



# Federal Heights

## 2022 DRINKING WATER QUALITY REPORT For Calendar Year 2021

### Public Water System Identification # CO-0101055

*Esta es información importante. Si no la pueden leer, necesitan que alguien se la traduzca*

We are pleased to present to you this year's water quality report. Our constant goal is to provide you with a safe and dependable supply of drinking water. Please contact the Public Works Department at 303-412-3539 to learn more about what you can do to help protect your drinking water resources, with any questions about this report, to learn more about our water system or for public participation opportunities that may affect water quality. We want our valued customers to be informed about your water utility, the services we provide, and the quality water we deliver to you every day.

Approximately 98% of our supplied water was treated surface water purchased from the City of Westminster. Their source water is from Standley Lake, which is located west of the city. The remaining 2% was provided by an 800-foot-deep well, located within the city limits of Federal Heights, drawing groundwater from the Arapahoe aquifer. This well was off for repairs for the majority of the 2020 calendar year. Due to our distribution system design and varying flows, residents may receive water from an individual source, or a blending of these sources.

All sources are routinely monitored for constituents in your drinking water according to Federal and State regulations. In order to ensure that tap water is safe to drink, the Colorado Department of Public Health and Environment (CDPHE) prescribes regulations limiting the amount of certain contaminants in water provided by public water systems. The FDA regulations establish limits for contaminants in bottled water that must provide the same protection for public health.

The sources of drinking water (both tap and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves naturally occurring minerals and, in some cases, radioactive material. It can also pick up substances resulting from the presence of animals or from human activity. Contaminants that may be present in source water include:

- **Microbial Contaminants** – Such as viruses and bacteria that may come from sewage treatment plants, septic systems, agricultural livestock operations and wildlife.
- **Inorganic Contaminants** – Such as salts and metals, which can be naturally occurring or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining, or farming.
- **Pesticides and Herbicides** – May come from a variety of sources, such as agriculture, urban stormwater runoff and residential uses.
- **Organic Chemical Contaminants** – Including synthetic and volatile organic chemicals, which are byproducts of industrial processes and petroleum production and also may come from gas stations, urban stormwater runoff and septic systems.
- **Radioactive Contaminants** – Can be naturally occurring or be the result of oil and gas production and mining activities.

## **Health Information About Water Quality**

All drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that the water poses a health risk. Some individuals may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as, persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV-AIDS or other immune system disorders, some elderly, and infants can be particularly at risk of infections. These people should seek advice about drinking water from their health care providers. For more information about contaminants and potential health effects, or to receive a copy of the U.S. EPA and U.S. CDC guidelines on appropriate means to lessen the risk of infection by cryptosporidium and microbiological contaminants, call the EPA Safe Drinking Water Hotline at 1-800-426-4791.

### **Lead in Drinking Water:**

If present, elevated levels of lead can cause serious health problems (especially for pregnant women or young children). It is possible that lead levels at your home may be higher than other homes in the community as a result of materials used in your homes plumbing. If you are concerned about lead in your water, you may wish to have your water tested. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flushing your tap for 30 seconds to 2 minutes before using water for drinking or cooking. Additional information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the Safe Drinking Water Hotline (1-800-426-4791) or at <http://www.epa.gov/safewater/lead>

### **Radioactive Contaminants:**

Certain minerals are radioactive and may emit forms of radiation known as photons and beta radiation. Some people who drink water containing beta particle and photon radioactivity in excess of the MCL over many years may have an increased risk of getting cancer. All detected radioactive contaminants were below the recommended "Maximum Contaminant Level" (MCL) allowed.

### **Secondary Standards**

Secondary standards are non-enforceable guidelines for contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends these standards but does not require water systems to comply. Detected contaminants must be reported.

### **Unregulated Contaminants:**

EPA has implemented the Unregulated Contaminant Monitoring Rule (UCMR) to collect data for contaminants that are suspected to be present in drinking water and do not have health-based standards set under the Safe Drinking Water Act. EPA uses the results of the UCMR monitoring to learn about the occurrence of unregulated contaminants in drinking water and to decide whether or not these contaminants will be regulated in the future. We performed monitoring and reported the analytical results of the monitoring to EPA in accordance with its Fourth Unregulated Contaminant Monitoring Rule (UCMR4).

Once EPA reviews the submitted results, the results are made available in the EPA's National Contaminant Occurrence Database (NCOD) (<http://www.epa.gov/dwucmr/national-contaminant-occurrence-database-ncod>). Consumers can review UCMR results by accessing the NCOD. Contaminants that were detected during our UCMR4 sampling and the corresponding analytical results are provided in this report.

More information about the contaminants that were included in UCMR4 monitoring can be found at: <https://drinktap.org/Water-Info/Whats-in-My-Water/Unregulated-Contaminant-Monitoring-Rule-UCMR>

Learn more about the EPA UCMR at: <http://www.epa.gov/dwucmr/learn-about-unregulated-contaminant-monitoring-rule> or contact the Safe Drinking Water Hotline at (800) 426-4791 or <http://water.epa.gov/drink/contact.cfm>

More information about contaminants and potential health effects can be obtained by calling the EPA's Safe Drinking Water Hotline at 1-800-426-4791 or by visiting <http://water.epa.gov/ground-water-and-drinking-water>

## Source Water Assessment Protection (SWAP) Information:

The Colorado Department of Public Health and Environment (CDPHE) has provided us with a “Source Water Assessment Report” for our water supply. For general information or to obtain a copy of the report please visit <https://www.colorado.gov/pacific/cdphe/swap-assessment-phase>. The report is located under “Find your public water system’s report”. Search the table using **101055**; (Federal Heights City of). You can also contact the Public Works Department at 303-412-3539 with any questions.

**Potential** sources of contamination in our source water area come from:

- **Commercial/Industrial Areas** such as: Dry cleaning businesses; Food processing plants; Gas stations and fueling areas; Commercial & Industrial transportation; Machine or maintenance & repair shops; Aboveground, Underground and Leaking storage tank sites
- **Residential/Municipal Areas** such as: High and Low Intensity residential areas; Parks & Recreational areas; Historic landfills; Transportation corridors and utility stations
- **Agricultural/Rural Areas** such as: Row Crops and Urban Recreational Grasses
- **Other Type Areas** such as: Septic Systems & Roads & other facilities

The Source Water Assessment Report provides a screening-level evaluation of potential contamination that **could** occur. It **does not** mean that the contamination **has or will** occur. We can use this information to evaluate the need to improve our current water treatment capabilities and prepare for future contamination threats. This can help us ensure that quality finished water is delivered to your homes. In addition, the source water assessment results provide a starting point for developing a source water protection plan. We have and continue to utilize related information to increase the protection of our water supply and distribution systems.

## Violations, Significant Deficiencies, and Formal Enforcement Actions

The City of Federal Heights routinely monitors for contaminants in your drinking water according to Federal and State laws. Violations and Formal Enforcement Actions, if any, are included in this report.

- **Federal Heights** – No Violations, Deficiencies, or Formal Enforcements for the calendar year 2021
- **Westminster – Non-Health Based Violation** – During the month of January 2022, the City of Westminster’s Northwest Water Treatment Facility was required to collect a total of 186 chlorine residual samples from the drinking water being pumped from the plant and into the distribution system. Though samples were collected and analyzed each day; due to online instrument failure only 171 samples were collected and analyzed. This resulted in a drinking water monitoring violation, which requires this public notification as directed by the Colorado Department of Public Health and Environment (CDPHE).

### **What does this mean? What should I do?**

This monitoring error was a violation but did not impact public health so customers do not need to seek alternative water supplies or take further actions. If a situation arises where the water is no longer safe to drink, you will be notified within 24 hours.

### **What is being done?**

This violation was resolved by January 31, 2022 through enhanced, daily, instrument verification procedures and improvements to online instrument programming sensitivity which will alert staff to a malfunction.

You may contact the Westminster’s Utilities Water Treatment staff at 6575 W. 88<sup>th</sup> Avenue, Westminster, CO, 80031 or 303-658-2500 for additional information regarding this public notice.

## Detected Contaminants Table

The table on the following page shows all detections found for all source waters in the period of January 1<sup>st</sup>, 2021 to December 31<sup>st</sup>, 2021, unless otherwise noted. The Federal Heights column includes testing dates for all detected contaminants. The “Range” column in the table will show a single value for those contaminants that were sampled only once. Only detected contaminants sampled within the last 5 years appear in this report. The State of Colorado requires monitoring for certain contaminants less than once per year because the concentrations of these contaminants are not expected to vary significantly from year to year, or the system is not considered vulnerable to this type of contamination. Some of our data, though representative, may be more than one year old. Suppliers may be required to test for different contaminants due to the source of the water. (Surface water for Westminster and groundwater for Federal Heights)

<b>DETECTED CONTAMINANTS</b>							
Contaminant	Unit	MCL & MRDL	MCLG & MRDLG	Maximum Contaminant Level Detected		Range	Violation
				Federal Heights	Westminster		
<b>INORGANIC CONTAMINANTS</b>							
Barium	ppm	2	2	<b>0.04</b> (9/4/19)	<b>0.045</b> (2021)	0.04- 0.048	No
Copper (30 samples in 2021)	ppm	90% <1.3	1.3	<b>0.28</b> (8/3/21) <b>90<sup>th</sup> Percentile = 0.1</b>	<b>0.21</b> (2021) <b>90<sup>th</sup> Percentile =0.15</b>	0 – 0.28	No
Fluoride	ppm	4	4	<b>1.1</b> (9/4/19)	<b>0.60</b> (2021)	0.60 – 1.1	No
Lead (30 samples in 2021)	ppb	90% <15	0	<b>3.2</b> (7/29/21) <b>90<sup>th</sup> Percentile = 0.8</b>	<b>23</b> (2021) <b>90<sup>th</sup> Percentile = 2.0</b>	0 – 23	No
Nickel	ppb	N/A	N/A	<b>Not Detected</b> (9/4/19)	<b>1.5</b> (2021)	0 – 1.5	No
Nitrate	ppm	10	10	<b>0.21</b> (11/18/21)	<b>0.20</b> (2020)	0.20 – 0.21	No
Selenium	ppb	50	50	<b>0.41</b> (9/4/19)	Not Detected	0.41 – 0.41	No
<b>MICROBIOLOGICAL CONTAMINANTS</b>							
Total Coliform Bacteria	ct/ml	<5% positive	0	<b>Not Detected</b> (99 samples in 2021)	Not Detected	0	No
Total Organic Carbon	ppm	TT=RAA <2	N/A	<b>Not Tested</b>	<b>1.7</b> (2021)	1.44 – 1.79	No
Turbidity	NTU	TT	N/A	<b>0.91</b> (9/7/21) <b>RAA = 0.25</b>	<b>0.087</b> (2021)	0.07 – 0.91	No
<b>PESTICIDES/SOC's</b>							
Lindane (gamma-BHC)	ppt	200	200	<b>76</b> (9/4/19) <b>Not Detected</b> 9/20/21	Not Detected	0 - 76	No
<b>RADIOACTIVE CONTAMINANTS</b>							
Alpha Emitters	pCi/L	15	0	<b>Not Detected</b> (9/4/19)	<b>0.62</b> (2021)	0 – 0.68	No
Beta Emitters	pCi/L	50	0	<b>Not Detected</b> (9/4/19)	<b>3.6</b> (2021)	0 – 4.9	No
Radium -226	pCi/L	5	0	<b>0.3</b> (9/4/19)	N/A	0.3 – 0.3	No
Radium -228	pCi/L	5	0	<b>2.2</b> (9/4/19)	N/A	2.2 – 2.2	No
Combined Radium -226/-228	pCi/L	5	0	<b>2.5</b> (9/4/19)	<b>0.29</b> (2021)	0.14 – 2.5	No
Uranium	ppb	30	0	<b>0.64</b> (9/4/19)	<b>0.61</b> (2021)	0.32 – 0.90	No
<b>ORGANIC CONTAMINANTS</b>							
Chloramines/Chlorine (0.2 mg/l min & 4.0 mg/l max)	ppm	MRDL=4 RAA < 4	MRDLG =4	<b>2.15</b> (3/8/21) <b>RAA = 1.82</b>	<b>2.70</b> (2021) <b>RAA = 1.97</b>	1.14 – 2.70	No
Total Haloacetic Acids (8 samples in 2021)	ppb	60 RAA <60	N/A	<b>18.1</b> (12/8/21) <b>RAA = 11.69</b>	<b>15.0</b> (2021) <b>RAA = 10.5</b>	5.3 – 18.1	No
Total Trihalomethanes (8 samples in 2021)	ppb	80 RAA <80	N/A	<b>50.3</b> (9/20/21) <b>RAA = 33.34</b>	<b>36.9</b> (2021) <b>RAA = 34.6</b>	19.2 – 50.3	No

## DETECTED CONTAMINANTS POSSIBLE SOURCE AND GENERAL TESTING INFORMATION

### INORGANIC CONTAMINANTS

<b>Barium</b> – Discharge of drilling wastes; Discharge from metal refineries; Erosion of natural deposits.
<b>Copper</b> – Corrosion of household plumbing systems; Erosion of natural deposits, leaching from wood preservatives – 90% of all samples taken must be within the MCL
<b>Fluoride</b> – Water additive which promotes strong teeth; Erosion of natural deposits; Discharge from fertilizer & aluminum factories
<b>Lead</b> – Corrosion of household plumbing systems; Erosion of natural deposits – 90% of all samples taken must be within the MCL
<b>Nickel</b> – Corrosion of plumbing materials
<b>Nitrate</b> – Runoff from fertilizer use; Leaching from septic tanks, sewage; Erosion of natural deposits
<b>Selenium</b> – Discharge from petroleum and metal refineries; erosion of natural deposits; discharge from mines

### MICROBIOLOGICAL CONTAMINANTS

<b>Total Coliform Bacteria</b> – Coliforms are bacteria that are naturally present in the environment and are used as an indicator that other, potentially harmful bacteria may be present. Standards are not violated if not detected in repeat samples at first detect site(s)
<b>Total Organic Carbon (TOC)</b> – Naturally present in the environment
<b>Turbidity</b> – Soil runoff – Differing source waters can require differing MCL requirements dependent on the type of treatment used.

### PESTICIDES/SOC's

<b>Lindane (gamma-BHC)</b> – Runoff/leaching from insecticide used on cattle, lumber, gardens
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### RADIOACTIVE CONTAMINANTS

<b>Alpha Emitters</b> – Erosion of natural deposits
<b>Beta Emitters</b> – Decay of natural and man-made deposits
<b>Radium -226</b> – Erosion of Natural Deposits
<b>Radium -228</b> – Erosion of Natural Deposits
<b>Combined Radium</b> – Erosion of Natural Deposits
<b>Uranium</b> - Erosion of natural deposits

### ORGANIC CONTAMINANTS – DISINFECTION BYPRODUCTS

<b>Chloramines/Chlorine</b> – Water additive used to control microbes – Measured in the distribution system – <b>TT Requirement</b> – At least 95% of samples per period (month or quarter) must be at least 0.2 ppm OR if sample size is less than 40 no more than one sample is below 0.2ppm
<b>Total Haloacetic Acids (HAA5)</b> – By-products of drinking water disinfection
<b>Total Trihalomethanes (TTHM)</b> – By-products of drinking water disinfection

## SECONDARY CONTAMINANTS AND OTHER MONITORING

Contaminant	Unit	Secondary Standard	Level Detected		Range (Lowest Value to Highest Value)
			Federal Heights	Westminster	
Alkalinity	ppm	N/A	Not Tested	48 – 61 (2021)	48 – 61
Ammonia (as N)	ppm	N/A	Not Tested	0.30 - 0.57 (2021)	0.30 – 0.57
Conductivity	umhos/cm	N/A	Not Tested	317 - 474 (2021)	317 – 474
pH	#	6.5 – 8.5	8.69 (4/7/21) RAA = 8.5	7.9 – 9.1 (2021)	7.9 – 9.1
Sodium	ppm	10,000	157 (9/4/19)	27 (2021)	27 – 157
Total Dissolved Solids	ppm	500	427 (9/4/19)	194 – 271 (2021)	194 – 427
Total Hardness	ppm	N/A	Not Tested	113 – 128 (2021)	113 - 128

### UCMR4 CONTAMINANTS MONITORING

Contaminant	Unit	Federal Heights Average	Westminster Average	Maximum Level & Date Detected		Range (Lowest Value to Highest Value)
				Federal Heights	Westminster	
Manganese	ppb	19.2	1.0	20.0 (4/24/18)	1.9 (2019)	0.43 - 20
Bromochloroacetic Acid	ppb	3.95	4.1	4.93 (9/17/18)	5.3 (2019)	3.35 – 5.3
Bromodichloroacetic Acid	ppb	2.85	2.8	3.58 (9/17/18)	3.9 (2019)	2.02 – 3.9
Chlorodibromoacetic Acid	ppb	1.18	1.6	1.5 (3/27/18)	2.2 (2019)	0.892 – 2.2
Dibromoacetic Acid	ppb	1.26	N/A	1.53 (3/27/18)	N/A	0.955 – 1.53
Dichloroacetic Acid	ppb	6.73	N/A	11.5 (9/17/18)	N/A	4.9 – 11.5
Monobromoacetic Acid	ppb	0.33	N/A	0.338 (6/26/18)	N/A	0.327 – 0.338
Monochloroacetic Acid	ppb	2.04	N/A	2.04 (9/17/18)	N/A	2.04 – 2.04
Tribromoacetic Acid	ppb	N/A	2.4	Not Detected	2.5 (2019)	2.1 – 2.5
Trichloroacetic Acid	ppb	2.84	N/A	4.22 (9/17/18)	N/A	1.78 – 4.22

### 2020 PFAS SAMPLING

Contaminant	Health Advisory Level	Federal Heights	Date Sampled	Information
PFOS	The EPA's health advisory of 70 parts per trillion (ppt), in total for PFOA & PFOS, represents an amount in drinking water likely to be without risk of health impacts over a lifetime.	0.62 ppt	3/25/20	Federal Heights sampling data can be found <a href="#">here</a> , by using the drop-down list and click on "Federal Heights City of"
PFOA		0.61 ppt		
PFBS		0.56 ppt		
PFHpA		0.43 ppt		
PFHxA		0.83 ppt		

## SECONDARY CONTAMINANTS/OTHER MONITORING – POSSIBLE SOURCES

**Alkalinity** – A measure of water’s capacity to neutralize acids and is also known as the buffering capacity.

**Ammonia (as N)** – Additive that is sometimes utilized to improve the water disinfection processes

**Conductivity** – A measure of the ability of a solution (water) to carry an electric current. Utilized in corrosion control processes

**pH** – A measure of the acidity or alkalinity of water. pH less than 7 is considered acidic and pH greater than seven is considered basic

**Sodium** – Erosion of natural deposits; a byproduct of water softeners

**Total Dissolved Solids** – Erosion of natural deposits

**Total Hardness** – Naturally dissolved Calcium and Magnesium from soil & lime – 100 ppm is equal to approximately 6 grains per gallon  
75 to 150 mg/l or ppm is considered moderately hard water

## UCMR4 CONTAMINANTS

**Manganese** – A mineral that naturally occurs in rocks and soil and may also be present due to underground pollution sources. In concentrations higher than 50 ppb the **manganese** may become noticeable by impairing color, odor, or taste.

**Bromochloroacetic Acid** – By-product of drinking water disinfection – May be included in future Total Haloacetic Acids Testing

**Bromodichloroacetic Acid** – By-product of drinking water disinfection – May be included in future Total Haloacetic Acids Testing

**Chlorodibromoacetic Acid** – By-product of drinking water disinfection – May be included in future Total Haloacetic Acids Testing

**Dibromoacetic Acid** – By-product of drinking water disinfection – Included in the Total Haloacetic Acids Testing

**Dichloroacetic Acid** – By-product of drinking water disinfection – Included in the Total Haloacetic Acids Testing

**Monobromoacetic Acid** – By-product of drinking water disinfection – Included in the Total Haloacetic Acids Testing

**Monochloroacetic Acid** – By-product of drinking water disinfection – Included in the Total Haloacetic Acids Testing

**Tribromoacetic Acid** – By-product of drinking water disinfection – May be included in future Total Haloacetic Acids Testing

**Trichloroacetic Acid** – By-product of drinking water disinfection – Included in the Total Haloacetic Acids Testing

## 2020 PFAS SAMPLING

**PFAS (Including PFOS, PFOA, PFBS, PFHpA & PFHxA)** – Per- and polyfluoroalkyl substances (PFAS) are a family of human-made chemicals that do not occur naturally in the environment. They have been used for decades as an ingredient to make products that resist heat, oil, stains, grease, and water. They are used in various products including firefighting foams, coating additives, and surface protection products for carpets and clothing. These chemicals can also be found in certain types of food packaging, dental floss, and cosmetic products. The main way people come into contact with PFAS is through food and personal care products. In fact, human contact with PFAS is widespread; nearly all people have measurable levels in their blood. [Testing Results Link](#)

## DEFINITIONS OF TERMS & ABBREVIATIONS USED IN THIS REPORT

**AL** – Action Level is the concentration of a contaminant, which if exceeded, triggers treatment and other regulatory requirements.  
For lead & copper, 90% of all samples taken must be within the MCL.

**Average** – Typical Value

**CDC** – (United States) Center for Disease Control

**Compliance Value** – Single or calculated value used to determine if regulatory contaminant level (e.g. MCL) is met. Examples of calculated values are the 90<sup>th</sup> Percentile, Running Annual Average (RAA) and Locational Running Annual Average (LRAA)

**ct/ml** – Count per milliliter

**EPA** – (United States) Environmental Protection Agency

**FDA** – The Food and Drug Administration

**Formal Enforcement Action** – Escalated action taken by the State (due to the risk to public health, or number or severity of violations) to bring a non-compliant water system back into compliance.

**Gross Alpha** – Gross alpha particle activity compliance value. It includes Radium-226, but excludes Radon 222, and Uranium

**Health-Based** – A violation of either a MCL or TT (Treatment Technique)

**MCL** – Maximum Contaminant Level – The “Maximum” allowed is the highest level of a contaminant that is allowed in drinking water.

**MCLG** – Maximum Contaminant Level Goal – The “Goal” is the level of a contaminant in drinking water, below which there is no known or expected risk to health. MCLGs allow for a margin of safety.

**MRDL** – Maximum Residual Disinfectant Level – The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.

**MRDLG** – Maximum Residual Disinfectant Level Goal – The level of a drinking water disinfectant, below which there is no known or expected risk to health. MRDLG’s do not reflect the benefits of the use of disinfectants to control microbial contaminants.

**N/A** – Not Applicable – Does not apply or not available

**Non-Health-Based** – A violation that is not a MCL or TT (Treatment Technique) violation

**NTU** – Nephelometric Turbidity Unit is a measurement of water clarity. Turbidity in excess of 5 NTU is just noticeable to the typical person

**pCi/L** – Picocuries per liter is a measurement of the radioactivity in water.

**ppb** – Parts per billion or Micrograms per liter(ug/L)-One part per billion corresponds to one minute in 2,000 years, or a single cent in \$10,000,000

**ppm** – Parts per million or Milligrams per liter (mg/l) – One part per million corresponds to one minute in 2 years, or a single cent in \$10,000

**ppt** - Parts per Trillion – One part per trillion corresponds to about thirty seconds out of every million years or a single cent in 10 billion dollars.

**RAA** – Running Annual Average – An average of monitoring results for the corresponding 12 calendar months.

**Range** – Lowest Value to Highest Value

**Sample Size** – Number or Count of values (i.e. number of water samples collected)

**TT** – A Treatment Technique is a required process intended to reduce the level of a contaminant in drinking water. Differing source waters can require differing MCL requirements and treatment processes dependent on the water source and the type of treatment used.

**umhos/cm** – Micromhos per centimeter

**Variance and Exemptions** – Department permission not to meet a MCL or Treatment Technique under certain conditions

**Violation** – Failure to meet a Colorado Primary Drinking Water Regulation

**<** – Less than; usually indicating lower than the testing ability of the laboratory equipment