A Survey of Key States' Regulatory Approaches to Water Reuse

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Acknowledgments

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1. Abbreviations

afy = acre-feet per year
BMP = best management practice
BOD_5 = biological oxygen demand over 5 days
CA SWB = California State Water Resources Control Board
$CBOD_5$ = carbonaceous biological oxygen demand over 5 days
CCR = California Code of Regulations
CDPHE = Colorado Department of Public Health and Environment
Cl = chlorine
CWA = Clean Water Act
CWCB = Colorado Water Conservation Board
DEP = Department of Environmental Protection
DEQ = Department of Environmental Quality
DO = dissolved oxygen
F.A.C = Florida Administrative Code
F.S. = Florida Statutes
Crypto = Cryptosporidium
IDAPA = Idaho Administrative Code
mgd = million gallons per day
mg-min/L = milligrams-minutes per liter
mg/l = milligrams per liter
MPN = most probable number
NOA = Notice of Authorization
NPDES = National Pollutant Discharge Elimination System
NTU = nephelometric turbidity units
NWRI = National Water Research Institute
OAR = Oregon Administrative Rules
PPAB = Pollution Prevention Advisory Board (Colorado, CDPHE)
RCW = Revised Code of Washington
Regional Boards = California Regional Water Quality Control Boards
Regulation 84 = WQCC Reclaimed Water Control Regulation 84
RO = reverse osmosis
SDWA = Safe Drinking Water Act
State Water Board = California State Water Resources Control Board
s.u. = standard unit
Total N = total nitrogen
Total P = total phosphorus
TSS = Total suspended solids
US EPA = U.S. Environmental Protection Agency
WE&RF = Water Environment & Research Foundation
WQCC = Water Quality Control Commission (Colorado)
WQCD = Water Quality Control Division (Colorado)
WQP = WQCC Water Quality Policy
WRCO = WateReuse Colorado
WWTF = wastewater treatment facility

2. Introduction

Colorado has a long history of beneficial water reuse, beginning with projects that were implemented in the 1950s. Over time non-potable reuse has grown to where there are now 27 reclaimed water treaters and nearly 500 reclaimed water users. In 2000, the Colorado Department of Public Health and Environment (CDPHE) Water Quality Control Commission (WQCC) promulgated reuse regulations that were initially limited to using reclaimed water for landscaping. Since then there have been four additional rulemakings and the number of approved uses for reclaimed water has grown.

Non-potable reuse[1] in Colorado is regulated under the WQCC Reclaimed Water Control Regulation 84 (Regulation 84), the purpose of which is to "establish requirements, prohibitions, standards and concentration limits for the use of reclaimed water to protect public health and the environment while encouraging the use of reclaimed water."[2] Regulation 84 defines reclaimed water as "domestic wastewater that has received secondary treatment by a domestic wastewater treatment works and such additional treatment as to enable the wastewater to meet the standards for approved uses". Regulation 84 applies to individual reclaimed water treaters (producers) and users with a WQCD Notice of Authorization (NOA) which is equivalent to a certification. Treated wastewater effluent that has been discharged to state waters, even if subsequently captured and reused downstream, and treated wastewater used at a wastewater treatment plant for irrigation or process uses are exempt or not covered under this regulation.

There is interest in the WQCD, the regulated community, state water planners, and other stakeholders, to increase opportunities for reuse under Regulation 84 while ensuring protection of public health and the environment. While there are many approved uses of reclaimed water in Colorado, historically much has been used for irrigation. To increase reuse opportunities, several new uses for reclaimed water are being proposed, including: (1) indoor toilet and urinal flushing; (2) commercial irrigation of edible crops for human consumption; (3) livestock wash-down uses; and (4) non-commercial irrigation of edible crops for human consumption. The WQCD has also expressed interest in considering broader changes to Colorado's regulatory framework that may better facilitate additional reuse while ensuring recycled water is appropriately treated and distributed to ensure protection of public health and the environment.

This white paper documents the information from a survey of several state reuse programs, with a focus on treatment and water quality requirements and allowed uses. States surveyed were identified in collaboration with the WQCD and WateReuse Colorado members and include California, Colorado, Florida, Idaho, Oregon, and Washington. State' processes for evaluating proposed new uses for reclaimed water, and regulatory agency staffing and funding are also addressed. It is important to note that any references to statutes, rules, regulations, or guidance in this document should not be substituted for reference of the primary documents.

[1] Non-potable graywater use is regulated separately under WQCC Regulation 86 Graywater Control Regulation and is not the topic of this research. In Colorado graywater is wastewater that is collected from bathroom and laundry room sinks, bathtubs, showers, and laundry machines in residential, commercial or industrial buildings or institutional facilities and reused onsite.

[2] CO WQCC, 2013

3. Project Scope

Regulating reuse of reclaimed water (treated wastewater) is complex and can encompass regulations, policies and guidance. Each state is unique and has its own drivers and legal and regulatory framework in which the use of recycled water can occur. This project is intended to for use by Colorado's reclaimed water regulators and water treaters and to help inform upcoming WQCC Regulation 84 water quality rulemakings.

Unlike many other water quality regulations, there are no federal reuse regulations to serve as the basis for state regulations. States interested in reuse must develop their own frameworks which has resulted in widely varying structure and content of regulations. The scope of this project is focused on recycled water classes or categories, treatment and water quality requirements, and approved uses of reclaimed water. While critical to ensuring a safe and effective reuse program, topics not addressed include: treatment facility siting, design and construction; facility operations and maintenance; operator certification and training; engineering, site management and other plans; permitting; compliance; record keeping and reporting; setbacks; signage; plumbing specifications; industrial pretreatment; monitoring (except as included with water quality requirements); storage; and reliability and redundancy. Additionally, some states' reuse regulations include graywater use, groundwater recharge, aquifer storage and recovery, indirect potable reuse and surface water augmentation. In Colorado such uses, as well as industrial wastewater, are regulated outside of Regulation 84 and are not addressed in this paper.

Under Colorado water law, the reuse of reclaimed municipal wastewater allowed under Regulation 84 can only occur utilizing water supplies that are legally reusable, or fully consumable[3]. As a result, only those communities and water rights holders with legally reusable water supplies can implement a reclaimed water program and only the reusable portion of their supplies can be reused. Many communities along Colorado's Front Range, where the majority of the state's population lives and where the greatest growth is projected to occur, own legally reusable water as part of their water supply portfolios. All reuse in Colorado, as discussed in this paper, must comply with Colorado water law.

4. State Support for Reuse

Drivers for reuse vary among and within states. Frequent motivators include drought resiliency, addressing water scarcity, increasingly stringent effluent discharge requirements, cost-competitiveness, and resource sustainability. As an inland state with a rapidly growing population and limited new water supply options, reuse is an increasingly cost-competitive means of stretching water supplies in Colorado to meet greater demands. In contrast, Florida is a coastal state, but it also has water supply concerns. In Florida significant concerns about environmental impacts to groundwater and coastal waters have led to mandatory reductions in effluent discharges through ocean outfalls, helping drive reuse in that state. While specific drivers among may vary, all states surveyed are experiencing a growing interest in reuse, including potable water reuse.

Mindsets have changed over time such that appropriately treated wastewater is considered a resource rather than a waste to be disposed of. In addition to providing the regulatory framework within which

[3] Under Colorado state law, legally reusable water sources can be used to extinction and may include transbasin diversions, transferred consumptive use, nontributary groundwater, and other decreed reusable supplies.

reuse may occur, which often includes the goal or purpose of encouraging or promoting reuse, some states go further to advance reuse, including the following examples:

- The 2015 Colorado Water Plan recognizes the important role reuse will play in meeting Colorado's supply and demand gap and specifically calls for state agencies to identify potential regulatory changes that foster permanent growth in reuse while protecting public health and the environment (CWCB, 2015).
- The California State Water Board's Recycled Water Policy established a mandate "to increase the use of recycled water in California by 200,000 afy [acre-feet/year] by 2020 and by an additional 300,000 afy by 2030". (CA SWB, 2013) The state is currently revising this goal, which helps guide state agencies.
- Florida has the following state requirements that have led to increased reuse:
    - Florida's reuse regulations require utilities serving or discharging within water resource caution areas (areas that have or are projected to have critical water supply problems) to complete a reuse a feasibility study (F.A.C. 62-610.820).
    - Florida's Antidegradation Policy (F.A.C. 62-4 and 62-302) prohibits new or expanded surface water discharges from domestic wastewater treatment facilities (WWTF) unless it can be shown that the discharge is "clearly in the public interest" or that reuse is infeasible.
    - The state's ocean outfall legislation (F.S. Section 403.086(9)(c)1) contains a prohibition on new ocean outfall discharges, requires advanced treatment for existing outfalls by 2018, and requires that existing facilities reuse a minimum of 60 percent of ocean discharges for beneficial purposes by the by the end of 2025.
    - Florida releases a detailed Annual Reuse Inventory report (FL DEP, 2016) that documents how much water is used, by which entity, for what uses, and where.
    - Senate Bill 536 required "DEP [Department of Environmental Protection], in coordination with stakeholders shall conduct a comprehensive study and submit a report on the expansion of use of reclaimed water, stormwater, and excess surface water in this state." The 2015 SB536 Final Report identified numerous specific recommendations to reduce impediments and increase reuse in Florida.
- Idaho's Recycled Water Rules (IDAPA 58.01.17 Section 100.03) including a policy "to promote, where appropriate, the practice of reuse of both municipal and industrial recycled water through the continued creation and implementation of rules and guidance that give permittees various opportunities for new forms of reuse." Among other actions to support reuse, the Water Quality Division of the Department of Environmental Quality organizes an annual reuse conference that is well attended by regulators and others in the reuse community from Idaho and throughout the West.
- Washington state statutes (RCW Chapter 90.46) and associated administrative code encourage and support the use of reclaimed water and requires that regional water supply and potable water supply plans consider reuse.
- Oregon's reuse regulations include the policy "to encourage the use of recycled water for domestic, agricultural, industrial, recreational, and other beneficial purposes in a manner which protects public health and the environment of the state" (OAR 340-055-007). In 2005, the

governor issued an Executive Order (No. 05-04) that recognized the important of reuse and ordered the state to promote policies and programs to encourage and support reuse.

States can play a clear role in encouraging water reuse through a variety of means including policies, legislation, information sharing, water stakeholder outreach, and more.

5. Regulatory Overview

The federal government does not have reuse specific regulations, though it released guidance on the topic in 2012 with the United States Environmental Protection Agency's (US EPA) *Guidelines for Water Reuse* (US EPA, 2012). States must develop and administer their own programs for safely reusing reclaimed water, relying on the existing frameworks of the federal Clean Water Act (CWA) and Safe Drinking Water Act (SDWA). The CWA regulates discharges of pollutants into waters of the United States and provides the authority under which wastewater standards are set. Treated wastewater discharge permits are issued pursuant to the National Pollutant Discharge Elimination System (NPDES) program under the CWA, under which some states issue permits for reclaimed water use. The SDWA protects drinking water sources including rivers, lakes, reservoirs, springs and groundwater. When reclaimed water may impact drinking water sources, the SDWA is applicable. Where reclaimed water is used to recharge groundwater, the Underground Injection Control (UIC) program stipulates requirements. In addition to complying with the CWA and SDWA, water reuse regulations must ensure reclaimed water is appropriate for the intended use and is protective of end users, utility workers, the general public, and the environment.

The content and organization of reuse regulatory frameworks are diverse. In some, various components of reuse are regulated via multiple regulations; in others, the regulations are more consolidated. Some states include extremely detailed requirements in their regulations while other states rely on guidance and policy documents. Lead regulatory agencies and key regulations[4] for the five states surveyed and Colorado are listed in Table 1. While this model is used elsewhere in the U.S.[5], Washington is unique among the states surveyed because their 1997 Water Reclamation and Reuse Standards are the only standards in Table 1 that have not been codified, serving as guidelines for the state that relies on its NPDES permitting authority to issue reuse permits.

[4] Other agencies, regulations, statutes, policies, and guidance may also have roles in regulating and implementing reuse.

[5] Per the US EPA *Guidelines for Water Reuse* (US EPA, 2012), states relying on guidelines to oversee reuse, either directly or incidentally, rather than regulations include Alabama, Georgia, Hawaii, Kansas, Maryland, Minnesota, New Jersey, New Mexico, North Dakota, Ohio, Pennsylvania, Rhode Island, South Dakota, Tennessee, and Washington.

Table 1: State Agencies and Regulations

State	Primary Regulating Agency/Agencies	Primary Regulations, Policies
Colorado	Colorado Department of Public Health and Environment Water Quality Control Commission (WQCC)	WQCC Regulation No. 84 Reclaimed Water Control Regulation
		WQCC Water Quality Policy (WQP) - 25 Monitoring and Reporting Requirements for Reclaimed Water Treatment Facilities
		WQCC Regulation #62 Regulations for Effluent Limitations
California	State Water Resources Control Board (State Water Board) and Regional Water Quality Control Boards (Regional Boards)	Uniform Statewide Recycling Criteria: California Code of Regulations, Title 22, Division 4, Chapter 3 [Sections 60001 - 60355]
		California Code of Regulations, Title 17, Division 1, Chapter 5 [Sections 7583 – 7586, Sections 7601 – 7605]
		State Water Board Recycled Water Policy
Florida	Department of Environmental Protection (DEP)	F.A.C. 62-610 Reuse of Reclaimed Water and Land Application
		F.A.C. 62-600.440 Disinfection Requirements and 62-600.445 pH Requirements
Idaho	Department of Environmental Quality (DEQ)	IDAPA 58.01.17 - Recycled Water Rules
Oregon	Department of Environmental Quality	OAR 340-055-0005 to OAR 340-055-0030 Recycled Water Use
Washington	Department of Ecology and Department of Health	RCW 90.46 Reclaimed Water
		Water Reclamation and Reuse Standards. Publication #97-23 [uncodified guidance]
		Draft rules anticipated to become effective in 2018: DRAFT 173-219 WAC Reclaimed Water Rules and DRAFT Reclaimed Water Facilities Manual: The Purple Book

The follow summarizes how each state approaches, staffs and funds reuse based on the regulations, rules, guidance and policy in Table 1 and information collected during phone calls with state regulators[6] in late May and Early June of 2017.

Colorado

When Colorado Regulation 84 was first adopted in 2000, landscape irrigation was the main reclaimed water use of interest at the time. Since then, there have been four additional rulemakings and another is scheduled to begin later this year. In the most recent rulemaking in 2013, the WQCC established several broader categories of uses to encompass similar use types. One example of this is the "Non-Discharging Construction and Road Maintenance" into which earlier "Dust Control", "Soil Compaction", "and Mechanized Street Sweeping" uses were incorporated. Currently Denver Water is proposing

[6] CO WQCD, 2017; CA SWB, 2017; FL DEP, 2017; ID DEQ, 2017; OR DEQ 2017; and WA Dept. of Ecology, 2017

several new types of reuse for Colorado, including edible crop irrigation, toilet and urinal flushing, and livestock wash-down and an upcoming rulemaking is scheduled for August 2018. While not required by statute, typically new uses in Colorado are proposed by reclaimed water treaters, who lead stakeholder and rulemaking processes, with the WQCD serving in advisory and review roles.

The WQCD implements the requirements of Regulation 84. Colorado currently has 27 reclaimed water treaters and 492 users. This is a substantial increase over the past decade, which began with approximately 100 users. Over that time WQCD staffing for reclaimed water has not increased significantly. Until recently, the state had the equivalent of one full time employee dedicated to reclaimed water, divided between permitting and compliance. Funding for Colorado's reclaimed water program comes from Colorado general funds, approved each year by the legislature, and from reclaimed water permit fees charged to treaters and established by statute. In 2017, Colorado assembled a one-time funding package from the Colorado Water Conservation Board and the Colorado Water Resources and Power Development Authority to create a three-year term-limited position. The primary goals and responsibilities of this position involve working on reuse regulations, helping to facilitate stakeholder meetings for the upcoming rulemaking hearing, and ensuring the new proposed uses of reclaimed water are safe for public health and the environment.

California

Water recycling in California is regulated by the State Water Resources Control Board (State Water Board) and nine Regional Water Quality Control Boards (Regional Boards). Prior to 2014, reuse was under the jurisdiction of the Department of Public Health. In that year, the state's Drinking Water Program, which administers recycled water use, was transferred from the Department of Public Health to the State Water Board (CA SWB, 2015b).

The State Water Board develops state regulations and policies that control reuse and they oversee the Regional Boards. The State Water Board ensures reuse projects are protective of public health and provides guidance and input to the Regional Boards on permit conditions. The Regional Boards are the local wastewater and reuse permitting and compliance authority. In 2016 a General Order (CA SWB, 2016) was implemented to streamline permitting of reuse projects. The Regional Board permitting process includes a formal board review of projects, which can be lengthy with significant delays if a review cycle is missed. The General Order allows faster and more streamlined permitting, without diminishing application requirements.

Three years ago California had only one reuse regulator at the state level. There are currently five staff dedicated to reuse. Three additional senior staff provide technical guidance as needed. A driver for this investment in resources has been the increased interest in potable reuse projects, which include indirect potable reuse, groundwater recharge and surface water augmentation. There are approximately two full time employee equivalents at the state level focused on non-potable reuse. In addition, the Regional Boards all have staff working on reuse. Funding for the reuse program through the Regional Boards is obtained from annual project fees. The State Water Board charges fees for service, and receives a minor amount of funding from general funds for reuse.

Prior to 2000, California's reuse regulations were more restrictive with limited uses. In 2000, reuse regulations were updated to include additional new uses. During that process the state made an effort to provide comprehensive rules to support a wide range of uses. The rules were developed based on state sponsored independent studies. The State Water Board is considering reopening the reuse regulation (CCR, Title 22) to make changes including less frequent sampling requirements for turbidity

and coliform, and possibly increasing virus removal requirements. They are likely moving towards a more technology-based approach to treatment that relies more on selection of unit processes that have been validated to provide pathogen removal.

Florida

Florida implemented their reuse program in the late 1980s. The rules have not changed much over time, though clarifications have been made and a few new uses added. The rules are comprehensive and the need for changes are infrequent. When a new use is proposed, the state forms a technical advisory committee consisting of regulators, other state agencies, scientists, consultants and other stakeholders.

Reuse in Florida has been relatively steady over time, with reuse volumes fluctuating depending in large part on the weather in a particular year. According to Florida's 2015 Reuse Inventory (FL DEP, 2016), in 2015 478 domestic WWTFs reported making reclaimed water available for reuse. 430 reuse systems were served and 738 millions of gallons per day (mgd) were used for beneficial purposes. Reclaimed water for irrigation was applied at 362,737 residences, 537 golf courses, 1,022 parks, 369 schools, and over 13,290 acres of edible crops (primarily citrus) on 68 farms.

A few years ago, a position in the reuse program was cut and the responsibilities of two full time positions were combined into one, Florida's Reuse Coordinator. Reuse permitting and compliance is managed in six district offices and two DEP branch offices, with those staff having responsibilities in addition to reuse. Funding for the Florida Reuse Program comes from a variety of sources including State Trust Funds (Water Quality Assurance and Permit Fee) and federal funding.

Idaho

Idaho issued its first reuse permit in 1989. Since that time reuse in Idaho has increased gradually with a few new permits a year. Idaho DEQ currently has 130 recycled water treater permits. Use and users are managed by the permitted reclaimed water producer, though additional state requirements may be applicable depending on the end use and user. The state issues reuse permits which are classified based on the source of the recycled water, municipal or industrial. Most reclaimed water is municipally sourced (71%) followed by industrial (27%) and combined (2%) (ID DEQ, 2015).

If a new use is requested, the state considers it on a case-by-case basis to determine whether it falls within existing rules and if DEQ can ensure it is safe. If a change to regulations is needed, DEQ conducts a rulemaking process, which is similar to the Colorado process and may take a few years.

That state (main) DEQ office has one full time reuse regulator and an enforcement officer who works on reuse part time. Additionally the wastewater program manager works on reuse at times. DEQ also has six regional offices with permit writers focused primarily on reuse permitting, who also work on compliance. Roughly, between the state and regional offices, approximately 16 staff work nearly full time on reuse and another four work on reuse part time. Depending on needs, other staff may support reuse staff. Idaho does not charge reuse permit fees and reuse funding is a combination of general funds and US EPA grants.

Washington

Washington is in a unique place among the states surveyed regarding its regulatory structure. It has Water Reclamation and Reuse Standards (WA Dept. of Ecology, 1997) that were published in 1997 but never codified. These standards serve as guidance rather than rules. The state permits reuse using its NPDES jurisdiction. The process of writing reuse rules has started and stopped multiple times, and for a

variety of reasons over the past decade. The state is currently on its fifth reuse rule writer, who has been making significant headway including the recent completion of an informal public comment period. The rule writer hopes to progress through the rulemaking process this year, with the rule becoming effective in early 2018. Along with the rule, similar to other programs, a guidance document, to be called the Purple Book, is being developed. Because the proposed rule is in draft form, the information in Table 2 and Table 3 is from the currently applicable 1997 guidance. The new rules are intended to be less prescriptive to allow for flexibility in treatment process selection and water quality requirements.

The currently applicable guidance specifies that the Department of Ecology and the Department of Health have combined jurisdiction over reuse, as noted in Table 1, but historically roles have been unclear. The draft rules clarify the different roles of these two departments. The Department of Ecology is typically the lead agency for reclaimed water use, because they have jurisdiction over wastewater treatment and any water that is discharged to a stream or groundwater. The Department of Health provides important guidance regarding cross connection control and is responsible for graywater and any reuse associated with on-site sewage systems.

Reuse in Washington has remained steady over time. The state believes reclaimed water producers are waiting for the new rules to become effective before pursuing new reuse projects. The state currently has about 28 permittees but is aware of additional interest in reuse. In the past the state had two to three engineers as well as administrative support for reuse. This staffing was decreased in recent years and there is currently one full time reclaimed water permit writer in the state's eastern office. Other permit writers and inspectors work on reuse at times and technical help is pulled in as needed. No one is managing the program and, as a result, there may be different interpretations of the reuse guidance among the four regional and two field offices. Funding for reuse is all through permit fees, with no general funds.

Oregon

Oregon's reuse regulations date back to 1990. They were modified in 2008 at which time the state added all existing uses of reclaimed water as well as a few anticipated uses. The regulations now cover a wide range of applications and, in most cases, new uses fall under an approved use. For new uses, the DEQ Reuse Program works with the Department of Health to determine risks and requirements. Currently reuse is covered as a subsection of the state's NPDES program but the state is considering separating it out as program with its own permitting.

There is interest in reuse in Oregon, with drought and water scarcity being significant drivers. The state has a wide spectrum of ecosystems ranging from rain forest to desert. While the drier eastern part of the state has long been aware of water supply issues, it is only in recent years that the normally wetter, western part of the state has also become concerned about sustainability of water supplies. In addition to water scarcity, increasingly stringent discharge permits are also driving interest in reuse.

Oregon has seen and continues to experience cuts to it reuse program funding in recent years as a result of the economic downturn. Funding for the Biosolids and Reuse Program comes from general funds and permit fees, although reuse is covered by general funds alone. Some staff that work part time on reuse are funded, at least in part, through permit fees. There is currently only one person working in graywater and reuse, where in the past an additional two staff worked on graywater. There is also someone in the western region that works part time on recycled water. Other staff who assist with

reuse compliance, reporting, plan review, permit writing and other items roughly equal a full time employee.

6. Minimum Treatment, Water Quality and Monitoring Requirements

By defining different classes of reclaimed water, states can better identify potential health and environmental risks associated with each class of water as well as their appropriate uses. Risks can be minimized by ensuring treatment levels are appropriate for allowed uses and through the proper management of reclaimed water at the approved use area through best management practices (BMPs). Health risks, for example, can be minimized by ensuring the removal of pathogenic microorganisms and by limiting exposure to reclaimed water.

Table 2 summarizes the different classes of reclaimed water states have defined, along with treatment, water quality and monitoring requirements. There is little consistency between states in how classes are established. For example, Colorado defines three classes, or categories, of reclaimed water, while Idaho has five. Another clear difference is that while some states require certain treatment processes be used, others are less prescriptive, allowing for various processes as long as water quality requirements are met. The water quality parameters relied on also differ.

Reclaimed water classes, treatment requirements and water quality standards are designed to safely allow for the beneficial use of wastewater that is treated to less than potable quality. As noted in Section 7 Reuse Applications, some states include groundwater recharge or certain types of surface water augmentation as reclaimed water uses. In those cases, the CWA or SDWA may come into play with more comprehensive and stringent requirements. The regulations should be referred to for specifics in those instances. Table 2 is intended to provide a high level summary of general requirements, but the regulations may include more detailed specifications and may be more or less stringent in specific circumstances or for a specific use.

Water quality requirements developed by states are not intended to be comprehensive of all constituents of potential concern but rather are selected for their ability to serve as indicators or surrogates representing the physical, chemical, biological or other characteristics of specific types of chemicals or organisms. Monitoring indicator and surrogate compounds has been demonstrated to provide a correlation with concentrations of a broader range of compounds, organisms or other concerns and help monitor treatment effectiveness. Given the wide range of constituents and acceptable levels required by the individual states, the regulations should be referenced if there is interest in understanding specific rationale.

Washington's new draft reuse rules include only two classes of recycled water (A and B), compared to the four classes in Table 2. In the draft rules, Class C and D, which were used for land treatment, have been removed. Class B requirements have been relaxed to allow for some uses that previously used Class C water. The new rules are based on California's, which are more performance based as compared to Washington's current prescriptive guidance. The California regulations and proposed Washington rules, are more technology based, with treatment processes performing at required levels assumed to be protective and meeting standards.

Several regulators mentioned that they are considering modifying their rules to reflect current standards and technology, for example moving towards log removal credits or adjusting monitoring frequencies. Others stated that they would like to better clarify certain requirements.

Some flexibility exists in state regulations to allow for variances on a case-by-case if, after review, proposals are found to be protective of public health and the environment. In some instances, alternative treatment processes may be allowed or water quality or monitoring requirements may be adjusted. Colorado Regulation 84, for example, includes a Variances section (section 84.11) that states "The Division may grant a variance from any provision of this regulation, except that with respect to the E.coli standards in section 84.7, a variance may only be granted from the "235/100 ml single sample maximum" standard. The Division may grant a variance in a particular case where the treater or the user demonstrates that the benefits to public health or the environment that will be created by compliance with the subject provision do not bear a reasonable relationship to the costs required to achieve compliance". Similarly Idaho's Recycled Water Rules include a Waivers section (IDAPA 58.01.17 940) that says waivers from the rule requirements may be granted by the Director [DEQ] on a case-by-case basis after demonstration existing water quality and beneficial uses are protected. Washington's reclaimed water guidance allows for "Other Methods of Treatment" (Water Reclamation and Reuse Standards, Section 1, Article 6, Section 1) upon demonstration that "an equal degree of treatment, public health protection and treatment reliability" will be provided.

Table 2: Minimum Treatment and Water Quality Standards[1]

Recycled Water Class (most to least restrictive for each state)	Water Class Description	Required Processes[2]				Turbidity (NTU)	TSS (mg/l)	Total N (mg/l)	Total P (mg/l)	BOD_5 (mg/l)	Oil and Grease (mg/l)	DO	pH (s.u.)	Giardia and Crypto	Bacterial indicators	
		Oxidized[3]	Clarified	Filtered	Disinfected										Total Coliform (organisms/ 100 ml)	*E. coli* (organisms/100 ml)
Colorado																
Category 3	Water at a minimum shall receive secondary treatment with filtration and disinfection			Yes	Yes. If Cl used, residual Cl instantaneous max = 0.5 mg/l	Continuous or grab samples every 12 hrs. Monthly avg ≤ 3; 5% of samples in month ≤ 5	4 grab samples/wk. 7-day avg ≤ 45; 30-day avg ≤ 30; & 85% removal			Monthly composite. 7-day avg ≤ 45; 30-day avg ≤ 30; & 85% removal	Visual & monthly grab sample ≤ 10		Monthly grab sample. 6.0 - 9.0			4 grab samples/wk. Non-detect in 75% of monthly samples; max in any sample = 126
Category 2	Water at a minimum shall receive secondary treatment with filtration and disinfection			Yes	Yes. If Cl used, residual Cl instantaneous max = 0.5 mg/l	Continuous or grab samples every 12 hrs. Monthly avg ≤ 3; 5% of samples in month ≤ 5	4 grab samples/wk. 7-day avg ≤ 45; 30-day avg ≤ 30; & 85% removal			Monthly composite. 7-day avg ≤ 45; 30-day avg ≤ 30; & 85% removal	Visual & monthly grab sample ≤ 10		Monthly grab sample. 6.0 - 9.0			2 grab samples/wk. Monthly geometric mean ≤ 126; max in any sample = 235
Category 1	Water at a minimum shall receive secondary treatment with disinfection				Yes. If Cl used, residual Cl instantaneous max = 0.5 mg/l		4 grab samples/wk. 7-day avg ≤ 45; daily max ≤ 30; & 85% removal			Monthly composite. 7-day avg ≤ 45; 30-day avg ≤ 30; & 85% removal	Visual & monthly grab sample ≤ 10		Monthly grab sample. 6.0 - 9.0			1 grab sample/wk. Monthly geometric mean ≤ 126; max in any sample = 235
California[4]																
Disinfected tertiary	Filtered and subsequently disinfected wastewater that meets the criteria specified	Yes		Yes	Yes. 450 mg-min/L w/90 min modal time (peak dry weather design flow) OR 99.999% removal of MS2 or polio virus	Continuous monitoring. Coagulation[5] w/soils or filter media: 24-hr avg of 4-hr samples ≤ 2. 5% of 1.2-hr samples over 24-hrs ≤ 5. Max at any time ≤ 10; OR membrane: 5% of 1.2-hr samples over 24-hrs ≤ 0.2. Max at any time = 0.5.									Daily monitoring. MPN ≤ 23 in no more than 1 sample in 30 days; 7-day median ≤ 2.2; max in any sample = 240	
Disinfected secondary-2.2	Recycled water that has been oxidized and disinfected that meets the criteria specified	Yes			Yes										Daily monitoring. MPN ≤ 23 in no more than 1 sample in 30 days; 7-day median ≤ 2.2	
Disinfected secondary-23	Recycled water that has been oxidized and disinfected that meets the criteria specified	Yes			Yes										Daily monitoring. MPN ≤ 240 in no more than 1 sample in 30 days; 7-day median ≤ 23	
Undisinfected secondary	Oxidized wastewater	Yes														

Table 2: Minimum Treatment and Water Quality Standards continued

Recycled Water Class	Water Class Description	Required Processes				Turbidity (NTU)	TSS (mg/l)	Total N (mg/l)	Total P (mg/l)	BOD_5 (mg/l)	Oil and Grease (mg/l)	DO	pH (s.u.)	Giardia and Crypto	Bacterial indicators	
		Oxidized	Clarified	Filtered	Disinfected										Total Coliform (organisms/100 ml)	*E. coli* (organisms /100 ml)
Florida																
Secondary, filtration and high-level disinfection				Yes	Yes. Continuous monitoring. If Cl used, total Cl residual ≥ 1.0 mg/l after ≥ 15 mins contact time at peak hourly flow. Addl reqs apply to new/expanded facilities[6]	Continuous monitoring. Limits specified in permits (limits based on achieving TSS and total coliform permit limits)	Max in any sample ≤ 5, after filtration and before disinfection			$CBOD_5$: annual avg ≤ 20; monthly avg ≤ 30; weekly avg ≤ 45; max in any sample ≤ 60.			6.0 - 8.5	Facilities w/capacity ≥ 1 mgd, sample 1x/2-yrs; facilities < 1 mgd sample 1x/5-yrs (sample immediately after disinfection).	Fecal coliform: 75% non-detect in 30-day period; max in any sample ≤ 25	
Secondary and basic disinfection					Yes. Continuous monitoring. If Cl used, total Cl residual ≥ 0.5 mg/l after ≥ 15 mins contact time at peak hourly flow.		Annual avg ≤ 20; monthly avg ≤ 30; weekly avg ≤ 45; max in any sample ≤ 60.			$CBOD_5$: annual avg ≤ 20; monthly avg ≤ 30; weekly avg ≤ 45; max in any sample ≤ 60.			6.0 - 8.5		Fecal coliform: Min 10 daily samples/month. Monthly geometric mean ≤ 200; No more than 10% of samples over 30 consecutive days > 400 mg/l; annual arithmetic mean of monthly geometric means ≤ 200; max in any sample ≤ 800	
Reduced secondary with low level disinfection[7]							< 40 - 60 mg/l			$CBOD_5$ < 40 - 60 mg/l			6.0 - 8.5		Fecal coliform: max in an sample ≤ 2400	

Table 2 Minimum Treatment and Water Quality Standards continued

Recycled Water Class	Water Class Description	Required Processes				Turbidity (NTU)	TSS (mg/l)	Total N (mg/l)	Total P (mg/l)	BOD_5 (mg/l)	Oil and Grease (mg/l)	DO	pH (s.u.)	Giardia and Crypto	Bacterial indicators	
		Oxidized	Clarified	Filtered	Disinfected										Total Coliform (organisms/100 ml)	*E. coli* (organisms/ 100 ml)
Idaho[8]																
Class A	Oxidized, coagulated, clarified, and filtered, or treated by an equivalent process and adequately disinfected	Yes	Yes (coagulate)	Yes	Yes. 450 mg-min/L at end of contact time (total Cl residual & modal contact ≥ 90 mins based on peak day dry flow) OR w/filtration achieves 5-log virus inactivation	Continuous monitoring after filtration, prior to disinfection. Granular or cloth media: daily arithmetic mean ≤ 2 and ≤ 5 at all times; OR membrane filter: daily arithmetic mean ≤ 0.2 and ≤ 0.5 at all times		Monthly arithmetic mean from weekly composite sampling. GW recharge ≤ 10 mg/l; residential irrigation and other non-recharge systems ≤ 30 mg/l		Weekly composite sampling. Monthly arithmetic mean: GW recharge ≤ 5 mg/l, residential irrigation and other non-recharge systems ≤ 10 mg/l			Daily grab samples. 6.0 - 9.0		Daily monitoring. 7-day median ≤ 2.2; max in any sample ≤ 23	
Class B	Oxidized, coagulated, clarified, and filtered, or treated by an equivalent process and adequately disinfected	Yes	Yes (coagulate)	Yes	Yes. Total Cl residual ≥ 1 mg/L after 30 mins contact time at peak flow OR comparable (if approved)	Continuous monitoring after filtration, prior to disinfection. Daily arithmetic mean ≤ 5 and ≤ 10 at all times									Daily monitoring. 7-day median ≤ 2.2; max in any sample ≤ 23	
Class C	Oxidized and adequately disinfected	Yes			Yes										Weekly monitoring. 5-day median ≤ 23; max in any sample ≤ 230	
Class D	Oxidized and adequately disinfected	Yes			Yes										Monthly monitoring. 3-day median ≤ 230; max in any sample ≤ 2300	
Class E	At least primary effluent quality															

Table 2 Minimum Treatment and Water Quality Standards continued

Recycled Water Class	Water Class Description	Required Processes				Turbidity (NTU)	TSS (mg/l)	Total N (mg/l)	Total P (mg/l)	BOD_5 (mg/l)	Oil and Grease (mg/l)	DO	pH (s.u.)	Giardia and Crypto	Bacterial indicators	
		Oxidized	Clarified	Filtered	Disinfected										Total Coliform (organisms/100 ml)	*E. coli* (organisms/100 ml)
Oregon																
Class A	An oxidized, filtered and disinfected wastewater that meets the numeric criteria	Yes		Yes	Yes (Permits may require monitoring to verify adequate disinfection)	Hourly monitoring, after filtration and before disinfection. 24-hr avg ≤ 2; 5% of samples in 24 hrs ≤ 5; max of any sample ≤ 10									Daily monitoring. 7-day median ≤ 2.2; max in any sample ≤ 23	
Class B	An oxidized and disinfected wastewater that meets the numeric criteria	Yes			Yes (Permits may require monitoring to verify adequate disinfection)										Monitoring 3 times/wk. 7-day median ≤ 2.2; max in any sample ≤ 23	
Class C	An oxidized and disinfected wastewater that meets the numeric criteria	Yes			Yes (Permits may require monitoring to verify adequate disinfection)										Weekly monitoring. 7-day median ≤ 23; max in 2 consecutive samples = 240	
Class D	An oxidized and disinfected wastewater that meets the numeric criteria	Yes			Yes (Permits may require monitoring to verify adequate disinfection)											Weekly monitoring. 30-day log mean ≤ 126; max in any sample ≤ 406
Non-disinfected	An oxidized wastewater	Yes														

Table 2 Minimum Treatment and Water Quality Standards continued

Recycled Water Class	Water Class Description	Required Processes				Turbidity (NTU)	TSS (mg/l)	Total N (mg/l)	Total P (mg/l)	BOD_5 (mg/l)	Oil and Grease (mg/l)	DO	pH (s.u.)	Giardia and Crypto	Bacterial indicators	
		Oxidized	Clarified	Filtered	Disinfected										Total Coliform (organisms/100 ml)	*E. coli* (organisms /100 ml)
Washington																
Class A	An oxidized, coagulated, filtered, disinfected wastewater	Yes	Yes (coagulate)	Yes	Yes. If Cl used: residual ≥ 1 mg/L after contact time of 30 mins, maintained at ≥ 0.5 mg/L to use area unless waived (impoundments/storage ponds excluded)	Continuous monitoring read ≥ every 4 hrs. Monthly arithmetic mean ≤ 2 and max of any sample ≤ 5	Daily monitoring (may be reduced w/approval on case by case basis). 24-hr composite samples. Monthly arithmetic mean ≤ 30.			Weekly monitoring. 24-hr composite samples. Monthly arithmetic mean ≤ 30 mg/l		Daily Grab sample "shall contain dissolved oxygen"			Daily grab samples. Daily analysis of 7-day median ≤ 2.2; max in any sample ≤ 23	
Class B	An oxidized, disinfected wastewater	Yes			Yes. If Cl used: residual ≥ 1 mg/L after contact time of 30 mins, maintained at ≥ 0.5 mg/L to use area unless waived (impoundments/storage ponds excluded)		Daily monitoring. 24-hr composite samples. Monthly arithmetic mean ≤ 30			Weekly monitoring. 24-hr composite samples. Monthly arithmetic mean ≤ 30 mg/l		Daily Grab sample "shall contain dissolved oxygen"			Daily grab samples. Daily analysis of 7-day median ≤ 2.2; max in any sample ≤ 23	
Class C	An oxidized, disinfected wastewater	Yes			Yes. If Cl used: residual ≥ 1 mg/L after contact time of 30 mins, maintained at ≥ 0.5 mg/L to use area unless waived (impoundments/storage ponds excluded)		Daily monitoring. 24-hr composite samples. Monthly arithmetic mean ≤ 30			Weekly monitoring. 24-hr composite samples. Monthly arithmetic mean ≤ 30 mg/l		Daily Grab sample "shall contain dissolved oxygen"			Daily grab samples. Daily analysis of. 7-day median ≤ 23; max in any sample ≤ 240	
Class D	An oxidized, disinfected wastewater	Yes			Yes. If Cl used: residual ≥ 1 mg/L after contact time of 30 mins, maintained at ≥ 0.5 mg/L to use area unless waived (impoundments/storage ponds excluded)		Daily monitoring. 24-hr composite samples. Monthly arithmetic mean ≤ 30			Weekly monitoring. 24-hr composite samples. Monthly arithmetic mean ≤ 30 mg/l		Daily Grab sample "shall contain dissolved oxygen"			Daily grab samples (may be decreased to 2xs/week w/approval). Daily analysis of 7-day median ≤ 240	

[1] Requirements are those specified in the reuse regulations and guidelines listed in Table 1. Additional requirements may by applicable. Several states include potable reuse, surface water augmentation and/or groundwater augmentation in their reuse regulations. Depending on the use and potentially impacted resources, requirements varied greatly and may exceed the requirements shown here.

[2] There may be additional requirements for optional treatment processes if utilized. Only processes required per the regulations are included here.

[3] The biological stabilization of organic matter.

[4] Per the California State Water Board's Recycled Water Policy "Permits or requirements for landscape irrigation projects shall include, in addition to any other appropriate recycled water monitoring requirements, monitoring for priority pollutants in the recycled water at the recycled water production facility once per year, except when the recycled water production facility has a design production flow for the entire water reuse system of one million gallons per day or less. For these smaller facilities, the recycled water shall be monitored for priority pollutants once every five years."

[5] For most uses of disinfected tertiary, if coagulation is not used, filter effluent turbidity ≤ 2 NTU. Continuous monitoring of filter influent. Influent does not exceed 5 NTU for more than 15 minutes and never exceeds 10 NTU.

[6] Per F.A.C. 62-600.440(6)(c), for high level disinfection when chlorine is used, prior to disinfection: if fecal coliform levels (organisms/100 ml) are ≤ 1,000, total Cl residual (mg/l) and peak hour contact time (mins) shall be ≥ 25; if fecal coliform levels are 1,000 - 10,000, total Cl residual and peak hour contact time shall be ≥ 40; if fecal coliform levels are 1,000 - 10,000, total Cl residual and peak hour contact time shall be ≥ 40; if fecal coliform levels > 10,000, total Cl residual and peak hour contact time shall be ≥ 120. Other combinations may be allowed if approved.

[7] This class of water is only for overland flow systems which are assumed to provide additional treatment throughout the use area. Per 5/31/2017 personal communication with Florida's Reuse Coordinator there are no overland flow systems in place and Florida doesn't consider such systems to be reuse.

[8] Idaho's Recycled Water Rules regulate reused water sources from municipal as well as industrial sources. The classes listed here are for municipal sources. Industrial requirements are determined on a case by case basis.

7. Reuse Applications

Table 3 provides an overview of the various uses approved for recycled water for the states surveyed, with the minimum class of water allowed for each use (higher quality water can be used). Importantly, each of the states surveyed have a mechanism to add new uses. States also allow for case-by-case review of uses not specifically identified in the regulations to determine if they may be permitted under an existing use.

States organized regulations differently however Table 3 provides a listing of comparable and similar uses together and maintaining states' wording, where possible. For example Colorado's high level "Non-Evaporative Industrial Processes" use includes concrete mixing (per the WQCC Regulation 84 2013 Statement of Basis and Purpose). Other states more specifically identify concrete mixing as a use as shown in the last row of the Industrial, Commercial and Construction uses in Table 3. Cooling uses are a similar example. As a result, when reviewing the Table 3 it is recommended that all uses listed for each General Use Category be reviewed together rather than comparing adjacent rows and columns where similar uses are grouped.

In formatting their regulations, some states grouped uses by overall type, followed by lists of specific uses and minimum classes of reclaimed water allowed for each. Other states grouped regulations by class of water followed by the approved uses for each. Also, some states were very specific in identifying uses while others provided broad categories with specific uses sporadically mentioned throughout the regulations in a manner that was not intended to be comprehensive. In the latter case, to help inform Colorado's Regulation 84 rulemakings, any specific uses mentioned throughout the regulations were pulled into Table 3. As an example of this, Florida breaks types of reuse into five broad categories, one of which is "Slow-Rate Land Application Systems: Public Access Areas, Residential Irrigation, and Edible Crops". But listed under that category are also dust control on construction sites, fire protection and aesthetic purposes such as decorative ponds or fountains. Each specific use mentioned has been listed in Table 3.

In approving uses of reclaimed water and the minimum class of water that can be applied, states must assess risks to public and worker health and the environment as well as the quality of water appropriate for the use. Risks vary based on water quality and potential for and type of exposure. This "Fit for Purpose" concept (U.S. EPA, 2012) is intended to result in the appropriate water being used for the appropriate purpose. Technology exists to treat any water to any quality, but when very high quality water is not required, reuse regulations generally allow for use of lower quality water while minimizing risk. In addition to treatment, water quality and use requirements, regulations often include best management practice (BMP) requirements. Example of BMPs include restricting public access to areas where reclaimed water is used, required worker training, required setbacks, and preventing runoff and ponding. BMPs are discussed in Section 8 Risk Management/Best Management Practices.

Typically water with the lowest level of treatment is suitable for applications with the lowest risk of public or environmental exposure, either directly or indirectly, and where lower quality is appropriate for the use. Water that has undergone high levels of treatment is appropriate for uses requiring higher quality and/or with more risk of public, worker or environmental exposure. Because states don't all categorize classes of reuse the same way, and because treatment and water quality criteria are not standardized, it is difficult to evaluate how consistently states are actually assessing risks among similar uses.

States also vary in the level of specificity provided when defining uses. For example, while Idaho has one type of golf course irrigation use, California specifies two types of golf course irrigation, one with restricted access (no irrigation during periods of golf course use) and another for unrestricted access. Unrestricted golf course irrigation in California requires reclaimed water be treated to a higher quality than restricted access golf course irrigation. Incorporating BMPs into use definitions can add flexibility regarding the minimum class of water that may be appropriate. Similarly, regulations may specify additional treatment or monitoring requirements for a specific use. For example, Florida has an additional TSS requirement for residential subsurface drip irrigation systems to prevent clogging and system malfunction.

More complex requirements are not covered in detail in the summary tables below, such as California's setback requirements which can vary by class of water, method of application, and the nature of and distance to potentially impacted resources, e.g., drinking water well, picnic area, surface water.
One use area that was very inconsistently defined and regulated among states, and even within a state[7], were uses that, rather than being considered a beneficial use, could be considered a discharge or a treatment component. This includes some land use and groundwater recharge applications, as well as any surface water beneficial uses such as Washington's streamflow augmentation, where the CWA or SDWA may come into play. When a state's reuse regulations specifically identifies these uses as reuse, the use was included in Table 3. BMPs, treatment and water quality standards, and monitoring requirements vary greatly for these uses, and can be significantly more comprehensive (in terms of constituents and frequency) because they frequently invoke the CWA or SDWA. As a result, the regulations should be referred to for those applications not covered in detail here if of interest.

[7] Florida's Reuse Water Coordinator noted that Overland Flow Systems identified in their regulations are intended to provide further treatment of wastewater prior to discharge from the use application area and as such are not considered to be reuse projects (FL DEP, 2017).

Table 3: Approved Uses of Reclaimed Water

General Use Category	Colorado		California		Florida		Idaho		Oregon		Washington	
	Use	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**
Industrial, Commercial and Construction	Evaporative industrial processes (no public exposure, limited and controlled exposure by trained workers. Includes cooling towers)	Category 1	Industrial process water that workers may contact	Disinfected tertiary							Industrial processes with worker exposure to water	Class A
	Non-evaporative industrial processes (no public exposure, limited and controlled exposure by trained workers. Includes closed loop cooling)	Category 1	Industrial boiler feed	Disinfected secondary-23							Industrial boiler feed	Class C
			Cooling or air conditioning (cooling tower, evap condenser, spraying, or creates a mist)	Disinfected tertiary	Open cooling towers	Secondary and basic disinfection (control aerosol drift and biological growth)			Industrial cooling	Class C	Industrial cooling, where aerosols or mist are created (cooling towers, forced air evap, spraying)	Class A
			Cooling or air conditioning (no cooling tower, evap condenser, spraying, or mist)	Disinfected secondary-23	Once-through, closed system cooling, water returned to WWTF	Secondary treatment					Industrial cooling, no aerosols or mist created	Class C
			Industrial process water that workers will not contact	Disinfected secondary-23							Industrial processes, no worker exposure to water	Class C
	Washwater applications (construction & maintenance equipment, concrete washout, mineral processing, similar. No public exposure, limited and controlled exposure by trained workers)	Category 2			Wash water or process water at industrial facilities	Secondary and basic disinfection						

Table 3: Approved Uses of Reclaimed Water continued

General Use Category	Colorado		California		Florida		Idaho		Oregon		Washington	
	Use	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**
Industrial, Commercial and Construction continued	Non-discharging construction and road maintenance (cooling, wetting, dust suppression, soil compaction, mechanized street cleaning, concrete mixing, other. No public exposure, limited and controlled exposure by trained workers)	Category 1	Dust control on roads and streets	Disinfected secondary-23	Dust control on construction sites	Secondary, filtration and high-level disinfection	Dust suppression at construction sites and control on roads and streets	Class C	Dust control	Class C	Dust control (dampening unpaved roads and other surfaces)	Class C
			Cleaning roads, sidewalks, outdoor work areas	Disinfected secondary-23	Cleaning roads, sidewalks and outdoor work areas	Secondary, filtration and high-level disinfection	Cleaning roads, sidewalks, outdoor work areas	Class C	Street sweeping	Class C	Washing yards, lots and sidewalks on corporation grounds	Class B
											Street sweeping (dampening brushes and street surfaces)	Class C
											Spray washing of streets	Class A
					Wastewater treatment plant use: irrigation, process, wash down, other purposes, toilet flushing, fire protection	Varies						
	Commercial laundries (no public exposure, limited and controlled exposure by trained workers)	Category 2	Commercial laundries	Disinfected tertiary	Commercial laundries	Secondary, filtration and high-level disinfection	Commercial Laundries	Class A				
	Automated vehicle washing (no public exposure, limited and controlled exposure by trained workers)	Category 2										
	Manual non-public vehicle washing (no public access, limited and controlled exposure by trained workers)	Category 2	Commercial car washes, incl hand washes (water not heated, general public excluded from washing process)	Disinfected tertiary	Vehicle washing	Secondary, filtration and high-level disinfection			Commercial car washing	Class A		

Table 3: Approved Uses of Reclaimed Water continued

General Use Category	Colorado		California		Florida		Idaho		Oregon		Washington	
	Use	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**
			Flushing sanitary sewers	Undisinfected secondary	Flushing sanitary sewers and reclaimed water lines	Secondary, filtration and high-level disinfection			Sanitary sewer flushing	Class C	Flushing sanitary sewers	Class D
			Backfill consolidation around nonpotable piping	Disinfected secondary-23			Backfill consolidation around non-potable piping	Class C			Consolidation of backfill via water jetting around pipelines (reclaimed water, sewage, storm drainage, gas, electricity conduits)	Class C
Industrial, Commercial and Construction continued			Backfill consolidation around potable water pipelines	Disinfected tertiary								
			Soil compaction	Disinfected secondary-23			Soil compaction	Class C			Dampening soil for compaction at construction sites, landfills and elsewhere	Class C
			Mixing concrete	Disinfected secondary-23	Mixing concrete	Secondary, filtration and high-level disinfection			Rock crushing, aggregate washing, mixing concrete	Class C	Washing aggregate and making concrete	Class C
	Zoo operations	Category 1										
			Publicly accessible impoundments at fish hatcheries	Disinfected secondary-2.2							Fish hatcheries	Class B
			Snowmaking for outdoor use	Disinfected tertiary			Snowmaking at winter parks, resorts	Class A				
					Ice for ice rinks	Secondary, filtration and high-level disinfection						
											Ship ballast	Class C

Table 3: Approved Uses of Reclaimed Water continued

General Use Category	Colorado		California		Florida		Idaho		Oregon		Washington	
	Use	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**
Landscape Irrigation	Restricted access	Category 1	Non-edible vegetation, access controlled	Disinfected secondary-23								
			Freeway landscaping, surface irrigation	Disinfected secondary-23			Highway medians and roadside vegetation	Class C	Highway medians, public restricted during application	Class C	Restricted access areas, freeway landscapes or other areas with similar public access or exposure	Class C
			Cemeteries, surface irrigation	Disinfected secondary-23			Cemeteries	Class C	Cemeteries, public restricted during application	Class C	Restricted access areas, cemeteries	Class C
			Golf courses, restricted access (no irrig in areas and during periods when in use), surface irrigation	Disinfected secondary-23					Golf courses, public access restricted during application	Class C	Open access golf courses	Class A
							Commercial campus irrigation	Class B	Industrial or business campuses, public access restricted during application	Class C		
							Parks, playground, school yards during non-use times	Class B				
	Unrestricted access	Category 2	Parks and playgrounds, surface irrigation	Disinfected tertiary	Slow-rate land application, public access and private areas with frequent use by multiple people such as residential lawns, golf courses, cemeteries, parks, landscape areas, and highway medians.	Secondary, filtration and high-level disinfection	Parks, playground, school yards during use times	Class A	Parks, playgrounds, school yards, other publically accessible landscapes	Class A	Open access areas such as parks, playgrounds, schoolyards, or other areas with similar public access or exposure	Class A
			Schoolyards, surface irrigation	Disinfected tertiary								
			Golf courses, unrestricted access, surface irrigation	Disinfected tertiary			Golf courses	Class B			Open access golf courses	Class A

Table 3: Approved Uses of Reclaimed Water continued

General Use Category	Colorado		California		Florida		Idaho		Oregon		Washington	
	Use	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**
Landscape Irrigation continued			Other irrig use not prohibited, surface irrigation	Disinfected tertiary								
	Resident-controlled	Category 3	Residential landscaping, surface irrigation	Disinfected tertiary	Residential lawns	Secondary, filtration and high-level disinfection	Residential landscape	Class A	Residential landscapes, publically accessible	Class A	Residential landscapes, open access	Class A
					Residential irrigation by subsurface slow rate land application systems	Secondary and basic disinfection w/addl TSS requirements						
Fire Protection	Nonresidential fire protection (non-residential area hydrants, fire trucks, commercial and industrial bldgs)	Category 2	Nonstructural fire fighting	Disinfected secondary-23			Nonstructural fire fighting at commercial, industrial or construction sites	Class C	Nonstructural fire fighting using aircraft	Class C		
	Residential fire protection (residential area hydrants, fire trucks, any structure where occupants can't access plumbing)	Category 3					Fire suppression	Class B			Fire fighting by dumping from aircraft	Class C
					Sprinkler systems at commercial or industrial facilities and motels, hotels, apt bldgs and condos where guests/residents do not have access to plumbing system for repairs or modifications	Secondary, filtration and high-level disinfection					Sprinkler systems in apartment buildings and condos where residents don't have access for repairs or modifications	Class A
			Structural fire fighting	Disinfected tertiary	Fire hydrants	Secondary, filtration and high-level disinfection			Stand alone fire suppression in commercial and residential buildings	Class B	Fire protection for hydrants or sprinkler systems in commercial or industrial sites or hotels or motels	Class A

Table 3: Approved Uses of Reclaimed Water continued

General Use Category	Colorado		California		Florida		Idaho		Oregon		Washington	
	Use	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**
Agricultural Irrigation (public access is generally restricted)	Non-food crop irrigation and silviculture, including trees. No direct human consumption, no crops where lactating dairy animals forage, and no trees producing nuts or fruits for human consumption	Category 1	Fodder and fiber crops and pasture for animals not producing milk for human consumption, surface irrigation	Undisinfected secondary	Overland flow systems[2] by sprinkling or flooding upper reaches of terraced, sloped, vegetated surfaces such as sod farms, forests, fodder crops, pasture lands, and similar area. At discharge point from use area effluent meets min of secondary and basic disinfection reqs.	Reduced secondary with low level disinfection	Fodder, fiber crops	Class E	Fodder, fiber, seed crops not for human consumption, commercial timber. No irrigation for 30 days before harvest (3 days for Class D water), public access prevented, sprinkler irrig prohibited without specific authorization	Non-disinfected	Nonfood crops: trees, fodder, fiber, and seed crops	Class D
			Food crops, incl root crops, where edible portion contacts irrig water (surface irrigation)	Disinfected tertiary	Edible crops to be peeled, skinned, cooked or thermally processed. Can contact water.	Secondary, filtration and high-level disinfection	Food crops, including all edible food crops	Class B	Any agricultural or horticultural use	Class A	Food crops, spray irrigation	Class A
			Food crops, edible portion above ground and doesn't contact irrig water	Disinfected secondary-2.2	Edible crops that will not be peeled, skinned, cooked or thermally processed. Irrig system precludes direct contact w/water.	Secondary, filtration and high-level disinfection					Food crops, surface irrigation, no contact of edible portion with water	Class B
											Food crops, surface irrigation of root crops	Class A
			Food crops that undergo pathogen-destroying processing, surface irrigation	Undisinfected secondary			Processed food crops (pathogen-destroying processing prior to consumption)	Class D	Processed food crops, no irrig for 3 days before harvest	Class C	Food crops, spray or surface irrigated, that are processed (physical or chemical) to destroy pathogens	Class D
			Ornamental nursery stock and sod farms, not restricted, surface irrigation	Disinfected secondary-23			Commercial timber, firewood	Class E	Firewood, ornamental nursery stock, Christmas trees, no irrig for 3 days before harvest	Class D		

Table 3: Approved Uses of Reclaimed Water continued

General Use Category	Colorado		California		Florida		Idaho		Oregon		Washington	
	Use	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**
Agricultural Irrigation (public access is generally restricted) continued			Non food-bearing trees, incl Christmas trees (up to 14 days before harvest or public access), surface irrigation	Undisinfected secondary			Ornamental nursery stock, Christmas trees	Class D				
			Ornamental nursery stock and sod farms (up to 14 days before harvest, sale, or public access), surface irrigation	Undisinfected secondary	Slow rate, restricted public access (unless subsurface irrig) land application systems. Surface or subsurface irrig incl pastures; sod farms; areas used to grow feed, fodder, fiber, or seed crops; trees including managed hardwood or softwood plantations; or similar areas.	Secondary and basic disinfection (w/addl TSS reqs if subsurface irrigation to prevent clogging)	Sod and seed crops, not for human ingestion	Class D	Sod, no irrig for 3 days before harvest	Class D	Nonfood crops: sod, ornamental plants for commercial use, or pasture which milking cows and goats have access to	Class C
			Seed crops not eaten by humans, surface irrigation	Undisinfected secondary								
					Cattle grazing not producing milk for human consumption	Secondary and basic disinfection	Pasture for animals not producing milk for human consumption	Class D	Pasture for animals. Restrict animals used for milk production from direct contact w/water	Class D		
			Pasture for animals producing milk for human consumption, surface irrigation	Disinfected secondary-23	Cattle grazing producing milk for human consumption	Secondary and basic disinfection with no application for 15 days before grazing OR high-level disinfection	Pasture for animals producing milk for human consumption	Class C				
			Orchards, irrig water doesn't contact edible portion of crop, surface irrigation	Undisinfected secondary			Orchards and vineyards, no fruit for raw use contacts irrig water or ground or water only contacts inedible portion of raw food crops	Class C	Orchards or vineyards if water is applied directly to soil, no harvested crop contact w/ground	Class C	Orchards and vineyards, surface irrigation, no fruit to be harvested in contact with water or ground	Class D
			Vineyard, water doesn't contact edible portion, surface irrigation	Undisinfected secondary	Tobacco or citrus (including for fresh fruit, concentrate or other). Can contact water.	Secondary, filtration and high-level disinfection						

Table 3: Approved Uses of Reclaimed Water continued

General Use Category	Colorado		California		Florida		Idaho		Oregon		Washington	
	Use	Minimum Water Class	Use	Minimum Water Class	Use	Minimum Water Class	Use	Minimum Water Class	Use	Minimum Water Class	Use	Minimum Water Class
Groundwater Recharge			IPR: groundwater replenishment, surface application	Disinfected tertiary w/addl reqs per CCR 60320.100 - 130	Groundwater recharge and IPR	Varies depending on receiving water body (per F.A.C. 62-610.550). Can require full treatment and disinfection.	Surface spreading, seepage ponds or other unlined surface features such as landscape impoundments, where recreation is prohibited (must comply w/IDAPA 58.01.11 "Ground Water Quality Rule")	Class A	Artificial groundwater recharge by surface infiltration or subsurface injection (per OAR chapter 340, division 44)	Class A	Groundwater recharge	Class A w/addl reqs
			IPR: groundwater replenishment, subsurface application	Full advanced treatment of oxidized wastewater (using RO and oxidation), w/addl reqs per CCR 60320.200 - 230.	Rapid infiltration basins/percolation ponds and adsorption fields	Secondary and basic disinfection w/addl treatment & monitoring reqs for certain projects	Subsurface distribution (must comply w/IDAPA 58.01.11 "Ground Water Quality Rule")	Class D				
Impoundments			Aesthetic or irrigation landscape impoundments w/out decorative fountains, no public contact	Disinfected secondary-23	Aesthetic purposes such as decorative ponds or fountains	Secondary, filtration and high-level disinfection			Landscape impoundments, no public contact. Incl but not limited to golf course ponds and non-residential landscape ponds. Aerators and decorative fixtures only when authorized.	Class C	Landscape impoundments, no public contact, incl but not limited to: golf course water ponds/hazards, landscape ponds and vegetative landscape ponds, e.g. “lily ponds.”	Class C
			Restricted recreational impoundments (use limited to fishing, boating and non-body contact activities)	Disinfected secondary-2.2					Restricted (non-body contact) recreational impoundments	Class B	Restricted recreational impoundments, limited to non-body contact activities such as fishing and boating.	Class B
			Nonrestricted recreational impoundments (no body contact limitations)	Disinfected tertiary[2]					Nonrestricted recreational impoundments, no body contact limitations, includes but not limited to lakes, publically accessible water features, public fishing ponds	Class A	Nonrestricted recreational impoundments, no body contact limitations, incl but not limited to recreational lakes, public water features (ponds) & fish ponds. No swimming pools unless specifically authorized.	Class A

Table 3: Approved Uses of Reclaimed Water continued

General Use Category	Colorado		California		Florida		Idaho		Oregon		Washington	
	Use	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**	**Use**	**Minimum Water Class**
Other and non-specified Uses	Other uses similar to those specified may be allowed	Varies according to use	Other uses not listed in CCR Title 22	Case-by-case w/reqs set by State Water Board and Regional Boards	Other non-specified activities that fall under Parts II through VII of 62-610 F.A.C.	Varies, as approved by DEP	Other uses on a case by case basis	Varies, as approved by DEQ	Any beneficial purpose authorized in writing	Pursuant to OAR 340-055-0016(6)	Other non-potable uses	Case by case basis, with approval by Depts of Health and Ecology
			Flushing toilets and urinals	Disinfected tertiary	Toilet flushing in commercial or industrial facilities and motels, hotels, apt bldgs and condos where guests/residents don't have access to plumbing system for repairs or modifications	Secondary, filtration and high-level disinfection	Toilet flushing at industrial or commercial sites w/trained personnel only for repairs	Class C	Nonresidential toilet or urinal flushing, floor drain trap priming	Class B	Flushing toilets and urinals at commercial and industrial sites, hotels and motels	Class A
			Priming drain traps	Disinfected tertiary							Flushing toilets in apartment buildings and condos where residents don't have access to system for repairs or modifications	Class A
											When authorized by local greywater program, flushing toilet and urinals, incl residential properties or units, where residents do not have access to system for repairs or modifications	Greywater equivalent to Class A or better
			Decorative fountains	Disinfected tertiary					Fountains, water not for human consumption	Class A	Decorative fountains, commercial and industrial	Class A
					Wetland creation, restoration and enhancement	Varies per F.A.C. 62.611					Constructed beneficial use wetlands, for wetland mitigation, only if acceptable to review agencies	Class A, with addl requirements

Table 3: Approved Uses of Reclaimed Water continued

General Use Category	Colorado		California		Florida		Idaho		Oregon		Washington	
	Use	Minimum Water Class	Use	Minimum Water Class	Use	Minimum Water Class	Use	Minimum Water Class	Use	Minimum Water Class	Use	Minimum Water Class
Other and non-specified Uses continued											Constructed beneficial use and treatment wetlands	Class B. Treatment wetlands may receive lower quality water if authorized by Depts of Health and Ecology.
											No swimming pools, unless specifically authorized by Depts of Health and Ecology	Not specified
											Streamflow augmentation w/identified beneficial purpose such as in-stream flow enhancement, irrigation supplies, water right replenishment or transfer and fisheries propagation.	Applicable Federal Clean Water Act regulations

[1] Per 5/31/2017 personal communication with Florida's Reuse Coordinator, though this is a category of use in the regulations, there are no overland flow systems in place and Florida doesn't consider these to be reuse.

[2] If conventional treatment not used, during first 12 months of operation monitor impoundment inflows monthly for Giardia, enteric viruses, and Cryptosporidium. Following first 12 months, monitor quarterly. Monitoring may be discontinued after the first two years with approval.

8. Risk Management/Best Management Practices

In addition to treatment requirements and water quality criteria specified in reclaimed water regulations, proper management of reclaimed water through best management practices (BMPs) is frequently required or recommended. BMPs, combined with treatment, water quality and use requirements can minimize potential health and environmental risks, increasing flexibility and opportunities for reuse.

Where BMPs were listed specifically or implicitly in defining a type of use, and when they were not overly complicated and could quickly be summarized, an attempt was made to include BMPs in Table 3. Examples of such BMPs include specifying in the use that edible portions of crop do not come into contact with reclaimed water, that public access to plumbing systems for repairs is restricted, and allowing use of different classes of water for parks and playgrounds during use and non-use periods, with higher quality required during periods of use.

The following is a list of the types BMPs included in the regulations surveyed. Additional BMP detail is difficult to summarize without providing specifics about the class of water, use, and type and proximity of potentially impacted resources (public and worker health, groundwater, surface water, etc.) The regulations should be referred to for specific items of interest. BMP requirements tend to be fewer for water of higher quality which have lower risks. BMPs may also decrease risks sufficiently that lower water quality becomes acceptable for a use.

<u>General BMPs</u>
Facility operation and maintenance
Monitoring and reporting
Contingency plans and infrastructure (e.g., storage for upset conditions, redundant treatment processes)

<u>Human Exposure Risks</u>
Plumbing requirements (e.g., labeled pipes, backflow prevention, cross connection control)
Water contained within approved use area
Setbacks or barriers (based on water quality and/or proximity to the public or important resources)
Restrict access to water, use areas, aerosols/mists, and plumbing
Water applied only during approved periods (e.g., during non-use by the public or not within 15 days of harvest)
Worker training and/or protective equipment
Signage
Additional treatment recommendations (not required), such as further disinfection and/or nutrient removal

<u>Ecological and Environmental Risks</u>
Avoid ponding, saturated soils, and runoff
Setbacks from surface waters and groundwater wells
Prescribed application methods (e.g., spray, subsurface, surface)
Agronomic application rates

9. Summary

Absent federal reuse regulations, states have developed their own regulations, policies and guidance that vary in structure, content and requirements. Similarly staffing and funding vary greatly, often not keeping up with the growing interest in and demand for water reuse projects. No conclusion is made here as to what the "right" reuse regulatory framework is. Each state has developed (or is developing, as in the case of Washington) regulations that work for them to address regionally relevant issues. However, this overview of key states' regulations will be useful to Colorado as it considers additional uses/general use categories that may be appropriate to adopt, as well as the risks associated with those uses and how to best mitigate those risks. None of the state regulators surveyed was able to identify significant health or environmental problems arising from their approved uses, suggesting states are successfully regulating reclaimed water.

During the scoping of this paper, several topics of interest were identified by the WQCD and WateReuse Colorado members that would require additional resources and time to summarize and therefore are out of scope for this document. Specifically, it would be useful to compare the treatment requirements and water quality criteria for the different water classes defined by the states to determine to what extent water quality is or is not similar for similar uses. Other topics where existing resources may be useful include: emerging contaminants, salinity management, one water/decentralized systems, and a more in depth analysis of BMP applications. Readers are directed to a wealth of water reuse related research compiled in reports published by the Water Environment & Research Foundation (WE&RF); Water Research Foundation (WRF); the National Water Research Institute (NWRI); the National Academies of Science, Engineering and Medicine; and the Australian Centre for Water Excellence, among others.

10. References

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