NONPOINT SOURCE SUCCESS STORY

Alaska

Removing Pyritic Rock Fill and Installing Limestone Buffers Restores Sweetwater Lake Tributaries

Waterbodies Improved

Rock material containing pyrite was used to upgrade a forest road on Alaska's Prince of Wales Island. Acidic runoff from the pyrite had caused heavy metals to dissolve out of surrounding native rock, creating high metal levels in portions of five streams draining into Sweetwater Lake. As a result, the Alaska Department of Environmental Conservation (ADEC) added the streams to the state's 2010 Clean Water Act (CWA) section 303(d) list of impaired waters for metals. Project partners excavated the pyritic rock and installed limestone buffers. All five streams now meet water quality standards (WQS). Alaska plans to propose removal of these waterbodies from the state's 2014 list of impaired waters.

Problem

The Sweetwater Lake watershed is in the largely undeveloped Tongass National Forest on Prince of Wales Island in southeast Alaska (Figure 1). While upgrading Forest Service road 3030 (FS 3030) in 2006, the U.S. Department of Transportation's Federal Highway Administration, Western Federal Lands Highway Division (WFLHD), inadvertently used rock fill that contained pyrite. The rock was crushed and used as roadbed and in stream crossings along more than 3 miles of FS 3030. When exposed to air and water, the pyrite oxidized to sulfuric acid, which in turn dissolved heavy metals present in the surrounding native rock material. Surface runoff and groundwater carried the metals into numerous streams, polluting a portion of each stream directly downstream from the road. The streams empty into Sweetwater Lake, which was not affected.

In June 2007 WFLHD identified culvert corrosion occurring at a stream crossing, identified the road fill as a likely source of acidity, and began monitoring water quality. Data showed that five streams crossing FS 3030 were affected. The levels of sulfate and metals (including aluminum [Al], cadmium [Cd], copper [Cu], iron [Fe], manganese [Mn], nickel [Ni], and zinc [Zi]) exceeded the natural background conditions as defined by Alaska's WQS. A biological survey revealed no fish or macroinvertebrates present in affected areas downstream of FS 3030, indicating that these portions of the streams were not supporting their "growth and propagation of fish, shellfish, and other aquatic life" designated use. As a result, ADEC placed five streams on the state's CWA section 303(d) list in 2010 (Table 1).

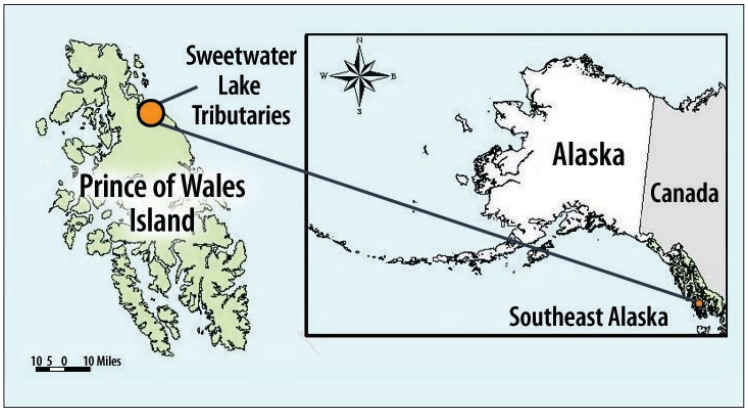

Figure 1. Sweetwater Lake is in southeastern Alaska.

Table 1. Unnamed Sweetwater Lake Tributaries Listed as Impaired in 2010

Waterbody[a]	Waterbody ID	Impaired Length (miles)	Listed Parameters
Stream 3	AK-10103-010	0.4	Al, Cd, Cu, Fe
Stream 6	AK-10103-012	1.14	Al, Cd, Cu, Fe, Mn, and sulfate
Stream 7	AK-10103-013	0.3	Al, Cd, Cu, Fe, Mn
Stream 8	AK-10103-014	0.3	Cd, Cu, Fe, Mn, Ni, Zn
Stream 9	AK-10103-015	0.8	Al, Cd, Cu, Fe, Mn, Ni, Zn, and sulfate

[a] *The waterbodies are unnamed tributaries and are referred to by number.*

In this watershed, background levels of metals are elevated because of naturally acidic conditions. (The upland areas include acidic peat and sedge bogs.) Therefore, when ADEC established cleanup goals, the elevated background concentrations of metals in unaffected stream reaches were considered representative of the natural water quality conditions (i.e., the conditions that support aquatic life in this area). To monitor stream condition, samples were collected during each monitoring event at a reference site in each stream (a site along the same stream but above the influence of the pyritic rock) and analyzed for the same parameters as those at the test sites. The concentration at each reference site was used to establish the natural-condition, background-based WQS for each monitoring event.

Project Highlights

Under federal law the pyritic rock met the definition of a release of a hazardous substance subject to site cleanup rules under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). WFLHD cooperated with state and federal partners to stop the acid rock drainage and restore the affected streams. Between 2008 and 2010, partners implemented numerous time-critical removal actions (TCRAs) under CERCLA, including excavating approximately 100,000 cubic yards of pyritic rock and replacing it with limestone. In areas where rock could not be removed, partners installed limestone buffer trenches to neutralize the acid drainage.

Results

Removing pyritic rock and adding limestone buffers has increased pH levels and decreased metal concentrations. For the post-TCRA monitoring periods in 2011, 2012, and 2013, samples from all five CWA section 303(d)-listed streams were below or approximately at WQS. Table 2 presents sample results for Stream 3. (The data for other streams show similar results, but they are not presented here because of space constraints.)

Biological monitoring conducted in 2011 showed that the streams now support their aquatic life designated use: 12 out of 14 surveyed reaches received a *very good* rating, and two received a *good* rating based on the Alaska Stream Condition Index for benthic macroinvertebrates. Sampling teams also noted the presence of juvenile fish in all 14 stream reaches. On the basis of these data, ADEC plans to propose removing all five tributaries from the 2014 impaired waters list.

Table 2. Metal Levels Found in Stream 3 (in Micrograms per Liter)

Date	Aluminum	Cadmium	Copper	Iron
9/9/2008	**4,150** (410)	**2.7** (0.37)	**460** (14.8)	**39,000** (2,000)
12/13/2008	**210** (87)	<0.2[a] (0.24)	<5.0[a] (8.57)	480 (1,000)
5/2/2009	90 (140)	<0.2[a] (0.2)	<5.0[a] (1.57)	<200[a] (200)
9/11/2010	240 (270)	<0.2[a] (0.21)	2.0 (7.22)	1,210 (1,500)
8/21/2011	260 (360)	<0.1[a] (0.2)	3.4 (7.32)	680 (1,000)
8/14/2012	230 (300)	<0.1[a] (0.1)	1.2 (5.51)	1,060 (1,490)
8/10/2013	70 (250)	<0.1[a] (0.34)	6.4 (13.4)	460 (5,560)

[a] *Analyte concentrations were below the detection limits.*

Notes:

- *The water quality standard established for each parameter for each monitoring event is shown in parentheses. These standards are based on levels identified at a reference site upstream of the project area.*
- *Results exceeding WQS are in bold.*
- *The TCRA for this site along Stream 3 was completed on 10/31/2008. Monitoring was conducted for 5 years to document recovery.*

Partners and Funding

Partners on the cleanup project included the WFLHD, the U.S. Department of Agriculture's Forest Service, the U.S. Environmental Protection Agency, and ADEC's Contaminated Sites Program. Other local, state, and federal agencies that provided technical assistance or cleanup plan review included the Alaska Department of Transportation, the Alaska Department of Natural Resources, the Alaska Department of Fish and Game, the National Oceanic and Atmospheric Administration's National Marine Fisheries Service, the U.S. Army Corps of Engineers, and the city of Coffman Cove.

WFLHD funded the TCRAs through the Alaska Forest Highway Program under the SAFETEA-LU (Safe Accountable Flexible Efficient Transportation Equity Act: A Legacy for Users). Restoration costs included $4.3 million to cover engineering, management, and sampling costs and another $6.7 million to excavate hazardous rock fill, install new rock and limestone buffers, and rebuild the road. WFLHD also helped develop a rock fill identification protocol now being used nationwide by the U.S. Department of Transportation.

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