A Department of Ecology Report

WASHINGTON STATE DEPARTMENT OF ECOLOGY

Arsenic Concentrations in Three Palmer Lake Sediment Samples

Abstract

Arsenic was analyzed in three Palmer Lake sediment samples in an effort to provide a preliminary indication of the level of contamination. The lake had been identified as a significant source of arsenic to the Similkameen River. Tailings particles from historical mining activity in British Columbia can enter the lake during periodic inflows from the Similkameen in the spring. Results showed arsenic concentrations of 20, 28, and 39 mg/Kg (dry weight) in the lake sediments. This level of sediment contamination has the potential to cause adverse biological effects in the lake, and the sediments may be acting as a chronic source of arsenic to the Similkameen River.

Background

The Washington State Department of Ecology (Ecology) Environmental Assessment (EA) Program has completed a Total Maximum Daily Load (TMDL) evaluation for arsenic in the Similkameen River (Johnson, 2002). In that study, Palmer Lake was identified as a significant source of arsenic to the river, causing a doubling of arsenic concentrations at certain times of the year. It appears likely that the lake has been contaminated with tailings particles from historical mining activity in British Columbia. Tailings can enter the lake when the Similkameen is at high flow in the spring, reversing flow direction in the lake outlet, Palmer Creek. The TMDL also identified the lake's inlet, Sinlahekin Creek, as a possible additional arsenic source. The TMDL report recommended evaluating arsenic sources and cycling in Palmer Lake.

The EA Program recently did sediment sampling in Palmer Lake as part of a separate statewide study on mercury (*Screening Survey of Mercury Levels in Edible Fish Tissue from Selected Lakes and Rivers of Washington State)*. This afforded an opportunity to obtain some arsenic data on Palmer Lake sediments and get a preliminary indication of the level of contamination. The results of that analysis are reported here.

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Methods

Three sediment samples were analyzed for arsenic. Figure 1 shows where the samples were collected. Two samples were collected at the north end of the lake near the outlet, one in 16 feet of water and the second in 60 feet of water. The third sample was collected in 74 feet of water near the center of the lake.

Methods of sediment sample collection, preservation, and handling are described in a quality assurance project plan for the mercury study (Anderson and Norton, 2002). Briefly, the samples consisted of the top 2 cm surface layer collected with a 0.01 m^2 petite Ponar grab. Each sample was a single grab. The grabs were homogenized, split into glass jars cleaned for trace metals analysis, and transported on ice to the Ecology Manchester Environmental Laboratory. Arsenic was analyzed by ICP/MS following EPA methods 3050 and 200.8. The results are for total recoverable arsenic. The complete data are available from the author.

Results and Discussion

The arsenic concentrations measured in the Palmer Lake sediment samples were as follows (parts per million, dry weight):

Site 1	28.3 mg/Kg
Site 4	39.4 mg/Kg
Site 5	20.4 mg/Kg
mean	29.4 mg/Kg

Higher concentrations were measured near the outlet than at center lake. This is consistent with the source of arsenic being the Similkameen River, although more samples would be needed to be confident of a spatial pattern.

Arsenic concentrations in the range of 20 to 39 mg/Kg are substantially elevated over background and are among the higher concentrations that have been measured in sediments from the Similkameen mainstem. Background concentrations of arsenic in freshwater sediments and terrestrial soils in Washington State have been put at around 3 mg/Kg (PTI, 1989; San Juan, 1994). Ecology's FSEDQUAL database shows median and 90th percentile concentrations of 5.6 and 23 mg/Kg, respectively, in freshwater sediments statewide.

Arsenic concentrations in the approximate range of 10 to 50 mg/Kg have been detected in Similkameen River sediments, with 91 mg/Kg being reported in a single sample collected near the mouth. In 14 samples collected between 1995 and 2001, the average arsenic concentration in mainstem sediments was 27 mg/Kg and the 90th percentile was 35 mg/Kg (Johnson and Plotnikoff, 2000; unpublished 2001 data provided by Patti Stone, Office of Environmental Trust, Colville Confederated Tribes).

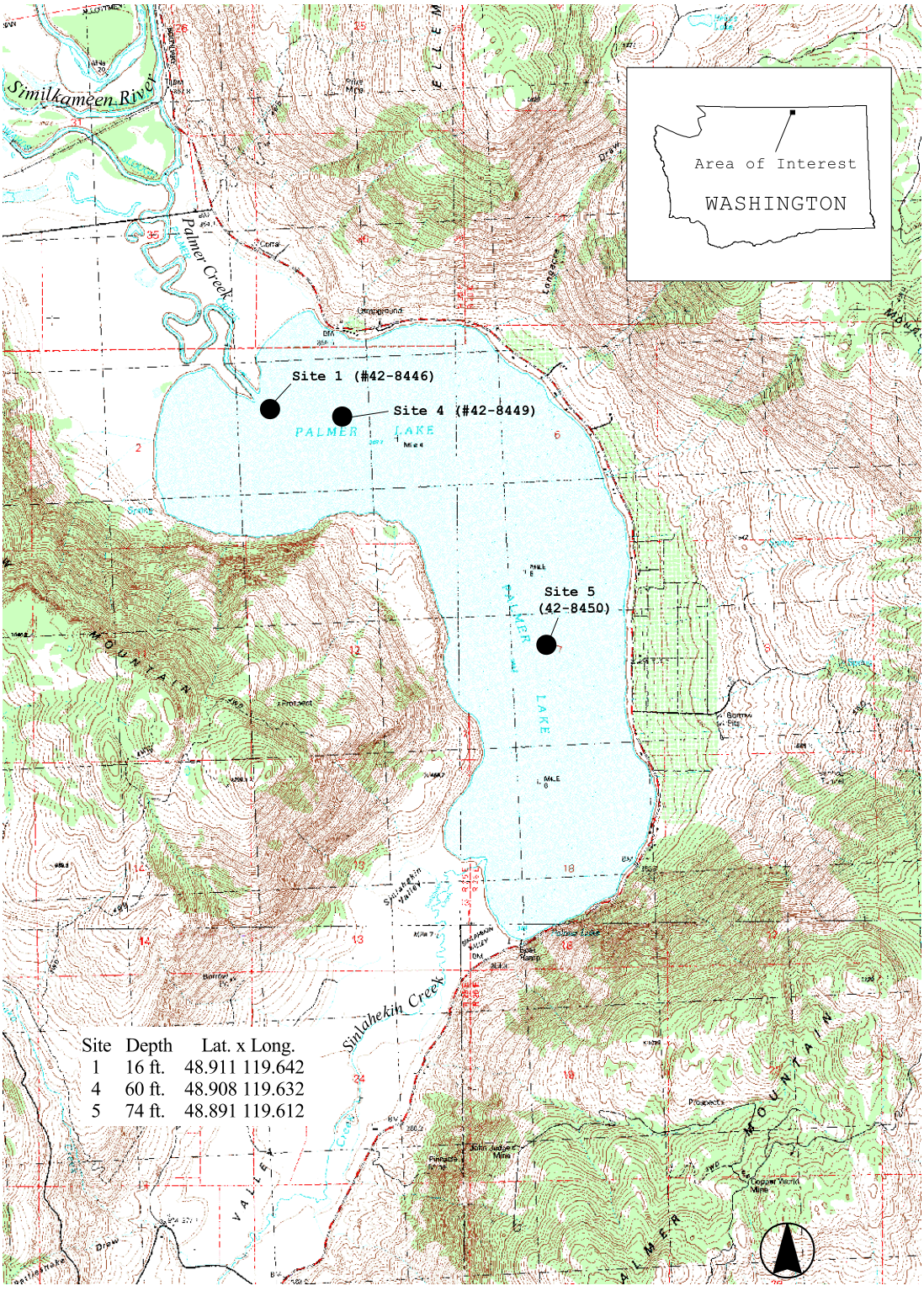

Figure 1. Location of Sediment Samples Analyzed for Arsenic

There are no numerical Washington State standards for arsenic in freshwater sediments. The Palmer Lake concentrations do, however, exceed or approach a number of guidelines commonly used to assess the biological significance of metals contamination in lakes, rivers, and streams. Guidelines for arsenic, which predict adverse effects on sediment-dwelling organisms, are listed below.

Value (mg/Kg)	Guideline	Reference
6.0	Lowest Effect Level	Persaud et al., 1993
8.2	Ecotox Threshold	EPA, 1996
9.8	Threshold Effect Concentration	MacDonald et al., 2000
17	Probable Effect Level	Environment Canada, 1999
33	Probably Effect Concentration	MacDonald et al., 2000
33	Severe Effects Level	Persaud et al., 1993
40	Lowest Apparent Effects Threshold	Cubbage et al., 1997
57	Sediment Quality Standard (marine)	Ecology, 1995

Conclusion and Recommendations

Results from this initial, limited sampling effort in Palmer Lake indicate that the level of arsenic contamination in the sediments is potentially significant, both with regard to aquatic life and as a chronic source of arsenic to the Similkameen River. These findings support the need for more extensive study, as recommended in the TMDL report. Toxicity tests on the sediments, not mentioned in the TMDL, also are recommended.

Acknowledgements

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