

# **NEEDS TO KNOW GUIDE FOR SURFACE WATER SYSTEM OPERATORS**

Presented by  
NORTH CAROLINA WATERWORKS OPERATORS ASSOCIATION  
BOARD OF EXAMINERS

**2018**

PART I  
NEED TO KNOW GUIDE - WATER TREATMENT PLANT OPERATION, VOLUME I  
Sections Listed are from 7th Edition

Guide for Water Treatment Plant Operation, Volume I, A Field Study Training Program Prepared by California State University, Sacramento, School of Engineering, Applied Research and Design Center in Cooperation with the National Environmental Training Association.

PART II  
NEED TO KNOW GUIDE - WATER TREATMENT PLANT OPERATION, VOLUME II  
Sections Listed are from 6th Edition

Guide for Water Treatment Plant Operation, Volume II, A Field Study Training Program Prepared by California State University, Sacramento, School of Engineering, Applied Research and Design Center in Cooperation with the National Environmental Training Association.

PART III  
NEED TO KNOW GUIDE - RULES GOVERNING PUBLIC WATER SYSTEMS  
Sections Listed are from January 8, 2016

Guide for "Rules Governing Public Water Systems", Section .0100 through .2100, Title 15A, Subchapter 18C of the North Carolina Administrative Code, Department of Environment, Health and Natural Resources, Division of Environmental Health.

PART IV  
NEED TO KNOW GUIDE - RULES GOVERNING WATER TREATMENT FACILITY OPERATORS  
Sections Listed are from December 1, 2008 Edition

Guide for "Rules Governing Water Treatment Facility Operators", Section .0100 through Section .2105, Title 15A, Subchapter 18D of the North Carolina Administrative Code, Department of Environment, Health and Natural Resources, Division of Environmental Health.

## PART I

WATER TREATMENT PLANT OPERATION VOLUME I

SECTION	TOPIC	C	B	A
1	<b>KEY TERMS: INTRODUCTION TO WATER TREATMENT</b>			
1.1	WATER AS A LIMITED RESOURCE	X	X	X
1.2	WATER TREATMENT	X	X	X
1.3	THE SAFE DRINKING WATER ACT	X	X	X
1.4	WATER TREATMENT PLANTS	X	X	X
1.4.1	Conventional Surface Water Treatment	X	X	X
1.4.2	Additional Treatment	X	X	X
1.5	PLANT OPERATION	X	X	X
1.5.1	Daily Operating Procedures	X	X	X
1.5.1.1	At the Start of the Shift	X	X	X
1.5.1.2	During the Shift	X	X	X
1.5.1.3	At the End of the Shift	X	X	X
1.5.2	Regulation of Flows	X	X	X
1.5.2.1	Treatment Process Changes	X	X	X
1.5.3	Chemical Use & Handling	X	X	X
1.5.3.1	Storage & Supply	X	X	X
1.5.3.2	Safe Handling	X	X	X
1.5.3.3	First Aid Procedures	X	X	X
1.5.4	Water Quality Monitoring	X	X	X
1.5.4.1	Turbidity Removal	X	X	X
1.5.4.2	Water Quality Complaints	X	X	X
1.5.5	Sludge Handling & Disposal		X	X
1.5.6	Process Instrumentation & Controls		X	X
1.5.6.1	Signal Transmission Methods		X	X
1.5.6.2	Control Methods		X	X
1.5.6.3	Computers		X	X
1.5.7	Emergency Conditions & Procedures	X	X	X
1.5.7.1	Treatment Process Failures	X	X	X
1.5.7.2	Process Equipment Failures	X	X	X
1.5.7.3	Power Failures	X	X	X
1.5.7.4	Fires	X	X	X
1.5.7.5	Natural Disasters	X	X	X
1.5.7.6	Communications	X	X	X
1.5.8	Operating Records & Reports	X	X	X
1.6	PLANT MAINTENANCE			X
1.6.1	Planning & Scheduling			X
1.6.2	Records & Management			X
1.6.3	Spare Parts Management			X
1.6.4	Cost & Budget Control			X
1.6.5	Emergency Repair Procedures			X
1.6.6	Training Program	X	X	X
1.6.7	Security	X	X	X
1.7	ENERGY CONSERVATION		X	X
1.7.1	Power Management		X	X
1.7.2	Power Cost Analysis		X	X
1.8	SUPERVISION & ADMINISTRATION	X	X	X
1.9	PUBLIC RELATIONS	X	X	X
1.10	SAFETY	X	X	X
1.11	WATER TREATMENT PLANT OPERATIONS	X	X	X
1.12	MATH ASSIGNMENT	X	X	X
CHAPTER REVIEW	REVIEW ALL QUESTIONS	ALL	ALL	ALL

## PART I

## WATER TREATMENT PLANT OPERATION VOLUME I

SECTION	TOPIC	C	B	A
2	<b>KEY TERMS: SOURCE WATER, RESERVOIR MANAGEMENT, &amp; INTAKE STRUCTURES</b>			
2.1	SOURCES OF WATER	X	X	X
2.1.1	Ocean	X	X	X
2.1.2	Surface Water Treatment Rule (SWTR)	X	X	X
2.1.2.1	Rivers & Streams	X	X	X
2.1.2.2	Lakes & Reservoirs	X	X	X
2.1.3	Groundwater	X	X	X
2.1.3.1	Wells	X	X	X
2.1.3.2	Springs	X	X	X
2.1.4	Reclaimed Water	X	X	X
2.2	SELECTION OF A WATER SOURCE	X	X	X
2.2.1	Water Rights	X	X	X
2.2.2	Sanitary Survey	X	X	X
2.2.3	Contamination	X	X	X
2.2.3.1	Physical Characteristics	X	X	X
2.2.3.2	Chemical Characteristics	X	X	X
2.2.3.3	Biological Factors	X	X	X
2.2.3.4	Radiological Factors	X	X	X
2.3	SURFACE RESERVOIRS AS DOMESTIC WATER SUPPLIES	X	X	X
2.3.1	Factors Affecting Water Quality	X	X	X
2.3.1.1	Watershed Conditions		X	
2.3.1.2	Thermal Stratification	X	X	X
2.3.1.3	Nutrients	X	X	X
2.3.1.4	Algal Blooms	X	X	X
2.3.1.5	Anaerobic Conditions	X	X	X
2.4	RESERVOIR MANAGEMENT PROGRAMS		X	X
2.4.1	Improvement & Maintenance of Water Quality		X	X
2.4.2	Reduction of Water Treatment Costs		X	X
2.4.3	Improvement & Maintenance of Fishery, Recreational, & Property Values		X	X
2.4.4	Removal of Trees & Brush in Areas to Be Flooded		X	X
2.4.5	Watershed Management		X	X
2.4.5.1	Wastewater		X	X
2.4.5.2	Fertilization		X	X
2.4.5.3	Industrial Discharges		X	X
2.4.5.4	Soil Grading & Farming Practices		X	X
2.4.5.5	Livestock Grazing		X	X
2.4.5.6	Pesticides & Herbicides		X	X
2.4.5.7	Wildfires		X	X
2.4.5.8	Land Use Control		X	X
2.4.5.9	Highway Stormwater Runoff		X	X
2.4.6	Algae Control by Chemical Methods		X	X
2.4.6.1	Chemicals Available		X	X
2.4.6.2	Methods of Copper Sulfate Applications		X	X
2.4.6.3	Copper Sulfate Doses		X	X
2.4.6.4	Monitoring		X	X
2.4.6.5	Recordkeeping		X	X
2.4.6.6	Safety		X	X
2.4.7	Reaeration & Artificial Destratification			X
2.4.7.1	Methods of Reaeration			X
2.4.7.2	Destratification			X
2.4.7.3	Hypolimnetic Aeration or Oxygenation			X
2.4.8	Managing Frozen Reservoirs			X
2.4.8.1	Physical Effects of Ice Formation			X

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SECTION	TOPIC	C	B	A
2.4.8.2	Effects on Raw Water Quality			X
2.4.8.3	Recreational Use of Reservoir Ice Surfaces			X
2.4.9	Dam & Reservoir Management			X
2.4.9.1	Dam Inspection & Maintenance			X
2.4.9.2	Reservoir Maintenance			X
2.5	LABORATORY & MONITORING PROGRAMS			X
2.5.1	Procedures			X
2.5.2	Recordkeeping			X
2.5.3	Safety			X
2.6	INTAKE STRUCTURES			X
2.6.1	Types of Intake Structures			X
2.6.2	Types of Intake Gates			X
2.6.3	Intake Screens & Trash Racks			X
2.6.4	Operation & Maintenance Procedures			X
2.6.5	Records & Management			X
2.6.6	Safety			X
2.7	Math Assignment	X	X	X
CHAPTER REVIEW	REVIEW ALL QUESTIONS	ALL	ALL	ALL
3	<b>KEY TERMS: COAGULATION &amp; FLOCCULATION</b>			
3.1	REMOVING PARTICULATES FROM WATER	X	X	X
3.2	COAGULATION	X	X	X
3.2.1	Coagulants	X	X	X
3.2.2	Basic Coagulant Chemistry	X	X	X
3.2.3	Effective Mixing	X	X	X
3.3	FLOCCULATION	X	X	X
3.3.1	Process Performance	X	X	X
3.3.1.1	Detention Time	X	X	X
3.3.1.2	Types of Flocculators (Stirrers)	X	X	X
3.3.1.3	Flocculation Basins	X	X	X
3.4	INTERACTION WITH OTHER TREATMENT PROCESSES	X	X	X
3.5	PROCESS CONTROL	X	X	X
3.6	NORMAL OPERASTIONS	X	X	X
3.6.1	Process Actions	X	X	X
3.6.2	Process Operations	X	X	X
3.6.2.1	Detention Times	X	X	X
3.3.2.2	The Jar Test	X	X	X
3.6.2.3	Streaming Current Meters	X	X	X
3.6.2.4	Evaluation of Plant Performance	X	X	X
3.6.3	Chemical Usage for Small Plants	X	X	X
3.6.3.1	Calculating the Amount of Chemical Required	X	X	X
3.6.3.2	Chemical Feeding	X	X	X
3.6.3.3	Preparation of Chemical Solutions	X	X	X
3.6.4	Recordkeeping	X	X	X
3.6.5	Safety	X	X	X
3.6.6	Communications	X	X	X
3.7	ABNORMAL CONDITIONS	X	X	X
3.7.1	Process Actions		X	X
3.7.2	Recordkeeping		X	X
3.7.3	Communications		X	X
3.8	STARTUP & SHUTDOWN PROCEDURES		X	X
3.8.1	Startup Procedure		X	X
3.8.2	Shutdown Procedure		X	X
3.8.3	Recordkeeping	X	X	X

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## WATER TREATMENT PLANT OPERATION VOLUME I

SECTION	TOPIC	C	B	A
3.8.4	Safety	X	X	X
3.9	LABORATORY TESTS	X	X	X
3.9.1	Sampling Procedures	X	X	X
3.9.2	Sample Analysis	X	X	X
3.9.3	Safety	X	X	X
3.9.4	Recordkeeping	X	X	X
3.10	EQUIPMENT OPERATION & MAINTENANCE	X	X	X
3.10.1	Chemical Feeders	X	X	X
3.10.2	Calibration Method	X	X	X
3.10.3	Preventive Maintenance Procedures	X	X	X
3.10.4	Safety	X	X	X
3.11	ENHANCED COAGULATION		X	X
3.11.1	Chemical Reactions		X	X
3.11.2	Process Control		X	X
3.12	BALLASTED FLOCCULATION		X	X
3.12.1	Process Stages		X	X
3.12.2	Startup		X	X
3.12.3	Microsand Management		X	X
3.12.3.1	Microsand Concentration Monitoring		X	X
3.12.3.2	Microsand Addition		X	X
3.12.4	Hydrocyclone Performance		X	X
3.12.5	Process Performance Monitoring		X	X
3.12.6	Process Optimization		X	X
3.12.7	Troubleshooting Procedures		X	X
3.12.8	Intermittent Use		X	X
3.12.8.1	Short-Term Standby Mode (Wet Storage)		X	X
3.12.8.2	Long Term Shutdown & Freeze Protection		X	X
3.12.9	Equipment Maintenance		X	X
3.12.9.1	Tube Setter Modules		X	X
3.12.9.2	Mixers		X	X
3.12.9.3	Scrapers		X	X
3.12.9.4	Microsand Recirculation Pumps		X	X
3.12.9.5	Hydrocyclones		X	X
3.13	MATH ASSIGNMENT	X	X	X
CHAPTER REVIEW	REVIEW ALL QUESTIONS	ALL	ALL	ALL
4	<b>KEY TERMS: SEDIMENTATION</b>			
4.1	PRESEDIMENTATION	X	X	X
4.2	PROCESS PERFORMANCE	X	X	X
4.2.1	Nature of Particulate Impurities	X	X	X
4.2.2	Water Temperature	X	X	X
4.2.3	Currents	X	X	X
4.2.4	Particle Interactions	X	X	X
4.3	SEDIMENTATION BASINS		X	X
4.3.1	Basin Types		X	X
4.3.1.1	Rectangular Basins		X	X
4.3.1.2	Double-Deck Basins		X	X
4.3.1.3	Circular & Square Basins		X	X
4.3.1.4	High-Rate Settlers		X	X
4.3.1.5	Solids-Contact Units		X	X
4.4	DESIGN & OPERATIONAL GUIDELINES	X	X	X
4.4.1	Basin Layout	X	X	X
4.4.2	Detention Time	X	X	X
4.4.3	Surface Loading		X	X

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SECTION	TOPIC	C	B	A
4.4.4	Effective Water Depth		X	X
4.4.5	Mean Flow Velocity		X	X
4.4.6	Weir Loading Time		X	X
4.5	SOLIDS-CONTACT CLARIFICATION		X	X
4.5.1	Operational Control		X	X
4.5.2	Maintenance		X	X
4.5.3	Calculations			X
4.6	SLUDGE HANDLING		X	X
4.6.1	Sludge Removal Systems	X	X	X
4.6.2	Sludge Removal Frequency	X	X	X
4.7	INTERACTION WITH OTHER TREATMENT PROCESSES	X	X	X
4.8	NORMAL OPERATIONS	X	X	X
4.8.1	Process Control	X	X	X
4.8.2	Process Actions	X	X	X
4.8.3	Recordkeeping		X	X
4.9	ABNORMAL OPERATIONS	X	X	X
4.9.1	Process Actions	X	X	X
4.10	STARTUP & SHUTDOWN PROCEDURES		X	X
4.10.1	Startup Procedure		X	X
4.10.2	Shutdown Procedure		X	X
4.11	LABORATORY TESTS	X	X	X
4.11.1	Sampling Procedures	X	X	X
4.11.2	Sample Analysis	X	X	X
4.12	EQUIPMENT OPERATION & MAINTENANCE		X	X
4.12.1	Corrosion Control		X	X
4.12.2	Preventive Maintenance Procedures		X	X
4.12.3	Safety	X	X	X
4.13	MATH ASSIGNMENT	X	X	X
CHAPTER REVIEW	REVIEW ALL QUESTIONS	ALL	ALL	ALL
5	<b>KEY TERMS: FILTRATION</b>			
5.1	FILTRATION MECHANISMS	X	X	X
5.2	TYPES OF FILTERS	X	X	X
5.2.1	Gravity Filtration	X	X	X
5.2.2	Pressure Filtration	X	X	X
5.2.4	Slow Sand Filtration			X
5.3	PROCESS PERFORMANCE CONSIDERATIONS		X	X
5.3.1	Filter Media			X
5.3.2	Operational Criteria			X
5.3.2.1	Filter Layout		X	X
5.3.2.2	Filter Production & Filtration Rate		X	X
5.3.2.3	Filtration Efficiency		X	X
5.3.3	Filter Operation	X	X	X
5.3.3.1	Filtration Mode	X	X	X
5.3.3.2	Backwashing	X	X	X
5.3.3.3	Surface Wash	X	X	X
5.3.4	Filter Control Systems			X
5.4	ACTIVATED CARBON FILTERS			X
5.5	INTERACTION WITH OTHER TREATMENT PROCESSES	X	X	X
5.5.1	Pretreatment Processes		X	X
5.5.2	Inline Filtration		X	X
5.5.3	Conventional Filtration (Treatment)		X	X
5.3.4	Direct Filtration		X	X
5.6	PROCESS CONTROL	X	X	X

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SECTION	TOPIC	C	B	A
5.7	OPERATING PROCEDURES ASSOCIATED WITH NORMAL PROCESS CONDITIONS	X	X	X
5.7.1	Process Actions		X	X
5.7.2	Mudball Evaluation Procedure			X
5.7.3	Process Calculations		X	X
5.7.3.1	Filter Efficiency		X	X
5.7.3.2	Filtration Rate		X	X
5.7.3.3	Backwash Rate		X	X
5.7.4	Recordkeeping		X	X
5.7.5	Filter Monitoring Instrumentation		X	X
5.8	OPERATING PROCEDURES ASSOCIATED WITH ABNORMAL PROCESS CONDITIONS			X
5.8.1	Process Actions		X	X
5.8.2	Air Binding	X	X	X
5.8.3	Excessive Head Loss		X	X
5.9	STARTUP & SHUTDOWN PROCEDURES	X	X	X
5.9.1	Implementation of Startup/Shutdown Procedures	X	X	X
5.9.1.1	Filter Checkout Procedures	X	X	X
5.9.1.2	Backwash Procedures	X	X	X
5.9.1.3	Filter Startup Procedures	X	X	X
5.9.1.4	Filter Shutdown Procedures	X	X	X
5.10	PROCESS & SUPPORT EQUIPMENT OPERATION & MAINTENANCE			X
5.10.1	EQUIPMENT OPERATION & MAINTENANCE		X	X
5.10.2	Preventive Maintenance Procedures		X	X
5.10.3	Safety Considerations	X	X	X
5.11	DRINKING WATER REGULATIONS		X	X
5.11.1	Safe Drinking Water Act (SDWA)	X	X	X
5.11.2	Surface Water Treatment Rule (SWTR)	X	X	X
5.11.3	Turbidity Requirements	X	X	X
5.12	PARTICLE COUNTERS			X
5.12.1	Particle Counting to Monitor Filter Performance			X
5.12.1.1	Filter Ripening			X
5.12.1.2	Filter Flow Rate			X
5.12.1.3	Filter Run Time			X
5.12.1.4	Filter Media Selection			X
5.12.1.5	Polymer Application			X
5.12.1.6	Other Uses of Particle Counters			X
5.12.2	How Particle Counters Work			X
5.12.3	Grab vs. In-Process Particle Counters			X
5.12.3.1	Grab Samples	X	X	X
5.12.3.2	In-Process Measurements		X	X
5.12.4	Particle Counters Compared to Turbidity Meters		X	X
5.12.5	Operation & Maintenance			X
5.12.5.1	Sampling		X	X
5.12.5.2	Flow Control			X
5.12.5.3	Sample Tubing		X	X
5.12.5.4	Bubbles		X	X
5.12.5.5	Initial Startup	X	X	X
5.12.5.6	Overconcentration			X
5.12.5.7	Troubleshooting		X	X
5.12.5.8	Quality Assurance/Quality Control			X
5.13	MATH ASSIGNMENT	X	X	X
CHAPTER REVIEW	REVIEW ALL QUESTIONS	ALL	ALL	ALL

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## WATER TREATMENT PLANT OPERATION VOLUME I

SECTION	TOPIC	C	B	A
6	<b>KEY TERMS: DISINFECTION</b>			
6.1	DRINKING WATER SAFETY	X	X	X
6.1.1	Safe Drinking Water Laws	X	X	X
6.2	FACTORS INFLUENCING DISINFECTION	X	X	X
6.2.1	pH	X	X	X
6.2.2	Temperature	X	X	X
6.2.3	Turbidity Requirements	X	X	X
6.2.3.1	Organic Matter	X	X	X
6.2.3.2	Inorganic Matter	X	X	X
6.2.4	Reducing Agents	X	X	X
6.2.5	Microorganisms	X	X	X
6.2.5.1	Removal Processes	X	X	X
6.3	DISINFECTION PROCESS	X	X	X
6.3.1	Physical Means of Disinfection	X	X	X
6.3.2	Chemical Disinfectants (Other than Chlorine)	X	X	X
6.3.3	Chlorine	X	X	X
6.3.3.1	Chlorine Disinfection Action	X	X	X
6.3.3.2	Reaction with Water	X	X	X
6.3.3.3	Reaction with Impurities in Water		X	X
6.3.4	Hypochlorite	X	X	X
6.3.4.1	Reactions with Water	X	X	X
6.3.4.2	Difference Between Chlorine Gas & Hypochlorite Compound Reactions	X	X	X
6.3.4.3	Onsite Chlorine Generation		X	X
6.3.5	Chlorine Dioxide		X	X
6.3.5.1	Reaction in Water		X	X
6.3.5.2	Reactions with Impurities in Water		X	X
6.3.6	Breakpoint Chlorination		X	X
6.3.7	Chloramination	X	X	X
6.3.7.1	Methods of Producing Chloramines	X	X	X
6.3.7.2	Chlorine-to-Ammonia-Nitrogen Ratios	X	X	X
6.3.7.3	Special Water Users	X	X	X
6.3.7.4	Blending Chloraminated Waters	X	X	X
6.3.7.5	Chloramine Residuals	X	X	X
6.3.8	Nitrification		X	X
6.3.8.1	Nitrification Prevention & Control		X	X
6.3.9	Chlorine Residual Testing	X	X	X
6.3.9.1	Chlorine Residual Curve		X	X
6.3.9.2	Critical Factors		X	X
6.3.10	CT Values		X	X
6.3.11	Process Calculations	X	X	X
6.4	POINTS OF CHLORINE APPLICATION	X	X	X
6.4.1	Prechlorination	X	X	X
6.4.2	Postchlorination	X	X	X
6.4.3	Rechlorination	X	X	X
6.4.4	Wells	X	X	X
6.4.5	Mains	X	X	X
6.4.6	Tanks & Reservoirs	X	X	X
6.5	OPERATION OF CHLORINATION EQUIPMENT	X	X	X
6.5.1	Hypochlorinators	X	X	X
6.5.2	Chlorinators	X	X	X
6.5.2.1	Chlorinator Flow Path		X	X
6.5.2.2	Chlorinator Parts & Their Purpose		X	X
6.5.3	Chlorine Containers	X	X	X
6.5.3.1	Plastic	X	X	X



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## WATER TREATMENT PLANT OPERATION VOLUME I

SECTION	TOPIC	C	B	A
6.5.3.2	Steel Cylinders	X	X	X
6.5.3.3	Ton Tanks	X	X	X
6.5.4	Protect Yourself from Chlorine	X	X	X
6.5.5	Removing Chlorine from Containers	X	X	X
6.5.5.1	Connections	X	X	X
6.5.5.2	Valves	X	X	X
6.5.5.3	Ton Tanks	X	X	X
6.5.6	Performance of Chlorination Units	X	X	X
6.5.6.1	Hypochlorinators		X	X
6.5.6.2	Chlorinators		X	X
6.5.7	Normal & Abnormal Operation	X	X	X
6.5.7.1	. Container Storage Area	X	X	X
6.5.7.2	Evaporators	X	X	X
6.5.7.3	Chlorinators, Including Injectors	X	X	X
6.5.7.4	Summary, Dailey Operation	X	X	X
6.5.7.5	Laboratory Tests	X	X	X
6.5.8	Troubleshooting Gas Chlorinator Systems	X	X	X
6.5.9	Disinfection Troubleshooting	X	X	X
6.5.10	Chlorination System Failure	X	X	X
6.6	MAINTENANCE	X	X	X
6.6.1	Chlorine Leaks	X	X	X
6.6.2	Installation	X	X	X
6.7	CHLORINE DIOXIDE FACILITES	X	X	X
6.7.1	Safe Handling of Chemicals	X	X	X
6.7.2	Operation		X	X
6.7.2.1	Prestart Procedures		X	X
6.7.2.2	Startup		X	X
6.7.2.3	Shutdown		X	X
6.7.3	Maintenance		X	X
6.7.4	Troubleshooting		X	X
6.8	MEASUREMENT OF CHLORINE RESIDUAL	X	X	X
6.8.1	Methods of Measuring Chlorine Residual	X	X	X
6.8.2	ORP Probes		X	X
6.9	CHLORINE SAFETY PROGRAM	X	X	X
6.9.1	Chlorine Hazards	X	X	X
6.9.2	Why Chlorine Must Be Handled with Care	X	X	X
6.9.3	Protect Yourself from Chlorine	X	X	X
6.9.4	Hypochlorite Safety	X	X	X
6.9.5	Chlorine Dioxide Safety	X	X	X
6.9.6	Operator Safety Training	X	X	X
6.9.7	CHEMTREC	X	X	X
6.10	ULTRAVIOLET (UV) SYSTEMS			X
6.10.1	UV Lamp Types			X
6.10.2	UV System Types			X
6.10.3	Safety			X
6.10.4	Operation			X
6.10.4.1	UV Light Intensity Effectiveness			X
6.10.4.2	Minimum UV Dose Management			X
6.10.4.3	Routine Operations Tasks			X
6.10.4.4	Wiping System			X
6.10.4.5	Equipment Startup/Shutdown Preliminary Steps			X
6.10.4.6	Shutdown Sequence			X
6.10.4.7	Cleaning the Tank			X
6.10.4.8	Startup Sequence			X

## PART I

## WATER TREATMENT PLANT OPERATION VOLUME I

SECTION	TOPIC	C	B	A
6.10.4.9	Monitoring Lamp Output Intensity			X
6.10.4.10	Monitoring Influent & Effluent Characteristics			X
6.10.5	Emergency Alarms			X
6.40.6	Maintenance			X
6.10.6.1	Quartz Sleeve Cleaning			X
6.10.6.2	Lamp Maintenance			X
6.10.7	Troubleshooting			X
6.10.7.1	System Hydraulics			X
6.10.7.2	Biofilms on UV Channel Walls & Equipment			X
6.10.7.3	Particles Shielding Bacteria			X
6.11	OZONE SYSTEMS	X	X	X
6.11.1	EQUIPMENT	X	X	X
6.11.2	Gas Preparation		X	X
6.11.3	Electrical Supply Unit		X	X
6.11.4	Ozone Generator		X	X
6.11.5	Ozone Contactor		X	X
6.11.6	Ozone Residuals	X	X	X
6.11.7	Safety	X	X	X
6.11.8	Maintenance		X	X
6.11.9	Applications of Ozone		X	X
6.11.10	Advantages and Limitations of Ozone	X	X	X
6.12	MIXED OXIDANTS (MIOX) SYSTEMS	X	X	X
6.13	TYPICAL CHLORINATION MATH PROBLEMS	X	X	X
6.13.1	Chlorinators	X	X	X
6.13.2	Hypochlorinators	X	X	X
6.14	MATH ASSIGNMENT	X	X	X
CHAPTER REVIEW	REVIEW ALL QUESTIONS	ALL	ALL	ALL
7	<b>KEY TERMS: CORROSION CONTROL</b>			
7.1	ADVERSE EFFECTS OF CORROSION	X	X	X
7.2	CORROSION PROCESS	X	X	X
7.2.1	Electrochemical Corrosion: The Galvanic Cell		X	X
7.3	FACTORS INFLUENCING CORROSION		X	X
7.3.1	Physical Factors		X	X
7.3.1.1	System Construction		X	X
7.3.1.2	System Pressure		X	X
7.3.1.3	Soil Moisture		X	X
7.3.1.4	Stray Electric Current		X	X
7.3.1.5	Temperature		X	X
7.3.1.6	Flow Velocity		X	X
7.3.2	Chemical Factors		X	X
7.3.2.1	Alkalinity		X	X
7.3.2.2	pH		X	X
7.3.2.3	Dissolved Oxygen		X	X
7.3.2.4	Dissolved Solids		X	X
7.3.2.5	Hardness		X	X
7.3.2.6	Chloride & Sulfate		X	X
7.3.2.7	Phosphate & Silicate		X	X
7.3.2.8	Trace Materials		X	X
7.3.3	Biological Factors		X	X
7.3.3.1	Iron Bacteria		X	X
7.3.3.2	Sulfate-Reducing Bacteria		X	X
7.3.4	Oxygen Concentration Cell			X
7.4	HOW TO DETERMINE IF CORROSION PROBLEMS EXIST	X	X	X

## PART I

## WATER TREATMENT PLANT OPERATION VOLUME I

SECTION	TOPIC	C	B	A
7.4.1	Examine Materials Removed from Distribution System	X	X	X
7.4.2	Flow Tests			X
7.4.3	Chemical Tests on Water			X
7.4.3.1	Dissolved Oxygen		X	X
7.4.3.2	Toxic Heavy Metals		X	X
7.4.3.3	Calcium Carbonate Saturation		X	X
7.4.4	Complaints	X	X	X
7.5	METHODS OF CONTROLLING CORROSION		X	X
7.5.1	Selection of Corrosion Control Chemicals		X	X
7.5.2	Determination of Chemical Dose		X	X
7.5.3	Determination of Chemical Feeder Setting		X	X
7.5.4	Zinc, Silica, and Phosphate Compounds		X	X
7.5.5	Cathodic Protection		X	X
7.5.5.1	How the Protection System Works			X
7.5.5.2	Equipment		X	X
7.5.5.3	Protection of Flocculators, Clarifiers, & Filters			X
7.5.5.4	Maintenance		X	X
7.5.6	Removal of Oxygen			X
7.5.7	External Corrosion			X
7.5.7.1	Soil Corrosion			X
7.5.7.2	Corrosion of Steel Embedded in Concrete			X
7.5.7.3	Stray Electric Currents		X	X
7.6	TROUBLESHOOTING		X	X
7.6.1	Internal Pipe Corrosion			X
7.6.2	External Pipe Corrosion			X
7.7	THE LEAD & COPPER RULE		X	X
7.7.1	Health Concerns	X	X	X
7.7.2	Regulations		X	X
7.7.3	Monitoring Requirements		X	X
7.7.3.1	Monitoring Frequency		X	X
7.7.3.2	Sampling Procedures		X	X
7.7.3.3	Maximum Contaminant Level Goals (MCLGs)		X	X
7.7.3.4	Other Water Quality Monitoring		X	X
7.7.3.5	Analytical Methods & Certification Requirements			X
7.7.4	Treatment Requirements			X
7.7.4.1	Corrosion Treatment Studies			X
7.7.4.2	Source Water Treatment			X
7.7.4.3	Lead Service Line Replacement			X
7.7.4.4	Treatment for Control of Lead & Copper			X
7.7.5	Public Education & Reporting Requirements			X
7.7.5.1	Public Education			X
7.7.5.2	Reporting & Recordkeeping Requirements			X
7.8	MATH ASSIGNMENT	X	X	X
CHAPTER REVIEW	REVIEW ALL QUESTIONS	ALL	ALL	ALL
8	<b>KEY TERMS: TASTE AND ODOR</b>			
8.1	EFFECTS OF TASTE & ODOR PROBLEMS	X	X	X
8.2	CAUSES OF TASTES & ODORS	X	X	X
8.2.1	Common Taste & Odor Compounds	X	X	X
8.2.2	Natural Causes		X	X
8.2.2.1	Biological Growth in Source Waters		X	X
8.2.2.2	Environmental Conditions		X	X
8.2.3	Human Causes	X	X	X
8.2.3.1	Municipal Wastewaters		X	X

## PART I

## WATER TREATMENT PLANT OPERATION VOLUME I

SECTION	TOPIC	C	B	A
8.2.3.2	Industrial Wastes		X	X
8.2.3.3	Chemical Spills		X	X
8.2.3.4	Urban Runoff		X	X
8.2.3.5	Agricultural Wastes		X	X
8.2.3.6	Treatment Plant & Distribution System Conditions		X	X
8.2.3.7	Household Plumbing		X	X
8.3	LOCATING TASTE & ODOR SOURCES	X	X	X
8.3.1	Raw Water Sources	X	X	X
8.3.2	Treatment Plant		X	X
8.3.3	Distribution System	X	X	X
8.4	TASTE & ODOR PREVENTION & MONITORING	X	X	X
8.4.1	Raw Water Management		X	X
8.4.2	Plant Maintenance		X	X
8.4.3	Distribution System Maintenance		X	X
8.5	TASTE & ODOR TREATMENT	X	X	X
8.5.1	Improved Coagulation/Flocculation/Sedimentation		X	X
8.5.2	Aeration Processes & Systems	X	X	X
8.5.2.1	Air Blowers		X	X
8.5.2.2	Cascades & Spray Aerators		X	X
8.5.2.3	Air Stripping		X	X
8.5.3	Oxidative Processes	X	X	X
8.5.3.1	Chlorine	X	X	X
8.5.3.2	Potassium Permanganate	X	X	X
8.5.3.3	Ozone	X	X	X
8.5.3.4	Chlorine Dioxide	X	X	X
8.5.4	Adsorption Processes	X	X	X
8.5.4.1	Powdered Activated Carbon		X	X
8.5.4.2	Granular Activated Carbon		X	X
8.6	IDENTIFYING TASTE & ODOR PROBLEMS	X	X	X
8.7	DEVELOPING A TASTE & ODOR CONTROL STRATEGY		X	X
8.8	MATH ASSIGNMENT	X	X	X
CHAPTER REVIEW	REVIEW ALL QUESTIONS	ALL	ALL	ALL
9	<b>KEY TERMS: LABORATORY PROCEDURES</b>			
9.1	BASIC LABORATORY CONCEPTS, EQUIPMENT, & TECHNIQUES	X	X	X
9.1.2	Chemical Names & Formulas	X	X	X
9.2	LABORATORY EQUIPMENT & TECHNIQUES	X	X	X
9.2.1	Water Laboratory Equipment	X	X	X
9.2.2	Using Laboratory Glassware	X	X	X
9.2.2.1	Reading Volumes	X	X	X
9.2.2.2	Using Pipets	X	X	X
9.2.3	Chemical Solutions	X	X	X
9.2.3.1	Mass Concentration		X	X
9.2.3.2	Molar Concentration		X	X
9.2.3.3	Normality		X	X
9.2.4	Data Recording & Recordkeeping	X	X	X
9.2.5	Laboratory Quality Control	X	X	X
9.3	LABORATORY SAFETY	X	X	X
9.3.1	Laboratory Hazards	X	X	X
9.3.2	Personal Safety & Hygiene	X	X	X
9.3.3	Preventing Laboratory Accidents	X	X	X
9.3.3.1	Chemical Storage	X	X	X
9.3.3.2	Moving Chemicals	X	X	X
9.3.3.3	Proper Laboratory Techniques	X	X	X

## PART I

## WATER TREATMENT PLANT OPERATION VOLUME I

SECTION	TOPIC	C	B	A
9.3.3.4	Accident Prevention	X	X	X
9.4	WATER QUALITY TESTS	X	X	X
9.4.1	Instrument-Based Tests	X	X	X
9.4.1.1	Temperature	X	X	X
9.4.1.2	pH	X	X	X
9.4.1.3	Turbidity	X	X	X
9.4.2	Titration-Based Tests	X	X	X
9.4.2.1	General Titration Procedure	X	X	X
9.4.2.2	Alkalinity	X	X	X
9.4.2.3	Hardness	X	X	X
9.4.2.4	Chlorine Residual Curve	X	X	X
9.4.3	Tests for Plant Processes	X	X	X
9.4.3.1	Jar Test for Coagulation/Flocculation	X	X	X
9.4.3.2	Chlorine Demand	X	X	X
9.4.4	Biological Tests	X	X	X
9.4.4.1	Test Methods Overview	X	X	X
9.4.4.2	What is Tested	X	X	X
9.4.4.3	General Materials Required for Microbiological Testing	X	X	X
9.4.4.4	Procedures for Testing Total Coliform Bacteria	X	X	X
9.4.4.5	Additional Test Methods	X	X	X
9.5	SAMPLING	X	X	X
9.5.1	Representative Sampling	X	X	X
9.5.1.1	Source Water Sampling	X	X	X
9.5.1.2	In-Plant Sampling	X	X	X
9.5.1.3	Distribution System Sampling		X	X
9.5.2	Types of Samples	X	X	X
9.5.2.1	Grab Samples	X	X	X
9.5.2.2	Composite Samples	X	X	X
9.5.3	Sampling Devices	X	X	X
9.5.4	Sampling Techniques	X	X	X
9.5.4.1	Surface Sampling	X	X	X
9.5.4.2	Depth Sampling	X	X	X
9.5.4.3	Water Tap Sampling	X	X	X
9.5.4.4	First-Draw Sampling	X	X	X
9.5.5	Sampling Containers & Preservation of Samples	X	X	X
9.5.5.1	Chain-of-Custody Samples	X	X	X
9.5.6	Reporting	X	X	X
9.6	MATH ASSIGNMENT	X	X	X
CHAPTER REVIEW	REVIEW ALL QUESTIONS	ALL	ALL	ALL
	<b>APPENDIX A: INTRODUCTION TO BASIC MATH FOR OPERATORS</b>			
	INTRODUCTION	X	X	X
	BASIC CONCEPTS (SECTIONS A.1 - A.4)	X	X	X
A.1	NUMBERS & OPERATIONS	X	X	X
A.1.1	Addition	X	X	X
A.1.2	Subtraction	X	X	X
A.1.3	Multiplication	X	X	X
A.1.4	Division	X	X	X
A.2	ORDER OF OPERATIONS	X	X	X
A.2.1	More on Exponents		X	X
A.3	BASIC ALGEBRA (SOLVING EQUATIONS)	X	X	X
A.4	PERCENTAGES	X	X	X
	INTERMEDIATE CONCEPTS (SECTIONS A.5 - A.6)	X	X	X
A.5	UNITS	X	X	X

## PART I

## WATER TREATMENT PLANT OPERATION VOLUME I

SECTION	TOPIC	C	B	A
A.5.1	Distance of Length	X	X	X
A.5.2	Area	X	X	X
A.5.2.1	Surface Area of a Rectangle	X	X	X
A.5.2.2	Surface Area of a Triangle		X	X
A.5.2.3	Surface Area of a Trapezoid		X	X
A.5.2.4	Surface Area of a Circle	X	X	X
A.5.2.5	Surface Area of a Cylinder	X	X	X
A.5.2.6	Surface Area of a Cone		X	X
A.5.2.7	Surface Area of a Sphere		X	X
A.5.3	Volume	X	X	X
A.5.3.1	Cube		X	X
A.5.3.2	Rectangular Prism		X	X
A.5.3.3	Triangular Prism		X	X
A.5.3.4	Cylinder	X	X	X
A.5.3.5	Cone		X	X
A.5.3.6	Sphere		X	X
A.5.4	Mass & Weight	X	X	X
A.5.5	Density Specific Weight, and Specific Gravity	X	X	X
A.5.6	Concentration	X	X	X
A.5.7	Velocity & Flow Rate		X	X
A.5.8	Force & Pressure		X	X
A.5.9	Work, Head, & Power		X	X
	ADVANCED CONCEPTS (SECTIONS A.7 - A.8)	X	X	X
A.7	PUMPS	X	X	X
A.7.1	Pressure	X	X	X
A.7.2	Work	X	X	X
A.7.3	Power	X	X	X
A.7.4	Horsepower	X	X	X
A.7.5	Head	X	X	X
A.7.6	Pump Characteristics	X	X	X
A.7.7	Evaluation of Pump Performance	X	X	X
A.7.7.1	Capacity	X	X	X
A.7.7.2	Efficiency	X	X	X
A.7.8	Pump Speed-Performance Relationships	X	X	X
A.7.9	Friction or Energy Losses	X	X	X
A.8	ANALYSIS & PRESENTATION OF DATA	X	X	X
A.8.1	Causes of Variations in Results	X	X	X
A.8.1.1	Water or Material Being Examined	X	X	X
A.8.1.2	Sampling	X	X	X
A.8.1.3	Testing	X	X	X
A.8.2	Controlling Variation	X	X	X
A.8.2.1	Reading Charts	X	X	X
A.8.3	Describing Data or Results	X	X	X
A.8.3.1	Graphs & Charts	X	X	X
A.8.3.2	Numerical Representation of Data	X	X	X
A.8.4	Moving Averages	X	X	X
A.8.5	More Applications of Graphs	X	X	X
A.8.5.1	Volume of Sludge in a Digester	X	X	X
A.8.5.2	Tracking BOD Loading	X	X	X
A.8.6	Regression Analysis (Prediction Equations, Trends, & Correlations)	X	X	X
A.8.6.1	Correlations	X	X	X
A.9	TYPICAL WATER TREATMENT PLANT PROBLEMS (ENGLISH)	X	X	X
A.9.1	Plant Operation	X	X	X
A.9.2	Flows	X	X	X

## PART I

WATER TREATMENT PLANT OPERATION VOLUME I

<b>SECTION</b>	<b>TOPIC</b>	<b>C</b>	<b>B</b>	<b>A</b>
A.9.3	Chemical Doses	X	X	X
A.9.4	Reservoir Management & Intake Structures	X	X	X
A.9.5	Coagulation & Flocculation	X	X	X
A.9.6	SEDIMENTATION BASINS	X	X	X
A.9.7	FILTRATION MECHANISMS	X	X	X
A.9.8	Disinfection	X	X	X
A.9.9	Corrosion Control	X	X	X
A.9.10	Laboratory Procedures	X	X	X

## PART II

## WATER TREATMENT PLANT OPERATION VOLUME II

SECTION	TOPIC	C	B	A
12.	<b>WORDS: IRON AND MANGANESE CONTROL</b>	X	X	X
12.0	NEED TO CONTROL IRON AND MANGANESE	X	X	X
12.10	Occurrence Of Iron And Manganese	X	X	X
12.11	Collection Of Iron And Manganese Samples	X	X	X
12.12	Analysis For Iron And Manganese		X	X
12.20	Alternate Source	X	X	X
12.21	Phosphate Treatment	X	X	X
12.22	Removal By Ion Exchange		X	X
12.23	Oxidation By Aeration		X	X
12.24	Oxidation With Chlorine		X	X
12.25	Oxidation With Permanganate		X	X
12.26	Operation Of Filters		X	X
12.27	Proprietary Process			X
12.28	Monitoring Of Treated Water	X	X	X
12.29	Summary			X
12.3	OPERATION OF AN IRON AND MANGANESE REMOVAL PLANT		X	X
12.30	Description Of Equipment And Process		X	X
12.31	Regeneration Of Manganese Greensand		X	X
12.32	Troubleshooting		X	X
12.4	MAINTENANCE OF A CHEMICAL FEEDER		X	X
12.5	TROUBLESHOOTING RED WATER PROBLEMS	X	X	X
13.	<b>WORDS: FLUORIDATION</b>	X	X	X
13.0	IMPORTANCE OF FLUORIDATION	X	X	X
13.1	FLUORIDATION PROGRAMS		X	X
13.2	COMPOUNDS USED TO FURNISH FLUORIDE ION	X	X	X
13.3	FLUORIDATION SYSTEMS		X	X
13.30	Chemical Feeders		X	X
13.31	Saturators		X	X
13.32	Downflow Saturators			X
13.33	Upflow Saturators			X
13.34	Large Hydrofluosilicic Acid Systems		X	X
13.4	FINAL CHECK-UP OF EQUIPMENT		X	X
13.40	Avoid Overfeeding	X	X	X
13.41	Review Of Designs And Specifications		X	X
13.5	CHEMICAL FEEDER START-UP		X	X
13.6	CHEMICAL FEEDER OPERATION		X	X
13.60	Fine Tuning		X	X
13.61	Preparation Of Fluoride Solution		X	X
13.62	Fluoridation Log Sheets		X	X
13.620	Hydrofluosilicic Acid		X	X
13.621	Sodium Silicofluoride		X	X
13.63	Equipment Check Procedures		X	X
13.7	PREVENTION OF OVERFEEDING	X	X	X
13.8	UNDERFEEDING	X	X	X
13.9	SHUTTING DOWN CHEMICAL SYSTEMS	X	X	X
13.10	MAINTENANCE	X	X	X
13.11	SAFETY IN HANDLING FLUORIDE COMPOUNDS	X	X	X
13.110	Avoid Overexposure	X	X	X
13.111	Symptoms Of Fluoride Poisoning	X	X	X
13.112	Basic First Aid	X	X	X
13.113	Protecting Yourself And Your Family	X	X	X
13.114	Training	X	X	X
13.12	CALCULATING FLUORIDE DOSAGES		X	X



## PART II

## WATER TREATMENT PLANT OPERATION VOLUME II

SECTION	TOPIC	C	B	A
15.	<b>WORDS: SPECIALIZED TREATMENT PROCESSES</b>	X	X	X
15.0	THE TRIHALOMETHANES (THM) PROBLEM		X	X
15.1	FEASIBILITY ANALYSIS PROCESS		X	X
15.2	PROBLEM DEFINITION			X
15.20	Sampling			X
15.21	THM Calculations		X	X
15.22	Chemistry of THM Formation			X
15.3	CONTROL STRATEGIES			X
15.4	EXISTING TREATMENT PROCESSES			X
15.5	TREATMENT PROCESS RESEARCH STUDY RESULTS			X
15.50	Consider Options			X
15.51	Remove THM's After They Are Formed			X
15.52	Remove THM Precursors			X
15.53	Alternative Disinfectants			X
15.6	SELECTION AND IMPLEMENTATION OF A COST-EFFECTIVE ALTERNATIVES			X
15.7	REGULATORY UPDATE		X	X
15.8	SUMMARY AND CONCLUSIONS			X
15.100	Why Are We Concerned About Arsenic?	X	X	X
15.101	What Are the Sources of Arsenic?	X	X	X
15.102	Chemistry of Arsenic		X	X
15.110	New Source Alternative to Treatment		X	X
15.111	Summary of Arsenic Treatment Options	X	X	X
15.112	Engineered Blending		X	X
15.113	Ion Exchange (IX)		X	X
15.114	Active Alumina (AA)			X
15.115	Oxidation-Filtration & Iron Based Adsorption			X
15.116	Point of Use (POU) & Point of Entry (POE) Devices		X	X
15.117	Proprietary Media		X	X
15.12	TYPICAL ARSENIC TREATMENT PLANT	X	X	X
15.120	Plant Start-Up & Shutdown		X	X
15.121	Operation		X	X
15.122	Maintenance		X	X
15.123	Troubleshooting			X
15.124	Safety & Security Issues	X	X	X
15.125	Review of Plans & Specifications			X
15.13	WASTEWATER AND RESIDUALS		X	X
15.140	MONITORING - Analysis of Arsenic	X	X	X
15.141	Types of Arsenic Sampling/Monitoring		X	X
15.142	Monitoring for Compliance		X	X
15.143	Monitoring for Process Control		X	X
15.15	RECORDKEEPING AND REPORTING		X	X
15.150	Records	X	X	X
15.151	Reporting		X	X
17.	<b>WORDS: HANDLING AND DISPOSAL OF PROCESS WASTES</b>		X	X
17.0	NEED FOR HANDLING AND DISPOSAL OF PROCESS WASTES		X	X
17.1	SOURCES OF TREATMENT PROCESS WASTES			X
17.2	PROCESS SLUDGE VOLUMES			X
17.3	METHODS OF HANDLING AND DISPOSING OF PROCESS WASTES			X
17.4	DRAINING AND CLEANING TANKS			X
17.5	BACKWASH RECOVERY PONDS (SOLAR LAGOONS)			X
17.6	SLUDGE DEWATERING PROCESSES			X
17.60	Solar Drying Lagoons			X
17.61	Sand Drying Beds			X
17.62	Belt Filter Presses			X

## PART II

## WATER TREATMENT PLANT OPERATION VOLUME II

SECTION	TOPIC	C	B	A
17.63	Centrifuges			X
17.64	Filter Presses			X
17.65	Vacuum Filters			X
17.7	DISCHARGE INTO COLLECTION SYSTEMS (SEWERS)			X
17.8	DISPOSAL OF SLUDGE			X
17.9	EQUIPMENT			X
17.90	Vacuum Trucks			X
17.91	Sludge Pumps			X
17.10	PLANT DRAINAGE WATERS			X
17.11	MONITORING AND REPORTING			X
18.	<b>WORDS: MAINTENANCE</b>	X	X	X
18.0	TREATMENT PLANT MAINTENANCE - GENERAL PROGRAM	X	X	X
18.00	Preventive Maintenance Records	X		X
18.01	Library of Manufacturers' Operation and Parts Manuals	X		X
18.02	Emergencies			X
18.03	Lockout/Tagout Procedures	X	X	X
18.10	Beware of Electricity	X		X
18.100	Recognize Your Limitations	X	X	X
18.11	Understanding Electricity	X	X	X
18.110	Volts	X	X	X
18.111	Direct Current (D.C.)	X	X	X
18.112	Alternating Current (A.C.)	X	X	X
18.113	Amps	X	X	X
18.114	Watts	X	X	X
18.115	Power Requirements	X	X	X
18.116	Conductors and Insulators		X	X
18.12	Tools, Meters and Testers		X	X
18.120	Voltage Testing		X	X
18.121	Ammeter		X	X
18.122	Megger		X	X
18.123	Ohmmeters		X	X
18.13	Switch Gear		X	X
18.130	Equipment Protective Devices	X	X	X
18.131	Fuses	X	X	X
18.132	Circuit Breakers	X	X	X
18.133	Overload Relays	X	X	X
18.134	Motor Starters		X	X
18.140	Electric Motors - Classifications		X	X
18.1410	Troubleshooting - Step-By-Step Procedures		X	X
18.1411	Troubleshooting Guide for Electric Motors	X	X	X
18.1412	Troubleshooting Guide for Magnetic Starters	X	X	X
18.1413	Trouble/Remedy Procedures for Induction Motors	X	X	X
18.142	Record Keeping		X	X
18.150	Auxiliary Electric Power - Safety First	X	X	X
18.151	Standby Power Generation	X		X
18.152	Emergency Lighting	X	X	X
18.153	Batteries	X	X	X
18.160	High Voltage - Transmission			X
18.161	Switch Gear			X
18.162	Power Distribution Transformers			X
18.17	Electrical Safety Checklist	X	X	X
18.2	MECHANICAL EQUIPMENT	X	X	X
18.20	Repair Shop	X	X	X
18.21	Pumps	X	X	X

## PART II

## WATER TREATMENT PLANT OPERATION VOLUME II

SECTION	TOPIC	C	B	A
18.210	Centrifugal Pumps	X	X	X
18.211	Let's Build a Pump	X	X	X
18.212	Vertical Centrifugal Pumps	X	X	X
18.213	Horizontal Centrifugal Pumps	X	X	X
18.214	Reciprocating or Piston Pumps	X	X	X
18.215	Progressive Cavity (Screw-Flow) Pumps	X	X	X
18.216	Chemical Metering Pumps	X	X	X
18.220	Purpose of Lubrication	X	X	X
18.221	Properties of Lubrication	X	X	X
18.222	Lubrication Schedule	X	X	X
18.223	Precautions	X	X	X
18.224	Pump Lubrication	X	X	X
18.225	Equipment Lubrication	X	X	X
18.230	Pump Maintenance - Section Format	X	X	X
18.231	Preventative Maintenance	X	X	X
18.231 #1	Pumps, General	X	X	X
18.231 #2	Reciprocating Pumps, General	X	X	X
18.231 #3	Propeller Pumps, General	X	X	X
18.231 #4	Progressive Cavity Pumps, General	X	X	X
18.231 #5	Pump Controls	X	X	X
18.231 #6	Electric Motors	X	X	X
18.231 #7	Belt Drives	X	X	X
18.231 #8	Chain Drives	X	X	X
18.231 #9	Variable Speed Belt Drives	X	X	X
18.231 #10	Couplings	X	X	X
18.231 #11	Shear Pins	X	X	X
18.240	Starting a New Pump	X	X	X
18.241	Pump Shutdown	X	X	X
18.242	Pump-Driving Equipment	X	X	X
18.243	Electrical Controls	X	X	X
18.244	Operating Troubles	X	X	X
18.245	Starting and Stopping Pumps	X	X	X
18.2450	Centrifugal Pumps	X	X	X
18.2451	Positive Displacement Pumps	X	X	X
18.25	Compressors	X	X	X
18.26	Valves	X	X	X
18.260	Uses of Valves	X	X	X
18.261	Gate Valves	X	X	X
18.262	Maintenance of Gate Valves	X	X	X
18.262 #12	Gate Valves	X	X	X
18.263	Globe Valves		X	X
18.264	Eccentric Valves		X	X
18.265	Butterfly Valves		X	X
18.266	Check Valves	X	X	X
18.267	Maintenance of Check Valves	X	X	X
18.267 #13	Check Valves	X	X	X
18.268	Automatic Valves		X	X
18.30	Gasoline Engines	X	X	X
18.300	Need to Maintain Gasoline Engines	X	X	X
18.301	Maintenance	X	X	X
18.302	Starting Problems		X	X
18.303	Running Problems		X	X
18.304	How to Start a Gasoline Engine		X	X
18.3040	Small Engines		X	X

## PART II

## WATER TREATMENT PLANT OPERATION VOLUME II

SECTION	TOPIC	C	B	A
18.3041	Large Engines		X	X
18.31	Diesel Engines		X	X
18.310	How Diesel Engines Work	X	X	X
18.311	Operation		X	X
18.312	Fuel System		X	X
18.313	Water-Cooled Diesel Engines		X	X
18.314	Air-Cooled Diesel Engines		X	X
18.315	How to Start Diesel Engines		X	X
18.316	Maintenance and Troubleshooting		X	X
18.32	Cooling Systems		X	X
18.330	Fuel Storage - Code Requirements	X	X	X
18.331	Diesel	X	X	X
18.332	Gasoline	X	X	X
18.333	Liquid Petroleum Gas (LPG)		X	X
18.334	Natural Gas		X	X
18.34	Standby Engines	X	X	X
18.40	Chemical Storage	X	X	X
18.41	Drainage from Chemical Storage and Feeders	X	X	X
18.42	Use of Feeder Manufacturer's Manual	X	X	X
18.43	Solid Feeders	X	X	X
18.44	Liquid Feeders	X	X	X
18.45	Gas Feeders		X	X
18.46	Calibration of Chemical Feeders		X	X
18.460	Large-Volume Metering Pumps		X	X
18.461	Small-Volume Metering Pumps		X	X
18.462	Dry Chemical Systems			X
18.47	Chlorinators	X	X	X
18.5	TANKS AND RESERVOIRS			X
18.50	Scheduling Inspections	X	X	X
18.51	Steel Tanks			X
18.52	Cathodic Protection			X
18.53	Concrete Tanks			X
18.6	BUILDING MAINTENANCE	X	X	X
19.	<b>WORDS: INSTRUMENTATION</b>	X	X	X
19.00	Importance & Nature of Instrumentation & Control Systems		X	X
19.01	Importance to the Water Treatment Operator		X	X
19.02	Nature of the Measurement Process		X	X
19.03	Explanation of Control Systems		X	X
19.030	Modulating Control Systems		X	X
19.031	Motor Control Stations		X	X
19.10	General Precautions		X	X
19.11	Electrical Hazards		X	X
19.12	Mechanical & Pneumatic Hazards		X	X
19.13	Confined Spaces		X	X
19.14	Oxygen Deficiency or Enrichment		X	X
19.15	Explosive Gas Mixtures		X	X
19.16	Falls & Associated Hazards		X	X
19.20	General Principles of Sensors		X	X
19.21	Pressure Measurements		X	X
19.22	Level Measurements		X	X
19.23	Flow (Rate of Flow and Total Flow)		X	X
19.24	Chemical Feed Rate		X	X
19.25	Process Instrumentation		X	X
19.26	Signal Transmitters/Transducers		X	X

## PART II

## WATER TREATMENT PLANT OPERATION VOLUME II

SECTION	TOPIC	C	B	A
19.30	Primary Elements		X	X
19.31	Panel Instruments		X	X
19.310	Indicators		X	X
19.311	Recorders		X	X
19.312	Totalizers		X	X
19.313	Alarms		X	X
19.32	Automatic Controller			X
19.33	Pump Controllers			X
19.34	Air Supply Systems			X
19.35	Laboratory Instruments			X
19.36	Test and Calibration Equipment			X
19.370	Computer Control Systems		X	X
19.371	Typical Computer Control System Functions		X	X
19.40	Proper Care of Instruments		X	X
19.41	Indications of Proper Function		X	X
19.42	Start-up/Shutdown Considerations		X	X
19.43	Preventative Maintenance		X	X
19.44	Operational Checks		X	X
19.45	Preventive Maintenance		X	X
20.	<b>WORDS: SAFETY</b>	X	X	X
20.00	What is Safety?	X	X	X
20.01	Causes of Accidents	X	X	X
20.02	Steps to Avoid Accidents	X	X	X
20.10	Safe Handling of Chemicals	X	X	X
20.11	Acids	X	X	X
20.110	Acetic Acid (Glacial)	X	X	X
20.111	Hydrofluosilic Acid	X	X	X
20.112	Hydrogen Fluoride	X	X	X
20.113	Hydrochloric Acid	X	X	X
20.114	Nitric Acid	X	X	X
20.115	Sulfuric Acid	X	X	X
20.12	Bases	X	X	X
20.120	Ammonia	X	X	X
20.121	Calcium Hydroxide	X	X	X
20.122	Sodium Hydroxide	X	X	X
20.123	Sodium Silicate	X	X	X
20.124	Hypochlorite	X	X	X
20.125	Sodium Carbonate	X	X	X
20.13	Gases	X	X	X
20.130	Chlorine	X	X	X
20.131	Carbon Dioxide			X
20.132	Sulfur Dioxide			X
20.14	Salts	X	X	X
20.140	Aluminum Sulfate (Alum)	X	X	X
20.141	Ferric Chloride	X	X	X
20.142	Ferric Sulfate	X	X	X
20.143	Ferrous Sulfate	X	X	X
20.144	Sodium Aluminate	X	X	X
20.145	Fluoride Compounds	X	X	X
20.15	Powders	X	X	X
20.150	Potassium Permanganate	X	X	X
20.151	Powdered Activated Carbon	X	X	X
20.152	Other Powders	X	X	X
20.16	Labeling of Chemical Containers	X	X	X

## PART II

## WATER TREATMENT PLANT OPERATION VOLUME II

SECTION	TOPIC	C	B	A
20.17	Chemical Storage Drains	X	X	X
20.20	Fire Prevention	X	X	X
20.21	Classification of Fires and Extinguishers	X	X	X
20.22	Fire Extinguisher Operation and Maintenance	X	X	X
20.23	Fire Hoses	X	X	X
20.24	Storage of Flammables	X	X	X
20.25	Exits	X	X	X
20.30	Maintenance Hazards	X	X	X
20.31	Cleaning	X	X	X
20.32	Painting	X	X	X
20.33	Cranes	X	X	X
20.34	Confined Spaces	X	X	X
20.35	Manholes	X	X	X
20.36	Power Tools	X	X	X
20.37	Welding	X	X	X
20.38	Safety Valves	X	X	X
20.40	Types of Vehicles	X	X	X
20.41	Maintenance	X	X	X
20.42	Seat Belts	X	X	X
20.43	Accident Prevention	X	X	X
20.44	Forklifts	X	X	X
20.50	Electrical Safety	X	X	X
20.51	Current - Voltage	X	X	X
20.52	Transformers	X	X	X
20.53	Electric Starters	X	X	X
20.54	Electric Motors	X	X	X
20.55	Instrumentation	X	X	X
20.56	Control Panels	X	X	X
20.57	Lockout/Tagout Procedure	X	X	X
20.60	Laboratory Hazards		X	X
20.61	Glassware		X	X
20.62	Chemicals		X	X
20.63	Biological Considerations		X	X
20.64	Radioactivity		X	X
20.65	Laboratory Equipment		X	X
20.650	Hot Plates		X	X
20.651	Water Stills		X	X
20.652	Sterilizers		X	X
20.653	Pipet Washers		X	X
20.70	Operator Safety	X	X	X
20.71	Respiratory Protection	X	X	X
20.72	Safety Equipment	X	X	X
20.73	Eye Protection	X	X	X
20.74	Foot Protection	X	X	X
20.75	Hand Protection	X	X	X
20.76	Head Protection	X	X	X
20.77	Water Safety	X	X	X
20.8	PREPARATION FOR EMERGENCIES	X	X	X
21.	<b>ADVANCED LABORATORY PROCEDURES</b>			
21.0	USE OF A SPECTROPHOTOMETER	X	X	X
21. #1	Algae Counts		X	X
21. #2	Calcium		X	X
21. #3	Chloride		X	X
21. #4	Color	X	X	X

## PART II

## WATER TREATMENT PLANT OPERATION VOLUME II

SECTION	TOPIC	C	B	A
21. #5	Dissolved Oxygen	X	X	X
21. #6	Fluoride		X	X
21. #7	Iron (Total)	X	X	X
21. #8	Manganese	X	X	X
21. #9	Marble Test (Calcium Carbonate Saturation Test)			X
21. #10	Metals		X	X
21. #11	Nitrate			X
21. #12	pH	X	X	X
21. #13	Specific Conductance (Conductivity)	X	X	X
21. #14	Sulfate			X
21. #15	Taste and Odor	X	X	X
21. #16	Trihalomethanes	X	X	X
21. #17	Total Dissolved Solids		X	X
22.	<b>WORDS: DRINKING WATER REGULATIONS</b>		X	X
22.0	HISTORY OF DRINKING WATER LAWS AND STANDARDS		X	X
22.1	HOW EPA DEVELOPS DRINKING WATER STANDARDS		X	X
22.10	Types of Contaminants		X	X
22.11	Identifying Contaminants To Be Regulated		X	X
22.12	Unregulated Contaminants		X	X
22.13	Newer & Proposed Regulations		X	X
22.130	Arsenic Rule	X	X	X
22.131	Lead & Copper Rule	X	X	X
22.132	Total Coliform Rule (TCR)	X	X	X
22.133	Surface Water Treatment Rules	X	X	X
22.134	Filter Backwash Recycling Rule (FBRR)	X	X	X
22.135	Disinfectants & Disinfection By-Products	X	X	X
22.136	Ground Water Rule (GWR)		X	X
22.137	Radionuclides Rule		X	X
22.138	Regulation of Microbial Contaminants in Drinking Water		X	X
22.139	Standardized Monitoring Framework (SMF)		X	X
22.139	Consumer Confidence Report (CCR) Rule		X	X
22.14	Setting Standards		X	X
22.15	Types of Water Systems		X	X
22.2	PRIMARY DRINKING WATER STANDARDS		X	X
22.20	Inorganic Chemical Standards		X	X
22.200	Antimony		X	X
22.201	Arsenic		X	X
22.202	Asbestos		X	X
22.203	Barium		X	X
22.204	Beryllium		X	X
22.205	Bromate		X	X
22.206	Cadmium		X	X
22.207	Chlorite		X	X
22.208	Chromium		X	X
22.209	Copper		X	X
22.2010	Cyanide		X	X
22.2011	Fluoride		X	X
22.2012	Lead and Copper		X	X
22.2013	Mercury		X	X
22.2014	Nitrate		X	X
22.2015	Nitrite		X	X
22.2016	Selenium		X	X
22.2017	Thallium		X	X
22.21	Organic Chemical Standards		X	X

## PART II

## WATER TREATMENT PLANT OPERATION VOLUME II

SECTION	TOPIC	C	B	A
22.210	Trichloroethylene		X	X
22.211	1,1-Dichloroethylene		X	X
22.212	Vinyl Chloride		X	X
22.213	1,1,1-Trichloroethane		X	X
22.214	1,2-Dichloroethane		X	X
22.215	Carbon Tetrachloride		X	X
22.216	Benzene		X	X
22.217	Para-Dichlorobenzene (p-Dichlorobenzene)		X	X
22.22	Microbial Standards		X	X
22.220	Total Coliform Rule		X	X
22.221	2012 Revised Total Coliform Rule (RTCR)		X	X
22.2200	Sanitary Survey		X	X
22.2201	Sampling Plan		X	X
22.2202	Laboratory Procedures		X	X
22.2203	Monitoring Frequency		X	X
22.2204	Determining Compliance		X	X
22.2205	Reporting and Notification Requirements		X	X
22.221	Surface Water Treatment Rule		X	X
22.2210	Criteria for Avoiding Filtration		X	X
22.2211	Requirements for Filtered Water Systems		X	X
22.2212	Chlorine Residual Substitutions		X	X
22.2213	Turbidity Requirements		X	X
22.2214	Monitoring Requirements		X	X
22.2215	CT Values		X	X
22.2216	Interim Enhanced Surface Water Treatment Rule (IESWTR)		X	X
22.2217	Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR)		X	X
22.2218	Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR)		X	X
22.23	Disinfectants and Disinfection By-Products (D/DBPs)		X	X
22.24	Radiological Standards		X	X
22.30	Enforcement of Regulations		X	X
22.31	Secondary Maximum Contaminant Levels		X	X
22.32	Monitoring		X	X
22.33	Secondary Contaminants		X	X
22.330	Aluminum		X	X
22.331	Chloride		X	X
22.332	Color		X	X
22.333	Copper		X	X
22.334	Corrosivity		X	X
22.335	Fluoride		X	X
22.336	Foaming Agents		X	X
22.337	Iron and Manganese		X	X
22.338	Iron		X	X
22.339	Manganese		X	X
22.3310	Odor		X	X
22.3311	pH		X	X
22.3312	Silver		X	X
22.3313	Sulfate		X	X
22.3314	Total Dissolved Solids (TDS)		X	X
22.3315	Zinc		X	X
22.4	SAMPLING PROCEDURES		X	X
22.40	Safe Drinking Water Regulations		X	X
22.41	Overview of Sampling		X	X
22.42	General Guidelines for Water Sampling		X	X
22.43	Selecting Sampling Locations		X	X



## PART II

## WATER TREATMENT PLANT OPERATION VOLUME II

SECTION	TOPIC	C	B	A
22.44	Use of Dedicated Sampling Stations		X	X
22.45	Sampling Points		X	X
22.46	Sampling Point Selection		X	X
22.47	Sampling Schedule			
22.48	Sampling Routine		X	X
22.49	Sample Collection		X	X
22.410	Frequency of Sampling		X	X
22.411	Chain-of-Custody Procedures		X	X
22.5	REPORTING PROCEDURES		X	X
22.6	NOTIFICATION REQUIREMENTS		X	X
22.7	RECORDKEEPING		X	X
22.8	CONSUMER CONFIDENCE REPORT (CCRs)		X	X
23	<b>WORDS: ADMINISTRATION</b>		X	X
23.0	NEED FOR UTILITY MANAGEMENT			X
23.1	FUNCTIONS OF A MANAGER			X
23.2	PLANNING			X
23.3	ORGANIZING			X
23.40	STAFFING - The Utility Manager's Responsibilities			X
23.41	How Many Employees Are Needed			X
23.42	Qualifications Profile			X
23.430	Advertising the Position			X
23.431	Paper Screening			X
23.432	Interviewing Applicants			X
23.433	Selecting the Most Qualified Candidate			X
23.44	New Employee Orientation			X
23.450	Probationary Period			X
23.451	Compensation			X
23.452	Training and Certification			X
23.453	Performance Evaluation			X
23.454	Dealing with Disciplinary Problems			X
23.455	Example Policy: Harassment			X
23.456	Labor Laws Governing Employer/Employee Relations			X
23.457	Personnel Records			X
23.50	Oral Communication			X
23.51	Written Communication			X
23.6	CONDUCTING MEETINGS			X
23.70	Establish Objectives			X
23.71	Utility Operations			X
23.72	The Mass Media			X
23.73	Being Interviewed			X
23.74	Public Speaking			X
23.75	Telephone Contacts			X
23.76	Consumer Inquiries			X
23.77	Plant Tours			X
23.8	FINANCIAL MANAGEMENT			X
23.80	Financial Stability			X
23.81	Budgeting			X
23.82	Equipment Repair/Replacement Funds			X
23.83	Water Rates			X
23.84	Capital Improvements and Funding in the Future			X
23.85	Financial Assistance			X
23.90	The Manager's Responsibilities			X
23.91	Purpose of O & M Programs			X
23.92	Types of Maintenance			X

## PART II

## WATER TREATMENT PLANT OPERATION VOLUME II

SECTION	TOPIC	C	B	A
23.93	Benefits of Managing Maintenance			X
23.94	Computer Control Systems			X
23.940	Description of SCADA Systems			X
23.941	Typical Water Treatment and Distribution SCADA Systems			X
23.95	Cross Connection Control Program			X
23.950	Importance of Cross Connection Control		X	X
23.951	Program Responsibilities			X
23.952	Water Supplier Program			X
23.953	Types of Backflow Prevention Devices			X
23.954	Devices Required for Various Types of Situations			X
23.96	Geographic Information System (GIS)			X
23.100	Planning for Emergency Response			X
23.101	Homeland Defense			X
23.1020	Handling the Threat of Contaminated Water Supplies - Importance			X
23.1021	Toxicity			X
23.1022	Emergency Contaminant Limits			X
23.1023	Protective Measures			X
23.1024	Emergency Countermeasures			X
23.1025	In Case of Contamination			X
23.1026	Cryptosporidium			X
23.1100	Everyone is Responsible for Safety		X	X
23.1101	Regulatory Agencies		X	X
23.1102	Managers			X
23.1103	Supervisors			X
23.1104	Operators			X
23.111	First Aid		X	X
23.112	Hazard Communication Program and Worker Right-To-Know (RTK) Laws			X
23.113	Confined Spaces Entry Procedures			X
23.114	Reporting			X
23.115	Training			X
23.116	Measuring			X
23.117	Human Factors			X
23.120	Purpose of Records		X	X
23.121	Types of Records		X	X
23.122	Types of Plant Operations Data			X
23.123	Maintenance Records		X	X
23.124	Procurement Records			X
23.125	Inventory Records			X
23.126	Equipment Records		X	X
23.127	Computer Record Keeping Systems			X
23.128	Disposition of Plant Records			X
23.130	Need for Conservation	X	X	X
23.131	What Is Water Conservation?	X	X	X
23.132	Elements of Water Conservation Program		X	X
23.1320	Residential Water Surveys		X	X
23.1321	Residential Plumbing Retrofits		X	X
23.1322	System Water Audits, Leak Detection, and Repair		X	X
23.1323	Meeting with Commodity Rates			X
23.1324	Large Landscape Conservation Programs			X
23.1325	High-Efficiency Clothes Washers			X
23.1326	Public Information Programs			X
23.1327	School Education Programs			X
23.1328	Conservation Programs for Commercial, Industrial & Institutional (CII) Sectors			X

## PART II

## WATER TREATMENT PLANT OPERATION VOLUME II

SECTION	TOPIC	C	B	A
23.1329	Wholesale Agency Assistance Programs			X
23.13210	Conservation Pricing			X
23.13211	Conservation Coordinator			X
23.13212	Water Wast Prohibition			X
23.13213	Residential ULFT Replacement Programs			X
23.13214	Potential Best Management Practices			X
23.133	EPA's WaterSense: Efficiency Made Easy			X
<b>A</b>	<b>HOW TO SOLVE WATER TREATMENT PLANT ARITHMETIC PROBLEMS</b>			
A.1	BASIC CONVERSION FACTORS (ENGLISH SYSTEM)		X	X
A.2	BASIC FORMULAS		X	X
A.30	Iron and Manganese Control - Examples 1 - 4		X	X
A.31	Fluoridation - Examples 5 - 10		X	X
A.33	Specialized Treatment Process - Example 24		X	X
A.34	Membrane Treatment Process - Examples 27-29			X
A.35	Maintenance - Examples 30 - 33		X	X
A.36	Advanced Laboratory Procedures - Example 34		X	X
A.37	Regulations - Example 38		X	X
A.38	Administration, Safety - Examples 39 - 40		X	X
A.4	BASIC CONVERSION FACTORS (METRIC SYSTEM)		X	X

## PART III

RULES GOVERNING PUBLIC WATER SYSTEMS

SECTION	TOPIC	C	B	A
.0102	DEFINITIONS	X	X	X
.0201	SURFACE WATER SUPPLIES FOR PUBLIC WATER SYSTEMS	X	X	X
.0202	REMOVAL OF DISSOLVED MATTER & SUSPENDED MATTER		X	X
.0301	APPLICABILITY: PRIOR NOTICE	X	X	X
.0303	SUBMISSIONS REQUIRED BY ENGINEER AND APPLICANT	X	X	X
.0304	APPLICATION FOR APPROVAL: BY WHOM MADE	X	X	X
.0305	APPROVALS NECESSARY BEFORE CONTRACTING OR CONSTRUCTION	X	X	X
.0306	CHANGES IN ENGINEERING PLANS OR SPECIFICATIONS AFTER APPROVAL	X	X	X
.0307	ENGINEER'S REPORT, WATER SYSTEM MANAGEMENT PLAN AND OTHER PLANS			X
.0308	ENGINEERING PLANS AND SPECIFICATIONS			X
.0309	FINAL APPROVAL			X
.0403	SURFACE WATER FACILITIES			X
.0404	WATER TREATMENT FACILITIES	X	X	X
.0405	STORAGE OF FINISHED WATER	X	X	X
.0406	DISTRIBUTION SYSTEMS	X	X	X
.0407	ELECTRICAL SYSTEMS	X	X	X
.0408	LEAD FREE CONSTRUCTION	X	X	X
.0409	SERVICE CONNECTIONS	X	X	X
.0501	PURPOSE			X
.0502	DESIGN CRITERIA			X
.0601	IMPOUNDMENTS: PRE-SETTLING RESERVOIRS			X
.0602	RAW WATER INTAKES			X
.0603	INTAKE CONDUITS			X
.0604	PUMPS: POWER FACILITIES			X
.0701	FLASH OR RAPID MIXING FACILITY			X
.0702	AIR MIXING			X
.0703	MECHANICAL FLOCCULATION			X
.0704	BAFFLED MIXING AND FLOCCULATION BASINS			X
.0705	CONDUITS: PIPES AND FLUMES: GATES AND VALVES			X
.0706	SEDIMENTATION BASIN			X
.0707	SOLIDS CONTACT OR UP-FLOW UNITS			X
.0708	GRAVITY FILTERS			X
.0709	PREVENTION OF BACKFLOW AND BACK-SIPHONAGE		X	X
.0710	OTHER WATER TREATMENT PLANTS			X
.0711	ALTERNATIVE FILTRATION TREATMENT TECHNOLOGIES			X
.0712	DIRECT FILTRATION			X
.0713	PRESSURE FILTERS			X
.0714	PILOT PLAN STUDIES			X
.0715	OTHER DESIGN STANDARDS			X
.0805	CAPACITIES: ELEVATED STORAGE			X
.0901	SIZE OF WATER MAINS	X	X	X
.0902	NUMBER OF RESIDENCES ON A WATER MAIN	X	X	X
.0903	DEAD END WATER MAINS	X	X	X
.0904	PIPE LAYING	X	X	X
.0905	TESTING NEW WATER MAINS	X	X	X
.0906	RELATION OF WATER MAINS TO SEWERS	X	X	X
.0907	VALVES		X	X
.1001	DISINFECTION OF NEW SYSTEM	X	X	X
.1003	DISINFECTION OF STORAGE TANKS & DISTRIBUTION SYSTEMS	X	X	X
.1201	RECREATIONAL ACTIVITIES			X
.1202	PROTECTION OF WATER QUALITY			X
.1203	MAINTENANCE OF PARKS			X
.1204	FISHING			X

## PART III

## RULES GOVERNING PUBLIC WATER SYSTEMS

SECTION	TOPIC	C	B	A
.1207	ANIMALS IN RESERVOIR			X
.1208	CONTROLLING THE DRAINAGE OF WASTES			X
.1209	UNTREATED DOMESTIC SEWAGE OR INDUSTRIAL WASTES			X
.1210	SEWAGE DISPOSAL			X
.1211	GROUND ABSORPTION SEWAGE COLLECTION: TREATMENT/DISP SYSTEMS			X
.1212	BURIAL OF CARCASSES			X
.1213	BURIAL GROUND			X
.1214	DISPOSAL OF ANY SUBSTANCE			X
.1301	OPERATION OF PUBLIC WATER SUPPLY - GENERAL REQUIREMENTS	X	X	X
.1302	TEST, FORMS & REPORTING	X	X	X
.1303	FACILITY OVERSIGHT	X	X	X
.1304	WATER SYSTEM OPERATION AND MAINTENANCE			X
.1401	POLICY- FLUORIDATION		X	X
.1402	FORMAL APPLICATION		X	X
.1404	FEEDING EQUIPMENT		X	X
.1405	PROTECTION OF OPERATORS	X	X	X
.1406	CONTROL OF TREATMENT PROCESS		X	X
.1407	APPROVAL MAY BE RESCINDED		X	X
.1502	MONITORING OF CONSECUTIVE PUBLIC WATER SYSTEMS		X	X
.1505	TURBIDITY SAMPLING AND ANALYSIS	X	X	X
.1506	MAXIMUM CONTAMINANT LEVELS FOR TURBIDITY	X	X	X
.1507	CORROSION CONTROL AND LEAD AND COPPER MONITORING	X	X	X
.1508	INORGANIC CHEMICAL SAMPLING AND ANALYSIS	X	X	X
.1509	SPECIAL MONITORING FOR SODIUM		X	X
.1510	MAXIMUM CONTAMINANT LEVEL FOR INORGANIC CHEMICALS	X	X	X
.1511	CONCENTRATION OF IRON	X	X	X
.1512	CONCENTRATION OF MANGANESE	X	X	X
.1513	TOTAL TRIHALOMETHANES SAMPLING AND ANALYSIS: 10,000 OR MORE		X	X
.1514	TREATMENT TECHNIQUES FOR TOTAL TRIHALOMETHANES		X	X
.1515	ORGANIC CHEMICALS OTHER THAN TTHM, SAMPLING AND ANALYSIS	X	X	X
.1516	SPECIAL MONITORING FOR ORGANIC CHEMICALS	X	X	X
.1517	MAXIMUM CONTAMINANT LEVEL FOR ORGANIC CHEMICALS		X	X
.1518	MAXIMUM CONTAMINANT LEVEL FOR ORGANIC CONTAMINANTS	X	X	X
.1519	MONITORING FREQUENCY FOR RADIOACTIVITY	X	X	X
.1520	MAXIMUM CONTAMINANT LEVELS FOR RADIUM	X	X	X
.1521	MAXIMUM CONTAMINANT LEVEL GOALS FOR RADIONUCLIDES			X
.1522	ANALYTICAL METHODS FOR RADIOACTIVITY			X
.1523	PUBLIC NOTICE	X	X	X
	Subpart Q - Public Notification of Drinking Water Violations	X	X	X
.1524	REPORTING FOR ORGANIC CHEMICALS	X	X	X
.1525	REPORTING REQUIREMENTS	X	X	X
.1526	RECORD MAINTENANCE	X	X	X
.1527	CERTIFIED LABORATORIES			X
.1528	ALTERNATE ANALYTICAL TECHNIQUES			X
.1529	POINT-OF-ENTRY AND OTHER TREATMENT DEVICES			X
.1531	SITING REQUIREMENTS			X
.1532	VARIANCES AND EXEMPTIONS			X
.1534	COLIFORM SAMPLING	X	X	X
.1535	MAXIMUM CONTAMINANT LEVELS FOR COLIFORM BACTERIA	X	X	X
.1536	TREATMENT TECHNIQUES		X	X
.1537	DRINKING WATER ADDITIVES		X	X
.1538	CONSUMER CONFIDENCE REPORT		X	X
.1601	REQUIREMENTS FOR A VARIANCE		X	X

## PART III

## RULES GOVERNING PUBLIC WATER SYSTEMS

SECTION	TOPIC	C	B	A
.1602	VARIANCE REQUEST			X
.1603	CONSIDERATION OF A VARIANCE REQUEST			X
.1604	DISPOSITION OF A VARIANCE REQUEST			X
.1605	PUBLIC HEARING OF VARIANCES AND SCHEDULES			X
.1606	VARIANCES FOR FLUORIDE			X
.1607	VARIANCES AND EXEMPTIONS FOR CHEMICALS, LEAD AND COPPER, AND RADIO-NUCLIDES			X
.1608	REQUIREMENTS FOR AN EXEMPTION			X
.1609	EXEMPTION REQUEST			X
.1610	CONSIDERATION OF AN EXEMPTION REQUEST			X
.1611	DISPOSITION OF AN EXEMPTION REQUEST			X
.1612	PUBLIC HEARINGS ON EXEMPTION SCHEDULES			X
.1613	FINAL SCHEDULE			X
.1614	BOTTLED WATER AND POINT-OF-USE DEVICES			X
.1904	WHEN PENALTIES MAY BE ASSESSED	X	X	X
.1905	AMOUNT OF PENALTY ASSESSMENT	X	X	X
.1913	RIGHT OF ENTRY AND INSPECTION	X	X	X
.2001	GENERAL REQUIREMENTS (FILTRATION AND DISINFECTION)	X	X	X
.2002	DISINFECTION	X	X	X
.2003	FILTER BACKWASH RECYCLING RULE		X	X
.2004	ANALYTICAL AND MONITORING REQUIREMENTS		X	X
.2005	CRITERIA FOR AVOIDING FILTRATION		X	X
.2006	REPORTING AND RECORD KEEPING RULES		X	X
.2007	SUBPART P - ENHANCED FILTRATION AND DISINFECTION (Systems serving 10,000 or more people)			X
.2007	SUBPART T - ENHANCED FILTRATION AND DISINFECTION (Systems serving fewer than 10,000 people)		X	X
.2008	DISINFECTANTS AND DISINFECTION BYPRODUCTS		X	X
.2101	PERMITS	X	X	X
.2102	APPLICATION FOR PERMITS	X	X	X
.2103	INITIAL PERMIT PERIOD	X	X	X
.2104	RENEWAL FEES	X	X	X
.2105	REVOCATION	X	X	X
	APPENDIX B - FIGURE 2 - NORTH CAROLINA GUIDELINES CROSS CONNEC	X	X	X

## PART IV

RULES GOVERNING WATER TREATMENT FACILITY OPERATORS

<b>SECTION</b>	<b>TOPIC</b>	<b>C</b>	<b>B</b>	<b>A</b>
0.0100	GENERAL POLICIES	X	X	X
.0105	Definitions	X	X	X
.0200	QUALIFICATIONS OF APPLICANTS AND CLASSIFICATION OF FACILITIES	X	X	X
.0201	Grades of Certification	X	X	X
.0202	Examinations	X	X	X
.0205	Classification of Water Treatment Facility	X	X	X
.0206	Certified Operator Required	X	X	X
.0300	APPLICATIONS AND FEES	X	X	X
.0301	Application for Exam	X	X	X
.0302	Application for Reciprocity	X	X	X
.0303	Application for Temporary Certificate	X	X	X
.0304	Fee Schedule	X	X	X
.0307	Revocation of Certificate	X	X	X
.0308	Continuing Education	X	X	X
.0309	Certification Reinstatement	X	X	X
.0400	ISSUANCE OF CERTIFICATE	X	X	X
.0401	Notification of Classification	X	X	X
.0403	Issuance of Grade Certificate	X	X	X
.0404	Temporary Certificate	X	X	X
.0501	Petitions	X	X	X
.0508	Declaratory Rules	X	X	X
.0601	Opportunity for Licensee or Applicant to Have Hearing	X	X	X
.0701	Operator in Responsible Charge	X	X	X