AMBIENT MARINE WATER QUALITY MONITORING

QUALITY ASSURANCE PROJECT PLAN FOR WATER QUALITY MONITORING SAMPLING AND ANALYSIS ACTIVITIES: Version 5

By:

The Aquatic Restoration and Research Institute
PO Box 923, Talkeetna, Alaska 99676
arri@arrialaska.org

&

Alaska Department of Environmental Conservation
Division of Water

June 2023

A. PROJECT MANAGEMENT ELEMENTS

A.1 Title and Approvals:

Title: Ambient Marine Water Quality Monitoring: Harbors and Shipping Lanes Project (HSLP)

Name: Jeffrey C. Davis, Project Manager Phone: (907) 315-4631
Organization Name: ARRI email: arri@arrialaska.org

Signature: _____ Date: _____

Name: Gay A. Davis, Project QA Officer Phone: (907) 3150-4632
Organization Name: ARRI email: arri@arrialaska.org

Signature: _____ Date: _____

Name: Maryann Fidel, Program Manager Phone: (907) 269-7522
ADEC DOW WQSAR Program email: Maryann.fidel@alaska.gov

Signature: _____ Date: _____

Name: John Clark ADEC DOW QA Officer Phone: (907) 269-3066
ADEC DOW WQSAR Program email: John.Clark@alaska.gov

Signature: _____ Date: _____

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TABLE OF CONTENTS

A. PROJECT MANAGEMENT ELEMENTS

LIST OF APPENDICES

LIST OF TABLES

LIST OF FIGURES

A.3 DISTRIBUTION LIST

Table 1 includes the names and addresses of those who will receive copies of the approved QAPP and subsequent revisions.

Table 1. QAPP distribution list.

NAME	POSITION	AGENCY/ Company	DIVISION/ BRANCH/SECTION	CONTACT INFORMATION
Jeffrey C. Davis	Project Manager	ARRI		Phone: (907) 315-4631 Email: arri@arrialaska.org
Gay A. Davis	Project Quality Assurance Officer	ARRI		Phone: (907) 315-4632 Email: arri@arrialaska.org
Howard Holmes	Project Manager	ALS Environmental	Kelso Laboratory	Phone: (360) 577-7222 Email:howard.holmes@alsglobal.com
Hope O'Neill	Lab Manager	Admiralty Environmental	Juneau	Phone: (907) 463-4415 Email: dwetzel@admiraltyenv.com
Jill Larna	Laboratory Manager	R&M Engineering	Ketchikan	Phone: (907) 225-7917 Email: jlarna@rmketchikan.com
Justin Nelson	Project Manager	SGS Environmental	Anchorage	Phone: (907) 562-2343 Email: justin.nelson@sgs.com
Patryce McKinney	Chief	Environmental Health Lab	Anchorage	Phone: (907) 375-8200 Email: Patryce.McKinney@alaska.gov
Scott Harding	Sales Account Manager	LuminUltra Technologies	Miami, Florida	Phone: (702) 550-8579 Email: scott.harding@luminultra.com
Maryann Fidel	Project Manager	ADEC	Division of Water	Phone: (907) 269-7522 Email: Maryann.fidel@alaska.gov
John Clark	QA Officer	ADEC	Division of Water	Phone: 907-269-3066 Email: john.clark@alaska.gov

A.4 PROJECT TASK/ORGANIZATION

Relationships among ARRI and DEC personnel are shown in Figure 1.

Maryann Fidel (DEC) DEC Project Manager. Ms. Fidel will oversee the project for DEC. She will provide technical support, QAPP review and revision, review of any proposed sampling plan modifications, and the review of all reports. During the 2023 season, she will be responsible for MST sampling, and sampling in Whittier and Valdez.

John Clark (DEC) DEC Division of Water QA Officer. Mr. Clark will be responsible for the review/approval of the QAPP. He will work with the DEC project manager to provide recommendations and requirements to the Project Managers.

Jeffrey C. Davis (ARRI) Project Manager. Mr. Davis will make sure that all field data are collected as specified in the QAPP for Juneau/Auke Bay, Ketchikan/Ward Cove, Seward and all shipping lane sites. He will be responsible for preparing all reports.

Gay A. Davis (ARRI) will act as ARRI Quality Assurance Officer. Ms. Davis will be responsible for making sure that all data are collected, replicate samples taken and analyzed, and all data entered and analyzed correctly.

ALS Environmental, 1317 S. 13th Ave Kelso, Washington, 98626, will be responsible for analyses of total and dissolved metals, and ammonia nitrogen.

Admiralty Environmental LLC, 641 W. Willoughby Ave., Suite 301 Juneau, Alaska 99801, will be responsible for analyzing all water samples collected from Juneau and surrounding areas for fecal coliform and *Enterococcus* bacteria analyses and providing quality control and quality assurance reports relative to parameters tested.

SGS Environmental, 200 West Potter Drive, Anchorage, Alaska 99518, we be responsible for analyzing all water samples collected from Seward, and ammonia-N for Whittier and Valdez. They will provide quality control assurance reports relative to parameters tested.

R&M Engineering, 7180 Revilla Road, Suite 300, Ketchikan Alaska, 99901, will be responsible for analyzing all water samples collected from locations close to Ketchikan for fecal coliform and *Enterococcus* bacteria from Ketchikan and Ward Cove and providing quality control assurance reports relative to parameters tested.

SoA Environmental Health Lab, 5251 Dr. Martin Luther King Jr. Avenue, Anchorage, AK 99507, will be responsible for all analysis, except for ammonia-N, for Whittier and Valdez. They will provide quality control assurance reports relative to parameters tested.

LuminUltra Technologies, 805 Pinnacle Drive, Suite M, Linthicum Heights, MD 21090, will be responsible for Microbial Source Tracking analysis.

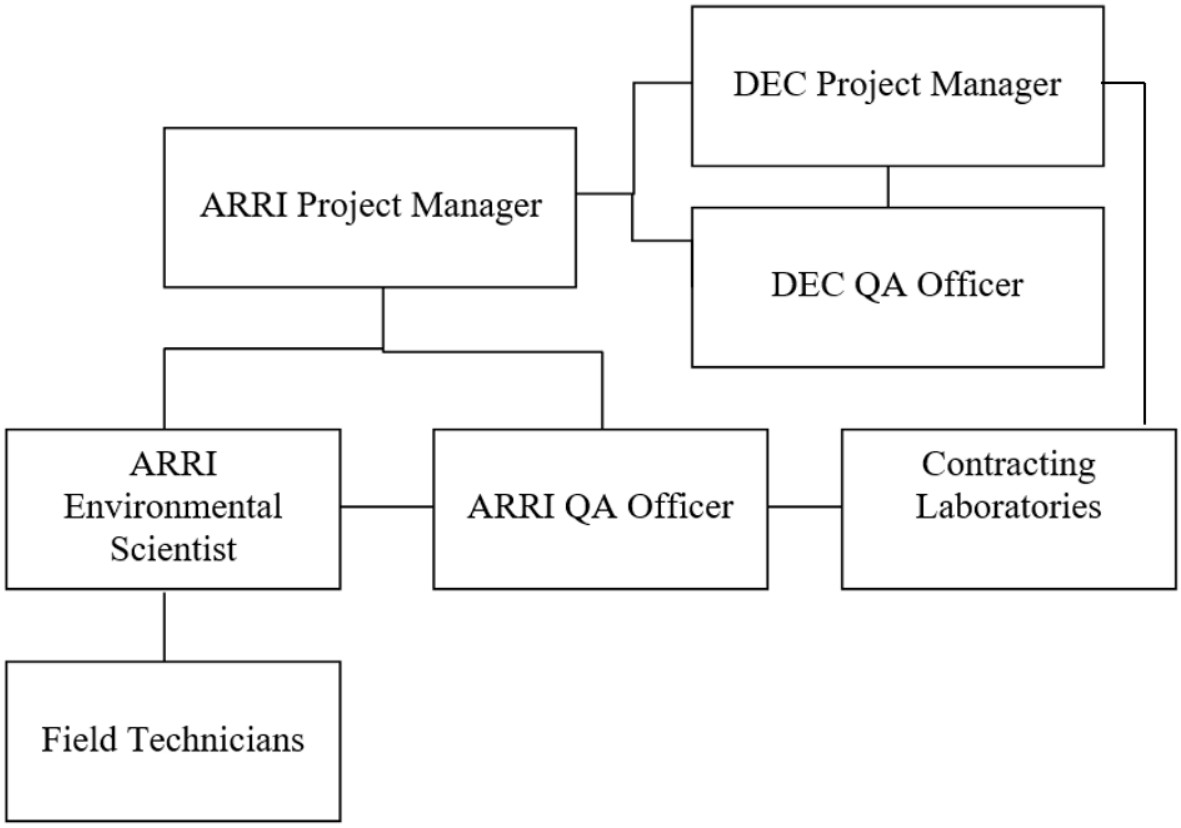

Figure 1. Relationship and lines of communication among personnel and organizations.

A.5 PROBLEM DEFINITION/BACKGROUND AND PROJECT OBJECTIVES

A.5.1 Problem Definition

The Alaska Department of Environmental Conservation (DEC) Water Quality is responsible for the monitoring of state waters for potential pollutants that could exceed the State's Water Quality Standards (18 AAC 70) (DEC 2018). The DEC, Commercial Passenger Vessel Environmental Compliance (CPVEC) program is responsible for authorizing proposed discharges from cruise ships to marine waters. The DEC has issued a general permit for these discharges that requires compliance with water quality standards at the point of discharge or submitting a request for a mixing zone. The current general permit is based on the best available ambient water quality data; however, these data are limited.

Monitoring of Alaska's high traffic harbors and shipping lanes is necessary to provide information about ambient conditions to inform permitting, and to determine if Alaska Water Quality Standards (WQS) are being meet.

A.5.2 Project Background

Water quality monitoring has been conducted to assess ambient conditions in marine waters since 2015, with some previous historic data. Ambient water quality data for marine waters prior to 2009 was summarized by the Science Advisory Panel (Appendix A). Starting in 2015 marine water quality assessment was conducted primarily in the Ports of Juneau and Skagway using methods established by the ADEC Division of Water (DOW) Commercial Passenger Vessel Environmental Compliance Program (CVECP). Subsequent sampling was expanded to include the Ports of Ketchikan, Sitka, Hoonah, and Seward. Beginning in 2020 and extending through 2022 the DEC, DOW, Water Quality Monitoring and Assessment (WQMA), continued and expanded the project to include six or more sites within each 19 ports from Nome to Ketchikan, and at 30 sampling sites distributed among major shipping lanes. Concentrations of ammonia-N, metals, and geometric mean bacterial concentrations were compared to Alaska Water Quality Standard (WQS) most stringent numeric criteria (18 AAC 70) (DEC 2018b). These data provide measures of ambient water quality in some of Alaska's busiest ports including measures during the period of decreased ship traffic due to the Covid-19 pandemic (2020 and 2021) compared to normal years (2022). Summary reports for 2020, 2021 and 2022 can be found at DEC's website[1]. This project provided screening-level data for select metals and ammonia-N, information toward attainment of WQS, and WQS assessment-level data for pathogens.

One objective for the 2023 marine water quality project is to obtain WQS assessment-level data for select metals and ammonia-N in some Alaskan Ports. The Clean Water Act mandates that each state monitor and report on the quality of its waters and list any waterbodies that do not meet Water Quality Standards. In order to make this determination data must meet minimum data requirements for 'assessment level' data fulfilling quality and quantity requirements under 2020 Alaska Consolidated Assessment and Listing Methodology[2] (CALM). Assessment level data is more rigorous than 'screening level' data and can be used to determine if the uses for water are being attained or if the waterbody is impaired (polluted). Water quality criteria and requirements for assessment level data are summarized in Table 2. Additional relevant considerations in the CALM include: spatial considerations of the water being characterized should consider the effect of an intervening tributary, outfall, or pollution source. The timing of a monitoring schedule should be such that sampling identifies the range of conditions in the assessment unit, including those periods critical to the attainment of the designated use.

More intensive sampling is required to obtain assessment-level data; therefore, ports were prioritized to determine where efforts should be directed. Prioritization criteria included (1) the number of large cruise ships (with greater than 500 passenger capacity that fall under DEC's General Permit), (2) results from past sampling (identification of WQC exceedances and trends of increasing contaminants), and (3) expected increases in cruise ship traffic. The ports of Juneau/Auke Bay and Ketchikan were selected due to the large number of cruise ships, the ports of Valdez and Seward due to increasing concentrations of metals, and the port of Whittier due to the construction of a new large cruise ship dock.

[1] https://dec.alaska.gov/water/water-quality/nonpoint-source-control/water-quality-resources/reports

[2] ADEC (2020) Alaska Consolidated Assessment and Listing Methodology (CALM), Water Quality (alaska.gov)

Table 2. Water quality standard criteria and data qualifications.

<table>
<tr><th>Parameter</th><th colspan="2">Water Quality Criteria[3]</th><th>Data Qualifications (CALM[4])</th></tr>
<tr><td rowspan="2">Pathogens[5]</td><td colspan="2">Fecal Coliform
Water Supply for seafood processing: In a 30-day period, the geometric mean of samples may not exceed 20 fecal coliform/100 ml, and not more than 10% of the samples may exceed 40 fecal coliform/100 ml.</td><td rowspan="2">The assessment period should span a minimum of two years, not necessarily consecutive, within five years. Datasets should have at least two distinct 30-day sampling intervals distributed over the course of the assessment period, with a minimum of five samples within the 30-day sampling interval. Bacteria levels can be affected by environmental factors; therefore, the assessment period should be representative of both ambient and adverse pollution conditions. Either units of cfu/100mL or MPN/100mL may be used, but because these units are not comparable, they must be consistent throughout the assessment period. Required metadata includes environmental conditions and microbial source tracking will be considered to distinguish human sources.</td></tr>
<tr><td colspan="2">Enterococcus
Marine contact recreation: In a 30-day period, the geometric mean of samples may not exceed 35 cfu/100mL more than once in a two-year period.</td></tr>
<tr><td rowspan="4">Toxic and Deleterious Organic and Inorganic Substances[6]</td><td rowspan="4">Marine aquatic life (chronic), exceeded more than once in the most recent 3-year period or a >5% exceedance frequency in the dataset</td><td>Dissolved Copper: 3.1 µg/L</td><td rowspan="4">The assessment period should span a minimum of two years, not necessarily consecutive, within five years. Datasets should have a minimum of 10 representative data points total. Concurrent pH, temperature and salinity measurements are needed for ammonia-N. Older data (> 5 years) may be considered as ancillary evidence when determining if a waterbody meets or exceeds WQ criteria if pollutant sources causing the impairment have not substantially changed or more</td></tr>
<tr><td>Dissolved Nickel: 8.2 µg/L</td></tr>
<tr><td>Dissolved Zinc: 86 µg/L</td></tr>
<tr><td>Ammonia-N: 0.3 mg/L (dependent on pH 8.6, temp 15ºC, and 30 ppt salinity)</td></tr>
</table>

[3] ADEC (2020) Water Quality Standards, 18 AAC 70

[4] ADEC (2020) Alaska Consolidated Assessment and Listing Methodology (CALM), Water Quality (alaska.gov)

[5] ADEC (2021) Pathogen Listing Methodology

[6] ADEC (2022) Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances

			recent confirmatory data is collected. Discrete samples may be considered to be representative of averaging periods if limited data is available.

A.5.3 Project Objective(s)

The goal of the marine water quality project is to provide reliable water quality data where marine transportation is concentrated. Evaluation of marine water quality data will determine if Alaska WQS are maintained within the busiest coastal waters and Ports. This effort will support DEC's mission to protect human health and the environment.

The current study has the following objectives:

1. To collect assessment-level data for select metals (Cu, Ni, Zn), ammonia-N and pathogens in three high priority harbors: Juneau (including Auke Bay), Ketchikan (including Ward Cove) and Seward.
2. The continued collection of screening-level data for metals and ammonia-N, and an additional set of assessment level data for pathogens in the ports of Whittier and Valdez.
3. To continue one-time sampling of metals, ammonia-N, and pathogens to produce screening level data for shipping lane sites.
4. Identify sources of fecal coliform bacteria through microbial source tracking in areas that have had multiple exceedances in the past (Valdez, Ketchikan/Ward Cove, and Seward).

Table 3 summarizes past sampling effort and lists the number of sampling events and samples to be collected from 2023 to June 2024.

Table 3. Number of samples and sampling sites in autumn 2023 and spring 2024 need to obtain assessment level data.

Port	**Number of Sampling sites**	**2023**				**2024 (Fiscal Year ending on June 30, 2024)**				**Totals from the most recent 5-year period unless otherwise noted with an ***			
		Metals		Pathogens		Metals		Pathogens		Metals		Pathogens	
		Events	Samples	Events	Samples	Events	Samples	Events	Samples	Events	Samples	Events	Samples
Juneau	4	3	12	5	20	4	16	5	20	10	52	25	154
Auke Bay	3	3	9	5	15	4	12	5	15	10	27	25	60
Ketchikan	3	2	6	5	15	0	0	5	15	10*	94*	25	150
Ward Cove	3	3	9	5	15	4	12	5	15	10	34	25	105
Seward	4 near community	3	12	5	20	4	16	5	20	10	35	25	85
	2 outside community	3	6	5	10	3	6	5	10	10*	24*	25	65
Valdez	4 near community	1	4	5	20	-	-	-	-	4	13	20	65
	2 outside community	1	2	5	10	-	-	-	-	4	11	20	55
Whittier	4 near community	1	4	5	20	-	-	-	-	4	13	20	65
	2 outside community	1	2	5	10	-	-	-	-	4	11	20	55
Shipping Lane Sites	30 sites sampled annually	1	30	1	30	1	15	1	15	N/A	N/A	N/A	N/A

*Ketchikan would use data from 2018 – 2024 (7 years of data). Metals data from 2018 is high quality and includes 56 samples from one sample event.

*Six years of data from (2019 – 2024) will be used for the MAU away from the community of Seward because there are very few potential sources of pollutants. Five years of data will be used for the MAU close to the community of Seward.

A.6 PROJECT/TASK DESCRIPTION and SCHEDULE

A.6.1 Project Description

The sampling design below describes the selection of sampling locations, sample collecting timing and frequency, sample parameters, and additional site data to be collected during each sampling event.

A.6.1.1 Sampling locations and Sampling sites
Water sampling will be conducted within seven ports; Seward, Ketchikan & Ward Cove, Juneau & Auke Bay, Whittier and Valdez, and at 30 sampling sites distributed among major shipping lanes throughout southeast and southcentral Alaska. See appendix B for maps and locations (latitude/longitude).

Within each port samples will be collected at three to six sampling sites representing different Marine Assessment Units (MAUs). Sampling sites within the Auke Bay, Juneau, Ketchikan, and Ward Cove harbors are within their respective MAU, sampling sites in the Ports of Valdez, Whittier, and Seward represent two MAUs. Sampling sites within each MAU were selected in areas of potentially high and low concentrations of pollutants (e.g. close to and far from communities or authorized mixing zones (see Appendix B for site selection justification).

Shipping lane sample sites were selected to represent areas of high vessel traffic in southeast and southcentral.

A.6.1.2 Sampling Dates and Sample Timing
Water sampling will occur during the spring (May – June) and fall of 2023 (July – September) and spring of 2024 (May - June). Sampling dates have been selected to increase temporal representation. Sampling within the Port of Whittier and Valdez will be conducted in the spring of 2023 and Auke Bay, Juneau, Ward Cove, Ketchikan, and Seward will be sampled in the fall of 2023 and spring of 2024.

A.6.1.3 Sample Parameters
Water quality sample parameters include total and dissolved copper, nickel, and zinc; ammonia-N; and *in situ* measures of salinity, pH, dissolved oxygen, and temperature. Measures of salinity, pH, dissolved oxygen, and temperature will be taken at 1, 2, 3 and 4-meter water depths when collecting water samples to be analyzed for metals and ammonia-N.

Water samples will be collected at all sampling sites in all harbors and submitted for laboratory analyses for fecal coliform bacteria and *enterococcus*. WQS exceedances for fecal coliform and *Enterococcus* bacteria are based on the geometric mean of 5 or more samples collected within a 30-day period. Five or more sample events will occur within a 30-day period in all MAUs near ports; however, only a single water sample will be collected for fecal coliform and *Enterococcus* analyses at shipping lane locations. Water temperature will be measured and recorded concurrent with pathogen sampling (between 0.2 - 0.7 m water depth).

Microbial Source Tracking (MST) will be used to confirm the presence or absence of anthropogenic sources and an indication of their prevalence in the environment[7]. Sample locations are those that have exhibited high numbers of bacteria in the past, or near potential cruise ships discharge, or both. Water samples will be collected for MST analyses at two sites in the Ports of Valdez, Ketchikan, Ward Cove, and Seward.

[7] EPA (2011) Using Microbial Source Tracking to Support TMDL Development and Implementation. Prepared by Tetra Tech, Inc. & Herrera Environmental Consultants. https://www.epa.gov/sites/default/files/2015-07/documents/mst_for_tmdls_guide_04_22_11.pdf

A.6.1.4 Additional Data Collection

Additional data collection during each sampling event will include sampling site latitude, longitude if this varies from established locations in the interest of safety. Site photographs will be taken opportunistically, or in the case of something unusual, and time, air temperature, tidal stage, and weather (precipitation estimates for past 48 hours to present) will be recorded on the field Data Collection Log (DCL). Observations of cruise ship discharges, outfalls, or other potential sources of bacteria or other pollutants that may influence harbor water quality will be recorded.

Other data collected during MST sampling will include tidal stage, precipitation and any observed potential sources of bacteria (such as cruise ships in port, observations of abundant marine mammals, birds, etc.).

A.6.2 Project Implementation Schedule

A summary of the project implementation schedule is provided in Table 4. Project implementation will require close coordination among ARRI and DEC. Responsibilities of the two parties are outlined in Table 4.

ARRI will be responsible for all logistics, coordination with analytical laboratories, and field sampling in Juneau/Auke Bay, Ketchikan/Ward Cove and Seward. DEC will be responsible for all logistics coordination with analytical laboratories, and field sampling in Whittier and Valdez, and will conduct the MST sampling. Each party will be responsible for entering the data that they collected in excel in a format provided by DEC. The dataset will be joined to be used in analysis and imported into the Ambient Water Quality Monitoring System (AWQMS).

ARRI will work with the DEC project manager to schedule sampling so that DEC representatives have the option to participate in field sampling.

Table 4. Summary of project task implementation schedule.

Activity	Measurement/ Parameter(s)	Sampling Sites and Depths	Sampling Frequency	Time Frame	Responsibility
QAPP	N/A	NA	Update as needed	Annual Review prior to field season	ARRI & DEC
Field Sampling	DO, pH, Temp, Salinity	1, 2, 3, and 4 m water depths at all sampling sites every time an ammonia-N, metals sample is taken	Concurrent with metals and ammonia-N sampling	May-Sept	ARRI & DEC

	Total and dissolved Cu, Ni, and Zn, and ammonia-N	Between 0.7 and 1.0 m at all sampling sites	Three sample events in Juneau/Auke, Ketchikan/Ward Cove, and Seward	July-Sept	ARRI
			One sample for shipping lanes	April - Sept	ARRI
			One sample event in Whittier and Valdez	May - June	DEC
	Fecal coliform and *Enterococcus* bacteria; air and water temperature	Between 0.2 - 0.7 m water depth at all sampling sites.	Five sampling events within a 30-day period in Ketchikan/Ward Cove, Juneau/Auke Bay and Seward.	July - Sept	ARRI
			One sample at all shipping lanes sites	April - Sept	ARRI
			Five sampling events within a 30-day period in Whittier and Valdez.	May - June	DEC
	Microbial Source Tracking (MST)	Between 0.2 - 0.7 m water depth at 2 samples in Valdez, 2 in Ketchikan, 2 in Ward Cove, 2 in Seward	One sampling event.	May - Sept	DEC
Lab Analyses	Fecal coliforms and *Enterococcus*	All sites	Analyses within sample holding time requirements (6 hours)	May-Sept	SGS, EH Laboratory, R&M Engineering, Admiralty Environmental
	Total and dissolved Cu, Ni, and Zn, and ammonia-N	All sites	Analyses within sample holding time requirements	May-Sept	EH Laboratory, SGS and ALS Environmental
	MST	2 Valdez 2 Ketchikan 2 Ward Cove 2 Seward 1 extra	Analyses within sample holding time requirements (48 hours)	May - Sept	LuminUltra

Laboratory QA Review	Review of laboratory data	All sites	Within 10 days of receipt	May-Sept	ARRI & DEC
Data Entry	Entry of field and laboratory data	All sites	Annual	June-Nov	ARRI & DEC
Data Review	Field Data QA	All field blanks and replicates	Annual	Oct-Nov	ARRI & DEC
Data Report			Annual	Mar	ARRI

A.6.2.1 Sampling

ARRI & DEC will conduct the field sampling as described within this QAPP and safety plans.

ARRI and DEC are using different instruments for In Situ measures. Each party will follow the manufacturer's guidance, and recommended calibration frequency.

Dissolved oxygen and pH probes and meters will be checked for accuracy (7.0 pH and 100% saturation) prior to and after each sampling event. Probes and meters will be calibrated if they are not reading within accepted accuracy range (0.1 pH units or 2% saturation). The accuracy of the water temperature and salinity probes and meters will be checked at the beginning and end of each field season with known standards or NIST-certified thermometers. Water samples for metal and ammonia analyses will be collected using either a pump or submerging a sample bottle to 0.7 to 1.0-meter water depth. Sample pump and tubing or collection containers will be rinsed thoroughly prior to transferring water to sample bottles. Laboratory sample bottles for fecal coliforms and *enterococcus*, and metals contain preservatives and cannot be rinsed. ARRI will field filtered water samples for metals analyses. DEC will have the laboratory filter metals. ARRI and DEC will ensure that all samples are preserved and submitted to the analytical laboratory within sample holding times. If holding times aren't made effort will be made to resample. Replicate samples for metals and ammonia-N, and bacteria will be collected during each sample event for QA analyses in addition to laboratory quality assurance procedures.

A.6.3 Results

ARRI will provide monthly progress reports to the DEC project manager (also see Section C.3) that identify any field sampling problems or recommended changes to field sampling procedures.

Laboratory analytical reports as a PDF Level II and as an EDD (when available) will be submitted to the DEC project manager within 10 days of receipt. Data that has gone through QC procedures (described in B.5.1 & 2) and review, verification, and validation procedures (described in Section D) will be provided by ARRI to the DEC project manager in an excel spreadsheet by January of each project year. The 'import configuration' or formatted excel spreadsheet will be provided by DEC prior to field sampling to ensure consistent data entry. The data from each party will be combined in one excel spreadsheet. The DEC and the ARRI project managers will work together to complete the Water Quality Data Review Checklist (Appendix C). The final dataset will be used by ARRI to produce an annual report, and DEC will ensure these data are uploaded and archived in the Environmental Protection Agency's databases including the Water Quality Exchange (WQX), and the AWQMS. This will support easy data discovery by others, and an analysis of trends over time.

All project results will be summarized in an annual draft and will include an evaluation of data quality objectives identified in this QAPP. ARRI will incorporate comments received from DEC on the draft report. Study results will be discussed relative to results of previous measures of ambient water quality. All field logs, field reports, laboratory reports, communication logs, and site photographs will be included as appendices to the summary report as requested by the DEC project manager.

A.7 DATA QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

A.7.1 Data Quality Objectives (DQOs)

The project's objective is to obtain measures of ambient water quality parameters to evaluate potential exceedances of the State's water quality criteria in locations of concentrated marine traffic. Screening level data for metals and assessment level data for pathogens will be collected for Whittier and Valdez. Assessment level data for metals and pathogens will be collected for Seward, Juneau/Auke, and Ketchikan/Ward Cove. Screening level data will be collected at shipping lane sites.

A.7.2 Measurement Quality Objectives (MQOs)

Measurement Quality Objectives (MQOs) are a subset of DQOs. MQOs are designed to evaluate and control various phases (sampling, preparation, and analysis) of the measurement process to ensure that total measurement uncertainty is within the range prescribed by the project's DQOs. MQOs define the acceptable quality (data validity) of field and laboratory data for the project. Table 5 provides a list of the project MQOs. MQOs are defined in terms of the following data quality indicators:

- Detectability
- Precision
- Bias/Accuracy
- Completeness
- Representativeness
- Comparability

Table 5. Project measurement quality objectives (MQO's).

Group	Analyte	Method	MDL (µg/L)	PQL (µg/L)	Precision (RPD)	Accuracy (% Rec)
Water Quality	DO	In situ (electronic probe) EPA 360.1	NA	±0.01 mg/L	±20%	±20%
	pH	In situ (electronic probe) EPA 150.1	NA	±0.01 pH units	±0.1 pH units	±0.1 pH units
	Temperature	In situ (electronic probe) EPA 170.1	NA	0.1°C	±0.2°C	±0.2°C
	Salinity	In situ (electronic probe) SM 2520B	NA	0.1 ppt (mg/g)	± 10%	± 10%
Total Recoverable Inorganics	Copper	EPA200.8	0.02	0.10	If result is > 5X the MDL then 20%	80-120
	Nickel	EPA200.8	0.03	0.20	If result is > 5X the MDL then 20%	80-120
	Zinc	EPA200.8	0.20	0.50	If result is > 5X the MDL then 20%	80-120
Dissolved Inorganics	Copper	EPA200.8	0.020	0.10	If result is > 5X the MDL then 20%	80-120
	Nickel	EPA200.8	0.03	0.20	If result is > 5X the MDL then 20%	80-120
	Zinc	EPA200.8	0.20	0.50	If result is > 5X the MDL then 20%	80-120
Nutrients	Ammonia-N	EPA 350.1	3.0	10.0	If result < 100µg/L, 40%; If result > 100 µg/L 20%	80 - 120
Biological	*Enterococcus*	ASTM D6503-99, D6503-14m D6503, or ENTEROLERT	1 MPN/100	10 MPN/100	60%	80 - 120
Biological	Fecal Coliforms	SM9222D	1-10 cfu/100mL	2 cfu/100mL	60%	80 - 120

Detectability is the ability of the method to reliably measure a pollutant concentration above background. DEC DOW uses two components to define detectability: method detection limit (MDL) and practical quantification limit (PQL) or reporting limit (RL).

- The MDL is the minimum value which the instrument can discern above background but no certainty to the accuracy of the measured value. For field measurements the manufacturer's listed instrument detection limit (IDL) can be used.

- The PQL or RL is the minimum value that can be reported with confidence (usually some multiple of the MDL).

Sample data measured below the MDL is reported as ND or non-detect. Sample data measured ≥ MDL but ≤ PQL or RL is reported as estimated data and flagged with a qualifier. Sample data measured above the PQL or RL is reported as reliable data unless otherwise qualified per the specific sample analysis. The MDL, PQL and result qualifiers (ND, estimated, actual) are reported by the lab and will be documented in excel during data entry.

Precision is the degree of agreement among repeated measurements of the same parameter and provides information about the consistency of methods. Precision is expressed in terms of the Relative Percent Difference (RPD) between two measurements (A and B).

For pathogens, metals and ammonia-N, precision will be assessed by measuring replicate (paired) samples at the same locations and as soon as possible to limit temporal variance in sample results. Field and laboratory precision is measured by collecting blind (to the laboratory) field duplicate samples. For paired and small data sets project precision is calculated using the following formula:

$$(RPD)\ \text{Pr}ecsion = \frac{(A-B)}{((A+B)/2)} \times 100$$

Precision will be checked by including a field replicate for each sampling event (day) for pathogens, Cu, Ni, Zn and ammonia-N.

For *In Situ* measures verification checks will be used to assess accuracy. If pre-sampling verifications falls outside of accuracy goals the instrument will be calibrated. If post-sampling verification fails, it will be noted on the DCL and those data will be flagged with a qualifier in the dataset.

When results are at least 5X the MDL *and* RPD is greater than 20% results will be flagged under the 'Result Qualifiers' as FFD – Field duplicate, failed. RPD greater than 20% for results < 5X the MDL are acceptable.

Bias (Accuracy) is a measure of confidence that describes how close a measurement is to its "true" value. Methods to determine and assess accuracy of field and laboratory measurements include, instrument calibrations, various types of QC checks (e.g., sample split measurements, sample spike recoveries, matrix spike duplicates, internal standards, sample blank measurements, field and lab blanks, external standards), performance audit samples (DMRQA, blind Water Supply or Water Pollution PE samples from A2LA certified, etc). Bias/Accuracy is usually assessed using the following formula:

$$Accuracy = \frac{MeasuredValue}{TrueValue} \times 100$$

Completeness is a measure of the percentage of valid samples collected and analyzed to yield sufficient information to make informed decisions with statistical confidence. Project completeness is determined for each pollutant parameter using the following formula:

$$\frac{T - (I+NC)}{T} \times (100\%) = \text{Completeness}$$

Where T = Total number of expected sample measurements, I = Number of invalid sample results, and NC = Number of sample measurements not produced (e.g. spilled sample, etc).

The completeness goal is 90% for the *entire project* as weather, equipment failure and transportation/shipping problems can affect sampling. Effort will be made to resample, or wait for good weather, when possible, in order to obtain 90% completeness. Due to the remoteness of some sites and the limited holding time for fecal coliform and *Enterococcus*, these results will be included in the 90% completeness goal when the bacteria samples make it within a 24 holding time. Those data will be flagged during data entry.

Representativeness

Sampling sites within ports were selected to represent potential pollutant sources (e.g. small boat harbors, cruise ship berths, municipal stormwater, commercial shipping), but sample sites are not within permitted mixing zone. Shipping lane, and mid-channel sites are representative of open ocean conditions, while those near shore sites are closer to anthropogenic inputs.

Parameters were selected to best represent cruise ship discharges.

Locations will be sampled during summer months that coincide with greater marine traffic (i.e. cruise ships, fishing, other tourism activity). Data will better represent water quality during this critical period of increased anthropogenic activity.

Comparability

As this is a long-term monitoring project data comparability over time is an important consideration. Sampling procedures and parameters have remained the same throughout the project allowing data to be compared to past sampling efforts to track change.

Some sample locations have changed in order to avoid mixing zones and be more spatially representative of newly formed MAUs. This iteration of the project that falls under this QAPP will focus on 7 high priority harbors instead of sampling at all 20, so we won't be able to track change (or compare years) for non-high priority harbors.

Some of these data (where parameters, sampling techniques and analytical methods match) will be comparable to previous project efforts dating back to 2015, and other projects, such as the ADEC's BEACH program. These comparisons will be explored on a case-by-case basis. In addition, these data will allow for comparison of near shore areas (such as harbors) to open ocean areas (shipping lanes and mid-channel).

Concentrations of ammonia-N, metals, and geometric mean bacterial concentrations will be compared to Alaska Water Quality Standard (WQS) for Marine Water numeric criteria (Alaska Water Quality Standards (http://www.dec.state.ak.us/water/wqsar/wqs/index.htm).

A.8 SPECIAL TRAINING REQUIREMENTS/CERTIFICATION (Table 6)

Jeffrey C. Davis (Project Manager) has a B.S. degree in Biology from University of Alaska Anchorage and a M.S. degree in Aquatic Ecology from Idaho State University. He has 25 years of experience in water quality sampling. Mr. Davis has experience in all the assessment techniques outlined in this document.

Gay Davis (Quality Assurance Officer) has a B.S. degree In Wildlife Biology from the University of Maine. She has 25 years of experience in stream evaluation and restoration. Ms. Davis has over 30 years of experience in stream ecological field assessment methods and water quality sampling.

Maryann Fidel (DEC Project Manager) had a B.S. degree in Resource Management from Utah State University and a M.S. degree in Environmental Science from Alaska Pacific University. She is a

Qualified Environmental Sampler and has over 10 years of experience designing and leading research projects and doing environmental sampling.

Table 6. Training for project field and laboratory staff.

Specialized Training/Certification	Field Staff	Lab Staff	Monitoring Supervisor	Lab Supervisor	Project QA Officer
Safety training	**X**	**X**	**X**	**X**	**X**
Water sampling techniques	**X**		**X**		**X**
Instrument calibration and QC activities for field measurements	**X**		**X**		**X**
Instrument calibration and QC activities for laboratory measurements		**X**		**X**	**X**
QA principles			**X**	**X**	**X**
QA for water monitoring systems			**X**		**X**
Chain of Custody procedures for samples and data	**X**	**X**	**X**	**X**	**X**
Specific EPA Approved Field Measurement Method Training	**X**		**X**		**X**
Specific EPA Approved Lab Analytical Method Training		**X**		**X**	**X**

Chemical analyses will be conducted by analytical laboratories that are accredited labs for the constituents analyzed. ALS Environmental is a NELAP accredited laboratory.

SGS Environmental, R&M Engineering, and Admiralty Environmental laboratories have been certified by the DEC drinking water program for the analysis of water samples for total fecal coliform bacteria and *Enterococcus*.

Field samplers for fecal coliform and *Enterococcus* bacteria will be trained in sample collection by the ARRI project manager and follow written guidance provided by the analytical laboratories.

LuminUltra is accredited to the international standard ISO17025:2017 by A2LA.

A.9 DOCUMENTS AND RECORDS

Table 7 is a list of project documents, storage location, and minimum retention time. Documents will be stored electronically using a cloud storage service.

Table 7. Project documents and records.

Categories	Record/Document Types	Location	Retention Time
Site Information	Site characterization file	DEC/ARRI	5 Years
	Site maps	Monitoring Reports, DEC/ARRI	5 years
	Site pictures	In Monitoring Report and electronic files, DEC/ARRI	5 years
Environmental Data Operations	QA Project Plan	DEC/ARRI	5 years
	Field Method SOPs	In QAPP	5 years
	Field Notebooks/Data Sheets	DEC/ARRI	5 years
	Sample collection/measurement records	ARRI	5 years
	Sample Handling & Custody Records	ARRI	5 years
	Chemical labels, MSDS sheets	NA	NA
	Inspection/Maintenance Records	NA	
	Lab data (sample, QC and calibration) including Data Collection Logs	DEC/ARRI	5 years
Data Reporting	Progress reports	DEC	5 years
	Project data/summary reports	DEC/ARRI	5 years
	Lab analysis reports	DEC/ARRI	5 years
	Data management plans/flowcharts	In QAPP	5 years
Quality Assurance	Data quality assessments	In Monitoring Report, DEC/ARRI	5 years
	Site audits	NA	NA
	Lab audits	ARRI	5 years
	QA reports/corrective action reports	In Final Report	5 years
	Response	DEC/ARRI	5 years
	Performance Evaluation Samples	DEC/ARRI	5 years

B. DATA GENERATION AND ACQUISITION

B.1 SAMPLING DESIGN

B.1.1 Monitoring Objectives and Data Quality Objectives

The main objective of this project is to obtain ambient measures of water quality. Under this QAPP monitoring objectives are specific to fulfilling the needs of the DOW, WQMA to assess waterbodies (see section A.5.3). Assessments will be included in the Integrated Report. Reports from previous years (ARRI 2018, r2019, 2020a, 2020b, 2022, and 2023) has pointed to some concerns and WQ exceedances at harbors receiving a large number of cruise ships, that will be further explored by collecting assessment level data. A harbor prioritization effort has also identified areas most at risk to cruise ship pollution where assessment level data will be collected. Screening level data will be collected for metals in Whittier and Valdez; and for all parameters in shipping lane sites in order to

continue tracking any emergent contaminate issues. Assessment of waterbodies will identify pollution issues that need to be addressed and can inform actions toward improving water quality.

The data quality objectives will fulfill data requirements in CALM for assessment level data, and will support monitoring objectives identified in section A.5.3.

B.1.2 Characterize the General Monitoring Locations Sites

Monitoring locations include sites within the community MAUs, those just outside of it, and sites in or near shipping lanes. When possible established sample locations were used to increase comparability to past sampling efforts, but seven sites (out of the 59 being sampled this season) are new. New sampling sites were selected to represent the new community MAUs better spatially. Within each MAU 2 – 4 sampling sites were selected. All sample sites avoid permitted mixing zones, except for those of cruise ships since these aren't georeferenced discharges. Effort was made in site selection to be representativeness of potential pollutant sources (e.g. small boat harbors, cruise ship berths, wastewater discharges, commercial shipping), but it is beyond the scope of this project, and available resources, to characterize each pollutant source.

B.1.3 Site-Specific Sample Collection Locations, Parameters to be Measured and Frequencies of Collection

Criteria for site selection included spatial representation of the MAU, and representation of potential pollutions sources, including cruise ships. See Appendix B for sample site description and selection justification.

Water samples to be analyzed for fecal coliform bacteria and *enterococcus* will be collected on five sampling dates within a 30-day period at all harbors and near shore sampling locations, and once for all shipping lane and mid-channel sites.

Table 8. List of sample parameters and frequency of samples for each sampling location. Site ID is location (LOC) and site number (SI). D is depth, X is a variable for the replicate, EB is equipment blank, and TB is field blank.

Site ID	Parameters to be measured	Sample Type	Sampling Frequency	Total Samples
LOC-SI	NH3-N, Cu, Ni, Zn	G	Once/Event, (1 or more events)	Min 5/Harbor
LOC-SI	Total fecal coliforms; enterococcus bacteria	G	Once/Event (5 events in 30 days)	Min 5/Harbor
LOC-SI-D	Temperature, pH, DO, salinity	I	Once/Event (1 or more events)	Min 20/ Harbor
LOC-SI X	NH3-N, Cu, Ni, Zn; fecal coliform, enterococcus	G	Once each Event	1/Harbor
LOC-EB	NH3-N, Cu, Ni, Zn	G	Once each Event	1/Harbor
LOC-TB	NH3-N, Cu, Ni, Zn	G	One each Event	1/Harbor
I ≡ In Situ Measurement G ≡ Grab Sample C ≡ Composite Sample				

B.2 SAMPLING METHOD REQUIREMENTS

B.2.1 Sample Types

Data will be collected through a combination of *in situ* measurements and grab samples (see section B.1.3). Samples collected by ARRI for laboratory analyses will be obtained by pumping water from the required depth and will be labelled as grab samples. Grab samples collected by DEC will be scooped from just below the surface using a dipper pole.

B.2.2 Sample Containers and Equipment

Sample bottles will be obtained from the analytical laboratories, except for the MST samples. MST sample bottles will fulfill lab specifications.

Sample bottles that will be used for metal and ammonia analyses provided by the laboratory will be double wrapped in sealable plastic bags per EPA method 1669 (Appendix D). Each bag will contain one 250 ml plastic bottle with ~ 3 ml of H_2SO_4 for ammonia analyses, one 250 to 500 ml plastic bottle with ~ 3 ml HNO_3 for total metals and analyses, and one 250 to 500 ml plastic bottle with ~ 3 ml of HNO_3 for dissolved metal analyses. Upon receipt from the laboratory, the sample bottles will be transferred to a pre-cleaned plastic cooler which will be taped closed until sampling.

Sample tubing and filters will be cleaned (acid or Alconox washed) prior to collection of field blanks and field sample collection. Sample tubing and filters will be flushed with sample water for 1 minute at each sampling site prior to sample collection. If a scoop is used to collect samples it will be rinsed at least three times within the water body before the sample is taken.

Following sample collection (see B.2.3 for sample collection procedures), the filled sample bottles within the double lined plastic bags will be placed within a second cooler that also contains frozen gel-paks and a temperature blank. A chain of custody form will be completed for each sampling event that identifies each sample, sampling date and time, and requested analyses including the analytical method. The chain of custody form will be placed in a sealable plastic bag inside the sample cooler. The sample cooler will be sealed closed using packing tape and shipped overnight via Alaska Air Cargo (or comparable shipping) to the analytical laboratory. For MST samples they will be shipped using FedEx ‘Special Overnight’ in order to make it to Miami within the 48 hour hold time. Upon receipt, the analytical laboratory will measure the cooler temperature (to 0.2°C) and time. Sample preservation and holding times are provided in Table 9.

Table 9. Preservation and holding times for sample analyses.

Analyte	Matrix	Container	Necessary Volume	Preservation and Filtration	Maximum Holding Time
Cu, Ni, Zn (Dissolved)	Surface Water	P, FP, G	250 - 500 mL	ARRI: Filtered within 15 minutes of collection using a 0.45 µm filter; HNO_3 to pH < 2	6 months
				Lab Filtered	7 days
Cu, Ni, Zn (Total Recoverable)	Surface Water	P, FP, G	250 - 500 mL	HNO_3 to pH < 2	6 months
NH_3-N	Surface Water	P, FP, G	250 mL	Cool <4°C; H_2SO_4 to pH < 2, do not freeze	28 Days
Fecal Coliforms Enterococcus	Surface Water	G, PA	250 mL	Cool <10°C; do not freeze, 0.0008% Na_2S2O_3	6 hours 2 hrs lab prep (**note:** time not additive)
Microbial Source Tracking	Surface Water	P	250mL	4 - 8° C	48 hours

P = polyethylene, FP = flouropolymer, G = glass, PA = autoclavable plastic

Sample bottles for fecal coliform and *Enterococcus* analyses will be obtained from the analytical laboratory and placed within a small cooler with frozen gel paks. Following sample collection, the labeled sample bottles will be returned to the cooler. A chain of custody form will be completed for each harbor and sampling event. Samples will be transported to the nearest state certified laboratory.

B.2.3 Sampling Methods

Field sampling done for ambient concentrations of Cu, Ni, and Zn, will, follow the "clean hands" methods described in EPA method 1669 (Appendix D), "Sampling ambient water for trace metals at EPA water quality criteria level," with some modifications. Samplers present will be identified on the DCL.

When metals are being sampled a field blank will be collected. Sampling locations will be accessed by a boat. The motor will be shut off when it is safe to do so and allowed to drift to the final sampling location. Upon arrival at a sampling location, sample collection for trace metals will occur first in order to avoid potential contamination from pH, salinity, and dissolved oxygen probes.

Samples collected by ARRI will use the continuous flow through pumping methods as described in EPA 1669 Section 8.2.8 (Appendix D). Both dirty hands (DH) and clean hands (CH) will wear clean powder-free vinyl exam gloves. DH will open the cooler with the sample bottles and open the outside

plastic bag. Clean Hands (CH) will transfer the inner bag and sample bottles to the sampling container. A glove bag as described in EPA 1669 section 6.6 will not be used. DH will set up the pump and connect the inlet tubing. DH will hold the pump while CH connects one end of the outlet tubing to the pump outlet. The pump will be turned on and allowed to run for ~ 1 minute prior to sample collection. Field blanks will then be collected from laboratory-provided deionized water. DH will then submerge the sample tubing to 1 m depth. With DH operating the pump, CH will fill the sample containers for ammonia-N, and total metals. The pump will be turned off and CH will attach a disposable 0.45 µm filter to the end of the outlet tubing. The pump will be turned back on by DH, the filter will be rinsed for approximately 10 seconds, and then the sample bottle for dissolved metals will be filled. CH will cap and label the bottles and seal them in a plastic bag and deposit the sealed bag with bottles into a second plastic bag. DH will seal the outer bag and place the samples in the cooler with frozen gel paks. Once the samples for metal analyses have been closed in the cooler, CH will remove the filter, the pump will be turned back on, and the sample for total fecal coliforms will be collected where required. The outlet tubing will be removed from the pump and stored within the sample container with the disposable filters by CH, and the sample container lid will be closed. Clean tubing will not be used for each sample; however, the lines will be flushed for one minute prior to sample collection at each sampling site.

DEC will also follow the clean hands/dirty hands method in appendix D when collecting metals and ammonia-N samples. The only difference being that water samples will be collected using a polyethylene water bottle on a pole. Sample depth will be 0.2 - 0.7 m. The sample bottle will be rinsed three times prior to taking the sample. Metals samples will be lab filtered using a 0.45 µm filter. For field blanks DEC will pour DI water into the collection bottle while at a sample location and then transfer water from the collection bottle to the sample bottles.

Once the metals samples have been collected, both samplers will coordinate the measurement and recording of *in situ* samples. Salinity, temperature and pH will be measured with a YSI 1030 meter (ARRI), AquaTroll 500 (DEC) or equivalent, by suspending the probe cables to the required depths. Tape will be used to mark the probe cables at 1m intervals. Dissolved oxygen and water temperature will be measured using a YSI Pro ODO (ARRI) and AquaTroll 500 (DEC) meter and probe. Water temperature from the pH and dissolved oxygen meters will be recorded.

B.3 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

B.3.1 Sampling Procedures

See Section B.2 of this QAPP – Sampling Method Requirements

B.3.2 Sample Custody Procedures

Chain of custody forms will be provided by the analytical laboratories. Chain of custody forms for ammonia-N and metals analyses will be placed in the cooler with the samples, the sample cooler sealed with shipping tape, and the cooler transferred to the airlines. The chain of custody form for fecal coliform analyses will be transferred with the samples directly to the analytical laboratory or through local airlines and couriers.

B.3.3 Shipping Requirements

Samples for ammonia-N and metals analyses will be shipped by "next day air" using Alaska Air Cargo (or comparable method). Cooler used to ship sample bottles for ammonia-N analyses will be filled with sufficient frozen gel packs to ensure that cooler temperatures that contain samples to be analyzed for ammonia-N are maintained ≤ 4°C during shipping.

Since DEC will not be field filtering or using an acid preservative for metals and ammonia-N, the holding time is 7 days. But since these samples will be delivered to the labs with the pathogen samples analysis will occur within holding time.

Bacteria samples will either be transported directly to analytical laboratories or shipped using local air service. If shipped we will look at flight schedules and schedule sampling in an effort to meet short holding times.

MST samples will be packed in a cooler with frozen gel-packs and shipped FedEx Overnight Special.

Cooler temperature will be checked by the analytical laboratory upon receipt.

B.4 ANALYTICAL METHODS AND REQUIREMENTS

Monitoring shall be conducted in accordance with EPA-approved analytical procedures and in compliance with 40 CFR Part 136, *Guidelines Establishing Test Procedures for Analysis of Pollutants*. Reference the Project's MQO table (section A7) of this QAPP for list of parameters of concern, approved analytical methods, method-specific detection and reporting limits, accuracy and precision values applicable to this project. 40 CFR, Part 136.6 lists other regulated pollutant parameters not listed in the MQO Table (section A7).

Under direction of the Project Managers, project staff will ensure that all equipment and sampling kits used in the field meet EPA-approved methods.

B.5 QUALITY CONTROL REQUIREMENTS

Data measurements, both field and laboratory, that do not meet the accuracy and precision limits described in Table 5 may, or may not, be used in the final report depending on degree to which limits are not met. However, the report will clearly state if there are any questions regarding the use of data, and all questionable data will be flagged with a qualifier explaining the issue.

For laboratory analyses, contract laboratories will submit quality control results along with sample analytical results. Laboratory quality control will include duplicates, matrix spikes, reference standards, and blanks. Laboratory accuracy and precision criteria must be equal to or greater than project criteria provided in Section A.7. Duplicate laboratory analyses will be conducted on at least 1 metals and ammonia-N sample for each sample event.

B.5.1 Field Quality Control (QC) Measures

Quality Control measures in the field include but are not limited to:

- Proper cleaning of sample containers and sampling equipment.

- Maintenance, cleaning and calibration of field equipment/ kits per the manufacturer's and/or laboratory's specifications, and field Standard Operating Procedures (SOPs).
- Calibration of field instrument accuracy using a known standard prior to sampling
- Conducting a verification check of field instrument accuracy using a known standard post sampling
- Chemical reagents and standard reference materials are used prior to expiration dates
- Proper field sample collection and analysis techniques.
- Completed Chain of Custody form, and correct sample labeling.
- Proper sample handling and shipping/transport techniques.
- One blind field replicate, field blank, and trip blank to the laboratory for each sample event

Table 10 describes field replicate procedures.

Table 10. Field quality control samples.

Field Quality Control Sample	Measurement Parameter	Frequency	QC Acceptance Criteria Limits
Field Blank	Dissolved Cu, Ni, Zn	Once per Sampling Event	< PQL
Field Replicate (blind to lab)	NH3-N, Cu, Ni, Zn, pathogens	Once per Sampling Event	Precision Table 5
Trip Blank	NH3-N, Cu, Ni, Zn	Once per Sampling Event	< MDL
Calibration Check Standard	Salinity, pH and DO	Prior to field sampling	Accuracy Table 5
Verification check	Salinity/Specific Conductance, pH, DO	After field sampling	Accuracy Table 5

B.5.2 Laboratory Quality Control (QC) Measures

For laboratory analyses, contract laboratories will submit quality control results along with sample analytical results. Laboratory quality control will include duplicates, matrix spikes, reference standards, and blanks. Laboratory accuracy and precision criteria must be equal to or greater than project criteria provided in Section A.7. Duplicate laboratory analyses will be conducted on 1 of every 10 elements (Total Cu, Ni, or Zn) analyzed (10%).

B.6 INSTRUMENT/EQUIPMENT TESTING, INSPECTIONAND MAINTENANCE REQUIREMENTS

Instruments and meters will be tested for proper operation as outlined in respective operating manuals (Appendices E,F & G). Inspections will occur prior to use. Equipment that does not calibrate or is not operating correctly will not be used. Duplicate instruments and meters are available for pH, salinity, dissolved oxygen, and temperature measures. In the case of complete equipment failure, new equipment will be purchased. The project manager will be responsible for calibrating and testing and storing equipment and the Data Collection Log. All calibrating, testing and storage will follow the

manufacturer's recommendations. Spare batteries and repair equipment will be taken during field sampling events.

Contracted and sub-contracted laboratories will follow the testing, inspection and maintenance procedures required by EPA Clean Water Act approved methods and as stated in the respective laboratory's QAP and SOPs.

B.7 INSTRUMENT CALIBRATION AND FREQUENCY

Instruments used to measure dissolved oxygen, pH, and salinity will be calibrated according to manufacturer's recommendations, and if they do not meet pre- or post-sampling verification checks. Calibration will be conducted following the methods outlined in the manufacturer's user manuals (Appendix E, F, G). The pH meter will be calibrated using 3 points, 4.0, 7.0, and 10.0. The specific conductivity meter generally does not require calibration but will be calibrated if it does not meet accuracy test. The dissolved oxygen meter will be calibrated in the field using 100% water saturated air. Calibration standards will not be used if storage date has expired.

Accuracy verification checks will be conducted for salinity, pH, and dissolved oxygen prior to and following each sampling event and results will be recorded on calibration logs. The pH meter will be checked for accuracy using a pH 7.0 standard (corrected for temperature), salinity in a 10 mS/cm standard, and dissolved oxygen in 100% saturated air. The pH meter will be recalibrated in not within 0.1 pH units, the dissolved oxygen if not within 2 % saturation and salinity if not within 0.1 mS/cm. If the meter does not meet the post-calibration verification, the data will be flagged, or the meter will be recalibrated and measures repeated if possible. Documentation of accuracy checks, including documentation of equipment malfunction, will be included in the DCL.

Contracted and sub-contracted laboratories will follow the calibration procedures found in its QAPP and the laboratory's Standard Operating Procedures (SOPs). Specific calibration procedures for regulated pollutants will be in agreement with the respective "EPA Approved" Clean Water Act Pollutant methods of analysis. Field and/or Laboratory calibration records will be made available to DEC upon request.

B.8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

Pre-cleaned sample containers will be obtained from each analytical lab with appropriate preservation method included in shipment from laboratory conducting the analyses. Any needed standards for equipment calibration, and filters will be purchased directly from the equipment manufacturer if possible or from a well-established chemical company. The QA officer will be responsible for ensuring that standards are not outdated and for the purchase of replacements. The date and source of all purchased materials will be recorded within a separate file for each piece of equipment and kept on file by ARRI along with equipment calibration records.

Contracted and sub-contracted laboratories will follow procedures in their laboratory's QAPP and SOPs for inspection/acceptance of supplies and consumables.

B.9 DATA ACQUISITION REQUIREMENTS (NON-DIRECT MEASUREMENTS)

Weather and tidal data will be downloaded or purchased through the National Oceanic and Atmospheric Administration (NOAA) web site (http://www.ncdc.noaa.gov/oa/ncdc.html) (https://tidesandcurrents.noaa.gov/) will be assumed accurate.

B.10 DATA MANAGEMENT

Field data will be written on sample Data Collection Log forms (Appendix H) and will be photocopied or scanned to digital copies at the end of each field day. The quality assurance officer or DEC program manager will copy the field notebooks, scan them into electronic format, and review the data to ensure that it is complete and check for any errors. Field and laboratory data sheets will be provided to the project manager. Accuracy of data entry will be checked by comparing approximately 10% of the field and laboratory data sheets with the Excel files for accuracy. If any errors are found they will be corrected and the project manager will check all of the field and laboratory data sheets with the Excel files, then data entry accuracy will be verified correct entry by comparing another 10% of the sheets. This process will be repeated until all errors are eliminated (Figure 2). The quality control officer will review any statistics or other comparisons. The ARRI project manager will write the final report, which will be proofed by the quality assurance officer and the DEC project manager. The quality assurance officer will check the results in the report and associated statistical error (i.e. standard deviation and confidence interval) against those calculated with computer programs. Any errors found will be corrected by the ARRI project manager.

Data Collection Logs will be used to store site specific field information, sample times, and other relevant details. The lead field sampler is responsible for ensuring that the all field data forms are correct. Field activities and observations will be noted on field data sheets during fieldwork. Descriptions will be clearly written with enough detail so that participants can reconstruct events later if necessary. Field data sheets will describe any changes that occur at the site, in particular, deviations from the QAPP as well as the reasons for the changes. Requirements for data forms will include the following:

- Entries will be made legibly with black (or dark) waterproof ink or in pencil
- Unbiased, accurate language will be used.
- Entries will be made while activities are in progress or as soon afterward as possible (the date and time that the notation is made should be noted, as well as the time of the observation itself).
- The date and time, will be recorded for each site.
- When field activity is complete, Data Collection Logs will be entered into the project file.

Data form corrections will be made by drawing a single line through the original entry allowing the original entry to be read. The corrected entry will be written alongside the original. Corrections will be initialed and dated and may require a footnote for explanation. The information in the Data Collection Log includes the following:

- Names of all field staff
- Station name and location
- Date and collection time of each sample
- pH and dissolved oxygen field calibration

- pH, DO, and Specific Conductance/Salinity post sample verification against a known standard
- Observations made during sample collection, including weather conditions, environmental conditions, complications, and other details associated with the sampling effort
- Sample description
- Any deviation from the sampling plan

Field sample Data Collection Logs and chain-of-custody forms will be completed for all samples and kept in the project file. Laboratory data results from the laboratories are recorded on laboratory data sheets, bench sheets and/or in laboratory logbooks for each sampling event. These records as well as control charts, logbook records of equipment maintenance records, calibration and quality control checks, such as preparation and use of standard solutions, inventory of supplies and consumables, check in of equipment, equipment parts and chemicals are kept on file at the laboratory.

Any procedural or equipment problems are recorded in the field data forms. Data results will include information on field and/or laboratory QA/QC problems and corrective actions.

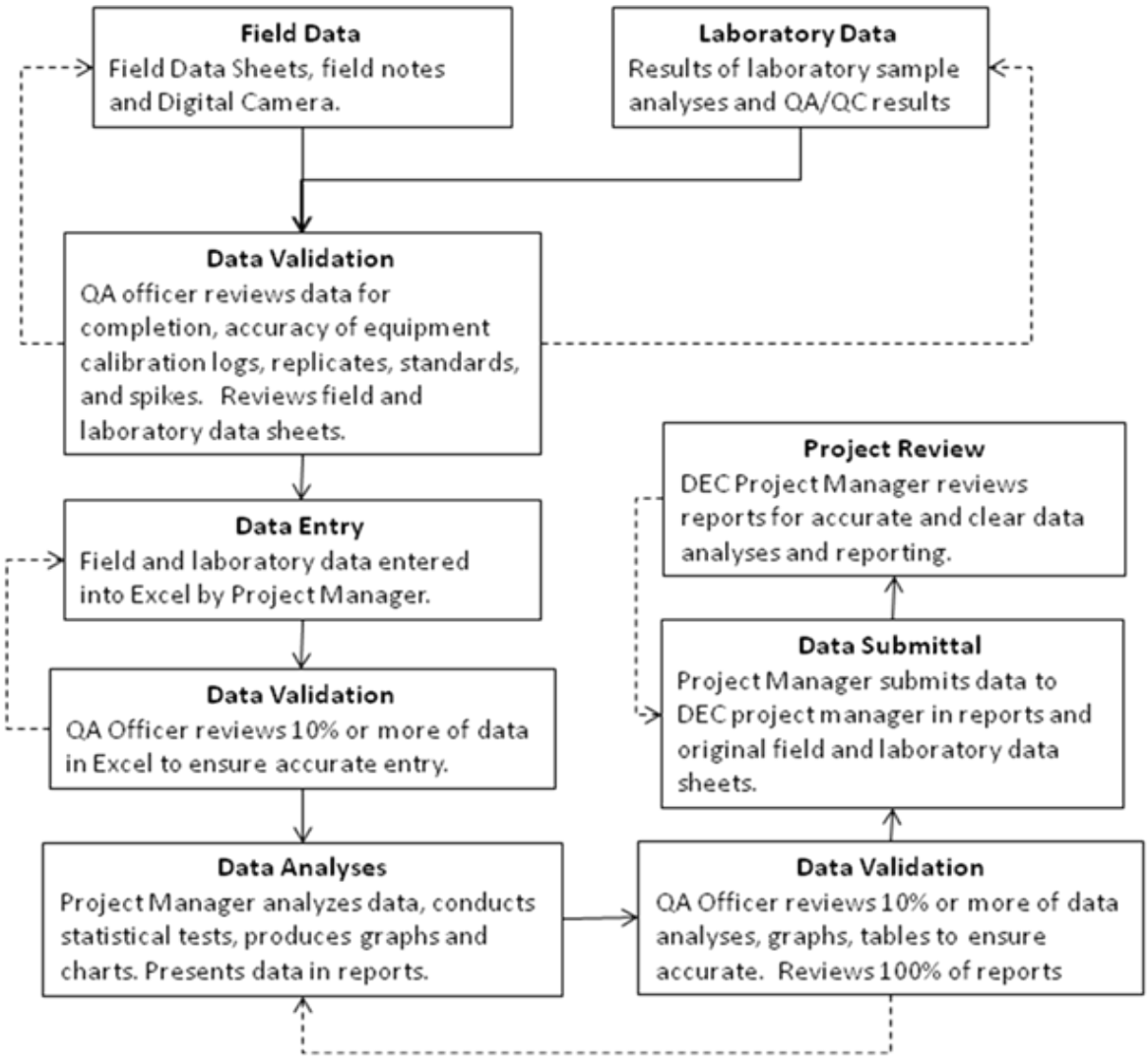

Figure 2. Data management flowchart.

B.11 DATA STORAGE AND RETENTION

Data storage and retention is described in Section A.9 and Table 7.

C. Assessments

C.1 Assessments and Response Actions

Project assessment will primarily be conducted through the preparation of reports for DEC by the ARRI project manager. Table 11 provides a list of the type and date of each required report. The DEC project manager will review all of the tasks accomplished against the project scope of work to ensure that all tasks are being completed. The ARRI project manager will review all data sheets and entered data to make sure that data collection is complete. If necessary, data collection processes or data entry will be modified. Any modifications of the data collection methods will be reviewed against the processes described within the QAPP to determine whether the document needs to be updated.

The project manager and QA officer will check on field sampling and contractor's laboratory practices to ensure that samples are handled correctly and consistently (see Data Management Section B.10 and Figure 2). The final report will contain an appendix that will detail all the QA procedures showing precision, accuracy, representativeness, and completeness. Data quality and comparability will be discussed in the body of the report as applicable. Any QA problems will be outlined and discussed relative to the validity of the conclusions in the report. Any corrective actions will be discussed as well as any actions that were not correctable.

The ARRI QA officer will report to ARRI project manager any consistent problems in data collection, analyses, or entry identified either internally or through a 3rd party audit. ARRI management will be responsible for developing and implementing a course of action to correct these problems. Where consistent problems may have affected project validity, these will be identified and reported to the DEC project manager directly and included in project reports as directed.

Table 11. List of project reporting requirements and due dates.

Report	Deliverable Date
Boat Safety Plan	Upon Request
Draft Collection Log (Data Sheet)	Prior to field sampling
Progress Reports	Monthly
Completed Data Collection Log	Within 30 days post sampling
Analytical Laboratory Reports (EDD II)	10 days following receipt of draft
Annual Summary Report Draft	January of each project year
Data in excel	January of each year

C.2 REVISIONS TO QAPP

As needed, the QAPP will be reviewed and revised by the project managers and the project QA officer. Minor revisions may be made without formal comment. Such minor revisions may include changes to identified project staff (but not lead project staff: QA project officer, project manager, sampling manager, contracted laboratories), QAPP distribution list and/or minor editorial changes.

Revisions to the QAPP that affect stated monitoring Data Quality Objectives, Measurement Quality Objectives, method specific data validation *"critical"* criteria and/or inclusion of new monitoring methods must seek review and pre-approval by DEC DOW QA Officer/DEC Project Management before being implemented.

It is likely that in future years the project will focus on certain harbors and/or regions but will use the same sample site locations, collection methods and lab analyses. Updates to frequency of sampling, season of sampling, minor methodology updates, and shifts in project objectives may be documented in an appendix to this QAPP, as a Sampling Analysis Plan. It must be agreed upon by all parties and include signatures of Project Managers, and QA Managers.

C.3 Deliverables and Reports to Management

Reports will be prepared by the ARRI project manager and distributed to the DEC project manager. Reports will update the status of the project relative to the schedule and tasks in the scope of work. The ARRI project manager will report monthly to the DEC project manager. Any field QA problems will be identified and reported to the DEC project manager. The final report will be submitted in electronic format along with the data tables and photo log. Any potential problems with data due to QA will be identified and reported in all submitted reports.

References

ARRI. 2018. CPVEC Ambient Water Quality Monitoring: Juneau and Skagway Harbors September 2015 through October 2017. Final Report for the Alaska Department of Environmental Conservation, Division of Water, Commercial Passenger Vessel Environmental Compliance Program. Aquatic Restoration and Research Institute, Talkeetna, AK.

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ARRI 2020a. CPVEC Ambient Water Quality Monitoring: Ketchikan (2018-2019) and Seward Harbors (2019). Final Report for the Alaska Department of Environmental Conservation, Division of Water, Commercial Passenger Vessel Environmental Compliance Program. Aquatic Restoration and Research Institute, Talkeetna, AK.

ARRI 2020b. Water Quality Measures in Alaska's Ports and Shipping Lanes: 2020 Annual Report. Final report for the Alaska Department of Environmental Conservation Division of Water. Aquatic Restoration and Research Institute, Talkeetna, AK.

ARRI 2021. Water Quality Measures in Alaska's Ports and Shipping Lanes: 2021 Annual Report. Final report for the Alaska Department of Environmental Conservation Division of Water. Aquatic Restoration and Research Institute, Talkeetna, AK.

ARRI 2023. Water Quality Measures in Alaska's Ports and Shipping Lanes: 2022 Annual Report. Final report for the Alaska Department of Environmental Conservation Division of Water. Aquatic Restoration and Research Institute, Talkeetna, AK.

ARRI 2022. Ambient Marine Water Quality Monitoring. Quality Assurance Project Plan for Water Quality Monitoring Sampling and Analysis Activities: Version 4. Prepared for the Alaska Department of Environmental Conservation Division of Water. Aquatic Restoration and Research Institute, Talkeetna, AK.

DEC. 2018a. Department of Environmental Conservation 18 AAC 70 Water Quality Standards as Amended as of April 6 2018.

DEC 2018b. State of Alaska Department of Environmental Conservation. Alaska Water Quality Criteria for Toxic and Other Deleterious Organic and Inorganic Substances Amended as of April 6 2018.