Reducing Lead in Drinking Water

A Technical Guidance for Minnesota's

School and Child Care Facilities

Note: Revisions to guidelines in progress. Updated edition available in early 2018.

Environmental Health Division
Drinking Water Protection Section

Contents

Introduction

What is the Purpose of this Guidance?

This guidance is designed to assist Minnesota's schools and non-residential childcare centers (hereinafter "schools") in minimizing the consumption of lead in drinking water by students and staff. It is the hope of the Minnesota Department of Health (MDH) that school administrators will review the guidance and implement the suggested activities to reduce levels of lead in their drinking water.

MDH is charged with the implementation of the United States Environmental Protection Agency (EPA) federal drinking water requirements for public water supplies (PWS) throughout Minnesota. PWSs are required by rule to provide water that meets federal requirements. Due to the potential adverse health effects of lead, MDH has developed this guidance to aid in the prevention and treatment of lead in drinking water at schools that may not fall under the monitoring framework set up in the federal rule.

Who Should Use This Guidance?

This guidance is intended for use by all public and private schools, preschools, nursery schools, and non-residential childcare centers in Minnesota. School administrators and others in positions of governance should review this guidance and implement activities to reduce lead levels at all taps used for drinking water and in food preparation. The specific instructions provided regarding testing and corrective actions are designed for school health, safety, maintenance personnel, and any consultants working with educational agencies to reduce lead levels in school's drinking water.

Why Worry About Lead in Schools?

Lead is a toxic material known to be harmful to human health if ingested or inhaled. Blood lead levels as low as 5 micrograms per deciliter (µg/dL) are associated with adverse mental, physical and behavioral effects on children. **No** measureable blood lead level is without negative effects.

Health Risks of Lead:

Children:

Children are especially susceptible to lead exposure because their bodies absorb metals at higher rates than the average adult. Children younger than six years old are most at risk due to their rapid rate of growth. Exposure to high levels of lead can cause damage to the brain, nervous system, red blood cells, and kidneys. Exposure to low levels of lead have the potential to cause lower IQ's, hearing impairments, reduced attention span, hyperactivity, developmental delays, and poor classroom performance.

Adults:

High blood lead levels in adults have been linked to increased blood pressure, poor muscle coordination, nerve damage, and hearing and vision impairment. Pregnant women and their fetuses are especially vulnerable to lead exposure since lead can significantly harm the fetus, causing lower birth weight and slowing normal mental and physical developments.

Common Lead Exposures:

Lead in the environment:

- Lead based paint and some glazes
- Lead contaminated dust and soil
- Improper disposal of commercial products such as automotive batteries, computers, and other electronic and visual communication devices
- Industrial sources such as mining, smelting, and refining

Lead in drinking water:

- Lead enters tap water through corrosion of plumbing materials

Why is Lead a Special Concern for Schools?

Children are more vulnerable to lead:

Children typically have higher intake rates for environmental materials (such as soil, dust, food, water, air, paint) than adults. They are more likely to play in the dirt and put their hands and other objects in their mouths. In addition, children tend to absorb a higher fraction of ingested lead than adults, which can slow normal physical and mental development of growing bodies.

Plumbing materials and water use patterns at schools:

Lead levels in the water within the plumbing system of schools can vary due to the different parts of the plumbing system (i.e. lead solder, brass fixtures, water usage, and age of materials). The amount of time the water is in contact with the various components of the plumbing system may have a large effect on the concentrations found as well. The "on-again, off-again" water use patterns of most schools can result in elevated lead levels in drinking water. Water that remains stagnant in plumbing overnight, over a weekend, or during a vacation is in longer contact with plumbing materials and therefore may contain higher levels of lead.

How Does Lead Get Into Drinking Water?

Lead in drinking water is primarily from materials and components associated with the water distribution system and plumbing. Lead is typically an "endpoint" problem, with the highest concentrations of lead near the tap. Lead may be present in various parts of the plumbing system such as lead solder, brass fixtures, and lead pipes. Lead is then leeched into the water passing through the plumbing system. The most common source of lead leeching is corrosion, a reaction between the water and lead pipes or solder. Dissolved oxygen, low pH, low mineral content and other water quality characteristics can affect the extent of corrosion.

In addition to the characteristics mentioned above, the amount of contact time between water and lead sources can affect the concentration of lead found in drinking water. The longer water remains standing in the plumbing system, the greater the potential for it to absorb lead. For this reason, the lead concentration has the potential to be at its highest when water has remained unused overnight or longer. Additional factors such as water chemistry, temperature, and age of the plumbing materials can affect the amount of lead in the water.

What Can Be Done to Reduce Lead Levels in Drinking Water?

Use only cold water for drinking and food preparation:

Hot water is more likely to contain higher levels of lead than cold water. Only water from the cold water tap should be used for drinking, preparing juice, mixing baby formula or food preparation. Boiling the water will not remove lead and may actually increase the concentration of lead.

Flush taps before use:

The longer water has been standing in the plumbing system, the more lead it may contain. Running water at a tap, usually for two to three minutes, prior to using it for drinking or food preparation will often reduce lead levels in the water. Flushing works by removing the water with the most lead from the drinking water system. Taps should be flushed twice a day – in the morning and at midday.

Routine maintenance:

Clean aerators on a quarterly basis – more if debris buildup is observed.

Test the water for lead:

The only way to determine how much lead is present in the drinking water is to have the water tested. Each tap or fixture providing water for drinking or food preparation should be tested at least every five years. Corrective action should then be taken at taps with elevated lead levels. More detailed instructions on testing water for lead and information about corrective actions can be found on pages 10 - 14.

Legal Background and Guidance

For the purpose of this guidance, schools are classified in three categories:

A. Schools that receive their water from a Community Public Water Supply (CPWS).

B. Schools with their own source (well) and serve 25 or more people (children and employees combined).

C. Schools with their own source (well) and serve fewer than 25 people (children and employees combined).

Please note if you believe your school falls in Category B but have not been classified as a Nontransient Noncommunity (NTNC) PWS, please call 651/201-4700 and ask to speak with a NTNC Compliance Officer.

The table below displays the rules, regulations and guidance applicable to each school category. Each rule, regulation or guidance will be explained in detail in the following sections.

Regulations and Guidance Governing Lead in Schools Drinking Water

Category	Description	LCR[1]	LCCA[2]	3T's[3]	Reduction of Lead in Drinking Water Act
A	Water Supplied by a Community PWS	YES	YES	YES	YES
B	Water Supplied by private source & have >25 employees & children	YES	YES	YES	YES
C	Water Supplied by private source & have <25 employees & children	NO	YES	YES	YES

[1]**LCR** - Lead and Copper Rule
[2]**LCCA** - Lead Contamination Control Act
[3]**3T's** - Training, Testing and Telling

The Safe Drinking Water Act (SDWA), Lead and Copper Rule (LCR)

Category A:

If a school is served by a CPWS, the CPWS is required to monitor select sites throughout the area of coverage on a pre-set schedule. No more than ten percent (10%) of the samples monitored from a PWSs drinking water taps may exceed the lead action level of 15 parts per billion (ppb). If the action level is exceeded, the CPWS is legally required to take corrective action. Due to the nature of site selection per the LCR and the number of samples required, schools are unlikely to be selected as a site to monitor and therefore consideration should be given to implementing their own monitoring schedule based on this guidance.

Category B:

If a school is served by their own water source and serve 25 or more of the same people for a minimum of 6 months, they qualify as a NTNC PWS. As a NTNC PWS, a set number of sites are selected to be monitored on a pre-set schedule. No more than ten percent (10%) of the samples monitored from a school's drinking water taps may exceed the lead action level of 15 ppb. If the action level is exceeded, the school is legally required to take corrective action.

Category C:

If a school is served by their own water source and serve less than 25 people, the requirements of the LCR of the SDWA do not apply.

More information on the LCR can be found at:
http://water.epa.gov/lawsregs/rulesregs/sdwa/lcr/index.cfm.

The Lead Contamination Control Act (LCCA)

This law applies to all categories of schools. The intent of the LCCA is to identify and reduce lead in drinking water at schools and relies on voluntary compliance by individual schools and school districts.

More information on the LCCA can be found at:
http://water.epa.gov/infrastructure/drinkingwater/schools/regulations.cfm

3T's

EPA developed the 3T's (Training, Testing, and Telling) to assist all categories of schools in reducing the lead concentrations in their drinking water. MDH recommends that all schools adopt and implement a lead reduction program focusing on the following six areas:

- Determine current understanding of water quality and obtaining financial assistance
- Identification of potential problem areas
- Develop a monitoring plan
- Collection and submittal of water samples
- Implementation of corrective action plans if lead concentrations exceed 20 µg/L
- Communication and public outreach

A copy of the guidance can be found at:
http://www.epa.gov/ogwdw/schools/pdfs/lead/toolkit_leadschools_guide_3ts_leadschools.pdf

The Safe Drinking Water Act (SDWA), Reduction of Lead in Drinking Water Act

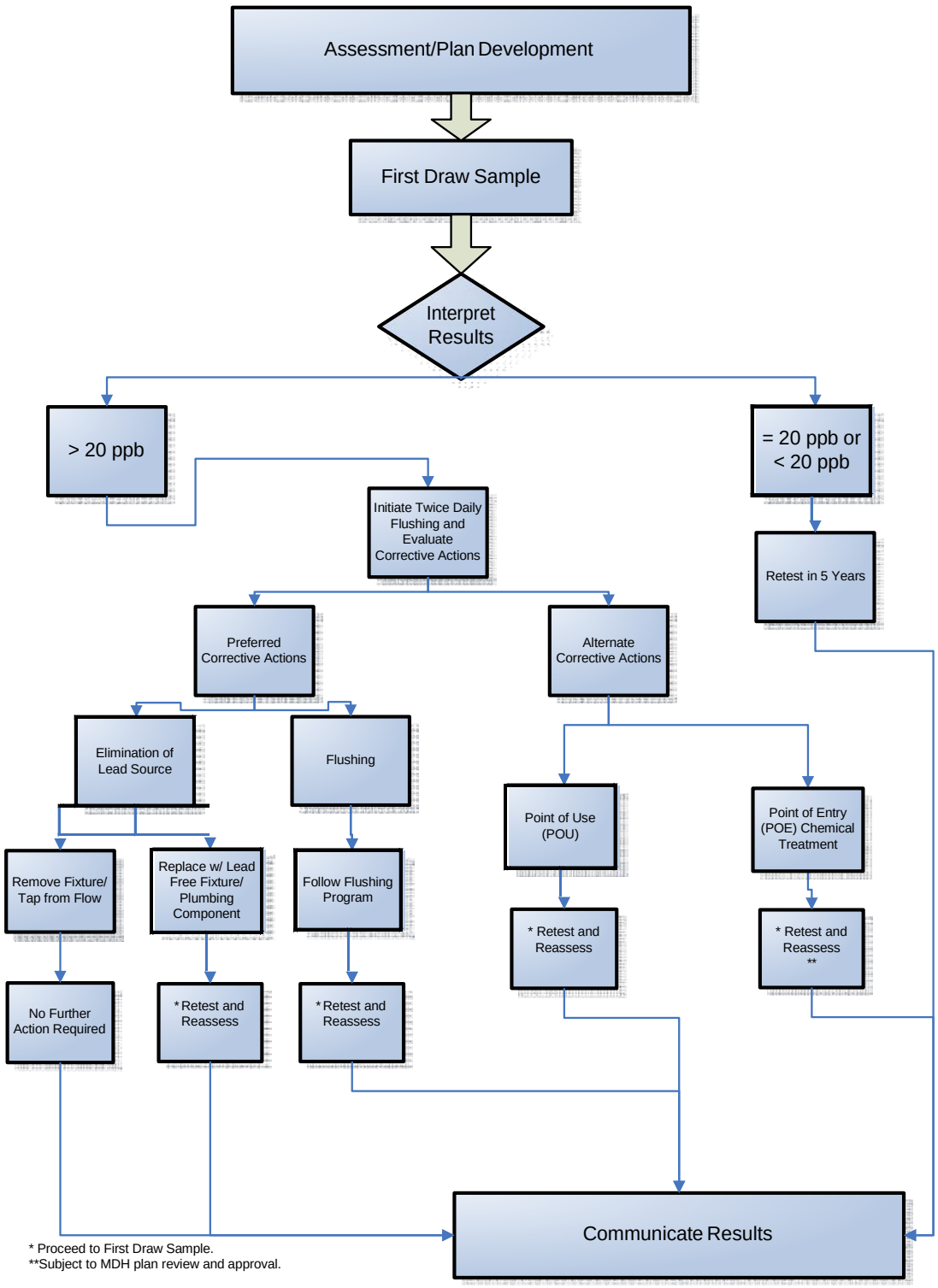
This law applies to all categories of schools. Lead found in drinking water is typically not from natural water and soil sources. The most common cause of lead concentration in water is due to the corrosion of pipes and plumbing fixtures. In an effort to reduce this contamination, EPA in 1986, amended the SDWA to mandate that all pipes, solders, fittings, and fixtures be lead free. Lead free was defined as solder and flux containing not more than 0.20% and lead, pipes, and pipefittings containing not more than 8.0% lead. All plumbing fittings and fixtures must meet the NSF/ANSI Standard 61.

In 2011, the enactment of the Reduction of Lead in Drinking Water Act was signed into law. The act reduces the allowable lead content in plumbing materials by modifying the SDWA definition of lead free. As of January 4, 2014, lead free is now defined as weighted average of not more than 0.25% in wetted surface material for pipe, pipe and plumbing fittings and fixtures. It retains the 0.20% lead limit for solders and flux as implemented in the 1986 amendments.

More information on the Reduction of Lead in Drinking Water Act can be found at:
http://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100GRDZ.txt.

How to Develop a Lead Monitoring and Reduction Plan

This schematic describes the six steps from Plan Development to Communicate Results. Details follow.



Step 1- Assessment and Sampling Plan Development:

When developing a program to test for lead in drinking water it is important to consider the following steps:

- Take inventory of all drinking water taps used for consumption (i.e. drinking water and food preparation)

  Taps used for human consumption should only be cold water taps; hot water taps should never be used to obtain water for drinking water or food preparation. Check all drinking fountains to ensure EPA has not identified them as having a lead lined tank under the LCCA. This list can be found at: http://tinyurl.com/kr8kppf

  If a drinking fountain within the school is found on this list, it should be removed from use immediately.

- Prioritize drinking water taps

  High priority: taps used by children under the age of six years of age or pregnant women (i.e. drinking fountains, nurse's office sinks, classrooms used for early childhood education and kitchen sinks).

  Medium priority: other taps regularly used to obtain water for drinking or cooking (i.e. home economic sinks, classroom sinks, and teacher's lounges).

  Low priority: all other taps that could be used to obtain water for drinking but are not typically used for that purpose (i.e. bathroom faucets and utility sinks).

- Determine a schedule for sampling

  All taps should be tested at a minimum of once every five years.

  If the budget does not allow all taps to be tested in the first year it is suggested that all high priority taps be tested the first year, the medium priority the second and the low priority the third. The fourth year should be used as a "make up" year if needed.

- Testing

  Determine which certified laboratory will analyze the drinking water samples and set up a contract with them. Certified laboratories can be found at: https://apps.health.state.mn.us/eldo/public/accreditedlabs/labsearch.seam.
  Field analyzers can be used in doing investigative work.

Step 2- Conduct First Draw Tap Monitoring:

Water from all taps used for drinking or food preparation should be tested for lead using first draw samples. First draw means that the samples are to be collected before the fixture is used or flushed during the day. Use only cold water for collecting lead samples.

Sample Site Preparation and Sample Collection

- The night before sampling, run each sample tap for two to three minutes.
- Do not use sampling taps for a minimum of six to eight hours. MDH recommends not exceeding 18 hours.
- Collect first draw sample. (250 mL)

  Option 1: Mail/deliver sample to laboratory certified to analyze lead in drinking water. Certified laboratories can be found at https://apps.health.state.mn.us/eldo/public/accreditedlabs/labsearch.seam. The laboratory will provide you with sample bottles and instructions for submitting samples.

  Option 2: Conduct an analysis using a field analyzer with a lower limit of detection (LOD) for lead equal to or below 5 ppb using instruments such as the Hach Pocket Calorimeter II, Lead Test or Hach SA 1100 Scanning Analyzer for Lead. Refer to manufacturer guidelines for correct sampling protocol and safety precautions in collection and disposal of samples.

Step 3- Interpret Sample Results:

- Verify that the results are expressed in ppb.
- If lead is at or below 20 ppb, the tap may be used for drinking water or food preparation and should be retested in five years. Proceed to Step 6.
- If lead exceeds 20 ppb, initiate twice daily flushing. Flush the tap in the morning before school begins and at midday. Evaluate and implement a corrective action plan. Proceed to Step 4.

Step 4- Corrective Actions:

In addition to twice daily flushing in Step 3, a corrective action needs to be implemented when results exceed 20 ppb. Although flushing often works to reduce lead in drinking water, it requires staff time, diligence, and commitment to ensure effectiveness and may not be the most cost effective long term corrective action.

Preferred:

Elimination of Lead Sources

Engineering plans and specifications for the plumbing system are useful for identifying sources of lead and helpful in determining if sources of lead can be removed from service or replaced with lead free fixtures.

- Remove tap/fixture from service. If the tap is seldom used, it may be disconnected or removed from the water supply line, but first verify the tap is not required for code compliance.

- Replace with lead free fixture/plumbing component.

- If the existing tap is suspected to be the source of contamination, replace with a lead free tap.

- Replace other sources of lead, including lead pipe, lead solder joints, and brass plumbing components with lead free materials.

To minimize the introduction of lead into drinking water systems, go to EPA website: http://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100GRDZ.txt to identify lead free certification marks for drinking water systems and plumbing materials.

Implement a Flushing Program

Flushing the drinking water taps (letting them run for a set amount of time) often works to reduce lead concentrations in drinking water. A flushing program works to reduce lead concentrations by clearing the taps of water that have been in contact with plumbing components that may be high in lead. There are two primary types of flushing programs: Individual Tap Flushing and Main Pipe Flushing.

An **Individual Tap Flushing Program** may be implemented if lead concentrations are found to be high at certain taps.

- Flush individual taps that have been tested and found to have high lead levels. This procedure is to be followed each day the school is in session.

During periods of normal use:

- Run each tap in the morning before children arrive for 2 to 3 minutes.

- Run each tap midday for two to three minutes.

After long weekends or breaks:

- Run each tap for ten to fifteen minutes before children return to school.

Return to normal use protocol.

A **Main Pipe Flushing Program** may be implemented if lead concentrations are found to be high throughout the entire system or confined to a certain area of the school. This procedure is to be followed each day the school is in session.

- Begin by flushing the tap furthest away from the water source for at least ten minutes.

- Next flush the tap the second furthest away and continue in this manner until all taps have been flushed.

- First draw and flushed samples should be collected and analyzed for lead every six months.

Review the results upon receipt.

- If the flushed sample results are not below the lead action level, other corrective action options should be explored.

- If the flushed sample results are below the lead action level, the flushing program can continue.

- If first draw samples drop below the lead action level for two consecutive six month rounds of testing, the flushing program can be discontinued. Monitoring should continue to one more six month round to ensure the lead levels do not increase again.

Alternate:

Point-of-Use (POU) Treatment Device - A POU water treatment device may be installed at taps which exceed 20 ppb of lead. It is strongly encouraged that the POU device is approved to meet NSF Standard 53, NSF Standard 58, or an equivalent standard. It is to be installed, operated, and maintained in accordance with the manufacturer's recommendations.

Point of Entry (POE) Chemical Treatment - Adjusting the water chemistry may reduce the amount of lead absorbed by the water. This may be done by adding a chemical to the water as it enters the building. Typical methods of chemical treatment include addition of a phosphate based or silica based corrosion inhibitor or an adjustment to the water's pH or hardness. All chemical treatment systems may be subject to MDH plan review and approval prior to installation. It must be noted the installation of POE treatment may subject the school to other requirements of the SDWA including additional water quality monitoring.

Step 5- Reassessment:

All taps affected by a corrective action (Step 4) are retested after the corrective action has been implemented. A first draw sample is to be taken, using the procedure outlined in Step 2.

Interpreting Post Corrective Action Results

- If the analysis shows lead at or below 20 ppb, no further action is required, as long as the corrective action remains in place. The next sample should be collected within five years.

- If the analysis shows lead remains above 20 ppb, continue twice daily flushing. A midday sample as specified in Step 3 is to be collected to determine if flushing is effective or a new corrective action can be implemented followed by retesting as specified in Step 2.

Step 6- Communicate Results:

In addition to testing for lead, a lead control program should include a communication plan. The purpose of a communication plan is to provide a process for school employees, students and parents to address questions, report results and provide ongoing, up-to-date information regarding sampling efforts.

EPA recommends that school management:

- Assign a designated person to be the contact.

- Notify affected individuals about the purpose of the testing as well as the results. School employees, students and parents should be informed and involved in the overall process. Examples are: meetings, open houses, public notices.

- Identify and share specific activities they are pursuing to correct any lead problems. Local health officials can assist in understanding potential health risks, technical assistance and communication strategies.

More information and sample public notice materials can be found at:
http://www.epa.gov/ogwdw/schools/pdfs/lead/toolkit_leadschools_guide_3ts_leadschools.pdf

Glossary

1. Action Level - Lead exposure level at which corrective action is required

2. Aerator - An aerator is found at the tip of the faucet. Aerators are screwed onto the faucet head, creating a non-splashing stream and delivering a mixture of water and air

3. Corrosion - A dissolving and wearing away of metal caused by a chemical reaction between water and plumbing materials in contact with the water

4. Faucet/Tap - Point of access for people to obtain water for drinking or food preparation. A faucet/tap can be a fixture, faucet, drinking fountain or water cooler. Drinking water taps typically do not include bathroom taps, hose bibbs, or custodial closet sinks

5. Field Analyzer - Instrument suitable for water quality field work or analysis

6. First Draw Sample - The first water drawn from a faucet/tap after the water has sat undisturbed in the plumbing system for at least 6 hours

7. Fittings - Plumbing components used to join sections of pipe or to join pipe to fixtures

8. Fixture - Exchangeable device connected for the distribution and use of water in a building. Examples: fountain, sinks, shower, tub, toilet, hydrant

9. Flush(ing) - Running the water at a faucet/tap or combination of faucets/taps to clear standing water from the plumbing system

10. Flush Sample - A water sample that has been collected following the flushing of a drinking water tap

11. Flux - A substance applied during soldering to facilitate the flow of solder. Flux used prior to 1986 contains lead and can itself be a source of lead contamination in water

12. Lead Free - Weighted average of not more than 0.25% in wetted surface material for pipe, pipe and plumbing fittings and fixtures

13. Limit of Detection (LOD) – The lowest quantity of a substance that can be distinguished from the absence of the substance due to the instruments analytical process

14. pH - A measure of acidity and alkalinity

15. Parts per Billion (ppb) - A standard unit of measurement commonly used to describe the concentration of lead in drinking water. Also expressed as microgram/liter (µg/L)

16. Point of Entry (POE) - A water treatment device installed to treat all water entering a single school, building, facility or home. Example: water softener

17. Point of Use (POU) - A water treatment device intended to treat water for direct consumption, typically at a single tap or a limited number of taps. Example: faucet mount cartridge filter

18. Public Water System (PWS) - A system that serves water to the public. System has at least 15 service connections or regularly serves an average of 25 individuals daily at least 60 days out of the year.

    a. Community Public Water System (CPWS) - A PWS which serves at least 15 service connections used by year round residents or regularly serves at least 25 year round residents. Examples: municipalities, manufactured mobile home parks

    b. Nontransient Noncommunity (NTNC) - A PWS that is not a CPWS and that regularly serves at least 25 of the same persons over 6 months per year. Examples: schools, childcare centers, factory

19. Schools - Minnesota's schools and non-residential childcare centers

20. Service Connection - The pipe that carries tap water from the public water main to a building

21. Solder - A metallic compound used to seal the joints between pipes. Until 1988, solder containing up to 50% lead was legally used in potable water plumbing. Lead free solders, which can contain up to 0.2% lead, often contain one or more of the following metals: antimony, tin, copper or silver

22. United States Environmental Protection Agency (EPA) - Federal agency with a mission to protect human health and the environment

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651-201-4700

Rev. 04/14
Printed on recycled paper