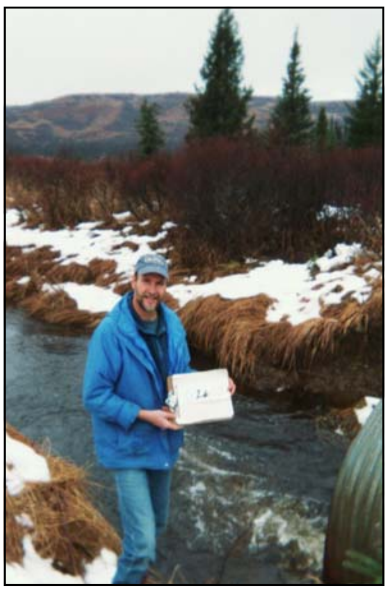
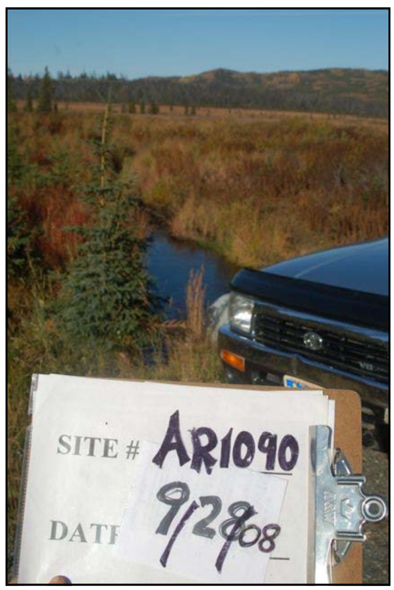
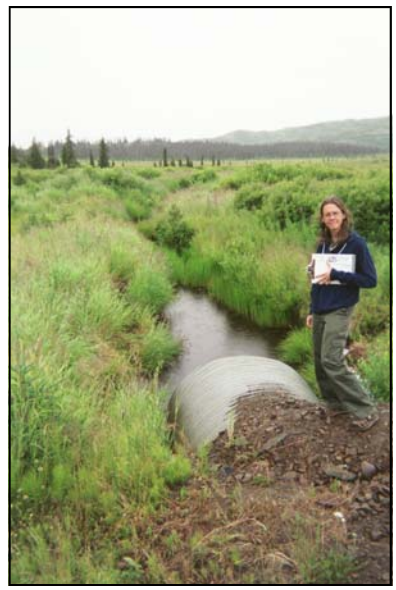
Citizens' Environmental Monitoring Program
Baseline Water Quality Report

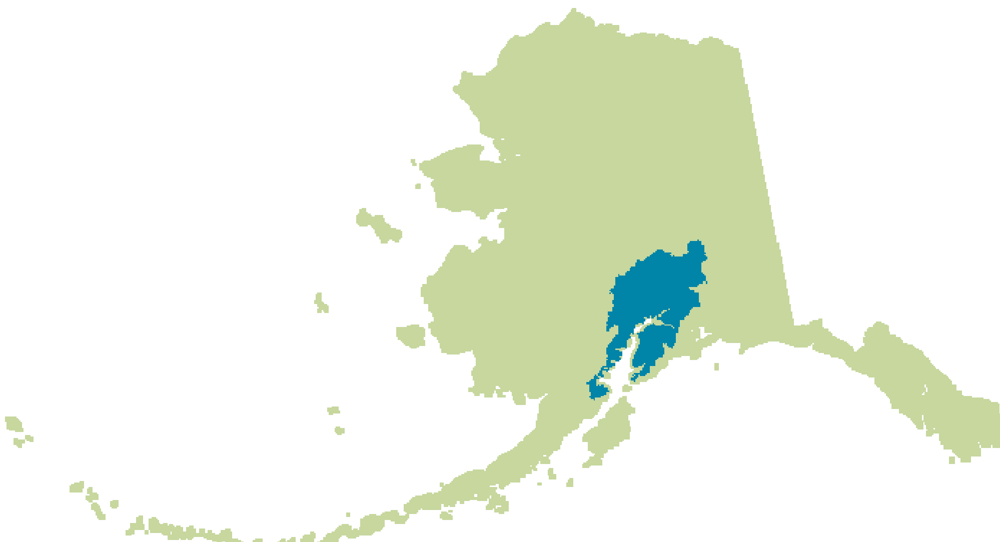






Beaver Creek

2002-2010



Cook Inletkeeper is a community-based nonprofit organization that combines advocacy, outreach, and science toward its mission to protect Alaska's Cook Inlet watershed and the life it sustains.

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INTRODUCTION

Citizens' Environmental Monitoring Program

With nearly a million miles of streams and rivers in Alaska, the lack of baseline water quality information—especially in populated regions such as Southcentral Alaska, home to the vast majority of Alaskans—may result in an inability to provide adequate oversight on future development. In response to this gap in knowledge, Cook Inletkeeper's volunteer water quality monitoring began in 1996 with the formation of the Citizens' Environmental Monitoring Program, known to many by its acronym—CEMP. The Citizens' Environmental Monitoring Program, the first of its kind in Alaska, is designed to meet the need for baseline water quality data for local watersheds around Southcentral Alaska. Baseline data collection is the primary aim of the CEMP model.

Neil (pictured above) and Kyra Wagner monitored Beaver Creek, a tributary to the Anchor River, from 2002 to 2010.

Many waterbodies in Alaska have not been polluted, and we rely on these systems to support our fish, wildlife, and human communities. Inletkeeper created the CEMP to provide Alaskans with the tools needed to be active stewards of our water and watersheds for future generations. By training citizen volunteers to monitor water quality we are empowering the community to keep its eyes and ears tuned to changes that may impact and threaten Alaska's water resources.

Baseline Reports

As we complete baseline data collection for a given waterbody, we create a baseline water quality report to compile watershed-specific information. Within these pages you will find background on the CEMP methods and quality assurance measures, GIS analyses of the individual watershed, and the water quality data we've collected through the years. Finally, each report provides suggestions for future monitoring efforts. It is our intention that these reports will become a comprehensive baseline water quality library which will provide landowners, city councils, developers, and communities with valuable information for responsible decision-making.

What are Baseline Data?

A baseline is defined as historical or reference information from which new data can be measured or compared. The Citizens' Environmental Monitoring Program collects baseline water quality data to better understand our current environment in a changing world. Population growth, increased development, and climate change are some of the catalysts for change which can alter the quality of our waterbodies. By collecting baseline data, we can track those changes and make better decisions to protect water quality for future generations. We use the following as guidelines for defining a baseline dataset:

- 5+ years of data with at least 80 site visits
- At least 40 site visits during summer months

- At least 5 site visits during every month of the year that the site was monitored

- 3 years of continuous temperature monitoring (at select sites)

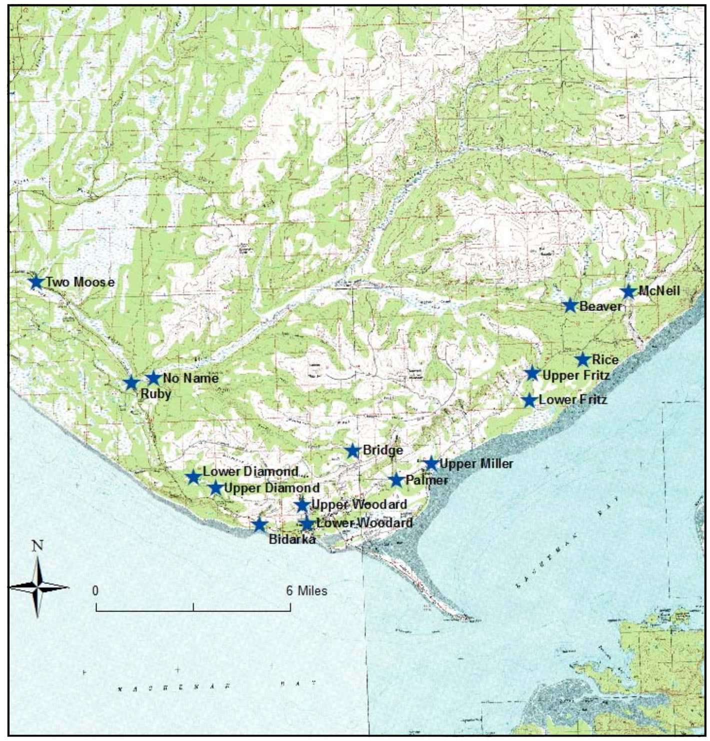
- 6 bioassessment sampling events over at least 3 years (at select sites)

For more information about these guidelines, see the CEMP Effectiveness Report (2003) available online at http://www.inletkeeper.org/CEMP/effectiveness.htm.

Kachemak Bay and Anchor River Watersheds

Inletkeeper's volunteer monitoring program in Cook Inlet has focused on surface water quality monitoring in the Kachemak Bay and Anchor River watersheds. To assist with the initial phases of developing and refining its Citizens' Environmental Monitoring Program, Inletkeeper convened a Technical Advisory Committee (TAC), comprised of water quality experts from across Alaska and beyond. To translate the recommendations of the TAC into workable implementation strategies, Inletkeeper convened a Citizens Advisory Panel (CAP), comprised of residents of the Southern Kenai Peninsula concerned about water quality. Together, the TAC and CAP provided Inletkeeper with invaluable input that shaped its monitoring program. Cook Inletkeeper's CEMP has trained over 300 volunteer water quality monitors since 1996. As of January 2011, over 2,000 observations have been made in the Kachemak Bay and Anchor River watersheds.

To meet its primary goal of baseline data collection in these watersheds, CEMP monitoring is focused on obtaining 5 or more years of complete datasets at individual sites within key sub-watersheds that flow into Kachemak Bay and the Cook Inlet via the Anchor River. The CEMP annual sampling schedule includes 16 site visits; a "complete dataset" has 75%, or at least 12 site



All of the CEMP sites that will have baseline water quality datasets completed by 2014. Baseline reports will be developed as datasets are completed. A full baseline water quality library from the efforts of the Kachemak Bay and Anchor River CEMP is anticipated by 2015.

visits, during the course of the year. Alternatively, a minimum of 80 site visits over the course of monitoring at a site may be used for a baseline dataset if other criteria are met. The map above shows the location of the sites that will have completed baseline datasets by 2014. Baseline reports for these sites will make up the baseline water quality library.

INTRODUCTION

CEMP Partnership of Southcentral Alaska

The Citizens' Environmental Monitoring Program (CEMP) was created by Cook Inletkeeper to actively engage citizen volunteers in the collection and distribution of important habitat and water quality data. By 1997, other organizations were interested in developing similar programs and the CEMP Partnership of Southcentral Alaska was formed. The Partnership developed guiding documents that are used by all Partner monitoring programs in the region. These documents include a Quality Assurance Project Plan, Standard Operating Procedures, and data quality objectives for all parameters. Since 2000 the Partnership has held an annual meeting in Anchorage in February. All CEMP Coordinators are recertified in testing methods, and a business meeting is held to discuss any proposed changes, challenges, or ideas for the Partnership in the coming year.

While each partner organization has a unique program, the CEMP Partnership has three priority objectives :

1. Inventory baseline water quality data in the waterways of Southcentral Alaska;

2. Detect and report significant changes and track water quality trends; and,

3. Raise public awareness of the importance of water quality through hands-on involvement.

As of 2010, the Partnership had trained over 700 citizens in water quality monitoring procedures described in the CEMP Quality Assurance Project Plan. Nearly 5,000 observations have been made at over 250 stream, wetland, lake, and estuarine sites in South central Alaska. Volunteers have contributed well over $550,000 of in-kind donations in helping the CEMP Partnership meet its objectives. In the coming years the Partnership will build its Baseline Water Quality Library with reports from around Southcentral Alaska. A contact list for current Partners can be found on the Inletkeeper website (http://www.inletkeeper.org)

Top: Jukes Lake, monitored through the Mat-Su Lake Monitoring Program. Bottom: CEMP monitoring with the Wasilla Soil and Water Conservation District.

CEMP Partnership Partners are (on the right from North to South):

Upper Susitna Soil and Water Conservation District (Talkeetna)

Wasilla Soil and Water Conservation District (Wasilla)

Mat-Su Borough Lake Monitoring Program (Palmer)

Anchorage Waterways Council (Anchorage)

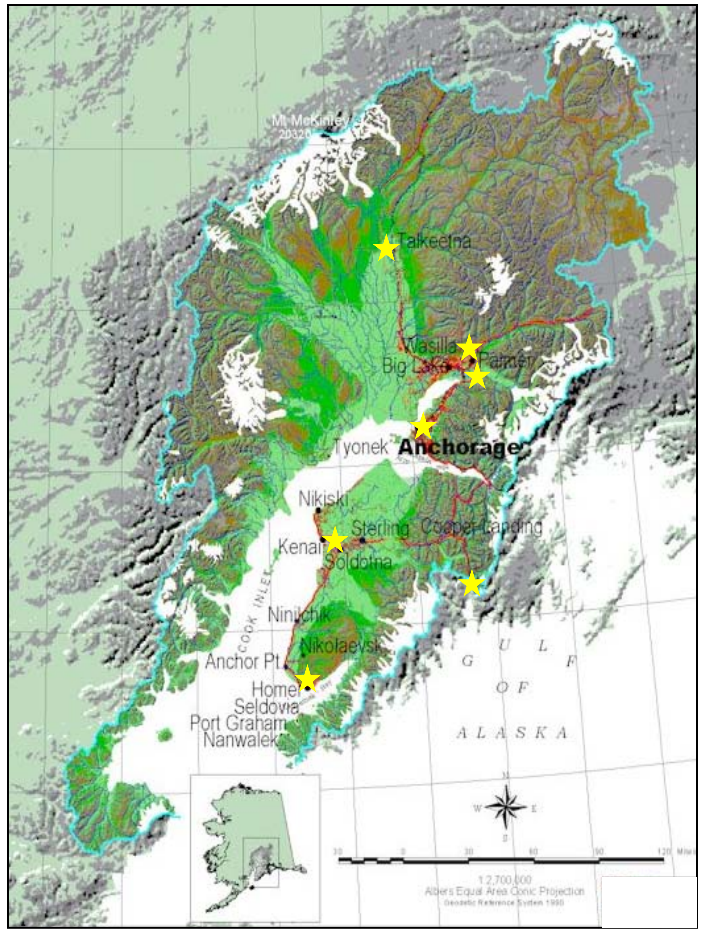
University of Alaska Anchorage Environment and Natural Resources Institute (Anchorage)

Kenai Watershed Forum (Soldotna)

Resurrection Bay Conservation Society (Seward)

Homer Soil and Water Conservation District (Homer)

Cook Inletkeeper (Homer)



Top: The Cook Inlet watershed with CEMP Partners represented with yellow stars. Bottom: Water quality monitoring and environmental education with the Anchorage Waterways Council.

METHODS

To ensure adequate quality assurance oversight and consistency of volunteer-collected data, Cook Inletkeeper staff follow the Quality Assurance Project Plan for Inletkeeper's CEMP. The Quality Assurance Project Plan (version 2002, updated in 2010) has been reviewed and approved by the Alaska Department of Environmental Conservation, the Environmental Protection Agency, and the project's Technical Advisory Committee. A Field Procedure booklet and Standard Operating Procedures outline detailed methods for sampling and data management. In accordance with the Quality Assurance Project Plan, many quality assurance and quality control measures are taken to validate the volunteer collected data, including training, Partnership-wide data quality objectives, and data management.

Volunteers learn how to follow protocols for collecting water quality data in the Inletkeeper lab during Phase II of CEMP training.

Training

Volunteers are required to complete Phase I through III of training to be eligible to collect data for CEMP. Phase I is an introduction to the watershed concept and monitoring procedures. Phase II is designed to teach the volunteers to use the monitoring kits and equipment. This phase involves both laboratory and field training. Phase III is an on-site training. Volunteers may begin monitoring on their own after successful completion of Phases I-III. Volunteer monitors must also attend an annual re-certification (Phase IV) training where they analyze blind performance evaluation standards and review monitoring procedures. Volunteers must complete a separate training in order to participate in biological monitoring. Trainings are offered once a year by University of Alaska Anchorage Environment and Natural Resources Institute certified trainers.

Data Quality Objectives

Volunteer monitors perform analysis on duplicate samples during each site visit. Replicate measurements are also taken for samples analyzed in the lab. Measurements must meet predetermined data quality objectives for sensitivity, precision, and accuracy. Data Quality Objectives for CEMP parameters used by Inletkeeper are included on the following page.

Data Management

The CEMP Coordinator reviews all data sheets for completeness. Volunteers are contacted if there are questions regarding the data sheet and monitoring event. The CEMP Coordinator enters all of the data into an MS Access database. This database was developed in 2000 in coordination with the Anchorage Waterways Council. It provides quality assurance checks on data entry and is used to review and summarize data for annual and baseline reports. As we complete baseline datasets, we are working with the Alaska Department of Environmental Conservation to migrate data into STORET—the Environmental Protection Agency's online repository for water quality monitoring data.

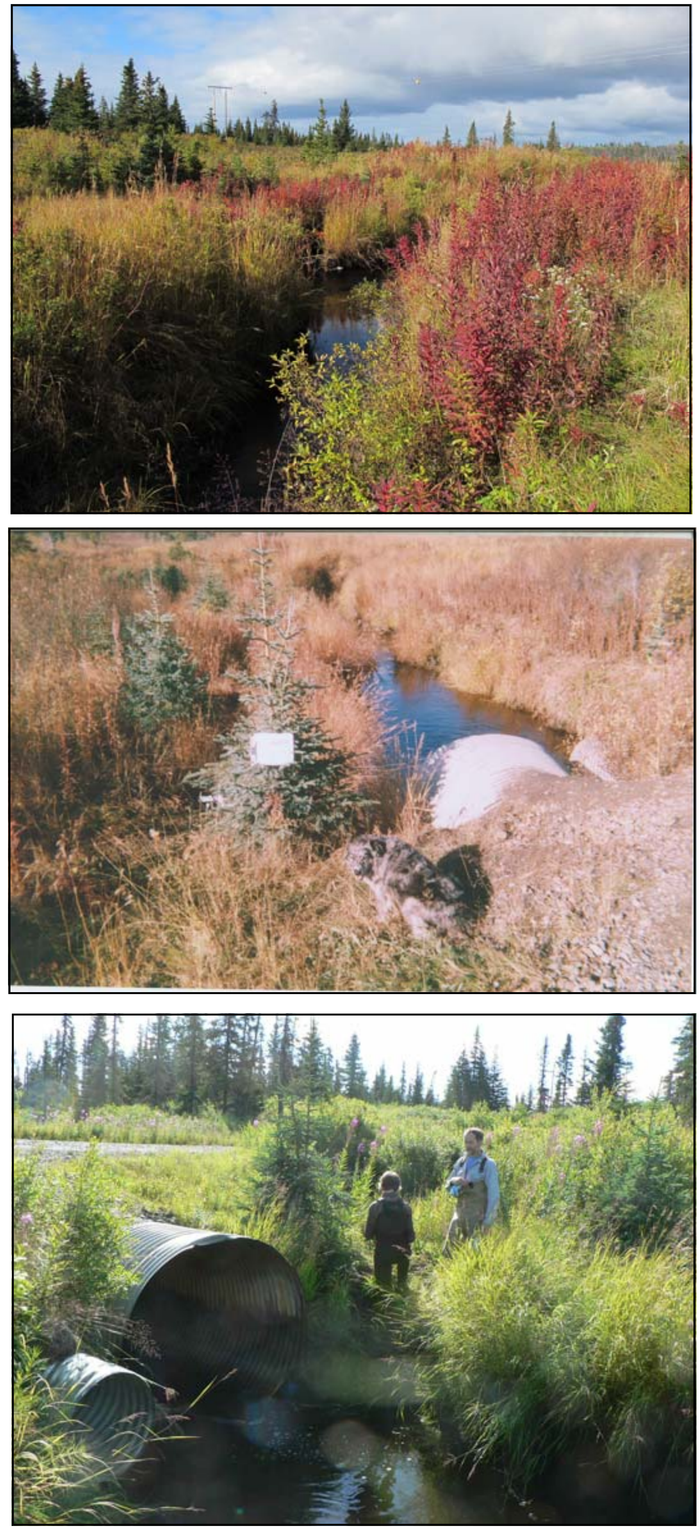
DATA QUALITY OBJECTIVES

Parameter	Method/Range	Units	Sensitivity (a)	Precision	Accuracy	Calibration Method
Air Temperature	Thermometer -40 to 120°F	Degree Farenheit (°F)	1.0°F	±1.0°F	±1.0°F	NIST Certified Thermometer
Water Temperature	Thermometer -5.0 to +50.0°C	Degrees Celsius (°C)	0.5°C	±0.5°C	±0.5°C	NIST Certified Thermometer
	Hanna Meter HI 98129 0.0 to 60.0 °C; 32.0 to 140.0°F	(°C) (°F)	0.1 °C 0.1°F	±0.5 °C ±1.0 °F	±0.5 °C ±1.0 °F	NIST Certified Thermometer
	Stowaway Tidbit (Onset Computer Corp.)	(°C) (°F)	0.16°C	5%	0.2 @ 20°C	NIST Certified Thermometer
pH	pH Octet Comparator (Wide-Range) Lamotte 5858 3.0 to 10.0 units	Standard pH units	0.25 units	±0.6 units	±0.4 units	Checked against Hanna Meter HI 98129
	Hanna pH Tester Combo HI98129 0.0 to 14.0	Standard pH units	0.01	±0.02 units	±0.01 units	Standard Solutions Method
Dissolved Oxygen	Micro Winkler Titration Lamotte 5856 0 to 20 mg/l	Milligrams per liter (mg/l)	0.1 mg/l	±0.6 mg/l	±0.3 mg/l	Checked against DO Meter
Turbidity	LaMotte Model 2020 Turbidity Meter 0.00 to 100 NTUs	Nephelometric Turbidity Units	<u>NTU Report to Nearest</u> 0 to 1.0 then 0.05NTU 10 to 40 then 1NTU 40 to 100 then 5NTU 100 to 400 then 10NTU 400 to 1000 then 50NTU over 1000 then 100NTU	±2% for readings below 100 NTUs ±3% above 100 NTUs	±2% or 0.05 for readings below 100 NTUs (whichever is greater) +3% above 100 NTUs	Standard Solutions Method
Specific Conductance	Hanna TDS Meter 0 to 3999 microS/cm	Micro-Siemens/cm (μS/cm) (converted to 25 °C)	1.0 μS	±2 units	±2% of the standard	Standard Solutions Method
E. Coli	EasyGel Coliscan 0 to 60 CFU	Number of colony forming units (CFU) per 100 ml	1 CFU/100 ml	Control checks of sterility, temperature	Control checks of sterility, temperature	Send water sample split to EPA/ADEC Certified Lab

WATER QUALITY PARAMETERS

Primary parameters (water temperature, dissolved oxygen, pH, specific conductance, turbidity, and bacteria) were measured using standard Environmental Protection Agency approved procedures and/or methods which are used by established citizens' volunteer monitoring programs (e.g., Friends of Casco Bay's Citizens' Water Quality Monitoring Program and Texas Watch's Volunteer Environmental Monitoring Program). Each of these procedures, as well as those used in measuring secondary parameters, is taken from the Volunteer Estuary/Lake/River/Stream Monitoring: A Method's Manual (EPA 1997). All methods used are consistent with those recommended by the test kit manufactures (LaMotte, Hanna, Hach and Micrology Laboratories).

CEMP monitors measures pH and specific conductance using waterproof Hanna combo meters. Monitors calibrate their meters before every sampling event. In addition, Inletkeeper's CEMP Coordinator collects all meters quarterly to clean and calibrate them in the laboratory. The meters automatically correct pH and conductivity values for the stream temperature.



Site photos from Upper Beaver Creek (AR-1090). Top: looking downstream, fall of 2010, Middle: looking downstream, fall of 2007, Bottom: looking upstream from below Bald Mountain Road during bioassessment in the summer of 2007.

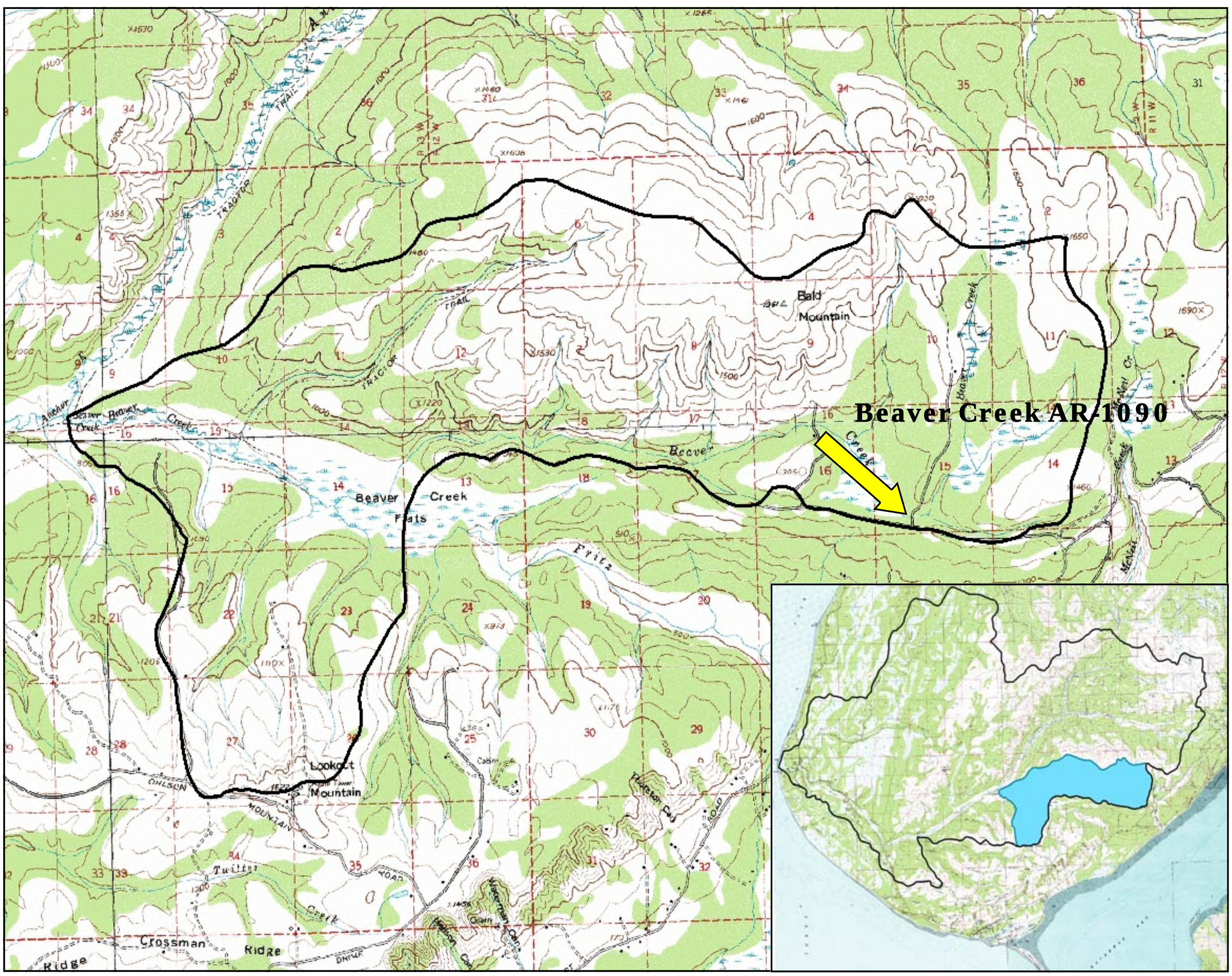
Results from sampling are referenced against state (Alaska Department of Environmental Conservation) and federal (Environmental Protection Agency) water quality standards. These standards are listed in the table below. Beaver Creek is held to standards for Water supply: Growth and Propagation of fish, shellfish, aquatic life, and wildlife.

Right: CEMP monitors go through a 3-day training to become certified for water quality sampling. In 2002 Inletkeeper had just moved into their new location on Ben Walters Lane. Neil and Kyra (back right) were trained as monitors in the old lab.

Department of Environmental Conservation Alaska Statewide Water Quality Standards 18AAC 70					
Water Use	**Water Temperature**	**Dissolved Oxygen**	**pH**	**Fecal Coliform Bacteria (FC)**	**Turbidity**
Water Supply: drinking, culinary, and food processing	May not exceed 15°C	Dissolved Oxygen (DO) must be > or = 4.0 mg/l	May not be < 6.0 or > 8.5	In a 30-day period, the geometric mean may not exceed 20 FC/100 ml, and not more than 10% of the samples may exceed 40 FC/100 ml	Not to exceed 5 NTU above natural conditions when the turdbidity is 50 NTU or less, and may not have more than 10% increase in turbidity when the natural turbidity is more than 50 NTU, not to exceed a maximum increase of 25 NTU
Water Supply: Growth and propogation of fish, shellfish, aquatic life, and wildlife	May not exceed 20°C. May not exceed where applicable: Fish migration routes: 15°C Fish spawning areas: 13°C Fish rearing areas: 15°C Egg & fry incubation: 13°C	DO mus be > or = 7.0 mg/l. The concentration of DO may not exceed 110% of saturation in any samples collected	May not be < 6.5 or > 8.5	Not applicable	Not to exceed 25 NTU above natural conditions
Water recreation: contact recreation (freshwater)	May not exceed 30°C	DO must be > or = 4.0 mg/l	May not be < 6.5 or > 8.5	In a 30-day period, the geometric mean may not exceed 100 FC/100 ml, and not more than one sample, or more than 10% of the samples if there are more than 10 samples, may exceed 200 FC/100 ml	Not to exceed 5 NTU above natural conditions when the turdbidity is 50 NTU or less, and may not have more than 10% increase in turbidity when the natural turbidity is more than 50 NTU, not to exceed a maximum increase of 15 NTU

BEAVER CREEK: OVERVIEW

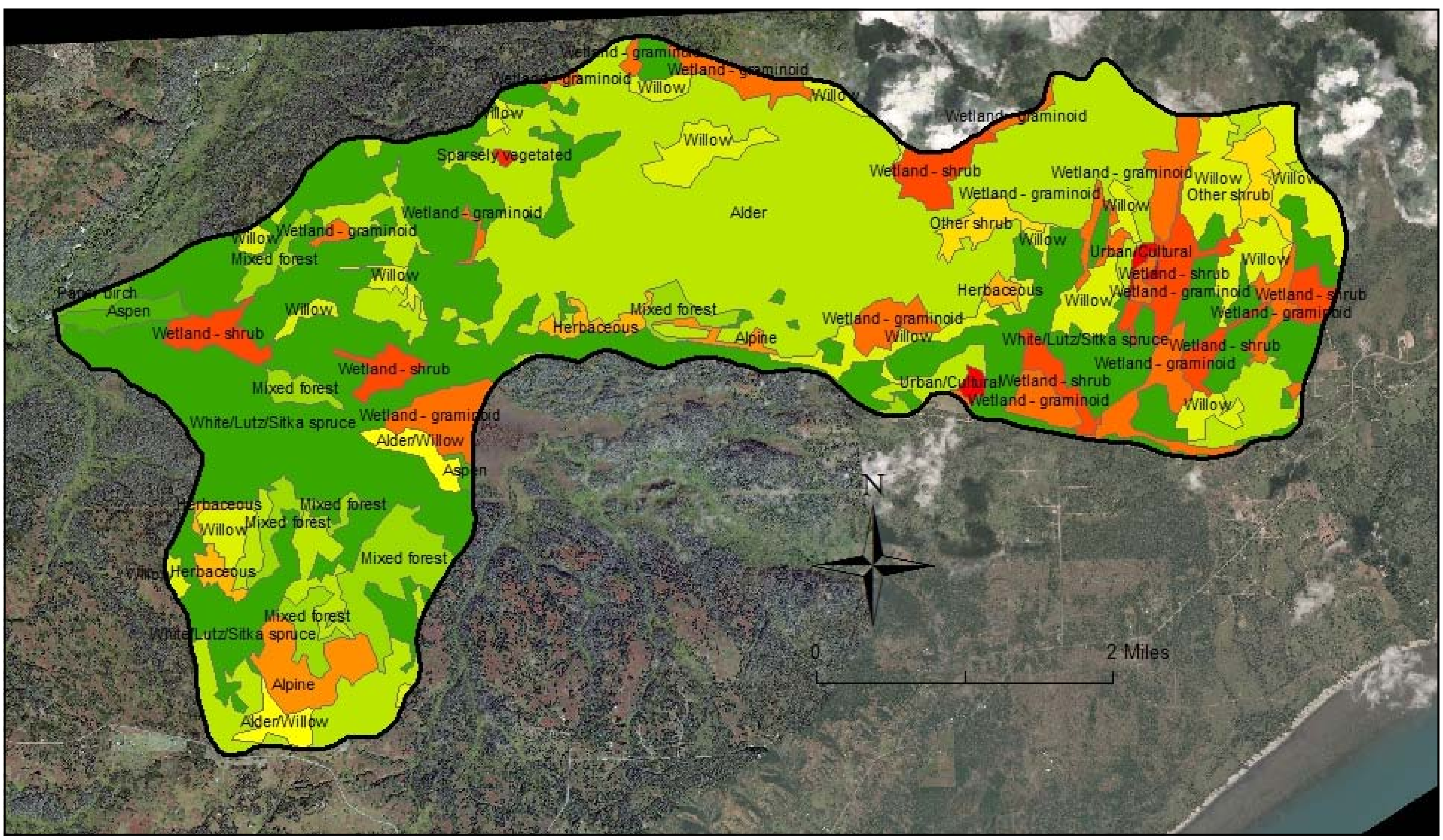
Beaver Creek is a tributary to the Anchor River on the lower Kenai Peninsula. The Anchor River watershed, outlined in black on the inset in the map below, covers 225 square miles and drains into the Cook Inlet. Communities within the Anchor River watershed include Homer, Anchor Point, and Nikolaevsk. The Beaver Creek watershed, highlighted in blue in the inset and outlined in the larger map below, covers 20 square miles. Beaver Creek and its numerous tributaries run nearly 30 miles, with 12.5 miles of anadromous streams (see the map of anadromous stream classifications on page 15). The Beaver Creek CEMP Site, AR-1090, marked with a yellow arrow on the map below, is located almost 2 miles down Hutler Road and below the culvert crossing for Bald Mountain Avenue (GPS Coordinates: 59° 44.314' N, 151° 18.371' W). The map on the right show the vegetation throughout the Beaver Creek watershed. Wetland vegetation types are in red and orange, and are labeled as such. 34.7% of the Beaver Creek watershed is classified as wetlands Learn more about the Anchor River Watershed in the Anchor River Watershed Action Plan online at: http://inletkeeper.org/salmon/AnchorRiverWatershedActionPlan.pdf



Vegetation Types

The Beaver Creek watershed is dominated by alder, willow, and wetland vegetation. Wetlands make up 34.7% of the vegetative communities in the watershed. The wetland communities occur largely in the eastern portion of the watershed and along the main stem corridor of Beaver Creek. There are some upland wetland complexes in the northern portion of the watershed, located along Bald Mountain. The CEMP sampling site for Beaver Creek is located in a wetland area, in a zone of shrubs and grasses. More information on Kenai Peninsula watersheds can be found online at the Kenai Lowland Wetland Mapping and Classification Home Page (http://www.kenaiwetlands.net).

Looking downstream from the Bald Mountain Road crossing at the Beaver Creek CEMP site. All water quality sampling was done downstream of the road crossing.

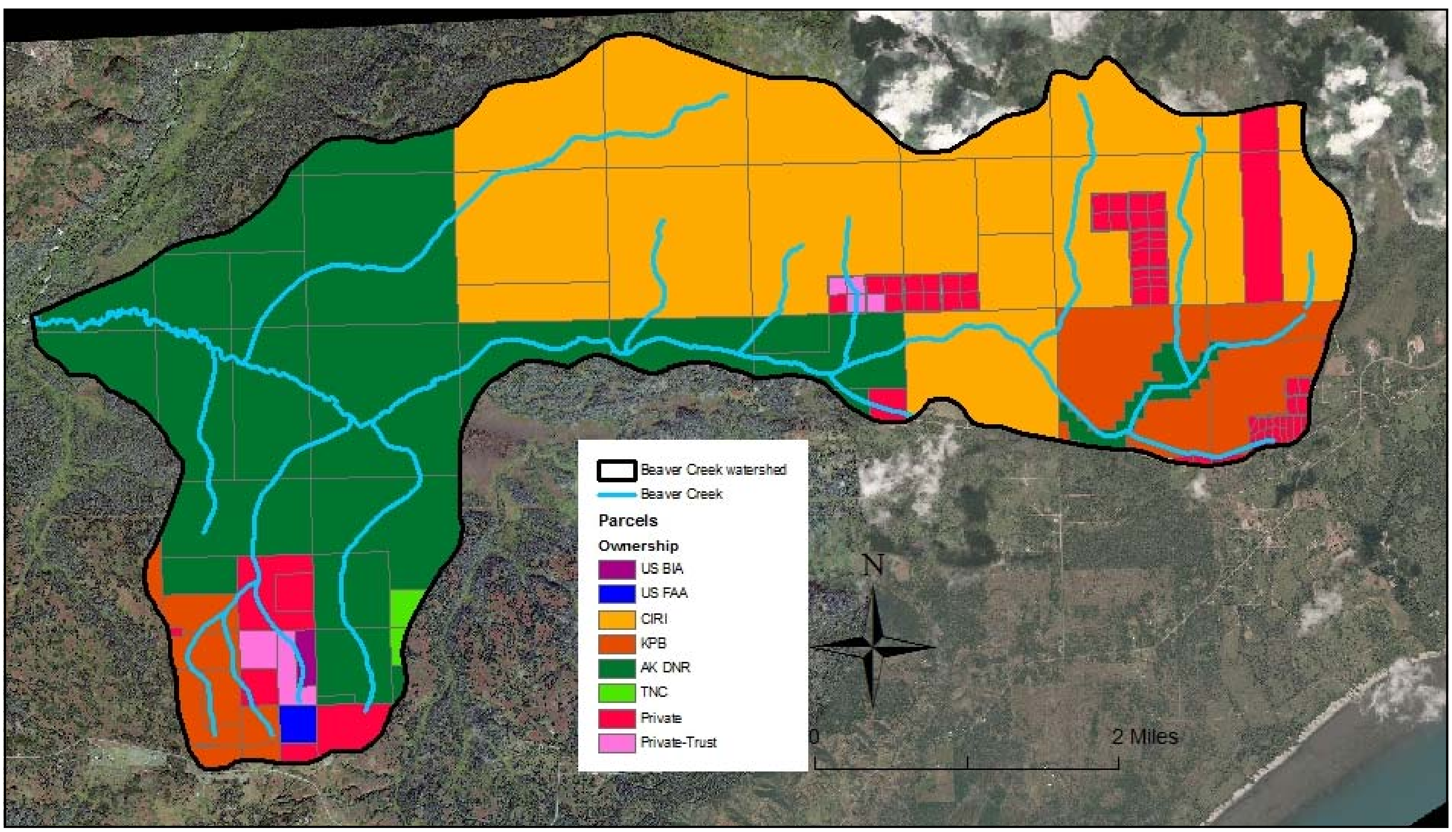


Left: topographic maps from United States Geologic Survey. Watershed boundaries: National Resources Conservation Service Watershed Boundary Database. Above: Vegetation type map: Kenai Fish and Wildlife Service. Basemap: ArcGIS Server Service. Quickbird satellite imagery, 2003.

BEAVER CREEK: OVERVIEW

Land Ownership

The majority of the lands in the Beaver Creek watershed are owned by Alaska Department of Natural Resources (AK DNR, 37.3%, dark green in the map below) and the native corporation Cook Inlet Region, Incorporated (CIRI, 37.2% light orange in the map below). Privately owned lands make up 14.1% of the watershed, and consist of generally small parcels located primarily in the eastern portion of the watershed, with a few in the south-west corner of the watershed boundary. The Nature Conservancy (TNC, light green in the map below) has two parcels that are partly within the Beaver Creek watershed. Other land holders include the federal government (US BIA, Bureau of Indian Affairs, and US FAA, the Federal Aviation Administration, 1.6%), and the Kenai Peninsula Borough (KPB, 9.9%). The Beaver Creek CEMP sampling site, AR-1090, is located in a road right-of-way surrounded by DNR-owned land. (All percentages are taken from the Anchor River Watershed Action Plan, http://inletkeeper.org/salmon/AnchorRiverWatershedActionPlan.pdf).

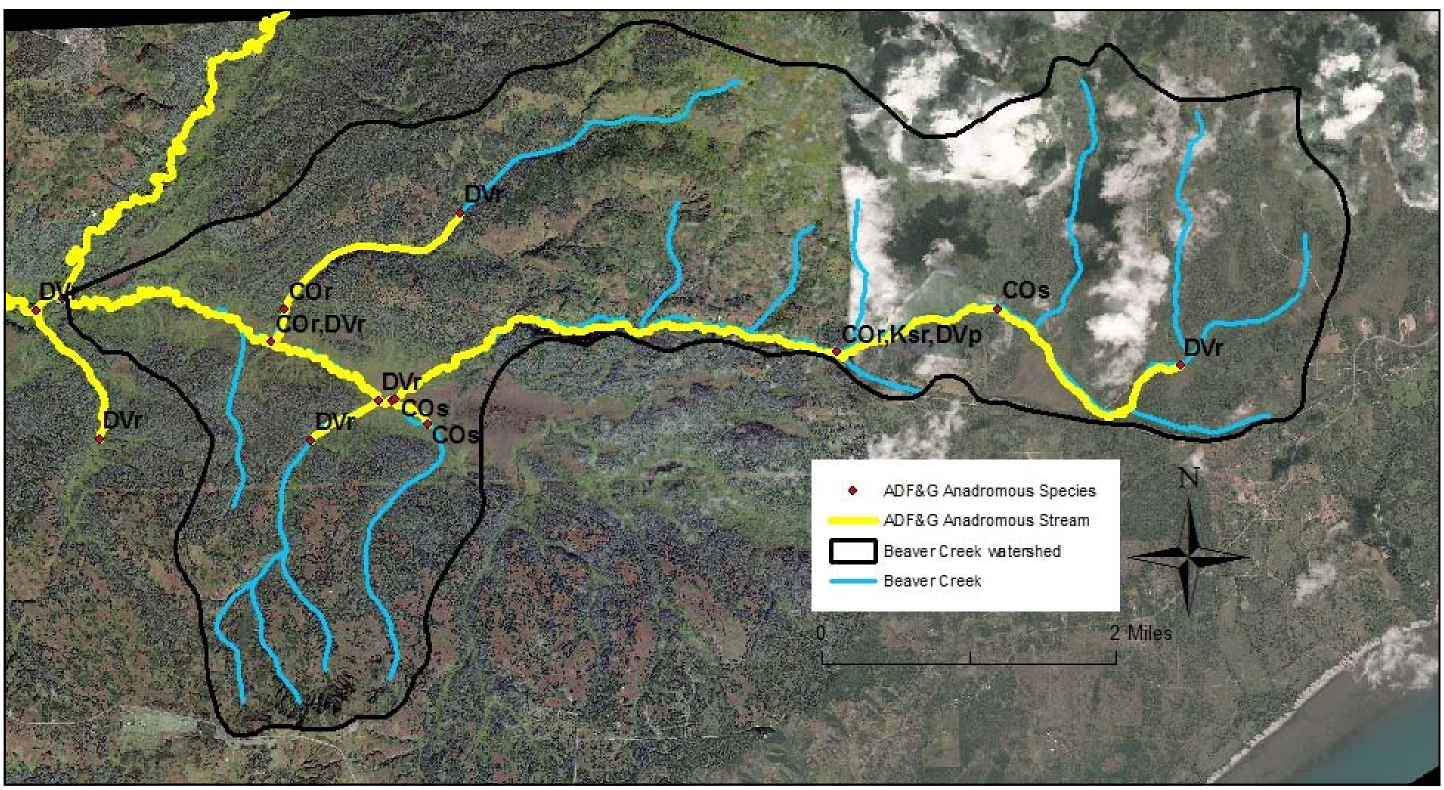


Watershed boundaries are from the National Resources Conservation Service Watershed Boundary Database, 2010. Basemap: ArcGIS Server Service. Quickbird satellite imagery, 2003. Ownership map from the Kenai Peninsula Borough GIS Division, 2010.

Salmon and other wildlife

There are 12.5 miles of documented anadromous streams in the Beaver Creek watershed. The map below shows these sections of the main stream and its tributaries highlighted in yellow. Each point represents the anadromous species that have been documented in these locations. Dolly Varden, Coho, and King salmon have all been documented in Beaver Creek and several of its tributaries (see the Alaska Department of Fish and Game's Anadromous Waters Catalog at: http://www.sf.adfg.state.ak.us/SARR/awc/).

The far western portions of the watershed are part of the Anchor Point/Fritz Creek Critical Habitat Area, established by the state of Alaska in 1989. The boundaries of the Critical Habitat Area roughly follow the AK DNR ownership boundaries (see the map on page 14). Brown and black bears, wolves, and moose are commonly seen throughout the Beaver Flats. Sandhill cranes have been documented using the Beaver Creek Flats area (www.cranewatch.org). Beaver are active in the watershed, with noted dam building around the CEMP sampling site (see page 21 for more on the beaver dams).



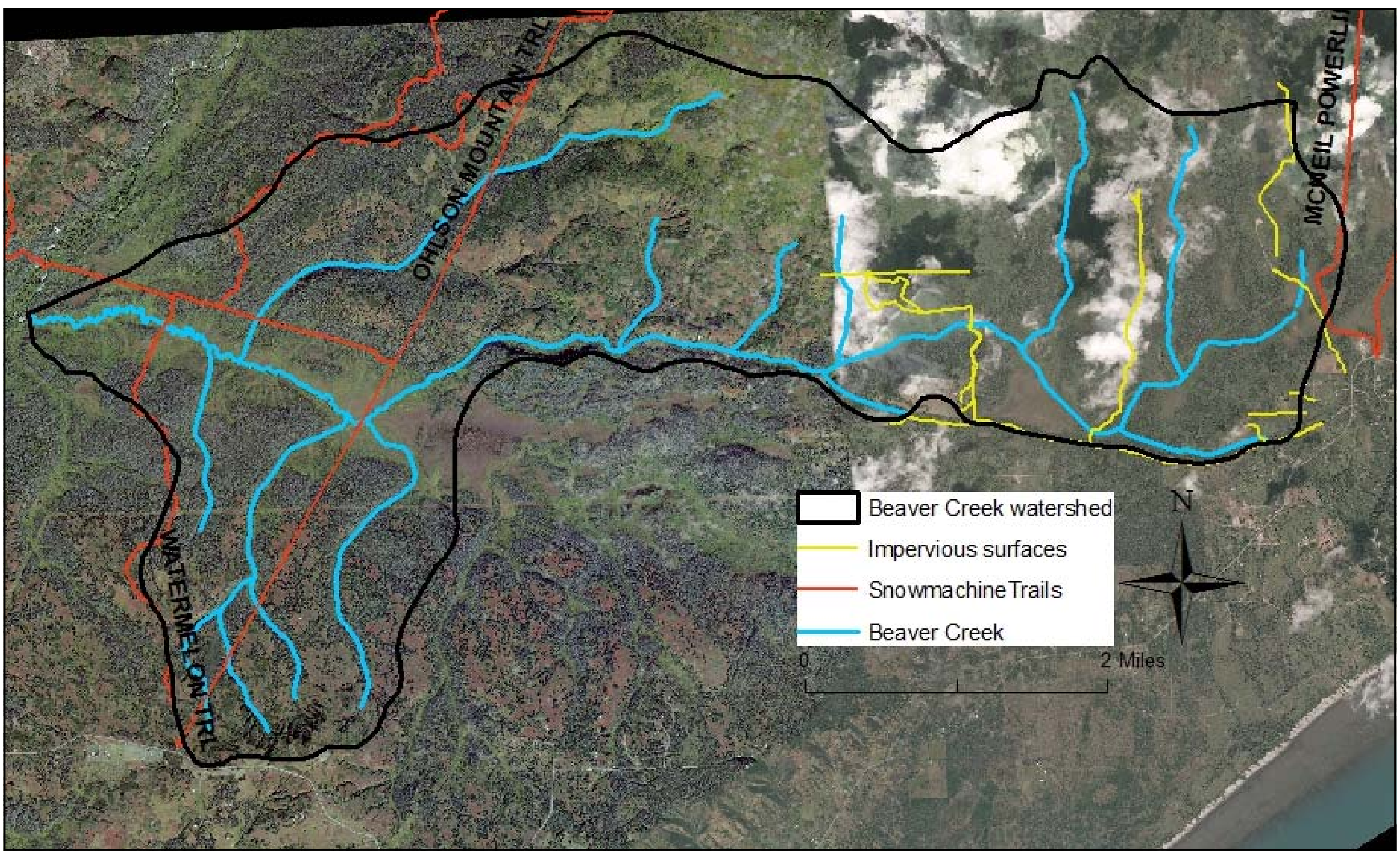
Watershed boundaries are from the National Resources Conservation Service Watershed Boundary Database, 2010. Basemap: ArcGIS Server Service. Quickbird satellite imagery, 2003. Anadromous species and stream data are from the Alaska Dept. of Fish & Game Anadromous Waters Catalog, 2009.

BEAVER CREEK: OVERVIEW

Human Use

In 2005, 0.28% of the Beaver Creek watershed was classified as impervious cover (Anchor River Watershed Action Plan, online at: online at: http://inletkeeper.org/salmon/AnchorRiverWatershedActionPlan.pdf). Yellow lines in the map below represent roads adjacent to and within the watershed. There are some private houses within the watershed, however as of 2010 the development footprint is relatively small. New dirt roads have been built in the past year, however, and new developments should be monitored to protect the quality of water and habitat in this important watershed.

The Beaver Creek watershed is accessed on the west end by ATV and snowmachine trails off of Ohlson Mountain Road. The Watermelon Trail is one of several trails in the watershed that is popular for recreation. The Homer Soil and Water Conservation District (HSWCD) was awarded funding in recent years to mitigate damage to stream banks and riparian vegetation at a stream crossing on Beaver Creek along the Watermelon Trail. Ongoing trail work and outreach activities continue to improve habitat and recreational opportunities in the Beaver Creek watershed (see the pictures on the facing page).

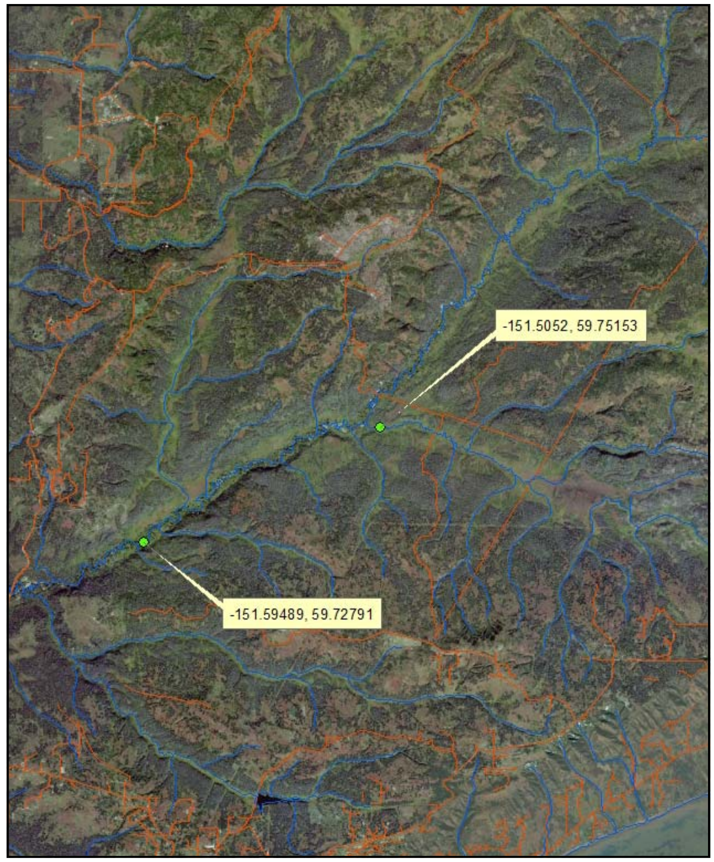


Watershed boundaries are from the National Resources Conservation Service Watershed Boundary Database, 2010. Basemap: ArcGIS Server Service. Quickbird satellite imagery, 2003. Impervious surfaces were derived from Kenai Peninsula Borough road maps, 2010. Snowmachine trails data provided by Caribou Hills Cabin Hoppers via the KPB GIS Division.

Invasive Species

Twenty-two species of high priority invasive weeds have been documented on the Kenai Peninsula (Integrated Weed Management Strategy, online at: http://www.homerswcd.org/invasives/FINCWMAStrategy120107.pdf). These weeds include reed canary grass, a weed that invades waterways and increases sedimentation, thereby degrading habitat for salmon and other wildlife.

In 2009-2010, the Homer Soil and Water Conservation District (HSWCD) surveyed Beaver Creek from the Hutler Road access to its confluence with the South Fork of the Anchor River. Their survey continued down the South Fork of the Anchor until reaching the first bridge on the North Fork Road. Reed canary grass infestations were found at two locations, marked on the map below. Reed canary grass and other invasive weeds are a high priority for resource managers and conservation groups on the Kenai Peninsula and across Alaska.



Left: These pictures were included in the Homer Soil and Water Conservation District's Final Report (2010) on the Watermelon Trail bridge crossing project (ADEC ACWA Grant Project #: ACWA-10-14). The top photo shows the trail crossing Beaver Creek prior to the project. The bottom photo shows the final bridge, located about 60 feet upstream of the original crossing. Above: This map, provided by the Homer Soil and Water Conservation District (01/2011), shows the locations of reed canary grass on the South Fork of the Anchor River and on lower Beaver Creek.

BEAVER CREEK: VOLUNTEER MONITORS

Neil and Kyra began monitoring Beaver Creek on January 26, 2003. They continued monitoring this site until the baseline dataset was completed in early-2010. They have donated a combined 302 hours of time to establish a baseline water quality dataset for Beaver Creek. They have also participated in bioassessment efforts at Beaver Creek, and have photo documented their efforts with some classic pictures.

We highlighted Neil and Kyra's great work in Inletkeeper's 2008 Winter Newsletter: Known around town as the "Sustainable Homer Lady", you may have spotted Kyra Wagner at the Farmer's Market. You may have noticed that her partner in crime, Neil Wagner, was a co-author for the City of Homer's Climate Action Plan. It is no surprise that this pair has also been involved in the water quality monitoring efforts of Cook Inletkeeper – an effort they have been involved

Neil and Kyra Wagner, Volunteer Monitors at Beaver Creek from 2002-2010.

in since December 2002! Neil and Kyra monitor Beaver Creek site AR-1090. When they first started monitoring Beaver Creek, they lived up on Bald Mountain, which is just a short way away from the site. They've lived in town for a number of years now, but continue to drive out there on monitoring days. When asked what they liked most about monitoring, Kyra replied "it's such a great excuse to get outside! In the

Kyra and Neil were dedicated winter water quality monitors. Often armed with axes and ice picks, they would work through the ice to collect water samples even on the coldest winter days.

winter, we'll drive up on Saturday, spend the day skiing and snowshoeing, spend the night in a cabin with some hot chocolate and then monitor our site on the way out on Sunday." Additionally, they've enjoyed watching a beaver build a dam at their site. Until about two years ago, Neil and Kyra's site was a bioassessment site, but since the beaver dammed it up, it has been too deep to collect insects. Neil explained that he spent about 25 years on Bald Mountain, and remembers both when there were many beavers in the area, and when trappers showed up and the populations declined. They are pleased that this beaver has stuck around, even if it flooded their monitoring site. Thanks so much, Neil and Kyra, for all your hard work!

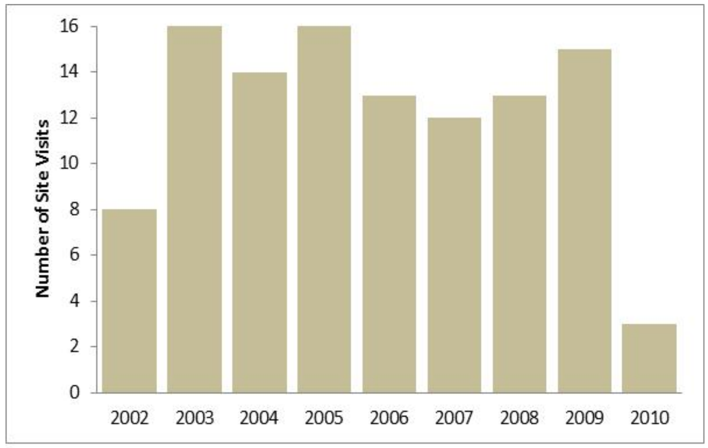
BEAVER CREEK: WATER QUALITY MONITORING 2002-2010

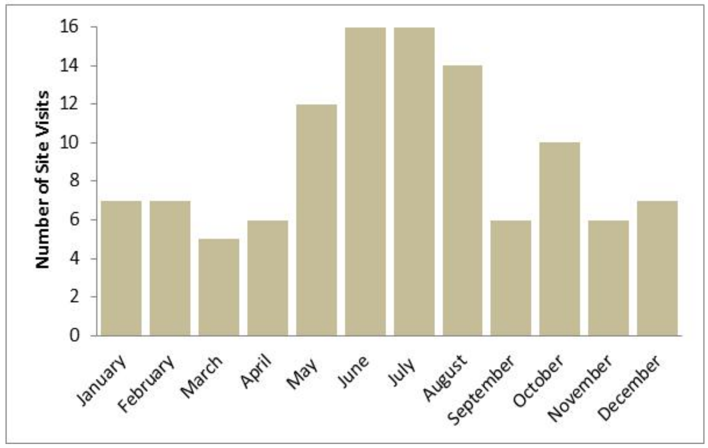
Baseline water quality monitoring began on June 6, 2002 and concluded on March 29, 2010 with a total of 112 observations. The figures on the right show these site visits broken down by year (top) and by month (bottom). Neil and Kyra collected complete datasets (12 or more site visits) in 7 of 8.5 years of monitoring. Each month is represented (bottom graph), by at least 5 site visits.

Inletkeeper staff and volunteers monitored aquatic insect communities twice per summer at Beaver Creek from 2002-2009. Sampling occurred in June only in 2002 and 2007, and no bioassessment was done in 2008. For reporting purposes, we have only used bioassessment data from 2004-2009 due to a change in protocols between the 2003 and 2004 sampling. Raw data from all years can be found online at Inletkeeper's website (http://www.inletkeeper.org).

Continuous temperature monitoring occurred at Beaver Creek in 2007. A temperature data logger was placed in Beaver Creek on June 25 and was removed on September 30, 2007. Water temperature was recorded every 15 minutes during this time period. Results from this effort are included on page 20, Beaver Creek: Temperature.

All water quality exceedences are noted in the respective sections and together in the Future Monitoring pages of the report (38-39).





Top: Number of site visits to Beaver Creek by year, from 2002—2010. Bottom: Number of site visits to Beaver Creek by month from 2002 – 2010.

BEAVER CREEK: TEMPERATURE

During CEMP site visits, monitors record water and air temperatures using alcohol-filled thermometers. Fish and other aquatic organisms are adapted to living within a certain temperature range. Changes in riparian (or streamside) vegetation, groundwater inputs, weather, and climate patterns can all affect water temperatures.

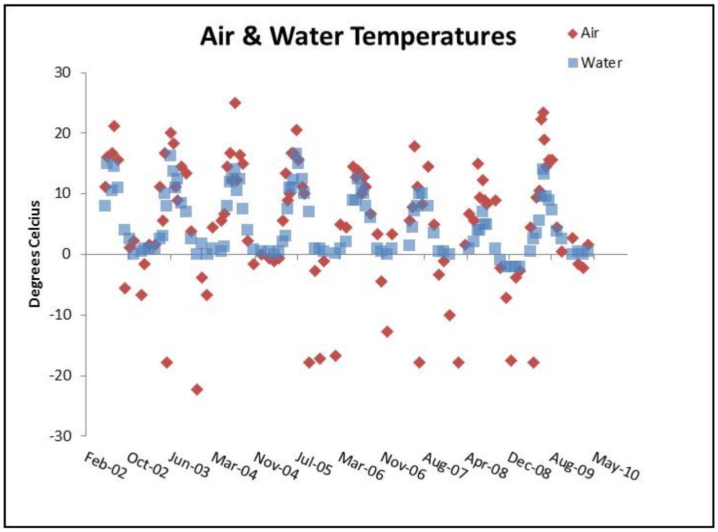
CEMP monitors took 110 water temperature measurements at Beaver Creek from 2002 to 2010. Water temperatures ranged from -2.0°C (during several years in the months of November, December, January, and February) to 16.5°C. Temperatures were at or above the state water quality standard for fish migration and rearing (15°C) on 4 days. Temperatures exceeded the standard for fish spawning and egg and fry incubation (13°C) on an additional 5 days (see pages 32-33 for all exceedences).

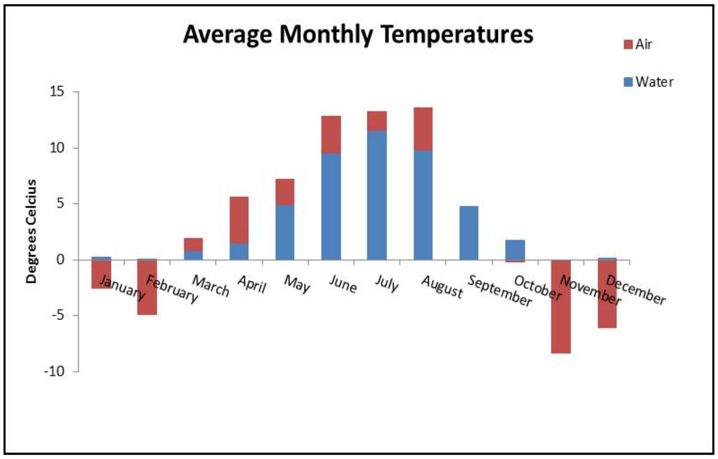
The average water temperature was 5.4°C. Air temperature was recorded during 112 site visits to Beaver Creek. The temperature ranged from 22°C on November 30, 2003 to 25°C on July 12, 2004. Average air temperature was 6.6°C (44°F). Monthly average air and water temperatures are in the bottom figure on the right.

Inletkeeper staff placed a temperature data logger in Beaver Creek from June 25 through September 30, 2007. This logger recorded water temperature every 15 minutes and stored the data until it was downloaded onto the computer. Daily maximum temperatures from the 2007 continuous temperature data can be seen in the figure on the next page.

There were 22 days in 2007 of temperatures exceeding the 13°C temperature water quality standard for fish spawning and egg and fry incubation, and 4 days when temperatures exceeded the standard for fish migration and rearing (15°C).

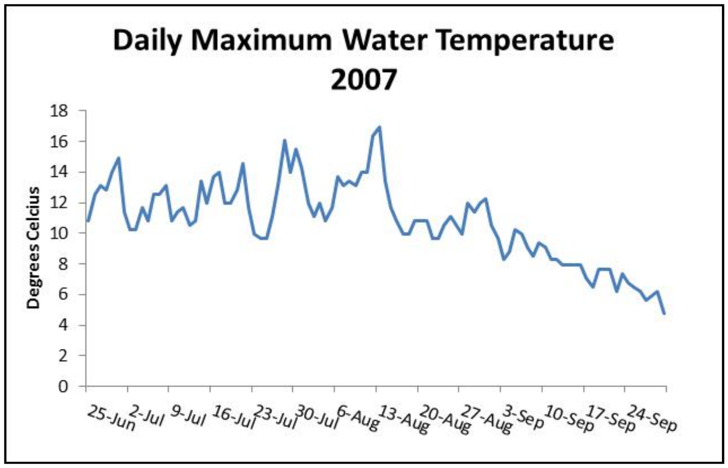
Temperature exceedences were dramatically underestimated in 2007 during site visits by CEMP monitors (see the table of exceedences on pages 32-33). One of the reasons for this may be timing of CEMP visits. All of the temperature exceedences recorded by the data logger occurred





Top: All water (blue) and air (red) temperatures taken with the alcohol-filled thermometers by CEMP monitors during site visits at Beaver Creek from June 6, 2002 to March 29, 2010. Bottom: Average water (blue) and air (red) temperatures by month from CEMP site visits between 2002 and 2010.

after 12:30 PM, and 68% of the exceedences occurred after 3:00 PM, while 48% of site visits occurred before 12:30 PM, and 87% of site visits were before 3:00 PM.



Top: Daily maximum water temperatures measured at Beaver Creek during 2007 by the continuous data logger. Left: Air and water thermometers are checked for accuracy every year in the lab during CEMP recertification.

Beaver Dam Construction at Beaver Creek

From the comments section of CEMP datasheets at Beaver Creek, by Neil & Kyra Wagner

July 11, 2006 Beaver pond a success!

July 30, 2006 Water up one foot over 2 weeks ago. Beaver dam is retaining water level.

Aug 13, 2006 Water rising from beaver dam downstream. Water level has increased about six inches in the last 2 weeks.

August 27, 2006 New beaver dam 25 feet downstream has raised water level about 2 feet. Several dams are below this new one.

September 24, 2006 Water six inches lower than last month

May 13, 2007 4 beaver lodges! Water about 1' higher than last year. Water backed up past culverts, road.

August 26, 2007 Were planning to count bugs but due to beaver dam, could not find a good spot.

August 27, 2008 We could see through the willows what appeared to be 2 new beaver lodges

BEAVER CREEK: DISSOLVED OXYGEN

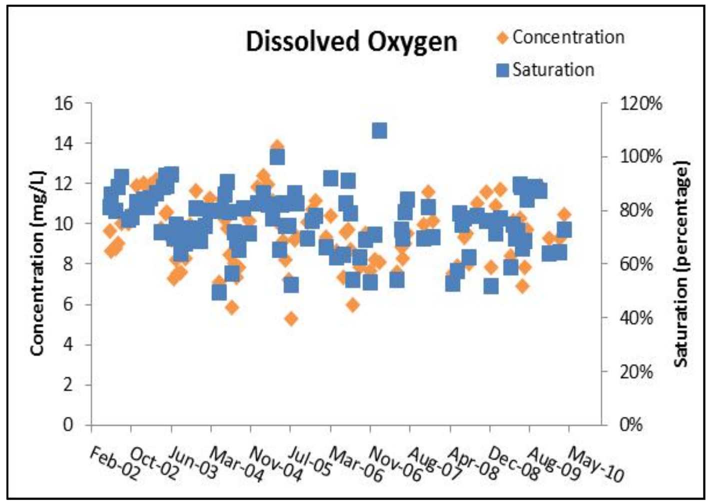
CEMP monitors the levels of dissolved oxygen (DO) in our streams. Oxygen is needed by fish and other aquatic organisms to live. We measure DO using a chemical titration, and express it as a concentration of milligrams of oxygen per liter of

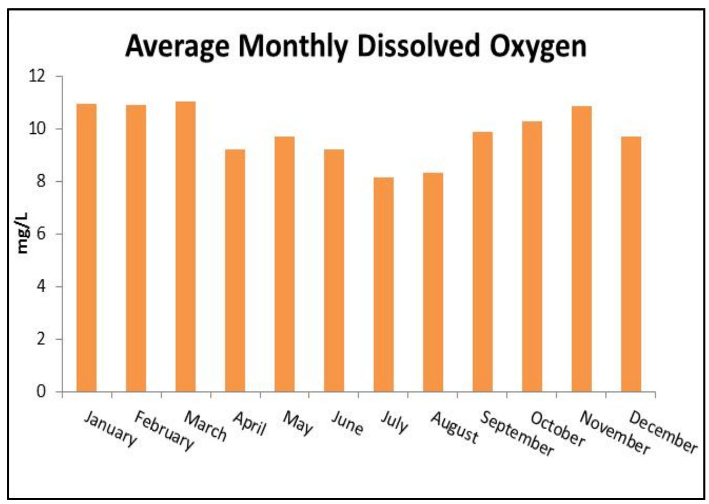
CEMP monitors measure dissolved oxygen using the Winkler Titration. Most of the chemical reagents in their monitoring kits are for this test.

water. The amount of oxygen that can be dissolved in water is temperature dependent; colder water can hold more oxygen. Therefore we also look at how saturated the water is with oxygen, that is – how much oxygen does it hold compared to what it could hold at that temperature. Saturation is expressed as a percent.

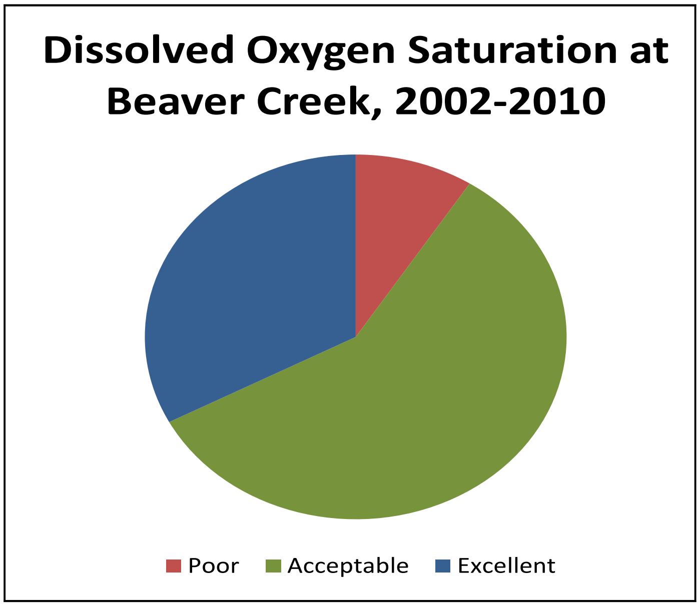
Changes in dissolved oxygen can be caused by turbulence and interactions with the air (like in a waterfall), decaying plant matter, sewage, and effluent wastewater inputs. High levels of photosynthesis and increased mixing with the air through riffles and small waterfalls could increase saturation levels above 100%, creating a condition of supersaturation.

The concentration of dissolved oxygen during 100 site visits at Beaver Creek ranged from 5.3 mg/L to 13.8 mg/L. Dissolved oxygen saturation ranged from 50% to 110%, and on average DO saturation was 76% at Beaver Creek. The lowest average DO concentrations (mg/L) occurred in the summer months of July and August, with highest levels in March and November (see the middle figure for all monthly averages). DO concentrations exceeded state water quality standards (< 7.0 mg/L) 4 times and are shown in red in the data tables on pages 32-33. Low summer-





Top: All dissolved oxygen concentration levels (mg/L, orange) and saturation (%, blue) measured by CEMP monitors during site visits at Beaver Creek from June 6, 2002 to March 29, 2010. Bottom: Average dissolved oxygen concentration levels by month from CEMP site visits between 2002 and 2010.



DO saturation levels at Beaver Creek relative to potential stress on salmonids.

time dissolved oxygen levels may present some stress to the embryo and larval stages of fish in Beaver Creek.

The figure above shows the breakdown of dissolved oxygen saturation levels at Beaver Creek relative to water conditions for salmonids and other aquatic life (adapted from *Testing the Waters*, S. Behar, River Network, 1996). Conditions were 'acceptable' (between 60 and 79% saturation) 64% of the time between 2002 and 2010. Conditions were 'excellent' (80-125%) just over a third of the time, and conditions were poor (below 60%) 10% of the time at Beaver Creek.

Volunteers Kyra Wagner and Phil Gordon use a kick-net to collect bug samples for bioassessment. All CEMP streams are tested for dissolved oxygen during bioassessment.

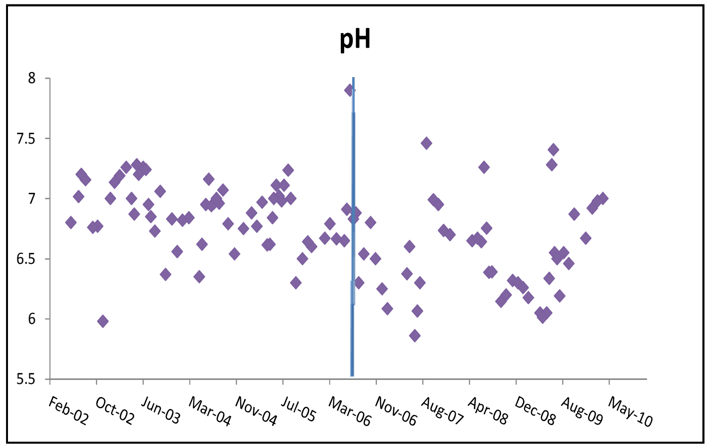
BEAVER CREEK: pH

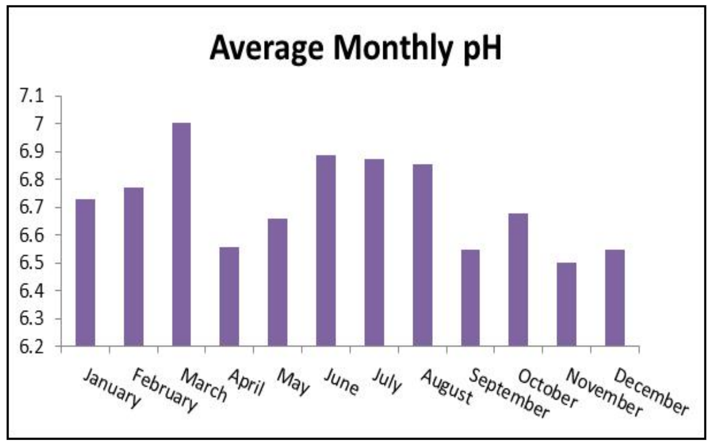
pH is a measure of the level of activity of hydrogen ions in the water. It is expressed on a logarithmic scale and ranges from 0 (acidic) to 14 (basic). Most streams naturally range between 6.5 to 8.0 pH units. Differences in pH can result from rain and groundwater inputs, decaying plant material, and inputs from runoff. Rain water tends to have a lower pH, ranging from 5.6-5.8.

pH ranged from 5.86 to 7.90 during 108 site visits between 2002-2010. pH levels tend to fluctuate throughout the year, with generally lower pH during the spring and fall months. The bottom figure on the right shows monthly average pH levels at Beaver Creek. Rain, which has a naturally lower pH than typical stream water, can lower stream pH as its often a major contributor to stream flows during the spring and fall months.

During the summer of 2006, beavers built a series of dams downstream of the CEMP monitoring site at Beaver Creek. Following the construction of these dams, the variability in pH increased and average pH levels have slightly decreased from 6.87 to 6.59 ($p<0.001$, $t=4.40$). The vertical blue line in the top figure shows when CEMP monitors first observed changes in the stream from the beaver dams.

There were 25 exceedences of the state water quality standard for pH at Beaver Creek. Twelve of these occurred between July, 2008 and June, 2009. There were 2 additional exceedences occurring in August and September of 2009.



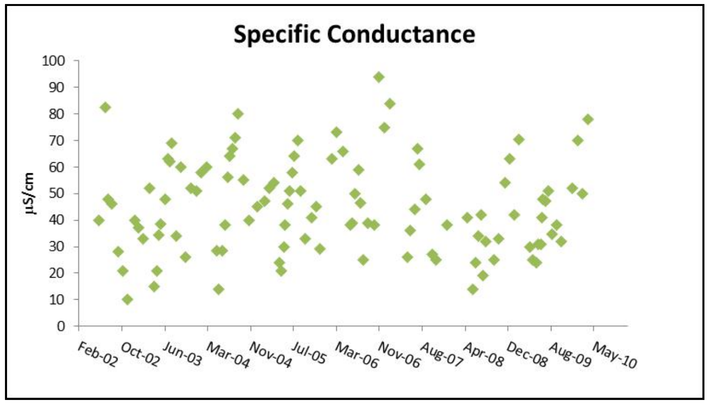


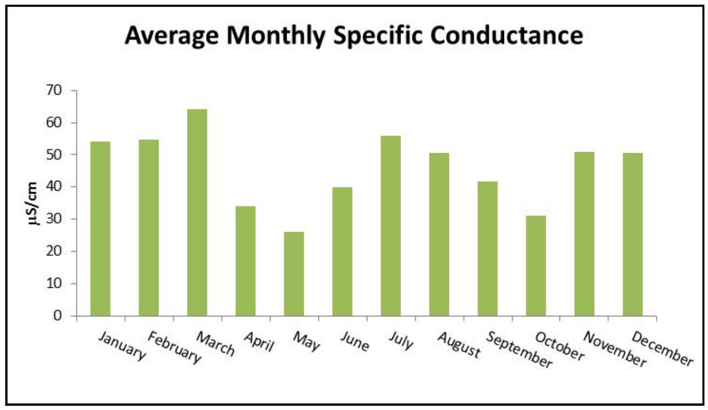
Top: All pH taken by the Hanna Meter by CEMP monitors during site visits at Beaver Creek from June 6, 2002 to March 29, 2010. The vertical blue line indicates the date when CEMP monitors first observed changes in the stream from the beaver dam construction. Bottom: Average pH by month from CEMP site visits between 2002 and 2010.

BEAVER CREEK: SPECIFIC CONDUCTANCE

Specific conductance measures the ability of water to conduct an electrical current at a given temperature. It is recorded as micro Siemens per centimeter (µS/cm). The presence of ions, or salts, in water increases the ability to conduct electricity; thus, specific conductance is way to measure the dissolved solids in a stream. Specific conductance is influenced by groundwater and rainwater inputs as well as road and other runoff.

CEMP volunteers measured specific conductance during 107 site visits to Beaver Creek between 2002 and 2010. Average specific conductance was 45 µS/cm and ranged from 10 µS/cm – 94 µS/cm. Throughout the year, specific conductance was higher during the winter and summer months and lower during April, May, and October. Heavy rains during these months may have diluted groundwater inputs to the stream, thereby lowering its specific conductance. This site is located just downstream of a small dirt road (Bald Mountain Road, off of Hutler Road, 11 miles east of Homer). While some runoff likely is produced during rain events, there is a minimal amount of impervious cover around and upstream from this Beaver Creek site, and specific conductance values are consequently low.





Top: All specific conductance data (µS/cm) were taken with a Hanna Meter (HI 98129) by CEMP monitors during site visits to Beaver Creek from June 6, 2002 to March 29, 2010. Bottom: Average specific conductance (µS/cm) by month from CEMP site visits between 2002 and 2010.

BEAVER CREEK: TURBIDITY

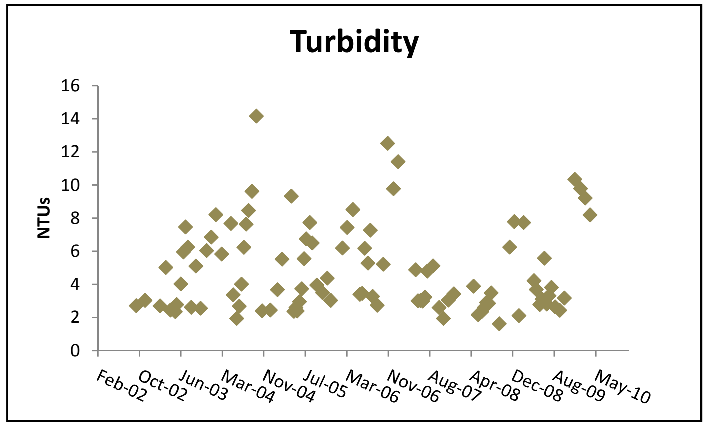
Turbidity is a measure of water clarity and describes the amount of light scattered or absorbed by water. Turbidity is measured in Nephelometric Turbidity Units (NTUs). Lower NTU values correspond to clearer water. Silt, clay, organic material, and colored organic compounds can all influence turbidity. Natural and human caused erosion, as well as storm water runoff can increase turbidity. Negative impacts from increased turbidity may include increased water temperatures, decreased habitat for fish and other aquatic organisms, and more opportunities for the growth of potentially harmful bacteria.

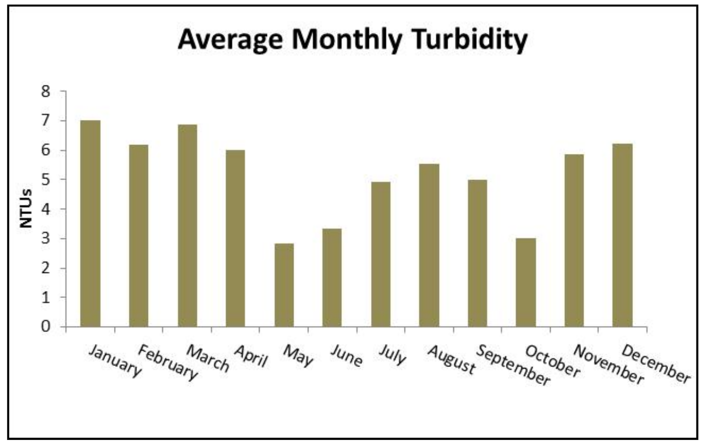
The state water quality standard for turbidity is related to natural conditions. CEMP data provide valuable information to establish what the natural turbidity conditions are for Beaver Creek.

CEMP monitors took turbidity samples during 100 site visits to Beaver Creek, beginning in 2003. Turbidity at Beaver Creek is generally low. Turbidity averaged 4.83 NTU and ranged from 1.61 NTU to 14.15 NTU.

Slightly higher turbidity occurred during winter and spring months, from December through April. Most CEMP streams experience higher turbidity during the spring break-up months when runoff and rainfall increase. Increases in winter turbidity may be due to sampling through the ice, which may introduce sediments into the sample.

An example comes from the site visit comments, recorded on January 31, 2010 (Turbidity = 9.78 NTU): "Axed down 6", water came up in the hole with lots of debris – don't know if it was suspended in stream or if it was stirred up by water rushing into the hole..."

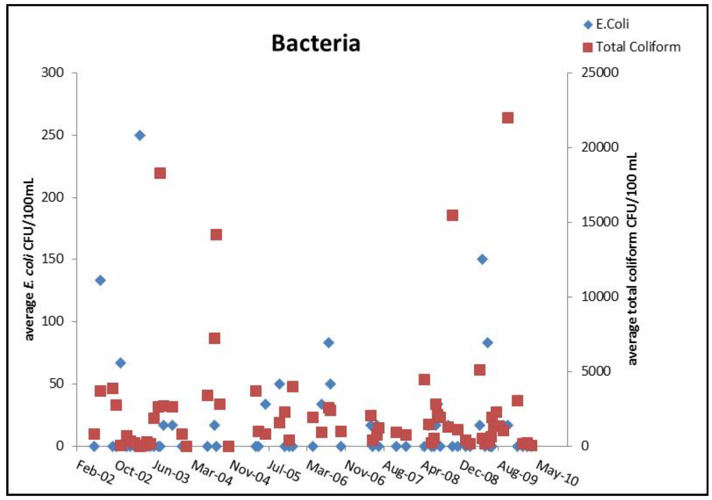


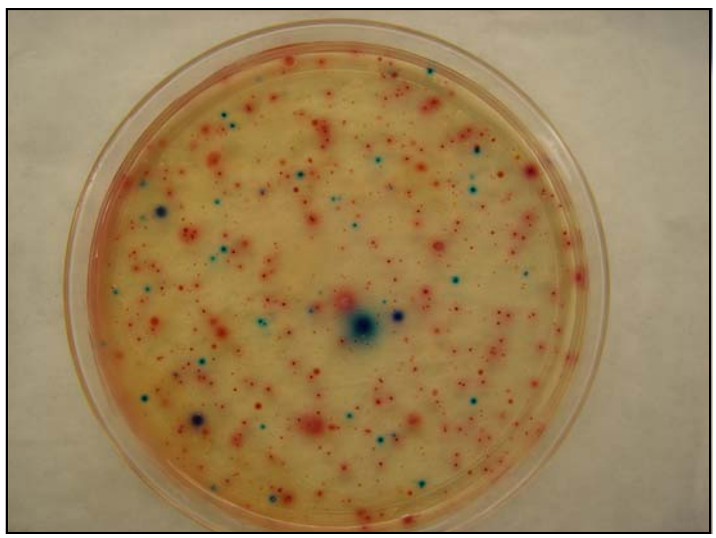


Top: All turbidity data (NTU) were collected by CEMP monitors during site visits to Beaver Creek from June 6, 2002 to March 29, 2010. Water samples for turbidity analysis are collected in the field and analyzed in the lab using a LaMotte Turbidimeter. Bottom: Average turbidity (NTU) by month from CEMP site visits between 2002 and 2010.

CEMP volunteers monitor for total coliforms and *E. coli* at all sites throughout the year. Many types of coliform bacteria are normally found in soil and water. *E. coli* is an indicator of fecal bacteria that is found in the intestines of human and other warm blooded animals. State water quality standards are for fecal coliforms. CEMP tests reveal the number of colony forming units (CFUs) of *E. coli*, which we utilize as a preliminary indicator of fecal coliforms. In the event of a persistent exceedences through both high and low stream flows, the CEMP Coordinator would send samples to a lab in Anchorage for official fecal coliform testing. Finding *E. coli* levels that are above state water quality standards may be indicative of contamination by runoff from animal waste, decaying animals, or human waste from sewage or leaking septic tanks.

CEMP monitors collected water samples for bacteria testing that were successfully plated and incubated during 69 site visits. Bacteria levels have been low throughout the years of sampling at Beaver Creek. Total coliform colonies were generally below 5,000/100mL. Four sampling events had total coliform numbers near or above 15,000/100mL (August 9, 2003 and 2004, and October 26, 2008 and 2009). Total coliforms include fecal and *E. coli* coliform bacteria. They are present in soils and surface waters and don't necessarily indicate pollution. Higher total coliforms counts are often found during periods of wet weather. *E. Coli* colonies were present in 39% of the samples (n = 27). The average number of colonies was 47/100mL. The highest *E. coli* colony count was 250/100mL on March 30, 2003. There was no discernable change in *E. coli* levels following the establishment of beaver dams downstream of the site in 2006. No changes were noted in water temperature, either, indicating that the influence from downstream dams either did not reach the sampling site or was minor in terms of these water quality parameters (see the bioassessment report on the following pages for further discussion on the influence of the beaver dams at Beaver Creek).





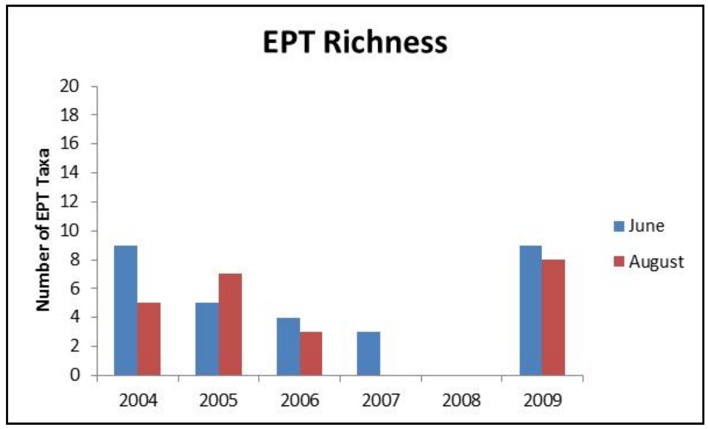
Top: Bacteria levels at Beaver Creek from June 6, 2002 to March 29, 2010. E. coli colonies are in blue, and total coliform colonies in red. Both data sets show the average colony forming units (CFU) per 100mL. Bottom: Water samples are mixed with a bacteria-growing medium and incubated on a petri dish for 48 hours. Different types of bacteria show up as different colors, providing counts of total coliform and E.coli colonies.

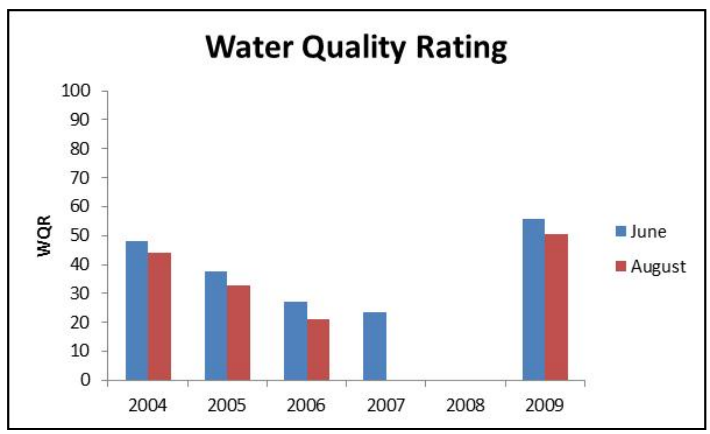
BEAVER CREEK: BIOASSESSMENT

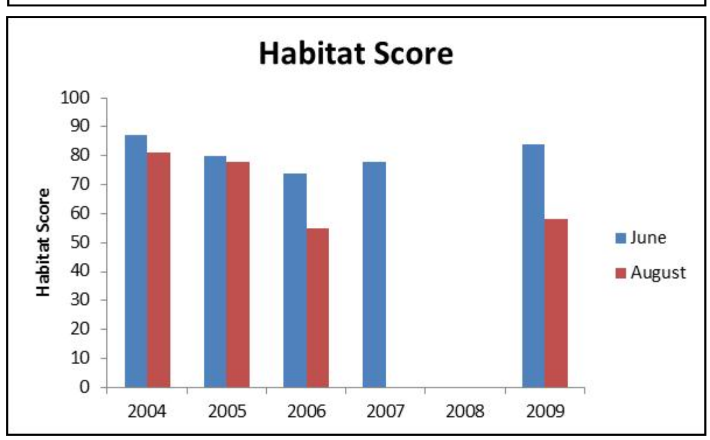
Inletkeeper staff and volunteers sampled aquatic macroinvertebrates (bioassessment) at Beaver Creek from 2002 to 2009 (no sampling was done in 2008). This monitoring of the biological community in the creek was done in June and again in August in all years (except no August samples in 2002 and 2007). Due to changes in the sampling protocols after 2003, analysis of the Beaver Creek bioassessment data begins in 2004.

We use three indices from the bioassessment data to assess the health of macroinvertebrate communities and water quality in CEMP streams. EPT Richness is the number of different types of macroinvertebrates that are considered "sensitive" to water pollution and/or habitat degradation. The Water Quality Rating (WQR) is an index that combines the types of macroinvertebrates sampled, their abundance, and how sensitive they are to pollution and/or habitat degradation. The Habitat Score is on a scale of 0-100. Ten components of the stream habitat are scored from excellent to poor in relation to their quality and availability as bug habitat.

EPT Richness ranged from 3-9 taxa over the years. The WQR ranged from 21.0 to 55.6. The EPT Richness and WQR both declined from 2004-2007 at Beaver Creek. In 2009, water had receded from the beaver dam construction and both indices were at their highest since sampling began in 2004. The lowest EPT Richness and WQR scores occurred in 2006 and 2007. Beaver dams tend to slow the flow of water, increasing sedimentation and decreasing available habitat for aquatic insects.







Bioassessment indices used to assess the macroinvertebrate community and water quality at Beaver Creek from 2004—2009 in June (blue) and again in August (red). Top: EPT Richness shows the number of taxa classified as Ephemeroptera (mayflies), Plecoptera (stoneflies), or Trichoptera (caddisflies) during sampling. Middle: The Water Quality Rating is on a scale of 0-100. This metric is calculated using several parameters (see text). Bottom: The Habitat Score is on a scale of 0-100 and rates 10 components of stream habitat for macroinvertebrates.

The habitat score at Beaver Creek ranged from 55-87. The lowest scores occurred in August of 2006 and 2009. Habitat scores generally declined from 2004 to 2007. June of 2009 had the highest habitat score (87) recorded at Beaver Creek. Early summer scores are often higher than in August, due in part to lower water levels later in the summer. Lower water levels tend to decrease the amount and diversity of habitat available to macroinvertebrates. The undisturbed riparian zone width and the vegetative cover of the stream banks scored between 8-10 at every site visit from 2004-2009. In between June and August of 2009 a major culvert replacement project began at Beaver Creek. The stream was considerably altered during this process, contributing to the lower habitat score during August 2009.

The tables below summarize the macroinvertebrates identified during sampling at Beaver Creek from 2002—2009. Taxa that are included as EPTs are: all caddisflies, Baetid (mayflies), Drunella (mayflies), Flatheads (mayflies), Golden Stoneflies, Nemourid (stoneflies), and Pale Morning Dun (mayflies). EPT richness is calculated by adding up mayfly (Ephemeroptera), stonefly (Plecoptera), and caddisfly (Trichoptera) taxa. Raw data from 2002 and 2003 is provided, but should be interpreted with caution.

A free-living caddisfly from bioassessment sampling in 2009. Photo by Tom Collopy.

		Jun-02	Jun-03	Aug-03	Jun-04	Aug-04	Jun-05	Aug-05	Jun-06	Aug-06	Jun-07	Jun-09	Aug-09
Mayflies	Baetid				300	40	30	300	5		10	120	200
	Drunella				1								
	Flathead					120			1			80	60
	Pale Morning Dun											8	
	Other	46	300	110		10	42	88			1		
Stoneflies	Golden								1				
	Little-yellow					120		4		9			20
	Nemourid		5									8	100
	Other			80	201	1							
Caddisflies	Big-organic											8	5
	Little-organic											25	
	Big-stone											12	
	Little-stone											40	4
	Free-living						2						90
	Square-case											16	45
	Other	13	30	90	17		150	8	10	12	4		
Non-EPT	Aquatic Worms	2		8	5	30	9	3	10		15	60	30
	Aquatic Mites	20	50	150	150	200	40	200	10	65	1	250	300
	Beetles	2	10	1		5	3	24		20		1	
	Blackflies	400	1800		80		45				3	350	2
	Craneflies	7	4	2	4	9	3		1		1		1
	Flatworms			2									
	Midges	400	1100	130	600	200	60	80	200	150	300	200	400
	Scuds					50							
	Other								20	1			

BEAVER CREEK: HABITAT ASSESSMENT

On August 18, 2010 Inletkeeper staff performed a habitat assessment over a 50-meter reach of Beaver Creek. The upstream boundary of the reach began at the outflow of the culvert, downstream of Bald Mountain Road and the CEMP sampling location, and continued downstream for 50 meters.

This 'Stream Walk' assessment is performed to provide the community with a snapshot of the physical environment surrounding a CEMP sampling site. This physical assessment complements the chemical and biological monitoring done over time by volunteers. Though similar in some aspects to the habitat assessment done during bioassessment, the Stream Walk is designed to provide detailed habitat information outside of a bioassessment sampling session. Stream Walks can be incorporated into future monitoring plans on a regular basis, and can provide qualitative information on the surrounding stream habitat in a cost- and time-effective manner.

The 50-meter Stream Walk reach (166 feet) was flat, with a slope of only 0.04%. The water was clear and stained in color. The streambed along the reach was composed of primarily gravel, with some cobble and to a lesser extent sand. There were some boulders in the stream, located exclusively around the new culvert (see the photos on the right). The stream was estimated to be 90% bank full. Stream width ranged from 3.6 feet to 12.5 feet, and was 5.5' wide on average. Stream depth ranged from 3 inches to over 3 feet, and was about 1 foot deep on average.

The riparian zone surrounding the stream was composed of intact native vegetation for greater than 60 feet on either side of the stream and along the entire survey reach. Stream banks stability was rated as 'moderate', with high sides dominated by grasses with natural erosion potential. The vegetation in the 60 foot buffer on either side of the There are residential neighborhoods down both Hutler Road and Bald Mountain Road, and as such there are opportunities for recreational/neighborhood use of this area. Aside from the road access, there is no evidence of use (i.e. trails, trampling of vegetation, etc.)

Beaver Creek, passing under Bald Mountain Rd. The old culvert pipes (top) were replaced in the summer of 2009 with one larger culvert arch to improve water flow during high water events (bottom).

along this stretch of Beaver Creek. See pages 16 and 17 for maps and further discussion of human use and recreation across the Beaver Creek watershed.

CEMP utilizes photographs taken throughout the years to document visual changes in the stream or surrounding environment. Site photographs can be found online, linked from Inletkeeper's website (http://www.inletkeeper.org) Future monitoring should include establishing photo points so that pictures can be easily compared over time.

Left: CEMP sampling site AR-1090, upper Beaver Creek, during the first year of sampling. This picture was taken in August of 2002.

Bottom: Two photos stitched together. Together these pictures provide a wider perspective of the riparian zone that was included in the Stream Walk assessment. These pictures were taken in August of 2010.

BEAVER CREEK: FUTURE MONITORING

Through CEMP, volunteers monitored baseline water quality at upper Beaver Creek from 2002-2010. This baseline report summarizes the chemical, biological, and physical data collected over these 8 years. Our monitoring efforts have shown overall high water quality in this salmon-bearing stream. Turbidity at this site is consistently below 10 NTUs, with only a handful of minor exceptions during spring months of heavy rainfall. Even during these times periods of high runoff our sampling has never shown turbidity above 14 NTUs. Bacteria levels are consistently low, with only one exceedence of *E.coli* occurring in March 2003. Summer dissolved oxygen levels have dipped below the state water quality standard once a year during 4 of the 5 years between 2005-2009. pH levels exceeded state water quality standards 25 times, with a minimum recorded pH of 5.86 which occurred in 2007. It is unclear why pH levels are low in this creek. Low values have been measured during every month of the year, and at least once every year. Wetland soils tend to be more acidic and may be influencing stream pH levels at this wetland-dominated site. This would be a good site to test methods for continuous pH monitoring to assess the frequency of low pH values.

pH		
Date	**Time**	**pH**
11/24/2002	12:00 PM	5.98
9/25/2005	10:20 AM	6.30
4/25/2004	4:15 PM	6.35
10/26/2003	11:15 AM	6.37
6/24/2007	11:15 AM	5.86
5/10/2009	7:35 AM	6.01
4/26/2009	10:00 AM	6.05
5/31/2009	8:55 AM	6.05
7/8/2007	12:27 PM	6.07
1/28/2007	1:00 PM	6.09
9/28/2008	10:00 AM	6.15
2/22/2009	11:15 AM	6.18
8/9/2009	10:00 AM	6.19
10/26/2008	12:57 PM	6.20
12/31/2006	2:20 PM	6.25
1/25/2009	10:45 AM	6.26
8/27/2006	11:50 AM	6.30
7/22/2007	4:30 PM	6.30
12/28/2008	4:00 PM	6.30
11/30/2008	1:05 PM	6.32
6/14/2009	9:05 PM	6.34
5/13/2007	11:44 AM	6.38
7/26/2008	10:30 AM	6.39
8/10/2008	11:10 AM	6.39
9/27/2009	12:50 PM	6.46

Above and on the right: water quality exceedences at Beaver Creek during CEMP monitoring from 2002-2010.

Water temperature data collected with the alcohol-filled thermometer on Beaver Creek showed 8 exceedences of state water quality standards during site visits. Continuous temperature monitoring, however, indicated 22 exceedences in 2007 alone—considerably more than indicated by the volunteer monitoring alone. Beaver Creek is listed as an anadromous stream; King and Coho salmon and Dolly Varden have been documented around the upper Beaver Creek CEMP site. As stream temperatures are likely to increase with increasing air temperatures due to climate change, Beaver Creek is a good candidate for long-term continuous temperature monitoring.

There was minimal development in the upper reaches of the watershed during the 8 years of our monitoring efforts. However, in the past 2

Dissolved oxygen		
Date	Time	mg/L
7/23/2005	5:45 PM	5.3
7/12/2004	10:04 AM	5.8
8/13/2006	9:45 PM	6.0
7/12/2009	12:30 PM	6.9
Bacteria		
Date	Time	CFU/100mL
3/30/2003	2:40 PM	250
Water Temperature (thermometer)		
Date	Time	Temperature (celcius)
7/10/2005	4:15 PM	16.5
6/29/2003	4:15 PM	16.0
7/23/2005	5:45 PM	15.0
8/1/2002	2:45 PM	14.5
7/12/2004	10:04 AM	14.0
7/14/2003	10:00 AM	14.0
7/6/2009	1:55 PM	14.0
7/12/2009	12:30 PM	13.0

years new access roads have been built on the lower slopes of Bald Mountain, downstream from the CEMP site. Many of the private parcels surrounding the headwaters of upper Beaver Creek are currently undeveloped or have light seasonal use. As the population of Homer grows, there is a potential for increased use of this area and increased impact on Beaver Creek.

Inletkeeper staff and volunteers maintained a visible presence during the culvert replacement project at the upper Beaver Creek site during the summer of 2009. Baseline water quality reports for CEMP sites provide a foundation for the protection of water quality in our watersheds.

Future Monitoring Recommendations

- Do a Stream Walk every other year (in summer), starting in 2012, with a minimum of 4 photographs taken from established photo points. Incorporate a basic invasive species assessment in partnership with the Homer Soil & Water Conservation District.
- Do a GIS analysis when new satellite images become available to Inletkeeper staff to assess new developments and changes in impervious cover.
- Consider continuous pH and temperature monitoring at this site.
- Resume chemical and biological water quality monitoring if impervious cover becomes greater than 2% in the upper portion of the watershed, in the event of a major spill or other environmental disaster in the upper watershed, or there are other qualitative indicators that water quality may be changing.

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Thank you, Neil and Kyra!