



Section 319

NONPOINT SOURCE PROGRAM SUCCESS STORY

Alaska

Water Quality Restored at Eagle River Flats to Revive Bird Population

Waterbody Improved

A military base's munitions use led to a buildup of white phosphorus particles in the sediments of Eagle River Flats (ERF), causing a high mortality rate in transient waterfowl populations. Alaska Department of Environmental Conservation (ADEC) placed the ERF on Alaska's 1996 and 1998 Clean Water Act section 303(d) lists of impaired waters because it violated the toxic and other deleterious organic and inorganic substances water quality standard. Based on EPA's approval of the U.S. Army's restoration plan through Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), ADEC moved this water to Category 4b ("impaired water with other pollution controls") in its 2002 Integrated Report. To restore the ERF, the U.S. Army seasonally drained the marsh and capped the polluted sediment layer to reduce saturation of the soil and increase soil temperature. These actions helped to successfully sublime the white phosphorus (change it from a solid to a gaseous state) and render it harmless to the local waterfowl populations. As a result of meeting the water quality goals set by CERCLA, the ADEC removed toxic and other deleterious organic and inorganic substances from the list of impairments in 2008.

Problem

ERF is an 865-hectare estuarine salt marsh that is completely within the boundaries of Fort Richardson Army Base along the upper Cook Inlet in Anchorage Borough, Alaska. Ongoing high waterfowl mortalities at ERF were first noted in the early 1980s. After initial sampling between 1983 and 1988, an interagency group consisting of the U.S. Army Environment Hygiene Agency, ADEC, U.S. Environmental Protection Agency (EPA), and Environmental Science and Engineering, Inc., concluded that the source of the problem was munitions from Fort Richardson, which had used ERF as its primary munitions impact area since the 1940s. The U.S. Army suspended the use of ERF as an active Army impact area in 1989.

In 1990 scientists from the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) pinpointed white phosphorus as the cause of the birds' decline. This compound, present in the smoke rounds used in Fort Richardson's munitions training, typically oxidizes quickly in the air and was not initially considered persistent in the environment or

harmful to wildlife. However, CRREL showed that the environmental conditions at ERF, including the soft, anoxic sediments and frequent deposition of sediment by flooding, contributed to the long-term stability of the white phosphorus as granules. As waterfowl fed on insects and seeds in the water and sediment, they also ingested the toxic white phosphorus granules. Ingestion of just a few milligrams of white phosphorus by waterfowl is lethal.

ADEC first placed 60 acres of the contaminated river flats on its 1996 section 303(d) list for not supporting its designated use of growth and propagation of fish, shellfish, other aquatic life and wildlife. It remained listed for subsequent years.

Dabbling ducks, the waterfowl species most in decline from the contamination, served as the bioindicator for water quality impairment. The Army set a five-year goal of a 50 percent reduction in waterfowl mortality of the fall population of dabbling ducks and a longer term goal of a total mortality rate of one percent within 20 years. One percent mortality represents the natural mortality rate and the measure of successful remediation for this cleanup.

Project Highlights

In 1994 ERF became a federal Superfund site and was subject to the remedial response requirements of CERCLA. Between 1998 and 2007, the Army implemented numerous water quality restoration projects, including draining the marsh and applying AquaBlok (to cap the sediment and prevent contaminants from entering the water column). During each field season, the Army placed six pumping systems into the contaminated ponds and drained them (Figure 1). This reduced the saturation of the soil and increased soil temperature, helping to sublimate the white phosphorus and render it harmless to the local waterfowl populations.



Figure 1. The Army placed pumping systems such as this one into the marsh to drain the water and allow the white phosphorus to oxidize into a harmless state. For more images of the restoration project, see www.crrel.usace.army.mil/erf/photographs/photos-remediation.

Results

As of 2002, the Army had met its five-year goal of a 50 percent reduction in waterfowl mortality of the dabbling ducks' fall population. By 2006 the Army had met its long-term goal of a one percent total mortality rate for the fall dabbling duck population. In addition, the Army sampled ponds and found that white phosphorus concentrations in the surface sediments were below baseline levels (see Table 1). Results of the field activities to date show a dramatic decrease in white phosphorus

concentrations in more than half the total acreage identified as contaminated. Because the site met the CERCLA milestones and waterfowl mortality returned to levels typical for the species in this area, ADEC no longer considers ERF impaired for toxic and other deleterious organic and inorganic substances and removed that pollutant from the list of impairments in 2008.

Table 1. Summary of data showing reductions in white phosphorus concentrations in the surface sediment of a crater in an intermittent pond that was pumped during ERF restoration efforts

Date Collected	WP Conc. ($\mu\text{g/g}$) in Crater Bottom
May 20, 1992	2,400
August 21, 1992	180
August 27, 1993	82
August 30, 1994	9.5
September 17, 1995	170
September 3, 1997•	1.6
August 25, 1998	0.037
September 21, 1999	0.0008
August 21, 2000	< 0.0002
September 11, 2001	< 0.0002
September 15, 2003	< 0.0002

• 1997 was the first year of active remediation by pond pumping.

Partners and Funding

The ERF Interagency Task Force included members from the U.S. Army, EPA, the U.S. Fish and Wildlife Service, the Alaska Department of Fish and Game, the ADEC, and the U.S. Army Toxic and Hazardous Materials Agency, now known as the U.S. Army Environment Center. The Army estimated the capital costs, operations and maintenance, and long-term monitoring at \$12.5 million for this remediation project.



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