U.S. Department of the Interior
Bureau of Land Management

Alaska Integrated Water & Aquatics Program Annual Report

Fiscal Year 2016

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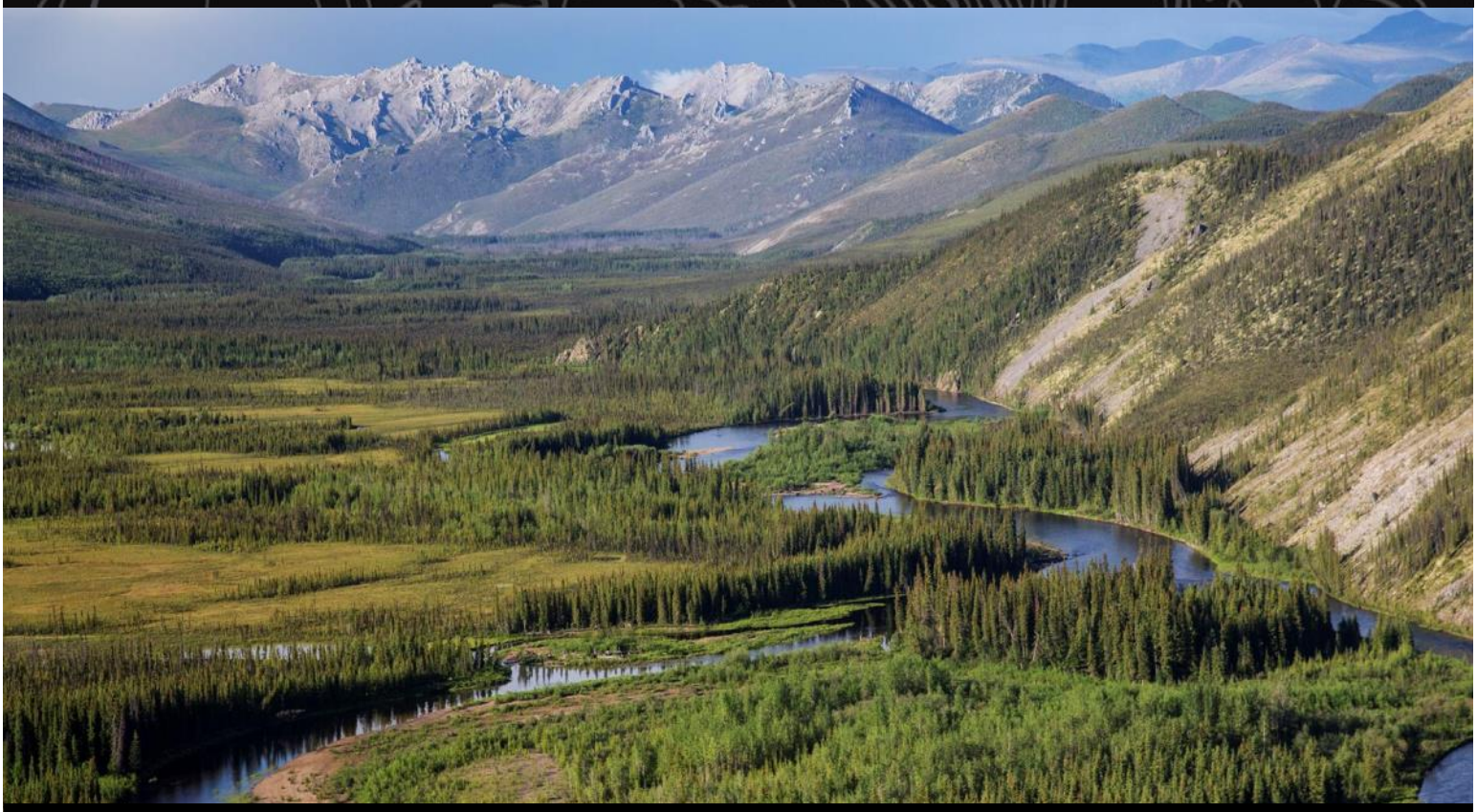

"Unless we practice conservation, those who come after us will have to pay the price of misery, degradation, and failure for the progress and prosperity of our day." - Gifford Pinchot

BLM Alaska State Office
Division of Resources
222 West 7th Avenue, #13
Anchorage, AK 99513

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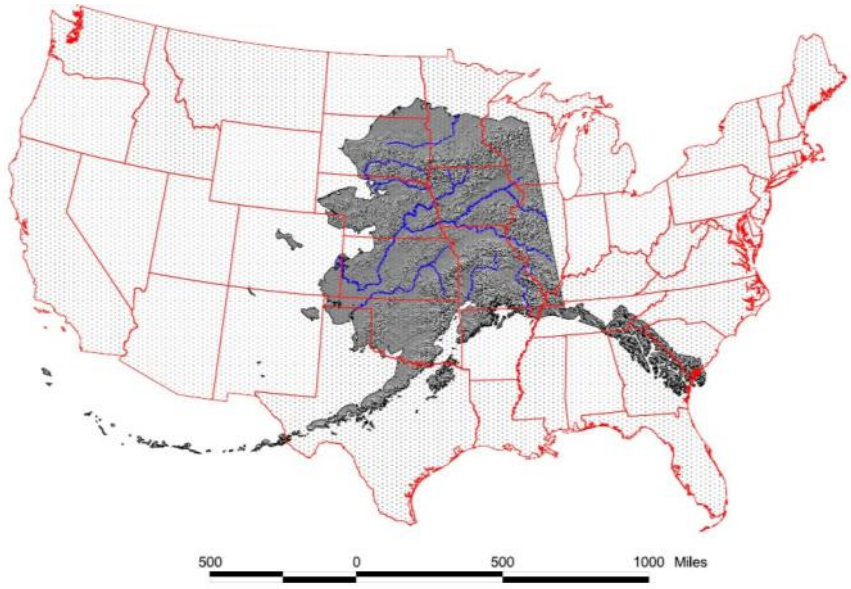
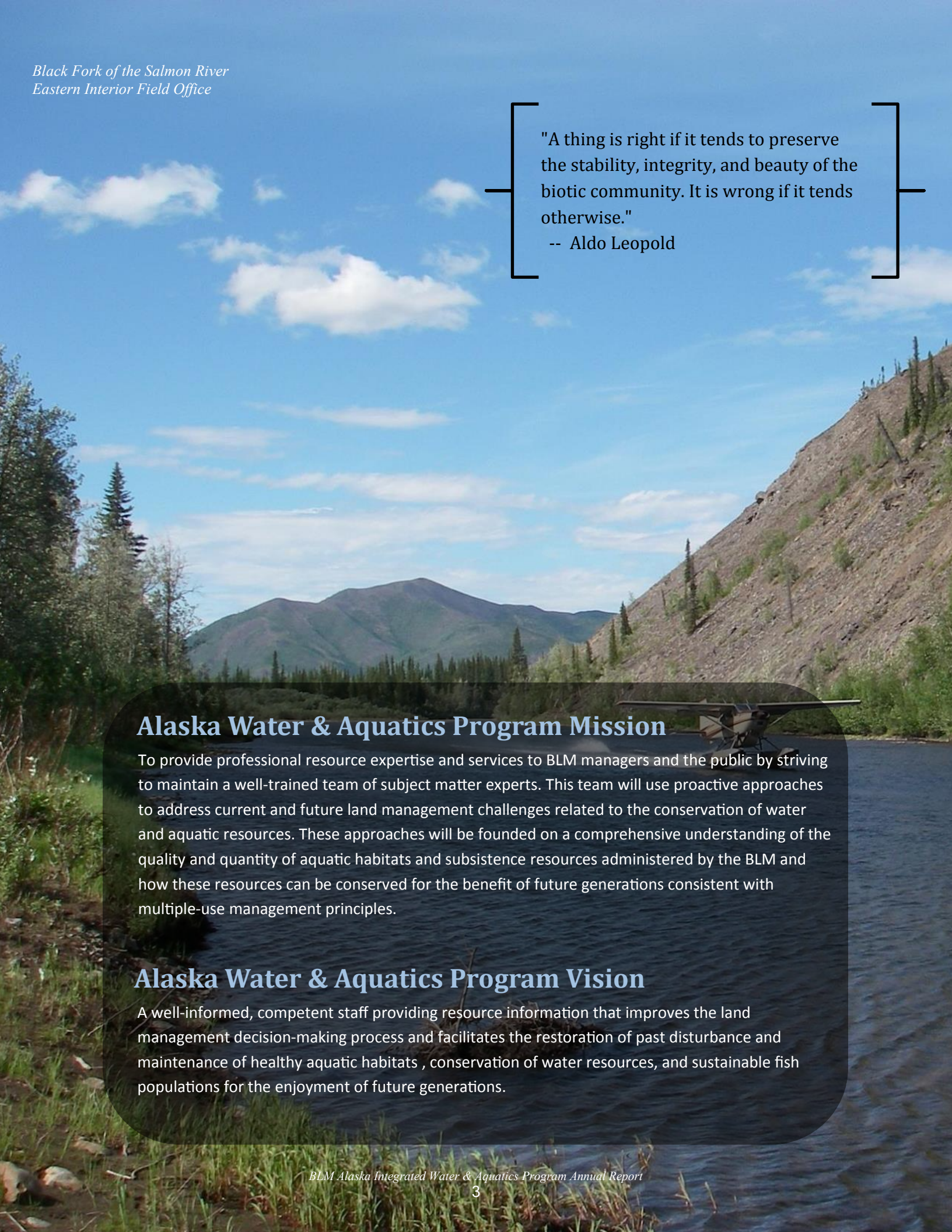


Scale

Alaska vs. the Rest of the US

BLM Alaska manages the vast majority of the aquatic and riparian habitats in the Bureau.

The report was compiled by Matthew S. Varner, BLM Alaska Riparian and Fisheries Program Leader, with considerable input from BLM Alaska's exceptional aquatics team (see page 4-6).



Black Fork of the Salmon River
Eastern Interior Field Office

"A thing is right if it tends to preserve the stability, integrity, and beauty of the biotic community. It is wrong if it tends otherwise."
-- Aldo Leopold

Alaska Water & Aquatics Program Mission

To provide professional resource expertise and services to BLM managers and the public by striving to maintain a well-trained team of subject matter experts. This team will use proactive approaches to address current and future land management challenges related to the conservation of water and aquatic resources. These approaches will be founded on a comprehensive understanding of the quality and quantity of aquatic habitats and subsistence resources administered by the BLM and how these resources can be conserved for the benefit of future generations consistent with multiple-use management principles.

Alaska Water & Aquatics Program Vision

A well-informed, competent staff providing resource information that improves the land management decision-making process and facilitates the restoration of past disturbance and maintenance of healthy aquatic habitats , conservation of water resources, and sustainable fish populations for the enjoyment of future generations.

State Office Staff

Renewable Resources Branch Aquatics Team

Fisheries/Riparian
Matthew Varner

Hydrology
Alan Peck

Geomorphology/Stream Restoration
Vacant

Aquatic AIM Crew Lead
Colin Brady

Matthew Varner

Colin Brady

Alan Peck

SPECIAL THANKS TO THE BLM NATIONAL OPERATIONS CENTER & WASHINGTON OFFICE

Much of the success in this summary report is made possible by the strong support from staff at the BLM National Operations Center (NOC) and the Washington Office. Base-funding support, as well as thematic and initiative funding, has greatly enhanced BLM Alaska's program effectiveness.

Specifically, a big thanks to NOC staff Melissa Dickard (1040) and Scott Miller (AIM), and to WO staff Stephanie Carman (Fisheries), Dave Hu (Fisheries), Karen Prentice (Healthy Lands), Gordon Toevs (AIM), McKinley Ben Miller (SWA), Ron McCormick (SWA), and Theresa Alexander (SWA) for their strong support of Alaska's efforts!

Anchorage District Profile

Anchorage Field Office

48.4K stream miles, 303.5K lake acres, & 10.3M wetland acres

Fisheries/Riparian	Hydrology
Merlyn Schelske	Ben Stratton

Program Emphasis: The vast majority of the program-related work focuses on baseline inventory in advance of current or future resource development, and understanding watershed condition and trend. This office manages one Wild and Scenic River, which includes in-season management of Chinook harvest.

Merlyn Schelske

Benjamin Stratton

Glennallen Field Office

3.7K stream miles, 56.2K lake acres, & 470.8K wetland acres

Fisheries/Riparian	Hydrology
Tim Sundlov	Mike Sondergaard

Program Emphasis: The vast majority of the program-related work focuses on baseline inventory in advance of current or future resource development and understanding watershed condition and trend. This office manages two Wild and Scenic Rivers, which are the most heavily used recreational fisheries on BLM-managed lands in Alaska.

Tim Sundlov

Mike Sondergaard

Fairbanks District Profile

District Staff

Aquatic Ecologist
Vacant

Eastern Interior Field Office

9.8K stream miles, 14K lake acres, & 2.4M wetland acres

Fisheries/Riparian	Hydrology
Jason Post	Ben Kennedy

Program Emphasis: Program-related work focuses on monitoring mitigation and reclamation effectiveness, as well as baseline inventory in advance of current or future mineral development and understanding watershed condition and trend. This office manages three Wild and Scenic Rivers and the Steese National Conservation Area.

Jason Post

Ben Kennedy

Central Yukon Field Office

22.4K stream miles, 64.9K lake acres, & 4.9M wetland acres

Fisheries/Riparian	Hydrology
Bob Karlen	Erica Lamb
Carl Kretsinger	
Dave Parker	
Dave Esse	

Program Emphasis: Program-related work focuses on monitoring mitigation and reclamation effectiveness, as well as baseline inventory in advance of current or future mineral development and understanding watershed condition and trend.

Bob Karlen

Dave Esse

Carl Kretsinger

Dave Parker

Erica Lamb

Arctic Office

34.4K stream miles, 2.1M lake acres, & 17.5M wetland acres

Fisheries/Riparian	Hydrology
Matthew Whitman	Richard Kemnitz

Program Emphasis: The vast majority of the program-related work focuses on baseline inventory in advance of current or future oil and gas development and understanding watershed condition and trend.

Matthew Whitman

Richard Kemnitz

WATER & AQUATICS PROGRAM SNAPSHOT

INTEGRATED OVERVIEW OF THE FISHERIES (1120), RIPARIAN (1040), & SOIL, WATER, AND AIR (1010) PROGRAMS

BLM Alaska manages 87% of the stream and river (lotic) habitats and 93% of the lake (lentic) habitats administered by the BLM nationwide. In addition, BLM Alaska has management responsibilities on more than 80% of the anadromous habitats administered by the BLM. To enable managers to carry out those responsibilities, the BLM Alaska aquatics programs are tasked with understanding the condition of these extensive habitats and populations, which are spread across a 365-million-acre state.

A variety of issues contribute to aquatic resource management complexities that will continue to challenge BLM Alaska managers. Ensuring that both the BLM Washington Office staff and BLM Alaska managers understand and are equipped to cope with these current and future challenges remains a high priority for the program. Many of these challenges involve increasing resource development (placer mining and oil and gas), increasing recreational uses, evolving land ownership pattern, staff and funding limitations, uncertainty surrounding watershed condition and trend, influences on aquatic resources, and the conservation of water and fish resources for subsistence users in accordance with the Alaska Native Claims Settlement Act (1980). To help address these challenges, the program engages with partners to collect and share resource condition information, utilize the latest science regarding data collection and resource management, and collaborate across the state to develop fully integrated land use plans that will ensure the conservation of aquatic resources, while also fulfilling our multiple-use mission.

PARTNERING

The BLM National Aquatic Monitoring Framework (Aquatic AIM) incorporates much of the EPA's National Rivers and Streams Assessment (NRSA) Protocol. In doing so, BLM Alaska has established a lasting partnership with the State of Alaska for stream assessment work. This partnership is paving the way for consistency across the federal family of land management agencies in the state, and potentially in the future with Canadian land managers.

PROTECTING WATER TO MEET DIVERSE NEEDS

BLM Alaska integrates the scientific elements of hydrology, geomorphology, biology, and water quality as a foundation in conserving and protecting water resources, while meeting its multiple use and sustained yield principles for managing the public land. BLM Alaska water-related activities include monitoring water quality and quantity, instream flow studies, climate and snowpack monitoring, cooperative watershed projects, and protecting/restoring water quality and aquatic habitats.

APPLYING THE LATEST SCIENCE

Environmental DNA (eDNA) is a rapidly developing science that utilizes the DNA shed from organisms collected through filtered water samples to detect species occurrence. Using this new technology, BLM Alaska hopes to be able to complete multispecies assessments at a fraction of the cost of traditional sampling techniques. This could revolutionize what we know about fish distribution in Alaska.

PLANNING FOR THE FUTURE

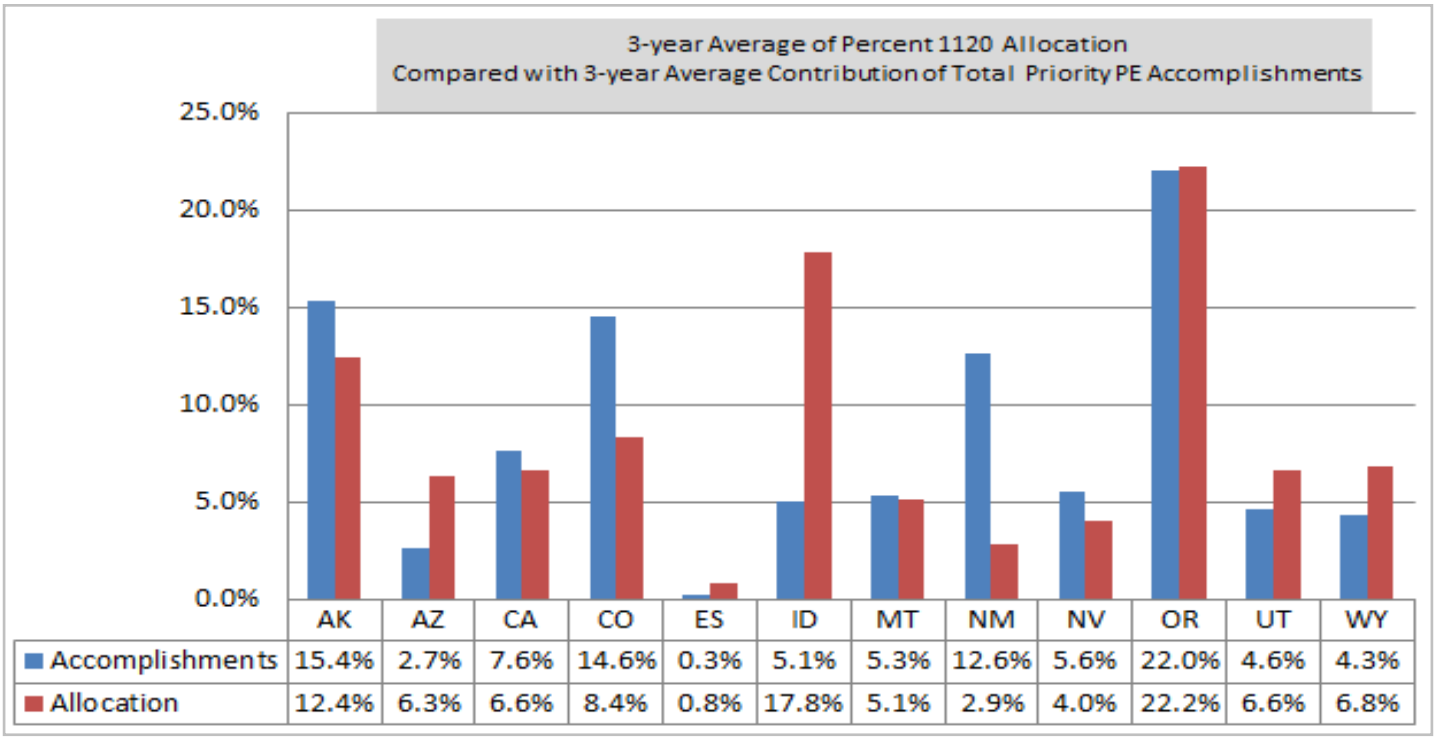
Resource Management Plans (RMPs) outline how BLM lands will be managed into the future. The Land Use Planning Handbook requires the identification of priority habitats, species, desired outcomes/habitat conditions, and actions or area-wide use restrictions. BLM Alaska has taken a landscape approach to fulfilling these requirements through the use of detailed GIS modeling efforts. These models take into account various datasets to ensure that an objective assessment of aquatic resources are used in the development of the land use plans in Alaska.

UNDERSTANDING RESOURCE CONDITIONS

Understanding the condition of the aquatic and riparian resources managed by the BLM is a significant challenge. By adopting the BLM's landscape approach, Alaska is shifting from project specific inventory and monitoring to an integrated framework of probabilistic sampling. By 2022, BLM Alaska is set to understand the condition of the 119K miles of streams on BLM-managed lands in Alaska.

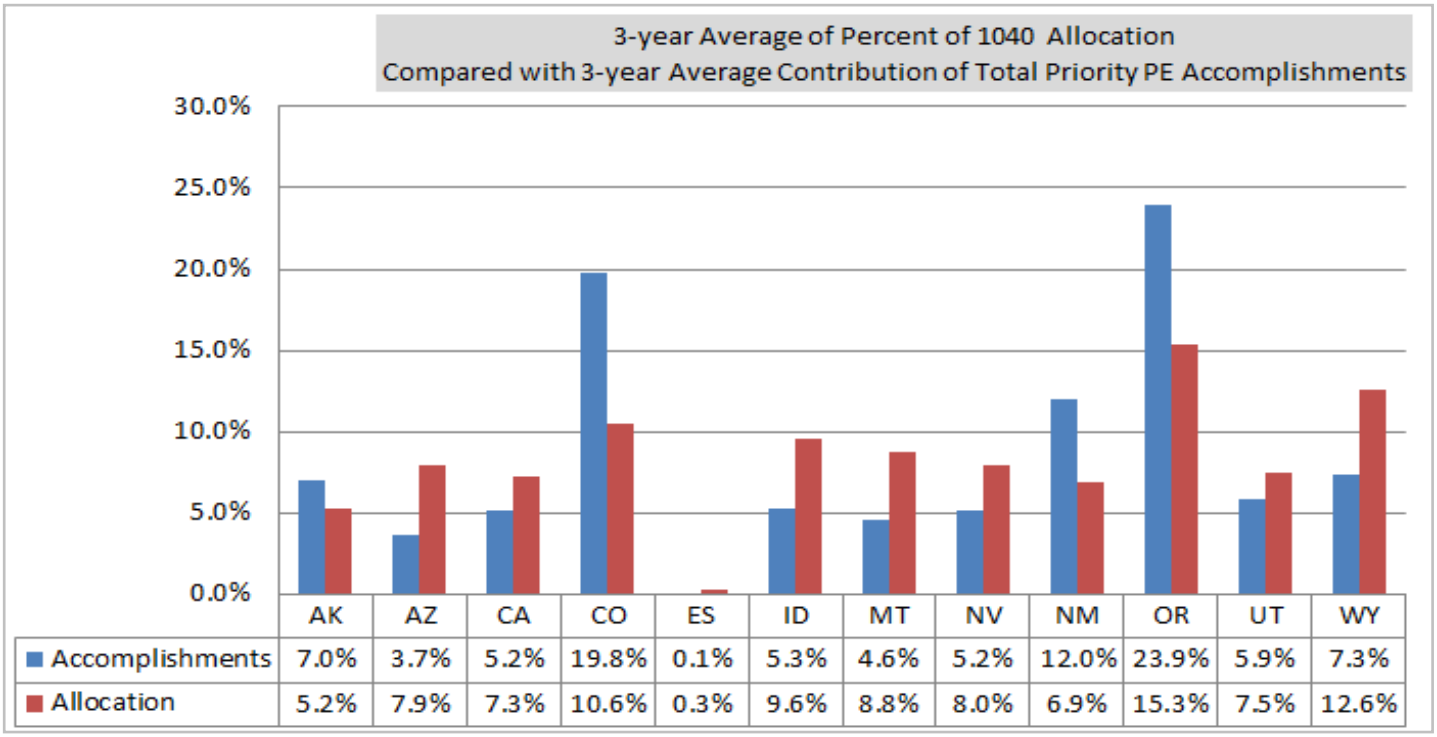
PROGRAM PERFORMANCE

FISHERIES (1120) AND RIPARIAN (1040) PROGRAMS



	AK	AZ	CA	CO	ES	ID	MT	NM	NV	OR	UT	WY
Accomplishments	15.4%	2.7%	7.6%	14.6%	0.3%	5.1%	5.3%	12.6%	5.6%	22.0%	4.6%	4.3%
Allocation	12.4%	6.3%	6.6%	8.4%	0.8%	17.8%	5.1%	2.9%	4.0%	22.2%	6.6%	6.8%

*Note that the 2009 WO program review of 1120 found that Alaska produced only 1% of the overall priority accomplishments from 2006-08. Since that time, BLM Alaska has increased performance and reporting accuracy with no additional base funding from WO.



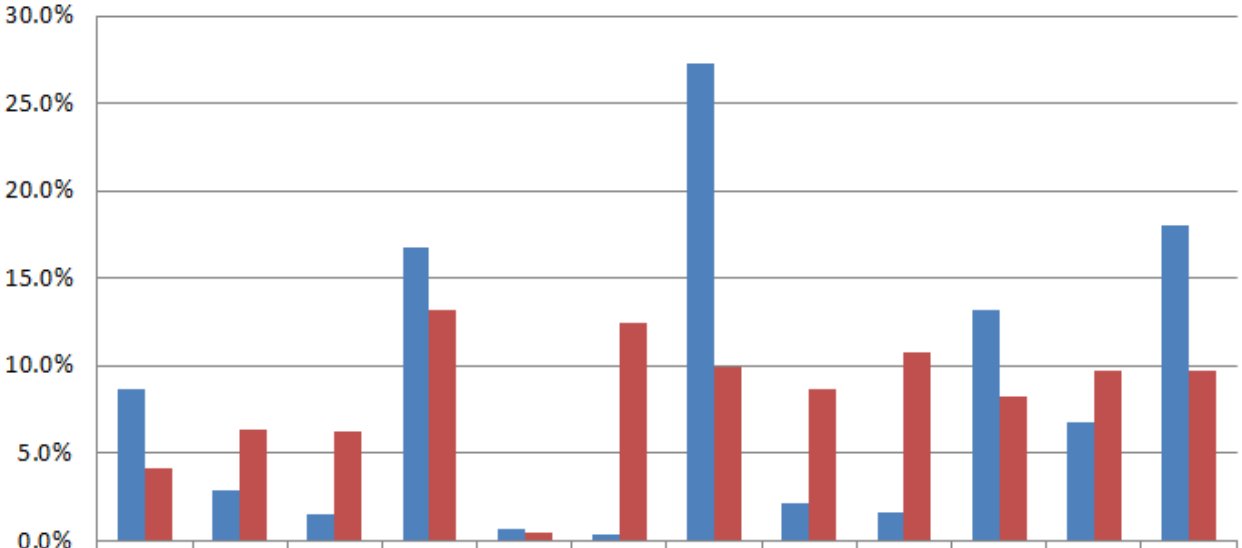
	AK	AZ	CA	CO	ES	ID	MT	NV	NM	OR	UT	WY
Accomplishments	7.0%	3.7%	5.2%	19.8%	0.1%	5.3%	4.6%	5.2%	12.0%	23.9%	5.9%	7.3%
Allocation	5.2%	7.9%	7.3%	10.6%	0.3%	9.6%	8.8%	8.0%	6.9%	15.3%	7.5%	12.6%

*Alaska outperforms every other BLM State based on its ability to accomplish priority program work with a relatively small allocation. Alaska's 1040 allocation is woefully inadequate, considering that the vast majority of riparian habitats exist in Alaska.

PROGRAM PERFORMANCE

SOIL, WATER, AND AIR (1010) PROGRAM

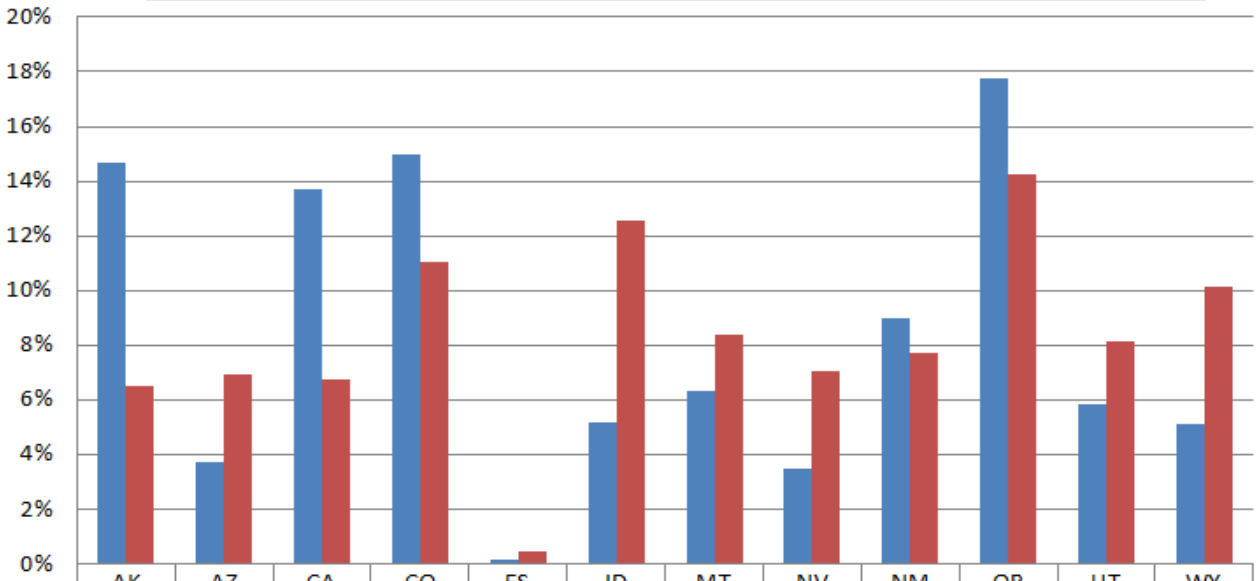
3-year Average of Percent of 1010 (Base) Allocation
Compared with 3-year Average Contribution of Total Priority PE Accomplishments



	AK	AZ	CA	CO	ES	ID	MT	NV	NM	OR	UT	WY
Accomplishments	8.7%	2.9%	1.5%	16.8%	0.7%	0.4%	27.3%	2.1%	1.7%	13.2%	6.7%	18.1%
Allocation	4.1%	6.3%	6.3%	13.2%	0.4%	12.4%	10.0%	8.7%	10.8%	8.2%	9.8%	9.7%

INTEGRATED PROGRAM

3-year Average of Percent 1010 (Base), 1040, and 1120 Allocations
Compared with 3-year Average Contribution of Total Priority PE Accomplishments



	AK	AZ	CA	CO	ES	ID	MT	NV	NM	OR	UT	WY
Accomplishments	15%	4%	14%	15%	0%	5%	6%	3%	9%	18%	6%	5%
Allocation	6%	7%	7%	11%	0%	13%	8%	7%	8%	14%	8%	10%

*Despite managing the vast majority of the Bureau's aquatic resources and performing exceedingly well, Alaska's water and aquatic programs receive a relatively small proportion of the base allocation in 1010, 1040, and 1120.

Beaver Creek
Eastern Interior Field Office

Alaska Statewide Efforts

AQUATIC AIM IMPLEMENTATION

Given the increasingly complex nature of environmental impacts, the sheer number of monitoring needs, and the expense of conducting field work in Alaska, it is not feasible to implement individual monitoring and assessment plans for each threat or use. Rather, many BLM management priorities share common themes requiring information regarding the location, abundance, condition, and trend of aquatic resources. Federal policies codify the need for shared information and mandate the inventory, maintenance, and recovery of the chemical, physical, and biological components of freshwater systems (e.g., FLPMA, CWA). The aquatic AIM program provides managers scientifically based data with known statistical confidence, along with assessments of a region's ecological resources and potentially the causes of effects that are observed.

Implementation of aquatic AIM in Alaska is an essential component of the BLM's landscape approach to management, which includes understanding watershed condition and trend and RMP effectiveness monitoring. Information gained from aquatic AIM also greatly enhances decision support related to compliance monitoring and mitigation effectiveness, thereby potentially reducing litigation risk and decision vulnerability. Specifically, aquatic AIM and BLM Alaska's Reclamation Effectiveness Monitoring policy are complementary and have been collectively used to support decision-making regarding stream reclamation.

Alaska began statewide implementation of aquatic AIM in 2016 and is scheduled to complete an assessment of all BLM-managed wadeable stream habitats by 2022 in Alaska. Alaska is not only integrating aquatic AIM into use authorizations, but into all five basic business lines for the BLM, including Planning, Use Authorizations, Budget/Workforce Planning, Effectiveness Monitoring, and Adaptive Management. This integration is essential to the success of the Landscape Approach to management in Alaska.

WORKSHOPS AND TRAINING

BLM Alaska sponsored two stream assessment/design trainings in 2016 for aquatic staff from the BLM and other agencies in Alaska. The first course was focused on assessing stream function and was attended by staff from several state and federal agencies. The second course was on stream design for mountain headwater systems. Annual training for staff since 2012 has greatly enhanced our understanding of stream functional assessments, reclamation techniques, and has facilitated a common understanding of terminology and techniques within the regulatory agencies in Alaska.

In 2016, BLM Alaska and the BLM National Training Center developed the Alaska Water Rights Course along with the Alaska offices of the U.S. Fish and Wildlife Service (USFWS), National Park Service (NPS) and U.S. Forest Service (USFS). The week long course included presentations and panel discussions from these federal agencies along with State agency staff. Topics covered Federal and Alaska-specific water rights in the first comprehensive "101" course offered to the agencies.

Staff training on stream assessment techniques.

STAFFING

In 2016, several new positions were added to the Table of Organization based on a strategic analysis of program needs and funding support from the Washington Office. These positions are currently vacant but are intended to be filled in Fiscal Year (FY) 2017.

The Alaska State Office added a geomorphologist, who will provide senior technical expertise regarding stream reclamation and stabilization to the field. This individual will be a key member of the aquatics team and assist with policy development, staff training, and data analysis.

The Alaska State Office also added a term Aquatic AIM Crew Lead position. This position will lead Aquatic AIM implementation efforts across the state by assisting with survey planning, crew training and oversight, and field logistics.

The Fairbanks District Office added an aquatic ecologist position, who will provide senior technical expertise on stream reclamation, landscape level data collection/interpretation, and overall support to the District on complex aquatic resource challenges.

STREAM DESIGN GUIDE

In 2016, the BLM drafted a report summarizing the State of the Science regarding placer mine reclamation on BLM-managed lands in Alaska. This report will be completed in 2017 and will pave the way for a guidance document on stream reclamation. The report will include design information and guidance, regional hydraulic geometry curves for Alaska mining districts, and specific information regarding construction sequencing and techniques, which have been demonstrated to work in the arctic environment of Alaska.

TECHNICAL ASSISTANCE TO MINERS

In 2016, BLM Alaska initiated a program to enhance stream reclamation on existing placer mining operations through the use of technical assistance from BLM staff. In 2016, BLM assisted one miner with stream reclamation layout and construction. BLM also completed several site visits with mine operators to provide suggestions for stream channel sizing and construction techniques. In 2017, BLM plans to provide technical assistance to at least two miners, who have specifically requested help. This program recognizes the challenges of stream reconstruction and limited capability of many small scale miners. Future plans of operation will include increased specificity regarding stream reconstruction so that miners and the BLM have clear stream reclamation expectations prior to mining.

Miner performing stream reclamation with technical assistance from the BLM.

Arctic Coastal Plain—National Petroleum Reserve Alaska
Arctic Office

Arctic Office

AIM-National Aquatic Monitoring Framework in the NPR-A

The Arctic Office initiated an aquatic AIM program initiated on the Arctic Coastal Plain (ACP) of the National Petroleum Reserve in Alaska (NPR-A) in 2015 through a coordinated effort with the Alaska Department of Environmental Conservation (ADEC), which was implementing the EPA's Environmental Monitoring and Assessment Program on BLM-managed lands in the Arctic. The two complementary programs were integrated to leverage the resources of both agencies and address overlapping objectives. The field aspect of the program was implemented by ADEC in 2015 and by the BLM in 2016. Over a period of two weeks in July, aquatic AIM data was collected in the NPR-A at 13 random sites as well as an additional seven targeted sites. Targeted sampling was conducted at established longer-term stream monitoring stations focused on evaluating habitat variability and change related to climate shifts and oil and gas land-use (see Fish Creek Watershed Observatory on page 19), so that habitat can be additionally evaluated in the context of the standardized AIM framework. The AIM program was further integrated with other ongoing Arctic work by collecting water samples for fish environmental-DNA (eDNA) analysis as part of a regional effort to map and predict priority species distribution (see eDNA project on page 21). Random sites in the eastern and central portions of the NPR-A ACP were completed in 2016, with sampling at the remainder of random sites in the west planned for 2017.

Aquatic AIM work in the Arctic was conducted out of Inigok, a remote BLM Administrative Site.

AIM crew member collecting streambank data.

COLVILLE RIVER BROAD WHITEFISH MOVEMENT STUDY

Broad whitefish are a culturally important subsistence resource for the community of Nuiqsut, located along the lower Colville River. However, primary spawning, feeding, and overwintering areas for this species are not known, despite ongoing oil and gas exploration and development along the Colville River over the last two decades. Given the importance of broad whitefish for subsistence users and the likelihood of impacts on local aquatic resources by climate shifts and oil and gas activities, a radio telemetry project was initiated in 2015 to better understand life history patterns and habitat use of these fish. Following a pilot information gathering effort during the first year, which engaged subsistence fishers from Nuiqsut, in 2016 a sample of broad whitefish were implanted with radio transmitters as they presumably migrated upriver towards spawning areas. A combination of stationary radio towers and fixed-wing relocation flights are being used to track fish movements. This effort is being undertaken by the BLM Arctic Office in collaboration with the Alaska Cooperative Fish and Wildlife Research Unit, USGS Alaska Science Center, The Wilderness Society, University of Alaska Fairbanks College of Fisheries and Ocean Sciences, and USFWS Fairbanks Field Office Fisheries Branch. Findings from this project will enable land managers to avoid sensitive areas and refine development plans to minimize impacts to the subsistence fishery.

Subsistence fishing under-ice in the lower Colville River.

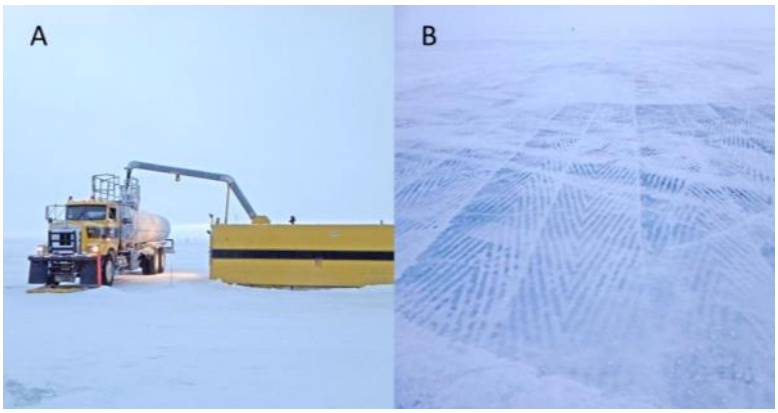
Broad whitefish captured in the middle Colville River during the late summer/early fall spawning migration.

A radio tower positioned above the Colville River helps track fish movements.

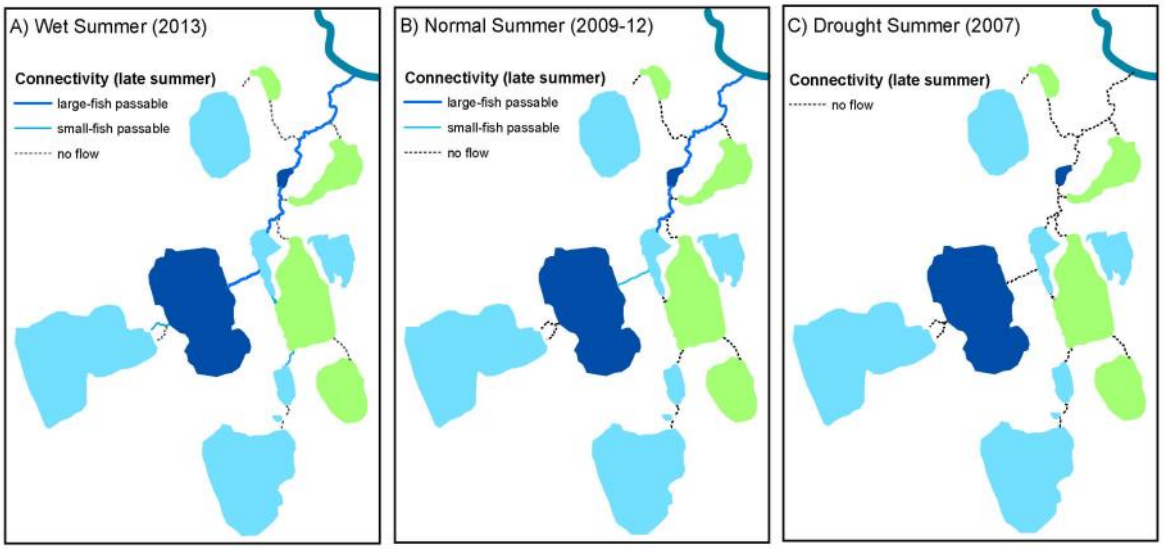
WINTER LAKE WATER EXTRACTION BMP EFFECTIVENESS MONITORING

The oil and gas industry conducts overland activities in the Arctic during winter to minimize potential impacts to the ecosystem. In order to accomplish this work, they often build ice roads and ice pads to support projects such as exploration drilling. Water from lakes is used for this temporary infrastructure and the volume utilized from each lake is limited by the BLM, according to guidelines in a Best Management Practice (BMP) for the NPR-A. Liquid water is removed from below the ice and ice aggregate is scraped from areas of a lake that are less than four feet deep and normally freeze to the bottom. From 2005-2011, studies by multiple agencies, including the BLM, investigated fish habitat conditions (e.g. water quality) under ice that could be potentially impacted by liquid water removal. No significant impacts were found, providing evidence that the BMP is effective in avoiding degradation to overwintering fish habitat. However, since then the emphasis has shifted to concerns regarding the potential impact of lake water removal in winter on downstream flows and habitat connectivity during the following summer. Many Arctic fish species make substantial seasonal movements, and reduced lake water supply could limit fish access to lakes, alter downstream habitat conditions, and reduce the transport of important fish prey items. In coordination with University of Alaska Fairbanks Water and Environmental Research Center, the BLM is monitoring a variety of lakes to better understand stream/lake linkages through a combination of water level monitoring and lake outlet stream gaging. The development of impact thresholds and standardized criteria to mitigate potential impacts is complicated by the presence of numerous interconnected stream/lake networks on the Arctic Coastal Plain and differences in drainage area, lake morphology, watershed position, and outlet channel structure, as well as annual variability in water balance.

A time-lapse camera complements monitoring at lake outlets.



Winter lake water use includes liquid pumped from under the ice (A) as well as ice aggregate scraped up from areas of grounded ice with a "trimmer" (B).



Annual stream/lake connectivity is variable, largely depending on summer precipitation.

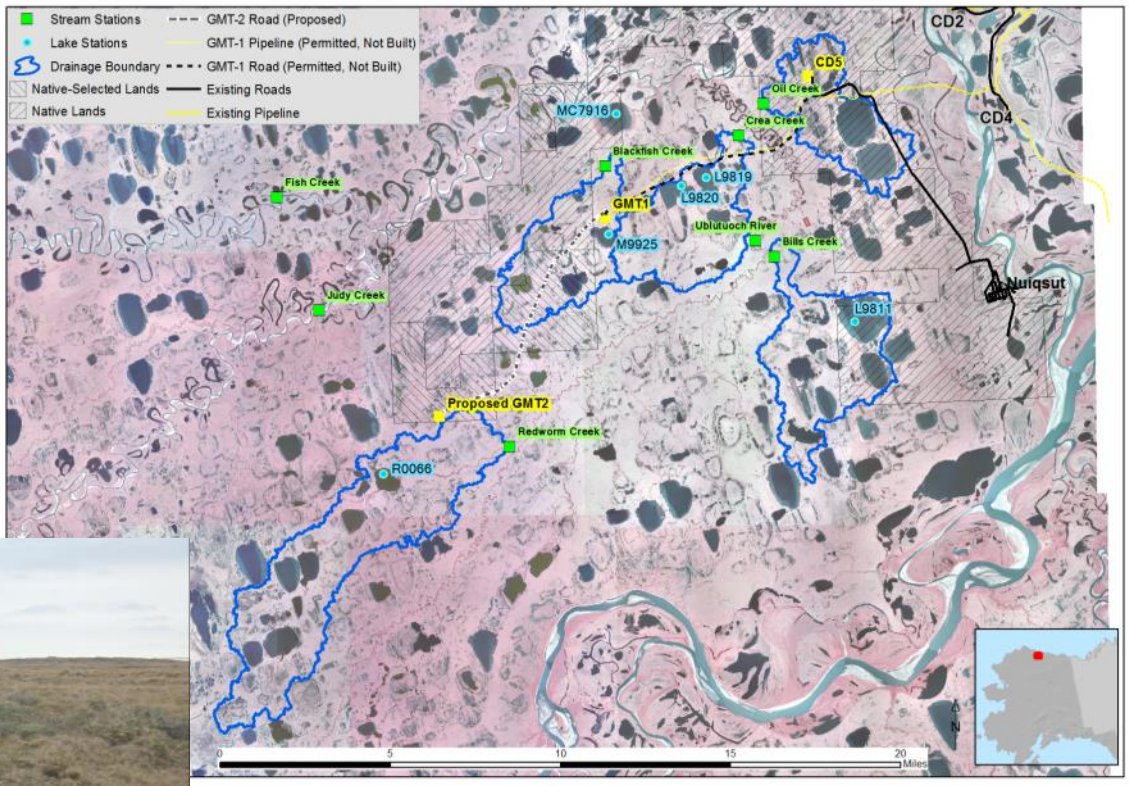
RESPONSE OF AN ARCTIC FRESHWATER ECOSYSTEM TO CLIMATE AND LAND-USE CHANGE

In 2013, the USFWS's Arctic Landscape Conservation Cooperative awarded funding for an interdisciplinary investigation into Arctic aquatic habitat dynamics likely to be affected by a shifting climate and increasing oil and gas land-use stressors. This work was chosen to be conducted in the Fish Creek Watershed (FCW) within the NPR-A. This was largely due to ongoing aquatic monitoring and habitat classification work already underway in this drainage, which provided a foundation of information to build upon (see Fish Creek Watershed Observatory project above). Primary investigators for this project include individuals from the BLM Arctic Office, USGS Alaska Science Center, and University of Alaska Fairbanks (UAF) Water and Environmental Research Center. Other specialists involved are from the USFWS, Alaska Division of Geological and Geophysical Surveys, UAF International Arctic Research Center, USACE Cold Regions Research and Engineering Lab, and USGS Geosciences and Environmental Change Science Center. This diverse group represents a variety of disciplines, such as biology, hydrology, hydrogeology, physical geography, snow science, permafrost science, and climatology. Ongoing work includes multi-scale climate modeling, aquatic habitat classification, large- and small-scale hydrology modeling, fish habitat use, and loon (Pacific and yellow-billed) habitat use. Researchers are largely analyzing the landscape in the context of lake classes, linking biology to important physical processes such as lake/stream connectivity and ice dynamics, and developing future scenarios to help evaluate likely habitat changes and the implications of those changes. An important milestone was reached in 2016 with the publication of a new lake-cover classification for the FCW, intended to guide research and inform management decisions. A peripheral objective of this project is to engage stakeholders, and in 2016 a survey was circulated to individuals representing resource management, environmental policy, environmental conservation, resource development, subsistence hunting/fishing, and scientific disciplines, to prioritize the focus of final analyses and future scenarios. As part of this outreach effort, a Traditional Ecological Knowledge workshop was recently held in Nuiqsut, a village adjacent to the FCW. A final synthesis of information generated from this project will be completed in 2018.

Community members from Nuiqsut participate in a Fish Creek area Traditional Ecological Knowledge workshop.

FISH CREEK WATERSHED OBSERVATORY

The Fish Creek Watershed drains a 4500 km^2 region of the Arctic Coastal Plain in the NPR-A. Located along the eastern boundary of the NPR-A, this watershed has been a focal area for oil and gas exploration since the early 2000s and is scheduled for construction of oil development infrastructure beginning in 2017. In response to these activities, the Fish Creek Watershed Observatory (Observatory) was initiated in 2008 to monitor and assess aquatic habitat at a landscape scale in relation to petroleum activities and climate change. A network of stream, lake, and meteorological monitoring sites distributed throughout the watershed are cooperatively operated by the BLM Arctic Office, University of Alaska Fairbanks Water and Environmental Research Center, USGS Alaska Science Center, and the USGS Geosciences and Environmental Change Science Center. Data collected includes water levels, discharge, temperature, various in-situ water quality parameters, ice thickness, and meteorological parameters, in coordination with additional synoptic investigations. Monitoring in an area of oil and gas leases known as the Greater Mooses Tooth (GMT) Unit is a priority of Observatory efforts. The permitted GMT1 project will include the first oil and gas production facility on federally managed land in the Arctic and the proposed GMT2 project is currently being evaluated through an EIS. This infrastructure will be connected to the recently built Colville Delta 5 (CD5) drilling pad adjacent to the NPR-A, extending the trajectory of oil and gas development westward from Prudhoe Bay. The overarching goal of the Observatory is to sustain long-term monitoring and facilitate integrated research to improve understanding of aquatic habitat conditions, trends, and variability in order to guide science-based land management decisions in the NPR-A.



The Greater Mooses Tooth Unit of oil and gas leases is a priority aquatic monitoring area in the Fish Creek Watershed Observatory.

Making a stream discharge measurement at the Oil Creek monitoring station where water drains from around the CD5 oil production pad (in distance).

ADF&G ANADROMOUS WATERS CATALOG AND FRESHWATER FISH INVENTORY

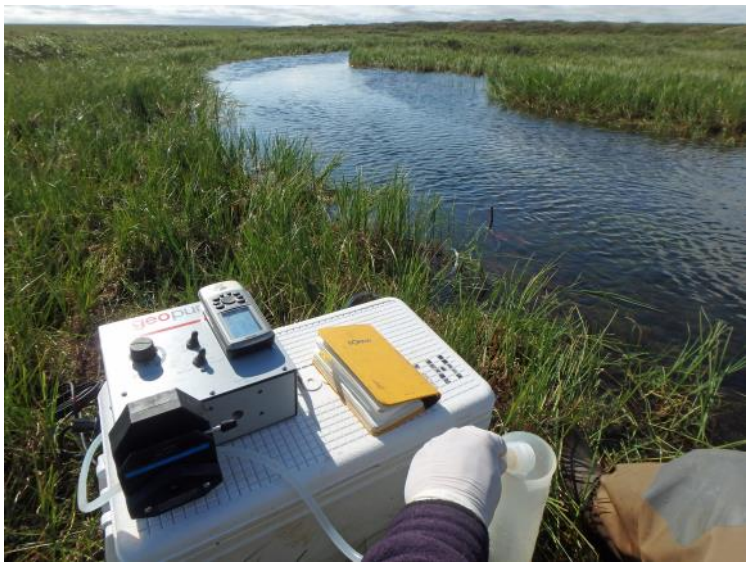
BLM Alaska contributed substantial funding and coordination support to the ADF&G to help initiate a two-year fish sampling program in the Arctic. From late July to mid-August, ADF&G Alaska Freshwater Fish Inventory (AFFI) program crews visited 123 study sites in select Arctic Ocean drainages on land within and adjacent to the NPR-A. Wadeable sites were sampled via backpack electrofishing and deeper sites were sampled by a cataraft-based electrofishing system. AFFI crews found a total of 11 fish species, including Arctic grayling, broad whitefish, burbot, chum salmon, Dolly Varden, longnose sucker, ninespine stickleback, northern pike, pink salmon, round whitefish, and slimy sculpin. From this sampling effort, the AFFI program submitted 13 nominations to the Anadromous Waters Catalog (AWC) documenting the presence of anadromous fish in streams throughout the study area. This resulted in the addition of approximately 366 km of previously undocumented anadromous fish habitat, which will now be afforded greater legal protections under the Anadromous Fish Act. In addition to conducting the fish inventory, AFFI staff also collected fish eDNA samples for an ongoing BLM effort at a subset of the inventory sites.

A cataraft-based electrofishing system was used to sample larger streams.

A chum salmon captured during the AFFI program sampling.

USING FISH EDNA TO MAP AND PREDICT PRIORITY SPECIES DISTRIBUTION

In 2014, a partnership between the BLM, Utah State University (USU), and the Desert Research Institute (DRI) was developed in order to obtain a grant from NASA to help investigate fish distribution in the NPR-A using eDNA techniques. During 2015 and 2016, the BLM coordinated the collection field samples from across the NPR-A through integration with other efforts, including AIM, Fish Creek Watershed Observatory, and the ADF&G Alaska Freshwater Fish Inventory program (see projects above). These integrated projects also conducted various levels of fish sampling with a variety of traditional gears, which will help evaluate the effectiveness of eDNA sampling in Arctic streams where many low-gradient channels and complicated networks of interconnected streams and lakes can effect downstream transport and storage of genetic materials. Lab analyses are being done at USU; while overall project coordination, mapping, and distribution modeling are being done at DRI. Genetic markers are being identified for priority species (based largely on subsistence fishing value), including Arctic grayling, broad whitefish, burbot, humpback whitefish, least cisco, and northern pike, all native to the Arctic region. To date, identification of unique species markers has been completed for grayling, burbot, and pike. Due to genetic similarities across the whitefish family (Coregonidae), isolating markers for different species has been challenging and is still underway.



Collecting a filtered water sample for fish eDNA analysis.

BLM NPR-A CLIMATE MONITORING PROGRAM

The BLM Alaska's climate monitoring program incorporates data from the BLM and other agencies to provide spatial coverage within the NPR-A. Climate data sources include Remote Automated Weather Stations (RAWS) at Umiat and Inigok airstrips, a NOAA supported U.S. Climate Reference Network (USCRN) station at Ivotuk airstrip, two USGS river gages, six BLM river gages and the USGS supported Global Terrestrial Network for Permafrost (GTN-P) climate monitoring program. The BLM maintains a hybrid power system, a 7000 amp hour battery bank charged by solar, wind, and diesel that powers the internet and webcams at Umiat. A smaller similar system is maintained by the USGS at Inigok. This allows year-round communication with the USGS GTN-P radio-networked climate monitoring sites and provides BLM personnel access to critical aviation flight-related websites while working in Umiat. The webcams are critical for flight planning, safety, and allows pilots to verify field conditions are above minimums before arriving. Snow surveys performed in NPR-A are used to validate automated snow depth sensor readings and helps the BLM to focus monitoring efforts as needed for low-snow conditions, to predict lake recharge. and obtain winter snow water equivalent values.

Remote Automated Weather Station within the NPR-A.

Umiat is an important staging area for oil and gas exploration and research activities in NPR-A. Umiat weather records were begun in 1949 and discontinued in 2001. In 2002, the BLM installed a weather station to continue the collection of these long-term records and converted it to a RAWS station in 2013. BLM Alaska maintains weather stations at Fish Creek, Ikpikpuk River, and Otuk Creekk gaging sites to provide real-time climate data representing coastal plain, foothills and Brooks Range regions. Air temperature and precipitation records were added to other gage sites to enhance the interpretation of streamflow records and for inclusion into regional climate analyses.

The performance-based BMPs and stipulations for NPR-A oil and gas exploration require that permitted activities be monitored and evaluated as part of BLM's adaptive management strategy. Hydrological and meteorological data are collected and correlated with critical aquatic and terrestrial habitat areas for fisheries, waterfowl, and mammalian studies and utilized for climate change modeling. Real-time and historical climate records are used to determine opening and closing dates for tundra and ice road travel and used to evaluate the likelihood of recharge to water bodies.

BLM Alaska's Umiat Field Camp is used as a base of operations for remote field operations in the NPR-A

BLM NPR-A GAGING PROGRAM

The BLM operates seven river gages and one lake level gage (L9817), and assists in running two USGS river gages (Colville River and Meade River). These gages are distributed in three physiographic regions and are situated close to oil development areas or along possible pipeline routes crossing major rivers. Six river gages have at least 14 years of data and the rest have over seven years.

Stream gage site within the NPR-A.

The gages provide annual peak stage and flow which can be used in determining the 100-year flood (and floodplain) for bridge and culvert design, impacts from snow and ice in the channel during breakup, and timing of adjacent lake recharge. Important characteristics for design of crossing structures consider whether peak flows are normally associated with snowmelt or summer rain events. The timing of first flows, peak flows and cessation of flow are important basin and physiographic runoff characteristics. For example, the Ublutuoch River channel fills completely with snow (about 14 feet deep) so within 2-3 days after the first water begins flowing it reaches peak stage. As the water cuts down through the snow the level drops, but the discharge increases and the peak discharge often occurs 2 -4 days after peak stage. If all snow was removed from the channel, the water surface would be 3-5 feet lower.

Real-time gage data is used for flood warnings, as well as by floaters, researchers, and subsistence users trying to access their cabins at low-water. Climate change may result in changes to the timing and magnitude of breakup flows, which also vary by physiographic regions. The Otuk Creek gage provides flood warnings for lower Colville operations. Continued gaging is needed to support estimates of peak, mean, and flow-duration statistics needed for design of stream crossings, streamside structures, fish habitat assessments and stream passability.

Data for these gages are located at the following websites:

http://ine.uaf.edu/werc/projects/npra-hydrology/Default.aspx

http://water.weather.gov/ahps2/index.php?wfo=pafg3

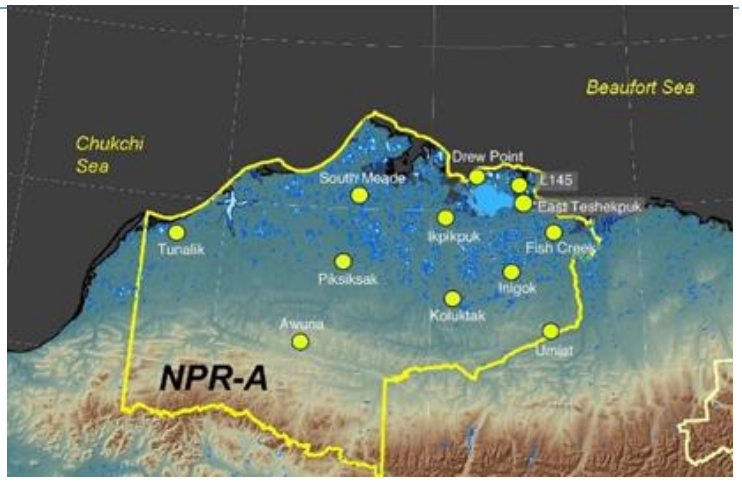
Seasonal stream discharge in the NPR-A can vary significantly, thereby underscoring the importance of long term gage stations.

USGS NPR-A CLIMATE MONITORING PROGRAM

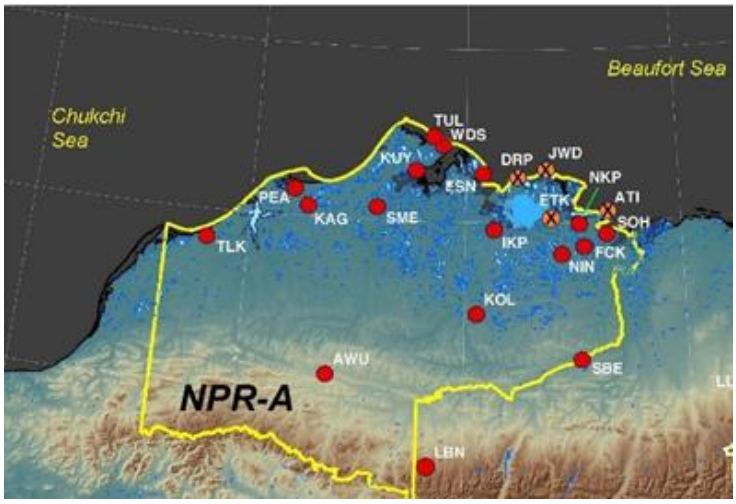
BLM Alaska provides logistical and financial support for the GTN -P Observing Network consisting of two primary arrays located in the NPR-A: (1) an array of 14 deep boreholes used to monitor changes in the thermal state of permafrost, and (2) an array of 11 climate-monitoring stations designed to satisfy a variety of DOI mission needs in the NPR-A. This network will improve our understanding of the interaction between surface conditions and the active layer. This is essential in providing fundamental baseline physical data for biological research and monitoring projects. The USGS has been monitoring permafrost temperatures in the deep borehole array periodically since the late 1970s and is developing mathematical models to extract the climate signal from the borehole temperature measurements. The first of the climate stations were deployed in 1998. Both arrays formally contribute to a number of global observing systems, including: the GTN-P, the Global Terrestrial Observing System (GTOS), and the Global Climate Observing System (GCOS). Among the Essential Climate Variables (ECVs) tracked by these global networks, the GTN-P networks currently monitor two ECVs within their domains; active-layer depth and the thermal state of permafrost.

These stations provide inputs needed for permafrost characterization and impact assessment models. The meteorological sensors will be used for climate, weather-prediction, storm-surge and coastal erosion modeling efforts, as well as short- and long-term interdisciplinary monitoring and research projects (such as understanding caribou movement patterns, coastal erosion, timing of break-up and freeze-up, and bird and fish habitat changes). Oil development will occur within these regions. Its impacts to wildlife may occur from climate change or development, or a combination of both. Monitoring the effects of climate change on the physical properties of permafrost and thereby understanding basic landscape health will assist in determining probable negative impacts of oil and gas drilling and production, potentially resulting in additional and/or more defined Stipulations/BMPs. These wildlife impacts will directly impact tribal communities that obtain 85% of their food from subsistence hunting. Real-time environmental data from this network is used in tundra travel decisions and monitoring, logistics and air operations. Most sites are connected via a radio-linked network and are being upgraded to iridium to provide continuous connectivity.

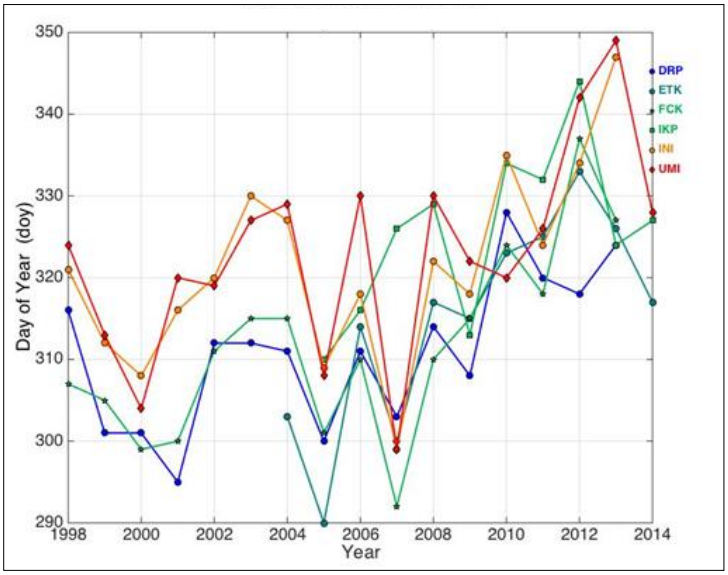
Data from this network is archived within the GTN-P (and the GCOS.



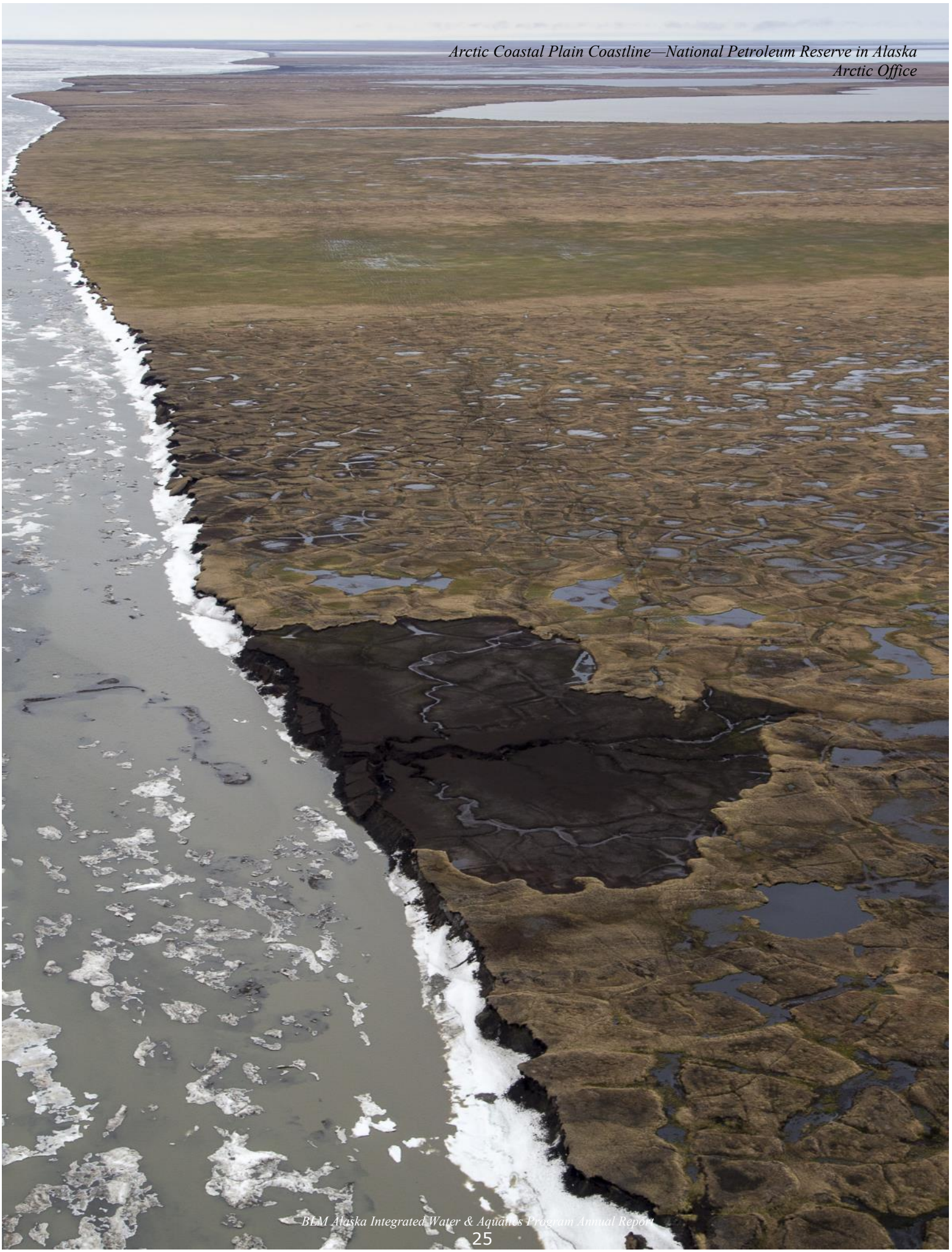
Arctic Climate-Station Network, USGS.



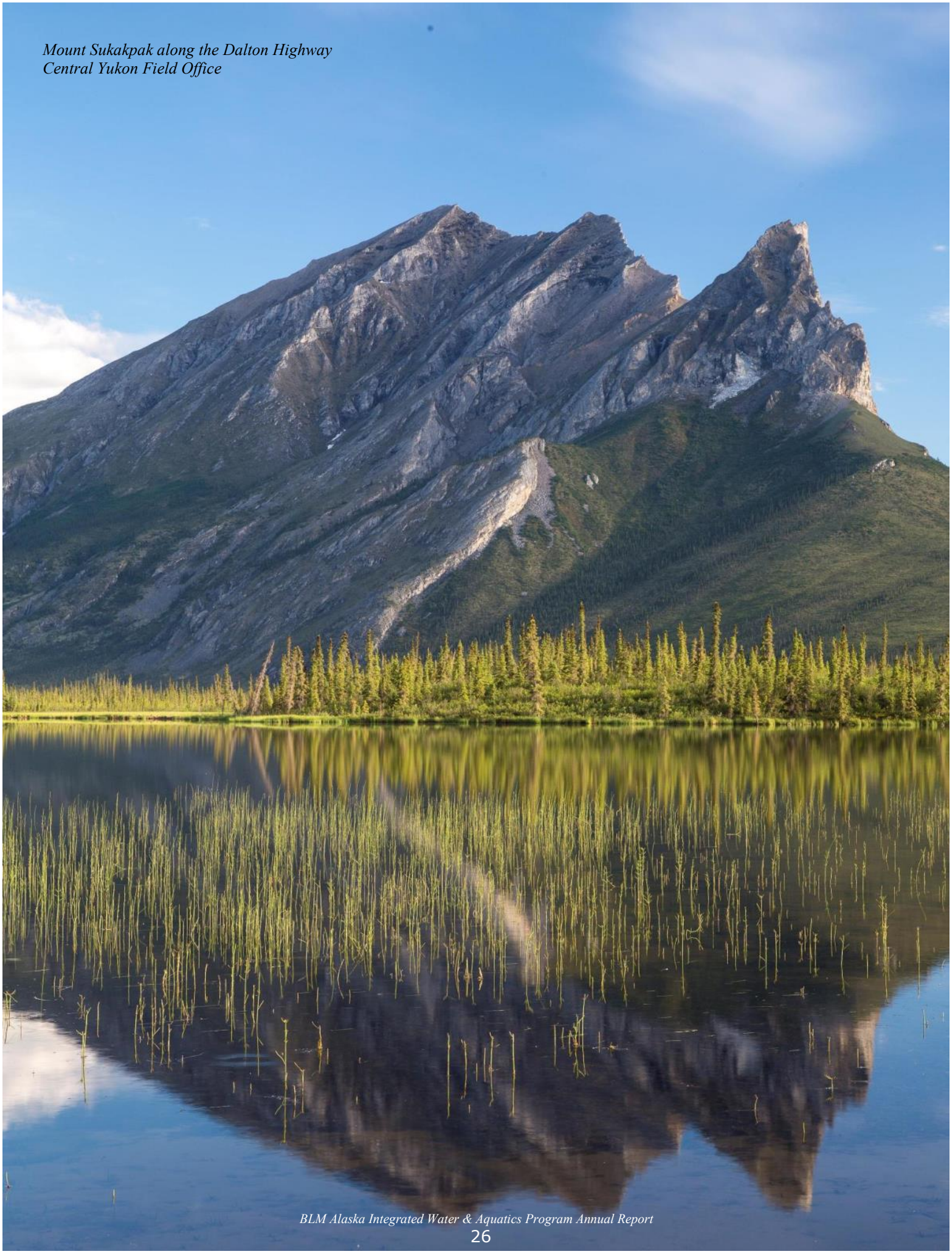
Arctic Deep-Borehole Array, USGS.



Active Layer Freeze Up Date.



Arctic Coastal Plain Coastline—National Petroleum Reserve in Alaska
Arctic Office



Mount Sukakpak along the Dalton Highway
Central Yukon Field Office

CENTRAL YUKON FIELD OFFICE

TOOLS TO ENHANCE PLACER MINE STREAM RECLAMATION

Within the Central Yukon Field Office (CYFO), historic and on-going placer mining is the primary source of degradation of aquatic and riparian resources on BLM-managed lands. The BLM permitting process for these mining activities requires that fish habitat is rehabilitated and water quality is maintained. To attain this standard, a complex set of hydraulic and geomorphic functions must be achieved. Reclamation of placer mined stream channels with excessive erosion, deposition, or degraded habitat is a priority of BLM Alaska. In the past, stream reclamation practices relied heavily on natural recovery processes to rehabilitate streams and, as a result, many sites took decades to stabilize. To improve stream reclamation success and shorten recovery timeframes, the BLM is now focused on using a more science based approach called the "Natural Channel Design" (NCD) method to achieve stream reclamation requirements.

NCD is intended to restore an impaired stream reach to a state where the stream can transport the current sediment load and runoff without aggradation or degradation, and maintain habitat similar to that of an unimpaired reach of similar physiography. For a channel to be restored to a pre-disturbance state, channel geometry must be documented at a pre-disturbance (reference) reach or from similar type stream channels (regional hydraulic geometry curves) in the immediate area.

On BLM-managed lands in the CYFO, placer mining is often occurring in streams with historic mining where there is limited reference reaches directly adjacent to disturbance. In these instances, regional curves along with reference reaches in nearby watersheds are used in natural channel design to verify field determinations of bankfull discharge and stream channel characteristics. These regional hydraulic geometry curves are developed by relating one variable (ordinary least-squares regressions relating bankfull discharge, bankfull cross-sectional area, bankfull width, bankfull mean depth, and bankfull slope) to drainage area. In 2016 this project collected stream channel characteristics from 18 undisturbed streams within the boundary of the CYFO in order to construct regional curves and help to establish regional reference conditions, as well as specific stream potential and geomorphic character. These curves will be used to estimate bankfull discharge and bankfull channel geometry to construct channels, which will maintain the water quality, and rehabilitate fish habitat as required by BLM performance standards.

Completing a cross-sectional survey for baseline data and regional curve development.

AIM-NATIONAL AQUATIC MONITORING FRAMEWORK IN THE CYFO

In 2016, as part of the statewide implementation of Aquatic AIM, the CYFO began its efforts on BLM-managed lands adjacent to the Dalton Highway. The overall project goals are to determine: (1) the condition and trend of aquatic resources such as water quality, geomorphic processes, aquatic biodiversity, and riparian vegetation in the CYFO area; (2) stressors contributing to degrading conditions with a focus on placer mining, but also includes gravel extraction, right-of-ways, and the Trans-Alaska Pipeline System (TAPS); and (3) thresholds of stream attributes to demonstrate desired conditions for aquatic resources in the on-going development of the Central Yukon RMP. During this effort, 14 reference and 10 targeted wadeable stream sites were sampled. Targeted sites included areas which are impacted by the Dalton Highway, TAPS, and historic and on-going placer mining. Additionally, at each AIM site crews collected fish distribution information by electrofishing and collecting stream channel cross-sections to use in the development of regional hydraulic geometry curves. Sampling will continue through 2017 within the Dalton Highway Corridor.

AIM crewmembers collecting physical habitat data.

AIM crewmember collecting water quality data.

AIM crew preparing to begin data collection.

FISH INVENTORY AND MONITORING

Each summer, BLM fisheries biologists collect information about the presence and distribution of fish species in watersheds where information is absent on public lands managed by the CYFO. However, as several fish species complete seasonal migrations their distribution at other times of year is unknown. Thus, large data gaps occur temporally with little to no information existing for anadromous and resident fish populations on BLM-managed lands in the fall and winter. With fall chum salmon, coho salmon, and whitefish species heavily used by subsistence users within Alaska, fish distribution information is an important component that BLM specialists and managers need for planning and NEPA analysis decisions. During the last week of September 2016, BLM biologists performed aerial surveys to document the presence or absence of spawning salmon and whitefish in three rivers located within the boundary of the CYFO. In the Big Salt River 1,184 fall chum and 32 coho salmon were observed and their spawning locations were mapped.

Spawning fall chum salmon within the Big Salt River.

Wolves along the Ray River.

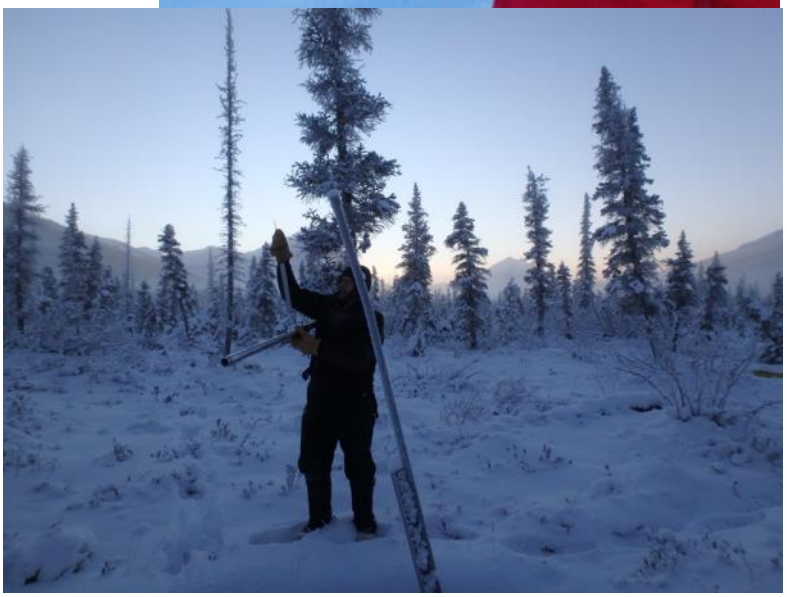
FAIRBANKS DISTRICT OFFICE SNOW SURVEYS

As part of BLM Alaska's effort to better understand the impacts of climate change, and to develop science-based adaptive management strategies for natural and cultural resources, the Fairbanks District Office (FDO) staff collect snow survey data in interior and northern Alaska annually.

These projects monitor winter snowpack at remote locations in the National Petroleum Reserve in Alaska (NPR-A), the Yukon River and Koyukuk River drainages, the White Mountains National Recreation Area (NRA), and the Fortymile region. Snow depth and density are collected at both snow courses where manual measurements occur monthly and at National Resources Conservation Service (NRCS) automated snow telemetry stations (SNOTEL). Data collection occurs at 2 long-term climate stations at Umiat, 7 snow courses and 3 SNOTEL stations along the Dalton Highway, 4 snow courses and 1 SNOTEL site in the White Mountains NRA, four snow courses in the Fortymile River area, and two remote fly-in sites in the Tozitna River and Lake Todatonten drainages.

Snow survey data has been recorded for more than 30 years at some of the sites. The surveys are conducted several times each winter (depending on the site) and include calibrating equipment and collecting snow depth, snow density, snow water equivalent, and air temperature. The results are published in a monthly *Basin Outlook* report during winter by NRCS. An Annual Data Summary is also compiled by NRCS at the end of each year. Data are accessible to the public at http://www.ambcs.org/.

Snow surveys are important for the public and professionals, contributing to resource protection through use in runoff and flood predictions, aviation weather and fire season forecasts, wildlife habitat monitoring, and culvert and bridge design. Measurements throughout the season and over the course of many years provides an improved understanding of shifting precipitation trends in Alaska. Understanding the effects of climate change is critical in making land management decisions. Changes in snowpack are notoriously hard to predict with models, which is why on the ground measurements are vitally important.



Hydrologists conducting snow surveys in December 2016, temperature -45°F.

FAIRBANKS OUTDOOR DAYS & FISHERIES OUTREACH

The Fairbanks District Office and Alaska Fire Service combined to join other agencies and organizations for Fairbanks Outdoor Days for area 6th graders, May 3-5, 2016. The annual event takes place on the University of Alaska Fairbanks campus at West Ridge and features a number of fun, hands-on stations staffed by agency personnel. These demonstrate a variety of outdoor-related occupations, and also provide natural resource information. Participating students learned about natural resources panning for gold; excavating a simulated archaeology dig; experiencing Leave No Trace camping skills; learning about fish habitats and Pacific salmon predators; and how wildlife biologists use telemetry to track wildlife and make population estimates. In addition to the various instructional stations, at lunchtime the Alaska Smokejumpers made demonstration jumps at West Ridge and then visited with the students.

Central Yukon Fish Biologist Dave Parker continued as the longest tenured station instructor at Outdoor Days this year with his 21st year of presentations to the sixth graders. Dave enthusiastically teaches students about the Pacific Salmon Life Cycle through the use of posters, a high energy game of tag, and an interactive photo question & answer discussion about habitat characteristics and possible adverse effects to aquatic ecosystems from various land use activities. Eighteen groups rotated through the station over the course of the 3 days. The fish station always ranks as a top station in the class evaluations.

The USFWS coordinates Fairbanks Outdoor Days. Other participating agencies and organizations include the University of Alaska Fairbanks, Fairbanks Northstar Borough School District, Arctic Research Consortium of the United States, Northern Land Use Research, Society of American Foresters, Fairbanks Soil and Water Conservation District, National Park Service, and the National Association of Retired Federal Employees.

CYFO Biologist Dave Parker teaching about the life cycle of salmon.

CYFO Biologist Dave Parker engaging local 6th graders about habitat management.

Fortymile Wild and Scenic River
Eastern Interior Field Office

EASTERN INTERIOR FIELD OFFICE

PLACER MINE RECLAMATION EFFECTIVENESS MONITORING

Aquatics staff continued to monitor the rehabilitation of stream and riparian habitats at placer gold mining operations within the Eastern Interior Field Office. The surface disturbing activities associated with this land use activity are intensive, and with the use of heavy equipment often strip away all of the vegetation, relocating the active stream into a temporary bypass channel, excavating the overburden material (10-25 vertical feet) from the original stream channel/floodplain down to bedrock, and then processing the excavated material to retrieve the gold.

After mining has been completed, the operator is required to reclaim the area by regrading and reshaping the mined area to blend with surrounding topography, to reconstruct a stable stream channel, to rehabilitate fish and wildlife habitat, and to revegetate disturbed areas.

Modern placer mining within the Fortymile Wild and Scenic River corridor.

In previous years, the following methods were used to evaluate stream reclamation efforts at numerous mine sites: Establishment of semi-permanent photopoints; visually estimating the riparian vegetation complexity; surveying 3 cross sectional and 1 longitudinal profiles of the stream channel; conducting a Bank Erosion Hazard Index (BEHI) survey of the entire stream reach; and, a survey of the bed material composition. Many of the same sites were re-visited and monitored in 2016.

The stream and riparian conditions showed little change from previous years and none of the sites have yet to achieve the reclamation requirements. The lack of streambank riparian vegetation is the primary deficiency for not attaining a stable stream channel and rehabilitation of fish habitat. Other deficiencies include the lack of bed form diversity, streambank erosion levels that measure in the high-to-extreme category, and bank height ratios that indicate the stream is disconnected from its floodplain/ floodprone area.

It's worth noting that the reclamation techniques used at these sites would not be expected to result in stable stream conditions for many years. Simply providing a "pilot channel" and then relying on natural stream and revegetation processes to create a stable stream channel with similar pattern, profile, and dimensions of the original channel has been demonstrated to take decades to recover in the Interior of Alaska. The BLM will continue to monitor the status and trend of the reclaimed stream sites. Findings from the monitoring efforts will be conveyed to mine operators, along with suggested corrective actions. If employed, these actions should reduce the time necessary to achieve the reclamation requirements.

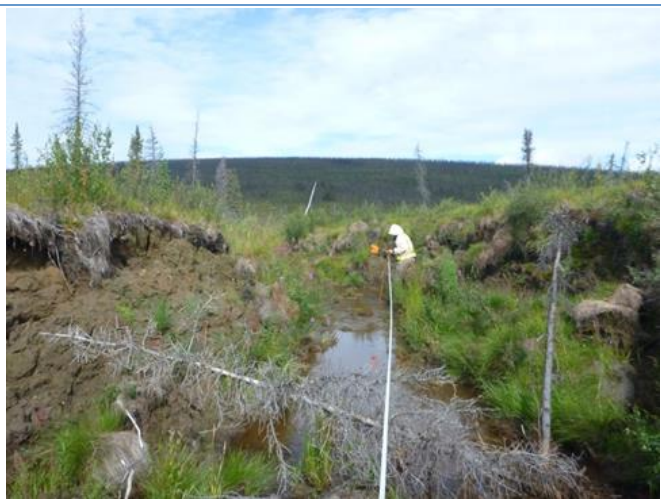
Reclamation completed in 2010 is still lacking lateral stability, bedform diversity, and riparian vegetation.

AIM-NATIONAL AQUATIC MONITORING FRAMEWORK IN THE EIFO

Starting in 2014, the Fisheries; Soil, Water and Air; and Riparian Programs began implementing aquatic AIM in Alaska. The initial project in the Eastern Interior Field Office (EIFO) was designed to: 1) assess the efficacy of resource management plans, with a specific focus on National Conservation Areas and Wild and Scenic Rivers; 2) quantify the impacts of placer mining and the effectiveness of stream reclamation; and 3) provide a quantitative baseline from which future changes can be assessed (e.g., climate change).

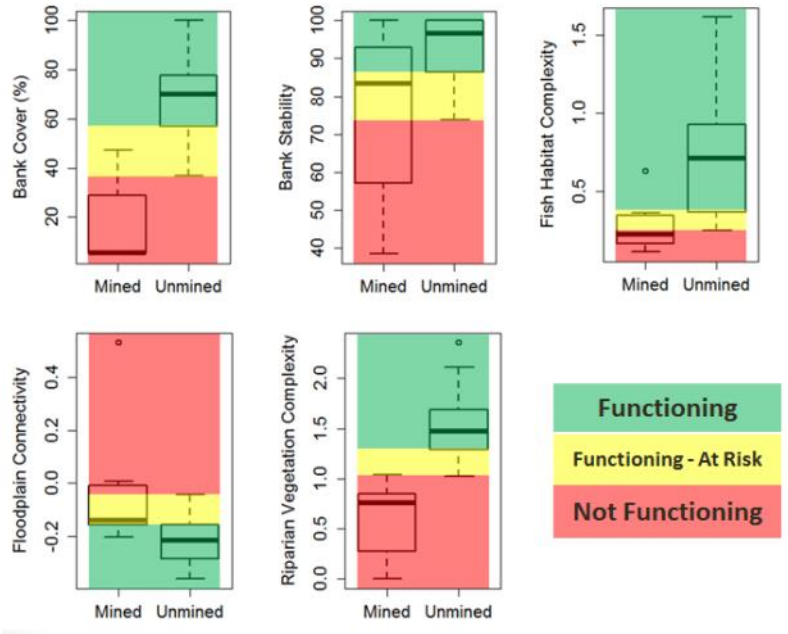
BLM Alaska recently adopted a policy to standardize collection of pre-mining baseline data statewide and ensure consistent data collection and analysis of reclamation. This policy provides for the integration of the monitoring methods in the aquatic AIM, which based on the EIFO pilot project, has been already employed in the issuance of reclamation related decisions. The systematic establishment of baseline conditions through aquatic AIM will provide the foundation for strong decision-making and science-based evaluations of RMP effectiveness into the future.

With the use of a helicopter and 4-person crews, the EIFO conducted AIM for approximately 2 weeks each summer from 2014-2016. During that time, AIM data was collected at 56 wadeable, large and small streams within the area managed by the EIFO. Forty of those sites were chosen by statistically valid methods, while 16 were targeted at streams previously impacted by placer gold mining activities. Unfortunately, the summer of 2016 was one of the wettest on record in the Interior of Alaska. Due to swollen streams and poor flying conditions, an AIM crew will need to visit a few more streams next year to complete the statistically representative number of small and large wadeable streams in the EIFO. Future efforts will also include the collection of AIM data for non-wadeable streams.



A diversity of sites were sampled from steep headwaters to lowland tundra streams.

AIM Crew preparing to complete a surveyed cross section.



This figure shows example results for bank condition, floodplain connectivity, riparian vegetative complexity, and instream habitat conditions compared between mined (reclaimed) and unmined sites. Values falling within the yellow and red shading for mined sites indicate moderate to significant deviation from potential natural conditions.

HYDROMETRIC MONITORING OF RESTORATION WATERSHED, FORTYMILE WILD AND SCENIC RIVER SYSTEM

Real-time comprehensive hydrological and meteorological monitoring is critical to documenting continued success of the Wade Creek Stream Reclamation Demonstration Projects, designed to showcase techniques for the accelerated recovery of in-stream and riparian habitats in historically mined watersheds within the Fortymile Wild and Scenic River corridor. In June of 2016, upstream of the project reach, the EIFO hydrology staff installed a stream gage and meteorological station with satellite telemetry capability, recording air temperature, wind direction and speed, precipitation, barometric pressure, solar radiation, water temperature, water stage, water turbidity, and soil temperature. During summer, air temperature, precipitation, water temperature, water stage and water turbidity are transmitted hourly to a National Weather Service web site available to the public at: https://hads.ncep.noaa.gov/index.shtm (NESDIS ID = 32B3A324, NWSLI ID = WDCA2). Water quality is monitored at the downstream end of the reclamation area utilizing an automated YSI 6600 multi-parameter water quality meter recording water temperature, conductivity, pH, turbidity, and dissolved oxygen at 15-minute intervals.

The BLM has a strong commitment to assess and learn from restoration outcomes while improving the health and resilience of our streams. Documenting the highly variable flow dynamics and water quality of Wade Creek to better assess sediment transport and erosion potential is relevant to this project, as well as the design of future restoration efforts.

Long-term quantitative stream flow monitoring using established monitoring protocols and standard statistical procedures will provide a valuable record of magnitude, duration, and frequency of flow events. This will allow BLM Alaska to evaluate and improve effectiveness of restoration efforts in placer-mined watersheds.

This project involved funding from the Healthy Land Initiative, as well as from several other programs. In future years efforts to monitor the project will include aquatic AIM methods, as well as terrestrial AIM techniques on the floodplain and transplant source areas.

Wade Creek stream gage and meteorological monitoring station.

Measuring stream discharge utilizing an acoustic doppler current profiler (ADCP).

HEALTHY LANDS & JACK WADE CREEK DEMONSTRATION PROJECTS

In 2015, the BLM completed a stream demonstration project on lower Jack Wade Creek (JWC) in the Fortymile River drainage. This area was mined from the early 1930s and into the 1940s using a large mechanical dredge, which left large tailings piles and unstable stream conditions that persist today. Portions of the watershed are still being mined using more traditional mechanical placer mining techniques, but the mining claims on the lower sections of creek were abandoned in the 1980s and 90s.

Heavy machinery is commonly used to access gold deposits in stream channels located on federal mining claims. During this process, the streambed, streambanks, and riparian vegetation are removed to access gold-bearing fluvial deposits, which may extend to the bedrock. One of the requirements after mining has been completed is for the operator to reconstruct a stable channel and rehabilitate fish habitat. Generally speaking, this is accomplished by reconstructing a stable channel that will maintain the pattern, dimension, and profile that was present prior to mining and has adequate riparian vegetation to reduce erosion and dissipate stream energy. The problem is that the techniques used rarely achieve those requirements. Conventional techniques have been to simply regrade the valley, create a pilot channel, and then allow natural channel forming processes and revegetation to occur and this usually takes decades in this subarctic environment.

The project goal is to demonstrate new techniques for reclaiming placer mined streams in Alaska that meet the aforementioned requirements within a few years. To accomplish this goal, the BLM contracted with veteran stream practitioners who recommended using similar techniques as those commonly used in the lower 48. Those techniques included using geomorphic data from stable streams in nearby basins as a design guide, as well as natural stream bank stabilization techniques to reestablish natural channel and floodplain function. The project has, and will continue to, serve as a classroom for local miners, resource specialists, and outside agencies through workshops, tours, and long-term monitoring.

So far, the project appears to be a great success by creating a stable stream channel and streambank riparian vegetation that can dissipate stream energies and prevent erosion within 1 year. Monitoring data show that pool depths and the pattern, profile, and dimension have been maintained since it was constructed, and the numbers of Arctic grayling have increased substantially based on visual surveys. In 2016, fisheries staff monitored the project by retaking photos at established photo points. Staff also used aquatic AIM methodologies to monitor any change in the stream channel and riparian vegetation, which will be compared to the post-construction measurements taken in 2015. This project will be monitored well into the future. This project involved funding from the Healthy Land Initiative and from several other programs. In FY 2016-2020, efforts to monitor the project will utilize aquatic AIM methods, as well as terrestrial AIM techniques on the floodplain and transplant source areas.

JWC Demonstration Site #1 (MP85) prior to construction (left) and one year after construction (right).


JWC Demonstration Site #1 (MP85) prior to construction (left) and one year after construction (right).


JWC Demonstration Site #1 (MP85) prior to construction (left) and one year after construction (right).

Tour of the JWC Demonstration Site #1 (MP85) with agency staff and members of the BLM Alaska Resource Advisory Council.

JACK WADE CREEK DEMONSTRATION PROJECT #2

In 2016, BLM Alaska completed another stream project in the Jack Wade Creek drainage. The project goal was to stabilize an eroding streambank that was encroaching on the Taylor Highway. The project also demonstrated alternative techniques, as opposed to armoring the bank with rip-rap rock, for stabilizing streambanks and improving fish and wildlife habitat.

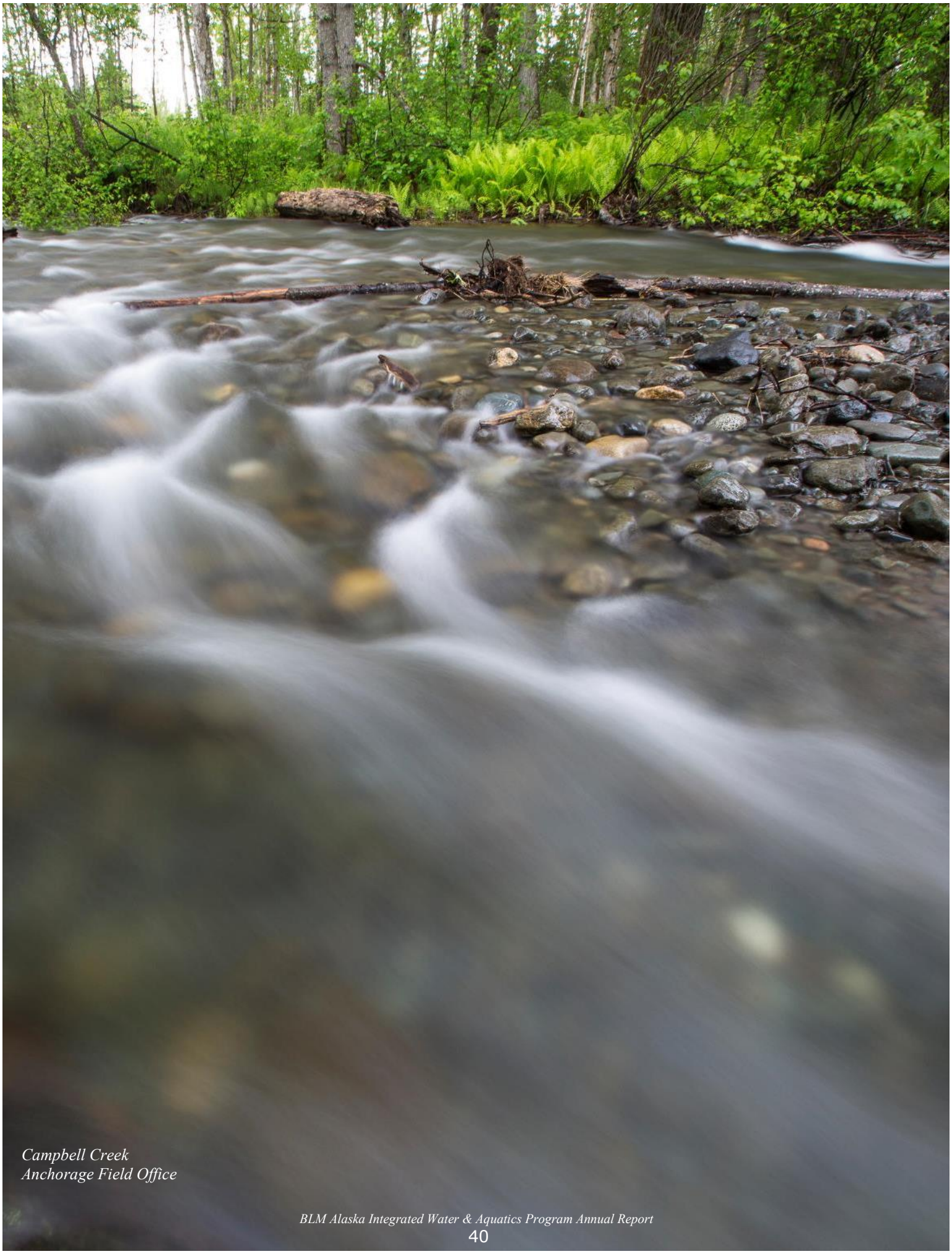
A few years ago the abandoned Jack Wade Creek dredge was removed from the stream due to liability and safety concerns. Once removed, the stream began cutting into the unstable and un-vegetated hill slope. The BLM worked with the same veteran stream practitioners to design and construct instream structures that re-direct streamflow towards the center of the channel and use natural vegetation techniques to stabilize the eroding streambanks. To accomplish this, a bankfull bench was constructed at approximately 5 feet wide and 400 feet long, willows and woody debris were transplanted along the bench, and 5 low-profile instream J-hook rock vane structures were installed in the reshaped channel to direct high flows away from the right bank.

Although not even a year old, the project appears to be a great success by creating a stable stream channel and streambank riparian vegetation that can dissipate stream energies and prevent erosion. The rock vane structures also improved fish habitat by creating preferred pool habitat for Arctic grayling in a stream reach that was previously dominated by shallow riffle habitat.

JWC Demonstration Site #2 (MP86) prior to dredge removal in 2007 (left) and after dredge removal in 2013 (right).

(Left) JWC Demonstration Site #2 (MP86) in 2015 illustrating significant bank erosion and impacts to the adjacent road right-of-way. (Right) Site #2 a month after stabilization.

Mosquito Fork
Eastern Interior Field Office



Campbell Creek
Anchorage Field Office

ANCHORAGE FIELD OFFICE

WATER RIGHTS DATA COLLECTION

Based on the likelihood of future mineral development in the Bering Sea-Western Interior region, BLM Alaska has initiated efforts to secure water rights on streams with high aquatic resource values in the region. In 2016, AFO staff completed 3 field trips using a helicopter to collect stream discharge information on 2 streams that flow into the Carter Spit Area of Critical Environmental Concern. This was the third year of data collection, with an addition 2-3 years needed for submitting an application for instream flow reservations. In addition to discharge, staff deployed data loggers to monitor water and air temperatures hourly throughout the year.

Ben Stratton collecting stream discharge at Cripple Creek.

PLATINUM WATER QUALITY AND DISCHARGE MEASUREMENTS

The Salmon River watershed is largely managed by the BLM and USFWS. Several platinum mining operations exist on BLM-managed lands and there is a history of water quality and fish passage issues within the basin. In 2016, staff conducted 3 monitoring inspections to deploy and retrieve equipment. This was the first year of a cooperative project with USFWS Togiak National Wildlife Refuge and USFWS Anchorage Water Resources to install equipment on the Salmon River just downstream of the Platinum Mine site administered by the BLM.

The BLM was assisted by USFWS with equipment and installation of a GEOS satellite transmitter for continuous satellite monitoring of the YSI EXO II Sonde for measuring turbidity, temp, pH, conductivity, ORP, DO, and TDS. The satellite antenna, data recorder, and various equipment from USFWS provides an hourly readout of YSI sonde measurements. Staff conducted 3 stage discharge measurements, and downloaded and redeployed Hobo air and water temperature loggers for recording data hourly throughout the year.

During the July 27 inspection, staff observed several thousand salmon present in the Salmon River consisting of Chinook, chum, pink, and sockeye unable to migrate above several instream barriers through mined channels. Salmon were unable to migrate upriver due to blocking of a portion of the river from lack of water. There appears to be 3 portions of the river that restrict access for salmon at the identified flow level. Staff installed a Hobo temperature sensor on May 28, 2016, in a dry section of river and recorded temperatures at the site hourly. From this data, staff identified that salmon were unlikely able to migrate from deployment on May 28, 2016 until July 30, 2016. On July 30 , salmon were likely able to migrate for 2 days and then again on August 6, 2016 for 5.5 days.

Satellite transmitter at Platinum Creek.

Platinum mine Salmon River dry section of mined river.

UNALAKLEET RIVER WEIR AND SUBSISTENCE MANAGEMENT

The BLM assisted ADF&G, Norton Sound Economic Development Corporation (NSEDC), and the Native Village of Unalakleet with the installation of the Unalakleet Weir. The weir is an ongoing 6-year cooperative project to monitor escapement of salmon and collect age, sex, and length (ASL) data on salmon, with another 2 years funded through an Office of Subsistence Management (OSM). Two BLM employees (Ben Stratton and Merlyn Schelske), and a BLM funded Alaska Native Science and Engineering Program (ANSEP) student (Jessica Mute) assisted with the installation of the weir.

In addition, the BLM continued water and air temperature data collection on two major rivers that contribute to the Unalakleet River—the Old Woman and North rivers. Hobo temperature sensors have been deployed at spawning location in these two rivers for 4 years, collecting hourly air and water temperatures.

Floating resistance board weir on the Unalakleet River provides critical information to BLM Alaska regarding salmon escapement.

CLIMATE CHANGE, SALMON LAKE, AND SOCKEYE SALMON

Climate change influences on the distribution of fish, especially key subsistence species like salmon, is a key question for fisheries managers. Salmon Lake represents the northern edge of sockeye salmon distribution, making it ideal to study changes in escapement and run timing.

The BLM has been a partner with USGS and NSEDC on an Arctic-Yukon-Kuskokwim Sustainable Salmon Initiative (AKASSI) funded project for 4 years, contributing personnel and equipment to the project. This year was the final year of the project with several publications, in preparation as a result of the study, including key results relating to changes in escapement timing for sockeye salmon returning to Salmon Lake.

Michael Carey (USGS) places a temperature sensor in the waters of the Imuruk Basin.

Michael Carey (USGS), Dereka Chargualaf (USGS), and Ben Stratton sampling spawning sockeye salmon at Salmon Lake.

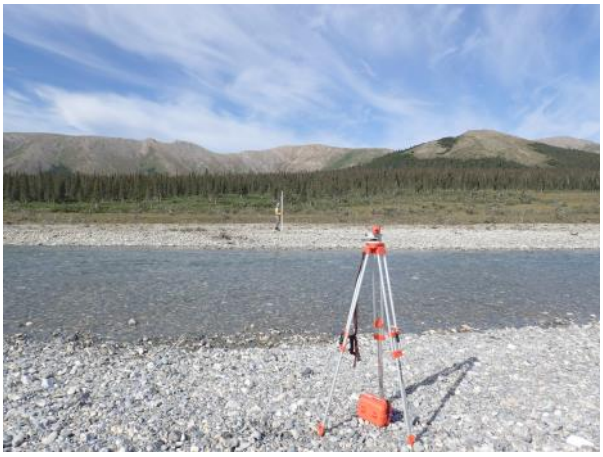
SQUIRREL, KIVALINA, AND TAGAGWIK RIVERS SURVEYS

In 2016, BLM Alaska staff conducted inspections of Special Recreation Permit (SRP) sites that were reported to have impacted riparian areas. The survey revealed that few sites had actually been impacted by authorized activities. In addition to inspecting SRP sites, a cross-sectional survey and discharge measurements were collected on the Squirrel River. These data are essential to the development of regional hydraulic geometry curves, which are useful for restoration planning and stream design. Air and water temperature sensors were also deployed as part of a long term monitoring strategy in the region.

The Kivalina River was also inspected and temperature sensors deployed at one of the largest chum salmon spawning areas on the Kivalina River. The BLM also assisted USGS in collecting Dolly Varden from the Kivalina River for genetic and isotope sample analysis as part of an ongoing USGS study.

The BLM also conducted a survey of the Tagagawik River for sheefish. The Tagagawik River was nominated by USFWS as an ACEC in the BSWI RMP for sheefish spawning and cultural significance.

Three days of helicopter time was needed to accomplish inspections and surveys of these remote lands in Northwest Alaska.



Setting up to complete a cross sectional profile of the Squirrel River.

Kivalina River.

SHEEFISH AND THE BIG RIVER

BLM Alaska Hydrologist Ben Stratton, Archaeologist Jenny Blanchard, and Fisheries Biologist Merlyn Schelske conducted an aerial survey of the Big River, flying via helicopter on September 27, 2016. The Big River has been identified through telemetry studies by the ADF&G as the primary location where the majority of sheefish spawn in the Kuskokwim River drainage. Sheefish is the largest member of the whitefish subfamily and can live 20-30 years. They are an important subsistence food and culturally important in western Alaska. To ensure the conservation of the species, the staff have identified portions of the Big River watershed as a potential ACEC in the Bering Sea-Western Interior RMP, which is under development. The AFO is also planning to begin conducting stream discharge measurements in 2017 as part of an effort to obtain instream water reservations.

Big River.

RED DEVIL FISH TISSUE AND RADIO TELEMETRY STUDY

The BLM has led a multi-year and multi-agency effort since 2010 designed to characterize the levels and potential sources of mercury in priority fish species within the middle Kuskokwim River, which includes the Red Devil Mine (RDM) site. Assistance from the ADF&G, as well as the USFWS, was essential during the study's design and implementation. People living along the river were also key to the study's success, since they provided invaluable assistance on where and when to collect fish samples for the targeted species. The USFWS, which has extensive expertise in analyzing contaminant data, led the preparation of the interim 2012 and final 2016 reports for the project.

The natural geology of the region includes numerous mineralized areas that contain roughly 69% of all the known mercury deposits in Alaska. Those same mineral deposits also contain other metals, including arsenic and antimony. The results of other fish contaminant studies in western Alaska since the mid-1990s show measurable concentrations of mercury in predator fish species in both the Kuskokwim and Yukon rivers. Based on that previous research, the BLM focused this study on metals, emphasizing mercury because it is shown to accumulate in larger predatory fish that are an important subsistence resource.

Since 2010, the BLM and ADF&G have collected tissue samples from over 1,200 fish from the Kuskokwim River and 17 of its tributaries, covering roughly 730 miles of stream. Of those sampled fish, nearly 570 were tagged with radio transmitters, and their movements were tracked over a 1-2 year period. The tracking data allows agency staff to correlate mercury concentrations in the tagged fish's tissue with the amount of time that the individual fish spent in specific areas of the Kuskokwim Basin.

This study found the greatest concentrations of mercury were captured northern pike (*Esox lucius*) associated with the George, Holitna, and Takotna rivers, which are major tributaries of the Kuskokwim River, but well outside the influence of the Red Devil Mine. Radio telemetry data found that adult pike within these rivers seldom move into the Kuskokwim River; therefore, their mercury burden appears to be a direct result of mercury exposure in those watersheds and not from other sources in the Kuskokwim River (see Figures on the next page).

Using multivariate regression analysis, a correlation was detected between the fish tissue concentration levels and the number of mines, which have known cinnabar (mercury) deposits associated with the primary ore body, within the watershed. In the Holitna River, one potential source of mercury could be Cinnabar Creek. The study found that fish from Cinnabar Creek, as well as Red Devil Creek, had elevated concentrations of mercury and arsenic compared to fish from tributaries where no mining had occurred. Detecting elevated mercury concentrations in fish near mined streams was expected based on past studies from the Kuskokwim and Yukon rivers. Arsenic levels were also expectedly high from fish collected near mined areas; however the proportion of inorganic arsenic was much higher than typically observed in fish.

RDM prior to stabilization of the tailings. The creek is in the foreground at the base of the eroding tailings.

RDM after interim stabilization efforts were completed to reduce mobilization of mine tailings into the creek.

ADF&G and staff from the Kuskokwim Native Association implanting a transmitter in a captured burbot.

(*continued from previous page*)

Prior to this study, fish consumption guidance to limit mercury exposure was issued by the State of Alaska for pike in the lower Kuskokwim and lower Yukon rivers. Information from this study led the State of Alaska to issue guidance for the middle Kuskokwim basin that included burbot (*Lota lota*) and pike. Fish consumption guidance for the Kuskokwim region can be found at: http://bit.ly/2dqa1nt

The results of this study illustrate that many natural mercury deposits and historic mine sites are adding mercury to the Kuskokwim watershed, which occurs within a highly mineralized region of western Alaska. These data will help subsistence users identify species and area combinations that will minimize mercury exposure from eating fish, especially for women of childbearing age and children.

The integrated final report is scheduled for release in February 2017 and will help address concerns about mercury and other contaminants in fish from the abandoned Red Devil mercury mine, currently undergoing cleanup, and other abandoned mines in the mid-Kuskokwim region.

Pike, which had consumed a small mammal, being prepped for lab analysis.

Pike from the Takotna River with internal anchor tag antenna visible.

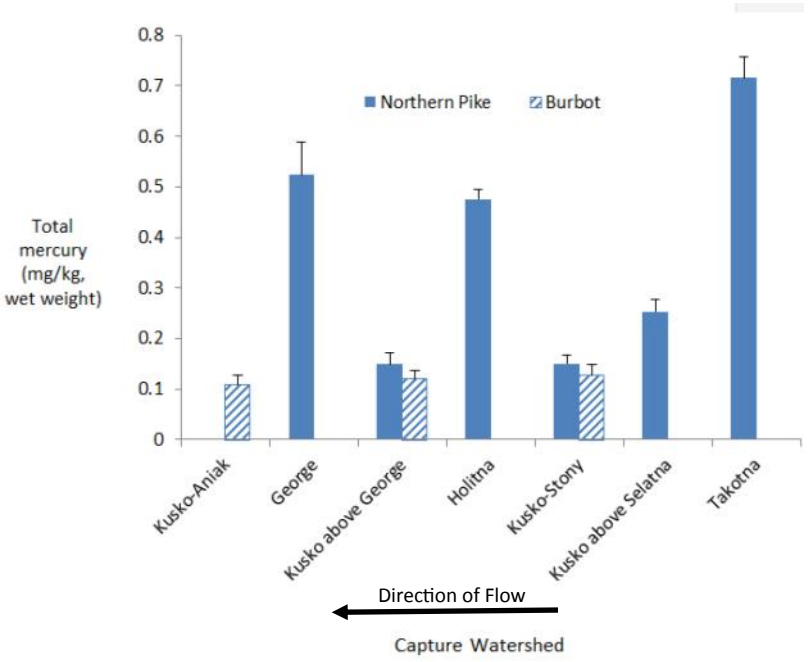


Figure 1. Total mercury concentrations (mg/kg, wet weight) (+ SE) in muscle biopsies of telemetered northern pike and burbot ("lush") across capture watersheds in the mid-Kuskokwim River region, Alaska, USA, 2011-2013.

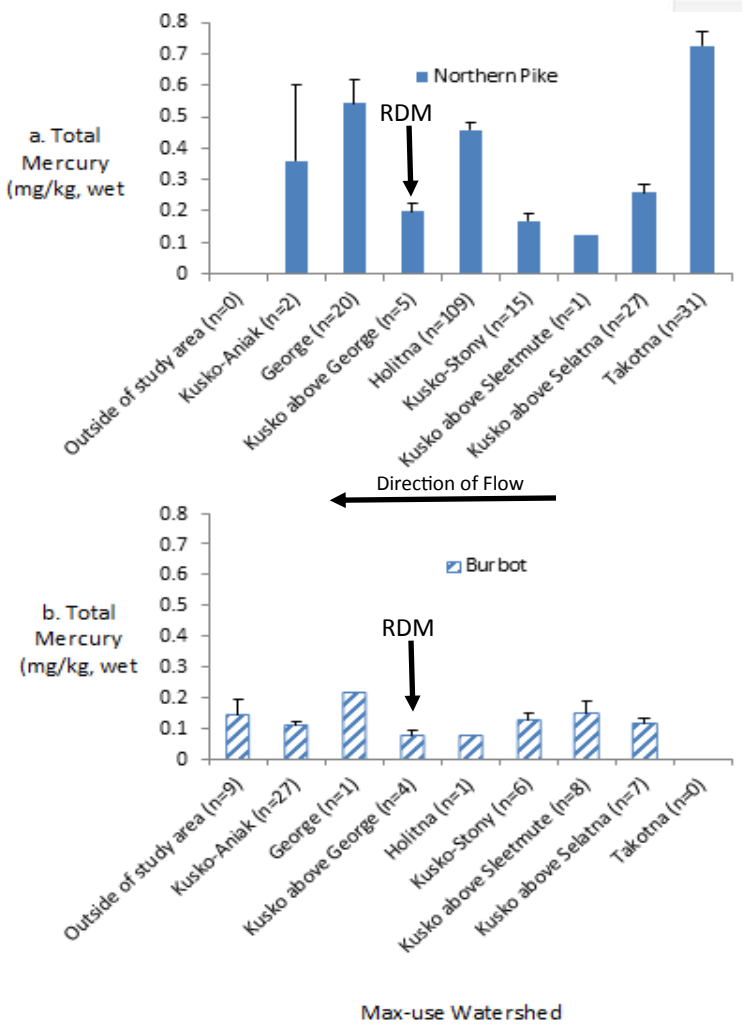


Figure 2a,b. Total mercury concentrations (mg/kg, wet weight) (+SE) in muscle biopsies of telemetered northern pike (4a) and burbot ("lush") (4b) across watersheds with the highest proportion of locations for individual fish (max-use watersheds) in the mid-Kuskokwim River region, Alaska, USA, 2011-2013.

Delta Wild and Scenic River
Glennallen Field Office

GLENNALLEN FIELD OFFICE

GULKANA FISH TOWER

The Gulkana River was designated a Wild and Scenic River and is managed by the BLM Glennallen Field Office (GFO). The river's fisheries values were recognized as an Outstandingly Remarkable Value (ORV) in the Gulkana River Management Plan. Chinook salmon are the keystone species of this watershed. The Gulkana River is a major tributary of the Copper River, which supports one of the largest Chinook and sockeye salmon subsistence fisheries in Alaska. Copper River Chinook and sockeye salmon are two of the most sought-after fish in the world. While commercial, subsistence, and personal-use salmon fishing does not occur directly in the Gulkana River, many of the Copper River Chinook and sockeye salmon originated from the Gulkana River and are returning to spawn.

A primary management objective of the ORV is to cooperate with ADF&G in monitoring Chinook salmon returns. Gulkana River Chinook salmon escapement monitoring (counting the returning salmon) by the BLM and ADF&G provides the only annual estimate of Chinook salmon escapement in the Copper River watershed and will continue a data set that currently spans 13 years.

Since 2002, Chinook salmon returns to the Gulkana River have declined precipitously. This year's return was the lowest on record. The in-season estimate of Chinook salmon escapement provided by this project has become extremely valuable for evaluating Gulkana River Chinook salmon run strength to ensure adequate escapement from downstream subsistence, commercial, personal-use, and sport fisheries. A dismal Chinook return this year prompted an early closure. The data that supported these management decisions was data applied from this project. This closure management decision was critical in ensuring future returns of Chinook and sockeye salmon to the Gulkana River and maintaining the fisheries ORV for this Wild and Scenic River.

Aerial view of the Gulkana River fish counting towers.

To make passing fish more visible and provide a well-defined manner of delineating passage, a continuous 2m-wide band of light-colored vinyl panels is anchored to the river bottom.

AIM-NATIONAL AQUATIC MONITORING FRAMEWORK IN THE GFO

In 2016, as part of the statewide implementation of aquatic AIM, the BLM GFO began its efforts on BLM-managed lands in the northern portion of the Field Office. The overall project goals were to: 1) determine the condition and trend of aquatic resources (i.e., water quality, geomorphic processes, aquatic biodiversity and riparian vegetation) in the GFO; 2) determine stressors contributing to degraded conditions and, 3) obtain thresholds of stream attributes to be able to show desired conditions for aquatic resources in the region. During this effort, twenty-five reference and 4 targeted wadeable stream sites were sampled. Targeted sites included areas which are impacted by historic and on-going placer mining.

(Left) AIM crew member sampling substrate in the icy water. (Above) AIM crew beginning to survey an impacted placer mined stream in the Valdez Creek watershed.

GULKANA ARCTIC GRAYLING TELEMETRY

The Gulkana River is a designated Wild and Scenic River managed by the GFO. The river's fisheries values were recognized as an ORV in the Gulkana River Management Plan. The majority of previous fisheries studies to date have been salmon-centric and concentrated on the mainstem of the Gulkana River. In an effort to better understand Arctic grayling use in the Gulkana, BLM Alaska initiated a cooperative study with the ADF&G. In 2016, 126 radio telemetry tags were surgically implanted in Arctic grayling distributed throughout 45 miles of the Gulkana River. The tags will be used to monitor movements to see which habitats are being used at different life stages. The first tracking flight was flown in November 2016 to examine the overwintering habitat that is being utilized. An interesting life history trait that has already emerged was that there were three distinct fish groupings of grayling; fish that were tagged highest in the drainage remained high in the drainage, fish tagged in the middle of the drainage migrated to the lower drainage, and fish tagged in the lower drainage remained lower drainage. In late May, the project team will begin to follow the fish to their spring spawning locations. This study is providing the data needed to document important Arctic grayling life stage activities (spawning, rearing, and migration) to create fish periodicity tables for the water rights application (see story on next page).

Underwater image of an Arctic grayling captured during the study.

PROJECT HEALING WATERS

The GFO and BLM Fairbanks District Office joined with Project Healing Waters (PHW)-Alaska, Wrangell Institute of Science and Environment, and devoted volunteers to host the 6th annual Tangle Lakes Project Healing Waters event. Project Healing Waters is a nationwide non-profit organization that is dedicated to the physical and emotional rehabilitation of disabled active military service personnel and veterans through fly fishing.

Last June, PHW participants traveled to the BLM-managed Delta Wild and Scenic River and Tangle Lakes, for three days of awesome fishing and camaraderie. A recent study showed that the density of Arctic grayling in the Delta River was the greatest ever observed among published density estimates for Alaska rivers.

Each day of PHW, participants and volunteers loaded into 5 jets boats provided by the BLM, and headed out onto the Delta Wild and Scenic River in search of grayling and lake trout. Each participant caught and released 30 to 100 grayling per day with most averaging 10 to 16 inches on bead head nymph flies and dry flies. This year, PHW also sponsored three participants from other PHW programs in North Carolina, Tennessee, and Fairbanks, Alaska. It was the participants' first fishing experience in Alaska and they were thrilled to catch so many Arctic grayling. Dave Roker, Vietnam Pilot, (age 80) summed up the trip: "It was a trip of lifetime; I caught over 100 Arctic grayling." Military service personnel had an unforgettable experience catching this beautiful and unique fish and learning about this extremely productive aquatic ecosystem.

2016 PHW participants and volunteers.

SFC (ret.) Manfred Aponte U.S. Army | Kosovo, Iraq & Afghanistan, displaying an Arctic grayling.

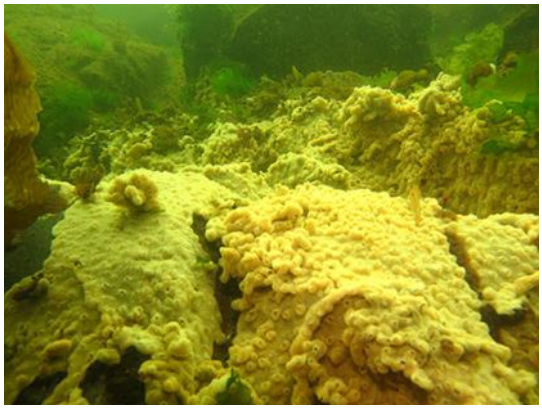
GULKANA RIVER WATER RIGHTS ADJUDICATION

To conserve fisheries resource values on the Gulkana WSR, the BLM has worked to acquire instream flow reservations for the entire Gulkana watershed. This year, fish periodicity tables were created for seven reaches of the watershed. Fish periodicity tables delineate life stage activity by timing for each species of interest. Life stage activities include adult and smolt migration, spawning, incubation, and rearing; which was determined for Chinook and sockeye salmon, steelhead, rainbow trout, Arctic grayling, and longnose sucker. Fish periodicity data for defining stream reaches and flow requirements were obtained and summarized from extensive reviews of scientific literature and personal communication from local fisheries biologists. In addition, detailed hydrology studies were completed to revise the original water rights application during adjudication.

Gulkana River winter streamflow.

SEA SQUIRT INVADES BLM SUBMERGED LANDS IN SE ALASKA

An invasive marine invertebrate known as "marine vomit" that can smother native species was found within Whiting Harbor in Sitka, Alaska in 2010. This non-native carpet sea squirt, *Didemnum vexillum*, (D. vex) is thought to be native to Japan. Based on growth of the sea squirt on Georges Bank on the east coast of the U.S. and populations globally, Federal and State biologists feared it would spread into Sitka Sound and then widely along the Alaska coast. The ADF&G, the Smithsonian Environmental Research Center (SERC), and the BLM joined together to begin a plan of action to tackle this invasive species. Managing marine ecosystems is a rare case for BLM involvement. The intertidal and filled submerged lands within Whiting Harbor were once withdrawn for use by the Navy during World War II and are now BLM-managed lands. D. vex is a filter-feeding marine invertebrate that forms large sheet-like colonies that carpets the seafloor and encapsulates hard structures and sessile competitors. D. vex is an aggressive colonizer that reproduces rapidly, altering marine benthic habitats and fouling ship hulls, moorings, docks, and boat ramps. There is concern that Pacific herring spawning beds in areas of D. vex infestation could be vulnerable to it, which could have negative impacts on the subsistence and commercial Pacific herring fisheries. The Whiting Harbor discovery represents >620 miles northward change in distribution from other known occurrences of D. vex in the Northwest Pacific. No other D. vex populations are known in Alaska.

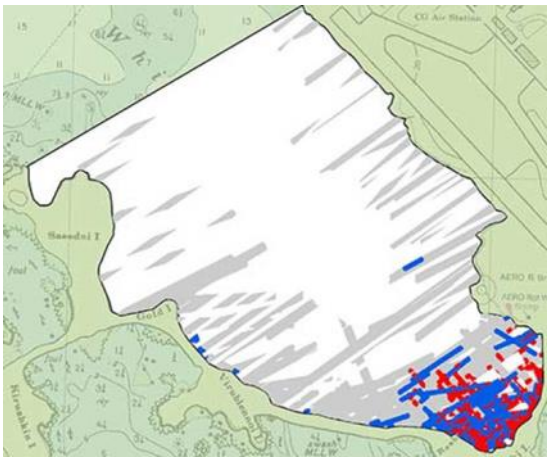


Underwater photo of D. vex carpeting subtidal boulders of Whiting Harbor.

D. vex reproduces both sexually and asexually, and can create new colonies through fragmentation and cloning. Lobes can break off, drift away, and settle on a new surface to grow on. D. vex is capable of living at a range of temperatures, salinities, and depths. These characteristics make it highly invasive and make eradication especially challenging because it can be further spread by recreational boating, marine shipping, drifting on floating material (algae, Styrofoam, debris, or buoys), cleaning of infested boat hulls, or transfer of shellfish stock or aquaculture equipment. The worst case is found in George's Bank between Canada and the U.S. in the Northwest Atlantic, where it covers and estimated area of 77 square miles.

Whiting Harbor, BLM-managed lands.

This summer, research divers from ADF&G and the Smithsonian Environmental Research Center went back to Whiting Harbor to replicate a dive survey that was completed in 2012 to delineate changes in the distribution of D.vex over the past four years. With transect rods, compasses and plenty of air in their tanks, three teams of SCUBA divers swam 94 transects throughout Whiting Harbor over a five-day period. An ADF&G biometrician then converted the transect data collected by the divers to create a map of the distribution and the percent cover of the D.vex (see map). The D. vex infestation in Whiting Harbor was detected on 176 acres of Whiting Harbor.



Changes in presence and percent cover of D.vex from 2012 to 2016. Blue indicates a decrease in occurrence, red indicates an increase in occurrence, areas not surveyed in both 2012 and 2016 are white, and grey represents no change.

One key observation during the survey was that the northernmost discrete population of D. vex along the northwest arm of Whiting Harbor was no longer detected. Divers spent a fair amount of time looking for this population and the head of the bay still has a patchy distribution of D. vex on the seabed. The initial analysis indicates the populations of the D. vex tunicate in Whiting Harbor is changing. In the coming year, ADF&G will continue to partner with the Smithsonian Environmental Research Center and the BLM to continue investigating options to eliminate the invasive tunicate from Alaska.

FAMILY ICE FISHING DAY

About 120 people converged on Silver Lake along the McCarthy road in April 2016 for the 6th annual Family Ice Fishing Day. This popular annual event is sponsored by the BLM - Glennallen Field Office and Wrangell Institute for Science and Environment (WISE).

The BLM, WISE, and volunteers were on hand to teach kid's ice fishing techniques, lure and bait selection and presentation, knot tying, and ice safety. The bite was hot and over 75 rainbow trout were caught. An underwater video camera also added to the excitement and kids observed how rainbow trout responded to their lure and bait presentations. It was great to see fishing values being formed in the kids who participated alongside their parents, chaperones, and friends. The annual Family Ice Fishing Day excites a life-long interest in winter ice fishing and creates outdoor memories.

Fish creating big smiles: Girls 1, Boys 0.

2016 Family Ice Fishing Day.

AQUATIC ECOLOGY CAMP

Through a partnership with the BLM, WISE is able to bring local middle schoolers on three days of aquatic exploration at Silver Lake along the McCarthy Road. Literally getting their feet wet as acting field scientists, students take water samples, analyze oxygen levels, set fyke nets, make determinations and predictions of whether fish could be present in varying ponds and streams, study culvert placements and stream morphology, examine plankton, set minnow traps, dissect trout, study river dynamics on a stream table, and even learn to row a boat and cast a fly rod. The GFO supports with camp with a fisheries staff member that leads aquatic resource education topics. The GFO also provides sampling and fishing equipment for the camp.

GFO Fisheries Technician Dan Larson shows the kids the rainbow trout captured in the fyke net that they set.

Sorting and identifying aquatic invertebrates.

STREAM TABLE PRESENTATIONS

Stream tables are a powerful educational tool that demonstrates basic principles of river behavior. Students can see a broad range of river processes such as pool and riffle development, perched culverts, channel incision, meander and floodplain formation, bed material transport, incision, head cutting, and bank failures. The GFO and the WISE engage students in this way at Earth Discovery Day and in the local schools to explore river processes through hands-on learning.

Knee-high to a stream table.

Stream table presentation at Earth Discovery Day.

Tangle Lakes
Glennallen Field Office

MARS LITE: WORKING IN A CHALLENGING WINTER ENVIRONMENT

by Lisa Jodwalis, retired Park Ranger. Photos by Kelly Egger, Natural Resource Specialist; Ben Kennedy, Hydrologist; Erin Julianus, Wildlife Biologist; Dave Bachrach, Volunteer. This story appeared in the BLM Daily on February 4 and December 19, 2016.

In the following essay, excerpted from BLM's 2016 Dalton Highway Visitor Guide, recently retired BLM Alaska park ranger Lisa Jodwalis uses a recent Hollywood science fiction movie to highlight the challenges (and thrills) of a winter visit to the remote Dalton Highway, which connects Interior Alaska and the North Slope.

Lisa Jodwalis worked as a park ranger and ran the Arctic Interagency Visitor Center in Coldfoot from 2001 to 2008. She assisted the BLM hydrologist with snow surveys along the Dalton Highway from 2011 to 2013 and has driven the road in every month except January. She always made it home without freezing any digits.

In the book and movie "The Martian," astronaut Mark Watney struggles to survive alone on a desolate desert planet where the average temperature is -80ºF. Although he has trained for this and NASA has provided some awesome tools, anything that can go wrong, does. Only his determination, resourcefulness, and know-how keep him alive. But that's science fiction, right?

In reality, northern Alaska can be as cold, hostile, and unforgiving as Mars. Winter starts in September and tapers to an often-stormy end in May. From November to March deep cold sets in and temperatures often drop to -50º or -60º F. A Mars-like -70º or -80º F is not uncommon. Icy winds howl across vast open spaces. With just a few hours of light on the horizon, the Arctic's midwinter darkness would have doomed Mark Watney, who relied on solar panels to energize his Habitat (camp) and rover.

The extreme weather, road conditions, and lack of services make venturing up the Dalton Highway in winter something like a Mars expedition. In fact, Watney had more resources available in the Habitat than travelers have along the Dalton. Gas? Stations are 250 miles apart. Food or grocery stores? If you don't stock up in Fairbanks you're out of luck. A warm place to stay? You may find a few vacancies in Coldfoot but the prices are steep. Advance reservations are essential for the handful of rooms in Wiseman, and bring your own food. Oilfield workers fill all lodgings in Deadhorse. Camping out? Only if you have arctic-grade expedition gear and experience assembling a tent with fast-freezing fingers.

Low-lying fog obscures the Dalton Highway on a frigid day in the upper Koyukuk River valley. (BLM photo by Kelly Egger)

Natural resource specialist Kelly Egger holds a thermometer reading -55 degrees Fahrenheit during one of the monthly snow surveys that BLM Alaska conducts along the Dalton Highway. (BLM photo by Ben Kennedy)

Before Watney set out on a 1,920-mile cross-Mars trip in his rover, he made sure it was stocked for every contingency including food, water, tools, space suit (for outside excursions), even containers for his personal waste. (Note, outhouses on the Dalton are not maintained in winter!) He planned for worst-case scenarios. If someone runs into trouble, it may be hours before another traveler passes. There's no cell phone service, so there's no way to call for roadside assistance. A vehicle, like Watney's rover, provides only a thin bubble of protection against the elements. Extreme cold can be paralyzing. Fingers, face, and toes are painfully numb within minutes of exposure, and frostbite can follow quickly.

A raven surveys the boreal forest from a black spruce tree south of the Yukon River. Ravens are among the hardy bird species that overwinter in northern Alaska. (BLM photo by Erin Julianus)

Yet the stark beauty of the arctic winter can reward the eye and heart: the northern lights glimmering overhead, a flock of ptarmigan lifting off like a whirlwind of winged snowballs, the setting sun afire beyond a storm of blowing snow crystals, each one lit like a diamond. It's a raw, breathtaking, unforgettable trip into winter's world. And if you're prepared you just might make it home.

The northern lights dance over Sukakpak Mountain, a Dalton Highway landmark in the Brooks Range. (Photo by Dave Bachrach)

Birch Creek—Steese National Conservation Area
Eastern Interior Field Office

BLM/AK/ST-17/008+6603+9130