# Resurrection Bay Watershed Program
# Citizens Environmental Monitoring Program (CEMP)
# 2008 - 2009 Report


Resurrection Bay
Conservation
Alliance

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# Table of Contents

# March 2010
# RBCA Citizens Environmental Monitoring Program (CEMP)
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## Program Background and History:

Resurrection Bay Conservation Alliance is a community nonprofit organization whose mission is "…to enjoy and advocate for healthy land water and air."

In August of 2007, RBCA launched the Resurrection Bay Watershed Program, with the goal of protecting and enhancing the watershed through monitoring, habitat assessment, education and advocacy of science-based resource management. During fall of 2007, the Watershed Program identified the need to implement a baseline water quality monitoring program. Although some water quality data was available for a few select streams on the Eastern Kenai Peninsula, no baseline data was available for the Resurrection Bay watershed. Establishing a baseline is critical as a benchmark by which future conditions can be compared. Once a baseline is established, the future trends can be clearly observed.

With very limited buildable lands in the Resurrection Bay watershed, and growing industrial activities, it is becoming increasingly important to monitor water quality to insure that we are aware of trends. A lack of baseline water quality information, especially in populated regions of southcentral Alaska, will result in a lack of oversight on future development and uninformed management decisions.

RBCA would address the following objectives by conducting a water monitoring program:

- Establish a scientifically rigorously means of documenting the baseline condition of the watershed's anadromous freshwater streams; then track stream health indicators and report exceedences of state or federal standards.

- Identify short-term or event-related water quality problems. In the process of tracking stream health indicators, abnormal observations would also be documented. These are then verified and reported as exceedences of state or federal standards, allowing for prompt response. These detections allow for correction or remediation of environmental problems.

- Raise awareness of the Resurrection Bay ecosystem via engaging area residents in a community stewardship program. Such a program provides a perfect forum for concerned citizens to become involved in a scientific program to monitor the health of our local environment. Clean water is a non-controversial issue of interest to varied groups, even individuals who don't consider themselves "activists."

- Build RBCA’s credibility with government agencies. RBCA’s monitoring and science work builds credibility with scientists and resource managers, its education and advocacy efforts enhance stewardship and citizen participation, and together, these efforts translate into RBCA’s contribution to a healthy Resurrection Bay watershed.

The Citizens Environmental Monitoring Program (CEMP) was chosen to fulfill these objectives. The CEMP was created by the US Environmental Protection Agency (EPA), and has been adopted by many conservation groups throughout the USA. RBCA’s CEMP development and implementation was made possible largely with the assistance of Cook Inletkeeper (CIK) and Anchorage Waterways Council (AWC), organizations that oversee large CEMPs. In 1996, CIK in Homer developed Alaska’s first scientifically defensible volunteer water quality monitoring program. Inletkeeper’s program in Homer has been recognized as a model by the state, and has helped to generate similar monitoring programs throughout Alaska.

CEMP data is scientifically rigorous and collected under strict quality control guidelines. The stream parameters currently being monitored were selected based on both EPA’s federal water quality standards and Alaska Department of Environmental Conservation’s (ADEC) state standards.

Our Quality Assurance Program Plan (QAPP) is reviewed and approved by ADEC and the US EPA. Additionally, it is now the only continuous program collecting water quality data in the Resurrection Bay watershed, employing the best available science.

The data we collect will be posted online and available to land managers, regulatory agencies, and the public. In turn, the data collected becomes a permanent record, and can be used for incorporation into future resource planning and management documents.

Figure 1.) Volunteers completing Phase III Training

## Current CEMP Status

In spring of 2008, RBCA implemented a pilot CEMP. By starting out small, RBCA was able to launch the program at minimal cost, as well as to gauge local interest in citizen science. A 5-member CEMP Technical Advisory Committee (TAC) was formed, and began working to prioritize sampling sites in area streams. These sites were prioritized based primarily on anadromous fish presence and human-generated threat potential (Appendix A). Four pilot collection sites were established and mapped.

Five citizen volunteers received Phase I-III training in May of 2008, and began data collection for these sites. Two RBCA volunteers received the higher Phase V training, allowing them to become “trained trainers.”

After a successful year of the pilot program, RBCA determined that enough momentum and public interest was present in order to expand the scope of CEMP.

In spring of 2009, four additional volunteers received training (Figure 1), bringing the total number of trained volunteers to eleven. Three additional streams sampling sites (as prioritized by the TAC in 2008) were added to the program, and sample collection began on these sites. A total of seven sites are now being sampled, with plans to begin sampling at least the next three priority sites in spring of 2010.

One individual was added to the TAC in 2009, for a total of 6 members.

In September of 2009, the CEMP received a generous grant from the Bullitt Foundation, allowing it to hire a half-time Monitoring Program Coordinator, as well as to purchase additional testing equipment.

As of January 2010, 132 observations have been made in the watershed. Our 11 volunteers dedicated over 400 hours of their time to the program to date; an in-kind value of approximately $7,650.

## CEMP Expansion Goals

The intended goal is to expand CEMP by maximizing the number of sampling sites and adding additional test parameters in order to obtain the best available data on area stream conditions. By increasing the scope of the program we will increase our success in establishing baseline water quality parameters, filling data gaps, detecting and reporting significant changes at monitoring sites, tracking water quality trends, while promoting stewardship and awareness of water quality issues and ecosystem health. At least one stream with no potential for human impacts will be added to the sampling array to serve as a control site. We also hope to increase the number of data sets collected annually to at least 160, therefore increasing data accuracy and providing an invaluable picture of the existing water quality conditions in our watershed.

Coliform bacteria testing will be added to the sampling parameters at selected stream sites in spring, 2010. While coliform bacteria are natural and most are harmless, the presence of high levels of coliform bacteria, particularly, fecal coliforms, may indicate that septic system(s) are failing and discharging sewage into the water. Certain species of these bacteria can cause severe illness such as typhoid fever and dysentery.

RBCA is also developing a water temperature monitoring program to be implemented in spring of 2010, utilizing data loggers such as TidbiTs®, placed in select stream locations. These are small and relatively inexpensive thermometers, and will be programmed to record water temperature every 15 minutes. TidbiTs® are user-friendly, and are an excellent tool for documenting this important parameter. By monitoring water temperatures, we hope to observe spatial and temporal temperature patterns and document the baseline conditions of our streams. Temperature is often the main factor in a stream's ability to support successful fish spawning. In addition to predicted global warming trends, development (construction) near or adjacent to streams usually requires clearing vegetation, decreasing shade, or cover.  Loss of cover could ultimately result in increased water temperatures and adverse impacts to salmonid reproduction.

Long-term CEMP conservation outcomes include, but are not limited to the following:

- Collecting a five-year data set for a minimum of 10 monitoring sites.
- Establishing baseline water quality parameters for these sites.
- Compiling a data summary with data trend analysis.
- Making recommendations for additional monitoring concerns.

**The CEMP Partnership:**

RBCA also joined the CEMP Partnership of Southcentral Alaska in 2009. The partnership includes Anchorage Waterways Council, Cook Inletkeeper, Matanuska-Susitna Borough, Wasilla Soil and Water Conservation District, Upper Susitna Soil and Water Conservation District, University of Alaska Anchorage, Environment and Natural Resources Institute, Kenai Watershed Forum, and the Homer Soil and Water Conservation District.

A primary goal of the Partnership is to collect baseline water quality data to detect significant changes over time, which requires 80 sampling events per site over 5-7 years. Data collection efforts need to be more focused to complete baseline datasets throughout the region. Another major goal is to strengthen the integrity and credibility of the Partnership through an independent Technical Systems Audit, as well as developing a regional monitoring strategy. The Partnership also plans to assess the status of all sites sampled to-date, address data analysis questions, and create a data analysis template.

Through the strength of this Partnership, we also hope to obtain funding that would sustain our individual programs and allow us to:

- Develop  a 5-year regional water quality monitoring strategy for Southcentral Alaska;
- Produce 1-5 standardized baseline water quality reports from all Partners that will include complete baseline datasets, long-term photo documentation, and GIS analysis of watershed land use;
- Complete a web-accessible baseline water quality report library for Southcentral Alaska with a
- schedule for posting future reports;
- Complete Technical System Audit reports from each Partner, including follow-up audits and annual QA/QC results from all monitoring activities at each Partner CEMP;
- Develop a unified training module available for all current and future Partners for training new water quality monitors.

Success of Partnership funding will insure that all future reports will appear in a standardized format.

## Parameters: What We Test For and Why:

### Temperature

Water temperature is one of the most important water quality parameters we test. It controls metabolic and reproductive activities in organisms, and determines what species inhabit the stream. Temperature also affects dissolved oxygen, and can influence bacterial growth and chemical reactions in water. The Alaska Department of Environmental Conservation (ADEC) maximum water quality standard for water temperature is 15°C for salmon migration and rearing, and 13°C for spawning, and egg and fry incubation. We use "regular" alcohol-filled thermometers and a Hanna Combo meter to record temperatures

### Dissolved Oxygen (DO)

DO is one of the most important indicators of a water body's ability to support aquatic life. It is essential for the basic metabolic processes of animals and plants inhabiting our streams. The ADEC standard for DO is 7.0 mg/l in waters used by anadromous fish. We use the Winkler titration method to measure dissolved oxygen.

### pH

pH is a measure of the acidity or alkalinity of a solution and is ranked on a scale from 1.0 to 14.0. Acidity increases as pH gets lower. pH affects many chemical and biological processes in the water.. The ADEC water quality standard for the growth and propagation of fish, shellfish, aquatic life, and wildlife is between 6.5 and 8.5. We measure pH using a Hanna Combo meter and perform duplicate colorimetric pH tests for conformation.

### Conductivity

Conductivity measures water's ability to pass an electric current, and can be used to indicate the dissolved solids or ion content of the water. Conductivity in streams is affected primarily by the geology of the area, but may also be affected by human sources such as septic systems or runoff. Conductivity is measured using the Hanna Combo meter.

### Turbidity (TDS)

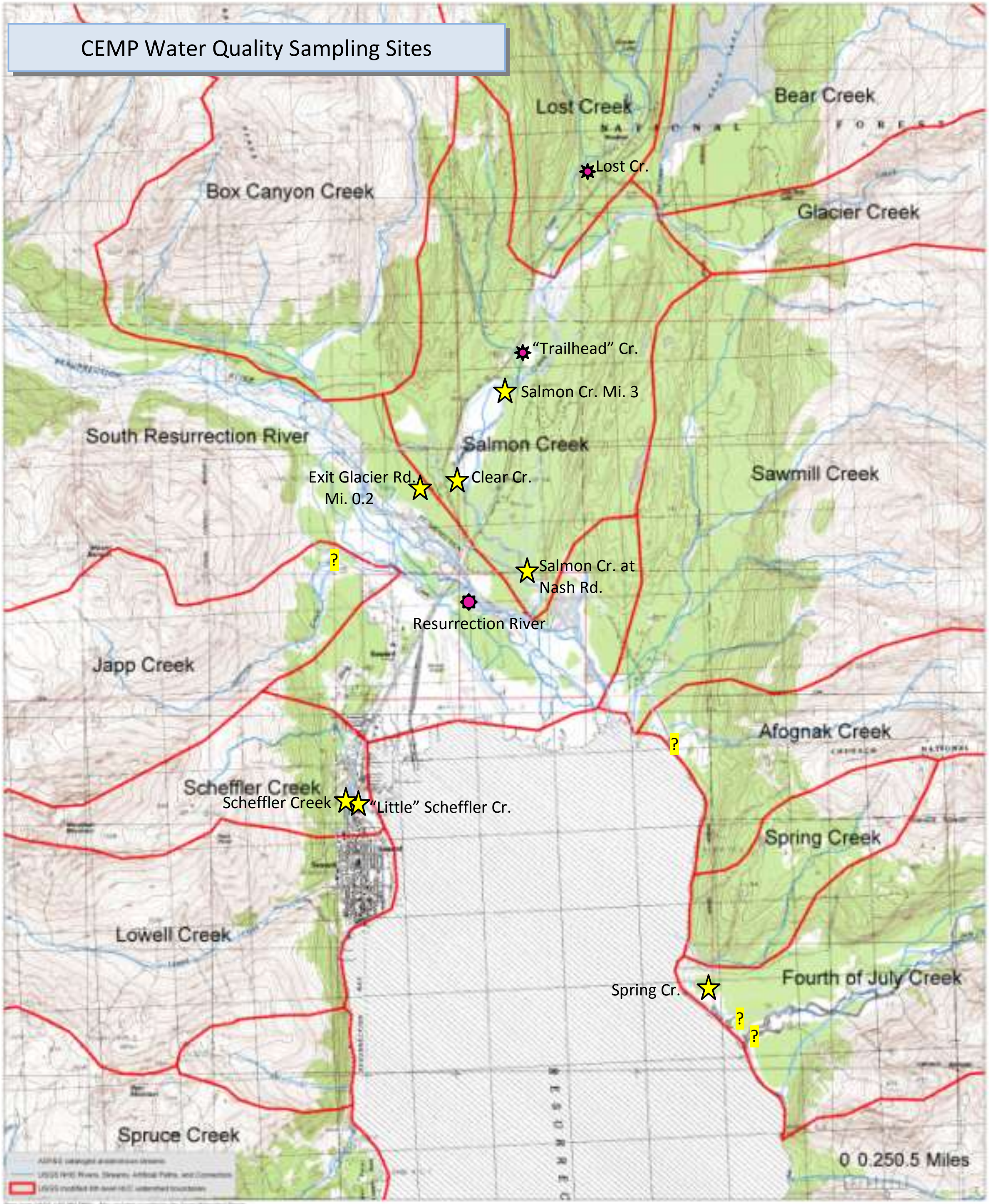
Turbidity measures water clarity. Any material mixed and suspended in water will reduce its clarity and make the water turbid, or cloudy.  High turbidity levels can be disruptive to aquatic systems in various ways such as: (1) interfering with the passage of light through water (resulting in reduced photosynthesis), (2) clogging the gills of some fish species, (3) causing an increase in water temperature, since suspended particles absorb more heat, resulting in a decrease of dissolved oxygen (warmer water holds less oxygen), and (4) smothering fish eggs and benthic macroinvertebrates, or aquatic insects. We use the Hanna Combo meter for TDS, and also a visual comparison method recorded in Jackson Turbidity units (JTUs).

## **Where We Sample and Why:**

The CEMP is endeavoring to sample representative streams from each of the major drainages within the Resurrection Bay watershed (Figure 2.) Although the larger area drainages include Resurrection River, Salmon Creek, and Sawmill Creek, we currently are not sampling Resurrection River and Sawmill Creek. The CEMP TAC determined that due to the degree of mixing and dilution of their waters, sampling large glacial drainages would not be representative of the overall watershed. Discrete events or subtle changes could potentially be masked by the large-volume flows.

Sample site selection criteria include the stream's fish-bearing status, and its proximity to human-generated impacts such as industrial or road runoff and construction. We also consider volunteer safety and access in choosing sites. Sites were selected that would not require extensive hiking or travel through private property. With the exception of two sites located adjacent to volunteer's homes, all sites are within road rights-of-way.

The TAC developed a Creek Sampling Location Decision Matrix in during the pilot CEMP in 2008 (Appendix A). The TAC identified all possible or potential threats to anadromous streams in the watershed and created a prioritization system to determine which streams were most important for the CEMP to collect data from. The first four prioritized streams described in this report received the highest ratings, and became pilot program sampling sites. Once the pilot program proved successful, sampling began in the next three prioritized streams in spring of 2009. The TAC recently updated the Decision Matrix during their spring 2010 meeting, re-evaluated and re-prioritizing some streams. It was decided that sampling the next two priority streams would begin in spring 2010: "Trailhead" Creek (adjacent to the Seward Highway), and Lost Creek near Salmon Creek mile 6.5. A third site, as yet to be determined will also be sampled, bring the total number of sites to ten.




**Key to CEMP Sites**

☆ = Current sampling site

✸ = Proposed site

? = Site for discussion

## 2008-2009 Monitoring Results:

The four sites with the most data sets (average 25 sets/site) are illustrated and discussed below. The three sites added in 2009 will not be discussed at length, as their data sets are not yet representative of a complete set of sixteen.
The raw data for these sites as well as the full data set for all seven sites can be viewed online at www.rbca-alaska.org, or a hard copy can be sent by mail on request.

**1.) Scheffler Creek**. This is an urban, anadromous stream; originating on Mt. Marathon and draining a residential area and a horse pasture before flowing into the north side of the "Seward lagoon." A flood event in late July of 2009 deposited large amounts of gravel at the site; altering the substrate from silty/sandy to predominately gravel. Coho (silver), Chum (dog) and Pink (humpy) salmon have been observed at the sample site, as well as unspeciated juvenile salmon.

Figure 3.) Scheffler Creek, looking upstream (north) from sampling site.

Figure 4.) Scheffler Creek site, looking downstream towards the outflow.

Table 1.) Scheffler Creek Water Quality Data

| # | Date | Time | Air Temp F | Therm Temp C | Meter Temp C | Color pH | meter pH | Conduc-tivity | TDS | DO mg/L |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 05/19/08 | 4:53 PM | 51 | 6.0 | 7.3 | 6.75 | 7.06 | 92 | 35 | 11.20 |
| 2 | 06/09/08 | 5:30 PM | 44 | 8.0 | 8.1 | 6.75 | 7.21 | 71 | 28 | 11.93 |
| 3 | 07/14/08 | 6:21 PM | 56 | 7.5 | 9.1 | 6.75 | 7.20 | 83 | 33 | 12.57 |
| 4 | 07/28/08 | 5:30 PM | 52 | 7.3 | 8.1 | 6.75 | 7.24 | 88 | 34 | 11.67 |
| 5 | 08/12/08 | 5:30 PM | 52 | 7.0 | 7.9 | 6.75 | 7.25 | 99 | 38 | 11.73 |
| 6 | 08/25/08 | 5:40 PM | 52 | 7.8 | 8.2 | 7.00 | 7.28 | 95 | 38 | 11.67 |
| 7 | 09/22/08 | 5:20 PM | 41 | 5.0 | 5.2 | 6.75 | 7.27 | 102 | 39 | 12.17 |
| 8 | 10/27/08 | 4:40 PM | 30 | 2.8 | 2.3 | 6.50 | 6.82 | 146 | 55 | 10.90 |
| 9 | 11/25/08 | 4:38 PM | 36 | 3.5 | 2.9 | 6.75 | 6.86 | 132 | 51 | |
| 10 | 12/22/08 | 4:19 PM | 26 | 2.8 | 1.8 | 6.75 | 6.98 | 128 | 48 | 12.40 |
| 11 | 01/28/09 | 5:10 PM | 26 | 2.0 | 2.5 | 6.75 | 6.93 | 149 | 57 | 11.63 |
| 12 | 02/23/09 | 4:02 PM | 29 | 2.8 | 2.5 | 6.75 | 6.93 | 125 | 48 | 12.00 |
| 13 | 03/25/09 | 4:10 PM | 32 | 6.5 | 0.9 | 6.75 | 6.94 | 121 | 46 | 12.20 |
| 14 | 04/28/09 | 5:50 PM | 48 | 6.0 | 6.3 | 6.75 | 6.92 | 120 | 47 | 11.77 |
| 15 | 05/11/09 | 5:51 PM | 56 | 7.0 | 6.5 | 6.75 | 7.09 | 80 | 31 | 13.50 |
| 16 | 05/25/09 | 4:35 PM | 53 | 8.0 | 7.4 | 6.75 | 7.34 | 103 | 41 | 11.87 |
| 17 | 06/10/09 | 5:43 PM | 52 | 8.0 | 9.6 | 6.75 | 6.97 | 76 | 31 | 11.77 |
| 18 | 06/23/09 | 4:35 PM | 52 | 8.0 | 8.5 | 7.00 | 7.34 | 80 | 32 | 11.40 |
| 19 | 06/24/09 | 6:35 PM | 55 | 10.5 | 8.7 | 6.75 | 7.09 | 95 | 38 | 12.20 |
| 20 | 07/15/09 | 3:32 PM | | 8.5 | 10.4 | 7.00 | 7.28 | 89 | 36 | 12.47 |
| 21 | 07/27/09 | 4:20 PM | 55 | 8.0 | 8.0 | 6.75 | 7.06 | 70 | 29 | 10.67 |
| 22 | 08/11/09 | 3:45 PM | 57 | 8.5 | 8.7 | 7.00 | 7.26 | 103 | 41 | 12.43 |
| 23 | 08/26/09 | 6:25 PM | 57 | 4.0 | 8.3 | 7.00 | 7.02 | 108 | 42 | 10.97 |
| 24 | 09/28/09 | 3:15 PM | 36 | 4.0 | 4.8 | 7.00 | 7.06 | 127 | 48 | 12.83 |
| 25 | 10/26/09 | 4:03 PM | 41 | 2.0 | 4.4 | 7.00 | 6.93 | 106 | 42 | 12.13 |
| 26 | 12/02/09 | 3:28 PM | 30 | 1.8 | 1.6 | 6.75 | 6.74 | 117 | 43 | 12.77 |
| 27 | 12/30/09 | 4:53 PM | 30 | | 1.3 | 6.75 | 7.26 | 129 | 48 | 14.77 |

Average summer stream temp = 4.8C DO = 10.0 mg/L
Average winter stream temp = 3.0C DO = 11.0 mg/L

**2.) <u>Exit Glacier Road, Mile 0.2</u>**

This anadromous stream is spring-fed, flowing through a residential area with a history of unofficial junkyards and storing or dumping of contaminants. It is also subject from road runoff. This is a low-gradient, low velocity stream with a relatively short reach.


Figure 5.) Exit Glacier Rd. Mile 0.2 sampling site, looking upstream

Table 2.) Exit Glacier Road, Mile 0.2 Water Quality Data

| # | Date | Time | Air Temp F | Therm. Temp C | Meter Temp C | Color pH | Meter pH | Specific Conduct-ivity | TDS | DO mg/L |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 06/09/08 | 3:00 PM | 60 | 7.00 | 8.1 | 6.75 | | 130 | 65 | 9.97 |
| 2 | 06/23/08 | 3:30 PM | 56 | 6.00 | 7.3 | 6.75 | 6.97 | 148 | 74 | 9.97 |
| 3 | 07/14/08 | 2:46 PM | 60 | 6.25 | 7.0 | 6.75 | 6.84 | 130 | 64 | 9.93 |
| 4 | 07/28/08 | 2:49 PM | 58 | 6.00 | 6.8 | 6.75 | 6.67 | 132 | 66 | 9.97 |
| 5 | 08/11/08 | 2:55 PM | 62 | 7.00 | 7.5 | 6.75 | 6.75 | 145 | 72 | 9.57 |
| 6 | 08/25/08 | 2:42 PM | 56 | 6.25 | 7.5 | 6.50 | 6.65 | 134 | 68 | 9.53 |
| 7 | 09/22/08 | 2:44 PM | 52 | 6.00 | 6.5 | 6.75 | 6.51 | 143 | 72 | 10.07 |
| 8 | 10/27/08 | 4:22 PM | 30 | 4.50 | 4.0 | 6.50 | 6.52 | 135 | 66 | 10.23 |
| 9 | 11/24/08 | 4:22 PM | 34 | 4.75 | 4.8 | 6.75 | 6.42 | 127 | 62 | 9.90 |
| 10 | 12/22/08 | 3:50 PM | 24 | 4.00 | 3.7 | 6.75 | 6.43 | 137 | 69 | 9.82 |
| 11 | 01/26/09 | 4:27 PM | 24 | 3.50 | 3.4 | 6.50 | 6.43 | 113 | 57 | 10.67 |
| 12 | 02/25/09 | | 36 | 6.50 | 5.8 | 6.75 | 6.53 | 136 | 65 | 10.70 |
| 13 | 03/23/09 | 4:35 PM | 38 | 4.50 | 4.3 | 6.75 | 5.93 | | | 10.57 |
| 14 | 04/27/09 | 5:15 PM | 50 | 5.75 | 6.1 | 6.50 | 7.00 | 109 | 54 | 10.40 |
| 15 | 05/11/09 | 5:34 PM | 62 | 5.50 | 5.5 | 6.50 | 6.26 | 118 | 58 | 10.07 |
| 16 | 05/26/09 | 5:00 PM | 61 | 6.5 | 8.1 | 6.50 | 7.13 | 122 | 61 | 7.67 |
| 17 | 06/08/09 | 4:50 PM | 54 | 5.25 | 5.5 | 6.50 | 5.62 | 117 | 59 | 10.27 |
| 18 | 06/22/09 | 5:12 PM | 44 | 5.00 | 4.7 | 6.63 | 7.06 | 121 | 60 | 9.73 |
| 19 | 07/13/09 | 4:47 PM | 58 | 6.00 | 5.5 | 6.75 | 5.64 | 124 | 62 | 9.47 |
| 20 | 07/27/09 | 5:07 PM | 57 | 5.50 | 5.9 | 6.75 | 6.87 | 117 | 58 | 9.60 |
| 21 | 08/10/09 | 12:52 PM | 54 | 5.00 | 5.8 | 6.75 | 6.78 | 122 | 61 | 9.97 |
| 22 | 08/24/09 | 3:58 PM | 56 | 5.00 | 6.0 | 6.75 | 7.24 | 125 | 62 | 9.93 |
| 23 | 09/28/09 | 1:22 PM | 46 | 4.25 | 4.7 | 6.75 | 7.25 | 118 | 59 | 10.40 |
| 24 | 11/30/09 | 12:27PM | 34 | 3.75 | 3.8 | 6.75 | 7.19 | 114 | 56 | 9.80 |
| 25 | 12/28/09 | 5:12 PM | 30 | 3.25 | 3.9 | 6.75 | 7.03 | 113 | 56 | 9.33 |

Average summer stream temp = 4.6C DO = 10.17 mg/L
Average winter stream temp = 6.2C DO = 9.69 mg/L

**3.) <u>Salmon Creek at Nash Road</u>**

This is an anadromous stream with a red salmon run. It drains a large residential area and is subject to upstream perturbances from construction activities and gravel extraction, as well as road runoff. A long-established junkyard subject to frequent flooding also lies upstream of the sampling site.


Figure 6.) Salmon Creek at Nash Road looking upstream to in an approximate northeast direction.

Table 3.) Salmon Creek at Nash Road Water Quality Data 2008-2009.

| # | Date | Time | Air Temp F | Therm. Temp C | Meter Temp C | Color pH | Meter pH | Specific Conduct-ivity | TDS | DO mg/L |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 06/09/08 | 3:40 PM | 52.0 | 9.0 | 9.7 | 7.00 | 7.51 | 96 | | 10.9 |
| 2 | 07/14/08 | 4:45 PM | 59.0 | 8.8 | 8.8 | 7.00 | 6.45 | 98 | 49 | 10.9 |
| 3 | 07/26/08 | 2:16 PM | 52.0 | 7.8 | 8.7 | 7.00 | 7.34 | 98 | 49 | 10.9 |
| 4 | 08/11/08 | 2:45 PM | 57.0 | 9.5 | 10.6 | 7.25 | 7.54 | 114 | 56 | 9.9 |
| 5 | 08/25/08 | 3:27 PM | 59.0 | 9.0 | 9.5 | 6.75 | 7.35 | 113 | 56 | 10.1 |
| 6 | 09/21/08 | 1:38 PM | 59.0 | 6.0 | 7.7 | 7.00 | 7.28 | 98 | 48 | 10.8 |
| 7 | 10/27/08 | 2:40 PM | 34.0 | 1.5 | 2.0 | 7.13 | 6.38 | 123 | 61 | 11.5 |
| 8 | 11/24/08 | 2:05 PM | 32.0 | 2.0 | 1.9 | 6.75 | 6.37 | 133 | 66 | 8.5 |
| 9 | 01/26/09 | 6:15 PM | 22.0 | 0.0 | 0.9 | 6.75 | 6.54 | 120 | 60 | |
| 10 | 02/25/09 | 4:20 PM | 34.0 | 2.5 | 1.6 | 6.75 | 7.08 | 130 | 65 | 11.8 |
| 11 | 03/25/09 | 6:20 PM | 31.0 | 2.5 | 1.7 | 6.75 | 6.87 | 129 | 64 | 11.1 |
| 12 | 05/12/09 | 4:25 AM | 62.0 | 11.8 | 12.0 | 6.75 | 7.35 | 106 | 53 | 10.5 |
| 13 | 05/26/09 | 3:35 PM | 60.0 | 12.0 | 12.4 | 6.75 | 7.35 | 99 | 49 | 10.0 |
| 14 | 06/17/09 | 2:25 PM | 54.0 | 8.5 | 8.1 | 6.75 | 6.85 | 108 | 53 | 7.5 |
| 15 | 07/01/09 | 6:26 PM | 53.0 | 9.8 | 10.9 | 7.00 | 6.49 | 101 | 51 | 9.8 |
| 16 | 07/14/09 | 6:55 PM | 59.0 | 9.8 | 10.7 | 7.00 | 6.40 | 91 | 45 | 10.2 |
| 17 | 07/28/09 | 4:40 PM | 52.0 | 8.0 | 8.2 | 6.75 | 7.03 | 89 | 44 | 9.7 |
| 18 | 08/12/09 | 2:33 PM | 56.0 | 9.3 | 8.7 | 6.75 | 7.20 | 99 | 50 | 9.1 |
| 19 | 08/24/09 | 3:46 PM | 70.0 | 11.5 | 12.2 | 6.75 | 7.28 | 105 | 52 | 9.6 |
| 20 | 09/29/09 | 5:02 PM | 48.0 | 7.8 | 6.7 | 6.75 | 7.42 | 113 | 56 | 10.1 |
| 21 | 10/26/09 | 5:45 PM | 41.0 | 5.0 | 4.8 | 7.00 | 7.44 | 103 | 50 | 10.8 |
| 22 | 12/01/09 | 1:00 PM | 38.0 | 2.5 | 1.4 | 6.75 | 7.29 | 95 | 47 | 10.3 |
| 23 | 12/28/09 | 4:20 PM | 31.0 | 2.5 | 1.8 | 6.75 | 7.34 | 110 | 56 | 10.6 |

Average summer stream temp = 9.6 C DO = 9.9 mg/L
Average winter stream temp = 3.2 C DO = 10.6mg/L

**4.) Spring Creek**

As the name implies, this is a spring-fed stream, flowing through an industrial park and subject to impacts from a shipyard's surface water runoff. It also flows parallel to the effluent pipeline exiting Spring Creek Correctional Facility's wastewater treatment lagoon. Chum and Pink salmon have been observed at the sampling site, although a high-gradient culvert just downstream of the site prevents all but the most intrepid individuals from travelling further upstream to spawn.


Figure 7.) Spring Creek sampling site

Table 4.) Spring Creek Water Quality Data

| # | Date | Air Temp F | Therm Temp C | Meter Temp C | Color pH | Meter pH | Conduc-tivity | TDS | DO mg/L |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 06/09/08 | 53 | 4.75 | 4.88 | 6.75 | 6.99 | 106 | 53 | 11.06 |
| 2 | 06/23/08 | 59.5 | 4.50 | 4.50 | 6.75 | 6.93 | 101 | 51 | 10.70 |
| 3 | 07/15/08 | 63 | 4.88 | 4.94 | 6.75 | 7.22 | 98 | 49 | 10.77 |
| 4 | 07/28/08 | 54 | 4.50 | 4.50 | 6.75 | 7.02 | 92 | 46 | 6.56 |
| 5 | 08/12/08 | 52 | 5.00 | 5.25 | 6.75 | 7.03 | 89 | 45 | 11.00 |
| 6 | 08/25/08 | 57 | 4.75 | 4.88 | 6.75 | 7.04 | 85 | 42 | 11.23 |
| 7 | 09/24/08 | 44 | 4.50 | 4.50 | 6.50 | 6.70 | 90 | 45 | 11.33 |
| 8 | 10/28/08 | 31 | 2.75 | 2.63 | 6.75 | 6.95 | 97 | 48 | 11.33 |
| 9 | 11/25/08 | 32 | 2.50 | 2.50 | 6.75 | 6.84 | 96 | 49 | 11.47 |
| 10 | 01/26/09 | 27 | 1.00 | 1.00 | 7.00 | 6.92 | 95 | 47 | 11.13 |
| 11 | 02/24/09 | 32 | 2.00 | 2.00 | 6.75 | 6.90 | 101 | 50 | 11.97 |
| 12 | 03/25/09 | 38 | 2.50 | 2.50 | 6.75 | 6.88 | 98 | 48 | 11.97 |
| 13 | 04/29/09 | 49 | 4.10 | 4.25 | 6.75 | 6.28 | 95 | 47 | 10.10 |
| 14 | 05/12/09 | 64 | 4.75 | 4.88 | 6.75 | 6.04 | 101 | 50 | 10.85 |
| 15 | 05/26/09 | 63 | 6.00 | 6.00 | 6.75 | 7.25 | 98 | 49 | 9.19 |
| 16 | 06/16/09 | 55 | 4.00 | 4.00 | 6.75 | 6.82 | 96 | 48 | 8.47 |
| 17 | 07/01/09 | 62 | 5.00 | 5.05 | 6.75 | 7.00 | 89 | 45 | 10.20 |
| 18 | 07/15/09 | 68 | 4.55 | 4.58 | 6.75 | 7.02 | 83 | 42 | 6.93 |
| 19 | 07/29/09 | 55 | 5.00 | 5.00 | 6.75 | 7.08 | 83 | 41 | 5.88 |
| 20 | 08/12/09 | 53 | 4.13 | 4.06 | 6.75 | 6.99 | 88 | 44 | 9.20 |
| 21 | 08/25/09 | 54 | 5.00 | 5.00 | 6.75 | 6.95 | 86 | 44 | 10.80 |
| 22 | 09/28/09 | 52 | 4.55 | 4.58 | 6.75 | 6.87 | 87 | 43 | 9.80 |
| 23 | 10/27/09 | 42 | 4.00 | 4.00 | 6.75 | 6.97 | 89 | 44 | 11.13 |
| 24 | 12/28/09 | 33 | 2.50 | 2.50 | 6.75 | 6.81 | 91 | 46 | 10.20 |

Average summer stream temp = 4.8C DO = 10.0 mg/L
Average winter stream temp = 3.0C DO = 11.0 mg/L

**Streams added in 2009:**
Sampling in the following streams, as mentioned above, began in spring of 2009, but do not have complete datasets (n=16) at this date.

**5.) “Little” Scheffler Creek**: This is a meandering stream with a silty substrate that flows adjacent to the Seward highway, through the Alaska Railroad yards, and into the Seward Lagoon via new fish-passage culverts installed in the summer of 2009. It is just east of Scheffler Creek.

**6.) Salmon Creek, Mile 3**: This site is upstream of Salmon Creek at Nash Road, and although it doesn’t have the same industrial threats as the Nash Road site, it flows through several large residential subdivisions and is subject to impacts from domestic livestock, flooding, and septic system failures.

**7.) Clear Creek:** This creek also flows through long-established residential areas and represents waters flowing from the west into Salmon Creek. This stream has been subjected to numerous “riparian reconfigurations” by adjacent property owners, and is a short distance downstream (less than .25 mile) of the Seward Highway.

## Discussion:

All of the parameters were generally within normal limits for Alaskan anadromous waters, as established by the ADEC (Appendix B) and US EPA, for all streams sampled in the 2-year data collection period. Several readings outside of the expected ranges were documented and are discussed below. Blank spaces on the data tables indicate that DQO were not met, and no data was recorded.

**pH:** Several pH instrument readings of less than 6.5 were recorded at three sites (Tables 2,3,4), however the colorimetric pHs performed in tandem with the Hanna Combo meter were within normal limits in all instances. It is unclear whether these instrument readings reflected an actual value, or can be attributed to operator or instrument error. The latter would be the most likely cause, as several of the Hanna meters developed “drifting” problems and were since removed from use.

**Dissolved oxygen (DO)**: Two dissolved oxygen readings were below the lower limit of 7.0 mg/L for anadromous fish (Table 4). Again, technical error seems a likely explanation in this case, although both low readings occurred in summer, when the water temperature for that stream was elevated. All of the sites demonstrated decreased dissolved oxygen corresponding with temperature increases, providing confidence in our Winkler titration methodology for dissolved oxygen measurement.

**Temperature:** No temperature exceedances for any salmonid life stage (as mandated by the ADEC) were recorded.

**Total Dissolved Solids (TDS)**: No exceedances were recorded.

**Conductivity:** ADEC does not have tolerance levels for conductivity, hence no exceedances were recorded.

Appendix A.) Stream selection criteria matrix

| Creek | Anadromous | Residential | Industrial | Ag./Livestock | Glacial | Recreation | Road Impacts | New Dev. | Control Point | Score |
|---|---|---|---|---|---|---|---|---|---|---|
| Spruce Creek | No | No | Low-4 | No | No | No | No | Low | No | 2 |
| Lowell Creek | No | No | No | No | No | Yes | No | Low | No | 2 |
| "Little" Scheffler Creek | Yes | Med | Med | Med-3 | No | Yes | High | Low | No | 12 |
| Scheffler Creek main | Yes | Med | Low-1 | Med-3 | No | Yes | Low | Med | No | 9 |
| Scheffler Creek upstream control | | | | | | | | | Yes | |
| Japanese Creek Lower | Yes | Low | Med-2 | No | Yes | No | No | Med | No | 6 |
| Resurrection River | Yes | No | Med-2 | Low-3 | Yes | Yes | Low | Med | No | 8 |
| Exit Glacier Rd. Mile 0.2 | Yes | Med | Low | No | No | Yes | Low | Med | No | 8 |
| Preachers Upper Control | | | | | | | | Low | Yes | |
| Clear Creek @ Hwy | Yes | Med | Low | Low-3 | No | Yes | Low | Low | No | 8 |
| Clear Creek Upper Control | | | | | | | | | Yes | |
| "Trailhead" Creek | Yes | Med | Low | No | No | No | High | Med | No | 9 |
| Salmon Creek @ Nash Rd | Yes | High | Med-2 | Med | Yes | Yes | Med | Med | No | 13 |
| Salmon Creek Mile 3 | Yes | High | Low | Low | Yes | No | Med | Med | No | 10 |
| Salmon Creek mile 6.5 bridge | Yes | Med | Low-2 | Low | No | No | Low | Med | No | 8 |
| Lost Creek | Yes | Low | No | Low | No | No | Med | Low | No | 6 |
| Grouse Creek | Yes | No | No | No | No | Yes | High | Low | No | 6 |
| Bear Creek | Yes | Med | Low | Low | No | Yes | No | Low | No | 7 |
| Glacier Creek | No | Med | Low-2 | Low | Yes | Yes | Low | Low | No | 7 |
| Sawmill Creek | No | Low | Low | No | No | Low | No | No | No | 3 |
| Afognak Creek | Yes | Low | Low | No | No | No | Low | No | No | 4 |
| Spring Creek | Yes | No | High | No | No | Yes | Low | High | No | 9 |
| Spring Creek Control | | | | | | | | | Yes | |
| SMIC Lagoon | No | No | High | No | No | Yes | No | High | No | 7 |
| Fourth of July Creek | Yes | No | Med-5 | No | Yes | Low | No | Med | No | 6 |

<u>Scoring system</u>: Yes = 1, except for glacial creeks, where Yes = 0, Low = 1, Med = 2, and High = 3.

Scoring system, con't.

1.) Contaminated harbor dredge spoils have been used for fill upstream of site.
2.) Gravel extraction activities upstream.
3.) Horse tours and/or stables may affect this area.
4.) Industrial activity in ad just above the high tide zone.
5.) Potential for upstream impacts.

Note: None of these creeks are a domestic water source.

Steam Selection Rankings:

| Ranking | Creek | Score |
|---|---|---|
| 1 | Salmon Creek @ Nash | 13 |
| 2 | "Little" Scheffler Creek | 12 |
| 3 | Salmon Cr. Mile 3 | 10 |
| 4 | Scheffler Creek main | 9 |
| 5 | Spring Creek | 9 |
| 6 | "Trailhead" Creek | 9 |
| 7 | Exit Glacier Rd. Mile 0.2 | 8 |
| 8 | Clear Creek @ Hwy | 8 |
| 9 | Salmon Creek @ mile 6.5 | 8 |
| 10 | Resurrection River | 8 |
| 11 | Fourth of July Creek | 8 |
| 12 | SMIC Lagoon | 7 |
| 13 | Bear Creek | 7 |
| 14 | Glacier Creek | 7 |
| 15 | Grouse Creek | 6 |
| 16 | Japanese Creek Lower | 6 |
| 17 | Lost Creek | 6 |
| 18 | Afognak Creek | 4 |
| 19 | Sawmill Creek | 3 |
| 20 | Spruce Creek | 2 |
| 21 | Lowell Creek | 2 |
| 22 | Scheffler Creek Control | |
| 23 | Spring Creek Control | |
| 24 | Clear Creek Control | |
| 25 | Preacher's Pond Control | |

key: Green shading indicates streams currently being sampled.

Appendix B.) Applicable ADEC tolerance levels.

**ADEC WATER QUALITY STANDARDS**
**Amended as of July 1, 2008**

| **3) DISSOLVED GAS (Oxygen), FOR FRESH WATER USES** | |
|---|---|
| (A) Water Supply<br>(i) drinking, culinary, and food processing | Dissolved oxygen (D.O.) must be greater than or equal to 4 mg/l (this does not apply to lakes or reservoirs in which supplies are taken from below the thermocline, or to groundwater). |
| (A) Water Supply<br>(ii) agriculture, including irrigation and stock watering | D.O. must be greater than 3 mg/l in surface waters. |
| (A) Water Supply<br>(iii) aquaculture | D.O. must be greater than 7 mg/l in surface waters. The concentration of total dissolved gas may not exceed 110% of saturation at any point of sample collection. |
| (A) Water Supply<br>(iv) industrial | May not cause detrimental effects on established water supply treatment levels. |
| (B) Water Recreation<br>(i) contact recreation | D.O. must be greater than or equal to 4 mg/l. |
| (B) Water Recreation<br>(ii) secondary recreation | Same as (3)(B)(i). |
| (C) Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife | D.O. must be greater than 7 mg/l in waters used by anadromous or resident fish. In no case may D.O. be less than 5 mg/l to a depth of 20 cm in the interstitial waters of gravel used by anadromous or resident fish for spawning (see note 2). For waters not used by anadromous or resident fish, D.O. must be greater than or equal to 5 mg/l. In no case may D.O. be greater than 17 mg/l. The concentration of total dissolved gas may not exceed 110% of saturation at any point of sample collection. |

| **(4) DISSOLVED INORGANIC SUBSTANCES (TDS), FOR FRESH WATER USES** | |
|---|---|
| (A) Water Supply<br>(i) drinking, culinary, and food processing | Total dissolved solids (TDS) from all sources may not exceed 500 mg/l. Neither chlorides nor sulfates may exceed 250 mg/l. |
| (A) Water Supply<br>(ii) agriculture, including irrigation and stock watering | TDS may not exceed 1,000 mg/l. Sodium adsorption ratio must be less than 2.5, sodium percentage less than 60%, and residual carbonate less than 1.25 milliequivalents/liter (see note 6). |

| (4) TDS, con't. | |
|---|---|
| (A) Water Supply<br>(iii) aquaculture | TDS may not exceed 1,000 mg/l. A concentration of TDS may not be present in water if that concentration causes or reasonably could be expected to cause an adverse effect to aquatic life (see note 12). |
| (A) Water Supply<br>(iv) industrial | No amounts above natural conditions that can cause corrosion, scaling, or process problems. |
| (B) Water Recreation<br>(i) contact recreation | Not applicable. |
| (B) Water Recreation<br>(ii) secondary recreation | Not applicable. |
| (C) Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife | Same as (4)(A)(iii). |

| **(6) pH, FOR FRESH WATER USES (variation of pH for water naturally outside the specified range must be toward the range)** | |
|---|---|
| (A) Water Supply<br>(i) drinking, culinary, and food processing | May not be less than 6.0 or greater than 8.5. |
| (A) Water Supply<br>(ii) agriculture, including irrigation and stock watering | May not be less than 5.0 or greater than 9.0. |
| (A) Water Supply<br>(iii) aquaculture | May not be less than 6.5 or greater than 8.5. May not vary more than 0.5 pH unit from natural conditions. |
| (A) Water Supply<br>(iv) industrial | May not be less than 5.0 or greater than 9.0. |
| (B) Water Recreation<br>(i) contact recreation | May not be less than 6.5 or greater than 8.5. If the natural condition pH is outside this range, substances may not be added that cause an increase in the buffering capacity of the water. |
| (B) Water Recreation<br>(ii) secondary recreation | Same as (6)(A)(iv). |
| (C) Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife | May not be less than 6.5 or greater than 8.5. May not vary more than 0.5 pH unit from natural conditions. |

| **(10) TEMPERATURE, FOR FRESH WATER USES** | |
|---|---|
| (A) Water Supply<br>(i) drinking, culinary, and food processing | May not exceed $15_{o}$C. |
| (A) Water Supply<br>(ii) agriculture, including irrigation and stock watering | May not exceed $30_{o}$C. |
| (A) Water Supply<br>(iii) aquaculture | May not exceed $20_{o}$C at any time. The following maximum temperatures may not be exceeded, where applicable:<br>Migration routes $15_{o}$ C<br>Spawning areas $13_{o}$ C<br>Rearing areas $15_{o}$ C<br>Egg & fry incubation $13_{o}$ C<br>For all other waters, the weekly average temperature may not exceed site-specific requirements needed to preserve normal species diversity or to prevent appearance of nuisance organisms. |
| (A) Water Supply<br>(iv) industrial | May not exceed $25_{o}$C. |
| (B) Water Recreation<br>(i) contact recreation | Same as (10)(A)(ii). |
| (B) Water Recreation<br>(ii) secondary recreation | Not applicable. |
| (C) Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife | Same as (10)(A)(iii). |