

8. Releases to the Environment

Releases of contaminants to the environment include spills, leaks, and other discharges or disposals that occur during human activities. The Washington Department of Ecology Toxics Cleanup Program (TCP) has identified 582 cleanup sites overlaying the SVRP aquifer (Figure 98). Cleanup sites are those where the release of one or more toxic substances is a risk to humans and the environment. The majority occur in the vicinity of downtown Spokane, along the Trent and Sprague corridors leading east to Spokane Valley, and along the Division Street/U.S. Route 2 and Market Street corridors going north, indicating this is largely an urban problem.

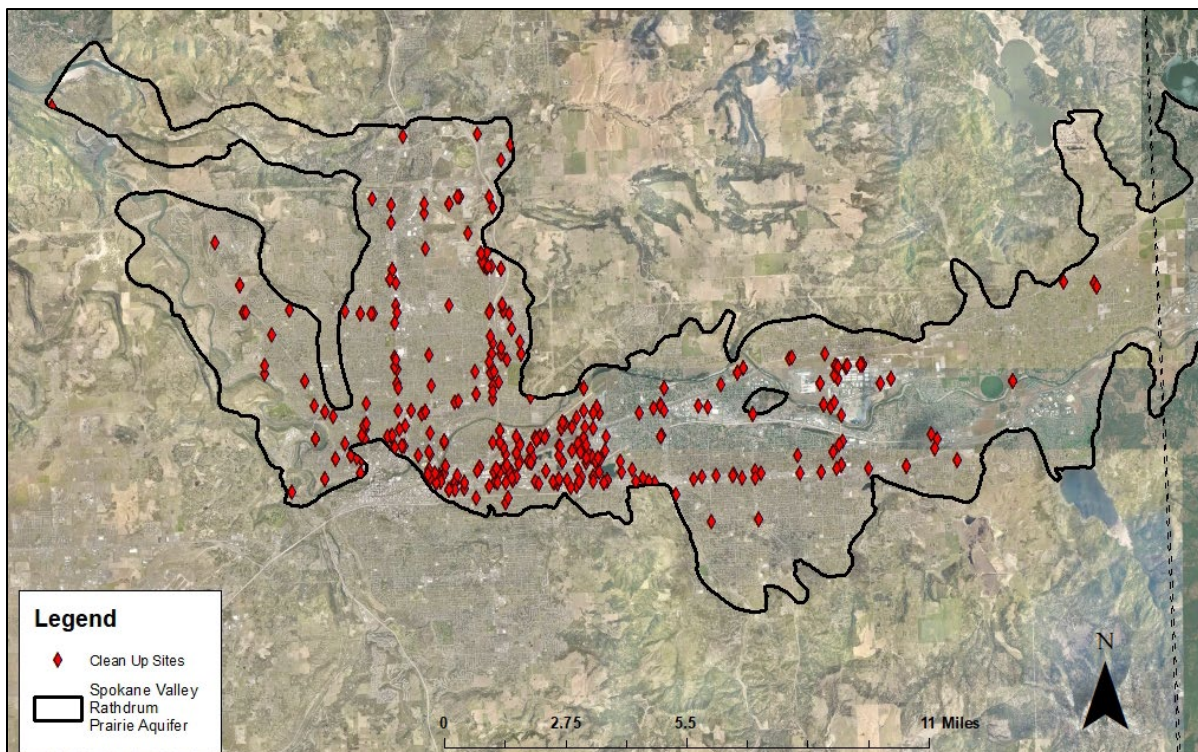


Figure 98. Washington Department of Ecology Toxics Cleanup Program (TCP) identified cleanup sites located over the Spokane Valley Rathdrum Prairie (SVRP) Aquifer in Spokane County.

The TCP identifies the contaminant(s) associated with each clean-up site, but most are grouped in broad categories with only a few contaminants identified individually. Only the County’s metals data correspond with TCP contaminant categories. Arsenic, lead, and mercury are individually identified by the TCP. These three metals are also included in a category for “priority pollutants” along with cadmium, chromium, copper, zinc, and other metals not tested for by the County.

While the SVRP aquifer is susceptible to contamination from direct releases, much of the metals data does not indicate high levels of contamination from direct releases. Most metals categorized as priority pollutants (cadmium, chromium, copper, lead, mercury, and zinc) are largely not detectable throughout the SVRP aquifer (Section 3.4) though there are 63 clean-up sites associated with priority pollutant metals. These 63 sites are difficult to correlate with detectable levels of individual metals because this group

includes several metals and detections are infrequent. Therefore, this analysis will focus on the three metals that are identified individually: lead, mercury, and arsenic.

For lead and mercury, the clean-up sites associated with these metals do not appear to be spatially or temporally correlated with the drinking water exceedances of these metals. For lead, exceedances occurred down-gradient from sites, but these are not correlated temporally with any exceedances (Figure 99). Mercury exceedances all occurred up-gradient of known contaminated sites (Figure 100).

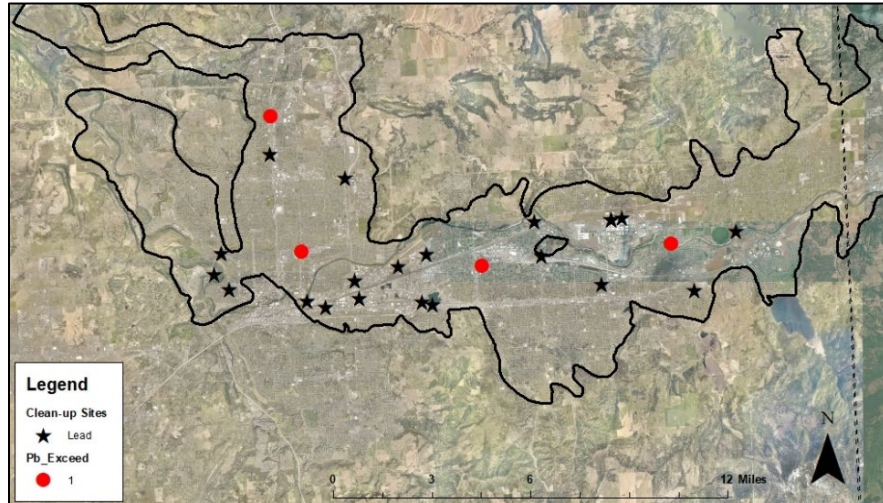


Figure 99. Locations of exceedances of the lead Drinking Water Standards in relation to Washington Department of Ecology Toxics Cleanup Program (TCP) cleanup sites associated with discharges of lead located over the Spokane Valley Rathdrum Prairie (SVRP) Aquifer in Spokane County.

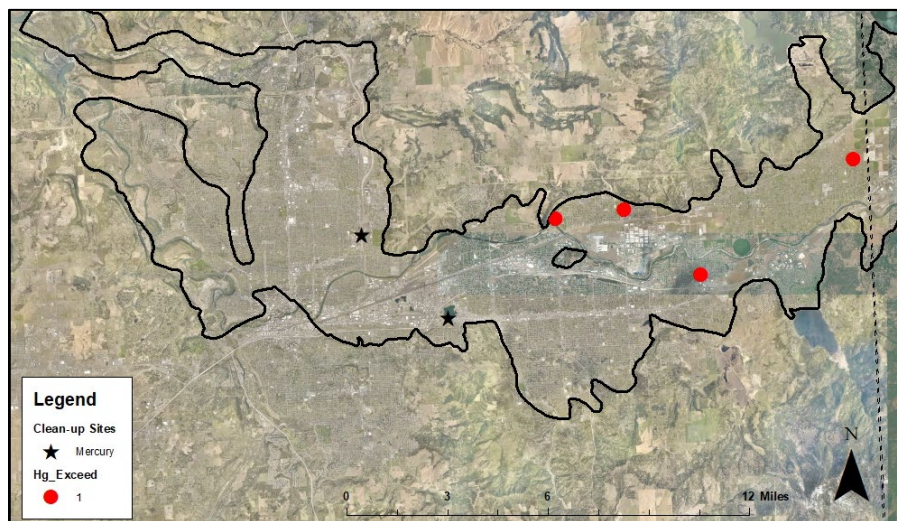


Figure 100. Locations of exceedances of the mercury Drinking Water Standards in relation to Washington Department of Ecology Toxics Cleanup Program (TCP) cleanup sites associated with discharges of mercury located over the Spokane Valley Rathdrum Prairie (SVRP) Aquifer in Spokane County.

There are 16 cleanup sites that are associated with the release of arsenic. While there are clean-up sites located in areas of high arsenic concentrations, there are also sites in areas with lower concentrations

(Figure 101). Two sites appear to be in the vicinity of elevated groundwater arsenic levels: the Spokane River Upriver Dam and Donkey Island and the HOLCIM cleanup sites.

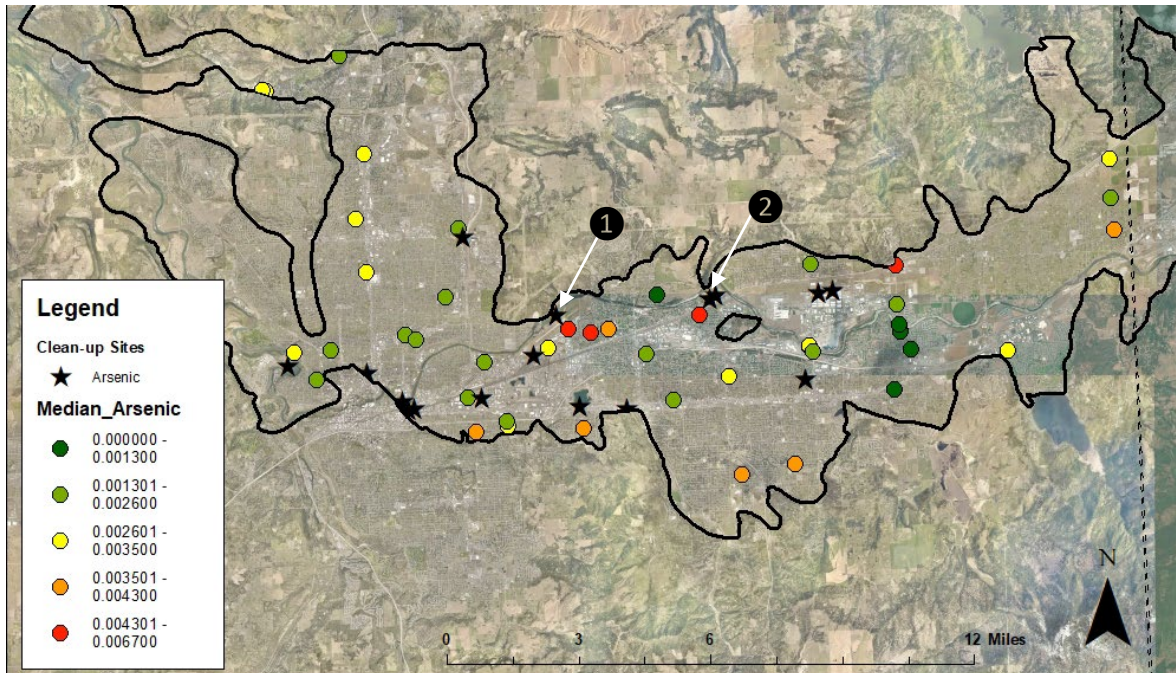


Figure 101. Median arsenic concentrations at monitoring locations in relation to Washington Department of Ecology Toxics Cleanup Program (TCP) cleanup sites associated with discharges of arsenic located over the Spokane Valley Rathdrum Prairie (SVRP) Aquifer in Spokane County. The Spokane River Upriver Dam and Donkey Island site and the HOLCIM site are noted by arrows 1 and 2, respectively.

The Upriver Dam and Donkey Island site is primarily known as a source of polychlorinated biphenyl (PCB) contamination in the Spokane River, but arsenic levels in river sediments were also found above clean-up limits. Clean-up activities at the site were completed in 2006 and 2007, which included capping contaminated sediments to prevent leaching of contaminants. The Spokane River at Upriver Dam is known as a losing reach and samples from nearby wells at Felts Field (5312C01) and Hales Ale (5311J05 and 5311J07) have higher median arsenic levels than other nearby locations (Figure 101).

Based on the 20-year trend analysis, the groundwater at these three locations shows decreasing levels of arsenic (Figure 102, Appendix E). However, the trend does not appear to be directly tied to clean-up activities at the site.

Data from the Felts Field well (5312C01) exhibited a declining trend in arsenic levels prior to 2007 ($z = -2.63$, $p < 0.05$) but no significant trend after ($z = -0.73$, $p > 0.05$). The shallower Hales Ale nested well (5311J05) had similar results with a decline in arsenic levels prior to 2007 ($z = -2.18$, $p < 0.05$), but no trend afterwards ($z = 1.91$, $p > 0.05$). The deeper Hales Ale nested well (5311J07) did not have a trend in arsenic level before ($z = -1.50$, $p > 0.05$) or after ($z = 0.11$, $p > 0.05$) clean-up activities in 2007.

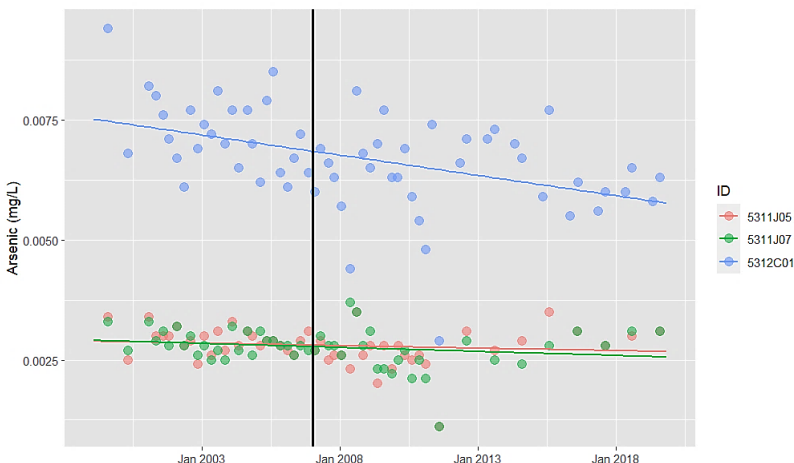


Figure 102. Plot of arsenic concentrations measured in samples collected over time at Felts Field monitoring well (5312C01) and the Hales Ale nested wells (5311J05 and 5311J07). The lines indicate the year 2007, which represents the date clean-up activities were finalized at the Upriver Dam and Donkey Island Site.

The HOLCIM site resulted in metal contamination in soils and groundwater including arsenic, cadmium, and lead resulting from cement kiln dust disposed at the site from operations between 1910 and 1967. Cleanup activities at the site were completed in 2016, including excavation of contaminated soils, use of clean back-fill, and capping the site. The monitoring well at Frederick and Bowdish (5409C02) is about 0.6 mile from the HOLCIM site. Arsenic levels at this well were stable over the 20-year period. There is not enough post clean-up data to determine if these activities had any impact on arsenic concentrations.

Although not covered under the TCP, the increase of chloride across the SVRP aquifer (Section 3.2.2) has concerned the County. It was suspected that this increase in chloride may be associated with the use of deicers [e.g. sodium chloride (NaCl), or magnesium chloride (MgCl)] in treating roads surfaces during the winter. In 2020, the County conducted a special investigation where samples were analyzed for bromide in to utilize chloride to bromide ratios to identify sources of chloride.

Chloride source identification is possible with the chloride to bromide (Cl/Br) ratio because these elements have different abundances in various substances and both are conserved in groundwater, meaning they are less affected by physical and chemical processes such as adsorption and oxidation-reduction reactions. This allows the use of simple binary mixing curves to describe how chloride and bromide concentrations in dilute groundwater would change with increasing influence from another source. The methodology is explained in more detail in the 2020 Annual Water Quality Monitoring Report (Spokane County Water Resources).

During this investigation, almost all samples (98 percent) were non-detect for bromide. Therefore, the Cl/Br ratios could not be accurately calculated for most of the samples. The two samples with detectable concentrations of bromide were collected from the monitoring well located at the Fire Station on Houston and Regal in North Spokane (Well ID 6327N04). These two samples had Cl/Br ratios of 332.98 and 456.95 with chloride concentrations of 19.5 and 22.3 mg/L respectively (Figure 103). These are at the low end of the range given for groundwater influenced by septic tank leachate, which has Cl/Br ratios between 400

and 1,100 with chloride concentrations between 20 and 100 mg/L (Katz et al 2011). The Fire Station well is located outside of the sewered area, so septic tank leachate makes sense as a possible source of chloride.

The prevalence of non-detects of bromide seemingly confounds the overall analysis. However, if the reporting limit of 0.1 mg/L is used, or even one-half the reporting limit, to substitute for the non-detect bromide data, the data would fall within the range of dilute groundwater just below the mixing line for septic tank effluent. Chloride concentrations in samples collected during the special investigation ranged from 7.45 to 32 mg/L and Cl/Br ratios fell between 36 and 640 using one-half the reporting limit and between 18 and 320 using the reporting limit for bromide.

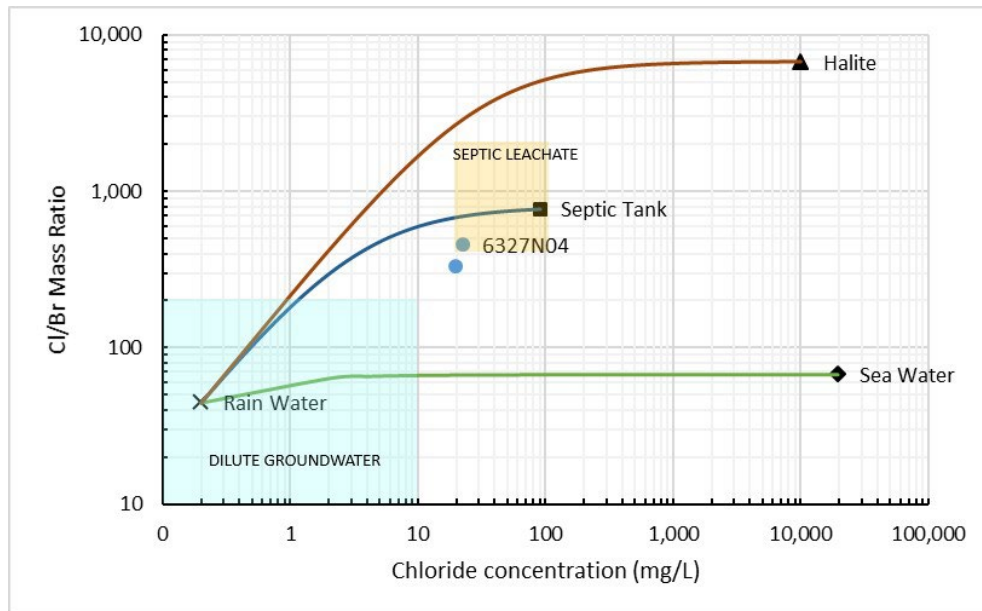


Figure 103. Plot of chloride to bromide (Cl/Br) ratios versus chloride concentrations in groundwater samples from Well ID 6327N04 in relation to the rain water, sea water, septic tank leachate, and halite (road rock salt) end members (Katz et al 2011) and the binary mixing lines between rain water and halite, septic tank leachate, and seawater. The range for dilute groundwater and septic tank leachate is also shown.

If runoff from road salt (halite) was the primary source of chloride as suspected, the data would result in higher Cl/Br ratios and higher chloride concentrations. For example, studies found that groundwater dominated by halite sources would have Cl/Br ratios of at least 1,000 with chloride concentrations of at least 100 mg/L and usually come from wells in usually within 100 feet of roads (Katz et al, 2011; Jagucki and Darner 2001; and Mullaney et al 2009). Even though most SVRP aquifer monitoring locations are within 100 feet of a road or parking lot, the data from this investigation is still not indicative of road deicing as the primary source of chloride. Given this, it is likely that chloride increase in the aquifer is the result of a combination of surface activities and not attributable to one main source.