Drinking Water Quality: Bromide

What is This Indicator, and Why Is It Important?

Bromide is another key indicator of the quality of Delta water as a source of drinking water. As discussed in the Total Organic Carbon indicator writeup, organic carbon and bromide are precursors to the formation of harmful disinfection byproducts (DBPs) in municipal water supplies. Source water with high DOC and bromide concentrations requires additional treatment steps, increases the cost of treatment, and may lead to increased health risk from exposure to disinfection byproducts. Since 22 million Californians get tap water that originates in the Delta, bromide in water exported from the Delta is important to both public health and the cost of drinking water in California. The CALFED Drinking Water Quality Program has the goal of achieving an average TOC concentration of 3 mg/L and bromide concentration of 50 µg/L or equivalent level of public health protection using a cost-effective combination of alternative source waters, source control and treatment technologies.

What Do the Data Show?

The data (Figure 1) show that the bromide concentration nearly always exceeds the CALFED target of 50 µg/L. Concentrations vary seasonally from slightly less than the target concentration to more than 500 µg/L. Unlike organic carbon however, the lowest bromide concentrations are associated with higher river flows. This is because nearly all of the bromide present in Delta water comes from seawater intrusion into the Delta which is lowest during periods of high outflow. These data shows the baseline conditions for this parameter as an indicator of the suitability of Delta water as a municipal water supply.

Discussion

Bromide is the other primary precursor to the formation of DBPs in drinking water. Delta water is high in bromide compared to most drinking sources but reducing bromide concentrations at the Delta export pumps is difficult. Bromide concentrations are almost entirely dependent on the amount of seawater mixing with freshwater in the Delta. The movement of water into and out of the Delta with the tides brings seawater up from San Francisco Bay creating a salinity (and bromide) gradient. There is some bromide coming from other sources in the watershed but nothing of significance compared to the amount of bromide coming from seawater.

Since there are no significant watershed sources of bromide, source control is not a promising option. Control of bromide concentrations at the export pumps is largely a matter of water management and storage. Water is stored, transported through, and exported from the Delta in a way that minimizes the amount of salt and bromide brought in from the Bay. Actions to protect Delta levees and protect against seawater intrusion should also help to reduce bromide concentrations.

The other way to address the problem of bromide in Delta water is through changes in disinfection processes at drinking water plants. Use of ozone instead of chlorine as the primary disinfectant reduces formation of trihalomethanes but produces bromate, another harmful disinfection byproduct. Studies funded by CALFED and others are underway to investigate new processes and process changes to reduce bromate formation. Use of chloramine instead of free chlorine is another disinfection option that can reduce the amount of DBPs formed in drinking

water distribution systems. Other emerging disinfection and treatment technologies are also being investigated to protect public health by reducing disinfection byproduct formation.

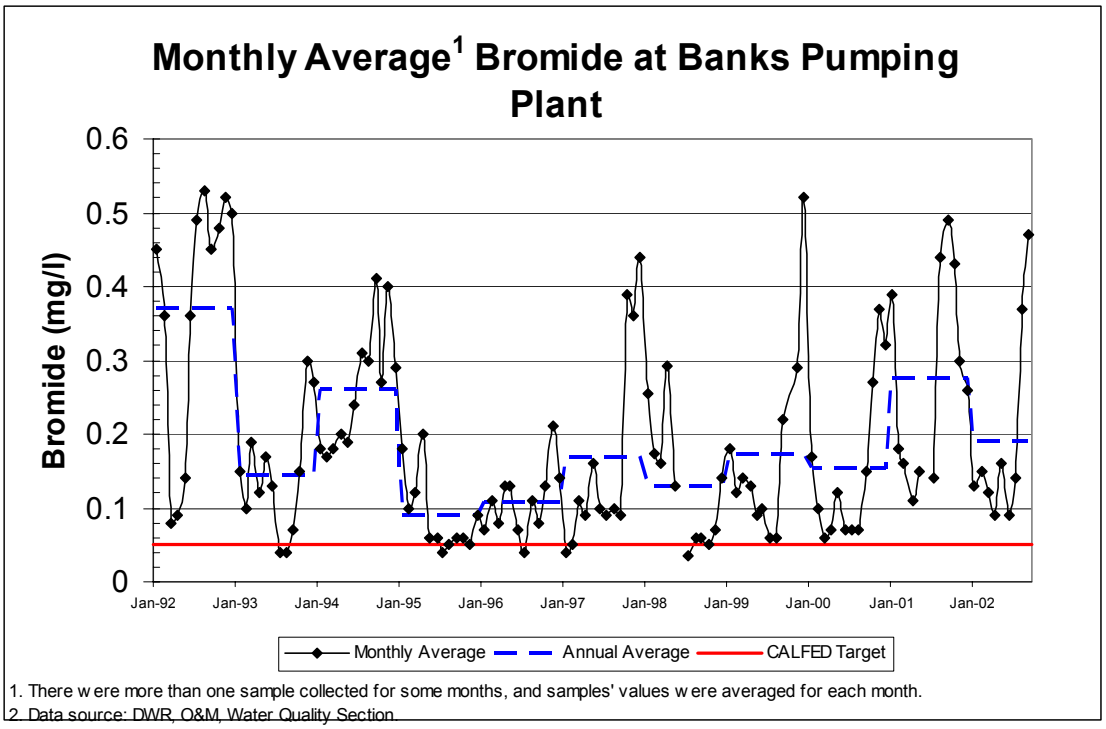

Figure 1. Bromide concentrations at the Harvey O. Banks Delta Pumping Plant, the point where the majority of the water destined for municipal uses leaves the Delta.

Technical Note: Total Organic Carbon and Bromide at the Delta Pumping Plant

The Indicator

Goal: This indicator responds to the Drinking Water Quality Program's (DWQP) ROD goal of 50 μg/L bromide at south and west Delta export locations.

The Data

Data Collection: There is an extensive set of bromide data for the Delta. Bromide can also be estimated from chloride concentrations at most Delta locations.

Data Quality / Limitations: There are few if any limitations. Bromide analysis is reliable, cheap, and routine. Continuous real-time analysis of bromide is possible and could help operators to avoid periods of high bromide concentration.

Degree of Development

Bromide data is available for all export locations, water treatment plants, and many Delta and river monitoring sites. Bromide is a conservative pollutant and as such is easily simulated using currently available computer models.

Longer-Term Science Needs

Bromide transport is determined by Delta hydrodynamics. Increased understanding of hydrodynamics and improved computer models will also help with bromide management. Research into alternative disinfection and treatment technologies helps with managing the harmful effects of bromide in tap water.