

REQUIRED RANGE OF KNOWLEDGE - Water Distribution System Operator, Grade 1

Applicants are not expected to have a complete mastery of all subjects but at least should have heard of them in the context of water quality and distribution systems. Ability in basic arithmetic and an understanding of basic conversions is requisite. Introduction to regulatory concepts.

SECTION	TOPIC	REFERENCE
Regulatory Knowledge	Safe Drinking Water Act; Source Water Protection Program; Wellhead Protection Program; Compliance and Enforcement; Operator Certification Program; R18-4-101 and R18-5-101 Define: Compliance Cycle, Compliance Period, Backflow and Cross Connection, On –Site Operator, On Site Representative	Arizona Administrative Code, Title 18, Chapter 4, Articles 1 definitions and Title 18, Chapter 5, Article 1, definitions; R18-5-104-(B) (E); ; R18-5-108; R18-5-109-(C)
Sources of Supply	Hydrologic cycle; Chemical, physical, and bacteriological characteristics; Groundwater and surface water supplies; Safeguards in well location and construction; Sanitary hazards for each type of water supply; Intakes; Watershed management; Water storage facilities; source water and finished water,	CSUS ~ Water Distribution System Operation and Maintenance, 4 th Ed. AWWA, Principles and Practices of Water Supply Operation, Water Sources, 3 rd Ed. And Water Transmission and Distribution, 3 rd Ed.; R18-4-301(E),R18-4-302(A), R18-4-303(A)

SECTION	TOPIC	REFERENCE
Disinfection	<p>Purpose of disinfection; Disinfectant types; Characteristics of chlorine and chlorine compounds; Available chlorine in various compounds; Chlorine demand; Prechlorination; Free vs. Combined chlorine; Breakpoint chlorination; Residual measurement; Gas vs. Liquid; application and methods; Effects of pH and temperature; chloramines; Relative effects on bacteria, viruses, cysts; Disinfection Byproducts Precursors, TTHM formation and HAA5 Define: Hypochlorous acid, Hydrochloric acid, Hypochlorite ion, Elemental chlorine, chlorine dioxide, Monochloramine, Dichloramine, and Trichloramine,</p>	<p>CSUS ~ Water Distribution System Operation and Maintenance, 4th Ed. AWWA, Principles and Practices of Water Supply Operation, Water Sources, 3rd Ed. And Water Transmission and Distribution, 3rd Ed. Handbook of Chlorination and Alternative Disinfectants, 4th Ed. Or other Chlorination and Disinfection reference material.</p>
Chemistry	<p>Elements; Compounds; Alkalinity; Hardness; pH; Significance of changes in pH and alkalinity</p>	<p>CSUS ~ Water Distribution System Operation and Maintenance, 4th Ed. AWWA, Principles and Practices of Water Supply Operation, Water Sources, 3rd Ed. And Water Transmission and Distribution, 3rd Ed.</p>
Water Quality Parameters	<p>Microbiological; Organic; Inorganic; Radiological; Mineral; Physical</p>	<p>CSUS ~ Water Distribution System Operation and Maintenance, 4th Ed. AWWA, Principles and Practices of Water Supply Operation, Water Sources, 3rd Ed. And Water Transmission and Distribution, 3rd Ed.</p>
Microbiological and Chemical Quality	<p>Bacteria, viruses, and protozoan; Coliform group; occurrence, significance; Oxygen starvation (methemoglobinemia) in infants; Potential waterborne diseases; Sampling requirements; sample siting plan, sample collection, and reporting requirements</p>	<p>CSUS ~ Water Distribution System Operation and Maintenance, 4th Ed. AWWA, Principles and Practices of Water Supply Operation, Water Sources, 3rd Ed. And Water Transmission and Distribution, 3rd Ed.</p>

SECTION	TOPIC	REFERENCE
System Operation & Maintenance	<p>Distribution pipe system - materials, sanitary hazards, cross-connection; Protection, detection, disinfection of new or repaired mains, operation and maintenance sampling; Metering pump calibrations; Pumps and water pressure - pump characteristics, operation and maintenance, positive displacement vs. centrifugal, calculation of pump output; Water storage facilities; source water and finished water, purposes, operation and maintenance, and reliability; Instrumentation; Diagnosis of minor electrical problems. Define: Static head, Pressure Head, Dynamic head, Main Classifications of Water Meters</p>	<p>CSUS ~ Water Distribution System Operation and Maintenance; 4th Ed. AWWA, Principles and Practices of Water Supply Operation, 3rd Ed. Water Transmission and Distribution; USC, Manual of Cross Connection Control, Ninth Edition</p>
Safety	<p>Common hazards; Sanitary hazards; Equipment; Emergencies; Cl₂ gas safety training, Lock out/Tag out; Confined space entry; Backflow and cross connection control; Confine space procedures; Hazard recognition in Trenching and shoring, ladder and climbing devices, soil types and spoil placement; utility location</p>	<p>CSUS ~ Water Distribution System Operation and Maintenance, 4th Ed. Ch..7 http://www.osha.gov/dts/osta/otm/otm_v/otm_v_2.html#2</p>
Chlorine gas safety	<p>Detection of leaks; Hazards and safety requirements for all types of disinfectants; Characteristics of fusible plugs in chlorine containers; Effects of heat applied to chlorine cylinder; Protection against inhalation of chlorine gas; Feed rate as effected by temperature, cylinder volume, and cylinder position; Chlorine storage, feeding, and measurements; Operation and maintenance of an auto analyzer, hypochlorinator and gas chlorinator; Effects of moisture on chlorine gas;</p>	<p>CSUS ~ Water Distribution System Operation and Maintenance, 4th Ed. Ch. 6,7; Handbook of Chlorination and Alternative Disinfectants, 4th Ed. Or other Chlorination and Disinfection reference material.</p>

SECTION	TOPIC	REFERENCE
Mapping	Importance of Mapping; east/west axis; Define types of Maps: grid; master; section; base; block, System map types and use, engineering drawings, stationing, plan and profile;	CSUS ~ Water Distribution System Operation and Maintenance, 4th
Introduction to Security concerns	Define: Vulnerability Assessment, Preparedness, Recovery, Mitigation, Detection, Delay and Response, Emergency Response Plan ~ Emergency Operations Plans R18-4-116	Reference: Water and Wastewater Security Product Guide, "Visual Surveillance Monitoring," USEPA, April 20, 2004 ~ Protecting Your Community's Assets: A Guide for Small Wastewater Systems, NETCSC, Nov. 2002, page 38 ~ Emergency Planning Interactive Guide, Illinois Section American Water Works Association and Midwest Technology Assistance Center, www.isawwa.org (click on "Emergency Planning CD"), Mutual Aid Overview page. ~ Emergency Preparedness U.S.A., FEMA, Unit 1, pages 1-2 ~ Guarding Against Terrorist and Security Threats: Suggested Measures for Drinking Water and Wastewater Utilities, Appendix B of Emergency Response Plan Guidance for Small and Medium Community Water Systems to Comply with the Public Health Security and Bioterrorism Preparedness and Response Act of 2002, USEPA, April 7, 2004
Math Concepts	Formulas; Units and conversion factors; Water measurements; Concentrations; Volume; Area; Flow rates and feed rates; Percentage; Fractions	CSUS ~ Water Distribution System Operation and Maintenance, 4 th

REQUIRED RANGE OF KNOWLEDGE - Water Distribution System Operator, Grade 2

Applicants are expected to be familiar with all subjects listed under Grade 1. They are not expected to have complete mastery of all subjects but at least should have some familiarity of them in the context of water quality and treatment. The ability to make common water works measurements, calculations, and conversion is expected. Enhanced knowledge of regulatory concepts.

SECTION	TOPIC	REFERENCE
Regulatory Knowledge	Safe Drinking Water Act; Source Water Protection Program; Wellhead Protection Program; Compliance and Enforcement; Capacity Development; Operator Certification Program; Technical Assistance Program; Define: backflow, facility, initial monitoring year, Susceptibility Waive, regulatory compliance period, regulatory compliance cycle	Arizona Administrative Code, Title 18, Chapter 4, Articles 1 definitions and Title 18, Chapter 5, Article 1, definitions; R18-4-104.N and 116.A, R18-4-118.D, R18-4-212.A, R18-4-106.A, R18-5-115A.1, R18-4-206.E.1 and 2, R18-4-208.H and R18-4-209., R18-4-212.K.1, R18-4-212.K.2, R18-4-216.M.1, R18-4-216.M.2.,A.1,2, R18-4-219.A, R18-4-311.B, R18-4-206.K.3, R18-5-116, R18-5-115A.2, R18-4-223, R18-4-310B, R18-4-503.A, R18-4-601.A
Sources of Water Supply	Physical, chemical, and biological characteristics; Stratification; effects on treatment and water quality; Treatment requirements / alternatives; Watershed management; Water storage facilities; source water and finished water,	CSUS ~ Water Distribution System Operation and Maintenance, 4 th Ed. AWWA, Principles and Practices of Water Supply Operation, Water Sources, 3 rd Ed. And Water Transmission and Distribution, 3 rd Ed.; R18-4-301(E),R18-4-302(A), R18-4-303(A)

SECTION	TOPIC	REFERENCE
Disinfection	Purpose of disinfection; Disinfectant types; Characteristics of chlorine and chlorine compounds; Available chlorine in various compounds; Chlorine demand; Prechlorination; meaning and significance; Free vs. Combined chlorine; Breakpoint chlorination; Residual measurement; Gas vs. Liquid; application and methods; Effects of pH and temperature; chloramines; Relative effects on bacteria, viruses, cysts; Disinfection Byproducts Precursors, TTHM formation and HAA5 Define: Hypochlorous acid, Hydrochloric acid, Hypochlorite ion, Elemental chlorine, chlorine dioxide, Monochloramine, Dichloramine, and Trichloramine,	CSUS ~ Water Distribution System Operation and Maintenance, 4th Ed. AWWA, Principles and Practices of Water Supply Operation, Water Sources, 3rd Ed. And Water Transmission and Distribution, 3rd Ed. Handbook of Chlorination and Alternative Disinfectants, 4th Ed. Or other Chlorination and Disinfection reference material.
Chemistry	Acids, bases, alkalinity; Anions, cations, dissociated compounds; Atoms, molecules, elements, compounds; Chemical properties of standard disinfectants; Gases, liquids, solids; Inorganic, organic compounds; Solution, concentration, precipitation	CSUS ~ Water Distribution System Operation and Maintenance, 4th Ed. AWWA, Principles and Practices of Water Supply Operation, Water Sources, 3rd Ed. And Water Transmission and Distribution, 3rd Ed.
Water Quality Parameters	Microbiological; Organic; Inorganic; Radiological; Mineral; Physical	CSUS ~ Water Distribution System Operation and Maintenance, 4 th Ed. AWWA, Principles and Practices of Water Supply Operation, Water Sources, 3 rd Ed. And Water Transmission and Distribution, 3 rd Ed.

SECTION	TOPIC	REFERENCE
Microbiological and Chemical Quality	Bacteria, viruses, and protozoan; Coliform group; occurrence, significance; Oxygen starvation (methemoglobinemia) in infants; Potential waterborne diseases; Sampling requirements; sample siting plan, sample collection, and reporting requirements	CSUS ~ Water Distribution System Operation and Maintenance, 4 th Ed. AWWA, Principles and Practices of Water Supply Operation, Water Sources, 3 rd Ed. And Water Transmission and Distribution, 3 rd Ed.
System Operation & Maintenance	Distribution pipe system - materials, sanitary hazards, cross-connection; Protection, detection, disinfection of new or repaired mains, operation and maintenance sampling; Metering pump calibrations; Pumps and water pressure - pump characteristics, operation and maintenance, positive displacement vs. centrifugal, calculation of pump output; Instrumentation; Diagnosis of minor electrical problems. Define: Static head, Pressure Head, Dynamic head, Main Classifications of Water Meters	CSUS ~ Water Distribution System Operation and Maintenance; 4 th Ed. AWWA, Principles and Practices of Water Supply Operation, 3 rd Ed. Water Transmission and Distribution; USC, Manual of Cross Connection Control, Ninth Edition
Safety	Common hazards; Sanitary hazards; Equipment; Emergencies; Cl ₂ gas safety training, Lock out/Tag out; Confined space entry; Backflow and cross connection control; Confine space procedures; Hazard recognition in Trenching and shoring, ladder and climbing devices, soil types and spoil placement utility location	CSUS ~ Water Distribution System Operation and Maintenance, 4 th Ed. Ch..7 http://www.osha.gov/dts/osta/otm/otm_v/otm_v_2.html#2

SECTION	TOPIC	REFERENCE
Chlorine gas safety	<p>Detection of leaks; Hazards and safety requirements for all types of disinfectants; Characteristics of fusible plugs in chlorine containers; Effects of heat applied to chlorine cylinder; Protection against inhalation of chlorine gas; Feed rate as effected by temperature, cylinder volume, and cylinder position; Chlorine storage, feeding, and measurements; Operation and maintenance of an auto analyzer, hypochlorinator and gas chlorinator; Effects of moisture on chlorine gas;</p>	<p>CSUS ~ Water Distribution System Operation and Maintenance, 4th Ed. Ch. 6,7; Handbook of Chlorination and Alternative Disinfectants, 4th Ed. Or other Chlorination and Disinfection reference material.</p>
Mapping	<p>Importance of Mapping; east/west axis; Define types of Maps: grid; master; section; base; block, System map types and use, engineering drawings, stationing, plan and profile;</p>	<p>CSUS ~ Water Distribution System Operation and Maintenance, 4th</p>

SECTION	TOPIC	REFERENCE
Introduction to Security concerns	Define: Vulnerability Assessment, Preparedness, Recovery, Mitigation, Detection, Delay and Response, Emergency Response Plan ~ Emergency Operations Plans R18-4-116	Reference: Water and Wastewater Security Product Guide, "Visual Surveillance Monitoring," USEPA, April 20, 2004 ~ Protecting Your Community's Assets: A Guide for Small Wastewater Systems, NETCSC, Nov. 2002, page 38 ~ Emergency Planning Interactive Guide, Illinois Section American Water Works Association and Midwest Technology Assistance Center, www.isawwa.org (click on "Emergency Planning CD"), Mutual Aid Overview page. ~ Emergency Preparedness U.S.A., FEMA, Unit 1, pages 1-2 ~ Guarding Against Terrorist and Security Threats: Suggested Measures for Drinking Water and Wastewater Utilities, Appendix B of Emergency Response Plan Guidance for Small and Medium Community Water Systems to Comply with the Public Health Security and Bioterrorism Preparedness and Response Act of 2002, USEPA, April 7, 2004
Math Concepts	Formulas; Units and conversion factors; Water measurements; Concentrations; Volume; Area; Flow rates and feed rates; Percentage; Fractions	CSUS ~ Water Distribution System Operation and Maintenance, 4 th

REQUIRED RANGE OF KNOWLEDGE - Water Distribution System Operator, Grade 3

Applicants are expected to have mastered all items listed under Grades 1 and 2, and a familiarity with the subjects listed under Grade 3. Must have the ability to make a wide range of water treatment calculations. Possess a well-developed knowledge of national and local drinking water regulations.

SECTION	TOPIC	REFERENCE
Regulatory Knowledge	Safe Drinking Water Act; Source Water Protection Program; Wellhead Protection Program; Compliance and Enforcement; Capacity Development; Monitoring Assistance Program; Operator Certification Program; Definition of Backflow, Initial Monitoring Year, VOC, Use Waiver, Susceptibility Waiver, Compliance Cycle, Compliance Period, Facility	Arizona Administrative Code, Title 18, Chapter 4, Articles 1 definitions and Title 18, Chapter 5, Article 1, definitions; R18-4-104.N, R18-4-104.U.1(g) or 2(b), R18-4-206.L, R18-4-208E.H, R18-4-212 K. R18-4-219.A R18-4-304.A R18-4-308A, R18-4-310.A. R18-4-311B, R18-4-314.A R18-4-503.A, R18-5-108; R18-5-109-C, R18-5-104-B,E, R18-5-115A.1
Sources of Water Supply	Physical, chemical, and biological characteristics; Stratification; effects on treatment and water quality; Treatment requirements / alternatives; Watershed management; Water storage facilities, Corrosion Control ; source water and finished water,	CSUS ~ Water Distribution System Operation and Maintenance, 4 th Ed. AWWA, Principles and Practices of Water Supply Operation, Water Sources, 3 rd Ed. And Water Transmission and Distribution, 3 rd Ed.; R18-4-301(E), R18-4-302(A), R18-4-303(A)

SECTION	TOPIC	REFERENCE
Disinfection	<p>Purpose of disinfection; Disinfectant types; Characteristics of chlorine and chlorine compounds; Available chlorine in various compounds; Chlorine demand; Prechlorination; meaning and significance; Free vs. Combined chlorine; Breakpoint chlorination; Residual measurement; Gas vs. Liquid; application and methods; Effects of pH and temperature; chloramines; Relative effects on bacteria, viruses, cysts; Disinfection Byproducts Precursors, TTHM formation and HAA5 Define: Hypochlorous acid, Hydrochloric acid, Hypochlorite ion, Elemental Chlorine, Chlorine Dioxide, Monochloramine, Dichloramine, and Trichloramine,</p>	<p>CSUS ~ Water Distribution System Operation and Maintenance, 4th Ed. AWWA, Principles and Practices of Water Supply Operation, Water Sources, 3rd Ed. And Water Transmission and Distribution, 3rd Ed. Handbook of Chlorination and Alternative Disinfectants, 4th Ed. Or other Chlorination and Disinfection reference material.</p>
Chemistry	<p>Acids, bases, alkalinity; Anions, cations, dissociated compounds; Atoms, molecules, elements, compounds; Chemical properties of standard disinfectants; Gases, liquids, solids; Define: Inorganic, organic compounds; Solution, concentration, precipitation, Aluminum Sulfate, Sodium Carbonate, Calcium Hydroxide, Zinc Orthophosphate; Marble and Langelier Test,</p>	<p>CSUS ~ Water Distribution System Operation and Maintenance, 4th Ed. AWWA, Principles and Practices of Water Supply Operation, Water Sources, 3rd Ed. And Water Transmission and Distribution, 3rd Ed.</p>
Water Quality Parameters	<p>Microbiological; Organic; Inorganic; Radiological; Mineral; Physical</p>	<p>CSUS ~ Water Distribution System Operation and Maintenance, 4th Ed. AWWA, Principles and Practices of Water Supply Operation, Water Sources, 3rd Ed. And Water Transmission and Distribution, 3rd Ed.</p>

SECTION	TOPIC	REFERENCE
Microbiological and Chemical Quality	Bacteria, viruses, and protozoan; Coliform group; occurrence, significance; Oxygen starvation (methemoglobinemia) in infants; Potential waterborne diseases; Sampling requirements; sample siting plan, sample collection, and reporting requirements	CSUS ~ Water Distribution System Operation and Maintenance, 4 th Ed. AWWA, Principles and Practices of Water Supply Operation, Water Sources, 3 rd Ed. And Water Transmission and Distribution, 3 rd Ed.
System Operation & Maintenance	Distribution pipe system - materials, sanitary hazards, Cross-Connection Control; Disinfection of new or repaired mains, operation and maintenance sampling; Metering pump calibrations; Pumps and water pressure - pump characteristics, operation and maintenance, positive displacement vs. centrifugal, calculation of pump output; Instrumentation; Diagnosis of minor electrical problems. Define: Static head, Pressure Head, Dynamic head, Main Classifications of Water Meters,	CSUS ~ Water Distribution System Operation and Maintenance; 4 th Ed. AWWA, Principles and Practices of Water Supply Operation, 3 rd Ed. Water Transmission and Distribution; USC, Manual of Cross Connection Control, Ninth Edition
Safety	Common hazards; Sanitary hazards; Equipment; Emergencies; Cl ₂ gas safety training, Lock out/Tag out; Confined space entry; Backflow and cross connection control; Confine space procedures; Hazard recognition in Trenching and shoring, ladder and climbing devices, soil types and spoil placement utility location, Use, Storage and Handling of Sodium Hexametaphosphate	CSUS ~ Water Distribution System Operation and Maintenance, 4 th Ed. Ch..7 http://www.osha.gov/dts/osta/otm/otm_v/otm_v_2.html#2

SECTION	TOPIC	REFERENCE
Chlorine gas safety	<p>Detection of leaks; Hazards and safety requirements for all types of disinfectants; Characteristics of fusible plugs in chlorine containers; Effects of heat applied to chlorine cylinder; Protection against inhalation of chlorine gas; Feed rate as effected by temperature, cylinder volume, and cylinder position; Chlorine storage, feeding, and measurements; Operation and maintenance of an auto analyzer, hypochlorinator and gas chlorinator; Effects of moisture on chlorine gas;</p>	<p>CSUS ~ Water Distribution System Operation and Maintenance, 4th Ed. Ch. 6,7; Handbook of Chlorination and Alternative Disinfectants, 4th Ed. Or other Chlorination and Disinfection reference material.</p>
Mapping	<p>Importance of Mapping; east/west axis; Define types of Maps: grid; master; section; base; block, System map types and use, engineering drawings, stationing, plan and profile;</p>	<p>CSUS ~ Water Distribution System Operation and Maintenance, 4th</p>

SECTION	TOPIC	REFERENCE
Introduction to Security concerns	Define: Vulnerability Assessment, Preparedness, Recovery, Mitigation, Detection, Delay and Response, Emergency Response Plan ~ Emergency Operations Plans R18-4-116	Reference: Water and Wastewater Security Product Guide, "Visual Surveillance Monitoring," USEPA, April 20, 2004 ~ Protecting Your Community's Assets: A Guide for Small Wastewater Systems, NETCSC, Nov. 2002, page 38 ~ Emergency Planning Interactive Guide, Illinois Section American Water Works Association and Midwest Technology Assistance Center, www.isawwa.org (click on "Emergency Planning CD"), Mutual Aid Overview page. ~ Emergency Preparedness U.S.A., FEMA, Unit 1, pages 1-2 ~ Guarding Against Terrorist and Security Threats: Suggested Measures for Drinking Water and Wastewater Utilities, Appendix B of Emergency Response Plan Guidance for Small and Medium Community Water Systems to Comply with the Public Health Security and Bioterrorism Preparedness and Response Act of 2002, USEPA, April 7, 2004
Math Concepts	Formulas; Units and conversion factors; Water measurements; Concentrations; Volume; Area; Flow rates and feed rates; Percentage; Fractions	CSUS ~ Water Distribution System Operation and Maintenance, 4 th

REQUIRED RANGE OF KNOWLEDGE - Water Distribution System Operator, Grade 4

Applicants are expected to have mastered all items listed under Grades 1, 2, and 3 plus a practical familiarity with treatment plant design, water utility management, safety, and public health. Must have the ability to make a wide range of water utility calculations is expected. Extensive knowledge of all drinking water regulations.

SECTION	TOPIC	REFERENCE
Regulatory Knowledge	Safe Drinking Water Act; Source Water Protection Program; Wellhead Protection Program; Compliance and Enforcement; Capacity Development; Monitoring Assistance Program; Operator Certification Program; Definition of Backflow, Initial Monitoring Year, VOC, POE, Use Waiver, Susceptibility Waiver, Compliance Cycle, Compliance Period	Arizona Administrative Code, Title 18, Chapter 4, Articles 1 definitions and Title 18, Chapter 5, Article 1, definitions; R18-5-104-U; R18-4-212.K, R18-4-219.A R18-4-308.A, R18-4-310 A; R18-4-311.B, R18-4-503.A, R18-4-505.B.3, R18-4-212.K, R18-4-106.A
Sources of Water Supply	Physical, chemical, and biological characteristics; Stratification; effects on treatment and water quality; Treatment requirements / alternatives; Watershed management; Water storage facilities; source water and finished water	CSUS ~ Water Distribution System Operation and Maintenance, 4 th Ed. AWWA, Principles and Practices of Water Supply Operation, Water Sources, 3 rd Ed. And Water Transmission and Distribution, 3 rd Ed.; R18-4-301(E),R18-4-302(A), R18-4-303(A)

SECTION	TOPIC	REFERENCE
Disinfection	<p>Purpose of disinfection; Disinfectant types; Characteristics of chlorine and chlorine compounds; Available chlorine in various compounds; Chlorine demand; Prechlorination; Free vs. Combined chlorine; Breakpoint chlorination; Residual measurement; Gas vs. Liquid; application and methods; Effects of pH and temperature; chloramines; Relative effects on bacteria, viruses, cysts; Disinfection Byproducts Precursors, TTHM formation and HAA5 Define: Hypochlorous acid, Hydrochloric acid, Hypochlorite ion, Elemental chlorine, chlorine dioxide, Monochloramine, Dichloramine, and Trichloramine,</p>	<p>CSUS ~ Water Distribution System Operation and Maintenance, 4th Ed. AWWA, Principles and Practices of Water Supply Operation, Water Sources, 3rd Ed. And Water Transmission and Distribution, 3rd Ed. Handbook of Chlorination and Alternative Disinfectants, 4th Ed. Or other Chlorination and Disinfection reference material.</p>
Chemistry	<p>Acids, bases, alkalinity; Anions, cations, dissociated compounds; Atoms, molecules, elements, compounds; Chemical properties of standard disinfectants; Gases, liquids, solids; Inorganic, organic compounds; Solution, concentration, precipitation</p>	<p>CSUS ~ Water Distribution System Operation and Maintenance, 4th Ed. AWWA, Principles and Practices of Water Supply Operation, Water Sources, 3rd Ed. And Water Transmission and Distribution, 3rd Ed.</p>
Water Quality Parameters	<p>Microbiological; Organic; Inorganic; Radiological; Mineral; Physical</p>	<p>CSUS ~ Water Distribution System Operation and Maintenance, 4th Ed. AWWA, Principles and Practices of Water Supply Operation, Water Sources, 3rd Ed. And Water Transmission and Distribution, 3rd Ed.</p>
Microbiological and Chemical Quality	<p>Bacteria, viruses, and protozoan; Coliform group; occurrence, significance; Oxygen starvation (methemoglobinemia) in infants; Potential waterborne diseases; Sampling requirements; sample siting plan, sample collection, and reporting requirements</p>	<p>CSUS ~ Water Distribution System Operation and Maintenance, 4th Ed. AWWA, Principles and Practices of Water Supply Operation, Water Sources, 3rd Ed. And Water Transmission and Distribution, 3rd Ed.</p>

SECTION	TOPIC	REFERENCE
System Operation & Maintenance	Distribution pipe system - materials, sanitary hazards, cross-connection; Protection, detection, disinfection of new or repaired mains, operation and maintenance sampling; Metering pump calibrations; Pumps and water pressure - pump characteristics, operation and maintenance, positive displacement vs. centrifugal, calculation of pump output; Instrumentation; Diagnosis of minor electrical problems. Define: Static head, Pressure Head, Dynamic head, Main Classifications of Water Meters	CSUS ~ Water Distribution System Operation and Maintenance; 4 th Ed. AWWA, Principles and Practices of Water Supply Operation, 3 rd Ed. Water Transmission and Distribution; USC, Manual of Cross Connection Control, Ninth Edition
Safety	Common hazards; Sanitary hazards; Equipment; Emergencies; Cl ₂ gas safety training, Lock out/Tag out; Confined space entry; Backflow and cross connection control; Confine space procedures; Hazard recognition in Trenching and shoring, ladder and climbing devices, soil types and spoil placement utility location; Use, Storage and Handling of Sodium Hexametaphosphate	CSUS ~ Water Distribution System Operation and Maintenance, 4 th Ed. Ch..7 http://www.osha.gov/dts/osta/otm/otm_v/otm_v_2.html#2
Chlorine gas safety	Detection of leaks; Hazards and safety requirements for all types of disinfectants; Characteristics of fusible plugs in chlorine containers; Effects of heat applied to chlorine cylinder; Protection against inhalation of chlorine gas; Feed rate as effected by temperature, cylinder volume, and cylinder position; Chlorine storage, feeding, and measurements; Operation and maintenance of an auto analyzer, hypochlorinator and gas chlorinator; Effects of moisture on chlorine gas;	CSUS ~ Water Distribution System Operation and Maintenance, 4th Ed. Ch. 6,7; Handbook of Chlorination and Alternative Disinfectants, 4th Ed. Or other Chlorination and Disinfection reference material.

SECTION	TOPIC	REFERENCE
Mapping	Importance of Mapping; east/west axis; Define types of Maps: grid; master; section; base; block, System map types and use, engineering drawings, stationing, plan and profile;	CSUS ~ Water Distribution System Operation and Maintenance, 4th
Introduction to Security concerns	Define: Vulnerability Assessment, Preparedness, Recovery, Mitigation, Detection, Delay and Response, Emergency Response Plan ~ Emergency Operations Plans R18-4-116	Reference: Water and Wastewater Security Product Guide, "Visual Surveillance Monitoring," USEPA, April 20, 2004 ~ Protecting Your Community's Assets: A Guide for Small Wastewater Systems, NETCSC, Nov. 2002, page 38 ~ Emergency Planning Interactive Guide, Illinois Section American Water Works Association and Midwest Technology Assistance Center, www.isawwa.org (click on "Emergency Planning CD"), Mutual Aid Overview page. ~ Emergency Preparedness U.S.A., FEMA, Unit 1, pages 1-2 ~ Guarding Against Terrorist and Security Threats: Suggested Measures for Drinking Water and Wastewater Utilities, Appendix B of Emergency Response Plan Guidance for Small and Medium Community Water Systems to Comply with the Public Health Security and Bioterrorism Preparedness and Response Act of 2002, USEPA, April 7, 2004
Math Concepts	Database querying; Using graphs in a presentation; Formulas; Units and conversion factors; Water measurements; Concentrations; Volume; Area; Flow rates and feed rates; Percentage; Fractions	CSUS ~ Water Distribution System Operation and Maintenance, 4 th