March 11, 2025

Subject:

A Review of Historic and In-Situ Industrial Contamination of Kentucky's Groundwater by The Kentucky Steward – Version 2

Dear Representatives,

I am an environmental engineer with nearly a decade of professional engineering consulting experience in the fields of environmental, geotechnical, and water resources engineering; as well as experience designing infrastructure in geologically/hydrogeologically complex areas of the state. My experience specifically includes the design and project management of some of Kentucky's largest infrastructure projects.

I am also a rural Kentucky farmer and outdoorsman and have worked (and continue to work alongside) power generation companies like LG&E-KU and East Kentucky Power Cooperative.

I am writing to you out of concern for what Senate Bill 89 (SB 89) proposes regarding the deregulation and re-defining of "waters of the Commonwealth" especially as it pertains to groundwater.

In the time following SB 89 passing the Senate vote, I have researched over 100 contaminants on the Kentucky Geological Survey's Groundwater Data Repository that pose significant health risks to Kentucky's drinking water, water resources, and groundwater; and thus, Kentucky's stakeholders.

My research has concluded that there is historic, as well as in-situ, systematic, industry-wide contamination of Kentucky's groundwater specifically caused by and perpetuated by a plethora of industrial corporations (i.e. power generation, landfills, superfund sites, etc.).

It is especially worth clarifying: **I am pro-industry, pro-worker, and pro-Kentucky**.

But as The Kentucky Steward LLC's mission statement is "Promoting the Ethical Stewardship of Kentucky's Environment and Culture"; I cannot support a senate bill with the faux label "pro-industry" when it sacrifices the health and well-being of Kentucky's water resources and the industry workers that they foster.

By analyzing over 637,000 water quality data analyses performed from 1975 to 2024, my research reflects that **redefining—and thus deregulating—"waters of the Commonwealth" to exclude "non-navigable waters" (especially groundwater) will enable unprecedented, and unmitigable environmental fallout that will introduce significant health risks to Kentucky stakeholders.**

I have prepared in kind for this house committee, as well as all other state house members and senators, a brief overview of my research that ultimately reflects why SB 89, as currently proposed, must NOT be passed.

Thank you for your consideration of SB 89. I hope the following research is informative and useful in your forthcoming ruling.

R. M. True | Founder, Managing Director – The Kentucky Steward LLC

A Review of Historic and In-Situ Industrial Contamination of Kentucky's Groundwater

by The Kentucky Steward

Executive Summary

This report presents an objective analysis of Kentucky groundwater contamination as it relates to industrial influence. By utilizing over 637,000 groundwater readings from 1975 to 2024 from the Kentucky Geological Survey's Groundwater Data Repository, this research analyzed 100 contaminants across nine analyte groups.

The findings reveal significant to extreme groundwater contamination throughout the state, including for dozens of carcinogenic contaminants frequent and severe exceedances of Max Contaminant Levels (MCLs) which characterize alarming health risks to Kentucky stakeholders.

Of the 100 contaminants analyzed, 68 maintain established MCLs. Within this group, 60 contaminants recorded frequent MCL exceedances, often at alarming magnitudes. For example, the **carcinogen** 1,2,3-trichloropropane **exceeded an MCL by 500,000,000%**. Each of the 100 KY Groundwater contaminants has been empirically analyzed through a plethora of metrics and an established severity scale, with specific discussion surrounding lead, arsenic, and PFAS (PFOA, PFOS).

Included in this report are means to visualize contamination with respect to Kentucky's diversified industrial footprint, as well as with respect to statewide utilities and domestic use wells dependent on groundwater for drinking water supply. Overlaying contamination data in this manner highlights a significant overlap, reinforcing the risk of exposure for communities dependent on these water supplies.

Of the 100 contaminants analyzed within this research, from June 1979 to June 2024, there has been 18,881 instances of 26 carcinogenic contaminants exceeding MCLs. Figures 7 and 8 herein depict each of the 18,881 instances overlayed on the state of Kentucky. Perhaps these figures reflect the purpose and ultimate conclusion of this research:

To contextualize and reinforce the necessity of frequent, comprehensive water quality monitoring and reporting requirements, particularly at industrial sites (including hazardous and solid waste landfills, superfund sites, underground storage tanks, and large-scale agriculture operations to name a few).

Given the timeliness of your consideration of SB 89, I respectfully urge you, on behalf of your constituents, as well as the state of Kentucky itself, to review these findings. I am confident no other entity has presented groundwater contamination to this committee or to any other house representative or senator. Thus, this report, considering SB 89's proposed impact to groundwater monitoring and reporting requirements for select industrial corporations/sites, is of the utmost importance.

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CHARACTERIZATION OF KENTUCKY'S HISTORIC AND 'IN-SITU' INDUSTRIAL CONTAMINATION OF GROUNDWATER

The purpose of this report is to characterize Kentucky's groundwater contamination as it relates to industrial influence. This analysis was necessary for several reasons:

- To quantify the extent and severity of industrial contaminants present in Kentucky groundwater.
- To assess contamination trends in relation to established Maximum Contaminant Levels (MCLs) set by the Environmental Protection Agency (EPA).
- To inform legislators and stakeholders of the public health risks posed by contaminants that exceed regulatory thresholds or lack defined limits.
- To emphasize the importance of maintaining water quality monitoring and reporting requirements, particularly in light of Senate Bill 89, which proposes to exclude select industrial corporations from such obligations.

This report presents objective groundwater data obtained from the Kentucky Geological Survey (KGS) and is structured to provide clear insights regarding contamination severity and potential risks to Kentucky stakeholders.

Kentucky Geological Survey's Groundwater Data Repository

All groundwater data analyzed for this report was obtained from the Kentucky Geological Survey's Groundwater Data Repository. The repository is a transparent, publicly accessible database managed by KGS staff, containing records from 1975 to 2024. It is a critical resource for stakeholders seeking to understand groundwater conditions in Kentucky.

During this research, an inconsistency was identified between the KGS online mapping service and downloadable analog data. After notifying KGS, the discrepancy was promptly corrected, ensuring that all KGS groundwater data sources now provide identical information.

The repository contains data for nearly 200 contaminants across 20 analyte groups. Each groundwater record includes key details such as analyte group, contaminant name, well ID, location coordinates, regulatory program, collection date, and result values (among other beneficial data). This comprehensive data structure allowed for accurate analysis of contamination presence and patterns across the state.

It should be noted that any concerned or curious Kentuckian can access the data on the repository. The Kentucky Steward LLC encourages you to do so.

Analysis of 100 Industrial Contaminants and the establishment of a severity scale

Following receipt of the full KGS data set, which included over 637,000 readings from 1975 to 2024, the data was distilled to focus on 100 contaminants representative of Kentucky's industrial profile. These contaminants were selected to reflect the influence of diverse industries, including power generation, chemical manufacturing, landfills, superfund sites, and agricultural operations.

The 100 contaminants evaluated span nine analyte groups: Metals, VOCs, SVOCs, PCBs, PFAS, Pesticides, Herbicides, Inorganics, and Nutrients. The inclusion of each of these groups reflects a representative lens of the influence of numerous contaminants, each with variable industrial applications across the state. Consequently, these analyte groups and the 100 contaminants included in this analysis represent the breadth and depth of groundwater contamination by Kentucky's diversified industries.

Categorizing the 100 KY Groundwater Contaminants

To organize the data effectively, five (5) contaminant categories resulted based on known health risks, MCL status, and contamination results:

- **Primary**: Contaminants that pose significant health risks to stakeholders with established MCLs that have been exceeded due to industrial influence.
- **Secondary**: Contaminants that pose significant health risks to stakeholders with established MCLs that have not been exceeded but are present in non-zero amounts, warranting monitoring as industrial contamination fluctuates.
- **Sub-secondary**: Contaminants that pose significant health risks to stakeholders with no established MCLs, but present in non-zero amounts; these require tracking given potential future MCL designations.
- **Tertiary**: Contaminants with inconclusive or poorly defined health effects, yet with established MCLs that have been exceeded.
- **Sub-tertiary**: Contaminants with inconclusive or poorly defined health effects and no established MCL.

This classification system highlights contaminants with both confirmed and potential risks to public health, emphasizing the need for ongoing monitoring and regulatory oversight.

Application of severity scale, health risks prioritized

To objectively assess the severity of each contaminant, a 100-point severity scale was developed. The scale considers six metrics:

- Health Risk Severity (50%) — Contaminants were weighted most heavily by health risks, with higher scores assigned to known carcinogens and severe systemic toxins.
  - 10pts - Eye irritant; skin irritant (or discoloration)
  - 20pts – Respiratory and/or gastrointestinal irritant / impermanent effect on blood (cholesterol, sugar, etc.)
  - 30pts – Organ-specific toxicity/damage; damage to central nervous system; permanent damage to blood cells (development), etc.
  - 40pts – Reproductive/developmental toxin OR affects bone health/development; harmful effects to infants and/or unborn children; OR suspected carcinogen.
  - 50pts – Known carcinogen; severe system toxin.

- Number of Non-Zero Analyses ≥ MCL (15%) — Points were assigned based on the frequency of MCL exceedances.
  - 15pts: $x \geq 300$ analyses greater than MCL
  - 10pts: $300 > x \geq 100$ analyses greater than MCL
  - 5pts: $100 > x > 0$ analyses greater than MCL

- MCL Exceedance % (10%) — Points reflected the highest recorded concentration relative to the established MCL.
  - 10pts: $x \geq 500\%$
  - 7pts: $500\% > x \geq 100\%$
  - 3pts: $x < 100\%$

- % of Non-Zero Analyses ≥ MCL (10%) — This metric captured the proportion of exceedances relative to total readings.
    - 10pts: x≥20%
    - 7pts: 20%>x≥10%
    - 3pts: x<10%

- Average as % of MCL (10%) — Points reflected the average concentration relative to the MCL.
    - 10pts: x≥100%
    - 7pts: 100>x≥25%
    - 3pts: x<25%

- MCL Exceedance (5%) — A binary metric indicating whether an MCL was exceeded.
    - 5pts: MCL was exceeded.
    - 0pts: MCL was NOT exceeded.

These empirical considerations were included in this research as they provide a refined, objective characterization of groundwater contamination from a surface level standpoint (i.e. whether an MCL was exceeded or not) as well as a comprehensive rendering of the magnitude of contamination (i.e. MCL exceedance %, No. of non-zero analyses exceeding MCL, and so forth).

Contaminants scoring above 30–40 points, for example, are considered severe. Those scoring 60–70 points or higher warrant significant concern due to substantial public health risks. Therefore, contaminants scoring above 70 warrant substantial concern with regard to environmental and community health.

Results of 100 KY Groundwater Contaminants Analysis

The results of this analysis reveal significant, and in many cases alarming, contamination of Kentucky's groundwater throughout the state. Of the 100 contaminants evaluated, 68 had MCLs; of the 68, 60 contaminants had exceeded their MCLs, with the majority of this group exceeding the MCL tens to thousands of times. See **Table 1. Risk Severity Results of 100 KY Groundwater Contaminants** for a comprehensive overview of all 100 contaminants. All 100 contaminants were ranked in ascending order of contamination severity (severity result out of 100pts). From Table 1, specific emphasis should be focused on MCL Exceedance %, No. of Non-zero analyses exceeding MCL, and Average as % of MCL. The greater the number, the more severe the environmental risk and impact to Kentucky stakeholders, specifically those that rely on groundwater for drinking water.

Notable findings include:

- **Carcinogenic contaminants exceeded MCLs by factors of 500 million and 50 million percent**, respectively (see 1,2,3-Trichloropropane and 1,2-Dibromoethane for example). Aside from these two outliers, Table 1. purports numerous carcinogenic contaminants maintaining MCL Exceedance percentages from 120 percent to several hundred thousand percent.
- Many carcinogenic contaminants (as well as others that damage organs and affect reproductive health), including Dichloromethane and Hexachloroethane, recorded thousands of individual readings above MCLs.

- The majority of all non-zero readings for many contaminants that pose significant health risks to stakeholders exceeded their respective MCLs.

The results included in **Table 1** illustrate not only the widespread presence of industrial contamination but also the concerning frequency and magnitude of contamination.

100 KY Groundwater Contaminants, Analyte Group and Categorical Summary

The distribution of contaminant types further emphasizes the widespread nature of industrial influence on Kentucky groundwater. See **Table 2. 100 KY Groundwater Contaminants - Analyte Group and Categorical Summary** below.

Table 1. Risk Severity Results of 100 KY Groundwater Contaminants.

Analysis performed by **The Kentucky Steward LLC**

Date: March 10, 2025

Note: All groundwater data provided by the Kentucky Geological Survey (GW Data Repository

NO. OF CONTAMINANTS RESEARCHED

100

Health Risk Severity Scale

10 Eye irritant; skin irritant (or discoloration)

20 Respiratory and/or gastro-intestinal irritant / impermanent effect on blood (cholesterol, sugar, etc.

30 Organ-specific toxicity/damage; damage to central nervous system; permanent damage to blood cells, et

40 Reproductive/developmental toxin OR affects bone health/development; harmful effects to infants and/or unborn children; OR suspected carcinoge

50 Known carcinogen; severe systemic toxin;

															CONTAMINANT SEVERITY SCALE							
															A	B	C	D	E	F		
	Analytes (Contaminant) Group	Contaminant	MCL (mg/L)	MCL Entity	Max Value (KGS) (mg/L)	MCL/Advisory Level Exceeded (Y/N)?	Max Reading / MCL (Exceedance %)	# of non-zero analyses	# of analyses exceeding MCL (#, x>MCL)	% of total non-zero analyses exceeding MCL	Average of non-zero analyses (mg/L)	Average as % of MCL	Median of non-zero analyses (mg/L)	Primary/ Secondary/ Sub-Secondary/ Tertiary/ Sub-Tertiary	Health Risk Severity @ 50% WT.	# of non-zero analyses ≥ MCL @ 15% WT.	MCL Exceedance % @ 10% WT.	% Total of non-zero analyses ≥ MCL @ 10% WT.	Average as % of MCL @ 10% WT.	MCL Exceedance (Y/N) @ 5% WT.	Contaminant Severity Cummulative Score / 100	Notes
1	VOCs	1,2,3-Trichloropropane	0.000005	EPA	25.000	Y	500000000.0%	3148	3148	100.00%	0.044821	896414.55%	0.000500	P	50	15	10	10	10	5	100	
2	VOCs	1,2-Dibromoethane (EDB)	0.00005	EPA	25.000	Y	50000000.0%	3126	3109	99.46%	0.045138	90276.75%	0.000500	P	50	15	10	10	10	5	100	
3	VOCs	Dichloromethane (Methylene chlori	0.005	EPA	462.000	Y	9240000.0%	3872	1049	27.09%	0.307886	6157.72%	0.000500	P	50	15	10	10	10	5	100	
4	SVOCs	Hexachloroethane	0.001	EPA	20.000	Y	2000000.0%	2808	1113	39.64%	0.047698	4769.83%	0.001000	P	50	15	10	10	10	5	100	
5	SVOCs	Pentachlorophenol	0.001	EPA	12.300	Y	1230000.0%	2205	878	39.82%	0.042964	4296.38%	0.000100	P	50	15	10	10	10	5	100	
6	VOCs	Vinyl chloride	0.002	EPA	25.000	Y	1250000.0%	3603	1109	30.78%	0.049884	2494.18%	0.000500	P	50	15	10	10	10	5	100	
7	Pesticide	Hexachlorobenzene	0.001	EPA	1.04	Y	104000.0%	2235	661	29.57%	0.006775	677.53%	0.000011	P	50	15	10	10	10	5	100	
8	SVOCs	bis(2-Ethylhexyl) phthalate	0.006	EPA	1.040	Y	17333.3%	953	589	61.80%	0.019863	331.05%	0.010000	P	50	15	10	10	10	5	100	
9	Metals	Arsenic	0.01	EPA	0.640	Y	6400.0%	3504	717	20.46%	0.012283	122.83%	0.002015	P	50	15	10	10	10	5	100	
10	VOCs	Trichloroethene	0.005	EPA	63.500	Y	1270000.0%	3669	714	19.46%	0.563483	11269.66%	0.000500	P	50	15	10	7	10	5	97	
11	VOCs	Benzene	0.005	EPA	75.200	Y	1504000.0%	4232	690	16.30%	0.128971	2579.42%	0.001000	P	50	15	10	7	10	5	97	
12	Metals	Lead	0.015	EPA	24.602	Y	164013.3%	4335	760	17.53%	0.036154	241.03%	0.003000	P	50	15	10	7	10	5	97	
13	Metals	Cadmium	0.005	EPA	2.510	Y	50200.0%	3869	383	9.90%	0.005164	103.29%	0.001000	P	50	15	10	3	10	5	93	
14	VOCs	1,2-Dibromo-3-chloropropane	0.0002	EPA	25.000	Y	12500000.0%	3117	3059	98.14%	0.047303	23651.70%	0.000500	P	40	15	10	10	10	5	90	Units: ng/L
15	SVOCs	Diethyl phthalate	0.006	EPA	1.040	Y	17333.3%	814	548	67.32%	0.016902	281.71%	0.010000	P	40	15	10	10	10	5	90	
16	PFAS	PFOA	4.0	EPA	52.9	Y	1322.5%	196	45	22.96%	4.111561	102.79%	0.769000	P	50	5	10	10	10	5	90	
17	VOCs	1,1-Dichloroethene	0.007	EPA	225.000	Y	3214285.7%	3561	395	11.09%	0.137836	1969.08%	0.000500	P	40	15	10	7	10	5	87	
18	PFAS	PFOS	4.0	EPA	216	Y	5400.0%	196	23	11.73%	8.576056	214.40%	0.769000	P	50	5	10	7	10	5	87	
19	VOCs	Chloroform	0.08	EPA	25.000	Y	31250.0%	3548	149	4.20%	0.050607	63.26%	0.000500	P	50	10	10	3	7	5	85	Units: ng/L
20	VOCs	1,1,1-Trichloroethane	0.002	EPA	919.000	Y	45950000.0%	3835	1419	37.00%	0.341707	17085.34%	0.000500	P	30	15	10	10	10	5	80	
21	SVOCs	2,4-Dinitrotoluene	0.0015	EPA	1.040	Y	69333.3%	1016	759	74.70%	0.015502	1033.47%	0.010000	P	30	15	10	10	10	5	80	
22	Metals	Thallium	0.002	EPA	3.370	Y	168500.0%	1188	454	38.22%	0.015539	776.94%	0.000500	P	30	15	10	10	10	5	80	
23	PCBs	Total PCBs (as Decalchlorobiphenyl)	0.0005	EPA	0.253	Y	50600.0%	1829	40	2.19%	0.000247	49.35%	0.000056	P	50	5	10	3	7	5	80	
24	VOCs	Toluene	1.0	EPA	610.000	Y	61000.0%	4224	42	0.99%	0.270908	27.09%	0.000582	P	50	5	10	3	7	5	80	
25	VOCs	Carbon tetrachloride	0.005	EPA	25.000	Y	500000.0%	3554	356	10.02%	0.047896	957.92%	0.000500	P	30	15	10	7	10	5	77	
26	SVOCs	1,3-Dichlorobenzene	0.005	EPA	5.000	Y	100000.0%	3432	533	15.53%	0.023504	470.08%	0.000500	P	30	15	10	7	10	5	77	
27	Metals	Beryllium	0.004	EPA	0.050	Y	1250.0%	1760	385	21.88%	0.002828	70.69%	0.001000	P	30	15	10	10	7	5	77	
28	Metals	Mercury	0.002	EPA	0.050	Y	2500.0%	3099	79	2.55%	0.000499	24.97%	0.000050	P	50	5	10	3	3	5	76	
29	Pesticide	Toxaphene	0.003	EPA	0.252	Y	8400.0%	886	23	2.60%	0.000607	20.22%	0.000100	P	50	5	10	3	3	5	76	
30	Pesticide	Atrazine	0.003	EPA	0.505	Y	16833.3%	1473	3	0.20%	0.000479	15.95%	0.000040	P	50	5	10	3	3	5	76	
31	Pesticide	Alachlor	0.002	EPA	0.126	Y	6300.0%	1330	1	0.08%	0.000133	6.66%	0.000021	P	50	5	10	3	3	5	76	
32	SVOCs	Naphthalene	0.7	EPA	15.300	Y	2185.7%	3954	36	0.91%	0.041828	5.98%	0.000500	P	50	5	10	3	3	5	76	
33	Pesticide	Heptachlor	0.004	EPA	0.052	Y	1287.5%	1732	33	1.91%	0.000226	5.64%	0.000010	P	50	5	10	3	3	5	76	
34	SVOCs	1,2-Dichlorobenzene	0.6	EPA	5.000	Y	833.3%	3434	13	0.38%	0.024085	4.01%	0.000500	P	50	5	10	3	3	5	76	
35	VOCs	1,1,2-Trichloroethane	0.005	EPA	52.200	Y	1044000.0%	3522	336	9.54%	0.060014	1200.28%	0.000500	P	30	15	10	3	10	5	73	
36	VOCs	1,2-Dichloropropane	0.005	EPA	25.000	Y	500000.0%	3540	319	9.01%	0.040388	807.77%	0.000500	P	30	15	10	3	10	5	73	
37	Metals	Hexavalent Chromium	0.1	EPA	0.170	Y	170.0%	81	1	1.23%	0.009457	9.46%	0.001000	P	50	5	7	3	3	5	73	
38	Metals	Lithium	0.01	EPA	76.000	Y	760000.0%	34	31	91.18%	6.164706	61647.06%	5.000000	P	30	5	10	10	10	5	70	
39	Metals	Antimony	0.006	EPA	3.042	Y	50700.0%	1754	851	48.52%	0.020663	344.38%	0.004000	P	20	15	10	10	10	5	70	
40	Metals	Strontium	4.0	EPA	200.000	Y	5000.0%	534	41	7.68%	2.235584	55.89%	0.194000	P	40	5	10	3	7	5	70	
41	VOCs	2,2-Dichloropropane	0.005	EPA	25.000	Y	500000.0%	3053	316	10.35%	0.046630	932.61%	0.000500	P	20	15	10	7	10	5	67	
42	Nutrients	Nitrite-N	1.0	EPA	29.300	Y	2930.0%	1533	41	2.67%	0.192361	19.24%	0.015000	P	40	5	10	3	3	5	66	
43	Herbicide	Dinoseb	0.007	EPA	0.052	Y	735.7%	1207	54	4.47%	0.001005	14.36%	0.000058	P	40	5	10	3	3	5	66	
44	Metals	Selenium	0.05	EPA	0.750	Y	1500.0%	3179	45	1.42%	0.005096	10.19%	0.002000	P	40	5	10	3	3	5	66	
45	Pesticide	Methoxychlor	0.04	EPA	0.400	Y	1000.0%	1804	6	0.33%	0.000652	1.63%	0.000011	P	40	5	10	3	3	5	66	
46	Herbicide	Silvex	0.05	EPA	0.250	Y	500.0%	1197	1	0.08%	0.000283	0.57%	0.000051	P	40	5	10	3	3	5	66	
47	VOCs	Styrene	0.1	EPA	25.0	Y	25000.0%	3454	113	3.27%	0.041819	41.82%	0.000500	P	30	10	10	3	7	5	65	
48	Pesticide	Technical Chlordane	0.002	EPA	0.001	N	50.0%	716	0	0.00%	0.000060	3.01%	0.000010	S	50	5	3	3	3	0	64	
49	Pesticide	Simazine	0.004	EPA	0.001	N	30.0%	1336	0	0.00%	0.000086	2.16%	0.000040	S	50	5	3	3	3	0	64	
50	VOCs	1,1-Dichloropropene	0.007	EPA	25.0	Y	357142.9%	3053	300	9.83%	0.046103	658.62%	0.000500	P	20	15	10	3	10	5	63	
51	Nutrients	Nitrate-N	10.0	EPA	32.2	Y	322.0%	1391	32	2.30%	2.185178	21.85%	0.970000	P	40	5	7	3	3	5	63	
52	Inorganic	Fluoride	4.0	EPA	12.0	Y	300.0%	1702	17	1.00%	0.429894	10.75%	0.179500	P	40	5	7	3	3	5	63	
53	Metals	Chromium	0.1	EPA	70.034	Y	70034.0%	4046	99	2.45%	0.044494	44.49%	0.003000	P	30	5	10	3	7	5	60	
54	SVOCs	1,2,4-Trichlorobenzene	0.07	EPA	5.000	Y	7142.9%	3345	90	2.69%	0.024140	34.49%	0.000500	P	30	5	10	3	7	5	60	
55	SVOCs	1,4-Dichlorobenzene	0.075	EPA	5.000	Y	6666.7%	3427	90	2.63%	0.023553	31.40%	0.000500	P	30	5	10	3	7	5	60	

56	Metals	Barium	2.0	EPA	362.0	Y	18100.0%	3150	41	1.30%	0.504780	25.24%	0.058500	P	30	5	10	3	7	5	**60**	
57	VOCs	Methyl-tert-butyl ether (MTBE)	0.05	KDOW	49.4	Y	98800.0%	2241	181	8.08%	0.163780	327.56%	0.000500	P	20	10	10	3	10	5	**58**	
58	Metals	Cyanide, total	0.2	EPA	4.700	Y	2350.0%	761	20	2.63%	0.037863	18.93%	0.010000	P	30	5	10	3	3	5	**56**	
59	Pesticide	Endrin	0.002	EPA	0.052	Y	2575.0%	1804	59	3.27%	0.000293	14.64%	0.000011	P	30	5	10	3	3	5	**56**	
60	VOCs	Ethylbenzene	0.7	EPA	25.0	Y	3571.4%	3828	55	1.44%	0.053939	7.71%	0.000500	P	30	5	10	3	3	5	**56**	
61	Pesticide	Cyanazine	0.001	KDOW	0.0001	N	10.0%	765	0	0.00%	0.000048	4.78%	0.000040	S	40	5	3	3	3	0	**54**	
62	Herbicide	Glyphosate	0.7	EPA	0.02	N	2.9%	652	0	0.00%	0.003487	0.50%	0.002000	S	40	5	3	3	3	0	**54**	
63	Metals	Copper	1.3	EPA	4.010	Y	308.5%	2875	2	0.07%	0.017947	1.38%	0.004000	P	30	5	7	3	3	5	**53**	
64	VOCs	Total Xylenes	10.0	EPA	13.100	Y	131.0%	2306	2	0.09%	0.041394	0.41%	0.000250	P	30	5	7	3	3	5	**53**	
65	SVOCs	2,6-Dinitrotoluene	N/A	N/A	61.84	N/A	N/A	1015	N/A	N/A	0.076489	N/A	0.010000	SS	50	0	0	0	0	0	**50**	
66	SVOCs	Dibenz(a,h)anthracene	N/A	N/A	1.040	N/A	N/A	1184	N/A	N/A	0.013118	N/A	0.010000	SS	50	0	0	0	0	0	**50**	
67	SVOCs	Indeno(1,2,3-cd)pyrene	N/A	N/A	1.040	N/A	N/A	1185	N/A	N/A	0.013044	N/A	0.010000	SS	50	0	0	0	0	0	**50**	
68	Pesticide	Dieldrin	N/A	N/A	0.052	N/A	N/A	1731	N/A	N/A	0.000227	N/A	0.000010	SS	50	0	0	0	0	0	**50**	
69	Metals	Manganese	0.3	EPA	3040.0	Y	1013333.3%	2775	895	32.25%	2.588483	862.83%	0.067700	T	0	15	10	10	10	5	**50**	
70	SVOCs	Fluorene	4.0	EPA	1.04	N	26.0%	1039	0	0.00%	0.014702	0.37%	0.010000	S	30	5	3	3	3	0	**44**	
71	Herbicide	2,4-D	0.07	EPA	0.01	N	14.3%	1270	0	0.00%	0.000238	0.34%	0.000080	S	30	5	3	3	3	0	**44**	
72	Herbicide	Picloram	0.5	EPA	0.004	N	0.8%	1073	0	0.00%	0.000063	0.01%	0.000051	S	30	5	3	3	3	0	**44**	
73	Metals	Boron	N/A	N/A	1.780	N/A	N/A	42	N/A	N/A	0.216143	N/A	0.100000	SS	40	0	0	0	0	0	**40**	
74	SVOCs	Dacthal (DCPA)	N/A	N/A	0.000051	N/A	N/A	1105	N/A	N/A	0.000013	N/A	0.000011	SS	40	0	0	0	0	0	**40**	
75	SVOCs	Dibutyl phthalate	N/A	N/A	1.040	N/A	N/A	964	N/A	N/A	0.017953	N/A	0.010000	SS	40	0	0	0	0	0	**40**	
76	Metals	Molybdenum	N/A	N/A	13.3	N/A	N/A	1300	N/A	N/A	0.027678	N/A	0.001000	SS	40	0	0	0	0	0	**40**	
77	VOCs	1,4-Dioxane	N/A	N/A	20.0	N/A	N/A	261	N/A	N/A	0.353189	N/A	0.028700	SS	40	0	0	0	0	0	**40**	
78	Herbicide	Linuron	N/A	N/A	0.000	N/A	N/A	142	N/A	N/A	0.000050	N/A	0.000050	SS	40	0	0	0	0	0	**40**	
79	SVOCs	Nitrobenzene	N/A	N/A	40.0	N/A	N/A	2808	N/A	N/A	0.183418	N/A	0.005420	SS	40	0	0	0	0	0	**40**	
80	Metals	Cobalt	N/A	N/A	0.738	N/A	N/A	1745	N/A	N/A	0.014331	N/A	0.002510	SS	30	0	0	0	0	0	**30**	
81	Herbicide	Dicamba	N/A	N/A	0.009	N/A	N/A	1077	N/A	N/A	0.000069	N/A	0.000051	SS	30	0	0	0	0	0	**30**	
82	VOCs	2-Chlorotoluene	N/A	N/A	25.0	N/A	N/A	3044	N/A	N/A	0.046238	N/A	0.000500	SS	30	0	0	0	0	0	**30**	
83	Metals	Tin	N/A	N/A	1.000	N/A	N/A	556	N/A	N/A	0.023299	N/A	0.012500	SS	30	0	0	0	0	0	**30**	
84	Metals	Silver	N/A	N/A	40	N/A	N/A	3100	N/A	N/A	0.016388	N/A	0.001000	SS	10	15	0	0	0	0	**25**	
85	VOCs	1,1,2,2-Tetrachloroethane	N/A	N/A	25.0	N/A	N/A	3549	N/A	N/A	0.043707	N/A	0.000500	SS	20	0	0	0	0	0	**20**	
86	VOCs	1,1-Dichloroethane	N/A	N/A	31.0	N/A	N/A	3568	N/A	N/A	0.068943	N/A	0.000500	SS	20	0	0	0	0	0	**20**	
87	Metals	Gold	N/A	N/A	0.034	N/A	N/A	6	N/A	N/A	0.022667	N/A	0.034000	SS	20	0	0	0	0	0	**20**	
88	VOCs	1,3,5-Trimethylbenzene	N/A	N/A	25.0	N/A	N/A	3045	N/A	N/A	0.048988	N/A	0.000500	SS	20	0	0	0	0	0	**20**	
89	Inorganic	Sulfate	N/A	N/A	9460.0	N/A	N/A	1961	N/A	N/A	110.961712	N/A	46.800000	SS	20	0	0	0	0	0	**20**	
90	VOCs	1-Chlorobutane	N/A	N/A	20.0	N/A	N/A	2208	N/A	N/A	0.059302	N/A	0.000500	SS	20	0	0	0	0	0	**20**	
91	SVOCs	Hexachlorobutadiene	N/A	N/A	5.000	N/A	N/A	6706	N/A	N/A	0.023850	N/A	0.000500	SS	20	0	0	0	0	0	**20**	
92	VOCs	1-Chlorohexane	N/A	N/A	25.0	N/A	N/A	2983	N/A	N/A	0.047130	N/A	0.000500	SS	20	0	0	0	0	0	**20**	
93	Metals	Sodium	N/A	N/A	26600.0	N/A	N/A	2619	N/A	N/A	192.416824	N/A	29.600000	ST	20	0	0	0	0	0	**20**	
94	Metals	Sulfur	N/A	N/A	85.100	N/A	N/A	216	N/A	N/A	11.374604	N/A	8.720000	SS	20	0	0	0	0	0	**20**	
95	Metals	Vanadium	N/A	N/A	0.840	N/A	N/A	1587	N/A	N/A	0.009766	N/A	0.001000	SS	20	0	0	0	0	0	**20**	
96	Pesticide	Metolachlor	N/A	N/A	0.005	N/A	N/A	1272	N/A	N/A	0.000054	N/A	0.000040	ST	20	0	0	0	0	0	**20**	
97	SVOCs	Isophorone	N/A	N/A	1.040	N/A	N/A	1016	N/A	N/A	0.015848	N/A	0.010000	SS	20	0	0	0	0	0	**20**	
98	SVOCs	Phenanthrene	N/A	N/A	2.570	N/A	N/A	1515	N/A	N/A	0.014050	N/A	0.010000	SS	10	0	0	0	0	0	**10**	
99	Inorganic	Chloride	N/A	N/A	56600.0	N/A	N/A	2194	N/A	N/A	112.835237	N/A	14.600000	ST	0	0	0	0	0	0	**0**	
100	Metals	Silicon	N/A	N/A	28.000	N/A	N/A	28	N/A	N/A	8.052241	N/A	5.250000	ST	0	0	0	0	0	0	**0**	

Table 2. 100 KY Groundwater Contaminants - Analyte Group / Categorical Summary

Analyte Group	# Contaminants Researched	Primary (#,%)	Secondary	Sub-Secondary	Tertiary	Sub-Tertiary	**Severity Scale Range**	Greatest Risk Contaminant
Metals	26	15	0	8	1	2	0 - 100	Arsenic
VOCs	27	20	0	7	0	0	20 - 100	1,2,3-trichloropropane
SVOCs	20	10	1	9	0	0	10 - 100	Hexachloroethane
PCBs	1	1	0	0	0	0	80	Total PCBs (as Decalchlorobiphenyl)
PFAS	2	2	0	0	0	0	95	PFOA
Pesticides	12	7	3	1	0	1	20 - 100	Hexachlorobenzene
Herbicides	7	2	3	2	0	0	30 - 66	Dinoseb
Inorganics	3	1	0	1	0	1	0 - 63	Fluoride
Nutrients	2	2	0	0	0	0	63 - 66	Nitrite-N
TOTALS	**100**	**60**	**7**	**28**	**1**	**4**		
	100%	60%	7%	28%	1%	4%		

Graphical representations of select KY Groundwater Contaminants: Lead, Arsenic, and PFAS (PFOA, PFOS)

Three contaminants, Lead, Arsenic, and PFAS (PFOA and PFOS) were selected to illustrate key contamination trends. These contaminants demonstrate both the persistence and variability of industrial pollutants in Kentucky groundwater.

- Lead and Arsenic are widely recognized as carcinogens and reflect extensive industrial use statewide. Groundwater data reflects lead and arsenic contamination occurring for over 40 years, with contamination into groundwater occurring at-present. See **Figure 1 and 2**, respectively. Note: Every groundwater data reading reflected on Figures 1 and 2 exceeds the MCL.
- PFAS contaminants, despite their relatively low MCL threshold (4 ng/L), have shown significant presence in groundwater. Unlike other contaminants, PFAS exceedances were recorded primarily through the regulatory lenses of drinking water and water withdrawal (i.e. water withdrawal here indicates any instance for water being withdrawn from the groundwater for societal or industrial use and testing prior to utilization as 'influent') in rather than at or near industrial sites. Thus, there is no groundwater data for PFAS in the close proximity to or directly below underground storage tanks, superfund sites, hazardous and solid waste sites, etc. Rather, comprehensive hydrogeologic studies would be necessary to effectively track PFAS point source contamination. This specifically underscores the importance of upholding water quality monitoring and reporting requirements, especially for industrial corporations at waste-present or prone sites. See **Figure 3** below.

These examples reinforce the critical role of water quality monitoring in identifying and mitigating risks to Kentucky stakeholders.

Figure 1

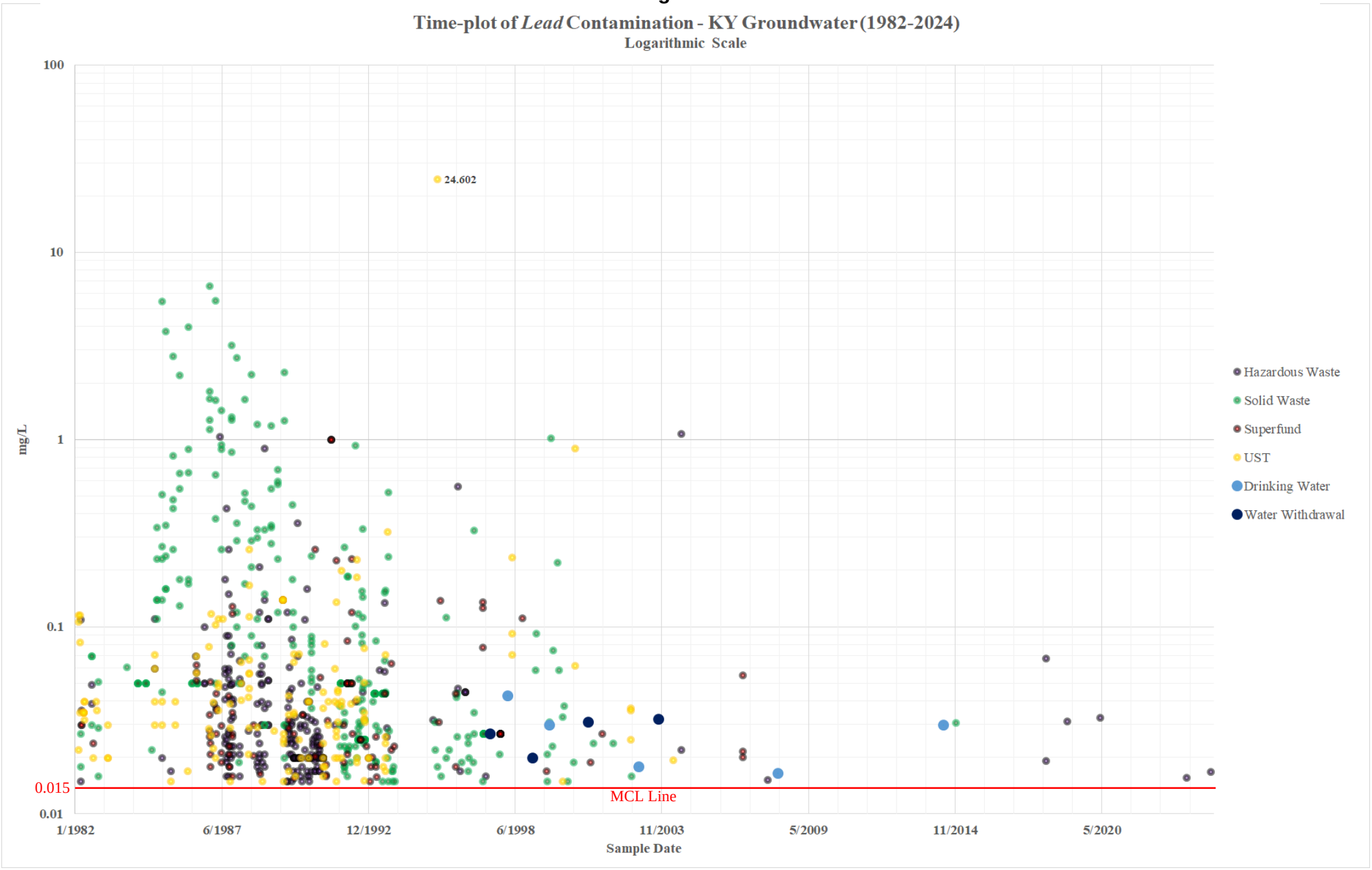

Time-plot of *Lead* Contamination - KY Groundwater (1982-2024)
Logarithmic Scale
100
10
1
0.1
0.015
0.01
mg/L
24.602
MCL Line
1/1982
6/1987
12/1992
6/1998
11/2003
5/2009
11/2014
5/2020
Sample Date
Hazardous Waste
Solid Waste
Superfund
UST
Drinking Water
Water Withdrawal

Figure 2

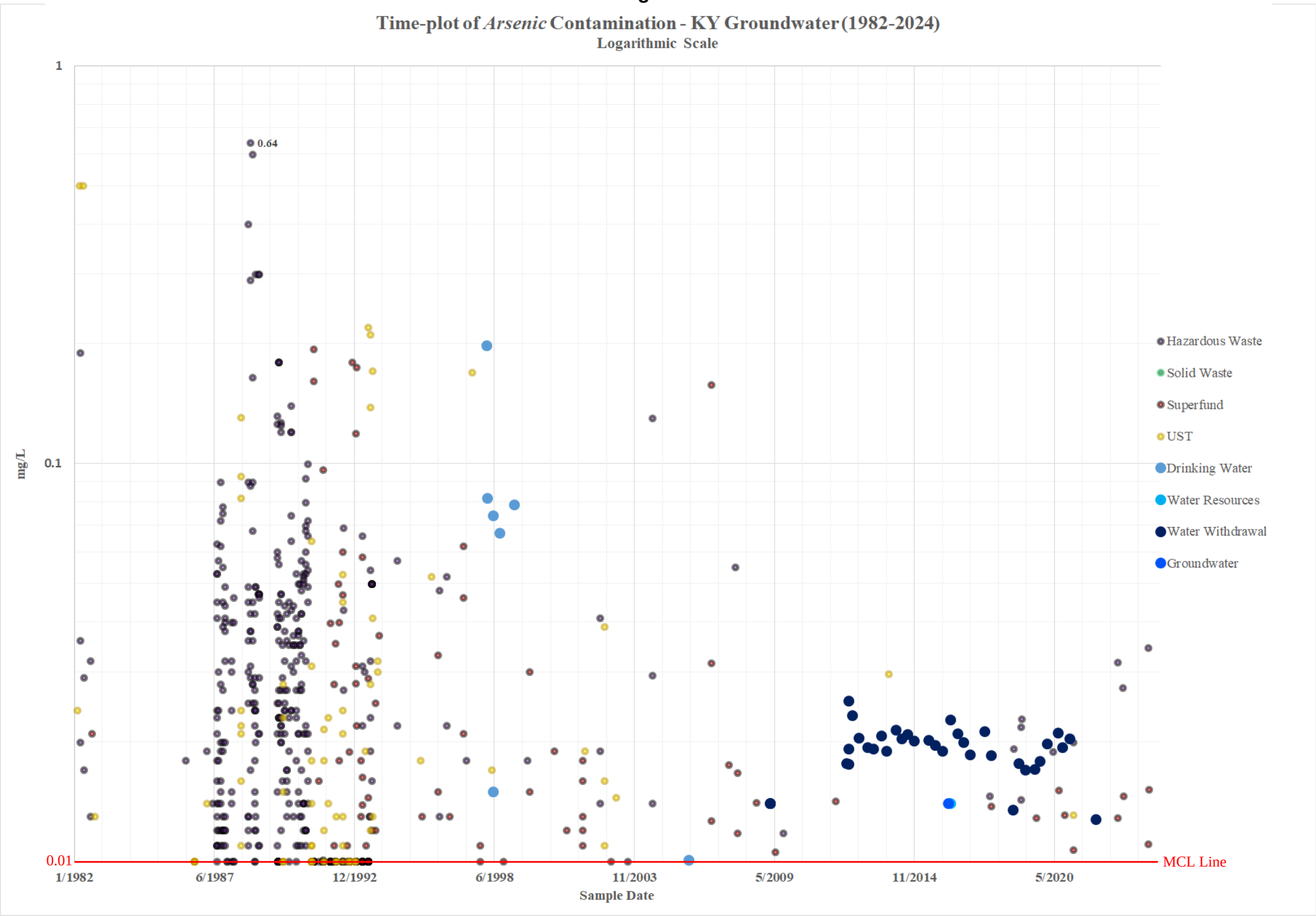
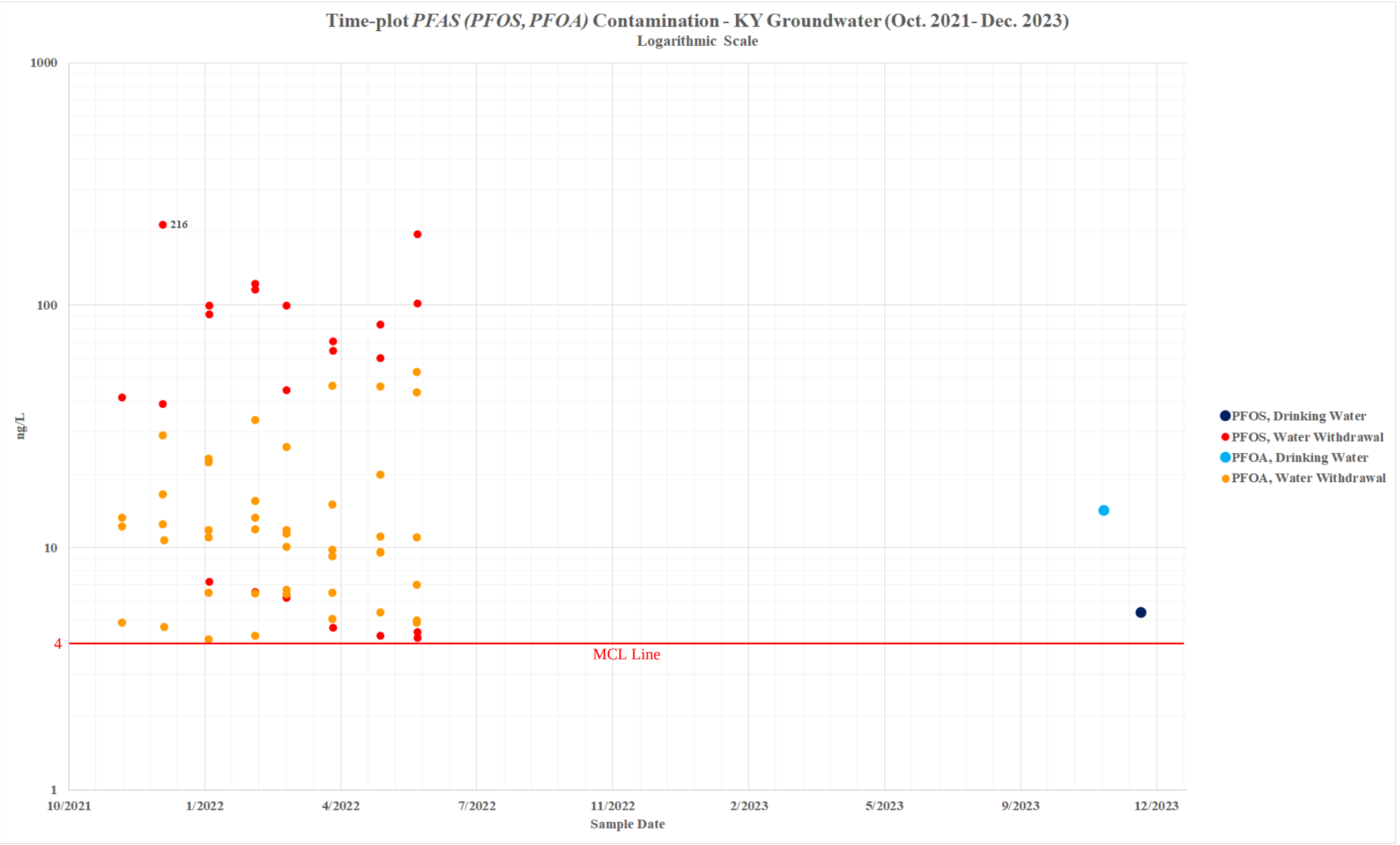

Time-plot of *Arsenic* Contamination - KY Groundwater (1982-2024)
Logarithmic Scale
1
0.1
0.01
mg/L
0.64
MCL Line
1/1982
6/1987
12/1992
6/1998
11/2003
5/2009
11/2014
5/2020
Sample Date
Hazardous Waste
Solid Waste
Superfund
UST
Drinking Water
Water Resources
Water Withdrawal
Groundwater

Figure 3


Time-plot PFAS (PFOS, PFOA) Contamination - KY Groundwater (Oct. 2021- Dec. 2023)
Logarithmic Scale
1000
100
10
4
1
ng/L
216
MCL Line
10/2021
1/2022
4/2022
7/2022
11/2022
2/2023
5/2023
9/2023
12/2023
Sample Date
PFOS, Drinking Water
PFOS, Water Withdrawal
PFOA, Drinking Water
PFOA, Water Withdrawal

Mapping select KY Groundwater Contamination against Utilities Dependent on Groundwater, Domestic Use Wells, and Areas of Groundwater Sensitivity throughout Kentucky

The KGS Data Repository is beneficial in that it supplies northings and eastings (NAD 83) for each groundwater data reading. Thus, all readings that exceeded MCLs for Lead and PFAS have been applied to several mapping resources produced by Kentucky Energy and Environmental Cabinet as well as KDOW. Additionally, select industrial companies/locations were applied to these Figures (sourced from the EPA and the Cabinet) to characterize the industrial influence with regard to widespread groundwater contamination throughout Kentucky.

For an industrial footprint and lead (a known carcinogen) contamination overlayed on statewide utilities dependent upon groundwater see **Figure 4**. For an industrial footprint and lead contamination overlayed on statewide domestic use wells see **Figure 5**.

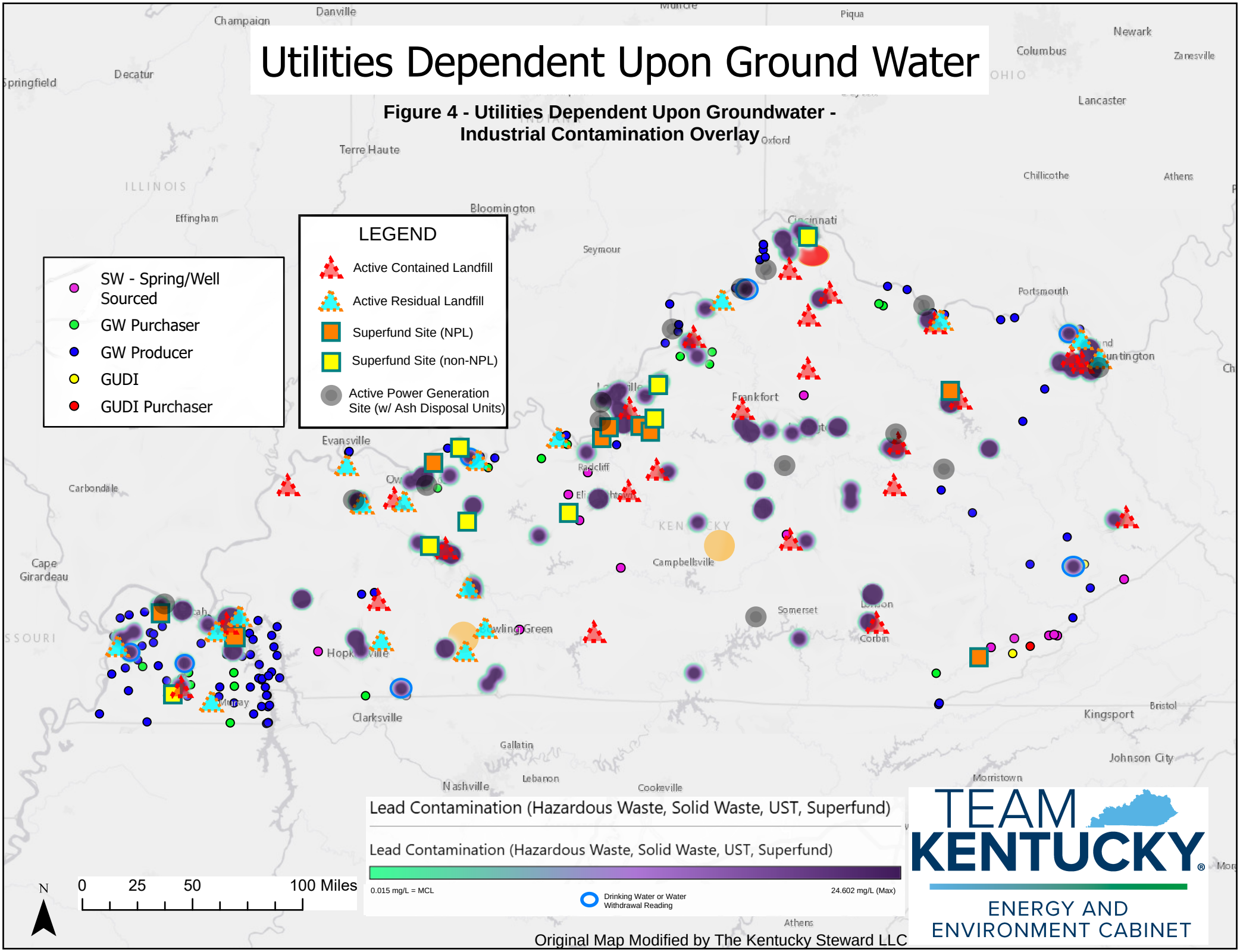
From Figures 4 and 5, the relationship between industrial activity and Kentucky groundwater contamination is clear. Graphical overlays demonstrate that industrial facilities — including power generation sites, superfund locations, and active landfills — are not only the primary sources of contamination but are unfortunately located in close proximity to domestic wells and utility sources dependent on groundwater.

Given Kentucky's complex hydrogeology, including karst systems and faulted bedrock formations, groundwater pathways are highly variable. This complexity amplifies the risk of industrial contaminants migrating into water supplies. Therefore, an industrial footprint as well as lead and PFAS contamination has been overlayed on Kentucky's areas of groundwater sensitivity.

As many industrial sites and the resultant contamination sourced from these sites are situated in sensitive groundwater areas throughout the state, maintaining comprehensive water quality monitoring and reporting requirements for industrial sites is vital. Namely, it should be understood that an industrial discharge of lead, for instance, in terms of groundwater contamination risk may not be equivalent depending on the location of the industrial site in Kentucky. The geologic complexity is so volatile that industrial corporations located mere miles away can have significantly varying magnitudes of groundwater contamination risks. See **Figure 6** below.

Utilities Dependent Upon Ground Water

Figure 4 - Utilities Dependent Upon Groundwater - Industrial Contamination Overlay



Original Map Modified by The Kentucky Steward LLC

Domestic Use Wells Impacted by Ground Water

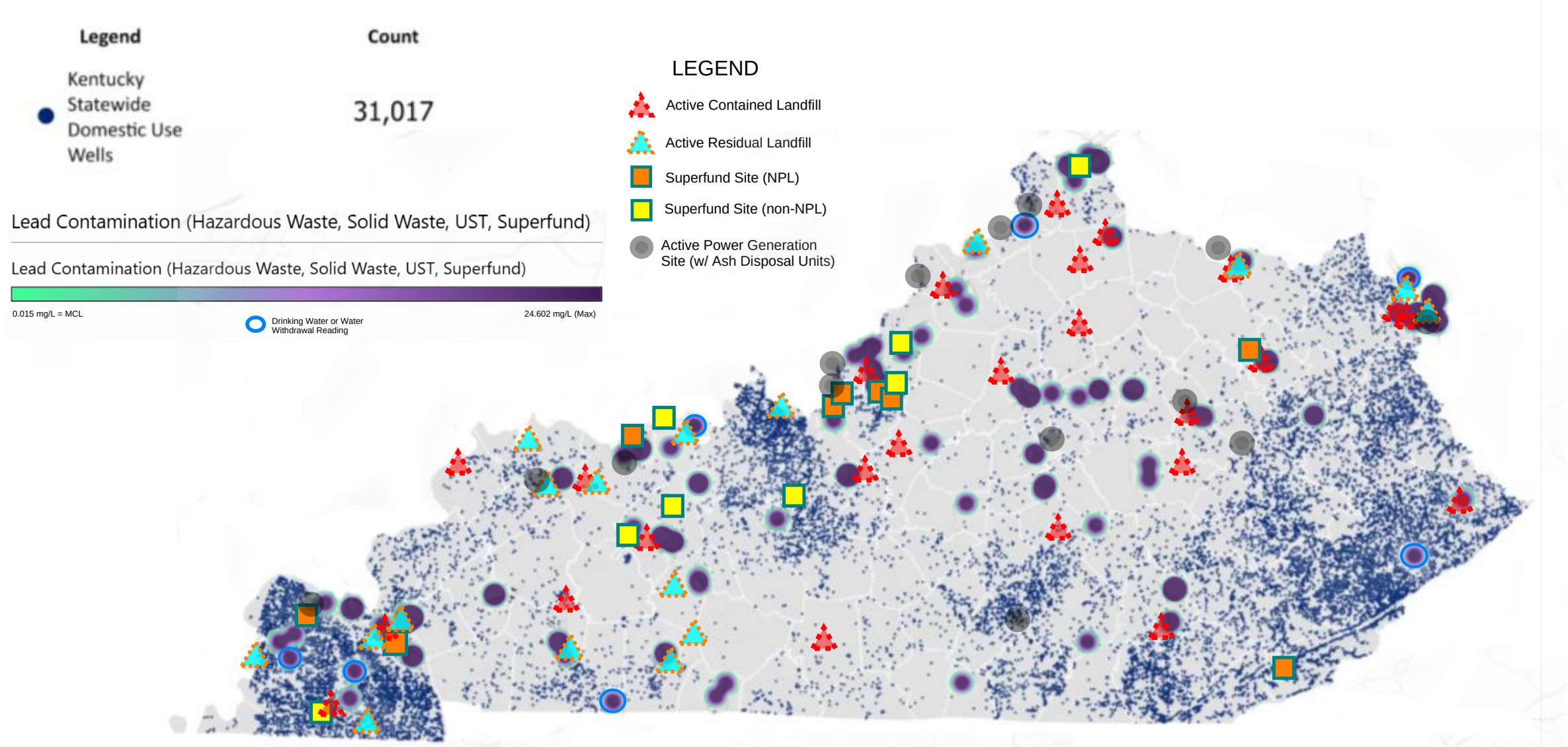


Figure 5 - Domestic Use Wells Impacted by Groundwater - Industrial Contamination Overlay

Original Map Modified by The Kentucky Steward LLC

Kentucky Energy and Environment Cabinet

Groundwater Sensitivity Regions of Kentucky

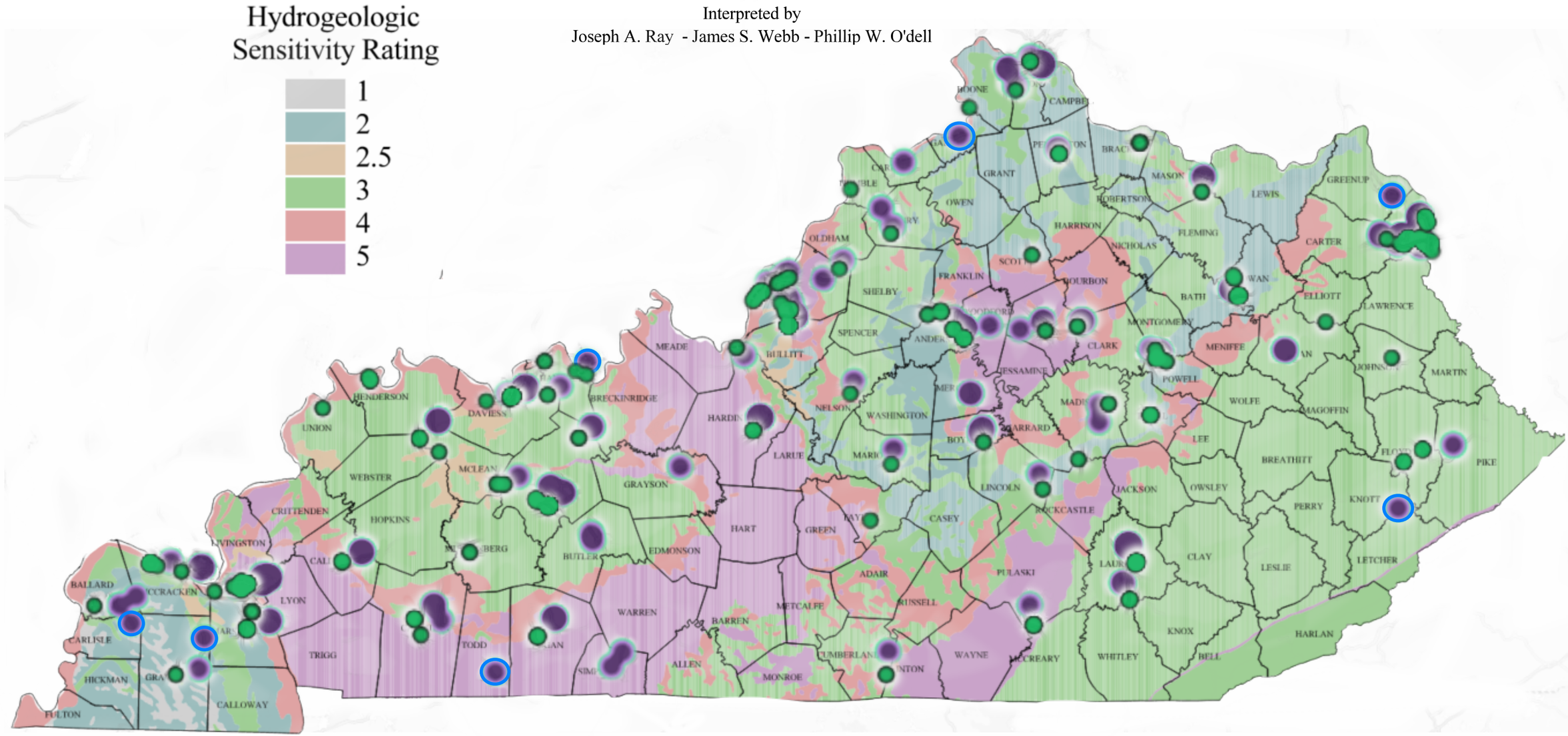
by

Kentucky Department for Environmental Protection
Division of Water
Groundwater Branch

1994

Interpreted by

Joseph A. Ray - James S. Webb - Phillip W. O'dell



PFAS (PFOA/PFOS) Contamination (Water Withdrawal, Drinking Water)

PFAS (PFOA/PFOS) Contamination (Water Withdrawal, Drinking Water)

4.0 ng/L or ppt = MCL — 216 ng/L (Max)

Drinking Water or Water Withdrawal Reading

Lead Contamination (Hazardous Waste, Solid Waste, UST, Superfund)

Lead Contamination (Hazardous Waste, Solid Waste, UST, Superfund)

0.015 mg/L = MCL — 24.602 mg/L (Max)

Drinking Water or Water Withdrawal Reading

Figure 6 - KY Groundwater Sensitivity - Industrial Contamination Overlay

Original Map Modified by The Kentucky Steward LLC

Analysis and Mapping of Carcinogenic Contamination of KY Groundwater

To characterize the greatest impact of industrial influence on KY groundwater, and thus Kentucky stakeholders that depend upon it, it is necessary to consider the contamination of carcinogenic pollutants. Of the 100 contaminants analyzed in this research, 60 were categorized as Primary contaminants. To reiterate, these contaminants pose significant health risks to Kentucky stakeholders and maintain a history, as well as in the majority of cases, a present in-situ contamination of Kentucky groundwater.

When considering Primary contaminants that are carcinogenic in nature, one assumes a conservative, or most severe reflection of industrial corporations' adverse influence to Kentucky groundwater and, by extension, stakeholders. Of the 60 Primary contaminants, 26 are carcinogenic (cancer causing) in nature (i.e. thus rendering higher severity scoring as discussed earlier). These contaminants are included below for reference:

- Metals: Arsenic, Cadmium, Lead, Mercury, and Hexavalent Chromium.
- VOCs: 1,2,3-trichloropropane, 1,2-dibromoethane (EDB), Dichloromethane (Methyl chloride), Trichloroethene, Benzene, Chloroform, Toluene, and vinyl chloride.
- SVOCs: Hexachloroethane, Pentachlorophenol, bis(2-Ethylhexyl) phthalate, Naphthalene, and 1,2-Dichlorobenzene.
- Pesticides: Hexachlorobenzene, Toxaphene, Atrazine, Alachlor, and Heptachlor.
- PCBs: Total PCBs (as Decalchlorobiphenyl)
- PFAS: PFOA and PFOS

From June 1979 to June 2024, there has been 18,881 instances of these carcinogenic contaminants exceeding MCLs. To fully characterize this, carcinogenic contamination exceeding MCL is reflected on **Figures 7** and **8** below.

Figure 7. Carcinogenic Contamination of KY Groundwater (1979-2024) - Colorized also reflects the regulatory breakdown for each MCL exceedance instance. Regulatory programs—which indicate where the groundwater sample was taken—are colorized in Figure 7 for categorical viewing. Readings that exceed MCLs under the regulatory programs: Hazardous Waste, Solid Waste, Superfund, and UST (underground storage tanks) are appropriately colorized as non-blue color variants as they are contamination sites. All contamination readings exceeding MCLs for the following regulatory programs: Drinking Water, Groundwater, Water Withdrawal, Water Resources, and Voluntary are appropriately colorized as variations of blue, as they represent groundwater that was or is to be used as a source of drinking water (to be treated at select utilities), or for process water in the industrial process. The regulatory programs Groundwater and Voluntary simply mean a Groundwater monitoring well itself, and a private Kentucky stakeholder testing a private well (likely out of concern or curiosity).

It is important to clarify that the power-scaled mapping of carcinogenic contamination is scaled by count number. Therefore, high columns indicate numerous contamination readings exceeding MCLs at that specific location.

Given the diverse colorization of the regulatory program breakdown, **Figure 8 – Carcinogenic Contamination of KY Groundwater (1979-2024) – Black and Blue** was included as a simple, yet

effective contrast rendering of all point-source, carcinogenic contamination readings and non-point source, carcinogenic contamination readings exceeding MCL. Namely, all carcinogenic contamination sourced from hazardous and solid waste landfills, superfund sites, and underground storage tanks is black; all drinking water, water resources, groundwater, and voluntary readings are variances of blue.

FIGURE 7 - CARCINOGENIC CONTAMINATION OF KENTUCKY GROUNDWATER (1979-2024) - COLORIZED

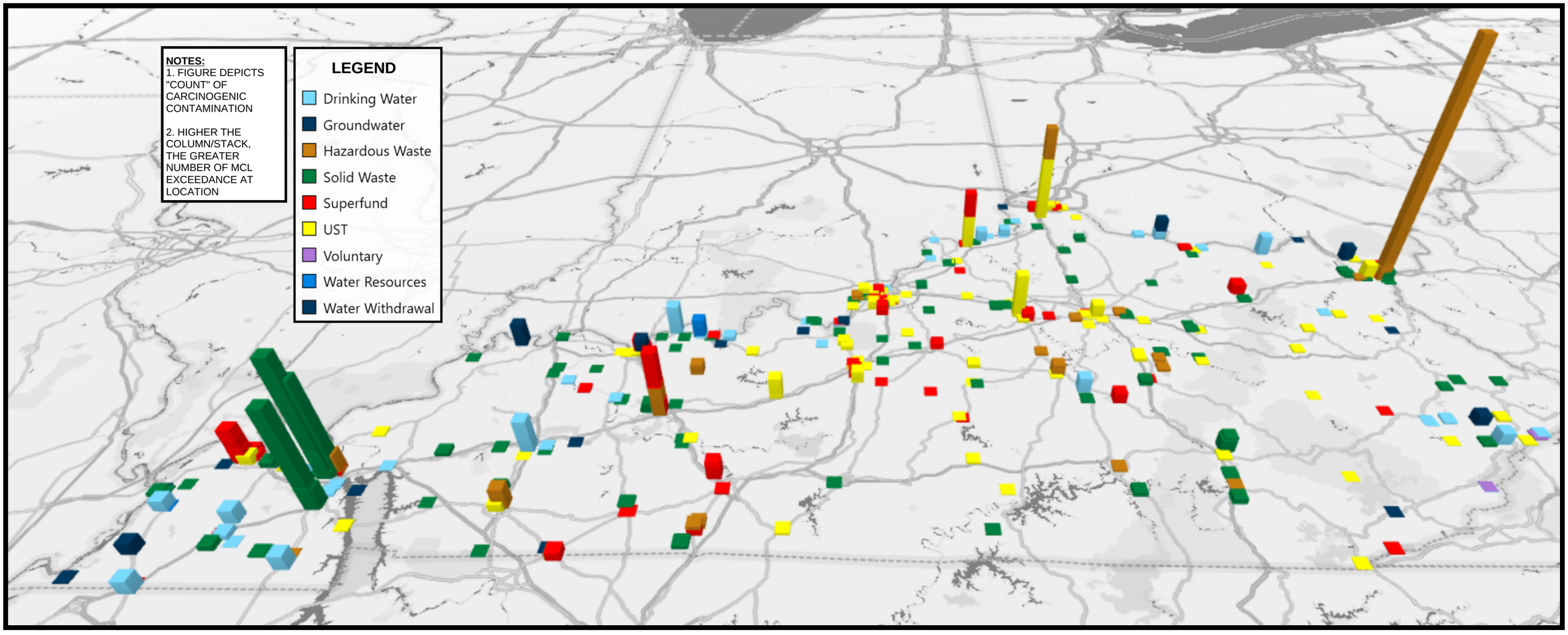
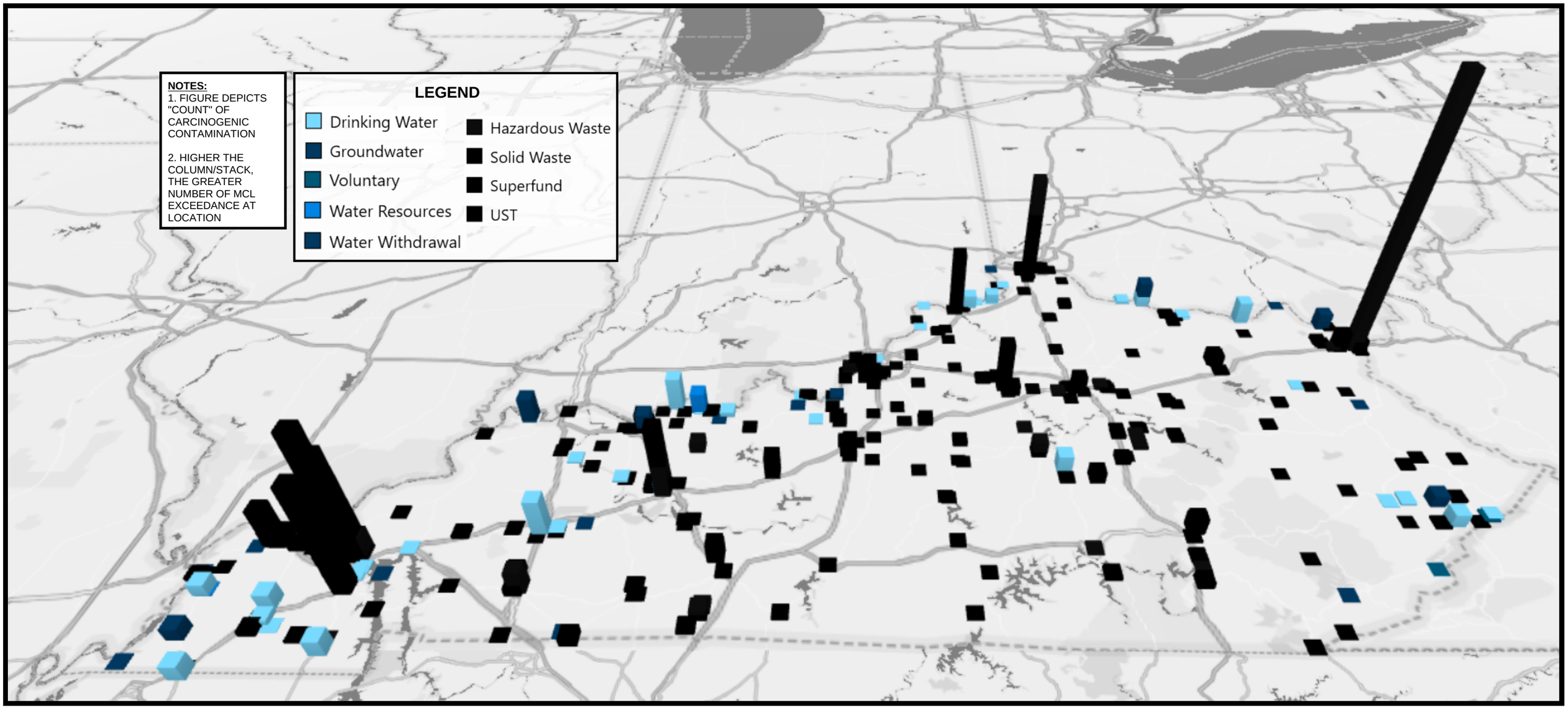


FIGURE 8 - CARCINOGENIC CONTAMINATION OF KENTUCKY GROUNDWATER (1979-2024) - BLACK AND BLUE



The following is clear upon viewing Figures 7 and 8, respectively:

1. There is an alarming history and in-situ presence of carcinogenic contamination in Kentucky groundwater.

2. The influence of industrial contamination on Kentucky stakeholder drinking water and process water is a clear and distinguishable. Namely, nearly all of the carcinogenic contamination of the regulatory programs: Drinking Water, Water Withdrawal, Water Resources, and Voluntary are located in close proximity to all point-source contamination sites, or regulatory programs: Hazardous and Solid Waste, Superfund, and UST.

3. There is a history and in-situ presence of carcinogenic contamination throughout the state; and thus, is not relegated to select parts of the state. Clearly, there are zones of greater contamination accumulation, but as industries are found nearly everywhere in Kentucky, so is resulting contamination.

It is worth noting several clarifications with regard to Figures 7 and 8, and the greater research as discussed in earlier sections:

1. All of the data discussed herein, and as reflected on Figures 1-8 represent groundwater readings.

2. These figures and report do not depict or consider environmental remediation efforts of these documented contamination events. This research specifically characterizes Kentucky groundwater contamination as contamination itself; and as a means to justify the continued, comprehensive groundwater quality monitoring and reporting requirements already required by industrial corporations in Kentucky.

3. Lastly, my research only extends to 100 contaminants maintained within the KGS Groundwater Data Repository. There are dozens of additional contaminants and 11 other analyte groups that were not included in this research. Thus, this research does not encapsulate the complete characterization of historic and present in-situ contamination (including carcinogenic contamination) of Kentucky groundwater.

Conclusive Remarks

The results of this research establish clear evidence of historic and ongoing industrial contamination in Kentucky groundwater. The presence of contaminants exceeding regulatory limits – in many cases by extreme orders of magnitude – underscores the public health risks posed to Kentucky stakeholders. This reality is further amplified given Kentucky's industrial corporations are in close proximity to areas of geologic groundwater sensitivity, as well as in close proximity to utilities and domestic use wells dependent upon groundwater.

Given the discussion of this greater report and rendering Figures 1 through 8, the following is clear and indisputable:

Kentucky unfortunately maintains a historic and present systematic, industry-wide contamination of its groundwater. This reality has taken place under more conservative regulatory requirements mandated by the state of Kentucky than those required by the EPA (federal government) itself. Thus, maintaining water quality monitoring and reporting requirements is essential to protecting public health. The data presented summarizes the potential consequences of weakening regulatory oversight, particularly for carcinogenic contaminants that continue to exceed MCLs at alarming rates as well as magnitudes. Sustained monitoring remains critical to identifying contamination trends, mitigating risks, and ensuring the long-term stewardship of Kentucky's groundwater resources.

The Kentucky Steward provides this research in kind to all state house representatives and senators not as a means to discuss contamination as 'contamination' itself, but rather highlight the necessity to gather, track, and interpret groundwater quality data. Without regulatory requirements for water quality monitoring and reporting, it will be impossible to accurately and effectively examine the industrial influence on Kentucky's stakeholders. One would result to back-calculating health symptoms to discern potential contamination sources, which is not timely or effective.

This research is conclusive given the objective rendering of historic and in-situ groundwater contamination. However, it is not conclusive in its reach. That is to say, there are many additional ways to interpret the data (from a county or community perspective, to many other renderings). If the house committee or other house representatives are interested in further evaluation, I welcome the opportunity.

As The Kentucky Steward's mission statement is: Promoting the Ethical Stewardship of Kentucky's Environment and Culture, I urge this house committee and other house representatives to consider this research in kind. It is objective and tells a disheartening story; one with a silver lining: there is data to interpret and evaluate. Without it, we will be lost in darkening waters.

Thank you,

R. M. True, Managing Director – The Kentucky Steward LLC. | www.thekentuckysteward.com