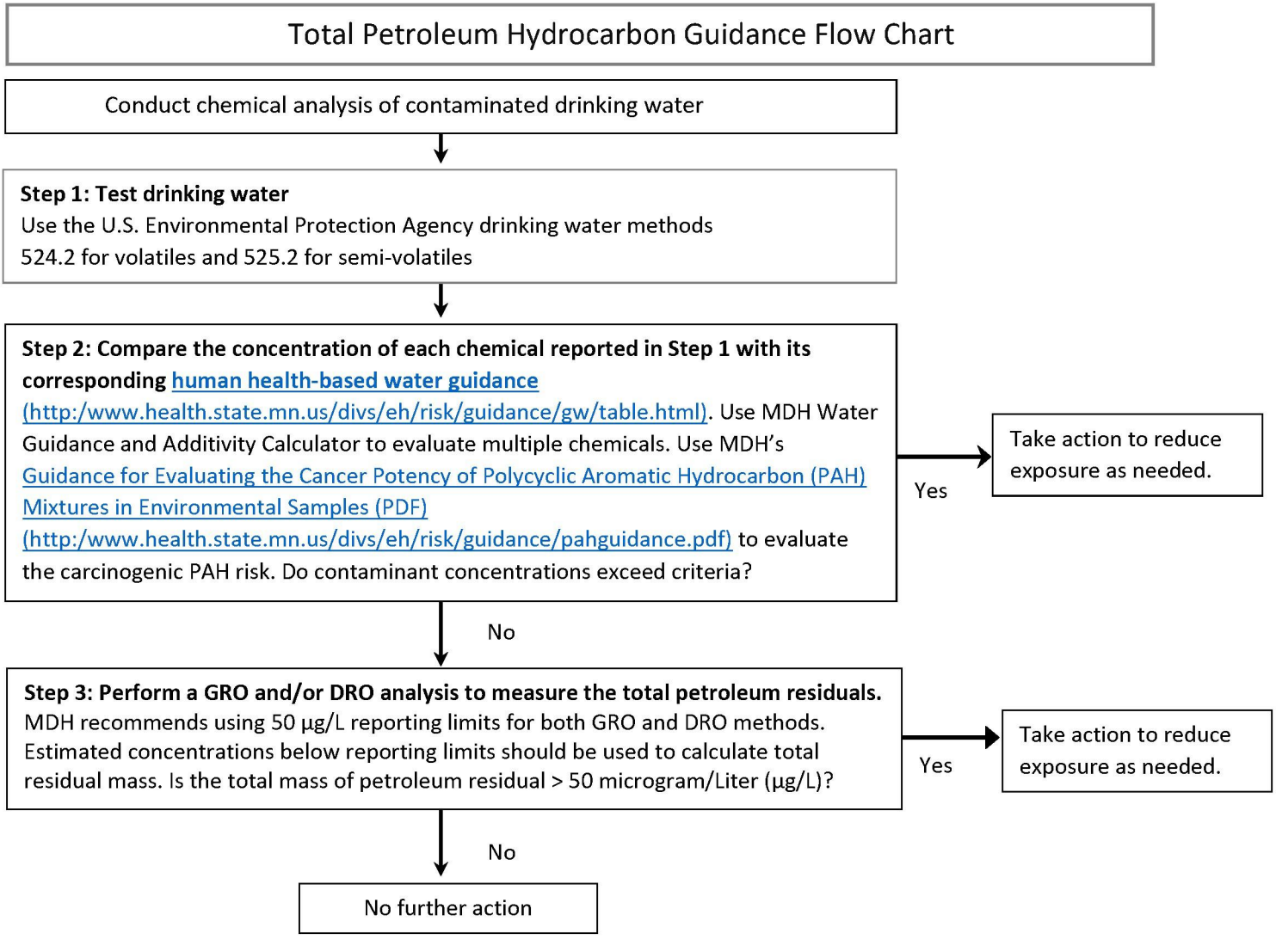
Guidance for Evaluating Health Risks from Gasoline and Diesel Contaminated Drinking Water

The Minnesota Department of Health (MDH) developed the following guidance for petroleum contaminated drinking water wells in February 2017. This guidance supersedes the total petroleum hydrocarbon (TPH) criteria developed in 2000.

Petroleum products contain many individual chemicals and drinking water criteria are available for only a small fraction of them. This guidance provides a margin of safety in situations where drinking water is contaminated with petroleum residuals that do not exceed individual chemical criteria. MDH recommends following the steps below to measure the total petroleum residual concentration and compare it to risk assessment advice (RAA) of 50 µg/L TPH which is based on a pyrene surrogate. This guidance may be amended as new information becomes available.

Note:
Do not use this guidance if contaminants other than petroleum mixtures are present. MDH also recommends notifying the Minnesota Duty Officer (651-649-5451) whenever petroleum contamination is found in a source of drinking water.

Follow the flow chart steps below to fully quantify TPH residuals in drinking water.



Complete the following steps to assess the full range of potential petroleum contaminants:

Step 1: Perform chemical analysis to identify specific chemicals.

- For gasoline and #2 fuel/diesel contamination, use EPA methods 524.2 and 525.2
    - Method 524.2 for volatile organic compounds will identify and quantify gasoline-related chemicals such as benzene, ethylbenzene, toluene, xylene and others.
    - Method 525.2 for semi-volatile organic compounds will identify and quantify larger carbon chain chemicals found in diesel such as pyrene, 2-methylnaphtalene, naphthalene and others.
- If heavier fuels (e.g., #3 through #6 fuel, jet fuels and kerosene), lube oils or hydraulic oils may be present, expand the analysis to include polycyclic aromatic hydrocarbons (PAHs) using MDH method SIM/GC/MS EXP List.

Make sure the analytical reporting limits are not above the individual drinking water criteria.

Step 2: Compare the concentration of each chemical reported in Step 1 with its corresponding human health-based water guidance value found on the Human Health-Based Water Guidance Table (http://www.health.state.mn.us/divs/eh/risk/guidance/gw/table.html).

Table 1 summarizes the TPH constituents for which MDH has drinking water health-based guidance.

- Use the MDH Guidance for Evaluating the Cancer Potency of Polycyclic Aromatic Hydrocarbon (PAH) Mixtures in Environmental Samples (PDF) (http:/www.health.state.mn.us/divs/eh/risk/guidance/pahguidance.pdf) to evaluate the carcinogenic PAH risk.
- Use the MDH Water Guidance and Additivity Calculator (Excel) (http://www.health.state.mn.us/divs/eh/risk/guidance/gw/guidance.xlsx) to evaluate the exposure if multiple chemicals are present (see Related Links at on the Human Health-Based Water Guidance Table (http://www.health.state.mn.us/divs/eh/risk/guidance/gw/table.html).

If any individual contaminant concentration exceeds MDH human health-based water criteria, treat the water or provide an alternative supply. If no individual chemical criteria are exceeded, proceed to Step 3.

Table 1. MDH Drinking Water Criteria for Petroleum Constituents #						
CAS Number	Compound	Criteria# (ug/L)			Product**	% by weight**
106-93-4	1,2-Dibromoethane	HRL93	Cancer	0.004	Gasoline Additive	Gasoline = unknown
107-06-2	1,2-Dichloroethane	HRL13	Cancer	1.0	Gasoline Additive	Gasoline = unknown
			Chronic	60		
1634-04-4	Methyl-tert-butylether	RAA13	Cancer	60	Gasoline Additive	Gasoline = 0.33
			Chronic	700		
110-54-3	n-Hexane	HRL94	Chronic	400	Gasoline	Gasoline = 2.4
71-43-2	Benzene	HRL09	Chronic	3	Gasoline and Diesel	Gasoline = 1.9
			Cancer	2		Diesel = 0.03
108-88-3	Toluene	HRL11	Chronic	200	Gasoline and Diesel	Gasoline = 8.1
						Diesel = 0.2
100-41-4	Ethylbenzene	HBV11	Chronic	50	Gasoline and Diesel	Gasoline = 1.7
						Diesel = 0.7
1330-20-7	Xylene	HBV11	Chronic	300	Gasoline and Diesel	Gasoline = 9
						Diesel = 0.5 (total xylene)
95-63-6	1,2,4-Trimethylbenzene	RAA10	Chronic	100	Gasoline	Gasoline = 3
108-67-8	1,3,5-Trimethylbenzene	HRL09	Chronic	100	Gasoline and Diesel	Gasoline = 9.8
						Diesel = 0.18
91-20-3	Naphthalene	HRL13	Chronic	70	Gasoline and Diesel	Gasoline = 0.25 (total naphthalenes = 3.1)
						Diesel = 0.26
91-57-6	2-Methylnaphthalene	RAA13	Chronic	8	Gasoline and Diesel	Gasoline = 0.218
						Diesel = 0.26
86-73-7	Fluorene	HRL93	Chronic	300	Diesel	Diesel = 0.086 (total fluorenes = 0.56)
120-12-7	Anthracene	HRL93	Chronic	2000	Diesel	Diesel = 0.0058
129-00-0	Pyrene	HBV15	Chronic	50	Diesel	Diesel = 0.0046
206-44-0	Fluoranthene	HBV15	Chronic	70	Diesel	Diesel = 0.0059
50-32-8	Benzo(a)pyrene	HBV18	Cancer	0.1	Diesel	Diesel = 0.00022
			Chronic	0.5		
Not Available	Total Petroleum Hydrocarbons (pyrene surrogate)	RAA17	Chronic	50	Petroleum Residual Mixture	100

* = If multiple compounds are found use the MDH Water Guidance and Additivity Calculator (Excel) (http://www.health.state.mn.us/divs/eh/risk/guidance/gw/guidance.xlsx)

** = Product percent by weight is adapted from Total Petroleum Hydrocarbon Criteria Working Group Series 1997

= The petroleum constituent criteria are subject to change. Please refer to the MDH website.

Step 3: Perform a GRO and/or DRO analysis to measure the total mass of petroleum residuals in the water.

MDH recommends using 50 µg/L reporting limits for both GRO and DRO methods. Provide estimated concentrations for the GRO and DRO results when reporting limits are not exceeded. Estimated concentrations below reporting limits should be used to calculate total residual mass.

- If the drinking water is contaminated with only gasoline run the GRO analysis and compare the result to the TPH RAA = 50 µg/L.

- If the water is only contaminated with diesel, run the DRO analysis and compare the result to the TPH RAA = 50 µg/L.

- If the water contains both the GRO and DRO, run both methods and compare the combined results to the TPH RAA = 50 µg/L.

    - The sum of the GRO and DRO concentrations is the total petroleum residual. However, to avoid double counting naphthalene concentrations measured in both the GRO and DRO methods, a naphthalene correction is needed. Add together the naphthalene concentrations measured in Step 1 (Method 524.2 and Method 525.2) and divide by two. The resulting naphthalene concentration is the naphthalene correction. Subtract that quantity from the GRO and DRO total residual measurement (see Example 3 in Table 2).

Table 2 shows example calculations for three contaminant combinations and two different reporting levels.

Table 2. Total Petroleum Hydrocarbon Residual Calculations

	Contaminant	Reporting Limit µg/L	Result µg/L	Exceeds TPH RAA, 50 µg/L
Example 1	Gasoline	100 GRO	67 J	yes
Example 2	Diesel	100 DRO	50 J	no
Example 3	Gasoline and Diesel	50 GRO 50 DRO	35 J (GRO) 20 J (DRO) – 5 µg/L naphthalene correction (total naphthalene ÷ 2) 50 J (GRO+DRO residual)	no
J = Estimated value below the reporting limit				

If you have questions about this guidance, contact the MDH Site Assessment and Consultation Unit at (health.hazard@state.mn.us, 651-201-4897 or toll-free 1-800-657-3908).