

Trace Elements

Trace element behavior in the environment is highly variable, as various factors influence speciation, fate, and transport. Some metals and metalloids, such as mercury and selenium, can occur in both inorganic and organic forms the latter species behaving much differently than the former. Some metals are essential to most species of organisms, while other metals are not known to be essential to any organism. Some organisms actively regulate their internal concentrations of certain metals, while other organisms store excess metals in a detoxified form. In short, the toxicology of metals is not only highly variable among different metals, it is highly variable among different species of organisms. Windward staff have extensive experience with these complexities, experience critical when conducting ecotoxicological and risk-based evaluations of metals.

Windward staff have developed close relationships with metals industry associations and representatives by providing technical support and working with both public and private clients (e.g., ports, municipalities, and boatyards) on metals-related issues. We support projects dealing with a wide range of topics: from broad-scale regulatory issues, such as water quality criteria (WQC) review and development of hazard classification methods for metals, to site-specific evaluations, including ecological and human health risk assessments and natural resource damage assessments (NRDAs). Windward has also collaborated with regulatory agencies in the United States, Canada, and elsewhere to facilitate technical and regulatory dialogue in order to develop mutually agreeable solutions.

Site-Specific Assessments

Site-specific ecological risk assessments (ERAs) are an integral part of many Windward projects. Windward ERAs have evaluated the potential risks posed by trace elements under existing conditions, as well as incorporated the modeled results of projected activities and conditions to evaluate future potential risks. These ERAs have included focused assessments, such as probabilistic risk evaluations of selenium and copper downstream from mining sites, and broader assessments of large suites of trace elements in water, sediment, and tissue. Windward's expertise, including coordinating and communicating with regulators, coupled with a strong background in metals ecotoxicology, gives our staff a strong foundation for conducting scientifically defensible and solution-oriented ERAs.

Fate & Effects

Several Windward staff work extensively on issues related to the fate and effects of metals in the environment. Our expertise comprises two key areas: metals bioavailability, including biotic ligand model (BLM) development and application, and selenium, the details of which can be accessed at www.windwardenv.com/selenium.

Windward supports a large number of clients in the metals and mining industry in a variety of ways. For example, we have conducted bioaccumulation and toxicity reviews for several trace elements in support of hazard classification method development for metals. We have also provided critical technical reviews of current or anticipated topics of special interest, such as updates on the state-of-the-science regarding diet-borne metals toxicity to aquatic organisms.

Windward staff develop and maintain aquatic toxicity databases for several metals. In some cases, these data have been incorporated into software tools that combine database processing, graphics, and jurisdiction-specific WQC calculations. These databases may also be used to develop proposals for updated WQC, as US Environmental Protection Agency's (EPA) criteria for several metals are as old as 30 years. Whenever possible and applicable, we strive to collaborate with our clients to publish our work in peer-reviewed scientific literature and present the work at scientific conferences.

Regulatory Support

Windward staff support industrial and municipal clients in adhering to environment regulations, such as discharge permits. Examples of such support include work plan development, toxicity testing, and data evaluations in support of deriving water effect ratios (WERs) for a) copper and zinc in stormwater discharges from Seattle-Tacoma International Airport (Seattle, Washington); b) copper in municipal wastewater discharges from a large wastewater treatment plant (WWTP) in Ogden, Utah; and c) silver and zinc in municipal wastewater dischargers from a WWTP in Chehalis, Washington.

Windward staff also work with regulators in developing updated ambient water quality criteria (AWQC). Examples of such work include coordination with EPA in developing its recommended BLM-based AWQC for copper in freshwater, and in the ongoing development of BLM-based copper AWQC in salt water.