DEPARTMENT OF
ECOLOGY
State of Washington

Quality Assurance Project Plan

Water Sampling for Formaldehyde at Five Fish & Wildlife Hatcheries in Washington State: Screening Study

March 2017

Publication No. 17-03-108

Publication Information

This document is an addendum to the U.S. Environmental Protection Agency's Quality Assurance Project Plan (QAPP) entitled "*Quality Assurance Project Plan for Water Sampling and Testing for Formaldehyde at Northwest Aquaculture Facilities*" (EPA 2016). The QAPP describes the objectives of the study and the procedures to be followed to achieve those objectives.

This document, *Quality Assurance Project Plan: Water Sampling for Formaldehyde at Five Fish & Wildlife Hatcheries in Washington State: Screening Study*, is available at:
https://fortress.wa.gov/ecy/publications/SummaryPages/1703108.html

Ecology's Activity Tracker Code for this study is 17-013.

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Quality Assurance Project Plan

Water Sampling for Formaldehyde at Five Fish & Wildlife Hatcheries in Washington State: Screening Study

March 2017

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EAP: Environmental Assessment Program
WQP: Water Quality Program

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2.0 Abstract

The U.S. Environmental Protection Agency (EPA) is conducting a study to measure the concentrations of formaldehyde in effluent from aquaculture facilities in Washington and Idaho (EPA, 2016). In Washington State, EPA is the National Pollutant Discharge Elimination System (NPDES) permitting authority for federal aquaculture facilities and aquaculture facilities in Indian Country. The Washington State Department of Ecology (Ecology) is the NPDES permitting authority for all other aquaculture facilities.

EPA conducted sampling and field analysis at five National Fish Hatcheries as documented in the *EPA Formaldehyde in NW Aquaculture Facility Water Study Quality Assurance Project Plan* (QAPP) (EPA, 2016). In coordination with EPA, Ecology conducted sampling and field analysis at five Washington Department of Fish & Wildlife (WDFW) hatcheries that use formalin.

This report documents Ecology's sampling and field analysis for this project, which is adapted from EPA's QAPP for the study and the subsequent Addendum to the QAPP (*Sample Plan Alteration Form #2*) documenting the addition of Ecology-sampled facilities.

3.0 Background

3.1 Introduction and problem statement

Formalin, a 37% by mass aqueous solution of formaldehyde gas, is commonly used to treat and reduce introduction of external parasites in fish hatcheries. This study is being conducted to collect empirical data on formaldehyde concentrations in hatchery effluents in Washington State. The data will be used to determine if concentrations are at levels that pose ecological risk to threatened species or their critical habitat (EPA, 2016).

Ecology's sampling at state-operated hatcheries was intended to supplement EPA's sampling at federally operated hatcheries. The addition of state hatcheries provides further empirical data for the overall study. Details and background about the overall project can be found in EPA's QAPP (EPA, 2016).

3.2 Study area and surroundings

Five WDFW state fish hatcheries that use formalin during treatments were selected for this study (Table 1, Figure 1). These hatcheries were selected by Ecology based on their relatively high use of formalin. Formalin use is reported to Ecology by each NPDES-permitted facility in an Annual Disease Control Chemical Use report.

Table 1. Participating WDFW hatcheries for this study, estimated formalin used per year, WDFW contacts for sampling coordination, sampling dates, and treatment types.

Participating Hatchery	Estimated Formalin Used per Year (Gallons)*	WDFW Contact	Sampling Date	Treatment Type
Kalama Falls Hatchery	1554	Sam Gibbons Manager (360) 673-4825 Sam.Gibbons@dfw.wa.gov	Sept 12, 2016	Adults & eggs
Wallace River Hatchery	2575	Brad Hostetler FHS4 (360) 793-1382 Bradley.Hostetler@dfw.wa.gov	Sept 19, 2016	Adults & eggs
Cowlitz Salmon Hatchery	6608	Larona Newhouse FHS4 (360) 673-4825 Sam.Gibbons@dfw.wa.gov	Sept 30, 2016	Adults
Priest Rapids Hatchery	2310	Glen Pearson FHS4 (509) 932-4481 Glen.Pearson@dfw.wa.gov	Nov 4, 2016 Nov 30, 2016	Adults (Nov 4) Eggs (Nov 30)
Hoodsport Hatchery	1155	Jorge Villarreal FHS4 (360) 877-2737 Jorge.Villarreal@dfw.wa.gov	Dec 7, 2016	Eggs

* Based on formalin use reported to Ecology by each facility in 2014.

3.2.3 Parameters of interest and potential sources

The parameter of interest is formaldehyde. The potential source is the hatchery performing formalin treatments as part of typical daily operations.

Ancillary data – including ammonia concentration, chlorine concentration, dissolved oxygen concentration, pH, and water temperature – were also collected.

3.2.4 Regulatory criteria or standards

Under Washington's Upland Fin-Fish Hatching and Rearing General NPDES Permit, aquaculture facilities that use formalin are required to follow chemical label instructions and report use and concentration information. Parasite-S by Western Chemical, Inc., is the commonly used chemical for formalin treatments. In the finding of no significant impact for Parasite-S, the Food and Drug Administration (FDA) requires a "10-fold dilution of finfish and penaeid shrimp treatment water and a 100-fold dilution of finfish egg treatment water." This should lead to a discharge concentration of no more than 25 ppm. According to the FDA, a

discharge concentration <25 ppm, instream dilution, infrequent use, and rapid degradation of formalin in water will cause no significant aquatic impact (EPA, 2015)

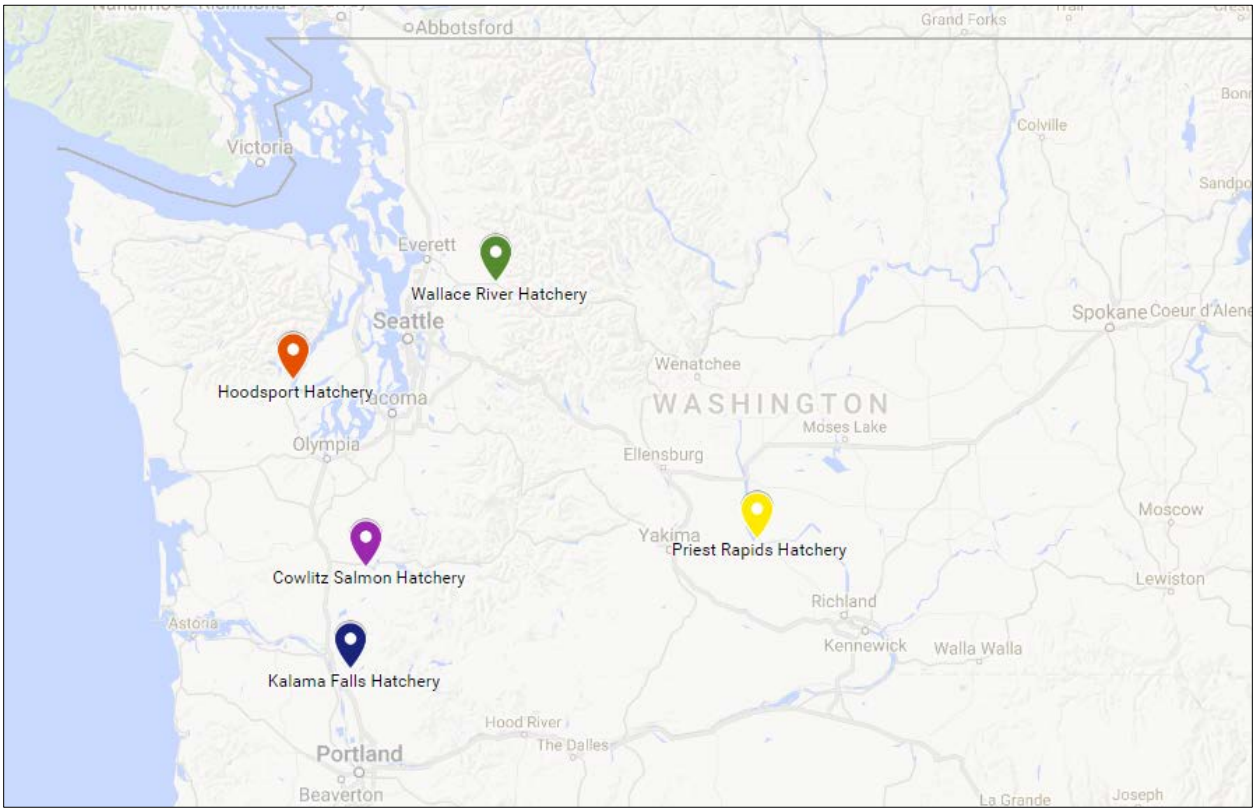

Figure 1. Location of participating WDFW hatcheries.

3.3 Water quality impairment studies

Not Applicable.

3.4 Effectiveness monitoring studies

Not Applicable.

4.0 Project Description

This section describes the specific objectives and tasks required for Ecology's sampling and field analysis at participating WDFW hatcheries. More information about the overall project can be found in EPA's QAPP (EPA 2016). No report or data interpretation will be provided by Ecology for this project.

4.1 Project goals

The goal of this study was to sample on behalf of EPA to provide an assessment of formaldehyde concentrations at WDFW hatcheries using the methods outlined in EPA (2016) as closely as possible.

4.2 Project objectives

The objectives for Ecology's sampling and field analysis were to:

- Collect water samples for laboratory analysis of formaldehyde concentration at each hatchery sampling site using an ISCO automated composite sampler (ISCO).
- Measure chlorine, ammonia, and formaldehyde concentration using test screening kits at each hatchery sampling site.
- Measure in-situ water chemistry (temperature, pH, dissolved oxygen) at each hatchery sampling site.

4.3 Information needed and sources

Not Applicable.

4.4 Tasks required

Pre-Sampling Tasks

- Coordinate with EPA staff prior to each sampling event.
- Schedule and verify sampling dates with hatchery managers.
- Print samples labels and obtain Chain of Custody form sent by EPA.
- Calibrate Hydrolab.
- Test ISCOs and charge ISCO batteries.
- Pre-wash sampling equipment.

Field Tasks

- Set up and program ISCOs to collect water samples for laboratory analysis of formaldehyde at each hatchery sampling site.
- Collect one grab sample per hatchery sampling site for measurement of chlorine, ammonia, and formaldehyde concentration using test screening kits.
- Measure water temperature, pH, and dissolved oxygen using Hydrolab at each hatchery sampling site.
- Collect information about formaldehyde treatment from hatchery staff.

Post-Sampling Tasks

- Send copy of Chain of Custody form, water quality data, and GPS coordinates to EPA staff.
- Ship samples to EPA Region 10 Laboratory.
- Perform Hydrolab post-calibration check.

Field Equipment Checklist

- ISCO water sample collection
  - ISCO automated samplers x 3
  - Pre-washed 1-L wedge-shaped polyethylene bottles x 24
  - Pre-washed 10-L glass jug x 2
  - 3/8" ID (1/2" OD) polyethylene/vinyl tubing for ISCOs (~50 feet total)
  - Clamps for attaching suction line to pump tube
  - 3 charged 12-volt batteries + chargers
  - 3 cables for connecting 12-volt batteries to ISCOs
  - Graduated cylinder for calibration (1000 mL)
  - 3 strainers for end of suction line
- GPS for documenting sample locations
- 125-mL glass jars for formaldehyde samples
- Hach Chlorine 46700-00 CL2 Test Kit with Pocket Colorimeter
- Hach AquaCheck Ammonia Test Strips
- QUANTOFIX® Formaldehyde Test Kit
- Calibrated Hydrolab, connection cable, & handheld meter
- Pre-washed 1-L polyethylene bottle for grab samples
- Extended pole for grab samples
- Cooler(s) with ice for water samples
- DI water for field equipment blank
- Field notebook
- EPA-Scribe preprinted labels and Chain of Custody forms (printed copy)
- Other
  - Writing utensils
  - Bubble wrap for sample jars
  - Packaging tape for sample labels
  - Ziploc bags- gallon size for water samples
  - Miscellaneous tools
  - Laboratory gloves
  - Boots, waders, rain gear

4.5 Systematic planning process used

This QAPP and the EPA QAPP (EPA, 2016) represent the systematic planning process for this project.

5.0 Organization and Schedule

5.1 Key individuals and their responsibilities

Key Ecology personnel (in addition to those EPA personnel identified in EPA's QAPP) are summarized in Table 2.

5.2 Special training and certifications

Not Applicable.

5.3 Organization chart

See Table 2.

Table 2. Organization of Ecology staff and project responsibilities.

Staff	Title	Responsibilities
Siana Wong Toxics Studies Unit Statewide Coordination Section Environmental Assessment Program Phone: 360-407-6432 Email: swon461@ecy.wa.gov	Project Manager	Leads field operations. Coordinates logistics and activities with EPA and participating WDFW hatcheries.
Brandee Era-Miller Toxics Studies Unit Statewide Coordination Section Environmental Assessment Program Phone: 360-407-6771 Email: bera461@ecy.wa.gov	Field Lead	Leads field operations. Reviews Ecology's QAPP.
Debby Sargeant Toxics Studies Unit Statewide Coordination Section Environmental Assessment Program Phone: 360-407-6775 Email: dsar461@ecy.wa.gov	Unit Supervisor for the Project Manager	Provides internal review, approves Ecology's final QAPP, manages budget and staffing needs
William R. Kammin Phone: 360-407-6964 Email: wkam461@ecy.wa.gov	Ecology Quality Assurance Officer	Reviews and approves the draft and final QAPP addendum.

5.4 Proposed project schedule

Five WDFW hatcheries that perform formalin treatments were selected for this study (Table 1). A one-time sampling event at each hatchery was coordinated with each of the hatchery facility managers during formalin treatment periods between September–December 7, 2016. The Priest Rapids Hatchery was sampled during two sampling events: once during adult treatments, and a second time during egg treatments. Contact information and sampling dates for each hatchery are shown in Table 1. Detailed schedules for each facility were determined in coordination with the EPA Region 10 lab staff, Principal Investigators, and Regional Sample Control Center prior to sample collection.

Ecology's sampling was also coordinated with EPA to ensure that similar sampling methods and procedures were used, and that samples were not submitted to EPA's laboratory during the same weeks in order to avoid overloading the laboratory's capacity. Ecology staff followed the EPA Region 10 sample shipment/delivery notification and coordination requirements with the EPA Regional Sample Control Center and lab staff.

Table 3. Proposed schedule for completing field work and data management tasks

Task	Due date	Lead staff
Field work completed	Dec 2016	Siana Wong
All in-situ and grab sample data and site coordinate information sent to EPA for entry into Scribe	Dec 2016	Siana Wong
Copies of field notes & files sent to EPA Project Manager	Jan 2017	Siana Wong

5.5 Budget and funding

Laboratory budget and funding for this project was provided by the EPA.

To complete Ecology's sampling, the EPA provided the following equipment:

- Pocket Colorimeter™ II, Chlorine (Free and Total).
- DPD Total Chlorine Reagent Powder Pillows for a 10 mL sample size.
- Free & Total Chlorine Test Strips, 0-10 mg/L.
- Ammonia (Nitrogen) Test Strips, 0-6.0 mg/L.
- Formaldehyde sample bottles, 125 mL.

All other equipment and staff time was provided by Ecology.

6.0 Quality Objectives

6.1 Data quality objectives

See EPA (2016).

6.2 Measurement quality objectives

See EPA (2016) for discussion on Measurement Quality Objectives (MQOs) for this study. MQOs for Ecology's Hydrolab measurements are shown in Table 4.

Table 4. Measurement quality objectives for Hydrolab calibration checks.

Parameter	Units	Accept	Qualify	Reject
pH	std. units	< or = ± 0.2	> ± 0.2 and < or = ± 0.8	> ± 0.8
Conductivity*	uS/cm	< or = ± 5	> ± 5 and < or = ± 15	> ± 15
Temperature	° C	< or = ± 0.2	> ± 0.2 and < or = ± 0.8	> ± 0.8
Dissolved Oxygen	mg/L	< or = ± 0.3	> ± 0.3 and < or = ± 0.8	> ± 0.8

* Criteria expressed as a percentage of readings; for example, buffer = 100.2 uS/cm and Hydrolab = 98.7 uS/cm; (100.2-98.7)/100.2 = 1.49% variation, which would fall into the acceptable data criteria of less than 5%.

6.2.1 Targets for precision, bias, and sensitivity

6.2.1.1 Precision

See EPA (2016).

6.2.1.2 Bias

See EPA (2016).

6.2.1.3 Sensitivity

See EPA (2016).

6.2.2 Targets for comparability, representativeness, and completeness

6.2.2.1 Comparability

See EPA (2016).

6.2.2.2 Representativeness

See EPA (2016).

6.2.2.3 Completeness

See EPA (2016).

6.3 Acceptance criteria for quality of existing data

See EPA (2016).

6.4 Model quality objectives

Not Applicable.

7.0 Study Design

The study design follows EPA's study design as described in EPA (2016).

7.1 Study boundaries

See Section 3.2 of this document.

7.2 Field data collection

7.2.1 Sampling location and frequency

At each hatchery, sampling occurred at the influent, effluent (discharge), and receiving water. Table 5 shows the site location at each hatchery, analyte to be collected/measured at each site, sample/measurement type, and general collection description.

Table 5. Summary of water samples/measurements collected at each hatchery location.

Sampling Location at Each Hatchery	Analyte	Collection Type – # Samples/ Measurements	Collection Description
Influent	Formaldehyde	Composite – 1	Automated ISCO sampler set up to collect sample at 20-minute intervals for 4 hours following formaldehyde treatment (12:1 composite)
	Chlorine (Total)	Grab – 1	Hach Chlorine 46700-00 CL2 Test Kit with Pocket Colorimeter
	Ammonia	Grab – 1	Hach AquaCheck Ammonia Test Strips
	Temperature	Measurement – 1	Hydrolab MiniSonde
	Dissolved Oxygen	Measurement – 1	Hydrolab MiniSonde
	pH	Measurement – 1	Hydrolab MiniSonde
	Formaldehyde Screening	Grab – 1	QUANTOFIX® Formaldehyde Test Kit
Effluent	Formaldehyde	Grab – 13	Automated ISCO sampler set up to collect 12 discrete samples at 20-minute intervals for 4 hours following formaldehyde treatment. One grab sample will also be collected manually during estimated peak formalin discharge.
	Chlorine (Total)	Grab – 1	Hach Chlorine 46700-00 CL2 Test Kit with Pocket Colorimeter
	Ammonia	Grab – 1	Hach AquaCheck Ammonia Test Strips
	Temperature	Measurement – 1	Hydrolab MiniSonde
	Dissolved Oxygen	Measurement – 1	Hydrolab MiniSonde
	pH	Measurement – 1	Hydrolab MiniSonde
	Formaldehyde Screening	Grab – 1	QUANTOFIX® Formaldehyde Test Kit
Receiving water	Formaldehyde	Composite – 1	Automated ISCO sampler set up to collect sample at 20-minute intervals for 4 hours following formaldehyde treatment (12:1 composite)
	Chlorine (Total)	Grab – 1	Hach Chlorine 46700-00 CL2 Test Kit with Pocket Colorimeter
	Ammonia	Grab – 1	Hach AquaCheck Ammonia Test Strips
	Temperature	Measurement – 1	Hydrolab MiniSonde
	Dissolved Oxygen	Measurement – 1	Hydrolab MiniSonde
	pH	Measurement – 1	Hydrolab MiniSonde
	Formaldehyde Screening	Grab – 1	QUANTOFIX® Formaldehyde Test Kit

7.2.2 Field parameters and laboratory analytes to be measured

The following parameters were measured/sampled at each hatchery as documented in the EPA QAPP:

- Formaldehyde - Lab
- Chlorine (Total) - Field
- Ammonia - Field
- Water Temperature - Field
- Dissolved Oxygen - Field
- pH - Field
- Formaldehyde Screening (test kits) - Field

7.3 Modeling and analysis design

No modeling or data analysis were conducted for this project.

7.3.1 Analytical framework

Not Applicable.

7.3.2 Model setup and data needs

Not Applicable.

7.4 Assumptions in relation to objectives and study area

Not Applicable.

7.5 Possible challenges and contingencies

7.5.1 Logistical problems

Field work was coordinated with hatchery staff to ensure that sampling occurred on treatment days during peak formalin treatment periods. Field schedules were also coordinated with EPA laboratory staff to ensure that the lab could process the samples during the targeted sampling dates. Each hatchery was visited prior to sampling day to determine sampling sites and identify any logistical challenges.

7.5.2 Practical constraints

Not Applicable.

7.5.3 Schedule limitations

Not Applicable.

8.0 Field Procedures

8.1 Invasive species evaluation

Not Applicable.

8.2 Measurement and sampling procedures

Measurement and sampling procedures followed EPA's QAPP (EPA, 2016) as closely as possible to ensure that data are comparable. No deviations occurred, with the exception of the type of instruments used for collecting samples (ISCO vs. Sigma automated sampler; Hydrolab vs. Horiba multi-probe instrument). Calibration of the Hydrolab followed Ecology's SOP (Anderson, 2016).

Formaldehyde

Formaldehyde samples for laboratory analysis were collected using automated ISCO (Model 6712) samplers. Three ISCO samplers were programmed to collect samples at the influent, effluent, and receiving water at each hatchery. Prior to sampling, ISCO samplers were calibrated at each hatchery location to ensure that the accurate volumes were collected.

Each ISCO was programmed to collect the first sample ~15 minutes before treatment started and the last sample ~1 hour after treatment ended. This helped ensure that the pulse of formalin running through the system was captured.

At the influent and receiving water, a composite sample was collected at 20-minute intervals over a four-hour period during the formalin treatment application. The composite consisted of 12x250-mL aliquots collected into a single 10-L pre-washed (soap + water followed by deionized water rinse) glass jug. The internal compartment of the ISCO sampler was filled with ice to keep the 10-L jug cold during the sampling. After the composite was collected, water from the 10-L jug was mixed and poured into a single 125 mL glass sample jar, and then stored in a cooler on ice. The remaining water in the 10-L jug was discarded.

At the effluent, the ISCO sampler was set up to collect 12 discrete samples over a four-hour period during the formalin treatment. Each discrete sample was comprised of 450-mL water collected in a pre-washed wedge-shaped 1-L polyethylene bottle. At the end of discrete sampling, water from each polyethylene bottle was mixed and poured into a 125 mL glass sample jar (12 total samples). One grab sample for laboratory analysis of formaldehyde was also collected at the effluent during estimated peak formalin discharge.

All formaldehyde samples were stored in a cooler with ice in the field, and then shipped overnight to EPA's laboratory for further processing and analysis.

Chlorine (Total)

Chlorine samples were taken from an aliquot of a grab sample collected at each of the influent, effluent, and receiving water sites. Total chlorine was analyzed on-site using a Hach Chlorine 46700-00 CL2 Test Kit with Pocket Colorimeter. Results were recorded in the field notebook.

Ammonia

Ammonia samples were taken from an aliquot of a grab sample collected at each of the influent, effluent, and receiving water sites. Ammonia was analyzed on-site using Hach AquaCheck Ammonia Test Strips, 0-6.0 mg/L. Results were recorded in the field notebook.

Temperature, Dissolved Oxygen, and pH

A calibrated Hydrolab MiniSonde was used to measure in-situ water temperature, dissolved oxygen, and pH at the influent, effluent, and receiving water sites. The Hydrolab was calibrated on the day prior to sampling following Ecology's SOP (Anderson, 2016). A post-calibration check was performed following each sampling event. Table 4 shows the MQOs for post-calibration checks. Results were recorded in the field notebook.

Formaldehyde screening kit

Formaldehyde screening samples were taken from an aliquot of a grab sample collected at each of the influent, effluent, and receiving water sites. QUANTOFIX® Formaldehyde Test Strips were used to analyze formaldehyde concentrations on-site. Results were recorded in the field notebook.

Flow

Flow information was obtained from facility staff.

Other hatchery facility information

Hatchery facility and formalin treatment information will be obtained from hatchery staff:

- Static Bath Treatment
  - Tank volume
  - Desired treatment concentration
  - Volume of formalin needed per treatment
- Flow-Through Treatment
  - Tank volume
  - Calculated flow rate
  - Duration of treatment
  - Flow-through concentration
  - Amount of formalin added initially
  - Amount of formalin added during treatment
  - Volume of formalin needed per treatment
- Maximum percent facility discharge treated
- Maximum volume of water discharged per day

8.3 Containers, preservation methods, holding times

Table 6 summarizes the number of samples collected, QC samples, matrix, laboratory method, reporting limit, accuracy and precision, completeness, container, preservation, and holding time for each analyte collected. All formaldehyde samples will be sent to the EPA Region 10 Laboratory for analysis.

Table 6. Summary of sample collection information, laboratory and field methods, QC objectives, preservation, and holding times.

Table is adapted from EPA (2016).

Analyte	# Samples per Hatchery	# QC Samples: Field Dups/ Blanks per Hatchery	Matrix	Collection Type	Method	Reporting Limits	Accuracy	Precision (RPD)	Completeness	Container	Preservation	Holding Time
Formaldehyde	15	1/1	Water	Lab Sample	EPA 1667A	100 µg/L	50-150%	30%	100%	125 mL Certified Clean Glass with Teflon Lid Liner	Cool to 4 C	5 days
Chlorine (Total)	3	1/NA	Water	Field Measurement	EPA 330.5	0-4.5 mg/L	± 0.02 mg/L	NA	100%	NA	NA	Analyze Immediately
Ammonia	3	1/NA	Water	Field Measurement	NA (Test Strip)	0-6.0 mg/L	± 0.5 mg/L color block	NA	100%	NA	NA	Analyze Immediately
Temperature	3	1/NA	Water	Field Measurement	EPA 170.1	NA	0.1 C	NA	100%	NA	NA	Analyze Immediately
Dissolved Oxygen	3	1/NA	Water	Field Measurement	EPA 360.1	0.05 mg/L	± 2%	30%	100%	NA	NA	Analyze Immediately
pH	3	1/NA	Water	Field Measurement	EPA 350.1	NA	0.1 pH unit	0.1 pH unit	100%	NA	NA	Analyze Immediately
Formaldehyde Screening (Test Kits)	3	1/NA	Water	Field Measurement	NA (Test Strip)	NA	NA	NA	100%	NA	NA	Analyze Immediately

8.4 Equipment decontamination

Prior to sampling, equipment used for collecting samples was washed with hot tap water and Liquinox soap, followed by tap water rinse and de-ionized water rinse. The specific procedure for decontaminating equipment can be found in Ecology's SOP (Friese, 2014).

8.5 Sample ID

Ecology coordinated with EPA staff to assign unique sample IDs prior to sampling at each hatchery.

8.6 Chain-of-custody

Chain-of-custody was maintained for all samples throughout the project. As Ecology was acting as the sampling entity only, with EPA being the data recipient and data user, all samples and associated field/lab and locational data were managed in a single Scribe file by EPA Office of Environmental Review and Assessment Environmental Services Unit staff. At minimum, Ecology hand-entered the sample collection date and time onto pre-printed Scribe sample labels and Chain of Custody forms for each facility. Immediately after each sampling event, Ecology scanned the completed printed copy of the Chain of Custody form and completed field form (EPA, 2016) to the EPA Regional Sample Control Center so that field data could be entered into Scribe and the lab Chain of Custody XML generated for sample receipt/login.

8.7 Field log requirements

Field data was recorded in a bound, waterproof notebook on Rite in the Rain paper. Attachment 3 of the EPA's QAPP for this project will be used as Ecology's template (EPA, 2016).

8.8 Other activities

Not Applicable.

9.0 Laboratory Procedures

9.1 Lab procedures table

See Table 5 of this document.

9.2 Sample preparation method(s)

Methods for formaldehyde analysis in water samples are documented by EPA Method 1667A.

9.3 Special method requirements

Not Applicable.

9.4 Laboratories accredited for methods

All water sample analyses for formaldehyde concentration were performed by the EPA Region 10 Laboratory.

10.0 Quality Control Procedures

10.1 Table of field and laboratory quality control

Table 5 summarizes field duplicate and blank sample collections for each analyte.

Field Duplicates

One duplicate field sample was collected per sampling event for each grab sample analyte (ammonia, chloride, formaldehyde). One duplicate sample for laboratory analysis of formaldehyde was also collected from a sample taken from the automated discrete sampler during each sampling event.

Field Blanks

One field (rinsate) blank was collected per facility and analyzed for formaldehyde at the laboratory. This was performed by running de-ionized water through the ISCO sampler, collecting the water in the 10-L glass jug, then pouring the water into a formaldehyde sample jar.

Laboratory Matrix Spike

Following discrete sample collection at the effluent site, three formaldehyde sample jars were filled from the first ISCO bottle (representing a sample prior to treatment start). The samples were used by the EPA laboratory to conduct a laboratory matrix spike and matrix spike duplicate.

10.2 Corrective action processes

All data were submitted to the EPA. Corrective action procedures are described in EPA (2016), and will be determined by the EPA Principal Investigator for this project.

11.0 Management Procedures

11.1 Data recording and reporting requirements

See EPA (2016). All data will be submitted to EPA for data reduction and reporting.

11.2 Laboratory data package requirements

See EPA (2016). All data will be submitted to EPA.

11.3 Electronic transfer requirements

Not Applicable.

11.4 EIM/STORET data upload procedures

Not Applicable. All data will be submitted to EPA. The EPA Principal Investigator of this project will provide data upon request.

11.5 Model information management

Not Applicable.

12.0 Audits and Reports

12.1 Field, laboratory, and other audits

To ensure Ecology's sampling and field analysis followed EPA's procedures, Ecology staff accompanied and observed EPA field staff on one of their sampling dates for this project. In addition, EPA staff assisted Ecology at the first WDFW hatchery sampled.

12.2 Responsible personnel

Not Applicable.

12.3 Frequency and distribution of report

Not Applicable.

12.4 Responsibility for reports

The EPA is responsible for all data reduction and reporting for this project (EPA, 2016).

13.0 Data Verification

13.1 Field data verification, requirements, and responsibilities

See EPA (2016).

13.2 Laboratory data verification

See EPA (2016).

13.3 Validation requirements, if necessary

See EPA (2016).

13.4 Model quality assessment

Not Applicable.

14.0 Data Quality (Usability) Assessment

14.1 Process for determining project objectives were met

EPA is responsible for all data quality determinations (EPA, 2016).

14.2 Treatment of non-detects

See EPA (2016).

14.3 Data analysis and presentation methods

All data will be submitted to the EPA for data analysis. Presentation methods will be determined by the principal investigator.

14.4 Sampling design evaluation

Not Applicable.

14.5 Documentation of assessment

See EPA (2016).

15.0 References

Anderson, P., 2016. Standard Operating Procedures for Hydrolab DataSonde® and MiniSonde® Multiprobes. Version 2.1. Washington State Department of Ecology, Olympia, WA. SOP Number EAP033. http://www.ecy.wa.gov/programs/eap/qa/docs/ECY_EAP_SOP_Hydrolab_v2_1EAP033.pdf

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16.0 Appendix. Glossaries, Acronyms, and Abbreviations

Glossary of General Terms

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

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

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

National Pollutant Discharge Elimination System (NPDES): National program for issuing, modifying, revoking and reissuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements under the Clean Water Act. The NPDES program regulates discharges from wastewater treatment plants, large factories, and other facilities that use, process, and discharge water back into lakes, streams, rivers, bays, and oceans.

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

Acronyms and Abbreviations

Ecology	Washington State Department of Ecology
EIM	Environmental Information Management database
EPA	U.S. Environmental Protection Agency
GPS	Global Positioning System
MQO	Measurement quality objective
NPDES	(See Glossary above)
QA	Quality assurance
QC	Quality control
SOP	Standard operating procedure
WDFW	Washington Department of Fish and Wildlife

Units of Measurement

mg/L	milligrams per liter (parts per million)
mL	milliliter
uS/cm	microsiemens per centimeter, a unit of conductivity

Quality Assurance Glossary

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

References for QA Glossary

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