WATER OPERATOR MATH BY ALTITUDE WATER LLC

PURE EXAM-PREP STUDY MATERIAL · ZERO MATH DRILLS

Class D & C Water Treatment Comprehensive Study Guide

For WPI/ABC & Colorado CWP Water Treatment Class D and C (WPI Class I–II). Processes, equipment, sampling and lab, disinfection, storage, safety, and troubleshooting — explained the way the exam tests them.

- 12 chapters · every Class D/C domain
- 60-question non-math mastery check
- "Exam Trap Alert" callouts
- Field-to-Exam troubleshooting tables
- Equipment, lab, safety & records
- Offline interactive study companion

Official Sources · Verified as of November 2026. Public pages only, cited for reference; confirm current details at the official source.

Source: Water Professionals International (WPI), *Standardized Water Treatment Operator Exams — Need-to-Know Criteria and Formula/Conversion Table* (as of November 2026). https://gowpi.org/services/abc-testing/standardized-exams/standardized-water-treatment-operator-exams/

Source: Water Professionals International (WPI), *Formula/Conversion Table — Water Treatment, Distribution & Water Laboratory Exams* (2024 edition, as of November 2026). https://gowpi.org/services/abc-testing/formula-conversion-tables/

Source: Water Professionals International (WPI), *Historical Need-to-Know Criteria (2019 standardized water treatment and distribution exams)* (as of November 2026). https://gowpi.org/services/abc-testing/need-to-know-criteria/

Source: Colorado CCWP Office, *CCWP – Need to know criteria and study resources* (as of November 2026). https://cdphe.colorado.gov/ccwp-need-to-know-criteria-and-study-resources

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CHAPTER 1 OF 12 · SOURCE WATER

Source Water, Hydrology, Wells & Raw Water Characteristics

LEARNING OBJECTIVES

- Trace the hydrologic cycle and explain how each pathway changes raw water quality.
- Compare groundwater and surface water sources, including GWUDI, and predict their typical treatment needs.
- Identify the parts of a well and explain static level, pumping level, drawdown, and the cone of depression.
- Describe lake and reservoir stratification and turnover and the water quality problems each season brings.
- Recognize the physical, chemical, and biological raw water parameters operators track and what a change in each one signals.
- Apply source water protection and wellhead protection concepts to exam scenarios.

CLASS D VS CLASS C SCOPE

Class D (WPI Class I)

Know the vocabulary cold: aquifer types, well components, static vs pumping level, turbidity, hardness, alkalinity, pH, and why surface water needs more treatment than protected groundwater. Expect direct definition and identification questions.

Class C (WPI Class II)

Add cause-and-effect reasoning: predict what turnover, spring runoff, or a storm does to coagulation and disinfection; explain GWUDI and why it needs the same filtration and disinfection barriers as surface water; choose the right operating response to a raw water change.

1.1 The Hydrologic Cycle and Why Source Matters

Every drop that reaches a treatment plant has already been 'treated' or contaminated by nature. Water evaporates, condenses, and falls as **precipitation**. Some of it runs off the land surface into streams, rivers, lakes, and reservoirs (**surface runoff**). Some infiltrates the soil and percolates down to the **saturated zone**, where it becomes **groundwater**. Plants return water to the atmosphere by **transpiration**, and water bodies return it by **evaporation** — together called evapotranspiration.

The path water takes controls what it carries. Runoff picks up suspended soil (turbidity), organic matter, animal waste, fertilizer, pesticides, and microorganisms in a matter of hours. Infiltrating water is naturally filtered by soil, so it is usually low in turbidity and pathogens, but it spends years in contact with rock and dissolves minerals — so groundwater tends to be **harder, higher in dissolved solids, and more likely to carry iron, manganese, hydrogen sulfide, arsenic, radionuclides, or nitrate** depending on the geology and land use.

Operators are tested on this logic constantly: if a question describes a source, you should be able to predict its likely problems and the treatment it needs before you read the answer choices.

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Groundwater vs. Surface Water — High-Yield Comparison

Characteristic	Groundwater (protected wells)	Surface water (rivers, lakes, reservoirs)
Turbidity	Usually low and steady	Variable; spikes after storms and snowmelt
Microbial risk	Lower (soil filtration) unless the well is under the influence or poorly sealed	High: Giardia, Cryptosporidium, viruses, bacteria
Temperature	Nearly constant year-round	Changes with season and depth
Hardness / TDS	Often higher (mineral contact)	Usually lower, varies with flow
Dissolved gases	May contain H2S, CO2, low or no dissolved oxygen	Usually oxygenated near the surface
Iron / manganese	Common in reduced (anaerobic) aquifers	Mainly from the bottom of stratified reservoirs
Organic matter / color	Typically low	Higher; source of DBP precursors and taste/odor
Quality change speed	Slow (months to years)	Fast (hours to days)
Typical treatment	Disinfection; possibly Fe/Mn removal, softening, or specific contaminant removal	Coagulation, flocculation, sedimentation, filtration, and disinfection (or an approved alternative filtration technology)

EXAM TRAP ALERT

Do not assume 'groundwater = safe.' Exams like to describe a shallow well near a river whose turbidity and temperature track the river. That is a sign the well may be **groundwater under the direct influence of surface water (GWUDI)** — and GWUDI sources must meet surface water treatment requirements.

1.2 Aquifers and Wells

An **aquifer** is a geologic formation that stores and transmits usable quantities of water — sand, gravel, fractured rock, or porous sandstone and limestone. An **aquitard** (or confining layer) is a low-permeability layer such as clay or shale that slows water movement.

- **Unconfined (water table) aquifer** — open to recharge from the surface directly above it. The top of the saturated zone is the **water table**, and it rises and falls with recharge and pumping. More vulnerable to surface contamination.
- **Confined aquifer** — sandwiched between confining layers and under pressure. Water in a well rises above the top of the aquifer. If it rises above the ground surface, the well is a **flowing artesian well**. Better protected, but recharge areas may be far away.
- **Perched water table** — a small saturated lens sitting on a local clay layer above the main water table; usually an unreliable, seasonal supply.
- **Springs** — points where groundwater naturally discharges to the surface; they can be very vulnerable because the collection area is often shallow.

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