



**OCT WATER QUALITY ACADEMY**  
**A US Government Funded Education Contractor**  
**An ANSI/IACET Accredited School Nationwide**  
**Class Description Submittal to OESAC**

**Title: Water Quality Sampling & Analysis**

**New Class**            or             **Class Renewal**

CEU Award requested: **0.7 CEUs.**

**OVERVIEW:**

This is a fundamental class that reviews the process and procedures of field sampling and laboratory wet bench-top analysis of specific water quality parameters, bacteriological analysis, and chemical analysis using state and federal water regulations and Standard Methods for the Examination of Water and Wastewater.

This class will be geared to applying these sampling and analysis processes and procedures to address specific techniques for water field sampling and testing and laboratory wet bench-top analysis. This class will address the basic understanding of physical, chemical, and biological analysis for contaminants found in drinking water.

**CLASS DESCRIPTION:**

The class presentations follow the accompanying eight (8) chapter workbook with approximately one (1) chapter presented every hour. An end-of-chapter quiz can be found at the end of every chapter.

Every water operator needs to have an understanding of the fundamental principles contained within the 1974 Safe Drinking Water Act (and subsequent amendments) and National Primary and Secondary Drinking Water Regulations. This class reviews water quality requirement, with an emphasis on the basic processes and procedures for sampling and testing, of water quality physical, chemical and biological contaminants. Each utility service should monitor its sampling and analysis requirements against the utilities Sample Siting Plan monitored by its regulator state agency.

**OUTLINE:**

1. State and Federal Drinking Water Regulations.
2. Water Quality Parameters -- Why They Are Important To Test.
3. General Aspects of Drinking Water Sample Collection.
4. National Primary and Secondary Drinking Water Regulations.
5. Chemical Rule – Inorganic Contaminants Sampling and Analysis Requirements.
6. Chemical Rule – Organic and Radioactive Contaminants Sampling and Analysis Requirements.

7. Chemical Rule – Bacteriological Contaminants Sampling and Analysis Requirements.
8. Recordkeeping Requirements – Plans, Documents, and Forms.

**DETAILED SUPPORTING DESCRIPTION:**

**CHAPTER 1. STATE AND FEDERAL DRINKING WATER REGULATIONS**

This chapter will focus on the importance of state and federal drinking water regulations. Chapter 1 will provide an overview of the history of adopted state and federal regulations starting from the 1900s to present day. It will also include the roles and responsibilities of the states to comply with the federal drinking water standards.



*Figure 1. SDWA & USEPA*

1. Adopted State/Federal Water Regulations, 1900-1970.
  - State Health Departments Roles
  - United States Public Health Service (USPHS) – Only federal program that regulated interstate carriers.
  - United State Environmental Protection Agency (USEPA) – picked up this role in 1970 based on the 1962 Public Health Service Standards.
2. Know what circumstances led to the **1974 Safe Drinking Water Act (SDWA)** including its major milestones and the 1986 and 1996 SDWA Amendments.
3. Learn about current emerging contaminants and its regulations from 2000 to present day including Total Trihalomethanes (TTHMs), Haloacetic Acids (HAA5s), and Per and Polyfluoroalkyl Substances (PFAS).
4. Understand the Role of the State Governments -- to accept responsibility for primary enforcement termed as **“PRIMACY”**.
5. Understand the Role of the Public Water Suppliers:
  - Responsibility of meeting regulations.
  - Routine monitoring.
  - Communication with public and regulatory agencies.
6. Learn the System Standards developed for:
  - a. Community Water Systems (CWS). *A public water system which has a potential to serve at least 15 service connections on a year-round basis or serves at least 25 individuals on a year-round basis. Service connections shall be counted as one*



*Figure 2. Developing System Standards*

(1) for each single-family residential unit or each commercial or industrial establishment to which drinking water is supplied from the system. Examples include

- Municipal Water Departments
- Private Water Utilities
- Regional Water Districts
- Mobile Home Park Systems
- Small Residential Subdivisions
- Tribal and Territorial Water Systems

b. Non-Community Water Systems (NCWS). *A public water system which is not a community type system and that serve at least 25 people for at least 60 days a year but do not serve the same population year-round.* Examples include:

- Schools
- Factories
- Office Buildings
- Hospitals

c. Non-transient Non-community Water Systems (NTNCWS). *A public water system that is not a community water system and that regularly serves at least 25 of the same persons over six (6) months per year.* Examples include:

- Schools and Universities
- Factories and Industrial Plants
- Office Buildings
- Hospitals and Nursing Homes
- Child Care Centers
- Power Plants
- Corporate Parks

## **CHAPTER 2. Water Quality Parameters – Why They Are Important To Test**

This chapter will provide an introduction to monitoring water quality parameters as follows:

- Physical Water Quality Parameters
- Chemical Water Quality Parameters
- Biological Water Quality Parameters

Chapter 2 will review water quality parameters and explain why testing them are important. This chapter will also provide protocols to field test some of the physical and chemical parameters using field testing devices. Other parameters will be discussed in later chapters for



**Figure 3. Water Quality Parameters**

collecting a sample to be analyzed at a laboratory. Each of the physical, chemical, and biological water quality parameters will be discussed in detail. This chapter will discuss parameters that affect water quality as follows:

1. Physical Parameters of Water Quality:

- **Turbidity:** Cloudiness, usually <1 NTU, ideally <5 NTU, indicating effectiveness of filtration.
- **Temperature**
- **Color:** Should be acceptable to consumers.
- **Taste/Odor:** Should be acceptable to consumers.
- **Total Dissolved Solids (TDS):** A Secondary Contaminant. 150-300 mg/L is considered ideal, with 500-1000 mg/L as a maximum limit before poor taste and health concerns occur.
- **Electrical Conductivity**

2. Chemical Parameters of Water Quality.

- **pH:** A Secondary Contaminant. 6.5-8.5 range to prevent corrosion and ensure safe consumption.
- **Acidity**
- **Alkalinity**
- **Chlorine.** A Secondary Contaminant. 250 mg/L. Can make the water taste salty.
  - Free Chlorine Residual
  - Total Chlorine Residual
- **Hardness:** Primarily Calcium and Magnesium; high levels can cause scaling.
- **Dissolved Oxygen**
- **Biological Oxygen Demand (BOD)**
- **Sulfate:** A Secondary Contaminant. 250 mg/L.
- **Aluminum**
- **Iron:** A Secondary Contaminant. 0.3 mg/L.
- **Manganese:** A Secondary Contaminant. 0.05 mg/L. California made this a Primary Contaminant in 2025.

3. Biological Parameters of Water Quality (Highest Priority):

- **Bacteria**
  - **Total Coliforms:** Indicates efficiency of treatment and potential bacterial presence.
  - ***E. coli*/Fecal Coliforms:** Must be zero. Indicates presence of waste and pathogens.
- **Algae**

- **Viruses**

### CHAPTER 3. GENERAL ASPECTS OF DRINKING WATER SAMPLE COLLECTION

1. Learn about how the requirements to become a state Certified Sampler and/or Laboratory Technician, and how these certifications relate to the Operator Certification and recertification guidelines of 1999.
2. Define the terms applicable to the collection of water quality monitoring samples as required by the Safe Drinking Water Act (SDWA), National Primary Drinking Water Regulations (NODWR), and Standard Methods for the Examination of Water and Wastewater:
3. Explain the purpose of water quality monitoring.
4. Review the step-by-step procedures common to the collection of all samples for the prevention of contamination of the sample.
5. Identify the technical basis for the primary drinking water regulations sampling procedures.
6. Define the importance of using appropriate techniques in the collection of water quality monitoring samples.
7. Develop a sampling plan to guide the operator in the timely collection of all primary drinking water regulation required samples.



**Figure 4. Water Quality Sampling Procedures**

### CHAPTER 4. NATIONAL PRIMARY AND SECONDARY DRINKING WATER REGULATIONS

The National Primary and Secondary Drinking Water Regulations group the contaminants to be analyzed into four (4) categories:

- Inorganic Contaminants (IOCs)
- Organic Contaminants (OCs)
  - ✓ Volatile Organic Contaminants (VOCs)
  - ✓ Synthetic Organic Contaminants (SVOCs)
- Radioactive Contaminants (RCs)
- Microbiological Contaminants (MCs)



**Figure 5. USEPA Drinking Water Regulations**

Samples for nitrate/nitrite analysis, lead-copper analysis, and asbestos are collected and analyzed separately. Chapters 5-7 will discuss the Chemical Rule for each group to include sample collection, analysis, and recordkeeping requirements. Asbestos will not be discussed. This chapter will:

1. Review the National Primary Drinking Water Regulations (NPDWR), and subsequent amendments, as it relates to:
  - Maximum Contamination Level Goal (MCLG)
  - Maximum Contamination Level (MCLs)
  - Maximum Residual Disinfectant Level (MRDL)
  - Treatment Technique (TT).
2. Review the National Secondary Drinking Water Regulations.
3. Review the log removal requirements for bacteriological contaminants.
4. Review Public Notification Requirements:
  - Public Notification: Tiers 1, 2 and 3.
5. Review the state adopted federal regulations, and determine whether the state standards are more stringent than the federal standards.

## **CHAPTER 5. CHEMICAL RULES – INORGANIC CONTAMINANTS SAMPLING AND ANALYSIS REQUIREMENTS**

Chapter 5 will review the drinking water sample and analysis requirements for the Inorganic Chemical Group. Recordkeeping requirements will also be reviewed.

1. Chemical Rule – Inorganic Contaminants
  - **Metals/Toxic Substances:** Strict limits on Arsenic (<10ug/L), Lead (<10ug/L), Mercury, and Chromium.
  - **Nitrate/Nitrite:** Dangerous to health (especially infants), usually limited to 10 mg/L for nitrate.
  - **Fluoride:** Often added, but should be managed to prevent fluorosis (typically <1.5 mg/L).
2. Sample Kits, Collection, Transport, and Analysis Requirements for:
  - Heavy Metal Group:
    - **ICP Scan:** Al, Ar, Ba, Be, B, Cd, Ca, Cr, Co, Fe, Mg, Mn, Mo, Ni, Pb, Si, Ag, Sn, V, Zn,
    - **SDWA Group 1:** Sb, As, Ba, Be, Cd, Cr, Hg, Ni, Se, Ti
  - Inorganic Non-Metals:
    - Cyanide
    - Fluoride

- Non-Heavy Metal Inorganic Contaminants:
  - **Complete Secondary Group:** Ca, Mg, K, Na, Fe, Mn, Hardness, Alkalinity, Bicarbonate, Carbonate, Chloride, Sulfate, Color, Conductivity, Odor, pH, Surfactants, TDS, and Turbidity.
  - **Major Anions and Cations Group:** Ca, Mg, K, Na, Bicarbonate, Carbonate, Chloride, Sulfate, and TDS.
  - **Nutrients Group:** Ammonia, Nitrate/Nitrite, Total Kjeldahl Nitrogen, Total Phosphorous.

3. The Lead-Copper Rule – Sample Kits, Collection, Transport, and Analysis Requirements.

## CHAPTER 6. CHEMICAL RULES – ORGANIC & RADIOACTIVE CONTAMINANTS SAMPLING AND ANALYSIS REQUIREMENTS

Chapter 6 will review the drinking water sample and analysis requirements for the Organic Chemical Group. Recordkeeping requirements will also be reviewed.

1. Chemical Rule

- Volatile Organic Chemical (VOCs)
- Synthetic Organic Chemicals (SVOCs)

2. Sample Kits, Collection, Transport, and Analysis Requirements for:

- VOCs
- SVOCs
- Acid Herbicides
- Carbamates
- Glyphosate
- Endothall

3. Disinfection/Disinfection By-Products Rule – Sample Kits, Collection, Transport, and Analysis Requirements

- Total Trihalomethanes (TTHMs)
- Haloacetic Acid Group (HAA5s)
  - Monochloroacetic Acid (MCAA)
  - Dichloroacetic Acid (DCAA)
  - Trichloroacetic Acid (TCAA)
  - Monobromoacetic Acid (MBAA)

4. Per and Polyfluoroalkyl Substances (PFAS) Rule – Sample Kits, Collection, Transport, and Analysis Requirements
  - PFOA
  - PFOS
  - PFHxS
  - PFNA
  - HFPO-DA (commonly known as GenX Chemicals)
  - Mixtures containing two or more of PFHxS, PFNA, HFPO-DA, and PFBS
5. Radionuclides Rule – Sample Kits, Collection, Transport, and Analysis Requirements
  - SDWA Sequential Flow Scheme
  - Gross Alpha/Beta
  - Radon-222

## **CHAPTER 7. CHEMICAL RULES – BACTERIOLOGICAL CONTAMINANTS SAMPLING AND ANALYSIS REQUIREMENTS**

Chapter 7 will review the drinking water sample and analysis requirements for the Microbiological Group. Recordkeeping requirements will also be reviewed.

1. Introduction the types of Waterborne Pathogens
  - Bacteria
  - Protozoa
  - Viruses
2. Introduction of the Coliform Group of Bacteria – An Indicator Organism.
3. Learn the Monthly Sampling Requirements of Microbiological Testing
  - Routine Sampling Frequencies.
  - Sample Siting Plan.
4. Review Sample Collection and Transport Requirements.
5. Review Repeat Sample Requirements and Addressing Violations.
6. The Total and Revised Coliform Rule – Sample Kits, Collection, Transport, and Analysis Requirements.
7. The Surface Water Treatment Rules (SWTR) – Sample Kits, Collection, Transport, and Analysis Requirements:

8. The Groundwater Rule (GRW) – Sample Kits, Collection, Transport, and Analysis Requirements.

**CHAPTER 8. RECORDKEEPING REQUIREMENTS – PLANS, DOCUMENTS, AND FORMS**

At least once (1) per year, a complete chemical analysis must be made on all types of water offered for sale in a Community Water System (CWS). All chemical analysis records must remain on file at the plant where water is treated for ten (10) years. Chapter 8 will provide guidance on developing a Sample Siting Plan, as well as, instructions on completing the necessary for sample collection, analysis, reporting and recordkeeping.

1. Filing Out the Sample Bottle Labels.
2. Calculating 90<sup>th</sup> Percentile
3. Developing a Sample Siting Plan – Components
4. Completing Forms and Records:
  - Microbiological Sample Request Form
  - Chain-of-Custody Form and Documentation
  - Interactive Analytical Request Form
  - Homeowner Tap Sample Collection Procedure Form
5. Review Recordkeeping Requirements.

**OBJECTIVES:**

- Students will learn the key points presented in all eight (8) chapters listed above that address sample, analysis, and reporting requirements.
- Students will gain a basic fundamental knowledge of all topics listed in the outline above.
- Students will have the opportunity to interact with an experienced instructor to clarify information on problems where they lack knowledge and understanding.
- Students will be prepared for state operations examinations to increase licensure in their state of residence.

**TIME PRESENTATION OUTLINE:**

Start Time	End Time	Instructional Time	Allotted Break Time	Chapter/Discussion/Quiz
8:00am	8:50am	50 minutes	8:50am–9:00am	State and Federal Drinking Water Regulations.
9:00am	9:50am	50 minutes	9:50am–10:00am	Water Quality Parameters -- Why They Are Important To Test.
10:00am	10:50am	50 minutes	10:50am-11:00am	General Aspects of Drinking Water Sample Collection.

11:00am	12:00pm	60 minutes	12:00pm-12:30pm	National Primary and Secondary Drinking Water Regulations.
12:30pm	1:20pm	50 minutes	1:20pm-1:30pm	Chemical Rule – Inorganic Contaminants Sampling and Analysis Requirements.
1:30pm	2:20pm	50 minutes	2:20pm-2:30pm	Chemical Rule – Organic and Radioactive Contaminants Sampling and Analysis Requirements.
2:30pm	3:20pm	50 minutes	3:20pm-3:30pm	Chemical Rule – Bacteriological Contaminants Sampling and Analysis Requirements.
3:30pm	4:30pm	60 minutes	END	Recordkeeping Requirement – Plans Documents, and Forms.
		420 minutes		

*6 sessions of 50 minutes of instruction and 2 sessions of 60 minutes of instruction equals 420 minutes. 420 minutes equates to 7 hours of instruction divided by 10 which is 0.7 CEUs.*

END