1,4-Dioxane Monitoring 2024

DRINKING WATER AMBIENT MONITORING PROGRAM

Background

Contaminant Information

1,4-Dioxane is a chemical that is used as a stabilizer for chlorinated solvents, which have many commercial and industrial applications such as manufacturing other chemicals and protecting aerospace and automotive parts. It can also be found in many consumer products such as bubble bath, shampoo, laundry detergent, soap, skin cleanser, adhesives, and antifreeze. Foods may also contain small amounts of 1,4-dioxane from some additives and packaging materials.

The United States Environmental Protection Agency has determined that 1,4-dioxane is a likely carcinogen that presents an unreasonable risk to human health.[1] One of the pathways of human exposure is through drinking water. Because of this, the Minnesota Department of Health (MDH) developed a health risk limit (HRL) of 1 µg per liter (1 µg /L) of drinking water, which is a guidance value that protects all people from cancer when exposed over a lifetime.

Occurrence

1,4-Dioxane has been detected in finished water at several public water systems (PWSs) and groundwater monitoring wells in Minnesota as part of past monitoring efforts such as the Unregulated Contaminants Monitoring Rule 3. Additionally, 1,4-dioxane is known to co-occur with the chlorinated organic solvents trichloroethylene (TCE) and tetrachloroethylene (PCE)[2], which are common groundwater contaminants that have been found in Minnesota.

Methods

Parameter Selection

Drinking Water Ambient Monitoring Program (DWAMP) analytes are selected for monitoring through input from MDH environmental health staff and partner agencies as well as analysis of

[1]United States Environmental Protection Agency, Office of Chemical Safety and Pollution Prevention. "Unreasonable Risk Determination for 1,4-Dioxane," October 2024. https://www.epa.gov/system/files/documents/2024-11/2.-1-4-dioxane-.-revised-risk-determination-.-public-release-.-hero-.-nov-2024.pdf.

[2]Interstate Technology Regulatory Council. "1,4-Dioxane," 2021. https://14d-1.itrcweb.org/history-of-use-and-potential-sources/.

several factors including contaminant health risk, occurrence in Minnesota drinking water, existing data, programmatic needs, health equity considerations, and laboratory feasibility.

Following the Contaminants of Emerging Concern (CEC) Framework—a plan of action for MDH Drinking Water Protection (DWP) staff to use as guidance when CECs are detected at PWSs—the DWP program identified a need for additional sampling at systems that had either past low-level detections of 1,4-dioxane or detections of TCE and/or PCE.

Because of these past detections, along with its occurrence in Minnesota groundwater and the risk to human health, the DWAMP team identified 1,4-dioxane as a priority contaminant to investigate in 2024.

Site selection

Nineteen Community and Noncommunity PWSs were identified that had previously been monitored for 1,4-dioxane and had detections at concentrations lower than 25% of the HRL (0.25 µg/L) in finished water. This group makes up the "CEC follow-up" category described in this report. These systems were chosen for follow-up monitoring to confirm whether concentrations remain under 0.25 µg/L, which is the threshold requiring follow-up action under the CEC Framework.

An additional 100 PWSs were selected for monitoring based on prior detections of TCE and/or PCE. This group makes up the "historical TCE/PCE" category described in this report. None of these systems had previously been sampled for 1,4-dioxane. All systems with at least one historical result exceeding 25% of the HRL for TCE (0.4 µg/L) or PCE (4 µg/L) were selected for sampling (84 systems). To achieve our target of sampling 100 systems, we selected 16 additional systems that had the highest detection frequencies of TCE and/or PCE over time and were not captured in the initial list.

Communications

Since this sampling is outside the scope of MDH's regular compliance monitoring, the DWAMP team reached out to system operators to ask them to opt in to this voluntary sampling effort. The communications primarily included general information about 1,4-dioxane, whether their system had a past low-level detection of 1,4-dioxane or elevated levels of TCE or PCE ("Historical TCE/PCE"), how the results would be shared, data privacy, and other logistical details. Most system operators were open to participating in the program. Out of 119 systems initially selected for sampling, 31 opted out, did not respond, or were not able to be sampled for logistical reasons.

All results were communicated to the respective PWSs, including the full report from the public health laboratory. Following the CEC Framework, the results were split up into four categories: those that were below 25% of the HRL, those that were between 25% and 50% of the HRL, those that were above 50% of the HRL, and those that exceeded the HRL. For results below 25% of the HRL, the team communicated with the PWS that there is no known health risk at this level, and thus no follow-up action recommended. For results above 25% but lower than 50% of

the HRL, the team communicated with the PWS that there is no known health risk at this level, and thus no follow-up action recommended. These results were also communicated to the MDH District Engineer and DWAMP recommended a follow-up sample within three years. There were no results above 50% of the HRL, but in this case DWAMP would have communicated with the MDH District Engineer prior to sending results to the system and recommended quarterly follow-up sampling. All recommendations are based on guidelines in the CEC Framework.

Sampling Procedures

The DWAMP samplers followed MDH's standard 1, 4-Dioxane Sample Collection Procedure (PDF). Samples were taken at every entry point at each selected system. The sampling points included taps at a treatment plant sink, a nearby hydrant, or directly from a tap in the well house. All of these represent finished (treated) water that is being distributed to the public.

We did not sample entry points where the only source is an emergency well, wells that were out of service on the day sampling occurred, or consecutive systems (systems that receive water from another PWS).

Quality Control Measures

The primary quality control measures for sample collection included field blanks, trip blanks, and duplicate samples. Field blanks are contaminant-free water samples that are taken to the sampling location and handled as though they were actively being sampled at the location. Trip blanks are contaminant-free water samples that are kept with the set of sample bottles before and after sample collection. These blanks both assess for contamination due to human error during transportation, sampling, and handling.

Entry points were randomly selected to be sampled for field blanks, trip blanks and duplicates. Of the 250 entry points selected for sampling, 25 were selected for duplicate sampling and 25 for field blanks. One system was selected for a trip blank.

At each entry point designated as a duplicate, an additional two bottles were collected to facilitate a second lab analysis.

For entry points designated for field blank samples, water was obtained from the Public Health Laboratory—this water was poured from its original container into a new sampling bottle. The sample was poured near the sampling tap in use.

For the trip blank sample, the same contaminant-free water used for field blanks was used. The container was labeled as a trip blank and was stored with the other samples. The cap was removed while sampling was occurring and put back on after sampling was finished.

Results

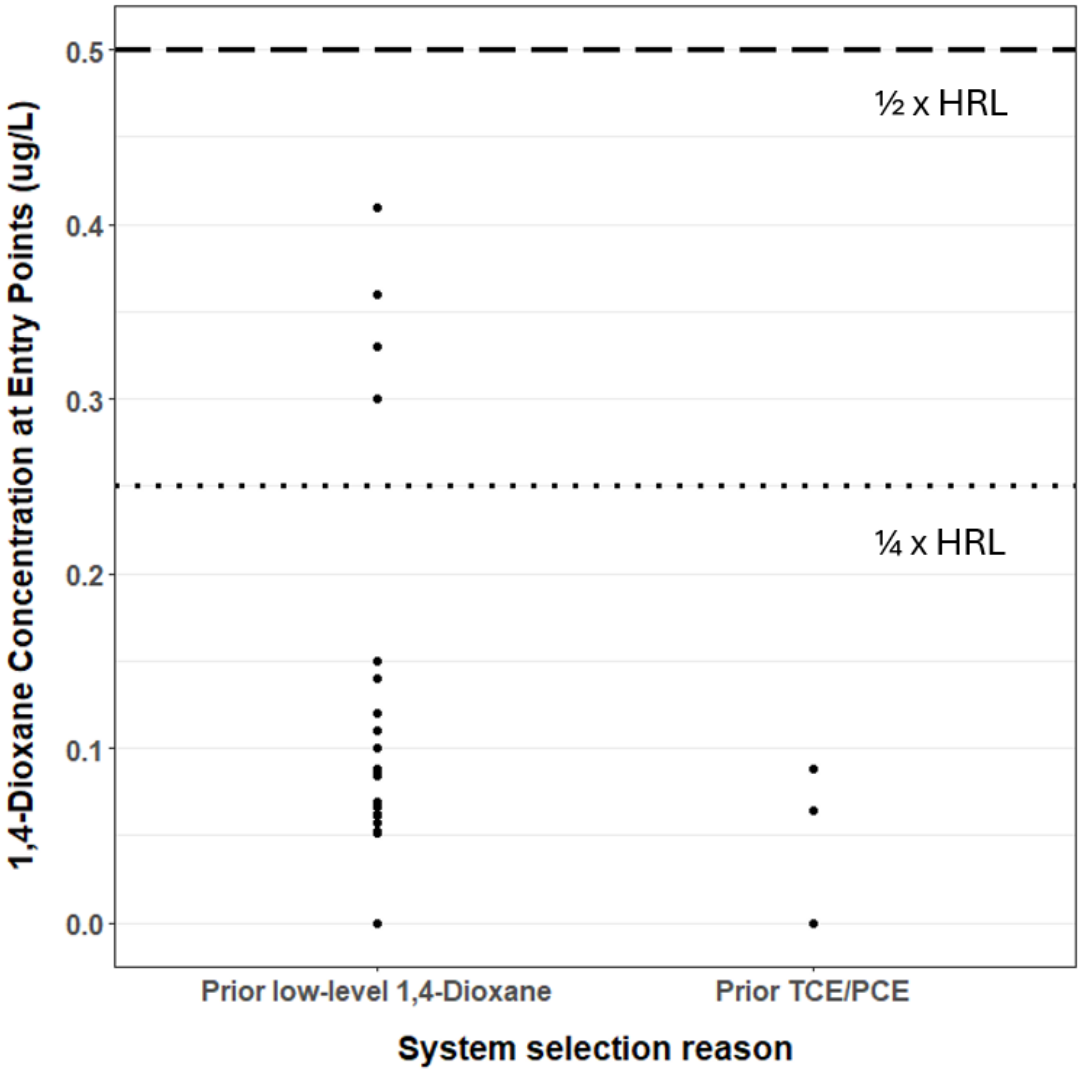
Out of the 119 systems originally selected for voluntary sampling, 88 participated. This includes 16 Community Water Systems with prior low-level 1,4-dioxane detections, 65 Community

Water Systems with prior TCE and/or PCE detections, and 8 Noncommunity Water Systems with prior TCE and/or PCE.

In the historical TCE/PCE group, 71 out of 73 systems had no detectable 1,4-dioxane at any entry point, including 7 out of the 8 Noncommunity systems. One Community and one Noncommunity system had detectable 1,4-Dioxane below 25% of the HRL.

In the CEC follow-up group, 12 out of 16 systems had detectable 1,4-dioxane in at least one entry point. Four of these systems had concentrations exceeding 25% of the HRL in one of their entry points, representing an increase from prior sampling. No results exceeded 50% of the HRL, the action level that triggers quarterly follow-up monitoring under MDH's CEC Framework. In Figure 1 (below), the zero line represents results below the laboratory reporting limit, which ranges from 0.049 to 0.051 µg/L.

Figure 1. 1,4-Dioxane Concentrations in Finished Water Samples from PWS Entry Points



Future Implications

Four systems, all within the Twin Cities metro area, had increases in 1,4-dioxane concentrations relative to previous sampling which pushed them into a higher action threshold under the CEC Framework. DWAMP has referred these systems to the Community Water Systems Unit within DWP for follow-up action, which will include additional sampling within three years. No further action is planned for the systems with concentrations measuring below 25% of the HRL at this time. Overall, a history of elevated TCE and PCE does not seem to predict elevated 1,4-dioxane at PWSs in Minnesota. DWAMP will revisit 1,4-dioxane monitoring in addition to sampling for other related chemicals in future years.

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