue data associated with their studies to Ecology for consideration in the technical assessment of data.
O'Neill, S.M., J.E. West, L.L. Johnson, J.A. Lanksbury, L.A. Niewolny, and A.J. Carey. 2013. Quality Assurance Project Plan: Toxic Contaminants in Outmigrating Juvenile Chinook Salmon (Oncorhynchus tshawytscha) From River Mouths and Nearshore Saltwater Habitats of Puget Sound. Washington Department of Fish and Wildlife; WDFW Publication Number FPT 14-07. Olympia, Washington. 51pp. https://wdfw.wa.gov/publications/01609	The QAPP submittal does not represent study results that demonstrate ambient water conditions at specific locations in Washington; we do note that WDFW submitted all relevant tissue data associated with their studies to Ecology for consideration in the technical assessment of data.
West, J.E., J.A. Lanksbury, L.A. Niewolny, and A.J. Carey. 2013. Quality Assurance Project Plan: Effectiveness Monitoring for a Creosote-piling Removal Project: Embryos of Pacific Herring (Clupea pallasi) as Sentinels for the Presence of Polycyclic Aromatic Hydrocarbons (PAHs). Washington Department of Fish and Wildlife; WDFW Publication Number FPT 13-11. Olympia, Washington. 38pp. https://wdfw.wa.gov/publications/01598	The QAPP submittal does not represent study results that demonstrate ambient water conditions at specific locations in Washington; we do note that WDFW submitted all relevant tissue data associated with their studies to Ecology for consideration in the technical assessment of data.

Narrative Data Submittal	Reasons(s) for not using Submittal
Lanksbury, J.A., J.E. West, and L.A. Niewolny. 2012. Quality Assurance Project Plan: Mussel Watch Pilot Expansion Project. Washington Department of Fish and Wildlife; WDFW Publication Number FPT 13-08. Olympia, Washington. 80pp. https://wdfw.wa.gov/publications/01596	The QAPP submittal does not represent study results that demonstrate ambient water conditions at specific locations in Washington; we do note that WDFW submitted all relevant tissue data associated with their studies to Ecology for consideration in the technical assessment of data.
West, J.E., L.A. Niewolny, S.R. Quinnell, and J.A. Lanksbury. 2012. Quality Assurance Project Plan: Toxic Contaminants in Dungeness crab (Cancer magister) and Spot Prawn (Pandalus platyceros) from Puget Sound, Washington, USA. Washington Department of Fish and Wildlife; WDFW Publication Number FPT 13-10. Olympia, Washington. 88pp. https://wdfw.wa.gov/publications/01436	The QAPP submittal does not represent study results that demonstrate ambient water conditions at specific locations in Washington; we do note that WDFW submitted all relevant tissue data associated with their studies to Ecology for consideration in the technical assessment of data.
West, J.E., J.A. Lanksbury, S. Jeffries, and M. Lance. 2009. Quality Assurance Project Plan: Persistent organic pollutants in three guilds of pelagic marine A Toxics-focused Biological Observation Program for the Salish Sea species from the Puget Sound. Washington Department of Fish and Wildlife; WDFW Publication Number 09-10-099. Olympia, Washington. 35pp https://wdfw.wa.gov/publications/01130	The QAPP submittal does not represent study results that demonstrate ambient water conditions at specific locations in Washington; we do note that WDFW submitted all relevant tissue data associated with their studies to Ecology for consideration in the technical assessment of data.
Moser, M.L., M.S. Myers, J.E. West, S.M. O'Neill, and B.J. Burke. 2013. English Sole Spawning Migration and Evidence for Feeding Site Fidelity in Puget Sound, U.S.A., with Implications for Contaminant Exposure. Northwest Science. 87 (4), 317-325. https://bioone.org/journals/northwest-science/volume-87/issue-4/046.087.0403/English-Sole-Spawning-Migration-and-Evidence-for-Feeding-Site-Fidelity/10.3955/046.087.0403.short	This study used acoustic telemetry to assess the potential for contaminant exposure during spawning migrations and to track the localized movements of adult English sole in the vicinity of Eagle Harbor.

Narrative Data Submittal	Reasons(s) for not using Submittal
Pacific Herring Biomass of spawning Pacific herring, Washington Department of Fish & Wildlife.pdf https://www.pugetsoundinfo.wa.gov/ProgressMeasure/Detail/36/VitalSigns	This study is on herring biomass.
West, J. E., S.M. O'Neill, G.M. Ylitalo, J.P. Incardona, D.C.Doty, and M.E. Dutch. 2014. An evaluation of background levels and sources of polycyclic aromatic hydrocarbons in naturally spawned embryos of Pacific herring (Clupea pallasii) from Puget Sound, Washington, USA. Science of the Total Environment 499: 114-124 https://www.sciencedirect.com/science/article/abs/pii/S0048969714012212	This study compared concentrations of polycyclic aromatic hydrocarbons, or PAHs, in naturally spawned herring embryos from five spawning areas across Puget Sound.
Ecology, Sensitivity to Eutrophication of the Southern Puget Sound Basin (2001) https://apps.ecology.wa.gov/publications/documents/0203059.pdf	This paper summarized three years of PSAMP data for mercury and PCBs in quillback rockfish; compared muscle tissue concentrations of these contaminants for three locations in Puget sound, assessed the importance of fish age, size, lipid content and location, and described these relationships using linear regression models. Any water quality data associated with the study that is in EIM or the federal Water Quality Portal would be used in the assessment of data.
U.S. Fish and Wildlife Service, Best Management Practices to Minimize Adverse Effects to Pacific Lamprey (Entosphenus tridentatus) (2010) https://www.blm.gov/sites/blm.gov/files/policies/IB-OR-2010-041_att.pdf	The purpose of this document is to provide information on Best Management Practices for Pacific lamprey that can be incorporated into any stream disturbing activity on lands managed by the Forest Service and Bureau of Land Management within the Columbia River basin.

Narrative Data Submittal	Reasons(s) for not using Submittal
Ecology, Perfluorinated Compounds in Washington Rivers and Lakes (Aug. 2010) https://apps.ecology.wa.gov/publications/documents/1003034.pdf	T he study represents an exploratory effort seeking information on 13 perfluorinated compounds (PFCs) statewide in surface waters, wastewater treatment plant effluents, and fish tissues. Generally speaking, total PFC concentrations in all matrices recorded as part of the study were within or below the range of values recorded at other United States locations.
Puget Sound Ecosystem Monitoring Program, Indicators of Biological Exposure and Effects of Chemicals of Emerging Concern (Jan. 31, 2013) https://www.eopugetsound.org/articles/2013-puget-sound-marine-waters-overview	This project notes that Contaminants of Emerging Concern (CECs) cover a wide range of man-made chemicals such as pharmaceuticals, personal care products, plasticizes, and automotive fluids. Regional monitoring has clearly indicated that many (perhaps thousands) of these compounds make their way into the Salish Sea and other regional waters, such as the Columbia River. As of yet, there has been no regional evaluation of which of those might be most important in terms of their potential to cause harm.
NMFS, 5-Year Review: Summary & Evaluation of Lower Columbia River Chinook, Columbia River Chum, Lower Columbia River Coho, and Lower Columbia River Steelhead (2011) https://www.fisheries.noaa.gov/resource/document/2016-5-year-review-summary-evaluation-lower-columbia-river-chinook-salmon	This document describes the results of the agency's five year status review for ESA-listed lower Columbia River salmon and steelhead species.
NMFS, 5-Year Review: Summary & Evaluation of Middle Columbia River Steelhead (2011) https://www.fisheries.noaa.gov/resource/document/2016-5-year-review-summary-evaluation-middle-columbia-river-steelhead	This document describes the results of the review of the ESA-listed Middle Columbia River (MCR) steelhead. Any water quality data associated with the study that is in EIM or the federal Water Quality Portal would be used in the assessment of data.

Narrative Data Submittal	Reasons(s) for not using Submittal
EPA, Ecological Condition of the Columbia River Estuary EPA 910-R-07-004 (Dec. 2007) https://archive.epa.gov/emap/archive-emap/web/pdf/columbia.pdf	This project was designed to evaluate the overall condition of the Columbia River estuary. Any water quality data associated with the study that is in EIM or the federal Water Quality Portal would be used in the assessment of data.
Lyndal Johnson et al., (2013): Persistent Organic Pollutants in Juvenile Chinook Salmon in the Columbia River Basin: Implications for Stock Recovery, Transactions of the American Fisheries Society, 142:1, 21-40;131 https://apps.ecology.wa.gov/publications/publications/1103024.pdf	In this study concentrations of persistent organic pollutants were measured in juvenile Chinook Salmon from various Columbia River stocks and life history types to evaluate the potential for adverse effects in these threatened and endangered fish. Any water quality data associated with the study that is in EIM or the federal Water Quality Portal would be used in the assessment of data.
Lower Columbia Estuary Partnership, Lower Columbia River Ecosystem Monitoring Project Annual Report for Year 6 (September 2009 to November 2010) (2011) https://www.estuarypartnership.org/resource/action-effectiveness-monitoring-columbia-river-estuary-habitat-restoration-program-annual-0	This report describes Ecosystem Monitoring Project accomplishments for the reported period of this on-going project. Any water quality data associated with the study that is in EIM or the federal Water Quality Portal would be used in the assessment of data.
Lower Columbia Estuary Partnership, Lower Columbia River Ecosystem Monitoring Project Annual Report for Year 5 (September 2008 to November 2009) (2010) https://www.estuarypartnership.org/resource/action-effectiveness-monitoring-columbia-river-estuary-habitat-restoration-program-annual-1	This report describes Ecosystem Monitoring Project accomplishments for the reported period of this on-going project. Any water quality data associated with the study that is in EIM or the federal Water Quality Portal would be used in the assessment of data.

Narrative Data Submittal	Reasons(s) for not using Submittal
Lower Columbia Estuary Partnership, Lower Columbia River Ecosystem Monitoring Project Annual Report for Year 4 (September 1, 2007 to August 31, 2008) (2009) https://www.estuarypartnership.org/resource/lower-columbia-river-ecosystem-monitoring-project-annual-report-year-4-september-1-2007	This report describes Ecosystem Monitoring Project accomplishments for the reported period of this on-going project. Any water quality data associated with the study that is in EIM or the federal Water Quality Portal would be used in the assessment of data.
Lower Columbia Estuary Partnership, Lower Columbia River Ecosystem Monitoring Project Annual Report for Year 3B (September 1, 2006 to August 31, 2007) (2008) https://www.estuarypartnership.org/resource/lower-columbia-river-ecosystem-monitoring-project-annual-report-year-3b-september-1-2006	This report describes Ecosystem Monitoring Project accomplishments for the reported period of this on-going project. Any water quality data associated with the study that is in EIM or the federal Water Quality Portal would be used in the assessment of data.
Lower Columbia Estuary Partnership, Lower Columbia River Ecosystem Monitoring Project Annual Report for Year 7 (September 1, 2010 to December 31, 2011) (2012) https://www.estuarypartnership.org/resource/action-effectiveness-monitoring-columbia-river-estuary-habitat-restoration-program-annual	This report describes Ecosystem Monitoring Project accomplishments for the reported period of this on-going project. Any water quality data associated with the study that is in EIM or the federal Water Quality Portal would be used in the assessment of data.
Lower Columbia Estuary Partnership, Lower Columbia River Ecosystem Monitoring Project Annual Report for Year 8 (October 1, 2011 to September 30, 2012) (2013) https://www.estuarypartnership.org/resource/lower-columbia-river-ecosystem-monitoring-program-annual-report-year-8-october-1-2011	This report describes Ecosystem Monitoring Project accomplishments for the reported period of this on-going project. Any water quality data associated with the study that is in EIM or the federal Water Quality Portal would be used in the assessment of data.

Narrative Data Submittal	Reasons(s) for not using Submittal
USGS, Foodweb transfer, sediment transport, and biological impacts of emerging and legacy organic contaminants in the lower Columbia River, Oregon and Washington, USA: USGS Contaminants and Habitat (ConHab) Project (2014) https://pubs.er.usgs.gov/publication/70047331	Thiswater quality data associated with the study that is in EIM or the federal Water Quality Portal would be used in the assessment of data.
USGS, Spatial and temporal trends in occurrence of emerging and legacy contaminants in the Lower Columbia River 2008–2010 (2014) https://pubs.er.usgs.gov/publication/70103270	In this study an 86-mile stretch of the river was sampled over a 3 year period in order to determine the spatial and temporal trends in the occurrence and concentration of water-borne organic contaminants. Any water quality data associated with the study that is in EIM or the federal Water Quality Portal would be used in the assessment of data.
USGS, Correlation of gene expression and contaminant concentrations in wild largescale suckers: A field-based study (2014) https://pubs.er.usgs.gov/publication/70058854	This project developed a custom microarray for largescale suckers (Catostomus macrocheilus) and used it to investigate the molecular effects of contaminant exposure on wild fish in the Columbia River.
USGS, A survey of benthic sediment contaminants in reaches of the Columbia River Estuary based on channel sedimentation characteristics (2014) https://pubs.er.usgs.gov/publication/70101339	The study goal was to characterize sediment contaminant detections and concentrations in reaches of the Columbia River Estuary that were concurrently being sampled to assess contaminants in water, invertebrates, fish, and osprey (Pandion haliaetus) eggs. Any water quality data associated with the study that is in EIM or the federal Water Quality Portal would be used in the assessment of data.

Narrative Data Submittal	Reasons(s) for not using Submittal
Henny et al., Wastewater dilution index partially explains observed polybrominated diphenyl ether flame retardant concentrations in osprey eggs from Columbia River Basin, 2008–2009 (2011) https://pubs.er.usgs.gov/publication/70004671	This study used the volume of Wastewater Treatment Plant (WWTP) discharge, a known source of PBDEs, as a measure of human activity at a location, and combined with river flow (both converted to millions of gallons/day) created a novel approach (an approximate Dilution Index) to relate waterborne contaminants to levels of these contaminants that reach avian eggs.

Table 9. Modeled results not appropriate for determining whether water quality standards in Washington are being met in specific waters

Narrative Data Submittal	Reasons(s) for not using Submittal
Mongillo T., E.E. Holmes, D.P. Noren, G.R. VanBlaricom, A.E. Punt, S.M. O'Neill, G.M. Ylitalo , M.B. Hanson, and P.S. Ross. 2012. Predicted polybrominated diphenyl ether (PBDE) and polychlorinated biphenyl (PCB) accumulation in Southern Resident killer whales. Mar. Ecol. Progress Ser. 453:263-277. http://www.int-res.com/abstracts/meps/v453/p263-277/	An individual-based modeling approach was used to predict the accumulation of sum PBDEs (ΣPBDEs) and sum PCBs (ΣPCBs) in specific individuals in the SRKW population. Modeled results are not appropriate to determine that standards in Washington are being met at specific waters.
Ecology, Estimating Loads of Nutrients, Bacteria, DO and TSS from 71 Watersheds Tributary to South Puget Sound (2001) https://apps.ecology.wa.gov/publications/documents/0203021.pdf	The primary goals of this study were to (1) assess the hydrodynamics and current water quality status of the South Puget Sound basin, and (2) develop computer models to simulate existing and future conditions in order to explore the links between loads and water quality at a finer resolution than is possible with the most extensive data collection programs. Modeled results are not appropriate to determine that standards in Washington are being met at specific waters.
Ecology, Control of Toxic Chemicals in Puget Sound Phase 2: Development of Simple Numerical Models, the long-term fate and bioaccumulation of polychlorinated biphenyls in Puget Sound (April 2009) https://apps.ecology.wa.gov/publications/publications/0903015.pdf	This study developed computer prediction tools to predict the concentration of PCBs in water, sediment, and biota of Puget Sound. Modeled results are not appropriate to determine that standards in Washington are being met at specific waters. Intent of the study was not to demonstrate ambient water conditions at specific locations.

Narrative Data Submittal	Reasons(s) for not using Submittal
Spromberg, J. and N. Scholz. 2011. Estimating the Future Decline of Wild Coho Salmon Populations Resulting from Early Spawner Die-Offs in Urbanizing Watersheds of the Pacific Northwest, USA. Integrated Environmental Assessment and Management, 9999, 2011. http://wildfishconservancy.org/what-we-do/science/research-and-monitoring/ongoing-projects/SprombergScholzIEAM2011prespawnmortincoho.pdf	This study modeled the potential consequence of current and future urbanization on wild coho salmon in urban streams in Puget Sound. Intent of the study was not to demonstrate ambient water conditions at specific locations.
Alava, J. et al. 2012. Habitat-Based PCB Environmental Quality Criteria for the Protection of Endangered Killer Whales (Orcinus orca). Environmental Science and Technology 2012, 46, 12655−12663. https://pubs.acs.org/doi/10.1021/es303062q	This study modeled PCB concentrations in killer whales and concludes that the uptake of PCBs by killer whales is through dietary consumption. Intent of the study was not to demonstrate ambient water conditions at specific locations.
Hickie, B. et al. Killer Whales (Orcinus orca) Face Protracted Health Risks Associated with Lifetime Exposure to PCBs. Environ. Sci. Technol. 2007, 41, 6613-6619. https://pubmed.ncbi.nlm.nih.gov/17948816/	This study modeled the lifetime exposure of killer whales to PCBs. Modeled results are not appropriate to determine that standards in Washington are being met at specific waters. Focus of study was unrelated to determining water quality or ambient conditions of specific waterbodies in Washington.

Table 10. Submittals from third parties that did not include documentation addressing the accuracy and completeness of the information submitted to Ecology, and/or study methods and data were not documented or readily available

Narrative Data Submittal	Reasons(s) for not using Submittal
NOAA Fisheries Northwest Fisheries Science Center, Habitat Quality, Toxics, and Salmon in the Lower Columbia Estuary: Multi-Year Coordinated Fish, Fish Prey, Habitat and Water Quality Data Collection under the Ecosystem Monitoring Project (Oct. 23, 2012) https://www.estuarypartnership.org/sites/default/files/resource_files/Johnson EMPSWG_2012_Oct28.pdf	This is a PowerPoint presentation given at the Lower Columbia Estuary Partnership Science Workgroup meeting. Submittal did not include documentation addressing the accuracy and completeness of the information submitted to Ecology, and study methods & data not documented or readily available.
Curtis Roegner, NOAA Fisheries, Oxygen-depleted water in the Columbia River estuary; Observations and consequences (April 23, 2013) https://www.estuarypartnership.org/sites/default/files/resource_files/Roegner LCREP 2013 DO.pdf	This is a PowerPoint presentation given at a NOAA Fisheries Estuary Partnership Science Work shop.Submittal did not include documentation addressing the accuracy and completeness of the information submitted to Ecology, and study methods & data not documented or readily available.
U.S. Fish and Wildlife Service, Environmental Conservation Online System, Listing and Occurrences for Washington https://www.fws.gov/southeast/conservation-tools/environmental-conservation-online-system/	This submittal is an online link to the Environmental Conservation online System (ECOS) which is a gateway web site that provides access to data systems in the U.S. Fish and Wildlife Service (Service) and other government data sources. Submittal did not include documentation addressing the accuracy and completeness of the information submitted to Ecology, and study methods & data not documented or readily available. Any water quality data associated with the submittal that is in EIM or the federal Water Quality Portal would be used in the assessment of data.
Fish and Wildlife Service, Environmental Conservation Online System, Species ad hoc Search [Species proposed for listing] https://ecos.fws.gov/ecp0/reports/ad-hoc-species-report?status=P&header=Species+Proposed+for+Listing&fleadreg=on&fstatus=on&finvpop=on	This submittal is an online link to the Environmental Conservation online System (ECOS) which is a gateway web site that provides access to data systems in the U.S. Fish and Wildlife Service (Service) and other government data sources.

Narrative Data Submittal	Reasons(s) for not using Submittal
U.S. Fish and Wildlife Service, Environmental Conservation Online System, Candidate Species Report https://ecos.fws.gov/ecp/species-reports	This submittal is an online link to the Environmental Conservation online System (ECOS) which is a gateway web site that provides access to data systems in the U.S. Fish and Wildlife Service (Service) and other government data sources. Submittal did not include documentation Any water quality data associated with the submittal that is in EIM or the federal Water Quality Portal would be used in the assessment of data.
U.S. Fish and Wildlife Service, Environmental Conservation Online System, Species Profile, Oregon spotted frog; https://www.fws.gov/oregonfwo/articles.cfm?id=149489458	This submittal is an online link to the Environmental Conservation online System (ECOS) which is a gateway web site that provides access to data systems in the U.S. Fish and Wildlife Service (Service) and other government data sources. Any water quality data associated with the submittal that is in EIM or the federal Water Quality Portal would be used in the assessment of data.
USFWS, Trace Elements and Oil-Related Contaminants in Sediment, Bivalves, and Eelgrass from Padilla and Fidalgo Bays, Skagit County, Washington	Unable to locate study.
USFWS, Environmental Contaminants Program On-Refuge Clean-up Investigations Sub-Activity WA-Preliminary Assessment to Determine Superfund Site Impacts on the Ridgefield National Wildlife Refuge (June 27, 2000) https://www.fws.gov/wafwo/contaminants_new.html	The link to this study goes to a USFWS website. The actual study could not be found on USFWS website. Submittal did not include documentation addressing the accuracy and completeness of the information submitted to Ecology, and study methods & data not documented or readily available.
O'Neill, S.M., et al. 2004. Concentrations of polybrominated diphenyl ethers (PBDEs) in fish from Puget Sound, WA, USA. Poster presentation: SETAC World Congress and 25th Annual Meeting in North America Society of Environmental Toxicology and Chemistry. Department of Fish and Wildlife. Olympia, Washington. https://wdfw.wa.gov/publications/01033	Submittal was a poster and did not include documentation addressing the accuracy and completeness of the information submitted to Ecology, and study methods & data not documented or readily available.

Narrative Data Submittal	Reasons(s) for not using Submittal
Arkoosh, M., J. Dietrich, G.M. Ylitalo, L.J. Johnson, and S.M. O'Neill. 2013. Polybrominated diphenyl ethers (PBDEs) and Chinook salmon health. U.S. Department of Commerce. National Oceanic and Atmospheric Association, National Marine Fisheries Service, Northwest Fisheries Science Center, Newport, Oregon. 49 pp. plus Appendices. *Submttal not on WDFW website.*	Unable to locate study. From title, this appears to paper look at PBDEs in comparison to Chinook salmon health. Submittal did not include documentation addressing the accuracy and completeness of the information submitted to Ecology, and study methods & data not documented or readily available.
O'Neill S.M., C.F. Bravo and T.K. Collier. (2008) Environmental Indicators for the Puget Sound Partnership: A Regional Effort to Select Provisional Indicators (Phase 1) Summary Report. Northwest Fisheries Science Center, Seattle Washington. 64 pp. https://www.academia.edu/1272967/Environmental_indicators_for_the_puget_sound_partnership_a_regional_effort_to_select_provisional_indicators_Phase_1_	Unable to locate this study on WDFW website. From title, this summary report is intended to select provisional indicators for Puget Sound. It is not an ambient monitoring study. Submittal did not include documentation addressing the accuracy and completeness of the information submitted to Ecology, and study methods & data not documented or readily available.

Table 11. Study submittals that fell outside the WQA cycle window of 2006 – 2017

Narrative Data Submittal	Reasons(s) for not using Submittal
Gregory J. Fuhrer, Dwight Q. Tanner, Jennifer L. Morace, Stuart W. McKenzie, and Kenneth A. Skach, USGS Water-Resources Investigations Report 95-4294: Water Quality of the Lower Columbia River Basin: Analysis of Current and Historical Water-Quality Data through 1994 (1996) https://pubs.usgs.gov/wri/1995/4294/report.pdf	Study submitted is more than 20 years old and falls outside of the WQA cycle window of 2006 – 2017. Note: more recent quality data has been collected on the Columbia River.
U.S.G.S. NASQAN National Stream Quality Accounting Network, Monitoring the Water Quality of the Nation's Large Rivers, Columbia River NASQAN Program, Fact Sheet FS-004-98 (regarding contamination in tissues of mink and river otter, and eggs of the bald eagle) https://pubs.usgs.gov/fs/1998/0004/report.pdf	Study submitted is more than 20 years old and falls outside of the WQA cycle window of 2006 – 2017. Note: more recent quality data has been collected on the Columbia River.
Dungeness Crab Species Monitored: Toxic Contaminants in Puget Sound Fish and Shellfish _Washington Department of Fish & Wildlife.pdf https://wdfw.wa.gov/species-habitats/science/marine-toxics	Study submitted falls outside of the WQA cycle window of 2006 – 2017. In a 2001 focus study, the Fish Component monitored for the presence and severity of toxic contaminants in this species at a limited number of sites in Puget Sound.
Lower Columbia River Bi-State Program, Reconnaissance Survey of the Lower Columbia River, Laboratory Data Report, Vol. 2: Sediment Inorganic Data, Sediment Conventional Data (Jan. 1992) https://www.estuarypartnership.org/sites/default/files/resource_files/TC8526_06_reconsurvey2_1d_vol_2.pdf	Study submitted is more than 20 years old and falls outside of the WQA cycle window of 2006 – 2017. No sample location information provided with laboratory samples, so data could not be georeferenced.
Lower Columbia River Bi-State Program, Reconnaissance Survey of the Lower Columbia River, Laboratory Data Report, Vol. 4: Tissue Data, Excluding Dioxins and Furans (1992) https://www.estuarypartnership.org/sites/default/files/resource_files/TC8526_06_reconsurvey2_1d_vol_4.pdf	Study submitted is more than 20 years old and falls outside of the WQA cycle window of 2006 – 2017. No sample location information provided with laboratory samples, so data could not be georeferenced.

Narrative Data Submittal	Reasons(s) for not using Submittal
Lower Columbia River Bi-State Program, Reconnaissance Survey of the Lower Columbia River, Section 2.1 Reconnaissance Survey. Task 6 Vol. 3 (1992) https://www.estuarypartnership.org/sites/default/files/resource_files/TC8526_06_reconsurvey2_1e_vol_3.pdf	Study submitted is more than 20 years old and falls outside of the WQA cycle window of 2006 – 2017. No sample location information provided with laboratory samples, so data could not be georeferenced.
Lower Columbia River Bi-State Program, Reconnaissance Survey of the Lower Columbia River, Section 2.1 Reconnaissance Survey. Lab Data Report Vol. 3 https://www.estuarypartnership.org/sites/default/files/resource_files/TC8526_06_reconsurvey2_1d_vol_3.pdf	Study submitted is more than 20 years old and falls outside of the WQA cycle window of 2006 – 2017. No sample location information provided with laboratory samples, so data could not be georeferenced.
Lower Columbia River Bi-State Program, Reconnaissance Survey of the Lower Columbia River, Section 2.1 Reconnaissance Survey. Lab Data Report Vol. 6 https://www.estuarypartnership.org/sites/default/files/resource_files/TC8526_06_reconsurvey2_1d_vol_6.pdf	Study submitted is more than 20 years old and falls outside of the WQA cycle window of 2006 – 2017. No sample location information provided with laboratory samples, so data could not be georeferenced.
Lower Columbia River Bi-State Program, Reconnaissance Survey of the Lower Columbia River, Section 2.1 Reconnaissance Survey. Lab Data Report Vol. 5 https://www.estuarypartnership.org/sites/default/files/resource_files/TC8526_06_reconsurvey2_1d_vol_5.pdf	Study submitted is more than 20 years old and falls outside of the WQA cycle window of 2006 – 2017. No sample location information provided with laboratory samples, so data could not be georeferenced.
Lower Columbia River Bi-State Program, Reconnaissance Survey of the Lower Columbia River, Section 2.1 Reconnaissance Survey. Lab Data Report Vol. 7 https://www.estuarypartnership.org/sites/default/files/resource_files/TC8526_06_reconsurvey2_1d_vol_7.pdf	Study submitted is more than 20 years old and falls outside of the WQA cycle window of 2006 – 2017. No sample location information provided with laboratory samples, so data could not be georeferenced.

Narrative Data Submittal	Reasons(s) for not using Submittal
USFWS, Environmental Contaminants in Great Blue Herons (Ardea Herodias) from the Lower Columbia River and Willamette Rivers, Oregon and Washington, USA (1999) https://setac.onlinelibrary.wiley.com/doi/full/10.1002/etc.5620181222	Study submitted is more than 20 years old and falls outside of the WQA cycle window of 2006 – 2017. This study does not focus on ambient water quality conditions of Washington waters. The project collected great blue heron (*Ardea herodias*) eggs and prey from six colonies in Oregon and Washington, USA, during 1994 to 1995.
USFWS, Organochlorine Contaminants in Double-Crested Cormorants from Lewis and Clark national Wildlife Refuge in the Columbia River Estuary (Oct. 18, 1999) https://pubs.er.usgs.gov/publication/70188686	Study submitted is more than 20 years old and falls outside of the WQA cycle window of 2006 – 2017. This study does not focus on ambient water quality conditions in Washington.
Charles Henny, Robert Grove, Olaf R Hedstrom, National Biological Service, Forest and Rangeland Ecosystem Science Center, Northwest Research Station, A Field Evaluation of Mink and River Otter on the Lower Columbia River and the Influence of Environmental Contaminants (Feb. 12, 1996) https://www.estuarypartnership.org/sites/default/files/resource_files/Sec_3_3_3a.pdf	Study submitted is more than 20 years old and falls outside of the WQA cycle window of 2006 – 2017. Intent of the study was not to demonstrate ambient water conditions at specific locations in Washington.
Ecology, Hood Canal Marine Sediments Data Summaries, Findings, Publications https://apps.ecology.wa.gov/publications/publications/1003006.pdf	Summary fact sheet submitted falls outside of the WQA cycle window of 2006 – 2017. All available sediment data from related Ecology studies was considered for listing.
Ecology, South Puget Sound Water Quality Study Phase 1 (Oct. 2002) https://apps.ecology.wa.gov/publications/publications/0203021.pdf	Data from South Puget Sound Water Quality Study Phase 1 falls outside of the WQA cycle window of 2006 – 2017. More recent data from this long term study was used in the current assessment.
O'Neill, S.M., and J.E. West. 2009. Marine distribution, life history traits and the accumulation of polychlorinated biphenyls (PCBs) in Chinook salmon (Oncorhynchus tshawytscha) from Puget Sound, Washington. Transactions of the American Fisheries Society 138:616-632. https://wdfw.wa.gov/publications/01030	This paper was based on data that were collected 1992-1996, clearly outside the data window for the 2018 WQ Assessment. Data from WDFW PSAMP database used in previous assessments.

Narrative Data Submittal	Reasons(s) for not using Submittal
O'Neill, S.M., J.E. West, and J.C. Hoeman. 1998. Spatial trends in the concentration of polychlorinated biphenyls (PCBs) in chinook (Oncorhynchus tshawytscha) and coho salmon (O. kisutch) in Puget Sound and factors affecting PCB accumulation: results from the Puget Sound Ambient Monitoring Program. Pages 312-328 in R. Strickland, editor. Puget Sound Research 1998 Conference Proceedings. Puget Sound Water Quality Action Team. Washington Department of Fish and Wildlife. Olympia, Washington. 17pp. https://wdfw.wa.gov/publications/01031	The data from these studies are well over 20 years old and fall outside of the data window for WQA. This study does not focus on ambient water quality conditions of Washington waters.
West, J.E., and S.M. O'Neill. 1998. Persistent pollutants and factors affecting their accumulation in rockfishes (Sebastes spp.) from Puget Sound, Washington. Pages 336-345 in R. Strickland, editor. Puget Sound Research 1998 Conference Proceedings. Puget Sound Water Quality Action Team. Washington Department of Fish and Wildlife. Olympia, Washington. 11pp. https://wdfw.wa.gov/publications/01037	The data from these studies are well over 20 years old and fall outside of the data window for this WQA. This study does not focus on ambient water quality conditions of Washington waters.
O'Neill, S.M., and J.E. West. 2001. Exposure of Pacific herring (Clupea pallasi) to persistent organic pollutants in Puget Sound and the Georgia Basin. Puget Sound Research 2001 Conference Proceedings. Puget Sound Water Quality Action Team. Washington Department of Fish and Wildlife. Olympia, Washington. 6pp. https://wdfw.wa.gov/publications/01028	The data from these studies are well over 20 years old and fall outside of the data window for this WQA. Focus of study was unrelated to determining water quality or ambient conditions of specific waterbodies.
West J.E., S.M. O'Neill, G.R. Lippert and S.R. Quinnell. 2002. Toxic contaminants in marine and anadromous fish from Puget Sound, Washington: Results from the Puget Sound Ambient Monitoring Program Fish Component, 1989-1999. pp. 56 + appendices, Washington Department of Fish and Wildlife, Olympia, WA. https://wdfw.wa.gov/publications/01026	The data from these studies are well over 20 years old and fall outside of the data window for this WQA. Focus of study was unrelated to determining water quality or ambient conditions of specific waterbodies. .

Narrative Data Submittal	Reasons(s) for not using Submittal
O'Neill, S.M., G.M. Ylitalo, M. Krahn, J.E. West, J. Bolton, and D. Brown. 2005. Elevated levels of persistent organic pollutants in Puget Sound versus other freeranging populations of Pacific salmon: the importance of residency in Puget Sound. Abstract of presentation at 2005 Puget Sound Georgia Basin Research Conference. Seattle, Washington. *Submittal not on WDFW Website.*	The data from these studies are well over 20 years old and fall outside of the data window for this WQA. Focus of study was unrelated to determining water quality or ambient conditions of specific waterbodies.
O'Neill, S.M., and J.E. West. 2002. Contaminants in Fish. Pages 66-77 in Puget Sound Water Quality Action Team, editors. 2002 Puget Sound Update: Eighth Report of the Puget Sound Ambient Monitoring Program. Olympia, Washington. 156pp. https://wdfw.wa.gov/publications/01029	The data from these studies are well over 20 years old and fall outside of the data window for this WQA. Focus of study was unrelated to determining water quality or ambient conditions of specific waterbodies.
West, J.E., S.M. O'Neill, G.R. Lippert, and S.R. Quinnell. 2001. Toxic contaminants in marine and anadromous fishes from Puget Sound, Washington: Results of the Puget Sound Ambient Monitoring Program Fish Component, 1989-1999. Washington Department of Fish and Wildlife. Olympia, Washington. 311pp. http://wdfw.wa.gov/publications/01026	The data from these studies are well over 20 years old and fall outside of the data window for this WQA. Focus of study was unrelated to determining water quality or ambient conditions of specific waterbodies.
West, J.E., S.M. O'Neill, D. Lomax, and L. Johnson. 2001. Implications for reproductive health in quillback rockfish (Sebastes maliger) from Puget Sound exposed to polychlorinated biphenyls. Puget Sound Research 2001 Conference Proceedings. Puget Sound Water Quality Action Team. Washington Department of Fish and Wildlife. Olympia, Washington. https://wdfw.wa.gov/publications/01041	The data from these studies are well over 20 years old and fall outside of the data window for this WQA. Focus of study was unrelated to determining water quality or ambient conditions of specific waterbodies.
O'Neill, S.M., and J.E. West. 2000. Toxic Contaminants in Fish. Pages 56-64 in Puget Sound Water Quality Action Team, editors. 2000 Puget Sound Update: Seventh Report of the Puget Sound Ambient Monitoring Program. Washington Department of Fish and Wildlife. Olympia, Washington. 133pp. https://wdfw.wa.gov/publications/01027	The data from these studies are well over 20 years old and fall outside of the data window for this WQA. Focus of study was unrelated to determining water quality or ambient conditions of specific waterbodies.

Narrative Data Submittal	Reasons(s) for not using Submittal
West, J. E. 1997. Protection and restoration of marine life in the inland waters of Washington State. Puget Sound/Georgia Basin Environmental Report Series: Number 6. Puget Sound Water Quality Action Team. Washington Department of Fish and Wildlife. Olympia, Washington. 154pp. http://wdfw.wa.gov/publications/01035	The data from these studies are well over 20 years old and fall outside of the data window for this WQA. Focus of study was unrelated to determining water quality or ambient conditions of specific waterbodies.
O'Neill, S.M., J.E. West, and S.R. Quinnell. 1995. Contaminant monitoring in fish: overview of the Puget Sound Ambient Monitoring Program Fish Task. Pages 35-50 in E. Robichaud, editor. Puget Sound Research 1995 Conference Proceedings. Puget Sound Water Quality Authority. Washington Department of Fish and Wildlife. Olympia, Washington. 18pp. https://wdfw.wa.gov/publications/01032	The data from these studies are well over 20 years old and fall outside of the data window for this WQA. Focus of study was unrelated to determining water quality or ambient conditions of specific waterbodies.
Olson, O.P., L. Johnson, G. Ylitalo, C. Rice, J. Cordell, T.K. Collier, and J. Steger. 2008. Fish habitat use and chemical contaminant exposure at restoration sites in Commencement Bay, Washington. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-88, 117 p. https://www.webapps.nwfsc.noaa.gov/assets/25/607_04162008_152110_CommencementBayTM88Final.pdf	The data from these studies are well over 20 years old and fall outside of the data window for this WQA. Focus of study was unrelated to determining water quality or ambient conditions of specific waterbodies.
Ross, p. et al. 2000. High PCB Concentrations in Free Ranging Pacific Killer Whales, Orcinus orca: Effects of Age, Sex and Dietary Preference. Marine Pollution Bulletin Vol. 40, No. 6, pp. 504±515, 2000. https://www.sciencedirect.com/science/article/abs/pii/S0025326X99002337	The data from this study was over 20 years old and fall outside of the data window for this WQA. Blubber biopsies were collected in British Columbia for the purpose of comparing different whale populations. Intent of the study was not to demonstrate ambient water conditions at specific locations in Washington.
USFWS, Environmental Contaminants in Bald Eagles Nesting in Hood Canal, Washington, 1992-1997 (July 29, 2000) https://ecos.fws.gov/ServCat/DownloadFile/21677?Reference=23158	The data from these studies are well over 20 years old and fall outside of the data window for this WQA. Focus of study was unrelated to determining water quality or ambient conditions of specific waterbodies.

Narrative Data Submittal	Reasons(s) for not using Submittal
Ecology, The Influence of Sediment Quality and Dissolved Oxygen on Benthic Invertebrate Communities in Hood Canal (2008) https://apps.ecology.wa.gov/publications/publications/0703047.pdf	The data from these studies fall outside of the data window for this WQA. Focus of study was unrelated to determining water quality or ambient conditions of specific waterbodies. Any D.O. and sediment data in EIM was considered and used for the assessment.
Ecology, Sediment Quality In Hood Canal (2005) https://apps.ecology.wa.gov/publications/documents/1003006.pdf	The data from these studies fall outside of the data window for this WQA. Focus of study was unrelated to determining water quality or ambient conditions of specific waterbodies. Any D.O. and sediment data in EIM was considered and used for the assessment.
Ecology, Benthic Infaunal Community Structure in Hood Canal in Relation to Sediment and Water Quality Variables (2005) https://apps.ecology.wa.gov/publications/documents/0703047.pdf	The data from these studies fall outside of the data window for this WQA. Focus of study was unrelated to determining water quality or ambient conditions of specific waterbodies.
Lower Columbia River Bi-State Program, Contaminant Ecology of Fish and Wildlife of the Lower Columbia River, Summary and Integration (April 1996) https://www.estuarypartnership.org/sites/default/files/resource_files/Sec_3_3_1b.pdf	Study submitted is more than 20 years old and falls outside of the WQA cycle window of 2006 – 2017. Intent of the study was not to demonstrate ambient water conditions at specific locations.
Columbia Basin Fish and Wildlife Authority, Contamination Ecology of Selected Fish and Wildlife of the Lower Columbia River, A Report to the Bi-State Water Quality Program (April 23, 1996) https://www.estuarypartnership.org/sites/default/files/resource_files/LCRBiStateFWS3.3.1a_CBFWA_WILD_ContamEcolSelectedFish%26WildinLCR96.pdf	Study submitted is more than 20 years old and falls outside of the WQA cycle window of 2006 – 2017. Intent of the study was not to demonstrate ambient water conditions at specific locations.
Columbia River Estuary Study Taskforce, Historic Habitats of the Lower Columbia River (Oct. 1995) https://www.estuarypartnership.org/sites/default/files/resource_files/LCRBiStateFWS3.5.5b_Graves_HistoricHabitatsofTheLCR95.PDF	Study submitted is more than 20 years old and falls outside of the WQA cycle window of 2006 – 2017. Intent of the study was not to demonstrate ambient water conditions at specific locations.

Narrative Data Submittal	Reasons(s) for not using Submittal
Lower Columbia River Bi-State Program, Reconnaissance Survey of the Lower Columbia River; Task 2 Summary Report: Inventory and Characterization of Pollutants (June 26, 1992) https://www.estuarypartnership.org/sites/default/files/resource_files/TC8526_02_reconsurvey1_2_task2b.pdf	Study submitted is more than 20 years old and falls outside of the WQA cycle window of 2006 – 2017. Intent of the study was not to demonstrate ambient water conditions at specific locations.
Washington State Department of Health, Health Analysis of Chemical Contaminants in Lower Columbia River Fish (May 1996) https://www.estuarypartnership.org/sites/default/files/resource_files/Additions_A_health_analysis.pdf	Study submitted is more than 20 years old and falls outside of the WQA cycle window of 2006 – 2017. Intent of the study was not to demonstrate ambient water conditions at specific locations.
Lower Columbia River Bi-State Program, Reconnaissance Survey of the Lower Columbia River, Task 6: Reconnaissance Report (May 17, 1992) https://www.estuarypartnership.org/sites/default/files/resource_files/TC8526_06_reconsurvey2_1e_vol_1.pdf	Study submitted is more than 20 years old and falls outside of the WQA cycle window of 2006 – 2017. Intent of the study was not to demonstrate ambient water conditions at specific locations.
Lower Columbia River Bi-State Program, Assessing Human Risks from Chemically Contaminated Fish in the Lower Columbia River: Risk Assessment (May 1, 1996) https://www.estuarypartnership.org/sites/default/files/resource_files/TC9968_05_sec4_1d.pdf	Study submitted is more than 20 years old and falls outside of the WQA cycle window of 2006 – 2017. Intent of the study was not to demonstrate ambient water conditions at specific locations.
Lower Columbia River Bi-State Program, Assessing Health of Fish Species and Fish Communities in the Lower Columbia River (Jan. 29, 1996) https://www.estuarypartnership.org/sites/default/files/resource_files/Sec_3_3_2b.pdf	Study submitted is more than 20 years old and falls outside of the WQA cycle window of 2006 – 2017. Intent of the study was not to demonstrate ambient water conditions at specific locations.
Lower Columbia River Bi-State Program, Reconnaissance Survey of the Lower Columbia River, Task 1: Final Summary Report (April 29, 1992) https://www.estuarypartnership.org/sites/default/files/resource_files/TC8526_01_reconsurvey1_1_task1d.pdf	Study submitted is more than 20 years old and falls outside of the WQA cycle window of 2006 – 2017. Intent of the study was not to demonstrate ambient water conditions at specific locations.

Narrative Data Submittal	Reasons(s) for not using Submittal
U.S. Fish and Wildlife Service, Interim report: Environmental contaminants in bald eagles nesting along the lower Columbia River (Feb. 9, 1996) https://www.estuarypartnership.org/sites/default/files/resource_files/Sec_3_3_4a.pdf	Study submitted is more than 20 years old and falls outside of the WQA cycle window of 2006 – 2017. Intent of the study was not to demonstrate ambient water conditions at specific locations.
Lower Columbia River Bi-State Program, The Health of the River 1990-1996, Integrated Technical Report (May 20, 1996) https://www.estuarypartnership.org/sites/default/files/resource_files/Additions_D_1996_health_of_the_river_integrated_report.pdf	Study submitted is more than 20 years old and falls outside of the WQA cycle window of 2006 – 2017. Intent of the study was not to demonstrate ambient water conditions at specific locations.
Lower Columbia Estuary Partnership, Lower Columbia River Ecosystem Monitoring Project Annual Report for Year 2 (September 1, 2004 to August 31, 2005) (2006) https://www.estuarypartnership.org/resource/lower-columbia-river-ecosystem-monitoring-project-annual-report-year-2-september-1-2004	Study submitted falls outside of the WQA cycle window of 2006 – 2017. Intent of the study was not to demonstrate ambient water conditions at specific locations.
Lower Columbia Estuary Partnership, Lower Columbia River Ecosystem Monitoring Project Annual Report for Year 3 (September 1, 2005 to August 31, 2006) (2007) https://www.estuarypartnership.org/sites/default/files/resource_files/Year 3 Ecosystem Monitoring Project Annual Report.pdf	Study submitted falls outside of the WQA cycle window of 2006 – 2017. Intent of the study was not to demonstrate ambient water conditions at specific locations.
Tom Rosetta and David Borys, Oregon DEQ, Identification of Sources of Pollutants to the Lower Columbia River Basin (June 1996) *https://www.estuarypartnership.org/sites/default/files/resource_files/Additions_C_id_of_pollutant_sources.pdf*	Study submitted falls outside of the WQA cycle window of 2006 – 2017. Intent of the study was not to demonstrate ambient water conditions at specific locations.
USF&WS, Changes in Productivity and Environmental Contaminants in Bald Eagles nesting Along the Lower Columbia River (Aug. 12, 1999) https://www.fws.gov/oregonfwo/Contaminants/FieldStudies/BaldEagle/LCR-BaldEagleFinalReport.pdf	Study submitted falls outside of the WQA cycle window of 2006 – 2017. Intent of the study was not to demonstrate ambient water conditions at specific locations.

Narrative Data Submittal	Reasons(s) for not using Submittal
USFWS, Effects of Nutrient Enrichment on Wetlands at Conboy Lake National Wildlife Refuge (2002) https://www.fws.gov/oregonfwo/documents/ScientificReports/ConboyLakeNutrient.pdf	Study submitted falls outside of the WQA cycle window of 2006 – 2017. Intent of the study was not to demonstrate ambient water conditions at specific locations in Washington.
West, J.E., and S.M. O'Neill. 1995. Accumulation of mercury and polychlorinated biphenyls in quillback rockfish (Sebastes maliger) from Puget Sound Washington. Pages 666-677 in E. Robichaud, editor. Puget Sound Research 1995 Conference Proceedings. Puget Sound Water Quality Authority. Washington Department of Fish and Wildlife. Olympia, Washington. 14pp. https://wdfw.wa.gov/publications/01036	Data submitted falls outside of the WQA cycle window of 2006 – 2017. Intent of the study was not to demonstrate ambient water conditions at specific locations in Washington. Modeled results are not appropriate to determine that standards in Washington are being met at specific waters.
West, J.E., R.M. Buckley, and D.C. Doty. 1994. Ecology and habitat use of juvenile rockfishes (Sebastes spp.) associated with artificial reefs in Puget Sound, Washington. Bulletin of Marine Science 55(2-3):344-350. https://www.ingentaconnect.com/content/umrsmas/bullmar/1994/00000055/f0020002/art00008	Study submitted falls outside of the WQA cycle window of 2006 – 2017. Modeled results are not appropriate to determine that standards in Washington are being met at specific waters. Focus of study was unrelated to determining water quality or ambient conditions of specific waterbodies.
Ralph Elston, Ph.D. AquaTechnics, Pathways and Management of Marine Nonindigenous Species in the Shared Waters of British Columbia and Washington (January 1997) https://www.amazon.co.uk/Pathways-management-nonindigenous-Washington-environmental/dp/B0006FANVK	The data from these studies are well over 20 years old and fall outside of the data window for this WQA.Submittal did not include documentation addressing the accuracy and completeness of the information submitted to Ecology, and study methods & data not documented or readily available.
Bigg, M., I. MacAskie, and G. Ellis. 1976. Abundance and movements of killer whales off eastern and southern Vancouver Island with comments on management. Ecological Reserves Collection, Government of British Columbia, Ref. No. 336. *Unable to locate study.*	This study was 45 years old and falls outside of the data window for this WQA. This study was not specific to Washington waters. Focus of study was unrelated to determining water quality or ambient conditions of specific waterbodies in Washington.

Narrative Data Submittal	Reasons(s) for not using Submittal
Grant, S.C.H. and P.S. Ross. 2002. Southern resident killer whales at risk: Toxic chemicals in the British Columbia and Washington environment. Can. Tech. Rep. Fish. Aquat. Sci. 2412: xii + 111 p. https://www.researchgate.net/publication/237636125_Southern_Resident_Killer_Whales_at_Risk_Toxic_Chemicals_in_the_British_Columbia_and_Washington_Environment	This submittal falls outside of the data window for this WQA. Intent of the study was not to demonstrate ambient water conditions at specific locations in Washington.
Stehr, C. et al. 2000. Exposure of juvenile chinook and chum salmon to chemical contaminants in the Hylebos Waterway of Commencement Bay, Tacoma, Washington. Journal of Aquatic Ecosystem Stress and Recovery 7: 215–227, 2000. https://link.springer.com/article/10.1023/A:1009905322386	The data from the study fall outside of the data window for this WQA. Further, data from these studies would not have been considered in the 2018 WQ Assessment because the tissue samples would not have met Policy 1-11 requirements.
Johnson, L. et al. 2006. Contaminant exposure in outmigrant juvenile salmon from Pacific Northwest estuaries of the United States. Environ Monit Assess DOI 10.1007/s10661-006-9216-7. https://pubmed.ncbi.nlm.nih.gov/16957861/	The data from these studies (collected 1996-2001) fall outside of the data window for this WQA. Further, data from these studies would not have been considered in the 2018 WQ Assessment because the tissue samples would not have met Policy 1-11 requirements.
Lower Columbia Estuary Partnership, Lower Columbia River and Estuary Ecosystem Monitoring; Water Quality and Salmon Sampling Report (2007) https://www.estuarypartnership.org/resource/lower-columbia-river-and-estuary-ecosystem-monitoring-water-quality-and-salmon-sampling	The data from these studies (collected 1996-2001) fall outside of the data window for this WQA. Further, data from these studies would not have been considered in the 2018 WQ Assessment because the tissue samples would not have met Policy 1-11 requirements.

Table 12. Data associated with a submittal was considered for listing, but did not show exceedances of the standards, or did not meet data or quality assurance requirements in accordance with credible data statutes and policies

Narrative Data Submittal	Reasons(s) for not using Submittal
Pacific Herring Species Monitored: Toxic Contaminants in Puget Sound Fish and Shellfish _Washington Department of Fish & Wildlife.pdf https://wdfw.wa.gov/species-habitats/science/marine-toxics/species-monitored	This submittal is a website that provides information on their pacific herring monitoring program. Focus of website is on WDFW's monitoring program, and not on determining water quality or ambient conditions of specific waterbodies. Associated data was considered but not used in the 2018 WQ Assessment because fish were analyzed as whole body, which is not considered edible fin-fish tissue.
Ecology, Persistent Bioaccumulative and Toxic Contaminants in Pelagic Marine Fish Species from Puget Sound (March 2011) https://apps.ecology.wa.gov/publications/publications/1110003.pdf	Data associated with this summary submittal was considered but not used in the 2018 WQ Assessment because the tissue data did not meet Policy 1-11 requirements. Fish were analyzed as whole body, including stomach contents and bile, which are not considered edible tissue types.
West, J.E., J.A. Lanksbury, S.M. O'Neill, and A. Marshall. 2011. Control of Toxic Chemicals in Puget Sound Phase 3: Persistent Bioaccumulative and Toxic Contaminants in Pelagic Marine Fish Species from Puget Sound. Washington Department of Fish and Wildlife. Olympia, Washington. 70pp. https://wdfw.wa.gov/publications/01362	Data from this study, associated with Phase 3 Puget Sound Toxics Loading Assessment, was considered but not used in the 2018 WQ Assessment because the tissue data did not meet Policy 1-11 requirements. Fish tissue type was whole body and whole body tissue is not considered an edible tissue type per Assessment Policy 1-11.
Lower Columbia Estuary Partnership, Juvenile Salmon Ecology in Tidal Freshwater Wetlands of the Lower Columbia River Estuary: Synthesis of the Ecosystem Monitoring Program, 2005–2010 (2013) https://www.estuarypartnership.org/resource/juvenile-salmon-ecology-tidal-freshwater-wetlands-lower-columbia-river-estuary-synthesis	Intent of the study was not to demonstrate ambient water conditions at specific locations. Any water quality data associated with the study that is in EIM or the federal Water Quality Portal would be used in the assessment of data.

Narrative Data Submittal	Reasons(s) for not using Submittal
Lanksbury, J.A., L.A. Niewolny, A.J. Carey, and J.E. West. 2014. Toxic Contaminants in Puget Sound's Nearshore Biota: A Large-Scale Synoptic Survey Using Transplanted Mussels (Mytilus trossulus). Washington Department of Fish and Wildlife; WDFW Report Number FPT 14-08. Olympia, Washington. 177pp. https://wdfw.wa.gov/publications/01643	This study focused on toxic contaminants generated primarily from terrestrial sources, and conveyed to Puget Sound nearshore habitats via stormwater and other hydraulic watershed processes. Intent of the study was not to demonstrate ambient water conditions at specific locations. Tissue data associated with the study were considered but could not be used because data were reported in dry weight and thus are not useable for the assessment because other ancillary data (percent moisture) is needed to calculate a wet weight for comparison to the TEC thresholds.
Lanksbury, J.A. and J.E. West. 2012. 2011/2012 Mussel Watch Phase 1: Sampling Summary and Progress Report. Washington Department of Fish and Wildlife. Olympia, Washington. 75pp. http://wdfw.wa.gov/publications/01381/	Tissue data associated with the study could not be used because it appears that data were reported in dry weight and thus are not useable for the assessment because other ancillary data (percent moisture) is needed to calculate a wet weight for comparison to the TEC thresholds. Listings from previous cycles based on Mussel Watch data were still carried forward.
Lanksbury, J.A., J.E. West, K. Herrmann, A. Hennings, K. Litle, and A. Johnson. 2010. Washington State **2009/10** Mussel Watch Pilot Project: A Collaboration between National, State and Local Partners. Olympia, WA. Puget Sound Partnership, 283pp. https://wdfw.wa.gov/publications/01127	Tissue data associated with the study could not be used because it appears that data were reported in dry weight and thus are not useable for the assessment because other ancillary data (percent moisture) is needed to calculate a wet weight for comparison to the TEC thresholds. Listings from previous cycles based on Mussel Watch data were still carried forward.
West, J.E., S.M. O'Neill, and G.M. Ylitalo. 2008. Spatial extent, magnitude, and patterns of persistent organochlorine pollutants in **Pacific herring** (Clupea pallasi) populations in the Puget Sound (USA) and the Georgia Basin (Canada). Science of the Total Environment 394:369-378. https://www.sciencedirect.com/science/article/abs/pii/S004896970701340X	Tissue data associated with the study could not be used because fish were analyzed as whole body, which is not considered edible fin-fish tissue in accordance with Policy 1-11.

Narrative Data Submittal	Reasons(s) for not using Submittal
Ecology, Toxic Contaminants in Harbor Seal (Phoca vitulina) Pups from Puget Sound (March 2011) https://apps.ecology.wa.gov/publications/publications/1110001.pdf	Data from the harbor seal pups was considered but not used in the 2018 Assessment in accordance with Policy 1-11 because harbor seals are not considered an edible species in Washington waterbodies.
Washington Department of Fish and Wildlife. 2011. Toxic Contaminants in Harbor Seal (Phoca vitulina) Pups from Puget Sound. Ecology Publication Number 11-10-001. https://apps.ecology.wa.gov/publications/documents/1110001.pdf	Data from the harbor seal pups was considered but not used in the 2018 Assessment in accordance with Policy 1-11 because harbor seals are not considered an edible species in Washington waterbodies.
Sound Experience Microplastic Citizen Science Program (SEMCSP) data and results, collected using methods summarized in an undergraduate research thesis at the University of Washington, Tacoma (Reetz, 2014). Submittal by Center for Biological Diversity via 6/30/2016 correspondence to Ecology. Reetz, L. R. (2014). Characterizing microplastics of surface waters in the Puget Sound, WA. Unpublished Undergraduate Research.	The submitter requests listing South Puget Sound, East of Anderson Island for microplastics based on the undergraduate research report (Reetz, 2014) and the accompanying data from SEMCSP. The study states that no quality assurance or quality control methods were in places for sample collection or lab processing. Additionally, the data records from SEMCSP did not correspond with the data presented in the study results section. For these reasons, this information would not meet Washington's Credible Data Act requirements (RCW 90.48.580) and was not further considered.
Gilman, N. E. (2013). Examining spatial concentrations of marine micro-plastics on shorelines in south Puget Sound, Washington. *Unpublished Thesis*. Submittal by Center for Biological Diversity via 6/30/2016 correspondence to Ecology.	This submittal did not meet listing requirements in Policy 1-11 for assessment of waters under Washington's narrative water quality criteria. The study would need to provide information that clearly documents the connection between sources, causes, and effects on designated uses in order to meet credible data requirements in Washington.

Narrative Data Submittal	Reasons(s) for not using Submittal
Davis, W., & Murphy, A. G. (2015). Plastic in surface waters of the Inside Passage and beaches of the Salish Sea in Washington State. *Marine Pollution Bulletin*, *97*(1-2), 169–177. Submittal by Center for Biological Diversity via 6/30/2016 correspondence to Ecology. http://doi.org/10.1016/j.marpolbul.2015.06.019	This submittal did not meet listing requirements in Policy 1-11 for assessment of waters under Washington's narrative water quality criteria. The study would need to provide information that clearly documents the connection between sources, causes, and effects on designated uses in order to meet credible data requirements in Washington.
Adventurers and Scientists for Conservation (ASC) Global Microplastics Initiative data. Submittal by Center for Biological Diversity via 6/30/2016 correspondence to Ecology. Data submitters cited a study by Lonnstead and Eklov (2016) which found impacts to development, growth, and behaviors of European Perch exposed to varying levels of microplastics. Lonnstedt, O. M., & Eklov, P. (2016). Environmentally relevant concentrations of microplastic particles influence larval fish ecology. *Science*, *352*(6290), 1213 – 1216. http://doi.org/10.1126/science.aad8828	Data collected in Washington's waters from 2014-2015 ranged from 0 to 32 microplastics/L. Based on current research, it's unclear whether the levels reported can impact local aquatic life. Due to lack of established criteria and lack of information supporting impacts to organisms in Washington's marine waters, there is not sufficient evidence to list this waterbody under Ecology's narrative criteria.
National Ocean and Atmosphere Administration's Pacific Marine Laboratory (NOAA/PMEL) West Coast Ocean Acidification monitoring surface seawater CO_2 data sets from which pH can be calculated, links to download data submitted via 6/30/2016 correspondence to Ecology.	After reviewing the pCO_2 data sets, Ecology determined that these data are not appropriate for use in the WQA. Ecology does not have approved numeric criteria for determining impairment to aquatic life utilizing surface water pCO_2 measurements. Additionally, Ecology does not have an established method for the conversion of salinity measurements to total alkalinity or conversion of pCO_2 to infer pH for purposes of the WQA. Due to lack of established criteria, appropriate methodology, and lack of information supporting impacts under Ecology's narrative criteria, it was determined that these pCO_2 data are not appropriate for use in the WQA.

Narrative Data Submittal	Reasons(s) for not using Submittal
National Ocean and Atmosphere Administration's Pacific Marine Laboratory (NOAA/PMEL) West Coast Ocean Acidification (WCOA) cruise, information on biological impacts on pteropods on the WOAC and NANOOS cruises, 2014, submitted via 6/30/2016 correspondence to Ecology. Data consists of pteropod shell damage characterization and calculated aragonite saturation based on samples collected from a 2014 WOAC and NANOOS cruise of Puget Sound. Ecology reviewed the pteropod data.	Ecology currently does not have numeric criteria for aragonite saturation or an approved standard methodology for analyzing marine biological organism data for purposes of the WQA. While data demonstrate a range of severity in pteropod shell damage, there are no reference conditions or sites with which to compare these data. Without reference conditions, it is unclear whether these data represent the natural conditions of aquatic life in Washington's waters. Additionally, the few samples collected are not likely to capture the potential variability in pteropod shell development. Ecology recognizes the relationships between pH, aragonite saturation, and pteropod shell dissolution as documented by Bednarsek and others (2012, 2014). However, there is not sufficient data collected in Washington's waters for purposes of listing under our narrative criteria at this time.
Center for Biological Diversity, data and information submittal to list Dabob OA mooring (47.97ºN, -124.95ºW) as impaired for ocean acidification, submitted via 6/24/2016 correspondence to Ecology.	The request to list this buoy site for ocean acidification is based on pCO_2 data from this station. The submitter asserts that these levels would correlate with relatively low pH. Ecology determined that using pCO_2 data trends alone are not appropriate for the WQA. Ecology does not have approved numeric criteria for determining impairment to aquatic life utilizing surface water pCO_2 measurements. Due to lack of established criteria and lack of information supporting impacts under Ecology's narrative criteria, it was determined that these pCO_2 data are not appropriate for use in the WQA.

Narrative Data Submittal	Reasons(s) for not using Submittal
Center for Biological Diversity, data and information submittal to list Twanoh (NANOOS ORCA buoy at Twanoh (47.37°N, 123.01°W) as impaired for ocean acidification, submitted via 6/24/2016 correspondence to Ecology.	The request to list this buoy site for ocean acidification is based on pCO_2 data from this station, which can reach levels well above 500 ppm. The submitter asserts that these levels would correlate with relatively low pH. Ecology determined that using pCO_2 data trends alone are not appropriate for the WQA. Due to lack of established criteria and lack of information supporting impacts under Ecology's narrative criteria, it was determined that these pCO_2 data are not appropriate for use in the WQA.
Center for Biological Diversity, pH data and information submittal to list Taylor Shellfish Farm (Dabob Bay, 47.8199ºN, -122.8215ºW) as impaired for ocean acidification, submitted via 6/24/2016 correspondence to Ecology.	Upon review of this third party submittal, there is not sufficient information provided with the data to demonstrate that quality assurance practices appropriate for the WQA were used. Also, It appears from our review that all pH monitoring data were within the acceptable range of 7.0 to 8.5 units based on application of Policy 1-11, and there was no accompanying analysis demonstrating that there was a human-caused variation within the range of less than 0.2 units. Due to lack of quality assurance documentation and lack of information supporting impacts under Ecology's narrative criteria requirements, it was determined that these pH data are not appropriate for use in the WQA.
Center for Biological Diversity, data and information submittal to list Dockton Park Station (Outer Quartermaster Harbor, 47.371618º N, -122.454097ºW) as impaired for ocean acidification, submitted via 6/24/2016 correspondence to Ecology. The outer Quartermaster Harbor mooring system is located in Dockton Park and it is part of the King County four active water quality stations.	Upon review of this third party submittal, there is not sufficient information provided with the data to demonstrate that quality assurance practices appropriate for the WQA were used. It was determined that these data are not appropriate for use in the WQA due to: lack of quality assurance documentation, discrepancies between data provided and data represented in figures, lack of established aragonite criteria, and lack of information supporting impacts under Ecology's narrative criteria.

Narrative Data Submittal	Reasons(s) for not using Submittal
Center for Biological Diversity, data and information submittal to list Quarter Master Yacht Club as impaired for ocean acidification, submitted via 6/24/2016 correspondence to Ecology. The inner Quartermaster Harbor mooring system is located at the Quartermaster Yacht Club.	Upon review of this third party submittal, there is not sufficient information provided with the data to demonstrate that quality assurance practices appropriate for the WQA were used. It was determined that these data are not appropriate for use in the WQA due to: lack of a quality assurance documentation, discrepancies between data provided and data represented in figures, lack of established aragonite criteria, and lack of information supporting impacts under Ecology's narrative criteria.
Center for Biological Diversity, data and information submittal to list Point Williams as impaired for ocean acidification, submitted via 6/24/2016 correspondence to Ecology. The mooring system located in Central Puget Sound off of Point Williams is deployed from an oceanic buoy.	Upon review of this third party submittal, there is not sufficient information provided with the data to demonstrate that quality assurance practices appropriate for the WQA were used. In summary, it was determined that these data are not appropriate for use in the WQA due to: lack of quality assurance documentation, discrepancies between data provided and data represented in figures, lack of established aragonite criteria, and lack of information supporting impacts under Ecology's narrative criteria.
Center for Biological Diversity, data and information submittal to list Seattle Aquarium as impaired for ocean acidification, submitted via 6/24/2016 correspondence to Ecology. The Elliott Bay mooring system is located at, and is a joint project with, the Seattle Aquarium.	Upon review of this third party submittal, there is not sufficient information provided with the data to demonstrate that quality assurance practices appropriate for the WQA were used. In summary, it was determined that these data are not appropriate for use in the WQA due to: lack of quality assurance documentation, discrepancies between data provided and data represented in figures, lack of established aragonite criteria, and lack of information supporting impacts under Ecology's narrative criteria.

Table 13. Study submittals that are not a water quality study, and are not related to determining ambient water conditions of specific waterbodies in Washington

Narrative Data Submittal	Reasons(s) for not using Submittal
Hood, E. 2005. Are EDCs Blurring Issues of Gender? Environmental Health Perspectives. VOLUME 113 | NUMBER 10 | October 2005: 671 – 677. *Unable to locate study online.*	This article is on adverse human health effects of exposure to endocrine-disrupting chemicals.
Lower Columbia Estuary Partnership, Historical Habitat Change in the Lower Columbia River, 1870 - 2010 (2012) https://www.estuarypartnership.org/sites/default/files/resource_files/Lower Columbia Estuary Historical Landcover Change final_2013_small.pdf	This is a spatial analysis of long term land cover change for the lower Columbia River estuary and its floodplain by comparing GIS representations of late 1800's maps.
U.S. Fish and Wildlife Service, Species Assessment and Listing Priority Assignment Form: Rana pretiosa (May 9, 2011) https://www.fs.fed.us/r6/sfpnw/issssp/documents/planning-docs/cp-fws-candidate-ha-rana-pretiosa-2011-05.pdf	This online page provides a species assessment and listing priority assignment for the Oregon spotted frog.
NMFS, Endangered and Threatened Wildlife and Plants: Threatened Status for Southern Distinct Population Segment of North American Green Sturgeon (April 7, 2006) https://www.fisheries.noaa.gov/action/critical-habitat-designation-southern-distinct-population-segment-north-american-green	This is an online page describing NOOA Fisheries action to conserve the threatened Southern Distinct Population Segment of North American green sturgeon.
NMFS, Endangered and Threatened Wildlife and Plants; Adding Four Marine Taxa to the List of Endangered and Threatened Wildlife, Final Rule (April 4, 2007) https://www.federalregister.gov/documents/2007/04/04/E7-6188/endangered-and-threatened-wildlife-and-plants-adding-four-marine-taxa-to-the-list-of-endangered-and	This is a federal register notice for a final rule where the U.S. Fish and Wildlife Service (Service), are adding four marine taxa to the List of Endangered and Threatened Wildlife

Narrative Data Submittal	Reasons(s) for not using Submittal
NMFS, Endangered and Threatened Wildlife and Plants; Marine and Anadromous Taxa: Additions, Removal, Updates, and Corrections to the List of Endangered and Threatened Wildlife (July 24, 2014) https://www.federalregister.gov/documents/2014/07/23/2014-16756/endangered-and-threatened-wildlife-and-plants-marine-and-anadromous-taxa-additions-removal-updates	This is a federal register notice for a final rule where the U.S. Fish and Wildlife Service (Service), are adding several marine taxa, removing one species, and revising the entries of many more in accordance with the Endangered Species Act of 1973, as amended (Act).
O'Neill, S. M., G.M. Ylitalo, and J.E. West. 2014. Energy content of Pacific salmon as prey of northern and southern resident killer whales. Endangered Species Research 25(2): 265-281. http://www.int-res.com/abstracts/esr/v25/n3/p265-281/	This study analyzed proximate composition and calculated caloric content of Pacific salmon to evaluate the importance of salmon species, population, body size, and lipid levels in determining their energy content as prey for killer whales.
West J.E., T.E. Helser, and S.M. O'Neill. 2014. Variation in quillback rockfish (Sebastes maliger) growth patterns from oceanic to inland waters of the Salish Sea. Bulletin of Marine Science. 90 (2): 747-761. https://www.ingentaconnect.com/content/umrsmas/bullmar/2014/00000090/00000003/art00001	This study compared patterns of growth variation in quillback rockfish from four regions across the Salish Sea.
da Silva, D.A.M., J. Buzitis, W.L. Reichert, J.E. West, S.M. O'Neill, L.L. Johnson, T.K. Collier, and G.M. Ylitalo. 2013. Endocrine disrupting chemicals in fish bile: A rapid method of analysis and field validation using English sole (Parophrys ventulus) from Puget Sound, WA, USA. Chemosphere 92(11): 1550-1556. https://www.sciencedirect.com/science/article/abs/pii/S0045653513006255?via%3Dihub	This study describes a recently developed and rapid method to measure bisphenol A (BPA), 17β-estradiol (E2) and 17α-ethynylestradiol (EE2) in bile of fish using enzymatic hydrolysis.
James, C.A., J. Kershner, J. Samhouri, S.M. O'Neill, and P.S. Levin. 2012. A methodology for evaluating and ranking water quantity indicators in support of ecosystem-based management. Environmental Management 49:703-19. https://link.springer.com/article/10.1007/s00267-012-9808-7	This paper describes an indicator evaluation and selection process designed to support the Ecosystem-based Management approach in Puget Sound.

Narrative Data Submittal	Reasons(s) for not using Submittal
Lanksbury, J.A. and J.E. West. 2011. Blue Mussels as Indicators of Stormwater Pollution in Nearshore Marine Habitats in Puget Sound: Proposed Revised Statement of Hypothesis. Washington Department of Fish and Wildlife. Olympia, Washington. 28pp. https://wdfw.wa.gov/publications/01366	This report summarizes the feasibility of applying a probabilistic random sampling design for monitoring the status and trends of toxic contaminants in blue mussels.
Johnson, L., C. Bravo, S.M. O'Neill, J.E. West, M.S. Myers, G. Ylitalo, N. Scholz, and T. Collier. 2010. A Toxics-Focused Biological Observing System for Puget Sound (Developed by the Washington Department of Fish and Wildlife and NOAA Fisheries for the Puget Sound Partnership). Washington Department of Ecology Publication #10-10-04. 30pp. https://wdfw.wa.gov/publications/01129	This concept paper provides a general description of the Toxics-Focused Biological Observing System.
Moser, M.L., M.S. Myers, B.J. Burke, and S.M. O'Neill. 2005. Effects of surgically-implanted transmitters on survival and feeding behavior of adult English sole. Pages 269-274 in M. T. Lembo and G. Marmulla, editors. Aquatic telemetry: advances and applications. Proceedings of the Fifth Conference on Telemetry held in Europe. FAO/COISPA, Ustica, Italy https://wdfw.wa.gov/publications/01043	A laboratory study was conducted to assess the feasibility of surgically implanting Acoustic telemetry transmitters for long-term monitoring of adult English sole.
Judd, N., S.M. O'Neill and D.A. Kalman. 2003. Are seafood PCB data sufficient to assess health risk for high seafood consumption groups? Human and Ecological Risk Assessment. 9:691-707. https://www.tandfonline.com/doi/abs/10.1080/713609962	This study looked at possible health risks from seafood PCB exposure for the Tulalip and Squaxin Island tribes.
West, J.E., S.M. O'Neill, and D.C. Doty. 2002. Polycyclic Aromatic Hydrocarbons in Dungeness crabs. Page 62 in Puget Sound Water Quality Action Team, editors. 2002 Puget Sound Update: Eighth Report of the Puget Sound Ambient Monitoring Program. Washington Department of Fish and Wildlife. Olympia, Washington. 156pp. https://wdfw.wa.gov/publications/01029	The goals of this pilot project were to determine whether crabs are sufficiently exposed to toxics (as measured by tissue burdens) to warrant their use as a monitoring species, especially for natural resource damage assessments in the event of an oil spill.

Narrative Data Submittal	Reasons(s) for not using Submittal
Rockfish Species Monitored_ Toxic Contaminants in Puget Sound Fish and Shellfish_Washington Department of Fish & Wildlife.pdf https://wdfw.wa.gov/species-habitats/science/marine-toxics	This submittal is a website that provides an identification guide for rockfish.
Staghorn Sculpin Species Monitored: Toxic Contaminants in Puget Sound Fish and Shellfish _Washington Department of Fish & Wildlife.pdf https://wdfw.wa.gov/species-habitats/science/marine-toxics	This submittal is a website that provides an identification guide for staghorn sculpin.
Pullin, A. & Knight, T. 2009. "Doing more good than harm – Building an evidence-base for conservation and environmental management". Biological Conservation 142 (2009) 931-934. https://www.sciencedirect.com/science/article/abs/pii/S0006320709000421	Paper on Building an evidence-base for conservation and environmental management. This paper provides tips on conducting a literature search.
Liberati, A. et.al. 2009. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. Journal of Clinical Epidemiology 62 (2009) https://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1000100	Journal article on reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration.
Dehart, M. Fish Passage Center. 2016. Memorandum on "The effect of water temperature on steelhead upstream passage". October 31, 2016. *Memorandum is not available online.*	This memo focuses on observing the timing of salmonids in the Columbia River passing over Bonneville Dam when temperatures are above 18°C, and summarized observed effects. Any relevant data showing excursions of temperature criteria found in EIM or the federal Water Quality Portal were included in the WQA.

Narrative Data Submittal	Reasons(s) for not using Submittal
Pullin, A. and Stewart, G. 2006. "Guidelines for Systematic Review in Conservation and Environmental Management". Conservation Biology Volume 20, No. 6, 1647–1656. https://www.researchgate.net/publication/6618138_Guidelines_for_Systematic_Review_in_Environmental_Management	Paper on Guidelines for Systematic Review in Conservation and Environmental Management.
Center for Reviews and Dissemination, University of York. 2009. CRD's guidance for undertaking reviews in health care. ISBN 978-1-900640-47-3. January 2009. https://www.york.ac.uk/media/crd/Systematic_Reviews.pdf	Guidance for undertaking reviews in health care.
Matkin, C. O, M. J. Moore, and F.M.D. Gulland. 2017. Review of Recent Research on Southern Resident Killer Whales (SRKW) to Detect Evidence of Poor Body Condition in the Population. Independent Science Panel Report to the SeaDoc Society. 3 pp. + Appendices. DOI 10.1575/1912/8803 https://georgiastrait.org/wp-content/uploads/2018/02/review-of-recent-research-on.pdf	This review found that poor body condition is associated with loss of fetuses, calves and adults. The causes of this are complex, and analysis is further compounded by stochastic events such as vessel strike.
James, C. et. al. 2015. Contaminants of Emerging Concern: A Prioritization Framework for Monitoring in Puget Sound. Puget Sound Ecosystem Monitoring Program Toxics Workgroup. January 2015. https://www.eopugetsound.org/sites/default/files/features/resources/CEC_Prioritization_White_Paper_2015-02-28.pdf	The purpose of this document is to define a process to identify a priority group of Contaminants of Emerging Concern (CEC) for marine and freshwater monitoring programs in the Pacific Northwest.
O'Neill, S., G. Ylitalo, and J. West. 2014. Energy content of Pacific salmon as prey of northern and southern resident killer whales. Endangered Species Research. Vol. 25: 265–281, 2014. https://www.int-res.com/abstracts/esr/v25/n3/p265-281/	Study of relationship of salmon to killer whales. No data was provided to show causal relationship with waterbody.

Narrative Data Submittal	Reasons(s) for not using Submittal
Mongillo, T. M., G. M. Ylitalo, L. D. Rhodes, S. M. O'Neill, D. P. Noren, and M. B. Hanson. 2016. Exposure to a mixture of toxic chemicals: Implications for the health of endangered Southern Resident killer whales. U.S. Dept. Commer., NOAA Tech. Memo. NMFSNWFSC-135, 107 p. doi:10.7289/V5/TM-NWFSC-135. https://www.webapps.nwfsc.noaa.gov/assets/25/8314_11302016_111957_TechMemo135.pdf?utm_source=Copy+of+August+Orca+News+-+8.29.2016&utm_campaign=2017.1.17+-+SRKW+Petition&utm_medium=email	The primary objectives of this study was to review the contaminants that may pose a risk to the Southern Resident killer whales and to discuss the health implications of exposure to these contaminants.
Puget Sound Institute. 2018. New Puget Sound Herring Research. February 5, 2018. https://www.pugetsoundinstitute.org/2018/02/new-puget-sound-herring-research/	This write-up focuses on the many hypothesized causes of herring declines, to try to pinpoint the primary cause or, therefore, the best management or policy actions for recovery.
Lundin, J. et al. 2016. Modulation in Persistent Organic Pollutant Concertation and Profile by Prey Availability and Reproductive Status in Southern Resident Killer Whale Scat Samples. Environmental Science and Technology. May 2016, 50, 12, 6506 – 6516. https://pubs.acs.org/doi/full/10.1021/acs.est.6b00825	This study broadens the understanding of persistent organic pollutants in the endangered Southern Resident killer whale population by addressing modulation by prey availability and reproductive status, along with endocrine disrupting effects.
Spromberg, J. et al. 2016. Coho salmon spawner mortality in western US urban watersheds: bioinfiltration prevents lethal storm water impacts. Journal of Applied Ecology 2016, 53, 398–407. doi: 10.1111/1365-2664.12534. https://waterquality.fisheries.org/wp-content/uploads/2016/07/Spromberg_et_al-2016-Journal_of_Applied_Ecology.pdf	Study on spawning mortality from urban stormwater found that mixtures of metals and petroleum hydrocarbons – conventional toxic constituents in urban storm water – are not sufficient to cause the spawner mortality syndrome.

Narrative Data Submittal	Reasons(s) for not using Submittal
Peck, K. et al. 2010. DEVELOPMENT OF AN ENZYME-LINKED IMMUNOSORBENT ASSAY FOR QUANTIFYING VITELLOGENIN IN PACIFIC SALMON AND ASSESSMENT OF FIELD EXPOSURE TO ENVIRONMENTAL ESTROGENS. Environmental Toxicology and Chemistry, Vol. 30, No. 2, pp. 477–486, 2011. https://setac.onlinelibrary.wiley.com/toc/15528618/2011/30/2	A competitive enzyme-linked immunosorbent assay was developed to quantitate vitellogenin (VTG) in plasma and serum of coho (Oncorhynchus kisutch) and chinook (O. tshawytscha) salmon. Identification of proper techniques for preserving VTG integrity in plasma and serum samples showed that VTG from both species was robust.
Fisheries and Oceans Canada. 2008. Recovery Strategy for the Northern and Southern Resident Killer Whales (Orcinus orca) in Canada. Species at Risk Act Recovery Strategy Series, Fisheries & Oceans Canada, Ottawa, ix + 81 pp. https://www.cbc.ca/bc/news/bc-081009-killer-whale-recovery-strategy.pdf	This paper outlines recovery strategies for the Northern and Southern resident killer whales in Canada. This recovery strategy focuses on numerous performance measures to reach objectives. It is focused on the overall improvement of recovering the species.
Aquatic Bioinvasion Research & Policy Institute, Portland State University, An assessment of marine biofouling introductions to the Puget Sound region of Washington State (May 2014) https://wdfw.wa.gov/sites/default/files/publications/01654/wdfw01654.pdf	This study focuses on biofouling that may be introduced by vessel traffic in various areas of Puget Sound, and looks at laws and regulations to protect from biofouling.
U.S.G.S., NAS - Nonindigenous Aquatic Species, Species Lists by State, Washington Query https://nas.er.usgs.gov/queries/StateSearch.aspx	USGS provides a list of nonindigenous aquatic species by state. A website disclaimer states that “the data represented on this site vary in accuracy, scale, completeness, extent of coverage and origin. It is the user's responsibility to use these data consistent with their intended purpose and within stated limitations.”
Ecology, Control of Toxic Chemicals in Puget Sound, Phase 3: Study of Atmospheric Deposition of Air Toxics to the Surface of Puget Sound (Sept. 2003) https://apps.ecology.wa.gov/publications/summarypages/1002012.html	This study provided revisions to prior estimates or first reported atmospheric deposition fluxes of polycyclic aromatic hydrocarbons (PAHs), polybrominated diphenyl ethers (PBDEs), and select trace elements for Puget Sound.

Narrative Data Submittal	Reasons(s) for not using Submittal
Ecology, Summary Technical Report Control of Toxic Chemicals in Puget Sound Phase 3: Loadings from POTW Discharge of Treated Wastewater (Dec. 2010) https://apps.ecology.wa.gov/publications/summarypages/1010057.html	The project team's purpose was to improve the estimates of toxic chemical loadings to Puget Sound by targeted assessment of National Pollutant Discharge Elimination System (NPDES) permitted publicly owned treatment works (POTWs).
Ecology, Control of Toxic Chemicals in Puget Sound Phase 3: Primary Sources of Selected Toxic Chemicals and Quantities Released in the Puget Sound Basin(Nov. 2011) https://apps.ecology.wa.gov/publications/documents/1103024.pdf	The overall goal of the project (Primary Sources) is to balance the chemical loading data generated from the Puget Sound Toxics Loading Analysis (PSTLA) with information on chemical releases in order for the Washington State Department of Ecology, the Puget Sound Partnership, and others to develop and implement a toxics reduction and control strategy.
Ecology, Estuarine Flow in the South Basin of Puget Sound and its Effects on Near-Bottom Dissolved Oxygen (Oct. 2007) https://apps.ecology.wa.gov/publications/publications/0703033.pdf	The south basin of Puget Sound is a complex and interconnected system of straits, open reaches, and fjord-like bays. South-basin waters exchange with main-basin Puget Sound waters over a sill (shallow area) and through the Tacoma Narrows. The study concluded that the estuarine flow pattern is controlled by variations in the wind.
Puget Sound Partnership, Aquatic Invasive Species Guidebook (July 2009) https://www.psp.wa.gov/downloads/ANS/NewANSGuide.pdf	This guide was developed to help people identify and report nonnative aquatic species that are considered invasive.
Puget Sound Partnership, Marine Invasive Species Identification Guide (June 2009) https://www.psp.wa.gov/downloads/ANS/MISM_Online.pdf	This Guide identifies invasive marine plants with specific details on identifying them.

Narrative Data Submittal	Reasons(s) for not using Submittal
NMFS, Endangered and Threatened Species; Designation of Critical Habitat for Southern Resident Killer Whale, Final Rule (Nov. 29, 2006) https://www.fisheries.noaa.gov/action/critical-habitat-southern-resident-killer-whale#:~:text=In%20November%202006%20we%20issued%20a%20final%20rule,habitat%20for%20the%20Southern%20Resident%20killer%20whale%20DPS	In November 2006 NMFS issued a final rule designating approximately 2,560 square miles (6,630 square km) of inland waters of Washington State as critical habitat for the Southern Resident killer whale.
NMFS, Southern Resident Killer Whale Critical Habitat https://www.fisheries.noaa.gov/west-coast/endangered-species-conservation/critical-habitat-southern-resident-killer-whales	Southern Resident killer whale critical habitat data (2006) can be downloaded as a shapefile, viewed interactively in the Protected Resources App, or accessed through a map service (REST URL).
NMFS, Southern Resident Killer Whales (Orcinus orca) 5-Year Review: Summary and Evaluation (Jan. 2011) https://www.fisheries.noaa.gov/resource/document/southern-resident-killer-whales-orcinus-orca-5-year-review-summary-and-evaluation	The Endangered Species Act of 1973 (ESA) requires completion of periodic reviews of species that are listed as threatened or endangered to ensure that the listing of these species remains accurate.
NMFS, Endangered and Threatened Wildlife and Plants: Endangered Status for Southern Resident Killer Whales, Final Rule (Nov. 18, 2005) https://www.federalregister.gov/documents/2019/04/15/2019-06917/endangered-and-threatened-wildlife-and-plants-endangered-status-of-the-gulf-of-mexico-brydes-whale	The Southern Resident Population was listed as endangered in 2005 under the Endangered Species Act and are considered depleted under the Marine Mammal Protection Act.
NMFS, Recovery Plan for Southern Resident Killer Whales (Orcinus orca) Jan. 18, 2008) https://www.fisheries.noaa.gov/resource/document/recovery-plan-southern-resident-killer-whales-orcinus-orca	This plan identifies a range of actions that will contribute to recovery of Southern Resident killer whales. Many of these actions will have a direct effect on killer whale habitat, but they will also help restore and improve a range of habitats, species.

Narrative Data Submittal	Reasons(s) for not using Submittal
USFWS, Draft Hazardous Materials and Environmental Assessment Report, Destruction Island, Washington (Jan. 2000) https://www.fws.gov/pacific/planning/draft/docs/WA/waislands/waislandsupdate2.pdf	The planning team and Service staff used input from the public, various organizations, other agencies, and affected Tribes to formulate the following issues that are the most significant to the Refuges. These issues will provide the basis for drafting management objectives and strategies for public review.
USFWS, News Release: Oregon Spotted Frog to be Protected under the Endangered Species Act Oregon and Washington populations will be listed as threatened (Aug. 28, 2014) https://www.fws.gov/wafwo/species/osf/NR_reopen2_CHcom_final_8_sept_2014.pdf	The U.S. Fish and Wildlife Service announced its decision to extend protection to the Oregon spotted frog (Rana pretiosa) as a threatened species under the Endangered Species Act.
USFWS, Environmental Contaminants Program Off-Refuge Investigations Trumpeter Swan Lead Shot Poisoning Investigation in Northwest Washington and Southwest British Columbia (June 2009) https://www.fws.gov/wafwo/pdf/EC_TRUSLead Shot Poisoning Final Report.pdf	Trumpeter (Cygnus buccinator) and tundra swan (Cygnus columbianus) populations wintering in northwest Washington State and on the Sumas Prairie, British Columbia, from 1999-2008, lost over 2,574 members, the majority (62%, 1,586) were confirmed as lead poisoned caused by the ingestion of lead pellets. In 2001, an international effort was initiated to locate the source(s) of the lead.
USFWS, Sea Otter (Enhydra lutris kenyoni) Washington Stock (Aug. 2008) https://www.fws.gov/wafwo/pdf/WA NSO SAR_Aug2008_final.pdf	The WDFW finalized their sea otter recovery plan in 2004. This stock is not classified as strategic because the population is growing and is not listed as “depleted” under the MMPA or “threatened” or “endangered” under the Endangered Species Act of 1973.
NMFS, Behavioral impairment and increased predation mortality in cutthroat trout exposed to carbaryl (Jan. 11, 2011) https://www.fws.gov/wafwo/documents/PR_Behavioralimpairment_Increasedpredationcutthroattroutexposedcarbaryl.pdf	This study showed that the olfactory system of trout is unresponsive to carbaryl, and that trout do not avoid seawater containing the pesticide at environmentally representative concentrations.

Narrative Data Submittal	Reasons(s) for not using Submittal
USGS, Chemical contaminants in fish feeds used in federal salmonid hatcheries in the USA (Jan. 12, 2007) https://www.fws.gov/wafwo/pdf/maule et al 2007 contam in fish food_final.pdf	Recent studies have demonstrated that fish feeds contain significant concentrations of contaminants, many of which can bioaccumulate and bioconcentrate in fish. Organochlorine (OC) contaminants are present in the fish oils and fish meals used in feed manufacture, and some researchers speculate that all fish feeds contain measurable levels of some contaminants.
Washington Herp Atlas, Pacific Giant Salamander https://wdfw.wa.gov/publications/02135	The Washington Herp Atlas link to each species account and to photos of each species, photos showing the key features for species identification and dot distribution maps.
Washington Herp Atlas, Cope's Giant Salamander https://wdfw.wa.gov/publications/02135	The Washington Herp Atlas link to each species account and to photos of each species, photos showing the key features for species identification and dot distribution maps.
Washington Herp Atlas, Cascade Torrent Salamander https://wdfw.wa.gov/publications/02135	The Washington Herp Atlas link to each species account and to photos of each species, photos showing the key features for species identification and dot distribution maps.
Washington Herp Atlas, Columbia Torrent Salamander https://wdfw.wa.gov/publications/02135	The Washington Herp Atlas link to each species account and to photos of each species, photos showing the key features for species identification and dot distribution maps.
Washington Herp Atlas, Olympic Torrent Salamander https://wdfw.wa.gov/publications/02135	The Washington Herp Atlas link to each species account and to photos of each species, photos showing the key features for species identification and dot distribution maps.

Narrative Data Submittal	Reasons(s) for not using Submittal
The following links were submitted from the Washington Invasive Species Council (WISC) website to consider as narrative listings for the WQA: https://invasivespecies.wa.gov/ Washington Invasive Species Council, Stop the Invasion: Viral Hemorrhagic Septicemia Washington Invasive Species Council, Stop the Invasion: Brazilian elodea6 Washington Invasive Species Council, Stop the Invasion: Bullfrog7 Washington Invasive Species Council, Stop the Invasion: Common Reed8 Washington Invasive Species Council, Stop the Invasion: Cordgrass9 Washington Invasive Species Council, Stop the Invasion: Eurasian Watermilfoil10 Washington Invasive Species Council, Stop the Invasion: European Green Crab11 Washington Invasive Species Council, Stop the Invasion: Hydrilla12 Washington Invasive Species Council, Stop the Invasion: Nonnative crayfish13 Washington Invasive Species Council, Stop the Invasion: New Zealand Mudsnail14 Washington Invasive Species Council, Stop the Invasion: Parrotfeather15 Washington Invasive Species Council, Tunicates, non-native16 Washington Invasive Species Council, Stop the Invasion: Variable Leaf Milfoil17	The Washington Invasive Species Council (WISC) is comprised of state and local environmental agencies, local governments and industry, and was developed to protect Washington's environment and economy from harmful invasive species. The WISC provides valuable information on invasive animals, insects, noxious weeds and other wildlife diseases that may occur in Washington. It provides assessment tools to help different agencies prioritize management of invasive species in their area.

TMDL and Alternative Pollution Control Projects

303(d) List TMDL Prioritization

The Department of Ecology has identified priorities that the agency will use to determine new Total Maximum Daily Load (TMDL) work. The criteria for establishing TMDL priorities are identified on page 30 of Chapter 1 of the Water Quality Assessment Policy 1-11[53]. Those criteria are:

- Criteria to prioritize TMDLs as higher priority include the following:
- Severity of the pollution problem
- Risks to public health
- Risks to threatened and endangered species
- Vulnerability of water bodies to degradation
- Waterbodies where a new or more stringent permit limit is needed for point sources
- Local support and interest in a watershed

This prioritization process resulted in rankings for TMDL development assigned to all 303(d) listed (Category 5) waters. Waters were assigned either a high", "medium", or "low" ranking, based on their TMDL prioritization status. These priorities were uploaded with our full WQA package into EPA's ATTAINS database to satisfy this requirement under the Clean Water Act.

The Department of Ecology has committed resources to completing the following TMDLs and since we have resources committed to these, they are identified as **high priority** TMDLs:

- Lower White River pH TMDL
- Budd Inlet Dissolved Oxygen TMDL
- Drayton Harbor Bacteria TMDL
- Whatcom Creek Bacteria TMDL

Additionally, the Department of Ecology has committed resources to complete the following TMDLs but expect completion beyond the 2022 WQ-27 timeframe so these will be ranked **medium priority**:

- Soos Temperature and Dissolved Oxygen TMDL
- Soos Fine Sediment TMDL
- Wide Hollow Creek Multiparameter TMDL

In addition, the agency has also prioritized and is committing resources to develop alternative cleanup efforts (straight to implementation (STI) projects and alternative restoration plans/TMDL Alternatives) however we ranked these alternatives **low priority** for TMDL development:

- Puget Sound Nutrient Source Reduction Project

[53] https://apps.ecology.wa.gov/publications/documents/1810035.pdf

- Sammamish River Temperature and Dissolved Oxygen Alternative Restoration Plan
- French Creek Temperature and Dissolved Oxygen Alternative Restoration Plan
- East Fork Lewis River Alternative Restoration Plan
- Burnt Bridge Creek Alternative Restoration Plan
- Hangman Creek Watershed DO/pH Alternative Restoration Plan
- Alkali Flat Creek STI
- Almota and Little Almota Creek STI
- Spring Flat Creek STI

The Department of Ecology coordinates its TMDL work among two different environmental programs and each year the Agency goes through a detailed process to identify new TMDLs and assign resources to that work. The outcome of that process takes a year and is dependent on the availability of scientific resources to assign to new TMDLs.

Each year in the fall, the water quality program holds an annual public TMDL prioritization webinar to solicit feedback from the public on our proposed water cleanup work for the next fiscal year. After this webinar, the regions decide on priorities to propose to the water quality program management team (PMT). Late in the calendar year, the regions propose new water cleanup projects to water quality PMT and the management team decides whether or not these priorities move forward as is or need to be reconsidered for the future. Once approval is given by water quality PMT, the projects proceed by being proposed to the Environmental Assessment Program. The Environmental Assessment Program then looks at their available resources and determines whether or not they have the capacity to proceed with proposed new TMDL projects as well as continue the carryover work as these projects take multiple years to complete. The Environmental Assessment Program brings the list of ongoing and newly proposed water cleanup projects back to Water Quality Program management team to discuss the projects that may or may not move forward for the following fiscal year. That meeting usually takes place in early June so the Environmental Assessment Program can start their work July 1, the start of the fiscal year. Those large complex projects such as TMDLs require extended scoping which takes a full fiscal year and starts July 1 and ends June 30 of the following year. Once we have scientific resources dedicated and assigned to a TMDL project then that becomes a high priority TMDL project.

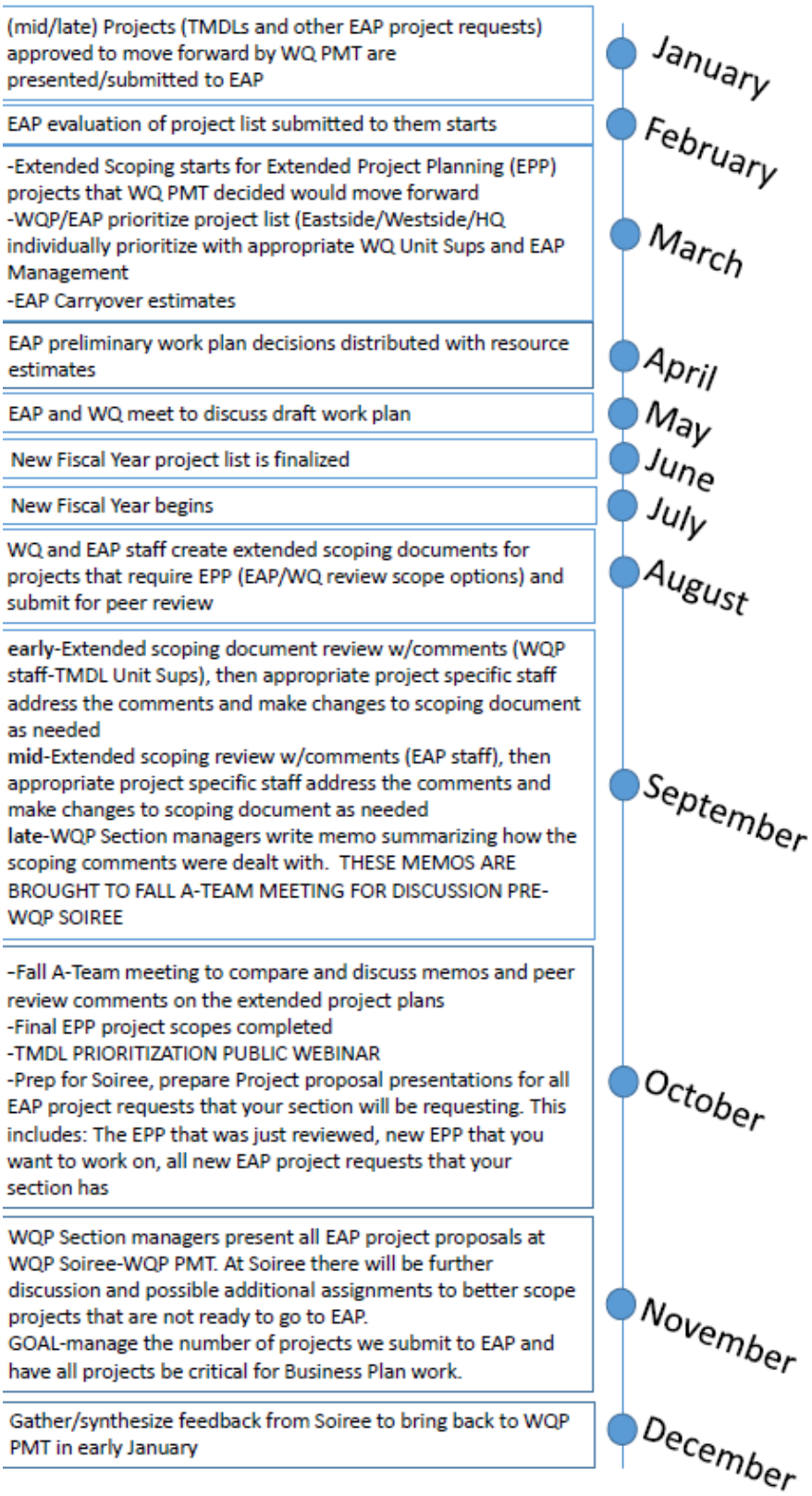

Figure 1. Annual internal Ecology process for water quality improvement projects

In addition, the Department of Ecology relies on the work of the State Forest and Fish Program for implementing best management practices on forest land. For that reason, waterbodies covered under the State Forest and Fish program are prioritized as low for the development of TMDLS and that is because we have a state program in place making sure best management practices get implemented on the ground.

Forest Practices Activities Under state law, landowners must conduct forest practices activities in a manner that supports the attainment of water quality standards. In 2000, Washington adopted revised forest practices rules that identify stream buffers and other management prescriptions expected to meet water quality standards. The state Forest Practices Board tests the forestry rules through a formal adaptive management program, which has the goal of identifying and expediently revising any forestry rules that do not support the attainment of water quality standards. Washington established the Clean Water Act Assurances as a formal agreement in the 1999 Forests and Fish Report in recognition of the improvements to the rules and commitments made. Under the Clean Water Act Assurances TMDL development is a low priority in watersheds where forestry is the primary land use, although Ecology may assign a higher TMDL development priority to forested watersheds with a broader mixture of land uses. Ecology's agreement to rely on the forest practices rules in lieu of developing separate TMDL load allocations or implementation requirements is conditioned upon maintaining an effective adaptive management program. Something like: Ecology actively participates in the adaptive management program and monitors its effectiveness by evaluating progress towards achieving a series of water quality related milestones. Additionally, Ecology periodically evaluates compliance with individual stipulations contained within the Clean Water Act Assurances, in order to determine if a continuation of the Assurances remains warranted. In addition to participation in the Adaptive Management Program, Ecology conducts field reviews of Forest Practices activities

TMDL Projects

The following citations are Total Maximum Daily Load reports supporting 4A category determinations:

Washington State Department of Ecology. 1993. Ballinger Lake Total Phosphorus Total Maximum Daily Load – Water Quality Improvement Report. Publication No. 93-10-202. https://fortress.wa.gov/ecy/publications/SummaryPages/9310202.html. [2, 3, 4]

Washington State Department of Ecology. 2008. Bear – Evans Watershed Fecal Coliform Bacteria Total Maximum Daily Load – Water Quality Improvement Report. Publication No. 08-10-026. https://fortress.wa.gov/ecy/publications/SummaryPages/0810026.html. [2, 3, 4]

Washington State Department of Ecology. 2008. Bear – Evans Watershed Temperature and Dissolved Oxygen Total Maximum Daily Load – Water Quality Improvement Report. Publication

No. 08-10-058. https://fortress.wa.gov/ecy/publications/SummaryPages/0810058.html. [2, 3, 4]

Washington State Department of Ecology. 1997. Campbell Lake Total Phosphorus Total Maximum Daily Load – Water Quality Improvement Report. Publication No. 97-10-201. https://fortress.wa.gov/ecy/publications/SummaryPages/9710201.html. [2, 3, 4]

Washington State Department of Ecology. 2014. Clarks Creek Watershed Dissolved Oxygen and Sediment Total Maximum Daily Load – Water Quality Improvement Report. Publication No. 14-10-030. https://fortress.wa.gov/ecy/publications/SummaryPages/1410030.html. [2, 3, 4]

Washington State Department of Ecology. 2007. Clarks Creek Watershed Fecal Coliform Bacteria Total Maximum Daily Load – Water Quality Improvement Report. Publication No. 07-10-110. https://fortress.wa.gov/ecy/publications/SummaryPages/0710110.html. [2, 3, 4]

Washington State Department of Ecology. 2009. Total Maximum Daily Loading (TMDL) to Limit Discharges of 2,3,7,8 TCDD (Dioxin) to the Columbia River Basin. Publication No. 09-10-058. https://fortress.wa.gov/ecy/publications/SummaryPages/0910058.html. [2, 3, 4]

Washington State Department of Ecology. 2005. Colville National Forest Temperature, Bacteria, pH and Dissolved Oxygen Total Maximum Daily Load (Water Cleanup Plan) Submittal Report. Publication No. 05-10-047. https://fortress.wa.gov/ecy/publications/SummaryPages/0510047.html. [2, 3, 4]

Washington State Department of Ecology. 2003. Colville River Dissolved Oxygen Total Maximum Daily Load – Submittal Report Amended. Publication No. 03-10-029. https://fortress.wa.gov/ecy/publications/SummaryPages/0310029.html. [2, 3, 4]

Washington State Department of Ecology. 2003. Colville River Watershed Bacteria Total Maximum Daily Load – Submittal Report Amended. Publication No. 03-10-030. https://fortress.wa.gov/ecy/publications/SummaryPages/0310030.html. [2, 3, 4]

Washington State Department of Ecology. 2004. Cottage Lake Total Phosphorus Total Maximum Daily Load – Water Quality Improvement Report. Publication No. 03-10-085. https://fortress.wa.gov/ecy/publications/SummaryPages/0310085.html. [2, 3, 4]

Washington State Department of Ecology. 1993. Crystal Creek Multi-Parameter Total Maximum Daily Load–Water Quality Improvement Report. Publication No. 93-10-212. https://apps.ecology.wa.gov/publications/documents/9310212.pdf. [2, 3, 4]

Washington State Department of Ecology. 2015. Deschutes River, Percival Creek and Budd Inlet Tributaries Multi-Parameter Total Maximum Daily Load–Water Quality Improvement Report. Publication No. 15-10-012. https://apps.ecology.wa.gov/publications/documents/1510012.pdf. [2, 3, 4]

Washington State Department of Ecology. 1993. Dragoon Creek Multi-Parameter Total Maximum Daily Load–Water Quality Improvement Report. Publication No. 93-10-209. https://apps.ecology.wa.gov/publications/documents/9310209.pdf. [2, 3, 4]

Washington State Department of Ecology. 2004. Water Cleanup Plan for Bacteria in Dungeness Bay Total Maximum Daily Load (TMDL) Submittal Report. Publication No. 04-10-026. https://fortress.wa.gov/ecy/publications/SummaryPages/0410026.html. [2, 3, 4]

Washington State Department of Ecology. 1992. Duwamish Waterway Ammonia-N Total Maximum Daily Load–Water Quality Improvement Report. Publication No. 92-10-204. https://apps.ecology.wa.gov/publications/documents/9210204.pdf. [2, 3, 4]

Washington State Department of Ecology. 1997. Erie Lake Total Phosphorus Total Maximum Daily Load – Water Quality Improvement Report. Publication No. 97-10-202. https://fortress.wa.gov/ecy/publications/SummaryPages/9710202.html. [2, 3, 4]

Washington State Department of Ecology. 2007. Fauntleroy Creek Fecal Coliform Total Maximum Daily Load–Water Quality Improvement Report. Publication No. 07-10-037. https://apps.ecology.wa.gov/publications/documents/0710037.pdf. [2, 3, 4]

Washington State Department of Ecology. 1993. Fenwick Lake Total Phosphorus Total Maximum Daily Load – Water Quality Improvement Report. Publication No. 93-10-203. https://fortress.wa.gov/ecy/publications/SummaryPages/9310203.html. [2, 3, 4]

Washington State Department of Ecology. 2000. Gibbons Creek Watershed Fecal Coliform Total Maximum Daily Load – Submittal Report. Publication No. 00-10-039. https://fortress.wa.gov/ecy/publications/SummaryPages/0010039.html. [2, 3, 4]

Washington State Department of Ecology. 2001. Granger Drain Fecal Coliform Bacteria Total Maximum Daily Load – Submittal Report. Publication No. 01-10-062. https://fortress.wa.gov/ecy/publications/SummaryPages/0110062.html. [2, 3, 4]

Washington State Department of Ecology. 2001. Grays Harbor/Chehalis Watershed Fecal Coliform Bacteria Total Maximum Daily Load – Submittal Report. Publication No. 01-10-025. https://fortress.wa.gov/ecy/publications/SummaryPages/0110025.html. [2, 3, 4]

Washington State Department of Ecology. 1992. Grays Harbor (Inner) Dioxin Total Maximum Daily Load – Water Quality Improvement Report. Publication No. 92-10-202. https://fortress.wa.gov/ecy/publications/SummaryPages/9210202.html. [2, 3, 4]

Washington State Department of Ecology. 2011. Green River Temperature Total Maximum Daily Load – Water Quality Improvement Report. Publication No. 11-10-046. https://fortress.wa.gov/ecy/publications/SummaryPages/1110046.html. [2, 3, 4]

Washington State Department of Ecology. 2009. Hangman (Latah) Creek Watershed Fecal Coliform, Temperature, and Turbidity Total Maximum Daily Load – Water Quality Improvement

Report. Publication No. 09-10-030. https://fortress.wa.gov/ecy/publications/SummaryPages/0910030.html. [2, 3, 4]

Washington State Department of Ecology. 2006. Henderson Inlet Watershed Fecal Coliform Bacteria, Dissolved Oxygen, pH, and Temperature Total Maximum Daily Load Study. Publication No. 06-03-012. https://fortress.wa.gov/ecy/publications/SummaryPages/0603012.html. [2, 3, 4]

Washington State Department of Ecology. 1999. Inner Bellingham Bay Contaminated Sediments Total Maximum Daily Load – Submittal Report. Publication No. 99-58-WQ. https://fortress.wa.gov/ecy/publications/SummaryPages/9958.html. [2, 3, 4]

Washington State Department of Ecology. 2004. Issaquah Creek Basin Water Cleanup Plan for Fecal Coliform Bacteria Total Maximum Daily Load Submittal Report. Publication No. 04-10-055. https://fortress.wa.gov/ecy/publications/SummaryPages/0410055.html. [2, 3, 4]

Washington State Department of Ecology. 2000. Johnson Creek Watershed Multi-Parameter Total Maximum Daily Load–Submittal Report. Publication No. 00-10-033. https://fortress.wa.gov/ecy/publications/SummaryPages/0010033.html. [2, 3, 4]

Washington State Department of Ecology. 1993. Lake Chelan Total Maximum Daily Loading for Total Phosphorus. TMDL Number: 47-001. Publication No. 93-10-204. https://fortress.wa.gov/ecy/publications/SummaryPages/9310204.html. [2, 3, 4]

Washington State Department of Ecology. 2006. Lake Chelan Watershed DDT and PCB Total Maximum Daily Load–Water Quality Improvement Report. Publication No. 06-10-022. https://fortress.wa.gov/ecy/publications/SummaryPages/0610022.html. [2, 3, 4]

Washington State Department of Ecology. 1993. Lake Sawyer Total Phosphorus Total Maximum Daily Load – Water Quality Improvement Report. Publication No. 93-10-201. https://fortress.wa.gov/ecy/publications/SummaryPages/9310201.html. [2, 3, 4]

Washington State Department of Ecology. 2013. Lake Whatcom Watershed Total Phosphorus and Bacteria Total Maximum Daily Load–Water Quality Improvement Report and Implementation Strategy. Publication No. 13-10-012. https://fortress.wa.gov/ecy/publications/SummaryPages/1310012.html. [2, 3, 4]

Washington State Department of Ecology. 2013. Liberty Bay Watershed Fecal Coliform Bacteria Total Maximum Daily Load TMDL and Water Quality Implementation Plan. Publication No. 13-10-014. https://fortress.wa.gov/ecy/publications/SummaryPages/1310014.html. [2, 3, 4]

Washington State Department of Ecology. 1993. Liberty Lake Total Phosphorus Total Maximum Daily Load – Water Quality Improvement Report. Publication No. 93-10-205. https://fortress.wa.gov/ecy/publications/SummaryPages/9310205.html. [2, 3, 4]

Washington State Department of Ecology. 2005. Little Bear Creek Water Cleanup Plan for Fecal Coliform Bacteria: Total Maximum Daily Load - Submittal Report. Publication No. 05-10-034. https://fortress.wa.gov/ecy/publications/SummaryPages/0510034.html. [2, 3, 4]

Washington State Department of Ecology. 2003. Little Klickitat River Watershed Temperature Total Maximum Daily Load Submittal Report. Publication No. 03-10-046. https://fortress.wa.gov/ecy/publications/SummaryPages/0310046.html. [2, 3, 4]

Washington State Department of Ecology. 2020. Little Spokane River Dissolved oxygen, pH, and Total Phosphorus Total Maximum Daily Load - Water Quality Improvement Report. Publication No. 20-10-033. https://fortress.wa.gov/ecy/publications/SummaryPages/2010033.html. [2, 3, 4]

Washington State Department of Ecology. 2012. Little Spokane River Watershed Fecal Coliform Bacteria, Temperature, and Turbidity - Total Maximum Daily Load Water Quality Improvement Report. Publication No. 11-10-075. https://fortress.wa.gov/ecy/publications/SummaryPages/1110075.html. [2, 3, 4]

Washington State Department of Ecology. 2002. Total Maximum Daily Load for Lower Columbia River Total Dissolved Gas. Publication No. 02-03-004. Total Maximum Daily Load for Lower Columbia River Total Dissolved Gas (wa.gov). [2, 3, 4]

Washington State Department of Ecology. 2002. Water Cleanup Plan for Bacteria in the Lower Dungeness Watershed Total Maximum Daily Load (TMDL) Submittal Report. Publication No. 02-10-015. https://fortress.wa.gov/ecy/publications/SummaryPages/0210015.html. [2, 3, 4]

Washington State Department of Ecology. 2004. Lower Okanogan River Basin DDT and PCBs Total Maximum Daily Load (TMDL): Submittal Report. Publication No. 04-10-043. https://fortress.wa.gov/ecy/publications/SummaryPages/0410043.html. [2, 3, 4]

Washington State Department of Ecology. 2003. Lower Similkameen River Arsenic Total Maximum Daily Load (TMDL): Submittal Report for Joint Issuance. Publication No. 03-10-074. https://fortress.wa.gov/ecy/publications/SummaryPages/0310074.html. [2, 3, 4]

Washington State Department of Ecology. 2000. Lower Skagit River Fecal Coliform Total Maximum Daily Load Submittal Report Water Cleanup Plan. Publication No. 00-10-010. https://fortress.wa.gov/ecy/publications/SummaryPages/0010010.html. [2, 3, 4]

Washington State Department of Ecology. 2008. Lower Skagit River Tributaries Temperature Total Maximum Daily Load Water Quality Improvement Report. Publication No. 08-10-020. https://fortress.wa.gov/ecy/publications/SummaryPages/0810020.html. [2, 3, 4]

Washington State Department of Ecology. 2003. Total Maximum Daily Load for Lower Snake River Total Dissolved Gas. Publication No. 03-03-020. https://fortress.wa.gov/ecy/publications/SummaryPages/0303020.html. [2, 3, 4]

Washington State Department of Ecology. 1992. Lower Snohomish River Dioxin Total Maximum Daily Load. Publication No. 92-10-203 https://fortress.wa.gov/ecy/publications/SummaryPages/9210203.html. [2, 3, 4]

Washington State Department of Ecology. 1998. Lower Yakima River Suspended Sediment Total Maximum Daily Load: USEPA Submittal Document. Publication No. 98-10-202. https://fortress.wa.gov/ecy/publications/SummaryPages/9810202.html. [2, 3, 4]

Washington State Department of Ecology. 2020. Mid-Yakima River Basin Bacteria Total Maximum Daily Load: Water Quality Improvement Report. Publication No. 20-10-030. https://fortress.wa.gov/ecy/publications/SummaryPages/2010030.html. [2, 3, 4]

Washington State Department of Ecology. 1993. Mill Creek Ammonia-Nitrogen Total Maximum Daily Load. Publication No. 93-10-211. https://fortress.wa.gov/ecy/publications/SummaryPages/9310211.html. [2, 3, 4]

Washington State Department of Ecology. 1997. Mill Creek Chlorine Total Maximum Daily Load. Publication No. 97-10-203. https://fortress.wa.gov/ecy/publications/SummaryPages/9710203.html. [2, 3, 4]

Washington State Department of Ecology. 2007. Mission Creek Watershed DDT Total Maximum Daily Load: Water Quality Improvement Report. Publication No. 07-10-046. https://fortress.wa.gov/ecy/publications/SummaryPages/0710046.html. [2, 3, 4]

Washington State Department of Ecology. 2011. Newaukum Creek Temperature Total Maximum Daily Load Water Quality Improvement Report and Implementation Plan. Publication No. 11-10-047. https://fortress.wa.gov/ecy/publications/SummaryPages/1110047.html. [2, 3, 4]

Washington State Department of Ecology. 2006. Newman Lake Total Phosphorus Total Maximum Daily Load – Water Quality Improvement Report. Publication No. 06-10-045. https://fortress.wa.gov/ecy/publications/SummaryPages/0610045.html. [2, 3, 4]

Washington State Department of Ecology. 2005. Nisqually Watershed Bacteria and Dissolved Oxygen Total Maximum Daily Load (Water Cleanup Plan) Submittal Report. Publication No. 05-10-040. https://fortress.wa.gov/ecy/publications/SummaryPages/0510040.html. [2, 3, 4]

Washington State Department of Ecology. 2000. Nooksack River Watershed Bacteria Total Maximum Daily Load Submittal Report. Publication No. 00-10-036. https://fortress.wa.gov/ecy/publications/SummaryPages/0010036.html. [2, 3, 4]

Washington State Department of Ecology. 2002. North Creek Fecal Coliform Total Maximum Daily Load Submittal Report. Publication No. 02-10-020. https://fortress.wa.gov/ecy/publications/SummaryPages/0210020.html. [2, 3, 4]

Washington State Department of Ecology. 2015. North Fork Palouse River Dissolved Oxygen and pH Total Maximum Daily Load: Water Quality Improvement Report and Implementation Plan. Publication No. 15-10-029. https://fortress.wa.gov/ecy/publications/SummaryPages/1510029.html. [2, 3, 4]

Washington State Department of Ecology. 2005. North Fork Palouse River Fecal Coliform Total Maximum Daily Load: Submittal Report. Publication No. 04-10-067. https://fortress.wa.gov/ecy/publications/SummaryPages/0410067.html. [2, 3, 4]

Washington State Department of Ecology. 2011. Oakland Bay, Hammersly Inlet, and Selected Tributaries Fecal Coliform Bacteria Total Maximum Daily Load; Water Quality Improvement Report (WQIR)/Implementation Plan (WQIP). Publication No. 11-10-039. https://fortress.wa.gov/ecy/publications/SummaryPages/1110039.html. [2, 3, 4]

Washington State Department of Ecology. 2020. Padilla Bay Freshwater Tributaries Fecal Coliform Bacteria Total Maximum Daily Load – Water Quality Improvement Report and Implementation Plan. Publication No. 20-10-036. https://fortress.wa.gov/ecy/publications/SummaryPages/2010036.html. [2, 3, 4]

Washington State Department of Ecology. 2010. Palouse River Fecal Coliform Bacteria Total Maximum Daily Load Water Quality Improvement Report and Implementation Plan. Publication No. 10-10-067. https://fortress.wa.gov/ecy/publications/SummaryPages/1010067.html. [2, 3, 4]

Washington State Department of Ecology. 2013. Palouse River Temperature Total Maximum Daily Load Water Quality Improvement Report and Implementation Plan. Publication No. 13-10-020. https://fortress.wa.gov/ecy/publications/SummaryPages/1310020.html. [2, 3, 4]

Washington State Department of Ecology. 2007. Palouse River Chlorinated Pesticide and PCB Total Maximum Daily Load Water Quality Improvement Report and Implementation Plan. Publication No. 07-03-018. https://fortress.wa.gov/ecy/publications/SummaryPages/0703018.html. [2, 3, 4]

Washington State Department of Ecology. 1994. Pataha Creek BOD, Ammonia-N, and Chlorine Total Maximum Daily Load. Publication No. 94-10-201. https://fortress.wa.gov/ecy/publications/SummaryPages/9410201.html. [2, 3, 4]

Washington State Department of Ecology. 2011. Pend Oreille River Temperature Total Maximum Daily Load: Water Quality Improvement Report. Publication No. 10-10-065. https://fortress.wa.gov/ecy/publications/SummaryPages/1010065.html. [2, 3, 4]

Washington State Department of Ecology. 2007. Pend Oreille River Total Dissolved Gas Total Maximum Daily Load: Water Quality Improvement Report. Publication No. 07-03-003. https://fortress.wa.gov/ecy/publications/SummaryPages/0703003.html. [2, 3, 4]

Washington State Department of Ecology. 2020. Pilchuck River Temperature and Dissolved Oxygen Total Maximum Daily Load - Water Quality Improvement Report and Implementation Plan. Publication No. 20-10-035. https://fortress.wa.gov/ecy/publications/SummaryPages/2010035.html. [2, 3, 4]

Washington State Department of Ecology. 1993. Pipers Creek Fecal Coliform Bacteria Total Maximum Daily Load. Publication No. 93-10-210. https://fortress.wa.gov/ecy/publications/SummaryPages/9310210.html. [2, 3, 4]

Washington State Department of Ecology. 1994. Puyallup River BOD and Ammonia Total Maximum Daily Load. Publication No. 94-e36. https://fortress.wa.gov/ecy/publications/SummaryPages/94e36.html. [2, 3, 4]

Washington State Department of Ecology. 2011. Puyallup River Watershed Fecal Coliform Total Maximum Daily Load Water Quality Improvement Report and Implementation Plan. Publication No. 11-10-040. https://fortress.wa.gov/ecy/publications/SummaryPages/1110040.html. [2, 3, 4]

Washington State Department of Ecology. 1998. Quincy NPDES Permit Total Maximum Daily Load for Wasteway DW237 and W645. Publication No. 98-10-201. https://fortress.wa.gov/ecy/publications/SummaryPages/9810201.html. [2, 3, 4]

Washington State Department of Ecology. 2001. Salmon Creek Watershed Bacteria and Turbidity Total Maximum Daily Load Submittal Report. Publication No. 01-10-007. https://fortress.wa.gov/ecy/publications/SummaryPages/0110007.html. [2, 3, 4]

Washington State Department of Ecology. 2011.Salmon Creek Temperature Total Maximum Daily Load Water Quality Improvement Report and Implementation Plan. Publication No. 11-10-044. https://fortress.wa.gov/ecy/publications/SummaryPages/1110044.html. [2, 3, 4]

Washington State Department of Ecology. 2009. Samish Bay Watershed Fecal Coliform Bacteria Total Maximum Daily Load Volume 1 – Water Quality Study Findings. Publication No. 09-10-019. https://fortress.wa.gov/ecy/publications/SummaryPages/0910019.html. [2, 3, 4]

Washington State Department of Ecology. 2009. Samish Bay Watershed Fecal Coliform Bacteria Total Maximum Daily Load Volume 2 – TMDL and Water Quality Implementation Plan. Publication No. 09-10-019. https://fortress.wa.gov/ecy/publications/SummaryPages/0910019.html. [2, 3, 4]

Washington State Department of Ecology. 2000. Simpson Northwest Timberlands Temperature Total Maximum Daily Load - Submittal Report. Publication No. 00-10-047. https://fortress.wa.gov/ecy/publications/SummaryPages/0010047.html. [2, 3, 4]

Washington State Department of Ecology. 2001. Skokomish River Basin Fecal Coliform Total Maximum Daily Load (Water Cleanup Plan) - Submittal Report. Publication No. 01-10-017. https://fortress.wa.gov/ecy/publications/SummaryPages/0110017.html. [2, 3, 4]

Washington State Department of Ecology. 2012. Sinclair and Dyes Inlets Fecal Coliform Bacteria Total Maximum Daily Load TMDL and Water Quality Implementation Plan. Publication No. 11-10-051. https://fortress.wa.gov/ecy/publications/SummaryPages/1110051.html. [2, 3, 4]

Washington State Department of Ecology. 1999. Snohomish River Estuary -- Total Maximum Daily Load Submittal Report. Publication No. 99-57. https://fortress.wa.gov/ecy/publications/SummaryPages/9957.html. [2, 3, 4]

Washington State Department of Ecology. 2000. Snohomish River Tributaries Fecal Coliform Total Maximum Daily Load Submittal Report. Publication No. 00-10-087. https://fortress.wa.gov/ecy/publications/SummaryPages/0010087.html. [2, 3, 4]

Washington State Department of Ecology. 1994. Snoqualmie River Total Maximum Daily Load Study. Ecology Report number 94-71. https://fortress.wa.gov/ecy/publications/SummaryPages/9471.html. [2, 3, 4]

Washington State Department of Ecology. 2011. Snoqualmie River Basin Temperature Total Maximum Daily Load Water Quality Improvement Report and Implementation Plan. Publication No. 11-10-041. https://fortress.wa.gov/ecy/publications/SummaryPages/1110041.html. [2, 3, 4]

Washington State Department of Ecology. 2020. South Fork Nooksack River Temperature Total Maximum Daily Load – Water Quality Improvement Report and Implementation Plan. Publication No. 20-10-007. https://fortress.wa.gov/ecy/publications/SummaryPages/2010007.html. [2, 3, 4]

Washington State Department of Ecology. 2009. South Fork Palouse River Fecal Coliform Bacteria Total Maximum Daily Load Water Quality Improvement Report. Publication No. 09-10-060. https://fortress.wa.gov/ecy/publications/SummaryPages/0910060.html. [2, 3, 4]

Washington State Department of Ecology. 2003. South Prairie Creek Bacteria and Temperature Total Maximum Daily Load (Water Cleanup Plan) Submittal Report. Publication No. 03-10-055. https://fortress.wa.gov/ecy/publications/SummaryPages/0310055.html. [2, 3, 4]

Washington State Department of Ecology. 2007. Spokane River and Lake Spokane Dissolved Oxygen Total Maximum Daily Load Water Quality Improvement Report. Publication No. 07-10-073. https://fortress.wa.gov/ecy/publications/SummaryPages/0710073.html. [2, 3, 4]

Washington State Department of Ecology. 1999. Spokane River Dissolved Metals Total Maximum Daily Load: Submittal Report. Publication No. 99-49. https://fortress.wa.gov/ecy/publications/SummaryPages/9949.html. [2, 3, 4]

Washington State Department of Ecology. 2005. Stillaguamish River Watershed Fecal Coliform, Dissolved Oxygen, pH, Mercury, and Arsenic Total Maximum Daily Load (Water Cleanup Plan) Submittal Report. Publication No. 05-10-044. https://fortress.wa.gov/ecy/publications/SummaryPages/0510044.html. [2, 3, 4]

Washington State Department of Ecology. 2004. Stillaguamish River Watershed Temperature Total Maximum Daily Load Study. Publication No. 04-03-010. https://fortress.wa.gov/ecy/publications/SummaryPages/0403010.html. [2, 3, 4]

Washington State Department of Ecology. 2006. Stillaguamish River Watershed Temperature Total Maximum Daily Load Water Quality Improvement Report Vol. 2 – Implementation Strategy. Publication No. 06-10-057. https://fortress.wa.gov/ecy/publications/SummaryPages/0610057.html. [2, 3, 4]

Washington State Department of Ecology. 1996. Water Quality-Based National Primary Discharge Elimination Systems Permit (NPDES) for the city of Sumas as a Total Maximum Daily Load (TMDL) for Sumas River-Biochemical Oxygen Demand, Ammonia-Nitrogen, Chlorine. Publication No. 96-10-201. https://fortress.wa.gov/ecy/publications/SummaryPages/9610201.html. [2, 3, 4]

Washington State Department of Ecology. 2006. Swamp Creek Fecal Coliform Bacteria Total Maximum Daily Load Water Quality Improvement Report and Implementation Plan. Publication No. 06-10-021. https://fortress.wa.gov/ecy/publications/SummaryPages/0610021.html. [2, 3, 4]

Washington State Department of Ecology. 2001. Teanaway River Temperature Total Maximum Daily Load - Submittal Report. Publication No. 01-10-019. https://fortress.wa.gov/ecy/publications/SummaryPages/0110019.html. [2, 3, 4]

Washington State Department of Ecology. 2006. Tributaries to Totten, Eld, and Little Skookum Inlets: Fecal Coliform Bacteria and Temperature Total Maximum Daily Load Water Quality Improvement Report. Publication No. 06-10-021. https://fortress.wa.gov/ecy/publications/SummaryPages/0610021.html. [2, 3, 4]

Washington State Department of Ecology. 2010. Tucannon River and Pataha Creek Temperature Total Maximum Daily Load Water Quality Improvement Report and Implementation Plan. Publication No. 10-10-019. https://fortress.wa.gov/ecy/publications/SummaryPages/1010019.html. [2, 3, 4]

Washington State Department of Ecology. 2002. Union River Fecal Coliform Total Maximum Daily Load - Submittal Report. Publication No. 02-10-022. https://fortress.wa.gov/ecy/publications/SummaryPages/0210022.html. [2, 3, 4]

Washington State Department of Ecology. 2004. Upper Chehalis River Fecal Coliform Total Maximum Daily Load - Submittal Report. Publication No. 04-10-041. https://fortress.wa.gov/ecy/publications/SummaryPages/0410041.html. [2, 3, 4]

Washington State Department of Ecology. 2000 Upper Chehalis River Basin Dissolved Oxygen Total Maximum Daily Load - Submittal Report. Publication No. 00-10-018. https://fortress.wa.gov/ecy/publications/SummaryPages/0010018.html. [2, 3, 4]

Washington State Department of Ecology. 1999. Upper Chehalis River Basin Temperature Total Maximum Daily Load. Publication No 99-52. https://fortress.wa.gov/ecy/publications/SummaryPages/9952.html. [2, 3, 4]

Washington State Department of Ecology. 2001. Upper Humptulips River Watershed Temperature Total Maximum Daily Load (Water Cleanup Plan) - Submittal Report. Publication No. 01-10-022. https://fortress.wa.gov/ecy/publications/SummaryPages/0110022.html. [2, 3, 4]

Washington State Department of Ecology. 2008. Upper Naches River Watershed Temperature Total Maximum Daily Load: Volume 1. Water Quality Study Findings. Publication No. 08-03-036. https://fortress.wa.gov/ecy/publications/SummaryPages/0803036.html. [2, 3, 4]

Washington State Department of Ecology. 2003. Mt. Baker Snoqualmie National Forest Upper White Watershed Sediment and Temperature Total Maximum Daily Load for Aquatic Habitat: Submittal Report. Publication No. 03-10-032. https://fortress.wa.gov/ecy/publications/SummaryPages/0310032.html. [2, 3, 4]

Washington State Department of Ecology. 2014. Upper Yakima River Tributaries Temperature Total Maximum Daily Load – Water Quality Improvement Report and Implementation Plan. Publication No. 14-10-037. https://fortress.wa.gov/ecy/publications/SummaryPages/1410037.html. [2, 3, 4]

Washington State Department of Ecology. 2002. Upper Yakima River Basin Suspended Sediment, Turbidity, and Organochlorine Pesticide Total Maximum Daily Load - Submittal Report. Publication No. 02-10-047. https://fortress.wa.gov/ecy/publications/SummaryPages/0210047.html. [2, 3, 4]

Washington State Department of Ecology. 2006. Walla Walla River Basin Fecal Coliform Total Maximum Daily Load – Water Quality Improvement Report. Publication No. 06-10-074. https://fortress.wa.gov/ecy/publications/SummaryPages/0610064.html. [2, 3, 4]

Washington State Department of Ecology. 2007. Walla Walla River Basin pH and Dissolved Oxygen Total Maximum Daily Load Study: Water Quality Improvement Report. Publication No. 07-03-010. https://fortress.wa.gov/ecy/publications/SummaryPages/0703010.html. [2, 3, 4]

Washington State Department of Ecology. 2007. Walla Walla River Watershed Temperature Total Maximum Daily Load: Water Quality Improvement Report. Publication No. 07-10-030. https://fortress.wa.gov/ecy/publications/SummaryPages/0710030.html. [2, 3, 4]

Washington State Department of Ecology. 2005. Walla Walla River Chlorinated Pesticides and PCBs Total Maximum Daily Load (Water Cleanup Plan): Submittal Report. Publication No. 05-10-079. https://fortress.wa.gov/ecy/publications/SummaryPages/0510079.html. [2, 3, 4]

Washington State Department of Ecology. 1993. Wapato Lake Total Phosphorus Total Maximum Daily Load – Water Quality Improvement Report. Publication No. 93-10-207. https://fortress.wa.gov/ecy/publications/SummaryPages/9310207.html. [2, 3, 4]

Washington State Department of Ecology. 1993. Weaver Creek BOD and Ammonia-N Total Maximum Daily Load. Publication No. 93-10-206. https://fortress.wa.gov/ecy/publications/SummaryPages/9310206.html. [2, 3, 4]

Washington State Department of Ecology. 2007. Wenatchee River Watershed (WRIA 45) Fecal Coliform Total Maximum Daily Load Water Quality Improvement Report. Publication No. 07-10-009. https://fortress.wa.gov/ecy/publications/SummaryPages/0710009.html. [2, 3, 4]

Washington State Department of Ecology. 2008. Wenatchee River Watershed Dissolved Oxygen and pH Total Maximum Daily Load: Water Quality Improvement Report. Publication No. 08-10-062. https://fortress.wa.gov/ecy/publications/SummaryPages/0810062.html. [2, 3, 4]

Washington State Department of Ecology. 2007. Wenatchee River Watershed Temperature Total Maximum Daily Load: Water Quality Improvement Report. Publication No. 07-10-045. https://fortress.wa.gov/ecy/publications/SummaryPages/0710045.html. [2, 3, 4]

Washington State Department of Ecology. 2011. Whatcom, Squalicum, and Padden Creeks Temperature Total Maximum Daily Load: Water Quality Improvement Report. Publication No. 11-10-019. https://fortress.wa.gov/ecy/publications/SummaryPages/1110019.html. [2, 3, 4]

Washington State Department of Ecology. 1993. Wildcat Creek Ammonia-N, BOD, Chlorine, and Fecal Coliform Total Maximum Daily Load. Publication No 93-10-208. https://fortress.wa.gov/ecy/publications/SummaryPages/9310208.html. [2, 3, 4]

Washington State Department of Ecology. 2006. Willapa River Dissolved Oxygen Total Maximum Daily Load: Water Quality Improvement Report and Implementation Plan. Publication No. 06-10-017. https://fortress.wa.gov/ecy/publications/SummaryPages/0610017.html. [2, 3, 4]

Washington State Department of Ecology. 2007. Willapa River Fecal Coliform Total Maximum Daily Load: Water Quality Improvement Report. Publication No. 07-03-021. https://fortress.wa.gov/ecy/publications/SummaryPages/0703021.html. [2, 3, 4]

Washington State Department of Ecology. 2005. Willapa River Watershed Temperature Total Maximum Daily Load (Water Cleanup Plan): Submittal Report and Detailed Implementation Plan. Publication No. 05-10-073. https://fortress.wa.gov/ecy/publications/SummaryPages/0510073.html. [2, 3, 4]

Washington State Department of Ecology. 2005. Wilson Creek Sub-Basin Bacteria Total Maximum Daily Load (Water Cleanup Plan): Submittal Report. Publication No. 05-10-041. https://fortress.wa.gov/ecy/publications/SummaryPages/0510041.html. [2, 3, 4]

Washington State Department of Ecology. 2002. Wind River Watershed Temperature Total Maximum Daily Load: Submittal Report. Publication No. 02-10-029. https://fortress.wa.gov/ecy/publications/SummaryPages/0210029.html. [2, 3, 4]

United States Environmental Protection Agency. 2020. Total Maximum Daily Loads (TMDLs) for the Deschutes River and its Tributaries. https://www.epa.gov/sites/production/files/2020-08/documents/tmdl-deschutes-july-31-2020.pdf. [2, 3, 4]

United States Environmental Protection Agency, Region 10. 2020. Total Maximum Daily Load (TMDL) for Temperature in the Columbia and Lower Snake Rivers. https://www.epa.gov/sites/production/files/2020-05/documents/r10-tmdl-columbia-snake-temperature-final-05182020-web.pdf. [4, 7]

Alternative Pollution Control Projects 4B Analyses

Alpowa Creek – February 2021

The Washington Department of Ecology (Ecology) Integrated Report (IR) proposes to exclude 16 listings for bacteria, dissolved oxygen, pH, and temperature from the 303(d) list and place these water bodies in category 4b of the IR. The specific listings are:

- Bacteria—40556 ,40557, 40558, 45991, and 72288
- dissolved oxygen—47040, 47041 and 47042
- pH—50347 and 50348
- temperature—40536, 40538, 73618, 73625, 73626

These water bodies were in several other categories of the 2012 IR. Water bodies 40557, 40558, 45991, 47041, 47042, and 50348 were listed in Category 4b. Water bodies 40536 and 40538 were in category 2. Water bodies 40556 and 50347 were in category 5. Water bodies 72288, 73616, and 73626 were in category 3. Ecology's basis for excluding these water bodies from the 303(d) list is outlined in this evaluation.

Identification of Segment and Statement of Problem Causing Impairment

Alpowa Creek is located in Garfield and Asotin Counties in southeastern Washington. It originates from several springs in the forested foothills of the Blue Mountains, travels through a desert canyon, and meets the Snake River near Clarkston, Washington. For generations the Alpowa Creek canyon has been used to range and feed livestock. Wheat and barley are also grown in the watershed. The creek provides significant habitat for the threatened Snake River Steelhead trout.

After years of uncontrolled livestock access to the creek, a large portion of the riparian corridor was in poor condition, and the stream was consistently in violation of the state fecal coliform standard.

Monitoring data for the listed segments was collected from 1999 through 2007. Only 1999 and 2000 data is available for segment 40557, and it is limited. WSU data show that during those two years, segment 40557 showed excursions above the geometric bacteria criterion, but there is no further detail. Information for the other segments is better. The highest fecal coliform count recorded was 1840 fecal coliform units/100 mL on May 27, 2003 between river kilometers 12.7 and 13.9. The lowest dissolved oxygen recorded was 4.4 mg/L on April 29, 2003 between river kilometers 18.2 and 20.2. The highest pH recorded was 8.8 between river kilometers 12.7 and 13.9. The temperature impaired segments routinely exceeded the 17.5-degree criterion for spawning, rearing, and migration; and the 13-degree supplemental spawning criterion.

The impairments are the result of a combination of factors. Winter feeding and uncontrolled livestock access to the stream had eliminated much of the vegetation within the stream corridor. This degraded riparian area could not provide shade to the stream, resulting in high

water temperatures. It also allowed manure to run directly into streams. In addition, the uncontrolled stream access allowed cattle to deposit manure directly into the water and to trample stream banks. There is also some evidence that failing septic systems may be contributing to the problem.

Livestock manure is a likely cause of the low dissolved oxygen and pH violations. Manure uses oxygen and lowers pH during decomposition by in-stream bacteria. Nutrients in the manure and from fertilizers stimulate excessive plant growth in the creek. This problem is exacerbated by high stream temperatures and an overabundance of sunlight exposure. Aquatic plants use oxygen for respiration at night and can raise the pH of the water during photosynthesis during the day. Controlling the excessive growth is key to meeting pH and dissolved oxygen criteria and improving the health of the aquatic community.

Description of Pollution Controls and How They Will Achieve Water Quality Standards

Water quality target

The bacteria impaired segments of Alpowa Creek are designated primary contact recreation. Ecology now uses Escherichia coli (E. Coli) as the criteria in this watershed. E. Coli levels must not exceed a geometric mean value of 100 CFU or MPN per 100 mL, with not more than 10 percent of all samples (or a single sample when less than ten sample points exist) exceeding 320 CFU or MPN per 100 mL.

For the dissolved oxygen impaired segments, the standards require that the lowest one-day minimum be no lower than 8.0 mg/L.

For the pH impaired segments, the standard requires the pH to be within the range of 6.5 to 8.5, with a human-caused variation within this range of less than 0.5 units. For the temperature impaired segments, the designated uses are spawning, rearing and migration, and the temperature criterion is 17.5 degrees Centigrade. In addition, listings 40538 and 73618 also have a supplemental spawning criterion of 13 degrees Centigrade from February 15 to June 1.

Controls that will achieve water quality standards

The Department of Ecology's Eastern Regional Office has established a Livestock and Water Quality program that uses a unique collaborative approach to address livestock-related problems. Instead of using the standard process that starts with a Category 5 listing, establishing a TMDL for the stream, writing an implementation plan, and finally getting to actual implementation, this strategy goes straight to implementation. The strategy is applied in watersheds in which the cause of a water quality impairment is clear.

Ecology encourages implementation of a wide variety of best management practices, however, a primary focus of the program has been to restore degraded riparian corridors and eliminate unlimited animal access to streams. Healthy riparian areas can improve water quality and

stream health in multiple ways, which make them a particularly valuable and cost-effective management practice. Healthy riparian areas:

- Slow bank erosion by holding soil in place during periods of high water.
- Reduce flood damage and sedimentation by slowing runoff and capturing the sediment that would otherwise be carried downstream.
- Help keep water cool and reduce light exposure in summer by shading the stream.
- Improve water quality by capturing sediment, nutrients, pesticides, pathogens, and other pollutants before they reach the stream.
- Enhance summer stream flow by improving water infiltration and storage.
- Create fish and wildlife habitat.
- Limit livestock manure inputs to the creek and riparian areas.

Ecology has a three-step riparian restoration strategy, which allows the department to efficiently apply resources to priority problem areas. The first step is to address the source of degradation-unlimited livestock access to streams and winter feeding operations in close proximity to the riparian corridor. Ecology relies primarily on livestock exclusion, and off-stream water supply to eliminate livestock access to the riparian area. In implementing this BMP, Ecology uses our 319 and centennial clean water grant guidelines, which require a minimum 75, 50 or 35-foot buffer between the livestock fence and the mean ordinary high water mark of the nearest stream bank depending on the type of stream. In many cases, the buffer width may be larger depending on the stream and site conditions.

By first addressing livestock access, Ecology seeks to abate the primary pollution sources—livestock in the stream, eroded stream banks, increased runoff, increased sedimentation, and subsequent transport of fecal matter. As vegetation naturally returns in the riparian area, site conditions become stabilized and the pollution sources are dramatically reduced. Also, this approach works to arrest morphological changes to the entire stream that are induced by erosion and sedimentation.

Ecology has spent much of its efforts and resources implementing this first step, in large part, because we have taken a holistic, watershed approach to protecting streams. By first addressing the primary sources of pollution and geomorphic change, Ecology can establish the necessary site conditions for successful restoration. Moreover, Ecology ensures that, first and foremost, the root problems are addressed for *the entire stream*, before resources are focused on site or segment specific restoration.

The second step occurs after a majority of site conditions have been stabilized, and the stream's entire geomorphic integrity is no longer jeopardized by the adjacent management practices. Ecology then conducts a reach by reach assessment to determine the appropriate trees and shrubs to be used for restoration. In some cases, federal programs require revegetation as part of the cost-share program, and so restoration work occurs simultaneously with livestock exclusion.

The third step is to work with local land owners to promote continuous and proper management of upland grazing lands.

In addition to the Livestock and Water Quality Program, Ecology's Eastern Regional Office has established a similar collaborative approach to address crop production-related problems. Ecology encourages implementation of a wide variety of best management practices, however, a primary focus of effort has been establishing minimum land use setbacks, restoring degraded riparian corridors, and converting conventionally farmed land to conservation tillage practices.

Ecology teams with conservation districts, local governments, and landowners to provide technical assistance and funding for implementation of best management practices.

Ecology uses our regulatory authority as a backstop when collaborative efforts fail. The Water Pollution Control Act (RCW 90.48) gives Ecology the authority to take enforcement actions against nonpoint polluters.

RCW 90.48 makes it unlawful for any person to "cause, permit or suffer to be thrown, run, drained, allowed to seep or otherwise discharged … any organic or inorganic matter that shall cause or tend to cause pollution of" waters of the state. Any person who violates or creates a substantial potential to violate the provisions of Chapter 90.48 RCW is subject to an enforcement order from Ecology pursuant to RCW 90.48.120. Ecology is authorized to "issue such order or directive as it deems appropriate under the circumstances[.]" In addition to administrative orders, violating Chapter 90.48 RCW may result in injunctions, civil penalties, and notices of violations.

It is worth noting that RCW 90.48.120 gives Ecology the authority to take action in response to nonpoint source pollution, the statute also gives Ecology the authority to take action based on a "substantial potential" to pollute state waters via either a point or nonpoint pollution source. Consequently, Ecology not only has authority to take action following a NPS pollution occurrence (i.e. there was a discharge), but has specific statutory authority to act proactively to prevent NPS pollution from occurring in the first place. Ecology's authority includes the authority to require a nonpoint source polluter to implement specific best management practices (BMPs). Ecology's authority can be used to prevent nonpoint pollution and require BMPs, as necessary.

Ecology has used this regulatory backstop several times since 2016.

The result of these partnerships has been the implementation of best management practices at hundreds of sites across several watersheds where water quality and fish habitat issues exist. By using a collaborative strategy, backed up by enforcement when necessary, Ecology has been able to create relationships and build trust with rural residents while improving water quality.

In the upper Alpowa Creek watershed, work with landowners began in 2003. Thirteen miles of riparian buffers were installed. The creek was fenced to protect it from livestock, and off-stream water sources were developed. Thousands of native trees and shrubs were planted in

the stream corridor to help stabilize banks and shade the stream. These buffers were constructed using Natural Resource Conservation Service standards, which require a minimum width of 35 feet. Many of these buffers were wider than the minimum. For buffers installed with state or federal financial assistance, we require an agreement with the landowner stipulating that the buffer and fence will be maintained for at least 10 years. Ecology has also planted additional native trees and shrubs in the riparian area of the creek in cooperation with the Public Utility district.

Fencing was generally installed adjacent to or upstream of the impaired segments. However, we have also fenced portions of the stream where there are presently no Category 5 listings, but where there was unrestricted cattle access to the stream. Riparian buffers are left to revegetate naturally in those areas in which there is enough live native vegetation left to recover. In all other areas we are installing buffers by planting native plants.

More recently, in the last five years the Pomeroy CD in collaboration with the Palouse CD have utilized salmon recovery funds to establish over 484 Post Assisted Log Structures on Alpowa Creek resulting in increased pooling and floodplain storage to improve temperature and sedimentation concerns on over three miles of Alpowa Creek. To date, several thousand acres of cropland have been converted to direct seed or conservation tillage practices throughout the watershed.

Ecology's Eastern Regional Office is expanding its implementation work to the entire watershed instead of focusing on just upper Alpowa Creek. As of 2018, a significant portion of the upper Watershed had riparian buffers that have been established through use of funds from the Conservation Reserve Enhancement Program, but some of that has since been removed and grazed which will continue to receive focus in the coming years.

Ecology's recent watershed evaluations in 2020 resulted in the program identifying an additional four sites with active water quality concerns. Once prioritization was completed two landowners were sent technical and financial assistance letters from Ecology, and are currently in communication to draft a plan with the Pomeroy CD to protect water quality. These efforts will continue in 2021 to identify and document ongoing sites of concern to further implement new projects in the watershed.

Since the riparian buffers were installed, native vegetation is returning, and water quality monitoring data indicate that the stream is now meeting the state fecal coliform standard during most months. In addition, many landowners have been pleasantly surprised with the on-the-ground results. While they point out that water quality and fish habitat projects create some new management challenges, they have also observed some exciting economic benefits to their operations. By providing off-stream water in strategic locations, livestock are now better dispersed throughout their range. This has resulted in healthier grasses and better forage. In turn, animals are typically more robust and healthy, and the amount of supplemental feed needed during the year is reduced.

As the amount of fecal coliform delivered to the stream is reduced with healthy riparian corridors providing shade, we expect minimum dissolved oxygen concentrations and pH levels to meet water quality criteria.

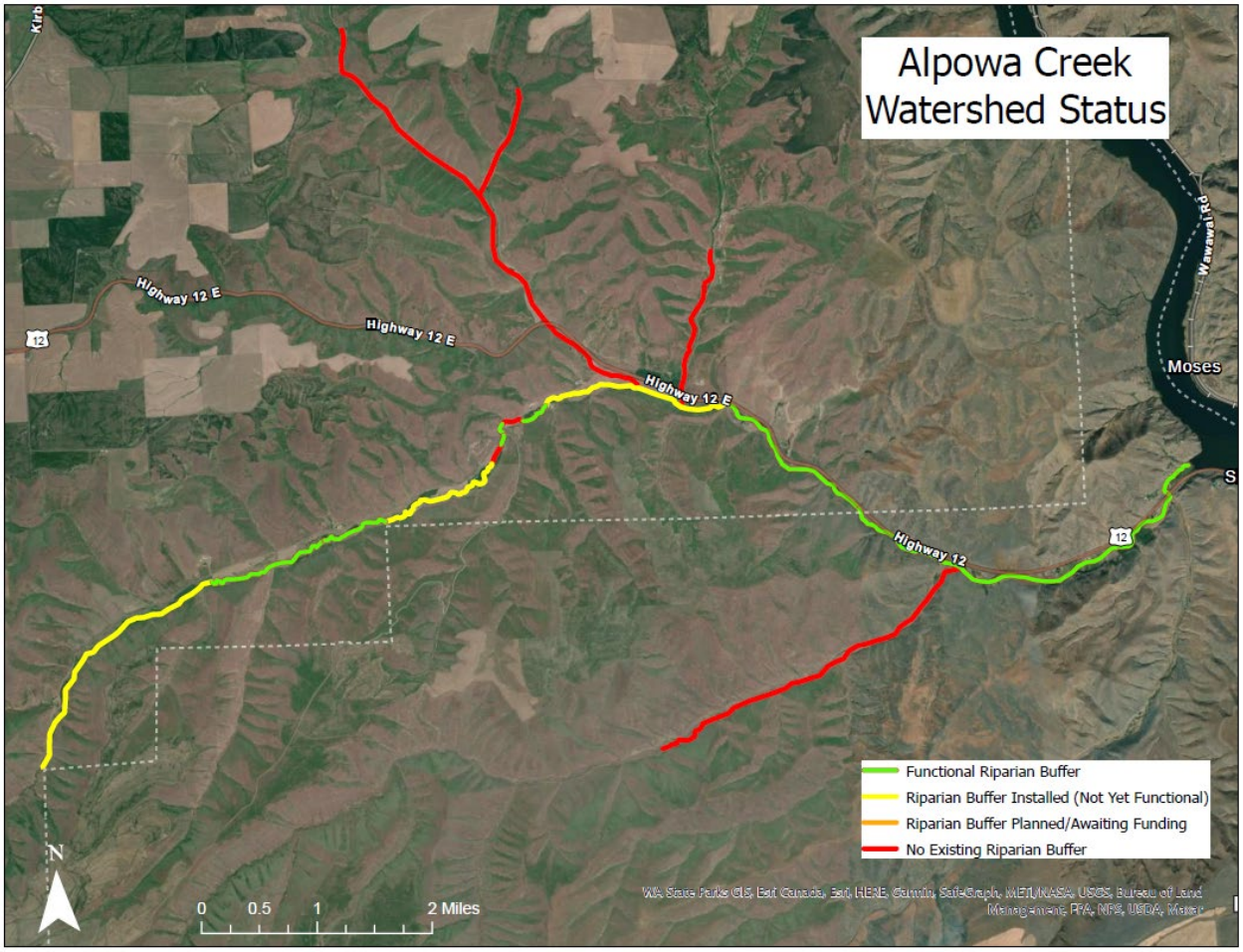

Figure 2. Alpowa Creek Status

Description of requirements under which pollution controls will be implemented.
It is Ecology's best professional judgement that the pollution controls which have been installed will result in the water quality standards being met. Maintenance of these controls has been ensured through 10-year landowner agreements that were established as part of the funding agreements for these projects. Additionally, Ecology staff will continue to perform watershed evaluations in this watershed to ensure that BMPs stay in place.

Estimate or Projection of Time When Water Quality Standards Will be Met

It will take time for the riparian corridor to fully recover and for the stream to re-establish its natural geometry. Ecology estimates that the riparian buffers will have grown enough to be fully effective in 10-15 years. With continued project implementation in the upper Alpowa Creek, increased focus in the watershed will help to meet the standards for fecal coliform,

dissolved oxygen and pH by 2030. Standards in the lower watershed and the temperature standards for the entire watershed should be met by 2035.

Schedule for Implementing Pollution Controls

As described earlier in this report, Ecology has worked with the conservation district, local governments, and landowners to implement a variety of best management practices in the upper Alpowa Creek watershed. It is our best professional judgment that this work will remedy the pollution problems in the impaired segments. Because it is our intention to restore the entire watershed and to prevent future pollution problems, we will be using monitoring data to track water quality improvements and to identify any new problem areas so they can be addressed. It will be an on-going process to get water bodies into compliance and to keep them in compliance.

Some work remains to be completed in the watershed. Landowners will now focus project implementation in the small tributaries to Alpowa Creek, where livestock still have uncontrolled access. Ecology's Livestock and Water Quality Program will continue to have an on-going presence in the watershed, and will continue working to achieve compliance with state water quality standards.

We will use monitoring data and evidence of additional work completed in this watershed to determine whether these listings will stay in Category 4b in the next Water Quality Assessment.

Monitoring Plan to Track Effectiveness of Pollution Controls

Monitoring results will be used to establish whether these projects are improving water quality and overall stream health. Monitoring data can also help to identify additional problem areas that should be addressed. Monitoring results will be reported to the public and EPA through Ecology's IR report development process. Ecology is planning on moving forward with an effectiveness monitoring study to cover all the region's 4b starting in 2022.

Commitment to Revise Pollution Controls as Necessary

Ecology will maintain a presence in the Alpowa Creek watershed to ensure that water quality continues to improve. We fully expect the Eastern Regional Office livestock program to achieve compliance with water quality standards. However, if it does not, Ecology will work with the conservation district, local governments, and landowners to determine other controls that could be used to achieve compliance.

Asotin Creek – December 2020

The Washington Department of Ecology (Ecology) Integrated Report (IR) proposes to exclude 17 temperature listings from the 303(d) list and place these water bodies in category 4b of the IR. The specific listings are:

- Temperature—13851, 13852, 13854, 13858, 13860, 13862, 13863, 13985, 13986, 20352, 20354, 22425, 22426, 22427, 22429, 22430, 29321

Ecology's basis for excluding these water bodies from the 303(d) list is outlined in this analysis.

Identification of Segment and Statement of Problem Causing Impairment

The Asotin Creek watershed is located in the southeast corner of Washington State. The majority of the watershed occurs within Asotin County. Some headwater streams get their start in Garfield County. Asotin Creek drains approximately 208,000 acres. The creek originates in the mixed conifer forests of the Blue Mountains. It cuts through layers of basalt rock and flows through narrow canyons before empting into the Snake River at the town of Asotin, Washington.

The name "Asotin" is derived from the Nez Perce word, Heesut'iin, "Eel Creek" (Hitchman 1985). The Asotin Creek watershed was the center of a fishing village for collecting Pacific lamprey (*Entosphenus tridentatus*), now rarely found in the creek. The watershed is still home to threatened species of fish including Snake River Steelhead as well as Bull Trout and Spring Chinook Salmon.

Asotin Creek has several tributaries, the largest is George Creek. Asotin creek is divided between the North and South Forks in the upper watershed. Other tributaries include Charley Creek, and Lick Creek. The George Creek watershed is approximately 89,000 acres and its major tributaries include Pintler Creek, Kelly Creek, and Rockpile Creek.

The geology of Asotin Creek region is of interest given it results in specific land-use patterns. The watershed consists of layers of basaltic rocks, formed by multiple ancient lava flows. The bedrock has been covered by fine-grained soils that are highly erodible. Folding of the underlying bedrock has resulted in a plateau increased in elevation and tilted to the north and east. The uplifting of the bedrock has caused streams to cut down and form steep and narrow v-shaped canyons.

The Asotin Creek watershed climate varies dramatically between the upper and lower portions of the watershed. Rainfall ranges from more than 45 inches in the higher elevations of the Blue Mountains to 12 inches near the confluence with the Snake River. This substantial variation occurs over approximately 20 miles, a relatively short distance. Ninety percent of the precipitation occurs between September and May with thirty percent of the winter's precipitation falling as snow. Snowfall at elevations less than 1,500 feet seldom lingers beyond three or four weeks, occasionally melting quickly enough to produce severe erosion.

Because of the differences in precipitation and elevation, vegetation also varies greatly in the watershed. Upland vegetation is dominated by mixed conifer forests in the upper watershed. The arid region near the Snake River is a shrub-steppe ecosystem dominated by sage and bunch grass. The stream corridor vegetation occurs in varying successional stages and consists mainly of alder and black cottonwood stands with mixed understory of shrubs. Ponderosa Pine is a dominant evergreen in much of the watershed. In the lower watershed, it typically occurs only in the transition zone between the riparian and upland areas. In the forested areas of the Blue Mountains, it is found throughout the uplands.

Multiple planning efforts have been completed in the Asotin Creek watershed. Most of these have been focused on salmon and steelhead recovery. The plans that have resulted all recognize stream temperature as a critical component of salmonid habitat and identify specific actions necessary to address temperature problems in the watershed. The Asotin Creek Model Watershed Plan proposed three implementation strategies to address the temperature problem:

- Streambank & Shoreline Protection
- Stream Channel Vegetation
- Fencing (Riparian)

The Bonneville Power Administration Sub-Basin Plan's strategies included management practices such as:

- Installing riparian buffers including livestock exclusion and planting
- Upholding existing land-use regulations
- Implementing conservation easements
- Decommissioning/paving roads

The Snake River Salmon Recovery plan identified riparian buffers and planting as primary tools to address temperature problems. The Middle Snake (WRIA 35) Watershed Plan identified stream temperature as a water quality problem and revegetation of stream corridors as a strategy to address it.

Much of the riparian vegetation in the Asotin Creek watershed is healthy compared to many eastern Washington watersheds. This is due to the rural location of the stream, the canyon geography that has prevented crop production along its banks, the public ownership of a significant portion of riparian area, and the extensive work by landowners to improve the riparian condition over the last several years.

However, there are five primary land-uses that cause nonpoint pollution and temperature problems in the Asotin watershed. Ecology's land use evaluation of the watershed has resulted in ranking the impacts causing the violations of temperature standards.

1) Livestock Feeding
2) Livestock Grazing
3) Urbanization
4) Forestry
5) Crop Production

Livestock Feeding—Winter feeding is a major source of impacts to riparian areas and vegetation on private lands. While many of the feeding areas have been fenced from surface water, much of that fence is too close to the creek to adequately protect surface water. Winter feeding areas continue to damage woody vegetation and prevent sapling recruitment and regeneration.

Livestock Grazing—Grazing activities also impact riparian vegetation, particularly in the upper portions of the watershed. Areas along the streams not ideal for winter feeding are often grazed from spring to fall. This includes some of the private forested areas.

Urbanization—Areas near Asotin are also likely contribute to temperature problems in the creek. Although the area is relatively small compared to the other land uses, the impacts to riparian vegetation are significant. Some homeowners have removed trees and shrubs and have lawns or pasture down to the water's edge. There are properties that own horses on small lots which access surface water and damage riparian vegetation. The city park and the Asotin Elementary school sports fields lack sufficient riparian vegetation.

Forestry—Historic timber harvesting on both public and private lands has removed many of the trees from the riparian zone. This has been particularly true on the Forest Service managed lands. Much of the shade in the upper watershed was lost due to historic logging activities. But, in recent years little logging has occurred in the riparian areas of the watershed. There has also been significant natural vegetation recovery and planting within the Umatilla National Forest.

Crop Production—Only a small portion of the riparian areas in the Asotin watershed are impacted by wheat and barley production. Most areas impacted by crop production occur in the upper Pintler Creek watershed where the streams are intermittent or ephemeral. In those areas, it is common for farming to occur up to streambanks or even through the stream channel.

Description of Pollution Controls and How They Will Achieve Water Quality Standards

Water quality target

In the Asotin Creek watershed, the water quality standards designate the following aquatic life beneficial uses:

Char spawning and rearing: This use protects spawning or early juvenile rearing by native char, or use by other species similarly dependent on such cold water. This use also protects summer foraging and migration of native char; and spawning, rearing, and migration by other salmonid species.

Core summer salmonid habitat: This use protects summer season, defined as June 15 through September 15, salmonid spawning or emergence, or adult holding; summer rearing habitat by one or more salmonids; or foraging by adult and sub-adult native char. Other protected uses include spawning outside of the summer season, rearing, and migration by salmonids.

Salmonid spawning, rearing, and migration: This use protects salmon or trout spawning and emergence that only occur outside of the summer season (September 16 – June 14). Other uses include rearing and migration by salmonids.

In some waters, special considerations have been included because they are necessary to protect spawning and incubation of char and salmonid species. Supplemental spawning/incubation criteria have been established for specified time periods to protect these special uses. Based on the beneficial uses, a numeric temperature criteria standard is established.

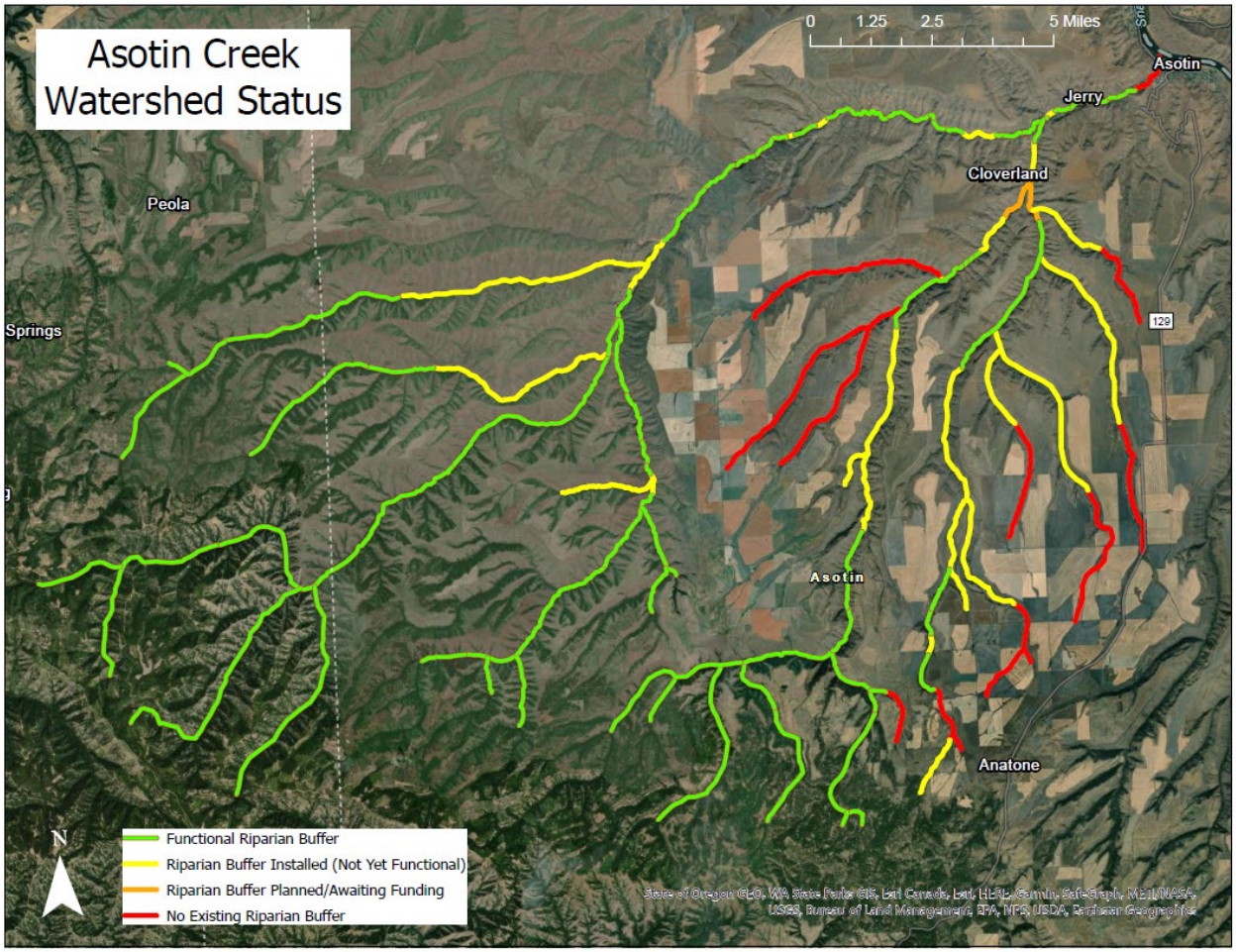

Figure 3. Asotin Creek Watershed Status

Controls that will achieve water quality standards

Asotin Creek is a relatively small stream. The bankfull width of the Asotin mainstem is approximately 13 meters (37 feet). The bankfull widths of lower reaches of the North Fork Asotin Creek, the South Fork Asotin Creek, and George Creek vary, but are generally half that width (Stuart, 2012). As would be expected, stream width diminishes significantly in the upper portions of the watershed. Buffer widths must be adequate to shade the stream and protect against other factors influencing temperature.

In order to meet water quality standards, Ecology will work with partners to create 75-foot-wide well-vegetated buffers on both sides of the stream (150 feet total) within the Asotin watershed for all areas used for livestock feeding, livestock grazing, and crop production. Ecology will focus on perennial reaches where stream flow occurs during the critical temperature period (late spring – early fall). Areas of the upper watershed where streams are intermittent or ephemeral are important for other water quality parameters but will be a lower priority. They will be planted and/or fenced as additional funding allows.

Ecology will implement an additional set of BMPs for properties with livestock. These BMPs use the construction specifications of the Natural Resource Conservation Service Field Office Technical Guide (FOTG). They are:

Livestock Exclusion Fence—A constructed barrier to animals that protects the riparian buffer. The fencing materials and the type and design of fence installed shall be of a high quality and durability. The type and design of fence installed must meet the management objective of excluding cattle from the riparian area. (FOTG Practice Code 382)

Watering Facility—A device to provide an adequate amount and quality of drinking water for livestock. Stock tanks should be installed as far from surface water as possible to protect against contamination of surface water via run-off or ground water connections. (FOTG Practice Code 361)

Stream Crossing—A stabilized area or structure constructed across a stream to provide a travel way for livestock. Stream crossings should be located in areas where the streambed is stable or where grade control can be provided to create a stable condition. (FOTG Practice Code 578)

For forest lands, the Washington State Forest Practices Rules (WAC 222-30) were developed with the expectation that the stream buffers and harvest management prescriptions were stringent enough to meet state water quality standards for temperature. These rules apply to all timber harvest on private lands within Washington. The program has some deficiencies, but provides a framework for bringing the forest practices rules and activities into full compliance with the water quality standards. Some additional discussions with the Department of Natural Resources (DNR) will occur to ensure water quality in Asotin Creek is adequately protected.

Currently, a no-cut buffer is required for fish bearing streams by the Forest Practices Rules. The rules establish a core zone of 30 feet from the stream where no harvest or construction is allowed. An additional 45-foot zone is also protected and no harvest is allowed except when:

- The basal area in the inner zone is greater than 110 square feet per acre and greater than 6 inches diameter. The harvest must leave at least 50 trees per acre including trees that shade the water.
- Thinning, and there are more than 100 trees per acre and the basal area is less than 60 square feet per acre. Still, 100 of the largest trees per acre must be left, including those that shade the stream.

Within the Umatilla National Forest, the Forest Service requires protected areas of 150 or 300 feet for perennial streams depending on the presence or absence of fish, but with exceptions. In addition, they require at least a 50 foot no-cut zone for non-fish-bearing intermittent streams. Some areas in the Umatilla National Forest will require additional planting based on historic harvest practices or natural events. Ecology will work with the Umatilla National Forest to ensure at least 75 feet of protection is required on all fish-bearing streams. In addition, some forest areas are subject to seasonal grazing. In these areas, a minimum of 35 feet of riparian corridor will be fenced to protect understory vegetation and prevent polluted run-off.

In the urbanized portion of the watershed, there are small areas 75-100ft vegetated buffers are not practical. This exception occurs primarily in lower Asotin Creek. Major roads or home locations do not allow for wider buffers. In these locations, Ecology will work to create 35 foot minimum vegetated buffers. Small buffers will be installed in a very small portion of the watershed (less than 2%) and should not affect the ability to meet water quality standards.

A significant amount of riparian planting has been completed in the Asotin watershed. Since 1998, more than 200,000 trees and shrubs have been planted, although more implementation is needed to achieve compliance with Washington's temperature standards.

Best management practice (BMP) implementation can be broken into two broad categories, riparian protection fencing and riparian planting. When fencing is installed to protect the riparian area from livestock, associated BMP, such as off-stream watering and stream crossings may also be necessary. In many cases, stream reaches will need both kinds of implementation. There are also stream reaches in the watershed where no livestock are present but additional planting is needed to adequately shade the stream.

In the last five years, an additional six miles of Asotin Creek was protected, with another five miles of buffer enhanced with plantings of over 13,000 trees in the riparian area. This watershed can be increasingly complex to establish robust buffers due to its arid and rocky conditions. The Asotin County CD continues to focus efforts on enhancement and maintenance in the watershed. Ecology has partnered with the CD on an active grant in the watershed to promote overbank flow and floodplain connection to improve temperature and sedimentation concerns. This has resulted in installing 116 Beaver Dam Analogs (BDAs) throughout the

watershed. The CD has recently submitted an FY22 state 319 water quality grant application to Ecology, which if funded will provide funding to protect and enhance an additional 40,000 stream feet and 20,000 trees to Asotin County watersheds, including Tenmile Creek. This grant would also provide enhanced technical assistance in the watershed to continue to see increased participation in water quality improvement projects.

In addition, farmers in the watershed are adopting direct seed technology, which is the practice of seeding a new crop into the standing stubble of a recently harvested crop without the traditional tillage of the ground. By doing so, soil erosion can be reduced by as much as 95 percent. This significantly reduces the volume of sediment washing into Tenmile Creek. All of these efforts will help address the temperature impairments. In recent years, the Asotin County CD has assisted in converting an additional 3400 acres to direct seed or conservation tillage in the watershed.

Ecology's Livestock and Water Quality Program has focused efforts back into Asotin Creek with recent watershed evaluations in 2020. As a result, the program identified an additional three sites with active water quality concerns. Once prioritization was completed one landowner was sent a technical and financial assistance letter from Ecology, and is currently in communication to draft a plan with the Asotin County CD which was included in their recent FY22 state 319 water quality grant application. These efforts will continue in 2021 to identify and document ongoing sites of concern to further implement new projects in the watershed.

Ecology uses our regulatory authority as a backstop when collaborative efforts fail. The Water Pollution Control Act (RCW 90.48) gives Ecology the authority to take enforcement actions against nonpoint polluters.

RCW 90.48 makes it unlawful for any person to "cause, permit or suffer to be thrown, run, drained, allowed to seep or otherwise discharged … any organic or inorganic matter that shall cause or tend to cause pollution of" waters of the state. Any person who violates or creates a substantial potential to violate the provisions of Chapter 90.48 RCW is subject to an enforcement order from Ecology pursuant to RCW 90.48.120. Ecology is authorized to "issue such order or directive as it deems appropriate under the circumstances[.]" In addition to administrative orders, violating Chapter 90.48 RCW may result in injunctions, civil penalties, and notices of violations.

It is worth noting that RCW 90.48.120 gives Ecology the authority to take action in response to nonpoint source pollution, the statute also gives Ecology the authority to take action based on a "substantial potential" to pollute state waters via either a point or nonpoint pollution source. Consequently, Ecology not only has authority to take action following a NPS pollution occurrence (i.e. there was a discharge), but has specific statutory authority to act proactively to prevent NPS pollution from occurring in the first place. Ecology's authority includes the authority to require a nonpoint source polluter to implement specific best management

practices (BMPs). Ecology's authority can be used to prevent nonpoint pollution and require BMPs, as necessary.

Ecology has used this regulatory backstop several times since 2016.

Estimate or Projection of Time When Water Quality Standards Will be Met

It will take time for the riparian corridor to fully recover and for the stream to re-establish its natural geometry. Ecology estimates that the riparian buffers will have grown enough to be fully effective in 10-15 years. While Asotin Creek continues to see projects implemented, increased focus in the watershed will help to meet the temperature standard throughout the entire watershed by 2025.

Schedule for Implementing Pollution Controls

As described earlier in this report, Ecology has worked with the conservation district, local governments, and landowners to implement a variety of best management practices in the Asotin Creek watershed, and landowners are continuing to implement best management practices that protect the stream corridor and improve water quality. It is our best professional judgment that this work will remedy the pollution problems in the impaired segments. Because it is our intention to restore the entire watershed and to prevent future pollution problems, we will be using monitoring data to track water quality improvements and to identify any new problem areas so they can be addressed. It will be an on-going process to get water bodies into compliance and to keep them in compliance.

Ecology's Livestock and Water Quality Program will continue to have an on-going presence in the watershed, and will continue working to achieve compliance with state water quality standards.

Monitoring Plan to Track effectiveness of Pollution Controls

Monitoring results will be used to establish whether these projects are improving water quality and overall stream health. Monitoring data can also help to identify additional problem areas that should be addressed. Monitoring results will be reported to the public and EPA through Ecology's IR report development process.

It takes time to implement riparian fencing and planting projects and time for planted vegetation to grow. Therefore, it is not necessary to monitor every year. At the same time, it is important to monitor frequently to capture water quality improvements over time as well as account for the annual variability that can result from different weather patterns. Ecology will use a two-year-on and two-year-off monitoring schedule to evaluate the effectiveness of this plan.

Commitment to Revise Pollution Controls as Necessary

Ecology will maintain a presence in the Asotin Creek watershed to ensure that water quality continues to improve. We fully expect the BMPs being implemented will achieve compliance

with water quality standards. However, if they do not, Ecology will work with its local partners to determine other controls that could be used to achieve compliance.

Couse Creek – December 2020

The Washington Department of Ecology (Ecology) Integrated Report (IR) proposes to exclude two listings from the 303(d) list and place these segments into category 4b. The specific listings are:

- Temperature—29318 and 29320

These water bodies were listed in category 4b of the 2012 IR. Ecology's basis for excluding these waterbodies from the 303(d) list is outlined in this evaluation.

Identification of Segment and Statement of Problem Causing Impairment

Couse Creek is located in Asotin County in southeastern Washington. The creek cuts through a deep canyon on its way to the Snake River. The plateaus above Couse Creek are farmed for wheat and barley, and the canyon is used for range and feeding livestock. Threatened Snake River Steelhead trout still return to Couse Creek each autumn.

Prior to 2001, livestock in the watershed had uncontrolled access to the creek, and were fed at several easy to reach locations along the stream. The riparian corridor was degraded. Trampling and overgrazing had damaged or removed many of the trees and shrubs along the stream corridor. This degraded riparian area could not provide shade to the stream, resulting in high water temperatures.

This is a sparsely populated area. There are no towns in the watershed and no point sources of pollution.

Monitoring data for these two segments was collected by the Washington Department of Fish and Wildlife, and covers the years 2000 through 2002. For segment 29318, data show that the highest daily temperature occurred in 2001. For that year, the 7-day mean of maximum daily temperature was 21.1 degrees Centigrade, and the maximum daily temperature was 23.4 degrees Centigrade from continuous measurements. For segment 29320, the highest temperatures occurred in 2000. For that year, the 7-day mean of maximum daily temperature was 23.3 degrees Centigrade, with a maximum daily temperature of 24.8 degrees Centigrade from continuous measurements.

Description of Pollution Controls and How They Will Achieve Water Quality Standards

Water quality target

The designated uses for the two impaired segments are spawning, rearing and migration, and the temperature criterion is 17.5 degrees Centigrade. In addition, the segments have a supplemental spawning criterion of 13 degrees Centigrade from February 15 to June 1.

Controls that will achieve water quality standards

The Department of Ecology's Eastern Regional Office has established a Livestock and Water Quality Program that uses a unique collaborative approach to address livestock-related problems. Instead of using the standard process that starts with a Category 5 listing, establishing a TMDL for the stream, writing an implementation plan, and finally getting to actual implementation, this strategy goes straight to implementation. The strategy is applied in watersheds in which the cause of a water quality impairment is clear.

Ecology encourages implementation of a wide variety of best management practices, however, a primary focus of the program has been to restore degraded riparian corridors and eliminate unlimited animal access to streams. Healthy riparian areas can improve water quality and stream health in multiple ways, which make them a particularly valuable and cost-effective management practice. Healthy riparian areas

- Slow bank erosion by holding soil in place during periods of high water.
- Reduce flood damage and sedimentation by slowing runoff and capturing the sediment that would otherwise be carried downstream.
- Help keep water cool in summer by shading the stream.
- Improve water quality by capturing sediment, nutrients, pesticides, pathogens, and other pollutants before they reach the stream.
- Enhance summer stream flow by improving water infiltration and storage.
- Create fish and wildlife habitat.
- Limit livestock manure inputs to the creek and riparian areas.

Ecology has a three-step riparian restoration strategy, which allows the department to efficiently apply resources to priority problem areas. The first step is to address the source of degradation unlimited livestock access to streams and winter feeding operations in close proximity to the riparian corridor. Ecology relies primarily on livestock exclusion, and off-stream water supply to restrict livestock access to the riparian area. In implementing this BMP, Ecology uses our 319 and centennial clean water grant guidelines, which require a minimum 75, 50 or 35 foot buffer between the livestock fence and the mean ordinary high water mark of the nearest stream bank depending on the type of stream. In many cases, the buffer width may be larger depending on the stream and site conditions.

By first addressing livestock access, Ecology seeks to abate the primary pollution sources—livestock in the stream, eroded stream banks, increased runoff, increased sedimentation, and subsequent transport of fecal matter. As vegetation naturally returns in the riparian area, site conditions become stabilized and the pollution sources are dramatically reduced. Also, this approach works to arrest morphological changes to the entire stream that are induced by erosion and sedimentation.

Ecology has spent much of its efforts and resources implementing this first step, in large part, because we have taken a holistic, watershed approach to protecting streams. By first addressing the primary sources of pollution and geomorphic change, Ecology can establish the

necessary site conditions for successful restoration. Moreover, Ecology ensures that, first and foremost, the root problems are addressed for *the entire stream*, before resources are focused on site or segment specific restoration.

The second step occurs after a majority of site conditions have been stabilized, and the stream's entire geomorphic integrity is no longer jeopardized by the adjacent management practices. Ecology then conducts a reach by reach assessment to determine the appropriate trees and shrubs to be used for restoration. In some cases federal programs require revegetation as part of the cost-share program, and so restoration work occurs simultaneously with livestock exclusion.

The third step is to work with local land owners to promote continuous and proper management of upland grazing lands.

In addition to the Livestock and Water Quality Program, Ecology's Eastern Regional Office has established a similar collaborative approach to address crop production-related problems. Ecology encourages implementation of a wide variety of best management practices, however, a primary focus of effort has been establishing minimum land use setbacks, restoring degraded riparian corridors, and converting conventionally farmed land to conservation tillage practices.

Ecology teams with conservation districts, local governments, and landowners to provide technical assistance and funding for implementation of best management practices. Ecology uses our regulatory authority as a backstop when collaborative efforts fail. The Water Pollution Control Act (RCW 90.48) gives Ecology the authority to take enforcement actions against nonpoint polluters.

RCW 90.48 makes it unlawful for any person to "cause, permit or suffer to be thrown, run, drained, allowed to seep or otherwise discharged … any organic or inorganic matter that shall cause or tend to cause pollution of" waters of the state. Any person who violates or creates a substantial potential to violate the provisions of Chapter 90.48 RCW is subject to an enforcement order from Ecology pursuant to RCW 90.48.120. Ecology is authorized to "issue such order or directive as it deems appropriate under the circumstances[.]" In addition to administrative orders, violating Chapter 90.48 RCW may result in injunctions, civil penalties, and notices of violations.

It is worth noting that RCW 90.48.120 gives Ecology the authority to take action in response to nonpoint source pollution, the statute also gives Ecology the authority to take action based on a "substantial potential" to pollute state waters via either a point or nonpoint pollution source. Consequently, Ecology not only has authority to take action following a NPS pollution occurrence (i.e. there was a discharge), but has specific statutory authority to act proactively to prevent NPS pollution from occurring in the first place. Ecology's authority includes the authority to require a nonpoint source polluter to implement specific best management practices (BMPs). Ecology's authority can be used to prevent nonpoint pollution and require BMPs, as necessary.

Ecology has used this regulatory backstop several times since 2016.

The result of these partnerships has been the implementation of best management practices at hundreds of sites across several watersheds where water quality and fish habitat issues exist. By using a collaborative strategy, backed up by enforcement when necessary, Ecology has been able to create relationships and build trust with rural residents while improving water quality.

In the Couse Creek watershed, work with landowners began in 2002. Eight miles of riparian buffers were installed. The creek was fenced to protect it from livestock, and off-stream water was provided at several key points. Thousands of native trees and shrubs were planted in the stream corridor. Buffers are constructed using Natural Resource Conservation Service standards, which require a minimum width of 35 feet. For buffers installed with state or federal financial assistance, we require an agreement with the landowner stipulating that the buffer and fence will be maintained for at least 10 years.

In addition, farmers in the watershed are adopting direct seed technology, which is the practice of seeding a new crop into the standing stubble of a recently harvested crop without the traditional tillage of the ground. By doing so, soil erosion can be reduced by as much as 95 percent. This significantly reduces the volume of sediment washing into Couse Creek. All of these efforts will help address the temperature impairments. In the last few years, the Asotin County CD has assisted in converting an additional 652 acres to direct seed or conservation tillage in the watershed.

All of these efforts will help address the temperature impairments. Initial cattle exclusion fencing was generally installed adjacent to or upstream of the impaired segments. However, we have also fenced portions of the stream and tributaries where there are presently no Category 5 listings, but where there was unrestricted cattle access to the stream.

Riparian buffers are left to revegetate naturally in those areas in which there is enough live native vegetation left to recover. In all other areas we are installing buffers by planting native plants. We expect the planting to continue for a few seasons to ensure all buffers are adequate and healthy. As of 2006, all cattle in the watershed have been fenced out of the stream.

In the last five years, an additional thirteen miles of riparian buffer was enhanced with plantings of over 9,000 trees in the riparian area. This watershed can be increasingly complex to establish robust buffers due to its arid and rocky conditions. The Asotin County CD continues to focus efforts on enhancement and maintenance in the watershed. Ecology has partnered with the CD on an active grant in the watershed to promote overbank flow and floodplain connection to improve temperature and sedimentation concerns. This has resulted in installing 46 Beaver Dam Analogs (BDAs) throughout the watershed. The CD has recently submitted an FY22 state 319 water quality grant application to Ecology, which if funded will provide funding to protect and enhance an additional 40,000 stream feet and 20,000 trees to Asotin County watersheds, including Couse Creek.

The Couse Creek watershed continues to recover. Since 2006, many riparian areas have been placed into the Conservation Reserve Enhancement Program, which requires maintenance of riparian plantings. Ecology has completed additional planting to increase riparian vegetation. In addition, Ecology has been encouraging landowners to implement direct seed technology through the use of state Centennial and federal 319 grant funds; and Bonneville Power Administration Direct Seed Cost-share.

Changes to the watershed are obvious. Trees and shrubs are now growing in the riparian area, and the channel is more defined and stable, with more consistent surface flow. There are Steelhead trout in the creek. Landowners are noticing the changes, too. One Couse Creek landowner told Ecology, “Since we implemented these projects we have stands of grass I have never seen before. The stream corridor looks healthier than it did three years ago.”

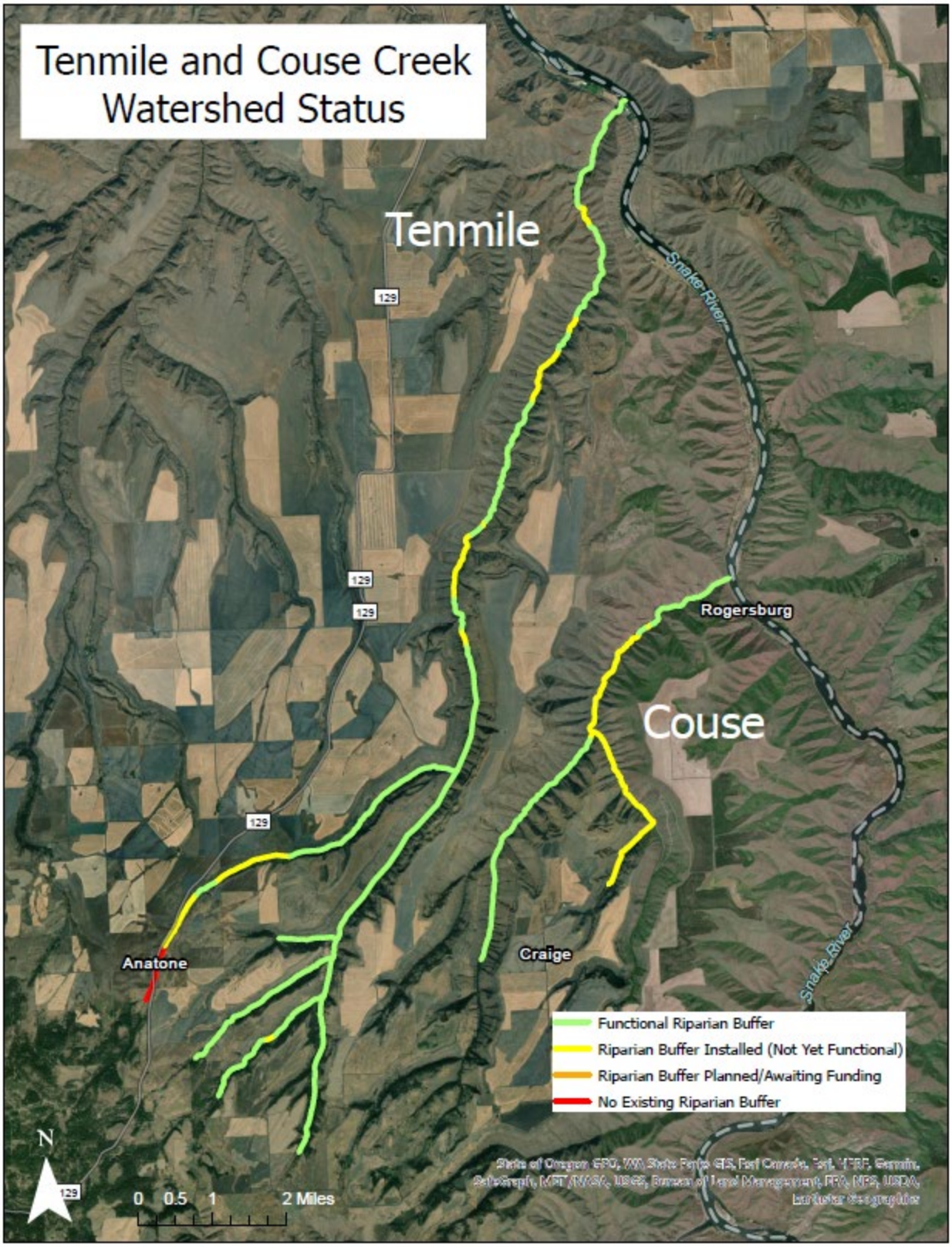

Figure 4. Tenmile and Couse Creek Watershed Status

Description of requirements under which pollution controls will be implemented

It is Ecology's best professional judgment that the pollution controls that have been installed will result in the water quality standards being met. Maintenance of these controls has been ensured through 10-year landowner agreements that were established as part of the funding agreements for these projects. Additionally, Ecology staff will continue to perform watershed evaluations in this watershed to ensure that BMPs stay in place.

Estimate or Projection of Time When Water Quality Standards Will be Met

It will take time for the riparian corridor to fully recover and for the stream to re-establish its natural geometry. Ecology estimates that the riparian buffers will have grown enough to be fully effective in 10-15 years. While Couse Creek continues to see projects implemented, increased focus in the watershed will help to meet the temperature standard throughout the entire watershed by 2025.

Schedule for Implementing Pollution Controls

As described earlier in this report, Ecology has worked with the conservation district, local governments, and landowners to implement a variety of best management practices in the Couse Creek watershed. It is our best professional judgment that this work will remedy the pollution problems in the impaired segments. Because it is our intention to restore the entire watershed and to prevent future pollution problems, we will be using monitoring data to track water quality improvements and to identify any new problem areas so they can be addressed. It will be an on-going process to get water bodies into compliance and to keep them in compliance.

Ecology's Livestock and Water Quality Program will continue to have an on-going presence in the watershed, and will continue working to achieve compliance with state water quality standards.

Monitoring Plan to Track Effectiveness of Pollution Controls

Monitoring results will be used to establish whether these projects are improving water quality and overall stream health. Monitoring data can also help to identify additional problem areas that should be addressed. Monitoring results will be reported to the public and EPA through Ecology's IR report development process. Ecology is planning on moving forward with an effectiveness monitoring study to cover all the region's 4b starting in 2022.

Commitment to Revise Pollution Controls as Necessary

Ecology will maintain a presence in the Couse Creek watershed to ensure that water quality continues to improve. We fully expect the Eastern Regional Office livestock and water quality program to achieve compliance with water quality standards. However, if it does not, Ecology will work with the conservation district, local governments, and landowners to determine other controls that could be used to achieve compliance.

Deadman and Meadow Creeks – December 2020

The Washington Department of Ecology (Ecology) Integrated Report (IR) proposes to exclude the following listings in Deadman and Meadow Creeks from the 303(d) list and place these segments into category 4b of the IR:

- seven listings (18827, 18828, 18829, 18830, 18831, 18832, and 40534) for temperature
- six listings (40553, 40554, 40555, 45999, 46000, and 72286) for bacteria
- three listings (47172, 47173, and 47174) for dissolved oxygen
- four listings (50438, 50473, 50474, 50475) for pH

These segments were in various categories of the 2012 IR. Listings 18827, 18828, 40534, 40554, and 40555 were in category 4b. Listings 18829, 40553, 40555, 50438, 50475, 18830, 18831, 46000, 47172, 47173, 50473, and 50475 were in category 5. Listing 18832 was in category 1. Listing 45999 was in category 2. Listing 72286 was in category 3.

Ecology's basis for excluding these waterbodies from the 303(d) list is outlined in this evaluation.

Identification of Segment and Statement of Problem Causing Impairment

Deadman and Meadow Creek are located in Garfield County in southeastern Washington. Both flow roughly east to west through rolling hills before their confluences meet at the Snake River. This is arid country, with rainfall in some areas averaging as little as 11 inches annually.

Historically, the surrounding hills were covered in bunchgrass and sage, and the meandering creek provided habitat for Steelhead trout. Approximately half the watershed today is used for non-irrigated crops such as wheat and barley, primarily in the high areas of the watershed. The other half, primarily the bottomlands near streams, provides range for livestock. From November through March, cattle are typically fed along the valley floor, which serves as a refuge from the region's harsh winter weather.

This is a sparsely populated area. There are no towns in the watershed and no point sources of pollution. The few farmhouses are widely dispersed in the watershed, and there is no evidence that septic systems are contributing pollution to streams.

Data for all pollutants and segments was collected by Washington State University (WSU) and the Washington Department of Fish and Wildlife (WDFW) between 2000 and 2007. WSU's data showed excursions above the criteria for both temperature and fecal coliform. Data collected by the Washington Department of Fish and Wildlife shows that the highest daily temperatures occurred in 2001. For segment 18827, data show a 7-day mean of maximum daily temperature of 24.3 degrees Centigrade, with a maximum daily temperature of 25.6 degrees Centigrade from continuous measurements. For segment 18828, data show a 7-day mean of maximum daily temperature of 20.7 degrees Centigrade, with a maximum daily temperature of 21.8 degrees Centigrade from continuous measurements. Dissolved oxygen data show consistent excursions below the criteria. pH data show both high and low pH excursions.

The impairments are the result of a combination of factors. Winter feeding and uncontrolled livestock access to the stream had eliminated much of the vegetation within the stream corridor. This degraded riparian area could not provide shade to the stream, resulting in high water temperatures. It also allowed manure to run directly into streams. In addition, the uncontrolled stream access allowed cattle to deposit manure directly into the water and to trample stream banks. The creek was shallow, wide, and muddy in many areas due to cattle trampling, and provided little habitat for Steelhead trout.

Description of Pollution Controls and How They Will Achieve Water Quality Standards

Water Quality Target

The designated uses for the temperature impaired segments are spawning, rearing and migration, and the temperature criterion is 17.5 degrees Centigrade, year-round. Segments 18827 and 18829 also have a supplemental spawning criterion of 13 degrees Centigrade from February 15 to June 1.

The designated use for the bacteria impaired segments is primary contact recreation. Ecology now uses Escherichia coli (E. Coli) as the criteria in this watershed. E. Coli levels must not exceed a geometric mean value of 100 CFU or MPN per 100 mL, with not more than 10 percent of all samples (or a single sample when less than ten sample points exist) exceeding 320 CFU or MPN per 100 mL.

For the dissolved oxygen impaired segments, the standards require that the lowest one-day minimum be no lower than 8.0 mg/L.

For the pH impaired segments, the standard requires the pH to be within the range of 6.5 to 8.5, with a human-caused variation within this range of less than 0.5 units.

Controls that will achieve water quality standards

The Department of Ecology's Eastern Regional Office has established a Livestock and Water Quality Program that uses a unique collaborative approach to address livestock-related problems. Instead of using the standard process that starts with a Category 5 listing, establishing a TMDL for the stream, writing an implementation plan, and finally getting to actual implementation, this strategy goes straight to implementation. The strategy is applied in watersheds in which the cause of a water quality impairment is clear.

Ecology encourages implementation of a wide variety of best management practices, however, a primary focus of the program has been to restore degraded riparian corridors and eliminate unlimited animal access to streams. Healthy riparian areas can improve water quality and stream health in multiple ways, which make them a particularly valuable and cost-effective management practice. Healthy riparian areas:

- Slow bank erosion by holding soil in place during periods of high water.

- Reduce flood damage and sedimentation by slowing runoff and capturing the sediment that would otherwise be carried downstream.
- Help keep water cool in summer by shading the stream.
- Improve water quality by capturing sediment, nutrients, pesticides, pathogens, and other pollutants before they reach the stream.
- Enhance summer stream flow by improving water infiltration and storage.
- Create fish and wildlife habitat.
- Limit livestock manure inputs to the creek and riparian areas.

Ecology has a three-step riparian restoration strategy, which allows the department to efficiently apply resources to priority problem areas. The first step is to address the source of degradation unlimited livestock access to streams and winterfeeding operations in close proximity to the riparian corridor. Ecology relies primarily on livestock exclusion, and off-stream water supply to restrict livestock access to the riparian area. In implementing this BMP, Ecology uses our 319 and centennial clean water grant guidelines, which require a minimum 75, 50 or 35-foot buffer between the livestock fence and the mean ordinary high water mark of the nearest stream bank depending on the type of stream. In many cases, the buffer width may be larger depending on the stream and site conditions.

By first addressing livestock access, Ecology seeks to abate the primary pollution sources—livestock in the stream, eroded streambanks, increased runoff, increased sedimentation, and subsequent transport of fecal matter. As vegetation naturally returns in the riparian area, site conditions become stabilized and the pollution sources are dramatically reduced. Also, this approach works to arrest morphological changes to the entire stream that are induced by erosion and sedimentation.

Ecology has spent much of its efforts and resources implementing this first step, in large part, because we have taken a holistic, watershed approach to protecting streams. By first addressing the primary sources of pollution and geomorphic change, Ecology can establish the necessary site conditions for successful restoration. Moreover, Ecology ensures that, first and foremost, the root problems are addressed for *the entire stream*, before resources are focused on site or segment specific restoration.

The second step occurs after a majority of site conditions have been stabilized, and the stream's entire geomorphic integrity is no longer jeopardized by the adjacent management practices. Ecology then conducts a reach by reach assessment to determine the appropriate trees and shrubs to be used for restoration. In some cases, federal programs require revegetation as part of the cost-share program, and so restoration work occurs simultaneously with livestock exclusion.

The third step is to work with local land owners to promote continuous and proper management of upland grazing lands.

In addition to the Livestock and Water Quality Program, Ecology's Eastern Regional Office has established a similar collaborative approach to address crop production-related problems. Ecology encourages implementation of a wide variety of best management practices, however, a primary focus of effort has been establishing minimum land use setbacks, restoring degraded riparian corridors, and converting conventionally farmed land to conservation tillage practices.

Ecology teams with conservation districts, local governments, and landowners to provide technical assistance and funding for implementation of best management practices. Ecology uses our regulatory authority as a backstop when collaborative efforts fail. The Water Pollution Control Act (RCW 90.48) gives Ecology the authority to take enforcement actions against nonpoint polluters.

RCW 90.48 makes it unlawful for any person to "cause, permit or suffer to be thrown, run, drained, allowed to seep or otherwise discharged … any organic or inorganic matter that shall cause or tend to cause pollution of" waters of the state. Any person who violates or creates a substantial potential to violate the provisions of Chapter 90.48 RCW is subject to an enforcement order from Ecology pursuant to RCW 90.48.120. Ecology is authorized to "issue such order or directive as it deems appropriate under the circumstances[.]" In addition to administrative orders, violating Chapter 90.48 RCW may result in injunctions, civil penalties, and notices of violations.

It is worth noting that RCW 90.48.120 gives Ecology the authority to take action in response to nonpoint source pollution, the statute also gives Ecology the authority to take action based on a "substantial potential" to pollute state waters via either a point or nonpoint pollution source. Consequently, Ecology not only has authority to take action following a NPS pollution occurrence (i.e. there was a discharge), but has specific statutory authority to act proactively to prevent NPS pollution from occurring in the first place. Ecology's authority includes the authority to require a nonpoint source polluter to implement specific best management practices (BMPs). Ecology's authority can be used to prevent nonpoint pollution and require BMPs, as necessary.

Ecology has used this regulatory backstop several times since 2016.

The result of these partnerships has been the implementation of best management practices at hundreds of sites across several watersheds where water quality and fish habitat issues exist. By using a collaborative strategy, backed up by enforcement when necessary, Ecology has been able to create relationships and build trust with rural residents while improving water quality.

In the Deadman Creek watershed, work with landowners began in 2002. Twenty-nine miles of riparian buffers were installed prior to 2014. In spring of 2014, ¾ mile of new cattle exclusion fence was installed in Meadow Creek and ¼ mile in Deadman Creek. The creek was fenced to protect it from livestock, and several off-stream watering facilities were installed. Feeding locations were moved away from the stream to prevent polluted runoff. Trees and shrubs were planted to stabilize banks, shade the stream, and provide wildlife habitat. Buffers are

constructed using Natural Resource Conservation Service standards, which require a minimum width of 35 feet. For buffers installed with state or federal financial assistance, we require an agreement with the landowner stipulating that the buffer and fence will be maintained for at least 10 years.

Fencing was generally installed adjacent to or upstream of the impaired segments. However, we are also fencing portions of the stream where there are presently no Category 5 listings, but where there is unrestricted cattle access to the stream. Riparian buffers are left to revegetate naturally in those areas in which there is enough live native vegetation left to recover. In all other areas we are installing buffers by planting native plants. By 2008, 80 percent of the cattle had been fenced out of the stream.

More recently, over the last 5 years the Pomeroy CD has added an additional 1.6 miles of livestock exclusion fencing on lower Deadman Creek with planting to help with revegetation. An additional site near the conjunction of the North and South Fork Deadman provided additional off-stream watering. In partnership with Ecology, the CD installed off-stream watering for a heavily polluted site on North Deadman Creek which will soon be under a CREP contract with another 2.5 miles of livestock exclusion fencing being added in 2021.

In Meadow Creek the Pomeroy CD has recently worked with two separate landowners to install open bottom culverts to access winter feeding grounds and prevent livestock crossing through surface water. In partnership with Ecology, the CD installed another mile of livestock exclusion fencing along Meadow Creek as well as a small spring-fed tributary. A major recent effort seen in this watershed has been the addition of both Beaver Dam Analogs (BDAs) as well as beaver re-location to assist with increasing annual water flows and promote floodplain storage for water temperatures and sedimentation. Both Deadman and Meadow Creek watersheds have seen a large increase of cropland shifting into direct seed or conservation tillage practices with increased technical assistance from the Pomeroy CD.

Most BMPs remain in good shape, although there was some backsliding prior to Ecology's 2013 re-assessment of the watershed. There had been gates and stream crossings left open and a few sections of fence that had not been completed. These are fixed now. Ecology has collected data that indicates an improving trend in the watershed, but there are data gaps so it is inconclusive, and the water is not yet meeting standards.

Ecology's Livestock and Water Quality Program has focused efforts back into Deadman and Meadow Creeks with recent watershed evaluations in 2020. As a result, the program identified an additional eighteen sites with active water quality concerns. Once prioritization was completed one landowner was sent a technical and financial assistance letter from Ecology, and is currently in communication to draft a plan with the Pomeroy CD. These efforts will continue in 2021 to identify and document ongoing sites of concern to further implement new projects in the watershed.

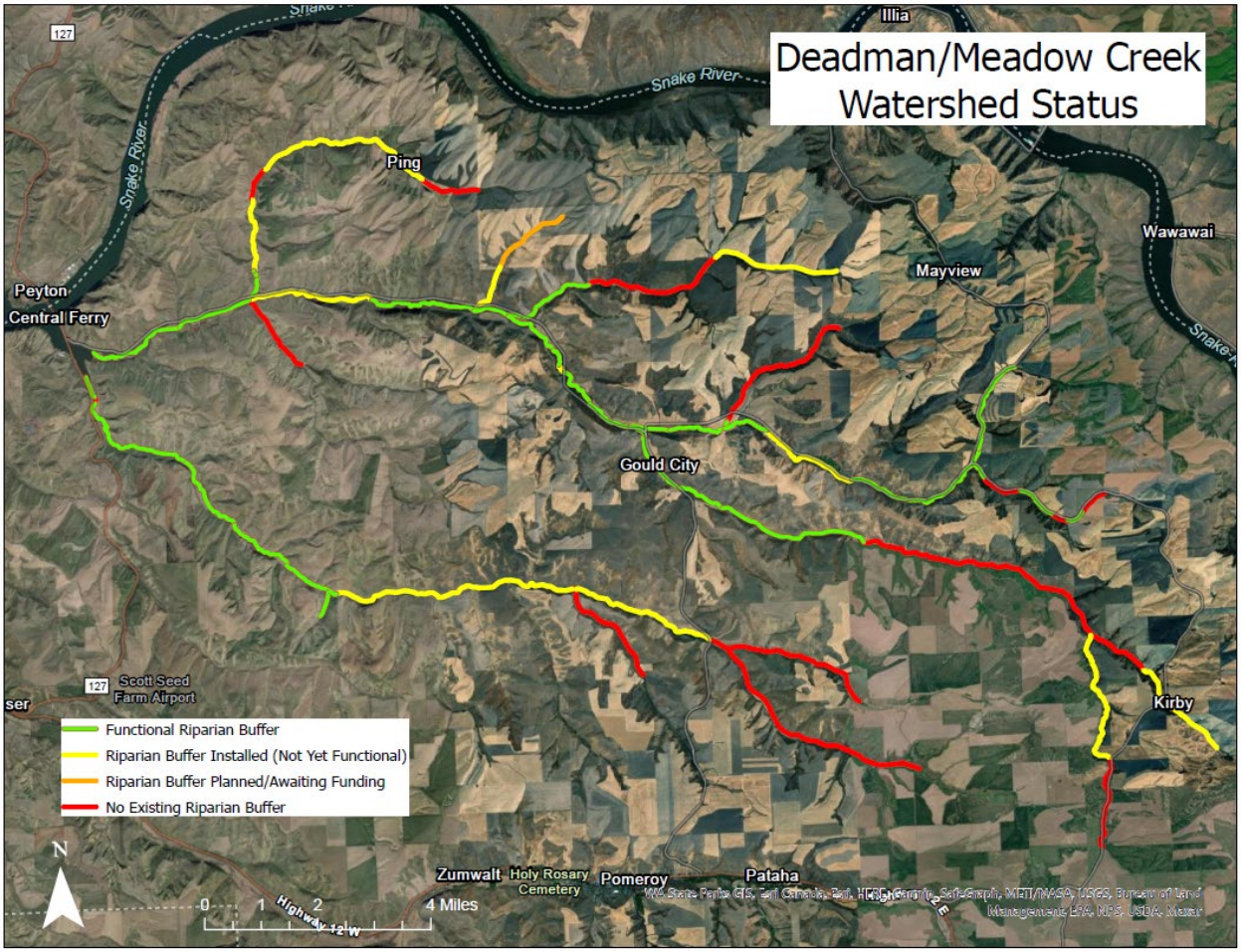

Figure 5. Deadman/Meadow Creek Watershed Status

Description of requirements under which pollution controls will be implemented

It is Ecology's best professional judgment that the pollution controls that have been installed will result in the water quality standards being met. Maintenance of these controls has been ensured through 10-year landowner agreements that were established as part of the funding agreements for these projects. Additionally, Ecology staff will continue to perform watershed evaluations in this watershed to ensure that BMPs stay in place.

Estimate or Projection of Time When Water Quality Standards Will be Met

It will take time for the riparian corridor to fully recover and for the stream to re-establish its natural geometry. Ecology estimates that the riparian buffers will have grown enough to be fully effective in 10-15 years. While Deadman and Meadow Creek continue to see projects implemented, increased focus in the watershed will help to meet temperature, fecal coliform, dissolved oxygen, and pH standards by 2035.

Schedule for Implementing Pollution Controls

As described earlier in this report, Ecology has worked with the conservation district, local governments, and landowners to implement a variety of best management practices in the Deadman and Meadow Creeks watershed. It is our best professional judgment that this work will remedy the pollution problems in the impaired segments. Because it is our intention to restore the entire watershed and to prevent future pollution problems, we will be using monitoring data to track water quality improvements and to identify any new problem areas so they can be addressed. It will be an on-going process to get water bodies into compliance and to keep them in compliance.

A few sites where cattle are adversely affecting water quality remain in the watershed, and Ecology's Livestock and Water Quality Program will continue working with landowners to address these problem areas.

In addition, farmers throughout the watershed are adopting conservation tillage practices that reduce soil erosion and keep sediment out of the stream. These practices also improve rain and snowmelt infiltration and reduce the change of damaging spring floods. A new challenge in the watershed is a noxious weed called False Indigo. As cattle are excluded from the stream corridor, this aggressive invader moves in. The Pomeroy Conservation District has a grant from the Department of Ecology to remove the weed and plant native trees and shrubs in its place. Ecology's livestock and water quality program will continue to have an on-going presence in the watershed, and will continue working to achieve compliance with state water quality standards.

Monitoring Plan to Track Effectiveness of Pollution Controls

Monitoring results will be used to establish whether these projects are improving water quality and overall stream health. Monitoring data can also help to identify additional problem areas that should be addressed. Monitoring results will be reported to the public and EPA through Ecology's IR report development process. Ecology is planning on moving forward with an effectiveness monitoring study to cover all the region's 4b starting in 2022.

Commitment to Revise Pollution Controls as Necessary

Ecology will maintain a presence in the Deadman Creek watershed to ensure that water quality continues to improve. We fully expect the Eastern Regional Office Livestock and Water Quality Program to achieve compliance with water quality standards. However, if it does not, Ecology will work with the conservation district, local governments, and landowners to determine other controls that could be used to achieve compliance.

Tenmile Creek – December 2020

The Washington Department of Ecology (Ecology) Integrated Report (IR) proposes to exclude six listings from the 303(d) list and place these segments into category 4b. The specific listings are:

- Temperature—18835, 18836, 20355, 20356, 29317
- Bacteria—72313

The temperature impaired water bodies were listed in category 4b and the bacteria impaired water body was listed in category 3 of the 2012 IR. Ecology's basis for excluding these waterbodies from the 303(d) list is outlined in this evaluation.

Identification of Segment and Statement of Problem Causing Impairment

Tenmile Creek is located in Asotin County in southeastern Washington. Mill Creek is a tributary of Tenmile Creek. Tenmile Creek drops 2000 feet from the fringes of the Blue Mountains to the Snake River. The canyon created by the creek provides habitat for a variety of wildlife including deer, elk, coyote, and many species of birds. Even cougar are known to frequent the area. Tenmile Creek is also home to threatened Snake River Steelhead trout.

The Tenmile Creek canyon is important range for cattle. It also provides an excellent location for winter feeding. Feeding at the canyon's base protects livestock from harsh winter weather. However, a century of these activities left the stream corridor in poor condition. Many of the trees were damaged or removed, and stream banks were trampled and overgrazed. Winter feeding and uncontrolled livestock access to the stream had eliminated much of the vegetation within the stream corridor. This degraded riparian area could not provide shade to the stream, resulting in high water temperatures.

This is a sparsely populated area. There are no towns in the watershed and no point sources of pollution.

Monitoring data for the temperature impaired segments was collected by the Washington Department of Fish and Wildlife, and covers the years 2000 through 2002. For segment 18835, the highest daily temperature occurred in 2001. Data show a 7-day mean of maximum daily temperature of 22.8 degrees Centigrade, with a maximum daily temperature of 23.8 degrees Centigrade from continuous measurements. For segment 18836, the highest daily temperature occurred in 2002. Data show a 7-day mean of maximum daily temperature of 17.9 degrees centigrade, with a maximum daily temperature of 20.1 degrees Centigrade from continuous measurements. For segments 20355, 20356, and 29317, data was collected only in 2000. For segment 20355, data show a 7-day mean of maximum daily temperature of 24.2 degrees Centigrade, with a maximum daily temperature of 25.3 degrees Centigrade from continuous measurements. For segment 20356, data show a 7-day mean of maximum daily temperature of 25.5 degrees Centigrade, with a maximum daily temperature of 26.2 degrees centigrade from continuous measurements. For segment 29317, data show a 7-day mean of maximum daily

temperature of 20.4 degrees Centigrade, with a maximum daily temperature of 21.6 degrees Centigrade from continuous measurements.

Monitoring data for the bacteria impaired segment was collected in water years 2005, 2006, and 2007. In 2005 3 of 6 samples (50%) showed an excursion of the % criterion for the waterbody, and the geometric mean of 165.7 exceeded the geometric mean criterion. In 2006, 3 of 13 samples (23%) showed an excursion of the % criterion for the waterbody, and the geometric mean of 57 did not exceed the geometric mean criterion. In 2007, 1 of 6 samples (17%) showed an excursion of the % criterion for the waterbody, and the geometric mean of 46.4 did not exceed the geometric mean criterion.

Description of Pollution Controls and How They Will Achieve Water Quality Standards

Water Quality Target

The designated uses for listings 18835, 18836, and 20355 are spawning, rearing and migration, and the temperature criterion is 17.5 degrees Centigrade, with a supplemental spawning criterion of 13 degrees Centigrade from February 15 to June 1.

The designated use for listings 20356 and 29317 is core salmonid habitat, and the temperature criterion is 16 degrees Centigrade, with a supplemental spawning criterion of 13 degrees Centigrade from February 15 to June 15.

The designated use for listing 72313 is primary contact recreation. Ecology now uses Escherichia coli (E. Coli) as the criteria in this watershed. E. Coli levels must not exceed a geometric mean value of 100 CFU or MPN per 100 mL, with not more than 10 percent of all samples (or a single sample when less than ten sample points exist) exceeding 320 CFU or MPN per 100 mL.

Controls that will achieve water quality standards

The Department of Ecology's Eastern Regional Office has established a Livestock and Water Quality Program that uses a unique collaborative approach to address livestock-related problems. Instead of using the standard process that starts with a Category 5 listing, establishing a TMDL for the stream, writing an implementation plan, and finally getting to actual implementation, this strategy goes straight to implementation. The strategy is applied in watersheds in which the cause of a water quality impairment is clear.

Ecology encourages implementation of a wide variety of best management practices, however, a primary focus of the program has been to restore degraded riparian corridors and eliminate unlimited animal access to streams. Healthy riparian areas can improve water quality and stream health in multiple ways, which make them a particularly valuable and cost-effective management practice. Healthy riparian areas:

- Slow bank erosion by holding soil in place during periods of high water.
- Reduce flood damage and sedimentation by slowing runoff and capturing the sediment that would otherwise be carried downstream.

- Help keep water cool in summer by shading the stream.
- Improve water quality by capturing sediment, nutrients, pesticides, pathogens, and other pollutants before they reach the stream.
- Enhance summer stream flow by improving water infiltration and storage.
- Create fish and wildlife habitat.
- Limit livestock manure inputs to the creek and riparian areas.

Ecology has a three-step riparian restoration strategy, which allows the department to efficiently apply resources to priority problem areas. The first step is to address the source of degradation – unlimited livestock access to streams and winterfeeding operations in close proximity to the riparian corridor. Ecology relies primarily on livestock exclusion, and off-stream water supply to restrict livestock access to the riparian area. In implementing this BMP, Ecology uses our 319 and centennial clean water grant guidelines, which require a minimum 75, 50 or 35-foot buffer between the livestock fence and the mean ordinary high water mark of the nearest stream bank depending on the type of stream. In many cases, the buffer width may be larger depending on the stream and site conditions.

By first addressing livestock access, Ecology seeks to abate the primary pollution sources—livestock in the stream, eroded streambanks, increased runoff, increased sedimentation, and subsequent transport of fecal matter. As vegetation naturally returns in the riparian area, site conditions become stabilized and the pollution sources are dramatically reduced. Also, this approach works to arrest morphological changes to the entire stream that are induced by erosion and sedimentation.

Ecology has spent much of its efforts and resources implementing this first step, in large part, because we have taken a holistic, watershed approach to protecting streams. By first addressing the primary sources of pollution and geomorphic change, Ecology can establish the necessary site conditions for successful restoration. Moreover, Ecology ensures that, first and foremost, the root problems are addressed for *the entire stream*, before resources are focused on site or segment specific restoration.

The second step occurs after a majority of site conditions have been stabilized, and the stream's entire geomorphic integrity is no longer jeopardized by the adjacent management practices. Ecology then conducts a reach by reach assessment to determine the appropriate trees and shrubs to be used for restoration. In some cases, federal programs require revegetation as part of the cost-share program, and so restoration work occurs simultaneously with livestock exclusion.

The third step is to work with local land owners to promote continuous and proper management of upland grazing lands.

In addition to the Livestock and Water Quality Program, Ecology's Eastern Regional Office has established a similar collaborative approach to address crop production-related problems. Ecology encourages implementation of a wide variety of best management practices, however, a

primary focus of effort has been establishing minimum land use setbacks, restoring degraded riparian corridors, and converting conventionally farmed land to conservation tillage practices.

Ecology teams with conservation districts, local governments, and landowners to provide technical assistance and funding for implementation of best management practices. Ecology uses our regulatory authority as a backstop when collaborative efforts fail. The Water Pollution Control Act (RCW 90.48) gives Ecology the authority to take enforcement actions against nonpoint polluters.

RCW 90.48 makes it unlawful for any person to "cause, permit or suffer to be thrown, run, drained, allowed to seep or otherwise discharged … any organic or inorganic matter that shall cause or tend to cause pollution of" waters of the state. Any person who violates or creates a substantial potential to violate the provisions of Chapter 90.48 RCW is subject to an enforcement order from Ecology pursuant to RCW 90.48.120. Ecology is authorized to "issue such order or directive as it deems appropriate under the circumstances[.]" In addition to administrative orders, violating Chapter 90.48 RCW may result in injunctions, civil penalties, and notices of violations.

It is worth noting that RCW 90.48.120 gives Ecology the authority to take action in response to nonpoint source pollution, the statute also gives Ecology the authority to take action based on a "substantial potential" to pollute state waters via either a point or nonpoint pollution source. Consequently, Ecology not only has authority to take action following a NPS pollution occurrence (i.e. there was a discharge), but has specific statutory authority to act proactively to prevent NPS pollution from occurring in the first place. Ecology's authority includes the authority to require a nonpoint source polluter to implement specific best management practices (BMPs). Ecology's authority can be used to prevent nonpoint pollution and require BMPs, as necessary.

Ecology has used this regulatory backstop several times since 2016.

The result of these partnerships has been the implementation of best management practices at hundreds of sites across several watersheds where water quality and fish habitat issues exist. By using a collaborative strategy, backed up by enforcement when necessary, Ecology has been able to create relationships and build trust with rural residents while improving water quality.

In the Tenmile Creek watershed, work with landowners began in 2002. As of 2014, twelve miles of riparian buffers were installed. The creek was fenced to protect it from livestock, and thousands of native trees and shrubs were planted in the stream corridor. Buffers are constructed using Natural Resource Conservation Service standards, which require a minimum width of 35 feet. For buffers installed with state or federal financial assistance, we require an agreement with the landowner stipulating that the buffer and fence will be maintained for at least 10 years.

Initial cattle exclusion fencing was generally installed adjacent to or upstream of the impaired segments. However, we have also fenced portions of the stream where there are presently no Category 5 listings, but where there was unrestricted cattle access to the stream. Riparian buffers are left to revegetate naturally in those areas in which there is enough live native vegetation left

to recover. In all other areas we are installing buffers by planting native plants. At this time, most of the upstream riparian areas have been restored. Planting is continuing where buffers need additional plants.

In addition, farmers in the watershed are adopting direct seed technology, which is the practice of seeding a new crop into the standing stubble of a recently harvested crop without the traditional tillage of the ground. By doing so, soil erosion can be reduced by as much as 95 percent. This significantly reduces the volume of sediment washing into Tenmile Creek. All of these efforts will help address the temperature impairments. In the last few years, the Asotin County CD has assisted in converting an additional 500 acres to direct seed or conservation tillage in the watershed.

Since 2008, Ecology has completed a large project that includes installation of a Conservation Reserve Enhancement Program buffer and moving a feeding operation further upland with a 75-foot setback. A large proportion of the riparian work in the watershed was funded with federal cost-share funds, which require landowner maintenance. Projects funded with state dollars have 10-year landowner agreements requiring maintenance.

In the last five years, an additional mile of Tenmile Creek was protected, with another thirteen miles of buffer enhanced with plantings of over 8,000 trees in the riparian area. This watershed can be increasingly complex to establish robust buffers due to its arid and rocky conditions. The Asotin County CD continues to focus efforts on enhancement and maintenance in the watershed. Ecology has partnered with the CD on an active grant in the watershed to promote overbank flow and floodplain connection to improve temperature and sedimentation concerns. This has resulted in installing 53 Beaver Dam Analogs (BDAs) throughout the watershed. The CD has recently submitted an FY22 state 319 water quality grant application to Ecology, which if funded will provide funding to protect and enhance an additional 40,000 stream feet and 20,000 trees to Asotin County watersheds, including Tenmile Creek.

The Tenmile and Mill Creek watershed continues to recover. Each year, the benefits to water quality and fish habitat are more dramatic. Native cottonwood, alder, and willow trees are quickly returning to the stream banks. Grasses along the stream are healthier and more deeply rooted. Additionally, manure and exposed soil are no longer visible near the creek. Steelhead trout are returning to the creek to spawn in greater numbers than have been recorded in several decades.

Description of requirements under which pollution controls will be implemented

It is Ecology's best professional judgement that the pollution controls that have been installed will result in the water quality standards being met. Maintenance of these controls has been ensured through 10-year landowner agreements that were established as part of the funding agreements for these projects. Additionally, Ecology staff will continue to perform watershed evaluations in this watershed to ensure that BMPs stay in place

Estimate or Projection of Time When Water Quality Standards Will be Met

It will take time for the riparian corridor to fully recover and for the stream to re-establish its natural geometry. Ecology estimates that the riparian buffers will have grown enough to be fully effective in 10-15 years. While Tenmile Creek continues to see projects implemented, increased focus in the watershed will help to meet the temperature standard throughout the entire watershed by 2025.

Schedule for Implementing Pollution Controls

As described earlier in this report, Ecology has worked with the conservation district, local governments, and landowners to implement a variety of best management practices in the Tenmile Creek watershed, and landowners are continuing to implement best management practices that protect the stream corridor and improve water quality. It is our best professional judgment that this work will remedy the pollution problems in the impaired segments. Because it is our intention to restore the entire watershed and to prevent future pollution problems, we will be using monitoring data to track water quality improvements and to identify any new problem areas so they can be addressed. It will be an on-going process to get water bodies into compliance and to keep them in compliance.

Ecology's Livestock and Water Quality Program will continue to have an on-going presence in the watershed, and will continue working to achieve compliance with state water quality standards.

Monitoring Plan to Track Effectiveness of Pollution Controls

Monitoring results will be used to establish whether these projects are improving water quality and overall stream health. Monitoring data can also help to identify additional problem areas that should be addressed. Monitoring results will be reported to the public and EPA through Ecology's IR report development process. Ecology is planning on moving forward with an effectiveness monitoring study to cover all the region's 4b starting in 2022.

Commitment to Revise Pollution Controls as Necessary

Ecology will maintain a presence in the Tenmile Creek watershed to ensure that water quality continues to improve. We fully expect the Eastern Regional Office livestock and water quality program to achieve compliance with water quality standards. However, if it does not, Ecology will work with the conservation district, local governments, and landowners to determine other controls that could be used to achieve compliance.

Steptoe Creek – December 2020

The Washington Department of Ecology (Ecology) Integrated Report (IR) proposes to exclude eight listings from the 303(d) list and place these segments into category 4b. The specific listings are:

- Temperature – 72995, 18833, 18834, 73628
- Bacteria – 46705, 77228, 45337
- pH – 50351

Ecology's basis for excluding these waterbodies from the 303(d) list is outlined in this evaluation.

Identification of Segment and Statement of Problem Causing Impairment

Steptoe Creek is a small tributary in the Snake River watershed (WRIA 35), located in the southeast corner of Washington State. Steptoe Creek drains 14,000 acres of primarily agricultural lands. Steptoe Creek watershed is comprised of two creeks, Steptoe Creek and Stuart Creek. These combine to form Steptoe Creek mainstem at stream mile 2.5 upstream from the mouth. Both are perennial spring fed streams that provide habitat for ESA listed Snake River Steelhead Trout.

Many of the stream reaches in the Steptoe Creek watershed have been subjected to more than a century of livestock grazing and feeding impacts. Streams lack sufficient riparian protection from livestock grazing. Reaches subject to winter feeding activities often have significantly reduced populations of trees and shrubs and lack adequate herbaceous ground cover. Portions of riparian areas that are not subject to feeding also show signs of overgrazing from range cattle. These signs include bare soils, compaction, erosion, cattle trailing, low tree and shrub species diversity, wide and shallow stream morphology, and a lack of young age-class woody species.

Much of the upper watershed is under crop production and it is common to produce crops to the edge of eroding streambanks. Ephemeral stream channels are typically farmed and subject to significant annual gully formation in conventional tillage systems. It is estimated that more than 60% of the crop ground is in a conventional tillage cropping system. Conventional tillage is usually defined as a Soil Tillage Intensity Rating (STIR) of more than 30. STIR is a system of estimating how much the soil is disturbed in order to seed crops. Conventional tillage systems are higher disturbance systems that typically reduce infiltration and cause more erosion.

While land area is split equally in the watershed between the two primary land uses, areas adjacent to perennial stream flow are dominated by livestock production. Nearly 80% of these riparian areas are currently grazed. This is a sparsely populated area. There are no towns in the watershed and no point sources of pollution.

In 2006 and 2007, the Department of Ecology performed extensive water quality monitoring in the Snake River area. Water quality was monitored at three locations in Steptoe Creek for multiple parameters including temperature, fecal coliform bacteria, dissolved oxygen, pH, and turbidity.

There had been little change in land-use since from when the data was collected until restoration actions began in 2016. We can conclude the data from that time was representative of the condition up to 2016. In addition to fecal coliform exceedances, the 2006-2007 data shows some low dissolved oxygen, high pH, and turbidity increases between the middle watershed and lower watershed. Future effectiveness monitoring is warranted in the Steptoe Creek watershed and plans are discussed in this document.

Description of Pollution Controls and How They Will Achieve Water Quality Standards

Water Quality Target

The designated use for listings 72995, 18833, 18834, and 73628 are spawning, rearing and migration, and the temperature criterion is 17.5 degrees Centigrade.

The designated use for listing 46705, 77228, and 45337 is primary contact recreation. Ecology now uses Escherichia coli (E. Coli) as the criteria in this watershed. E. Coli levels must not exceed a geometric mean value of 100 CFU or MPN per 100 mL, with not more than 10 percent of all samples (or a single sample when less than ten sample points exist) exceeding 320 CFU or MPN per 100 mL.

The designated use for listing 50351 is spawning, rearing and migration, and the pH criterion is within the range of 6.5 to 8.5 with a human-caused variation within the above range of less than 0.5 units.

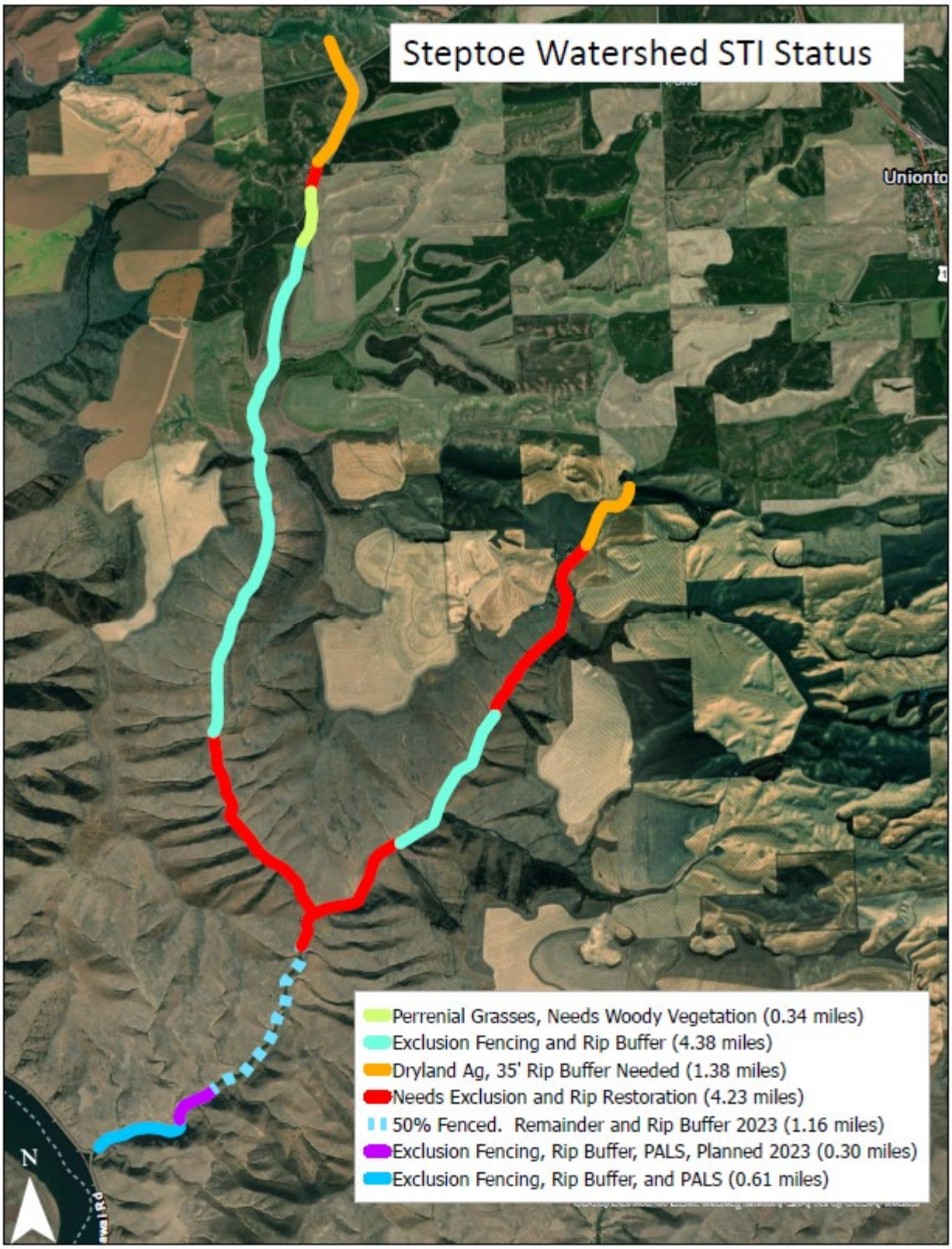

Figure 6. Steptoe Watershed Status

Controls that will achieve water quality standards

The Department of Ecology's Eastern Regional Office has established a Livestock and Water Quality Program that uses a unique collaborative approach to address livestock-related problems. Instead of using the standard process that starts with a Category 5 listing, establishing a TMDL for the stream, writing an implementation plan, and finally getting to actual implementation, this strategy goes straight to implementation. The strategy is applied in watersheds in which the cause of a water quality impairment is clear.

Ecology encourages implementation of a wide variety of best management practices, however, a primary focus of the program has been to restore degraded riparian corridors and eliminate unlimited animal access to streams. Healthy riparian areas can improve water quality and stream health in multiple ways, which make them a particularly valuable and cost-effective management practice. Healthy riparian areas:

- Slow bank erosion by holding soil in place during periods of high water.
- Reduce flood damage and sedimentation by slowing runoff and capturing the sediment that would otherwise be carried downstream.
- Help keep water cool in summer by shading the stream.
- Improve water quality by capturing sediment, nutrients, pesticides, pathogens, and other pollutants before they reach the stream.
- Enhance summer stream flow by improving water infiltration and storage.
- Create fish and wildlife habitat.
- Limit livestock manure inputs to the creek and riparian areas.

Ecology has a three-step riparian restoration strategy, which allows the department to efficiently apply resources to priority problem areas. The first step is to address the source of degradation – unlimited livestock access to streams and winterfeeding operations in close proximity to the riparian corridor. Ecology relies primarily on livestock exclusion, and off-stream water supply to restrict livestock access to the riparian area. In implementing this BMP, Ecology uses NRCS riparian buffer standards, which require a minimum 35-foot buffer between the livestock fence and the mean ordinary high water mark of the nearest stream bank. In many cases, the buffer width may be larger depending on the stream and site conditions.

By first addressing livestock access, Ecology seeks to abate the primary pollution sources—livestock in the stream, eroded streambanks, increased runoff, increased sedimentation, and subsequent transport of fecal matter. As vegetation naturally returns in the riparian area, site conditions become stabilized and the pollution sources are dramatically reduced. Also, this approach works to arrest morphological changes to the entire stream that are induced by erosion and sedimentation.

Ecology has spent much of its efforts and resources implementing this first step, in large part, because we have taken a holistic, watershed approach to protecting streams. By first addressing the primary sources of pollution and geomorphic change, Ecology can establish the necessary site

conditions for successful restoration. Moreover, Ecology ensures that, first and foremost, the root problems are addressed for *the entire stream*, before resources are focused on site or segment specific restoration.

The second step occurs after a majority of site conditions have been stabilized, and the stream's entire geomorphic integrity is no longer jeopardized by the adjacent management practices.

Ecology then conducts a reach by reach assessment to determine the appropriate trees and shrubs to be used for restoration. In some cases, federal programs require revegetation as part of the cost-share program, and so restoration work occurs simultaneously with livestock exclusion. The third step is to work with local land owners to promote continuous and proper management of upland grazing lands.

In addition to the Livestock and Water Quality Program, Ecology's Eastern Regional Office has established a similar collaborative approach to address crop production-related problems. Ecology encourages implementation of a wide variety of best management practices, however, a primary focus of effort has been establishing minimum land use setbacks, restoring degraded riparian corridors, and converting conventionally farmed land to conservation tillage practices.

Ecology teams with conservation districts, local governments, and landowners to provide technical assistance and funding for implementation of best management practices. Ecology uses our regulatory authority as a backstop when collaborative efforts fail. The Water Pollution Control Act (RCW 90.48) gives Ecology the authority to take enforcement actions against nonpoint polluters.

RCW 90.48 makes it unlawful for any person to "cause, permit or suffer to be thrown, run, drained, allowed to seep or otherwise discharged … any organic or inorganic matter that shall cause or tend to cause pollution of" waters of the state. Any person who violates or creates a substantial potential to violate the provisions of Chapter 90.48 RCW is subject to an enforcement order from Ecology pursuant to RCW 90.48.120. Ecology is authorized to "issue such order or directive as it deems appropriate under the circumstances[.]" In addition to administrative orders, violating Chapter 90.48 RCW may result in injunctions, civil penalties, and notices of violations.

It is worth noting that RCW 90.48.120 gives Ecology the authority to take action in response to nonpoint source pollution, the statute also gives Ecology the authority to take action based on a "substantial potential" to pollute state waters via either a point or nonpoint pollution source. Consequently, Ecology not only has authority to take action following a NPS pollution occurrence (i.e. there was a discharge), but has specific statutory authority to act proactively to prevent NPS pollution from occurring in the first place. Ecology's authority includes the authority to require a nonpoint source polluter to implement specific best management practices (BMPs). Ecology's authority can be used to prevent nonpoint pollution and require BMPs, as necessary.

Ecology has used this regulatory backstop several times since 2016.

The result of these partnerships has been the implementation of best management practices at hundreds of sites where water quality and fish habitat issues exist. By using a collaborative strategy, backed up by enforcement when necessary, Ecology has been able to create relationships and build trust with rural residents while improving water quality. In the Steptoe Creek watershed, work with landowners largely begun in 2016. The Snake River Salmon Recovery Board partnered with the Palouse Conservation District to replace a perched culvert at river mile 0.5 that blocked upstream migration of ESA listed Snake River Steelhead Trout.

Most of the 0.5 miles of Steptoe Creek upstream from the mouth to the existing barrier had historically been the site of a livestock confinement area. The entire confinement area was located in the floodplain, the limited livestock fencing on site was located within 20 feet of the stream and livestock had access to surface water in some of this area. A major effort took place in 2018 – 2020 at this site that, relocated feeding areas and holding corrals off the creek, installed 5,000 feet of livestock exclusion fencing, and planted 12 acres of riparian buffer. 61 instream post assisted log structures (PALS) were installed along 2,200 feet of Steptoe Creek directly upstream of this site over the summer of 2020.

Approx. 4 miles up from the mouth of Steptoe Creek is another large livestock operation that Ecology staff had been attempting to work with since 2002. Ecology issued an Administrative Order for this site in December 2018. Since the Order issuance, 1.7 miles of exclusion fencing and several off-stream watering facilities have been installed. Two additional off-stream watering facilities, another 0.75 miles of exclusion fencing, one livestock crossing, a corral relocation, and 13.5 acres of riparian restoration are planned for implementation on this site in 2021 and 2022.

Riparian buffers and livestock BMPs are constructed using NRCS standards, which require a minimum width of 35 feet. For buffers installed with state or federal financial assistance, we require a 50’ minimum buffer along Steptoe Creek, and an agreement with the landowner stipulating that the buffer and livestock BMPs will be maintained for at least 10 years.

Initial cattle exclusion fencing was generally installed adjacent to the impaired segments. However, we have also fenced portions of the stream where there are presently no Category 5 listings, but where there was unrestricted cattle access to the stream. Riparian buffers are left to revegetate naturally in those areas in which there is enough live native vegetation left to recover. In all other areas we are installing buffers by planting native plants. Planting is continuing where buffers need additional plants.

In addition, farmers in the upper watershed are adopting direct seed technology, which is the practice of seeding a new crop into the standing stubble of a recently harvested crop without the conventional tillage of the ground. By doing so, soil erosion can be reduced by as much as 95 percent. This significantly reduces the volume of sediment washing into Steptoe Creek. The Palouse Conservation District has been the recipient of several direct seed cost-share program Ecology grants that have made it easier for farmers to transition from conventional tillage to conservation tillage practices.

For crop production areas in the upper watershed, vegetated buffer width may be adjusted based on the upland STIR and whether or not seasonal flow occurs during or near the critical temperature period. For long term intermittent and perennial stream reaches with a STIR greater than 30, no buffer should be less than 75 feet wide. In tillage areas, no buffer should be less than 35 feet wide regardless of flow and STIR.

The Steptoe Creek watershed continues to recover. Each year, the benefits to water quality and fish habitat are more dramatic. Native cottonwood, alder, and willow trees are quickly returning to the stream banks. Grasses along the stream are healthier and more deeply rooted. Additionally, manure and exposed soil are becoming less common near the creek.

Description of requirements under which pollution controls will be implemented
It is Ecology's best professional judgment that the pollution controls that have been installed and planned will result in the water quality standards being met. Maintenance of the installed controls have been ensured through 10-year landowner agreements that were established as part of the funding agreements for these projects. Additionally, Ecology staff will continue to perform watershed evaluations in this watershed to ensure that BMPs stay in place.

Estimate or Projection of Time When Water Quality Standards Will be Met

It will take time for the riparian corridor to fully recover, and for the recently installed and planned future plantings to mature. Ecology estimates that the riparian buffers will have grown enough to be fully effective in 10-15 years, so Steptoe Creek will be meeting the standards for fecal coliform, temperature, and pH by 2031-2036.

Schedule for Implementing Pollution Controls

As described earlier in this report, Ecology has worked with the conservation district, local governments, and landowners to implement a variety of best management practices in the Steptoe Creek watershed, and landowners are continuing to implement best management practices that protect the stream corridor and improve water quality. It is our best professional judgment that this work will remedy the pollution problems in the impaired segments. Because it is our intention to restore the entire watershed and to prevent future pollution problems, we will be using monitoring data to track water quality improvements and to identify any new problem areas so they can be addressed. It will be an on-going process to get water bodies into compliance and to keep them in compliance.

Ecology's Livestock and Water Quality Program will continue to have an on-going presence in the watershed, and will continue working to achieve compliance with state water quality standards.

Monitoring Plan to Track Effectiveness of Pollution Controls

The Palouse Conservation District (PCD) is taking the lead on future effectiveness monitoring in the Steptoe Creek watershed. PCD recently submitted an FY22 state 319 water quality grant application to Ecology, which if funded will include a robust monitoring effort to begin December 2021. Proposed water quality monitoring will be conducted at three locations along Steptoe

Creek in conjunction with livestock exclusion, riparian restoration, and in-stream structure installation throughout Steptoe Canyon.

These sites will be instrumented with pressure sensors and monumented reference points to gauge stage height, providing a 15-minute water level dataset. Rating curves for Steptoe Creek will be developed using continuous stage height measurements in combination with routine and storm event discharge measurements over three years. In addition to discharge, grab samples and water quality readings from a YSI ProDSS will be collected monthly and during storm events providing data on fecal coliform bacteria, inorganic nitrogen, phosphorus, suspended sediment concentrations (SSC), pH, dissolved oxygen, electric conductivity, turbidity, and temperature. Concentrations of fecal coliform bacteria, nitrate/nitrate/ammonia, total phosphorus, orthophosphate, and SSC will be flow weighted and annual pollutant loads will be calculated for each location.

Commitment to Revise Pollution Controls as Necessary

Ecology will maintain a presence in the Steptoe Creek watershed to ensure that water quality continues to improve. We fully expect the Eastern Regional Office Livestock and Water Quality Program to achieve compliance with water quality standards. However, if it does not, Ecology will work with the conservation district, local governments, and landowners to determine other controls that could be used to achieve compliance.

Entiat River – February 2021

The Washington Department of Ecology (Ecology) Integrated Report (IR) proposes to exclude two temperature listings (3731 and 73057), from the 303(d) list and place these water bodies in category 4b of the IR. Ecology's basis for excluding these water bodies from the 303(d) list is outlined in this analysis.

Identification of Segment and Statement of Problem Causing Impairment

These segments are located just above the mouth of the Entiat River, which empties into the Columbia River. The most likely causes of the temperature impairment are the loss of riparian vegetation and changes to the channel width-to-depth ratio caused by sedimentation from roads, timber harvest, and agricultural practices.

Description of Pollution Controls and How They Will Achieve Water Quality Standards

The Entiat Watershed Planning Group produced the Coordinated Resource Management Plan in 1999. This plan evaluated the watershed's condition and made recommendations designed to protect water quality and threatened and endangered fish. The sources of temperature impairment in the Entiat River are identified in the plan as:

- Reduced riparian shade resulting from removal of riparian vegetation and stream widening.
- Timber harvest and roads on Forest Service land in the upper basin also contribute to loss of riparian shade and degraded channel conditions.

The plan made several recommendations to help cool the water.

- Work with landowners to maintain and enhance riparian vegetation and wetlands, and implement streambank planting.
- Continue to work with NRCS on conserving water used for irrigation.
- Continue compliance with the forest practices rules, which protect riparian areas and allow for their re-establishment.
- Promote incentives for landowners to restrict unlimited access to streams by livestock.

The plan also included a recommendation to further plan under the Watershed Planning Act to evaluate base flow needs and establish minimum in-stream flows. The subsequent WRIA 46 Entiat Watershed Management Plan, which incorporated the findings of the Coordinated Resource Management Plan and recommended establishment of instream flows, was adopted unanimously by the Chelan County Board of Commissioners on September 13, 2004. The instream flow recommendations were codified as Chapter 173- 546 of the Washington Administrative Code.

Land ownership in the basin is approximately 85% federal, which is primarily in the upper basin, 6% state, and 9% private. The upper watershed is in Wenatchee National Forest. Between the forest boundary, at river mile 26 and river mile 11.7, the land use is primarily rural residential,

either year round or seasonal, with a few dispersed pasture areas. Below river mile 11.5, the use is predominantly pear and apple orchards with some rural residential use.

The watershed planning committee performed an aerial remote sensing survey and used the Stream Network Temperature Model (SNTEMP) to identify problem areas in the river and to test different scenarios of best management practices implementation. The model was used to evaluate the effects of three alternative actions, singly and in combination. The three are:

1. Increase in stream flow,
2. System wide increase in riparian shade, and
3. Reduction in channel width in the lower river.

Increases to streamflow were evaluated because a larger mass of water would take longer to warm. Increased shade was evaluated because it would reduce the amount and intensity of solar radiation reaching the water, thus reducing the water temperature. In the Entiat River watershed, numerous forest fires, combined with flood control measures in the lower 15 river miles, have significantly reduced the overall amount and quality of riparian vegetation along the river. The Entiat Watershed Planning Unit has recommended actions that would increase the riparian vegetation within the watershed, as well as reduce the threat of future forest fires that would threaten both the existing and proposed improved riparian vegetation. Decreased channel width was evaluated because it is expected that the channel will return to a more normal geomorphology once functioning riparian areas are re-established.

Based on the results of the model simulations performed with SNTEMP, the following recommendations were made:

- SNTEMP predicted reductions in water temperatures for all three alternative actions, suggesting that implementation of any of the three actions would help reduce water temperatures to some extent.
- Of the feasible alternatives, SNTEMP predicted the largest reductions in water temperatures when riparian shade was increased by 50% (Alternative Action 3). Therefore, an aggressive approach to increasing the current riparian shade conditions throughout the watershed should be undertaken to address high water temperatures.
- In addition, if Entiat Watershed Planning Unit resources are available, decreases to channel width in the lower 10 RMs in conjunction with changes in shade should also be considered (Alternative Action 4).
- A 10% change in streamflow is not likely to significantly affect water temperature.

As identified in the watershed plan and in the SNTEMP analysis of the Entiat River, the most effective best management practices to address the temperature listing are revegetating riparian areas, preventing further riparian vegetation removal, and restoring channel geomorphology and width-to-depth ratios.

Wenatchee National Forest has an approved TMDL, prepared by the Department of Ecology, which specifies areas throughout the forest where riparian shade must be maintained or re-established. The Forest Service is also required to comply with state water quality standards.

Implementation of the TMDL should restore 85% of the watershed to a fully functioning riparian condition and help re-establish the original channel geomorphology. Management of state and privately owned lands in the watershed must comply with the state forest practices rules, which are designed to achieve compliance with the state water quality standards and the Clean Water Act. For the remainder of the watershed, the 9% that is privately owned and not used for forestry, the watershed plan recommends re-establishing and maintaining riparian vegetation along at least 50% of the stream. The area is subject to wildfires, which make it unlikely that a higher percentage of riparian vegetation could be continuously maintained. This percentage is similar to that prescribed in the eastside section of the state forest practices rules.

Implementation of the Wenatchee National Forest TMDL, combined with required compliance with the state forest rules and the riparian restoration strategy for the remainder of the land in the watershed is expected to restore riparian areas in the watershed to a fully functioning condition. This will result in compliance with the state water quality standards either by cooling the river to or below the numeric criterion or by achieving the Entiat River's natural condition.

Several enforceable pollution controls will assure implementation of the watershed plan.

- The Forest Service land is subject to the Wenatchee National Forest TMDL.
- The remainder of the watershed is subject to the state forest practices rules for forestry land uses.
- The agricultural and residential uses in the lower watershed are subject to the Chelan County Shoreline Master Program and critical areas ordinance, both of which are designed to minimize or eliminate impacts to riparian vegetation due to development activities on private lands.
- The Entiat Water Resources Management Program has been codified as Chapter 173- 546 of the Washington Administrative Code. This rule establishes enforceable minimum in-stream flow requirements for the upper and lower Entiat River and the Mad River, a tributary of the Entiat.

State and local agencies are working together to restore Entiat riparian areas. The following projects were completed prior to 2008.

- The Department of Fish and Wildlife completed the Wilson side channel reconnection project in 2004. This project consisted of placing a diversion pipe in the Entiat River that provides an estimated 10 cubic feet per second of flow through 1,000 feet of rehabilitated side channel. The side channel was restored using large woody debris, boulders, and riparian plantings. The project is located at river mile 6.7.
- The Department of Fish and Wildlife completed an off channel habitat project in 2004. This project deepened a .3-acre spring-fed pond and installed rootwads to provide habitat and cover for juvenile fish. The pond's outlet stream was cleared and deepened, and several large woody debris structures were installed along the Entiat River just upstream and downstream of the stream outlet. The project is located at river mile 6.2.
- Chelan County Public Works, with the cooperation of several other agencies, replaced the Stormy Creek culvert in 2004 with a pre-cast concrete bridge. The slope in the area was

regarded from 6% to 4%, spawning gravel was placed in the creek, and riparian vegetation was planted. Approximately ½ mile of fish habitat was reopened.

- The Cascadia Conservation District re-vegetated an estimated 1.3 acres of riparian vegetation between river mile 3.2 and 3.8 in 2005 and 2006. In 2007, an additional 1.1 acres were re-vegetated at several locations in the drainage. • Three surface water diversions were converted to groundwater wells for four irrigators in the basin. Wells were installed at river miles 4.0 and 6.3.
- The Bridge-to-Bridge, Phase 1 project consisted of the installation of a rock crossvane, side-channel habitat improvements, irrigation intake and outfall improvements, and riparian restoration. A rock crossvane was constructed to convey water into the Chelan County PUD irrigation side-channel, canal and intake pipe. The rock crossvane and the eleven rootwads were constructed to increase pool habitat and instream complexity. The rehabilitated side-channel had three boulder clusters and two log structures (constructed from 4 logs) installed to increase complexity and off-channel habitat. The slide-gate to the irrigation intake was replaced to allow year round watering of the 1000 feet of irrigation canal. The irrigation outfall structure had an additional flashboard installed and two rock step-pools installed to assist in fish passage. This project was designed by the NRCS and installed by the Cascadia Conservation District in fall of 2006 at river mile 3.2.
- The Milne Project, located between river mile 2.8 and river mile 3.2, consisted of the installation of 13 logs with rootwads, six boulder barbs, six boulder clusters, and an irrigation diversion barb with sluice gate. Riparian planting along the access areas was also completed. The structures were installed in September 2007 with funds from the Salmon Recovery Funding Board and US Bureau of Reclamation.
- The Hanan-Detwiler rock crossvane and large woody debris were installed at rivermile 5.1 with funding from the Salmon Recovery Funding Board and US Bureau of Reclamation. The rock crossvane will serve to convey water into the HananDetwiler irrigation system and provide pool habitat. The two log structures each consisted of two logs with rootwads installed into the banks to provide fish habitat and a source of gravel through scouring. The project was completed in October 2007.

The following projects were completed after 2008.

- The Roaring Creek Flow Enhancement and Barrier Removal project removed two surface water diversions from Roaring Creek between RM 0.85 and RM 1.3. This project was completed in 2010. • The 2010 Lower Entiat Riparian Restoration Project restored 4.3 acres (.65 miles) of riparian habitat directly adjacent the Entiat River.
- The 2011 Entiat Riparian Project restored 4.2 acres of riparian habitat directly adjacent the Entiat River, by installing native riparian trees, shrubs, and native grasses (5 of 5 sites), livestock exclusion fencing (1 of 5 sites) and temporary irrigation systems (3 of 5 sites), and controlling of noxious weeds at all five sites. The Roaring Creek Flow Enhancement and Barrier Removal project removed two surface water diversions from Roaring Creek between RM 0.85 and RM 1.3. This project was completed in 2010.
- The 2010 Lower Entiat Riparian Restoration Project restored 4.3 acres (.65 miles) of riparian habitat directly adjacent the Entiat River.

- The 2011 Entiat Riparian Project restored 4.2 acres of riparian habitat directly adjacent the Entiat River, by installing native riparian trees, shrubs, and native grasses (5 of 5 sites), livestock exclusion fencing (1 of 5 sites) and temporary irrigation systems (3 of 5 sites), and controlling of noxious weeds at all five sites. 2014 WQA—4B Analysis for Entiat River Page 5.
- The Entiat RM 21.5 LWD and Riparian Restoration project established woody riparian vegetation at the site by combining the installation of 14 large woody debris (LWD) structures along 645 feet of existing bank with an accompanying 100-foot wide, approximately 1.9 acre, riparian planting area behind it. This project was completed in 2010.
- The 2010 Surface Water to Wells Conversion project replaced a 1.5 cfs surface water diversion for the Gaines Ditch in the lower Entiat River with four irrigation wells. Replacing the surface water diversion avoids fish entrainment and mortality, as well as providing water savings through higher delivery efficiencies. The conversion also keeps surface water in stream during low flow, peak irrigation use periods in late summer and fall.
- The 2012 Tyee Ranch project installed 4.5 acres of riparian plantings, placement of engineered log jams and other large woody debris (LWD) structures, an excavated re-connection to floodplain and abandoned side channels.
- In 2014 five salmon habitat restoration projects were completed in the lower seven miles of the Entiat River. Three project sponsors were involved in the 2014 Entiat River habitat project implementation; Yakama Nation (YN) with a project at (RM 2.3-3.3), Chelan County Natural Resource Department (CCNRD) with two projects (RM 1.65 and RM 4.0-4.3), and Cascadia Conservation District (CCD) with two projects (RM 0.8-2.3 and RM 6.7-7.8). Project elements include habitat logs and boulder clusters placed along the channel margins, improvements to existing side channel areas, two engineered log jams near the upstream end of two side channels to provide habitat and help direct flow into the side channels, and the creation of two new off channel alcoves, for high flow refuge.
- In 2017 several habitat projects were completed. The Yakama Nation, in collaboration with the US Forest Service Entiat Ranger District, enhanced side-channel connections and added engineered log structures along two areas of the Upper Middle Entiat. These projects offer more habitat for endangered salmon species. The Chelan Douglas Land Trust (CDLT) purchased 26 acres of property for protection which included approximately 4,425 feet of critical riverbank. The Cascade Columbia Fisheries Enhancement Group (CCFEG), a local non-profit organization which works to restore native fish habitat, removed two fish passage barriers along Stormy Creek, opening up about three miles of salmon habitat. The Fisheries Enhancement Group partnered with the US Fish and Wildlife Service to complete the work.

Estimate or Projection of Time When Water Quality Standards Will be Met

Because it will take time to complete restoration projects and for new vegetation to grow, we estimate that compliance with the temperature standard will be achieved in 2028.

Schedule for Implementing Pollution Controls

As described earlier in this report, the Entiat River Planning Unit has already begun implementing restoration projects, and continues to work with other agencies to design projects, obtain funding, and complete the actual restoration work. There is a good record of on-going implementation, and we expect this to continue.

Monitoring Plan to Track Effectiveness of Pollution Controls

The Entiat River is monitored by one of Ecology's long term monitoring stations so there will be direct information available to determine whether implementation activities are making a difference.

Commitment to Revise Pollution Controls as Necessary

Ecology will continue to work with the Entiat River Planning Unit to ensure that implementation continues and that water quality in the Entiat River continues to improve. We fully expect the program to achieve compliance with water quality standards. However, if it does not, Ecology will work with the planning unit to determine other controls that could be used to achieve compliance.

Yellowjacket Creek – February 2021

The Washington Department of Ecology (Ecology) Integrated Report (IR) proposes to exclude three listings (19866, 19868, 19869) for temperature on Yellowjacket Creek from the 303(d) list and placed these water bodies in category 4b of the IR. Listing 19866 was listed in category 5 of the 2008 IR. Listings 19868 and 19869 were in category 4b. Ecology's basis for excluding these water bodies from the 303(d) list is outlined in this evaluation

Identification of Segment and Statement of Problem Causing Impairment

Yellowjacket Creek is one of eight subwatersheds within the Lower Cispus River watershed. The 15.5-mile creek flows northerly from its headwaters at 4,276 feet above mean sea level to its confluence (1,259 feet above mean seal level) with the Cispus River at river mile 17.2. The mean stream gradient is 3.7%, calculated from digitized 7.5- minute topographic maps.

Table 14 below summarizes the monitoring network for the watershed. Since 2016, several sites were added to the temperature monitoring network:

- Resumed monitoring in Pumice Creek in 2017,
- Resumed monitoring at Pinto Creek at the mouth of Yellowjacket Creek in 2017,
- New site added at Badger Creek at the 2810-041 Road in 2019,
- New site added at Yellowjacket Creek at RM 11 in 2019,
- New site added at Veta Creek at the Yellowjacket confluence at the 28 road in 2019,
- New site added at High Bridge Creek at the 29 road in 2019,
- New site added at Galena Creek in 2019, and
- New site added at Lambert Creek in 2019

The Forest Service plans to continue monitoring at all current sites as part of the ongoing commitment to monitor and improve water quality in the Yellowjacket Creek subwatershed.

Most monitored tributaries of Yellowjacket Creek did not exceed 16°C in the years monitored. Veta Creek had a short window of exceedance in 2020. Pumice Creek exceed 16°C in two of the twelve years it was monitored, and McCoy Creek had one exceedance in ten years of monitoring. Exceedances in lower Yellowjacket Creek were measured at the confluence of the Cispus River (fifteen of twenty years monitored), and upstream of the McCoy Creek confluence (four of eighteen years monitored). Exceedances were not observed in Yellowjacket at river mile 11, although this site has only two years of monitoring data. All sites on the Cispus River have numerous exceedances. Monitoring data show that exceedances are most common in broad alluvial channels that have been incised and widened from past and continuing land use practices.

Table 14. Temperature summaries at monitoring sites in Yellowjacket Creek, tributaries, and the Cispus River

Stream Name	Monitoring Location	Maximum 7-day average temperature in 2020 (°C)	Years monitored	Years temperature exceeded maximum 7-day average of 16 °C (# and years)	Highest maximum 7-day average temperature (°C)
Pumice Creek	At confluence with Pinto Creek	14.0	12 2001-2005, 2007, 2009-2010, 2017-2020	2 2001 and 2009	16.6 (2009)
Pinto Creek	At confluence with Yellowjacket Creek	13.5	5 2001-2003, 2019-2020	0	15.2 (2001)
Pinto Creek	At 2800-144 Road	n/a	1 2001	0	12.1 (2001)
Badger Creek	At mouth	n/a	1 2001	0	12.0 (2001)
Badger Creek	At 2810-041 Road	11.8	1 2020	0	11.8 (2020)
Veta Creek	At confluence with Yellowjacket Creek	16.4	2 2019, 2020	1 2020	16.4 (2020)
Galena Creek	Near Yellowjacket Confluence	13.7	2 2019-2020	0	13.7 (2020)
Lambert Creek	At 29 Road	10.8	2 2019-2020	0	10.9 (2019)

Stream Name	Monitoring Location	Maximum 7-day average temperature in 2020 (°C)	Years monitored	Years temperature exceeded maximum 7-day average of 16 °C (# and years)	Highest maximum 7-day average temperature (°C)
High Bridge Creek	At 29 Road	12.8	2 2019-2020	0	12.8 (2020)
McCoy Creek	At Confluence with Yellowjacket Creek	15.1	10 2001, 2009-2014, 2017-2020	1 2009	16.6 (2009)
Yellowjacket Creek	Above McCoy Creek	15.3	18 2001, 2003-2010, 2012-2020	4 2004, 2006, 2009, 2015	17.3 (2015)
Yellowjacket Creek	At confluence with Cispus River	18.3	21 1996, 1999-2017, 2020	15 2000-2003, 2005-2007, 2009, 2012-2017, 2020	20.9 (2015)
Yellowjacket Creek	River Mile 11	11.2	2 2019, 2020	0	11.6 (2019)
Cispus River	Above North Fork Cispus River	13.9	18 1994, 2000, 2003-2011, 2013-2016, 2018-2020	3 2005, 2009, 2015	17.1 (2015)
Cispus River	Above Yellowjacket Creek	16.2	9 2000, 2011-2015, 2017-2018, 2020	6 2013-2015, 2017-2018, 2020	18.4 (2015)

Stream Name	Monitoring Location	Maximum 7-day average temperature in 2020 (°C)	Years monitored	Years temperature exceeded maximum 7-day average of 16 °C (# and years)	Highest maximum 7-day average temperature (°C)
Cispus River	Below Greenhorn Creek	17.5	16 2000, 2003-2005, 2007, 2009-2020	14 2003- 2005, 2007, 2009-2010, 2012-2015, 2017-2020	20.0 (2015)
Cispus River	Below Iron Creek (at Forest boundary)	17.5	21 1999-2020	19 2000-2007, 2009-2010, 2012-2020	19.9 (2015)

*Site added since 2014.

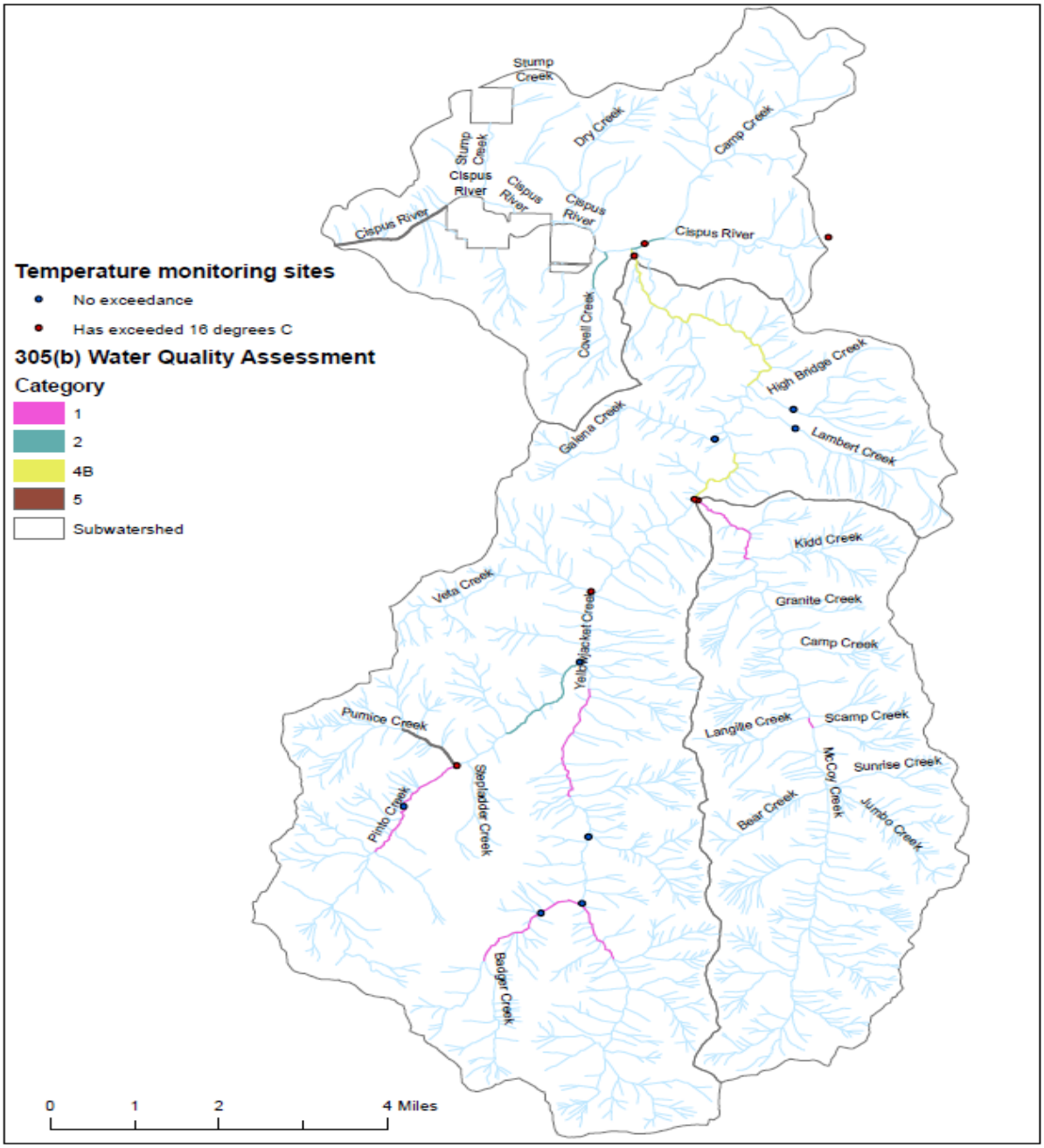

Figure 7. Yellowjacket Creek, McCoy Creek, and Camp Creek-Cispus River subwatersheds, temperature monitoring sites, and 305(b) status

Description of Pollution Controls and How They Will Achieve Water Quality Standards

The designated use for the temperature impaired segments of Yellowjacket Creek is core summer salmonid habitat, and the temperature criterion is 16 degrees centigrade, year round. In addition, the segments have a supplemental spawning criterion of 13 degrees centigrade from February 15 to June 15.

Most riparian areas in the watershed will be restored by passive restoration, which means letting the areas recover on their own. This process can take 100 years or more. In addition, the Forest Service has implemented some active riparian restoration projects, which generally involve thinning riparian stands to encourage the remaining trees to grow faster and therefore provide more shade sooner. Stream temperatures in the smaller tributaries in the upper watershed should improve within the next five to ten years as vegetation grows and streambank stability increases (barring any additional natural disturbances or extreme climatic trends). Stream temperatures in the lowest reaches of the Yellowjacket Creek watershed will take longer to show improvement because the stream has widened and shallowed from excessive sediment inputs. In this area, lowered stream temperatures will depend as much on the stream recovering its natural geometry and stability as on restoring riparian shade.

Work that the Forest Service has done and plans to do to address road related sediment problems will also help to solve the temperature impairments in Yellowjacket Creek. The stream has widened and shallowed because of human caused sedimentation, and as roads are repaired, decommissioned, and routinely maintained, the sediment load to streams will decrease.

However, stream recovery takes time even when sediment delivery is decreased. Streams may take a decade or more to move past excessive sediment loads, and the amount of time this takes depends on the magnitude of flow events that occur. Consequently, stream widths may narrow temporarily and then widen again after a flow event that is large enough to move some of the excessive sediment load stored within the streams. As channel stability improves through time, other restoration treatments, such as placement of large wood in the channel, will become more viable.

It is anticipated that with the completion of identified high priority work, episodic inputs of accelerated sediment from roads, undersized or aging culverts, and bank instability will be decreased from the channel condition imprints observed historically. The overall effectiveness of these treatments should become evident by increased watershed stability in response to future flood events. Monitoring of BMP effectiveness and periodic aerial photo interpretation would help define recovery trends and timeframes.

Again, implementation of projects to improve temperature on the Forest fall into three primary categories: 1) Road treatments, 2) Riparian Reserve enhancement, and 3) stream restoration. Treatment types, and the objectives these projects fulfil to restore watershed processes to improve temperature are shown in Table 15.

Table 15. Treatment types, and objectives and definitions of treatments

Treatment Type	Definition and objectives
Decommission	Road decommissioning includes activities that stabilize and restore uneeded roads to a more natural state to mitigate hydrologic risk and reduce erosion and sedimentation. Decommissioning treatments can include all of the following

Treatment Type	Definition and objectives
	techniques; revegetation, installation of waterbars, removal of culverts and road fill, removal of unstable road shoulders, full road prism obliteration and restoration of natural slope. Type and scale of treatment is dependent on site-specific considerations. Decommissioned roads will not be used in the future and are left in a state where erosion and sedimentation risk is eliminated.
Culvert upgrades/replacements	Replacement of culvert crossings to facilitate aquatic organism passage and improve hydraulic function to restore processes that improve temperature. Culvert replacements reduce the risk of crossing failure and the episodic input of sediment associated with these failures.
Reconstruction/maintenance	Road reconstruction and maintenance involves the improvement of existing roads to improve safety, service and environmental standards. Practices include refurbishing ditches and other drainage structures, rebuilding inlets and outlets, shaping road surface to drain properly, slope and fill stabilization, and improvement of surfacing.
Close/hydrologic stabilization	Hydrologic stabilization is a technique to store and stabilize roads to avoid, minimize, or mitigate adverse effects to water quality, aquatic habitat, and riparian resources. Hydrologically stabilized roads minimize erosion and hydrologic connectivity between the road and stream system. Practices include, but are not limited to, removal of culverts and fill presenting an unacceptable risk of failure or flow diversion, and suitable measures to ensure the road surface will intercept, collect, and remove water from the road surface in a manner that reduces concentrated flow in ditches, culverts, and over fill slopes and road surfaces without frequent maintenance. Roads that are hydrologically stabilized would remain as part of the FS road system; therefore the intent is to retain the integrity of the roadway to the extent practicable, and measures would be implemented to reduce sediment delivery from the road surface road fills to reduce the risk of crossing failure and stream diversion.
Riparian Reserve Enhancement	Vegetation treatment objectives for Riparian Reserves as defined in the Northwest Forest Plan are to accelerate the development of late successional stand characteristics which in the long-term, will provide shade to perennial streams. Actions include thinning densely stocked young stands to reduce

Treatment Type	Definition and objectives
	competition during the early stages of growth and addressing stands that were identified in a shade model as lacking effective shade to perennial streams.
Stream Restoration	Restoration of hydrologic, floodplain, and riparian function through placement of in-stream large wood structures to scour pools, sort gravels, support floodplain forest succession, re-engage relict side channels, and provide shade. Large wood structures are generally positioned to encourage development of a multi-thread channel network, providing side channel and off-channel habitat throughout a range of flows to encourage sustenance of summer low-flows and encourage Riparian Reserve development. Projects also include planting of adapted native trees and shrubs to accelerate riparian restoration. Wood for projects is generally acquired through harvest of upland stands, and trees from the adjacent Riparian Reserve.

Projects completed in the Yellowjacket subwatershed that contribute toward improving the functions that will eventually lower stream temperature are shown in Table 16. There were no projects completed in the McCoy Creek subwatershed in this timeframe.

Table 16. Projects completed in the Yellowjacket subwatershed since 2014

Project Type	Total	Location and year
Culvert upgrades	5 crossings	Forest Road (FR) 2800-000 at MP 9.1, 2017 FR 2809-000 at MP 0.1, 2017 FR 2800-000 at MP 7.8, 2018 FR 2810-000 at MP 1.3, 2019 FR 2810-000 at MP 1.9, 2019
Road Decommission	0.5 miles	FR 7700-239, 2016
Road reconstruction and maintenance	31.7 miles	FR 7700-000 23 miles 2019 FR 7605-000 9.7 miles 2019
Riparian Reserve Enhancement	2015 9.8 acres 2016 18.6 2017 18.5 acres 2019 5 acres 2020 13.3 acres	Pinto Creek-2015, 2016 Veta Creek-2015 Yellowjacket Creek 2017, 2019, 2020

Project Type	Total	Location and year
Yellowjacket Stream Restoration	6 large wood installed at the mouth of Yellowjacket Creek	2020

Watershed Condition Framework

The Forest Service developed and began implementing the Watershed Condition Framework (WCF) in 2011 to provide a consistent, comparable, and credible process for improving the health of watersheds on national forests and grasslands. The WCF forms the basis for the management of aquatic resources on the Forest and includes 6-steps: a) classification of watershed condition at the subwatershed scale; b) prioritization of watersheds for restoration; c) development of Watershed Restoration Action Plans (WRAP) for Priority Watersheds; d) implementation of the integrated restoration projects defined in those plans; e) tracking of restoration accomplishments; and f) monitoring and verification. Additional details are available in the Watershed Condition Framework document (USDA Forest Service, 2011a. Watershed Condition Framework. FS-977. Washington, DC. 24 pp.) and Watershed Condition Classification (WCC) Technical Guide (USDA Forest Service, 2011b. Watershed Condition Classification Technical Guide. FS-978. Washington, DC. 41 pp.).

The Forest is in the process of designating the Yellowjacket subwatershed as a priority watershed under step c of the WCF, based on water quality concerns, and the strong focus of ongoing and planned aquatic and riparian restoration in the subwatershed. The WRAP for the Yellowjacket subwatershed is under development with a final draft anticipated in early 2021. The WRAP for the Yellowjacket subwatershed classifies watershed condition, and presents essential projects the Forest and partners will complete over the next five years. Upon completion of these essential projects, the FS anticipates that overall watershed condition will be improved in the Yellowjacket subwatershed, and that the functional processes that will eventually improve temperatures in Yellowjacket Creek have been restored, or are on a trajectory toward restoration.

Designation of the Yellowjacket subwatershed as a priority is in alignment with the Yellowjacket Restoration project, and will position the Forest to leverage funds from multiple sources to ensure aquatic restoration projects are implemented.

Vegetation Management Project Planning

The Gifford-Pinchot National Forest has developed a 10-year vegetation management plan that identifies planning areas across the Forest where vegetation restoration projects will be planned and implemented. The Yellowjacket subwatershed is within the current planning area for the Yellowjacket Restoration project. The project is currently under pre-NEPA analysis, with a final NEPA decision planned for early 2022, with implementation following over the next five to ten years. Most planned projects in the Yellowjacket subwatershed are identified in this report are part of this larger planning effort. Including these aquatic restoration projects as part of the

larger Yellowjacket project planning process will open funding opportunities and ensure that projects are completed in a timely fashion.

Roads Analysis

The Forest completed a Forest-wide Travel Analysis Report in 2015 (USDA Forest Service. 2015. Travel analysis report Gifford Pinchot National Forest. Vancouver, WA. 47 p.) under the Travel Management Rule (36 CFR 212) resulting in a prioritization of roads on national forest lands that addresses access and environmental risk, including water quality, setting the stage for further reductions in road miles and targeted improvement in the remaining road system. This report provides a recommendation for management for all roads under the Forest's jurisdiction.

This broad-scale Forest-level analysis will be applied at the project scale to inform road treatments in the Yellowjacket project. Additional analysis tools are useful to along with the Geomorphic Analysis and Inventory Project_Lite (GRAIP_Lite) (Nelson, N. Luce, C. and T Black. 2019. GRAIP_Lite: A system for road impact assessment. USDA Forest Service Rocky Mountain Research Station, Boise Aquatic Sciences Lab. 145 p) GRAIP_Lite is a system of spatial analysis tools developed by the Forest Service Rocky Mountain Research Station that models road-related sediment impacts to stream habitats. This model in combination with field reconnaissance will be used in the Yellowjacket project planning process to determine areas where roads present a higher risk to the stream system, and prioritizing roads for restoration or remediation efforts.

Climate Vulnerability Analysis and Climate Resiliency

The Gifford Pinchot National Forest completed a climate change vulnerability assessment in October 2019 (Hudec, J.L. Halofsky, J.E., Peterson, D.L., and Ho, J.J., eds. 2019. Climate change vulnerability and adaptation in southwest Washington. Gen. Tech. Rep. PNW-GTR-977. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 249 p.) With respect to maintenance and enhancement of the functions that improve temperature, this analysis focused on potential thermal impacts to anadromous fish species, emphasizing the need to build aquatic habitat resiliency and connectivity. Key themes include:

- Strategic prioritization or restoration of natural thermal, hydrologic, and wood regimes;
- Management of fluvial connectivity and assisted migration;
- Maintain and diversify aquatic monitoring programs

The Forest is working toward these goals and focusing efforts to build resiliency in watersheds where aquatic function has been compromised through past land use practices. Essential projects in the Yellowjacket Creek WRAP focus on building resiliency, particularly in reaches of Yellowjacket Creek that have been incised and widened where temperature is elevated.

Estimate or Projection of Time When Water Quality Standards Will be Met

Waters in Yellowjacket Creek will continue to violate temperature standards until excess sediment has worked its way out of the system and streams have recovered their natural geometry and the riparian areas have recovered. Given the time it takes for natural systems to

recover, Ecology estimates that it will take 40 years for Yellowjacket Creek to meet the temperature standard.

Schedule for Implementing Pollution Controls

Projects planned in the Yellowjacket subwatershed over the next five years are shown in Table 17. With the exception of the Yellowjacket stream restoration, projects are in the pre-NEPA planning phase and are subject to change based on the results of the NEPA analysis.

Table 17. Projects planned in the Yellowjacket subwatershed through 2025

Project Name	Description
Road Reconstruction	40-50 miles of treatment anticipated
Motorized trail reconstruction	Approximately 10 miles of motorized trails treated
Culvert Replacements	3 fish aquatic organism passage improvement projects: Veta Creek (FR 7713-000), High Bridge Creek (FR 2900-000) Badger Creek (FR 2810-041) 1 culvert replacement for hydraulic upgrade on Yellowjacket Creek at FR 2810-041
Road Hydrologic stabilization	Approximately 15 miles of road treated
Unauthorized road closures	Full removal of unauthorized roads in the Pumice and Pinto Creeks headwaters
Riparian Reserve Enhancement	Approximately 50 acres of Riparian Reserve enhancement throughout riparian areas in the Yellowjacket subwatershed
*Yellowjacket Creek Stream Restoration RM 1-6	Installation of large woody debris, side channel reconnection, and riparian enhancement in Yellowjacket Creek from the 28 Road to the McCoy Creek confluence Improve hydrologic function in Yellowjacket Creek and promote deep pool formation, side channel and floodplain connectivity, and old forest characteristics in Riparian Reserves adjacent to Yellowjacket Creek.
Pinto Creek Stream Restoration	Improve hydrologic function in Pinto Creek through installation of large woody debris to promote deep pool formation, side channel and floodplain connectivity, and promote old forest characteristics in Riparian Reserves adjacent to Pinto Creek.

*Yellowjacket Creek Stream Restoration-The Yellowjacket Stream Restoration is the largest planned active restoration project, with the potential to deliver direct benefits to stream temperature in Yellowjacket Creek. The Forest is partnering with is Cowlitz Tribe and multiple funding agencies to complete the project over the next four years.Temperature exceedances in lower Yellowjacket Creek are a direct effect of diminished aquatic function. Past land use practices have resulted in an incised and widened channel with areas of channel instability, few stable wood accumulations, rapid bank erosion and lateral channel adjustment, and isolated floodplain terraces. The channel habitat is dominated by low gradient riffle and pool sequence

with abundant cobble (mean D50 ranging from 137-232 mm). Large wood is sparse throughout the first 1.7 miles of Yellowjacket Creek, averaging 11 pieces of large wood>24 in diameter per mile. The Yellowjacket Restoration project includes restoration of instream and off channel habitats to enhance natural geomorphic and hydrologic processes through installation of large wood. Most of the restoration reach will result in no less than two active channels, more than doubling the channel length and available edge habitat to improve riparian function and decrease stream temperature. The placement of large wood in Yellowjacket will be such that they enhance flow deflection into side and distributary channels, with some minor excavation at the inlets to introduce perennial flow. Log jams will also encourage pool formation and enhance water storage and hyporheic exchange, which will improve stream temperatures. Approximately 36 large engineered log jams will be installed in Yellowjacket Creek on approximately six miles of stream. Project implementation began in 2020, with phased work continuing for the next four years.

Monitoring Plan to Track Effectiveness of Pollution Controls

As detailed above the Forest Service monitor temperatures at multiple locations. They plan to continue monitoring at all current sites as part of the ongoing commitment to monitor and improve water quality in the Yellowjacket Creek subwatershed.

Commitment to Revise Pollution Controls as Necessary

The Gifford Pinchot National Forest is required under the Forest Plan for the forest, as amended by the Northwest forest Plan (NWFP), to adjust and adapt activities if monitoring demonstrates that goals and objectives of the plan are not being met. In addition, an interagency aquatic monitoring effort, Aquatic-Riparian Effectiveness Monitoring Protocol (AREMP) has been in place since the inception of the NWFP with requirements to evaluate the effectiveness of the NWFP aquatic conservation strategy, and address watershed condition trends across the NWFP area. The outcomes of AREMP will be critical in determining whether implementation is working and if additional management practices will be needed.

Ecology expects that implementation activities completed and planned in the Yellowjacket watershed will achieve compliance with state water quality standards. However, if they do not, Ecology will work with the Forest Service to determine other controls that could be used to achieve compliance.

Kitsap County Pollution Identification and Correction (PIC) Program – February 2021

The Washington Department of Ecology (Ecology) Integrated Report (IR) proposes to exclude the following listings for fecal coliform from the 303(d) list and place these water bodies in category 4b of the IR. Ecology's basis for excluding these waterbodies from the 303(d) list is outlined in this evaluation.

- Bacteria—7652, 10370, 10371, 10375, 10376, 10387, 23695, 74746, 7633, 74656, 7643, 53094, 53113, 53110, 53117, 38667, 43034, 53101, 53091, 36197, 53106, 38524, 53108, 74678, 38528, 53109, 7645, 7646, 7647, 52902, 60190, 38833, 53096, 38863, 53100, 74639, 38816, 53097, 74792, 74793, 53116, 7636, 7640, 7641, 7643, 10387, 53095, 53149, 53150, 53187 and 53188.

Kitsap County segments proposed for category 1 that were previously in category 4b include:

- 7651-Martha-John Creek
- 7637-Dogfish Creek
- 10389-Purdy Creek
- 38460-Boyce Creek
- 38616-Gorst Creek

Identification of Segment and Statement of Problem Causing Impairment

These creeks are located in various parts of Kitsap County. The fecal coliform pollution in these streams was identified by Kitsap County through its on-going monitoring program. The primary sources of bacteria pollution in Kitsap County are:

- Failing septic and sewer systems
- Faulty stormwater systems
- Pet and livestock waste
- Runoff from farms

Description of Pollution Controls and How They Will Achieve Water Quality Standards

In the early 1990s, Kitsap County agencies faced several difficult issues:

- The Public Health District sought more permanent funding to deal with shellfish closures, failing septic systems, and other water quality problems.
- The Department of Public Works needed to develop a stormwater management program in response to the U.S. Environmental Protection Agency's National Pollutant Discharge Elimination System Permit Program.
- The conservation district needed to respond to 1989 legislative approval to seek a fee to fund programs for landowner assistance.
- The Department of Community Development sought more permanent funding for state mandated watershed planning efforts.

A group of County Managers and Commissioners with a long range vision for water quality began working together to design a coordinated interagency partnership to meet multiple needs in the county. In October 1993, after two years of planning and public process, the Kitsap County Board of Commissioners adopted Ordinance 156-1993, establishing the Kitsap County Surface and Stormwater Management Program (KCSSWM), now renamed Clean Water Kitsap. The goals of the program are to:

- Protect public health and natural resources.
- Minimize institutional costs.
- Meet state and federal regulatory requirements.
- Provide a permanent funding source to address nonpoint source pollution.

Kitsap Public Health is the primary agency responsible for monitoring, identifying, and prioritizing nonpoint fecal pollution correction programs in Kitsap County. In response to the fecal pollution problem, Kitsap Public Health developed a Pollution Identification and Correction (PIC) program, an Onsite Sewage System (OSS) Monitoring and Maintenance program, and a Water Protection Complaint Response program. The PIC program receives a significant portion of its funding from the Clean Water Kitsap Program. SSWM fees are assessed on properties in the unincorporated area of Kitsap County. Fees appear on annual property tax billings.

Kitsap Public Health's PIC program, OSS Monitoring and Maintenance program and Complaint response program utilize existing local regulations and authority to address FC pollution sources and enforce correction when necessary. These programs incorporate a strong educational element to prevent future fecal pollution.

The Kitsap Public Health District has monitored major streams and marine waters for FC on a routine basis since 1996. This extensive monitoring program has resulted in the listing of many Kitsap County marine and freshwater bodies for fecal coliform pollution on Washington State's 303(d) List of impaired or threatened waters. During the 2013 water year, both stream and marine stations were typically sampled once each month.

Fewer samples may be collected at a monitoring station due to lack of flow during the dry season, hazardous weather conditions, equipment failures, or other circumstances.

The PIC Program uses water quality monitoring data to identify priority water bodies for cleanup. The primary focus of the monitoring program is to assess long-term pollution trends associated with human sewage and animal waste from nonpoint sources. Health District staff sample water quality monthly at approximately 95 stations on 54 streams and 67 marine stations. Field equipment measures turbidity, dissolved oxygen, pH, and temperature. Fecal coliform samples are analyzed by an Ecology accredited laboratory. Data are used to identify areas in need of pollution control and to evaluate the effectiveness of the correction program.

Clean up projects are designed to address the causes and sources of bacterial water pollution in specific geographic areas that the trend monitoring program has identified. SSWM provides funding for PIC projects. The goal of each PIC project is to:

- Protect public health.
- Protect shellfish resources.
- Preserve, protect, and restore surface water quality.

The best management practices (BMPs) being used to improve water quality include a requirement to properly operate and maintain on-site systems in the watershed. Kitsap Public Health District is actively engaged in on-site system education, dye testing of suspect systems, and enforcement of the Kitsap County Board of Health Ordinance 2008- 11, On-Site Sewage System and General Sewage Sanitation Regulations, which requires proper design, installation, repair, operation and maintenance of on-site septic systems. In addition, the Kitsap Conservation District assists small farm owners and owners of livestock to implement BMPs for animal waste management and farm pollution control. The conservation district's role is as a non-regulatory agency. When a regulatory approach is needed, the Health District enforces the Solid Waste Regulations (KCBOH 2004-2).

Several enforceable pollution controls will assure that compliance with water quality standards is achieved.

- Kitsap County Ordinance 156-1993, establishing the Surface and Stormwater Management Program, now known as Clean Water Kitsap, which created an on-going, stable source of funding.
- Kitsap County Board of Health Ordinance 2008-11, On-Site Sewage System and General Sewage Sanitation Regulations, which requires proper design, installation, repair, operation and maintenance of on-site septic systems.
- Kitsap County Board of Health Ordinance 2004-2, Solid Waste Regulations, which regulate handling and disposal of animal manure and pet waste; animal waste violations are enforced by the Health District under this ordinance.
- RCW 90.72, Shellfish Protection Districts.

Estimate or Projection of Time When Water Quality Standards Will be Met

All waters in Kitsap County are subject to one of the following standards for bacteria. The county-wide monitoring program compares monitoring data with the appropriate standard to determine whether the water body is on an improving trend and whether it has achieved compliance with standards.

Primary Contact Recreation Bacteria Criteria in Fresh Water

Table 18. Primary contact recreation bacteria criteria in fresh water

Bacterial Indicator	Criteria
E. Coli	E. coli organism levels within an averaging period must not exceed a geometric mean value of 100 CFU or MPN per 100 mL, with not more

Bacterial Indicator	Criteria
	than 10 percent of all samples (or any single sample when less than ten sample points exist) obtained within the averaging period exceeding 320 CFU or MPN per 100 mL.
Fecal coliform (expires 12/31/2020)	Fecal coliform organism levels within an averaging period must not exceed a geometric mean value of 100 CFU or MPN per 100 mL, with not more than 10 percent of all samples (or any single sample when less than ten sample points exist) obtained within an averaging period exceeding 200 CFU or MPN per 100 mL.

Marine

Table 19. Primary contact recreation bacteria criteria in marine water

Bacterial Indicator	Criteria
Fecal Coliform bacteria	Fecal coliform organ-ism levels are used to protect shellfish harvesting. Criteria are ex-pressed as colony forming units (CFU) or most probable number (MPN). Fecal coliform must not exceed a geometric mean value of 14 CFU or MPN per 100 mL, and not have more than 10 percent of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value exceeding 43 CFU or MPN per 100 mL.

Ecology expects that most of the water bodies covered by Kitsap County's PIC program will achieve compliance with bacteria standards by 2025. However, it should be noted that bacteria problems are likely to re-occur as septic systems age and properties change hands, so it should not be considered a failing of the PIC program if some waters move into category 1, and then occasionally move back into category 4b. In fact, an issue to remember with nonpoint pollution is that it is not the kind of thing that can be fixed just once. Instead, it requires continual vigilance, which is just what the PIC program provides.

Schedule for Implementing Pollution Controls

As described earlier in this report, Kitsap County has already implemented the PIC program and is continuing periodic monitoring, identifying problems, and fixing them. This is an on-going program, exactly what's needed to solve nonpoint pollution problems and to keep them from happening again.

Monitoring Plan to Track Effectiveness of Pollution Controls

Kitsap County has a countywide monitoring program. Samples are taken monthly and compared to the bacteria standard. Assessment results are reported to the public and EPA through Kitsap County's website and through Ecology's IR report development process.

Commitment to Revise Pollution Controls as Necessary

Ecology will continue to work with Kitsap County to ensure that the PIC program continues. We fully expect the program to achieve compliance with bacteria water quality standards throughout the county. However, if it does not, Ecology will work with Kitsap County to determine other controls that could be used to achieve compliance.

Dissolved Gas (TDG) Impairments Addressed by Federal Energy Regulatory Commission (FERC) licenses – February 2021

The Washington Department of Ecology (Ecology) Integrated Report (IR) proposes to exclude six listings for TDG from the 303(d) list and place these segments into category 4b. The specific listings are:

- 15183, 15184—Spokane River
- 6532- Lewis River, Swift #1 Tailrace
- 6542—Lewis River, Yale Tailrace
- 6533—Swift Creek #2 Power Canal
- 6535— Lewis River, Swift #2 Tailrace

All of the listings were in category 5 of the 2012 IR. Ecology's basis for excluding these waterbodies from the 303(d) list is outlined in this evaluation.

Identification of Segment and Statement of Problem Causing Impairment

Segments 15183 and 15184 are located in the Spokane River downstream of Avista's Long Lake Dam. Segment 6532 is located within the bypass channel downstream of Pacificorp's Swift No. 1 Project, 6542 is located downstream of Pacificorp's Yale Project within the tailrace, 6533 is located downstream of PacifiCorp's Swift No. 1 Project within the power canal, and 6535is located downstream of Cowlitz County Public Utility District (PUD) Swift No. 2 Project within the tailrace, all in the Lewis River. Impairments in these segments are caused by exceedance of Washington's TDG criterion, which requires that TDG shall not exceed 110 percent of saturation at any point of sample collection. The TDG exceedances at these locations are caused by large spills from the dams.

Description of Pollution Controls and How They Will Achieve Water Quality Standards

Under section 401(a)(1) of the Clean Water Act, the Federal Energy Regulatory Commission may not issue a license for a hydroelectric project unless the state water quality certifying agency has issued a Water Quality Certification (WQC)for the project or has waived certification by failing to act within a reasonable period of time, not to exceed one year. Section 401(d) of the CLEAN WATER ACT provides that state certification shall become a condition of any federal license that authorizes construction or operation of the project.

The FERC license for Long Lake Dam was issued June 18, 2009, and is available here: https://www.ezview.wa.gov/Portals/_1962/images/FERC%20401s/SpokRvrCleancopyOrder6702FERC2545.pdf

The FERC licenses for the Yale, Swift No. 1, and Swift No. 2 Projects and the WQCs were issued on October 9, 2006 and four amendments were issued on December 21, 2007, January 17, 2008, October 3, 2008, and November 7, 2011.These three Projects are listed as Lewis River

Hydroelectric Projects and individual dams are located below the Lewis River link, and are available here:

https://ecology.wa.gov/Regulations-Permits/Permits-certifications/401-Water-quality-certification/Certifications-for-hydropower-licenses.

For all three of these FERC licenses, the Department of Ecology has issued a CLEAN WATER ACT 401 WQC that requires compliance with state water quality standards for TDG. The WQC are typically a component of the FERC licenses.

All of the 401 WQCs contain the following requirements: (1) compliance with all state water quality standards approved by the EPA; (2) compliance with sediment quality standards;(3) prohibition of discharge of any solid or liquid waste to the waters of Washington; and (4) reservation of Washington Ecology's authority.

Estimate or Projection of Time When Water Quality Standards Will be Met

The Long Lake Project completed structural modifications and designed spillway protocols in 2016 as specified in their approved TDG Water Quality Attainment Plan. Currently, effectiveness monitoring for those modifications and protocols is being conducted. Evaluation of the effectiveness monitoring will be completed by 2023. Therefore, the Long Lake Project should achieve compliance by 2023. Ecology will continue to work with Avista as part of their dam compliance and review TDG spill data collected.

The Lewis River Projects (Yale, Swift No. 1 and Swift No. 2) are currently working on compliance with the TDG standards. A Water Quality Management Plan was approved on March 25, 2013 which included these three Projects. The Swift No. 1 Project spill related TDG Attainment Plan was approved on February 25, 2014. Therefore, Yale and Swift No. 2 Projects should have achieved compliance by March 25, 2023 and Swift No. 1 should have achieved compliance by February 25, 2024. Ecology routinely reviews data related to TDG spills provided by PacifiCorp and Cowlitz County PUD.

Schedule for Implementing Pollution Controls

Pollution controls are presently in place for all four projects, as required by the FERC licenses.

Monitoring Plan to Track Effectiveness of Pollution Controls

The FERC license holders are required to monitor TDG and to implement control and attainment measures. They are also required to develop and implement a TDG attainment plan if monitoring indicates that TDG exceeds 110 percent saturation. Reductions in TDG will improve water quality for aquatic organisms, specifically fish species, inhabiting the project area.

Commitment to Revise Pollution Controls as Necessary

If gas abatement plans are required, and if monitoring to test the effectiveness of the gas abatement controls implemented through the plans shows that the TDG abatement measures identified in the plans and subsequently employed are not successful in meeting the water quality criterion within the first ten (10) years of discovery of TDG criterion exceedances caused by spill, Ecology will require further activities to meet the water quality criterion. Significant structural or operational revisions that may impose potentially unreasonable costs or create potentially unreasonable societal effects may be evaluated as part of a formal Use Attainability Analysis consistent with the federal and state water quality regulations after the ten-year compliance period has ended.

Cow Creek – November 2020

Cow Creek flows nearly 50 miles from Sprague Lake in the Northwest Palouse region to the Palouse River in the south. It is an agricultural dominated watershed. Riparian areas were heavily grazed by livestock for more than a century. In the early 2000s, multiple segments of the creek were listed as category 5 for pollutants associated with agricultural run-off. Starting in 2004, Ecology partnered with the Adams Conservation District. For nearly a decade, extensive riparian restoration efforts were undertaken. Over 50 miles of livestock exclusion fencing were installed and thousands of trees and shrubs were planted to revegetate the riparian areas.

Unfortunately, much of the stream is not accessible from county roads. Changes at the Adams CD and the political climate in the watershed made both further implementation efforts and Ecology's ability to ensure on-going livestock exclusion difficult. Ecology is aware of significant backsliding in the watershed and we believe cattle again have access in riparian areas on inaccessible private property. We anticipate these land management changes will result in increases in pollution to the creek. Unfortunately, at this time we have limited access to implement the 4B strategy, document water quality violations, and enforce the Water Pollution Control Act. Therefore, these listings are being moved out of 4B and back to Category 5 this assessment cycle:

- Dissolved oxygen – 40643, 40644, 40645, 40646, 40647, 40648, 40649
- Fecal coliform – 45969, 45990, 40661, 40662, 40663, 46020
- pH – 40652, 40653, 40654, 40655, 40656, 40657
- Temperature – 40634, 40635, 40636, 40637, 40638, 40639, 40640

Contaminated Sediments – August 2021

Contaminated sediment sites are regulated under CERCLA or the Model Toxics Control Act Chapter 70.105D RCW (MTCA) and the Sediment Management Standards 173-204 WAC (SMS). The SMS were promulgated under both the Clean Water Act and MTCA and were approved as Water Quality Standards by the EPA in 1991. Washington State's Category 4B listings for sediment meet the EPA's accepted alternatives to a TMDL "other pollution control requirements". Specifically, the Category 4B listings for sediment are sediment cleanup sites that have an approved Record of Decision (for EPA led CERCLA sites) or a Cleanup Action Plan (for state led MTCA sites).

All Cleanup Action Plans must meet the cleanup and source control requirements under CERCLA, MTCA and the SMS. A Cleanup Action Plan describes the selected cleanup method(s) and specifies cleanup standards and other requirements. It is based on information and technical analyses generated during the Remedial Investigation and Feasibility Study and consideration of public comments and community concerns. The cleanup process and Cleanup Action Plans for contaminated sediment sites listed in Category 4B address the six elements required by EPA for a Category 4B designation. This includes:

- Identification of the grid(s) and statement of the problem causing the sediment contamination.
- Description of the remedy/cleanup goals and how they will achieve the Sediment Management Standards.
- A projected timeframe when the Sediment Management Standards will be met.
- Schedule for implementing the remedy based on the Sediment Management Standards requirements.
- Operation and Maintenance plan that includes monitoring to determine effectiveness of the remedy.
- Adaptive management plan to revise the remedy if necessary.

Similar to a Record of Decision, a Cleanup Action Plan describes the selected cleanup method(s) and specifies cleanup standards and other requirements. It includes the technical analyses from the Remedial Investigation and Feasibility Study; and consideration of public comments and community concerns. Specifically, a Cleanup Action Plan includes the following:

- Site description: Includes a legal description of the site and its boundaries as well as the surrounding area.
- Site history: Includes current and historical uses, sources, and activities that may have contributed to the contamination.
- Enforcement history.
- Remedial Investigation and Feasibility Study
    - Details site characteristics and defines the extent and magnitude of contamination at a site.

    - Evaluates potential impacts on human health and the environment; and established cleanup criteria.
    - Evaluates cleanup alternatives.
- Remedial Design: Includes the development of detailed plans and specifications to carry out the selected method of cleanup.
- Cleanup Construction plan: Includes implementation of the selected cleanup action (i.e., actions taken at a site to eliminate, render less toxic, stabilize, contain, immobilize, isolate, treat, destroy, or remove a hazardous substance). Includes construction activities such as removal of contaminated sediment for off-site treatment or disposal; containing contaminated sediment beneath a cap or barrier; the addition of chemicals or enhancement of the growth of microorganisms that break down contaminants in place, monitored natural attenuation, or enhanced natural recovery.
- Time frame to achieve cleanup goals: Nature and extent of contaminants.
- Cleanup objectives.
- Operation and Maintenance plan: Includes activities conducted at a site after cleanup construction is completed to ensure that the cleanup or containment system is functioning properly.
- Monitoring requirements and protocols: Includes required long term monitoring to determine the immediate and long term effectiveness of the remedy.
- Institutional Controls: Measures taken to limit or prohibit activities that may interfere with the integrity of a cleanup action or that may result in exposure to hazardous substances.
- Five year reviews: A review of post-cleanup conditions and monitoring data that may be required at least every five years to ensure that human health and the environment are being protected.
- Cost: Includes the cost of the remedy and ongoing monitoring and maintenance.
- Funding: Includes how the cleanup will be funded for the long term.
- Public comments, responses to public comments.

CERCLA sediment cleanup sites will not be delisted until Ecology exercises our independent authority under MTCA to confirm that a cleanup site is in compliance with the SMS for all chemicals of concern including all chemicals on the 303(d) list. This could include verification by previous sampling or new confirmational sediment sampling, required or conducted by Ecology, after EPA has determined final compliance with the cleanup goals in the Record of Decision. If Ecology determines that a cleanup site is not in compliance with the SMS for all chemicals of concern, including all chemicals on the 303(d) list, new Category 5 listings will be designated for the exceeded parameters. If the site is determined to be in compliance with the SMS and the 303(d) listed chemicals of concern, the site will be listed in Category 1.

To review summaries of Category 4B sediment listings please visit:

- Sediment Cleanups at: https://ecology.wa.gov/Spills-Cleanup/Contamination-cleanup/Sediment-cleanups.
- Ecology's Cleanup and Tank Search website at: https://ecology.wa.gov/Spills-Cleanup/Contamination-cleanup/Cleanup-sites.
- To review the Record of Decision for Category 4B sediment listings please visit the EPA's website at: https://www.epa.gov/aboutepa/epa-washington

The table in Appendix A represents the 2018 list of Category 4B sediment sites, including:

- Assessment Unit and Type
- Parameter Name
- Sediment Cleanup Site Name
- Statute: CERCLA, MTCA, RCRA, RCW 90.48
- Activity: ROD, CAP, CM
- Stage of the cleanup process (Cleanup construction, Operation and Maintenance etc.).
- Cleanup Site and Facility Identifiers (CSID; FSID). CSID is used to find site information.

Appendix A: 2018 WQA Sediment Category 4B Cleanup Sites

Appendix A is only available on the internet, linked to this report at:

https://fortress.wa.gov/ecy/ezshare/wq/WQAssessment/AppendixA.pdf