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Drinking Water Treatment

SAFE DRINKING WATER ACT • CELEBRATING 25 YEARS • PROTECT OUR HEALTH FROM SOURCE TO TAP

Public Water Systems

Public Water Systems (PWSs) come in all shapes and sizes, and no two are exactly the same. They may be publicly or privately owned and maintained. While their design may vary, they all share the same goal – providing safe, reliable drinking water to the communities they serve. To do this, most water systems must treat their water. The types of treatment provided by a specific PWS vary depending on the size of the system, whether they use ground water or surface water, and the quality of the source water.

Tapping a Source of Water

Large-scale water supply systems tend to rely on surface water sources, while smaller systems tend to rely on ground water. Around 35 percent of the population served by community water systems (CWSs) drink water that originates as ground water. Ground water is usually pumped from wells ranging from shallow to deep (50 to 1,000 feet). The remaining 65 percent of the population served by CWSs receive water taken primarily from surface water sources like rivers, lakes, and reservoirs.

All **public water systems** must have at least 15 service connections or serve at least 25 people per day for 60 days of the year.

Drinking water standards apply to water systems differently based on their type and size:

- **Community Water System** (there are approximately 55,000) – A public water system that serves the same people year-round. Most residences including *homes, apartments, and condominiums in cities, small towns, and mobile home parks* are served by Community Water Systems.
- **Non-Community Water System** – A public water system that serves the public but does not serve the same people year-round. There are two types of non-community systems:
  - **Non-Transient Non-Community Water System** (there are approximately 20,000) – A non-community water system that serves the same people more than six months per year, but not year-round, for example, a *school with its own water supply* is considered a non-transient system.
  - **Transient non-community water system** (there are approximately 95,000) – A non-community water system that serves the public but not the same individuals for more than six months, for example, *a rest area or campground* may be considered a transient water system.

Treating Raw Water

The amount and type of treatment applied by a PWS varies with the source type and quality. Many ground water systems can satisfy all Federal requirements without applying any treatment, while others need to add chlorine or additional treatment. USEPA is developing a ground water rule that will specify the appropriate use of disinfection and will address other components of ground water systems to assure public health protection. Because surface water systems are exposed to direct wet weather runoff and to the atmosphere and are therefore more easily contaminated, federal and state regulations require that these systems treat their water. Applicable Federal Regulations include the Surface Water Treatment Rule, the Interim Enhanced Surface Water Treatment Rule, and the Stage I Disinfectants/Disinfection Byproducts Rule.

Water suppliers use a variety of treatment processes to remove contaminants from drinking water. These individual processes may be arranged in a "treatment train" (a series of processes applied in sequence). The most commonly used processes include filtration, flocculation and sedimentation, and disinfection for surface water. Some treatment trains also include ion exchange and adsorption. Water utilities select a combination of treatment processes most appropriate to treat the contaminants found in the raw water used by the system.

Types of Treatment

Flocculation/Sedimentation

Flocculation refers to water treatment processes that combine or "coagulate" small particles into larger particles, which settle out of the water as

sediment. Alum and iron salts or synthetic organic polymers (used alone or in combination with metal salts) are generally used to promote coagulation. Settling or sedimentation occurs naturally as flocculated particles settle out of the water.

Filtration
Many water treatment facilities use filtration to remove all particles from the water. Those particles include clays and silts, natural organic matter, precipitates from other treatment processes in the facility, iron and manganese, and microorganisms. Filtration clarifies water and enhances the effectiveness of disinfection.

Ion Exchange
Ion exchange processes are used to remove inorganic contaminants if they cannot be removed adequately by filtration or sedimentation. Ion exchange can be used to treat hard water. It can also be used to remove arsenic, chromium, excess fluoride, nitrates, radium, and uranium.

Adsorption
Organic contaminants, unwanted coloring, and taste–and-odor-causing compounds can stick to the surface of granular or powder activated carbon and are thus removed from the drinking water.

Disinfection (chlorination/ozonation)
Water is often disinfected before it enters the distribution system to ensure that potentially dangerous microbes are killed. Chlorine, chloramines, or chlorine dioxide are most often used because they are very effective disinfectants, not only at the treatment plant but also in the pipes that distribute water to our homes and businesses. Ozone is a powerful disinfectant, and ultraviolet radiation is an effective disinfectant and treatment for relatively clean source waters, but neither of these are effective in controlling biological contaminants in the distribution pipes.

Monitoring Water Quality

Water systems monitor for a wide variety of contaminants to verify that the water they provide to the public meets all federal and state standards. Currently, the nation's community water systems (CWSs) and non-transient non-community water systems (NTNCWSs) must monitor for more than 83 contaminants. The major classes of contaminants include volatile organic compounds (VOCs), synthetic organic compounds (SOCs), inorganic compounds (IOCs), radionuclides, and microbial organisms (including bacteria). Testing for these contaminants takes place on varying schedules and at different locations throughout the water system.

Transient non-community water systems may monitor less frequently and for fewer contaminants than CWSs. Because these types of systems serve an ever-changing population, it is most important for them to monitor for contaminants such as microbiologicals and nitrate that can cause an immediate, acute public health effect.

Water systems also monitor for a number of contaminants that are currently not regulated. This monitoring data provides the basis for identifying contaminants to be regulated in the future.

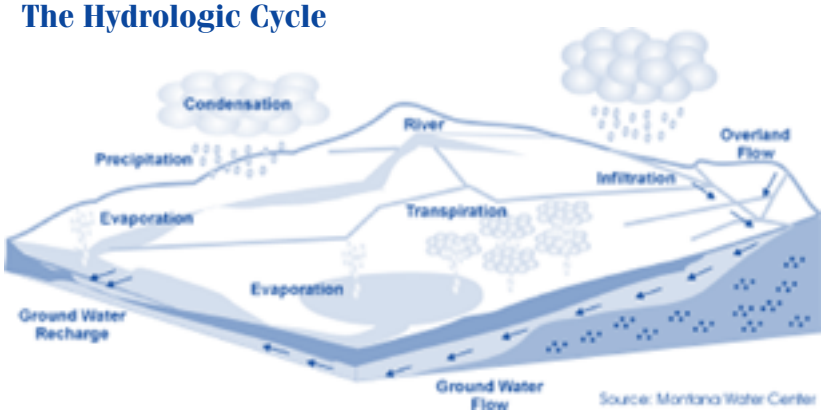
Distribution to Customers

An underground network of pipes typically delivers drinking water to the homes and businesses served by the water system. Small systems serving just a handful of households may be relatively simple. Large metropolitan water systems can be extremely complex – sometimes with thousands of miles of piping serving millions of people. Although water may be safe when leaving the water treatment plant it is important to ensure that this water does not become contaminated in the distribution system because of such things as water main breaks, pressure problems, or growth of microorganisms. Much of the existing drinking water infrastructure was built many years ago. The USEPA Infrastructure Needs Survey, released in 1997, estimated that drinking water systems will need to invest $138.4 billion over a 20 year period to ensure the continued source development, storage, treatment, and distribution of safe drinking water. Many agree this is a very conservative low estimate.

The Water Cycle

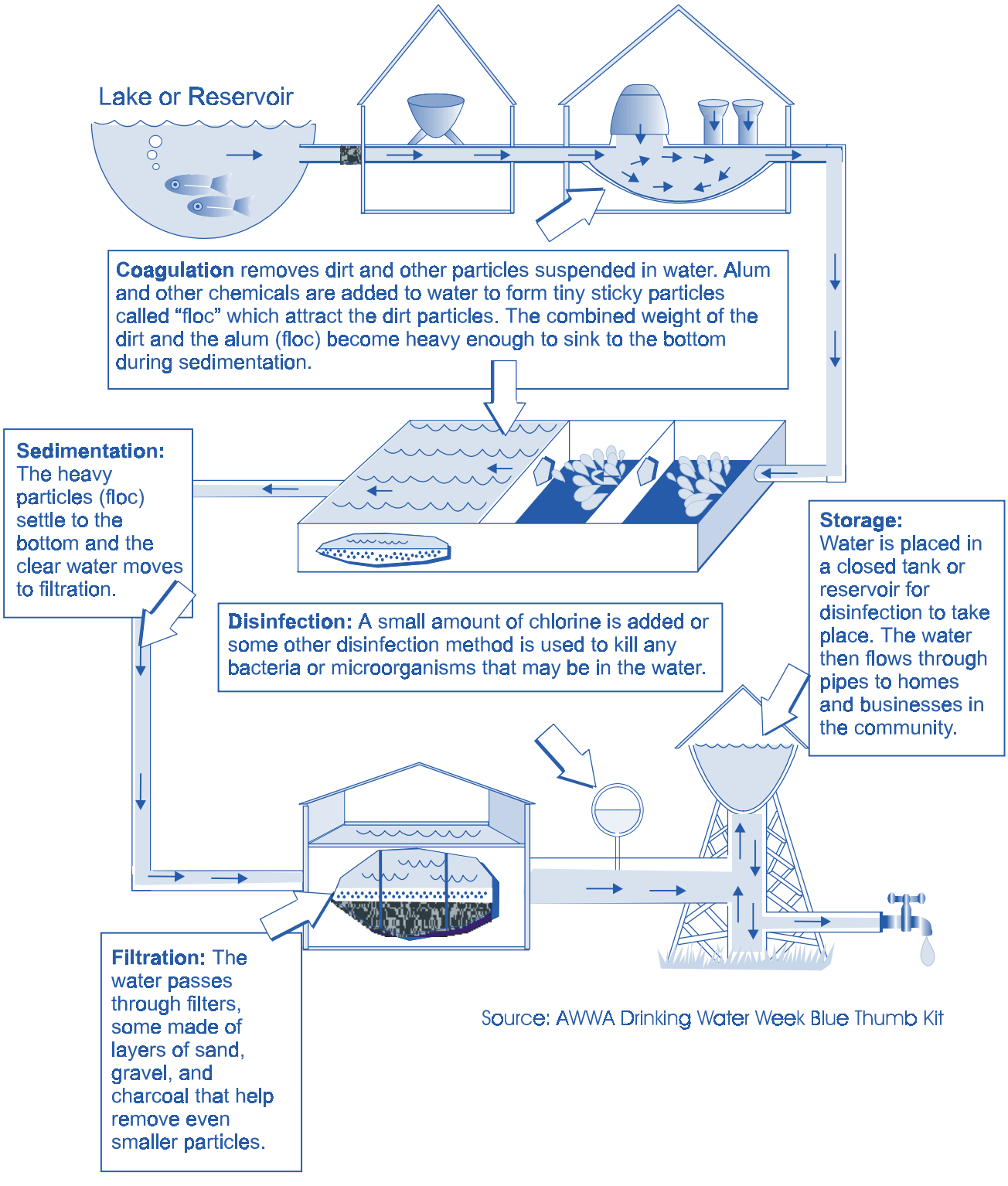
Drinking water can come from both surface water and ground water. The water cycle begins with rainwater and snow melt that gathers in lakes and rivers which interact with ground water.

The Hydrologic Cycle



Water Treatment Plant

Follow a drop of water from the source through the treatment process. Water may be treated differently in different communities depending on the quality of the water which enters the plant. Groundwater is located underground and typically requires less treatment than water from lakes, rivers, and streams.



Source: AWWA Drinking Water Week Blue Thumb Kit