QUALITY ASSURANCE
PROJECT PLAN

For

Water Quality Monitoring of Campsite Component

Of

"Keeping Our Traditions and Reducing Our Risks:
Developing Sustainable Camp Practices that Protect Subsistence"
EPA Project X7-96044501-1

Nelson Island Consortium of
Caninermiut and Qaluyaat Communities
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Prepared for

U.S. Environmental Protection Agency
Region 10

and

State of Alaska
Department of Environmental Conservation

Prepared with assistance from
Zender Environmental Health & Research Group
310 East Tenth Avenue
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June 2008

ACKNOWLEDGEMENTS

Together, we, the Nelson Island Consortium of Caninermiut and Qaluyaat Communities, decided upon the logo *"CANINERMIUT/ QALUYAAT-LLU NUNAMTA MENUITENGNAQLERKAANUNNUNAM CALIARAT"* for this project. In Yup'ik, it means something like, "We must work Together to Keep the Coastal and Nelson Island Communities and Environment Clean for our subsistence." We are so pleased that we as a consortium could work together on this important matter and that we had such strong support from our partners, as well.

We wish to thank the United States Environmental Protection Agency for supporting us and for providing funding to us for this project. Tami Fordham, our Project Officer, has been very helpful to us throughout the project. In addition, Zender Environmental—Lynn Zender and Simone Sebalo—have helped ensure that our project stayed on track and provided helpful technical assistance to us.

Quyana cakneq!

APPROVAL PAGE

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	Jim Gendron
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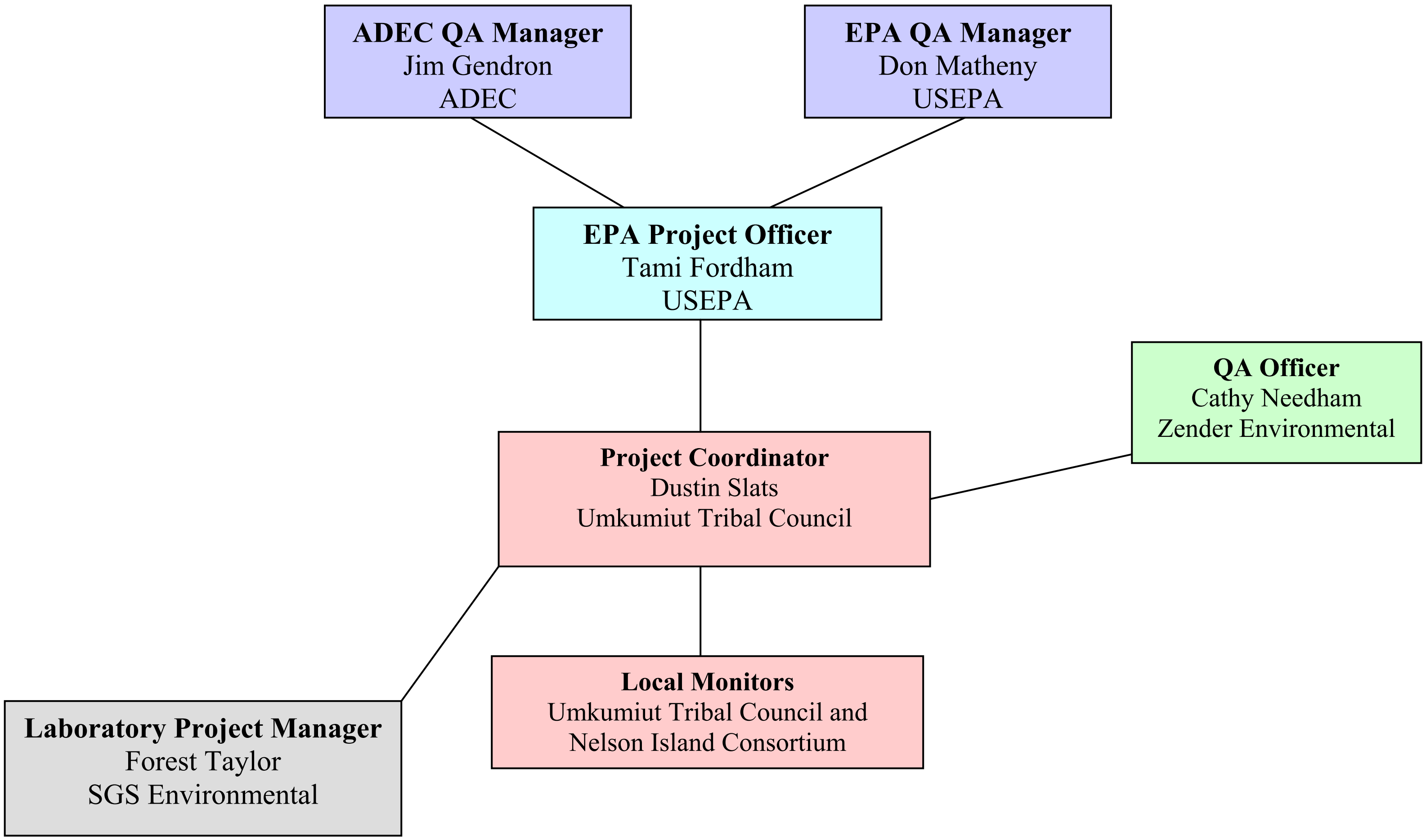
Figure F1. PROJECT ORGANIZATION



A4. PROJECT/TASK ORGANIZATION

Don Matheny, USEPA Quality Assurance Manager
Provides guidance regarding QAPP requirements and is responsible for its approval.

Jim Gendron, ADEC Quality Assurance Manager
Provides guidance regarding QAPP requirements and is responsible for its approval.

Tami Fordham, USEPA Multi-media Grant Project Officer
Serves as primary EPA contact for grantee. Makes recommendations for work plan, QAPP, and all other aspects of the project to align project goals with those of EPA. Reviews and approves quarterly reports and deliverables, financial records, and final project report.

Cathy Needham, Quality Assurance Officer, Zender Environmental
Provides water quality training, oversees water quality sampling events, and provides technical assistance. Validates, manages, and interprets water quality data for the NIC.

Dustin Slats, Project Coordinator, Umkumiut Tribal Council
Coordinates logistics for and participates in water quality sampling. Communicates with Chair of the NIC and with NIC representatives to ensure their active participation in project. Responsible for grant reporting.

Local Monitors, Umkumiut Tribal Council and Nelson Island Consortium
Participate in one-day training to learn to calibrate water quality equipment and collect laboratory samples. Perform field sampling under guidance of QA officer.

Forest Taylor, Laboratory Project Manager, SGS
Provides data results to grantee in a timely manner. Reports any hold time exceedences or irregularities of data.

A5. PROBLEM DEFINITION/BACKGROUND AND PROJECT OBJECTIVES

For thousands of years, the peoples of the communities of Chefornak, Newtok, Nightmute, Umkumiut, Tununak, Toksook Bay, and Kipnuk in western coastal Alaska, have shared the Nelson Island area lands and waters for subsistence activities, and have led a traditional subsistence lifestyle, including retention of Yup'ik as our primary language. We lead a "subsistence lifestyle", which here is a cultural term that, for Yup'ik peoples, includes societal morals and values such as guidance by elders and gratitude for our environment's gifts, in addition to living off the local ocean, lands, and waters.

The Nelson Island Consortium (NIC) formed in 2003 as a grass-roots organization effort to bring our communities together in a traditional manner to retain and protect our environment, and retain and protect our very lives and culture. The NIC shares the work of protecting our habitat and learning about ways to address new environmental problems while retaining traditional ways of community decision making.

Nelson Island was named in 1878 after Edward Nelson, a Smithsonian naturalist. It has a predominately maritime climate with an average of 22 inches of precipitation annually, including 43 inches of snowfall on average (DCRA, 2008). All villages in the NIC are in the Bethel recording district. The topography of Nelson Island is similar to the nearby Yukon-Kuskokwim Delta, with numerous lakes and ponds and discontinuous permafrost. Relief in these subarctic lowlands rarely exceeds ten feet and is often present because of pingos, small hills of earth-covered ice (Burns, 1964).

Previous Water Quality Studies

Few surface water quality data exist for Nelson Island. The U.S. Geological Survey collected surface water quality and stream discharge information seven times at the Takikchak River (Station 15304400) near Newtok from May 2004 to September 2005. Sampling included basic physico-chemical parameters, as well as nutrients, metals, BTEX, and other VOCs (USGS, 2005a). An additional site was sampled near Newtok, Mertarvik Spring Creek (Station 15304405), was sampled four times from May 2005 to June 2006 for basic physico-chemical parameters and stream discharge (USGS, 2005b). Mertarvik is the location to which the village of Newtok is being relocated due to extensive erosion.

Project Objectives

1. To obtain baseline water quality data for our campsites so that we can protect them for our subsistence uses.

2. To use these data for comparisons between sites and over time to see if any trends can be found with regard to changes in camp practices, education efforts, or level of camp use.

    - We will be able to identify trends and protect the environment for our fish, keeping their populations high. We can use this information to show people whether higher use at certain sites is impacting their water quality and thus possibly the fish. We can encourage people to use lower-use sites if the more frequently used sites show significant impacts from use.

3. To also use these data to determine if contaminants from the "arctic sink" are measurable in our waters and are impacting our subsistence resources.
    - We will be able to maintain the water quality of our sites at least within our local source control. If we find that we cannot explain how some contaminants are there, we can look for additional funding to find the source. If we find chemicals that are not generated here, then we can publicize this finding to outside world to ask them to stop producing these chemicals.

A6. PROJECT/TASK DESCRIPTION

The water quality sampling of our campsites is one component of a larger project that is devoted to protecting our subsistence resources. We met in September 2007 to discuss the water quality sampling and to collectively decide which sites are most important to sample. Two sites stood out as being extremely important to us (Cakcaaq and Toksook River). In addition, each of the seven villages in the NIC selected two sites that they believe to be most important to their village for subsistence. (Chefornak will confirm their two sites at the June training/sampling.)

We will sample as many of the 17 selected sites (see Section B1) as we can during one week in June 2008 based out of Umkumiut. The sites that we cannot travel to during this week will be sampled in July and/or August. Basic water quality parameters and stream discharge will be sampled at all 17 sites. All sites will also be sampled for contaminants, which will be measured in the laboratory. Note that due to the expense of the dioxin lab analysis, we will only collect dioxin samples at half of the sites plus the control (8 sites). Early in the week, we will be trained to calibrate and use the water quality equipment and how to collect the laboratory samples by the project QA officer. We will then spend the rest of the week sampling the sites, sending out lab samples, and incubating and enumerating bacteria samples with assistance from the QA officer. We will sample any remaining sites over the summer (with remote technical assistance from our QA officer, if needed), and we will send the later-collected data to our QA officer for QA/QC checks.

The following measurements will be made at all sites: air temperature, surface water pH, temperature, conductivity, dissolved oxygen, oxidation-reduction potential, turbidity, *E. Coli* and total coliform, and stream discharge (when possible/applicable). Sample bottles will be filled with whole surface water and analyzed by the laboratory for contaminants including total metals (including mercury), total alkalinity, benzene-ethylene-toluene-xylene (BTEX), diesel range organics (DRO), pesticides, polychlorinated biphenyls (PCBs), and dioxins (8 sites). Hardness calculations will be made by our project QA officer using total metals laboratory results. Instrument calibration logs will be maintained for quality assurance purposes.

The bulk of the sampling will take place over the course of four days in June. Samples will be shipped to the laboratory from Umkumiut. The project coordinator and/or trained participants will incubate and enumerate the Coliscan Easygel samples in Umkumiut, as these samples have a 24-hour hold time.

All data will be entered into a Microsoft Excel workbook and validated by the project QA officer. Any DEC water quality standard exceedences will be reported to the Umkumiut Tribal Council. At the Council's discretion, these exceedences may be reported to DEC. EPA will receive all raw data and a final report of the study results as a deliverable for this project.

Figure F2: Map of Sampling Area

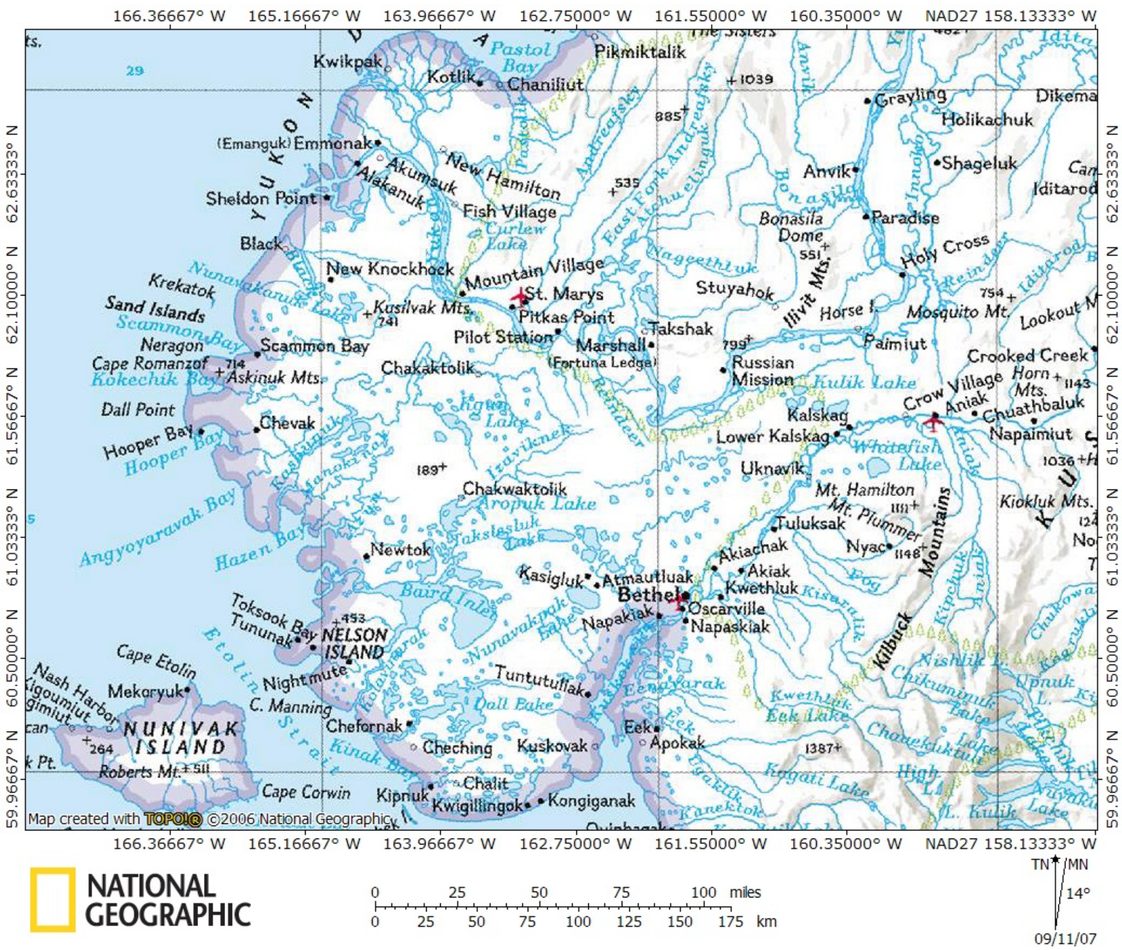


Table T1 SCHEDULE OF PROJECT EVENTS

MAJOR TASK CATEGORIES	O	N	D	J	F	M	A	M	J	J	A	S
QAPP approved by EPA, ADEC								X				
Contract laboratory								X	X			
Perform assessment (sample)									X	X	X	
Data entry/validation										X	X	
Final report											X	X

A7. DATA QUALITY OBJECTIVES FOR MEASUREMENT DATA

Objectives for precision, accuracy, representativeness, comparability, and completeness are summarized below, and Table T2 lists the data quality objectives for this project. The sample matrix for all parameters is surface water except for air temperature. These measurement quality objectives (MQOs) were selected to support the project objectives as detailed in Section A5.

Precision

Precision is the degree of agreement among repeated measurements of the same characteristic, or parameter, and gives information about the consistency of methods. The project officer will perform duplicate sample analyses during all sample collection events and quality control (QC) sessions. Variation of duplicate values for each parameter must not exceed the range of precision specified in Table 2. If the precision range is exceeded, a third measurement will be taken.

Accuracy

Accuracy is a measure of confidence that describes how close a measurement is to its “true” value. For this project, accuracy will be measured by comparative sampling. Values are compared to standards when possible and must fall within the specific range for each parameter as indicated in Table T2. Accuracy of procedures and equipment used in the monitoring program will be verified using standard testing materials for each parameter. Calibration procedures are listed in Table T2 and described in further detail in Section B16.

Representativeness

Representativeness is the extent to which measurements represent the true environmental condition. It is the degree to which the data from the project accurately represent a particular characteristic in the sample medium. Representativeness of data is considered in project design and sampling site selection.

Representativeness will not be routinely monitored throughout this project, but is incorporated when necessary in interpreting the data.

Detectability

Detectability is the concentration at which an analyte can be detected, which is dependent on the method being employed. According to EPA, the method detection limit (MDL) is "the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte." Detectability may be an issue for the dissolved metals and nutrient samples for this project.

Comparability

Comparability is the degree to which data can be compared directly to similar studies. Using standardized sampling, analytical methods and units of reporting with comparable sensitivity will help to ensure comparability. The Umkumiut Tribal Council has selected testing methods that are DEC- and EPA-approved and/or currently being employed by other water-quality monitoring programs throughout the state.

Completeness

Completeness is the comparison between the amount of usable data collected versus the amount of data called for in the sampling plan. In this monitoring program, completeness is measured as the percentage of total samples collected and analyzed as a whole and for individual parameters and sites as compared to the goals set out by the project design. The Umkumiut Tribal Council has a completeness goal for this project of 95%.

A8. Special Training/Certifications

Dustin Slats is the Umkumiut Tribal Council Environmental Coordinator. He attended a water quality workshop in September 2007 hosted by the Association of Village Council Presidents (AVCP).

Cathy Needham, Environmental Consultant with KAI Environmental Services, will serve as the Project Quality Assurance Officer via sub-contract to Zender Environmental Health and Research Group. Cathy has both a B.S. and M.S. in Zoology and has eight years of experience working with Alaska Tribes on a variety of watershed and water quality assessments.

Local monitors who participate in the one-day training and June field sampling will receive a certificate of completion for their efforts. The training will be comprehensive (see agenda in Appendix A) and prepare local monitors to sample any remaining sites over the summer with remote technical assistance (phone/fax/e-mail) from the project QA officer.

A9. Documents and Records

The following documents will be included in our final report to EPA for this project:

- Any QAPP revisions
- Equipment calibration records
- Field data sheets
- Laboratory analysis results
- Validated data in Microsoft Excel workbook
- Summary and interpretation of results
- Suggestions for future water quality monitoring efforts

All documents will be kept on file at the Umkumiut Tribal Council office for a minimum of 3 years. The requested turnaround time for laboratory results is 10 working days.

Table T2: DATA QUALITY OBJECTIVES
(Sample matrix is water for all samples except air temperature)

FIELD SAMPLES

Parameter	Method/Range	Units	Accuracy	Precision	Calibration Method	Method Reference
Temperature, air	Thermometer –10 to 110 °C	Degrees Celsius (°C)	± 0.5 °C	± 0.5 °C	NIST Certified Thermometer (-8 to 32°C)	EPA 170.1, SM 2550 B
Temperature, water	YSI 556 -5.0 + 45.0 °C	Degrees Celsius (°C)	± 0.15 °C	± 0.3 °C	NIST Certified Thermometer (-8 to 32°C) at YSI-certified calibration vendor	EPA 170.1, SM 2550 B
	Hanna Combo Meter (HI 98129) 0.0 to 60.0 °C	Degrees Celsius (°C)	±0.5 °C	±0.5 °C	NIST Certified Thermometer (-8 to 32°C)	170.1
pH	YSI 556 PH 0 to 14	Standard pH units (at 20°C)	± 0.2 units	± 0.3 units	Standard Solutions (pH 7 and 4)	EPA 150.1, SM 4500-H+
	Hanna Combo Meter (HI 98129) 0.0 to 14.0	Standard pH units (at 20°C)	±0.3 units	±0.3 units	Standard Solutions Method	150.1
Specific Conductance	YSI 556 0 to 100 mS/cm	µS/cm	± 0.5% of reading or ± 0.001 mS/cm, whichever is greater (4 m cable)	± 0.1 mS/cm	Standard Solutions (1413 µS/cm)	EPA 0120.1, SM 2510 B
	Hanna Combo Meter (HI 98129) 0 to 3999 µS/cm	µS/cm (converted to 25 °C)	2% of full scale (80 µS/cm)	2% of full scale (80 µS/cm)	Standard Solutions Method	0120.1
Oxidation-reduction potential (ORP)	YSI 556 -999 to +999 mV	mV	± 20 mV	± 50 mV	Standard Solutions	Platinum button
Dissolved Oxygen	YSI 556 0 to 50 mg/L and 0 to 500% saturation	mg/L & percent saturation	0 to 20 mg/L, ± 2% of the reading or 0.2 mg/L, whichever is greater; 0 to 200% ± 2% of reading	± 0.3 mg/L, ± 0.1% air saturation	Saturated Air Calibration	EPA 0360.1, SM 4500-O G

Table T2: DATA QUALITY OBJECTIVES, Continued

Barometric Pressure	YSI 556 500 to 800 mm Hg	mm Hg	0.1 mm Hg	± 3 mm Hg within 15 ºC of calibration temperature	YSI-certified calibration vendor	Internal barometer in YSI 556. STORET code 00025
Turbidity	Nephelometric (Hach 2100P) 0.00 to 1100 NTU	Nephelometric Turbidity Units (NTU)	0.05 or ±2% for readings below 100 NTU, whichever is greater. ±3% above 100 NTU	< 100 NTU, 2 NTU or < 10%, whichever is greater	Standard Solutions (NTU)	EPA 0180.1, SM 2130 B
E. Coli and Total Coliform	Coliscan Easygel	# of *E.coli* other coliform colonies	1 CFU/100mL	1 CFU/100mL	N/A	Micrology Laboratories, LLC 1996.
Stream Velocity & Discharge (estimate)	Global Flow Probe (FP-201) 0.3 to 25 (fps)	Feet per second (fps)	NA	0.1 fps	Computer calibration and mechanical friction calibration of propeller bushing (factory)	0003.4

LABORATORY SAMPLES

Parameter	Method/Range	Units	Detection Limits	Precision	Calibration Method	Method Reference
Total metals (See Appendix B for list of metals)	ICP-MS scan	µg/L	See Appendix B	RPD Limit = 15		EPA 200.8, SW 6020
Total mercury	Mercury by cold vapor	µg/L	MD = 0.062, PQ = 0.2	RPD Limit = 15		EPA 245.1, SW 7470A
BTEX	GC/ECD	µg/L	MD = 0.62 (except benzene 0.2) PQ = 2 (except benzene 0.5)	RPD Limit = 20		SW 8021B
DRO	GC/FID	mg/L	MD = 0.06, PQ = 0.3	RPD Limit = 20		AK 102
Pesticides/PCBs (See Appendix B for list of analytes)	ECD	µg/L	MD = pesticides 0.0094 (except toxaphene=0.31); PCBs = 0.031 (PCBs) PQ = pesticides 0.03 (except toxaphene=1); PCBs = 0.1	RPD Limit = 25 for all except toxaphene = 30	Laboratory calibration blanks & standards; initial calibration verification / quality control sample	SW 8081/8082
Dioxins (See Appendix B for list of dioxins)	Dioxin-furan method	Pg/L	See Appendix B	See Appendix B		SW 8290
Hardness	Calculation	mg/L $CaCO_3$	Calculation	Calculation	N/A	Standard Methods; 2340B
Alkalinity	SM20 2320B	mg/L	PQL: 10; MDL 3.1	RPD Limit= 25	Calibration as above	Standard Methods; 2320B

MEASUREMENT AND DATA ACQUISITION

B1. Sampling Process Design

Water quality measurements and samples will be taken on Nelson Island during the week in June 2008 and over the summer. Data we collect in the summer will be sent to our QA officer to review and validate. Sampling will take place at the sites listed in Table T3. Stream discharge measurements will be made at sites that have high enough velocity to make accurate measurements. GPS Coordinates (minimum accuracy 20 feet) will be collected in the field using the World Geodetic System 1984 (WGS84). Each sample location will have a minimum of two photographs taken at the site.

Table T3: Nelson Island Sampling Locations

Sample Site	Village Selecting Site
Control	All villages
Cakcaaq	All villages
Tuqsuk kuik (Toksook River)	All villages
Ciluugun	Newtok
Nengliq	Newtok
Quqaqlliq River	Kipnuk
Qallaneq (fresh water from a hill)	Kipnuk
Allanruyagaq	Tununak
Tununrem Kangia	Tununak
Alaqucuk River	Toksook Bay
Qalulleq	Toksook Bay
Old Chefornak	Chefornak
Qinaruq	Chefornak
Waterspring west of Nightmute	Nightmute
Waterspring east of Nightmute	Nightmute
Waterspring 1 west of Umkumiut	Umkumiut
Waterspring 2 west of Umkumiut	Umkumiut

The sampling crew will consist of at least one local monitor and one boat captain (as well as the project QA officer during the June sampling/training week). Sample site locations will be established at the midpoint of the waterbody (stream, river, lake, or slough). Stream/river sample sites will be located on a straight reach of the river, ideally with a uniform channel cross section. Water quality samples/measurements will be taken at elbow-depth from the surface of the water. Stream discharge measurements will be made at six-tenths depth if the stream is less than 2.5 feet deep, and at two- and eight-tenth depths if greater than 2.5 feet deep as detailed in Appendix C.

The matrix for all samples will be water except for air temperature. We will sample one control site and 16 sample sites for all water quality field parameters and stream discharge (when applicable). Laboratory samples will be collected at all 17 sites and taken in duplicate at two sites (except dioxins—8 samples, one duplicate). This equates to 8 field measurements with the YSI 556 and turbidimeter (an average or CV of replicates) at 17 sample sites (136 measurements). In addition, we anticipate that approximately half of the sites (~8) will be appropriate for stream discharge measurements, so we estimate that we will make a total of 144 field measurements for this project. There will be two Coliscan samples taken at each of the 17 sites (34 samples). Finally, 6 laboratory samples will be collected at all 17 sites, and two sites will have duplicate samples collected (114 samples). In addition, dioxin samples will be collected at the control and 7 additional sites with one site duplicated (9 samples). Thus, the sum of field measurements, and Coliscan and lab samples is 301 measurements/samples.

Field measurements (made at all sites)
- Air temperature
- Water temperature
- Dissolved oxygen
- Barometric pressure
- pH
- Specific conductance
- Oxidation-reduction potential
- Turbidity
- Stream discharge (when appropriate)
- *E. Coli* and total coliform (Coliscan Easygel samples)
- Observation of any oil sheen present

Laboratory samples (collected at all sites)
- Total metals
- Total mercury
- BTEX
- DRO
- Pesticides/PCBs
- Total Alkalinity
- Dioxins (at only 8 sites)

The project coordinator and project QA officer are responsible for all corrective actions in the field, data analysis, and reporting. The QA officer and EPA project officer will be made aware of any corrective actions required.

This is a baseline water quality assessment that will assess local and global sources of contaminants through laboratory sampling. Sample sites were selected using our traditional knowledge and are of utmost importance for our subsistence gathering and ultimately our survival as a people.

Assumptions for our assessment include:
- Sampling during the summer months will represent average contaminant concentrations.
- If we cannot get to all sites in June, samples we collect in July and August will similarly represent contaminant levels. The later-collected data are comparable with the June data.

As with any project, there are a number of possibilities for potential problems. Nelson Island experiences very harsh storms and weather, so we will be conscious and cautious of weather conditions. We will take the greatest precautions for our safety regarding wildlife, tundra, and waterbody conditions (e.g., ice). We are relying on the sampling boat to not break down during the sampling excursion, though we could experience mechanical issues or propeller damage. If high water poses a danger, we will delay our departure or if we are en route, we may abort our sampling. We hope that few if any of these potential problems are experienced.

B2. Sampling Methods

Upon establishment of a sample site and setting an anchor, the sampling team will complete the first page of the data sheet (Appendix D) and take photographs of the site. During this time, the project QA officer or a trained monitor will calibrate the YSI 556 multi-meter (dissolved oxygen) and turbidimeter. All measurements and sample water will be collected from the upstream side (when applicable) of the anchored skiff at elbow depth. Water temperature, dissolved oxygen, oxidation-reduction potential, pH, and specific conductance readings will be taken with the YSI 556 multi-meter. Turbidity tubes will be filled at elbow depth and analyzed with the Hach 2100 instrument. In the event that the YSI 556 malfunctions, we will use a calibrated Hanna Combo meter to collect pH, specific conductance, and temperature data, and we will note this equipment change on our data sheet. All field measurements will be made in duplicate with 10% distilled water blanks.

Laboratory sample bottles will also be filled at elbow depth below the water surface. The sampler will face upstream and dip the sample jar into the water while facing the current. For bacteria sampling, three milliliters of water will be collected using a sterile, disposable pipette at elbow depth and added to the Coliscan Easygel vials. The vials will immediately be placed on ice and their collection times noted. Duplicate laboratory samples will be collected at one site. Blank laboratory samples will be collected only for BTEX (one blank per cooler containing BTEX samples or 10% of samples, whichever is greater). Sample bottles that are supplied with acids already in the container will be carefully filled so as not to rinse out the preservative. For BTEX, the 40 ml VOA vials will be slowly filled to the top with a visible meniscus showing. The vials will be gently tapped to release any air bubbles trapped against the inside of the glass prior to capping. The bottles used for pesticides or dioxins may be used as sampling containers for filling VOA vials provided the bottles are sampled from the same location. All Coliscan Easygel samples will be collected in duplicate with 10% distilled water blanks.

Table T2 lists the methods and most of the equipment needed for the project. All sample collection and calibration procedures will be according to manufacturer instructions (Appendix C).

Additional equipment includes:

- Hand-held GPS unit
- Digital camera
- Maps of Nelson Island
- Calibration solutions for pH, specific conductance, ORP, and turbidity
- Distilled water (2 gallons) and squirt bottle
- Sample coolers and bottles with blue ice
- Chain of custody forms
- Repair kit

- Safety glasses
- Rubber gauntlet & nitrile gloves
- Kim wipes and paper towels
- Field data sheets, pens, pencils, permanent markers, clipboard
- Field tape measure
- Weighted cable to measure depth
- Coliscan Easygel vials (kept frozen until sampling)
- Coliscan supplies: Petri dishes, identification key, bleach
- Incubators (2) with thermometers (G.Q.F. Mfg., 30 to 120 ˚C range)
- Waste containers for pH, ORP, & conductivity solutions

The main support facility for this project is SGS Environmental Services. The project QA officer and project coordinator are responsible for corrective actions for any improperly working equipment when sampling. The YSI probe and turbidity tubes will be rinsed thoroughly with distilled water after each use.

Sample container volumes, preservation methods, and maximum hold times are those recommended by SGS Laboratory and are summarized in Table T-4 below:

Table T4: Sample parameters, methods, container size, preservatives and hold times

Parameter	Method	Recommended Container	Preservative	Hold Time
Metals, Total (other than Hex. Cr & Hg)	EPA 200.8	1x250 or 500 mL HDPE	HNO_3	180 days
Mercury, Total	EPA 245.1, SW 7470A	1x250 or 500 mL HDPE	HNO_3	28 days
BTEX	SW 8021	3x40 ml amber VOA vials w/ septa	4ºC & HCl	14 days
DRO	AK 102	2x1L amber glass	4ºC & HCl	14 days
Pesticides/PCBs	SW 8081/8082	2x1 L amber glass	4ºC	7 days
Dioxins	SW 8290	2 x 1 L amber glass	4ºC	7 days
Total Alkalinity as CaCO3	SM 2320B	1x250 or 500 ml HDPE	4ºC	48 hours
Total Hardness	Calculation	N/A	N/A	N/A
Coliscan Easygel	Micrology Laboratories, LLC 1996.	30 mL HDPE (contains pectin-gel medium)	N/A	24 hours (until plating)

All other samples are field measurements.

B3. Sample Handling and Custody

Laboratory sample handling will include completing labels provided by SGS completely and legibly with permanent marker. Samples will be placed immediately on ice in a sample cooler at 4˚C. Samples collected early in the week will remain in the sample cooler with ice packs replaced daily. Coolers will be sealed before shipment with a friable tape. Chain of custody forms will also be provided by SGS and used during airline transport of the samples to Anchorage.

Coliscan samples will be labeled with the site name and replicate number. Coliscan samples will also be placed immediately on ice in a sample cooler at 4˚C. They will remain on ice until they are plated in Umkumiut by the project QA officer, project coordinator, or trained monitor.

B4. Analytical Methods

Table T2 identifies analytical methods and required equipment for all field measurements and laboratory samples, as well as method detection limits for the lab samples. The protocol for Coliscan Easygel sample processing is located in Appendix C. The project QA officer and project coordinator are responsible for corrective actions for field measurements and for laboratory samples until they are released to SGS. Once in SGS's custody, Heather Hall, SGS's Quality Assurance officer will be responsible for any corrective actions. We have requested a turnaround time of 10 working days for this project.

B5. Quality Control

Duplicate measurements will be made for all field measurements including Coliscan. If duplicates exceed the desired precision range, a third measurement will be made. Distilled water field blanks will be measured for 10% of the field samples and Coliscan samples. Laboratory samples will be duplicated at one site. Blank laboratory samples will be collected only for BTEX (one blank per sample cooler containing BTEX samples or 10%, whichever is greater). Data that do not meet project accuracy and precision requirements will be submitted to EPA (and DEC, if applicable) as flagged data.

Relative percent difference between duplicate samples will be calculated for all data, and relative standard deviation will be calculated for triplicate samples.

Relative percent difference (RPD, duplicate samples) is defined:

$$RPD = \frac{(C1 - C2)}{(C1 + C2)/2} * 100$$

where C1 = the larger of the two sample values and C2 = the smaller of the two sample values.

Coefficient of Variation (CV, triplicate samples) is defined:

$$CV=(S/Xbar) \times 100,$$

where s = standard deviation of repeated samples and Xbar = mean of repeated samples.

Laboratory quality control procedures and QC statistic calculations are detailed in full in SGS's QAPP (SGS QA Manual, Revision 7.1, June 15, 2004). These include a 10% frequency requirement for Continuing Calibration Variations (CCVs), batching, trip, field, and method blanks, etc. SGS is an ADEC-approved laboratory.

B6. Instrument/Equipment Testing, Inspection and Maintenance

All equipment and supplies are checked upon receipt and prior to departure from Anchorage by the project QA officer to ensure that operations are within technical specifications. Each calibration solution and reagent bottle is dated with the expiration date prior to use. The YSI 556 multi-probe will be calibrated by the vendor prior to purchase. Laboratory sample bottles will be inspected and well-padded for transport to the field. One additional set of bottles will be requested from SGS in case of damage. An instrument calibration and maintenance log will be updated each time equipment is calibrated or maintained (both paper copy and Excel spreadsheet, see Appendix E). This log will be kept on file with the instruments at the Umkumiut Tribal Council's environmental office.

In Umkumiut, the project QA officer and project coordinator will again inspect all equipment and supplies to sure they are clean and in good working order. Spare parts will be brought to the field including extra turbidity tubes, lab sample bottles, and YSI 556 dissolved oxygen membranes. Spare parts except for YSI 556 dissolved oxygen membranes are stored at the Umkumiut environmental office. The project QA officer and project coordinator are responsible for all preventive and corrective maintenance, including ensuring adequate padding exists in equipment cases, replacing old batteries, cleaning equipment, etc.

B7. Instrument/Equipment Calibration and Frequency

The YSI temperature probe will be compared against vendor's NIST-certified thermometer (-8 to 32 ºC) prior to purchase of the instrument. We will also send our YSI 556 to a YSI-certified vendor so that all parameters including temperature will be calibrated and maintained at least annually. Prior to departure for sampling from Umkumiut each day, equipment will again be calibrated (YSI 556 & turbidimeter) and inspected (all equipment/supplies, lab bottles, etc.). Calibration procedures will be performed according to manufacturer instructions as described in Appendix C.

The turbidity meter dissolved oxygen sensor of the YSI 556 meter will be calibrated (saturated air method) at each sampling site. Calibration results will be recorded in the instrument calibration and maintenance log. The paper copy of the calibration/maintenance log is stored at the Umkumiut environmental office and is backed up with an electronic spreadsheet. The electronic spreadsheet will be emailed to the project QA officer after any sampling activity.

B8. Inspection/Acceptance of Supplies and Consumables

It is the responsibility of the project QA officer to ensure that all supplies and consumables are fully functional and adequate for project needs. Expiration dates of calibration solutions and Coliscan medium will be inspected upon receipt. Supplies and equipment will be purchased under the supervision of the EPA project officer. Equipment purchase records will be kept in the Umkumiut environmental office.

B9. Non-direct Measurements

USGS 1:24,000 topographic maps from National Geographic TOPO! software GPS data will be collected at the sampling locations using a hand-held unit which derives latitude and longitude readings using the World Geodetic System 1984 (WGS84). There are few limitations associated with these data.

Total hardness concentrations will be calculated using total calcium and magnesium values obtained from SGS in the total metals analysis (EPA 200.8). The method reference for total hardness is Standards Methods 2340B. The calculations will be made in Microsoft Excel using the following equation:

Total hardness (mg/L $CaCO_3$) = ((mg/L Calcium) * (2.5)) + ((mg/L Magnesium) * (4.1))

B10. Data Management

All observational data and field measurements will be recorded at the time of sampling on field data sheets printed on Rite in the Rain paper. The field datasheets will be kept on file in the Umkumiut environmental office and copies made for the project QA officer. Data from the sheets will be entered into a Microsoft Excel spreadsheet by the project QA officer. All data entered into the spreadsheet will be compared to the original data sheet after entry to locate any errors. Next, precision checks will be made of the duplicate/triplicate samples by the project QA officer to ensure that collected data meet standards outlined in Table T2. Calculations will be made by the project QA officer for relative percent difference (duplicate samples) and relative standard deviation (triplicate samples) for data deemed to be precise. Any data that fail to meet ADEC water quality standards will be highlighted in the spreadsheet by the project QA officer. The project QA officer will write a final report, which will be reviewed by the project coordinator before the report is submitted to EPA.

ASSESSMENTS AND OVERSIGHT

C1. Assessments and Response Actions

The data will be reviewed by the project coordinator and project QA officer. Data that have been validated and appear not to meet state water quality standards will be flagged, and EPA and the Nelson Island Consortium notified. The project coordinator and project QA officer are responsible for such corrective actions. The project QA officer is responsible for corrective actions pertaining to any problems in data collection and with sample chain of custody forms.

C2. Reports to Management

The project QA officer will produce a final report summarizing the results of this water quality assessment, any significant quality assurance problems, and recommendations for the Umkumiut Tribal Council and Nelson Island Consortium. The final report will be distributed to all parties on the distribution list (Section A3). The project coordinator is responsible for all other reporting to EPA for this project.

DATA VALIDATION AND USABILITY

D1. Data Review, Validation and Verification Requirements

Data collected by the project coordinator and trained monitors are subject to review by the project QA officer to ensure the data meet QAPP objectives. Decisions to reject or qualify data will be made by the project QA officer. Field measurements will be accepted if instruments were properly calibrated and duplicate measurements meet the precision range stated in Table T2 for each parameter. Field measurement data will be flagged if only two of three replicates meet precision requirements. Data will be rejected if equipment is determined to be faulty after data are collected. Laboratory data are accepted, rejected, and/or qualified according to SGS' standard operating procedures as detailed in the SGS QAPP (SGS QA Manual, Revision 7.1, June 15, 2004).

D2. Validation and Verification Methods

All data from field data sheets will be entered into a Microsoft Excel spreadsheet and reviewed by the project QA officer. Data will be evaluated to ensure they are within accuracy/precision limits in the spreadsheet, and calculations using the precise/accurate data will be made for relative percent difference (duplicate samples) and relative standard deviation (triplicate samples) to validate the data. Verification of the data, decimal point, formulae, and completeness checks, will be performed by the project QA officer. Any issues that arise will be resolved by the project QA officer through careful review of the data.

Equipment calibration and maintenance and quality control checks will be recorded in their respective logs and checked for deviations from typical calibration readings prior to equipment usage. Logs will also be entered into Microsoft Excel spreadsheets to back-up the information.

D3. Reconciliation with User Requirements

The main objective of this project is to perform a baseline water quality assessment at important subsistence campsites on Nelson Island. The study is designed to meet this objective. It is possible that waterbody conditions could be less than ideal (remaining ice, heavy rains, drought, etc.) when sampling takes place, laboratory samples could exceed their hold times (unlikely), or field equipment could be damaged in the field or during transport from Anchorage to Umkumiut. Any of these occurrences would be unfortunate and would make the study less robust. If there are such occurrences, project results and objectives would be reconciled in an Excel spreadsheet and reviewed by the project QA officer.

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Appendix A: Agenda for Water Quality Training & Sampling

Agenda for Nelson Island Consortium Water Quality Training and Baseline Water Quality Sampling Umkumiut, Alaska, June 2008

Facilitated by Zender Environmental Health & Research Group

Monday: Arrival and Begin Water Quality Training

Morning	Participants & project QA officer arrive Umkumiut
1 p.m.	Introduction of training goals & concepts
1:30 p.m.	Importance of collecting baseline water quality data (Power Point presentation)
2:15 p.m.	Break
2:30 p.m.	How to measure water temperature, pH, conductivity, and dissolved oxygen simultaneously using a YSI 556 multi-probe (Power Point presentation)
3:30 p.m.	Break
3:45 p.m.	How to measure turbidity using a Hach 2100 turbidity meter (Power Point presentation)

Tuesday: Continue Water Quality Training & Begin Sampling

9 a.m.	Participants practice calibrating YSI 556 probes and Hach 2100 turbidity meters
12 noon	Lunch
1 p.m.	Participants depart for sampling sites near Umkumiut and Nightmute

Wednesday, Thursday, and Friday (to early-afternoon): Water Quality Testing

- Participants will spend 2.5 days sampling as many of the sites as possible.
- The project QA officer will transport the lab samples to Anchorage and will deliver them to SGS

****Participants should bring warm clothing, rain gear, boots, bug spray, etc. for sampling.**

Appendix B: Additional Laboratory Sample Parameter Information

ICP-MS Scan (EPA 200.7) Detection and Reporting Limits

Analyte	Method Detection Limit (MD) (µg/L)	Practical Quantitation Limit (PQ) (µg/L)	Reporting Limit Range
Iron	0.0124	0.04	85 - 115

ICP-MS Scan (EPA 200.8) Detection and Reporting Limits

Analyte	Method Detection Limit (MD) (µg/L)	Practical Quantitation Limit (PQ) (µg/L)	Reporting Limit Range
Aluminum	6.2	20	85 - 115
Antimony	0.31	1	85 - 115
Arsenic	2.5	5	85 - 115
Barium	0.94	3	85 - 115
Beryllium	0.13	0.4	85 - 115
Calcium	150	500	85 - 115
Cadmium	0.05	0.5	85 - 115
Cobalt	1.2	4	85 - 115
Chromium	0.31	1	85 - 115
Copper	0.31	1	85 - 115
Lead	0.062	0.2	85 - 115
Potassium	150	500	85 - 115
Magnesium	15	50	85 - 115
Manganese	0.31	1	85 - 115
Molybdenum	3.1	10	85 - 115
Sodium	150	500	85 - 115
Nickel	0.62	2	85 - 115
Phosphorus	62	200	85 - 115
Selenium	1.5	5	85 - 115
Thallium	0.31	1	85 - 115
Tin	0.31	1	85 - 115
Titanium	1.5	5	85 - 115
Vanadium	6.2	20	85 - 115
Silicon	62	200	85 - 115
Silver	0.31	1	85 - 115
Zinc	1.5	5	85 - 115

List of Pesticides/PCBs

SW 8081A	SW8082
Tetrachloro-m-xylene	Arochlor-1016
gamma-Chlordane	Arochlor-1221
alpha-Chlordane	Arochlor-1232
alpha-BHC	Arochlor-1242
beta-BHC	Arochlor-1248
gamma-BHC (Lindane)	Arochlor-1254
delta-BHC	Arochlor-1260
Heptachlor	
Aldrin	
Heptachlor epoxide	
Endosulfan I	
4,4'-DDE	
Dieldrin	
Endrin	
Endosulfan II	
4,4'-DDD	
Endrin aldehyde	
4,4'-DDT	
Endosulfan sulfate	
Endrin ketone	
Methoxychlor	
Toxaphene	

Dioxin SW 8290 Reporting Limits for Water			
Analyte	**Method Detection Limit (MD) (pg/L)**	**Practical Quantitation Limit (PQ) (pg/L)**	**Method Detection Limit (MD) (pg/L)**
2378-TCDD	0.940	3.3	10
12378-PeCDD	0.963	11.8	50
123478-HxCDD	1.23	9.1	50
123678-HxCDD	2.06	5.7	50
123789-HxCDD	1.46	7.7	50
1234678-HpCDD	3.46	3.5	50
OCDD	1.03	22.7	100
2378-TCDF	0.563	4.5	10
12378-PeCDF	2.25	5.2	50
23478-PeCDF	1.50	7.3	50
123478-HxCDF	2.59	4.4	50
123678-HxCDF	2.02	5.6	50
234678-HxCDF	2.16	5.2	50
123789-HxCDF	2.97	3.8	50
1234678-HpCDF	1.79	6.5	50
1234789-HpCDF	1.94	5.8	50
OCDF	2.52	8.8	100

Appendix C: Instrument Calibration and Sample Collection Procedures

<u>CALIBRATION</u>

YSI 556 Multi-meter Calibration
(Temperature, pH, specific conductance, dissolved oxygen, oxidation-reduction potential)

The YSI 556 Multi-probe will be calibrated and in good working order upon receipt from the vendor. The meter will be calibrated in Umkumiut at the beginning of each sampling day. As well, the dissolved oxygen sensor will be calibrated at *each* sample site. Calibration of the YSI 556 will be performed according to manufacturer instructions as summarized below.

The transport/calibration cup that comes with the meter will be used for calibration. Sensors will be completely submersed when calibration values are entered, and recommended volumes will be used when performing calibrations. The probe will be rinsed between calibration solutions and shaken to rid excess rinse water and dried with paper towels or a cotton cloth. A small amount of previously-used calibration solution will be used to pre-rinse the probe prior to the next calibration parameter. Port plugs for ports that do not have sensors installed will remain in place to keep electrical connectors dry.

Temperature and Barometer calibration

1. The temperature and barometer will be calibrated once per year or if we suspect erroneous readings by a YSI-certified repair shop. Therefore, we will not calibrate these parameters ourselves.

Conductivity calibration

1. At the main menu, select “calibrate,” then “conductivity,” and then “specific conductance.”
2. Place Fifty-five (55) mL of conductivity calibration standard into the clean, pre-rinsed transport/calibration cup.
3. Carefully immerse the sensor end of probe module into calibration solution.
4. Gently rotate and/or move the probe module up and down to remove any bubbles from the conductivity cell (make sure vent hole is completely immersed).
5. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.
6. Use keypad to enter the calibration value of the standard (1413 μS/cm, enter as 1.413 mS/cm).
7. Allow one minute for temperature equilibration.
8. When specific conductance reading shows no significant change for approximately 30 seconds, press “enter.” (This accepts the calibration.)
9. Press “enter” again to continue to Conductivity Calibrate Selection Screen.
10. Press “escape” to return to the calibrate menu.
11. Rinse probe module, sensors, and calibration/transport cup in distilled water and dry.

Dissolved oxygen calibration--water saturated air method

1. Ensure that instrument has been on for at least 20 minutes to polarize DO sensor.
2. The multi-meter will be calibrated for DO % saturation, which automatically calibrates DO mg/L. Measurements will be made in mg/L.

3. Go to calibrate screen.
4. Highlight "Dissolved Oxygen," press "enter," select "select DO saturation," and press "enter" again.
5. Place 3 mm (1/8 inch) of water in the bottom of the transport/calibration cup.
6. Place the probe module into the transport/calibration cup, ensuring that the DO and temperature sensors are not immersed in the water.
7. Engage only 1 or 2 threads of the cup to ensure the DO sensor is vented to the atmosphere.
8. The unit has the optional barometer, so no entry is required.
9. Press "enter"
10. Allow approximately 10 minutes for the air in the transport/calibration cup to become saturated water and for temperature equilibration.
11. After 10 minutes, observe the reading under DO mg/L. When reading shows no significant change for approximately 30 seconds, press enter. This accepts the calibration and prompts you to press "enter" again to continue. Then "escape" to return to calibration menu.
12. Rinse probe module and sensors in distilled water and dry.

PH Calibration

1. Go to calibrate screen
2. Use arrow keys to highlight the pH selection, press "enter."
3. Select "2 point," press enter.
4. Pre-rinse transport/calibration cup with pH buffer 7
5. Place 30 mL of pH 7 calibration solution in the transport/calibration cup.
6. Carefully immerse the sensor end of the probe module into the solution.
7. Gently rotate and/or move the probe module up and down to remove any bubbles from the pH sensor. Ensure that sensor is completely immersed.
8. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.
9. Enter the calibration value of the buffer at the current temperature (printed on the buffer label).
10. Allow at least one minute for temperature equilibration before proceeding.
11. Observe the reading under pH. When the reading shows no significant change for approximately 30 seconds, press "enter."
12. Press "enter" again to return to the Specified pH Calibration Screen.
13. Rinse the probe module, transport/calibration cup, and sensors in distilled water and then with next buffer.
14. Repeat above steps for second (pH 4) buffer.
15. Press "enter" and then "escape" to return to Calibrate Screen.
16. Rinse the probe module, transport/calibration cup, and sensors in distilled water and dry.

ORP Calibration

1. At Calibrate screen, highlight "ORP" and press "enter."
2. Place 30 mL of ORP calibration solution into pre-rinsed transport/calibration cup.
3. Carefully immerse the sensor end of the probe module into the solution.
4. Gently rotate and/or move the probe module up and down to remove any bubbles from the pH sensor. Ensure that sensor is completely immersed.
5. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.

6. Enter the correct value of the calibration solution at the current temperature. Zobell solutions are as follows:

Temperature deg. C	Zobell Solution Value, mV
-5	270.0
0	263.5
5	257.0
10	250.5
15	244.0
20	237.5

7. Press “enter.” The ORP calibration screen is displayed.
8. Allow at least one minute for temperature equilibrium before proceeding.
9. Verify that the temperature reading matches the value you entered.
10. Observe the reading under ORP. When reading shows no significant change for approximately 30 seconds, press “enter” to accept calibration.
11. Press “enter” again to continue to the Calibrate Screen.
12. Rinse the probe module and sensors with distilled water and dry.

Hanna Combo Meter (HI98129)
The Hanna Combo meter will be used in the event that the YSI 556 malfunctions or if we suspect erroneous readings.
pH
1. Meter should be stored in pH 7.01 solution.
2. Rinse clean, labeled beakers with small amounts of 4.01, 7.01 and 1413 µS/cm calibration solutions and fill to 20 mL line.
3. Rinse meter with distilled water and place in beaker of 7.01 solution.
4. Turn meter on by pressing the MODE button. If meter is not in pH mode, press SET/HOLD button until it is.
5. Allow meter to stabilize for two minutes in the 7.01 solution.
6. Record the pre-calibration pH and temperature reading in the calibration log
7. Press MODE button through the “off” reading until “cal” is shown on display, then release button.
8. Display will read “7.01 use,” and “cal” will flash in the lower left-hand corner
9. Swirl meter and solution while instrument is calibrating
10. When display reads “4.01 use,” rinse probe with distilled water (over waste container)
11. Place probe in 4.01 calibration solution and swirl until “cal” stops flashing and probe goes to measurement mode
12. Immediately record the post-calibration pH and temperature reading in the calibration log

Conductivity
1. Rinse probe again with distilled water and place in conductivity solution
2. Press SET/HOLD button once to reach conductivity mode
3. When reading is stable, record pre-calibration conductivity and temperature in calibration log
4. Press MODE button through the “off” reading until “cal” is shown on display, then release button.
5. Display will read “1413 use” and “cal” will flash in the lower left-hand corner
6. Swirl meter and solution while instrument is calibrating

7. When "cal" stops flashing, probe goes into measurement mode
8. Record the post-calibration conductivity and temperature readings in calibration log
9. Rinse probe with distilled water
10. Fill the small cylinder in the probe cap with the used pH 7.01 solution for storage.
11. Wash beakers with tap water and rinse with distilled water for storage.

Hach 2100 Turbidity Meter
The turbidity meter will be calibrated by the manufacturer and vendor upon purchase. Several calibration standards will be included with the meter, which will be checked periodically during the sampling and after the last sampling to determine any instrument drift. The utmost care will be taken to ensure cleanliness and prevent scratching of the turbidity tubes. We will send the turbidity meter to a Hach-certified maintenance/repair location once per year to ensure it remains calibrated to manufacturer specifications.

Flow Meter (Global FP 201)
The flow meter is factory calibrated, so calibration is not required for this meter unless the battery is changed (normal battery life is 3 years or more). The flow meter will be recalibrated following manufacturer instructions if the battery is changed. The following equipment inspection procedure will be followed prior to flow meter usage.

1. Inspect the flow meter for any damage
2. Remove any visible debris from the propeller area, and rinse with clean water, if necessary
3. Blow into the propeller in the direction of flow. Ensure that it spins freely and makes a chattering noise
4. If the propeller does not spin freely, remove the prop screw and prop, clean with soap and water, and replace (prop screw should be tight, but still allow the prop to turn freely).
5. Check that computer display is functioning, and reading in feet per second.

SAMPLE ANALYSIS

YSI 556 Multi-meter
The multi-meter will be calibrated for dissolved oxygen at every site. It will be calibrated for specific conductance, pH, and ORP prior to departure from Umkumiut on each sampling day. Sample analysis is as follows:

1. Press "on/off" key
2. Make sure the probe sensor guard is installed.
3. Place the probe module in the sample. Be sure to completely immerse all the sensors.
4. Rapidly move the probe module through the sample to provide fresh sample to the DO sensor.
5. Watch the readings on the display until they are stable
6. Record results on data sheet.

Hanna Combo Meter
The Hanna Combo meter will be used if the YSI 556 malfunctions.
1. Turn meter on by pressing the "mode" button

2. Press "set/hold" button until probe is in pH mode
3. Allow probe to stabilize for approximately 15 seconds
4. Record temperature reading (replicate 1)
5. Wait 15 seconds, then record temperature again (replicate 2)
6. Press "set/hold" button to change to conductivity mode, and again take replicate measurements 15 seconds apart.
7. Rinse probe with distilled water, fill cap reservoir with pH 7.01 solution, and cap.

Turbidity
Turbidity tubes will be filled elbow-depth below the surface and analyzed as follows:
1. Ensure that turbidity tubes are clean
2. Turn on turbidimeter
3. Rinse turbidity tubes with sample water three times
4. Holding necks of vials, place turbidity tube in sample water for approximately 1 minute. This will allow the tubes' temperatures to equilibrate to the water and will prevent condensation.
5. Fill and cap turbidity tubes under water to prevent air bubbles
6. Wipe turbidity tube with a Kimwipe
7. Align indexing tube and meter arrows, insert tube into meter, and close lid
8. Insert tube 1 and press "read" button. Turbidity value is displayed within 5 seconds. Record replicate 1 value.
9. Insert tube 2 and press "read" button. Record replicate 2 value
10. Turn meter off by pressing the "read" button for two seconds
11. Rinse turbidity tubes with distilled water prior to storage.

Filling Laboratory Sample Jars
Laboratory sample jars will be filled according to laboratory suggested procedures at elbow-depth below the surface.

Plating and Enumerating Coliscan Easygel Samples
Coliscan samples will be kept on ice until arrival in Umkumiut where they will be plated as soon as possible. Clean nitrile gloves will be worn at all times during sample processing. For this, sterile petri dishes will be labeled with their respective sample identification numbers. Coliscan vials containing both medium and 3 mL of sample water (added at sample site) will be swirled and then poured into the correctly-labeled Petri dishes. Lids will be placed onto the Petri dishes, and the dishes will be gently swirled until the entire dish is covered with liquid. The dishes will be covered and allowed to solidify for approximately 40 minutes. Next, the dishes will be placed upside-down in a G.Q.F. Manufacturing (30 to 120 ˚C range) incubator and incubated at 35ºC for 24 hours.

After 24 hours, the dishes will be enumerated and the results recorded on the Coliscan sample log sheet (Appendix F). Colonies will be recorded as *E. coli* colonies (blue/purple), coliform colonies (pink/red), and non-coliform colonies (teal). These data will be entered into a Microsoft Excel spreadsheet, and results will be converted to colonies per 100 mL. To do this, the project QA officer or project coordinator will divide 100 mL by the sample volume (3 mL) and then multiply by the number of colonies. For example:
100 mL / 3 mL = 33 x 6 coliform colonies = 198 coliform colonies / 100 mL.

When all Petri dishes have been enumerated, 5 mL of bleach will be placed onto the surface of plate's medium and allowed to sit for 10 minutes. Next, dishes will be placed in waterproof bags and discarded in the trash. This analytical cycle can repeat itself efficiently, as we have purchased two incubators. Thus, when returning from the field, the new samples can be plated and placed into one incubator, and the samples reaching the end of their incubation period can be removed from the other and enumerated.

Stream flow
The method used to measure stream flow will depend on a number of variables including width and depth of stream and stream velocity. A benchmark (nail in tree, etc.) will be established at all sample sites to establish a vertical datum. Each time a site is sampled, the stream stage will be measured with reference to the established benchmark. In addition to stage measurements, stream discharge may be estimated and/or measured using the below methods:

If cross sectional area and stream velocity can only be estimated:
1. Estimate channel width
2. Estimate depth of channel in increments across the width of the channel, if possible
3. Estimate stream velocity using float method or flow meter at water surface and any other depths possible

If stream has a firm bottom, is wadeable, and cross sectional area and stream velocity can be measured (Saunders, 1998):
1. Establish a tag line by securing each end of a tape measure to a survey stake or another secure means
2. Measure depth and velocity at as many points as is feasible (1≥20 points)
3. Determine the number and locations of sample points (1 point every foot, etc.)
4. Determine the depth of the velocity measurement at each point
    a. If stream depth is <2.5 ft., average velocity will be measured at six-tenths depth (as measured from the surface of the stream)
    b. If stream depth is >2.5 ft., the average velocity will be measured at both two- and eight-tenths depths.
5. Point flow meter propeller in direction of flow at first observation point
6. Ensure that flow probe is on "average speed" mode
7. Allow display to stabilize for 40 seconds and record measurement
    a. Stand sideways, to the side, and downstream of flow meter while taking measurements. Meter should remain vertical.
8. All measurements will be recorded on field data sheet
9. Repeat for as many observation points as is feasible across the width of the stream channel
10. To calculate discharge:
    a. Multiply depth by sample interval width (ft^2) to obtain cross sectional area
    b. Determine the vertically-averaged velocity at observation point (ft/sec)
        i. This is the velocity at six-tenths depth. If two-and eight-tenths velocities were measured, average these velocity values to determine vertically-averaged velocity
    c. Multiply cross sectional area by vertically-averaged velocity to obtain discharge (cfs) for each observation point
    d. Sum the discharge of each observation for the total discharge (cfs)
11. Calculate average velocity by dividing total discharge by cross sectional area (ft/sec)

Appendix D: Data Collection Field Sheet

Site Description:	**Date:**
	Time arrived at site:
Est. maximum depth at site (ft.):	**Latitude (**GPS)**:**
Stream Stage (normal, above/below normal):	**Longitude** (GPS):
	Waypoint name (GPS):
Data collectors:	

Air temperature (ºC, shade):	
Weather condition (circle one): Cloudless. Thunderstorms. Squalls. Rain, sleet, snow, or hail. Rain showers. Drifting snow, or dust/sand storm. Visibility less than 1000 M Fog or dust. Visibility less than 1000 M. Drizzle or light rain. Snow, sleet, or hail. Rain. Overcast. Cloudy or partly cloudy. Other ______________________________________	**Water Physical Appearance** (circle one): Clear - crystal clear, transparent water Green OR Muddy plus extensive floating scum/foul odor Green - algal coloration evident Foamy - natural or from pollution Tea-colored - clear, natural coloration from wetland Muddy - cloudy brown due to high sediment levels Milky - not quite crystal clear; cloudy white or gray Other ______________________________________

Wildlife Observed (birds, beaver, moose, etc.):

Oil sheen observed at site?

Comments:

Number of digital photographs taken & description:

WATER QUALITY FIELD DATA
(All samples collected at elbow-depth below water surface):

Dissolved oxygen, temperature, ORP, pH, Specific conductance (YSI 556)
DQOs: Temp, pH, DO=0.3 °C, mg/L; Spec. cond=100 µS/cm, turbidity=2NTU, ORP=50mV

Start time:	Replicate 1	Replicate 2	Replicate 3 (if R_1-R_2 > DQO)	DI Blank (10%)
Water temp. (°C)				
Specific conductance (µS/cm)				
Dissolved Oxygen (mg/L)				
Dissolved Oxygen (% Saturation)				
pH				
Oxidation-reduction potential (mV)				
Barometric pressure (mm Hg)				

Turbidity
DQO: +/- ≤ 2 NTU or 10%, whichever is greater (when sample < 100 NTU)

Start time:	Measurement 1	Measure. 2	Measure. 3	Measure. 4
Turbidity (NTU)				
Turbidity (NTU) rep. (10%)				
DI Blank (10%)				

Coliscan Easygel
(collect duplicates at all sites)

Sample Type	**Time Collected**
Coliscan sample 1	
Coliscan sample 2	
DI blank (10%)	

Laboratory Samples

Analyte	**Time Collected**
Total metals	
Total mercury	
BTEX	
DRO	
Pesticides/PCBs	
Dioxins	
Total Alkalinity	

Stream Discharge Cross Sectional Area & Velocity Measurements

Observation number	Position on tag line (or distance from edge) (ft)	Total depth at observation point (ft)	Depth at which measurement is made (ft)	Average velocity (ft/sec)	Comments

Appendix E: Instrument Calibration and Maintenance Log

YSI 556

Date	Time	Location	Temperature (deg C), NIST/YSI	Barometer (mm Hg) Barometer/ YSI	Conductivity (vs. 1.413 mS/cm)	Dissolved oxygen (vs. 100 % saturation)	PH standards 4, 7, and/or 10	ORP, Zobell Solution Value	Comments
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Hach 2100 Turbidity Meter

Date	Time	Location	Standard selected	Initial standard reading	Reading after calibration	Comments

Appendix F: Coliscan Easygel Sample Log Sheet

Sample ID	Date/time Collected (from field data sheet)	Date/time Plated	Date/time Enumerated	Number of *E. Coli* colonies (blue/purple)	Number of coliform colonies (pink/red)	Number of non-coliform colonies (teal)