

**ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF SPILL PREVENTION AND RESPONSE
CONTAMINATED SITES PROGRAM**

Technical Memorandum

Date: March 2009

Arsenic in Soil

PURPOSE:

The purpose of this technical memorandum is to develop clear evaluation and soil sampling criteria for arsenic, and to clarify the arsenic footnote in table B1 of 18 AAC 75.341. Note 15 states: "Due to naturally occurring variable concentrations throughout the State of Alaska, arsenic must be evaluated as a contaminant of potential concern on a site specific basis." Although the focus of this technical memorandum is arsenic, the same approach may be employed for other naturally occurring inorganic substances.

BACKGROUND:

Arsenic is a naturally occurring metal in Alaska. It is often found in concentrations above the regulatory cleanup level in 18 AAC 75.341 Table B1. These concentrations are typically referred to as "background."

Arsenic is found in two forms: inorganic (combined with oxygen, chlorine, and sulphur) and organic (combined with oxygen and hydrogen). The toxicity of arsenic depends very heavily on its form. Inorganic arsenic (arsenite, arsenate) is considered to be most toxic, whereas, organic (methylated) forms of arsenic are the most common metabolites of the human body and are found to be much less toxic. Arsenic poses significant non-cancer health risks to humans in addition to being a known human carcinogen.

Naturally occurring arsenic is released into the environment by volcanoes and through weathering of arsenic-containing minerals and ores. Anthropogenic arsenic sources include various commercial and industrial processes. In industry, arsenic is a by-product of the smelting process for many metal ores, including lead, gold, zinc, cobalt, and nickel. It is also used in multiple commercial products such as fungicides, herbicides, preservatives, and pharmaceutical products.

Anthropogenic is defined as a substance (in this case arsenic) of human origin or resulting from human activity. Therefore, anthropogenic arsenic sources include naturally occurring arsenic sources altered or disturbed by human activity, *e.g.* mine tailings, as well as "man-made" arsenic released into the environment.

Factors that may significantly determine the fate of soil arsenic are organic matter content, clay content and microbial activity. Soil containing high levels of adsorptive materials, such as clay or organic matter, are likely to retard the leachability of arsenic in soils. However, arsenic may leach into groundwater from soils with low adsorptive capacity. Indirect evidence suggests that leaching of arsenic from soils into groundwater may be quite common.

APPLICABILITY:

The following scenarios discuss the need for background samples, cleanup, institutional controls, and cumulative risk calculations depending on whether the arsenic source at a contaminated site is

naturally occurring or anthropogenic. Anthropogenic sources not only include arsenic that may be present in substances such as wood preservatives (e.g., chrome copper arsenate), but also altered or disturbed arsenic sources that otherwise would be considered naturally occurring.

No Cleanup Required

The presence of arsenic may be considered naturally occurring if a site has no known or suspected anthropogenic arsenic sources. Cleanup and/or institutional controls applicable to arsenic are typically not required in these situations. Generally, it is unnecessary to collect background arsenic samples for comparison to data that may be generated during a standard RCRA metals scan **unless** the data indicate source area uncertainty. Cumulative risk calculations should not include the risk contribution from the naturally occurring arsenic. However, depending on site specific circumstances, the risk posed by naturally occurring arsenic may need to be discussed qualitatively in the uncertainty risk analysis and managed appropriately.

Cleanup to Background and/or Institutional Controls

Arsenic samples within site boundaries must be collected if there are known or suspected anthropogenic arsenic sources, including altered or disturbed areas that may contain naturally occurring arsenic. Background arsenic samples should be collected within site boundaries, but outside of known or suspected anthropogenic sources according to a department approved work plan. If detected source area concentrations exceed applicable cleanup levels (Table B1, method 3, or method 4) and are greater than naturally occurring background concentrations, cleanup and/or institutional controls may be necessary to ensure that potential future exposure to contamination above background concentrations does not occur. Arsenic must also be included in cumulative risk calculations in these instances. Institutional controls may be necessary to ensure that residual contamination within the site boundaries is managed appropriately.

Institutional Controls Only

Disturbed or altered naturally occurring arsenic sources, while considered anthropogenic, may be present above applicable cleanup levels but below surrounding background levels. These cases, although atypical, have been known to exist. Cleanup will not generally be required in these situations; however, cumulative risk calculations must be conducted and institutional controls may be applicable to ensure that residual arsenic contamination within the site boundaries is managed appropriately.