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Analysis of Water Pollutants Across Greater Omaha

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Abstract

Purpose. Water is a finite resource, and the water which people utilize for daily tasks may have the potential to become contaminated in sitting bodies of water. Health complications, such as birth defects and cancer, have an increased chance of occurring when these water sources become contaminated with pollutants. Preventative and treatment methods are components of the legislation put in place to prevent concentrations from reaching levels capable of causing these ailments. However, sites sometimes fail to keep them under tolerated levels. This study is intended to examine if several locations across Omaha are keeping pollutants under legal concentrations and analyze any trends in the data.

Methods. Locations (n=10) are sampled twice each, with exactly two-weeks between collections. The water is stored in pre-washed, water-tight glass containers which are then kept at room temperature from the time of collection until the time of testing. Each water sample is tested twice to confirm readings, resulting in 40 total tests. The water testing strips give back concentrations in parts per million (ppm). Testing sites ranged from downtown by the Missouri River to just east of 204th Street in western Omaha.

Results. pH, hardness, and alkalinity vary throughout the locations in tolerable ranges. Adams Park, Elmwood Park, Candlewood Reservoir, and Walnut Grove gave a non-zero pollutant concentration for at least one of the four trials when excluding hardness and alkalinity. Despite detectable levels at the four locations, none appear to exceed the threshold enforced for each pollutant. The remaining locations have no detectable pollutant concentrations for this water kit.

Conclusion. In line with reports put out by the Metropolitan Utilities District of Omaha, the results of this study indicate that Omaha's water follows regulation and has very low, if not zero,

concentrations of many of the major pollutants associated with discussions regarding water pollution.

Introduction

Initially introduced in 1948, the Federal Water Pollution Control Act is one of the most influential pieces of environmental legislation in U.S. history. This ambitious framework sought to address and regulate the volume of pollutants discharged into the nation's waterways. It would later be revised in 1972, where it would take on its more commonly known name of the Clean Water Act (*History of the Clean Water Act | US EPA*, 2023).

The Clean Water Act (CWA) is often faced with challenges pertaining to its somewhat ambiguous definition of what waters fall under regulation. Due to its significant role in environmental health and regulation enforced on commerce/production sites, it has seen many different implementations. During the time between its introduction in 1948 and the revisions of 1972, waters under regulation of the act were defined as any "navigable waters" of the United States (*Water*, 2024). Uncertainty surrounded this wording, and there were debates over formations such as wetlands, which don't necessarily house navigable waters in the ways that rivers or lakes do.

In the years following 1972, interpretation of the wording lead to legislation which would include the aforementioned formation, amongst others, under regulation of the CWA despite not exactly fitting the outline described. Between this time and the early 2000s, environmental organizations and governing bodies shifted away from using "navigable waters" and instead employed a broader "waters of the United States, including the territorial seas" (Rapanos v. United States, 2006). The passed legislation and change in defined protection under the act signaled a period where many different systems were legally safe from pollution.

It is worth noting that groundwater is not included under the CWA. The original wording, “navigable waters”, shaped the discussion to primarily revolve around surface water bodies, and a separate legal framework known as the Safe Water Drinking Act took charge of the groundwater debates (*Summary of the Safe Drinking Water Act | US EPA*, 2023). The transition in the definition of enforced waters appeared to have simplified the debate to some degree. However, another complication to the breadth of the CWA came during April of 2020 when the Supreme Court of the United States (SCOTUS) issued its ruling on *County of Maui, Hawaii v. Hawaii Wildlife Fund*. SCOTUS ruled that pollutants discharged into the groundwater of Maui violated the CWA, applying the act to groundwater issues for the first time (County of Maui, Hawaii v. Hawaii Wildlife Fund). The state and national courts are continuing to argue over how to carry out action as a result of this decision.

Under the most significant recent court case, *Sackett v. Environmental Protection Agency* (2023), SCOTUS rejected the idea of a “significant nexus” involving wetlands to be protected under the CWA (*Final Rule: The Navigable Waters Protection Rule | US EPA*, 2023). The decision appears to remove protection for wetlands with a significant nexus to navigable bodies of water, giving the most recent implementation of the CWA.

The Environmental Protection Agency (EPA) oversees the rule making process and the enforcement of most aspects regarding the CWA (*NPDES Permit Basics | US EPA*, 2023). Currently, it is not economically viable to fully restrict all forms of pollution from entering the waters of the United States, so there is a legal process which allows for point sources to pollute in moderation. Single sites with the potential of discharging pollution are known as point sources. Animal feedlots, industrial facilities, government programs, and other point sources are issued permits to pollute sustainable levels of waste. National Pollutant Discharge Elimination

System (NPDES) permits are meant to limit and monitor how much pollution is entering water systems. When a group obtains their permit from the EPA, there are strict guidelines to follow. Breaching these rules can cause denial for reapplication, permit revocation, or legal battles resulting in significant fines or even jail time depending on the severity and duration of the breach (*NPDES Permit Basics | US EPA*, 2023).

Nebraska as a whole has historically and contemporarily faced challenges with certain pollutants in its water, specifically its groundwater (Wells et al., 2018). The agricultural nature of the state means that there is a much higher presence of fertilizers to aid crop growth. Nitrate is a common fertilizer base. For example, ammonium nitrate fertilizer is made by oxidizing ammonia into nitric acid and following it up by combining the nitric acid with additional ammonia to neutralize the compound. Similar processes can also be seen with other ions like potassium and calcium.

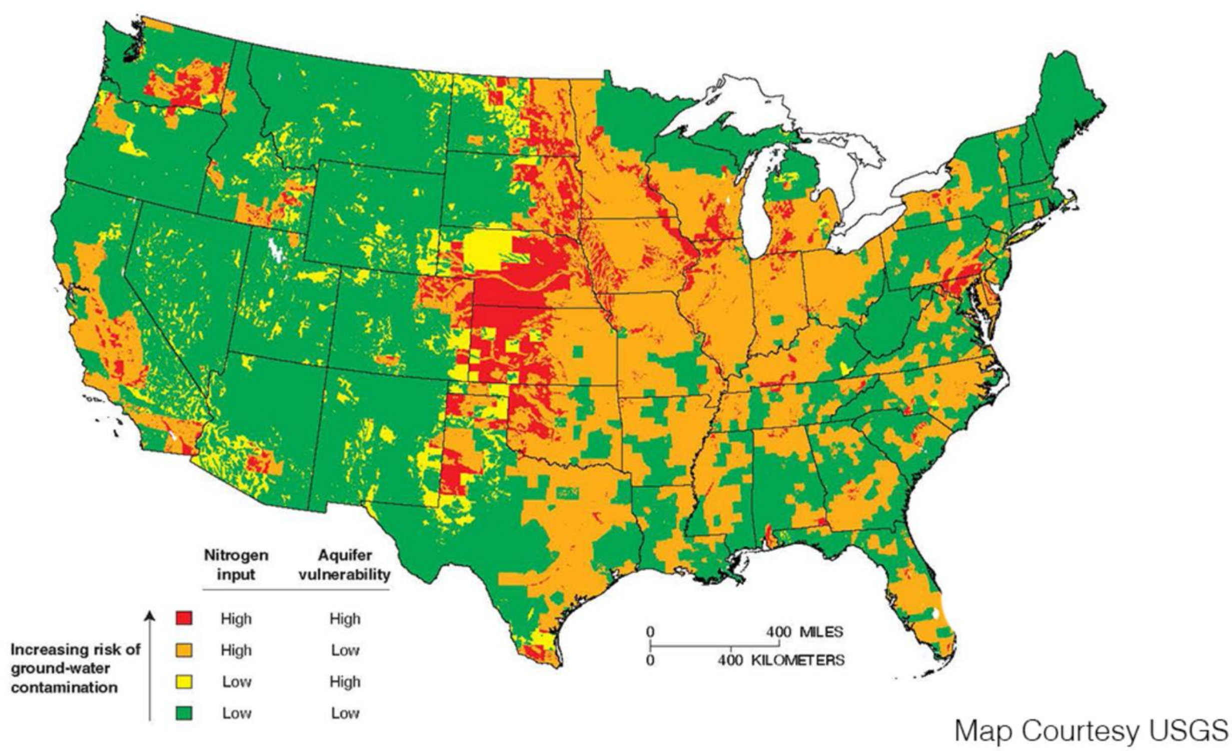


Figure 1. United States groundwater nitrogen pollution risk in 1999. *United States Geological Survey*

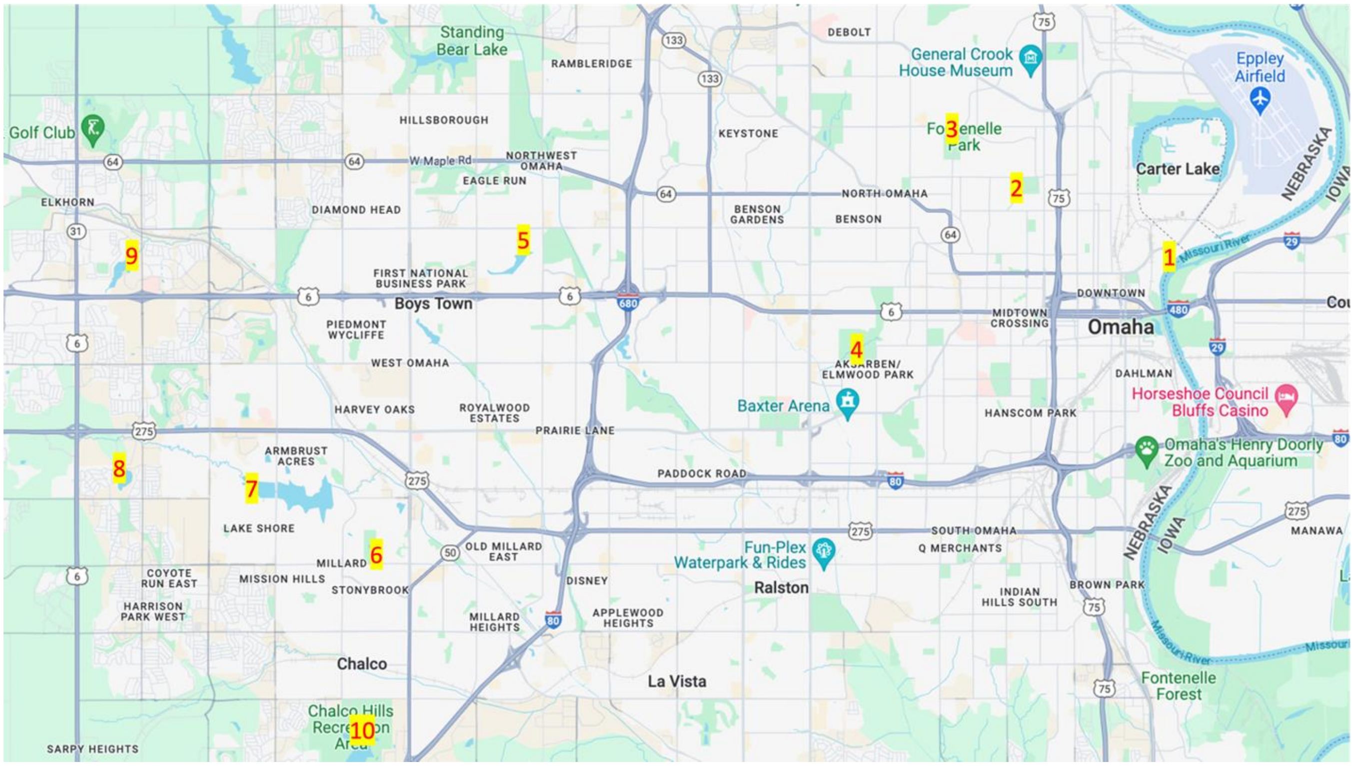
Pollutants are such a danger in groundwater due to their association with health complications, birth defects, and cancers (Knobeloch et al., 2000). Blue baby syndrome is one of the most prominent examples associated with nitrate pollution in central and western Nebraska towns that rely on well-water for consumption. Omaha is an exception to the agriculture trend in Nebraska, so it is reasonable to ask if the city's water faces as great of a risk as much of the rest of the state. Despite the lingering damage caused by historical issues such as the two lead smelting plants near downtown Omaha, Metropolitan Utilities District of Omaha reports that the city's water has been safe for many years. Their most recent report released in March of 2024 indicates nitrate concentrations between 3 and 6 ppm and lead concentrations under 0.001 ppm (see Appendix B).

Methods

Water sites were determined with spread across Omaha and ease of driving to each location in mind. Two water samples were collected from each location, with a two-week interval after the initial collection date. Due to time constraints, collection dates 1 and date 2 are not the same for every location. However, it is exactly 14 days between collection date 1 and date 2. Samples were stored in a cool and dry location between gathering and testing. Water testing took place on March 23rd. Each water sample was tested with two separate test strips to confirm ppm range findings.

Procedure for water testing: Containers were left sealed until directly before and immediately after entering the testing strip into the water. The strips themselves are also left sealed until the water is ready. Strips were entered into the water and left completely submerged for 5 seconds. After removing them from the water, they are then gentle shaken off and set onto fresh paper towels to absorb excess water. On the side of the container housing the strips, a color indicator for each of the pollutants tested gives a range in ppm. Visually matching the color indicated from the tested strip to the container is how concentration ranges are obtained (see Appendix A).

Location Number	Location Name	Latitude, Longitude	Date 1 Collection	Date 2 Collection
1	Omaha Riverfront Trail	41.271916, -95.921245	3/1/24	3/15/24
2	Adams Park	41.285074, -95.965892	3/1/24	3/15/24
3	Fontenelle Lagoon	41.297527, -95.984045	3/1/24	3/15/24
4	Elmwood Park	41.252994, -96.007050	3/1/24	3/15/24
5	Candlewood Reservoir	41.272853, -96.104936	3/2/24	3/16/24
6	Walnut Grove Park	41.209042, -96.150244	3/1/24	3/15/24
7	Zorinsky Lake	41.219936, -96.182096	3/1//24	3/15/24
8	Whitehawk Lake	41.225422, -96.220732	3/1/24	3/15/24
9	Lawrence Youngman Lake	41.270331, -96.217097	3/2/24	3/16/24
10	Wehrspann Lake	41.165893, -96.155384	3/5/24	3/19/24



Results

Results are listed in corresponding order to their location on the test strips (Appendix A).

Hydrogen Ion (pH): All sites indicate a mostly neutral hydrogen concentration, ranging from 6-7 for all trials. Pure water has a pH of exactly 7, but this does not indicate a level of contamination or pollutants.

Calcium and Magnesium (Hardness): Adams Park reported the lowest concentration of water hardness at 25ppm. Elmwood Park and Zorinksy Lake gave the highest concentrations at 250ppm. Lawrence Youngman Lake indicated a color somewhere between 100 and 250ppm. All other locations fell in between, with most reporting around 100ppm.

Hydrogen Sulfide: No hydrogen sulfide was detected at any of the locations during any of the trials.

Iron: No iron was detected at any of the locations during any of the trials.

Copper: No copper was detected at any of the locations during any of the trials.

Lead: No lead was detected at any of the locations during any of the trials.

Manganese: No manganese was detected at any of the locations during any of the trials.

Chlorine: No chlorine was detected at any of the locations during any of the trials.

Mercury: No mercury was detected at any of the locations during any of the trials.

Nitrate: Elmwood Park reported as the only location that had a non-zero concentration for nitrates. All four of the trails failed to match the color indicating zero nitrate concentration and instead matched closer to the color indicating 10 ppm.

Nitrite: No nitrites were detected at any of the locations during any of the trials.

Sulfate: Omaha Riverfront, Fontenelle Lagoon, Elmwood Park, Zorinksy Lake, Whitehawk Lake, Lawrence Youngman Lake, and Wehrspann Lake all indicated zero sulfate concentration for all four trials. Adams Park had detectable levels in each trial ranging between the 0 and 200 ppm colors. Candlewood Reservoir had one trial report between 0 and 200 ppm. Walnut Grove had two trials indicate a clear 200 ppm and two trials indicate a color between 200 and 400 ppm.

Zinc: Three of the four trials at Walnut Grove detect between 0 and 5 ppm. The remaining run indicated a clear 0 concentration.

Fluoride: No fluoride was detected at any of the locations during any of the trials.

Sodium Chloride: Sodium chloride is detected only at Walnut Grove, with three trials indicating a color between 100 and 250 ppm. The remaining trial indicates a concentration of 250 ppm.

Alkalinity: Alkaline concentrations range greatly throughout the 10 locations. These numbers indicate the water's ability to resist acidification, composed of weak acids and their conjugate base pairs, a buffer system. Walnut Grove reported the lowest alkalinity at 40 ppm. Omaha Riverfront, Elmwood Park, and Whitehawk Lake reported the highest values at 180 ppm on all trials. Lawrence Youngman Lake gave colors indicating a concentration between 120 and 180 ppm.

Omaha Riverfront Trail (1)

Substance Tested	Day 1 Trial 1	Day 1 Trial 2	Day 2 Trial 1	Day 2 Trial 2
pH	6	6	6	6
Hardness	50-100	50-100	50-100	50-100
Hydrogen Sulfide	0	0	0	0
Iron	0	0	0	0
Copper	0	0	0	0
Lead	0	0	0	0
Manganese	0	0	0	0
Chlorine	0	0	0	0
Mercury	0	0	0	0
Nitrate	0	0	0	0
Nitrite	0	0	0	0
Sulfate	0	0	0	0
Zinc	0	0	0	0
Fluoride	0	0	0	0
Sodium Chloride	0	0	0	0
Alkalinity	180	180	180	180

Adams Park (2)

Substance Tested	Day 1 Trial 1	Day 1 Trial 2	Day 2 Trial 1	Day 2 Trial 2
pH	6	6	6	6
Hardness	25	25	25	25
Hydrogen Sulfide	0	0	0	0
Iron	0	0	0	0
Copper	0	0	0	0
Lead	0	0	0	0
Manganese	0	0	0	0
Chlorine	0	0	0	0
Mercury	0	0	0	0
Nitrate	0	0	0	0
Nitrite	0	0	0	0
Sulfate	0-200	0-200	0-200	0-200
Zinc	0	0	0	0

Fluoride	0	0	0	0
Sodium Chloride	0	0	0	0
Alkalinity	80	80	80	80

Fontenelle Lagoon (3)

Substance Tested	Day 1 Trial 1	Day 1 Trial 2	Day 2 Trial 1	Day 2 Trial 2
pH	6	6.5	6	6.5
Hardness	100	100	100	50-100
Hydrogen Sulfide	0	0	0	0
Iron	0	0	0	0
Copper	0	0	0	0
Lead	0	0	0	0
Manganese	0	0	0	0
Chlorine	0	0	0	0
Mercury	0	0	0	0
Nitrate	0	0	0	0
Nitrite	0	0	0	0
Sulfate	0	0	0	0
Zinc	0	0	0	0
Fluoride	0	0	0	0
Sodium Chloride	0	0	0	0
Alkalinity	80	80	80	80

Elmwood Park (4)

Substance Tested	Day 1 Trial 1	Day 1 Trial 2	Day 2 Trial 1	Day 2 Trial 2
pH	6.5	7	7	7
Hardness	250	250	250	250
Hydrogen Sulfide	0	0	0	0
Iron	0	0	0	0
Copper	0	0	0	0
Lead	0	0	0	0
Manganese	0	0	0	0
Chlorine	0	0	0	0
Mercury	0	0	0	0
Nitrate	10	10	10	10
Nitrite	0	0	0	0
Sulfate	0	0	0	0

Zinc	0	0	0	0
Fluoride	0	0	0	0
Sodium Chloride	0	0	0	0
Alkalinity	180	180	180	180

Candlewood Reservoir (5)

Substance Tested	Day 1 Trial 1	Day 1 Trial 2	Day 2 Trial 1	Day 2 Trial 2
pH	6.5	7	6.5	6.5
Hardness	100	100	100	100
Hydrogen Sulfide	0	0	0	0
Iron	0	0	0	0
Copper	0	0	0	0
Lead	0	0	0	0
Manganese	0	0	0	0
Chlorine	0	0	0	0
Mercury	0	0	0	0
Nitrate	0	0	0	0
Nitrite	0	0	0	0
Sulfate	0-200	0	0	0
Zinc	0	0	0	0
Fluoride	0	0	0	0
Sodium Chloride	0	0	0	0
Alkalinity	120	120	120	120

Walnut Grove (6)

Substance Tested	Day 1 Trial 1	Day 1 Trial 2	Day 2 Trial 1	Day 2 Trial 2
pH	6.5	6.5	6.5	6.5
Hardness	50	50	50	50
Hydrogen Sulfide	0	0	0	0
Iron	0	0	0	0
Copper	0	0	0	0
Lead	0	0	0	0
Manganese	0	0	0	0
Chlorine	0	0	0	0
Mercury	0	0	0	0
Nitrate	0	0	0	0
Nitrite	0	0	0	0

Sulfate	200-400	200	200	200-400
Zinc	0	0-5	0-5	0-5
Fluoride	0	0	0	0
Sodium Chloride	250	100-250	100-250	100-250
Alkalinity	40	40	40	0-40

Zorinsky Lake (7)

Substance Tested	Day 1 Trial 1	Day 1 Trial 2	Day 2 Trial 1	Day 2 Trial 2
pH	7	7	7	7
Hardness	250	100-250	250	250
Hydrogen Sulfide	0	0	0	0
Iron	0	0	0	0
Copper	0	0	0	0
Lead	0	0	0	0
Manganese	0	0	0	0
Chlorine	0	0	0	0
Mercury	0	0	0	0
Nitrate	0	0	0	0
Nitrite	0	0	0	0
Sulfate	0	0	0	0
Zinc	0	0	0	0
Fluoride	0	0	0	0
Sodium Chloride	0	0	0	0
Alkalinity	120	120	120	120

Whitehawk Lake (8)

Substance Tested	Day 1 Trial 1	Day 1 Trial 2	Day 2 Trial 1	Day 2 Trial 2
pH	7	7	7	7
Hardness	100	100	100	100
Hydrogen Sulfide	0	0	0	0
Iron	0	0	0	0
Copper	0	0	0	0
Lead	0	0	0	0
Manganese	0	0	0	0
Chlorine	0	0	0	0
Mercury	0	0	0	0
Nitrate	0	0	0	0

Nitrite	0	0	0	0
Sulfate	0	0	0	0
Zinc	0	0	0	0
Fluoride	0	0	0	0
Sodium Chloride	0	0	0	0
Alkalinity	180	180	180	180

Lawrence Youngman Lake (9)

Substance Tested	Day 1 Trial 1	Day 1 Trial 2	Day 2 Trial 1	Day 2 Trial 2
pH	7	6.5	7	7
Hardness	100-250	100-250	100-250	100-250
Hydrogen Sulfide	0	0	0	0
Iron	0	0	0	0
Copper	0	0	0	0
Lead	0	0	0	0
Manganese	0	0	0	0
Chlorine	0	0	0	0
Mercury	0	0	0	0
Nitrate	0	0	0	0
Nitrite	0	0	0	0
Sulfate	0	0	0	0
Zinc	0	0	0	0
Fluoride	0	0	0	0
Sodium Chloride	0	0	0	0
Alkalinity	120-180	120-180	120-180	120-180

Wehrspann Lake (10)

Substance Tested	Day 1 Trial 1	Day 1 Trial 2	Day 2 Trial 1	Day 2 Trial 2
pH	6.5	6.5	6.5	6.5
Hardness	100	100	100	100
Hydrogen Sulfide	0	0	0	0
Iron	0	0	0	0
Copper	0	0	0	0
Lead	0	0	0	0
Manganese	0	0	0	0
Chlorine	0	0	0	0
Mercury	0	0	0	0

Nitrate	0	0	0	0
Nitrite	0	0	0	0
Sulfate	0	0	0	0
Zinc	0	0	0	0
Fluoride	0	0	0	0
Sodium Chloride	0	0	0	0
Alkalinity	120	120	120	120

The results from this study can be compared between locations and used as a representation for Omaha's water quality when observed together. Based on the number of pollutants present and their quantities, Walnut Grove reported the poorest water quality. This site was one of three to possess sulfates, the only to possess sodium chloride, the only to possess zinc, and also had an exceptionally low alkalinity.

Elmwood Park is another notable location due to its high water hardness and alkalinity. This site was also the only to report concentrations of nitrates. Using the same metrics, Omaha Riverfront, Fontenelle Lagoon, Zorinsky Lake, Whitehawk Lake, Lawrence Youngman Lake, and Wehrspann Lake all show particularly safe water. None of these testing sites indicated any of the pollutants examined.

Discussion

These findings support the reports put out from the MUD of Omaha stating that Omaha follows regulation for the tested qualities. There are minimal detectable amounts of pollutants, and there does not appear to be any trend in the locations that do contain the reported pollutants. Nitrates are found in central Omaha. Sulfates are found in east, central, and west Omaha. Zinc and sodium chloride are found in west Omaha.

Though the data lacks a trend in that aspect, it might be worth investigating pollution through the lens of socio-economic divisions. Are waters nearer to poorer neighborhoods reporting higher pollutant concentrations or higher number of pollutants? There are ideas of environmental injustice illustrating the inequality of ailments placed on certain groups compared to another group. Perhaps water quality is one of these issues.

Despite optimistic findings during this study, it is important to note its limitations. These results are a representation of only 10 of the several hundreds or thousands of potential water bodies throughout Omaha. Additional locations would help come to a more accurate illustration of the state of Omaha's water. Another factor to consider is the quality of the kit used to test the water. The kits used are simple tests gathered from Amazon and only give a general range using color to determine pollutant numbers. In the event where a pollutant is present in numbers exceeding the highest color option, there is no way to know what range to put the concentration at.

Time of year is another idea to consider. During the winter, chemicals are often used in mass to thaw ice and prevent freezing. However, in the summer, different chemicals are used to treat weeds and supplement vegetation growth. Depending on the conditions during the time of testing, there may be varying amounts of any given anion or inorganic contaminant present in water.

Conclusion

These methods cannot conclude the reasoning behind the pollutants. However, locations such as Elmwood Park may have reasonable explanations. Perhaps there is a relation between the nitrate levels and its proximity to a golf course, locations well known for manicured grass. Alternatively, it could be due to the high human traffic through the area on a regular basis.

Similar could be brought up for Walnut Grove. The area sees high human interaction on a daily basis and has several commercial businesses withing close proximity to its water.

Overall, it is reasonable to conclude that the water across Omaha is safe and follows regulation set under the CWA when analyzing all the data as a model for Omaha's water. Despite the presence of zinc, sodium chloride, nitrate, and sulfate, their concentrations fall within acceptable levels (5ppm, no set regulation, 10ppm, 500ppm respectively). Omaha seems to break the trend of Nebraska's challenges with water pollution, but it is important to maintain and further improve upon these levels because even trace amounts of chemicals can lead to significant issues.

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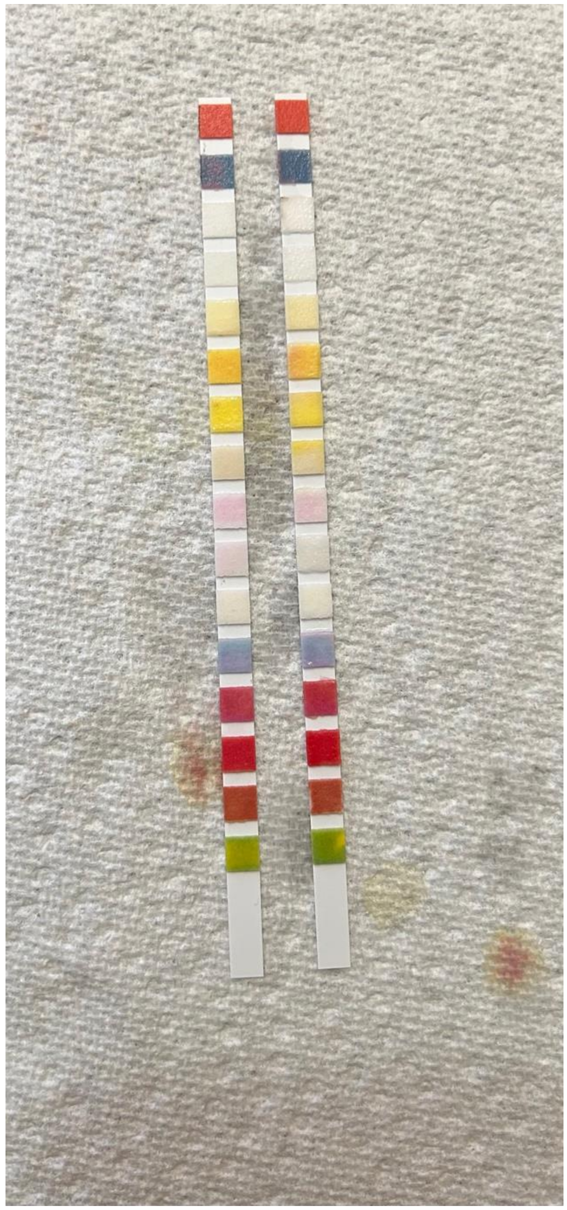
groundwater isotopes, Age-Dating, and monitoring. *Water*, *10*(8), 1047.
https://doi.org/10.3390/w10081047

Appendix.

A: Water test strip example results



B: MUD reports for Platte South and West Plants

METROPOLITAN UTILITIES DISTRICT OF OMAHA
REPORT OF WATER ANALYSIS

Platte South Plant — Monthly Averages

Source: Finished Water — Date: March 2024

Temperature	9.6	°C
Turbidity (NTU)	0.04	Units
Total Organic Carbon	2.4	mg/L
Color	4	Units
Dissolved Oxygen (O_2)	7.2	mg/L
Langelier Index	1.44	
UV-ABS @ 254 nm	5.7	ABS/m
Specific Conductance @ 25 °C	530	μmhos
Total Dissolved Solids	427	mg/L
Silica (SiO_2)	30.9	mg/L
pH	9.12	Units
Alkalinity ($CaCO_3$)		
Phenolphthalein (P)	23	mg/L
Total (M)	160	mg/L
Total Hardness ($CaCO_3$)	180	mg/L
Carbonate	160	mg/L
Non-carbonate	20	mg/L
Nitrogen (N)		
Ammonia	<0.05	mg/L
Nitrite	<0.02	mg/L
Nitrate	1.55	mg/L
Chlorine (Cl_2)		
Free Residual	-	mg/L
Total Residual	2.06	mg/L
Surfactants (MBAS)	-	mg/L
Radioactivity :		
Gross Alpha & Beta	-	pCi/L
Iodine 131	-	pCi/L
Radium 226	-	pCi/L
Strontium 90	-	pCi/L
Tritium	-	pCi/L

Cations :			
Calcium	(Ca)	52	mg/L
Magnesium	(Mg)	12	mg/L
Sodium	(Na)	45	mg/L
Potassium	(K)	7.1	mg/L
Anions :			
Bicarbonate	(HCO3)	139	mg/L
Carbonate	(CO3)	27.6	mg/L
Hydroxide	(OH)	<0.1	mg/L
Fluoride	(F)	0.65	mg/L
Chloride	(Cl)	40	mg/L
Bromide	(Br)	0.04	mg/L
Nitrite	(NO2)	<0.07	mg/L
Nitrate	(NO3)	6.87	mg/L
Phosphate	(PO4)	0.78	mg/L
Sulfate	(SO4)	65	mg/L
Trace Inorganics :			
Aluminum	(Al)	<0.01	mg/L
Copper	(Cu)	0.042	mg/L
Iron	(Fe)	0.107	mg/L
Lithium	(Li)	0.019	mg/L
Manganese	(Mn)	0.065	mg/L
Strontium	(Sr)	0.379	mg/L
Zinc	(Zn)	<0.005	mg/L
Antimony	(Sb)	< 1.0	μg/L
Arsenic	(As)	6.71	μg/L
Barium	(Ba)	78.6	μg/L
Beryllium	(Be)	< 1.0	μg/L
Cadmium	(Cd)	< 1.0	μg/L
Chromium	(Cr)	< 1.0	μg/L
Lead	(Pb)	< 1.0	μg/L
Mercury	(Hg)	-	μg/L
Nickel	(Ni)	1.43	μg/L
Selenium	(Se)	< 5.0	μg/L
Thallium	(Tl)	< 1.0	μg/L
Organics :			
Atrazine		-	μg/L
Metolachlor		-	μg/L

Bacteriological Quality : Distribution System

Meets U.S.E.P.A. drinking water standards:

T. Coli - 0.00%; E. Coli - Absent

Giardia - Cryptosporidium -

Renate Alumbaugh
Water Analyst

Form 1267 R-6F — Platte South Monthly Water Analysis 2024:Mar2024

METROPOLITAN UTILITIES DISTRICT OF OMAHA
REPORT OF WATER ANALYSIS

Platte West Plant — Monthly Averages

Source: Finished Water — Date: March 2024

Temperature	13.4	°C
Turbidity (NTU)	0.04	Units
Total Organic Carbon	1.8	mg/L
Color	2	Units
Dissolved Oxygen (O_2)	6.6	mg/L
Langelier Index	1.12	
UV-ABS @ 254 nm	4.6	ABS/m
Specific Conductance @ 25 °C	448	mmhos
Dissolved Solids (Calculated)	362	mg/L
Silica (SiO_2)	25.7	mg/L
pH	8.87	mg/L
Alkalinity ($CaCO_3$)		
Phenolphthalein (P)	11	mg/L
Total (M)	123	mg/L
Total Hardness ($CaCO_3$)	151	mg/L
Carbonate	123	mg/L
Non-carbonate	28	mg/L
Nitrogen (N)		
Ammonia	<0.05	mg/L
Nitrite	<0.02	mg/L
Nitrate	0.70	mg/L
Chlorine (Cl_2)		
Free Residual	0.04	mg/L
Total Residual	2.23	mg/L
Surfactants (MBAS)	-	mg/L
Trace Inorganics:		
Iron (total)	<0.02	mg/L
Iron (dissolved)	-	mg/L
Manganese (total)	<0.02	mg/L
Manganese (dissolved)	-	mg/L

Cations :			
Calcium	(Ca)	48	mg/L
Magnesium	(Mg)	7.8	mg/L
Sodium	(Na)	32	mg/L
Potassium	(K)	9.0	mg/L
Anions :			
Bicarbonate	(HCO_3)	123	mg/L
Carbonate	(CO_3)	13.2	mg/L
Hydroxide	(OH)	<0.1	mg/L
Fluoride	(F)	0.8	mg/L
Chloride	(Cl)	18	mg/L
Bromide	(Br)	0.02	mg/L
Nitrite	(NO_2)	<0.07	mg/L
Nitrate	(NO_3)	3.10	mg/L
Phosphate-ortho	(PO_4)	0.27	mg/L
Sulfate	(SO_4)	81	mg/L
Trace Inorganics :			
Aluminum	(Al)	<0.01	mg/L
Copper	(Cu)	<0.001	mg/L
Iron	(Fe)	<0.02	mg/L
Lithium	(Li)	0.019	mg/L
Manganese	(Mn)	<0.02	mg/L
Strontium	(Sr)	0.309	mg/L
Zinc	(Zn)	<0.005	mg/L
Antimony	(Sb)	<1.0	µg/L
Arsenic	(As)	3.32	µg/L
Barium	(Ba)	69.1	µg/L
Beryllium	(Be)	<1.0	µg/L
Cadmium	(Cd)	<1.0	µg/L
Chromium	(Cr)	<1.0	µg/L
Lead	(Pb)	<1.0	µg/L
Mercury	(Hg)	-	µg/L
Nickel	(Ni)	1.09	µg/L
Selenium	(Se)	<5.0	µg/L
Thallium	(Tl)	<1.0	µg/L
Organics :			
Atrazine		-	µg/L
Metolachlor		-	µg/L

Bacteriological Quality : Distribution System

Meets U.S.E.P.A. drinking water standards:

TC - 0.00%; *E. coli* - Absent

Giardia - Cryptosporidium -

Brent Paine
Water Analyst