STATE OF COLORADO

Department of Public Health and Environment

2009 BASELINE ASSESSMENT REPORT

ON THE

STATUS OF PUBLIC WATER SYSTEM TRAINING OPPORTUNITIES IN COLORADO

Colorado Department of Public Health and Environment

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1.0 Introduction

In Colorado, over 2,000 public water systems are responsible for supplying safe drinking water to the public. They range in size from a small restaurant or community of 25 people to a service area the size of metropolitan Denver. Some use groundwater wells as a source of supply, and some use the state's rivers, lakes, and reservoirs. Treatment at public water systems can range drastically – from a simple chlorinator housed in a small shed to a very complex treatment system costing millions of dollars to construct and operate each year.

Regardless of the system, drinking water treatment and distribution is always required to be conducted under the direction of a responsible certified water professional and properly managed by knowledgeable and competent leadership. Of the complex systems that supply safe drinking water to the public in Colorado, the human infrastructure is just as critical as the physical.

Did you know?

Over 2,350 water treatment operator certifications and over 2,540 distribution system operator certifications are currently held by water professionals in Colorado.

This report was prepared by the Capacity Building Unit of the Safe Drinking Water Program at the Colorado Department of Public Health and Environment (CDPHE). The purpose of the Capacity Building Unit (CBU) is to provide training, technical assistance, and management support services to public water systems so they can strengthen their abilities to supply safe drinking water to the public. In this function, CBU directly provides services to public water system professionals, and utilizes set-aside funds from the Drinking Water State Revolving Fund (SRF) and other EPA grants to retain contractors to provide additional services. The purpose of the analysis described in this report is to evaluate the current training available for certified water professionals in Colorado and to recommend opportunities to improve the status quo. Recommendations will be incorporated into strategic planning efforts.

Today, a diverse group of Colorado businesses, agencies, schools, and nonprofit organizations provide training services and assistance to public water systems. Training events are often granted training units (TUs) for the renewal of applicable licenses by the *Colorado Water and Wastewater Facility Operators Certification Board.* Each training provider is guided by its own unique mission and goals, and may be supported by a variety of funding sources. While CBU supports a large portion of the training and assistance available to public water systems in Colorado, the full scope of available training is not well understood or documented, and gaps in the training spectrum have not been clearly identified.

To bridge the gap between water system training needs and available training services, and to ensure that Drinking Water SRF funds are utilized as effectively and efficiently as possible in Colorado, CBU has launched a three-phase project designed to:

- Establish a baseline and preliminary gap analysis of existing training and technical assistance services for public water systems;
- Convene a Training Roundtable to review and evaluate common compliance weaknesses at public water systems, build consensus on identified gaps in existing training services, and propose steps for developing a more cohesive, organized, and strategically aligned training and assistance network; and
- Apply project results to develop a five-year strategic plan for CBU.

This baseline report on the *Status of Public Water System Training Opportunities in Colorado* represents the first step in developing a new, collaborative, and state-wide training strategy. This report includes the following sections:

- What an Operator Needs to Know
- Current Training Offerings
- Compliance Weaknesses at Public Water Systems
- Opportunities for Training Program Improvement
- Summary and Conclusions

2.0 What an Operator Needs to Know

To have the ability to supply safe drinking water to the public, public water system professionals, including operators, managers, and leadership are required to develop knowledge, skills, and expertise in subject areas including technical, managerial, financial, and safety issues. Further, operators of drinking water facilities and distribution systems are required to be licensed as Certified Water Professionals. Certification renewals require documentation of continuing education measured in training units (TUs). Establishing "what an operator needs to know" is fundamental to developing a meaningful and effective operator certification program.

In Colorado, two organizations administer the drinking water certification program: *Colorado Environmental Certification and Testing, Incorporated (CECTI)* administers the water treatment operator certification program, while the *Colorado Water Distribution and Wastewater Collection Systems Certification Council ("Certification Council")* administers the water distribution system operator certification program. Both programs employ examination services offered by the nation-wide Association of Boards of Certification (ABC). ABC enables individual certification programs to develop their own unique operator examinations by selecting test questions from a wide variety of stock questions.

In recent years, ABC has developed "*Need-to-Know Criteria" d*escribing the core competencies covered on ABC standardized exams. The ABC *Need-to-Know Criteria for Water Treatment Operators*[1] and *ABC Need-to-Know Criteria for Distribution Operators*[2] are provided in Attachment A. These documents identify the following core competencies for water treatment operators and distribution operators, respectively:

<u>Water Treatment Operator Core Competencies:</u>

- Monitor, Evaluate and Adjust Treatment Processes
- Understand and Conduct Laboratory Analyses
- Evaluate Characteristics of Source Water
- Comply with Drinking Water Regulations
- Operate and Maintain Equipment
- Perform Security, Safety and Administrative Procedures

[1] Association of Boards of Certification (2007). *ABC Need-to-Know Criteria for Water Treatment Operators.* Ames, Iowa.
[2] Association of Boards of Certification (2009). *ABC Need-to-Know Criteria for Distribution Operators.* Ames, Iowa.

Distribution Operator Core Competencies:

- Understand System Design
- Monitor, Evaluate and Adjust Disinfection
- Comply with Drinking Water Regulations
- Understand Water Quality Parameters and Sampling
- Conduct System Inspection
- Install Equipment
- Operate Equipment
- Evaluate and Maintain Equipment
- Perform Security, Safety and Administrative Duties

Both CECTI and the Certification Council have modified the ABC Need-to-Know Criteria to develop Colorado Need-to-Know criteria, as shown in Tables 2.1 and 2.2, respectively. CECTI and the Certification Council use these state-specific criteria to select relevant and appropriate test questions for inclusion on Colorado's operator certification exams.

The "Need-to-Know" approach for developing standardized exams is revisited as an opportunity for training program improvement in Section 5.0. Specifically, it is suggested that "Need-to-Know" criteria could be used to define and develop a set of core courses that fulfill operator training needs. Using the "Need-to-Know" criteria, new training courses could be developed where existing courses are inadequate to cover fundamentals.

The value of organizing and even standardizing core competencies is to form a foundation on which well-planned, engaging, and meaningful certification programs *and* classroom curricula can be developed. A discussion of available training *vis-a-vis* need-to-know skills and knowledge follows in the next section.

Table 2.1. What a Water System Operator Needs to Know

Colorado Environmental Certification and Testing, Inc.				
What a Water Operator Needs To Know Criteria	**Class A**	**Class B**	**Class C**	**Class D**
Regulations				
Knowledge of the Colorado Primary Drinking Water Regulations	x	x	x	x
Knowledge of Regulation 100	x	x	x	x
Knowledge of CDPHE Laboratory Manual	x	x	x	x
Knowledge of CDPHE Guidance Manuals	x	x		
Safety				
Knowledge of safety regulations	x	x	x	x
Ability to identify potential safety hazards and recognize unsafe work conditions	x	x	x	x
Knowledge of personal protective equipment and its use	x	x	x	x
Familiarity with material safety data sheets	x	x	x	x
Familiarity with safe practices for chemical handling	x	x	x	x
Knowledge of confined space protocols	x	x	x	x
Knowledge of electrical safety	x	x	x	x
Knowledge of lock-out and tag-out	x	x	x	x
Source Water				
Knowledge of Hydrology	x	x	x	x
Knowledge of groundwater and wells	x	x	x	x
Algae control in reservoirs	x	x	x	
Treatment				
Coagulation and Enhanced Coagulation	x	x		
Coagulation aid polymer and filter aid polymer	x	x		
Chlorine disinfection with gaseous chlorine, sodium hypochlorite or calcium hypochlorite	x	x	x	x
CT calculations	x	x		

Colorado Environmental Certification and Testing, Inc. *(Continued)*				
What a Water Operator Needs To Know Criteria	**Class A**	**Class B**	**Class C**	**Class D**
Chloramination	x	x		
Disinfection with ozone	x	x	x	x
Disinfection with ultraviolet light	x	x	x	x
Disinfection with chlorine dioxide	x	x	x	
Bag filters	x	x	x	x
Cartridge filters	x	x	x	x
Granular media filtration and backwashing	x	x		
Diatomaceous earth filters	x	x	x	
Reverse osmosis and air stripping	x	x	x	
Membrane filters	x	x	x	
Slow sand filters	x	x	x	
Activated Carbon	x	x	x	
Chemical dosage adjustments	x	x	x	x
Ion exchange	x	x	x	
Fluoridation	x	x	x	
Corrosion control	x	x	x	
Instrumentation and control	x	x		
Softening	x	x	x	
Solids handling	x	x		
Mechanical				
Ability to read meters	x	x	x	x
Knowledge of centrifugal and positive displacement pumps	x	x	x	x
Knowledge of chlorinators and chlorine systems	x	x	x	x
Knowledge of pipes, valves and fittings	x	x	x	x
Intake structures	x	x	x	
Chemical feed systems	x	x	x	
Mixers and diffusers	x	x		
Mechanical drive systems	x	x	x	

Colorado Environmental Certification and Testing, Inc. *(Continued)*				
What a Water Operator Needs To Know Criteria	**Class A**	**Class B**	**Class C**	**Class D**
Hydraulics				
Pressure	x	x	x	x
Head loss	x	x	x	x
Velocity and flow in pipes and open channels	x	x		
Knowledge of weirs and using them for flow measurement	x	x	x	
Knowledge of backflow prevention devices	x	x	x	x
Administration				
Budgeting	x	x	x	x
Public relations	x	x		
Emergency response	x	x	x	x
Vulnerability assessment	x	x	x	x
Supervision	x	x		
Water quality reporting	x	x	x	x
Housekeeping	x	x	x	x
Math				
Ability to calculate tank volumes, draw down and detention time	x	x	x	
Ability to calculate chemical dosages and daily use of chemicals	x	x	x	
Ability to calculate treatment costs	x	x	x	x
Ability to calculate consumption from meter readings	x	x	x	x
Ability to calculate head loss	x	x	x	x
Ability to calculate horsepower	x	x		
Ability to calculate pumping rates	x	x	x	x
Ability to calculate dilutions	x	x	x	
Ability to calculate draw down and recovery in wells	x	x	x	x
Ability to calculate loading rates	x	x		

Colorado Environmental Certification and Testing, Inc. *(Continued)*				
What a Water Operator Needs To Know Criteria	**Class A**	**Class B**	**Class C**	**Class D**
Laboratory				
Interpretation of lab results	x	x	x	x
Temperature testing	x	x	x	x
Glassware	x	x	x	x
Chlorine residual testing	x	x	x	x
Ozone residual testing	x	x	x	x
Chlorine dioxide residual testing	x	x	x	
Jar Testing	x	x		
Hardness testing	x	x	x	x
Alkalinity testing	x	x		
pH testing	x	x		
Turbidity testing	x	x		
Fluoride testing	x	x	x	
Serial dilutions	x	x		
Iron testing	x	x	x	
Manganese testing	x	x	x	
Sampling procedures for bacterial testing	x	x	x	
QA/QC and instrument calibration	x	x	x	x
Streaming Current Testing	x	x		
Zeta testing	x	x		
Basic Science				
Chemical Formulae and Reactions	x	x		
Concentrations – molarity and normality	x	x		
Basic microbiology	x	x		
Oxygen saturation	x	x		

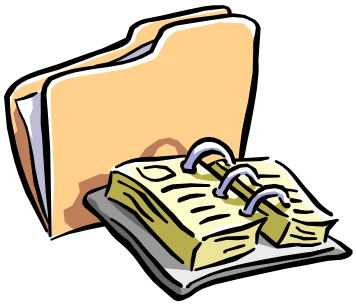
Table 2.2. What a Distribution System Operator Needs to Know

Colorado Water Distribution and Wastewater Collection Systems Certification Council			
What a Distribution System Operator Needs To Know Criteria	**Class 1**	**Class 2**	**Class 3**
Water Sources, Treatment, Storage, Disinfection	x		
Transmission and Distribution Systems	x		
Public Health Regulations, Water Quality, Chlorination	x		
Basic Math Function - Addition, Subtraction, Multiplication, Division using Basic Formulas including Area, Volume, Conversions, and Flow Rates	x		
Basic Hydraulics - Pressure, Velocity, Thrust	x		
Pipe-laying and Maintenance, Valves, Fire Hydrants	x		
Meters and Services	x		
Pumps, Motors, Electricity	x		
Safety	x		
System Operation	x		
Water Sources - well construction and operation, cleaning, integration into the system, water quality standards	x	x	
Transmission and Distribution System – pipe-laying and repairs, appurtenances - valves, taps, fire hydrants, hydraulic forces, chlorination practices	x	x	
System Operations - hydraulics, pressure and volume, basic design principles, flow tests, emergency operations, gravity and pumped systems	x	x	
Working Math - in addition to the basic arithmetic problem skills the Class 2 operator should be able to use conversions factors and perform flow rate, thrust, pressure, and power and chlorine dosage calculations	x	x	
Pumps and Motors - types, applications, design, reading and interpreting pump curves, operation and maintenance	x	x	

Colorado Water Distribution and Wastewater Collection Systems Certification Council *(Continued)*			
What a Distribution System Operator Needs To Know Criteria	**Class 1**	**Class 2**	**Class 3**
Electricity, Instrumentation, and Controls - basic circuits, principles of electricity and automation, protection hazards, generators, transformers, use of instrumentation and control systems	x	x	
Reservoirs/Storage - purpose, hydraulic considerations, maintenance, disinfection, cathodic protection	x	x	
Meters and Service Lines - types and purpose of meters, meter installation practices, service line installation, protection, meter reading, cross connections	x	x	
Safety-First Aid - barricading, structural hazards, working in confined spaces, power and hand tool use, equipment and vehicle operation, chlorine use, trench work, hazardous materials	x	x	
Maps and Records - operation and maintenance records, system maps, construction drawings, blueprints, scaling, symbols, interference	x	x	
Public Relations - complaints, employee relations, regulatory agencies	x	x	
System Planning - sizing Distribution mains, transmission requirements, water hammer, material choices	x	x	x
Calculations - thrust blocks and anchors, chlorine dose problems, velocity, conversions, formula applications to multi-part questions, graphs and tables	x	x	x
Administration - rates, personnel, accounting principles, power and chemical use, liabilities, insurance, records, mapping, supervision, reporting, public relations, and federal and state regulations	x	x	x

3.0 Current Training Offerings

Training for Colorado's public water system professionals is offered by a diverse group of businesses, agencies, schools, and nonprofit organizations. At this time, the Operator Certification Program Office (OCPO) web page[3] is the only venue in Colorado through which operators can gain a comprehensive list of training courses that offer required training units (TUs) for operator certification. Other training that may be available, but does not offer TUs, is not included on this list. The Colorado Water and Wastewater Facility Operators Certification Board (WWFOCB) retained OCPO to develop and maintain this web page, and to provide administrative support for the operator certification program, in the summer of 2000.



On the OCPO web page, available training courses are categorized as water treatment, wastewater treatment, industrial wastewater treatment, water distribution, wastewater collection, supplemental, and "all courses." In addition, courses are categorized as being either "in-house," meaning that they are offered by a specific organization for a select audience or internal staff or "open enrollment," meaning that all operators can attend. Finally, courses are organized based on whether they are offered on multiple dates throughout the year, on specific dates, or whether they are web-based. It should be noted that the presence of a training event on the OCPO web page does not guarantee that the event will be offered during the year. The OPCO web page simply lists events that have been granted TUs and proposed scheduling information submitted by the training provider.

In December 2009, Dr. Joy Barrett of the Rural Community Assistance Program prepared the *Draft Catalog of Technical, Managerial, and Financial Training and Services Provided for Small Public Drinking Water Systems and Staff in Colorado*[4] which includes information on many of these courses, along with information on select courses identified through internet searches and phone interviews. CBU compiled much of the information provided by Ms. Barrett in the draft *Tap into Training – A Course Catalog of Colorado's Drinking Water-Related Training Events* (Attachment B). This draft catalog is offered as proof-of-concept for a proposed tool to help operators identify valuable training events and opportunities to obtain TUs.

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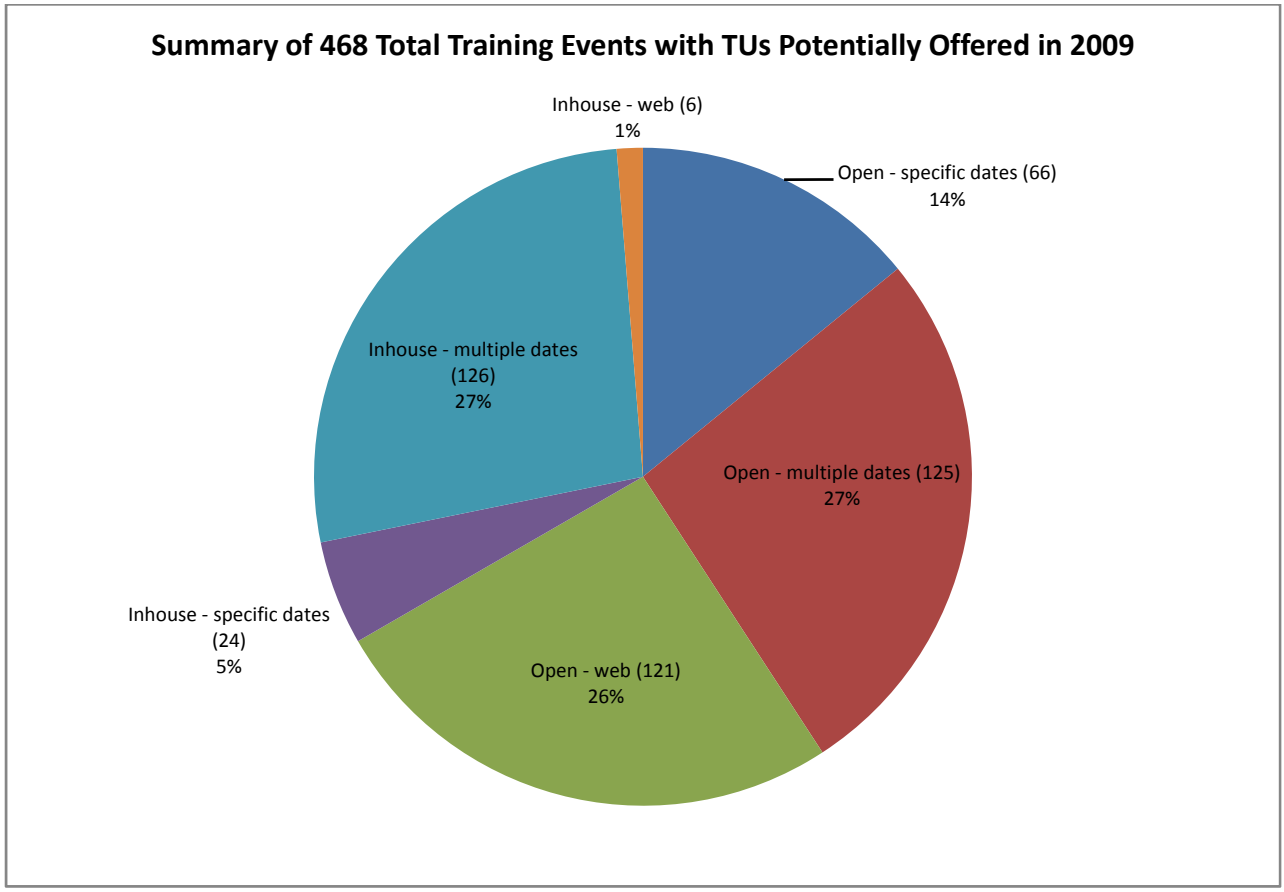
[3] Colorado Operator Certification Program Office. 2009. http://www.ocpoweb.com/index.cfm

[4] Barrett, Joy. Ph.D., Rural Community Assistance Partnership. December 2009. *Draft Catalog of Technical, Managerial, and Financial Training and Services Provided for Small Public Drinking Water Systems and Staff in Colorado.*

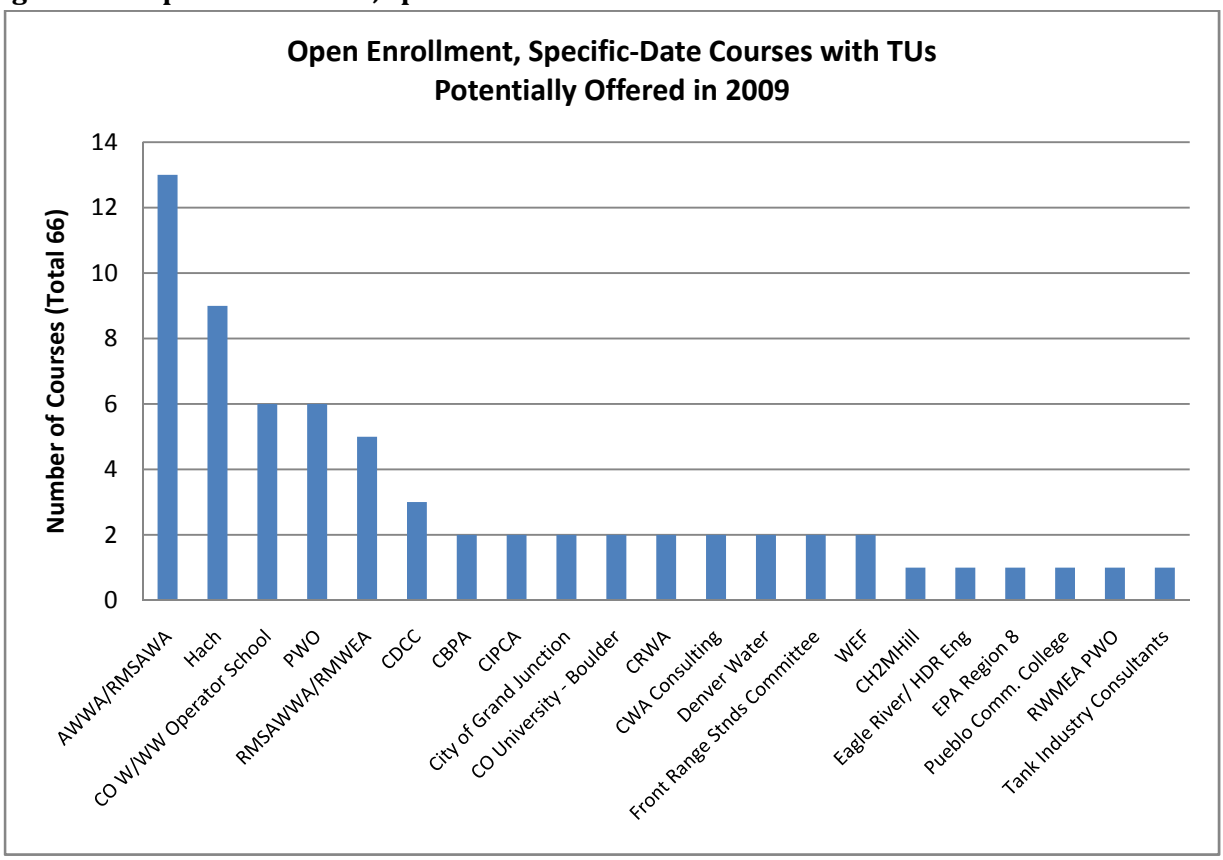
In December 2009, CBU also queried the OCPO web page for "all courses" and all types of courses with TUs potentially offered in 2009 and compiled and summarized these data in a series of charts and graphs. Figure 3.1, below, provides a summary of all 468 training events with TUs potentially offered in Colorado in 2009. Figures 3.2 through 3.4 show how many open enrollment events were potentially offered and the primary providers of those training events. Figure 3.5 shows the number of TUs potentially offered in open enrollment courses. Figure 3.6 shows the primary content of courses through which operators could obtain "water treatment" TUs.

Figure 3.1. Summary of 468 Total Training Events with TUs Offered in 2009



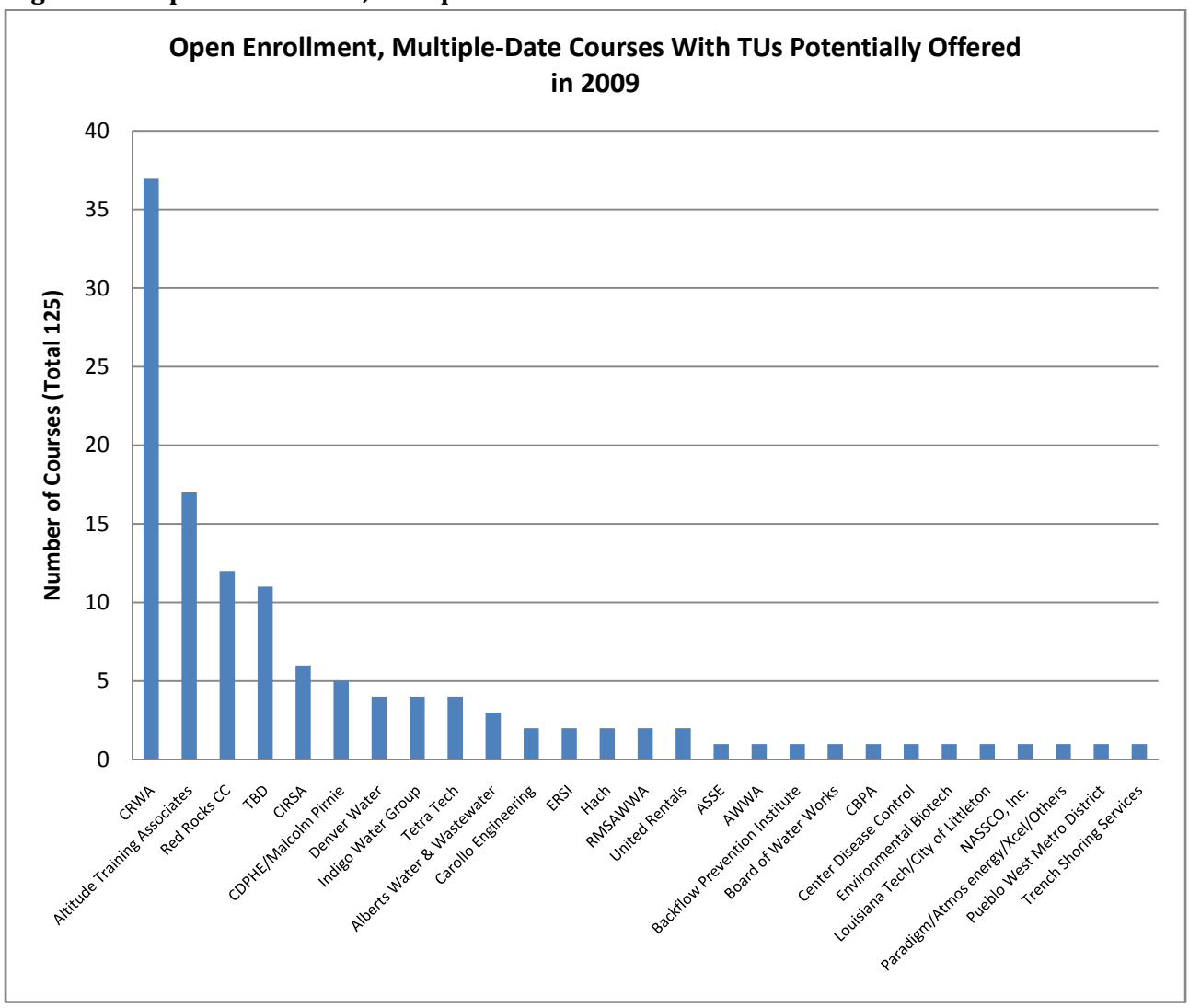
As shown in Figure 3.1, a total of 468 training events with TUs were identified on the OCPO web page. Again, in-house training is offered for a select audience or internal staff, while open-enrollment training implies that all operators can attend. Sixty seven percent (67%) of all training events were open-enrollment, while 33% were in-house events. Of the open enrollment events, 41% were classroom-based (on specific dates or multiple dates) and 26% were web-based.

Figure 3.2. Open Enrollment, Specific-Date Courses with TUs



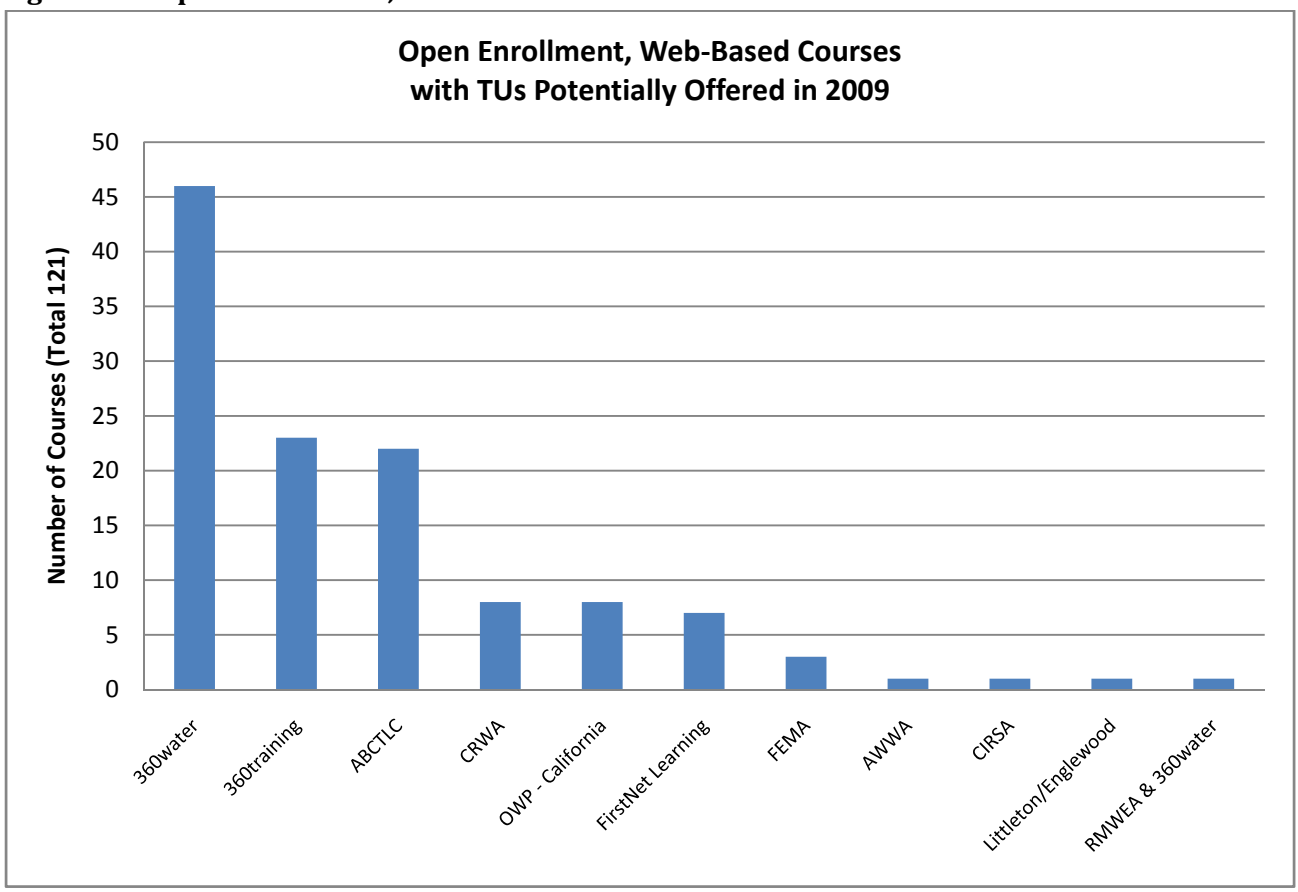
The individual providers of open enrollment classes are shown in Figures 3.2 (for specific-date classes) and 3.3 (for multiple-date classes), respectively. The American Water Works Association (AWWA) and Rocky Mountain Section of the AWWA (RMSAWWA) were the leading providers of open enrollment, specific-date courses, followed by Hach Company (Figure 3.2).

Figure 3.3. Open Enrollment, Multiple-Date Courses with TUs



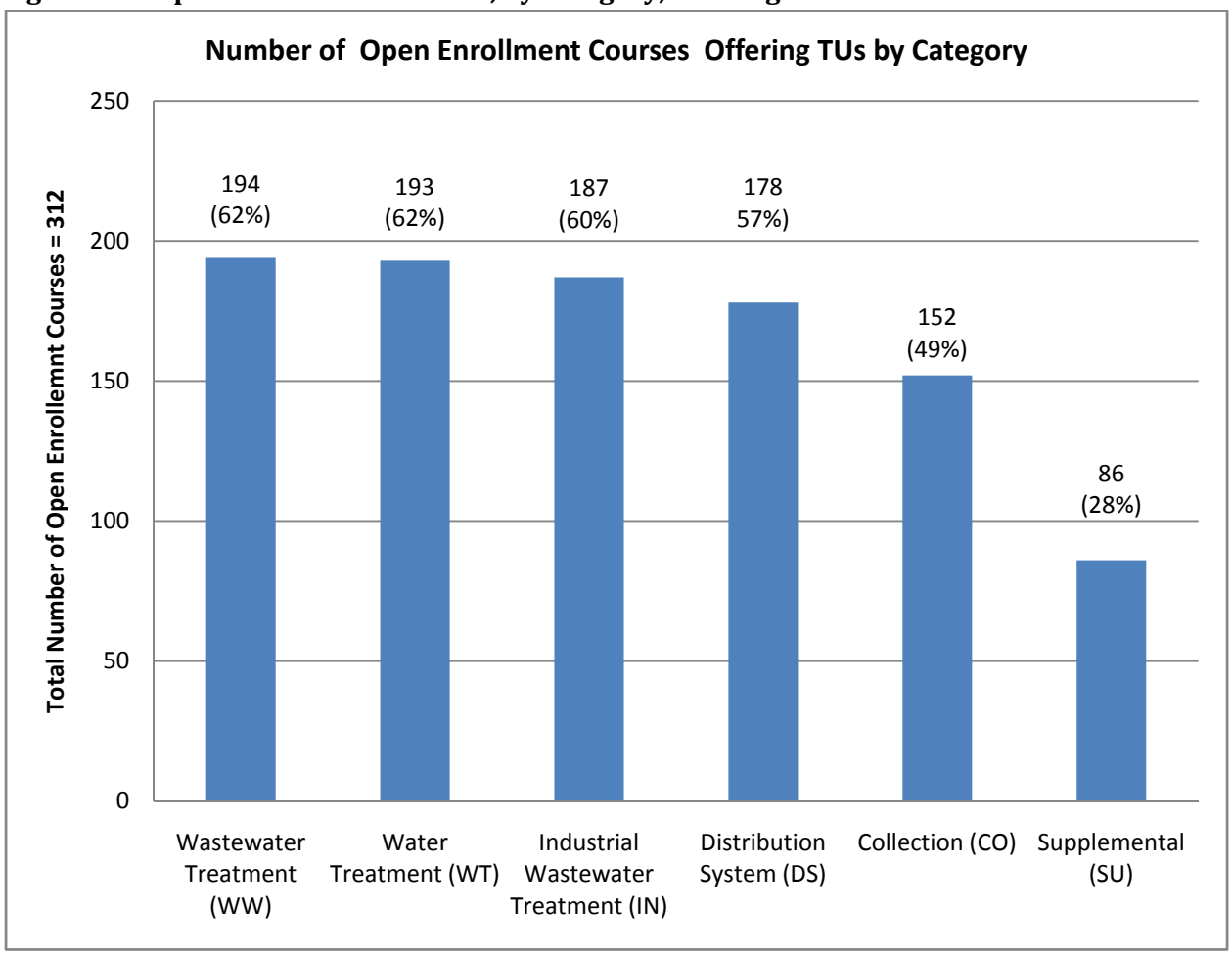
The vast majority of open enrollment, multiple-date courses were offered by Colorado Rural Water Association (CRWA). The next leading provider of open enrollment, multiple-date courses was Altitude Training Associates based in Cheyenne, Wyoming (Figure 3.3). Review of the OCPO web page shows that Altitude Training Associates primarily offered courses related to safety.

Figure 3.4. Open Enrollment, Web-Based Courses



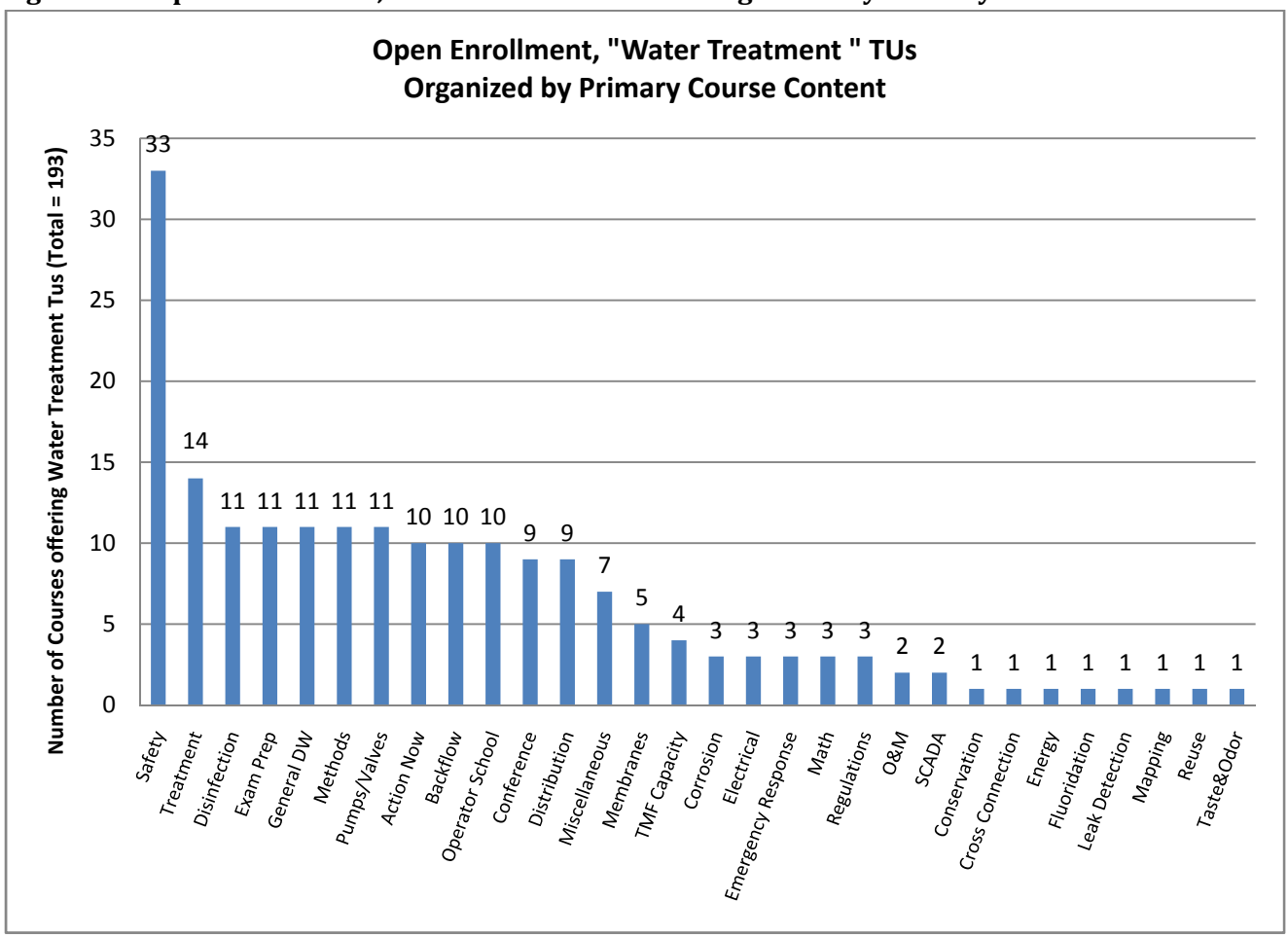
The lead providers of open enrollment, web-based courses are shown in Figure 3.4. The majority of web-based courses were offered by *360water* based in Columbus, Ohio, followed by *360training* based in Austin, Texas, and *ABC Technical Learning College* (ABCTLC.com) based in Payson, Arizona.

Figure 3.5. Open Enrollment Courses, by Category, Offering TUs



CBU reviewed all open enrollment courses to determine how TU credits were distributed by TU category. Figure 3.5 shows that 193 (~62%) of all open enrollment courses offered *water treatment* TUs. Many courses were eligible for TUs in more than one category.

Figure 3.6. Open Enrollment, "Water Treatment" TUs Organized by Primary Course Content



CBU also reviewed the primary course content of all 193 open enrollment courses offering water treatment TUs in 2009. As shown in Figure 3.6, the vast majority (i.e., 33 or 17 %) of all open enrollment courses with water treatment TUs presented *safety* as the primary course content. Only 14 (7%) of the courses presented *treatment* as the primary course content, and only 11 (6%) of the courses presented *disinfection* as the primary course content.

4.0 Compliance Weaknesses at Public Water Systems

In September 2009, Jeff Oxenford and Sharon Williams, CBU, developed the *Failure and Root Cause Analysis Project Report*[5] which identifies and evaluates important trends in compliance failures at public water systems in Colorado. The report includes a summary of Acute Team data, sanitary survey results, and self-reported compliance data collected at public water systems over a three-year period, from July 1, 2005, through June 30, 2008. This report includes the following four key findings:

- During the study period, over 50% of the public water system failures that resulted in an Acute Team response were associated with distribution system deficiencies and surface water system treatment deficiencies.

- Individual significant deficiencies identified during a sanitary survey were most commonly associated with the lack of a certified operator, failure to obtain design approval, deficient disinfection equipment, or failure to maintain an adequate disinfection residual in the distribution system. When grouped into categories, significant deficiencies were most commonly associated with "treatment" (primarily inadequate disinfection equipment) and "distribution systems" (primarily failure to maintain disinfection residuals and cross-connection control).

- Individual minor deficiencies identified during a sanitary survey were most commonly associated with the lack of or inadequate cross-connection control plan, bacteriological sample-siting plan, or monitoring plan. When grouped into categories, minor deficiencies were most commonly associated with "monitoring, reporting, and data verification" (primarily lack of or inadequate bacteriological sample-siting plan and general monitoring plan) and "system management and operation" (primarily failure to maintain cross-connection control).

- Approximately 63% of all systems in Colorado reported at least one violation during the study period, and approximately 11% of all systems reported at least one violation in the *high-priority* category of maximum contaminant level (MCL) violations. MCL violations were most frequently associated with the total coliform rule, followed by the radionuclide rule, and the inorganic contaminant rule.

[5] Oxenford, Jeff and Williams, Sharon Israel, Capacity Building Unit, Safe Drinking Water Program. September 2009. *Failure and Root Cause Analysis Final Report.* Available for download at: www.cdphe.state.co.us/wq/drinkingwater/pdf/FRCAFinalReport.pdf

This report identifies following five primary reasons for observed failures in public water systems:

- Disinfection:
  - Failure to maintain disinfection residuals
  - Inadequate disinfection equipment
  - Positive total coliform
- Cross-Connection Control:
  - Presence of cross connections
  - Lack of cross-connection control planning
- Distribution System Operations:
  - Failure to maintain disinfection residuals
  - Failure to maintain cross-connection control
- Failure to Plan:
  - Lack of, or inadequate, bacteriological (bacti) sample-siting plan
  - Lack of, or inadequate, general monitoring plan
  - Failure to obtain design approval
- Management and Operation:
  - Operator compliance with State requirements
  - Failure to monitor and report water quality in compliance with regulations
  - Failure to obtain design approval prior to construction

The continued presence of compliance weakness in public water systems, as demonstrated through the *Failure and Root Cause Analysis Project Report*, suggests that available public water system training and technical assistance is not covering many core competencies sufficiently, and that opportunities exist to further develop or enhance public water system training and technical assistance in Colorado.

5.0 Opportunities for Training Program Improvement

The *Failure and Root Cause Analysis Project Report* (Section 4.0) identified a number of areas of public water system operations that need improvement. Compliance violations, acute failures, and field-discovered deficiencies at public water systems are often symptoms of other underlying technical, managerial, and financial system weaknesses. In order to ensure that public water systems develop and maintain the capacity necessary to provide safe drinking water to the public, training and assistance programs must acknowledge and address these underlying factors. In this section, the following opportunities for training program improvement are considered:

- Improve the content focus, accessibility, and quality of training,
- Help operators to identify critical training, and
- Improve communication and coordination among the training community.

This list of opportunities is not intended to be all inclusive, but rather is intended to promote and facilitate discussion among the public water system training and assistance community.

5.1 Improve the content focus, accessibility, and quality of training

➢ **Improve the content focus of training**

✓ <u>Align Training With "Need-to-Know" Criteria</u>

ABC has developed nationwide guidance on what an operator "needs to know" to effectively operate and maintain a treatment system (see Section 2.0). In Colorado, both CECTI and the Certification Council have applied the ABC model to develop state-specific "need to know" criteria for the purposes of selecting relevant and appropriate test questions for operator certification exams. The "need to know" criteria could be further used to define and develop a set of core courses that carefully fulfill operator training needs. Using this criteria, new training courses could be developed where existing courses are inadequate to cover fundamentals.

✓ <u>Align Training with Observed Compliance Weaknesses</u>

The results of the *Failure and Root Cause Analysis Project Report* (Section 4.0) suggest that operators may lack sufficient knowledge and technical skills in the areas of disinfection, cross-connection control, distribution system operations, and planning and monitoring requirements.

The results of the *Failure and Root Cause Analysis Project Report* could be used to develop new training in areas of observed weaknesses. For example:

Compliance Weakness:

Disinfection – Develop additional training courses covering the fundamental need for and value of drinking water disinfection; disinfection processes, technologies, and optimization; sampling, reporting, and recordkeeping protocols; and regulatory requirements, etc.

Distribution System Operations – Develop additional training courses covering the fundamental principles of leak detection, line repair, line disinfection, system mapping, etc.

Failure to Plan – Provide additional training on the importance and principles of system management and planning, including training on the new *Monitoring Plan Template* developed by the WQCD.

✓ <u>Increase Focus on Management and Financial Training</u>

Public water systems that lack adequate funding are likely to lack the technical, managerial, and financial capacity to comply with applicable regulations and ensure the consistent delivery of safe drinking water. The following approaches could be used to enhance system management and financial capacity through training:

Focus Greater Outreach, Training, and Assistance on Water System Boards and Managers

Identifying, contacting, and scheduling training for boards of directors, small community town councils, mayors, town managers, general managers, and public works directors of small public water systems is challenging due to the diverse schedules, competing priorities, and often volunteer nature of these individuals. Nonetheless, these individuals play a critical role in developing and maintaining the management and financial capacity of the water systems serving their communities. Focusing greater outreach, training, and assistance on water system boards and managers might involve providing more frequent and more in-depth instruction on the role of management and budgeting in successful regulatory compliance and public health protection, including:

- Sustainable rate structures and rate-setting,
- Human resource management,
- Budgeting,
- Asset management, and
- Models of regionalization and consolidation.

Link Capacity Building Assistance to the Systems in Greatest Need of Support

In 2005, CBU initiated a program to build the technical, managerial, and financial (TMF) capacity of public water systems by providing water systems with one-on-one TMF assessments and

assistance. Through contractor support from Malcolm Pirnie, Inc. and Stantec, over 70 water systems have received TMF assessments and assistance. Water systems were selected for assistance based on a variety of reasons. In their December 2009 Technical, Managerial, and Financial (TMF) Capacity Assistance Program Final Project Report[6], Malcolm Pirnie recommended enhancing the TMF assistance program by *focusing* system selection on target water systems that most need TMF capacity building. According to Malcolm Pirnie, this would involve additional coordination within the WQCD and the identification of key criteria. Systems that may benefit from capacity building assistance include:

- Systems that are out of compliance or are struggling to maintain compliance
- SRF applicants (or applicants of other similar funding sources, if applicable), and
- New water systems seeking approval.

➢ **Improve the accessibility of training**

The accessibility of training to water system operators is largely dependent on the cost, location, and frequency of the training. In order to assess the frequency of operator training for critical topics, Dr. Joy Barrett of the Rural Community Association Partnership (RCAP) compared the number and type of available operator training events identified through the OCPO web page to the compliance weaknesses identified in the *Failure and Root Cause Analysis Project Report*. This comparison (Table 5.1) suggests that, for example, only 22 classes on disinfection equipment were available to meet the training needs of over 2,000 operators in Colorado last year. Note that the cost or location of these classes is not reflected in the table.

In the report titled *Status of Water Distribution System Training for Small and/or Rural Water System Operators*[7], Ray Olson found that training for small/rural operators "is not usually affordable and is rarely convenient." Mr. Olson identified the following benefits of providing operators with low- or no-cost training:

- Allows operators with low or no training budgets to receive training,
- Allows the Safe Drinking Water Program to require a specific operator to attend training without the operator incurring the cost of training (i.e., this may mitigate compliance issues),
- Provides training opportunities for potential operators looking to see if this type of work may be of interest to them, and
- Simplifies certification renewals.

[6] Malcolm Pirnie, Inc. December 2009. *Technical, Managerial, and Financial (TMF) Capacity Assistance Program Final Project Report.*
[7] Olson, Ray. October 5, 2006. *Status of Water Distribution System Training for Small and/or Rural Water System Operators.*

Mr. Olson also identified the following difficulties in providing operators with low- or no-cost training:

- Difficult to find trainers for low-/no-cost events in remote areas,
- Difficult to fund low-/no-cost events, and
- Not all training venues are equipped for training.

Table 5.1. Comparison between most frequently observed failures at public water systems and available training opportunities

Primary Reasons for Observed Compliance Failures [a/]	Number and Types of Training Events			
	Offered on Specific Dates	Offered on Multiple Dates	Web-Based	Total Number of Training Opportunities
Disinfection				
Failure to maintain disinfection residuals	17	6	5	28
Inadequate disinfection equipment	12	7	3	22
Positive total coliform	16	6	5	27
Cross-Connection Control				
Presence of cross connections	7	1	1	9
Lack of cross-connection control planning	9	1	1	11
Distribution System Operations				
Failure to maintain disinfection residuals	17	6	5	28
Failure to maintain cross-connection control	9	0	1	10
Failure to Plan				
Lack of, or inadequate, bacteriological sample-siting plan	10	1	1	12
Lack of, or inadequate, general monitoring plan	10	1	1	12
Failure to obtain design approval	10	1	1	12
Management and Operation				
Operator compliance with State requirements	10	1	1	12
Failure to monitor and report water quality in compliance with regulations	10	1	1	12
Failure to obtain design approval prior to construction	10	1	1	12

[a/] Based on CBU's *Failure and Root Cause Analysis Project Report*, September 2009.

Many operators in small towns have responsibilities beyond serving as water treatment or distribution operators, and many small utilities have low training budgets and few staff members to provide coverage when their co-workers are away. Ensuring the availability of high-quality, low-cost training at convenient times and locations throughout Colorado could have a significant impact on

reducing compliance weaknesses at public water systems. Developing mentoring programs or web-based chat groups may also provide a forum for delivering focused training across the state.

- **Improve the quality of training**

In addition to being focused and accessible, the training offered to water system operators must be meaningful, engaging, and high-quality. As state previously, CECTI and the Certification Council review training materials and grant TUs to approved courses. These organizations employ a thoughtful review process to ensure that courses granted TUs cover key topics. However, this review process may not consistently ensure that courses include *high-quality instruction* and *excellent instructional design*. In order to improve Colorado's water system training program, all training entities might embrace an agreed-upon classroom model that includes:

- An established curriculum,
- Excellent instructional design (e.g., including adult education and hands-on applied learning techniques),
- Relevant material, and
- Excellent instructors.

The training community may engage in a systematic approach to ensuring that all operator training events follow this model. Leveraging existing curricula, such as the California State University's Sacramento Foundation drinking water operator training materials, may provide another way to increase the overall quality and consistency of training courses.

5.2 Help operators identify critical training

The wide range of training courses available in Colorado is not well tracked or documented in such a manner that the course descriptions can be referenced easily by topic. As stated previously, the OCPO web page lists training events that have been granted TUs, but not all approved training events are offered during the year. A comprehensive training catalog with course descriptions could be maintained by the training community and could serve as a valuable reference for operators seeking opportunities to build their knowledge and skills and gain TUs. A training catalog could also be used as a tool to direct operators to the core courses that meet their "Need-to-Know" criteria at each level of operator certification. As a proof-of-concept, CBU has compiled the draft *Tap into Training – A Course Catalog of Colorado's Drinking Water-Related Training Events* (Attachment B) based on information on the OCPO web page and information provided by Dr. Joy Barrett in the draft *Training Catalog for Public Water System Operators in Colorado.*

5.3 Improve communication and coordination among the training community

The Colorado businesses, agencies, schools, and nonprofit organizations that provide training services and assistance to public water systems are all guided by their own program missions and goal. No mechanism exists to assess the full scope of available water system training or the potential gaps in the training spectrum. In February 2010, CBU is hosting a Training Roundtable as a first step in developing a strategically aligned state-wide training network for the benefit of public water systems. The Training Roundtable participants will play an important role in assessing existing training opportunities, identifying gaps, and developing recommendations for increased collaboration and problem solving.

Training Roundtable participants will be challenged with establishing their own mission statement and charter. Potential outcomes of the Training Roundtable may include commitments to improve training program coordination, outreach, and marketing through:

- Coordinated and strategic review of training gaps,
- Development of new training materials,
- Coordinated selection of training locations to ensure state-wide training coverage,
- Development and maintenance of a shared training calendar and course catalog,
- Development and implementation of a "classroom model" (see Section 5.2) that ensures consistent, high-quality instruction,
- Coordinated marketing and outreach to operators, managers, and other target audiences, and
- Coordinated outreach to and partnership with important stakeholders.

6.0 Summary and Conclusions

In Colorado, over 2,000 public water systems are responsible for supplying safe drinking water to the public. To be successful, each one must be operated and managed by well-trained and competent professionals. Colorado needs a robust human infrastructure to ensure that the public is supplied safe drinking water every day.

The purpose of the Capacity Building Unit in the Colorado Safe Drinking Water Program is to provide training, technical assistance, and management support services to public water systems so they can strengthen their ability to supply safe drinking water to the public. In order to achieve this goal and to ensure that resources are strategically and effectively applied to deliver meaningful and high-quality services to public water systems in Colorado, CBU has launched a three-phase project designed to:

- Establish a baseline and preliminary gap analysis of existing training and technical assistance services for public water systems;
- Convene a Training Roundtable to review and evaluate common compliance weaknesses at public water systems; build consensus on identified gaps in existing training services; and propose steps for developing a more cohesive, organized, and strategically aligned training and assistance network; and
- Apply project results to develop a five-year strategic plan for CBU.

This report represents the first step in developing a new CBU training strategy. Opportunities identified in this report include improving the content focus, accessibility, and quality of training, helping operators identify critical training, and improving communications and coordination among the training community -- all for the benefit of the professionals responsible for public water systems, and, ultimately, each person supplied safe drinking water from a public water system. The Training Roundtable participants will be challenged with considering these and other opportunities and building the foundation for a new and improved water system training program.

Through this strategic planning process, CBU will seek out opportunities to learn from stakeholders, improve communication and information sharing, more effectively utilize resources, and apply lessons learned in guiding future training efforts. As a result of these efforts, we will develop a more robust training system for public water system professionals, and we anticipate a future with fewer acute system failures, fewer compliance violations, and fewer system deficiencies.

We look forward to the task ahead.

Attachment A: ABC Need-to-Know Criteria

ABC Need-to-Know Criteria for Water Treatment Operators

and

ABC Need-to-Know Criteria for Distribution Operators

ABC Need-to-Know Criteria for Water Treatment Operators

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Introduction

As part of the development of its certification exams, the Association of Boards of Certification (ABC) conducted a job analysis of water treatment operators during 1980 and 1981. The purpose of the job analysis was to identify the essential job tasks performed by water treatment operators and the capabilities required to competently perform these job tasks. The results of this job analysis provided ABC with the foundation for the development of valid water treatment certification exams. These exams were offered by ABC for the first time in 1982.

ABC periodically re-evaluates the need-to-know criteria to ensure it reflects current technology. Our most recent evaluation was conducted in 2006 when ABC conducted a national survey of water treatment operators. This Need-to-Know Criteria was developed from the results of the 2006 job analysis and will be used to determine the content of the ABC water treatment certification exams administered beginning in January 2008.

The information in this document reflects the essential job tasks performed by operators and their requisite capabilities. This document is intended to be used by certification programs and trainers to help prepare operators for certification in the profession.

How the Need-to-Know Criteria was Developed

Task Survey

ABC's Water Treatment Validation and Examination Committee provided technical assistance throughout the job analysis process. This committee worked with ABC staff to develop the national job task survey. 501 certified water treatment operators throughout the United States and Canada were invited to complete the survey. 173 surveys were completed for a response rate of 35%. 11% of the respondents were class I operators, 30% were class II operators, 28% were class III operators, and 31% were class IV operators.

In this survey, certified operators were asked to rate job tasks and capabilities on rating scales for frequency of performance and seriousness of inadequate or incorrect performance. These two rating scales were used because they provide useful information (i.e., how critical each task is and how frequently each task is performed) pertaining to certification. The survey also included a background information section where demographic data such as gender, age, ethnic origin, educational level attained, work experience, and certification level were collected. Space was provided at the end of the survey for operators to list any important tasks performed on their job which were not included on the survey and to make general comments.

Survey Results

The mean, standard deviation, and the percentage of respondents performing each task statement were computed. The mean was used to determine the importance of items and the standard deviation was used to identify items with a wide variation in responses. The percentage of respondents performing each task statement was used to identify tasks and capabilities commonly performed by operators throughout the United States and Canada.

A criticality value of 2(mean seriousness rating) + mean frequency rating was calculated for each item on the survey. This formula gives extra weight to the seriousness rating in determining critical items and was appropriate because it emphasized the purpose of certification—to provide competent operators.

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Core Competencies

The ABC Water Treatment Validation and Examination Committee reviewed the results of the task survey to identify the most important and commonly performed job tasks and capabilities for water treatment operators. Tasks and their requisite capabilities performed by at least 50% of the respondents and with a high criticality value were designated as core competencies. They were the most important and commonly performed job tasks and capabilities.

The core competencies were considered the essential tasks and capabilities for water treatment operators. The core competencies are clustered into the following job duties:

- Monitor, Evaluate and Adjust Treatment Processes
- Laboratory Analysis
- Evaluate Characteristics of Source Water
- Comply with Drinking Water Regulations
- Operate and Maintain Equipment
- Perform Security, Safety and Administrative Procedures

The level of knowledge (i.e., comprehension, application, analysis) required for each task is also identified in the following pages.

- **Comprehension** is the most basic level of understanding and remembering. Items written at the comprehension level require examinees to recognize, remember, or identify important ideas.
- Items written at the **application** level require examinees to interpret, calculate, predict, use or apply information and solve problems.
- Items written at the **analysis** level require examinees to compare, contrast, diagnose, examine, analyze, and relate important concepts.

The level of knowledge is a hierarchy from basic comprehension to analysis. The level of knowledge tested is cumulative. Therefore, tasks identified as application may include questions written at both the application and comprehension levels. Tasks identified as analysis may include questions written at the comprehension, application and analysis levels.

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Core Competencies for Water Treatment Operators

Monitor, Evaluate and Adjust Treatment Processes	Class Level			
	I	II	III	IV
Source Water Treatment				
Algae control	Comprehension	Application	Application	Analysis
Chemical treatment (copper sulfate)	Comprehension	Application	Application	Analysis
Intake structure/wellhead	Comprehension	Comprehension	Application	Analysis
Chemical Treatment/Addition				
Taste and odor control	Comprehension	Application	Application	Analysis
Fluoridation	Comprehension	Analysis	Analysis	Analysis
Chlorine disinfection	Analysis	Analysis	Analysis	Analysis
Chlorine dioxide disinfection	Comprehension	Comprehension	Application	Application
Chloramination	Comprehension	Comprehension	Application	Application
Ozone disinfection		Comprehension	Application	Application
Ultraviolet disinfection	Comprehension	Comprehension	Application	Application
pH adjustment for process control	Comprehension	Application	Analysis	Analysis
pH adjustment for corrosion control	Application	Application	Analysis	Analysis
Corrosion control	Comprehension	Comprehension	Application	Analysis
Potassium permanganate	Application	Analysis	Analysis	Analysis
Coagulation and Flocculation				
Chemical coagulants	Comprehension	Application	Application	Analysis
Rapid mix units	Comprehension	Application	Application	Analysis
Flocculation tanks/basins	Comprehension	Application	Application	Analysis
Clarification/Sedimentation				
Sedimentation basins	Comprehension	Application	Application	Analysis
Upflow solids-contact clarification	Comprehension	Comprehension	Application	Analysis
Inclined-plate sedimentation		Comprehension	Application	Analysis
Tube settlers/high-rate		Comprehension	Application	Analysis
Dissolved air flotation		Comprehension	Application	Analysis
Other clarification/sedimentation		Comprehension	Application	Analysis
Filtration				
Gravity/rapid sand filtration	Comprehension	Application	Application	Analysis
Membrane filtration (MF, UF, NF)	Comprehension	Comprehension	Comprehension	Application
Reverse osmosis	Comprehension	Comprehension	Application	Analysis
Electrodialysis		Comprehension	Comprehension	Comprehension
Cartridge filters	Comprehension	Application	Application	Application
Slow sand filters	Comprehension	Application	Application	Analysis
Pressure or greensand filtration	Application	Application	Application	Application

(continued)

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Core Competencies (continued)

Monitor, Evaluate and Adjust Treatment Processes (continued)	Class Level			
	I	II	III	IV
Other Treatment Processes				
Aeration	Comprehension	Application	Application	Analysis
Packed tower aeration		Comprehension	Comprehension	Comprehension
Ion exchange softening	Comprehension	Comprehension	Comprehension	Comprehension
Iron and manganese sequestration/removal	Application	Application	Application	Application
Lime-soda ash softening	Comprehension	Comprehension	Application	Analysis
Granular activated carbon		Comprehension	Comprehension	Application
Powdered activated carbon		Comprehension	Comprehension	Application
Coagulation aids	Comprehension	Application	Application	Analysis
Filter aids		Application	Application	Analysis
Backwash aids		Application	Application	Analysis
Residuals Disposal				
Backwash water/supernatant	Comprehension	Comprehension	Application	Analysis
Deep well injection		Comprehension	Comprehension	Comprehension
Discharge to lagoons and then surface water		Comprehension	Comprehension	Comprehension
Discharge to sewers	Comprehension	Comprehension	Comprehension	Comprehension
Drying beds/evaporation ponds		Comprehension	Comprehension	Comprehension
Land application		Comprehension	Comprehension	Comprehension
Mechanical dewatering		Comprehension	Application	Analysis

Job Tasks Required for Treatment Processes

- Adjust chemical feed rates
- Adjust flow patterns
- Adjust process units
- Calculate dosage rates
- Confirm chemical strength
- Diagnose/troubleshoot process units
- Measure chemical weight/volume
- Monitor and evaluate process units
- Perform basic math
- Perform physical measurements
- Perform process control calculations
- Prepare chemicals

Capabilities Required for Treatment Processes

- Ability to maintain processes in normal operating condition
- Knowledge of chemical application procedures
- Knowledge of chemical handling and storage procedures
- Knowledge of chemical properties
- Knowledge of general biology and chemistry
- Knowledge of general electrical principles
- Knowledge of hydraulic principles
- Knowledge of math concepts
- Knowledge of normal chemical range
- Knowledge of physical science
- Knowledge of principles of measurement
- Knowledge of treatment concepts and processes
- Knowledge of water treatment design parameters

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Core Competencies (continued)

Laboratory Analysis	Class Level			
	I	II	III	IV
Collect Samples				
Alkalinity	Comprehension	Application	Application	Application
Carbon dioxide			Comprehension	Comprehension
Chlorine demand	Analysis	Analysis	Analysis	Analysis
Chlorine residual	Analysis	Analysis	Analysis	Analysis
Conductivity			Comprehension	Comprehension
Cryptosporidium	Comprehension	Comprehension	Comprehension	Comprehension
Disinfectant by-products (THM)	Comprehension	Comprehension	Comprehension	Comprehension
Dissolved oxygen	Comprehension	Comprehension	Comprehension	Comprehension
Fluoride concentration	Comprehension	Application	Application	Application
Giardia lamblia	Comprehension	Comprehension	Comprehension	Comprehension
Hardness	Comprehension	Comprehension	Comprehension	Comprehension
Inorganic (heavy metal) chemical	Comprehension	Comprehension	Comprehension	Comprehension
Iron/manganese	Application	Application	Application	Application
Jar test	Comprehension	Comprehension	Comprehension	Comprehension
Lead/copper	Comprehension	Application	Application	Application
Microbiological	Application	Application	Application	Application
Nitrate	Comprehension	Comprehension	Comprehension	Comprehension
Ortho-polyphosphate	Comprehension	Comprehension	Comprehension	Comprehension
pH	Application	Application	Application	Application
Radiological parameters	Comprehension	Comprehension	Comprehension	Comprehension
Settleable solids		Comprehension	Comprehension	Comprehension
Synthetic organic chemicals	Comprehension	Comprehension	Comprehension	Comprehension
Taste and odor thresholds	Comprehension	Comprehension	Comprehension	Comprehension
Temperature	Application	Application	Application	Application
Turbidity	Analysis	Analysis	Analysis	Analysis
Total organic carbon (TOC)	Comprehension	Comprehension	Comprehension	Comprehension
Total suspended solids (TSS)			Comprehension	Comprehension
Volatile organic chemicals		Comprehension	Comprehension	Comprehension
Interpret Analysis				
Alkalinity	Comprehension	Comprehension	Comprehension	Comprehension
Carbon dioxide			Application	Application
Chlorine demand	Application	Application	Application	Application
Chlorine residual	Analysis	Analysis	Analysis	Analysis
Conductivity			Comprehension	Comprehension
Cryptosporidium	Comprehension	Comprehension	Comprehension	Comprehension
Disinfectant by-products (THM)	Comprehension	Comprehension	Comprehension	Comprehension
Dissolved oxygen	Comprehension	Comprehension	Comprehension	Comprehension

(continued)

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Core Competencies (continued)

Laboratory Analysis (continued)	Class Level			
	I	II	III	IV
Fluoride concentration	Comprehension	Comprehension	Comprehension	Application
Giardia lamblia	Comprehension	Comprehension	Comprehension	Comprehension
Hardness	Comprehension	Comprehension	Comprehension	Comprehension
Inorganic (heavy metal) chemical	Comprehension	Comprehension	Comprehension	Comprehension
Iron/manganese	Comprehension	Comprehension	Comprehension	Comprehension
Jar test	Comprehension	Application	Application	Analysis
Lead/copper	Comprehension	Comprehension	Comprehension	Comprehension
Microbiological	Comprehension	Application	Application	Analysis
Nitrate	Comprehension	Comprehension	Comprehension	Comprehension
Ortho-polyphosphate	Comprehension	Comprehension	Application	Application
pH	Application	Application	Application	Application
Settleable solids		Comprehension	Comprehension	Comprehension
Taste and odor thresholds	Comprehension	Comprehension	Comprehension	Comprehension
Temperature	Comprehension	Comprehension	Comprehension	Comprehension
Turbidity	Analysis	Analysis	Analysis	Analysis
Total organic carbon (TOC)	Comprehension	Comprehension	Comprehension	Comprehension
Total suspended solids (TSS)			Comprehension	Comprehension
Volatile organic chemicals			Comprehension	Comprehension
Perform Plant Process Control Analysis				
Alkalinity	Comprehension	Application	Application	Application
Carbon dioxide			Comprehension	Comprehension
Chlorine demand	Application	Application	Application	Application
Chlorine residual	Analysis	Analysis	Analysis	Analysis
Conductivity			Comprehension	Comprehension
Dissolved oxygen			Comprehension	Comprehension
Fluoride concentration	Comprehension	Application	Application	Application
Hardness	Comprehension	Comprehension	Comprehension	Comprehension
Iron/manganese	Application	Application	Application	Application
Jar test	Comprehension	Application	Application	Analysis
Microbiological		Comprehension	Application	Application
Ortho-polyphosphate	Comprehension	Comprehension	Comprehension	Comprehension
pH	Application	Application	Application	Application
Settleable solids		Comprehension	Comprehension	Comprehension
Taste and odor thresholds	Comprehension	Comprehension	Comprehension	Comprehension
Temperature	Comprehension	Comprehension	Comprehension	Comprehension
Turbidity	Analysis	Analysis	Analysis	Analysis
Total suspended solids (TSS)			Comprehension	Comprehension

(continued)

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Core Competencies (continued)

Job Tasks Required for Laboratory Analysis

- Analyze samples
- Calculate results of tests
- Calibrate lab instruments
- Check reagents
- Evaluate data
- Interpret test results
- Maintain log book
- Make reagents
- Measure and prepare chemicals
- Operate lab instruments
- Preserve, store, and ship samples
- Record samples
- Select proper test method
- Select sample locations and take samples
- Store and dispose of chemicals
- Summarize results of analysis

Capabilities Required for Laboratory Analysis

- Ability to recognize abnormal analytical results
- Knowledge of basic laboratory techniques
- Knowledge of chemical handling and storage procedures
- Knowledge of drinking water regulations
- Knowledge of general biology, chemistry and physical science
- Knowledge of laboratory equipment
- Knowledge of normal characteristics of water
- Knowledge of principles of measurement
- Knowledge of quality control/quality assurance practices
- Knowledge of sample containers
- Knowledge of sampling procedures
- Knowledge of *Standard Methods for the Examination of Water and Wastewater*

Evaluate Characteristics of Source Water	Class Level			
	I	II	III	IV
Bacteriological	Comprehension	Analysis	Analysis	Analysis
Biological	Comprehension	Comprehension	Comprehension	Comprehension
Chemical	Comprehension	Comprehension	Comprehension	Application
Physical	Comprehension	Comprehension	Comprehension	Application
Agriculture, recreation and industry impact	Comprehension	Comprehension	Comprehension	Comprehension
Groundwater conditions	Comprehension	Comprehension	Comprehension	Comprehension
Reservoir stratification		Comprehension	Comprehension	Comprehension
Stratification/turnover challenges	Comprehension	Comprehension	Comprehension	Comprehension

Capabilities Required to Evaluate Characteristics of Source Water

- Ability to communicate observations verbally and in writing
- Ability to recognize abnormal conditions
- Knowledge of hydrology
- Knowledge of normal characteristics of water
- Knowledge of sanitary survey process
- Knowledge of watershed protection/wellhead protection

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Core Competencies (continued)

Comply with Drinking Water Regulations	Class Level			
	I	II	III	IV
United States Exams – Code of Federal Regulations, Title 40, Part 141 - National Primary Drinking Water Regulations				
Subpart A - General definitions	Comprehension	Comprehension	Comprehension	Comprehension
Subpart B - Maximum contaminant levels	Comprehension	Comprehension	Comprehension	Comprehension
Subpart C - Monitoring and analytical requirements	Comprehension	Comprehension	Comprehension	Comprehension
Subpart D - Reporting and recordkeeping	Comprehension	Comprehension	Comprehension	Comprehension
Subpart E - Special regulations	Comprehension	Comprehension	Comprehension	Comprehension
Subpart G - National revised primary drinking water regulations: maximum contaminant level and maximum residual disinfectant levels	Comprehension	Comprehension	Comprehension	Comprehension
Subpart H - Filtration and disinfection	Comprehension	Comprehension	Comprehension	Comprehension
Subpart I - Control of lead and copper	Comprehension	Comprehension	Comprehension	Comprehension
Subpart J - Use of non-centralized treatment devices	Comprehension	Comprehension	Comprehension	Comprehension
Subpart K - Treatment techniques	Comprehension	Comprehension	Comprehension	Comprehension
Subpart L - Disinfection residuals, disinfection byproducts, and disinfection byproduct precursors	Comprehension	Comprehension	Comprehension	Comprehension
Subpart O - Consumer confidence reports	Comprehension	Comprehension	Comprehension	Comprehension
Subpart P - Enhanced filtration and disinfection	Comprehension	Comprehension	Comprehension	Comprehension
Subpart Q - Public notification of drinking water violations	Comprehension	Comprehension	Comprehension	Comprehension
Canadian Exams				
Provincial and territorial regulations	Comprehension	Comprehension	Comprehension	Comprehension

Operate and Maintain Equipment	Class Level			
	I	II	III	IV
Operate Equipment				
Blowers, compressors and pneumatics	Comprehension	Application	Application	Application
Chemical feeders	Analysis	Analysis	Analysis	Analysis
Computers	Application	Application	Application	Application
Electronic testing equipment	Comprehension	Comprehension	Comprehension	Comprehension
Generators	Comprehension	Comprehension	Comprehension	Comprehension
Hydraulic equipment		Comprehension	Comprehension	Comprehension
Instrumentation	Application	Application	Application	Application
Intake structure/well	Application	Application	Application	Application
Prime movers/drives (engines and motors)	Application	Application	Application	Application
Valves	Application	Application	Application	Application
Water pumps	Analysis	Analysis	Analysis	Analysis

(continued)

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Core Competencies (continued)

Operate and Maintain Equipment (continued)	Class Level			
	I	II	III	IV
Maintain Equipment				
Blowers, compressors and pneumatics	Comprehension	Application	Application	Application
Chemical feeders	Application	Application	Application	Application
Computers	Application	Application	Application	Application
Electronic testing equipment	Comprehension	Comprehension	Comprehension	Comprehension
Fittings	Comprehension	Comprehension	Comprehension	Comprehension
Generators	Comprehension	Comprehension	Comprehension	Comprehension
Hydraulic equipment		Comprehension	Comprehension	Comprehension
Instrumentation	Application	Application	Application	Application
Intake structure/well	Comprehension	Comprehension	Comprehension	Comprehension
Pipes	Comprehension	Comprehension	Comprehension	Comprehension
Prime movers/drives (engines and motors)	Comprehension	Comprehension	Comprehension	Comprehension
Valves	Comprehension	Comprehension	Comprehension	Comprehension
Water pumps	Application	Application	Application	Application
Water treatment filters	Comprehension	Application	Application	Application

Job Tasks Required to Operate and Maintain Equipment

- Calculate pump drawdown and pump efficiency
- Calibrate equipment
- Change oil/lubricate equipment
- Clean equipment
- Diagnose/troubleshoot equipment
- Evaluate and adjust equipment
- Interpret pump performance curves
- Maintain seals and bearings
- Monitor charts, meters and pressure gauges
- Perform cathodic protection
- Perform general maintenance
- Prime pumps
- Recognize potential backflow and cross-connection conditions
- Repack pumps
- Replace equipment
- Start up and shut down equipment
- Test for and repair leaks

Capabilities Required to Operate and Maintain Equipment

- Ability to differentiate between preventive and corrective maintenance
- Ability to discriminate between normal and abnormal operating conditions
- Knowledge of control systems
- Knowledge of drinking water treatment concepts
- Knowledge of facility operation and maintenance
- Knowledge of function of tools
- Knowledge of general electrical and mechanical principles
- Knowledge of hydraulic and pneumatic principles
- Knowledge of lubricant and fluid characteristics
- Knowledge of process control instrumentation

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Core Competencies (continued)

Perform Security, Safety and Administrative Procedures	Class Level			
	I	II	III	IV
Follow safety procedures related to				
Chemical handling	Application	Analysis	Analysis	Analysis
Confined space entry	Analysis	Analysis	Analysis	Analysis
Electrical hazards	Application	Application	Application	Application
Facility upset	Application	Application	Application	Application
Fire safety	Application	Application	Application	Application
Lock-out/tag-out	Application	Application	Application	Application
Pathogens	Application	Application	Application	Application
Personal protective equipment	Analysis	Analysis	Analysis	Analysis
Safety equipment	Application	Application	Application	Application
Spill response	Application	Application	Application	Application
Perform administrative procedures, such as				
Administer compliance and laboratory programs	Comprehension	Comprehension	Comprehension	Comprehension
Administer emergency preparedness, safety and security programs	Comprehension	Comprehension	Comprehension	Comprehension
Assign work to proper trade	Comprehension	Comprehension	Comprehension	Comprehension
Conduct training	Comprehension	Comprehension	Comprehension	Comprehension
Develop budget	Comprehension	Comprehension	Comprehension	Comprehension
Develop operation and maintenance plan	Comprehension	Comprehension	Comprehension	Comprehension
Develop written policies and procedures	Comprehension	Comprehension	Comprehension	Comprehension
Direct quality control programs		Comprehension	Comprehension	Comprehension
Order supplies/equipment	Comprehension	Comprehension	Comprehension	Comprehension
Perform basic math	Application	Application	Application	Application
Plan and organize work activities	Comprehension	Comprehension	Comprehension	Comprehension
Record and evaluate data	Analysis	Analysis	Analysis	Analysis
Respond to complaints	Application	Application	Application	Application
Review reports	Comprehension	Comprehension	Comprehension	Comprehension
Write regulatory authority reports	Application	Application	Application	Application

Capabilities Required to Perform Security, Safety and Administrative Procedures

- Ability to assess likelihood of emergencies occurring
- Ability to recognize unsafe work conditions
- Ability to translate technical language into common terminology
- Knowledge of emergency plans
- Knowledge of information storage and recovery systems
- Knowledge of local codes and ordinances
- Knowledge of Material Safety Data Sheets
- Knowledge of monitoring and reporting requirements
- Knowledge of potential causes and impact of abnormal facility conditions
- Knowledge of principles of finance
- Knowledge of principles of management
- Knowledge of principles of public relations
- Knowledge of public administration practices
- Knowledge of recordkeeping function and policies
- Knowledge of regulations
- Knowledge of reporting responsibilities
- Knowledge of risk management

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ABC Water Treatment Certification Exams

The ABC water treatment certification exams evaluate an operator's knowledge of tasks related to the operation of water treatment plants. The Water Treatment V&E Committee determined the content of each exam based on the results of the national job analysis. To pass an ABC exam, an operator must demonstrate knowledge of these core competencies. Because certificates may be used to work in various treatment plants, the exams may include technologies that are not used in each treatment plant but are commonly used in many treatment plants.

Four levels of certification exams are offered by ABC, with class I being the lowest level and class IV the highest level. The specifications for the exams are based on a weighting of the job analysis results so that they reflect the criticality of tasks performed on the job. The specifications list the percentage of questions on the exam that fall under each job duty. For example, 24% of the questions on the ABC class I exam relate to the job duty "Monitor, Evaluate and Adjust Treatment Processes." For a list of tasks and capabilities associated with each job duty, please refer to the list of core competencies on the previous pages.

ABC Water Treatment Exam Specifications

	Exam Level			
	Class I	Class II	Class III	Class IV
Monitor, Evaluate and Adjust Treatment Processes	24%	38%	43%	43%
Laboratory Analysis	16%	19%	16%	16%
Evaluate Characteristics of Source Water	5%	5%	5%	5%
Comply with Drinking Water Regulations	20%	15%	15%	15%
Operate and Maintain Equipment	24%	16%	15%	15%
Perform Security, Safety and Administrative Procedures	11%	7%	6%	6%

Suggested Water Treatment Exam References

The following are approved as reference sources for the ABC water treatment examinations. Operators should use the latest edition of these reference sources to prepare for the exam.

American Water Works Association (AWWA)

Principles and Practices of Water Supply Operations Series:
- *Water Sources*
- *Water Treatment*
- *Water Transmission and Distribution*
- *Water Quality*
- *Basic Science Concepts and Applications*

Other AWWA References:
- *Water Quality and Treatment*
- *Water System Security, A Field Guide*

To order, contact: American Water Works Association
6666 W Quincy Ave
Denver CO 80235

Web site: www.awwa.org
Phone: (800) 926-7337
Fax: (303) 347-0804
E-mail: custsvc@awwa.org

(continued)

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Suggested Water Treatment Exam References *(continued)*

Association of State Drinking Water Administrators (ASDWA) and National Rural Water Association (NRWA)

• *Security Vulnerability Self Assessment Guide for Small Drinking Water Systems*

To order, contact: ASDWA
1401 Wilson Blvd Ste 1225
Arlington VA 22209

Web site: www.asdwa.org (available online in PDF format; select "Program Areas," then "Security," then "Training and Tools")
Phone: (703) 812-9505
Fax: (703) 812-9506
E-mail: info@asdwa.org

California State University, Sacramento (CSUS) Foundation, Office of Water Programs

• *Water Treatment Plant Operation*, Volumes I and II
• *Manage for Success*

To order, contact: Office of Water Programs
California State University, Sacramento
6000 J St
Sacramento CA 95819-6025

Web site: www.owp.csus.edu
Phone: (916) 278-6142
Fax: (916) 278-5959
E-mail: wateroffice@owp.csus.edu

Regulations

For United States exams:

- *Code of Federal Regulations*, Title 40, Part 141 (www.gpo.gov)
- State regulations (contact information for state certification programs is available on the Certification Contacts page of ABC's web site, www.abccert.org)

For Canadian exams:

- *Guidelines for Canadian Drinking Water Quality*. Federal-Provincial-Territorial Subcommittee on Drinking Water. Ottawa, ON: Health Canada (www.hc-sc.gc.ca/waterquality)
- Provincial and territorial regulations (contact information for provincial/territorial certification programs is available on the Certification Contacts page of ABC's web site, www.abccert.org)

Study Guides

American Water Works Association, *Operator Certification Study Guide: A Guide to Preparing for Water Treatment and Distribution Operator Certification Exams* (www.awwa.org; complete contact information is on preceding page)

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ABC Need-to-Know Criteria for Distribution Operators

ABC
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Boards of Certification

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Acknowledgment

The Association would like to thank the members of the 2008 Distribution Validation and Examination Committee for their effort in conducting the job analysis and developing the *ABC Need-to-Know Criteria for Distribution Operators*. 2008 committee members included:

- Jess Jones, Cincinnati OH, Chair
- Martin Nutt, Little Rock, AR, ABC Distribution Division Director
- Tom Arnbrister, Shelton, WA
- Richard Bond, Florissant, CO
- Shawn Bradford, Goodyear, AZ
- Audrey Buchanan, Sydney, NS
- Cindy Cook, Santa Barbara, CA
- Russ Glaser, Vancouver, WA
- Wes Haskell, Bangor, ME
- Don Jackson, Ware Shoals, SC
- Ray Olson, Castle Rock, CO
- Thomas Rothermich, St. Louis, MO

Introduction

As part of the development of its certification exams, the Association of Boards of Certification (ABC) conducted a job analysis of water distribution operators in 2008. As part of this process, ABC conducted a national survey of distribution operators. This *Need-to-Know Criteria* was developed from the results of ABC's 2008 distribution operator job analysis.

How the *Need-to-Know* Criteria Was Developed

Review of Task Survey
The results of the 2008 task survey were provided to the ABC Distribution V&E Committee. In the task survey, operators rated job tasks and capabilities for frequency of performance and seriousness of inadequate or incorrect performance. These two rating scales were used because they provide useful information (i.e., how critical each task is and how frequently each task is performed) pertaining to certification. Of the 147 operators who completed the survey, 23% were class I operators, 37% were class II operators, 23% were class III operators, and 17% were class IV operators.

Committee Ratings
The Distribution V&E Committee met in September 2008 to begin development of the new *Need-to-Know Criteria*. During their meeting, the committee rated the job tasks and capabilities found in the job analysis as essential, useful or not need-to-know and identified the level of knowledge (i.e., comprehension, application, analysis) required by operators for each task.

Analysis of Ratings
The committee ratings were combined with the operator ratings from the task survey to form a composite criticality rating. The composite criticality ratings and percentage of operators reporting that they performed the tasks were used to determine what is covered on each level of certification exam.

Core Competencies

The essential tasks and capabilities that were identified through this process are called the core competencies. The following pages list the core competencies for distribution operators. The core competencies are clustered into the following job duties:

- System Design
- Monitor, Evaluate and Adjust Disinfection
- Comply with Drinking Water Regulations
- Water Quality Parameters and Sampling
- System Inspection
- Install Equipment
- Operate Equipment
- Evaluate and Maintain Equipment
- Perform Security, Safety and Administrative Duties

The level of knowledge (i.e., comprehension, application, analysis) required for each task is also identified in the following pages.

- **Comprehension** is the most basic level of understanding and remembering. Items written at the comprehension level require examinees to recognize, remember, or identify important ideas.
- Items written at the **application** level require examinees to interpret, calculate, predict, use or apply information and solve problems.
- Items written at the **analysis** level require examinees to compare, contrast, diagnose, examine, analyze, and relate important concepts.

The level of knowledge is a hierarchy from basic comprehension to analysis. The level of knowledge tested is cumulative. Therefore, tasks identified as application may include questions written at both the application and comprehension levels. Tasks identified as analysis may include questions written at the comprehension, application and analysis levels.

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Core Competencies for Distribution Operators

System Design	Class I	Class II	Class III	Class IV
Assess system demand	Comprehension	Comprehension	Comprehension	Comprehension
Select materials		Comprehension	Comprehension	Comprehension
System layout		Comprehension	Comprehension	Comprehension
Write plans		Comprehension	Comprehension	Comprehension
System map	Comprehension	Comprehension	Comprehension	Comprehension
Perform pressure readings	Comprehension	Comprehension	Comprehension	Comprehension
Select type of pipes	Comprehension	Comprehension	Comprehension	Comprehension
Wells	Comprehension	Comprehension	Comprehension	Comprehension
Read blueprints, readings, and maps	Comprehension	Comprehension	Comprehension	Comprehension
Install shoring	Comprehension	Application	Application	Analysis
Install joint restraints	Comprehension	Application	Application	Analysis
Install thrust blocks	Comprehension	Application	Application	Analysis

Required Capabilities:

- Ability to adjust equipment
- Ability to diagnose/troubleshoot system units
- Ability to discriminate between normal and abnormal conditions
- Ability to inspect pumps
- Ability to monitor electrical and mechanical equipment
- Knowledge of cathodic protection
- Knowledge of types of joints, restraints and thrust blocks
- Knowledge of fireflow requirements
- Knowledge of general electrical, hydraulic and mechanical principles
- Knowledge of measuring instruments
- Knowledge of piping material, type and size
- Knowledge of pneumatics
- Knowledge of regulations
- Knowledge of standards
- Knowledge of start-up and shut down procedures
- Knowledge of testing instruments
- Knowledge of water reuse
- Knowledge of watershed management
- Knowledge of well drilling principles
- Knowledge of well-head protection

Monitor, Evaluate and Adjust Disinfection	Class I	Class II	Class III	Class IV
Monitor chlorine disinfection	Comprehension	Comprehension	Comprehension	Comprehension
Evaluate chlorine disinfection	Analysis	Analysis	Analysis	Analysis
Adjust chlorine disinfection	Application	Application	Application	Application

Required Capabilities:

- Ability to adjust flow patterns
- Ability to diagnose, troubleshoot and adjust system units
- Ability to evaluate and maintain system units
- Ability to perform basic math
- Knowledge of general chemistry and physical science
- Knowledge of general electrical and hydraulic principles
- Knowledge of principles of measurement
- Knowledge of regulations

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Core Competencies (Continued)

Comply with Drinking Water Regulations	Class I	Class II	Class III	Class IV
United States Exams – Code of Federal Regulations, Title 40, Part 141 – National Primary Drinking Water Regulations:				
Subpart A - General definitions	Comprehension	Comprehension	Comprehension	Comprehension
Subpart B - Maximum contaminant levels	Comprehension	Comprehension	Comprehension	Comprehension
Subpart C - Monitoring and analytical requirements	Comprehension	Comprehension	Comprehension	Comprehension
Subpart D - Reporting and recordkeeping	Comprehension	Comprehension	Comprehension	Comprehension
Subpart I - Control of lead and copper	Comprehension	Comprehension	Comprehension	Comprehension
Subpart Q - Public notification of drinking water violations	Comprehension	Comprehension	Comprehension	Comprehension
Canadian Exams				
Provincial and territorial regulations	Comprehension	Comprehension	Comprehension	Comprehension

Water Quality Parameters and Sampling	Class I	Class II	Class III	Class IV
Chlorine demand	Application	Application	Application	Analysis
Chlorine residual	Application	Application	Application	Analysis
pH	Application	Application	Application	Analysis
Temperature	Application	Application	Application	Analysis
Turbidity	Application	Application	Application	Analysis

Required Capabilities:

- Ability to calibrate instruments
- Ability to follow written procedures
- Ability to interpret Material Safety Data Sheets
- Ability to perform and interpret laboratory analyses
- Ability to perform basic math
- Ability to recognize normal and abnormal analytical results
- Knowledge of general chemistry and physical science
- Knowledge of laboratory equipment
- Knowledge of normal characteristics of water
- Knowledge of principles of measurement
- Knowledge of proper chemical handling and storage
- Knowledge of proper sampling procedures
- Knowledge of public notification requirements
- Knowledge of quality control/quality assurance practices
- Knowledge of regulations
- Knowledge of reporting requirements

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Core Competencies (Continued)

System Inspection	Class I	Class II	Class III	Class IV
Cross-connection surveys	Comprehension	Comprehension	Application	Application
Sample site plan	Comprehension	Comprehension	Application	Application

Required Capabilities:

- Ability to communicate verbally and in writing
- Ability to discern between normal and abnormal conditions
- Knowledge of hydrology
- Knowledge of monitoring requirements
- Knowledge of proper sampling procedures and requirements
- Knowledge of sanitary survey process
- Knowledge of well-head protection
- Knowledge of safety procedures

Install Equipment	Class I	Class II	Class III	Class IV
Hydrants	Comprehension	Application	Application	Application
Meters	Comprehension	Application	Application	Application
Service piping	Comprehension	Application	Application	Application
Service connections	Comprehension	Application	Application	Application
Shoring	Comprehension	Application	Application	Application
Taps	Comprehension	Application	Application	Analysis
Valves	Comprehension	Application	Application	Analysis
Water mains	Comprehension	Application	Application	Analysis

Required Capabilities:

- Ability to follow written procedures
- Knowledge of backflow prevention assemblies and methods
- Knowledge of facility operation and maintenance
- Knowledge of function of tools
- Knowledge of pipe fittings and joining methods
- Knowledge of piping material, type and size
- Knowledge of regulations
- Knowledge of start-up and shut-down procedures
- Knowledge of well drilling principles

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Core Competencies (Continued)

Operate Equipment	Class I	Class II	Class III	Class IV
Blowers and compressors	Comprehension	Comprehension	Comprehension	Comprehension
Centrifugal pumps	Comprehension	Comprehension	Comprehension	Analysis
Chlorinators	Comprehension	Comprehension	Application	Application
Computers	Comprehension	Comprehension	Comprehension	Comprehension
Electric motors	Comprehension	Comprehension	Comprehension	Comprehension
Electronic testing equipment	Comprehension	Comprehension	Comprehension	Comprehension
Generators	Comprehension	Comprehension	Comprehension	Comprehension
Hand tools	Comprehension	Comprehension	Comprehension	Comprehension
Heavy vehicles	Comprehension	Comprehension	Comprehension	Comprehension
Hydrants	Comprehension	Application	Application	Application
Instrumentation	Comprehension	Comprehension	Comprehension	Comprehension
Leak correlators/detectors	Comprehension	Application	Application	Application
Pipe locators	Comprehension	Application	Application	Application
Positive-displacement pumps	Comprehension	Application	Application	Analysis
Power tools	Comprehension	Comprehension	Comprehension	Comprehension
Remote terminal units (RTU)	Comprehension	Comprehension	Comprehension	Comprehension
Samplers	Comprehension	Comprehension	Comprehension	Comprehension
SCADA system	Comprehension	Comprehension	Comprehension	Comprehension
Tapping equipment	Comprehension	Application	Application	Analysis
Telemetry system	Comprehension	Comprehension	Comprehension	Comprehension
Valve locators	Comprehension	Comprehension	Comprehension	Comprehension
Valves	Comprehension	Comprehension	Comprehension	Comprehension

Required Capabilities:

- Ability to evaluate and adjust equipment
- Ability to discriminate between normal and abnormal conditions
- Ability to monitor electrical and mechanical equipment
- Knowledge of data acquisition techniques
- Knowledge of function of tools
- Knowledge of general electrical, hydraulic and mechanical principles
- Knowledge of regulations
- Knowledge of safety procedures and emergency plans
- Knowledge of start-up and shut-down procedures

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Core Competencies (Continued)

Evaluate and Maintain Equipment	Class I	Class II	Class III	Class IV
Evaluate Operation of Equipment				
Check speed of equipment	Comprehension	Comprehension	Application	Analysis
Inspect equipment for abnormal conditions	Comprehension	Comprehension	Comprehension	Comprehension
Measure temperature of equipment	Comprehension	Comprehension	Comprehension	Comprehension
Read charts	Comprehension	Comprehension	Comprehension	Comprehension
Read gauges	Comprehension	Comprehension	Comprehension	Comprehension
Read meters	Comprehension	Comprehension	Comprehension	Comprehension
Maintain Equipment				
Backflow prevention methods and assemblies	Comprehension	Application	Application	Analysis
Blowers and compressors	Comprehension	Comprehension	Comprehension	Comprehension
Cathodic protection devices	Comprehension	Comprehension	Comprehension	Application
Chlorinators	Comprehension	Application	Application	Application
Corrosion control	Comprehension	Comprehension	Comprehension	Application
Electric motors	Comprehension	Comprehension	Comprehension	Comprehension
Fittings	Comprehension	Comprehension	Application	Application
Generators	Comprehension	Comprehension	Comprehension	Comprehension
Hydrants	Comprehension	Application	Application	Analysis
Hydraulic equipment	Comprehension	Comprehension	Comprehension	Application
Instrumentation	Comprehension	Comprehension	Comprehension	Comprehension
Pipe Joints	Comprehension	Application	Application	Application
Leak detection programs	Comprehension	Comprehension	Comprehension	Comprehension
Meters	Comprehension	Application	Application	Analysis
Service pipes	Comprehension	Comprehension	Application	Application
Pressure sensors instruments	Comprehension	Comprehension	Comprehension	Comprehension
Pumps	Comprehension	Comprehension	Application	Application
Service connections	Comprehension	Application	Application	Analysis
Valves	Comprehension	Application	Application	Analysis
Water mains	Comprehension	Application	Application	Analysis
Water storage facility	Comprehension	Application	Application	Analysis

Required Capabilities:

- Ability to assign work to proper trade
- Ability to calibrate equipment
- Ability to diagnose/troubleshoot equipment
- Ability to differentiate between preventive & corrective maintenance
- Ability to discriminate between normal and abnormal conditions
- Ability to follow written procedures
- Ability to order necessary spare parts
- Ability to perform general maintenance
- Ability to record information
- Knowledge of backflow prevention, methods and assemblies
- Knowledge of corrosion control process
- Knowledge of dechlorination process
- Knowledge of different types of cross-connections
- Knowledge of disinfection process
- Knowledge of facility operation and maintenance
- Knowledge of general electrical, hydraulic and mechanical principles
- Knowledge of pipe fittings and joining methods
- Knowledge of piping material, type and size
- Knowledge of pneumatics
- Knowledge of protective coatings and paints
- Knowledge of regulations and standards
- Knowledge of start-up and shut-down procedures

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Core Competencies (Continued)

Perform Security, Safety and Administrative Duties				
	Class I	Class II	Class III	Class IV
Perform security and safety procedures related to:				
Chemical handling	Application	Application	Application	Application
Confined space entry	Application	Application	Application	Application
Electrical grounding	Application	Application	Application	Application
Excavation	Application	Application	Application	Application
Facility inspection	Application	Application	Application	Application
Fire safety	Application	Application	Application	Application
Lifting	Application	Application	Application	Application
Lock-out/tag-out	Application	Application	Application	Application
Personal protection equipment	Application	Application	Application	Application
Public protection	Application	Application	Application	Application
Shoring	Application	Application	Application	Application
Slips, trips, and falls	Application	Application	Application	Application
Tailgate safety session	Application	Application	Application	Application
Terrorism	Application	Application	Application	Application
Traffic/work zone	Application	Application	Application	Application
Trenching	Application	Application	Application	Application
Contamination	Comprehension	Comprehension	Application	Application
Facility upset	Comprehension	Comprehension	Application	Application
Natural disaster	Comprehension	Comprehension	Application	Application
Power outage	Comprehension	Application	Application	Application
Spill response	Comprehension	Comprehension	Application	Analysis
Vandalism	Comprehension	Comprehension	Comprehension	Comprehension
Perform administrative procedures, such as:				
Administer safety & compliance program	Comprehension	Comprehension	Comprehension	Comprehension
Develop budget	Comprehension	Application	Application	Application
Develop operation and maintenance plan	Comprehension	Application	Application	Application
Organize work activities	Comprehension	Comprehension	Comprehension	Comprehension
Plan work activities	Comprehension	Analysis	Analysis	Analysis
Train employees	Comprehension	Comprehension	Comprehension	Comprehension
Write internal reports	Comprehension	Comprehension	Comprehension	Comprehension
Write state/provincial reports	Analysis	Analysis	Analysis	Analysis
Make oral presentations	Comprehension	Comprehension	Comprehension	Comprehension
Respond to complaints	Comprehension	Comprehension	Comprehension	Comprehension
Restore private property	Comprehension	Comprehension	Comprehension	Comprehension
Restore traffic	Comprehension	Comprehension	Comprehension	Comprehension

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Core Competencies (Continued)

Perform Security, Safety and Administrative Duties (continued)				
	Class I	Class II	Class III	Class IV
Promote customer service program	Comprehension	Comprehension	Comprehension	Comprehension
Promote media relations program				Comprehension
Promote public information program	Comprehension	Comprehension	Comprehension	Comprehension

Required Capabilities:

- Ability to assess likelihood of disaster occurring
- Ability to communicate verbally and in writing
- Ability to conduct meetings and training programs
- Ability to coordinate emergency response with other organizations
- Ability to demonstrate safe work habits and identify potential safety hazards/unsafe work conditions
- Ability to develop a staffing plan and work unit
- Ability to evaluate facility performance
- Ability to organize information and follow written procedures
- Ability to generate written safety procedures and capital plans
- Ability to interpret data and review reports
- Ability to interpret Material Safety Data Sheets
- Ability to obtain unbiased data
- Ability to perform basic math
- Ability to perform impact assessments
- Ability to prepare and evaluate proposals
- Ability to select and operate safety equipment
- Ability to translate technical language into common terminology
- Knowledge of emergency plans
- Knowledge of facility operation and maintenance practices
- Knowledge of local codes and ordinances
- Knowledge of memorandums of understanding and agreements
- Knowledge of monitoring and reporting requirements
- Knowledge of policies and procedures
- Knowledge of potential causes of disasters in facility
- Knowledge of principles of finance
- Knowledge of principles of general communication
- Knowledge of principles of management
- Knowledge of principles of public relations
- Knowledge of public notification requirements and public participation process
- Knowledge of record keeping policies
- Knowledge of regulations
- Knowledge of risk management
- Knowledge of safe Drinking Water Act
- Knowledge of safety procedures

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ABC Distribution Certification Exams

The ABC distribution certification exams evaluate an operator's knowledge of tasks related to the operation of distribution systems. The ABC Distribution V&E Committee determined the content of each exam based on the results of the national job analysis. To successfully take an ABC exam, an operator must demonstrate knowledge of the core competencies in this document.

Four levels of certification exams are offered by ABC, with class I being the lowest level and class IV the highest level. The specifications for the exams are based on a weighting of the job analysis results so that they reflect the criticality of tasks performed on the job. The specifications list the percentage of questions on the exam that fall under each job duty. For example, 7 to 10% of the questions on the ABC class I exam relate to "System Design." For a list of tasks and capabilities associated with each job duty, please refer to the list of core competencies on the previous pages.

ABC Distribution Exam Specifications

	Exam Level			
	Class I	Class II	Class III	Class IV
System Design	7% - 10%	10% -13%	13% - 16%	15% - 18%
Monitor, Adjust & Evaluate Disinfection	5%	5%	5%	5%
Comply with Drinking Water Regulations	10% - 13%	10% - 13%	10% - 13%	10% - 13%
Water Quality Parameters & Sampling	12% - 15%	12% - 15%	12% - 15%	12% - 15%
System Inspection	5%	5%	5%	5%
Install Equipment	11% - 14%	9% - 12%	9% - 12%	6%- 9%
Operate Equipment	15% - 18%	16% - 19%	13% - 16%	13% - 16%
Evaluate & Maintain Equipment	14% - 17%	12% - 15%	7% - 10%	5%
Perform Security, Safety & Administrative Duties	12% - 15%	12% - 15%	17% - 20%	20% - 23%

Suggested Distribution Exam References

The following are approved as reference sources for the ABC distribution examinations. Operators should use the latest edition of these reference sources to prepare for the exam.

American Water Works Association (AWWA)

- *Water Transmission and Distribution*
- *Water Distribution Operator Training Handbook*
- *Basic Science Concepts and Applications*
- *Water System Security, A Field Guide*
- *Water Quality*

To order, contact: American Water Works Association
6666 West Quincy Ave.
Denver, CO 80235
Web site: www.awwa.org
Phone: (800) 926-7337
Fax: (303) 347-0804
E-mail: custsvc@awwa.org

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Association of State Drinking Water Administrators (ASDWA) and National Rural Water Association (NRWA)

- *Security Vulnerability Self Assessment Guide for Small Drinking Water Systems*

To order, contact: ASDWA
1025 Connecticut Ave NW Ste 903
Washington DC 20036
Available online in PDF format (select .Security.):
Web site: www.asdwa.org
Phone: (202) 293-7655
Fax: (202) 293-7656
E-mail: info@asdwa.org

California State University, Sacramento (CSUS) Foundation, Office of Water Programs

- *Water Distribution System Operation and Maintenance*
- *Small Water System Operation and Maintenance*
- *Manage for Success*

To order, contact: Office of Water Programs
California State University, Sacramento
6000 J Street
Sacramento, CA 95819-6025
Web site: www.owp.csus.edu
Phone: (916) 278-6142
Fax: (916) 278-5959
E-mail: wateroffice@owp.csus.edu

Regulations

For United States exams:

- *Code of Federal Regulations*, Title 40, Part 141 (www.gpo.gov)
- State regulations (contact information for state certification programs is available on the Certification Contacts page of ABC.s web site, www.abccert.org)

For Canadian exams:

- *Guidelines for Canadian Drinking Water Quality*. Federal-Provincial-Territorial Subcommittee on Drinking Water. Ottawa, ON: Health Canada (www.hc-sc.gc.ca/waterquality)
- Provincial and territorial regulations (contact information for provincial/territorial certification programs is available on the Certification Contacts page of ABC.s web site, www.abccert.org)

Study Guides

American Water Works Association, *Operator Certification Study Guide: A Guide to Preparing for Water Treatment and Distribution Operator Certification Exams* (www.awwa.org; complete contact information is on preceding page)

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Attachment B: Course Catalog

Tap Into Training
A Course Catalog of Colorado's Drinking Water-Related Training Events