

Volatile Organic Compounds

What are they?

Volatile Organic Compounds (VOCs) are a group of common industrial and household chemicals that evaporate, or volatilize, when exposed to air. Examples of products containing VOCs include gasoline and industrial solvents, paints, paint thinners, air fresheners and household products such as spot and stain removers. Chemical names for the VOCs in these products include benzene, Trichloroethylene (TCE), toluene and vinyl chloride, among others. Improper handling or disposal of VOCs is often the reason why they occur in groundwater.



Collection of household products containing VOCs including paints, stains, and paint thinners. *Photo: Tom Murphy VII*

Health risks vary depending on the VOC. Short-term exposure to high concentrations of many VOCs can cause nausea, dizziness, anemia, fatigue or other health problems. Long-term exposure to some VOCs may cause cancer, liver damage, spasms, and impaired speech, hearing and vision. For more on the health effects of specific VOCs, see the resources listed by the Wisconsin Department of Health Services (DHS) at <https://www.dhs.wisconsin.gov/water/index.htm>.

Occurrence in Wisconsin

At least 59 different VOCs have been found in groundwater in Wisconsin, although only 34 of those have health based standards (groundwater [WI NR 140.10](#), drinking water [WI NR 809.24](#)). The main sources of VOCs in Wisconsin groundwater are landfills, leaking underground storage tanks (LUSTs), and a variety of facilities that use VOCs in their regular operations, including gas stations, bulk petroleum and pipeline



Installation of a compacted clay and geotextile liner at a landfill site in Wisconsin. *Photo: DNR*

facilities, plating facilities, dry cleaners and other industrial facilities. The Department of Natural Resources (DNR) currently tracks about 700 current or former landfills, 21,000 LUSTs and 8,000 other facilities which are required to monitor groundwater. The DNR also tracks approximately 39,000 spills, some of which are also sources of VOCs. Given how common potential sources of VOCs are, these substances are more frequently found in groundwater near urban

industrial and commercial areas. However, exceedances of groundwater standards for VOCs have been reported in every county in the state.

GCC Agency Actions

Early studies by the DNR and DHS in the late 1980s and early 1990s focused on VOC contamination from landfills, specifically from those without linings to protect groundwater from leachate. DNR scientists found that VOCs contaminated groundwater at 60% of unlined industrial landfills and 80% of unlined municipal solid waste landfills (Friedman, 1988; Batista and Connelly, 1989). Further review of monitoring data showed that while VOC levels typically decrease following the closure of unlined landfills, concentrations remain high and do not always show continued improvement within a reasonable period of time (Battista and Connelly, 1994). In the late 1990s, this knowledge raised concerns since increasing numbers of residential developments were located close to old, closed landfills. In 1999, the DNR and DHS designed targeted sampling of private wells near old, closed landfills to investigate and address the problem. For wells where VOCs were detected above drinking water standards, residents were given health advisories not to drink water and the DNR took follow-up measures at the nearby landfills. Much more stringent engineering standards have guided the design of modern landfills (those built after the 1980s), so these have a much better record in terms of VOC contamination, but older landfills continue to remain a concern (US DHHS, 2006).



Drilling to monitor for VOCs near a Wisconsin landfill.

Photo: [DNR](#)

A critical role of GCC agencies is identifying and monitoring all known sources of VOCs, not only landfills. The Department of Agriculture and Consumer Protection (DATCP) keeps track of all underground storage tanks (USTs) with a capacity of 60 gallons or greater; this registry has identified over 180,000 USTs since 1991. Hazardous waste treatment, storage and disposal facilities must be licensed by the DNR and are subject to corrective action authorities in the event of spills or releases. The DNR's Bureau for Remediation and Redevelopment oversees investigation or remediation at 128 RCRA 2020 corrective action sites. More broadly, the Hazardous Substance Spill Law requires immediate notification to the DNR when any hazardous spills or discharges occur and requires that all necessary actions be pursued to restore the environment to the extent practicable. The spills program also develops outreach materials to help reduce the number and magnitude of spills and provide guidance for responding to spills. Topics

addressed include spills from home fuel oil tanks, responses to illegal methamphetamine labs and mercury spills, all of which can lead to significant environmental impacts, if not properly addressed.

Future Work

Continuing to identify and monitor known sources of VOCs is key to continued protection of drinking water. Each year, several hundred contaminated sites, some of which involve VOCs, are reported to the DNR and each year, cleanup begins at another several hundred sites. Continuing to track and respond to this ongoing issue remains an important objective for GCC agencies.

As part of a continuing commitment to protect public health, public welfare, and the environment, the DNR periodically updates groundwater quality standards in ch. NR 140, Wis. Adm. Code. In 2018 the DNR requested that DHS review new toxicological information available for five VOCs: Trichloroethylene (TCE), Tetrachloroethylene (PCE), 1,2,3-Trichloropropane (1,2,3-TCP), 1,1-Dichloroethane (1,1-DCA) and 1,4-Dioxane, to see if updated groundwater standards for these substances was warranted. Based on its review, DHS has recommended updated standards for four of the reviewed VOCs (see <https://www.dhs.wisconsin.gov/water/gws.htm>). The DNR is currently in formal rulemaking to potentially adopt the DHS recommended updated standards into ch. NR 140.

Further Reading

DHS resources for contaminants in drinking water [\[link\]](#)

DNR overview of VOCs in private drinking water wells [\[link\]](#)

DNR map of open and closed contaminated sites [\[link\]](#)

DNR database of contaminated soil and groundwater [\[link\]](#)

DHS overview of vapor intrusion [\[link\]](#)

USGS report on VOCs in the nation's groundwater and drinking water wells [\[link\]](#)

References

Friedman, M.A. 1988. Volatile Organic Compounds in Groundwater and Leachate at Wisconsin Landfills. Wisconsin groundwater management practice monitoring project, DNR-004. Available at <http://digital.library.wisc.edu/1711.dl/EcoNatRes.FriedmanVolatile>

Battista, J.R. and J.P. Connelly. 1989. VOC Contamination at Selected Wisconsin Landfills – Sampling Results and Policy Implications. Wisconsin groundwater management practice monitoring project, DNR-005. Available at <http://digital.library.wisc.edu/1711.dl/EcoNatRes.BattistaVOC>

Battista, J.R. and J.P. Connelly. 1994. VOCs at Wisconsin landfills: recent findings. In: Proceedings of the 17th International Madison Waste Conference, Madison, WI, pp. 67–86

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