

## **IONIC STRENGTH: SIMPLE CONCEPTUAL MODEL NARRATIVE**

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Geologic and natural sources of ions, in combination with human activities (e.g., agricultural, resource extraction, and industrial practices), can contribute to changes in the ion content of streams and rivers. Human activities can increase ionic strength either directly (i.e., by introducing new ions to freshwater systems) or indirectly (i.e., by decreasing uptake of ions in a watershed, or by increasing delivery of ions to freshwater systems). For example, industrial, residential and commercial activities may be associated with direct discharges of ion-rich waters to surface water, via sources such as industrial or wastewater treatment plant effluents. These activities also are associated with increases in impervious surface cover, which can lead to increased delivery of ions to surface waters (e.g., due to increased deposition and surface runoff). Direct and indirect pathways both may result in increased ion content of surface runoff, subsurface waters, or particles, and ultimately change the ion content of streams and rivers. Groundwater withdrawals near coastal areas may increase the ion content of subsurface water through saltwater intrusion, and activities which increase ion-rich groundwater inputs to freshwater systems (e.g., irrigation) also may change the ion content of receiving waters. Ion content is related to several other potential stressors, including temperature, sediment, pH, metals, other toxic chemicals, and flow alteration. For example, bioavailability of toxic metals can vary with ionic strength, and decreases in pH affect total ionic strength and ionic composition. These potential interactions among stressors should be considered when ionic strength is a possible cause of impairment.

Changes in ions within freshwater systems may affect biota via changes in total ionic strength or ionic composition. Although ionic strength may decrease due to human influences (e.g., downstream of dilute industrial discharges), most often it rises with human activity. Elevated ionic strength, or large fluctuations in ionic strength over relatively short time periods, may affect freshwater biota via several mechanisms, including increased osmotic stress and increased competition for gill binding sites. Changes in ionic composition may adversely impact biota if, for example, especially toxic ions become more abundant.