1. Basic and applied math
   - Perform addition, subtraction, multiplication and division of whole numbers and decimals
   - Square and cube whole numbers, fractions, mixed numbers and decimals
   - Using conventional formulas, solve for
     ⇒ Diameter and Radius
     ⇒ Circumference
     ⇒ Perimeter
     ⇒ Area: Surface area, cross-sectional area, and sidewall area for circles, rectangles, and triangles
     ⇒ Volume: Circular tanks, pipes, and rectangular tanks
     ⇒ Dosages: lbs and lbs/day
     ⇒ Solutions: Weight of solutions, dilution (gal of concentrated solution), dosage (mg/L), and % strength (available)
     ⇒ Hydraulics: Total head (suction & pressure), velocity, and average velocity
     ⇒ Pumps: Water HP, Brake HP, and efficiency
     ⇒ Electricity: Power
     ⇒ Motors: Motor HP, motor kW, and motor power (kWh/day)
     ⇒ Wire-to-Water Efficiency
     ⇒ Blowers: Blower size (cfm)
     ⇒ Population Equivalent (PE): Design flow and population equivalent
     ⇒ Lift Stations: Detention time, filling time, pumping time, emptying time
     ⇒ Construction: Slope (ft/ft) and slope (%)
     ⇒ Flow and Leaks
       ♦ Peaking Factor
   - Convert fractions to percentage and vice-versa
   - Plot and interpret graphs, including line, bar, percentage, and broken line
   - Read tables
   - Develop tables
   - Using conversion references, convert from English to metric and vice-versa
   - Calculate percent removal for I/I

2. Basic and applied science
   - Identify and describe chemicals used in wastewater
   - Define and describe the significance of basic concepts in wastewater chemistry
   - Define basic concepts of soils
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- Define basic concepts of the hydrologic cycle and hydrology
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3. Safety
   • Identify basic categories of safety hazards
   • Identify basic safety procedures
   • Describe personal safety procedures
   • Describe basic fire safety procedures
   • Describe chemical safety procedures
   • Describe confined space safety procedures
   • Identify chemical placards
   • Identify and describe use of safety equipment

4. Units of expression
   • Defining and measuring units of expression, such as ppm, mg/L,
     lbs/mg, etc.
   • Perform necessary calculations
   • Convert from one unit to another using appropriate references or
     formulas
     ⇒ Time: Days, hours, minutes, and seconds
     ⇒ Distance: Tenths, inches, feet, yards, and miles
     ⇒ Area: Square inches, square feet, square yards, and acres
     ⇒ Volume
       ♦ Cubic feet, cubic yards, and gallons
       ♦ Gallons, milliliters, and liters
     ⇒ Weight
       ♦ Cubic feet, gallons, ounces, tons and pounds
       ♦ Milligrams, grams, kilograms, and pounds
     ⇒ Flow: mgd, gpd, gpm, and cfs
     ⇒ Head: psi and feet
     ⇒ Dosage: mg/L, ppm, and %
     ⇒ Power: HP and kW

5. Electrical concepts
   • Define basic concepts
   • Terminology
   • Advanced concepts

6. Hydraulic concepts
   • Define basic concepts

7. Maps and plans
   • Interpret and use maps and plans
   • Perform necessary calculations
   • Update system maps as needed

8. Sources and characteristics
   • Identify sources
   • Describe source quality and quantity
   • Identify physical, chemical, and biological characteristics
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8. Sources and characteristics cont’d
   - Describe effects of the physical, chemical, and biological characteristics
   - Define pollution prevention concepts and terminology
   - Describe pollution prevention practices

9. Public health principles
10. System types: Sanitary, storm, and combined
11. Gravity collection systems
    - Building sewers (service lines)
    - Lateral sewers
    - Branch sewers
    - Main sewers
    - Trunk sewers
    - Interceptor sewers
    - Outfall sewers

12. Low pressure collection systems
13. Vacuum collection systems
14. Lift stations
    - General purpose
    - Wet wells
    - Dry wells
    - Electrical controls, including VFDs
    - Transformers
    - Motors: Single phase, poly phase, and variable speed
    - Drives: Coupled, direct (shaft & gear), speed reducer (fixed and variable), right angle, and universal
    - Pumps
      ⇒ Centrifugal: Submersible, flooded suction, and self-priming
      ⇒ Positive displacement: Diaphragm, piston plunger, and progressive cavity
      ⇒ Screw
      ⇒ Turbine
      ⇒ Metering
      ⇒ Pneumatic ejector
      ⇒ Pump testing
      ⇒ Components for each pump
      ⇒ Maintenance
    - Blowers & compressors: Centrifugal and positive displacement (rotary and piston)
    - Series/parallel
    - Generators
    - Engines: Gasoline, diesel, and LP/Natural gas
    - Valves
    - Screening devices
14. Lift stations cont’d

- Controls and metering
  - Signal generators: Bubblers, electrical probes, floats and ultrasonic
  - Signal transmitters: Electric, pneumatic, hydraulic, mechanical, and telemetry
  - Signal receivers: Counters, indicators, log scale indicators, totalizers, recorders, and combination recorders
- Meters
  - Hydraulic: Rotameter
  - Electrical: Amp, watt (watt hour meter), multitesters (VOM), and megger
  - Mechanical: RPM
  - Alarms
  - Controls: Pneumatic, float, hydraulic, electrical, telemetry, timers
- Corrosion control
  - Cathodic protection devices
    - Anode rod/bags
    - Cathode rod/bags
    - Rectifiers
    - Potentiometers
- Emergency response
- Dehumidifiers

15. System components

- Pipes: ACP, CIP, concrete, VCP, DIP, steel, thermoplastic, and thermoset plastic
- Pipe joints: Gasketed, flanged, cement mortar, solvent cement, compression, welded, heat fusion, bituminous, elastomeric sealing compound, mastic, dresser, victaulic, fused, and threaded
- Valves: Ball, check, globe, gate, plug, petcock, pressure control, vacuum relief, mud, butterfly, multiport, telescoping, sluice gate, air release, and foot
- Fittings: Coupling, union, plugs/caps, and special
- Manholes
- Pressure sewers
- Force mains
- Backflow prevention devices
- Cleanouts
- Inverted siphons
- Diversion structures
- Catch basins
- Hydrants
16. Cleaning and maintenance
- Stoppages
- Hydraulic
- Mechanical
- Sewer lines and system components
- Operation and maintenance
- Combination cleaner

17. Inspection and testing
- Sewer lines and system components
- Closed-circuit television
- Flow monitoring
- Ground water gauging
- Smoke
- Dye
- Lift station
- Lamping
- Air and water
- Vacuum
- Mandrel

18. Construction, repair, and replacement
- Damage
- Excavation
  ⇒ Equipment
  ⇒ Location of utilities
- Shoring/shielding/sloping/benching
- Sewers
- Manholes
- Inspection
- Testing

19. Sewer rehabilitation
- Corrosion
- Grouting and sealing
- Trenchless technology
- Manhole rehabilitation
- Service line rehabilitation
- Inspection
- Testing

20. Infiltration/inflow/exfiltration detection
- SSES
- Infiltration/exfiltration
- Inflow

21. Flow measurement
- Manual
- Flow meters
22. Chemical addition
- Roots
- Grease
- Corrosion
- Rodents and insects
- Disinfection
- Application: Flooding, spraying, and foaming
- Chemical feeders: Solids, liquids, gas, slurry, and evaporators
- Testing

23. Odor control
- Chlorine
- Hydrogen peroxide
- Oxygenation
- Lime
- Sodium hydroxide
- Iron salts
- Masking agents
- Other chemicals
- Testing

24. Right of ways/easement
- Maintenance and equipment: Mechanical and chemical
- Acquisition

25. Information management systems
- Manual
- CMMS

26. Administration
- Set goals and objectives
- Benchmarking
- Planning
- Personnel
- Finances
  - Operating budget
  - Capital improvement budget
  - Capital planning budget
- Operation and maintenance management
- Information and record keeping
- Safety - policies
- Emergency response – O & M
- Public relations
  - PR interactions
  - PR policies
26. Administration cont’d

Security
⇒ Vulnerability assessment
⇒ Risk management plan
⇒ Operations continuity plan
⇒ Emergency response plan
⇒ Special events
⇒ Site

- Laws, regulations, and compliance issues
- Information management systems
- Design review
- Inventory control

For more study information, please contact

- Office of Water Programs, California State University Sacramento, 6000 J St, Sacramento, CA 95819-6025, call 916-278-6142, fax 916-278-5959, email wateroffice@owp.csus.edu, www.owp.csus.edu
⇒ Volume I of the *Operation and Maintenance of Wastewater Collection Systems*
⇒ Volume II of the *Operation and Maintenance of Wastewater Collection Systems*
⇒ *Collection System Operation and Maintenance Training Videos*

⇒ *WEF/ABC Collection System Operators’ Guide to Preparing for the Certification Examination*
⇒ *WEF Wastewater Collection System Operator Certification Studybook*

Disclaimer: Please note that this study guide is being provided to help you prepare for your exam. It was created from the “Needs-to-Know” validated by the South Carolina Voluntary Certification Committee, but it is NOT the “Need-to-Know”. To obtain a copy of the validated “Needs-to-Know”, please contact our office: SCAWWA / WEASC, 200-C Rich Lex Dr., Lexington, SC 9072-9274, 803-939-9574.