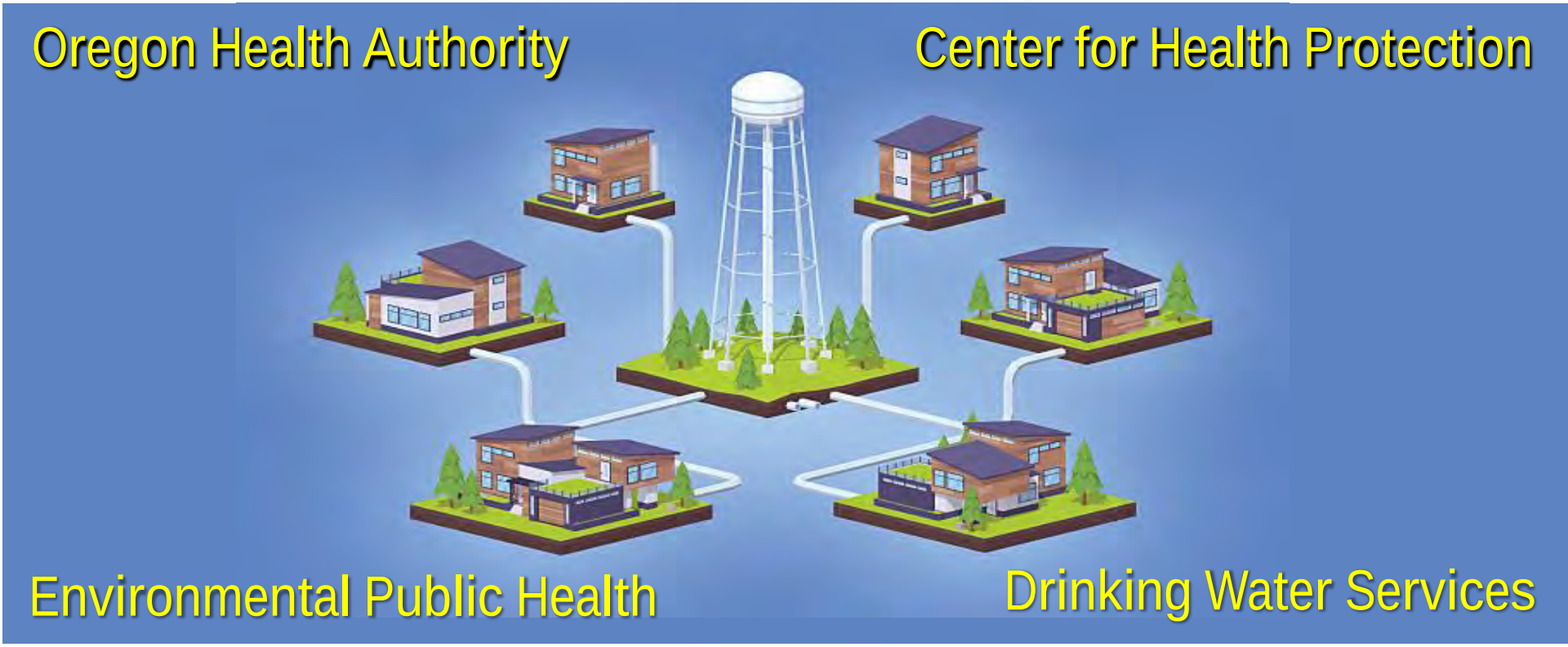
Basics For Small Water Systems In Oregon



Oregon Health Authority

CENTER FOR HEALTH PROTECTION, ENVIRONMENTAL PUBLIC HEALTH

Drinking Water Services

Oregon Association of Water Utilities

- Established 1977
- Governed by Board of Directors
- 800+ members
- 8 field staff
- Provide Assistance
  - Technical
  - Managerial
  - Financial

Basics for Small Water Systems in Oregon

Basics Course (Units 1, 2, & 3) is REQUIRED for Certification

Advanced Course (Unit 4) is Under Construction

Oregon Health Authority

UNIT 1 – ESSENTIALS

1.1 – Drinking Water Services Authorities, Standards, and Functions

1.2 – Classification of Public Water Systems

1.3 – Basic Responsibilities of Water Suppliers

1.4 – Who to Call

1.5 – Water System Surveys and Significant Deficiencies

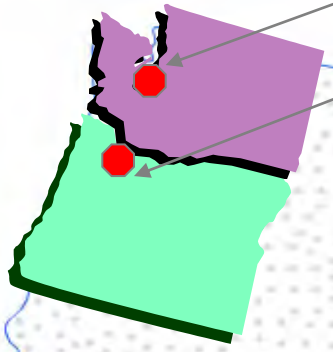
1.6 – Cross-Connection and Backflow Prevention

1.1 Drinking Water Services Authorities, Standards, and Functions

Topics to Review

- Authorities, organization, and functions
- Oregon drinking water standards
  - Background
  - Regulated contaminants and standards

Safe Drinking Water Act Legislation



Seattle – EPA Region 10 Main Office

Portland – Oregon Drinking Water Services Main Office

Washington DC – US EPA Headquarters

Became law in 1974

Amendments made in 1986 and 1996

Applies to more than 170,000 public water systems!

Drinking water quality is regulated by the Environmental Protection Agency (EPA)

State Drinking Water Authorities and Rules

- Oregon Revised Statute (ORS) 448 – Water Systems
- Oregon Administrative Rule (OAR) 333-061 – Public Water Systems
- Formal agreement with US EPA

Drinking Water Services Roles

- **US EPA**
  - **SETS** standards to protect health
- **Local Public Health Regulators/County/ODA**
  - **ENSURE** health standards are met
- **Public Water Systems**
  - **PROVIDE** safe water

State / County / Dept. of Agriculture Drinking Water Services Functions

- Technical assistance and training
- Ensure and enforce compliance
- Water system survey inspections
- Investigation and response on contamination incidents
- Emergency response planning
- Regulate Oregon Very Small public systems

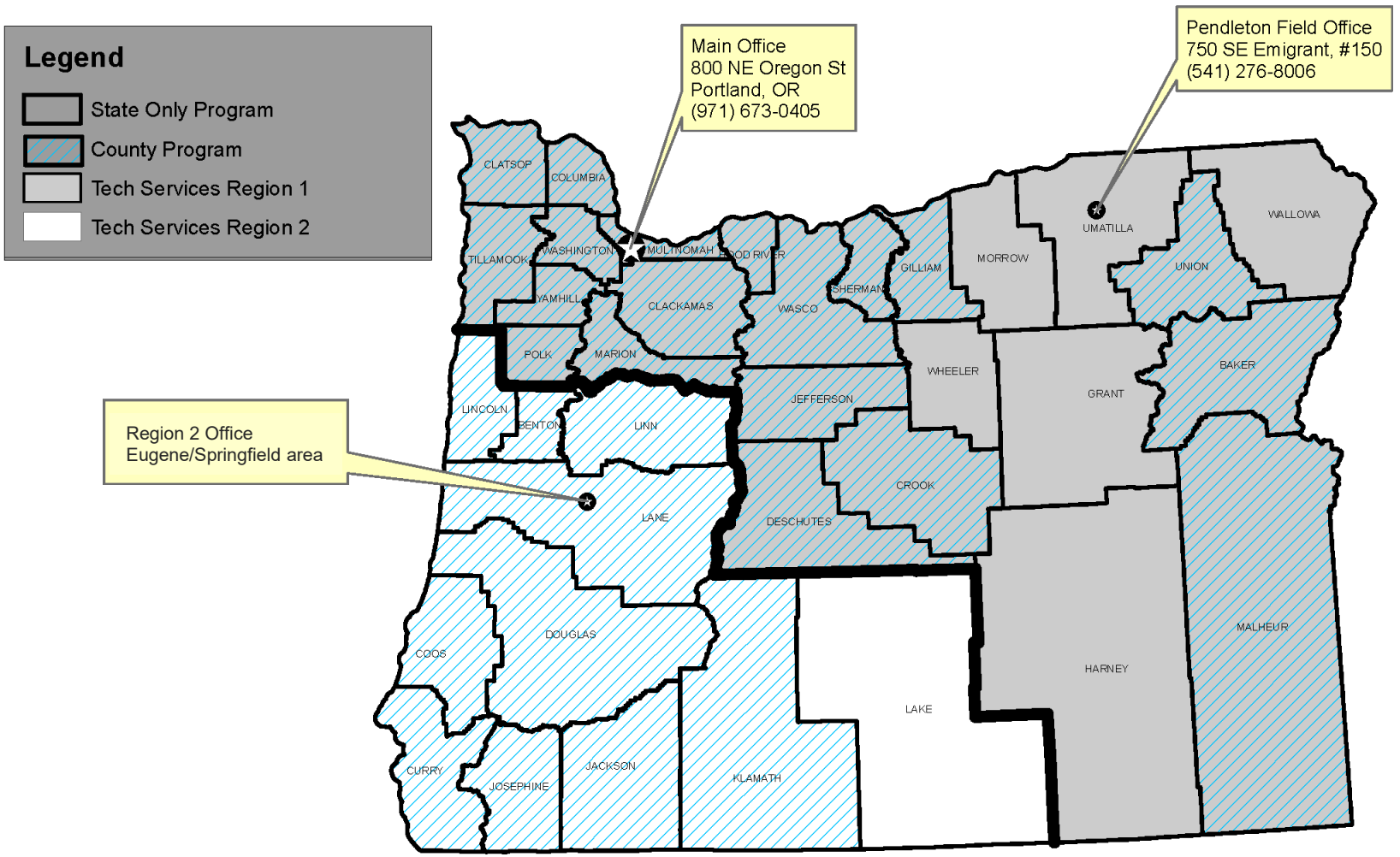
State-Specific Program Functions

- State Revolving Loan Fund
- Operator certification
- Data management
- Source water protection
- Plan review and approval
- Cross-connection / backflow prevention
- Security
- Formal enforcement

Drinking Water Services Organization

- **Work units**
  - Technical Services Region 1
  - Technical Services Region 2
  - Data Management, Compliance & Enforcement
  - Protection, Planning & Certification
- **Community Partners**
  - Counties, Oregon Dept. of Agriculture
  - Agencies

Drinking Water Services Technical Service Regions



Tom Pattee, April 2020

Safe Drinking Water Act (SDWA) Multiple Barrier Approach

Protecting Drinking Water from "Source to Tap"

1.2 Classification of Public Water Systems

Topics to Review

- Classification factors
  - ❖Population type and number served
  - ❖Number of connections
  - ❖Source(s) of water
- Oregon public water system data

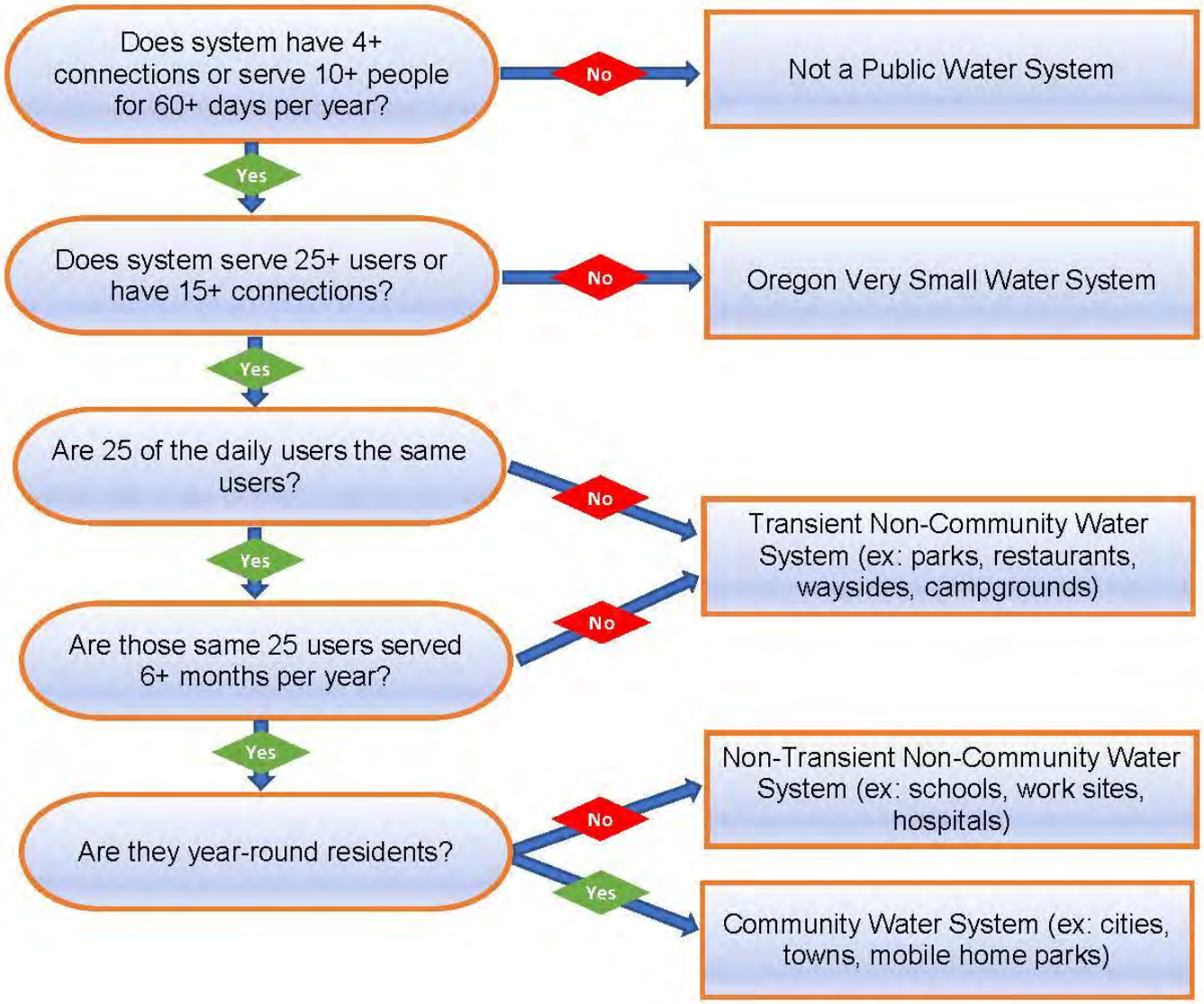
Classification Types and Criteria

SYSTEM CLASSIFICATION TYPE		POPULATION, CONNECTION, AND USE CRITERIA
Community	=	15 or more connection or 25+ people year round.
Non-Transient Non-Community	=	25+ of the same people for at least 6 months per year
Transient Non-Community	=	25+ different people per day for at least 60 days per year.
Oregon Very Small	=	Serves 4 to 14 connections or 10 to 24 people for at least 60 days per year.

Note: System classification changes may result in different sampling requirements!

Classifying Public Water Systems – Flowchart

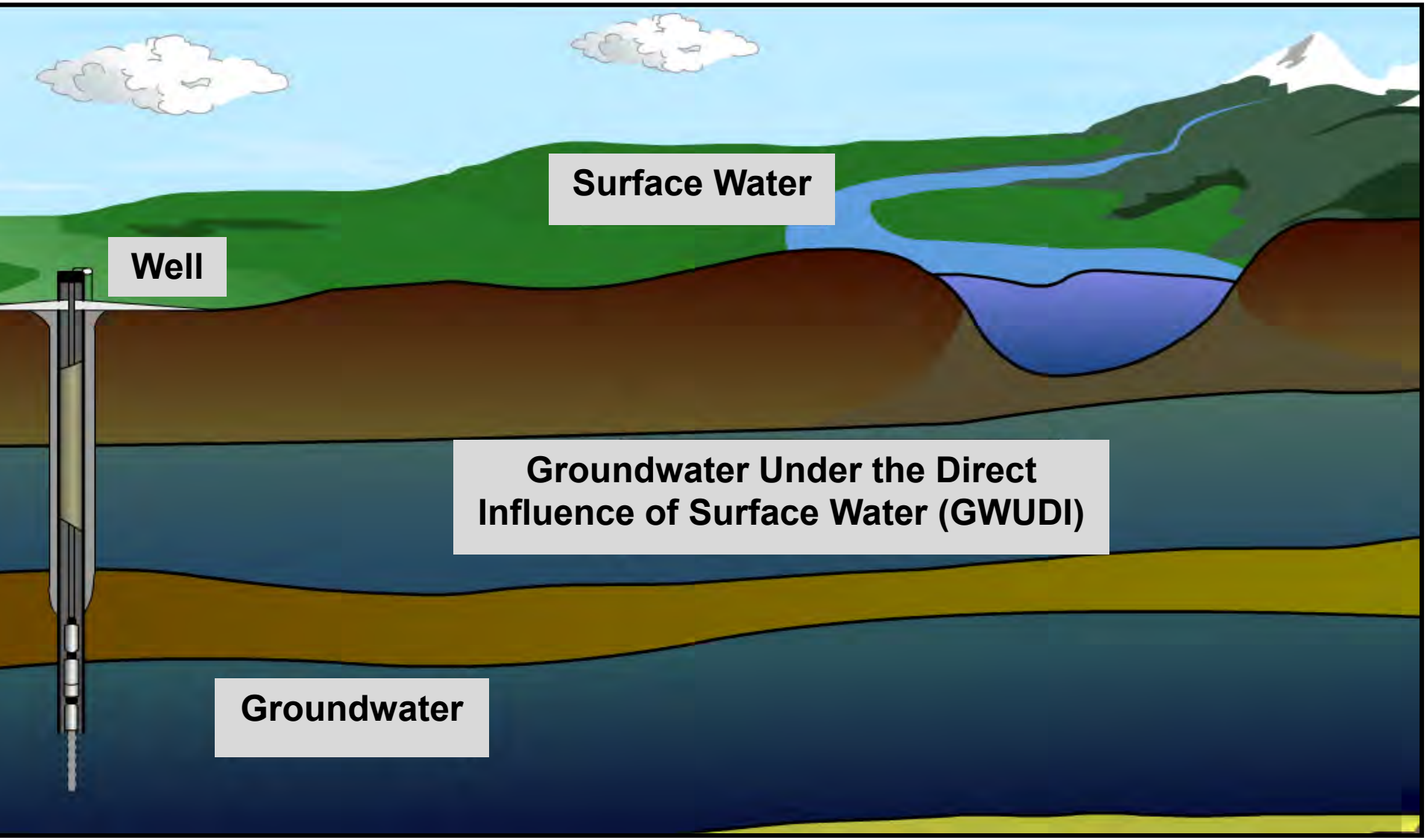
DETERMINE YOUR WATER SYSTEM TYPE



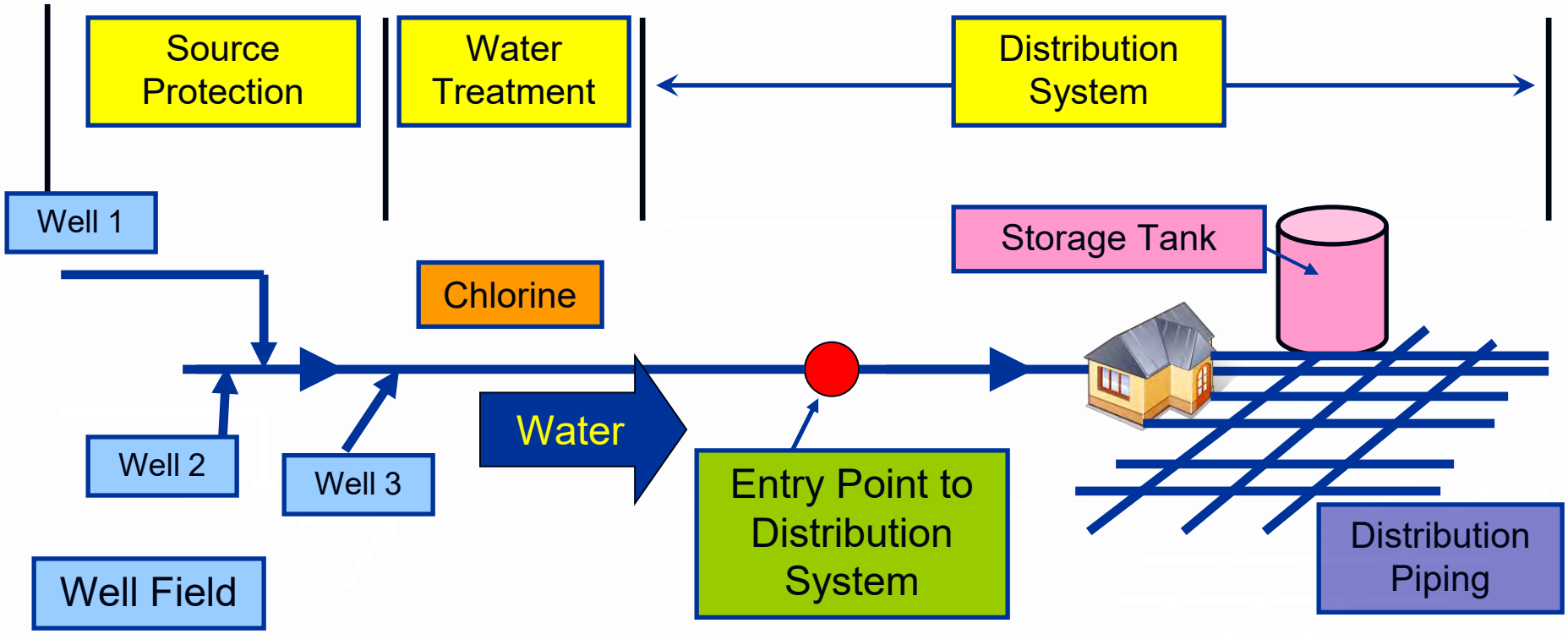
What Is the Source of Your Drinking Water?

- Water quality monitoring and reporting requirements are based on **source type**
- Three main source categories:
  - **Groundwater** (most small systems)
  - **Surface water**
  - Groundwater under the direct influence of surface water (**GWUDI**)
- Some systems have a **combination** of sources.

Surface Water and Groundwater Sources

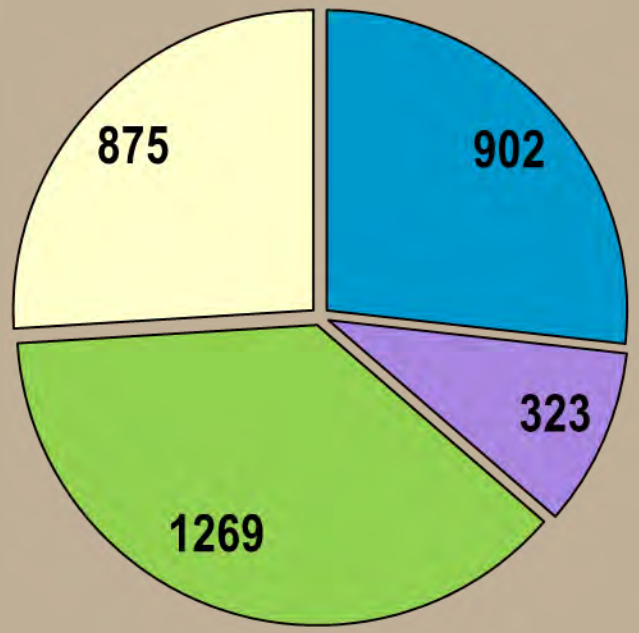


Typical Features of a Groundwater System



Oregon Public Water Systems by Type

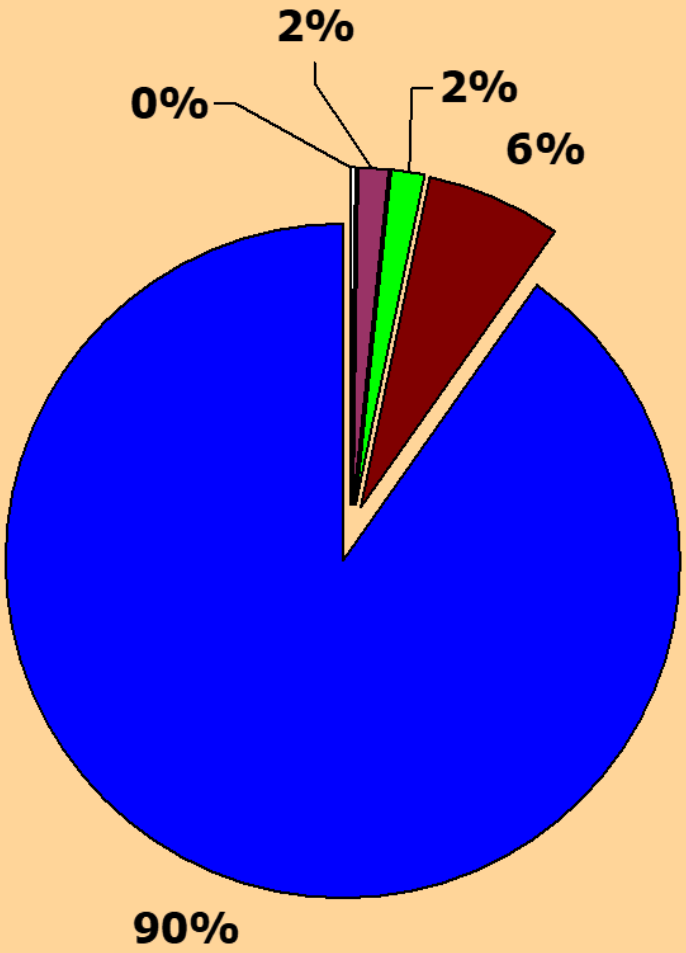
3,374 total public water systems
(as of May 2020)



- Community (cities, mobile home parks)
- Non-Transient Non-Community (schools, employers)
- Transient Non-Community (campgrounds, restaurants)
- OVS systems (4-14 connections, 10-24 people)

Oregon Public Water Systems by Size

90% of water systems serve fewer than 500 people



- More than 100,000 people (5)
- 10,001-100,000 people (53)
- 3,301-10,000 people (56)
- 501-3,300 people (220)
- 10-500 people (3,083)

1.3 Basic Responsibilities of Water Suppliers

Topics to Review

- Key responsibilities of water suppliers
- Terms – definitions and descriptions

Key Public Water System Responsibilities

- **Water Quality Monitoring and Reporting** (OAR 333-061-0036 and -0040)
- **Water Operator Certification** (OAR 333-061-0205)
- **Emergency Response Planning** (OAR 333-061-0064)
- **Capacity Requirements** (OAR 333-061-0061)
- **Plan Review and Approval** (OAR 333-061-0060)
- **Public Notification** (OAR 333-061-0042)
- **Consumer Confidence Reports** (OAR 333-061-0043)
- **Operations & Maintenance Manual** (OAR 333-061-0065)
- **Sanitary Survey** (OAR 333-061-0076)

Water Quality Monitoring and Reporting

All public water systems are required to collect microbiological and chemical samples to establish, demonstrate, and maintain water quality.

- Required frequencies of microbiological and chemical sample collection vary depending on system classification.
- Samples must be analyzed at a state-accredited lab.

Water Operator Certification

Operators of all Community and Non-Transient Non-Community systems must meet certain requirements, which are based on system size and complexity.

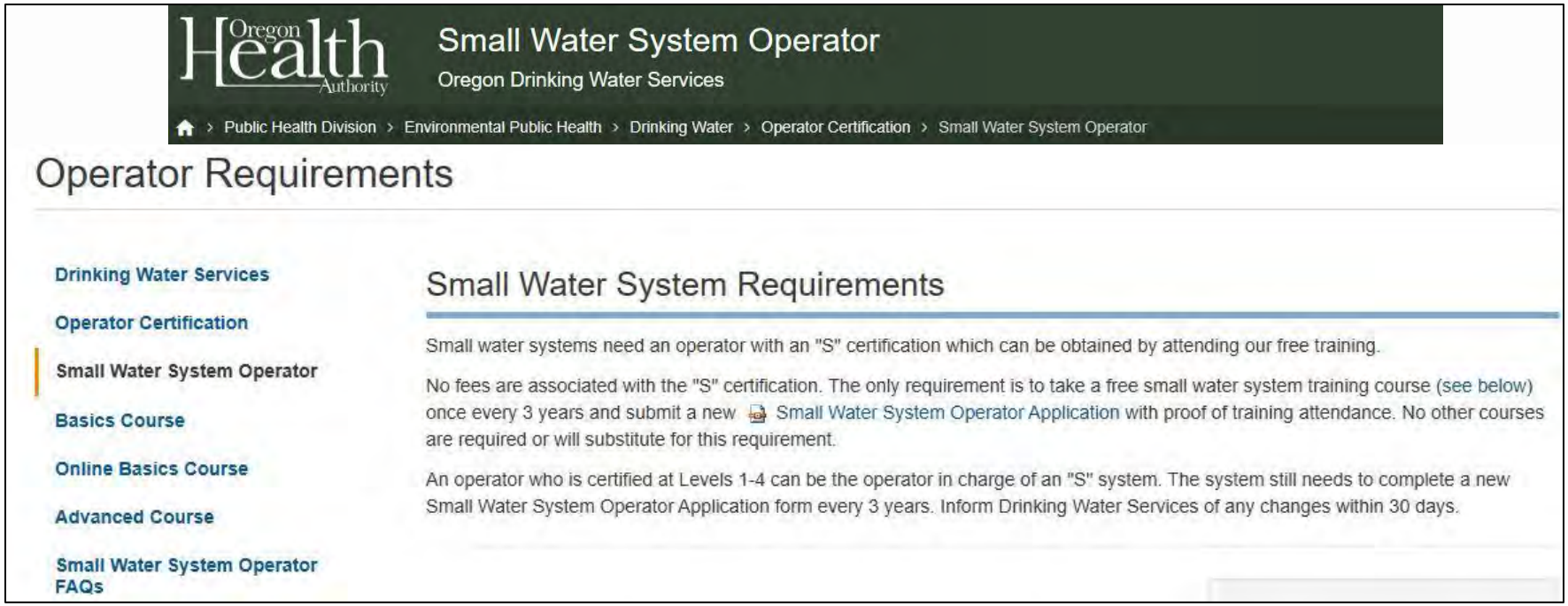
Three basic types of operator certification

- Small Water System Operator
- Water Treatment
- Water Distribution

Small systems with **less than 150 connections** that use only groundwater or purchase water from another public system without adding treatment are classified as **small water systems (designation S)**.

Water Operator Certification Details Small Water Systems

Small Water System Operator Requirement:
Complete the course **Basics for Small Water Systems in Oregon** for first and subsequent certifications. Certification is valid for 3 years, expiring on July 31 of the third year.



Capacity Requirements

Public water systems must demonstrate the technical, managerial, and financial (TMF) ability to deliver safe and reliable drinking water to the public.

- Factors evaluated include appropriate permitting, water rights, plan review, land use requirements, water quality results, certification of the operator(s), rate structure, billing procedures, and communication.
- Revolving loan fund applicants must demonstrate TMF capacity to qualify for infrastructure improvement monies.
- Capacity development is required only for Non-Transient Non-Community systems and Community systems.

Plan Review and Approval

Plans must be submitted to and approved by DWS prior to construction of a new water system or major modifications to existing systems.

- Prior to construction, modification or expansion of your water system, you must submit plans, review fee, and evidence of land use compatibility to DWS for approval.
- New systems must provide evidence of TMF capacity for final plan approval.

How to Use the DWS Website

http://oregon.gov/oha/PH/HealthyEnvironments/DrinkingWater/Pages/index.aspx

Oregon Health Authority

Drinking Water

Oregon Drinking Water Services

Public Health Division > Environmental Public Health > Drinking Water

Working to keep drinking water safe for Oregonians

Access to safe drinking water is essential to human health. Each person on Earth requires at least 20 to 50 liters of clean, safe water a day for drinking, cooking and simply keeping themselves clean. Oregon Drinking Water Services works to help keep drinking water safe for Oregonians.

Oregon Drinking Water Services (DWS) administers and enforces drinking water quality standards for public water systems in the state of Oregon. DWS focuses resources in the areas of highest public health benefit and promotes voluntary compliance with state and federal drinking water standards. DWS also emphasizes prevention of contamination through source water protection, provides technical assistance to water systems and provides water system operator training.

Contact Us | Sign up for DWS Alerts | Data Online

- Guidance for Reopening Building Water Systems After Prolonged Shut Down - *Updated April 29, 2020*
- Public Water Systems and Novel Coronavirus 2019 (COVID-19) Frequently Asked Questions - *Updated May 1, 2020*

Services

- Cross Connection & Backflow Prevention
- Emergency Response
- Groundwater & Source Water Protection
- Monitoring & Reporting
- Operator Certification
- Plan Review
- State Revolving Fund (SRF)
- Water System Operations

Resources

- County & Department of Agriculture Resources
- Data Online
- Domestic Well Safety Program
- Drinking Water Advisory Committee (DWAC)
- For Consumers
- Rules & Implementation Guidance
- Training Opportunities
- Site Map
- Contact Us

News and Hot Topics

Link
NEW - Annual Water System Fee Info
2020 Drinking Water Source Protection Project Priority List
Start-up tips for seasonal systems
Rulemaking: Adoption of Annual Fees
Cyanotoxin Resources for Water System Operators
Information on Healthy School Facilities

View archived hot topics and news items

Features of the Drinking Water Services Website

Links to:

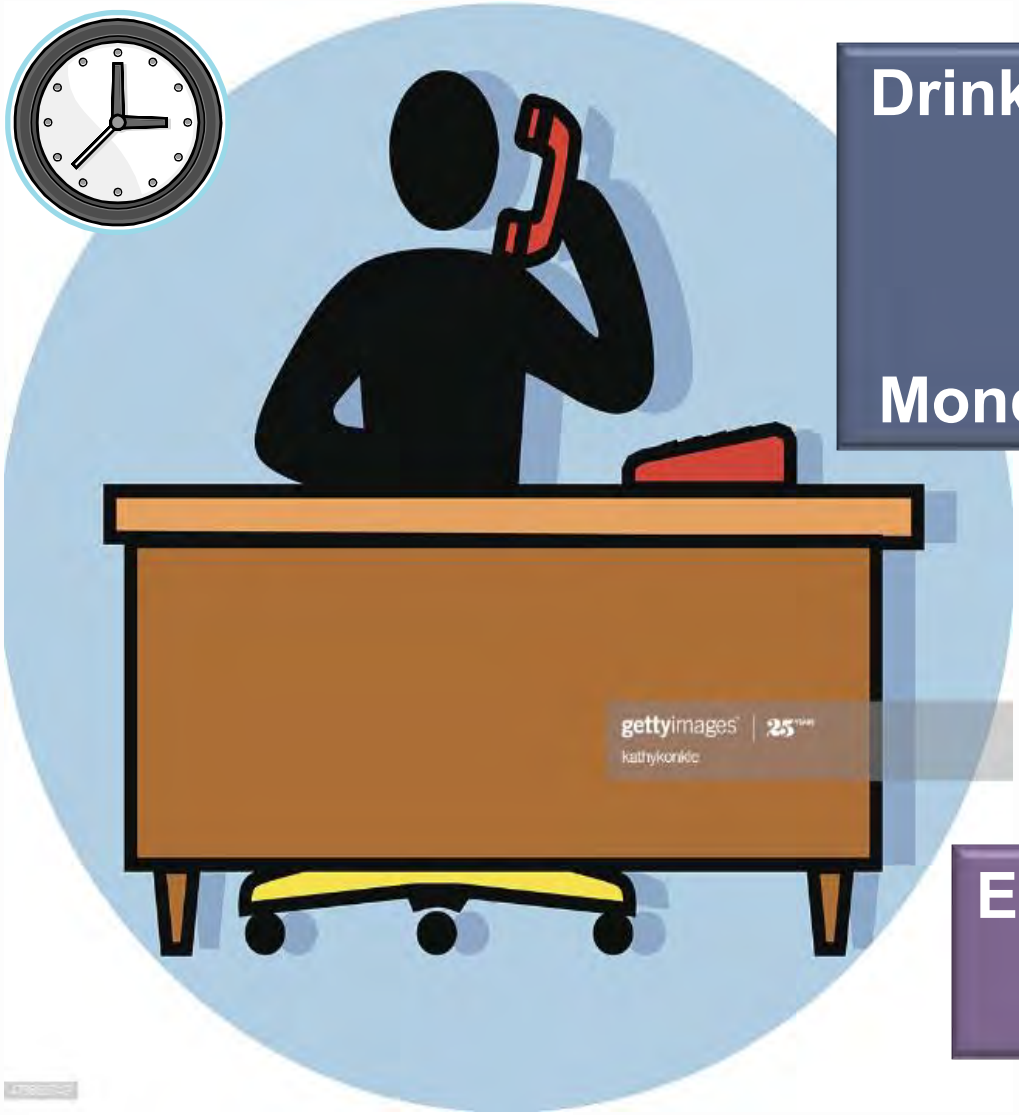
- Data Online (PWS test results and schedules)
- Emergency Preparedness & Security
- Operator Certification
- Monitoring – forms, labs, contaminant health effects
- System Operations – treatment, best management practices, shock chlorination
- Cross-Connections
- Rules and Rule Guidance
- Templates - for Consumer Confidence Reports, public notices, etc.
- Plan Review
- Pipeline Newsletter

1.4 Who To Call for Help

Topics to Review

- OHA Drinking Water Services
- Local regulators (county health department or Oregon Department of Agriculture)
- Cross-Connection & Backflow Prevention Program
- OHA & DEQ Drinking Water Source Protection Program
- Industry organizations and resources
- Technical assistance contractors
- State-accredited laboratories

Contact Information



Drinking Water Services (DWS) Technical Assistance

Call (971) 673-0405

Monday – Friday, 8 am to 5 pm

EPA Drinking Water Hotline

1-800-426-4791

After-Hours Contact Information

To reach Drinking Water Services during the evening or on weekends and holidays, please call the OHA Public Health Duty Officer:

Cell: (503) 704-1174

How to Find Your Local Regulator

Click here

Cross-Connection Control Contact

Cross-Connection and Backflow Prevention Program Coordinator

- Certification: (971) 673-0321
- Cross-Connection email: cross.connection@dhsoha.state.or.us
- Operator certification email: dws.opcert@dhsoha.state.or.us
- Fax: 971-673-0694
- Address: DWS-CC/BPP, P.O. Box 14450, Portland OR 97293-0450

Drinking Water Source Protection Contacts

Oregon Health Authority

Groundwater Protection Coordinator

541-684-2440 (call phone duty at 971-673-0405 for updated number)

Oregon DEQ

Surface Water Protection Coordinator

503-229-5664

Free Technical Assistance for Water Systems

Small Water System Circuit Riders

Circuit riders can assist small Community and nonprofit water systems with a wide variety of issues, including:

- Operational troubleshooting
- Submitting applications for project funding
- Emergency operations assistance
- Equipment and treatment recommendations
- Guidance on water system planning

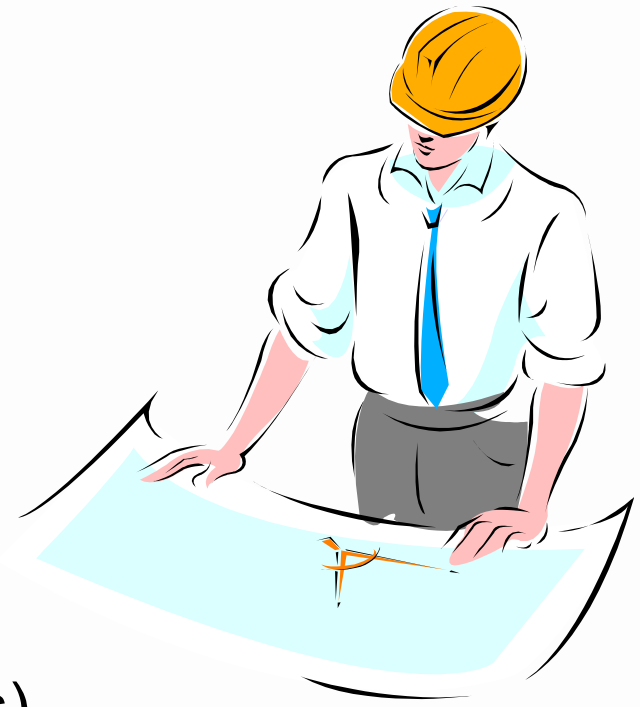
Free Technical Assistance for Water Systems

Small Water System Circuit Rider (<10,000 population)

Civil West Engineering, Inc.

(541) 266-8601

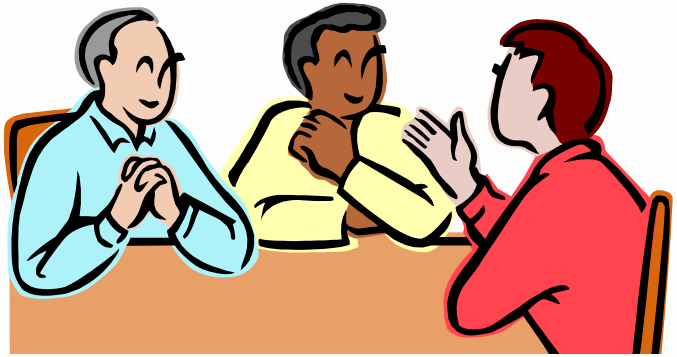
https://www.civilwest.com/



Available for Community and not-for-profit Transient and Non-Transient water systems (e.g., schools)

List of Helpful Organizations & Resources

- American Water Works Association (AWWA) Pacific NW Section
- Oregon Water/Wastewater Agency Response Network (ORWARN)
- Oregon Association of Water Utilities (OAWU)
- Rural Community Assistance Corporation (RCAC)
- NSF – List of approved chemicals and components for public water systems



Drinking Water State Revolving Fund (DWSRF)

- Provides financing to assist in compliance with the Safe Water Drinking Act and amendments.
- All Community and nonprofit Non-Community public water systems are eligible for funding.
- Provides low-interest loans and subsidies for eligible **infrastructure improvements** (terms up to 30 years).
- These systems are also eligible for loans up to $100,000 and grants up to $30,000 for **Drinking Water Source Protection** (DWSP) efforts.
- Up to $20,000 (100% principal forgiveness) is available for planning activities under the Sustainable Infrastructure Planning Projects (SIPP) program.

DWSRF Application & Project Eligibility

- Eligible infrastructure projects must address a compliance issue and/or a public health risk according to the 1996 SDWA amendments
- Applicants may apply for any phase or combination of phases in a single Letter of Interest (LOI).
  - Planning, engineering design or construction
- An eligible project can focus on:
  - Water source, treatment, storage, supply, transmission or distribution, or system consolidation and purchases

NOTE
All services must be metered. Loan *can* include the cost of metering.

DWSRF Coordinator (971) 673-0422

State-Accredited Labs

- All public water systems are required to have their samples analyzed at a state-accredited laboratory.
- See the DWS website for the most recently updated list.

1.5 Water System Surveys and Significant Deficiencies

Topics to Review

- What is a water system survey?
- Utilizing information from a survey
- Water system survey frequencies
- What is a significant deficiency?
- Correction of significant deficiencies

Definition of a Water System Survey

Water System Survey

A detailed on-site review of the water sources, facilities, equipment, operation, and maintenance of a public water system to evaluate the adequacy of those elements for producing and distributing safe drinking water

Why Conduct Water System Surveys?

- The goals of the water system survey are to:
  - Evaluate the system's capability for providing safe drinking water
  - Assess compliance with regulations
  - Provide feedback to the water system so that public health protections are maintained

Preparing for a Water System Survey

A water system survey includes office time to review the following records:

For all water systems:

1. Written coliform sampling plan.
2. A map of the distribution system.
3. Operation and Maintenance Manual, and other written procedures.
4. Emergency Response Plan.
5. Chemical dosage records if treatment is applied.
6. Proof of NSF Standard 60 certification (http://info.nsf.org/Certified/PwsChemicals/) for each chemical added to the drinking water.

Preparing for a Water System Survey (cont.)

7. Chlorine residual monitoring records if the system is chlorinated.
8. Results of any tracer study to verify disinfection contact time, if applicable.
9. Photos or other documents that provide enough detail to determine the current condition of storage reservoir features:
    a. Access hatch in open and closed/locked positions,
    b. Air vents that show all screening is secure with no gaps, and
    c. Any other openings into the tank interior such as telemetry ports and cathodic protection.

Preparing for a Water System Survey (cont.)

In addition, for Community water systems:

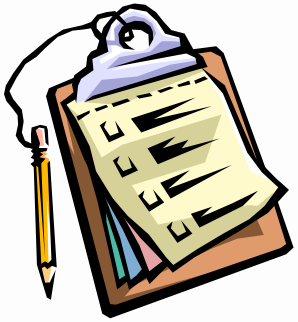
10. Cross-connection control program plan, records, latest Annual Summary Report, etc.

11. Written protocols for under-certified operators, if applicable.

Note: Reviewing the previous water system survey is advised. Contact your drinking water regulator to request a copy of the previous survey.

Water System Survey Frequencies

Community systems:
Every 3 years



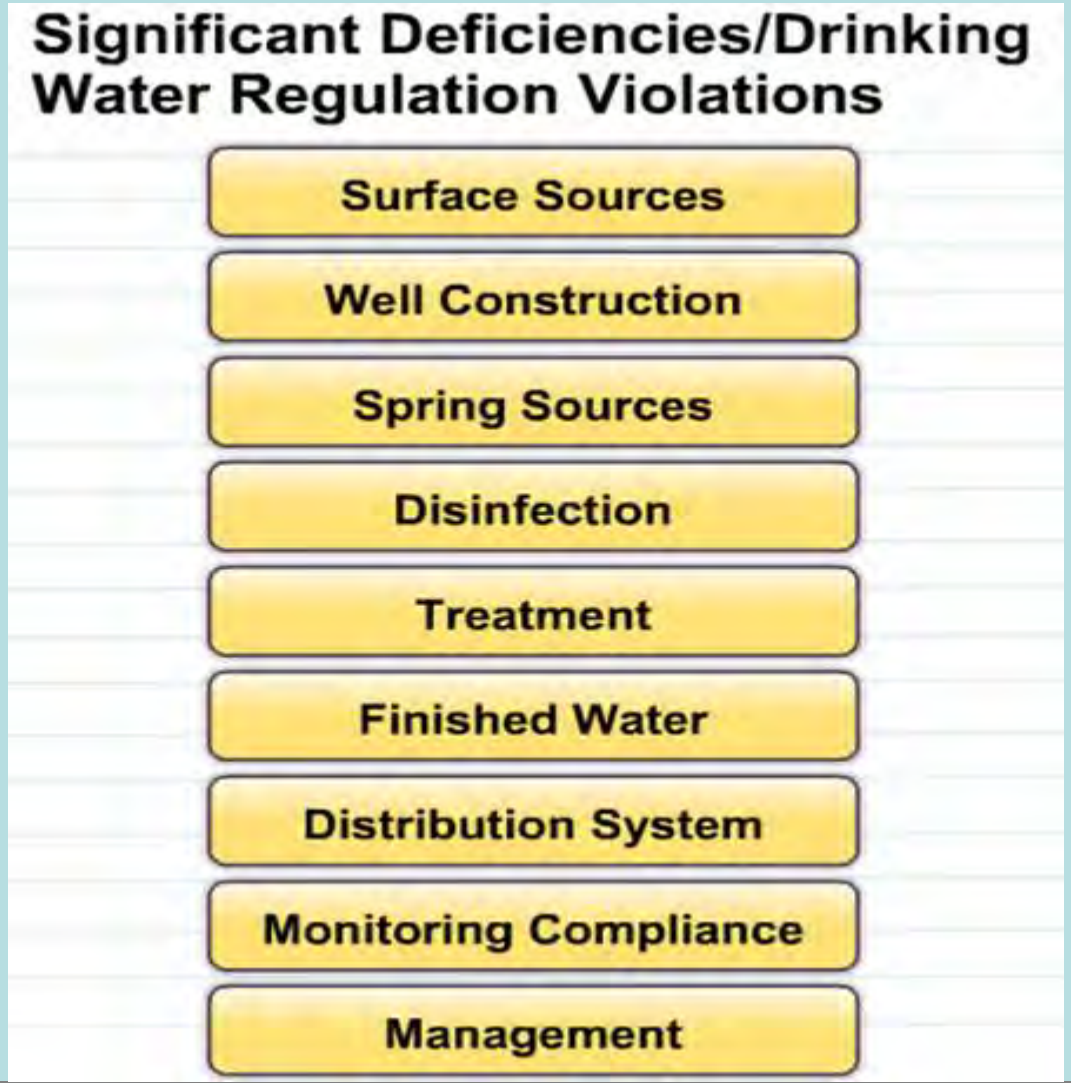
Transient and Non-Transient Non-Community systems:
Every 5 years

Water System Fees

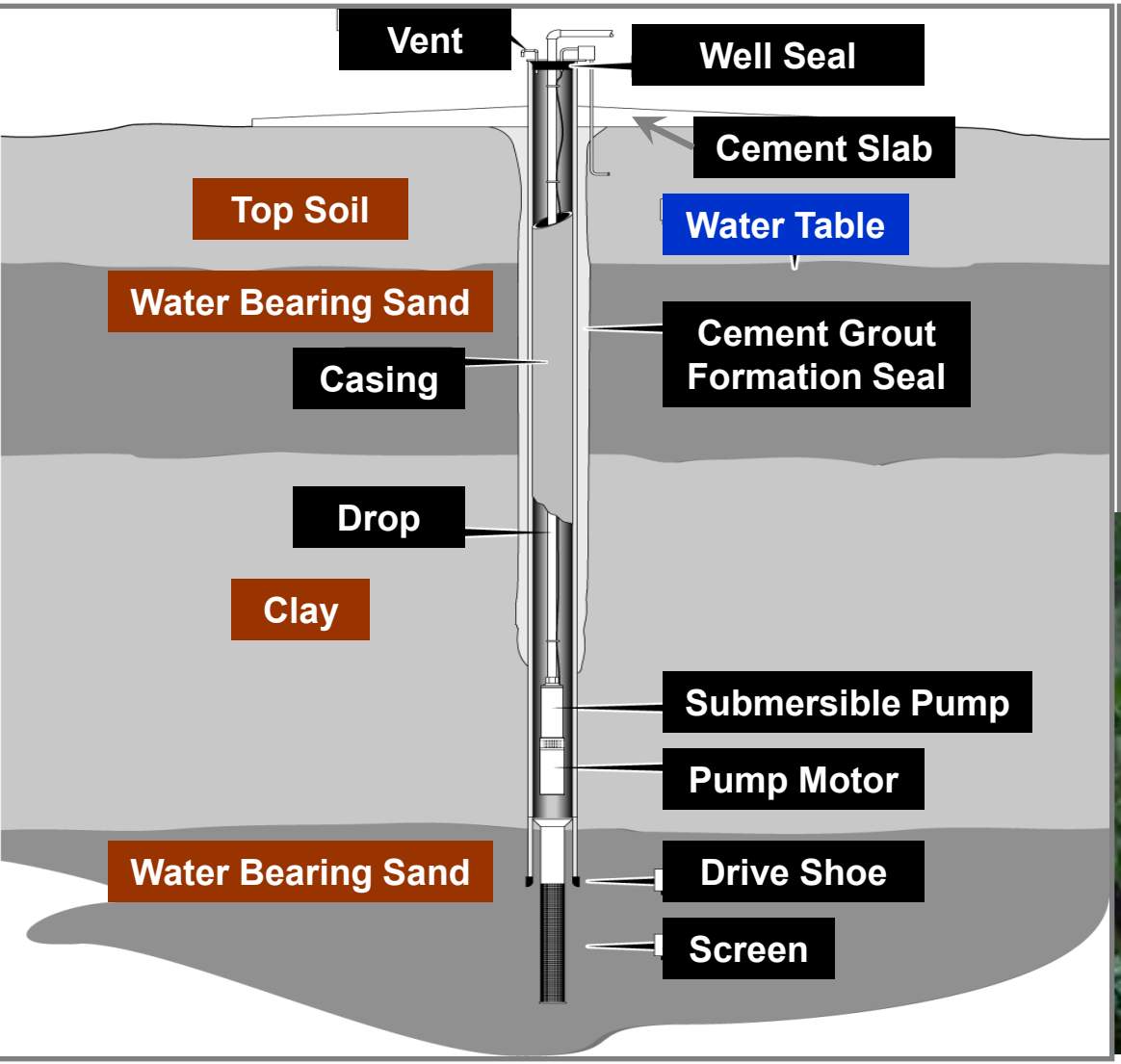
Fees now in effect

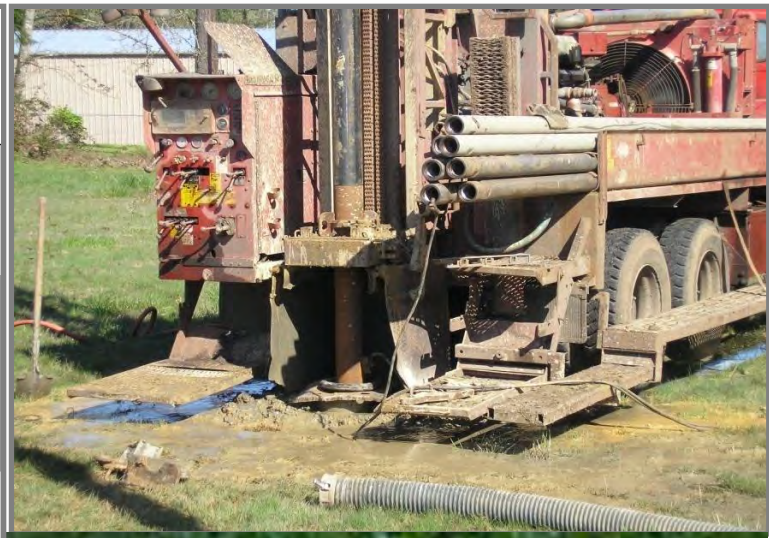
Water System Type	Number of Service Connections	Population	Fee	Late Fee
Oregon Very Small	4–14	10–24	$75	$25
Non-Community water system (Transient, Non-Transient)	N/A	25 or more	$150	$50
Small Community water system with or without treatment	15–250	25–1,000	$175	$50
Community water system without water treatment	251–500		$675	$100
	501–1,000		$1,125	$100
	1,1001–3,000		$1,500	$150
	3,001–5,000		$3,000	$150
	5,001–10,000		$5,625	$250
	10,001–15,000		$9,000	$250
	15,001–30,000		$13,500	$250
	30,001–100,000		$31,500	$500
	>100,000		$48,750	$500

Categories and Definitions of Significant Deficiencies



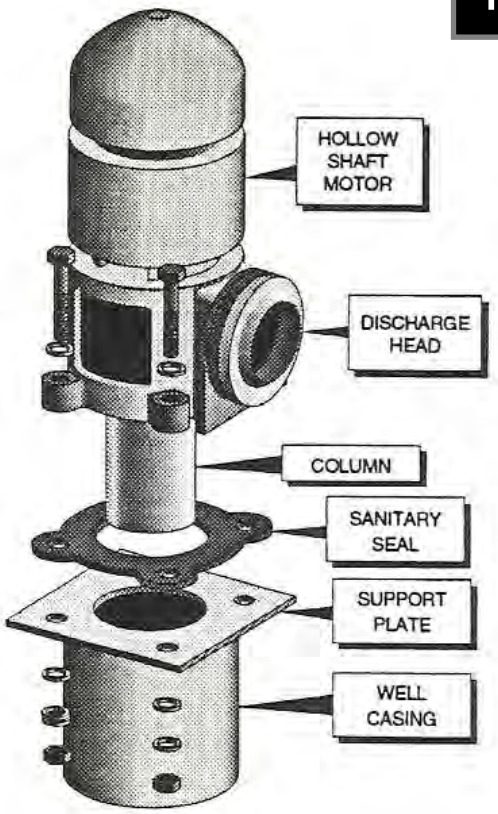
Well Construction



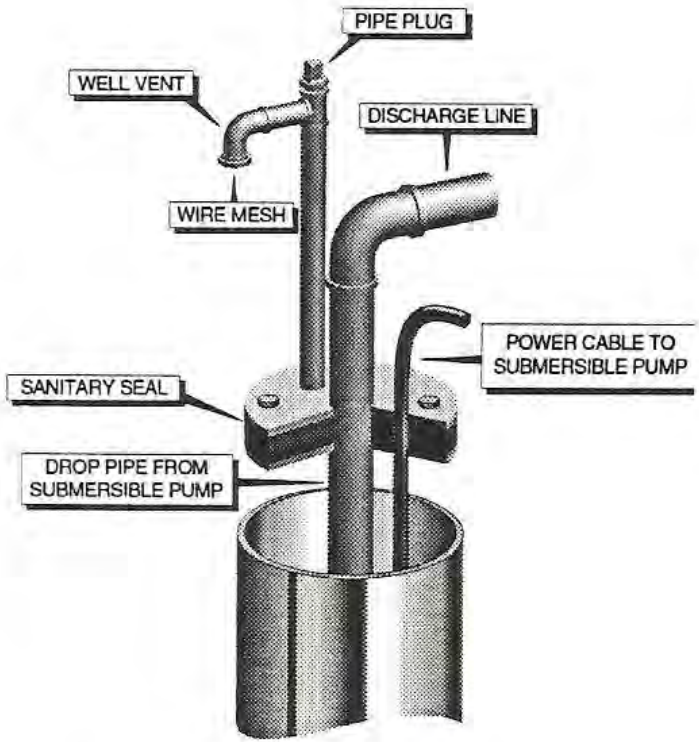


Wellhead Design and Construction

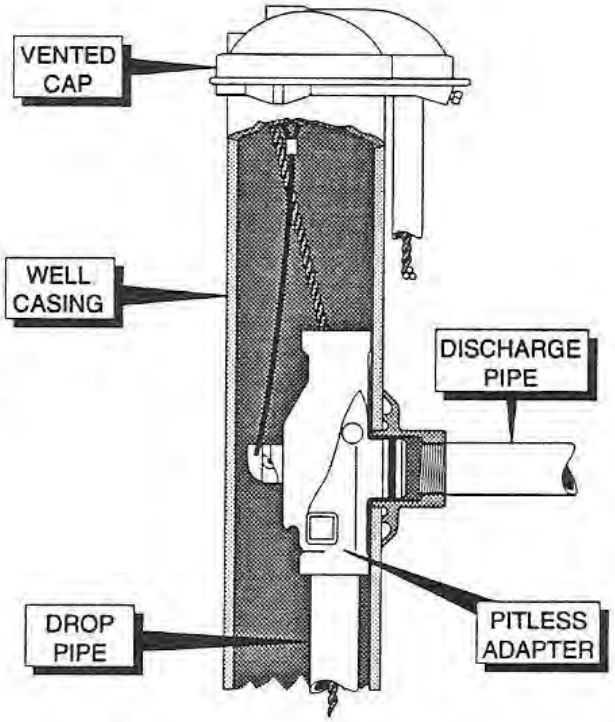
Three typical wellhead designs



Vertical Turbine



Submersible Pump with Top Discharge Line

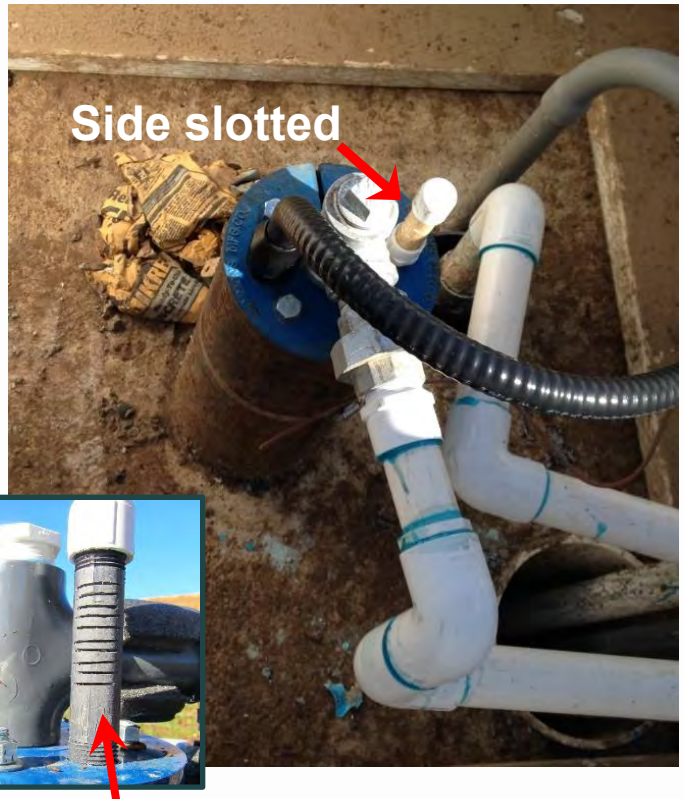


Submersible Pump with Pitless Adapter

Wellhead Design Examples

Well Vent Design - Examples

Not rule compliant



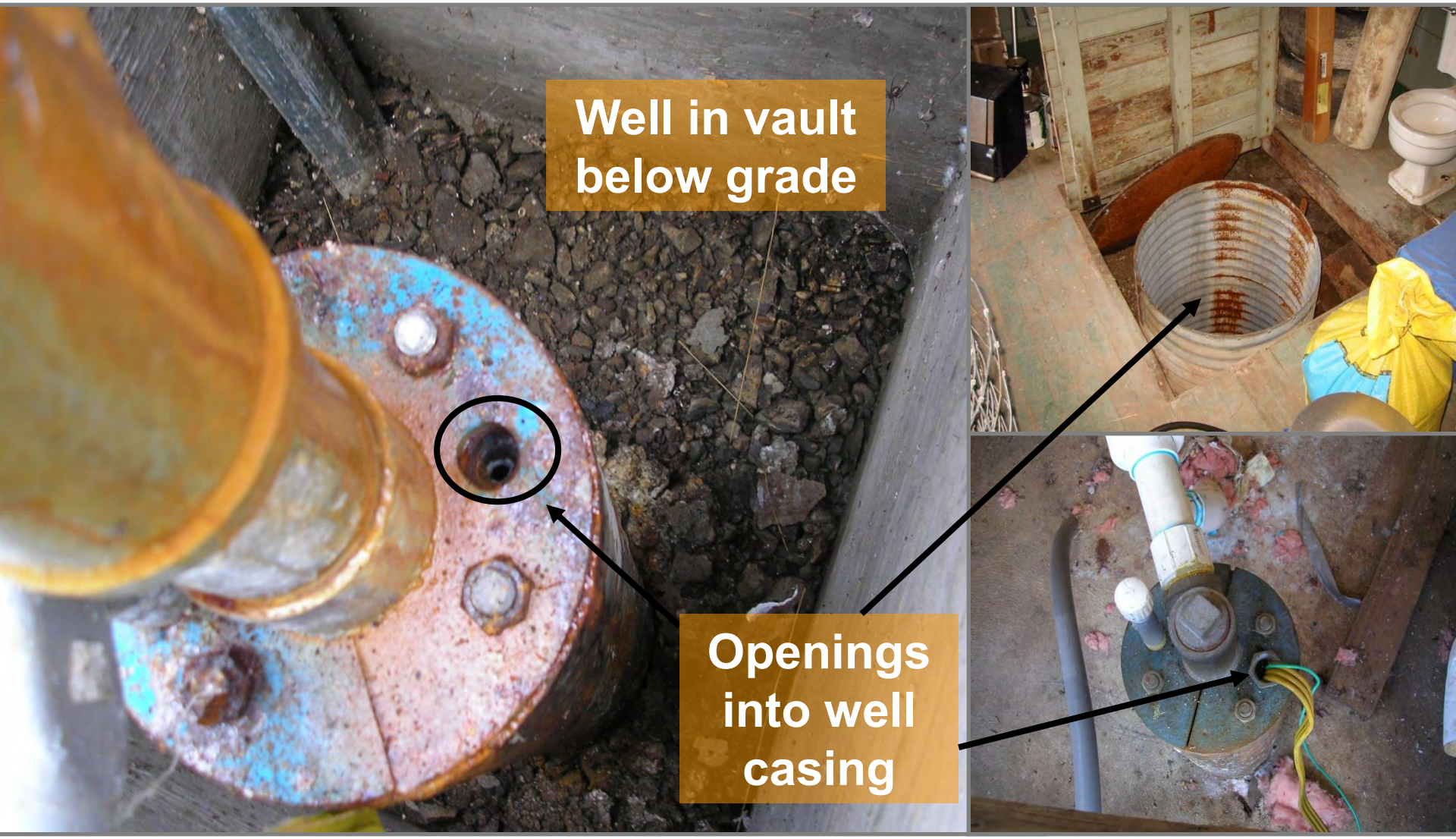
Close-up of a side slotted vent

Rule compliant

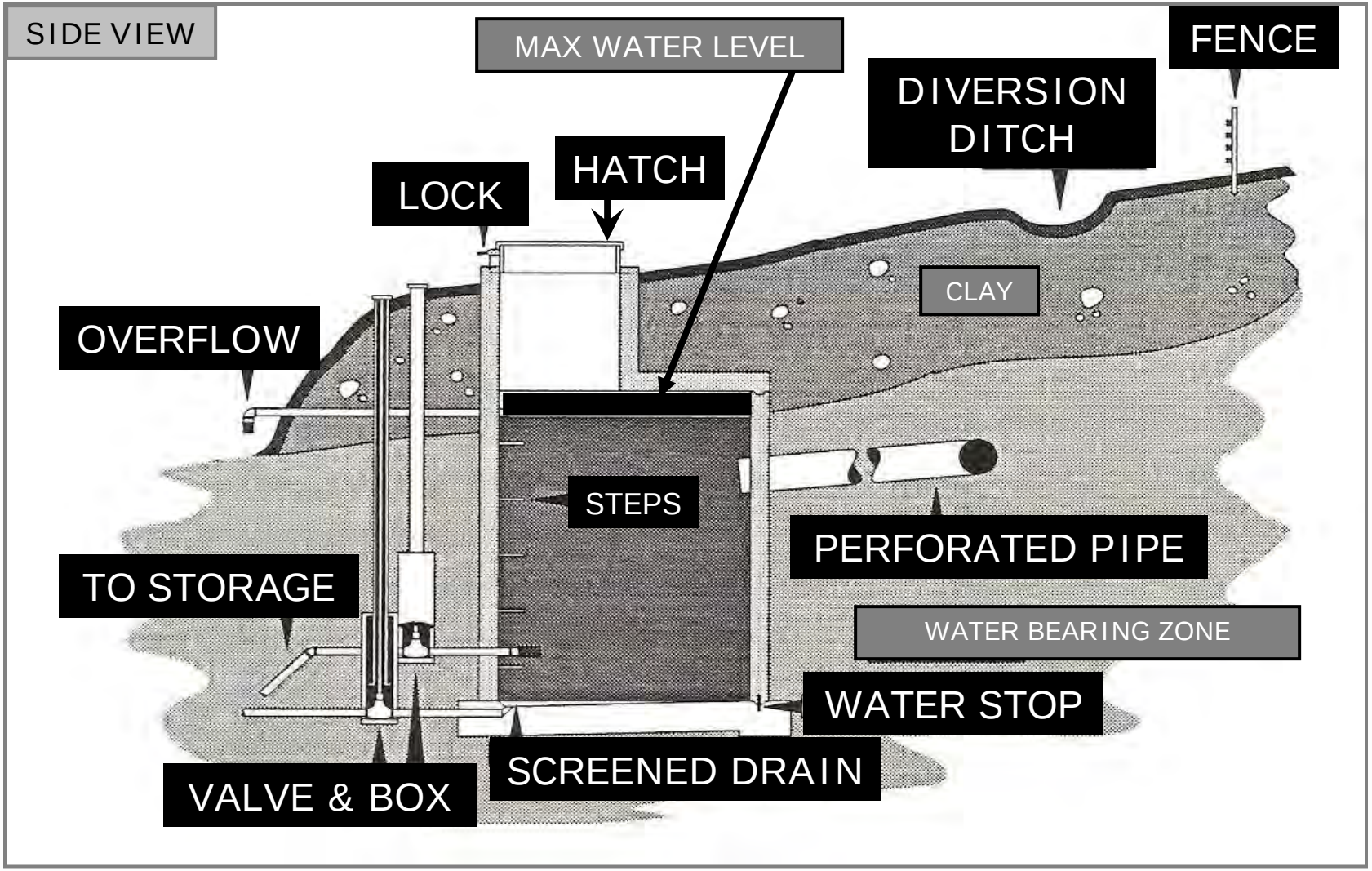
Return bend with screen

Alt. vent design

Wellhead Deficiencies

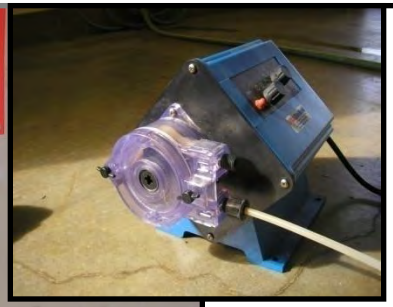


Spring Box Design

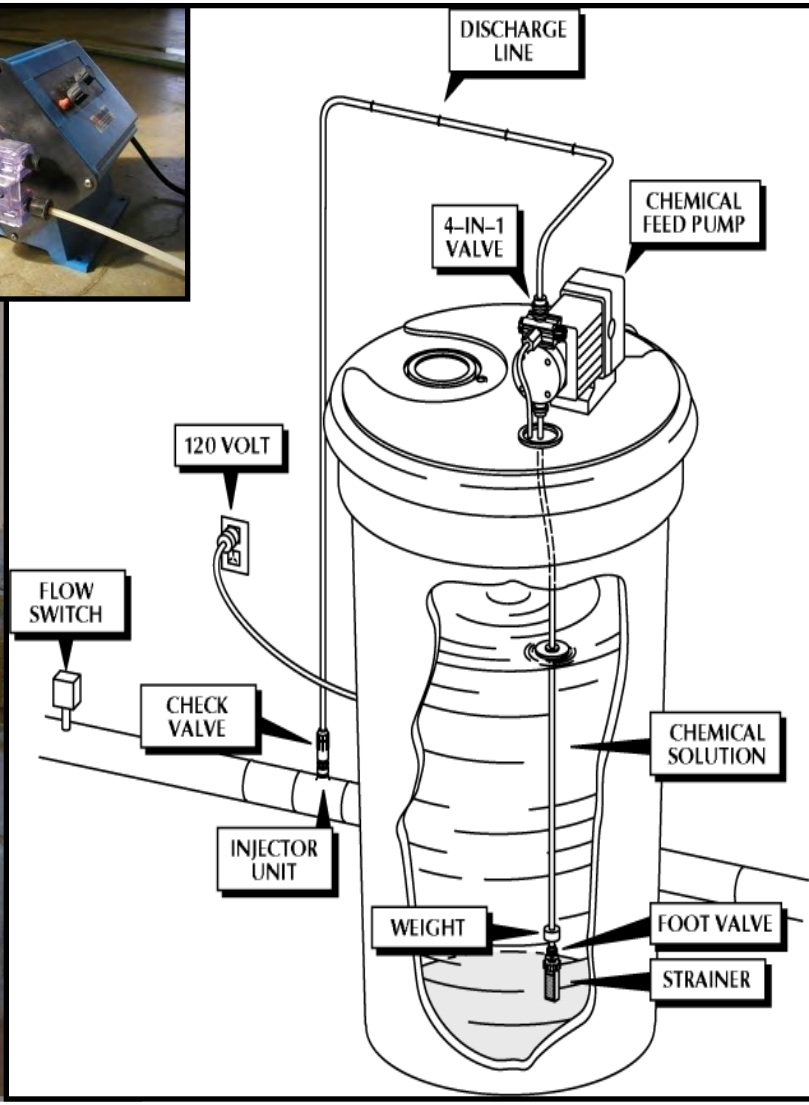


Spring Box Design – Example

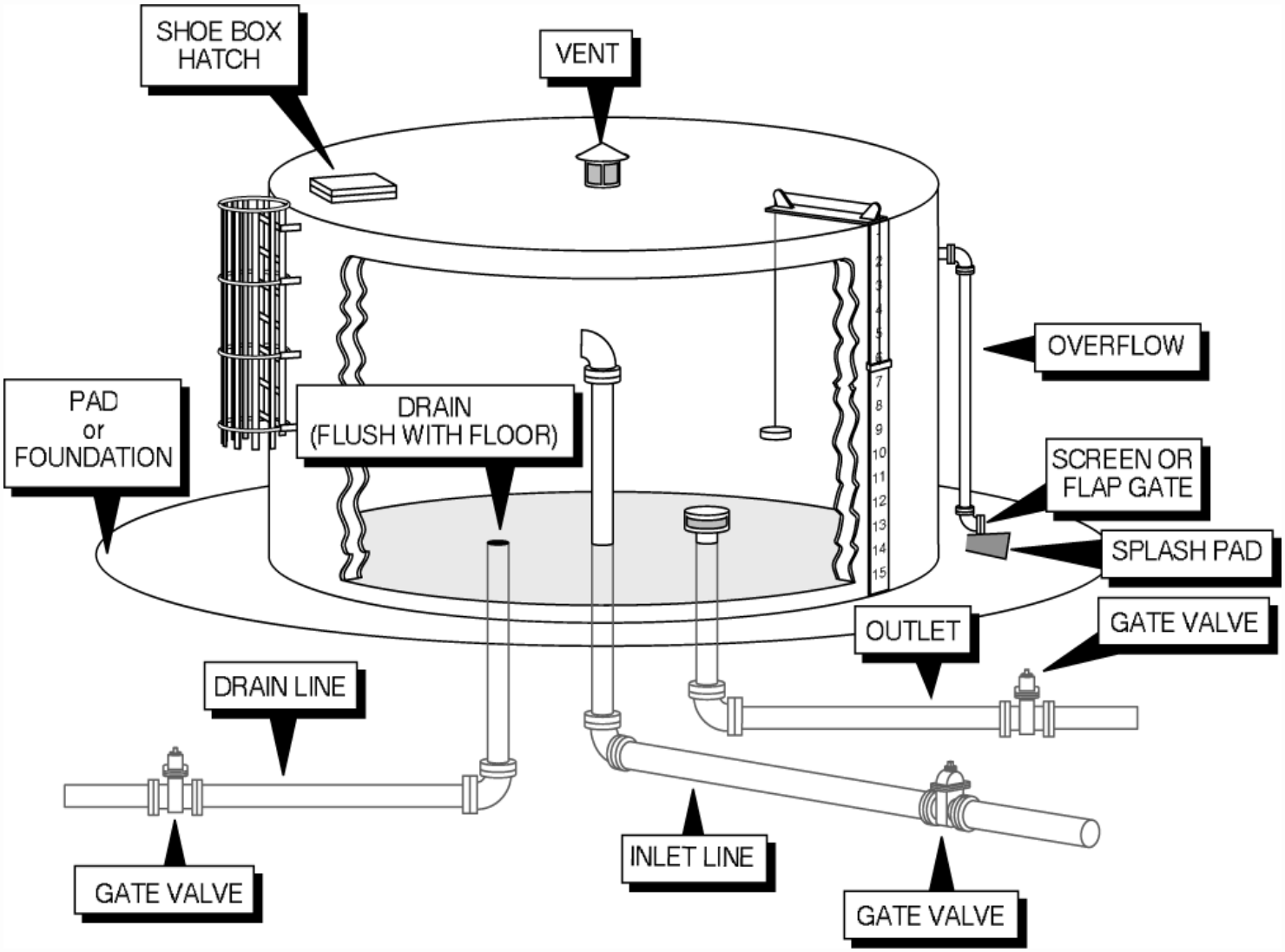
Disinfection and Treatment



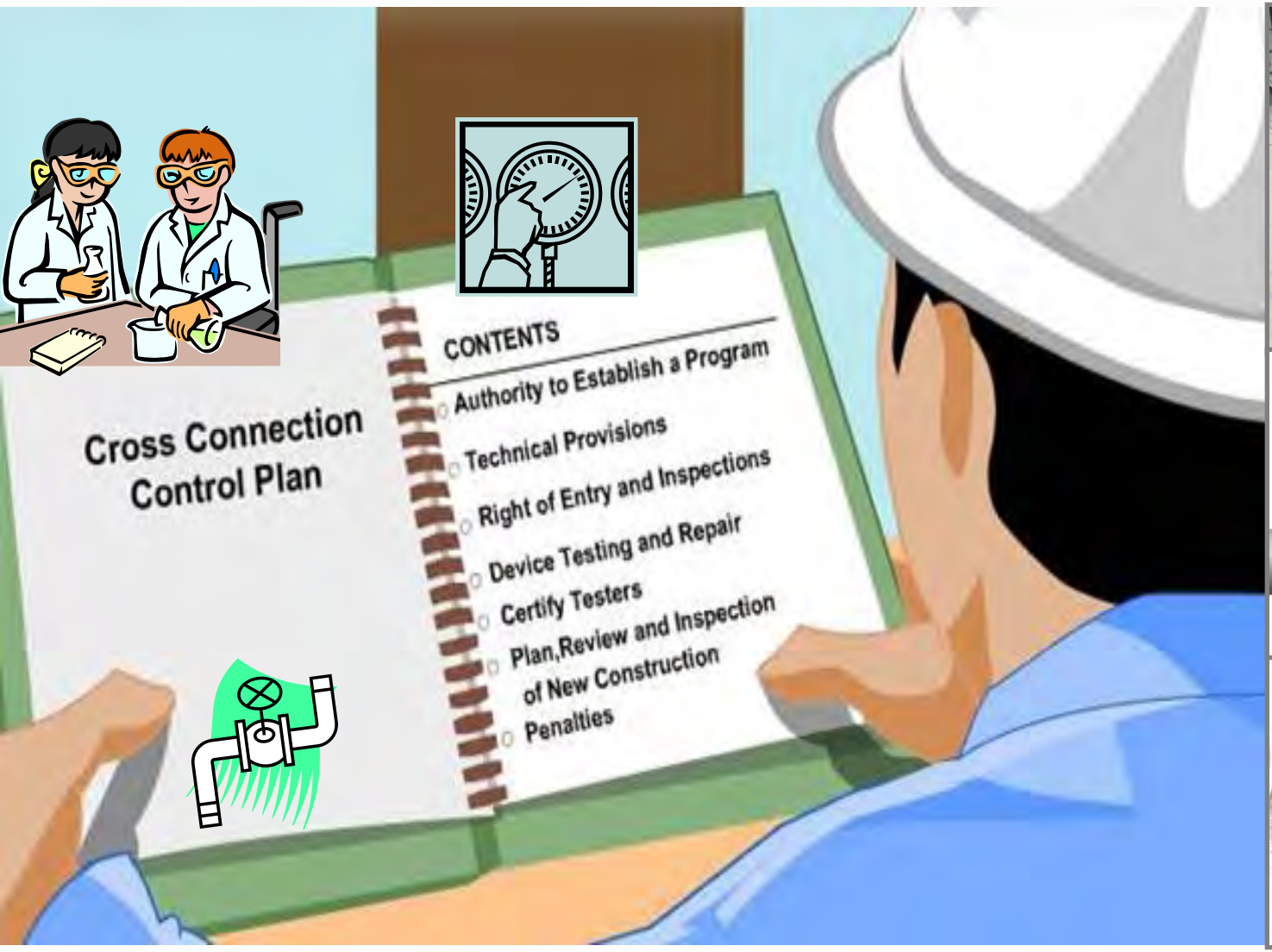
Hypochlorinator feed pump and tank

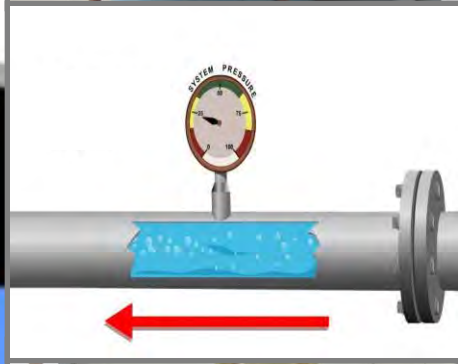


Finished Water Storage



Distribution and Monitoring Deficiencies





Management and Operations Deficiencies

Correcting Significant Deficiencies

Groundwater Systems:

- Must acknowledge the deficiencies within 30 days and correct all deficiencies or be on a DWS-approved written corrective action plan within 120 days.

Surface Water Systems:

- Must correct deficiencies or be on a DWS-approved written corrective action plan within 45 days.

Developing a Corrective Action Plan

Drinking Water Source Protection Program Partnership

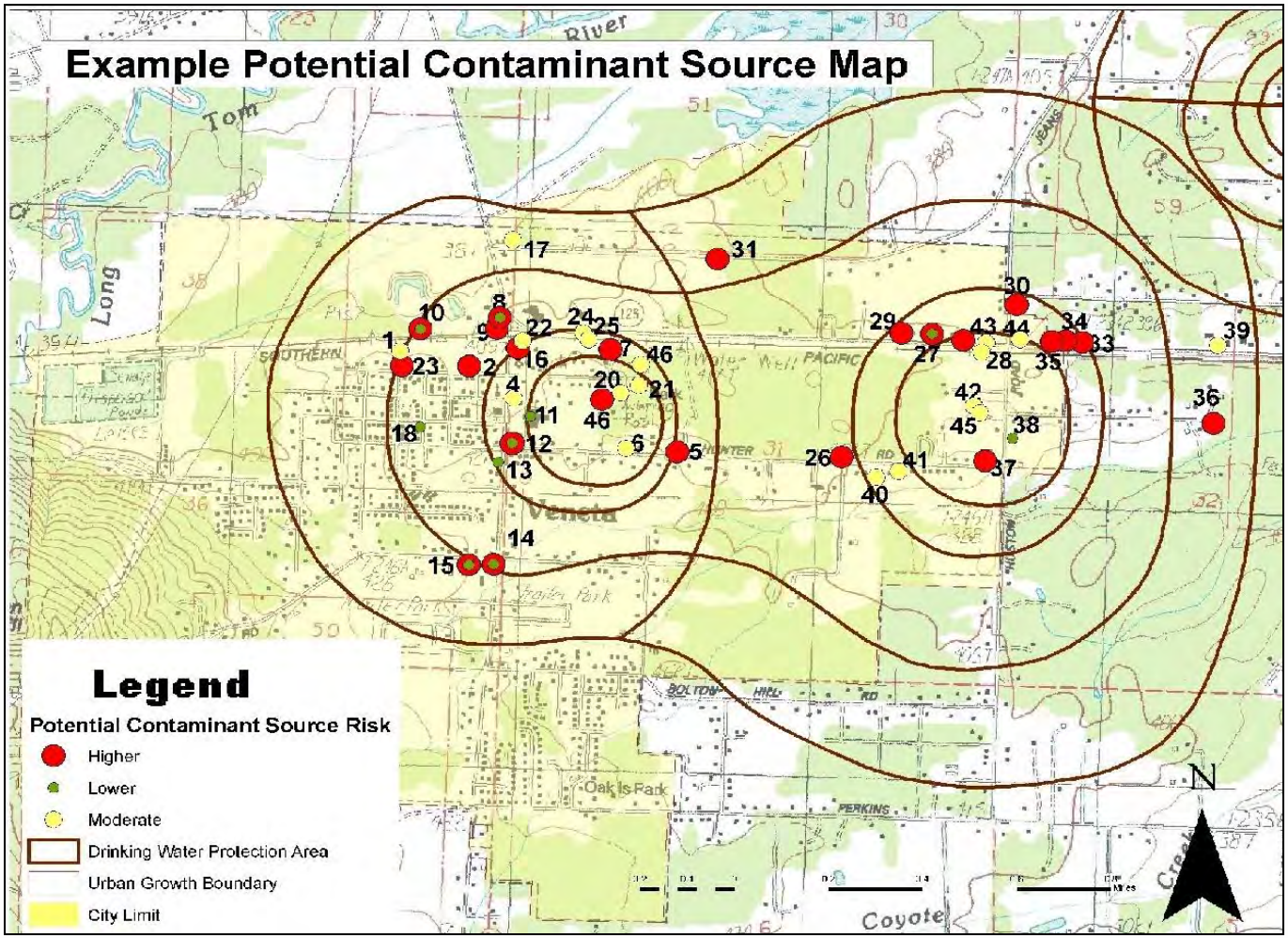
Drinking Water Protection Program Administered by:

State of Oregon Department of Environmental Quality

&

Oregon Health Authority

Source Water Assessment – Delineation and PCS Inventory Example



1	Repair Shop
2	Repair Shop
4	Medical/Vet Offices
5	Septic Systems - High Density
6	High Density Housing
7	Repair Shop
8	Parking Lots/Malls
9	Dry Cleaners
9	UST
10	Gas Station

Drinking Water Source Protection

Contact Information:

OHA – DWS
Tom Pattee

541-684-2440 (or call phone duty at 971-673-0405 for updated number)

DEQ
Julie Harvey

503-229-5664

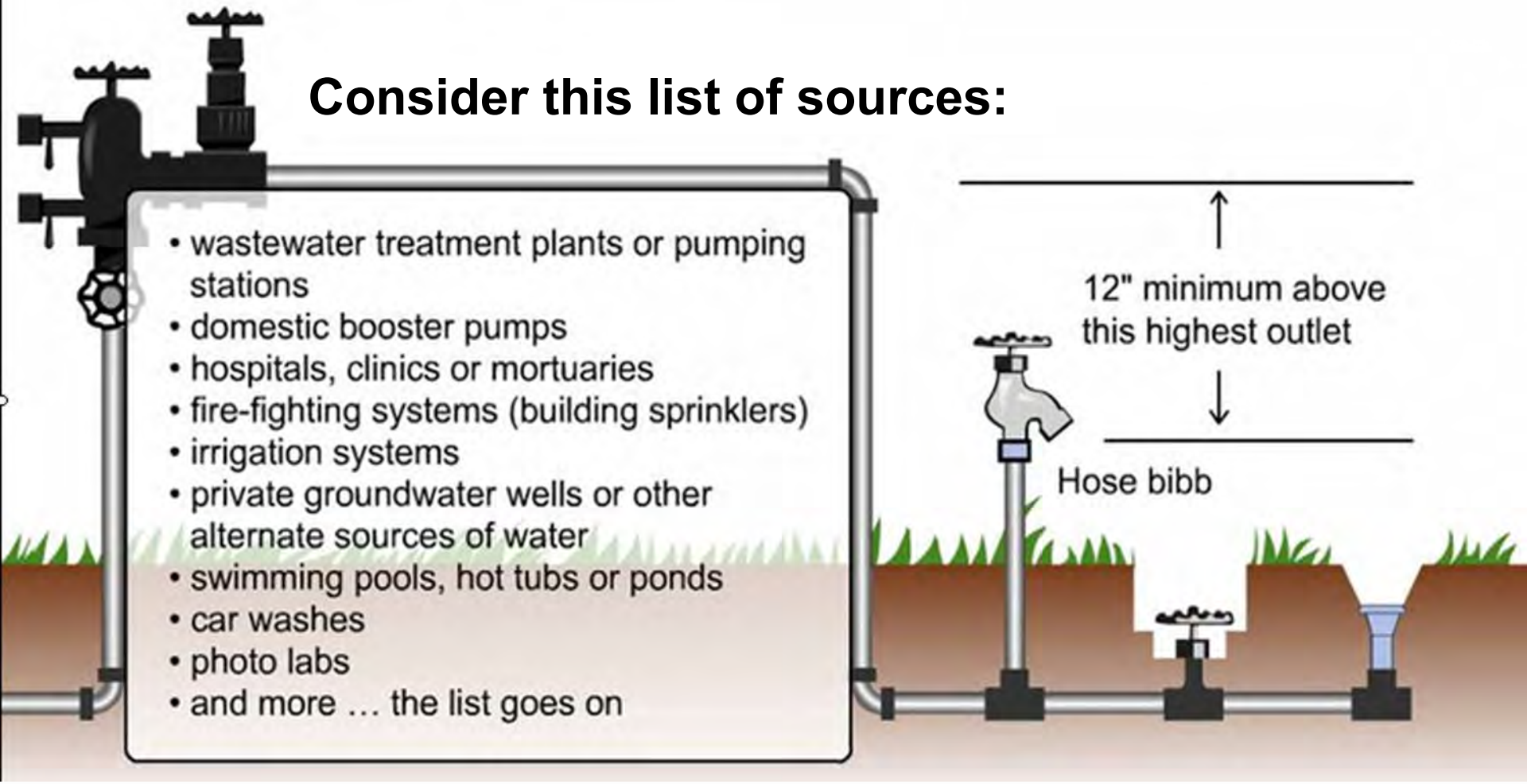
1.6 Cross-Connection and Backflow Prevention

- **Topics to Review**
  - What are cross-connections?
  - What are backflow, backpressure, and backsiphonage?
  - Methods of backflow prevention
  - Elements of a cross-connection / backflow prevention program
  - Backflow devices and methods

Cross-Connections

Consider this list of sources:

- wastewater treatment plants or pumping stations
- domestic booster pumps
- hospitals, clinics or mortuaries
- fire-fighting systems (building sprinklers)
- irrigation systems
- private groundwater wells or other alternate sources of water
- swimming pools, hot tubs or ponds
- car washes
- photo labs
- and more … the list goes on



What Are Backflow, Backpressure, and Backsiphonage?

Backflow is the reversal of flow from its normal or intended direction. Backflow can be caused by backpressure or backsiphonage.

Backpressure is an elevation of pressure downstream that can cause water to flow opposite of its intended direction.

Backsiphonage is a drop in the distribution system pressure that can cause water to flow opposite of its intended direction.

Enabling Authority or Local Ordinance (Community Systems)

- All Community waters systems are required to have a written enabling authority or local ordinance that authorizes the discontinuation of water service for the following:
  - Unprotected cross-connections
  - An approved backflow assembly not installed or maintained properly
  - Approved assemblies not tested annually
    - Approved tester and device lists

- Enabling Authority Template for small systems is on the website: www.healthoregon.org/crossconnection

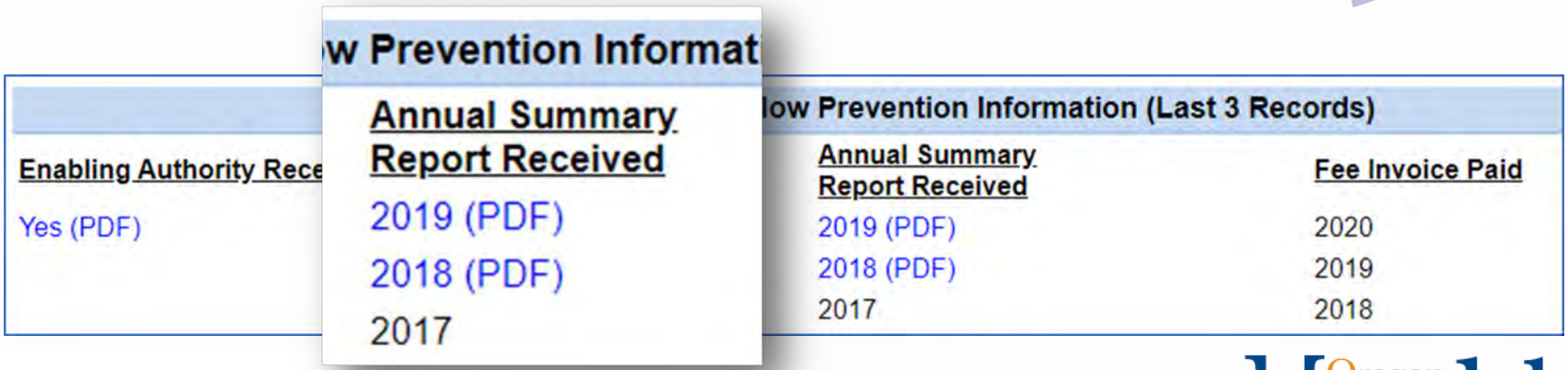
Enabling Authority Received
Yes (PDF)

Cross Connection/Backflow Prevention Information (Last 3 Records)	
Annual Summary Report Received	Fee Invoice Paid
2019 (PDF)	2020
2018 (PDF)	2019
2017	2018

Annual Summary Report (ASR) (Community Systems)

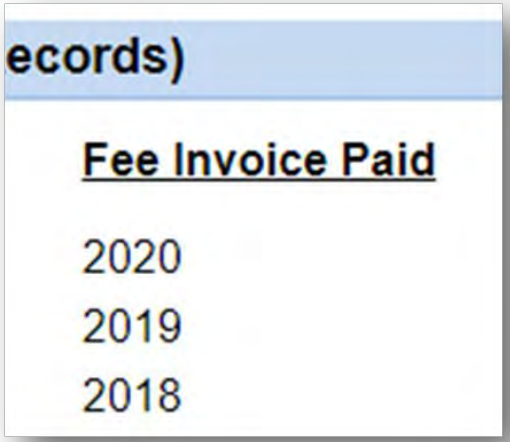
Annual Summary Reports (ASRs)

- The ASR is a summary of backflow tests completed during the year.
- All backflow assemblies must be tested every year by a certified backflow tester.
- OHA mails a postcard in early January. Prepare and submit by March 31.
- The last three ASRs are viewable on Data Online: www.yourwater.oregon.gov



Cross-Connection Annual Fee (Community Systems)

- Fee is due annually by December 31.
- Amount is based on the number of service connections in the system.
  - 15-99 connections - $30.00
  - 100-999 connections - $75.00
- DWS mails an invoice in November each year.
  - Pay online with a credit card, or
  - Submit a check with the invoice
- Verify the fee was received by checking Data Online: www.yourwater.oregon.gov


ecords)

Fee Invoice Paid
2020
2019
2018

Cross Connection/Backflow Prevention Information (Last 3 Records)		
Enabling Authority Received	Annual Summary Report Received	Fee Invoice Paid
Yes (PDF)	2019 (PDF)	2020
	2018 (PDF)	2019
	2017	2018

Backflow Prevention Assemblies, Devices, and Methods

Assemblies

- Reduced Pressure (RP)
- Double Check (DC)
- Pressure Vacuum Breaker (PVB)

Devices

- Atmospheric Vacuum Breaker (AVB)

Method

- Air Gap

- Approved backflow prevention methods are based on the degree of identified hazard:
  - Health hazard (contaminant)
  - Non-health hazard (pollutant)

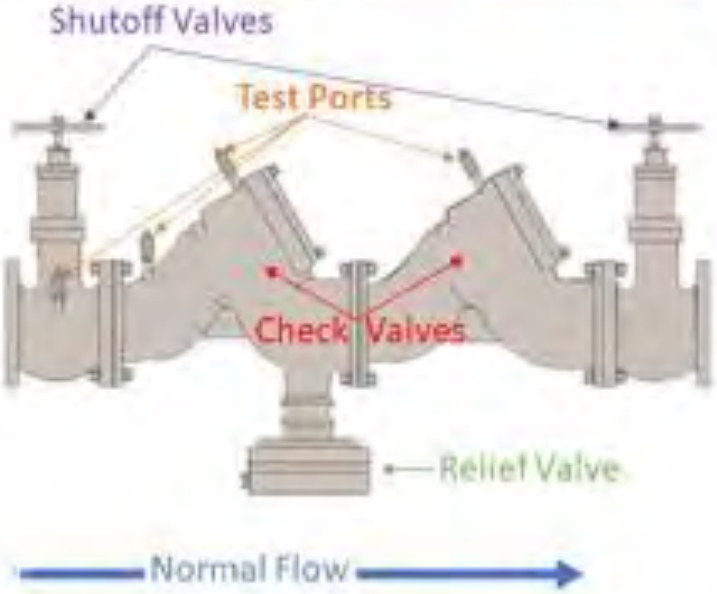
Backflow Prevention Assemblies – Examples

Assemblies are testable

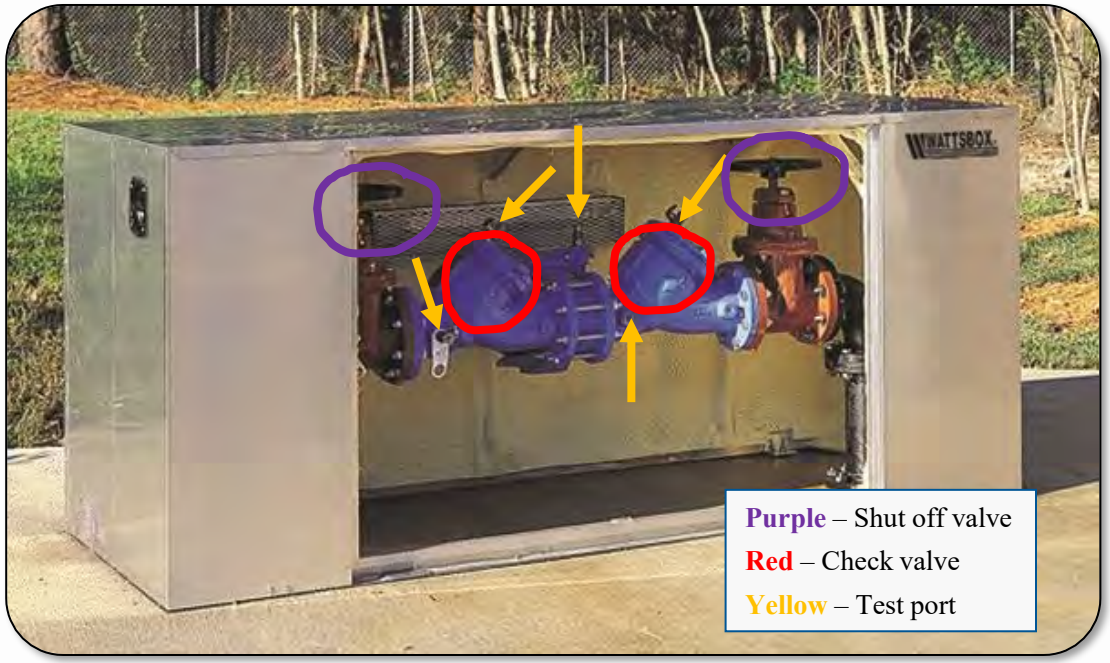
Reduced Pressure

Double Check

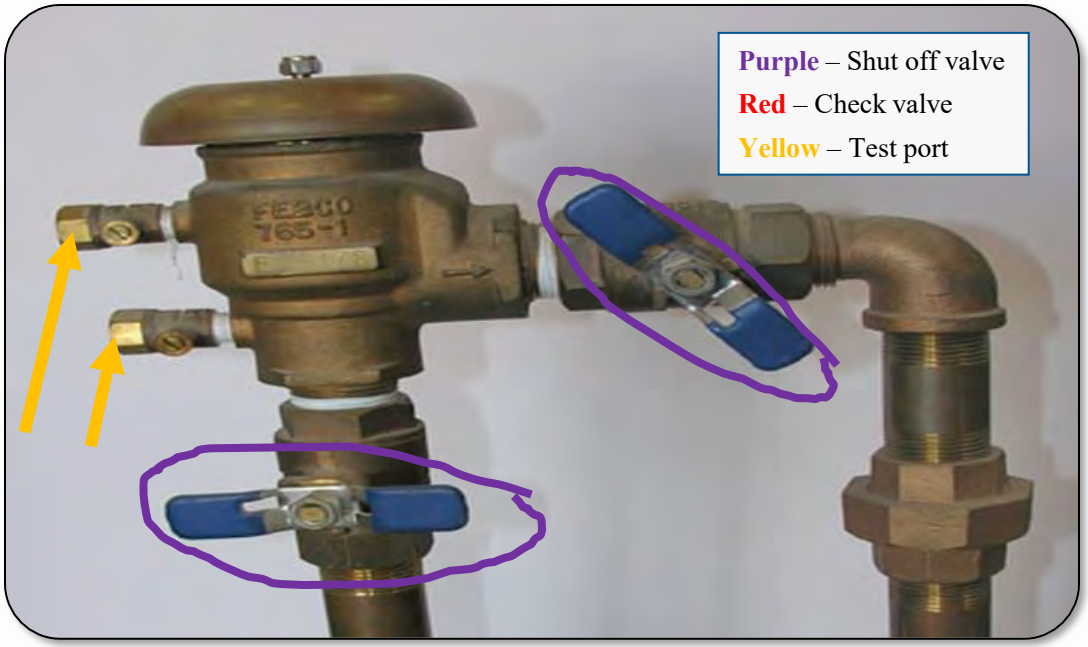
Pressure Vacuum Breaker



Double Check (DC) Backflow Prevention Assembly – Example

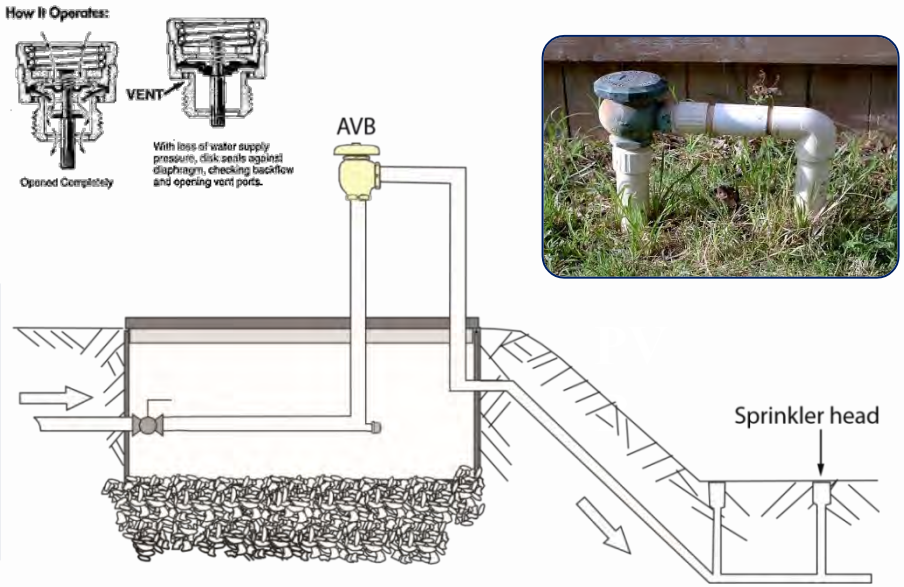


Pressure Vacuum Breaker (PVB) Backflow Prevention Assembly – Example



Atmospheric Vacuum Breaker (AVB) Backflow Prevention Assembly – Example

A **device** is **not testable** and includes **Atmospheric Vacuum Breakers**

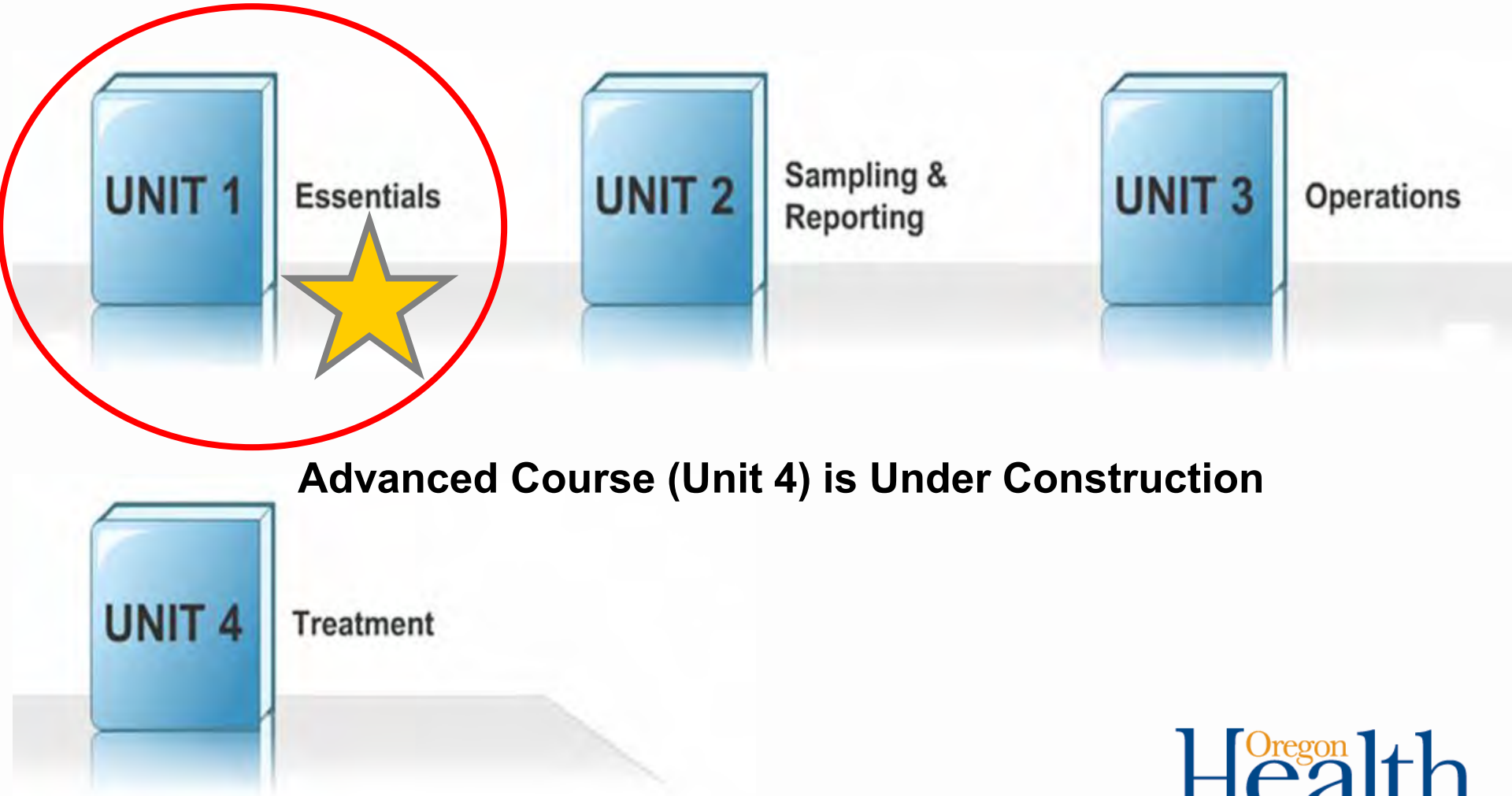


Air Gap Backflow Prevention Method – Example

The air gap between the kitchen faucet and the top of the counter is the most common air gap.

Basics for Small Water Systems in Oregon

Congratulations! You've completed UNIT 1!



Advanced Course (Unit 4) is Under Construction

UNIT 2 – SAMPLING AND REPORTING

2.1 – Drinking Water Contaminants

2.2 – Understanding Standards

2.3 – Public Notice Requirements

2.4 – Consumer Confidence Reports

2.1 Drinking Water Contaminants

Topics to Review

- Types of health effects and exposure
- Types and characteristics of contaminants
  - Microbiological
    - Bacteria, viruses, and protozoa
    - Waterborne disease outbreaks
  - Chemical
    - Organics (synthetic and volatile)
    - Inorganics (nitrate, arsenic, lead, and copper)
  - Radionuclides (gross alpha, radium, and uranium)

Types of Health Effects From Drinking Water Contaminants

Which of these health effects can result from drinking a single glass of water?

?

Types of Health Effects from Drinking Water Contaminants

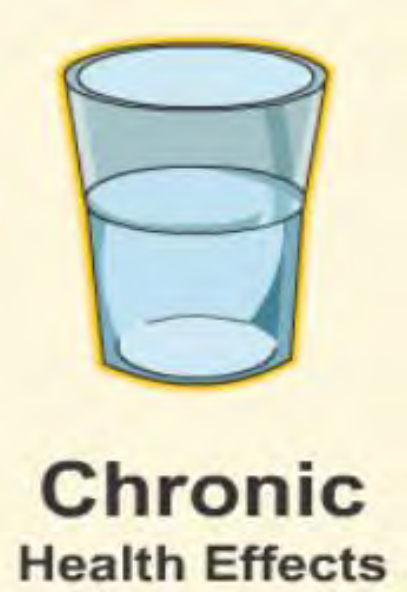
Acute health effects generally occur within hours or days of exposure and may result from consumption of very small amounts of water.

Problems develop over short-term exposure

Example: acute gastrointestinal illness

Types of Health Effects from Drinking Water Contaminants

Chronic health effects are usually a result of prolonged exposure to drinking water contaminants at low chemical concentrations.



Examples: cancers, organ damage

Problems develop over long-term exposure

Types of Exposure

- **Long-term exposure** – same people daily (communities, schools, workplaces) affected by:
  - Acute contaminants
  - Chronic contaminants
- **Short-term exposure** – different people daily (campgrounds, parks, motels, restaurants) affected by:
  - Acute contaminants
- EPA bases drinking water exposure on 2 liters per day

Forms of EPA Drinking Water Standards

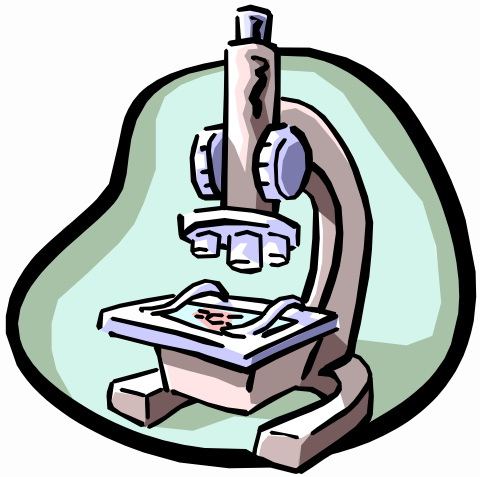
- **Maximum Contaminant Level (MCL)**
  - Enforceable standard set as close as feasible to the MCLG considering technology, treatment, cost, and field conditions
- **Treatment Technique (TT)**
  - Enforceable procedure or level of technological performance which PWSs must follow to ensure control of contaminants
- **Action Level (AL)**
  - Level which prompts further data collection and investigative actions by water supplier

Which Contaminants Does EPA Regulate?

Contaminants that:

- May have adverse effects on public health.
- Are known or likely to occur in public drinking water systems that have levels of health concerns.

Regulation presents meaningful opportunities for health risk reduction for persons served by public water systems.



Categories of Regulated Drinking Water Contaminants

- **7 Microbials** (bacteria, viruses, parasites)
- **7 Disinfection by-products** (trihalomethanes, haloacetic acids)
- **16 Inorganic chemicals** (arsenic, nitrate, lead)
- **56 Organic chemicals** (solvents, pesticides)
- **5 Radiological contaminants** (uranium)

Currently, over 90 contaminants are regulated.

Classification of Drinking Water Contaminants

Microbial Contaminants

- Bacteria
- Viruses
- Protozoa

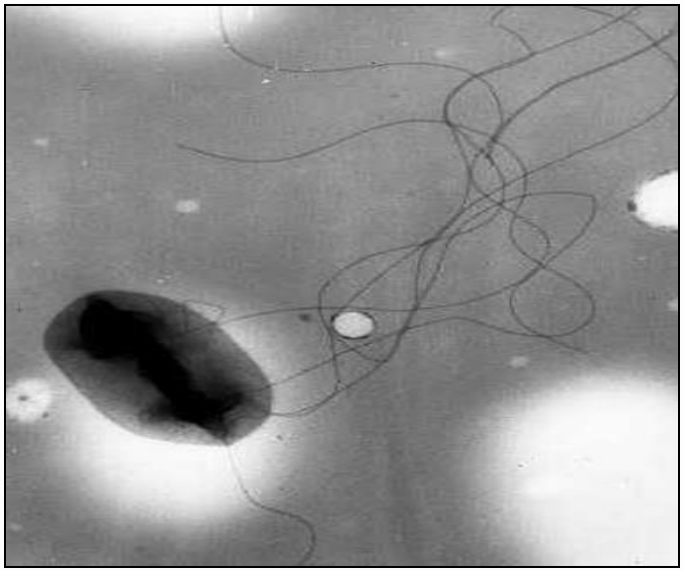
Chemical Contaminants

- Inorganics (IOC)
- Volatiles (VOC)
- Synthetics (SOC)
- Radionuclides

Let's review each of these

Microbial Contaminants – Bacteria

Bacteria are single-celled micro-organisms of many different shapes and sizes.



E. coli

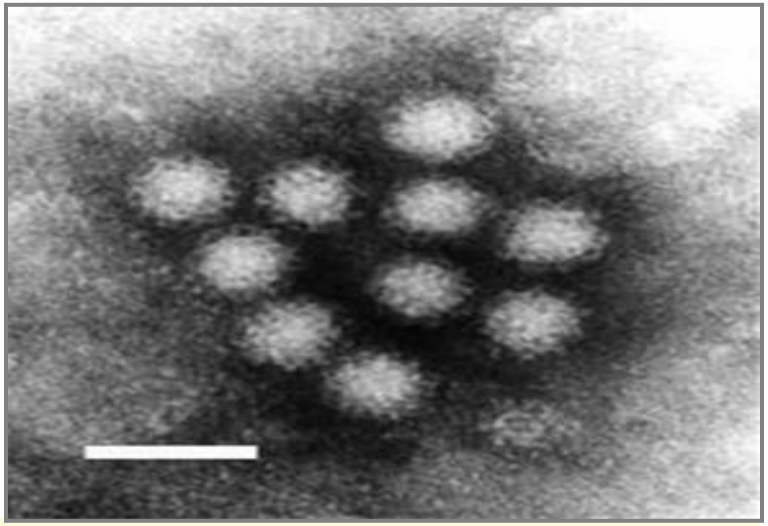
Bacteriological testing

Bacteria

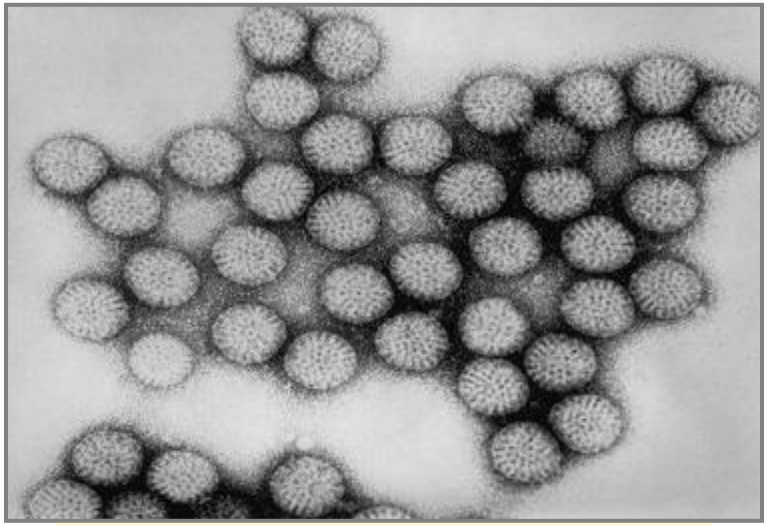
Some strains of *E.coli* are serious bacterial contaminants. *E. coli* is short for *Escherichia coli.*

Microbial Contaminants – Viruses

Viruses are comprised of complex molecules that have no independent metabolism and depend on living cells for reproduction.



Norwalk Virus

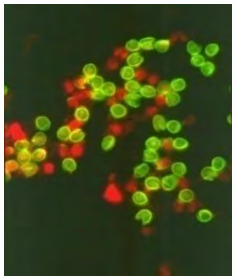


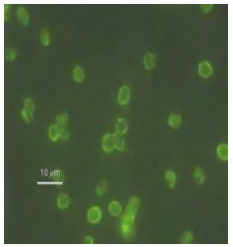
Rotavirus

Microbial Contaminants – Protozoa

Protozoa are composed of one-celled organisms within a cyst, which makes it difficult to treat.

Giardia lamblia





Cryptosporidium

Protozoa

The most common harmful protozoa are *Giardia lamblia* and *Cryptosporidium*.

Revised Total Coliform Rule

- **Applies to** – ALL types of public water systems
- **Purpose** – Increase public health protection by reducing potential pathways for fecal contamination to enter distribution systems.
- **Health Concerns** – acute gastrointestinal illness
  - Nausea, cramps, headaches, and diarrhea
  - Increased risk to infants, children, elderly, and immuno-compromised individuals

Total Coliform Bacteria

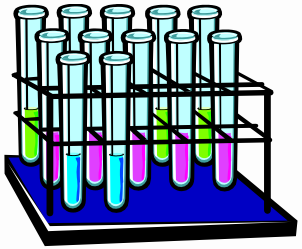
- **Stays in water longer than most disease-causing organisms**

- Elevated levels of coliform bacteria *suggest* problems in the system.
- Sources may include runoff, infiltration, leaching, inadequate disinfection, and others.

Negative coliform test on the left and positive on the right

Coliform Bacteria Indicator of Contamination

- **Total coliform test:** Most common test used to determine whether bacterial pathogens are present
  - Relatively **easy and inexpensive** to conduct
  - **Present or absent result** – easy to interpret
  - Used as an **indicator** of possible fecal contamination or the presence of other pathogens in the water system.
  - More specific testing can be done if needed.



Testing for viruses and protozoa is <u>not</u> routinely conducted because special methods and equipment are needed.

Microbial Contaminants and Potential Health Effects

Microbial Contaminant	*Type*	*Sources of Contaminant*	*Potential Health Effects From Ingestion Through Water*
Norovirus (Norwalk-like viruses)	Virus	Human feces Shellfish grown in polluted waters	Causes acute gastroenteritis. Is highly contagious. Symptoms include vomiting and diarrhea. Symptoms last 1 or more days.
Escherichia coli O157:H7 (or *E. coli* O157:H7)	Bacterium	Animal or human feces	Symptoms include diarrhea and occasionally kidney failure. Symptoms last 5 to 10 days.
Shigella	Bacterium	Human feces	Symptoms include diarrhea, fever and stomach cramps.
Giardia lamblia	Protozoan	Animal or human feces	Symptoms include cramps, nausea, and general weakness. Symptoms may last 2 to 6 weeks or longer.
Cryptosporidium	Protozoan	Animal or human feces	Symptoms include diarrhea, stomach pain, vomiting. Symptoms typically last 1 to 2 weeks.
Legionella pneumophila	Bacterium	Occurs naturally in fresh water. Can also grow in building water systems, e.g., air conditioning units.	Symptoms include cough, shortness of breath, fever, muscle aches, headaches. Diarrhea, nausea and confusion have been associated.

Source: Center for Disease Control https://www.cdc.gov/diseasesconditions/index.html

Drinking Water
Chemical Contaminants of Concern

Very small amounts of chemical contaminants can be harmful!

Organic Chemicals – SOCs

Synthetic Organic Chemicals are mostly man-made, carbon-based compounds that may be found in pesticides, herbicides, and fungicides.

Herbicide Container

Crop-Dusting Airplane

SOCs

SOCs or *synthetic organic chemicals* are common contaminants in water and are also used in the making of plastics.

Organic Chemicals – VOCs

The Volatile Organic Chemical contaminant group includes solvents, fuels, paints, and degreasers.

Paint

Fuels – Petroleum Products

VOCs

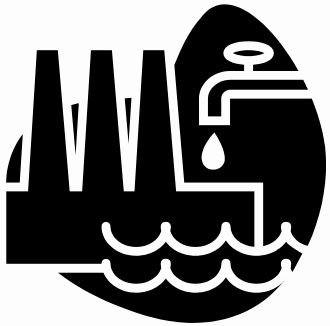
VOCs or *volatile organic chemicals* are man-made compounds that readily vaporize from water into the air at normal temperatures.

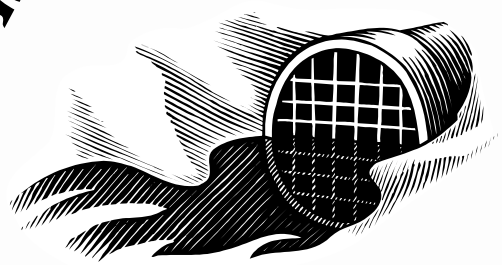
Inorganic Chemical (IOC) Rules

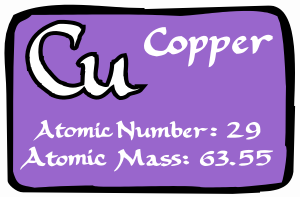
- **Apply to** – all Community and Non-Transient Non-Community water systems. Nitrate and arsenic sampling applies to all water systems.
- **Purpose** – protect public health by reducing exposure to 16 metals and minerals, both naturally occurring and from agriculture and industry. Nitrate and arsenic are of primary concern.
- **Health concern** – primarily chronic effects, including cancer, on organs, blood, and bones. Nitrate has acute effects on blood for infants.

Inorganic Chemicals – IOCs

Inorganic chemical contaminants come from naturally occurring minerals.







Salts

Iron Contamination

IOCs

IOCs or *inorganic chemicals* come from naturally occurring minerals such as salts, iron, and calcium, and from industrial contamination.

Radionuclide Rules

- **Apply to** – All community water systems
- **Purpose** – Protect public health by reducing exposure to 5 radioactive contaminants, both geologic and man-made. Rarely found in high levels in Oregon.
- **Health concerns** – Primarily cancer from long-term exposure

Radionuclides

Radionuclides

- Radionuclides are also contaminants of concern that can occur as a result of human activities or be from natural sources.
- Regulated radionuclides:
  - Gross Alpha
  - Radium 226/228/radon
  - Uranium

2.1 – Understanding Standards

Topics to Review

- What are drinking water standards?
- Maximum Contaminant Levels / Standards
- Action Levels
- Alert Levels for further testing
- Interpreting test results / units of measure
- Other useful standards

How Much Contamination Is Acceptable in Drinking Water?

Drinking Water Standards

- Limit the amount of contamination to a level considered “acceptable”

EPA sets the National Drinking Water Standards

- Uses the latest available research on health effects
- Considers feasibility and cost of analysis and treatment

Maximum Contaminant Levels / Standards – Review of Definitions

Term	Definition
Primary Standards	Standards that set enforceable limits on the amount of contamination allowed in public drinking water
Maximum Contaminant Levels (MCLs)	The maximum allowable level of a contaminant in water delivered to the users

Maximum Contaminant Levels / Standards – Review of Definitions (cont.)

Term	Definition
Secondary Standards	Standards that EPA sets as guidelines for aesthetic contaminants
Secondary Maximum Contaminant Levels	Recommended limits on contaminants that may affect taste, odor, color

Action Level

ACTION LEVEL

- A special standard set for lead and copper, that if exceeded requires some action by the water supplier

EXCEEDING AN ACTION LEVEL may require

- Customer notification (sometimes immediately)
- Additional testing
- Installation of equipment to reduce the contaminant

Alert Levels for Further Testing

Maximum Contaminant Level (MCL)

Enforceable limit

ACTION LEVEL

Requires additional steps to be taken

ALERT LEVEL

Set at ½ the MCL

Take Immediate Action

ALERT LEVEL

- Health risk, action may be required so contaminant does not reach the MCL!
- Set at ½ MCL for inorganic contaminants (e.g., nitrate > 50% of MCL)
- Set at the detection level for organic chemicals

Any time an Alert Level is EXCEEDED:

Inform OHA or the local regulatory agency

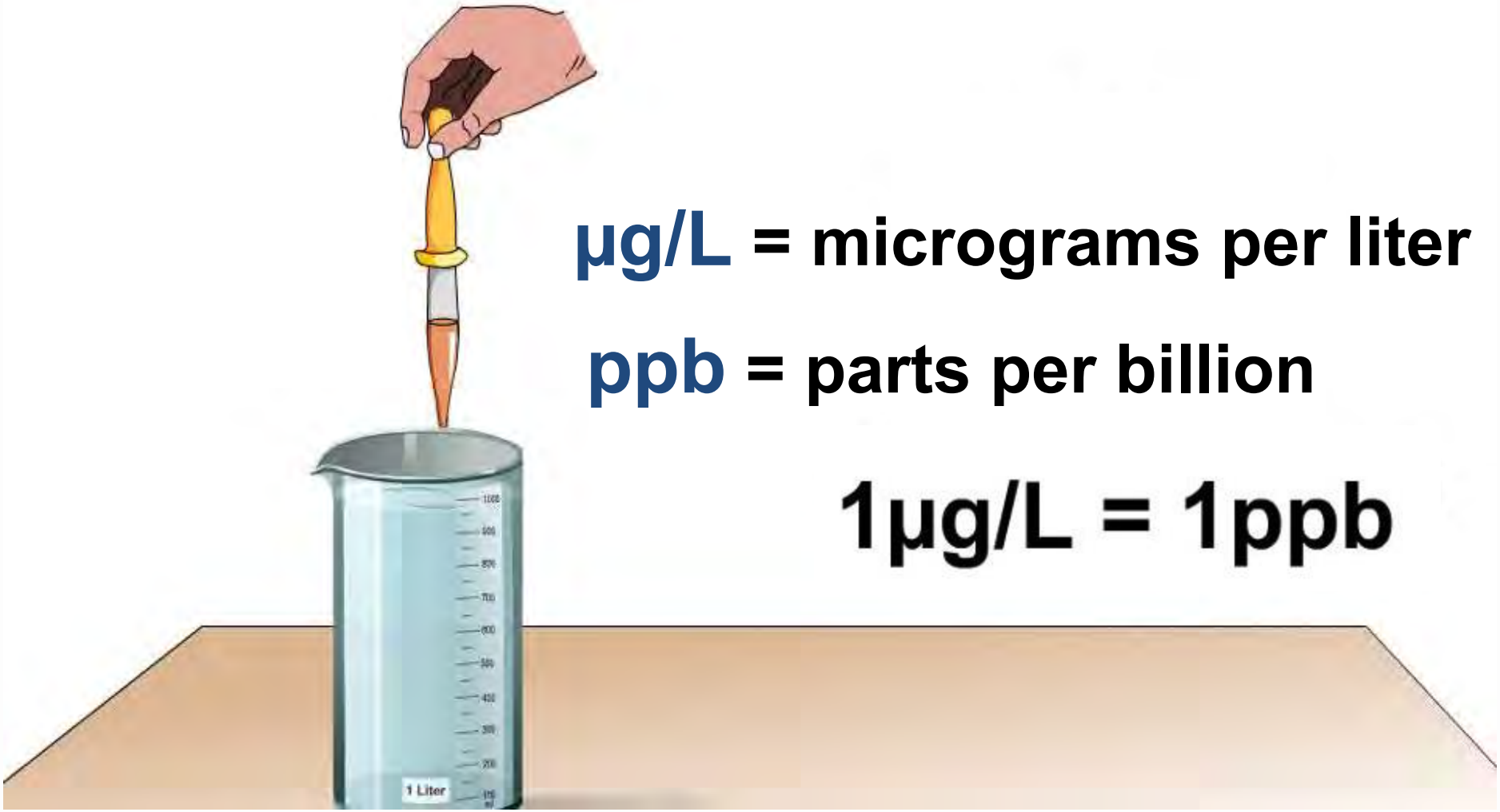
Interpreting Test Results
Units of Measure

mg/L = milligrams per liter

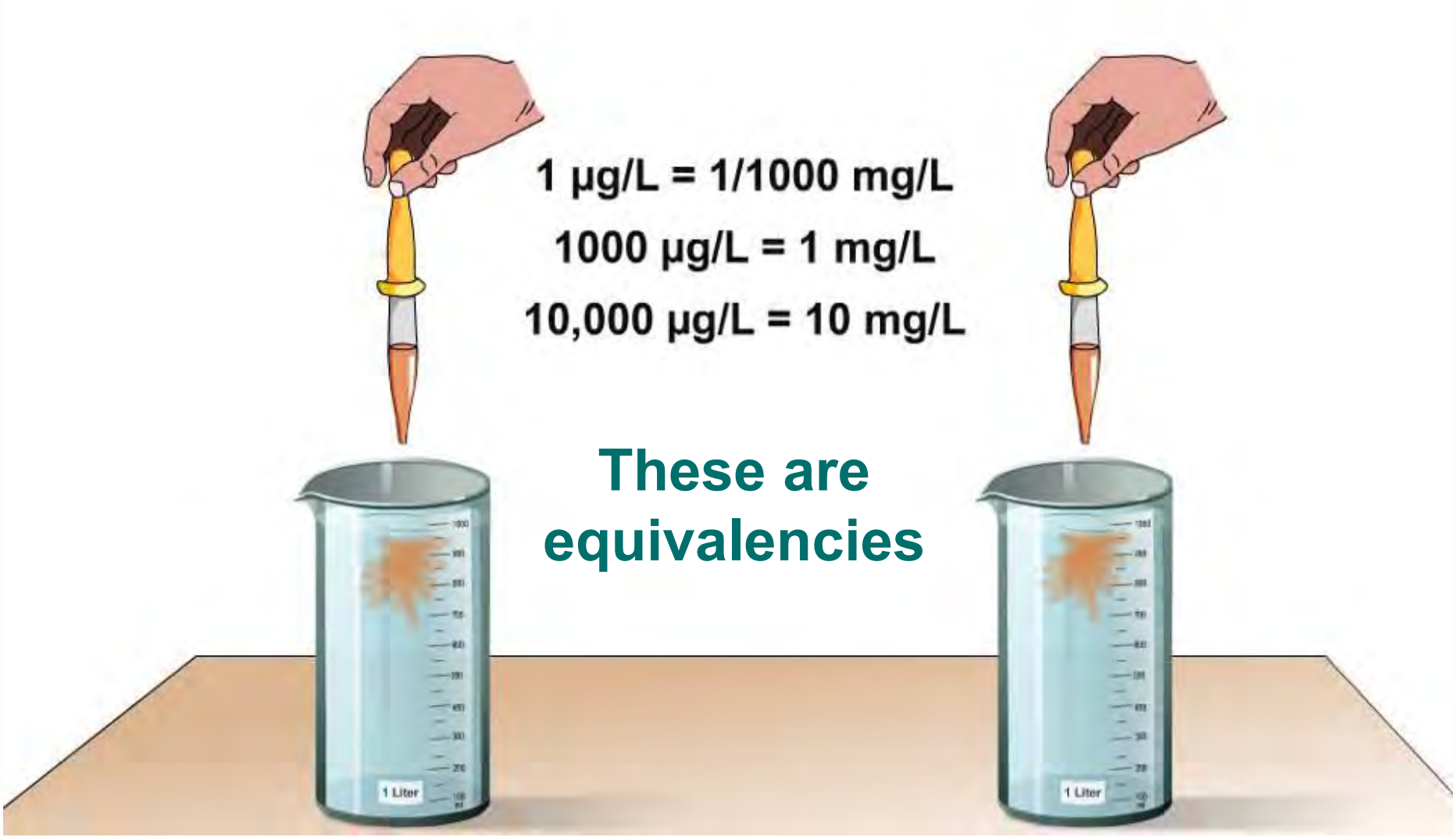
ppm = parts per million

1 mg/L = 1 ppm

Unit Ratios


µg/L = micrograms per liter
ppb = parts per billion
1µg/L = 1ppb
1 Liter

Unit Ratios


1 µg/L = 1/1000 mg/L
1000 µg/L = 1 mg/L
10,000 µg/L = 10 mg/L
These are equivalencies
1 Liter
1 Liter

Organizations That Produce Standards

National Sanitation Foundation

American Water Works Association

National Sanitation Foundation

National Sanitation Foundation

Water Distribution System Program

NSF/ANSI Standard 61:
Drinking Water System Components -- Health Effects

NSF/ANSI Standard 60:
Drinking Water Treatment Chemicals -- Health Effects

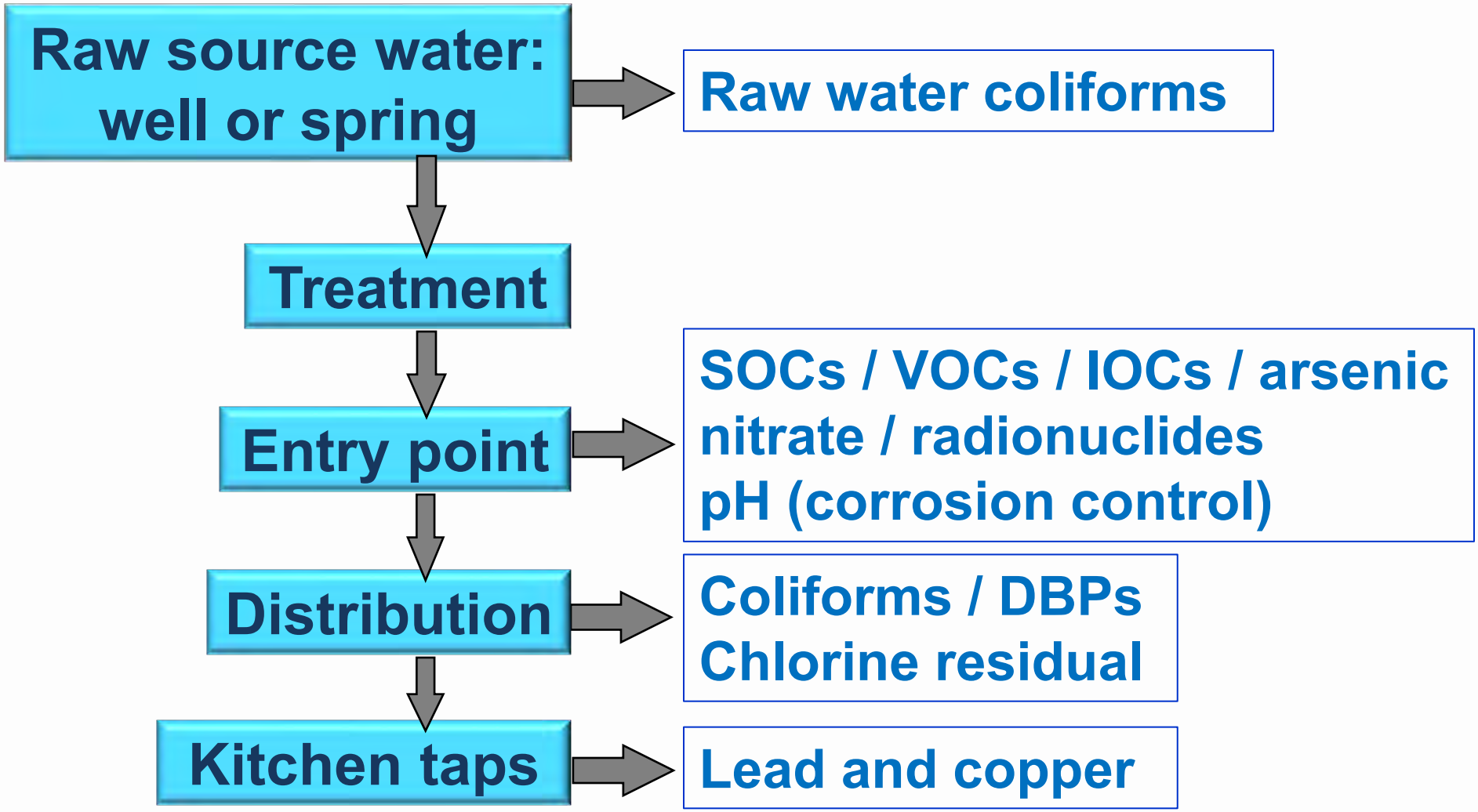
National Sanitation Foundation

Overview of Sampling and Reporting Requirements

Why Test?

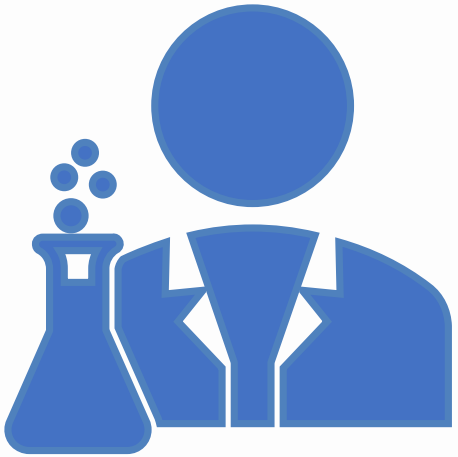
- To determine drinking water quality
- To detect water quality problems
- It's a legal requirement
- Failure to conduct tests could result in:
  - Customer health problems
  - Compliance violations
  - Financial penalties against the water supplier

Where to Sample



Who Can Test Drinking Water?

- Testing is the responsibility of the ***WATER SUPPLIER***
- Anyone familiar with recommended procedures may collect samples, including:
  - The operator (most common)
  - Someone trained by the operator
  - Contracted personnel (lab, operator)
  - State certified drinking water laboratory personnel



What Must Be Tested?

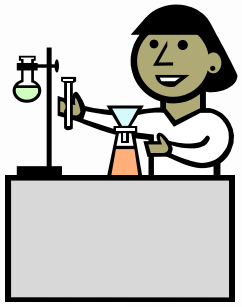
- Your ***water system classification*** determines which tests are required and at what frequency.
- Testing for small water systems includes:
  - Coliform (or microbial)
  - Inorganic chemicals (IOCs)
    - Nitrate and occasionally arsenic
  - Organic chemicals (Comm. & NTNC only)
    - Volatile Organic Chemicals (VOCs)
    - Synthetic Organic Chemicals (SOCs)
  - Radiologicals (Community water systems only)

How Often Do I Test?

- **Coliform testing frequency**
  - Depends on population served and system classification
  - Small water systems sample monthly or quarterly
- **Chemical testing frequency**
  - Varies greatly by individual contaminants
    - Yearly
    - Every 3 years
    - Possibly just once in 6 years or a 9-year compliance period if waiver(s) in place

What Laboratory Can I Use?

- **Must use a state-accredited lab**
- **For an updated list of accredited labs, see:**
  - http://public.health.oregon.gov/HealthyEnvironments/DrinkingWater/Monitoring/Pages/labs.aspx
  - Click on “Oregon Labs for Drinking Water and Public Testing”



Do I Need to Report Test Results?

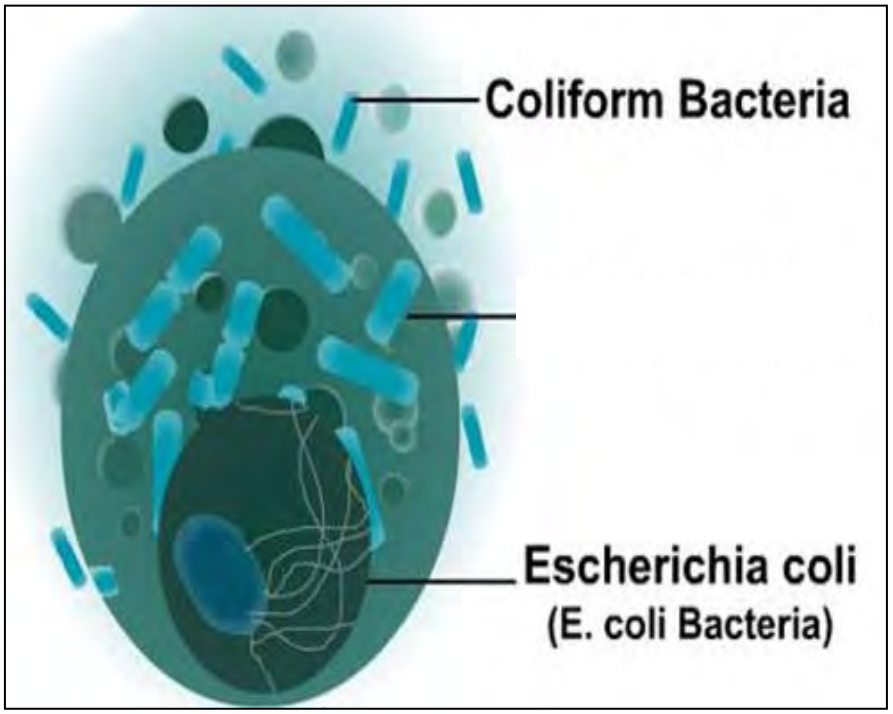
Report results to DWS
WITHIN 10 DAYS following the end of reporting period

The water supplier MUST:

- Report results directly to DWS or arrange for lab to report results to DWS
- Labs are required to report all MCLs (including positive coliform results) to DWS within 24 hours of notification

Coliform Sampling

Why Test for Coliform Bacteria?



- **Coliform bacteria** are an indicator bacteria – their presence is an indication of potential contamination pathways.
- ***E. coli*** bacteria are a type of fecal coliform bacteria.

Which Coliform Samples Must Be Collected and When?

TYPES OF DISTRIBUTION SAMPLES

Routine Samples

- Taken monthly or quarterly
- Results must be reported to DWS
- Three temporary routine samples must be collected the month following any positive routine results for systems on quarterly sampling schedule.

Repeat Samples

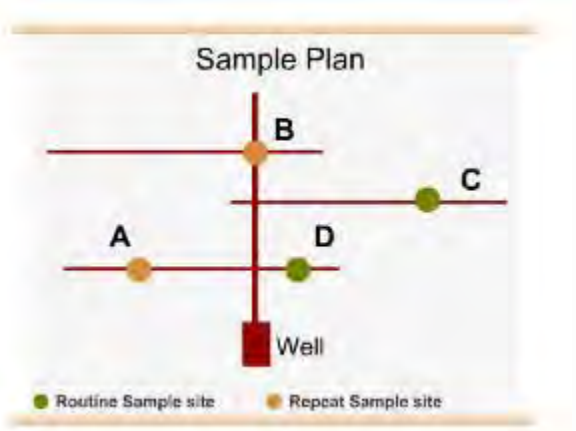
- At least three samples required, only after coliform is detected in a routine sample
- Report results to DWS within 10 days

Special Samples

- Taken after repairs or for other reasons

Where in the Distribution System Should Coliform Samples Be Collected?

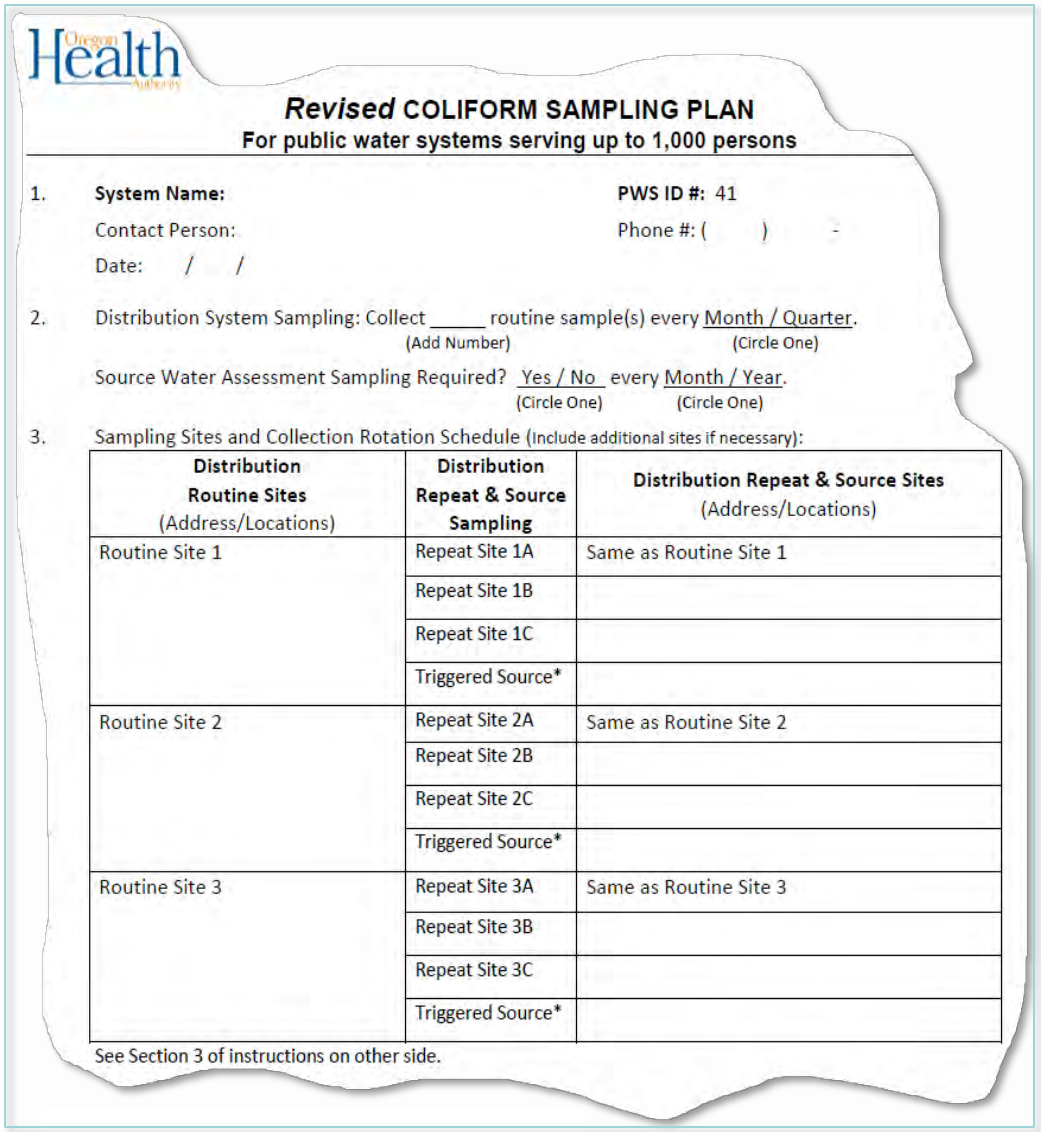
- Must be representative of the *entire* system over the course of a year:
  - Identify ROUTINE sample site locations.
  - Identify REPEAT sample locations that correspond to each routine site.



WELL

Routine Sample Site **Repeat Sample Site**

What Is a Coliform Sampling Plan?



Oregon Health Authority

***Revised* COLIFORM SAMPLING PLAN**

For public water systems serving up to 1,000 persons

1. **System Name:** **PWS ID #:** 41
   Contact Person: Phone #: ( ) -
   Date: / /

2. Distribution System Sampling: Collect _____ routine sample(s) every Month / Quarter.
   (Add Number) (Circle One)
   Source Water Assessment Sampling Required? Yes / No every Month / Year.
   (Circle One) (Circle One)

3. Sampling Sites and Collection Rotation Schedule (Include additional sites if necessary):

Distribution Routine Sites (Address/Locations)	**Distribution Repeat & Source Sampling**	**Distribution Repeat & Source Sites** (Address/Locations)
Routine Site 1	Repeat Site 1A	Same as Routine Site 1
	Repeat Site 1B	
	Repeat Site 1C	
	Triggered Source*	
Routine Site 2	Repeat Site 2A	Same as Routine Site 2
	Repeat Site 2B	
	Repeat Site 2C	
	Triggered Source*	
Routine Site 3	Repeat Site 3A	Same as Routine Site 3
	Repeat Site 3B	
	Repeat Site 3C	
	Triggered Source*	

See Section 3 of instructions on other side.

The **coliform sampling plan** guides the water operator in selecting routine sampling sites to ensure that sampling and coliform testing is conducted at representative points throughout the system.

Three Types of Source Samples

- **Triggered Samples**
  - Taken at the source after a positive routine sample
- **Assessment Samples**
  - Ongoing, periodic sampling (either annually or monthly) not tied to previous test results
- **Confirmation Samples**
  - Taken immediately after an *E. coli* positive source sample

Filling Out a Laboratory Form

Oregon Health Authority

State of Oregon - Drinking Water Services
Microbiological Analysis (Coliform) Reporting Form for Public Water Supplies (v3.3)

PWS# 4 1 _____
PWS Name: _____
City, County: _____
Phone: _____ Fax: _____

Return address for report:
Name: _____
Address: _____
City, State, Zip: _____

ORELAP#:
Lab Name:
Address:
Phone/Fax:

Bottle#: _____
□ Results do not meet NELAC Standards-See page 2
Lab Sample ID#: _____

Sample Collected Date/Time: ____ / ____ / ____ ____ : ____
MM DD YYYY Hour : Min
□ AM □ PM
Chlorinated: □No □Yes
Free Chlorine: _____ mg/L
Collected By: _____

DISTRIBUTION Sample Type: □ **Routine** □ ***Repeat** □ **Temporary Routine** □ **Special**

*Date of Initial Positive: ____ / ____ / ____ (MM / DD / YYYY)
*Original Positive ID#: _____
Address: _____
Sampled at (ex. "SINK"): _____

SOURCE Sample Type: □ ***Triggered** □ ***Confirmation** □ **Assessment** □ **Special**

*Date of Initial Positive: ____ / ____ / ____ (MM / DD / YYYY)
*Original Positive ID#: _____
Source ID: **SRC-** _____
Source name (ex. "WELL #1"): _____

How To Fill Out a Lab Slip

- **Public water system number (PWS#)** – Enter the ID number for the system being sampled.
- **PWS Name** – Enter full name of the sampled system.
- **City, County** – Enter city and county where system is located.
- **Phone** – Enter the phone number that the lab should call if they have questions about the sample or to report results.
- **Return Address** – Enter mailing address for test results.

How to Fill Out a Lab Slip (cont.)

- **Sample Collection Date/Time** – enter date and time the sample was collected, check AM or PM
- **Collected By** – Enter the name of the person who collected the sample.
- **Sample Point** – Enter a description of the sample location, such as “123 Main St. hose bib.”
- **Sample Type** – Check box under the distribution or source heading, as appropriate.
- **Chlorinated?** – Check “yes” if chlorinated, “no” if not.

How to Fill Out a Lab Slip (cont.)

- **Free Chlorine –** If the system is chlorinated, use a DPD test kit to measure the free chlorine residual at the site in the distribution system, then enter result. If sampled from source or raw water, leave blank.
- **Date of initial positive –** If the sample was collected as a repeat, enter the date the original positive routine sample was collected, otherwise leave blank.
- **Original Positive ID# -** enter the sample number of the initial positive routine sample, otherwise leave blank.

Collect the Sample – Send It to the Lab

Use only lab-provided sample bottles for bacteriological sampling

- Flush the line thoroughly for 3-5 minutes.
- Conduct chlorine residual test if your water is chlorinated.
- Reduce the water flow to a slow, steady stream.
- Uncap the sample bottle and hold the inside of the lid down while collecting sample.
- Fill the sample bottle and leave an air space in top of bottle. Do not overfill.
- Replace the cap immediately.
- Package the sample for delivery to the laboratory and include the lab form. Transport the sample on ice packs.
- Mail or deliver the sample to the lab immediately. Samples over 30 hours old will not be analyzed.

What Action Is Needed When a Sample Is Positive?

- Notify your Regulatory Agency *within 24 hours*.
- Take REPEAT and TRIGGERED source samples *within 24 hours*.

Laboratories must report all positive results to DWS within 24 hours to: (Fax) 971-673-0694

Do these things *BEFORE* taking any corrective action

Follow-Up Coliform Sampling

- **Number of repeat samples**
  - Three repeat samples required for systems collecting one routine sample per month or quarter (i.e., systems with <1000 population)
- **Location of repeat samples**
  - One from the same location as the original positive sample; at least one within five service connections upstream and at least one within five service connections downstream from the original positive site
- **Triggered source sample(s)**
  - One from each active source *(unless system is implementing GWR compliance monitoring [4-log] virus inactivation)*
- **Number of temporary routine samples**
  - Three temporary routine samples the **month following a positive result** (when on a quarterly sampling schedule)

Revised Total Coliform Rule (RTCR)

The RTCR takes a "find and fix" approach

Level 1 investigation: Water system identifies and corrects possible contamination pathways and submits the OHA-DWS form. A Level 1 investigation is triggered by:

- Confirmed total coliform, or
- Failure to take all required repeat samples after one routine TC+.

Level 2 investigation: This approach is more detailed and is conducted by a regulator. A Level 2 investigation is triggered by:

- Confirmed *E. coli,*
- Continued total coliform present results over time, or
- Failure to conduct a Level 1 investigation.

Revised Total Coliform Rule (RTCR) cont.

- Public Notification
  - No longer required for total coliform results
  - Required for *E. coli* violation
  - Required for failure to conduct investigation or take corrective action
- Seasonal systems
  - Must complete and submit a seasonal start-up checklist to DWS. Checklist is located at:

    https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/DRINKINGWATER/RULES/Documents/revisedcoliform/seasonal-start-up-checklist.pdf
  - Must sample for coliform monthly

Inorganic Chemical Sampling

Why Sample for Inorganic Chemicals?

Inorganic Chemicals (IOCs)

- Include salts, metals, and minerals
- Many pose health risks
- Many are primary contaminants
- Usually of mineral origin or are by-products of agriculture, industry, or commerce.

What Are the Health Effects of IOCs?

Wide range of symptoms and adverse health effects:

- **Nitrate**
  - Acute: Nitrate converts to nitrite and interferes with the oxygen-carrying capacity of blood. Signs and symptoms include shortness of breath and blue skin. Condition is known as *blue-baby syndrome*.
- **Arsenic**
  - Acute: Thickening and discoloration of skin, lower GI tract symptoms, paralysis, blindness
  - Chronic: Cancer – skin, nasal passages, bladder, lungs, kidney, liver, and prostate

- **Lead and Copper**
  - Lead: Nervous system and overall child development, cancer, stroke, high blood pressure
  - Copper: Severe stomach cramps and intestinal illness

How Often Must IOC Samples Be Collected?

- **All Systems** must collect nitrate samples annually.
- **Community and NTNC Systems**
  - The IOC group is tested once during each 3-year period. See *Chemical Schedule Detail* for your system in Data Online.
  - Sampling frequency for individual contaminants may vary within the 3-year cycle.
  - IF your system has a history of no MCL violations in three rounds of testing, you may apply for reduced monitoring (contact DWS or county health department).
- See the chemical monitoring facts sheets (online) for list of IOCs and details on testing frequencies.

What Are the Lead and Copper Sampling Requirements?

Applies to Community and NTNC systems only

Initial Tap Sampling

- Systems with population < 100
  - **5 samples**
- Systems with population 101 to 500
  - **10 samples**
- Systems with population 501 to 3300
  - **20 samples**

Future sampling schedules are determined based on initial and ongoing tap sample results.

How Do I Sample for Lead and Copper?

1. Get sample kits from the lab.
2. Instruct customers on how to take the sample.
   - Must be a “first draw” sample from a representative drinking water faucet.
   - 6+ hour water detention time before the “first draw.”
3. Fill out “chain of custody.”
4. Collect the samples.
5. Fill out the laboratory form.
6. Submit to laboratory for analysis.

Organic Chemical Sampling

Why Sample for Organic Chemicals?

ORGANIC CHEMICALS

- More than 100 organic chemicals are regulated. Most are from industrial activity, landfills, gas stations, and pesticide use.
- Many may cause cancer and all have harmful health affects with sufficient dose.

Characteristics of Organic Chemicals

Organic Chemicals

Volatile Organic Chemicals (VOCs)

Vaporize into the air at normal temperatures

Inhalation and drinking hazard

May produce an odor

Synthetic Organic Chemicals (SOCs)

Mostly man-made, carbon-based compounds

Most are pesticides

Do not readily escape into the air from water

What Are the Health Effects of Organic Chemicals?

Range of symptoms and adverse health effects for VOCs and SOCs include:

- May cause cancer even at very low levels (µg/L: ppb)
- Can be inhaled or absorbed through the skin
- May cause damage to liver, kidneys, nervous system, and circulatory system

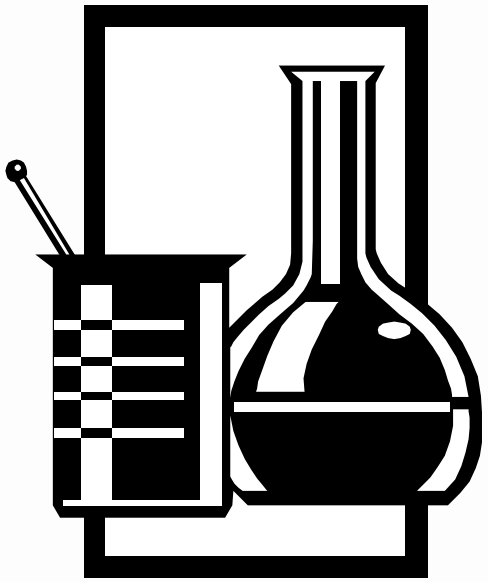
How Often Must Organic Chemical Samples Be Collected?

- **Community and NTNC water systems only:**
  - Initial monitoring for groundwater systems is annual. After three rounds of testing the system may qualify for a 3-year testing schedule.
  - Individual contaminant sampling frequency may vary within the 3-year period for individual contaminants.
- See the document ***Routine Chemical Monitoring*** for a list of organic chemicals and details on testing frequency.

Find details about your organic chemical testing schedule at Drinking Water Data Online:

https://yourwater.oregon.gov/

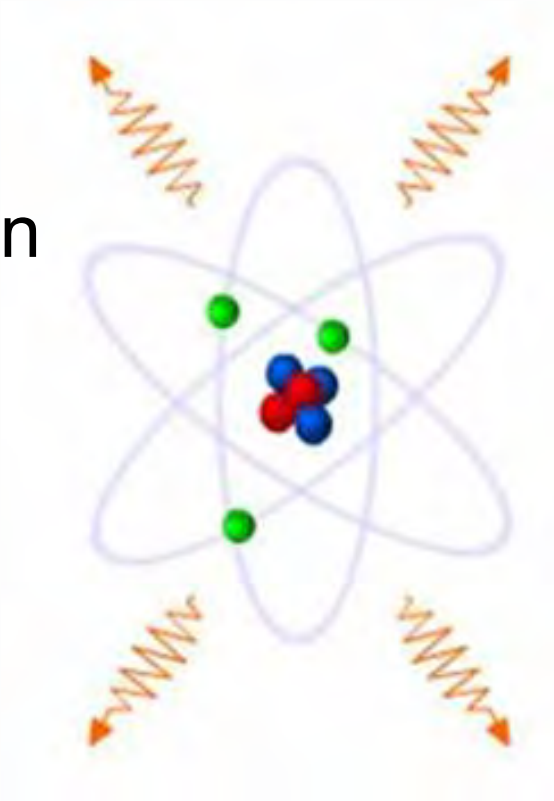
How Do I Sample for Organic Chemicals?



- Procedure varies depending on whether it is a VOC or SOC test.
- Laboratories supply the test kits with instructions.
- Follow the instructions!
- Laboratories may also have sampling services available.

Radionuclides

- May cause adverse health effects that may lead to cancer
- Occur naturally in water from radium, uranium, and radon
- Can be released by man-made sources
- This testing is *required only for Community PWSs*



Disinfectant By-Products (DBPs)

For systems that add chlorine or other disinfectants:

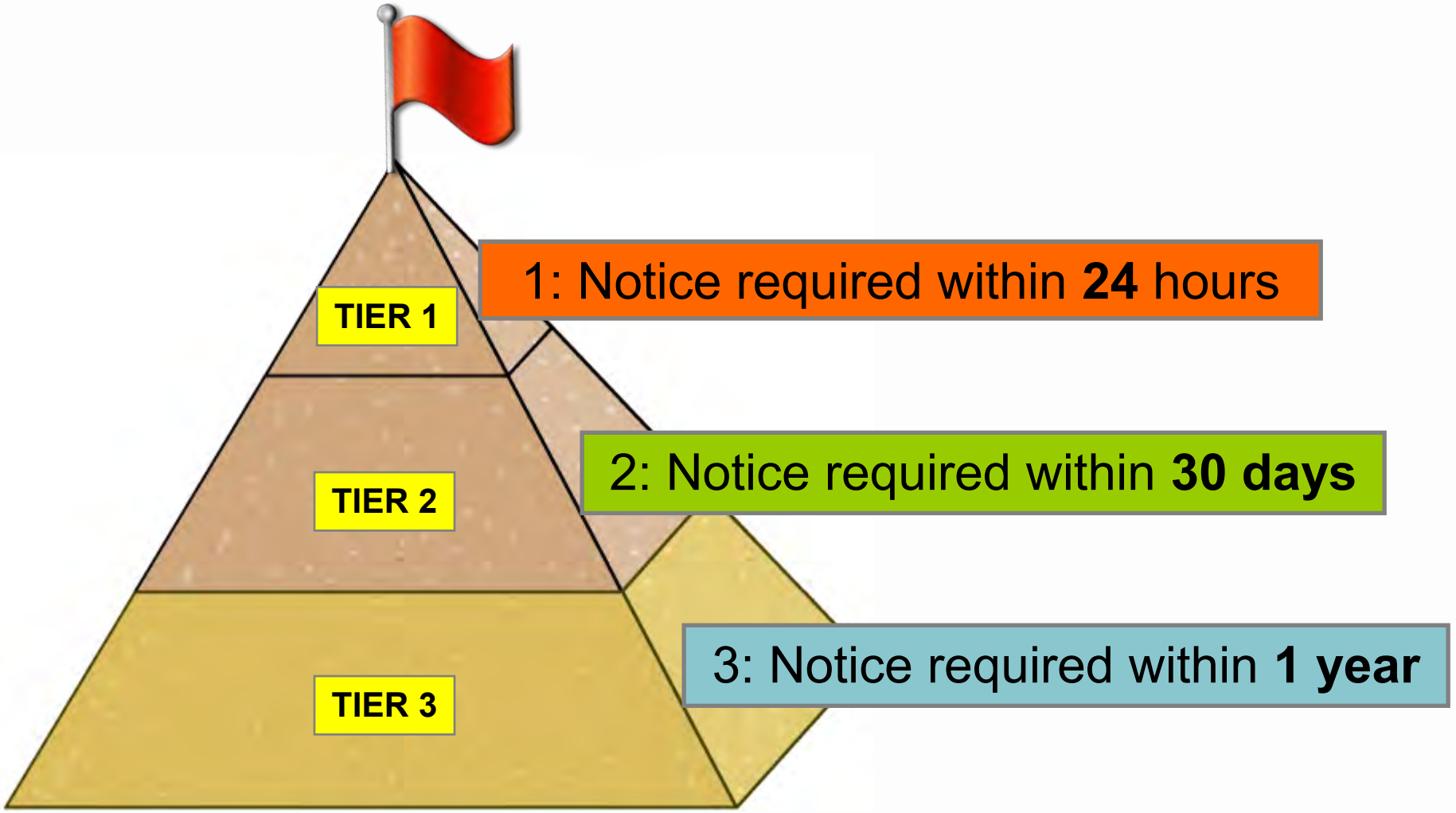
- DBPs may form when disinfectant reacts with organic substances in the water.
- Regulated DBPs include:
  - Trihalomethanes (TTHMs)
  - Haloacetic Acids (HAA5s)
- DPBs pose a significant health risk.

2.3 – Public Notice Requirements

- **Topics to Review**
  - Public notice frequently asked questions (FAQs)
  - Available templates

Public Notice FAQs

What Are the Three Tiers of Public Notice?



Specifics for Tier 1 Public Notice

- **Tier 1** public notice is required for:
  - Violations of the primary drinking water standards – **immediate notice is required (within 24 hours)**
  - Water systems that have significant potential to have serious adverse effects on human health as a result of short-term exposure (e.g., waterborne disease outbreak, presence of fecal coliform or *E. coli,* or nitrates above the MCL)
  - Loss of pressure (less than 20 psi)

Tier 1: Notice within 24 hours required

Specifics for Tier 2 Public Notice

- Notice required for **Tier 2** as soon as possible, but must be in less than 30 days
- Required for all other water quality violations and situations with potential to have serious adverse effects on human health, such as:
  - Chemical MCLs exceeded
  - Treatment technique (TT)
  - Coliform investigation not completed

Tier 2: Notice required within **30 days**

Specifics for Tier 3 Public Notice

- **Tier 3** public notice must be issued within 1 year of the violation or situation.
  - Community public water systems may use their annual Consumer Confidence Reports (CCR) to detail all violations and situations that occurred during the previous twelve months.
- Required for all other water quality violations not applied as Tier 1 or Tier 2 violations

Tier 3: Notice required within **1 year**

2.4 – Consumer Confidence Reports

(Community water systems only)

- **Topics to Review**
  - Consumer Confidence Reports (FAQs)
  - Available templates

Consumer Confidence Reports (CCRs)

What is a Consumer Confidence Report?

- A CCR is an annual report to customers on the system's water source, water quality, and operations.
- Required for all Community water systems.

When Must the Report Be Distributed and Certified?

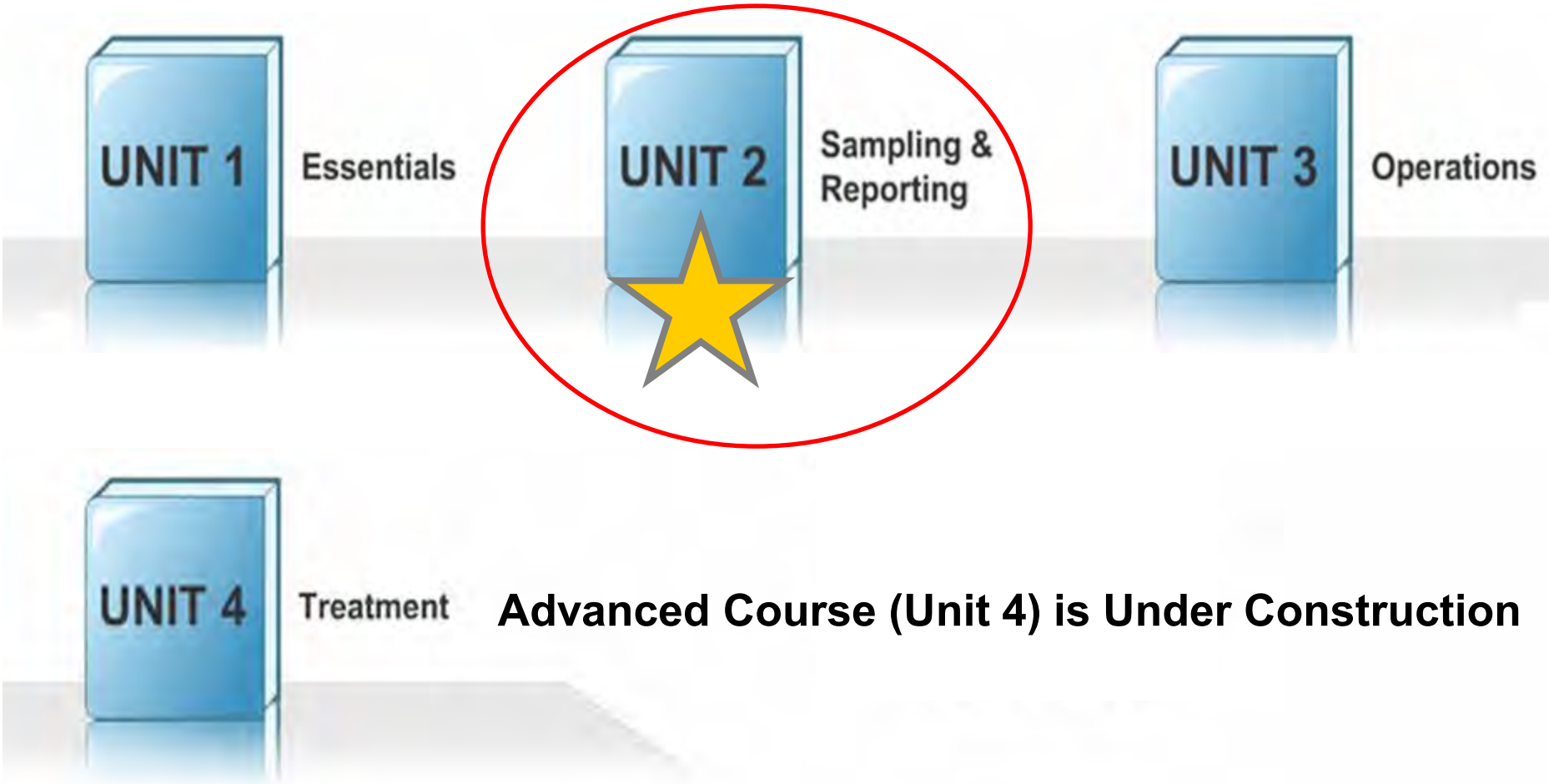
- Due date for CCR to customers and DWS.
  - **July 1 of each year to cover the previous calendar year**
- Due date of certification form to DWS
  - **October 1 of each year**

Consumer Confidence Reports and Available Templates

https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/DRINKINGWATER/MONITORING/Pages/ccr.aspx

Basics for Small Water Systems in Oregon

You've completed UNIT 2. WAY TO GO!



Advanced Course (Unit 4) is Under Construction

UNIT 3 – OPERATIONS

3.1 – Disinfection and Treatment Methods

3.2 – Developing and Maintaining an O&M Manual

3.3 – Developing and Maintaining an Emergency Response Plan

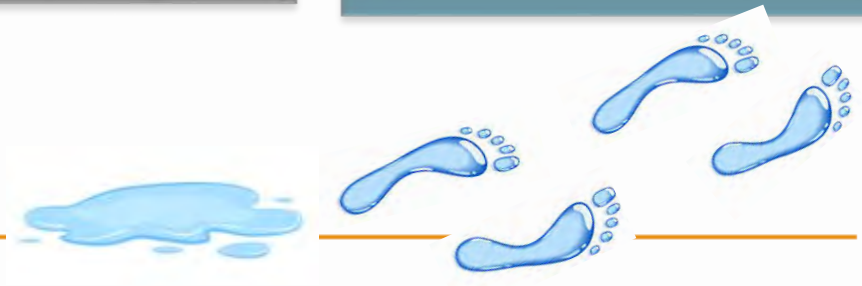
3.4 – Recordkeeping

3.5 – Shock Chlorination Procedure for Wells

3.6 – Leak Prevention and Repair

3.7 – Distribution System Operation and Maintenance

3.8 – Cleaning and Maintenance of Storage Tanks

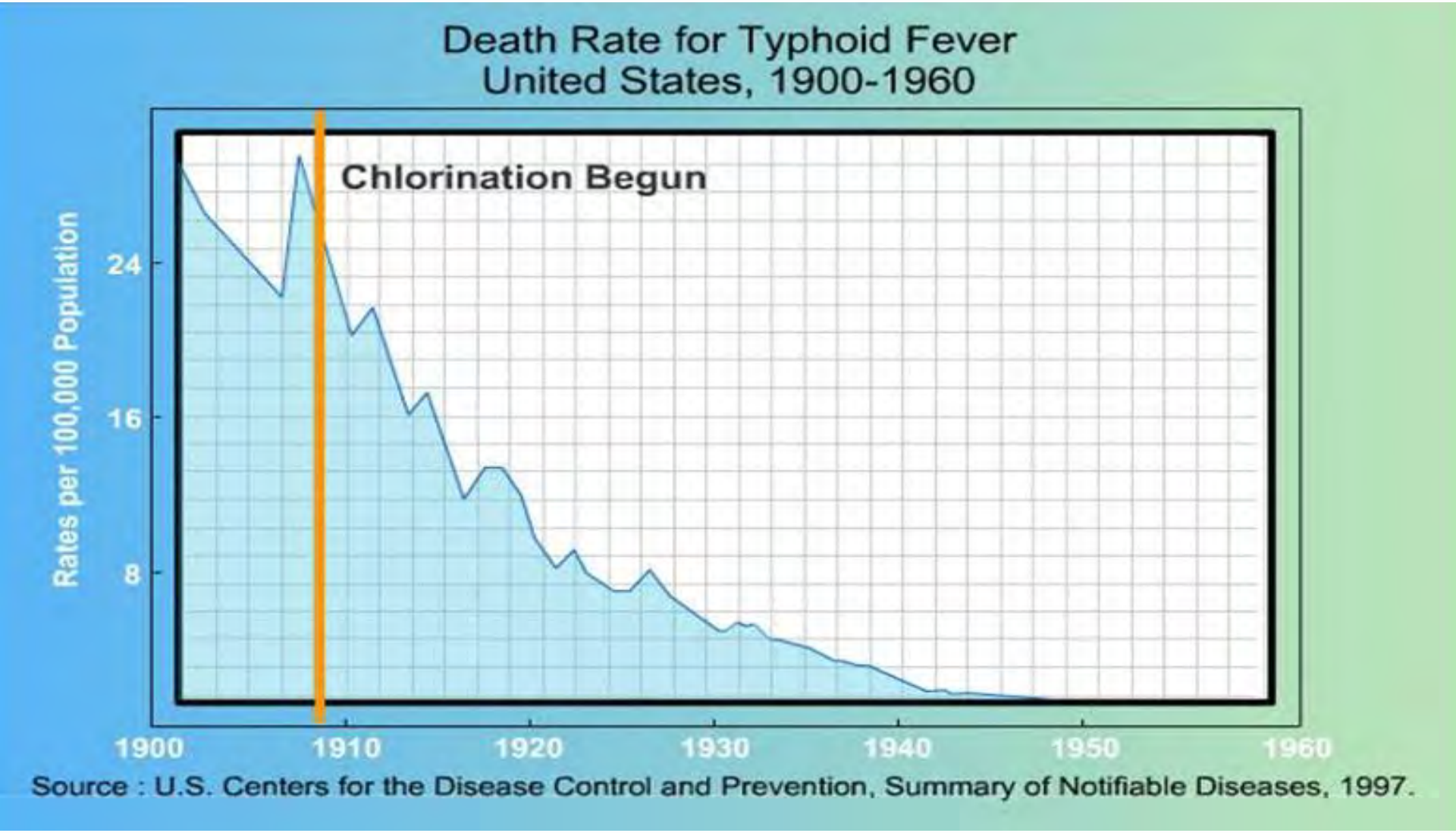


3.1 Disinfection and Treatment Methods

Topics to Review

- Chlorine
- Ultraviolet light
- Ozone
- Iron and manganese removal
- Corrosion control
- Nitrate removal
- Arsenic removal
- Filtration

Introduction to Chlorination



Advantages and Drawbacks of Chlorination

Advantages:

- HIGHLY EFFECTIVE against MOST waterborne diseases
- Relatively low cost
- Reduces taste and odor problems
- Used as an oxidizing agent for iron, manganese, and hydrogen sulfide

Drawbacks:

- Chlorine is a potential carcinogen
- Chlorine + Organic matter = Disinfection-By-Products (DBPs), potential carcinogens
- Perceivable taste and odor at a sufficient concentration

When Using Chlorine, Consider…

- **Factors influencing effectiveness of chlorine:**
  - pH level
  - Temperature
  - Free chlorine residual
  - Contact time
  - Interfering agents

- **Products must have National Science Foundation (NSF) standard 60 certification noted by certified logo or equivalent.**

What Happens When Chlorine Combines With Water?

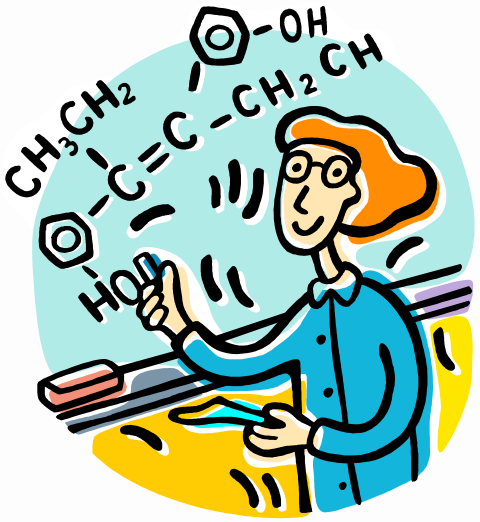
$$Cl_2 + H_2O = HOCl + OCl^-$$

Cl_2 = Chlorine

H_2O = Water

HOCl = Hypochlorous acid

OCl^- = Hypochlorite ion



Chlorine Definitions

Chlorine Demand

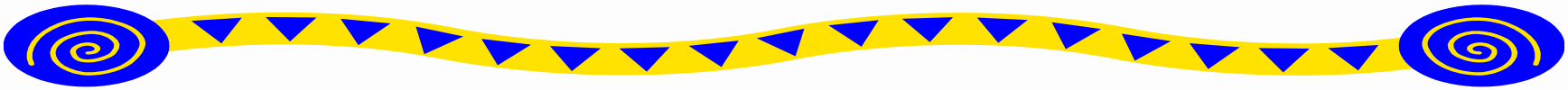
The amount of chlorine that is **used up in inactivating micro-organisms**

Chlorine Residual

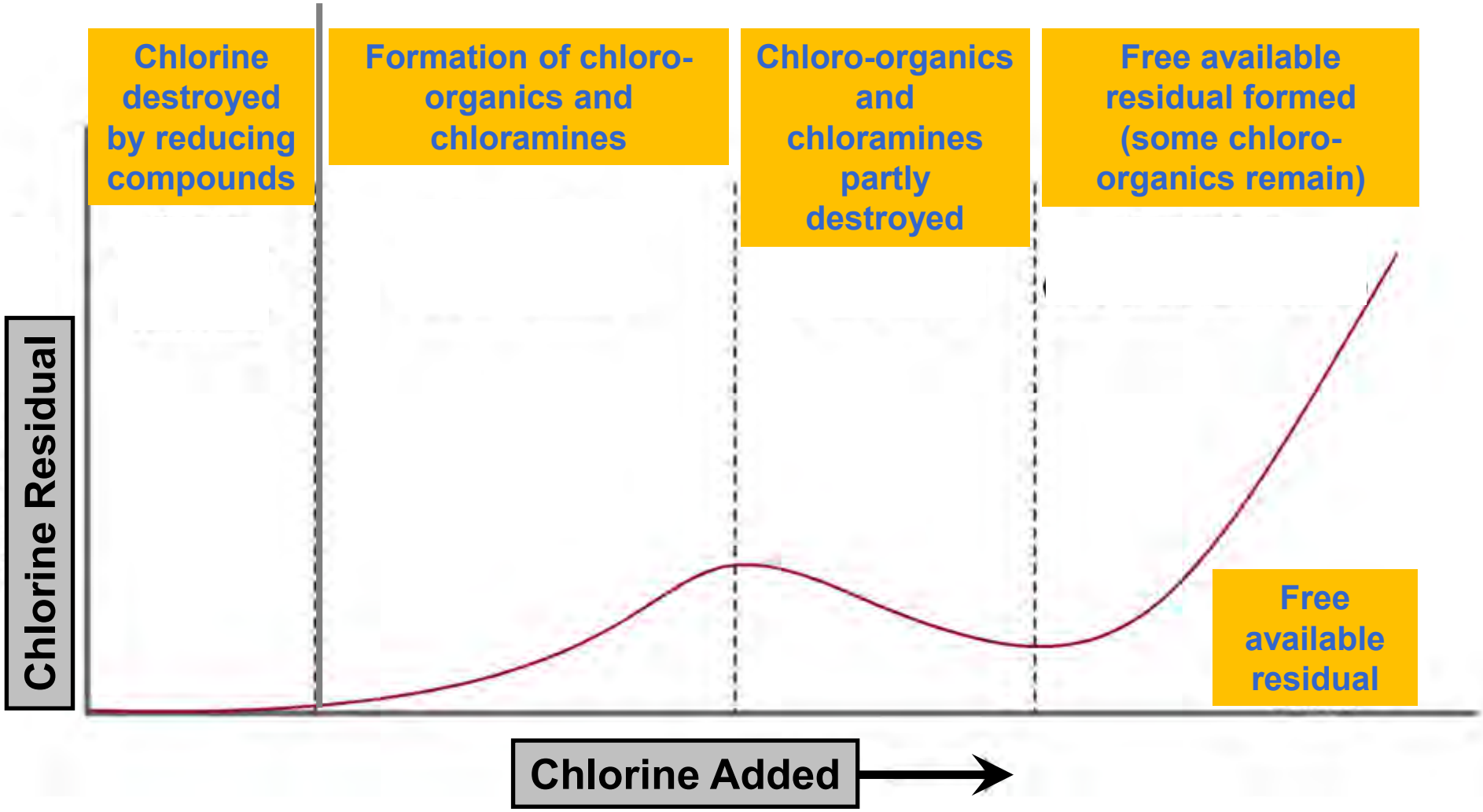
The amount of chlorine that is **left over after the micro-organisms are inactivated**

How Does Chlorine Work?

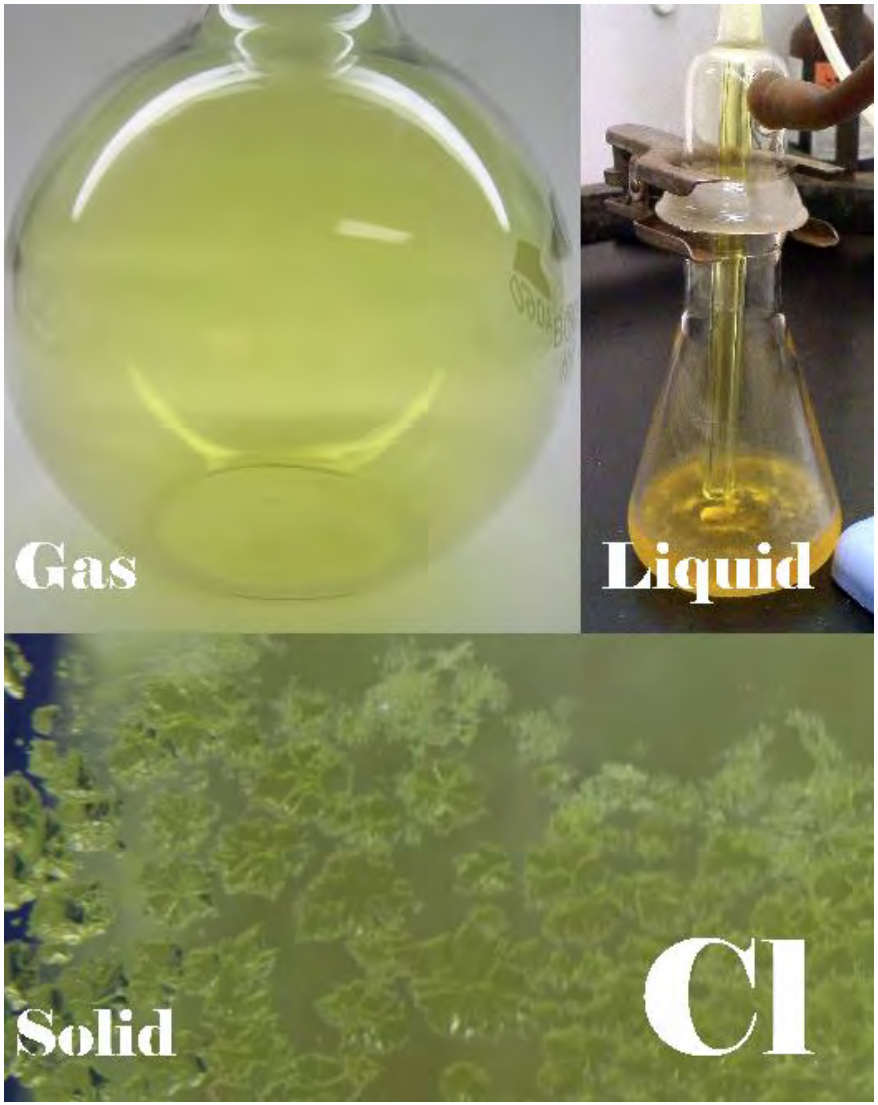
Dose = Demand + Residual

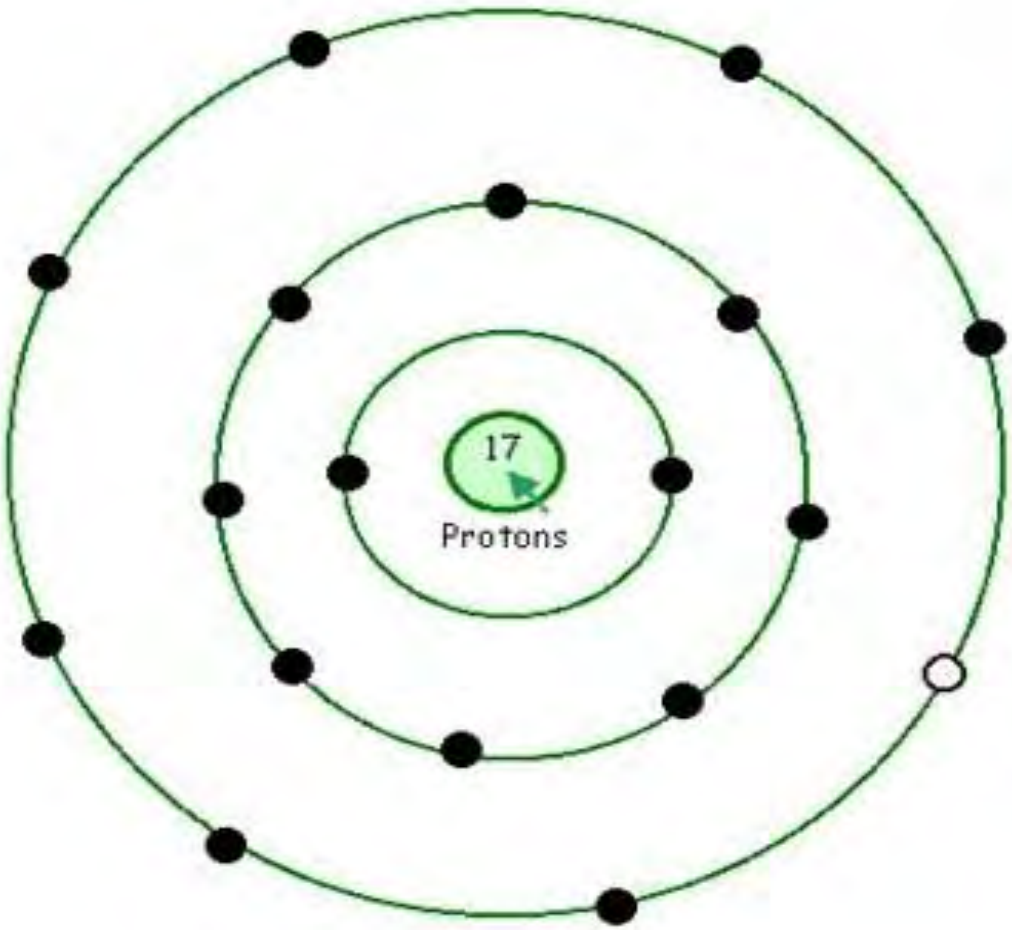


Breakpoint Chlorination



Forms of Chlorine





Dry Chlorine

Occurs as **calcium hypochlorite**. Usually found in powder or tablet form, it contains about 65% chlorine by weight. Solid form is mixed with water to achieve desired strength and then fed into the water system using a small pump.

- **Advantages**
  - Cost and ease of use
- **Disadvantages**
  - Produces an inconsistent chlorine residual
  - Can react violently with chlorine products and some organic materials

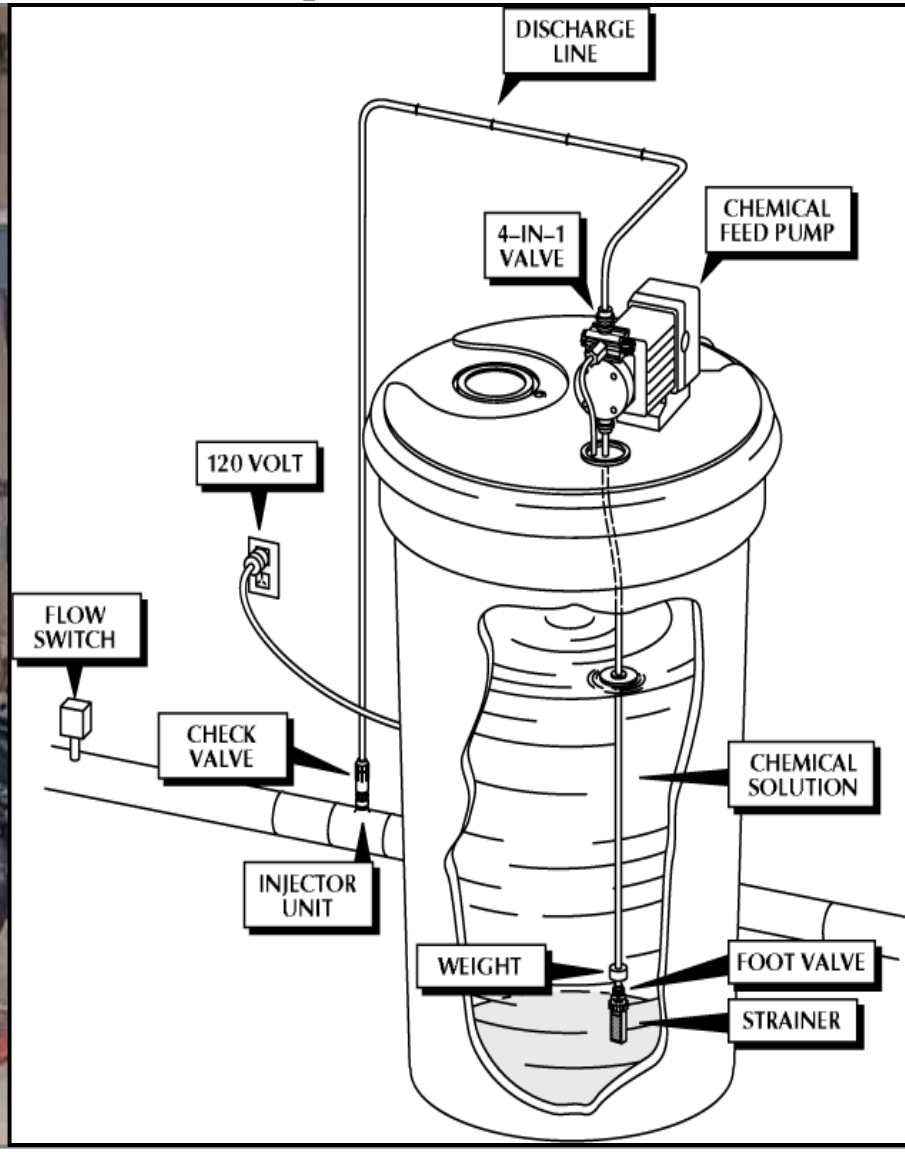
Dry Chlorine Example

Liquid Chlorine

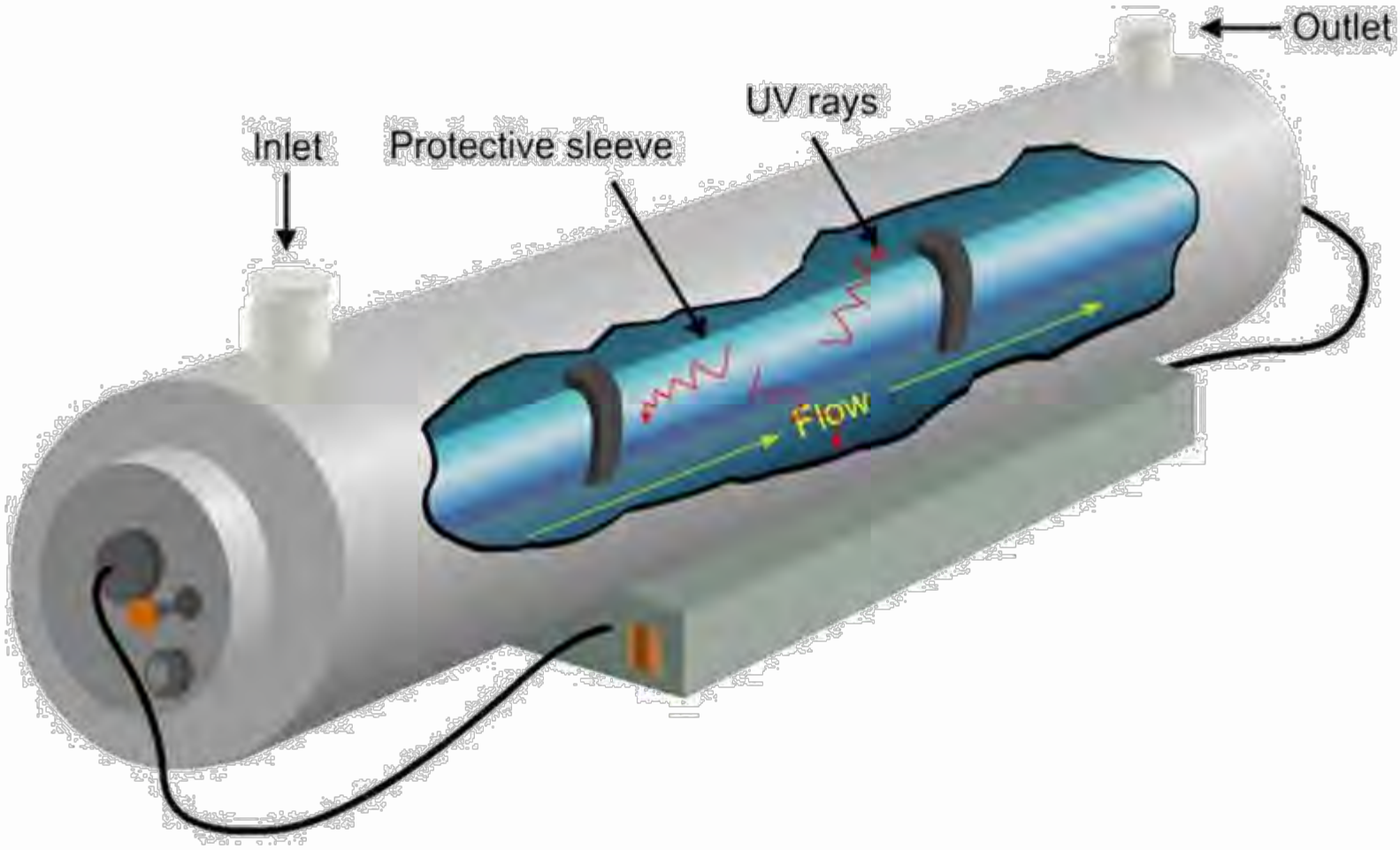
Liquid chlorine is a clear, light-yellow chemical called **sodium hypochlorite**. It is available in industrial strengths of 12.5% and 15% chlorine by volume. It is mixed with water to reach the desired strength, then fed into the water system with a small pump.

- **Most commonly used form of chlorine**
- **Advantages**
  - Low cost and ease of use
- **Disadvantages**
  - Loss of potency over time
  - Safety issues because of its corrosive nature

Liquid Chlorine Examples



Ultra Violet Unit



UV Reactor Example

Ultraviolet Reactor Advantages and Operational Criteria

- **Effective nonchemical disinfectant**
  - No chemicals, therefore, no DBPs
- **Suitable for small systems with limited distribution**
  - No contact time required
  - Simple
  - Low operation and maintenance cost
- **Must meet plan review requirements:**
  - Minimum dosage 38 $^{mWsec}/_{cm2}$
  - Intensity monitor
  - Automatic shutoff for water if unit fails
  - No bypass without an air gap

Disadvantages of UV

- **In distribution, UV light does not ensure a continuous process of disinfection.**
  - UV light leaves no residual in the water, so water in the distribution system is not protected.

- **Water treated with UV light may still require chlorination because bacteria may regrow in the distribution system.**

Iron and Manganese: Problems

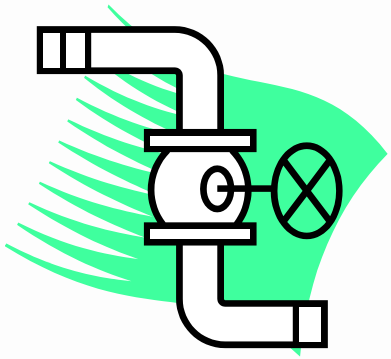
Dissolved minerals (such as Fe and Mn). Impurities may need to be removed before the water is ready for use.

Objectionable levels:

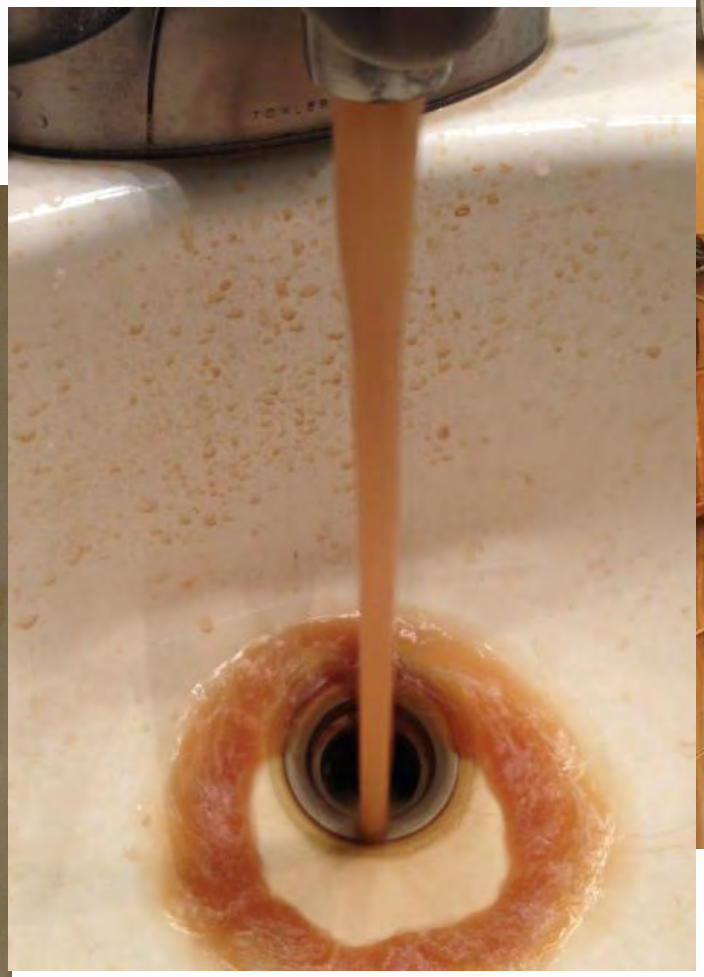
Iron 0.3 ppm - Fe

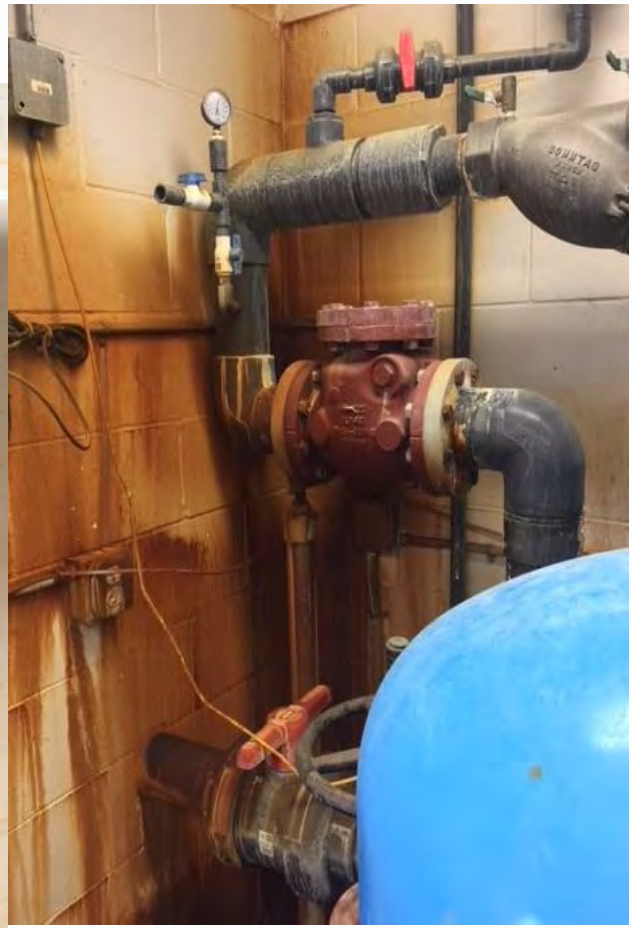
Manganese: 0.05 ppm - Mn

- Stains
- Deposits build up in the plumbing
- Decreases equipment life



Problems With Iron and Manganese





Common Removal Processes

Aeration

Polyphosphate Treatment

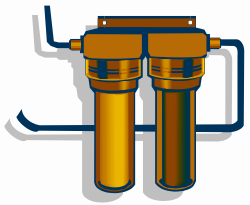
Ion Exchange

Greensand Filtration

Oxidation and Filtration

Iron and Manganese Removal Processes – Details

- **Aeration**: Contact of water with air, which oxidizes minerals, causes them to participate out
- **Ion Exchange:** Process of absorbing contaminant ions into or onto an exchange medium
  - Medium is usually a synthetic plastic resin designed to have either a positive or negative charge
  - Can be used to remove low levels of iron and manganese



- **Polyphosphate Treatment:** Reacts with dissolved iron and manganese, trapping them in a complex molecule
  - Iron and manganese not available to react with oxygen and do not precipitate
  - Relatively inexpensive for low levels of iron and manganese

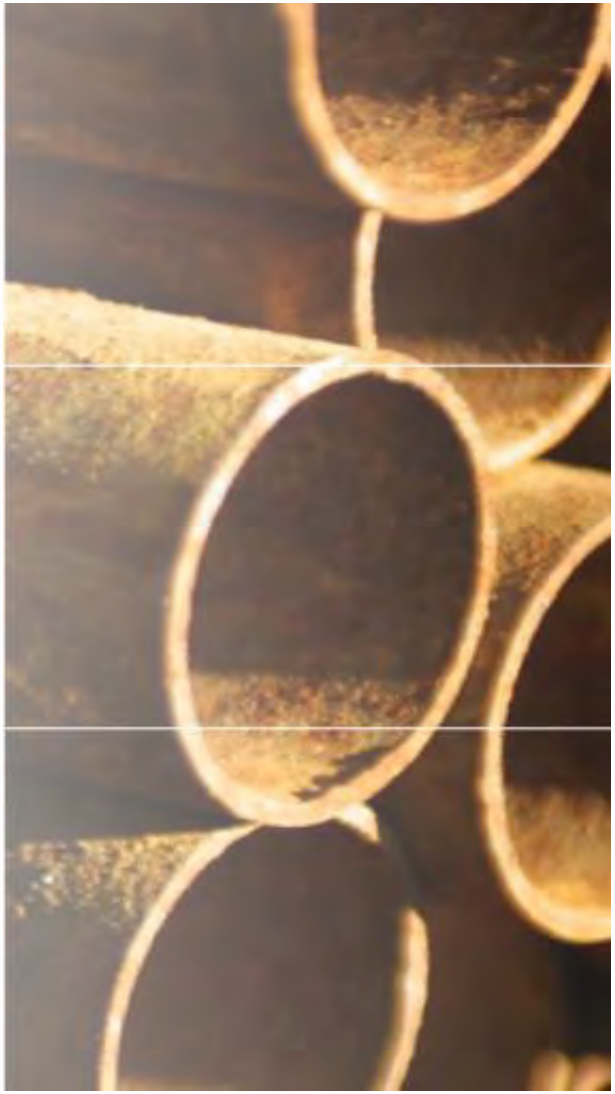
Iron and Manganese Removal Processes – Details *(continued)*

- **Oxidation and Filtration:** Accepted method of removal.
  - Chlorine is usually used as the oxidant.
  - Soluble iron and manganese quickly begin to precipitate after chlorine contact.
- **Greensand Filtration:**
  - Uses greensand with glauconite as the active material.
  - The filter absorbs the soluble iron and manganese from the water.

Iron and Manganese Filters

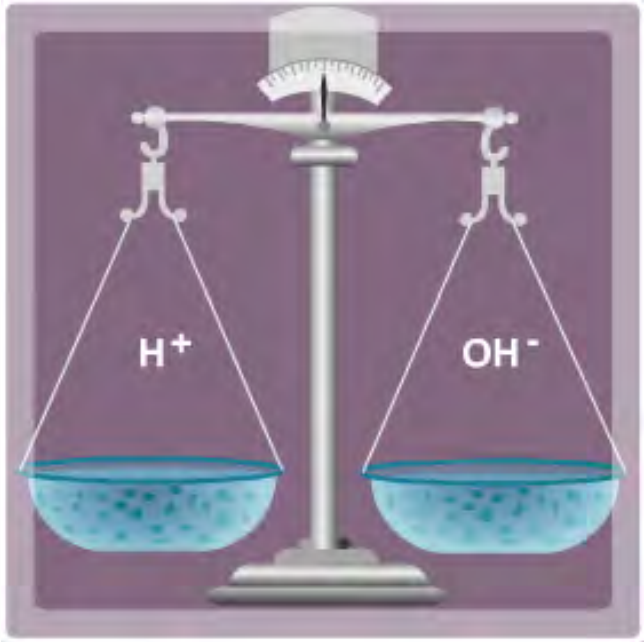
Corrosion and Corrosion Control

- Corrosion is a maintenance issue and may be a health hazard. It is your responsibility as a water distributor to take adequate corrosion control measures.
- Care must be taken to maintain water quality at levels that will control corrosion but not conflict with optimum pH levels for disinfection and control of disinfection by-products.



Long-Term Measures for Corrosion Control

Long-term measures for addressing lead and other corrosion by-products include:

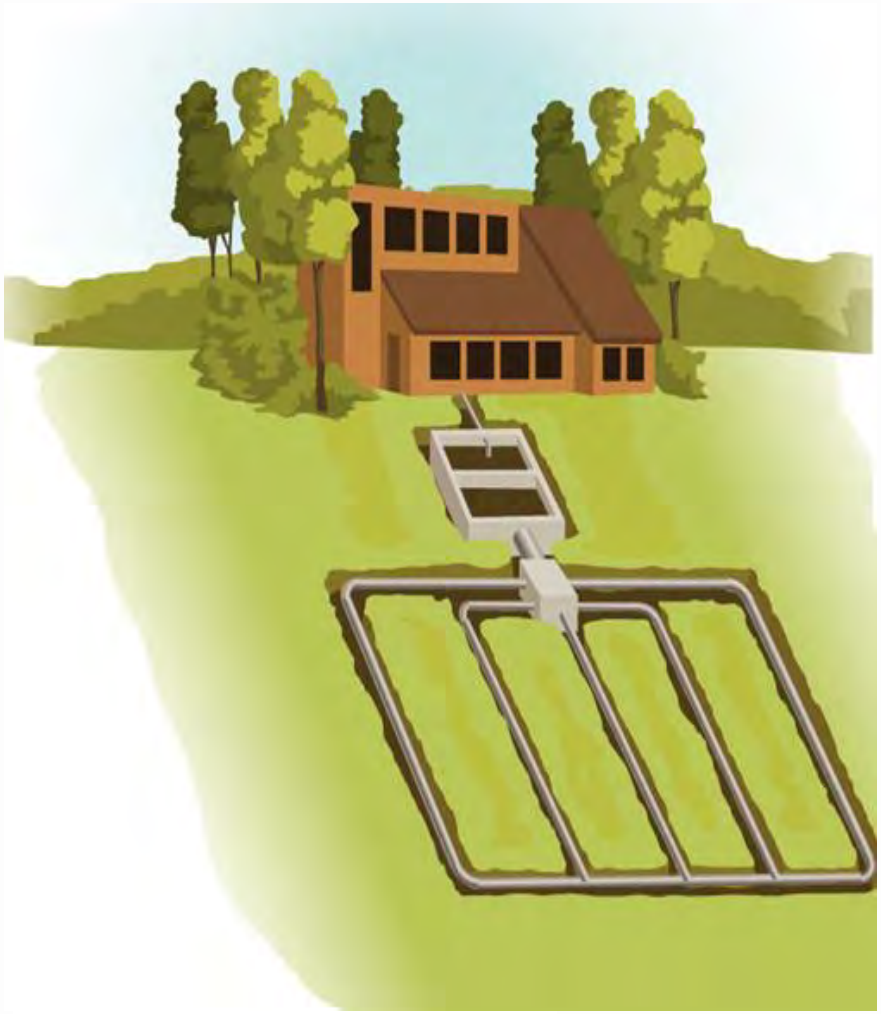


- pH and/or alkalinity adjustment
- Corrosion inhibitors
- Coatings and linings
- Cathodic protection

Cathodic Protection

- The wall of a reservoir is connected to the negative side of the power supply.
- This tends to reverse the flow of electrons from the anode (sacrificial), sending them through the water and back to the reservoir wall.
- The result is reduced migration of metallic ions from the steel.

Nitrate Overview



Primary Sources

- Fertilizers
- Sewage
- Animal waste

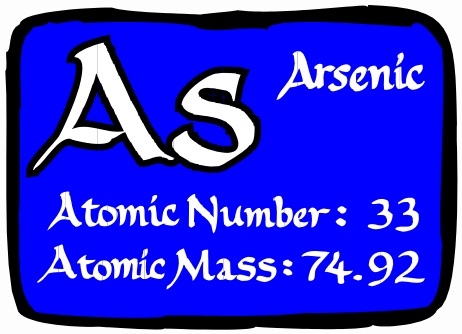
Removal Methods

- Reverse osmosis
- Membrane filtration
- Electrodialysis reversal
- Ion exchange

Arsenic Overview

Too much arsenic can cause:

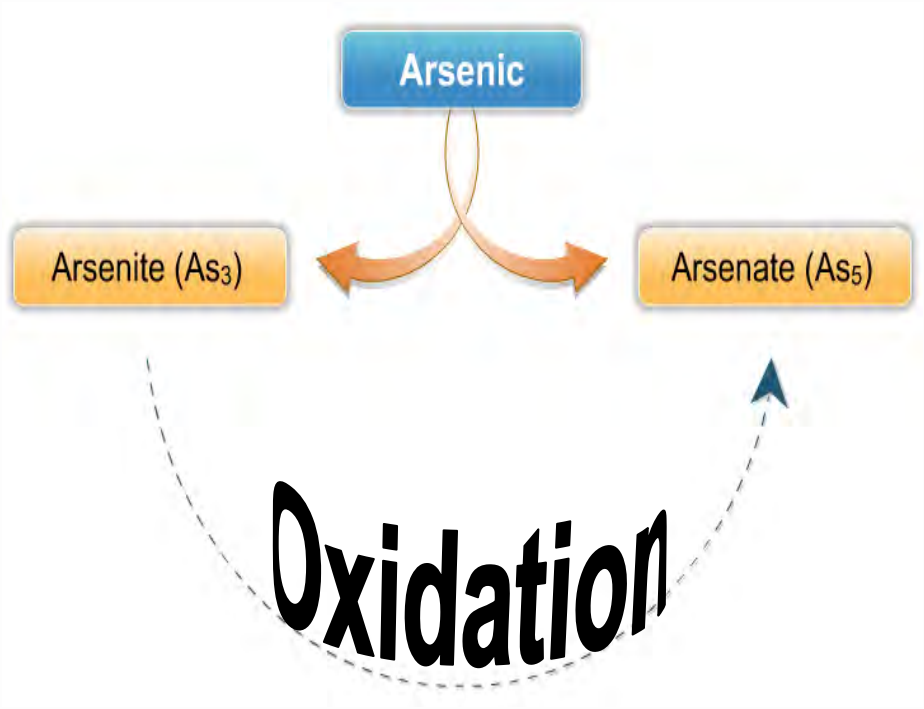
- Cancer in the bladder, lungs, skin, kidneys, nasal passages, liver, and prostate
- Cardiovascular and pulmonary diseases
- Immunological deficiencies
- Neurological problems
- Diabetes
- Anemia



Arsenic Overview (cont.)

Methods of Arsenic Removal

- Conventional filtration
- Ion exchange
- Reverse osmosis
- Activated alumina
- Coagulation-aided microfiltration
- Oxidation filtration



Arsenic Treatment Examples

3.2 Developing and Maintaining an Operations & Maintenance Manual

Topics to Review

- Introduction to the O&M Manual
- Developing the O&M Manual
- Reviewing the O&M Manual

Suggested Steps for Developing an O&M Manual

Contents

1. System facilities
2. Operational personnel
3. Routine operational tasks
4. Regulatory operational tasks
5. Maintenance procedures
6. Compliance procedures
7. Troubleshooting operational problems

Put these documents together and your O&M Manual is ready!

Sample Form
Routine Operational Tasks and Schedule

System Name:		
	Daily Tasks	**Performed By**
1.	Inspect well	
2.	Check storage tank	
3.	Maintain gauges & valves	
4.	Maintain distribution system	
5.	Respond to consumer complaints	
	Weekly Task	**Performed By**
1.	Inspect valves	
	Monthly Task	**Performed By**
1.	Take bacteriological sample	
	Semi-Annual Tasks	**Performed By**
1.	Flush dead end lines	
2.	Flush sediment from storage tank	
3.	Exercise valves	

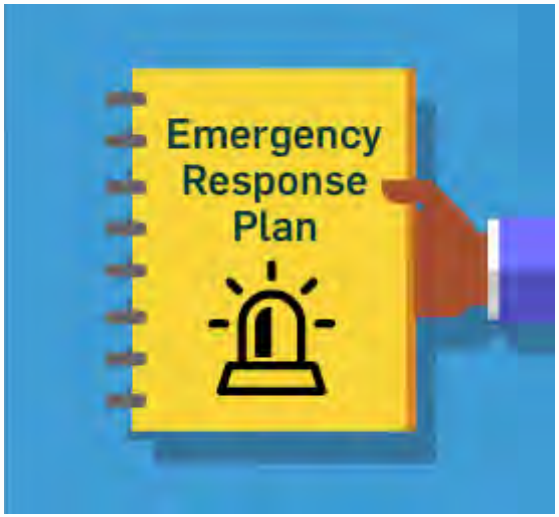
3.3 Developing and Maintaining an Emergency Response Plan (ERP)

Topics to Review

- Introduction to the ERP
- Developing the ERP
- Information available on DWS website
- Reviewing the ERP

Emergency Response Plan Introduction

- Provides information to aid utilities in planning a response to contamination threats or events.
- Gives specific instructions about who to call when there is an emergency situation that may affect the water system.



- Addresses security measures for the water system.

Developing the ERP

ERP Core Elements

1. System specific information
2. Water system roles and responsibilities
3. Communication procedures
4. Personnel safety
5. Identification of alternate water source(s)
6. Replacement equipment and chemical supplies
7. Property protection
8. Water sampling and monitoring

Information Available Online

https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/DRINKINGWATER/PREPAREDNESS/Pages/index.aspx

Emergency Response

Drinking Water Services

Emergency Response

Emergency Preparedness and Planning

Contact Us

Key Contacts and Resources in an Emergency

Emergency Response
After hours emergencies: evenings, weekends & holidays
Contact the on-call DWS manager.
Phone: 503-704-1174

To report a spill, contact
Oregon Emergency Response System (OERS)
1-800-452-0311
(or in Salem 503-378-6377)

Oregon Drinking Water Services
Hours of Operation
8:00 AM - 4:30 PM, Mon-Fri
971-673-0405

Emergency Response for Operators and Partners

- Incident Action Checklists for Water Utilities – On the go checklists to help during response and recovery activities.
- EPA Pandemic Incident Action Checklist for Water Systems
- Coliform Monitoring – Resources and procedures following positive coliform samples.
- Best Management Practices (BMPs) for water main breaks and service outages:
  - BMP for Repairing Existing Water Mains
  - BMP for Service Outages and Reduced Pressure Events
- Shock Chlorination - How to shock chlorinate storage tanks, wells and distribution systems.
- Oregon's Water/Wastewater Agency Response Network (ORWARN). No commitment, reduced insurance rates, request assistance such as emergency equipment, personnel and resources from systems in the network.

Key Resources

- Data Online
- For Consumers
- Site Map

Review and Update the ERP Regularly

Examples of updates needed:

- ✓ Items noted during surveys
- ✓ Out-of-date contact information (e.g., city council changeover, changed testing lab, new supply vendor, new water system personnel)
- ✓ Upgrades performed to the water system (e.g., new water source and/or treatment added)

3.4 Recordkeeping

Keep records:

- As long as legally required
- As long as deemed useful

If records are not in place, the institutional knowledge base built by your staff could be lost forever.

Oregon State Rules – Records

OARs

Oregon Administrative Rules

OAR 333-061-0025 (6)

- Records should be made available when the system is inspected.

OAR 333-061-0040 (2)

- Sets specific record-retention requirements.

Records To Keep: Equipment and Maintenance

- Well logs (including name and type of pump)
- System documents (showing layout, “as-builts,” maps, etc.)
- List of equipment (with make and model numbers and dates purchased)
- Equipment manuals (recommend keeping with the O&M Manual)

Records To Keep: Equipment and Maintenance

- **Ledger of completed maintenance work**
- **Operational logs** (run times, meter readings, settings, observations, etc.)
- **Future maintenance schedule and description of equipment condition**
- **Procurement records** (ordered parts and supplies to forecast future needs)

Records To Keep: Sampling and Monitoring Compliance

- Coliform Sampling Plan
- Total coliform test results
  - *Retention requirement: At least 5 years*
- All other lab analysis results
  - *Retention requirement: At least 10 years*
- Actions taken to correct any noncompliance issues
  - *Retention requirement: 3 years*
- Issued public notices
  - *Retention requirement: 3 years*

Records To Keep: Planning and Management

- Operations & Maintenance Manual
- Consumer Confidence Reports
  - *Retention requirement: 5 years*
- Emergency Response Plans
- Water system surveys, reports, communications, etc.
  - *Retention requirement: 10 years*
- Other system-developed programs, such as water conservation and cross-connection control

Records To Keep: Administrative and Legal

- **Financial records** (monthly financial reports, annual budgets, etc.)
- **Public meeting records**
- **Personnel records** (kept confidentially)
- **Compliance/administrative orders**
- **Records of any variances or permits**
  - ***Retention requirement: 5 years***
- **Water rights documents**
  - ***Retention requirement: Indefinite period***
- **System ordinances, resolutions, by-laws, etc.**

3.5 Shock Chlorination Procedure for Wells

Topics to Review

- What is shock chlorination?
- When should shock chlorination be used?
- Shock chlorination procedure

What Is Shock Chlorination?

Shock chlorination is a disinfection treatment that is recommended when a well is contaminated with bacteria.

Shock chlorination may involve disinfection of the entire water system in addition to the well. High concentrations of chlorine are used.

When Should Shock Chlorination Be Used?

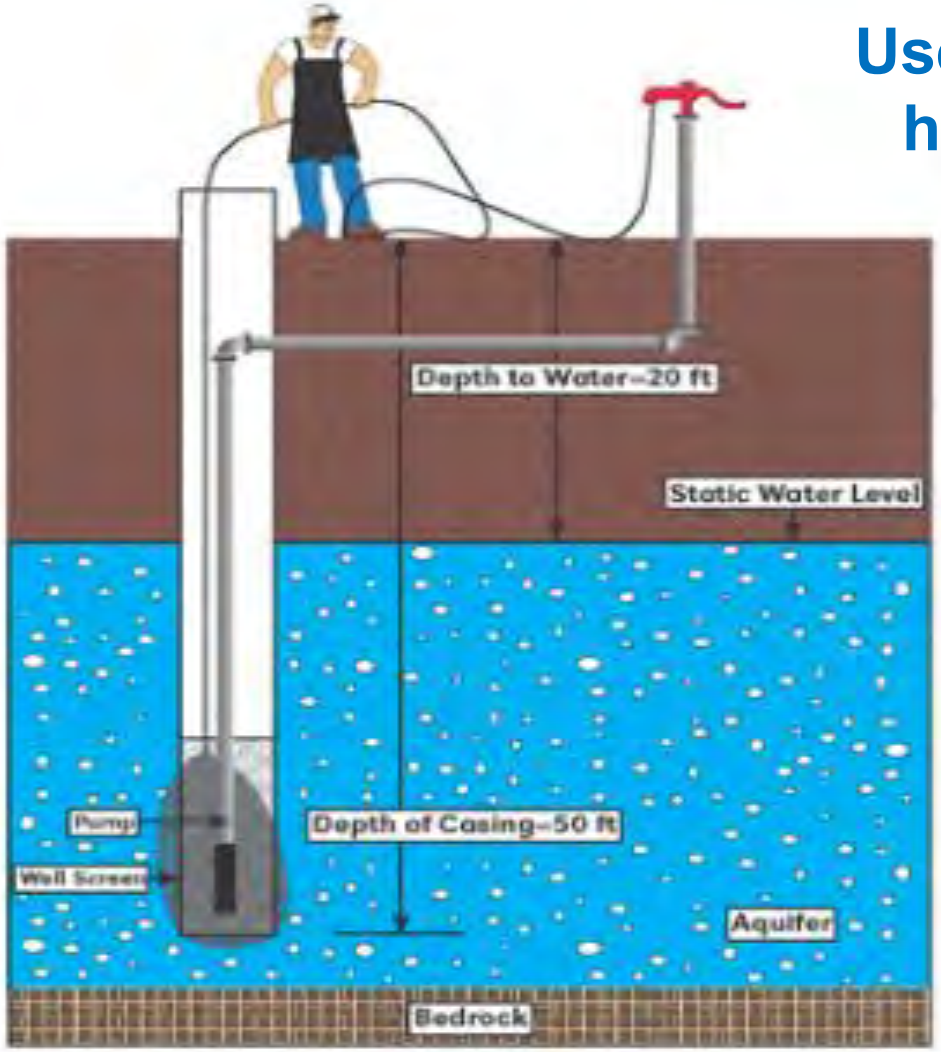
Shock chlorination is recommended:

- When a new well is constructed.
- When the sanitary seal is broken in the process of well maintenance.
- When the well water has tested positive for coliform or when there has been some other contamination.
- As a preventative measure to kill biofilms that may have developed in the well casing.

Remember to use NSF-approved chlorine!

Shock Chlorination Procedure

Example of how to recirculate water down a well

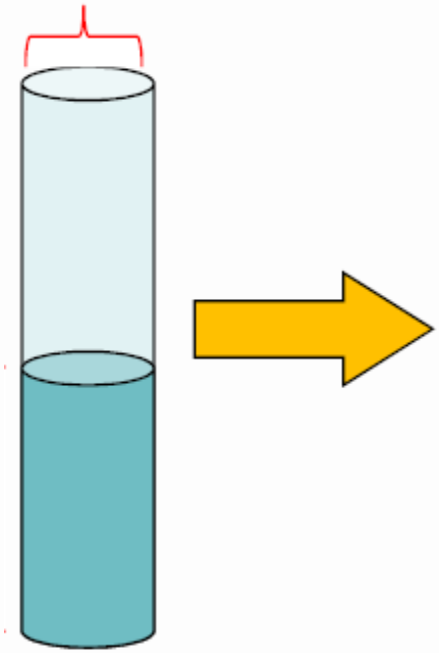


Use a nearby hose bibb

https://www.oregon.gov/oha/ph/healthyenvironments/drinkingwater/operations/pages/shockchlorination.aspx

STEP 1
Determine Volume of Water in the Well

Diameter 6”



Well casing diameter (inches)	Gallons per foot of length
4	0.65
6	1.5
8	2.6
10	4.1
12	5.9
14	8.0

STEP 2
Add Chlorine Solution

Pour the needed amount of chlorine solution into the well, either through the well seal vent port or by carefully removing the well seal. Recirculate the well water through the hose back into the well.

OHA recommends introducing a solution consisting of 50 ppm chlorine into the well.

10 ppm chlorine = 24-hour contact time

50 ppm chlorine = 6-hour contact time

STEP 3
Open All Faucets

While continuing to feed a 10 ppm or 50 ppm bleach solution into the well, open all inside and outside faucets connected to the system until a strong odor is detected.

STEP 4
Let the Water Stand in System for 24 hours

Let the water stand in the system for 24 hours at 10 ppm of chlorine to allow sufficient time for disinfection.

STEP 5
Let Chlorinated Water Flush Out of the System

After 24 hours, run the faucets and let the chlorinated water flush out until the odor of chlorine dissipates.

Make sure the chlorinated water is disposed of in an environmentally safe manner, away from vegetation and aquatic life.

STEP 6
Conduct Bacteriological Testing

Conduct bacteriological testing and release the water for consumption only after the bacteriological testing shows that the water is safe for drinking.

Always inform customers in advance about the shock chlorination schedule and tell them when to expect potable water to return to the system.

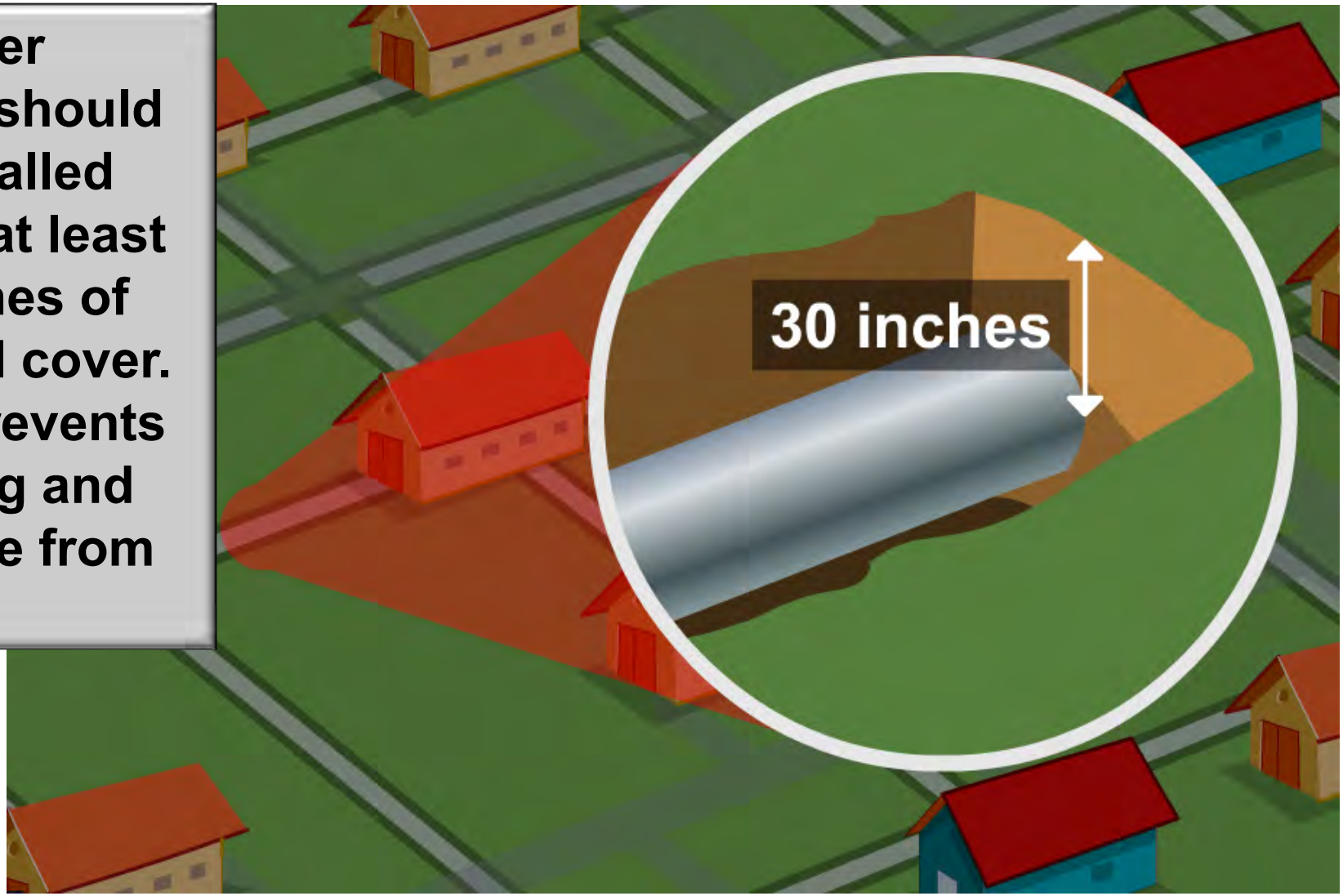
3.6 Leak Prevention and Repair

Topics to Review

- Preventing water pipe leaks
- Steps involved in pipe repair
- Using the Emergency Repair Plan

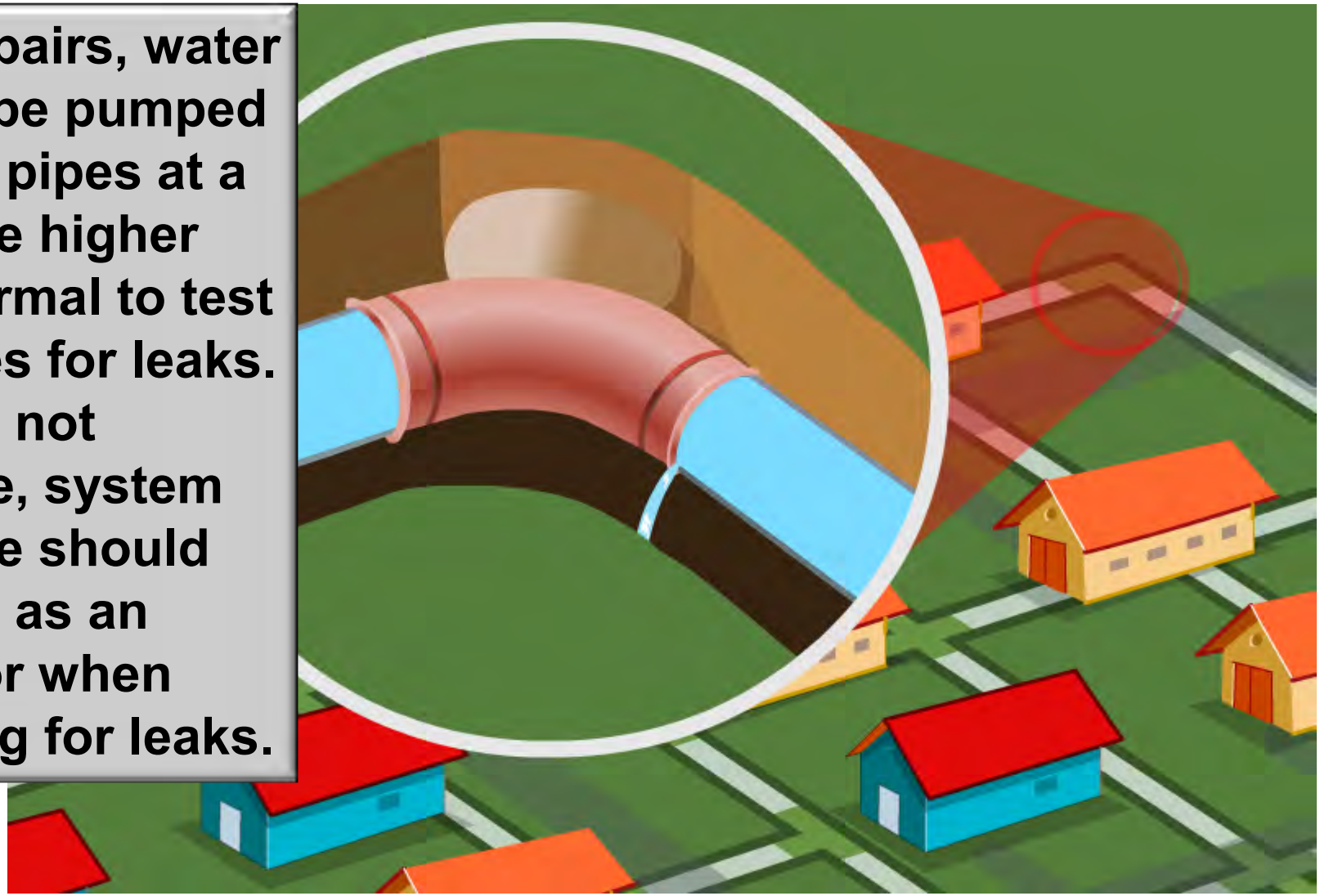
Good Practices in Pipe Construction and Repair

All water mains should be installed under at least 30 inches of ground cover. This prevents freezing and damage from traffic.



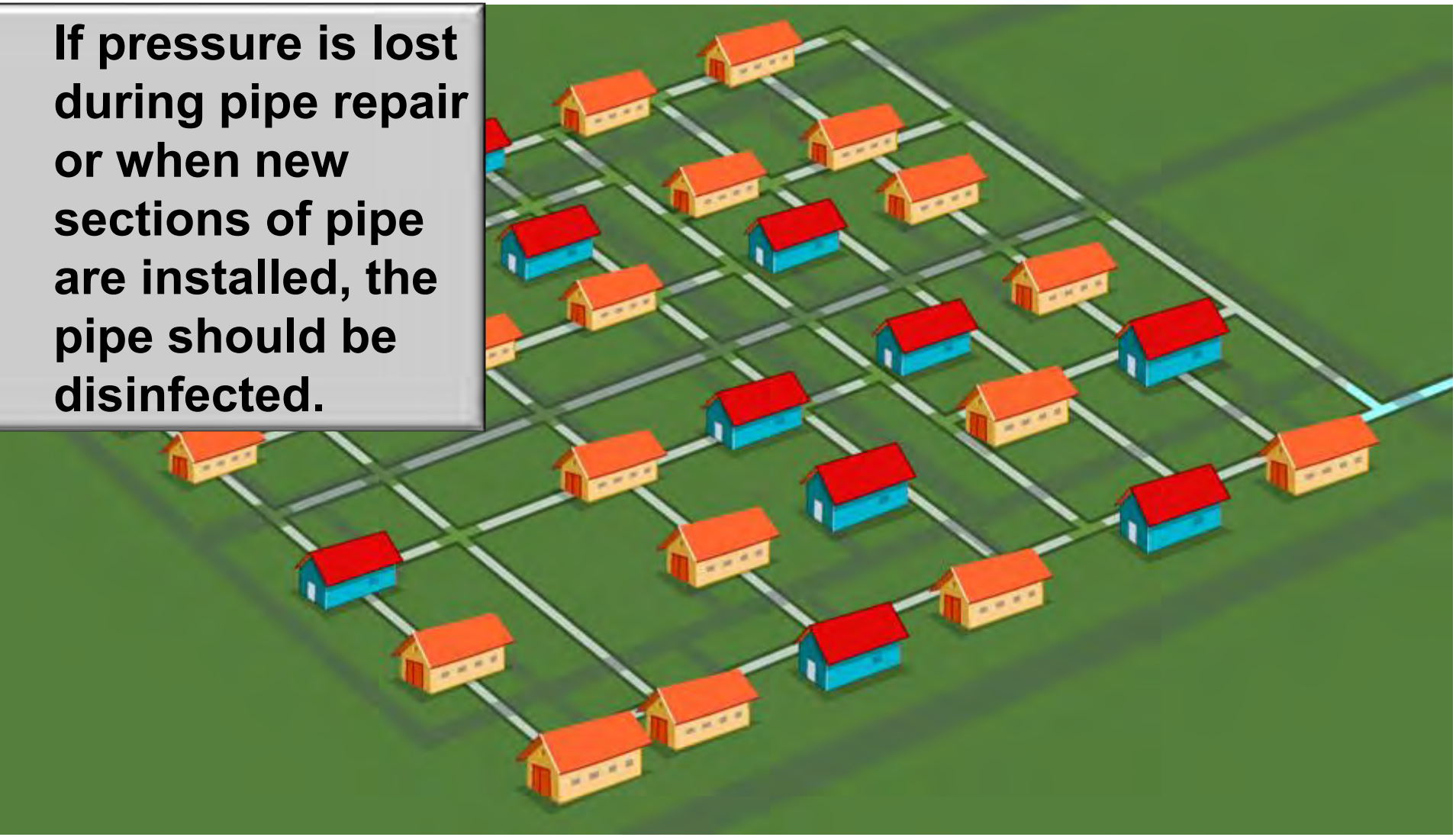
Good Practices in Pipe Construction and Repair

After repairs, water should be pumped into the pipes at a pressure higher than normal to test the pipes for leaks. If this is not possible, system pressure should be used as an indicator when checking for leaks.

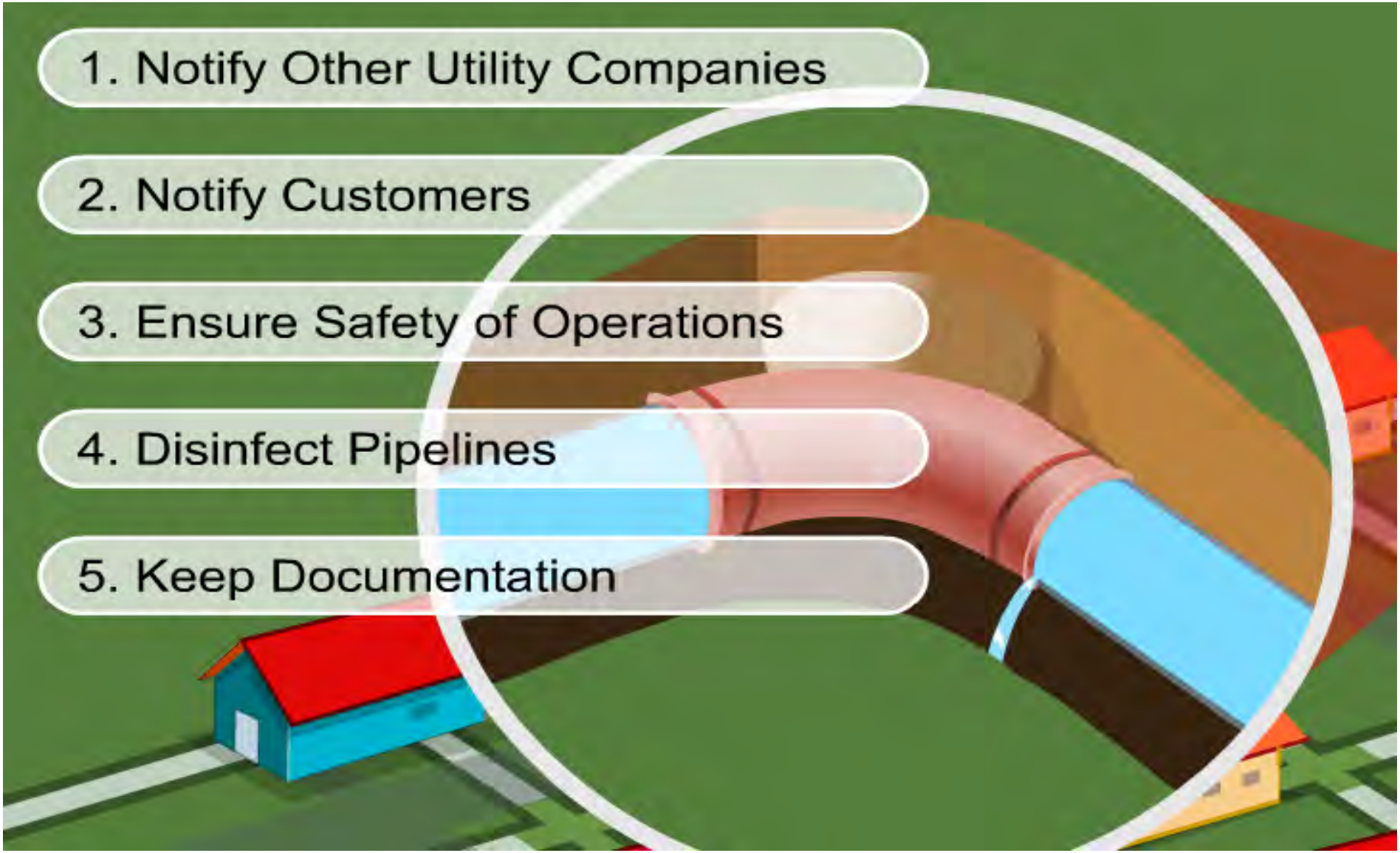


Good Practices in Pipe Construction and Repair

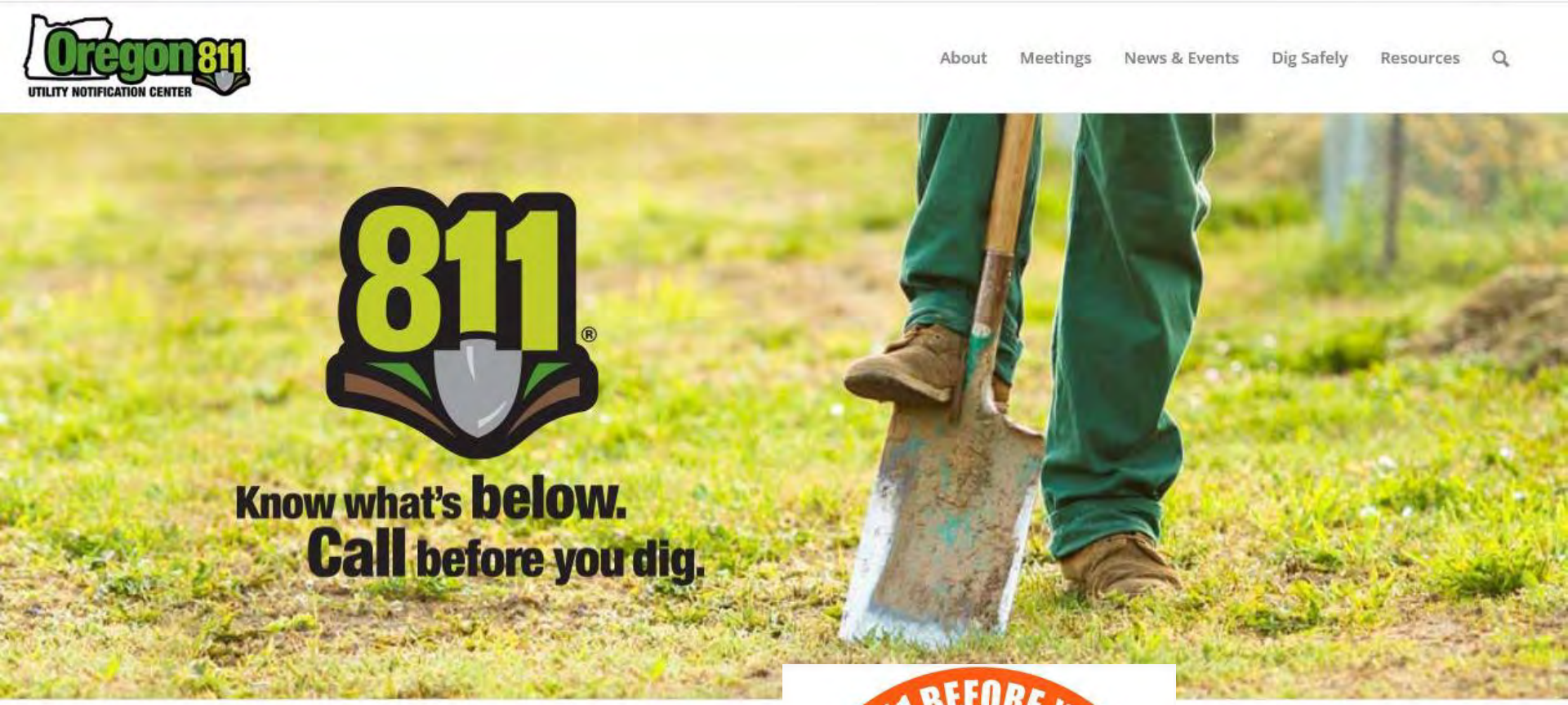
If pressure is lost during pipe repair or when new sections of pipe are installed, the pipe should be disinfected.



Pipe Repair Tips



Pipe Repair Tips



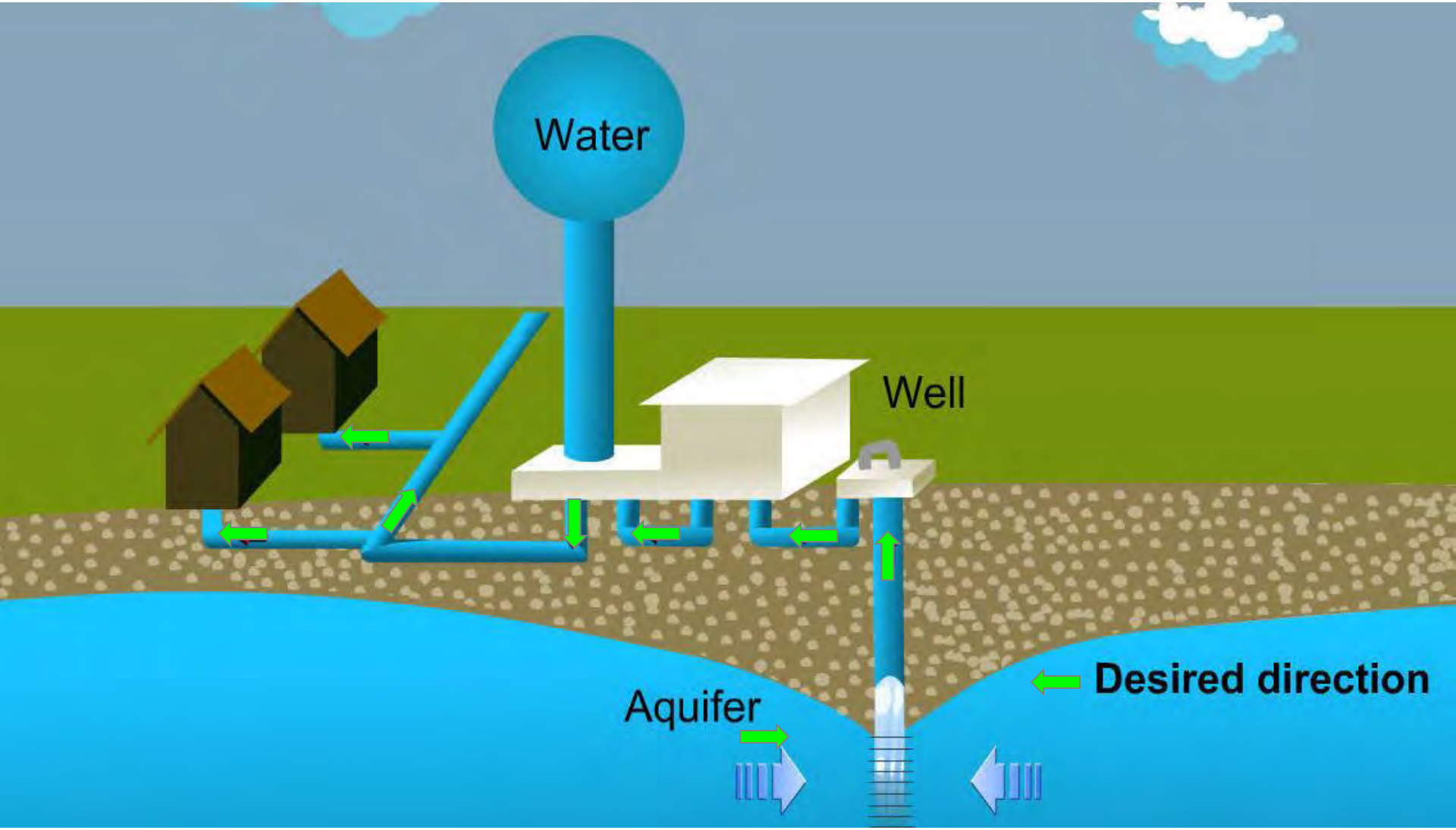
Digsafelyoregon.com

CALL 811 BEFORE YOU DIG
Oregon 811
UTILITY NOTIFICATION CENTER
www.digsafelyoregon.com

Topics to Review

- Understanding a pressurized system
- Understanding and implementing a flushing program
- Understanding and implementing a valve exercising program

Pressurized Systems

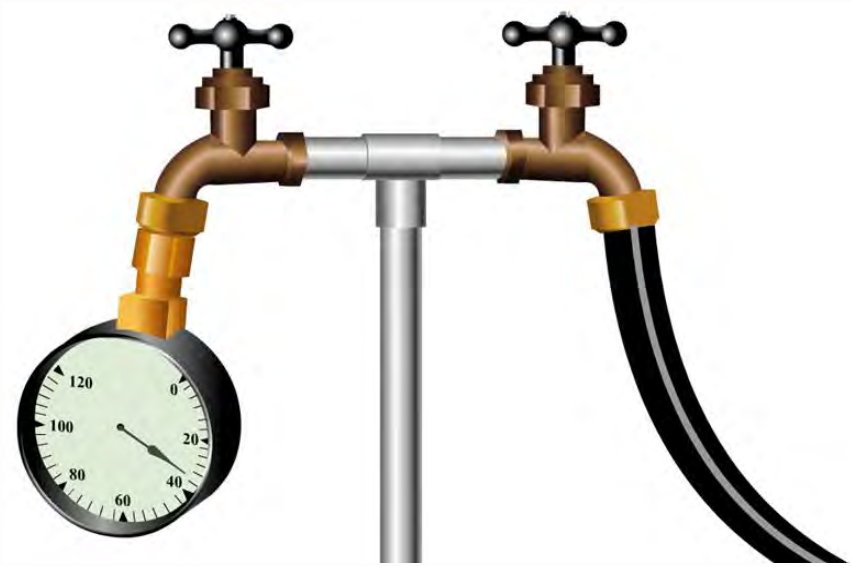


Pressurized Systems

Typical Pressures

Domestic Use: 35 - 90 psi

Commercial Use: 75 psi



Oregon Regulations:

A public water system's distribution piping must be designed and installed to ensure a minimum pressure of at least 20 psi throughout the distribution system, *under all conditions of flow*.

Measuring Pressure

Pressure is measured in "pounds per square inch" (psi)

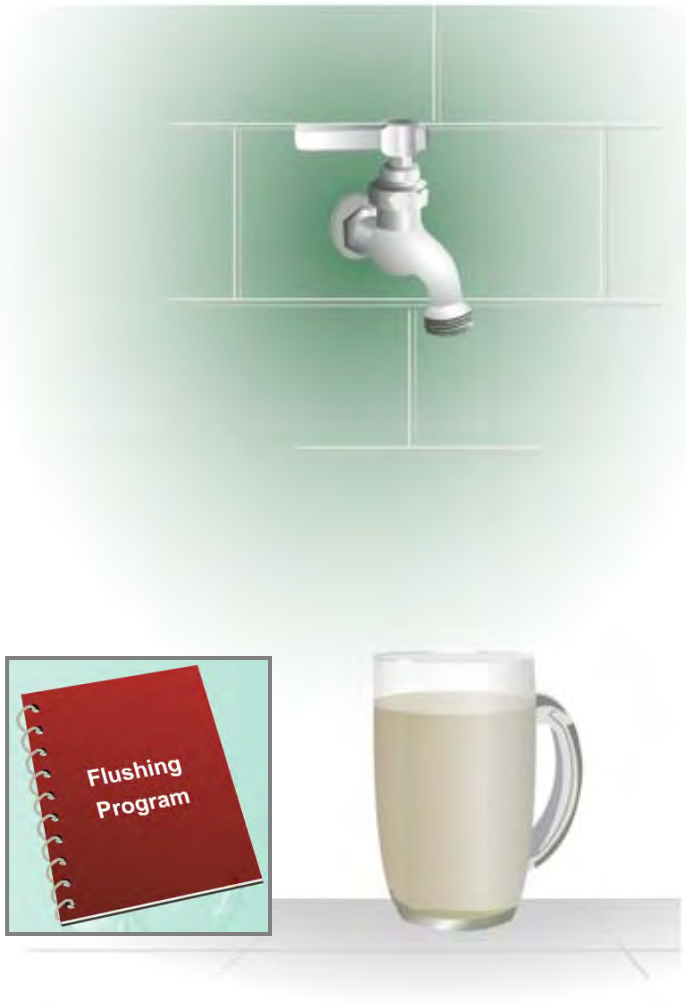
1 psi = 2.31 feet of water

1 foot of water = 0.433 psi

Line Flushing Program

Contaminated Water

- Taste problems
- Odor problems
- Shortens the life of meters, valves, and other system components
- Increased complaints from customers



Line Flushing Program

Notify Customers

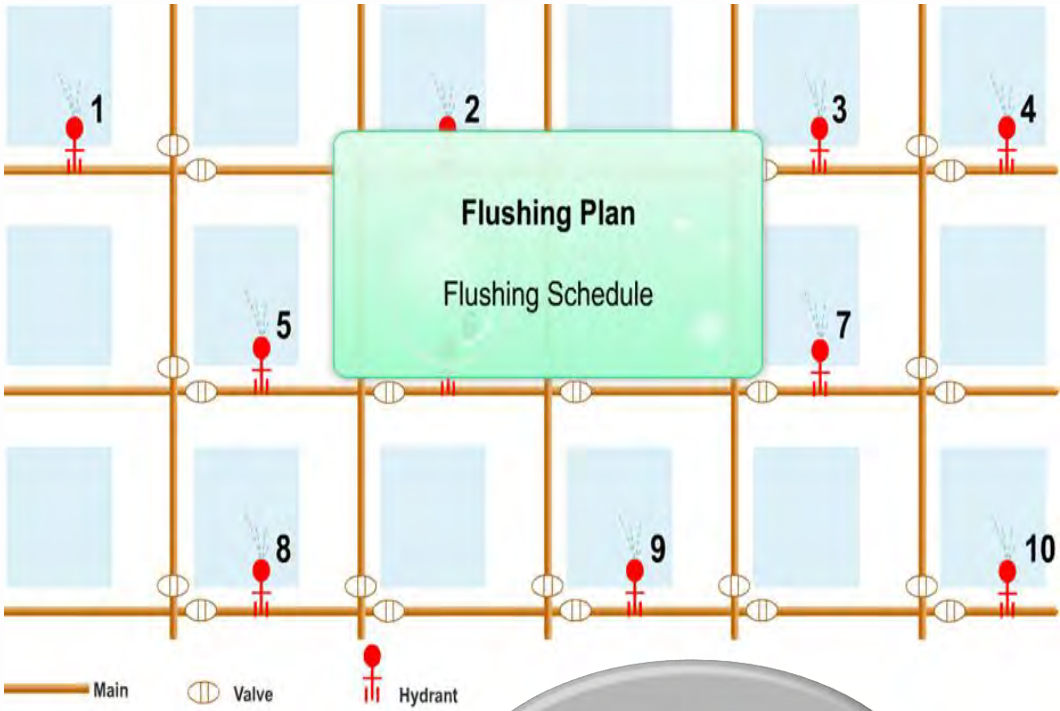
Establish detailed procedures to notify your customers about:

- **The flushing schedule**
- **The expected generation of dirty water**
- **The procedure for flushing the dirty water from *their* lines**

Line Flushing Program

Factors in Implementing a Flushing Program:

- Size of water pipes
- Locations of outlets
- Locations of main valves
- Water disposal

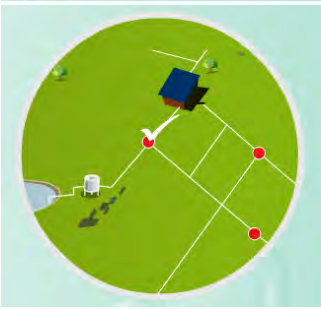


If fire hydrants are not available, installation of hydrants or blow-off valves in strategic locations should be considered a priority.

Develop a valve and line-flushing map and keep it updated!

Line Flushing Program

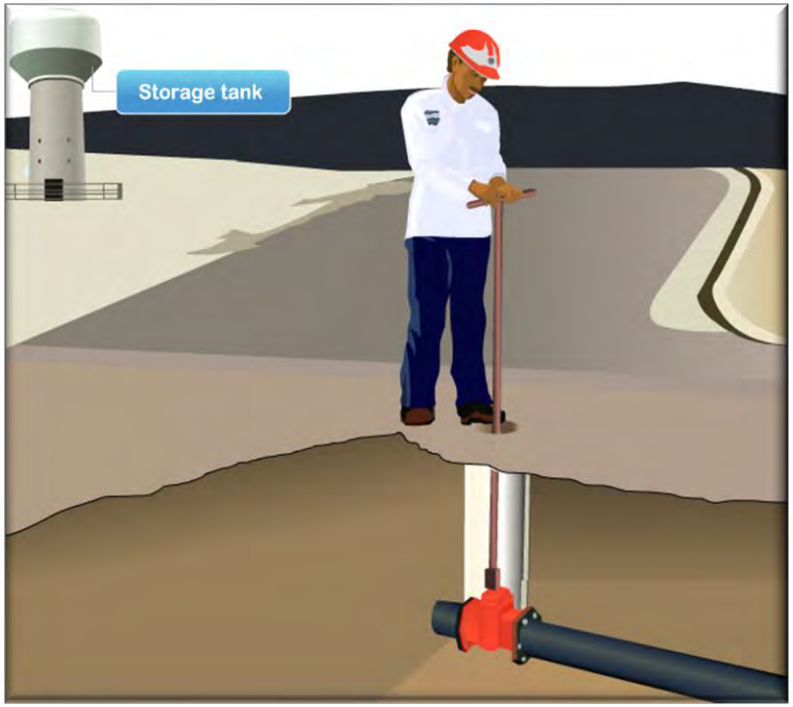
- Allow only trained staff to flush hydrants.
- Open and close hydrants slowly to avoid water hammer or other damage.
- Carry out flushing at blow-offs on dead-end lines and at fire hydrants throughout the system ***at least once a year.***
- Always begin flushing with the hydrant closest to the pump station or storage tank.
- Dechlorinate flush water if above 5.0 ppm



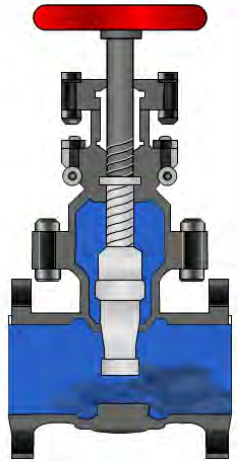
Why?

This way, clean water chases out the dirty water.

Valve Exercising Frequency



- Exercising Valves
  - Annually (minimum)
  - Preventative
- Repairs
  - Time consuming
  - Expensive



If water quality is poor due to sediment, iron, manganese, or other constituents,
consider a more frequent exercise schedule.

What to Include in a Valve Exercising Program

- **Inspect and clean valve boxes and document each valve for leaks, ease of operation, and number of turns to open/close.**
  - Document inspection findings, name of operator, date, duration, etc.
- **Conduct a flow test, pressure test, fire hydrant inspection, and others a minimum of once per year.**
  - Complete tests after the hydrant and flushing exercises to assure accurate and comparable results.

3.8 Cleaning and Maintenance of Storage Tanks

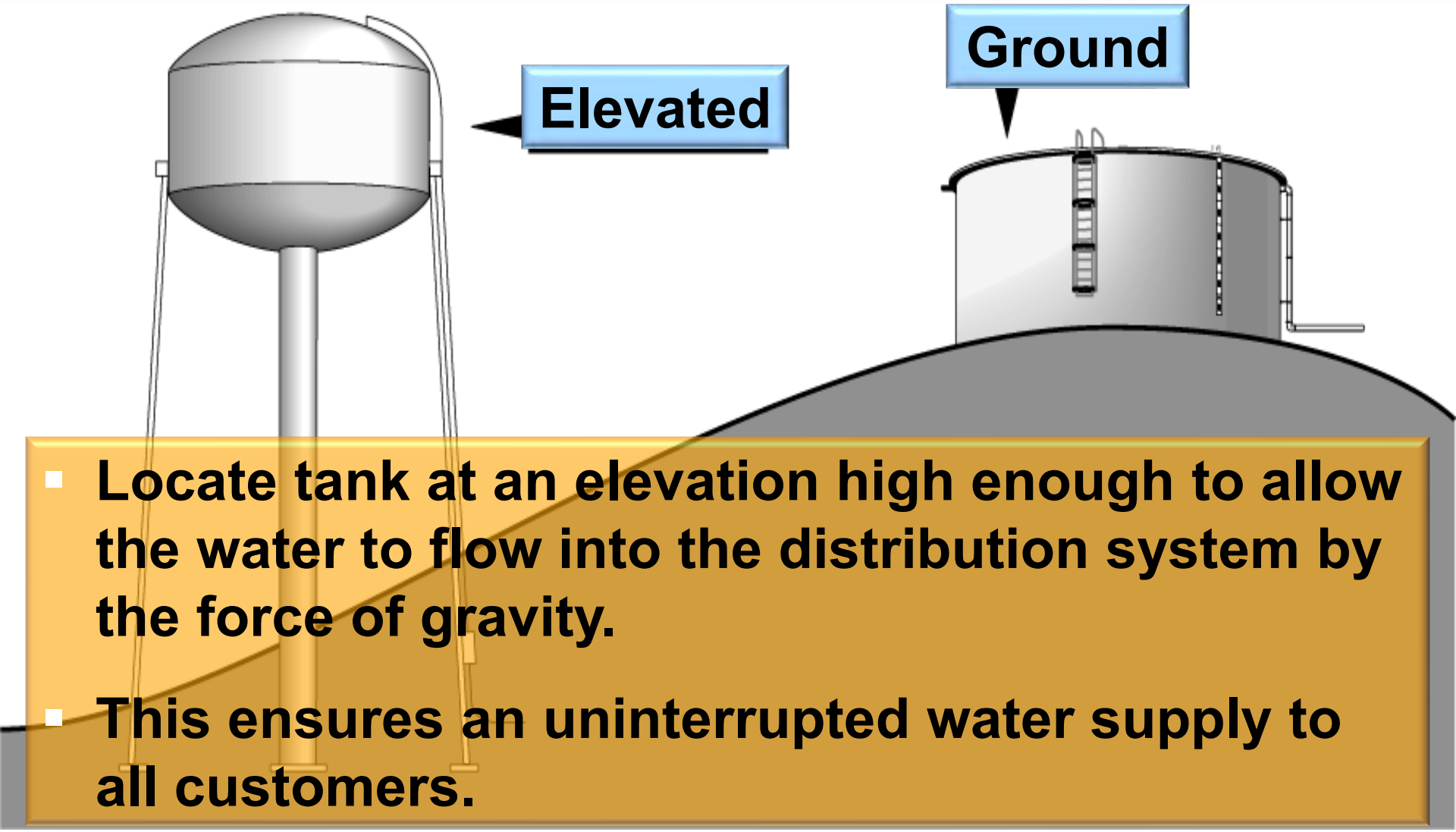
Topics to Review:

- Storage tanks
- Developing a maintenance program
- Storage tank chlorination

Overview of Storage Tanks

- Storage tanks allow water systems to meet fluctuating water demands.
- Storage tanks typically store amounts of water equivalent to 1 to 3 days of the system's average daily supply of water.

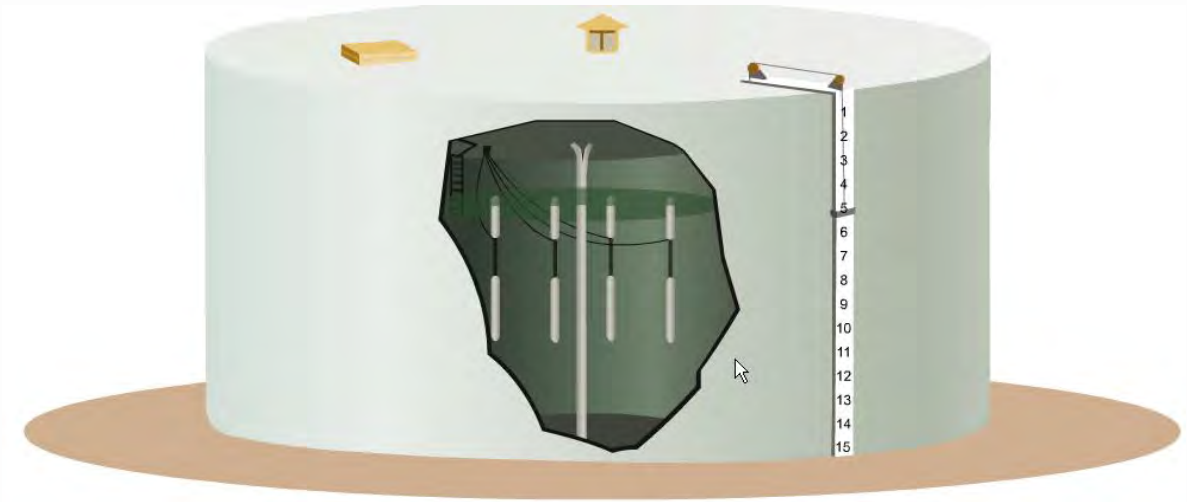
Two Types of Storage Tanks / Reservoirs



- Locate tank at an elevation high enough to allow the water to flow into the distribution system by the force of gravity.
- This ensures an uninterrupted water supply to all customers.

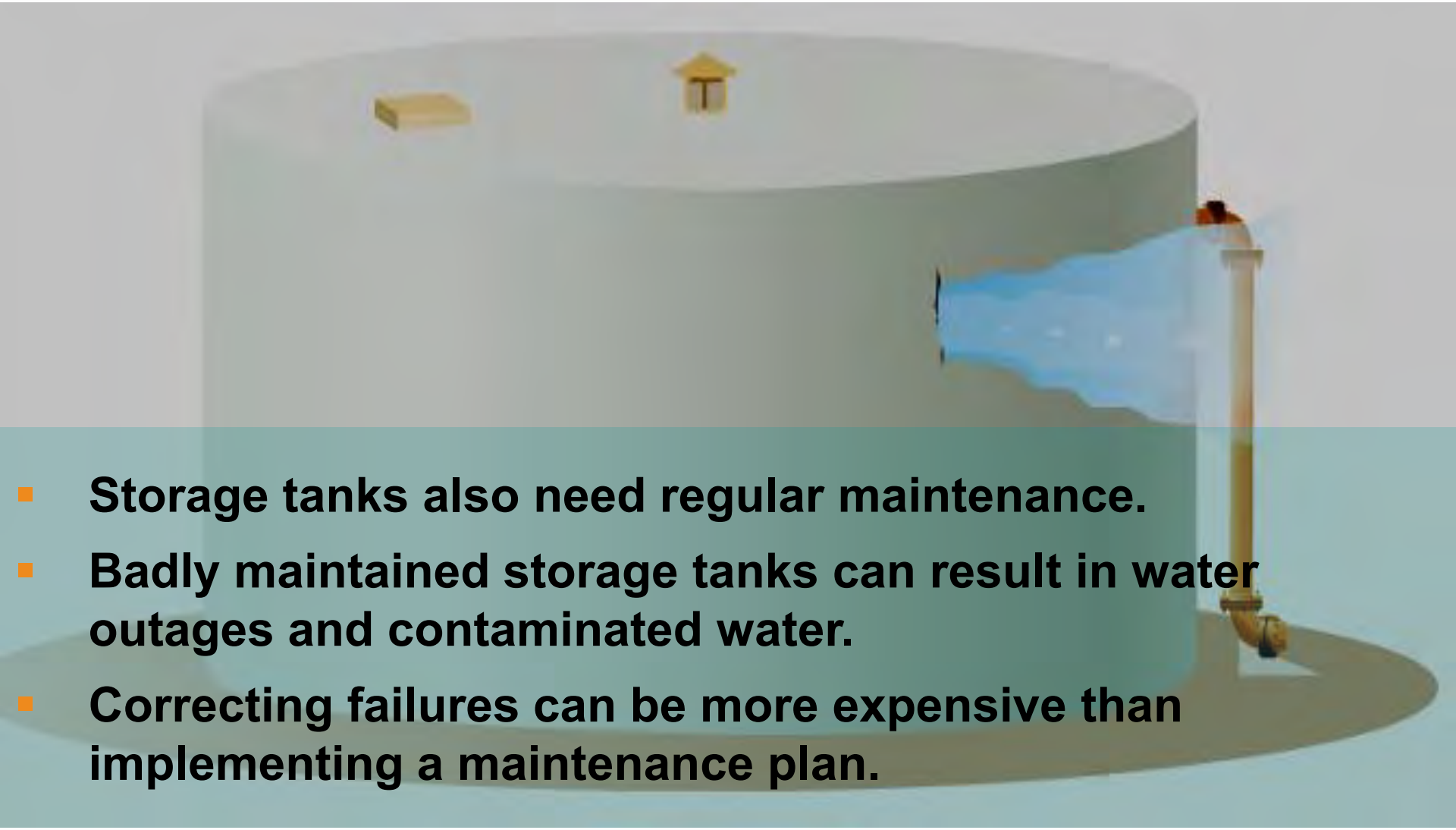
Storage Tanks

Water quality in a storage tank is greatly improved when constructed with separate inlet and outlet pipes, located on opposite sides and at different levels.



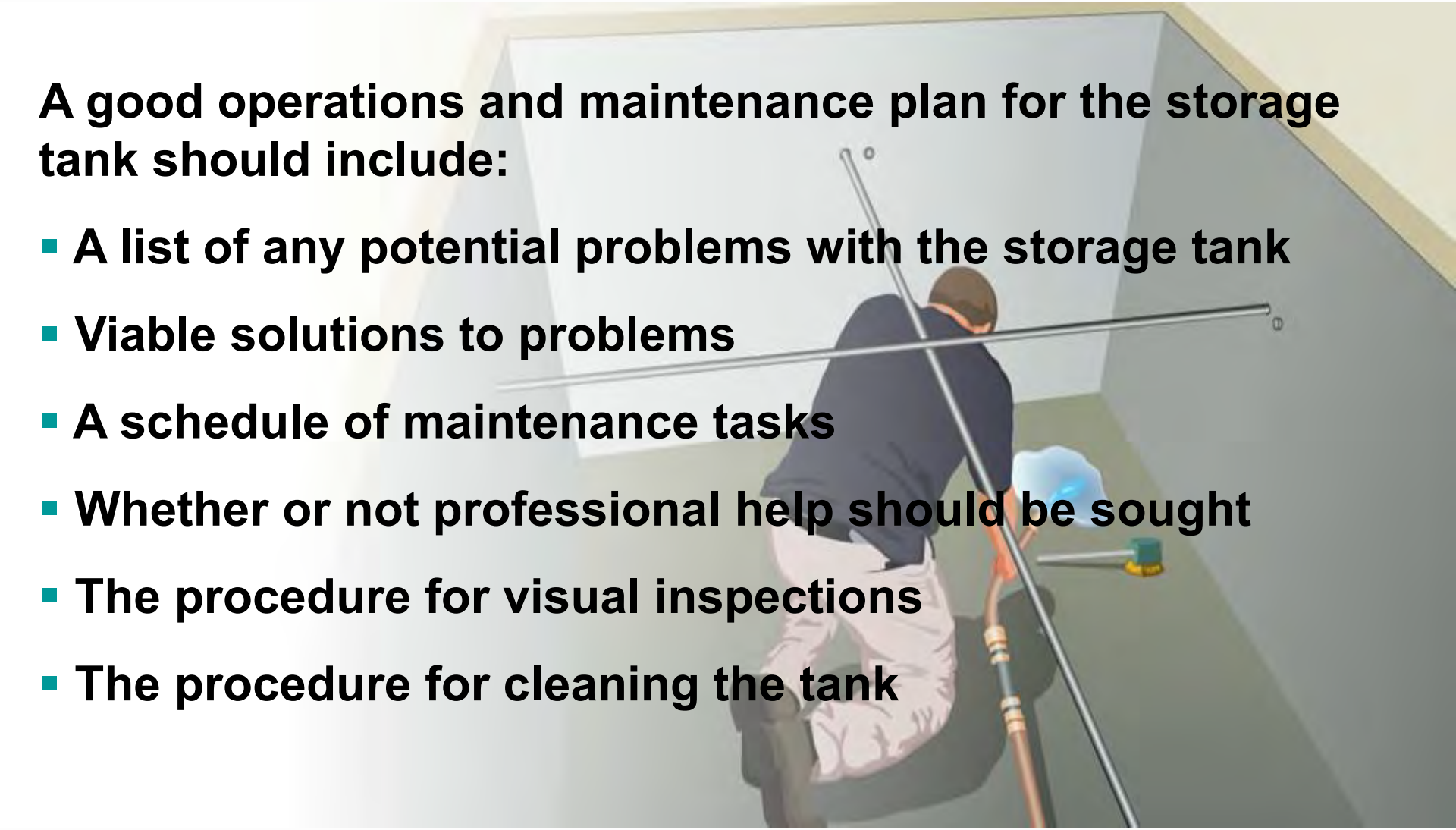
Baffles (such as walls, curtains, or spirals) inside the storage tank increase water circulation (and contact time if chlorinating) by preventing water from leaving the storage tank too quickly.

Maintenance Program



- Storage tanks also need regular maintenance.
- Badly maintained storage tanks can result in water outages and contaminated water.
- Correcting failures can be more expensive than implementing a maintenance plan.

Maintenance Program



A good operations and maintenance plan for the storage tank should include:

- **A list of any potential problems with the storage tank**
- **Viable solutions to problems**
- **A schedule of maintenance tasks**
- **Whether or not professional help should be sought**
- **The procedure for visual inspections**
- **The procedure for cleaning the tank**

Storage Tank Examples

Concrete Reservoir

Corroded Steel Tank

Storage Tank Examples

Storage Tank Chlorination

After a storage tank has been drained and cleaned, it should be disinfected using chlorine (AWWA C652).

There are three methods of chlorinating a storage tank:

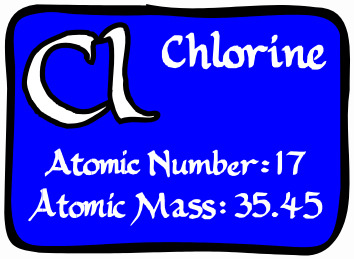
Method A → **Add 10 ppm chlorine solution, allow to stand for 24 hours.**

Method B → **Add 50 ppm chlorine solution, allow to stand for 6 hours.**

Method C → **Direct spray 200 ppm chlorine solution, allow to remain for 30 minutes prior to filling the tank.**

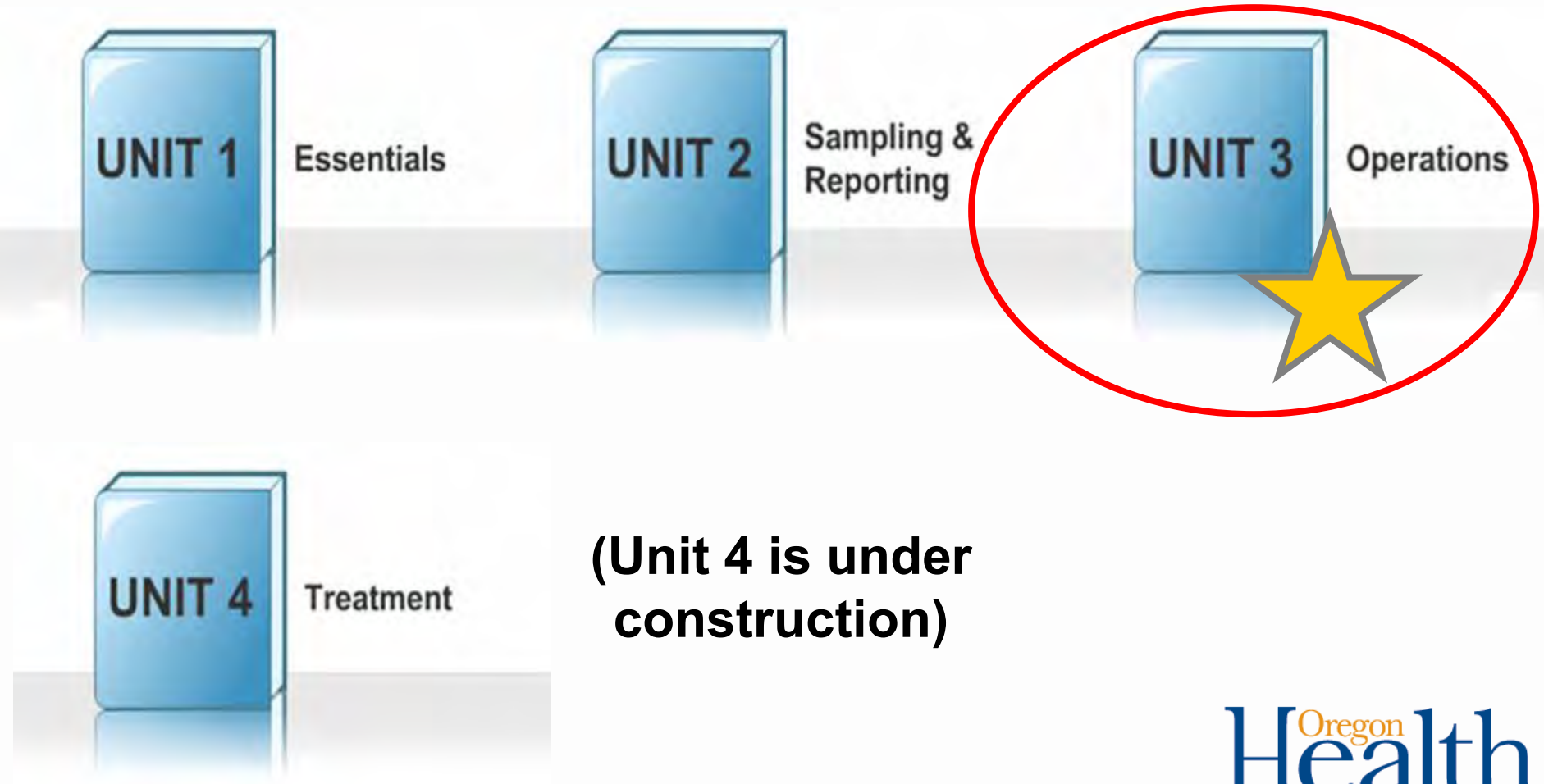
Storage Tank Chlorination – Final Steps

- Chlorinated water must be disposed of in an environmentally safe manner.
- A negative (absent) total coliform sample result is necessary before the tank may be brought back in use.
- It is important to keep a record of maintenance activities. These records are useful when scheduling future maintenance.



Basics for Small Water Systems in Oregon

You've completed UNIT 3 – Operations. WAY TO GO!



(Unit 4 is under construction)