IMPLEMENTATION PLAN:

BRISTOL BAY REGIONAL WATER TEMPERATURE MONITORING NETWORK

Prepared by
Sue Mauger, Cook Inletkeeper
and
Tim Troll, Bristol Bay Heritage Land Trust
for the
Western Alaska Landscape Conservation Cooperative
and the
Southwest Alaska Salmon Habitat Partnership

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Bristol Bay Regional Water Temperature Monitoring Network

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Background

The Bristol Bay region of Southwest Alaska provides abundant, intact habitat for numerous species, including 35 fishes, more than 190 birds, and more than 40 terrestrial mammals. Chief among these resources is a world-class commercial and sport fishery for Pacific salmon and other important resident fishes that are also essential to sustaining the region's culture and way of life. The exceptional quality of the Bristol Bay region's fish populations can be attributed to several factors, the most important of which is the presence of high quality, diverse aquatic habitats (SWASHP 2011).

Although salmon exist over a wide range of climatic conditions along the Pacific coast, individual stocks have adapted life history strategies—time of emergence, run timing, and residence time in freshwater—that are often unique to a region and its watersheds. Freshwater systems vitally important for salmon and other species in the Bristol Bay region are vulnerable to changes resulting from shifts in climate and land use. Some of these changes could prove harmful for salmon and other fish. For instance, water temperature increases have been shown to induce stress in salmon populations, which makes the fish more vulnerable to pollution, predation and disease (Richter and Kolmes 2005). However, climate change may also be beneficial as cold systems warm and become more productive and new habitats open for exploitation (Schindler et al. 2005). The lack of comparable, long-term water temperature data in the Bristol Bay region makes it difficult to gauge the status and trends of thermal habitats across the landscape, which is necessary for developing adaptation strategies for responding to climate change.

Recent efforts in Alaska to develop alternative approaches for science-based decision making in the face of an uncertain future have highlighted the need to collaborate regionally. During a National Park Service workshop in 2011, Alaskan participants agreed that most or all potential climate scenarios pointed toward a need for coordinating communication and partnerships with other public and private entities, increasing the fluidity and connections between research and monitoring, and compiling seamless data sets (NPS 2013). In 2013, the Western Alaska Landscape Conservation Cooperative (LCC) hosted an interagency workshop on water temperature monitoring to explore a coordinated strategy to address the need for more collaboration to develop regional datasets. An important outcome of this workshop was the need to identify regional coordinators who can work with partners to expand or improve upon data collection efforts in their respective regions (Reynolds et al. 2013).

Entities within the Bristol Bay region are well positioned to successfully implement a voluntary water temperature monitoring network to collect the long-term datasets needed to understand current and future trends in thermal regimes and assess climate change impacts on aquatic systems and fisheries resources. Agency and community-level support to develop a comprehensive water temperature monitoring program has already been documented by the Southwest Alaska Salmon Habitat Partnership (SW Partnership), which was formed to protect, conserve, and, if necessary, restore watersheds that sustain wild salmon populations, and the fisheries of Southwest Alaska. The SW Partnership's Strategic Plan identifies climate change as a likely high threat and the need to "assess the probable impacts of climate change on salmon by monitoring physical parameters such as flows and freshwater/estuarine water temperatures (SWASHP 2011)." Additionally there are strong federal and university partners with long-term capacity and commitment to the region.

In April 2014, with Western Alaska LCC support, Bristol Bay Heritage Land Trust hosted a discussion about water temperature activities currently occurring within the Bristol Bay region with a goal of identifying what obstacles people perceive in collecting, analyzing, sharing and storing water temperature data to make it useful for regional climate change analysis. The meeting was attended by 26 individuals representing 16 entities: National Park Service (Lake Clark National Park & Preserve, Inventory & Monitoring Program – SWAN); U.S. Fish and Wildlife Service (Anchorage Field Office, Togiak NWR, Kodiak NWR); University of Alaska Anchorage (Natural Heritage Program, Bristol Bay Campus), Alaska Department of Environmental Conservation, University of Alaska Fairbanks, University of Washington, Bristol Bay Native Association, The Nature Conservancy, Trout Unlimited, Cook Inletkeeper, Western Alaska LCC, and Bristol Bay Heritage Land Trust. The group represented a range of water temperature data producers, consumers and promoters. Data producers typically were motivated to collect water temperature data to continue an existing time series as part of a monitoring program or to assess the effects of water temperature on biological processes.

In a pre-meeting survey, 56% of the respondents described their organization's current level of interest in understanding and/or assessing the effect of climate variability and change on water temperature as 'very interested and a high priority that drives funding and decision making.' Eighty-eight percent said their organization was supportive of integrating their existing monitoring efforts into a larger regional network to address climate change effects on water temperature. With this level of interest and engagement and new funding opportunities through the Western Alaska LCC and SW Partnership, Bristol Bay Heritage Land Trust is prepared to step up to the role of regional coordinator and foster the implementation of a voluntary water temperature monitoring network for the Bristol Bay region.

Goals and Objectives

The goal of the Bristol Bay Regional Water Temperature Monitoring Network is to generate water temperature data which meet the information needs of individual cooperators while simultaneously generating data relevant for assessing changes in stream and lake temperatures at a regional scale. The Network's short-term (3-5 year) objectives are to:

- increase data collecting capacity in the Bristol Bay region;
- institute the use of minimum data collection standards to produce data useful for the analysis of regional trends;
- compliment and leverage other monitoring efforts;
- update and submit site-specific metadata annually to the Alaska Online Aquatic Temperature Site project (a statewide metadata clearinghouse); and
- provide public access to water temperature data.

Longer term (5-20 year) Network objectives are to:

- describe current temperature patterns across a range of stream and lake types;
- identify geomorphic controls on thermal profiles;
- describe projected water temperature trends under different climate scenarios;
- understand impacts on salmon and other species of regional significance; and
- provide reliable temperature data to support development of proactive approaches to managing salmon stocks in response to climate change.

The Bristol Bay Network's geographic scope includes portions of the Ahklun Mountains, Bristol Bay Lowlands, and Lime Hills ecoregions and encompasses nine sub-basins (4th level, 8-digit hydrologic unit codes (HUCs; Figure 1).

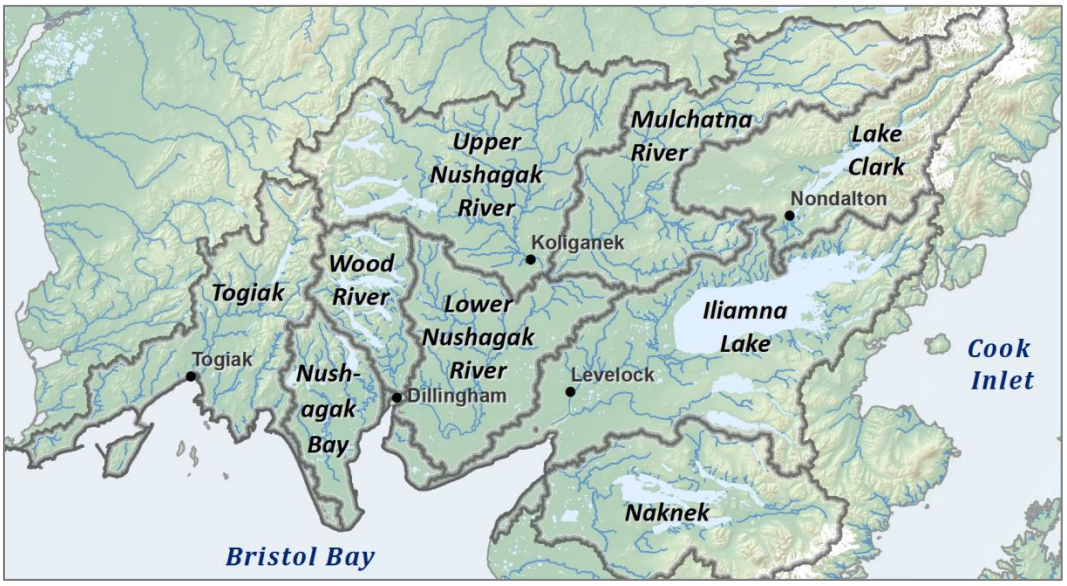

Figure 1. Map of the Bristol Bay Network's geographic scope with sub-basin boundaries outlined.

Roles and Responsibilities

Objectives will be accomplished with oversight from the Network Coordinator, with assistance from the Technical Coordinator, and voluntary participation by Network Cooperators.

Network Coordinator

Bristol Bay Heritage Land Trust (BBHLT) will serve as the Network Coordinator for the Bristol Bay region. BBHLT has demonstrated a capacity to collaborate among local partners with technical advisors in the past and has a seat on the Steering Committee for the SW Partnership. BBHLT's past success and strong existing engagement with regional partners will be important building blocks to garner voluntary participation in the regional network.

BBHLT will administer the Network's operation and oversee the implementation plan; and will be responsible for engaging and communicating with Cooperators and interested parties via email, phone, and meetings regarding needs and status of plan implementation. BBHLT will serve as liaison between Network Cooperators and regional entities such as the Western Alaska LCC and SW Partnership. On behalf of Network Cooperators, the Coordinator may lead development of grant applications and subsequent coordination of approved grant funds to support the implementation plan.

BBHLT will use the following engagement strategies:

- Invite Cooperators to participate in the SW Partnership meeting held bi-annually in December (Anchorage). Cooperators can share monitoring updates and BBHLT can organize group discussions on special topics of concern/interest related to the Network.
- Invite Cooperators to participate in the Southwest Alaska Interagency Meeting (SWIM) held annually in March (Dillingham, UAA BBC). This meeting has good web-based connectivity to allow Cooperators based outside the region or state to participate.
- Continue to serve on the SW Partnership Steering Committee to facilitate discussions with partners and help build long-term and broad support.

Technical Coordinator

BBHLT will contract with Cook Inletkeeper (CIK) to provide technical coordination of Network Cooperators. CIK will work with Cooperators to establish new sites, where and when possible, that meet the Network's longer term objectives; and promote and provide training for the use of minimum data collection standards to produce data useful for the analysis of regional trends. The Technical Coordinator will host an annual teleconference for all Cooperators to share new developments pertaining to data standards, data and metadata clearinghouses, and provide an opportunity for Network Cooperators to share challenges, offer advice, and identify needs.

The Technical Coordinator will continue to collaborate with UAA and Bristol Bay Native

Association to provide training, guidance and quarterly reminders for Indian General Assistance Program (IGAP) Coordinators from Bristol Bay communities to build local capacity among these Cooperators. If individual Cooperators communicate a need that can't be met through training, the Technical Coordinator will provide data evaluation and data storage tasks directly or through a data managing contractor.

Network Cooperators

The primary roles of Network Cooperators are to collect, manage, share, and store water temperature data in a manner compatible with the goal of the Network and that meet the minimum data collecting standards for Alaska (see page 10, Data Standards section). All Cooperators agree to sign a non-binding MOU (Appendix A) at the start of plan implementation. Signatories shall agree to support network objectives and data standards, as well as share resources and knowledge, but are not expected to provide any data analysis that goes beyond their specific information needs.

Individual Cooperators are responsible for submitting and annually updating site-specific metadata to the Alaska Online Aquatic Temperature Site (AKOATS) project, which is presently managed by the Alaska Natural Heritage Program, UAA. Site-specific metadata includes the minimum metadata standards (the "who" and the "where" of the data) as well as details about what was collected, when it was collected and how it was collected. The Technical Coordinator will provide the site-specific metadata template to each Cooperator at the start of plan implementation, send an annual reminder about updating this information, and work with Cooperators to achieve this task.

Network Cooperators will be willing to provide quality-controlled temperature data to requesting entities and members of the public. Cooperators will provide a copy of temperature data to the Technical Coordinator who will work with a data managing contractor to establish a secondary archive location.

Sampling Design

Current and historical information about surface water temperature sampling locations are available through the AKOATS project. As of October 2014, 265 sites in the Bristol Bay region were included in the AKOATS project meta-database: 156 lake sites and 109 stream sites. About half of these have only discrete measurements, which are not useful for a regional analysis but do provide some indication of accessibility for future site selection and potential interest by local partners. Of the 138 sites with continuous temperature measurements taken with data loggers for either the open-water season or year round, sampling duration ranged from 1 to 25 years (Figure 2). 72 sites are currently active: 9 lake sites and 63 stream sites (Figures 3 and 4).

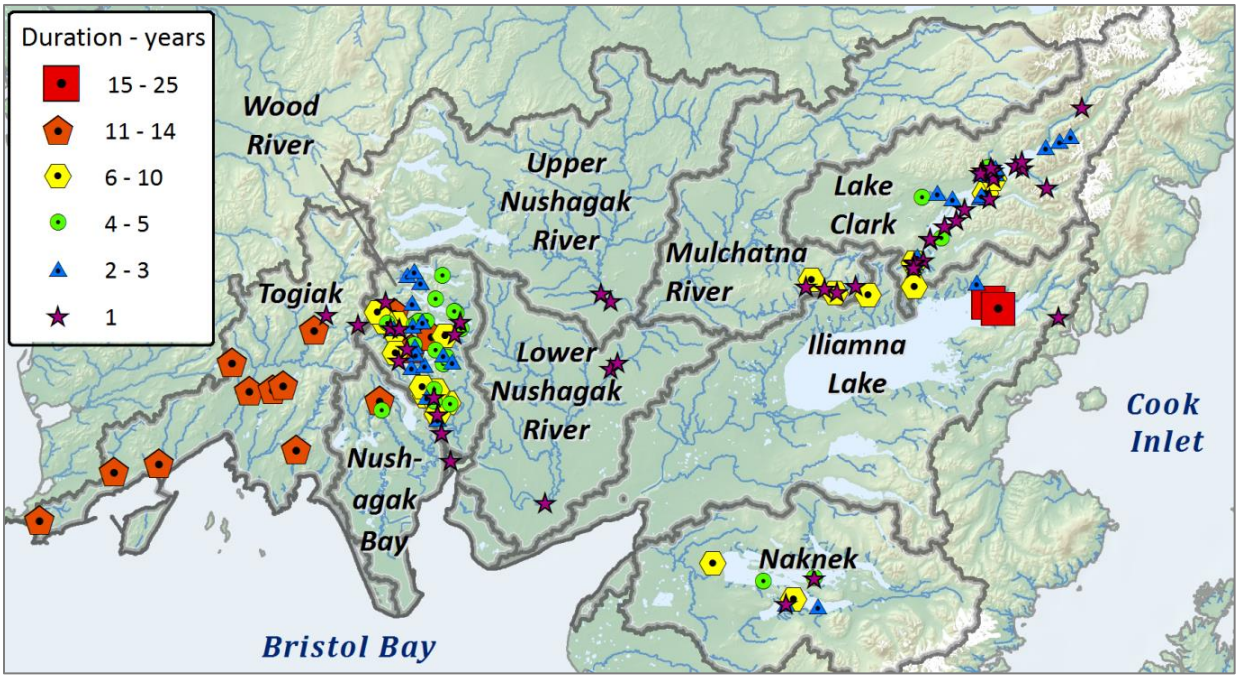

Figure 2. Water temperature sampling sites with continuous datasets in the AKOATS meta-database (n=138). Sites are identified by the number of years of data collection.

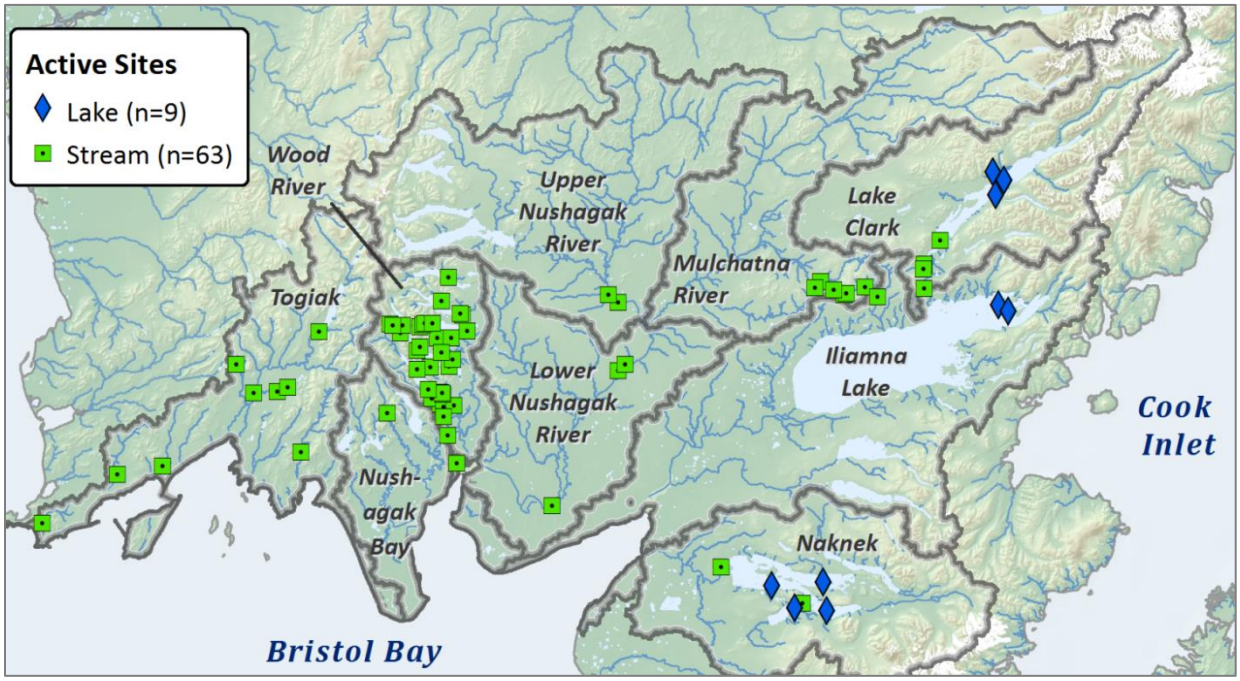

Figure 3. Currently active water temperature sampling sites with continuous sensors (n=72) in the AKOATS meta-database. Note – not all Cooperators' sites are in the meta-database.

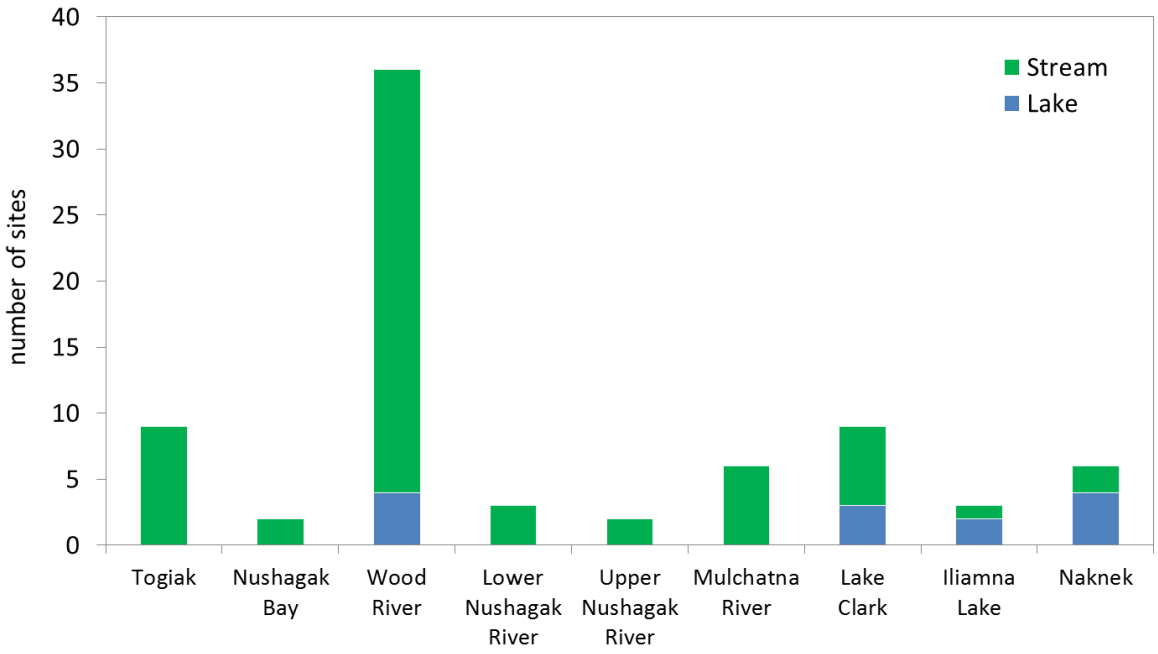

Figure 4. Distribution of active monitoring sites with continuous sensors across Bristol Bay sub-basins. Graph includes sites in the AKOATS meta-database plus 4 lakes sites in the Wood River sub-basin.

The Network's sampling design will incorporate existing long-term monitoring efforts (Tier 1 sites, predominantly in Togiak, Wood River, Naknek, Iliamna Lake and Lake Clark sub-basins), build local community capacity (Tier 2 sites, mostly in the Lower and Upper Nushagak sub-basins), and address the need to capture a range of landscape characteristics (Tier 3 sites, Nushagak and Kvichak River watersheds).

Tier 1 Sites: The majority of existing water temperature monitoring site distribution reflects federal land ownership (Togiak National Wildlife Refuge; Lake Clark National Park and Preserve; Katmai National Park and Preserve); long-term University of Washington presence in the Wood River system; and established USGS and NOAA stations. Many of these sites are the best candidates for designation as long-term reference sites (i.e., to be monitored at least 20 years) given expected continuation of organizational commitments. Engaged Tier 1 site Cooperators include Togiak National Wildlife Refuge (10 stream sites); University of Washington (4 lake sites, 40 stream sites,); and National Park Service (6 lakes sites, multiple stream sites). These entities are the most likely to be able to sustain personnel and equipment costs and have internal capacity to manage data. Additional potential Tier 1 site Cooperators include USGS and NOAA River Forecast Center.

Tier 2 Sites: Nushagak Bay, Upper and Lower Nushagak River and Mulchatna River sub-basins have few existing monitoring sites (Figure 4) and are the focus for establishing new sites through engagement with community members and IGAP Coordinators from Bristol Bay

villages. Starting in 2013, BBHLT provided support for Cook Inletkeeper to incorporate standardized stream temperature monitoring protocol training into the annual Water Quality/QAPP recertification class for local monitors. This class is attended yearly by community members from Bristol Bay villages and is sponsored by the Bristol Bay Native Association (BBNA) and the Bristol Bay Campus, UAA, and taught by Dan Bogan of Alaska Natural Heritage Program (ANHP), UAA. Following the training in 2014, community members established eight new stream temperature monitoring sites with technical assistance from Cook Inletkeeper. Engaged Tier 2 site Cooperators include New Stuyahok Traditional Council (2 sites); New Koliganek Village Council (2 sites); Aleknagik Traditional Council (2 sites); Nondalton Tribal Council (1 site), and the Bristol Bay Campus (1 site). These entities have field capacity but will need to work with the Technical Coordinator to achieve data management and metadata objectives through additional training or by employing a data managing contractor. An additional potential Tier 2 site Cooperator is Levelock Village Council (2 sites). Villages not presently involved in the recertification class may also be potential Cooperators but this will require significant outreach to engage these communities and build capacity.

Tier 3 Sites: Additional Cooperators are needed to expand the geographic scope of monitoring sites to meet the Network's objective to describe current temperature profiles across a range of stream and lake types. Tier 3 site Cooperators include university-affiliated research entities and NGOs working in the region and that often have strong partnerships with local fishing lodges, pilots, and guides to facilitate travel logistics. Engaged Tier 3 Cooperators include Alaska Natural Heritage Program, UAA (5 stream sites); Center for Science in Public Participation; Trout Unlimited; and The Nature Conservancy of Alaska. These entities often have field and data management capabilities, but lack dedicated funding to collect long-term datasets.

A preliminary sampling design for Tier 3 sites within the Nushagak and Kvichak River watersheds has been developed based on results from regional analyses conducted in Alaska identifying elevation to be one of the most important watershed characteristics controlling summertime stream temperature (Lisi et al. 2013, Mauger 2013). The distribution of existing Bristol Bay stream temperature sites across an elevation gradient shows a need for additional Tier 3 sites to be located at higher elevations (Figure 5). Seventeen proposed sites have been selected across the landscape that target higher elevations (Figures 6 and 7). Precise site locations are being guided by work using remote sensing techniques to improve mapping of salmon habitat (Woll 2014), on-the-ground knowledge of local researchers, and logistical considerations. If funding is available, up to 6 of the proposed sites will be established in 2015 with data collection continuing for 3 years. At that time, a new sub-set of sites will be established and monitored for 3 years. Using this cost-effective framework, we will rotate through all 17 sites, collecting 3 years of data at each site, over 9 years. Additional Tier 3 sites

will be added over time if field logistics and budgets allow. The Technical Coordinator will work with Tier 3 site Cooperators to implement the sampling design.

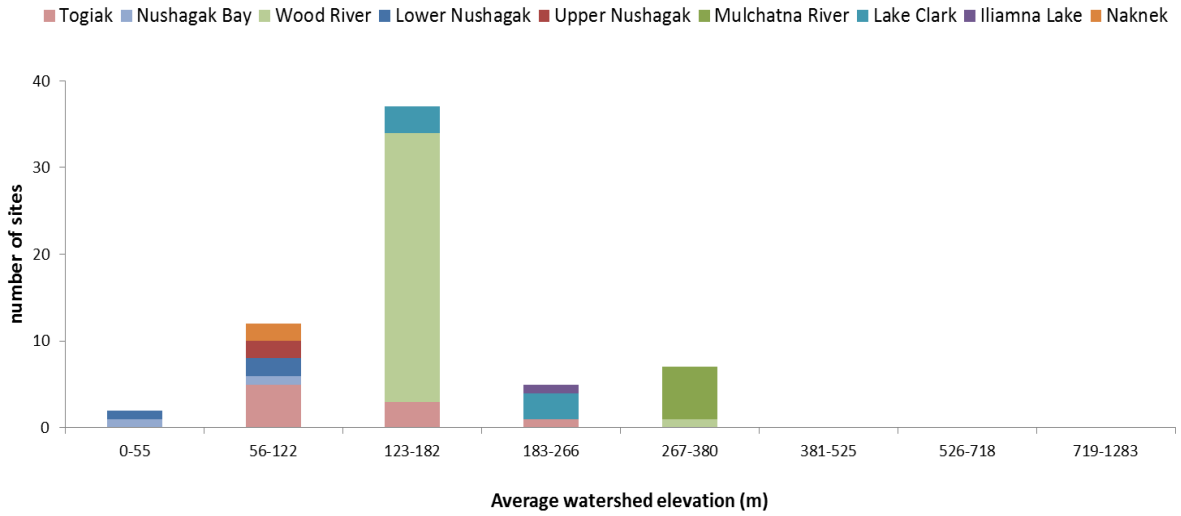

Figure 5. Existing Tier 1-3 stream sites distributed on a mean watershed elevation gradient (n=63).

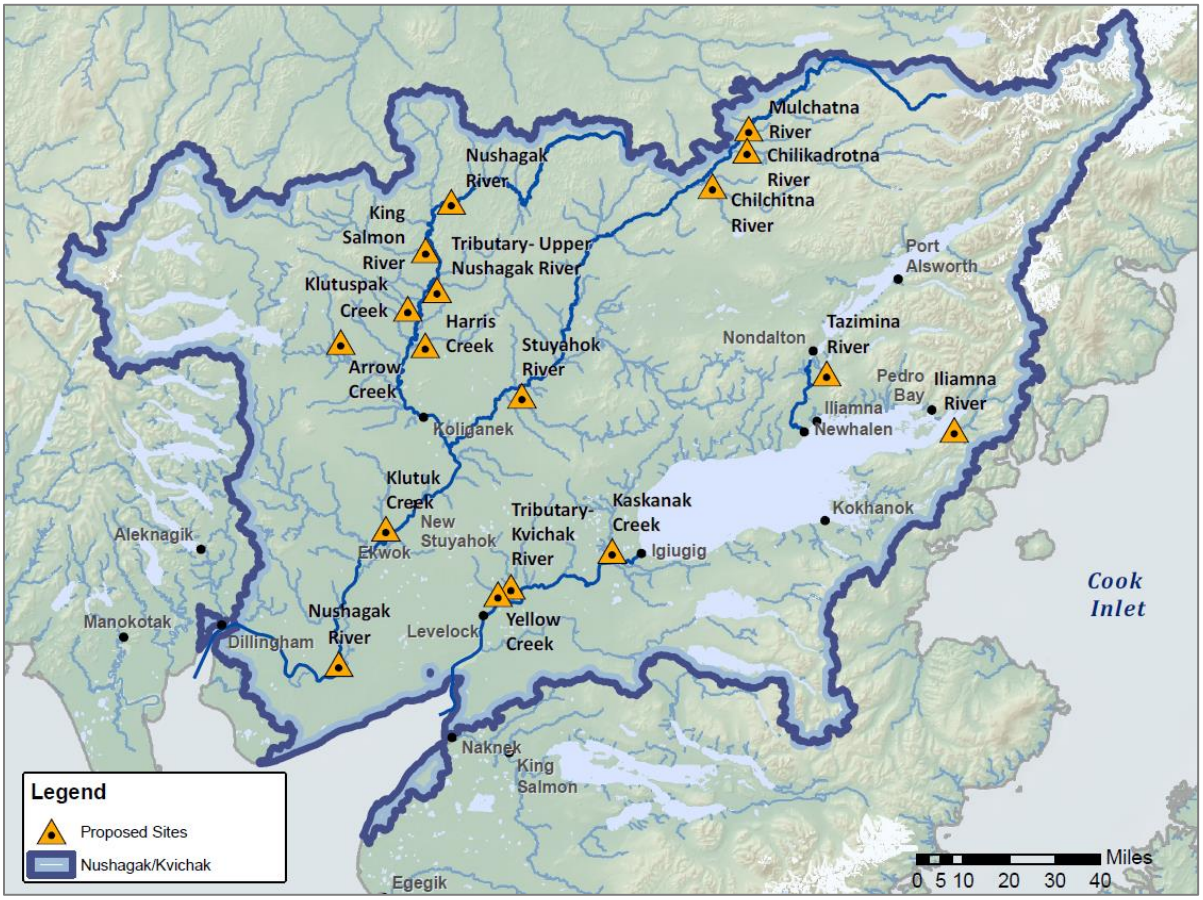

Figure 6. Proposed Tier 3 sites in the Nushagak and Kvichak River watersheds (n=17).

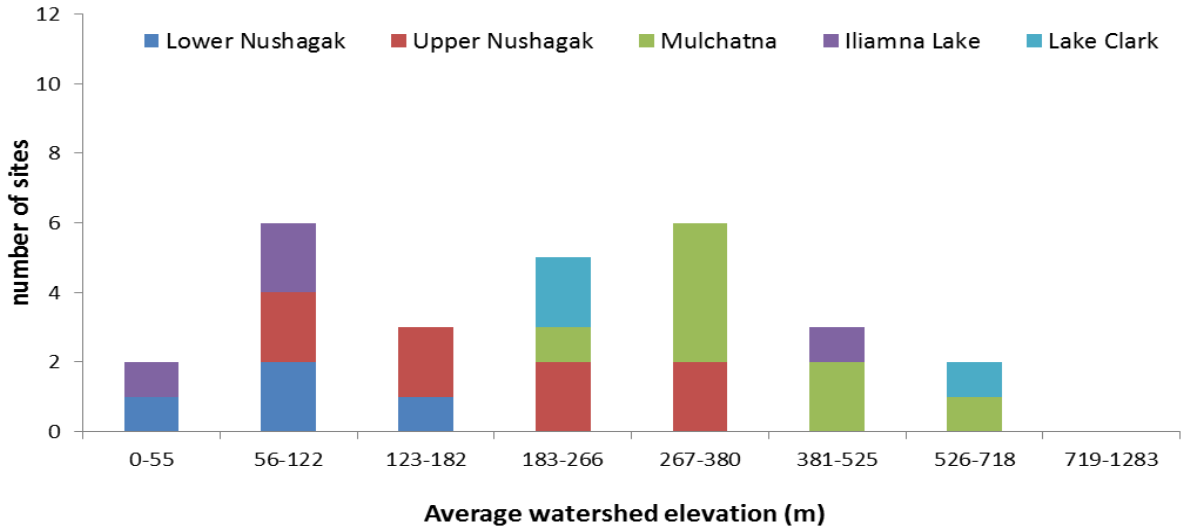

Figure 7. Existing Tier 2 sites (n =5), existing Tier 3 sites (n=5) and proposed Tier 3 sites (n=17) along a mean watershed elevation gradient in the Nushagak and Kvichak River watersheds.

Data Standards

With Western Alaska LCC support, the Alaska Natural Heritage Program, UAA and Cook Inletkeeper developed a set of minimum standards for stream temperature data collection to generate data useful for regional-scale analyses (Mauger et al. 2014). By meeting these minimum standards, Network Cooperators can collect both project-specific data and data useful for achieving Network objectives. The standards cover data logger accuracy and range; sampling frequency and duration; quality assurance steps including accuracy checks, site selection and data evaluation; and finally, metadata documentation, data storage and sharing (Table 1).

The stream temperature data collecting standards and associated protocols are not meant to supersede existing agency-specific protocols being used by Network Cooperators. In some cases, Cooperators may choose more rigorous quality assurance methods or shorter sampling intervals to meet their needs. Fortunately, such decisions will not preclude the usefulness of these data for regional analysis as the standards outlined in Table 1 are only minimum standards. Voluntary adherence to minimum standards by Network Cooperators will go a long way to help stretch limited research dollars and, most importantly, to generate valuable datasets for understanding thermal patterns across Bristol Bay's vast freshwater ecosystems.

To promote the adoption of the minimum standards, the Technical Coordinator will:

- establish a regional technical working group with representatives of Tier 1 and Tier 3 site Cooperators to review the new minimum data standards in early 2015 and identify any incompatibilities with existing protocols being used by Cooperators.

- continue working with BBNA and Bristol Bay Campus, UAA to train Tier 2 site Cooperators to integrate the new minimum data standards into their Quality Assurance Project Plans to ensure compatibility with community-based data collection.
- communicate with all Network Cooperators annually on any changes made to the minimum standards and to ensure they update their site-specific metadata so that changes in sampling methods or duration are captured.

Many of the minimum standards established for stream temperature data collection are also relevant for lake temperature data collection, such as data logger accuracy, range and quality assurance measures as well as data management; however, site selection, deployment and retrieval methods are only relevant for running water habitats. Currently, two engaged Network Cooperators - National Park Service and University of Washington - are collecting lake temperature data. The National Park Service has developed protocols for monitoring temperature in small, shallow lakes of Central and Northern Alaska (Larsen et al. 2011) and the relatively large, deep lakes of Southwest Alaska (Shearer et al. in review). Network Cooperators will be encouraged to use these protocols in lieu of a set of lake-specific minimum standards.

Table 1. Minimum data collection standards for regional analysis of stream thermal regimes.

Minimum Standards		
Data Logger	Accuracy	±0.25°C
	Measurement range	-4° to 37°C (24° to 99°F)
Data Collection	Sampling frequency	1 hour interval
	Sampling period/duration	1 calendar month
Quality Assurance and Quality Control	Accuracy checks	water bath at two temperatures: 0°C and 20°C before and after field deployment to verify logger accuracy (varies ≤ 0.25°C compared with a NIST-certified thermometer)
	Site selection	five measurements across the stream width to verify that the site is well-mixed (i.e. varies ≤ 0.25°C)
	Data evaluation	remove erroneous data from the dataset
Data Storage	File formats	CSV format in 2 locations
	Metadata	unique site identifier agency/organization name and contact latitude and longitude sample frequency stored with temperature data
	Sharing	quality-controlled hourly data

Data Management

At the April 2014 meeting, management of regional data from multiple partners was highlighted as a significant concern and potential roadblock to the Network's success. For this monitoring effort to be successful we need a 20-year horizon in thinking about how and where regional data will be compiled and stored and by whom. These are relevant issues for any regional scale effort when dealing with continuous water temperature data as these datasets are typically very large. It is unlikely that these issues will be resolved by Bristol Bay partners in isolation as these discussions are ongoing across the state and among agencies. The Interagency Hydrology Committee for Alaska is an organization of technical specialists working at the Federal, State, and local levels, who coordinate the collection and implementation of water resources related data throughout the State of Alaska. The IHCA meets twice per year to coordinate multi-agency issues and exchange of information. The Technical Coordinator will attend IHCA meetings to keep Bristol Bay-specific issues filtering up to state- and agency-wide discussions.

Meanwhile, the newly developed minimum standards for data storage provide guidance on metadata, file formats for data storage and sharing. Network Cooperators will be expected to meet these standards. We anticipate that Tier 1 Cooperators will meet these expectations with no significant involvement from the Technical Coordinator; however, Tier 2 and 3 Cooperators may need additional training or involvement of a data managing contractor. If funding is available, we see the best scenario to be a Tier 3 Cooperator taking on the role of data manager for Tier 2 and 3 sites. Alternatively, a non-Cooperator contractor can be employed to assist with this task.

Sustainability

Cooperators identified funding as the biggest obstacle that might prevent them from involvement in a larger regional network (Figure 8). Specific funding-related obstacles include 1) the year-to-year nature of funding preventing commitment to long-term sampling, and 2) current funding levels limiting expansions in sampling. Although these are standard challenges of long-term monitoring, we must be realistic about what is sustainable over time and among Cooperators.

BBHLT has a strong track record of securing funding for research and monitoring efforts in the region. BBHLT will work with partners to develop proposals to support annual monitoring costs from some of the following sources: SW Alaska Salmon Habitat Partnership, Bristol Bay Regional Seafood Development Association, EPA's Indian General Assistance Program (IGAP), and in-kind support from fishing lodges and other local businesses.

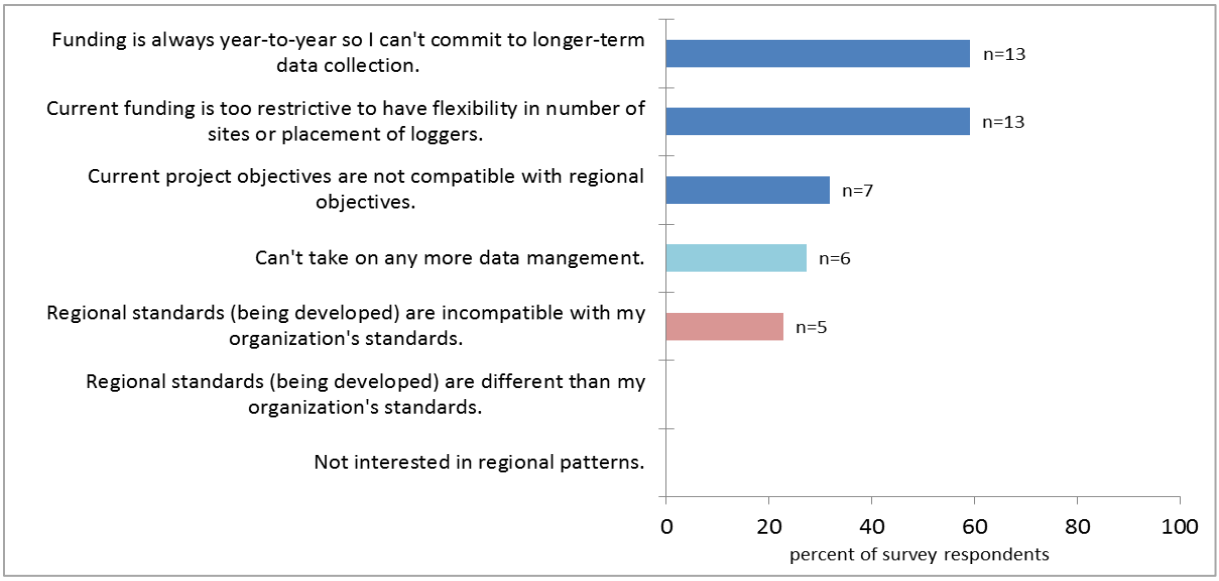

Figure 8. Survey responses collected prior to the April 2014 meeting regarding obstacles to involvement in a regional network.

Timeline

This plan has an initial three-year (2015-2017, Table 2) timeline to reach full implementation of the sampling design. The first year will require significant communication between the Network Coordinator, Technical Coordinator and all Network Cooperators to address the remaining uncertainty about data management capabilities and needs. We will be strategic in our use of initial Western Alaska LCC funding and heed practical advice for data management of long-term monitoring programs (Sergeant et al. 2012), which includes that a monitoring network should expect to commit at least one-third of all resources to data management, analysis and reporting.

Budget

Table 3 attempts to flesh out a “complete" budget for all engaged Network Cooperators. The budget provides estimates of Tier 1 Cooperator’s funding needs to maintain their existing sites. In many cases monitoring costs are wrapped into other projects and cannot be isolated as the cost to collect just temperature data; however, we are attempting to capture this real cost as no funding is secure year to year and, for the Network to succeed, these dollars will be needed. For Tier 2 sites, IGAP Coordinators will be developing EPA proposals and budgets in December 2014 for FY2016. Equipment and travel costs associated with their engagement in the Network will be incorporated into these proposals. Costs for Tier 3 Cooperators are estimated based on 2 visits to 6 sites/year using a combination of boat and helicopter travel and leveraging other field work in the Bristol Bay region.

Table 2. Three-year Timeline for Implementation Plan tasks

Year	Timeline	Task
2015	January-April	Cooperator funding agreements established Memorandum of Understandings signed Minimum data collection standards reviewed by Tier 1 and 3 Cooperators Technical Coordinator teleconference with all Cooperators Field season logistical planning and coordination Equipment purchased
	May-October	Establishment of new sites and upgrading of existing sites to meet minimum data standards Data collection & management
	November-December	Cooperator meeting to review plan progress and make revisions Completion of annual progress report Submission of metadata to AKOATS
2016	January-April	Cooperator funding agreements updated or established Initiate planning to derive long-term network funding Technical Coordinator teleconference with all Cooperators Field season logistical planning and coordination Equipment purchased if needed
	May-October	Data collection & management Planning to derive long-term network funding support
	November-December	Cooperator meeting to review work progress Completion of progress report Planning to derive long-term network funding Submission of metadata to AKOATS
2017	January-April	Cooperator funding agreements updated or established Conclude planning and implement long-term network funding plan Technical Coordinator teleconference with all Cooperators Field season logistical planning and coordination Equipment purchased in needed
	May-October	Data collection & management
	November-December	Cooperator meeting to review work progress Completion of progress report Produce implementation plan for 2018-2020 Submission of metadata to AKOATS

Table 3. Three-year "complete" budget to accomplish Implementation Plan tasks.

Role	Organization	Category	Funding Support Need 2015	2016	2017	TOTAL
Network Coordinator and Technical Coordinator	BBHLT and Cook Inletkeeper (Contractor)	Personnel Cost	7,500	7,500	7,500	
		Travel	1,400	1,400	1,400	
		Supplies & Equipment	500	500	500	
		Contractual	25,000	25,000	25,000	
		TOTAL	34,400	34,400	34,400	103,200
Cooperators: Tier 1 Sites	Togiak NWR	Personnel Cost	5,000	5,000	5,000	
		Travel	3,500	3,500	3,500	
		Supplies & Equipment	1,500	1,500	1,500	
		TOTAL	10,000	10,000	10,000	30,000
	NPS	Personnel Cost	29,000	29,000	29,000	
		Travel	6,000	6,000	6,000	
		Supplies & Equipment	5,000	5,000	5,000	
		TOTAL	40,000	40,000	40,000	120,000
	UW	Personnel Cost	19,500	19,500	19,500	
		Travel	18,000	18,000	18,000	
		Supplies & Equipment	2,500	2,500	2,500	
		TOTAL	40,000	40,000	40,000	120,000
Cooperators: Tier 2 Sites	BBNA/BBC and ANHP-UAA/CIK	Personnel Cost	5,100	5,100	5,100	
		Travel	10,900	10,900	10,900	
		Supplies & Equipment	350	350	350	
		TOTAL	16,350	16,350	16,350	49,050
	Community/IGAP members from 6 villages	Personnel Cost	5,000	5,000	5,000	
		Travel	2,200	2,200	2,200	
		Supplies & Equipment	5,750	1,000	1,000	
		TOTAL	12,950	8,200	8,200	29,350
Cooperators: Tier 3 Sites	ANKP, UAA CSPP TU TNC of Alaska CIK	Personnel Cost	8,000	8,000	8,000	
		Travel	9,600	9,600	9,600	
		Supplies & Equipment	2,400	600	600	
		TOTAL	20,000	18,200	18,200	56,400
GRAND TOTAL			172,700	166,150	166,150	508,000

The budget in Table 4 is the "barebones" option where the Western Alaska LCC would provide no direct support to Network Cooperators, but would support the Network Coordinator and Technical Coordinator to work with Cooperators to develop new funding streams and continue to build capacity in Bristol Bay communities. The Network's objectives would not be met in the 3 year timeline with this budget.

Table 4. "Barebones" budget to partially accomplish timeline tasks.

			Funding Support Need			
Role	Organization	Category	2015	2016	2017	TOTAL
Network Coordinator and Technical Coordinator	BBHLT and Cook Inletkeeper (Contractor)	Personnel Cost	7,500	7,500	7,500	
		Travel	1,400	1,400	1,400	
		Supplies & Equipment	500	500	500	
		Contractual	10,000	10,000	10,000	
		TOTAL	19,400	19,400	19,400	58,200
Cooperators: Tier 1 Sites	Togiak NWR NPS UW					
Cooperators: Tier 2 Sites	BBNA/UAA-BBC/CIK	Personnel Cost				
		Travel	5,000	5,000	5,000	
		Supplies & Equipment	2,500	500	500	
		TOTAL	7,500	5,500	5,500	18,500
	Community/IGAP members from 6 villages					
Cooperators: Tier 3 Sites	ANKP, UAA CSPP TU TNC of Alaska					
GRAND TOTAL			26,900	24,900	24,900	76,700

Table 5 is a realistic budget for meeting the Network's short term objectives on a three year timeline. This budget assumes Cooperators have additional funding sources and can leverage field and travel budgets to be as cost-effective as possible. We have built in a contingency fund for Tier 1 Cooperators in case year-to-year funding fluctuates to a point that they can no longer sustain their existing sites. The Network Coordinator will communicate with the Tier 1 Cooperators annually to discuss the best allocation of these funds.

Table 5. "Realistic" budget to accomplish timeline tasks and meet short-term objectives.

Role	Organization	Category	Funding Support Need			
			2015	2016	2017	TOTAL
Network Coordinator and Technical Coordinator	BBHLT and Cook Inletkeeper (Contractor)	Personnel Cost	7,500	7,500	7,500	
		Travel	1,400	1,400	1,400	
		Supplies & Equipment	500	500	500	
		Contractual	25,000	25,000	25,000	
		TOTAL	34,400	34,400	34,400	103,200
Cooperators: Tier 1 Sites	Togiak NWR NPS UW	Contingency				
		TOTAL	10,000	10,000	10,000	30,000
Cooperators: Tier 2 Sites	BBNA/UAA-BBC/CIK	Personnel Cost				
		Travel	6,000	6,000	6,000	
		Supplies & Equipment	350	350	350	
		TOTAL	6,350	6,350	6,350	19,050
	Community/IGAP members from 6 villages	Personnel Cost				
		Travel	1,200	1,200	1,200	
		Supplies & Equipment	5,750			
		TOTAL	6,950	1,200	1,200	9,350
Cooperators: Tier 3 Sites	ANKP, UAA CSPP TU TNC of Alaska	Personnel Cost	8,000	8,000	8,000	
		Travel	9,200	7,000	7,000	
		Supplies & Equipment	2,400	500	500	
		TOTAL	20,000	15,500	15,500	51,000
GRAND TOTAL			77,700	67,450	67,450	212,600

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Appendix A. Memorandum of Understanding

Bristol Bay Regional Water Temperature Monitoring Network

The purpose of this Memorandum of Understanding (MOU) is to establish a framework for cost-efficient communication and coordination of a network among public and private sector organizations that have interest in acquisition of water temperature data in the Bristol Bay region. Signatories of this MOU, hereafter referred to as "Cooperators" may consist of private, municipal, state, federal, and tribal entities with an interest in water temperature data collection. Cooperators will benefit from shared resources, combined expertise, shared responsibilities, unified strategy, consistency of methods, and collective results.

Areas of Agreement

Signatories shall agree to support Goals and Objectives as outlined in "Implementation Plan: Bristol Bay Regional Water Temperature Monitoring Network" as well as share resources and knowledge.

Furthermore, they shall agree to:

- Meet minimum standards and protocols to ensure the quality and comparability of water temperature data;
- Upgrade equipment to meet minimum standards;
- Update and submit site-specific metadata annually to the Alaska Online Aquatic Temperature Site project (a statewide metadata clearinghouse)
- Provide copies of metadata and quality-controlled data to requesting entities and members of the public;
- If a statewide Data Clearinghouse is established, copies of metadata and data will be provided to the organization responsible for operation of the Clearinghouse;
- On behalf of Cooperators, the Network Coordinator may lead development of grant applications and subsequent coordination of approved grant funds to support implementation of the network plan.

Independent Responsibilities

Each Cooperator is:

- Responsible to its own governing body;
- Responsible and accountable for its own funds, equipment, and personnel;
- Shall assume no responsibility for network-scale analysis of data or reporting of results from such analysis.

Modification and Termination

This agreement will be effective from the date of signature of at least two Cooperators. Any Cooperator may terminate their involvement via written notice to the Network Coordinator.

This MOU may be amended as necessary by mutual consent of the Cooperators by execution of a written amendment signed and dated by a majority of Cooperators.

This MOU will be reviewed every three (3) years and updated as necessary.

Contact Information

Tim Troll
Bristol Bay Heritage Land Trust
690 Main Street
Dillingham, AK 99576
Phone: (907) 868-1618
Email: nmwtlandtrust@hotmail.com

Memorandum of Understanding

Bristol Bay Regional Water Temperature Monitoring Network

Signatory Page

_____

Name of Cooperator

Hereby agrees to the terms of the Memorandum of Understanding.

_____

Signature Date

_____

Printed Name

_____

Title

_____

Address

_____

City/State/Zip

_____

Phone and Fax numbers

_____

Email address