Developing Water Reuse Regulations

A State-Level Guide

Final Report

Developing Water Reuse Regulations: A State-Level Guide

Prepared for
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ACWA	Association of Clean Water Administrators
AOP	Advanced Oxidation Process
ASDWA	Association of State Drinking Water Administrators
ASR	Aquifer Storage and Recovery
AWWA	American Water Works Association
BOD	Biochemical Oxygen Demand
CCL	Contaminant Candidate List
CCP	Critical Control Point
CFR	Code of Federal Regulations
COD	Chemical Oxygen Demand
CWA	Clean Water Act
DPR	Direct Potable Reuse
DW	Drinking Water
EAR	Enhanced Aquifer Recharge
EBPR	Enhanced Biological Phosphorus Removal
ELCR	Excess Lifetime Cancer Risk
EPA	U.S. Environmental Protection Agency
FDA	U.S. Food and Drug Administration
FSMA	Food Safety Modernization Act
GWR	Groundwater Recharge
GWRS	Groundwater Replenishment System
HACCP	Hazard Analysis and Critical Control Point
HCD	Housing and Community Development
HQ	Hazard Quotient
IPP(s)	Industrial Pretreatment Program(s)
IPR	Indirect Potable Reuse
LRT(s)	Log Reduction Target(s)
LRV	Log Reduction Value
MAR	Managed Aquifer Recharge
MF	microfiltration
MGD	Million Gallons per Day
MOU	Memorandum of Understanding
MLE	Modified Ludzack-Ettinger
NACWA	National Association of Clean Water Agencies
NDMA	N-Nitrosodimethylamine
NPDES	National Pollutant Discharge Elimination System
NPP	National Pretreatment Program
NPR	Non-Potable Reuse
NSF	NSF International
OC San	Orange County Sanitation District
OCWD	Orange County Water District
ONWS	Onsite Non-potable Water System
PFAS	Per- and Polyfluoroalkyl Substances
POTW	Publicly Owned Treatment Works
PPCPs	Pharmaceuticals And Personal Care Products
QMRA	Quantitative Microbial Risk Assessment
RfD(s)	Reference Dose(s)
RO	Reverse Osmosis
SDWA	Safe Drinking Water Act
SWA	Surface Water Augmentation
SWRCB	State Water Resources Control Board
TCEQ	Texas Commission on Environmental Quality
TDS	Total Dissolved Solids
TMDLs	Total Maximum Daily Loads
TMF	Technical, Managerial, and Financial (capacity)
TN	Total Nitrate
TOC	Total Organic Carbon
TP	Total Phosphorus
TSS	Total Suspended Solids
UF	Ultrafiltration
UIC	Underground Injection Control
UV	Ultraviolet
UV-AOP	UV-based advanced oxidation processes
WEF	Water Environment Federation
WHO	World Health Organization
WPI	Water Professionals International
WRA	WateReuse Association
WRAP	Water Reuse Action Plan
WRF	Water Research Foundation
WW	Wastewater
WWTP	Wastewater Treatment Plant

Section 1

Purpose

What you need to know

This section explains the intended audience of *Developing Water Reuse Regulations: A State-Level Guide* (Guide), what it is intended to support, and how readers can navigate its contents.

Water reuse is increasingly being explored across the United States to address water supply reliability, support economic development, protect environmental resources, and enhance community resilience. Successful adoption of water reuse depends on a combination of factors, including public confidence, technical and scientific understanding, funding and implementation support, governance structures, and regulatory frameworks.

Policy plays an important role in defining how water reuse is evaluated, implemented, and overseen. Regulation for water reuse is primarily state-led, and approaches varying state by state. This Guide is for individuals interested in the development or revision of water reuse regulations. Water reuse takes many forms, and this Guide is applicable to all, including potable, non-potable, industrial, and onsite water reuse applications (both commercial and residential). While regulators are responsible for drafting and overseeing regulations, the process of developing regulations begins well before formal rulemaking. This Guide is designed to help stakeholders participate in or perhaps facilitate water reuse policymaking through the arc of the development process.

Readers will find resources about understanding the regulatory landscape, engaging constructively and contributing to technical and policy discussions inherent to water reuse policymaking.

KEY TERMS:

For the purposes of the Guide, *water reuse* refers to the intentional treatment and reuse of municipal wastewater, stormwater, or other used water sources for beneficial purposes, including non-potable, potable, and environmental applications.

When discussing the people involved with rulemaking, we use the terms *stakeholders* and *practitioners* to broadly represent people and organizations engaged in water reuse.

The Guide was developed…

- For practitioners in the water sector looking to work with state regulatory agencies to develop or revise water reuse regulations and standards in their state
- For utilities, consultants, environmental organizations, and other partners involved as stakeholders in the rulemaking process
- As a resource that can also benefit regulators who are developing or revising water reuse regulations

The Guide does…

- Provide a framework for how to engage in state-level rulemaking process
- Explore specific technical considerations that go into rule development and how they integrate with legal, technical, public health and implementation considerations

- Provide examples and case studies for how others have navigated rulemaking for water reuse
- Present examples and applications for different types of water reuse, including potable, non-potable, industrial, and onsite reuse

The Guide does not…

- Replace current statutes, regulations, guidance, or consultation with responsible regulatory authorities
- Recommend a uniform state or federal regulatory model
- Provide templates with regulatory language
- Provide recommendations for drafting legislative proposals or statutory development

How to Use this Guide

Each state considering changes to its water reuse policy will begin with its unique statutory and regulatory landscape. Each will have its own history and practice of policy making procedures. Most importantly, the policy drivers for water reuse are specific to the communities, industries, and households of each state. This Guide provides an approach to understanding local context and suggestions for how to navigate development of policies that meet those circumstances.

Content in this Guide is designed to be accessible to individuals with different levels of familiarity with water reuse and policy development. Throughout the sections, you will see these symbols:

What you need to know about this topic. Creating a shared understanding of the concept and how it fits into rulemaking.	**Overview**
How to apply the information. Introducing essential information that most people need to make or evaluate decisions.	**Core**
Additional depth to understand the details behind the core information.	**Deep Dive**

How the Guide was developed

The Guide was developed through a structured, iterative process, combining technical working sessions, extensive regulator and stakeholder engagement, oversight from a Technical Advisory Committee and regulatory advisors, and repeated cycles of drafting and review.

- Partner Meetings (seven Partner Representatives)
- Technical Advisory Committee (five Committee Members)
- Workshops (100+ Participants)
- Focus Groups (65 Participants; Figure 1-1)
- Interviews
- WateReuse Membership, specifically including the Industrial Reuse Committee, Coalition for Water Recycling, and State Section Leadership

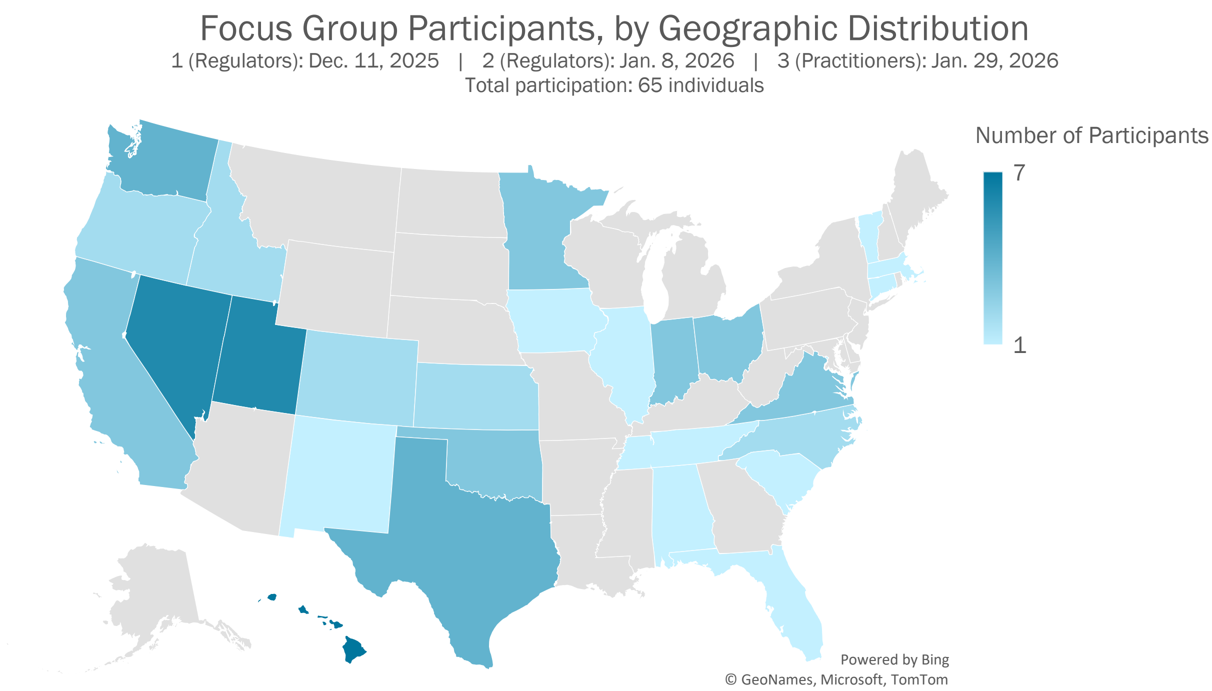

Figure 1-1. Distribution of focus group participants who contributed insights during Guide development

Section 2

Background

What you need to know

This section introduces the major drivers for reuse, defines the primary reuse types covered in the Guide, and highlights how regulatory approaches may differ by application.

For the purposes of the Guide, *water reuse* refers to the intentional treatment and reuse of municipal wastewater, stormwater, or other used water sources for beneficial purposes, including non-potable, potable, and environmental applications. Each state defines water reuse through legislation and specific regulations, resulting in a variety of terms like *reclaimed water*, *recycled water*, or *reused water*. For the purposes of this Guide, *water reuse* is used to represent these terms.

Drivers for Water Reuse

Across all contexts, the policy framework for water reuse incorporates multiple public policy considerations, including protecting public health, addressing long-term water supply scarcity, managing climate risk, meeting the demands of population growth, supporting economic development, assuring environmental protection, and overcoming infrastructure challenges. Developing a water reuse policy framework that will be resilient and implementable over the long-term often requires careful study, consideration of multiple points of view, and ultimately evaluating whether the framework works in practice given the context-specific drivers, which include:

> **FOR MORE INFO:**
>
> How reuse is defined and its drivers:
>
> Water Reuse 101 (WateReuse Association)
>
> Basic Information about Water Reuse (U.S. EPA)

- **Water Supply Reliability.** Increasing drought frequency and severity, groundwater depletion, and hydrologic variability have reduced the reliability of traditional water supplies. Water reuse provides another water source that improves system reliability.
- **Population and Industrial Growth.** Growing communities and water-intensive industries or businesses require additional supply, where new conventional sources are limited. Reuse supports growth by maximizing existing water resources and providing fit-for-purpose[1] water supplies.
- **Environmental Protection and Ecosystem Benefits.** Reuse can support environmental objectives by reducing pollutant loads to sensitive surface waters, intentionally recharging groundwater, or

[1] "*Fit-for-purpose specifications*" are the treatment requirements to bring water from a particular source to the quality needed, to ensure public health, environmental protection, or specific user needs. (U.S. EPA, 2026)

augmenting streamflows through managed releases or aquifer replenishment. Together, these approaches can contribute to ecosystem protection, habitat restoration, and improved watershed health.

- **Aging Infrastructure and Regulatory Pressures.** Many water and wastewater systems face aging infrastructure, rising maintenance costs, and increasingly stringent water quality regulations (e.g., nutrient limits). Reuse can be part of a solution that optimizes existing assets, reduces discharge volumes, and provides operational flexibility.
- **Water Security and System Resilience.** By diversifying water supply portfolios, water reuse decreases vulnerability to supply disruptions (e.g., drought, infrastructure failures).

FOR MORE INFO:

[Water Reuse: Potential for Expanding the Nation's Water Supply (National Academies)]

[National Water Reuse Action Plan (U.S. EPA)]

[Water Reuse to Support Environmental Restoration Resources (U.S. EPA)]

Types of Water Reuse

The Guide focuses on water reuse that relies on treated wastewater being reused after treatment to produce water that is “fit-for-purpose.” This focus means that the Guide does not reflect projects that capture natural waters (e.g., rainwater or stormwater). In this section, *source water* means where the water originates before wastewater treatment, and *end use* means how the water is ultimately used. For simplicity, the reuse types are described below (i.e., potable, non-potable, onsite, and industrial reuse) and should be considered holistically rather than treating them separately.

Non-Potable Reuse

Non-Potable Reuse (NPR) is the most common form of regulated water reuse in practice today. Treated wastewater can be used for:

- **Agricultural applications.** Uses include irrigation of food and non-food crops, orchards, vineyards, pasture, and fodder crops.
- **Impoundments.** This type of reuse includes constructed or managed surface water bodies that intentionally store reclaimed water for recreational, ornamental, irrigation supply, or other non-potable purposes.
- **Consumption by livestock.** Animal and livestock consumption.
- **Environmental restoration.** Uses include sustaining in-stream flows to support wetlands or other natural habitats, as well as aquifer recharge to protect aquifers from saltwater intrusion[2].
- **Centralized or municipal uses.** This includes end uses such as landscaping, toilet flushing, dust control, soil compaction, fire protection, commercial laundry, vehicle washing, street cleaning, cooling towers, fountains, snowmaking, etc.
- **Industrial applications.** This type of NPR is described in the “Industrial” subsection.

[2] In some states, recharge projects intended to augment drinking water aquifers or prevent saltwater intrusion can also be considered forms of indirect potable reuse or groundwater augmentation and are discussed in the following section, potable reuse.

There are important distinctions within these broad categories. These distinctions are defined by the level of human contact with or proximity to the water. NPR applications can be either unrestricted access or restricted access controlled by physical or institutional barriers. Unrestricted landscape irrigation requires the use of signage, purple piping, and fixtures indicating non-potable water use. Access and the associated level of body contact will dictate acceptable water quality at the point of application. Treatment requirements for agricultural reuse depend on the crop type and how the food crop is consumed or exposed to recycled water. Requirements are generally more stringent for crops eaten raw or with edible portions that contact recycled water, and less stringent for non-food crops and animal fodder.

FOR MORE INFO:

Centralized Non-Potable Reuse Resources | US EPA

Reusing Water for Agricultural Activities Resources | US EPA

Water Reuse for Consumption by Livestock Resources | US EPA

Reusing Water for Landscaping Resources | US EPA

Potable Reuse

Potable reuse refers to a scenario where highly treated municipal wastewater effluent is used to augment drinking water supplies through indirect potable reuse (IPR), which includes an environmental buffer, or direct potable reuse (DPR), which does not include an environmental buffer. Depending on how the scenario is implemented, potable reuse can be further classified into the following categories:

FOR MORE INFO:

Reusing Water for Potable Applications Resources | US EPA

City of San Diego Pure Water Program

Orange County Groundwater Replenishment System (GWRS)

Surface water augmentation. A type of IPR where treated effluent is introduced into surface water bodies such as lakes, rivers or reservoirs that are used for drinking water supplies. IPR projects supplement existing drinking water sources. Intentional augmentation of lakes and reservoirs has also been practiced in some states through existing National Pollutant Discharge Elimination Systems (NPDES) and state effluent discharge permits (e.g., California, Virginia).

Groundwater augmentation. A type of IPR where treated effluent is injected into a groundwater aquifer or allowed to percolate through surface spreading into an aquifer. The Orange County Water District (OCWD) Groundwater Replenishment System (GWRS) includes groundwater recharge through both injection and surface spreading.[3] This practice may also be referred to as managed aquifer recharge (MAR), enhanced aquifer recharge (EAR) or aquifer storage and recovery (ASR).

Raw water augmentation. A type of direct potable reuse (DPR) in which highly treated recycled water is introduced into a conveyance system that delivers raw water to a drinking water treatment plant.

Treated drinking water augmentation. A type of direct potable reuse (DPR) in which highly treated recycled water is introduced directly into a potable water distribution system.

[3] The GWRS between OCWD and Orange County Sanitation District (OC San) is a key reference for groundwater augmentation projects in the United States.

Onsite Reuse

Onsite reuse refers to the treatment and use of wastewater generated at or near the point of use for non-potable applications. These systems are sometimes referred to as “onsite non-potable water systems” (ONWS). ONWS are typically implemented at the building, campus, community, or satellite scale and are characterized by limited or no reliance on centralized infrastructure. These systems can be used to complement or in place of centralized wastewater infrastructure.

Unlike centralized reuse systems operated by utilities, onsite reuse systems are often managed by property owners, building managers, homeowners' associations, or other entities. As a result, regulatory approaches may differ with respect to permitted uses, operational responsibilities, monitoring requirements, and oversight mechanisms.

FOR MORE INFO:

Onsite Non-Potable Water Reuse Resources | US EPA

National Blue Ribbon Commission for Onsite Water Systems

Distributed Water Infrastructure Framework and Possibilities | WEF

While the water sector uses a variety of terms and definitions to describe sub-categories of onsite reuse, this guide approaches different types of onsite reuse in terms of the scale of implementation, including:

- **Building-scale systems.** Systems serving a single building, such as single-family residential, multi-family residential, commercial, institutional buildings, where wastewater is treated and reused onsite for non-potable applications (e.g., toilet flushing and landscape irrigation).
- **Campus-scale systems.** Systems serving multiple buildings under common ownership or management, such as campuses or planned developments, with shared collection, treatment, and reuse infrastructure.
- **District-scale systems.** Systems that cross individual property boundaries to serve multiple parcels often requiring a designated management entity (e.g., special district or homeowner association) to be responsible for operations, permitting, and compliance.
- **Satellite systems.** Systems that reuse wastewater within or adjacent to a centralized wastewater collection network, including systems that intercept wastewater before it enters the sewer or divert flows from existing collection infrastructure for localized reuse (i.e., “sewer mining”).

For many onsite reuse projects, building and plumbing codes are as important as water reuse regulations. These codes establish requirements for system design, construction, cross-connection control, and ongoing operation, and can significantly influence project feasibility and implementation. States across the U.S. have varying levels of rules in place for types of onsite water reuse, such as graywater recycling and stormwater harvesting, with notable examples being in San Francisco, CA, New York City, NY and Austin, TX. The State of California recently formalized rules for ONWS in 2026.

ONWS FOCUSES ON SCALE:

- Community-level
- District-level
- Building-level
- Satellite systems

Industrial Reuse

Industrial reuse refers to the use of treated wastewater or recycled process water for industrial and manufacturing applications where water quality requirements are driven by operational needs and worker exposure rather than human consumption. Industrial reuse is a well-established practice in many sectors and is often suited to fit-for-purpose treatment approaches due to limited public exposure.[4]

In many states, industrial reuse occurs under site-specific requirements established through Clean Water Act (CWA) industrial pretreatment programs (IPP) and pollutant loading limits in wastewater discharge permits, depending on whether recycled water is mined from the local municipal collection systems, managed onsite or discharged to a municipal system or receiving water. As a result, states may view industrial reuse as an operational and permitting issue rather than a distinct category requiring new reuse regulations.

FOR MORE INFO:

U.S. EPA, National Pretreatment Program (40 CFR Part 403)

Water Reuse for Industrial Applications Resources | US EPA

Water Reuse Action Plan 2.0 | US EPA

WateReuse Association, Accelerating Industrial Reuse (2025)

Given the variety of applications within industrial processes, this Guide does not attempt to address the variety of individual cases. However, some common applications include:

- **Cooling and heat rejection.** Cooling towers, indirect evaporative cooling systems, and other industrial heat rejection processes.
- **Data centers.** Cooling and thermal management systems supporting data center operations, including evaporative, liquid, and hybrid cooling configurations.
- **Boiler feed and steam generation.** Boiler makeup water and reuse of boiler blowdown with appropriate treatment.
- **Manufacturing and processing operations.** Process water for manufacturing, rinsing, washing, and material handling across sectors such as automotive manufacturing, electronics, and non-product food and beverage applications.
- **Energy and resource extraction.** Water used in oil and gas operations, mining, and associated processing activities.
- **Facility and equipment maintenance.** Equipment washing, floor cleaning, vehicle washing, and other maintenance uses.

Regulations and oversight for industrial reuse are typically informed by both the source of recycled water and the location and configuration of the end use application. At the federal level, industrial wastewater discharges to municipal collection systems are regulated under the CWA through the National Pretreatment Program (40 Code of Federal Regulations [CFR] Part 403), which operates as part of the broader NPDES framework governing wastewater discharges. In some cases, new reuse-specific rules are not required for these scenarios. In geographies where data centers are planned or already in operation, water reuse may be implemented to meet cooling water demands. It is notable that consideration must be given to concentrated blow down streams that may be returned to the sewer system and managed through an industrial pretreatment program.

4 "Fit-for-purpose" means matching water quality and treatment to the requirements of a specific use, ensuring safety and performance without unnecessary treatment.

CASE STUDY: Non-Potable Reuse

Washington State's Reclaimed Water Rule

Relevancy

DRIVERS

Water supply reliability and environmental restoration created a shared rationale that helped sustain rulemaking over multiple decades.

RELEVANT DRIVERS

- ☒ Increasing Water Scarcity and Supply Reliability
- ☐ Population and Industrial Growth
- ☒ Environmental Protection and Ecosystem Benefits
- ☐ Aging Infrastructure and Regulatory Pressures
- ☒ Water Security and System Reliability

REUSE TYPES

A single reclaimed water framework was structured to support multiple reuse applications rather than creating separate regulatory programs.

RELEVANT WATER REUSE TYPES

- ☐ Potable Reuse
- ☒ Non-Potable Reuse
- ☐ Onsite Reuse
- ☒ Industrial Reuse

POLICY TOOLS

Legislative direction was established years before formal rule adoption, resulting in an extended implementation timeline.

RELEVANT REGULATORY & POLICY TOOLS

- ☒ Direction-Setting Tools
- ☒ Implementation and Support Tools
- ☒ Legal Tools

CURRENT STATUS

Washington adopted its Reclaimed Water Rule in 2018 and now operates a mature statewide program with established permitting and regulatory oversight.

The program illustrates how long-term stakeholder engagement can continue through implementation after rule adoption.

RULEMAKING PHASE (CURRENT STATUS)

- ☐ Discovery
- ☐ Initial Engagement
- ☐ Validation
- ☒ Adoption

Timeline

Year	Major Activities
1992	Reclaimed Water Act (RCW 90.46) was passed, directing WA DOH and DOE to develop a rule to: – Preserve potable water – Contribute to instream flows and wetlands – Reduce discharges to Puget Sound – Respond to growth and climate change" – (RCW 90.46.005)
1995	Amendment requiring standards for environmental uses (e.g., wetlands, stream flow augmentation, and ground water recharge) (RCW 90.46.080-100)
1997	Amendment addressing water rights, demonstration projects, and standards for graywater use (RCW 90.46.110-140)
2001	Amendment adding agricultural industrial process water (RCW 90.46.150)
2002	Amendment adding industrial process water (RCW 90.46.160)
2006	Rulemaking begins
2007	Initial authority, duties, and permit requirements included (RCW 90.46.200-220)
2010	Rulemaking suspended by Executive Order 10-06 due to budget constraints from the Great Recession (EO 10-06)
2014	Advisory Committee is reconvened to continue rulemaking
2015	Public comment period on draft rule language Initial draft rule is withdrawn for additional revisions
2016	New rule writer is hired
2017	Advisory Committee is reconvened Informal public comment period (Spring) Formal Public Comment Period (Fall)
2018	Reclaimed Water Rule adopted (January 23) and became effective (February 23)

BENEFICIAL USES/PURPOSES

Commercial, industrial, and institutional uses

Constructed wetlands

Irrigation or land application

Groundwater recharge

Surface water augmentation

Wetland augmentation

RULE EFFECTIVE DATE

February 23, 2018

RESOURCES

CHAPTER 90.46 RCW

CHAPTER 173-219 WAC

WASTEWATER TO WATER RESOURCE: WASHINGTON STATE'S RECLAIMED WATER RULE..

Reclaiming the Water and Reclaimed Water's Part.

CASE STUDY: Potable Reuse

Florida's Journey from Non-Potable to Potable Reuse

Relevancy

DRIVERS

Existing non-potable reuse programs created a foundation that allowed water supply reliability and drought resilience objectives to become part of the state's reuse strategy over time.

RELEVANT DRIVERS

☒ Increasing Water Scarcity and Supply Reliability

☐ Population and Industrial Growth

☒ Environmental Protection and Ecosystem Benefits

☐ Aging Infrastructure and Regulatory Pressures

☒ Water Security and System Reliability

REUSE TYPES

Long-standing non-potable reuse programs provided the technical, institutional, and regulatory experience needed to support subsequent potable reuse development.

RELEVANT WATER REUSE TYPES

☒ Potable Reuse

☒ Non-Potable Reuse

☐ Onsite Reuse

☐ Industrial Reuse

POLICY TOOLS

Potable reuse was advanced through a combination of planning, stakeholder engagement, technical studies, legislative actions, and rulemaking rather than through a single regulatory initiative.

RELEVANT REGULATORY & POLICY TOOLS

☒ Direction-Setting Tools

☒ Implementation and Support Tools

☒ Legal Tools

CURRENT STATUS

The program illustrates how potable reuse adoption can build upon existing reuse authorities and programs rather than requiring the creation of an entirely new regulatory framework.

RULEMAKING PHASE (CURRENT STATUS)

☐ Discovery

☐ Initial Engagement

☐ Evaluation

☒ Adoption

Timeline

Year	Major Activities
1986	State agencies establish the Water Reuse Program, formalizing reuse within environmental and public health regulation.
1989	Reuse codified in statute through Section 403.064, F.S., requiring reuse feasibility evaluations in wastewater permitting.
1991	DEP and partners publish Reuse Feasibility Study Guidelines defining required study elements.
1993	Reuse Conventions issued to establish statewide consistency in reuse implementation.
1996	Reuse Convention refinements finalized, strengthening groundwater recharge and irrigation requirements.
1999	Aquifer Storage and Recovery (ASR) authorized under reuse rules (Rule 62-610.466, F.A.C.).
2001	Reuse efficiency elevated within statewide water conservation policy.
2003	Reuse Strategy Report released, identifying priority strategies for program evolution.
2012	HB 639 affirms reclaimed water as waters of the state and clarifies utility authority.
2014	SB 536 directs statewide evaluation of barriers to expanded reuse.
2015	DEP publishes reuse expansion report identifying regulatory and implementation challenges.
2019	Executive Order 19-12 advances alternative water supply coordination and public outreach. Legislature provided $250,000 for a statewide public education campaign Florida Potable Reuse Commission convened to develop a statewide potable reuse framework.
2020	Framework for the Implementation for Potable Reuse completed SB 712 directs initiation of potable reuse rulemaking.
2021	SB 64 mandates elimination of non-beneficial surface water discharges by 2032.
2025	Chapter 62-565, F.A.C. becomes effective, establishing statewide DPR and IPR regulatory requirements.

BENEFICIAL USES/PURPOSES

Offset potable water demands

Reduce reliance on surface and groundwater withdrawals

Minimize non-beneficial surface water discharges

Improve system resilience during drought and growth conditions

Support long-term water supply planning and One Water goals

RULE EFFECTIVE DATE

February 26, 2025

RESOURCES

62-565.100 : General - Florida Administrative Rules, Law, Code, Register - FAC, FAR, eRulemaking

Framework-for-Potable-Reuse-in-Florida.pdf

CHAPTER 403 SECTION 064 - 2020 FLORIDA STATUTES - THE FLORIDA SENATE

CASE STUDY: Onsite Reuse

California's Onsite Treated Non-Potable Water Systems Rule

California demonstrates how states can transition from local pilot programs and municipal ordinances to a consistent statewide regulatory framework for emerging reuse applications.

Relevancy

DRIVERS

Local water supply challenges and development pressures created demand for decentralized reuse systems before a statewide regulatory framework existed.

RELEVANT DRIVERS

☒ Increasing Water Scarcity and Supply Reliability

☒ Population and Industrial Growth

☐ Environmental Protection and Ecosystem Benefits

☒ Aging Infrastructure and Regulatory Pressures

☒ Water Security and System Reliability

REUSE TYPES

Building-scale and district-scale reuse applications provided practical experience that informed development of a broader statewide onsite reuse framework.

RELEVANT WATER REUSE TYPES

☐ Potable Reuse

☒ Non-Potable Reuse

☒ Onsite Reuse

☐ Industrial Reuse

POLICY TOOLS

Statewide regulations were built on lessons learned from local ordinances, pilot projects, applied research, and public health guidance rather than being developed from scratch.

RELEVANT REGULATORY & POLICY TOOLS

☒ Direction-Setting Tools

☒ Implementation and Support Tools

☒ Legal Tools

CURRENT STATUS

The framework illustrates how states can transition from locally implemented reuse programs to consistent statewide regulation while retaining concepts proven through implementation experience.

RULEMAKING PHASE (CURRENT STATUS)

☐ Discovery

☐ Initial Engagement

☐ Evaluation

☒ Adoption

Timeline

Year	Major Activities
2012	San Francisco adopts the Non-Potable Water Ordinance (Article 12C), establishing permitting for onsite reuse systems in new developments.
2013	San Francisco expands the Article 12C ordinance to support district-scale onsite water reuse systems.
2014	A statewide drought emergency heightens interest in alternative water supplies, including onsite and decentralized reuse.
2015	San Francisco makes onsite water reuse mandatory for large new developments under Article 12C, reinforcing the city as a test bed for building-scale reuse regulation.
2016	The National Blue Ribbon Commission for Onsite Non-Potable Water Systems is launched, with San Francisco Public Utilities Commission participation, contributing national policy and implementation frameworks for decentralized reuse.
2017	*Risk-Based Framework for the Development of Public Health Guidance for Decentralized Non-Potable Water Systems* published through a partnership with San Francisco Public Utilities Commission and the Water Research Foundation. This guidance establishes technical principles that later inform state regulatory approaches to onsite reuse.
2018	The California Legislature passes SB-966, directing the State Water Resources Control Board (SWRCB) to develop statewide regulations for onsite treated non-potable water reuse and directing the Department of Housing and Community Development (HCD) to align building standards.
2019	California begins implementing SB-966, including amendments to the California Plumbing Code to recognize onsite treated non-potable water systems (CPC § 516.0).
2021	San Francisco amends Article 12C to reduce threshold water budget calculations, expand mandatory onsite reuse requirements, and specify scenarios requiring blackwater reuse.
2022	SWRCB conducts stakeholder workshops to gather input on regulatory scope, technical standards, and implementation considerations for statewide onsite reuse regulations.
2024	The State of California advances Title 22 rulemaking for onsite treated non-potable water systems under SB-966 authority.
2025	SWRCB issues proposed regulatory language (Title 22), conducts a public comment period, and holds an adoption hearing.
2026	Amended Title 22 OTNWS regulations take effect (February), establishing a statewide regulatory framework for permitting and oversight of onsite treated non-potable water reuse systems by local jurisdictions.

BENEFICIAL USES/PURPOSES

Toilet and urinal flushing
Subsurface landscape irrigation
Industrial processes with limited human contact
Dust control (restricted)
Decorative water features (restricted)
Cooling tower make-up water

RULE EFFECTIVE DATE

Amended Title 22 language was effective on April 22, 2026

RESOURCES

Regulations for Onsite Treatment and Reuse of Nonpotable Water (SWRCB, 2026)
San Francisco Public Utilities Commission, Onsite Water Reuse Program
National Blue Ribbon Commission for Onsite Water Systems
Risk-Based Framework for the Development of Public Health Guidance for Decentralized Non-Potable Water Systems (Report, 2017)

ONSITE NON-POTABLE WATER SYSTEM GUIDANCE MANUAL (REPORT, 2020)

CASE STUDY: Industrial Reuse

Texas's Evolving Framework for Beneficial Use of Produced Water

Relevancy

DRIVERS

Produced water volumes, water supply concerns, and interest in beneficial reuse created pressure to evaluate whether treated produced water could serve uses beyond traditional oil and gas operations.

RELEVANT DRIVERS

☒ Increasing Water Scarcity and Supply Reliability

☒ Population and Industrial Growth

☒ Environmental Protection and Ecosystem Benefits

☐ Aging Infrastructure and Regulatory Pressures

☒ Water Security and System Reliability

REUSE TYPES

The framework focuses on expanding potential reuse opportunities for a wastewater stream that has historically been managed within the oil and gas sector.

RELEVANT WATER REUSE TYPES

☐ Potable Reuse

☐ Non-Potable Reuse

☐ Onsite Reuse

☒ Industrial Reuse

POLICY TOOLS

Research, pilot authorizations, stakeholder collaboration, and regulatory development are being used concurrently to address technical, environmental, and public health uncertainties before broad implementation.

RELEVANT REGULATORY & POLICY TOOLS

☒ Direction-Setting Tools

☒ Implementation and Support Tools

☒ Legal Tools

CURRENT STATUS

The effort illustrates how states can evaluate emerging reuse applications through phased testing and regulatory development before establishing long-term implementation requirements.

RULEMAKING PHASE (CURRENT STATUS)

☐ Discovery

☐ Initial Engagement

☒ Evaluation

☒ Adoption

Timeline

Year	Major Activities
2013	Texas established liability protections associated with treatment of fluid oil and gas waste for beneficial use. The 2025 legislative analysis explains that these protections originally contemplated reuse associated with drilling and oil or gas production.
2021	SB 601 established the Texas Produced Water Consortium to study the economics, technologies, environmental considerations, and public-health considerations associated with beneficial uses of produced water. The Consortium was also charged with informing permitting and testing standards and identifying potential statutory or administrative-rule changes.
2023	SB 1047 directed the Consortium to select a pilot project or program and submit a report by October 1, 2024, addressing pilot status and suggested policy, regulatory, or legislative changes.
2023	The Railroad Commission sought informal public input on revisions to its oil and gas waste management and recycling rules. The agency identified evolving interest in produced-water treatment and reuse within and outside the oil and gas industry as one reason for revising the framework.
2024	The Railroad Commission issued the Produced Water Beneficial Reuse Framework for Pilot Study Authorization, creating a pathway for authorization of pilot studies involving beneficial uses outside regular oil and gas operations. The pilots were intended to examine treatment effectiveness, water quality, storage, testing, and documentation. Surface-water discharge was not allowed under the pilot framework.
2024	The Texas Produced Water Consortium submitted its report, Beneficial Use of Produced Water in Texas, to the Legislature. The report documented the Consortium's work and included participation from state agencies, industry, researchers, environmental organizations, and other stakeholders.
2025	HB 49 amended Texas liability provisions to address treatment and beneficial use beyond the oil and gas applications contemplated by the earlier framework. It also directed the Railroad Commission to adopt rules governing treatment and beneficial use of fluid oil and gas waste, treated waste, and treatment byproducts.
2025	SB 1145 authorized the Texas Commission on Environmental Quality to issue permits for land application of treated produced water and required standards that prevent pollution of surface and subsurface water. The law took effect September 1, 2025.
2026	The Texas Commission on Environmental Quality proposed amendments to 30 TAC Chapters 210 and 309 to implement SB 1145 and the transfer of land-application permitting authority.
2026	The Texas Produced Water Consortium released a pilot-testing water-quality report based on 60 water samples collected through pilot projects during 2024 and 2025. The Consortium described it as an evaluation of polished, desalinated produced water developed with participation from agriculture, environmental organizations, industry, public-health representatives, and regulators.

BENEFICIAL USES/PURPOSES

Reuse within oil and gas extraction and completion operations

Land application of treated produced water under state permit

Crop irrigation and other agricultural pilot applications

Industrial uses outside conventional oil and gas operations

Recovery of minerals or other products from produced water

Development of an additional nontraditional water source

Reduction in reliance on underground injection for disposal

RULE EFFECTIVE DATE

Statute effective September 1, 2026

Regulations still under development

RESOURCES

TEXAS PRODUCED WATER CONSORTIUM OVERVIEW

2024 TEXAS PRODUCED WATER CONSORTIUM REPORT TO THE LEGISLATURE

RAILROAD COMMISSION PRODUCED WATER BENEFICIAL REUSE PILOT FRAMEWORK

TEXAS SB 1047, 2023 ENROLLED TEXT

TEXAS HB 49, 2025 ENROLLED TEXT

TEXAS SB 1145, 2025 ENROLLED TEXT

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY RULE PROPOSALS

2026 PRODUCED WATER TREATMENT PILOT TESTING WATER QUALITY REPORT

Section 3

Understanding How Water Reuse is Governed

What you need to know

This section explains the current framework for how regulatory authority is established and exercised for water reuse across the United States. Particularly, we focus on jurisdictional authority, policy making pathways, and the factors that influence a state's readiness to develop or revise reuse policies.

Currently, water reuse is governed at a state level through a shared and layered system of statutory authorities that span public health and safety, environmental protection, and water resource management.

Understanding who has been delegated responsibility for water reuse policy under state law and how that authority is carried out in practice is a critical first step in navigating policy development.

Mechanisms for Implementing Policy

There are a number of tools available to develop and implement policy. Some set mandatory requirements like laws and regulations, while others provide direction or encouragement. This Guide focuses primarily on legal mechanisms to authorize and oversee water reuse. Direction-setting and implementation tools are included to provide context for how regulatory frameworks are shaped and applied but are not fully covered in this document.

LEVELS OF AUTHORITY AND HOW THEY IMPACT POLICYMAKING

State Legislature: establishes authority through Statutes

State Agencies: implement authority through Regulations, Rules, Permits

Stakeholders: implement and comply with Regulations

Direction Setting Tools

How states express priorities, goals, and intent for water reuse.

Policy. A formal statement adopted by a government or agency that communicates priorities, values, or goals and guides decision-making. Policies are generally non-binding and may or may not include dedicated funding.

Planning Documents. Non-binding documents adopted by a government, agency, or jurisdiction that articulate long-term goals, priorities, or strategies (e.g., roadmaps, master plans, strategic plans). Planning documents guide decision-making and future actions but do not establish enforceable requirements.

Implementation and Support Tools

Mechanisms that support, apply, and enforce reuse requirements in practice.

Guidance. Informational material issued by a government or agency to explain, interpret, or clarify how laws, regulations, or policies may be applied. Guidance is non-binding and intended to support consistent decision-making.

Professional Standards. Established benchmarks or criteria used to assess performance, quality, or outcomes. Standards are not independently enforceable unless incorporated into statutes, regulations, rules, or permits.

Technical Assistance. Support services provided by a government agency or partner organization to help regulated entities and/or stakeholders understand requirements and implement programs or projects. Technical assistance is non-binding and intended to facilitate implementation and compliance.

Funding Mechanisms. Grants, loans, bonds, and other financial resources that support the planning, design, construction, and implementation of water reuse programs or projects. Funding may accompany policy or regulatory actions but does not independently establish requirements.

Legal Tools

Instruments that establish requirements and authorize or restrict reuse.

Statute. A law enacted by a legislative body that establishes legal authority and mandatory requirements. Statutes define what is required or prohibited and delegate authority for implementation which is often elaborated upon through regulations.

Regulation/Rules. Enforceable requirements issued by an authorized agency under the authority of a statute to implement and operationalize legislative intent. Regulations have the force of law.

Ordinance. A law adopted by a local governing body (e.g., city council or county board) that establishes legally enforceable requirements within a specific jurisdiction. Ordinances often implement or supplement state law and regulations at the local level.

Permits. Formal approvals issued by the permitting authority that authorize specific activities under defined conditions. Permits apply existing statutes, regulations, rules, or ordinances to individual projects or entities and are enforceable through compliance requirements, monitoring, and reporting.

Levels of Jurisdictional Authorities

Jurisdictional authority refers to the agency or governmental entity empowered to develop or enforce compliance with statutes, regulations, rules, permits, and ordinances.

Federal Role

Federal agencies do not directly regulate water reuse. However, two existing federal laws are relevant:

- The **Safe Drinking Water Act (SDWA)** establishes national minimum standards for drinking water quality and provides a framework for state primacy. The SDWA empowers the U.S. Environmental Protection Agency (EPA) to set national minimum standards for drinking water quality, with states having primary enforcement authority (i.e., primacy) if they meet EPA requirements. States can (and often do) adopt more stringent tailoring requirements to state-specific circumstances (e.g. potable reuse). Primary drinking water standards do not apply to non-potable or industrial reuse. SDWA also requires the EPA to set federal requirements to prevent injection into subsurface geology from contaminating underground sources of drinking water. States can also assume primacy for Underground Injection Control (UIC) program implementation, which impacts indirect potable reuse applications.

- The **Clean Water Act (CWA)** regulates discharges of pollutants to surface waters and governs wastewater treatment and pretreatment programs. The CWA regulates discharges of pollutants to surface waters (rivers, lakes, oceans) through NPDES permits. CWA regulations play a large role in the management of wastewaters that may be included in a reuse initiative but does not regulate water that is intentionally reused unless that water is eventually discharged to surface water. Under the CWA, states are charged not just with managing individual discharges but considering the implications of multiple discharges cumulatively on water quality in surface waters. Water body health is impacted by both the pollutant loadings discharged and the quantity of water returned to the water body. Reuse projects again can play a role in both.

While neither statute explicitly regulates water reuse, they provide the broader legal and regulatory framework within which water reuse programs are developed and implemented. EPA administers programs authorized under statutes such as the SDWA and CWA, while states often assume primary implementation and enforcement responsibilities and may adopt requirements that are more stringent than federal standards. Other federal statutes, such as the Food Safety Modernization Act (FSMA), may also influence how recycled water is used in agricultural settings.

To date, explicit federal involvement in water reuse has largely focused on:

- Building awareness about water reuse
- Supporting the development of technical guidance and resources
- Funding research and demonstration projects
- Advancing scientific understanding and risk assessment

One major example is the EPA's Water Reuse Action Plan, which provides a collaborative framework for addressing technical, institutional, and financial barriers while supporting state and local implementation.

FOR MORE INFO:

National Water Reuse Action Plan (U.S. EPA, 2020)

Water Reuse Action Plan 2.0 (U.S. EPA, 2026)

State Role

States play a significant role in developing and implementing water reuse policy within their jurisdictions. While federal statutes such as the SDWA and CWA establish overarching regulatory frameworks, states often determine how water reuse is addressed through their existing authorities, regulatory programs, and policy priorities.

Authority to Protect Public Health and Safety

States have a long-established role in protecting public health, safety, and the environment. Beyond administering federally authorized programs such as the SDWA and CWA, states often rely on existing state-level authorities when developing water reuse policies and regulatory frameworks.

Examples of other state laws and regulation relevant to water reuse include:

- Building codes
- Plumbing codes
- Professional licensure requirements

These authorities provide an important foundation for state water reuse frameworks and influence how reuse projects are designed, implemented, and overseen.

Water Rights Law

State authority also extends to the allocation and management of water resources. While federal law governs certain navigable waters, state and local laws generally govern surface water rights and groundwater management. Understanding a state's water rights framework is therefore an important consideration when evaluating water reuse policy options.

Water rights law, together with state water planning efforts, may also influence interest in water reuse by informing decisions related to water supply reliability, economic development, and environmental protection (see Figure 3-1).

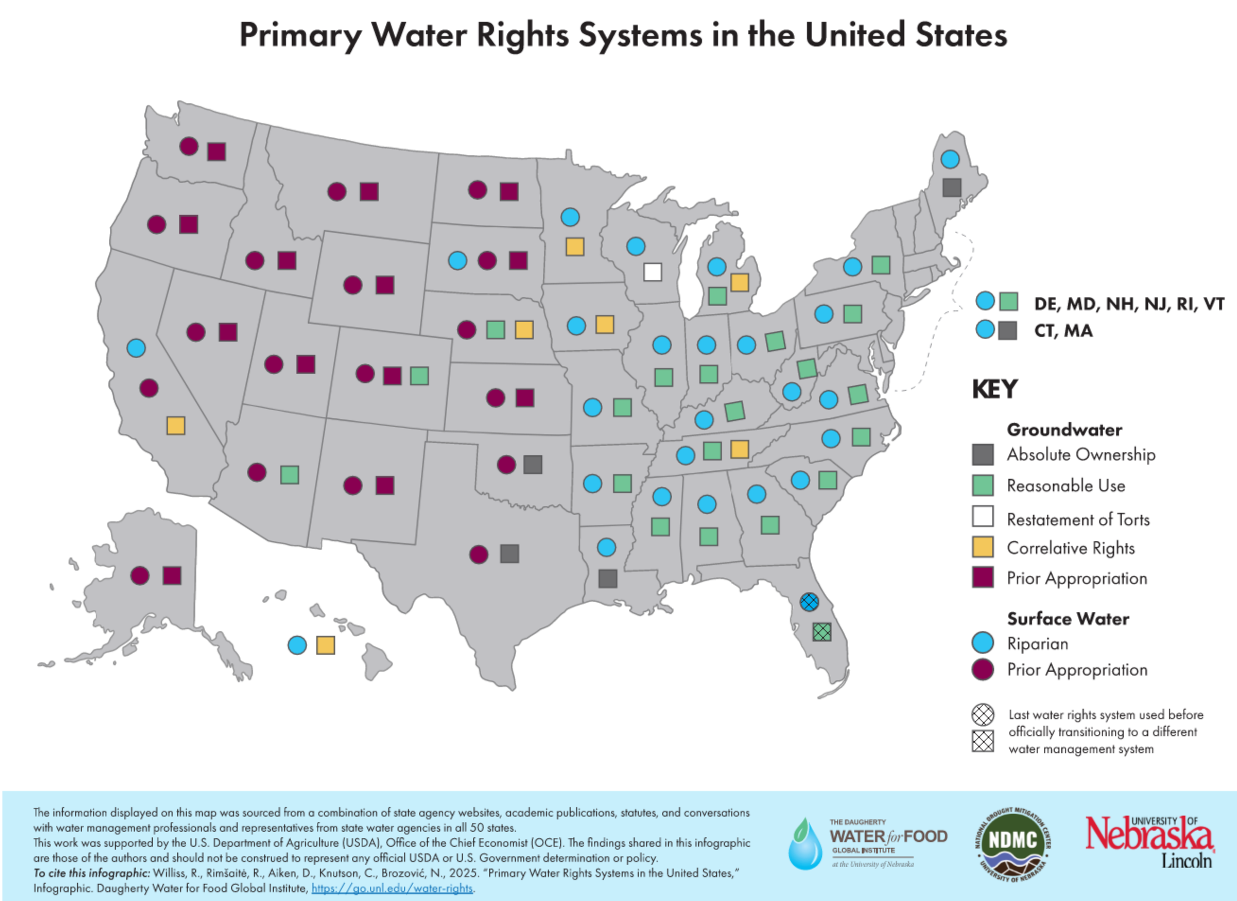

Figure 3-1. Primary water rights systems in the U.S.

Source: Williss et al. 2025

State Authority and Local Powers

The authority available to local governments is established through state law. This authority can influence which regulatory, governance, funding, and service delivery tools are available to local entities.

For example, state law may affect:

- Adoption of health and safety codes

> **FOR MORE INFO:**
>
> [The Balancing Act: Understanding the Role of State and Local Government]

- Formation of regional authorities
- Authority to collect fees
- Provision of services beyond jurisdictional boundaries

As a result, implementation of community-scale water reuse programs often depends on authorities delegated by the state to local governments.

State Corporation Commissions

In some states, utility oversight responsibilities also extend to state corporation or public utility commissions. These entities may determine service territories and review utility investments and expenditures that are recovered through rates and fees. Their decisions can influence the implementation of community-scale water reuse programs.

FOR MORE INFO:

[Regulations and End-Use Specifications Explorer (REUSExplorer) | US EPA]

State Water Reuse Frameworks

State approaches reflect the unique combination of state-specific determinants including:

- Hydrology
- Available and anticipated water supply
- Local and agency structure and capacity
- Population density and distribution
- Distribution of water uses
- Public perception

As a result, there is no single model for water reuse governance. Approaches that work well in one state may not translate directly to another. The range of existing state approaches is illustrated through EPA's REUSExplorer resource (U.S. EPA, 2026).

Local / Regional Role

Local and regional entities may also have authority over certain aspects of water reuse where that authority has been delegated by the state. In many cases, water reuse initiatives are locally led and implemented within broader state policy frameworks. In other instances, state or regional policies may more actively encourage, facilitate, or establish conditions that support water reuse adoption as part of broader water resource management objectives. Examples include Florida's reuse programs, California's long-standing investment in recycled water, and water management initiatives in portions of the Great Lakes region.

These entities cannot establish requirements that are less stringent than applicable state standards, although they may impose additional conditions where authorized by state law.

Examples of local or sub-state authorities include:

- Regional water quality boards
- Special districts or authorities
- Local health departments

Because water reuse often involves multiple areas of jurisdiction and expertise, establishing and implementing reuse programs frequently requires coordination among state, regional, and local agencies.

Types of Agencies Typically Involved with Water Reuse Projects

The variability of how water reuse projects are regulated from state-to-state means that multiple agencies might be connected to regulatory oversight, but with different focuses. For the purpose of this guide, we focus primarily on the agencies at the state level.

Common State Agencies

Within state government, multiple agencies are often involved in governing different components of a reuse project. Governance of reuse is best understood as a Venn diagram of overlapping authorities with the degree of overlap varying state by state.

- **Public Health Agencies** typically manage a broad portfolio of community health topics ranging from senior care to communicable disease to public health standards. Some departments of health oversee SDWA primacy, private wells standards, and septic tank regulations, but more broadly speaking these agencies have the most direct link to the medical community and serve as an authoritative voice on environmental health topics.
- **Environmental Agencies** typically oversee CWA and SDWA primacy as well as other environmental statutes. Even when located within the same state agency CWA and SDWA implementation often operate under numerous separate administrative structures. These agencies may play a role in water resource management and oversee groundwater protection program implementation. For example, the city of Columbus and the New Albany region worked collaboratively with OhioEPA for the successful development of an industrial park in Ohio.
- **Building, Plumbing, and Code Offices** can be significantly removed from the state health department or environmental agency in state government organization. Also, different codes can reside in different administrative branches. These offices do typically maintain a clear channel of communication with local government agencies that implement their codes. These state programs are particularly relevant for onsite reuse systems. They are often the basis for dual plumbing, cross-connection control, and building-scale treatment and reuse installations, ensuring that reuse systems do not compromise potable water systems or public safety.
- **Agriculture, Food, and Industry-Related Agencies** may be involved when reuse affects agricultural production, food processing, or industrial operations. These agencies address product safety, sanitation, crop protection, and process compatibility, and their involvement depends on the intended end use of the recycled water.

Each state also takes its own approach to how authority and responsibility for implementation is retained by the state or delegated to local government. It is worth noting that the actual list of agencies relevant to the reuse discussion can expand dramatically from this list. For example, if a reuse program aims to promote reuse in schools, then state school environmental health programs may be involved. Similarly, if a state seeks to support reuse within industrial parks or broader economic development initiatives, economic development agencies may play a role in project planning, infrastructure coordination, funding, or implementation.

Determine the Governance Landscape in Your State

There is no one-size-fits-all model for the development and implementation of water reuse regulations. Each state, together with its partners, must determine how reuse fits within its own legal authority, agency structure, and policy context. While this Guide provides a framework, it cannot account for the unique history or governance in every state, making it essential for stakeholders to understand their own state and the specific governance landscape before starting any policy revision or development.

As a starting point to understand jurisdictional authority for a specific state and reuse application, consider the following:

Existing Statutory Authority

State statutes should include the following information:

- Key definitions
- Assigned authorities
- Enabling language related to reuse or water quality oversight
- The scope and limits of agency powers

Existing regulations and guidance further clarify:

- How agency authorities are implemented in practice
- Areas where responsibilities overlap
- Existing implementation challenges
- Delegation of responsibilities across agencies

Agency Authorities and Responsibilities

Water reuse oversight may involve multiple agencies. Relevant considerations often include:

- The scope of an agency's assigned authority
- The scope and limits of agency powers
- How authority is delegated within the agency
- Reliance on other agencies or programs to support implementation

Regulatory and Policy Frameworks

Agencies that commonly play a role in water reuse oversight may include:

- Departments of health
- Environmental protection agencies
- Water resource or water quality boards

Interactions Among Authorities

Understanding how authority is distributed across agencies can help clarify:

- How responsibilities overlap or interact
- Known implementation challenges within the current governance structure
- Opportunities for coordination among agencies with related responsibilities

Gauging Readiness for Policymaking

Readiness refers to how much incentive exists to change or create new rules. Readiness is a combination of understanding what existing regulations apply to your specific type of reuse application and the ease with which you can navigate this process. Simply put, some states may not have regulations for reuse, but a permitting pathway exists that makes it feasible to pursue recycled water projects regardless.

Even if it would be helpful to have a new or modified statute in place, there are other factors that might affect the timing and willingness of elected officials to support rulemaking. Potential considerations follow:

Political Landscape

- **Leadership transitions and election cycles:** Imminent changes in the governor's office may signal shifts in agency leadership and regulatory priorities, causing turnover or delays. Agencies often pause or slow rulemaking during election years to avoid political sensitivity or loss of continuity.
- **Policy priorities of the administration:** State-level priorities (e.g., economic development, environmental protection, infrastructure modernization) influence the extent to which water reuse fits into the political agenda.
- **Engagement history with elected officials:** If elected officials and agency leadership are unfamiliar with reuse or have limited exposure to water sector or infrastructure issues, practitioners may need dedicated time for education and dialogue before advancing proposed rule changes.
- **Inter-governmental dynamics:** The relationships between enforcement agencies, environmental boards, and legislative committees matter significantly. Each plays a unique role in rulemaking, and misalignment across them can delay or complicate progress.

FOR MORE INFO:

Community Engagement Strategies for Reuse: A Practical Guide

Water Reuse Communications Library

Public Perception

- **Public trust in government:** States navigating high profile controversies or strained government–public relations may experience heightened skepticism. This can amplify the need for community engagement, education, and transparency. Creation of water recycling regulations may bolster public acceptance and confidence in recycled water because it will clarify that public health is being well protected.
- **Awareness of local water issues:** If the public recognizes drivers like drought, growth pressures, or resource constraints, they are often more open to water reuse. If not, rulemaking may require a parallel effort to build foundational understanding.
- **Perception of local utilities:** When utilities are seen as reliable "anchor institutions," their messages about reuse carry more weight. Where trust is weaker, additional engagement strategies may be necessary.

Industry and Economic Development

- **Industry demand for reliable water supplies:** Large water-dependent sectors (e.g., data centers, semiconductor manufacturing, or food and beverage producers) may accelerate interest in reuse regulations and permitting frameworks, especially if reliable supply is a limiting factor. Focus group discussions emphasized that influential industries could shape rulemaking priorities.
- **Economic development priorities:** States aiming to attract new industries may pursue clearer reuse regulations to signal stability, predictability, and environmental stewardship. Conversely, competing economic or budget priorities can slow regulatory modernization.

While new or revised regulations may help address identified barriers, policy changes can also create unintended effects that influence implementation, stakeholder relationships, and future decision-making. For that reason, practitioners should evaluate regulatory needs within the context of the broader political, institutional, and economic environment in which change will occur.

Common Institutional Pathways for Policymaking

Depending on the policy objective and the available statutory authority, different legislative, regulatory, permitting, or guidance mechanisms may be appropriate. States have generally developed or implemented water reuse through one of four broad institutional pathways, which reflect how those policy tools are applied within a given statutory and regulatory context. The pathway available in a particular state is often shaped by existing laws and governance structures rather than a discrete choice among alternatives.

- **Modify an existing statute and its rules (A).** Used when an existing statute addresses reuse but requires legislative amendments, along with corresponding rule changes, to expand authority, clarify scope, or allow for new types of reuse applications.
- **Modify existing rules without changing statute(s) (B).** Applied when existing statutes provide sufficient authority for reuse and agencies can update or adopt rules to address new reuse applications, performance standards, or oversight needs.
- **Adopt a new statute and new rules (C).** Necessary where existing statutes do not authorize reuse or provide clear regulatory direction, requiring both new legislation and regulation.
- **Existing permitting authorities and implementation guidance remain sufficient (D).** Applied when existing permitting authorities, administrative practices, or implementation guidance provide sufficient flexibility to support reuse projects without the need for reuse-specific legislation or regulation.

Figure 3-2 illustrates these common institutional pathways and the associated legislative and regulatory processes that may occur within each pathway. Specific requirements and sequencing will vary by state.

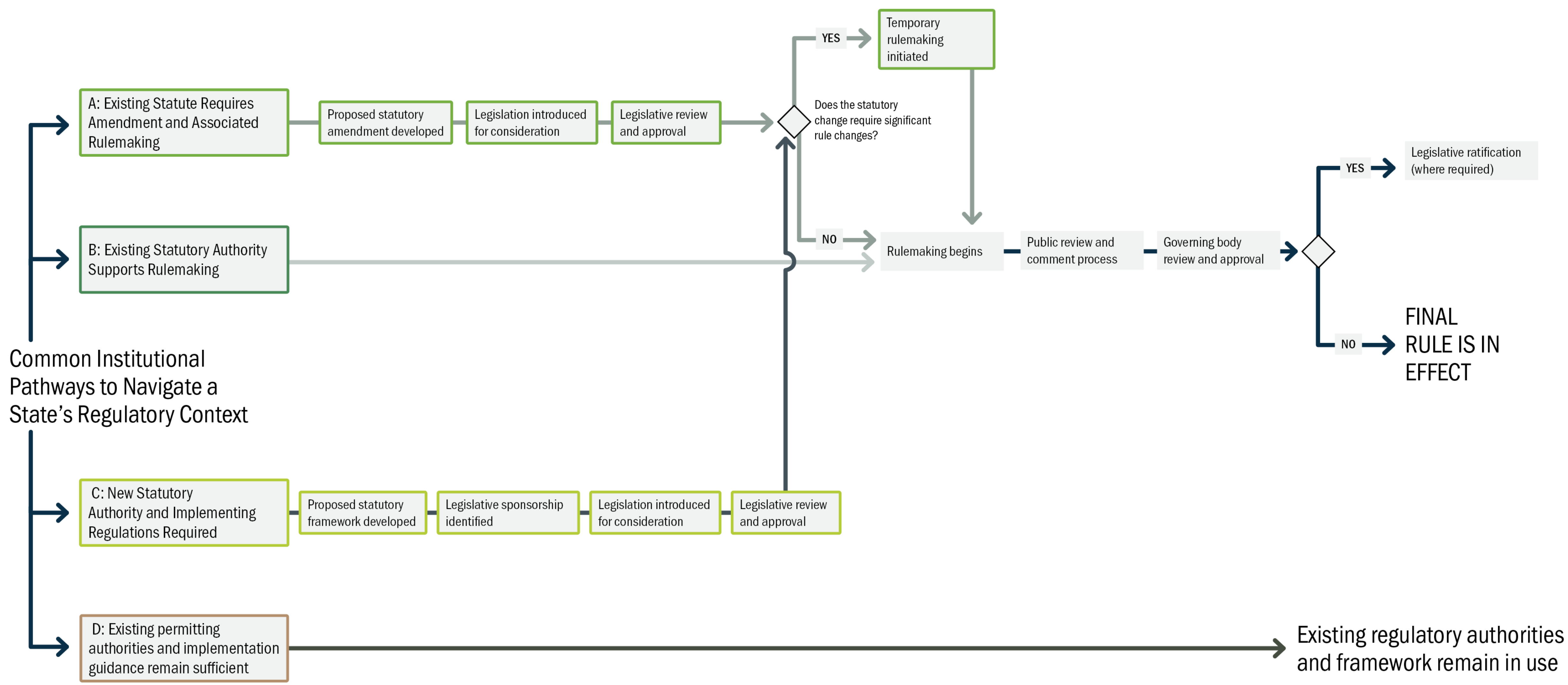

Figure 3-2. Institutional pathways through which water reuse regulations may be developed, modified, or implemented[5].

[5] The pathways available in a particular state depend on existing statutory authority, regulatory structures, and governance processes.

Section 4

Navigating the Rulemaking Process

What you need to know

This section outlines the typical phases of the water reuse rulemaking process and what practitioners should focus on at each stage. It highlights common challenges, engagement strategies, and decision points that shape how water reuse regulations move from concept to adoption.

Four Phases of Rulemaking

Rulemaking takes time and is not always linear. However, there are typically four major phases that stakeholders might encounter during the process:

- **Discovery.** Defining why reuse is being considered, which reuse applications are relevant, and how existing statutes, regulations, and authorities apply.
- **Initial Engagement.** Early alignment and trust-building through structured conversations with regulators, partners, and stakeholders before positions harden.
- **Evaluation.** Testing proposed approaches for technical soundness, regulatory defensibility, and real-world feasibility using data, pilots, and existing frameworks.
- **Adoption.** Formalizes and implements rules, translating regulatory intent into workable requirements, guidance, and enforcement practices.

The phases organize common functions associated with policy development. They do not represent a universal or strictly sequential process. Depending on the state, pathway, and reuse application, phases may overlap, occur in a different order, or be revisited as legal authority, technical information, or implementation needs evolve. For example, a state may move through Evaluation and Adoption once to establish statutory authority, then revisit those same functions later when developing implementing regulations.

Discovery Phase

The Discovery Phase focuses on understanding the conditions that shape if and how water reuse may advance within a state. This includes understanding why reuse is being considered, how existing legal and regulatory frameworks apply, who may be involved in future rulemaking discussions, and whether changes to statutes, regulations, or permitting approaches are likely to be necessary.

Key Considerations

- **State-Level Drivers.** Water reuse is often pursued for different reasons across states and regions, including water supply reliability, environmental objectives, economic development, population growth, or infrastructure needs. Understanding these drivers can help explain the level of interest in reuse and the broader policy context within which future decisions may be made.
- **Reuse Applications.** Different reuse applications, including potable, non-potable, onsite, and industrial reuse, may be governed through different regulatory programs, authorities, and levels of oversight. Identifying the applications under consideration helps establish the regulatory and institutional context for subsequent discussions.
- **Regulatory Landscape.** Existing statutes, regulations, permits, guidance documents, and agency authorities often shape how reuse is currently implemented and what opportunities or constraints may exist for future policy development. Consideration is typically given to which agencies have jurisdiction, how authority is distributed across programs, and whether existing permitting pathways already support the intended reuse application.
- **Rulemaking Readiness.** States vary in their readiness and incentive to pursue rulemaking. In some cases, existing permitting pathways may be sufficient to support reuse projects without creating new regulations. In others, statutory, regulatory, or institutional barriers may create interest in modifying the existing framework. Understanding the relationship between current practices and desired outcomes can help clarify whether rulemaking is an appropriate pathway for change.
- **People, Roles, and Interests.** A wide range of organizations and individuals may influence or be affected by water reuse policy discussions, including regulators, utilities, industry representatives, consultants, environmental organizations, elected officials, and community members. Understanding the interests, responsibilities, and perspectives associated with these groups can help inform future engagement efforts. Illustrative approaches may include stakeholder mapping, listening sessions, interviews, surveys, focus groups, or exploratory discussions.
- **Public Understanding and Engagement.** Early assessment may document the community's familiarity with water reuse, prior experiences with utilities or regulatory agencies, local concerns, trusted information sources, and opportunities for participation. Understanding this context can help identify information needs and inform engagement during later phases.
- **Institutional Capacity.** Capacity considerations may include the legal, technical, financial, staffing, and organizational resources available to support potential rulemaking activities and future implementation. These considerations may apply both to entities responsible for developing regulations and to those that would ultimately be responsible for complying with them.

Table 4-1. Common Challenges and Potential Mitigation Approaches Encountered During the Discovery Phase

Common Challenges	Potential Mitigation Strategies	Illustrative Example
Differing views on the purpose of reuse and the problem being addressed	• Identify state-specific drivers and objectives early. • Develop a clear problem statement linked to those drivers. • Test messaging internally before broader stakeholder engagement.	**Florida (Potable Reuse).** Participants described how conversations became more productive once discussions shifted from potable reuse as a technology initiative to potable reuse as part of a broader water supply reliability strategy linked to statewide water resource planning objectives.
Lack of shared terminology for discussing reuse applications and drivers	• Start with commonly accepted definitions and existing state terminology where available. • Distinguish between end use, source water, and regulatory objectives. • Document terminology that requires clarification before broader discussions begin.	**Indiana (Industrial Reuse).** Initial discussions revealed differing interpretations of "reuse" among participants. Establishing common terminology helped determine whether the issue represented a project-specific exception or broader interest in future rulemaking.
Limited agreement on whether rulemaking is needed or which pathway is appropriate	• Focus first on the problem being addressed rather than preferred solutions. • Review prior attempts, existing authorities, and current permitting approaches. • Evaluate whether existing pathways can support the intended reuse application before considering regulatory changes.	**Texas (Onsite Reuse).** Reviewing both successful and unsuccessful reuse efforts helped participants better understand existing barriers and whether modifications to current approaches were warranted.
Unclear or fragmented regulatory authority across agencies	• Identify agencies with jurisdictional authority or oversight responsibilities • Document how authority is distributed across programs. • Surface areas requiring interagency coordination before advancing policy discussions.	**Utah (Non-Potable Reuse).** Early discussions highlighted overlapping responsibilities across water quality, environmental, and water resources programs, prompting additional coordination before decisions on future regulatory approaches were made.
Reliance on a single champion rather than broader institutional support	• Engage multiple programs and organizations early in the process • Document unresolved questions, information gaps, and alternative perspectives. • Build awareness across agencies and stakeholder groups rather than concentrating ownership with one individual or program.	**California (Direct Potable Reuse).** The development of DPR regulations involved multiple agencies, expert panels, and advisory groups over an extended period. Participants noted that broad institutional involvement helped sustain momentum through leadership changes and multiple stages of technical review.
Limited understanding of existing permitting pathways and regulatory constraints	• Inventory existing permits, policies, guidance, and regulations that may apply to reuse. • Identify where projects are already proceeding under existing authorities. • Clarify what barriers are regulatory versus technical, financial, or institutional.	**Virginia (Surface Water Augmentation).** Participants noted that understanding how reuse projects had advanced through existing permitting and water quality programs helped frame subsequent discussions about whether additional reuse-specific requirements were needed.

Note: Examples reflect information provided through project interviews, workshops, focus groups, and review of state-specific regulatory and policy materials during development of the Guide. They are intended to illustrate specific challenges and approaches discussed during the engagement process and do not represent comprehensive case studies of each state's reuse program.

Initial Engagement Phase

The Initial Engagement Phase focuses on building shared understanding among regulators, utilities, practitioners, industry representatives, and other interested parties before specific rulemaking approaches or technical positions become firmly established. This stage is often characterized by exploratory discussions that help clarify interests, opportunities, constraints, and potential paths forward. These conversations can help establish the foundation for future technical, regulatory, and stakeholder engagement activities.

FOR MORE INFO:

Multi-agency Water Reuse Programs: Lessons for Successful Collaboration (Report, U.S. EPA & WateReuse Association)

Key Considerations

- **Alignment and Shared Understanding.** A common understanding of the drivers, opportunities, and challenges associated with water reuse within the state or region can be beneficial for establishing consistent expectations across stakeholders. At this stage, discussions typically focus on understanding perspectives and identifying areas of common interest rather than advancing specific regulatory approaches or language.
- **Early Regulator Engagement.** Early discussions with those with regulatory authority can help clarify existing limits to authority, responsibilities, institutional constraints, and potential areas requiring further evaluation. These conversations may also provide insight into how different authorities view emerging reuse opportunities and what considerations may influence future rulemaking efforts.
- **Communication and Public Engagement.** Early engagement can establish shared understanding of the reuse application, the regulatory process, and the public health protections under consideration. Engagement approaches should reflect the local context and clearly communicate what decisions are being considered, how input will be used, and which requirements remain subject to technical or regulatory authority.
- **Readiness and Available Policymaking Pathways.** With an understanding of the current policy environment identified during Discovery, stakeholders can start evaluating which institutional pathways are available to them for policymaking. In some cases, stakeholders may begin developing a conceptual policymaking roadmap that identifies the preferred regulatory approach, including key decision points, anticipated stakeholders, and areas where additional information or coordination may be needed.
- **Coalition Building and Coordination.** Early engagement can support opportunities for coordination among utilities, regulators, practitioners, industries, environmental organizations, and other interested parties. In some states, these relationships evolve into formal working groups, advisory committees, or other collaborative structures that support continued information sharing throughout the rulemaking process.

Table 4-2. Common Challenges and Potential Mitigation Approaches Encountered During the Initial Engagement Phase.

Common Challenges	Potential Mitigation Strategies	Illustrative Example
Early discussions begin before there is a shared understanding of the reuse application or objectives.	• Clarify the reuse application, drivers, and anticipated outcomes before engaging broadly. • Frame early discussions as exploratory rather than decision-making forums. • Establish a common understanding of the problem to be addressed before discussing solutions.	**Indiana (Industrial Reuse).** A single industrial facility inquiry prompted regulators to evaluate how reuse fit within existing authorities. Participants noted that establishing common terminology and a shared understanding of what constituted "reuse" was necessary before determining whether a project-specific permitting approach or broader rulemaking effort was needed.
Regulators perceive engagement as advocacy for a predetermined outcome rather than a collaborative discussion.	• Engage regulators as technical and policy partners rather than decision-makers being asked to approve a proposal. • Focus discussions on questions, constraints, and information needs rather than preferred solutions. • Use examples and lessons learned to support discussion rather than promote a single pathway.	**Colorado (DPR).** Stakeholders, technical experts, and regulators participated in iterative discussions that examined options, technical considerations, and implementation concerns before specific regulatory language was developed.
Regulatory staff are managing competing priorities and limited capacity.	• Align engagement activities with existing regulatory schedules and workloads where possible. • Use structured discussions focused on specific questions or decisions. • Clearly communicate how stakeholder input will be used.	**Minnesota (General Reuse).** Participants discussed long-term uncertainty associated with future funding and resource availability, highlighting how staffing and program capacity can affect the ability of regulatory agencies to sustain engagement and advance rulemaking efforts.
Engagement occurs within agency silos rather than across programs with shared responsibilities.	• Include drinking water, wastewater, public health, environmental, and other relevant programs early in discussions. • Establish regular coordination mechanisms where multiple agencies have responsibilities. • Create opportunities for agencies to discuss shared interests and overlapping authorities.	**Oklahoma (Non-Potable Reuse).** Participants described using a 30–40 person workgroup consisting of regulatory agencies, utilities, and industry representatives. The multi-agency structure helped build awareness across programs and supported coordination among organizations with shared responsibilities.
Participants have different expectations regarding timelines, outcomes, or decision-making authority.	• Communicate the purpose of engagement activities and the anticipated decision-making process. • Discuss statutory, procedural, and institutional constraints that may affect timing. • Use examples from similar efforts to illustrate realistic expectations.	**Tennessee (Potable Reuse).** Participants described using multiple volunteer workgroups to review national examples and adapt lessons learned to state-specific needs, helping build shared understanding before advancing regulatory development.

Note: Examples reflect information provided through project interviews, workshops, focus groups, and review of state-specific regulatory and policy materials during development of the Guide. They are intended to illustrate specific challenges and approaches discussed during the engagement process and do not represent comprehensive case studies of each state's reuse program.

Evaluation Phase

The Evaluation Phase focuses on whether proposed regulatory approaches are technically sound, implementable, and consistent with the state's legal, regulatory, and institutional context. During this phase, concepts identified through earlier discussions are examined in greater detail using available research, technical information, regulatory precedent, operational experience, and stakeholder input. The objective is not to eliminate all uncertainty, but to develop sufficient confidence that a proposed approach can be justified, implemented, and sustained over time.

States approach this phase differently depending on available resources, technical complexity, and reuse applications under consideration. Existing regulatory frameworks, pilot studies, advisory groups, expert reviews, and interagency coordination are commonly used to inform decision-making.

Key Considerations

- **Technical Foundations and Evidence.** Regulatory language is often informed by available research, pilot studies, operational experience, risk assessments, engineering evaluations, and other technical information. Consideration is generally given to whether sufficient evidence exists to support proposed health benchmarks, treatment requirements, monitoring approaches, operational expectations, or other regulatory provisions.
- **Regulatory Defensibility.** Proposed requirements are evaluated to determine whether they can be supported within existing statutory authority and whether they can be justified scientifically, legally, and procedurally. This may include assessing consistency with existing state programs, reviewing regulatory precedents from other jurisdictions, and understanding how similar issues have been addressed elsewhere.
- **Implementation and Enforcement Feasibility.** Regulatory requirements may be evaluated through the lens of implementation, permitting, compliance, monitoring, and enforcement. Considerations often include the availability of technical tools, staffing capabilities, operator qualifications, program administration needs, and the practical implications of proposed requirements for regulated entities and oversight agencies.
- **Public Understanding and Confidence.** As regulatory concepts become more defined, engagement can help identify public questions, explain the basis for proposed public health protections, and clarify how stakeholder input has informed the evaluation. Technical defensibility and public understanding are distinct considerations, and both may affect implementation.

Table 4-3. Common Challenges and Potential Mitigation Approaches Encountered During the Evaluation Phase.		
Common Challenges	**Potential Mitigation Strategies**	**Illustrative Example**
Limited technical, staffing, or financial capacity to conduct state-specific technical evaluations.	• Adapt existing frameworks, research, guidance, and regulatory approaches where appropriate. • Focus resources on state-specific questions that remain unresolved. • Leverage expert panels, advisory groups, and partner organizations to supplement internal capacity.	**Multiple States (DPR).** Participants from multiple states described relying on examples from California, Colorado, Arizona, Florida, Texas, EPA science, and national guidance because limited staff capacity and compressed timelines often prevent extensive state-specific technical evaluations.
Difficulty coordinating across regulatory programs with overlapping responsibilities.	• Clarify agency roles and decision-making responsibilities early. • Create opportunities for routine coordination among drinking water, wastewater, public health, and environmental programs. • Establish shared technical review processes where appropriate.	**Utah (Non-Potable Reuse).** Participants described utilities being directed between drinking water and water quality programs until agency leadership established a coordinated approach, illustrating the need for clear roles and interagency collaboration.
Insufficient data or operational experience to support confidence in proposed requirements.	• Use pilot studies, demonstration projects, operational data, and research findings where available. • Focus new data collection on key uncertainties. • Leverage validated treatment performance information and accepted certification programs when appropriate.	**Nevada (IPR).** Participants described using pilot projects, quantitative microbial risk assessment studies, and research partnerships to build confidence in proposed technical requirements and support development of DPR regulations.
Difficulty reaching consensus on technical requirements and risk management approaches.	• Use technical advisory panels, expert working groups, or peer review processes. • Clearly document assumptions, uncertainties, and tradeoffs. • Separate technical evaluation from regulatory decision-making where possible.	**Tennessee (Potable Reuse).** Participants described using working groups and applicability assessments that compared California, Colorado, Arizona, and Florida regulations together with EPA science to support discussions regarding pathogen reduction requirements and technical criteria.
Questions regarding implementability, permitting, compliance, and enforcement.	• Evaluate proposed requirements against existing permitting and compliance programs. • Assess staffing, operator qualification, monitoring, and reporting implications. • Consider how requirements would function for different utility sizes and reuse applications.	**Texas (DPR).** Participants described using site-specific permitting and evaluation approaches to assess how treatment and operational requirements could be implemented within existing regulatory structures.
Stakeholder concerns influencing confidence in proposed approaches.	• Coordinate technical evaluation with stakeholder engagement and communication activities. • Address significant concerns early in the evaluation process. • Clearly communicate the basis for technical and regulatory decisions.	**Utah (Non-Potable Reuse).** Participants described how public opposition slowed rulemaking when outreach was insufficient, highlighting the importance of addressing stakeholder concerns early and coordinating technical evaluation with public engagement efforts.

Note: Examples reflect information provided through project interviews, workshops, focus groups, and review of state-specific regulatory and policy materials during development of the Guide. They are intended to illustrate specific challenges and approaches discussed during the engagement process and do not represent comprehensive case studies of each state's reuse program.

Adoption Phase

The Adoption Phase focuses on formalizing and implementing water reuse regulations following the evaluation and refinement of proposed regulatory approaches. During this stage, concepts are translated into enforceable requirements and supporting implementation frameworks. Depending on the state and type of reuse application, adoption may involve administrative, legislative, board-level, or other approval processes. Implementation activities often continue well beyond formal adoption as agencies, utilities, operators, and other stakeholders adapt to new requirements and gain experience applying them in practice.

Key Considerations

- **Formal Adoption Processes.** Administrative, legislative, or regulatory procedures are typically required to establish new or revised requirements. These processes may include public notice, stakeholder review, public comment periods, hearings, response to comments, and formal approval by the responsible authority. Requirements and timelines vary significantly across states and regulatory programs.
- **Implementation Frameworks and Administrative Readiness.** Guidance documents, permitting tools, implementation procedures, compliance frameworks, and other supporting resources may be needed to administer new requirements. Capacity of regulatory agencies and regulated entities impacts the ability to consistently interpret, implement, and oversee new regulations.
- **Workforce and Operational Readiness.** Successful implementation depends on having the technical, managerial, and operational capacity needed to support compliance, both in the regulatory authorities overseeing compliance and for impacted stakeholders. Depending on the reuse application, considerations may include operator training, certification requirements, monitoring programs, reporting systems, permit administration, and ongoing technical support.
- **Public Communication and Continued Engagement.** Communication during adoption and implementation should explain the final requirements, the public health protections they establish, how public input was considered, and what opportunities remain for continued engagement. Communication needs may evolve as regulations move into permitting and implementation.
- **Implementation Support and Incentives.** Some states complement regulatory requirements with supportive mechanisms that are intended to facilitate adoption and encourage participation. Examples may include technical assistance, training programs, pilot projects, grant funding, financing programs, phased implementation schedules, or other approaches that reduce barriers to implementation.
- **Long-Term Adaptability and Continuous Improvement.** As technologies, science, and implementation experience evolve, states may consider how regulatory frameworks can be updated and refined while maintaining regulatory certainty and public health protection.

Table 4-4. Common Challenges and Potential Mitigation Approaches Encountered During the Adoption Phase.		
Common Challenges	**Potential Mitigation Strategies**	**Illustrative Example**
Limited regulatory capacity to implement and administer new requirements.	• Develop implementation guidance, permitting tools, and internal procedures alongside rule adoption. • Identify staffing and resource needs prior to implementation. • Align implementation schedules with regulatory capacity.	**Tennessee (Potable Reuse).** Participants noted that legislative directives often must move through multiple layers of review while being implemented by agencies with existing workload commitments, highlighting the importance of considering administrative capacity during implementation.
Workforce readiness and operator training requirements.	• Evaluate whether existing certification programs are sufficient. • Develop supplemental training, endorsements, or certification requirements where necessary • Phase implementation to allow workforce development.	**California (Potable Reuse).** Stakeholders consistently identified operator expertise and advanced treatment system operations as important implementation considerations during development of potable reuse requirements
Public concerns emerge during formal adoption or early implementation.	• Maintain transparency throughout adoption • Clearly communicate how public input influenced final requirements. • Coordinate public communication with implementation activities.	**Utah (Non-Potable Reuse).** Participants described how public opposition slowed rulemaking when outreach occurred too late in the process, illustrating the importance of maintaining communication and stakeholder engagement as regulations move toward adoption and implementation.
Political, legislative, or administrative timing affecting adoption.	• Consider election cycles, board schedules, legislative calendars, and leadership transitions when planning adoption activities. • Build support across multiple stakeholder groups. • Account for potential schedule changes.	**Tennessee (Potable Reuse).** Participants described how legislative priorities, procedural review requirements, and approval timelines influenced when reuse-related actions could move forward, independent of technical readiness.
Translating adopted requirements into consistent permitting and implementation practices.	• Develop permitting guidance and implementation tools. • Use early permits and projects to identify areas needing clarification. • Refine guidance as implementation experience grows.	**Washington (Potable Reuse).** Participants noted that numerous successful non-potable reuse projects helped establish familiarity with reuse among regulators and practitioners, providing practical experience that informed subsequent implementation discussions for new reuse applications.
Limited willingness to advance new reuse applications without demonstrated success.	• Reference existing projects and regulatory programs from other jurisdictions. • Share implementation lessons learned. • Highlight operational experience where appropriate.	**California (Potable Reuse).** Participants frequently referred to the Orange County Groundwater Replenishment System (GWRS) as an example of how long-term operational success can build confidence among regulators and support broader adoption of potable reuse.
Uncertainty regarding implementation support, incentives, and risk-sharing mechanisms.	• Consider technical assistance, phased implementation, pilot programs, funding support, or other implementation tools. • Evaluate how support mechanisms complement regulatory requirements. • Assess whether specific reuse sectors face barriers not addressed through regulations alone.	**Minnesota (General Reuse).** Participants noted concerns about future funding availability, demonstrating how implementation support mechanisms and resource commitments can influence long-term success after regulations are adopted.

Note: Examples reflect information provided through project interviews, workshops, focus groups, and review of state-specific regulatory and policy materials during development of the Guide. They are intended to illustrate specific challenges and approaches discussed during the engagement process and do not represent comprehensive case studies of each state's reuse program.

State Regulatory Guidance Workshop

From Building Blocks to Policy: Developing Effective Water Reuse Regulations

41st Annual WateReuse Symposium
Los Angeles, California

Scenario-based discussions at the WateReuse Symposium (March 2026).

Putting the Guide into Action

The project team facilitated a scenario-based workshop for 60 to70 participants focused on translating the Guide's building blocks into practical rulemaking pathways.

Through four scenarios representing different water reuse applications, attendees worked through the phases of rulemaking (Section 4) and the regulatory building blocks (Section 5) to inform discussion and shared learning.

Connecting the Phases of Rulemaking and the Regulatory Building Blocks

The phases of rulemaking describe when decisions occur, while the building blocks define what must be addressed. Workshop participants emphasized that.

During the workshop, participants used the graphic below to work through scenarios and reflect on how their states have navigated the phases of rulemaking and the associated building blocks.

Scenarios Covered

Non-potable reuse: Municipal and landscape irrigation (non-potable reuse)

Indirect potable reuse: Groundwater recharge or surface water augmentation

Direct potable reuse
Onsite non-potable reuse: Toilet flushing, cooling, irrigation

Industrial reuse: Data center cooling

Lessons Learned

Most states are still early in rulemaking. Most groups identified both in scenarios and reality being in Discovery or Initial Engagement. It is important to clearly articulate the "why" for regulation before advancing technical requirements.

Institutional capacity (Building Block 7) emerges early and continues to shape decisions across all rulemaking phases.

Phased, adaptive frameworks are preferred. Participants cautioned against trying to resolve every issue in a single rulemaking effort and favored iterative approaches that can evolve with experience, emerging risks, and growing capacity.

Section 5

Building Blocks to Support Regulatory Language for Rulemaking

What you need to know

This section provides a framework for those evaluating or developing technical considerations during the rulemaking process. Organized into seven categories, these elements are drawn from established drinking water and wastewater regulatory practices.

The "Building Blocks" outline the major technical elements essential to designing and regulating a water reuse system. Each building block provides:

- The rationale for its significance in the rulemaking (and design) process for a water reuse system,
- Adjustments that might be needed for different types of reuse applications,
- A foundation for the technical language, and
- Recommendations and guidance to help facilitate productive conversations with the regulatory community.

As outlined in Figure 5-1, these include identifying health risk benchmarks, characterizing source water, identifying water quality goals, implementing engineered controls, and conducting ongoing verification. Together, they form a framework that synthesizes current scientific knowledge and legislative structures, many of which originate outside reuse but are also critical to the states that have adopted regulations for water reuse. These foundational building blocks define how reuse schemes will be regulated to protect public health. This guide offers options for consideration, recognizing that what states ultimately adopt will require some level of effort and cost for administration and compliance. Each state will need to evaluate this balance within the context of specific types of reuse applications to determine what makes the most sense.

While the Building Blocks are presented as distinct technical components, they are highly interconnected and are often considered iteratively rather than sequentially during the rulemaking process (i.e., developing specific requirements to implement a statute related to water reuse). In practice, progress in one building block may inform, refine, or require revisiting others as assumptions are tested, data gaps are identified, and policy objectives evolve. As a result, states may engage with these building blocks in different orders or concurrently, depending on the reuse application, regulatory context, and level of existing knowledge.

The intent of this document is not to specify technical details associated with every combination of source water and end use, but to provide enough information to inform regulatory recommendations for different combinations.

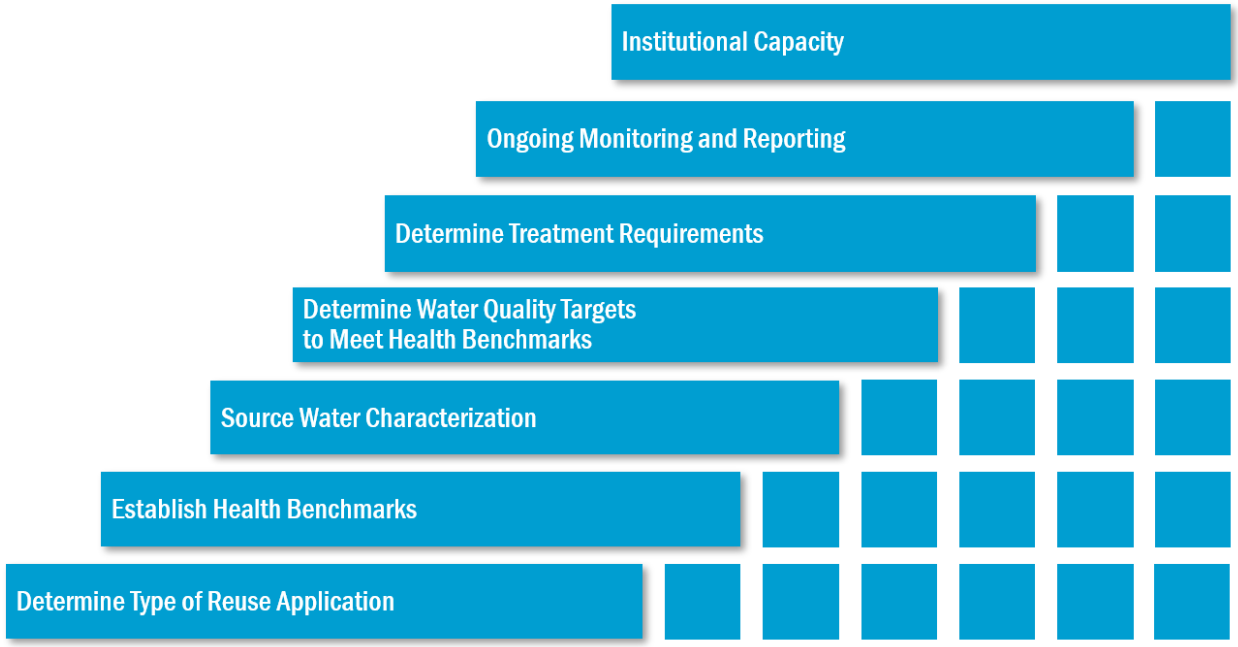

Figure 5-1. Building blocks for developing reuse regulation requirements

Building Block 1: Determine Type of Reuse Application

Summary

Determining the type of reuse is a foundational step that informs all subsequent technical, regulatory, and institutional decisions addressed in the other Building Blocks. Before a state can establish health-based targets or select treatment and monitoring requirements, it must clearly define why water reuse is being pursued, who the water will serve, and how the water will be used. This Building Block establishes that foundation by clarifying the intended end use, degree of human exposure, water quantity and reliability expectations, and the regulatory and institutional context within which reuse will occur.

Decisions Informed by This Building Block

Building Block 1 informs a set of early crosscutting decisions that shape the overall regulatory framework and constrain or enable choices in later Building Blocks. Specifically, this Building Block supports decisions about:

- Which reuse applications the state intends to regulate (e.g., industrial reuse, agricultural irrigation, non-potable municipal reuse, potable reuse)
- What reliability and performance expectations must be met to support the intended uses and users
- Which regulatory pathways and authorities apply and whether existing frameworks can be adapted or new rules are needed
- What existing policy mechanisms, statutes, and regulations already govern or influence reuse, and where gaps, conflicts, or enabling authorities exist

- Who must be engaged during rulemaking, and at what level to address technical credibility, public trust, and implementability

These decisions establish the boundaries and assumptions that inform treatment targets, monitoring frameworks, permitting structures, operational controls, and governance approaches addressed in subsequent Building Blocks.

Key Considerations

Defining the type of reuse, drivers, and reliability needs

Prior to developing health targets, states need a foundation that defines the end use, defines the users, and frames what water quality and quantity/reliability is needed.

Understanding the "Why"

The first step in confirming the type of reuse needed is articulating the purpose and drivers. These shape the appropriate regulatory approach and influence decisions about treatment, monitoring, stakeholder engagement, and implementation timelines. Clearly documenting the "why" helps states distinguish among reuse applications that may appear similar on the surface but require different regulatory responses.

Defining End Uses and Users

Confirming the type of reuse requires a clear definition of:

- **End uses,** e.g., industrial cooling, irrigation, environmental enhancement, potable supply
- **Users,** e.g., industrial operators, municipalities, the general public, agricultural producers
- **Pathways of exposure,** including both intended and incidental human contact

These elements determine the degree of human exposure and, therefore, the level of health protection that must be achieved.

QUESTIONS TO DISCUSS:

What are the intended end uses of the reused water?

Who are the direct users, and who may be indirectly exposed?

What exposure pathways are plausible under normal operating conditions?

How might uses or users evolve over time in ways that would affect exposure considerations?

Do existing regulatory definitions clearly accommodate these uses and users?

Water Quantity Requirements

Water quantity considerations go beyond total volume and include reliability, variability, and operational constraints. Key considerations include:

- **Demand profile**: Average and peak demands, seasonal variability, and growth projections
- **Reliability expectations**: Whether the reuse supply must be continuous, interruptible, or supplemental
- **Storage needs**: Requirements to manage mismatches between supply and demand
- **System integration**: How reuse interacts with existing water supply and wastewater systems

For example, industrial reuse applications often require highly reliable, consistent flow, which may necessitate redundancy, backup supplies, or contractual supply guarantees. In contrast, irrigation with recycled water may tolerate greater variability but require higher peak capacity during specific seasons. These quantity and reliability considerations influence system design, contractual arrangements, and long-term financial planning.

Water Quality Drivers

Water quality drivers are requirements for the intended end use and the full range of downstream impacts associated with that use. Confirming the type of reuse allows states to identify which constituents matter and at what concentrations while considering human health and ecological outcomes together rather than in isolation. Key elements include:

- **Exposure pathways**: including direct ingestion, incidental contact, aerosolization, and indirect exposure via soils, crops, or receiving waters affecting workers, recreational users, nearby residents, and the general public
- **Constituents of concern**: Pathogens, nutrients, metals, salts, organic compounds, or emerging contaminants
- **Ecological and environmental considerations**, including nutrient loading, salinity, metals, and other constituents that may affect soils, groundwater, surface waters, or sensitive ecosystems

QUESTIONS TO DISCUSS:

What human health outcomes are most sensitive to water quality for this reuse type?

What ecological impacts (e.g., nutrients, salts, metals) may occur even when human exposure is limited?

While many reuse water quality requirements are driven by human health endpoints, other impacts (i.e., ecological) may be equally important to regulatory development depending on the reuse type. For example, irrigation reuse may raise concerns related to nutrient loading, salt accumulation, or long-term soil and groundwater impacts. Industrial reuse applications may be constrained less by public health considerations and more by water quality parameters needed to maintain reliable industrial system performance. For these applications, water quality targets may be driven more by the intended industrial use and system performance needs than by regulatory requirements that focus on human or ecological health.

As illustrated in Figure 5-2, reuse applications with a higher likelihood of human exposure generally require higher levels of treatment and more robust monitoring and control frameworks. Confirming the reuse type at this stage also helps align ecological objectives with human health goals, and that regulatory requirements address the full set of risks and outcomes associated with the intended use.

QUESTIONS TO DISCUSS:

What operational water quality requirements are critical for system performance or processes?

Which constituents of concern drive risk for this application?

How should human health protection, environmental protection, and operational feasibility be handled?

When human exposure is low, what non-health impacts still warrant regulatory controls?

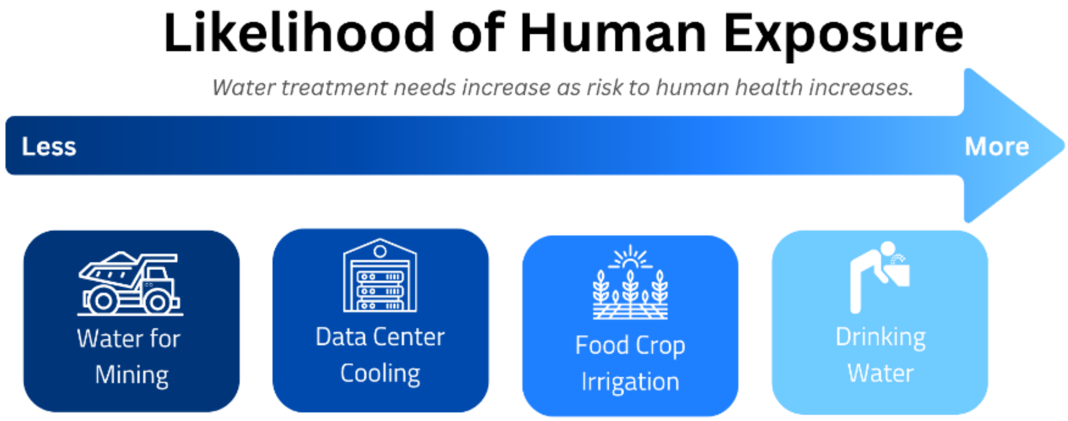

Figure 5-2. Likelihood of human exposure and the relative level of treatment and monitoring rigor needed to protect public health. Source: U.S. EPA 2025.

Existing regulatory pathways and jurisdictional authority

Confirming the type of reuse also requires an early assessment of regulatory authority and institutional roles. Different reuse applications may fall under different statutory authorities or require coordination across multiple agencies. This assessment includes evaluating the current policy landscape to understand what mechanisms already exist, how they are being used, and whether they support or constrain the intended reuse application.

For example, industrial reuse may involve:

- Discharge permits for source wastewater
- Reuse-specific permits or approvals
- Coordination with occupational safety or environmental agencies

Identifying these jurisdictional and legal relationships early helps surface gaps that must be addressed in later Building Blocks, particularly Building Block 7, where governance, compliance, and accountability mechanisms are developed in detail.

QUESTIONS TO DISCUSS:

Which agencies have authority over this type of reuse?

What existing statutes, regulations, policies, or guidance already apply?

Are current policy mechanisms being actively used, underutilized, or applied inconsistently?

Can existing frameworks be adapted, or are new rules required?

What gaps, overlaps, or conflicts exist in authority?

What legal or policy instruments are needed (e.g., permits, guidance, contracts, Memorandums of Understanding-MOUs)?

Stakeholders and level of engagement during rulemaking

The type of reuse also determines who needs to be engaged, when, and how. Stakeholder engagement strategies should be scaled to the level of public interest, technical complexity, and potential controversy associated with the reuse application. Different stakeholder engagement approaches have been taken by States as highlighted below.

- **Staff-led development with stakeholder input**, as in Colorado's development of Regulation 84 for non-potable reuse.
- **Research driven rulemaking with expert review**, as in California's development of Title 22 direct potable reuse regulations, supported by state funded research and an invite-only external expert panel.
- **Open technical working groups**, as used in the development of potable reuse rules in Florida, Colorado, and Tennessee, allowing broad participation by experts and practitioners.

It is worth noting that rulemaking engagement activities can be resource-intensive, often requiring significant staff time, technical expertise, stakeholder engagement, and, in some cases, support from external consultants or subject matter experts. Leveraging existing technical resources, guidance documents, and frameworks have the potential to help reduce the time and effort needed to develop reuse regulations for multiple source waters and end uses.

With the type of reuse confirmed, states are positioned to move from defining the problem into the subsequent Building Blocks with clarity about the technical considerations those decisions are intended to support.

QUESTIONS TO DISCUSS:

Who is directly or indirectly affected by the reuse application?

What level of public interest or concern is expected?

What technical expertise is required to inform rulemaking?

How transparent and inclusive should the process be given the reuse type?

What engagement approach best supports credibility, trust, and implementability?

Building Block 2: Establish Health Benchmarks

Summary

Federal regulations already establish health benchmarks for drinking water under the SDWA and for treated wastewater discharged to the environment under the Clean Water Act (CWA). In the context of water reuse, regulators must assess how recycled water aligns with these frameworks and whether additional health benchmarks are warranted based on the intended end use.

Health risk benchmarks are commonly categorized as pathogen risks and chemical risks (including both non-carcinogenic and carcinogenic effects). Reuse guidelines and/or regulations should be grounded in established risk assessment approaches, while recognizing that reuse systems differ widely in source water quality and exposure pathways.

Pathogens are often prioritized in public communication and risk management because they present immediate, acute health risks, whereas chemical risks typically arise from long-term exposure. These risks are not additive or directly comparable: actions that reduce acute risks, such as disinfection, may introduce long-term risks through disinfection byproducts. Risk interactions are further complicated by variability in individual susceptibility and health endpoints. In addition to health-based considerations, non-technical factors (e.g., public perception) can shape how benchmarks are set. The relative importance of pathogen, chemical, and ecological risks will vary by source water and end use. While pathogen risks are a primary consideration for many municipal reuse applications, other reuse applications (e.g., industrial reuse or produced water reuse) may be driven more by chemical, operational, or ecological considerations, particularly for non-municipal source waters.

Decisions Informed by This Building Block

- Specify an approach for choosing the benchmark for pathogen risk mitigation
- Identify chemicals that should be considered for the intended source water-end use combination
- Identify potential ecological risk implications of the intended source water-end use combination

Key Considerations

Pathogen Risk Benchmarking Approaches

Core Risk Characteristics

For reuse applications involving source waters with fecal contamination (e.g., municipal wastewater, graywater, rainwater), pathogens are the primary drivers of acute, short-term illness risk and have historically been the dominant focus of water reuse regulations. These risks also tend to have higher public visibility and generate greater public concern than other types of risk.

Pathogen Risk Paradigms

Infection risk is the concern for pathogens because they pose acute health risks (e.g., gastrointestinal issues), which are immediate and require careful consideration. Regardless of the type of reuse, the pathogen end health benchmarks remain consistent in the intention to protect public health.

Epidemiological and Quantitative Microbial Risk Assessment (QMRA) based approaches are best understood as points along the same scientific continuum. Epidemiological approaches are grounded in observed public health outcomes, while QMRA reflects more recent advances in pathogen characterization, data availability, analytical tools, and exposure modeling. Both approaches rely on best available science, are protective of human health and are designed to achieve the same public health outcome: limiting infection risk to an acceptable benchmark.

Regulators have historically applied two primary approaches to mitigating pathogen risks across different reuse end uses:

- **Quantitative Microbial Risk Assessment Approach:** Systematic assessment of the likelihood of negative health consequences, such as infections or illnesses, when a population is exposed to pathogens. This method can be used to determine the corresponding level of treatment needed to reduce risk to a defined acceptable value. Follows the process of hazard identification, exposure assessment, dose response, and risk characterization. As described in EPA's 2025 *Risk-Based Framework for Developing Microbial Treatment Targets for Water Reuse*, QMRA is applied in a fit-for-purpose manner, supporting microbial treatment targets (e.g., pathogen log reduction requirements) that are protective of public health for specific reuse applications and exposure scenarios.

- **Epidemiological Risk Assessment Approach:** Uses historical epidemiological evidence to establish that treatment barriers or indicator-based parameters to mitigate pathogen risks for specific source water–end use combinations, typically for non-potable end uses. States with existing epidemiology-based regulations may continue to rely on those historical frameworks while incorporating emerging risk-based tools, such as QMRA, as science and regulatory needs evolve.

FOR MORE INFO:

QMRA:

Risk-Based Framework for Developing Microbial Treatment Targets for Water Reuse (U.S. EPA, 2025)

National Primary Drinking Water Regulations | US EPA

Potable Reuse - Guidance for Producing Safe Drinking Water (WHO, 2017)

EPIDEMIOLOGICAL RISK:

Risk-Based Framework for the Development of Public Health Guidance for Decentralized Non-Potable Water Systems (WRF, 2017)

A Guidebook for Developing and Implementing Regulations for Onsite Non-Potable Water Systems (US Water Alliance & WRF, 2017)

2012 Guidelines for Water Reuse (U.S. EPA, 2012)

Chemical Risk Benchmarking Rationale

Core Risk Characteristics

Chemical risks are primarily associated with chronic, long-term exposure rather than acute health effects. These risks include both carcinogenic effects, which are evaluated based on excess lifetime cancer risk, and threshold-based, non-carcinogenic effects, for which adverse outcomes are not expected below defined exposure levels.

Chemical Risk Categories

To identify acceptable chemical risk benchmarks, existing regulations should be the first place to look, including but not limited to SDWA, CWA, FSMA, and state specific regulations. For constituents without regulatory standards, other health-based guidance values (e.g., health advisory limits and notification levels) may provide appropriate risk benchmarks.

Chemicals in this category may include aesthetic standards highlighted in the SDWA to improve public acceptance of reuse. If the end use necessitates consideration due to risks not captured by existing regulation, unregulated chemicals may be considered for risk benchmark development:

- For non-carcinogenic chemicals, risk is typically evaluated by comparing estimated exposures to reference doses (RfDs), which represent daily exposure levels that are not expected to result in adverse health effects.
- Carcinogenic risks, i.e., excess lifetime cancer risks (ELCRs), may be quantified for chemicals that are known or suspected human carcinogens with cancer slope factors. The U.S. EPA outlines a goal of between 10^{-4} and 10^{-6} excess lifetime cancer risk for drinking water (see sidebar references).

Figure 5-3 provides a graphical depiction of how chemical risk benchmarks may be developed, and Building Block 4 discusses considerations for quantifying exposure.

FOR MORE INFO:

[2017 Potable Reuse Compendium | US EPA]

[2018 Edition of the Drinking Water Standards and Health Advisories Tables (EPA 822-F-18-001)]

QUESTIONS TO DISCUSS:

What exposure pathways are realistic for the intended reuse application?

Are there credible risks that fall outside of the existing regulatory frameworks?

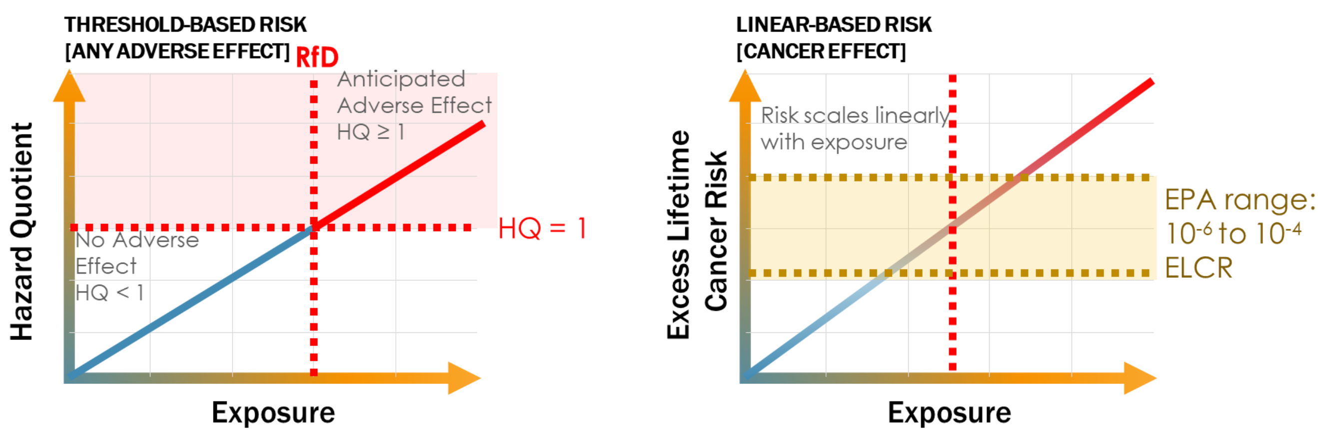

Figure 5-3. Chemical risk characterization approaches

Considerations for Ecological Risk

Core Risk Characteristics

Ecological risks are associated with potential impacts to non-human receptors, including aquatic and terrestrial species, habitats, and ecosystem functions. Unlike pathogen risks, which focus on direct human health outcomes, and chemical risks, which often center on long-term human exposure, ecological risks consider how changes in water quality, quantity, or timing may affect ecological communities over time. These risks are typically context-specific and depend on local environmental conditions, receiving waters, and sensitive species present.

Regulatory Context

Many ecological risks related to water reuse are addressed through CWA–based regulatory programs that are designed to protect aquatic life and designated uses of water bodies. These programs are rooted in the establishment and implementation of:

- **Water quality criteria** developed to protect aquatic life and ecological integrity within a specific water body. Ecological evaluations may also consider U.S. EPA Aquatic Life Benchmarks, which provide screening-level values for assessing potential risks that chemical exposures may pose to aquatic organisms and can support ecological risk evaluations where applicable (U.S. EPA, 2026).
- **Total maximum daily loads (TMDLs)** that define allowable pollutant loads needed to meet water quality standards
- **Waste load allocations** assigned to individual non-domestic industrial and commercial sources (referred to here as *dischargers*) to ensure collective compliance with applicable ecological thresholds.
- **Nutrient application limits or agronomic loading rates** that control land application of nutrients to match crop needs and minimize impacts to soil, groundwater, and receiving waters.

FOR MORE INFO:

EcoRisk Portal | US EPA

National Recommended Water Quality Criteria - Aquatic Life Criteria Table | US EPA

Overview of Total Maximum Daily Loads (TMDLs) | US EPA

QUESTIONS TO DISCUSS:

Are existing CWA based programs and requirements sufficient to protect ecological receptors under anticipated reuse conditions?

Would the reuse application introduce new exposure pathways, stressors, or cumulative effects not fully addressed by current regulatory mechanisms?

Can ecological risks be effectively managed through existing permitting, monitoring, or watershed based tools, rather than through new reuse specific ecological benchmarks?

Building Block 3: Source Water Characterization

Summary

Source water characterization establishes whether the quality and variability of the source water are appropriate for the intended reuse application and its associated regulatory framework. .

Municipal wastewater has a long track record of being used as source water for both potable and non-potable reuse applications. As a result, there is quite a bit of research on characterization of municipal wastewater for accompanying source water regulations. Expansion of reuse applications has also opened the door for a more diverse set of source waters, including industrial wastewaters.

Decisions Informed by This Building Block

- When additional source water characterization is necessary to support rulemaking
- Which source water assumptions can be standardized versus evaluated case by case
- How variability in source water can be addressed through monitoring and treatment
- What characterization expectations belong in regulation versus guidance

Key Considerations

Identifying Source Water Type and Implications for Characterization

Municipal Wastewater

Municipal wastewater has historically been the most common source for reuse applications, leading to more established characterization data and regulatory assumptions compared to other source water types. This source is understood to reflect a mixture of domestic flows, commercial and industrial contributions, and, in some cases, hauled wastes or special discharges. The extensive body of municipal wastewater characterization data has enabled the development of state-of-the-science reference pathogen density datasets that can support regulatory development for both potable and non-potable applications and reduce the need for extensive site-specific monitoring (U.S. EPA, 2025). Some regulatory frameworks rely on standardized municipal wastewater assumptions and default pathogen treatment requirements (e.g., California), while others allow or require site-specific source water characterization to inform treatment requirements (e.g., Texas). Colorado's DPR framework includes provisions for both approaches.

FOR MORE INFO:

National Pretreatment Program | US EPA

Resources for Permit Writers | US EPA

QUESTIONS TO DISCUSS:

Why do many reuse regulations rely on assumptions about municipal wastewater?

When is additional source water characterization needed?

Much of the existing understanding of municipal wastewater quality and variability is grounded in decades of implementation of the CWA's NPDES.

As a result, regulatory assumptions for municipal wastewater are informed by:

- Routine influent and effluent monitoring conducted under NPDES permits
- Established pretreatment programs that manage industrial and commercial discharges to municipal sewer systems

- Longstanding use of standardized parameters (e.g., flow, biochemical oxygen demand [BOD], total suspended solids [TSS], nutrients) to evaluate treatment performance and compliance

When reuse applications rely on source waters that diverge from these assumptions, additional source water characterization may be needed to assess whether established regulatory expectations remain appropriate.

Other Types of Source Water

Some reuse programs use source waters other than conventionally characterized municipal wastewater, including:

- Municipal wastewater with a higher proportion of industrial or commercial discharges than is typically assumed in reuse regulations
- Pretreated industrial discharges
- Pretreated or partially treated effluent
- Blended, intercepted, or diverted flows
- Onsite collected waters, such as graywater

Considerations for Source Water Characterization

Degree of Exposure

The extent of source water characterization is driven primarily by the intended reuse application and the degree of human exposure associated with that use. This can be thought of through level of exposure:

- Higher-exposure reuse applications (e.g., potable reuse) require:
  - Greater confidence in source water composition and variability
  - Consideration of both typical and worst-case conditions
  - Lower-exposure reuse applications (e.g., some non-potable uses) often rely on: Greater reliance on end-use controls (e.g., crop restrictions, irrigation method restrictions, or prohibited uses) and exposure management measures (e.g., setback distances, signage, controlled public access, or irrigation timing requirements)

  Treatment as the primary protective mechanism

This process should be done in alignment with the *Establishing Health Benchmarks (Building Block 2)* to account for potential human and/or ecological impacts.

FOR MORE INFO:

Municipal Wastewater | US EPA

Pathogen Peak "Averaging" in Potable Reuse Systems: Lessons Learned from Wastewater Surveillance of SARS-CoV-2 | ACS ES&T Water

Design of Water Resource Recovery Facilities (MOP 8) (Water Environment Federation [WEF])

Variability of Quality and Conditions Over Time

Source water quality is dynamic and variability often matters more than average conditions when setting regulatory expectations for reuse. Several factors influence how source water variability should be considered in rulemaking, including:

- Temporal variability, such as:
  - Diurnal and seasonal fluctuations
  - Peak loading or episodic events
  - Changes during disease outbreaks or extreme weather (e.g., drought)
- Influence of upstream activities and system changes, such as:
  - Additional industrial inputs and modifications to existing industrial process
  - Modifications to pretreatment programs
  - Population growth or system expansion

QUESTIONS TO DISCUSS:

How should variability over time (e.g., seasonal changes, episodic events) be accounted for in regulation?

Understanding how source water quality varies over time helps assess the level of treatment robustness needed and identify potential operational vulnerabilities that may not be evident under average conditions. These insights, in turn, inform regulatory decisions about whether reuse rules can reasonably be based on representative source water conditions, such as the reference pathogen density distributions described by U.S. EPA (2025), or whether they should explicitly account for some assumed worst-case scenarios to provide consistent protection.

FOR MORE INFO:

Direct potable reuse monitoring: Testing water quality in a municipal water supply system — Volume 1. (TWDB & WRF, 2014)

Most potable reuse regulations address this through ongoing source water monitoring requirements, typically formalized as part of an enhanced source water monitoring plan, as discussed in *Building Block 5*.

Regulated Versus Unregulated Constituents

Existing regulatory programs already manage many constituents relevant to reuse, with many others indirectly controlled through pretreatment programs and treatment requirements. However, unregulated or emerging constituents may warrant additional consideration in specific contexts, particularly for potable reuse applications or source waters with significant industrial inputs. For example, Orange County Water District's Groundwater Replenishment System demonstrates how source water characterization programs adapt to incorporate emerging and unregulated constituents (i.e., pharmaceuticals and per- and polyfluoroalkyl substances [PFAS]) as science evolves (Dadakis, 2020; Orange County Water District, n.d.).

FOR MORE INFO:

FAQ - Orange County Water District

Orange County Water District: Protecting Groundwater From Pharmaceutical Contamination - Issuu

The distinction between regulated and unregulated constituents becomes more pronounced as reuse applications move closer to direct human consumption:

- For **non-potable reuse**, parameter selection is generally guided by the CWA and state standards, focusing on target parameters including pathogens, solids, organic carbon, nutrients, and metals.
- For **potable reuse**, characterization often extends beyond regulated parameters to include unregulated constituents of emerging concern (i.e., *surrogate and indicator compounds*) and in some cases industry-specific chemicals such as U.S. Food and Drug Administration (FDA) standards for industrial applications.

QUESTIONS TO DISCUSS:

Which constituents are already managed through existing pretreatment, treatment, or water quality programs?

Regulatory decisions in these cases focus on whether additional characterization provides meaningful insights for rulemaking and public health protection, and how to balance that benefit against the potential burden of monitoring requirements that exceed regulatory value or capacity.

Structuring Source Water Characterization Requirements

Decisions about source water characterization are not only technical in nature; they also reflect broader choices about regulatory design, including the appropriate level of prescriptiveness and regulatory burden. While more detailed characterization can increase confidence in treatment efficacy and human health protection, it may also introduce additional cost, administrative complexity, and implementation challenges for both utilities and regulators that may not result in commensurate public health benefits.

From a regulatory design perspective, characterization requirements can be structured in different ways, each with distinct benefits and tradeoffs:

- Prescriptive characterization requirements
  - Provide consistency and clarity across jurisdictions
  - Reduce case-by-case judgment during implementation
  - Can increase regulatory burden and may require data that provides limited incremental value for lower-risk applications
- Tiered characterization frameworks
  - Trigger characterization based on defined criteria such as reuse application, exposure level, or source water characteristics
  - Align data requirements with potential risk
  - Require clearer decision thresholds and greater upfront policy design
- Flexible characterization frameworks
  - Allow regulators to tailor characterization based on site-specific context
  - Provide flexibility for utilities with strong existing data or controls
  - May reduce predictability and increase reliance on regulatory judgment and staff capacity

QUESTIONS TO DISCUSS:

Under what conditions should additional source water characterization be required?

What characterization expectations belong in regulation versus permitting or guidance?

How can characterization requirements be structured to remain scalable across different utilities and reuse types?

Building Block 4: Determine Water Quality Targets to Meet Health Benchmarks

Summary

Evaluating exposure pathways for a given type of reuse helps determine the regulatory controls needed to protect human health and the environment. Anticipated human exposure is quantified using dosage estimates, which are then used to establish pathogen log reduction targets (LRTs) and chemical concentration limits. Ecological exposure can also be quantified specifically to the site through existing measures in the CWA and state regulatory frameworks.

Human exposure may occur through intentional consumption of reuse water or through incidental contact associated with non-potable end uses. Although non-potable uses are not intended for drinking, they are still evaluated from a public health perspective when there is potential for unintentional exposure including ingestion. Pathogens are generally the primary concern for human health protection, while chemicals may pose risks to human health, ecological systems, and industrial process integrity. Ecological exposure is through application of reclaimed water either directly (e.g., wetland creation), or indirectly (e.g., golf course watering) that may result in runoff or infiltration into surface or groundwaters.

Decisions Informed by This Building Block

Source water characterization (*Building Block 3*) identifies parameters of interest that should be accounted for in water quality targets that satisfy health benchmarks (*Building Block 2*). This building block provides context for how to set targets for these parameters. The following methods may be used to locate existing resources to identify limits for pathogens and chemicals. Setting limits aligns with four major considerations:

1. **Exposure Assessment**: Make an assumption about the anticipated exposure of a human to pathogens or chemicals to enable the derivation of pathogen and chemical limits.
2. **Pathogen Limit Derivation**: Identify what, if any, pathogen reduction targets are needed for the specified source water and end use type to mitigate acute risk.
3. **Chemical Limit Derivation**: Identify what, if any, chemical limits should be set to mitigate chronic risks associated with a source water and end use type pairing.
4. **Nutrient Limit Derivation:** Identify the existing regulatory framework in the state and establish a process that addresses parameter loadings that could impact ecological endpoints. Ecological endpoints may be captured within existing NPDES permitting for a wastewater treatment plant (WWTP) or a WWTP whose flows serve as a source water.

Key Considerations

Exposure Assessment

In water reuse, exposure assessment identifies potential exposure pathways and estimates how contact with pathogens or chemicals in reused water could result in health or environmental risks. This process shapes how protective water quality goals need to be for a given reuse application. For example, exposure assessments for potable are typically based on intentional, long-term ingestion of recycled water, whereas exposure assessments for non-potable, onsite, and industrial reuse applications are often based on incidental or indirect pathways that can have lower exposure potential.

FOR MORE INFO:

2018 Edition of the Drinking Water Standards and Health Advisories Tables (EPA 822-F-18-001)

Guidelines for Drinking-Water Quality, 4th edition (WHO, 2017)

For some non-potable reuse applications, inhalation of aerosols may be an important exposure pathway to consider. Aerosols can be generated during activities such as cooling tower operation, spray irrigation, decorative water features, toilet flushing, and certain industrial processes. A recognized concern associated with aerosol-generating reuse applications is exposure to pathogens such as *Legionella pneumophila*, which is primarily transmitted through inhalation rather than ingestion (Hamilton et al, 2018).

Exposure assessments are based on a set of assumptions and inputs that reflect the intended reuse application and potential exposure pathways, including:

- Pathogen or chemical concentration
- Exposure assumptions appropriate for the end use including ingestion, inhalation of aerosols, dermal contact, exposure frequency, and exposure duration (U.S. EPA, 2019)
- Volume of water ingested. Both the U.S. EPA and World Health Organization (WHO) recommend using average water consumption of 2 to 2.4 L/day for the purposes of potable water consumption (U.S. EPA, 2018, 2025; WHO, 2017a).
- Human body mass of specific age groups (only applicable to chemical risk assessment). Exposure assessments often consider sensitive populations, including infants and children, whose exposure assumptions may differ from those of adults and can influence allowable risk-based limits (U.S. EPA, 2019). For adults, U.S. EPA typically assumes that the average mass of a human is 70 kg, whereas WHO assumes people weight 60 kg on average per person (U.S. EPA, 2018; WHO, 2017a).

QUESTIONS TO DISCUSS:

To what extent should water quality goals differ across reuse types?

What level of treated water quality is necessary to support the intended reuse application?

Exposure assessment provides the context for determining whether numeric limits are needed, which risks must be addressed, and how conservative assumptions should be.

Pathogen Limit Derivation

Pathogen limit derivation is the process of translating a health-protective benchmark into regulatory pathogen control requirements for a specific source water and reuse application. This step occurs after an equivalent level of public health protection has been established using approaches such as QMRA-based analyses, epidemiological evidence, or regulatory precedent, as described in *Building Block 2*. Because pathogen concentrations associated with health benchmarks are often difficult to measure directly, pathogen limits are frequently expressed as treatment performance requirements, such as log reduction targets, rather than numerical pathogen concentration limits as shown in Table 5.

Once a health-protective target has been established, regulatory programs may implement pathogen control requirements in different ways. These approaches generally fall into two categories:

QMRA Approach. Pathogen concentration limits or pathogen log reduction targets are derived from health benchmarks using risk-estimation methods such as QMRA, engineering analyses, source water quality data, exposure assumptions, and treatment performance information. These approaches establish a direct connection between the regulatory requirement and the underlying health objective.

Epidemiological Risk Assessment Approach. Compliance is demonstrated through treatment, operational, or performance requirements rather than direct pathogen limits. These frameworks typically rely on established regulatory precedent, epidemiology data, demonstrated treatment capabilities, and treatment performance monitoring.

FOR MORE INFO:

QMRA:

Risk-Based Framework for Developing Microbial Treatment. (U.S. EPA, 2025)

Review of quantitative microbial risk assessments for potable water reuse - Environmental Science: Water Research & Technology (RSC Publishing)

Quantitative Microbial Risk Assessment | Wiley Online Books

EPIDEMIOLOGY APPROACHES:

2012 Guidelines for Water Reuse (U.S. EPA, 2012)

Chemical Limit Derivation

Chemical limits focus mostly on chronic risk management. Reuse-specific characterization activities may also identify unregulated or emerging chemicals of concern (e.g., nitrogenous disinfection by-products, unregulated PFAS of interest). These chemicals may pose potential concern in reuse waters for specific end uses.

Regulated chemicals. Where applicable, existing regulatory limits should serve as the foundation for reuse regulations as discussed in Building Block 2 under Chemical Risk Categories. For chemicals already regulated by the U.S. EPA or the relevant state for specific end uses (e.g., potable water, irrigation), established limits provide regulatory precedent and consistency across programs.

General water quality parameters. Parameters that do not pose direct health risks to humans, such as total dissolved solids (TDS) and alkalinity, but do have implications for water stability, aesthetics, or receiving environment should be considered on a case-by-case basis in alignment with existing regulations for SDWA and CWA.

Unregulated chemicals. Source water characterization activities may identify additional chemicals of concern that are not regulated by EPA (e.g., nitrogenous disinfection by-products, PFAS, etc.) and some chemicals may pose potential concern in reuse waters for specific end uses. For chemicals of potential concern that are not regulated under existing regulations, threshold-based and cancer risk assessment approaches can be used to characterize non-carcinogenic and carcinogenic risks, respectively, and to inform the development of health-based limits.

QUESTIONS TO DISCUSS:

Are numeric water quality goals required, or can performance based goals provide equivalent protection?

How do proposed goals align with existing drinking water or environmental standards?

How should health benchmarks be reflected in water quality goals?

Non-cancer chemicals. To characterize threshold-based chemical risk, hazard quotients (HQ) are used. HQs are the ratio of exposure and the acceptable RfD for a chemical. RfDs may be identified from toxicity databases assembled by the WHO and U.S. EPA for most chemicals (U.S. EPA, 2020; WHO, 2017), and the Water Research Foundation (WRF) for certain pharmaceuticals and personal care products (PPCPs) (Bruce & Pleus, 2015; Jones et al., 2025). Additional work could be done to develop RfDs using literature toxicology data, which should only be undertaken by teams of knowledgeable toxicologists.

Cancer chemicals. To characterize cancer-based risks, an ELCR approach is used. ELCR are quantified by multiplying a chemical dose by the chemical's associated cancer slope factor (U.S. EPA, 2020; WHO, 2017).

Chemicals without health risk information:

While extensive chemical risk assessment methods and databases have been developed, there will always be concern about unknown chemicals with unknown risk implications with regard to any water quality regulation. This concern is not unique to reuse, which is why water quality regulations have been developed to adapt to improved scientific understanding about risks not previously considered. This should also be true of reuse regulations as they are developed. Further, current research shows that application of advanced treatment schemes can reduce risks associated with chemicals below risks of existing raw water supplies (Jones et al., 2025; Lau et al., 2024; Soller et al., 2015; Soller & Nellor, 2007). Between the inclusion of adaptive language for emerging chemicals of concern and the efficacy of advanced treatment, the implications of unknown chemicals with unknown risks should not constitute undue focus but should enable adaptivity to new information.

> **FOR MORE INFO:**
>
> Prioritization and Risk Ranking of Regulated and Unregulated Chemicals in US Drinking Water | Environmental Science & Technology
>
> Quantitative Relative Chemical Assessment to Support Risk Frameworks for Water Recycling | ACS ES&T Water
>
> Framework for Direct Potable Reuse (WateReuse Association, 2015)

Ecological Limit Derivation

Nutrient limits are primarily driven by ecological risk and are often shaped by alignment with existing regulatory programs noted in *Building Block #2*. Reuse regulations should complement, not replace, existing ecological protection programs such as water quality standards or TMDLs, or other ecological protection programs. Reuse-related pollutant loads should not cause exceedances of established environmental thresholds.

Table 5-1. Summary of Log Reduction Targets Across a Variety of States for Potable Reuse.					
State	Scenario	Regulatory Starting Point	Pathogen Target Approach		
Indirect Potable Reuse			Description of requirements above and beyond SDWA and CWA		
California	GWR	WW Effluent	LRTs: 12/10/10 V/C/G + >60-Day Retention + WQ Targets		
California	SWA	WW Effluent	LRTs: >8/7/8 V/C/G +24-Hour Dilution of 100:1 + 120-Day Average Retention + WQ Targets; Add 1-log if 24-Hour Dilution is 10:1; Add 1-log if Average Retention is 60 Days		
Florida	SWA	WW Effluent	WQ targets		
Georgia	SWA	WW Effluent	Unregulated chemicals		
Massachusetts	ASR	WW Effluent	Groundwater discharge permit		
Montana	GWR/SWA	WW Effluent	WQ Targets + oxidation, coagulation, filtration and disinfection barriers		
Nevada	GWR	WW Effluent	LRTs: 12/10/10 V/C/G + WQ targets		
New Mexico	ASR	WW Effluent	Groundwater discharge permit		
North Carolina	GWR/SWA	WW Effluent	Pretreatment mixing barrier		
Oklahoma	SWA	WW Effluent	LRTs: 5/3/3 V/C/G + WQ targets		
	ASR	WW Effluent	Groundwater discharge permit		
Oregon	GWR	WW Effluent	Treatment barriers + WQ targets		
Pennsylvania	GWR/SWA	WW Effluent	WQ targets + disinfection barrier		
Texas	GWR/SWA	WW Effluent	Existing SDWA and CWA framework		
Virginia	GWR/SWA	WW Effluent	WQ targets + disinfection barrier		
Washington	GWR/SWA	WW Effluent	WQ targets + disinfection barrier + 4 LRT virus and filtration in some cases		
Direct Potable Reuse			Virus LRT	*Cryptosporidium* LRT	*Giardia* LRT
Arizona	Standard	Raw WW	13	10	10
	Site Specific	WW Effluent	≥8	≥5.5	≥6
California	Standard	Raw WW	16 (20)**	11 (15)**	10 (14)**
Colorado	Standard	Raw WW	12	10	10
	Site Specific	WW Effluent	≥8	≥5.5	≥6
Florida	Standard	Raw WW	14	12	12
Texas	Site Specific	WW Effluent	≥8	≥5.5	≥6
U.S. EPA	Guidance	Raw WW	14.5	10.5	9.5

Note: ASR = aquifer storage recovery, GWR = groundwater recharge, SWA = surface water augmentation, WQ = water quality, V/C/G = virus/Cryptosporidium/Giardia, WW = wastewater. Specific WQ targets differ by state and range from limits on microbial indicators to specific chemical (e.g., nitrogen species) and physical (e.g., turbidity) water quality characteristics. Also, IPR and DPR regulations are held to SDWA and CWA standards in addition to requirements listed in this table.
***LRT required by regulation add up to 20, 15, and 14 when considering a treatment failure buffer while base case QMRA resulted in 16, 11, and 10 LRT.*
(U.S. EPA, 2026)

Building Block 5: Determine Treatment Requirements

Summary

Treatment requirements vary by end-use and are intended to manage risk associated with pathogens and chemical so that the limits established in *Building Block 4* are met. Building Block 5 addresses how regulations translate water quality goals into treatment and operational requirements.

Decisions Informed by This Building Block

- The degree of regulatory flexibility allowed in treatment requirements (e.g., prescriptive, performance-based, or hybrid approaches)
- Whether source control measures are required, and if so, whether enhanced source control is applied universally or on a project-specific basis
- How treatment requirements differ by reuse application based on exposure potential and pathogen and chemical reduction targets
- The level of testing, demonstration and validation needed to demonstrate treatment performance

Key Considerations

Regulatory Flexibility in Treatment Requirements

A central regulatory decision in developing water reuse requirements is how much flexibility to allow in demonstrating compliance with established health benchmarks and water quality goals. States may define treatment requirements through a prescriptive approach that specifies technologies or configurations, allow flexibility under performance-based approaches, or apply hybrid frameworks that combine elements of both.

Each approach involves tradeoffs. Table 7 summarizes key considerations and tradeoffs associated with prescriptive and flexible treatment technology selection for reuse, highlighting how these approaches differ across regulatory intent, permitting, cost, and allowance for innovation.

> **QUESTIONS TO DISCUSS:**
>
> What level of source control is necessary to achieve established water quality goals?
>
> Should treatment requirements be technology specific or performance based?

Table 5-2. Considerations for Prescriptive and Flexible Treatment Technology Selection for Reuse

Consideration	Prescriptive Approaches	Performance-Based Approaches
Regulatory Intent and Certainty	Establish a predictable framework for compliance requirements Provide clear expectations for regulators and regulated entities	Allow multiple pathways for demonstrating compliance Rely on clearly defined performance criteria to maintain regulatory clarity
Permitting	Require less negotiation on technology selection when default treatment trains are used Typically rely on well-established permitting pathways Where alternatives are allowed, utilities may need to justify equivalency through additional documentation	Allow greater negotiation on technology selection May introduce added uncertainty and variability into the permitting process Can increase review effort depending on the proposed approach

Table 5-2. Considerations for Prescriptive and Flexible Treatment Technology Selection for Reuse		
Consideration	**Prescriptive Approaches**	**Performance-Based Approaches**
Cost	May limit optimization of alternative treatment approaches Can result in higher capital or operational costs where prescriptive configurations are required In some cases, cost may become a barrier to reuse implementation	Enable cost savings through optimization of technology and process selection Allow tailoring to source water quality and end use Support balancing performance, cost, and operational considerations
Innovation	More limited, as substitution of emerging technologies may not be allowed even if performance goals can be met Adoption of new technologies may require regulatory updates	Support research, innovation, and adoption of emerging treatment technologies Allow new approaches to be implemented without frequent changes to regulatory language

Hybrid Approaches

Most state reuse regulations follow a hybrid regulatory approach that combines elements from prescriptive and performance-based approaches. For example, regulations may establish baseline treatment requirements while allowing alternative treatment configurations when equivalent performance can be demonstrated.

Table 5-3 illustrates how California and Colorado implement hybrid regulatory frameworks that establish baseline treatment expectations while allowing alternative technologies when equivalent performance can be demonstrated.

Table 5-3. State Approaches to Treatment Technology Requirements			
State	**Classification/Application**	**Specified Technologies**	**Alternative Technology Approach**
California[1]	Non-Potable Title 22 Disinfected Tertiary	Filtration: granular media or membrane (i.e., MF/UF/NF or RO) Disinfection: chlorine, UV, or validated alternative	Allows the use of alternative treatment technologies for non-potable reuse if they are or are approved through a conditional acceptance process
California[1]	Potable Reuse Title 22 Indirect Direct Potable Reuse	Microfiltration or ultrafiltration followed by reverse osmosis (RO), advanced oxidation process (AOP) (UV/H_2O_2 or equivalent), and stabilization and disinfection prior to environmental buffer (groundwater aquifer or surface water reservoir)	Alternatives or substitutions only if equivalent performance is demonstrated through pilot-scale testing and evaluated by an Independent Expert Panel, then approved by the Division of Drinking Water.
California[1]	Potable Reuse Title 22 Direct Potable Reuse	Ozone followed by biologically activated carbon, microfiltration or ultrafiltration, RO, and AOP UV/H_2O_2 or equivalent AOP processes approved; chlorination is also often added to achieve the required LRVs	Same as Title 22 Indirect Direct Potable Reuse
Colorado[2]	Non-Potable Regulation 84, Category 3 Plus	Filtration (select one): • Conventional filtration • Direct filtration • Membrane filtration • Bag or cartridge filtration Disinfection (select one): • Free chlorine or chloramines • UV light	Allows only filtration and disinfection approaches identified in the regulation or separately accepted by the Division. Alternative technologies must demonstrate compliance with the required performance standards.

Table 5-3. State Approaches to Treatment Technology Requirements			
State	Classification/Application	Specified Technologies	Alternative Technology Approach
Colorado[3]	Potable Reuse Regulation 11, Direct Potable Reuse	Provides lists of accepted treatment techniques under categories of filtration, disinfection, and advanced oxidation for pathogens and chemical reduction.	Alternative treatment techniques must be proposed and accepted by the department based on meeting pathogen reductions and can be applied for in accordance with Policy 5, Design Criteria for Potable Water Systems.

1. California State Water Resources Control Board. California Code of Regulations, Title 22: Water Recycling Criteria (Law Book). Division of Drinking Water, October 1, 2018. Title 22 Code of Regulations

2. Colorado Department of Public Health and Environment (CDPHE), Water Quality Control Commission. Regulation No. 84 – Reclaimed Water Control Regulation, 5 Code of Colorado Regulations (CCR) 1002-84. Colorado Secretary of State. Code of Colorado Regulations

3. Colorado Department of Public Health and Environment (CDPHE), Water Quality Control Commission. Regulation No. 11 – Colorado Primary Drinking Water Regulations, 5 Code of Colorado Regulations (CCR) 1002-11. Colorado Secretary of State. Code of Colorado Regulations 5 CCR 1002-11

(U.S. EPA, 2026)

Managing Variability in Source Water Quality

Source control is the first barrier in any reuse scheme and plays a critical role in managing variability in source water quality by managing industrial contaminants entering the wastewater stream. Effective source control helps protect treatment processes, infrastructure, and public health by reducing the potential for treatment interference, operational disruptions, and unanticipated contaminant loading.

QUESTIONS TO DISCUSS:

How should treatment requirements address variability in source water quality?

The National Pretreatment Program is a federally established program under the CWA and NPDES framework. Implementation may be administered by EPA, an authorized state, or an approved local municipality (Publicly Owned Treatment Works [POTW]), depending on the state's authorization status and the municipality's pretreatment program approval (U.S. EPA, 2026). The National Pretreatment Program (NPP) serves as the baseline source control framework for wastewater treatment systems. Under the CWA, the NPP:

- Provides source control by regulating pollutant discharges from *dischargers*.
- Gives wastewater treatment plants legal authority to establish site-specific pretreatment requirements to prevent pass-through of pollutants and interference with treatment processes.
- Protects WWTPs through maintaining permit compliance by preventing treatment interference and pass-through of pollutants to the effluent or biosolids.
- Does not address reuse-specific requirements (e.g., human health exposure at the point of reuse, trace organic contaminants, and advanced treatment performance requirements).

NPP regulates many contaminants (e.g., metals and toxic industrial pollutants) and water quality conditions (e.g., extreme pH and treatment-interfering discharges) relevant to both wastewater treatment performance and non-potable reuse objectives.

Enhanced source control builds upon the NPP foundation with additional measures designed to support reuse-specific water quality and public health objectives.

FOR MORE INFO:

[WateReuse Association 2015 Framework for Direct Potable Reuse]

[An Enhanced Source Control Framework for Industrial Contaminants in Potable Reuse]

[EPA 2017 Potable Reuse Compendium]

Enhanced Source Control

Enhanced source control builds on baseline pretreatment requirements under the CWA by addressing reuse-specific concerns that are not explicitly managed through the NPP. From a regulatory perspective, enhanced source control helps to manage variability in source water quality and reduce conditions that could challenge advanced treatment performance and/or increase public health risk. Enhanced source control programs may include additional requirements (beyond those established under the NPP), such as:

- Additional source water and collection system monitoring
- Expanded local limits for selected constituents
- Discharge management practices such as blending or segregation
- Treatment or process controls implemented by dischargers

While non-potable reuse regulations typically do not require enhanced source control in addition to existing federal programs (CWA, NPP), state-level pretreatment programs may require stricter source controls depending on the reuse application. For example, reclaimed water used for wetland or stream augmentation may be required to meet additional source control measures to limit nutrients, metals, or other contaminants for protection of sensitive ecosystems.

Considerations for Implementing Enhanced Source Control

A central regulatory decision is whether enhanced source control requirements for potable reuse should be:

- Required as a standard requirement for potable reuse project approval (in addition to existing pretreatment and source control programs); or
- Applied on a project-specific or case-by-case basis, with greater reliance on treatment performance and existing regulatory programs

Several states require utilities to develop and implement an enhanced source control program as part of potable reuse project approval, while others evaluate source control needs on a case-by-case basis. For example, Arizona, California, Colorado, and Florida require an enhanced source control program to be developed and implemented by the utility, whereas Texas regulates potable reuse projects individually, relying more heavily on treatment performance requirements and existing pretreatment and drinking water regulations rather than a standalone enhanced source control program (e.g., Texas Commission on Environmental Quality [TCEQ] 2024; Texas Health and Safety Code § 341.0391 2024)

Enhanced source control requirements may be implemented through different regulatory mechanisms, including:

- Enforceable regulatory requirements, which establish minimum statewide expectations, compliance obligations, and oversight requirements.
- Guidance documents, policies, or utility-specific plans, which provide flexibility for implementation approaches, site-specific conditions, and emerging contaminants or risks.

States use different approaches to implement enhanced source control requirements. Some states incorporate requirements directly into regulation, while others rely more heavily on guidance, policy, or project-specific approvals. For example:

- Arizona codifies enhanced source control requirements directly within its Advanced Water Purification regulations, providing clear and enforceable expectations but limiting project-specific flexibility and making updates more difficult.
- In contrast, Colorado does not codify detailed enhanced source control elements in Regulation 11, instead implementing requirements through Colorado Department of Public Health and Environment policy and project-specific approvals. This allows greater flexibility and faster updates but may reduce consistency across projects.

States also vary in the scope required in enhanced source control programs, including differences in requirements for:

- Industrial user inventories
- Chemical inventories and source characterization
- Collection system monitoring and early-warning programs
- Source control program governance, oversight, and stakeholder involvement

Examples of differences in enhanced source control program scope include:

- Arizona and Colorado require comprehensive, risk-based inventories of non-domestic dischargers and chemicals, whereas California and Florida focus more on chemical tracking within existing pretreatment authority.
- California and Arizona also require enhanced or real-time collection system monitoring and formal source control committees, while Colorado and Florida allow facility-specific monitoring approaches and do not mandate committees.

Treatment Requirements Across Reuse Types

> **QUESTIONS TO DISCUSS:**
>
> **How should treatment expectations differ across reuse types?**

The pathogen and chemical reduction targets discussed in Building Blocks 2 and 4 provide the basis for determining both the level of treatment and barriers required in a reuse treatment train. Treatment barriers include both natural (e.g., soil aquifer treatment and environmental buffers) and engineered unit processes (e.g., filtration, disinfection, or advanced treatment processes like reverse osmosis [RO]). These barriers can be sequenced into a treatment train that provides multiple layers of protection against microbial and chemical contaminants. Regulatory language may prescribe specific treatment technologies, require treatment barriers that provide distinct removal mechanisms for pathogens and chemical control, such as physical separation, adsorption, and advanced oxidation, or combine these approaches. This section describes how pathogen- and chemical-driven targets influence treatment selection and barrier redundancy for reuse applications.

A consideration when establishing reuse treatment requirements is the point at which treatment performance is evaluated and credited. The POTW serves as an important treatment and source-control barrier that can provide solids removal, biological treatment, nutrient reduction, and flow stabilization prior to reuse-specific treatment. The point at which regulatory accounting begins can influence pathogen reduction targets, treatment crediting approaches, monitoring requirements, and the extent to which existing CWA treatment requirements are recognized within a reuse framework.

Non-potable Reuse Treatment Selection Considerations

States generally establish non-potable reuse treatment requirements using a fit-for-purpose approach, where the level of treatment increases with human exposure and environmental impact. Treatment selection is shaped by pathogen and chemical reduction objectives, which regulations typically define through specified treatment technologies, end-use-specific water quality criteria, or both.

(Non-potable) Pathogen Reduction Requirements. Pathogen reduction[6] requirements generally increase with the potential for human exposure associated with the reuse application. To illustrate this point, lower-exposure end uses such as irrigation of non-food crops, industrial cooling, and dust suppression generally require a lower level of treatment (e.g., secondary treatment). In contrast, higher-exposure end uses involving public contact, such as unrestricted landscape irrigation or recreational impoundments, require a higher level of treatment that may require treatment barriers beyond secondary treatment (e.g., filtration and disinfection) to meet health benchmarks.

(Non-potable) Chemical Requirements. Chemical requirements are generally addressed through CWA-based effluent standards and end-use-specific limits on constituents such as nutrients, metals, and salinity. While pathogen control often drives treatment barrier selection, additional treatment may be required for applications with stringent nutrient or receiving-water requirements, such as irrigation, industrial reuse, or discharge to nutrient-sensitive waters.

Common (Non-Potable) Treatment Processes. To meet pathogen and chemical reduction targets, common treatment processes[7] downstream of secondary treatment may include:

- **Enhanced biological treatment.** Enhanced biological treatment may be required to achieve nutrient removal objectives, particularly for ammonia, total nitrogen (TN), nitrate, and total phosphorus (TP). Common enhanced biological treatment processes include nitrification-denitrification processes for nitrogen removal (e.g., Modified Ludzack-Ettinger [MLE] and 4- or 5-stage Bardenpho configurations) and enhanced biological phosphorus removal (EBPR) processes that incorporate anaerobic and aerobic treatment zones to promote biological phosphorus uptake and removal.
- **Filtration.** Filtration may be required to provide additional removal of suspended solids, protozoa (e.g., *Giardia*, and *Cryptosporidium*), bacteria, and other particulate-associated contaminants. Filtration technologies can include conventional media filtration, direct filtration, cloth media filtration, bag or cartridge filtration, microfiltration (MF), and ultrafiltration (UF).
- **Disinfection.** Disinfection may be required to achieve pathogen reduction requirements. Common disinfection technologies include chlorination, chloramination, and ultraviolet (UV) irradiation.

[6] Pathogen reduction is commonly addressed through indicator-based approaches that are verified through operational parameters such as turbidity, UV dose, and chlorine CT. However, some non-potable reuse frameworks, particularly onsite reuse systems, use QMRA-based LRTs to establish required pathogen reductions (U.S. EPA, 2025). In these cases, treatment selection is based on achieving specified pathogen reduction targets through validated treatment barriers, similar to potable reuse approaches.

[7] Blending, while not treatment, is sometimes used in non-potable applications. For example, potable water may be blended with reclaimed water for cooling tower use.

Potable Reuse Treatment Selection Considerations

Potable reuse regulations require a multiple-barrier treatment approach. Treatment selection is driven primarily by pathogen reduction requirements and chemical reduction targets. Together, these requirements determine the number, type, and diversity of treatment barriers needed to provide reliable public health protection.

(Potable) Pathogen Reduction Requirements. For pathogen reduction, states establish minimum LRTs for enteric viruses, Cryptosporidium, and Giardia. Individual treatment processes are assigned Log Reduction Value (LRV) credits based on validation testing, and the cumulative LRVs across the treatment train must meet the required LRTs.

Table 5-4 summarizes representative pathogen LRV credits assigned to individual treatment processes. These values illustrate the range of credits that may be recognized under current IPR and DPR treatment frameworks. To demonstrate compliance with pathogen reduction requirements, potable reuse regulations often rely on pathogen crediting frameworks that assign LRV credits to individual treatment processes based on demonstrated performance and validation testing (USC ReWater Center, 2024). Actual credited LRVs vary by regulatory program, treatment process validation, and operating conditions.

Table 5-4. Potable Reuse Pathogen LRV Credits by Treatment Process

Treatment Process	Log Reduction Value Range		
	Virus	Giardia	Cryptosporidium
Ozone	0-4	0-3	0-3
Microfiltration or Ultrafiltration	0	4	4
Reverse Osmosis	1-3	1-3	1-3
UV Disinfection (>300 mJ/cm2) or UV-AOP	6	6	6
Free Chlorine	1-6	1-3	0

(Potable) Chemical Reduction Targets. Chemical reduction targets are co-drivers of barrier selection alongside pathogen LRTs. Regulatory requirements on specific chemical constituents can influence the type of technology selected. For example, UV-based advanced oxidation processes (UV-AOP) are commonly selected for simultaneous 1,4-dioxane and N-nitrosodimethylamine (NDMA) reduction and RO is selected to reduce TDS if required.

FOR MORE INFO:

2017 EPA Potable Reuse Compendium

WateReuse Association 2015 Framework for Direct Potable Reuse

2012 Guidelines for Water Reuse (U.S. EPA, 2012)

Potable Water Reuse Report Series (USC ReWater Center & Trussell Technologies)

(Potable) Integrated Multiple-Barrier Treatment Trains. Treatment technologies can contribute to both pathogen and chemical reduction. Using the example above, UV-AOP and RO can reduce target chemical constituents while also providing pathogen LRV credits. However, no single treatment technology can achieve the full set of required pathogen LRTs on its own. Potable reuse treatment trains therefore rely on multiple independent barriers with complementary and diverse treatment mechanisms to provide overlapping protection. Common removal mechanisms include:

- Physical separation
- Adsorption
- Advanced oxidation
- Disinfection or inactivation

Regulations may prescribe specific treatment technologies, require treatment barriers that provide distinct removal mechanisms, or combine these approaches to meet pathogen LRTs and chemical reduction targets. Table 5-5 illustrates how states apply these concepts in practice. Some states, including Colorado and Arizona, allow individual barriers to contribute to both pathogen and chemical treatment goals.

Table 5-5. Potable Reuse Treatment Requirements by State

State(s) Using Approach as of EOY 2025	Minimum Treatment Barriers Specified in Regulations
California, IPR	Chemical control: Two barriers (RO and AOP) Pathogen control: Three independent barriers
California, DPR	Chemical control: Three barriers (ozone-biologically activated carbon, reverse osmosis, and UV/AOP) Pathogen control: Four independent barriers
Colorado, DPR	Pathogen Control: Three barriers for pathogens (disinfection and/or filtration) Chemical control: RO-based treatment train: Two barriers (RO, AOP) Non-RO treatment train: Three barriers (adsorption, AOP, and one other technology)
Arizona, DPR	Pathogen Control: One filtration and one disinfection barrier Chemical Control: Three diverse and separate treatment processes Must include AOP and physical separation
Texas, DPR	Pathogen and chemical control: Two physical removal treatment processes Two inactivation or oxidation treatment processes
Florida, DPR	Pathogen control: At least two treatment processes Chemical control: At least two treatment processes

(Potable) Environmental Buffers and Blending. In addition to engineered treatment processes, potable reuse regulations may incorporate environmental buffers and blending as part of the overall reuse framework.

- **Environmental buffers**: For IPR, an environmental buffer serves as an additional barrier through retention time, dilution, and natural attenuation. Under California Title 22, groundwater retention can be credited for up to a 1-log virus reduction based on documented tracer studies.
- **Blending**: Blending is sometimes incorporated into potable reuse systems, particularly IPR projects, where advanced treated water is combined with surface water or groundwater before subsequent drinking water treatment. While blending can provide dilution, it is not considered a treatment process.

Demonstrating and Validating Treatment Performance

Once treatment technologies are selected, the next step is to demonstrate that each treatment technology in the treatment train reliably achieves intended performance for selected treatment goals. Treatment demonstration and validation typically occur during planning, design, permitting, startup, and ongoing operation, depending on the treatment process and applicable regulatory requirements. Activities may include:

- Evaluation of existing operational and monitoring data and supplemental sampling to determine whether current treatment processes already meet the requirements of the intended reuse application.
- Bench- or pilot-scale testing to demonstrate pathogen reduction, chemical removal, and overall treatment performance under a range of expected operating conditions. These pilot studies generate empirical data that supports treatment train design and, in some cases, permit approval.
- Pre-validation of unit process and field performance testing prior to design or during startup. For example, protocols like the Membrane Filtration Guidance Manual (U.S. EPA, 2005) are used to demonstrate treatment performance and assign pathogen removal credits.
- For established treatment technologies, validation may use published literature including accepted validation protocols, or documented performance data demonstrating operation within established design and operating parameters.
- Demonstration of compliance with NPDWRs and other required water quality standards during startup and commissioning.
- If required, validation of treatment performance at critical control points (CCPs). CCPs are treatment barriers within the treatment train that address public health risks like chemicals and pathogens. Selected parameters are continuously monitored at CCPs to demonstrate treatment performance within established critical limits to support risk-based process control (e.g., Hazard Analysis and Critical Control Point[8]). Critical limits define the threshold at which

FOR MORE INFO:

Membrane Filtration Guidance Manual

NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse

QUESTIONS TO DISCUSS:

How will treatment performance be demonstrated and verified?

What requirements belong in regulation versus permits or guidance?

[8] HACCP (Hazard Analysis and Critical Control Point) is a risk-based framework that identifies hazards and establishes CCPs where treatment performance must be monitored and controlled.

the performance of a CCP can no longer be assured and corrective action is required. Additional discussion of CCPs and critical limits are included in Building Block 6.

Non-Potable Reuse

Non-potable reuse regulations generally take a more limited approach to formal treatment demonstration and validation which reflects the lower exposure potential coupled with reliance on established treatment practices. Common approaches used to verify treatment performance in non-potable reuse applications are summarized below.

- Compliance is typically demonstrated through achievement of treated water quality requirements for selected parameters (e.g., turbidity and *E. coli* or total coliform limits). Formal validation of pathogen log reduction credits assigned to individual treatment barriers is not common for most non-potable reuse systems.
- If required, validation that a CCP can be reliably monitored and maintained within established critical limits.
- For on-site non-potable water systems, full project-specific performance verification is not always required when pre-validated treatment technologies are used. Instead, regulations may rely on treatment technologies that have been certified by an accredited third-party organization to applicable performance standards (e.g., NSF/ANSI 350), monitoring at key control points, targeted field verification, and site-specific operational testing to address application-specific risks.

FOR MORE INFO:

Onsite Non-Potable Water Reuse Research | US EPA

National Blue Ribbon Commission for Onsite Water Systems Risk-Based Framework for the Development of Public Health Guidance for Decentralized Non-Potable Water Systems (Report, 2017)

Onsite Non-Potable Water System Guidance Manual (Report, 2020)

Potable Reuse

For potable reuse, treatment demonstration and validation are used to verify that treatment processes can consistently achieve required pathogen and chemical reduction targets under a range of operating conditions. Requirements for treatment demonstration and validation may be addressed directly in regulations, through guidance documents, or through a combination of both. Demonstration and validation activities typically occur before full-scale startup and support permitting and regulatory approval of the reuse system.

Common considerations for potable reuse treatment demonstration and validation include:

- Quantitative validation of treatment performance for technologies receiving LRV credits for virus, Giardia, and Cryptosporidium.
- Validation that selected monitoring parameters at CCPs reliably indicate treatment performance and can be used to verify ongoing compliance with established critical limits.
- Demonstration that treatment processes can maintain required performance under expected operating conditions and appropriately respond to off-specification events. The water is considered off-specification when a parameter exceeds a critical limit.

FOR MORE INFO:

Critical Control Point Assessment to Quantify Robustness and Reliability of Multiple Treatment Barriers of DPR Scheme

Demonstration of Innovation to Improve Pathogen Removal, Validation, and/or Monitoring in Carbon-Based Advanced Treatment for Potable Reuse (WRF Project 5129)

Practice Highlight

The California Validation Initiative (CalVal)

Using Guidance to Support Consistent, Defensible Treatment Requirements for Potable Reuse

Background & Purpose

As California implemented statewide potable reuse regulations, utilities and regulators encountered variability in how treatment validation, pathogen crediting, and monitoring requirements were interpreted and applied across projects. While regulations established clear public health objectives, flexibility in demonstrating performance led to inconsistent implementation over time.

CalVal was initiated to address this gap by providing nonbinding, regulator-informed, technology-specific guidance that supports consistent and predictable evaluation of treatment performance, without introducing new regulations or limiting regulatory discretion. CalVal supports permitting, design, validation, and compliance for indirect potable reuse (IPR) projects by clarifying performance expectations and documenting implementation practices under existing regulations.

Scope

CalVal guidance focuses on:

- Treatment validation and performance demonstration
- Pathogen log reduction crediting
- Monitoring and reporting expectations tied to treatment performance
- Guidance is being developed in phases, beginning with membrane filtration, reverse osmosis, and UV advanced oxidation, with additional technologies planned.

Approach

CalVal was developed through a collaborative, regulator-engaged process, including review of approved IPR projects, structured stakeholder workshops, targeted research, and ongoing coordination with the California Division of Drinking Water.

Rather than prescribing treatment trains, CalVal supports a hybrid, performance-based approach, providing technical clarity while preserving flexibility for project-specific conditions.

Impact

From the utility and regulator perspective, CalVal demonstrates how guidance can strengthen implementation of performance-based treatment requirements by:

- Increasing predictability during permitting
- Improving regulatory submittal quality
- Reducing late-stage revisions and rework
- Supporting consistent public health protection
- Aligning expectations while preserving regulatory discretion

CalVal illustrates how states can complement regulatory treatment requirements with shared technical foundations to bridge the gap between rule language and implementation.

PROJECT OUTCOMES
Nonbinding technical guidance supporting consistent implementation of California's potable reuse regulations

PROJECT DATES
Start: January 2024

Status: In progress

TYPE OF REUSE
Indirect Potable Reuse (Groundwater Recharge and Surface Water Augmentation)

ALIGNMENT WITH BUILDING BLOCKS
Building Block 5 – Structuring Treatment Requirements

Building Block 6 – Ongoing Monitoring and Operations

WEBSITE: [CALVAL]

Building Block 6: Ongoing Monitoring and Reporting

Summary

Ongoing operational monitoring and reporting are used to assess and maintain treatment performance and demonstrate continued compliance with requirements established prior to full-scale start up. This Building Block provides regulatory considerations for ongoing monitoring, off-specification management, and reporting.

Decisions Informed by This Building Block

- What ongoing monitoring is needed for treatment performance and compliance
- Which parameters must be monitored and where monitoring occurs within the reuse system
- How off-specification conditions are defined and managed
- How data are reported and used for regulatory oversight and compliance

Key Considerations

Monitoring

> **QUESTION TO DISCUSS:**
>
> **Which parameters should be tracked via sampling to fit the type of reuse application being considered?**

Monitoring provides the data needed to verify treatment performance and demonstrate compliance with water quality objectives. Treatment performance monitoring and compliance monitoring serve different but complementary roles. Treatment performance monitoring evaluates whether treatment processes are operating as intended. Where the failure of a treatment process could compromise the system's ability to meet health-based treatment objectives, one or more critical limits might be established for select monitoring parameters. Exceeding a critical limit would indicate that treatment performance criteria might no longer be met and would trigger corrective action, such as operational adjustments, diversion, or shutdown. If a parameter exceeds the critical limit(s) of a treatment barrier, the water is considered off-specification (off-spec).

Monitoring requirements may apply at multiple points throughout a reuse system, including:

- **Source or influent water** to characterize incoming water quality and identify potential changes that may affect treatment performance.
- **Treatment processes** to verify operational performance and confirm treatment objectives are being achieved.
- **Finished recycled water** to demonstrate compliance with water quality goals and regulatory requirements.

Table 5-6 outlines ongoing monitoring considerations for verifying treatment process performance and demonstrating water quality compliance. Non-potable recycled water monitoring parameters and frequency may vary significantly depending on the level of exposure anticipated. Collecting monthly non-potable recycled water grab samples to confirm pathogen limit compliance may be sufficient for some non-potable applications with limited exposure (e.g., non-edible crop irrigation) while online monitoring or daily grab samples may be necessary for other non-potable reuse applications with more direct exposure pathways (e.g., edible crop irrigation, unrestricted residential landscape irrigation, or cooling applications that cause exposure to aerosols). Potable reuse systems typically require continuous online monitoring at CCPs to verify that treatment processes are operating within established critical limits and regulatory compliance monitoring of the finished recycled water.

Table 5-6. Ongoing Recycled Water Monitoring Considerations

Reuse Type	Sample Type	Monitoring Objective	Target Parameters
Non-potable	Online	Demonstrate filtration and disinfection performance (for some end uses)	Turbidity Disinfection (e.g., CT, chlorine residual, UV dose)
	Grab Sample	Demonstrate reuse water quality compliance	Pathogens (Total coliform, *E. coli*, Fecal Coliform) Solids (e.g., TSS, TDS) Organic carbon (e.g., COD, TOC, BOD) Nutrients (e.g., N, P) Inorganic contaminants (e.g., boron, nitrate)
Indirect potable	Online	Demonstrate acceptable performance of CCPs Demonstrate finished water quality compliance	Surrogate/indicator compounds Operational Parameters
	Grab Sample	Demonstrate SDWA compliance Evaluate presence of unregulated chemicals	Regulated parameters Unregulated surrogate/indicator compounds
Direct potable	Online	Demonstrate acceptable performance of CCPs Demonstrate finished water quality	Surrogate/indicator compounds Operational Parameters
	Grab	Demonstrate SDWA compliance Evaluate presence of unregulated chemicals of potential concern	Regulated parameters Surrogate/indicator compounds Industry-specific chemicals

Critical Control Points

As discussed above, CCPs are treatment barriers where selected parameters are monitored to verify that a treatment process is operating within established critical limits (Walker, 2016). Critical limits monitoring is a subset of process monitoring used where detection and response are necessary to protect public health. Some non-potable reuse applications might choose to establish critical limits. Most common critical limit monitoring parameters in non-potable reuse systems are after filtration (e.g., turbidity) and disinfection processes (e.g., contact time or UV dose). The use of CPPs reflects the principles of HACCP systems, which use a systematic process to identify hazards and then establish monitoring and control measures at critical points in the treatment train (U.S. Department of Agriculture, 2020)

For potable reuse systems, CCPs typically are identified because treatment performance is directly linked to protection of public health. CCPs are continuously monitored to verify that water quality or operating parameters remain within critical limits that demonstrate acceptable performance.

Key policy decisions include how prescriptive monitoring requirements should be, how much discretion is afforded to permit writers, and how monitoring expectations scale across reuse types without creating unnecessary burden for lower-risk applications.

When incorporated into regulation, CCP frameworks establish clear expectations for:

- Which treatment processes are considered critical to public health protection
- What parameters or surrogate indicators must be continuously or frequently monitored
- What constitutes an off-specification condition
- What response actions are required when performance deviates from established limits

States must decide whether CCP concepts are codified directly in regulation, described in guidance, or implemented primarily through project-specific permits. Most states limit formal CCP requirements to potable reuse applications, where exposure potential and risk tolerance justify real-time verification and rapid response.

Off-Specification Management

Off-specification water can occur when a critical limit is exceeded or when monitoring demonstrates that recycled water does not meet applicable water quality or regulatory requirements. An off-specification management plan defines response protocols when these critical limits are exceeded (e.g., if a process fails, water is diverted, the plant shuts down, or flow is switched to another treatment unit).

Monitoring is only effective if paired with clear expectations for how off-specification conditions are addressed. States must determine:

- What constitutes an off-specification event for different reuse types
- What immediate and longer-term operational responses are required
- When regulatory notification or public communication is triggered
- How repeated or systemic issues are escalated

These expectations may be established through regulation, permits, or enforceable operating plans, depending on the desired balance of consistency and flexibility.

Reporting

Once a water reuse project is operational, ongoing reporting supports regulatory oversight by documenting treatment performance, water quality trends, and compliance status over time.

Reporting requirements often vary by reuse type and system complexity. States may specify reporting content, frequency, and format directly in regulation, or establish these requirements through permits on a case-by-case basis. Where possible, states may leverage existing reporting systems (e.g., discharge monitoring reports) to reduce redundancy and improve efficiency.

Typical policy considerations include:

- Minimum reporting frequency by reuse type
- Parameters reported routinely versus periodically
- Documentation of maintenance activities and system performance trends
- Timing and method of reporting non-compliance events

At least annual reporting is common for many non-potable reuse applications, while potable reuse projects typically require more frequent reporting. Noncompliance events that could result in risk to human health generally warrant rapid regulatory notification and, in some cases, immediate public communication in accordance with established communication plans.

Building Block 7: Institutional Capacity

Summary

Institutional capacity at the state level refers to the collective ability of a state's regulatory institutions and regulated community to successfully adopt, implement, administer, and comply with new or modified water reuse rules over time. Although regulations establish the technical and operational requirements for reuse, long-term program success depends on having the governance structures, staffing, expertise, financial resources, and operator capabilities necessary to support implementation following full-scale deployment.

Following adoption of reuse regulations, regulatory authorities and stakeholders responsible for compliance must have the institutional capacity needed to implement, administer, comply with, and adapt those requirements over time. This building block focuses on the institutional capabilities needed to support long-term program implementation and oversight.

Decisions Informed by This Building Block

- Authority and governance for statewide implementation
- Administrative and programmatic capacity to oversee the regulation
- Operational capacity to comply with the regulation
- Adaptability, support, and long-term sustainability of implementation

Key Considerations

Institutional capacity is not uniform across reuse applications. The level and nature of capacity needed varies based on the type, scale, and complexity of reuse being considered, as well as the degree of public, environmental, or operational risk involved.

QUESTIONS TO DISCUSS:

Do the regulatory authorities in the state have sufficient capacity to oversee proposed rules?

Do utilities in the state have sufficient capacity to comply with proposed rules?

Authority and Governance for Statewide Implementation

Reuse programs often involve multiple regulatory authorities, including wastewater, drinking water, public health, environmental, and, in some cases, building or plumbing agencies. States must determine how permitting, compliance oversight, enforcement, operator certification, and ongoing program administration are coordinated across these entities. Where responsibilities overlap or are not clearly defined, implementation can become inconsistent across reuse applications or jurisdictions.

Regulatory responsibilities may vary depending on the reuse application. For example:

- Non-potable reuse rules may rely largely on existing wastewater program authority.
- Potable reuse rules often require tighter coordination between drinking water and wastewater agencies, particularly when evaluating higher Technical, Managerial, and Financial (TMF) expectations for DPR.
- On-site reuse requires significant coordination among drinking water, wastewater, public health, building, plumbing, and local government agencies because project approval, construction standards, cross-connection control, ongoing operation, and compliance oversight may be administered through separate regulatory programs.
- Industrial reuse may require additional legal agreements between producers and end users that fall outside traditional utility-customer relationships and regulatory authority.

Administrative and Programmatic Capacity

Once reuse regulations are adopted, regulatory agencies must have the capacity to administer the program and support ongoing compliance.

This includes the ability to review permit applications, evaluate compliance, track violations and corrective actions, and may include demonstration of TMF capacity (e.g., documentation of operational plans and compliance history). The administrative burden associated with reuse rules varies significantly depending on how prescriptive or flexible the rule is.

The following examples illustrate how the level of effort varies based on reuse type:

- A standardized non-potable reuse rule with clearly defined treatment and monitoring requirements may require minimal TMF review.
- A DPR framework that allows alternative treatment trains or site-specific demonstrations may require regulators to assess detailed technical documentation, operational readiness, and long-term financial planning.
- Industrial reuse permits may require review of contractual arrangements, operational responsibilities, and financial risk allocation between parties.

Statewide Operational Capacity

An important consideration is whether utilities have the capacity needed to operate, manage, and sustain reuse systems while achieving and maintaining regulatory compliance.

The level of capacity needed to implement and sustain reuse systems varies by reuse application. Examples include:

- Non-potable reuse: Statewide capacity may hinge on utilities' ability to maintain certified operators qualified to operate complex treatment systems, document compliance histories, and manage routine monitoring and reporting. For many states, these expectations align closely with existing wastewater program capacity.
- Potable reuse (IPR/DPR): Higher expectations may include validated treatment processes, emergency response planning, advanced operator training, robust compliance records, and long-term financial planning for operations and maintenance of advanced treatment systems (e.g., membrane replacement, UV lamp replacement, and chemical use). States must consider how many utilities can reasonably meet these expectations and how assessments are scaled.
- Industrial reuse: capacity may be distributed across multiple entities, requiring managerial capacity to coordinate ownership, operations, and compliance, and financial capacity to sustain treatment systems that are closely tied to industrial demand and reliability expectations.

Operator Certifications

Reliable operation of reuse systems depends on appropriately trained and certified operators. States must decide whether existing operator certification programs are sufficient or whether additional endorsements, training, or reuse-specific certifications are warranted.

Operator certification requirements vary widely among states and are often tailored based on:

- Type of reuse and exposure potential
- Treatment system complexity
- Source water characteristics

For non-potable reuse, operator requirements frequently align with existing wastewater treatment certification programs. Potable reuse systems, by contrast, often require operators with expertise spanning both wastewater and drinking water treatment, particularly where advanced treatment processes are employed. Onsite non-potable water systems may require skills beyond those covered by traditional wastewater operator certification programs. The National Blue Ribbon Commission and Water Professionals International (WPI) have developed training and certification resources that states may consider when evaluating workforce needs for decentralized reuse systems (National Blue Ribbon Commission for Onsite Water Systems, 2026; U.S. EPA, 2026).

QUESTIONS TO DISCUSS:

Can water reuse facility operators be certified under an existing operator certification program (i.e. wastewater or drinking water)?

Should a separate water reuse operator certification program or enhancement certification be developed?

How can treatment requirements remain flexible while still enforceable?

States may address workforce readiness through a combination of:

- Minimum operator certification requirements
- Reuse-specific endorsements or advanced treatment credentials
- Training programs supported through guidance or professional organizations

Adaptability, Support, and Long-Term Sustainability

Institutional capacity also depends on a state's ability to support implementation and adapt over time. This includes guidance documents, training programs, phased or tiered requirements, and technical assistance that help utilities build capacity as reuse programs expand. It also includes mechanisms to update rules as technologies evolve, new reuse applications emerge, or scientific understanding changes.

States with strong institutional capacity treat TMF as an ongoing condition supported through operator training and certification pathways, technical assistance, guidance on acceptable demonstrations of capacity, and periodic review of compliance and performance data. Sustainable funding is also needed to maintain regulatory staffing, workforce development, implementation support, and the long-term operation and oversight of reuse programs. Funding mechanisms may vary by state and program, but their availability can affect whether agencies and regulated entities can sustain these capabilities as reuse expands.

QUESTIONS TO DISCUSS:

What implementation support (guidance, phased compliance, training) may be needed?

How will the state monitor, support, and adapt implementation over time?

Section 6

Conclusion

Water reuse continues to evolve as states respond to changing water supply conditions, emerging technologies, new scientific understanding, and local priorities. While no single regulatory approach is appropriate for every state, the experiences presented throughout this Guide demonstrate that effective reuse programs are built through thoughtful engagement, clear public health objectives, and regulatory frameworks that reflect local needs and governance structures.

As states evaluate new or revised reuse regulations, this Guide is intended to serve as a resource for understanding common considerations, identifying potential pathways forward, and supporting informed discussions among regulators, practitioners, utilities, and stakeholders. Ultimately, the most effective regulatory frameworks will be those that protect public health while remaining implementable, adaptable, and responsive to the unique circumstances of each state. Successful adoption of water reuse will also depend on broader factors including public confidence, institutional capacity, technical support, and implementation resources.

Author's Note

This document was prepared solely for WateReuse Association and partnering organizations in accordance with professional standards at the time the services were performed and in accordance with the contract between WateReuse Association and Brown and Caldwell dated August 14, 2025. This document is governed by the specific scope of work authorized by WateReuse Association; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by WateReuse Association and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

Water reuse governance, regulatory authorities, policymaking processes, and implementation practices vary significantly across states and reuse applications. This Guide provides a framework for understanding common considerations associated with water reuse rulemaking and regulatory development, but it does not prescribe a single approach or represent all state-specific circumstances. Regulatory requirements, agency authorities, permitting pathways, and administrative procedures are subject to change and should be verified through applicable statutes, regulations, guidance documents, and discussions with the appropriate regulatory authorities.

Examples, case studies, and discussion topics included throughout the Guide are intended to illustrate concepts and highlight approaches used in various jurisdictions. These examples should not be interpreted as endorsements, recommendations, or indications that a particular approach is appropriate for every state, reuse application, or regulatory context.

Scientific understanding, treatment technologies, risk assessment methods, and regulatory practices related to water reuse continue to evolve. As a result, certain technical approaches, risk management frameworks, and regulatory examples described in this Guide may change over time as new information becomes available.

Section 7

Glossary

Adiabatic Cooling
A form of evaporative cooling in which water is evaporated to reduce air temperature before the air passes over a heat exchanger or cooling equipment, reducing mechanical cooling requirements.

Beneficial Use
A legally recognized use of water that is considered reasonable and appropriate under state law. Definitions vary by state and may include municipal, agricultural, industrial, environmental, and other authorized uses.

Constituent of Concern
A chemical, pathogen, nutrient, metal, or other water quality parameter that may pose a risk to public health, the environment, or the intended reuse application and therefore warrants evaluation during regulatory development.

Critical Control Point (CCP)
A treatment barrier that is specifically intended to prevent, eliminate, or reduce a public health hazard (such as pathogens or chemical contaminants) and has measurable controls to verify that it is performing properly.

Direct Potable Reuse (DPR)
A form of potable reuse in which highly treated wastewater is introduced directly into a drinking water treatment process or potable water supply without an environmental buffer.

Emerging Contaminant
A chemical or class of chemicals that may not yet be subject to regulatory limits but is receiving growing attention because of potential human health or environmental concerns.

Enabling Authority
The legal authority established through statutes or other laws that allows a government agency to implement, administer, or enforce a regulatory program.

End Use
The intended application or purpose for which reused water is ultimately utilized.

Enhanced Source Control
Additional measures beyond traditional pretreatment requirements that are intended to address reuse-specific concerns and manage source water quality in support of water reuse objectives.

Environmental Buffer
A natural system, such as an aquifer, reservoir, river, or lake, that separates advanced treated water from potable use and may provide storage, retention time, dilution, or natural attenuation.

Epidemiological Risk Assessment
A risk assessment approach that relies on observed public health outcomes and epidemiological evidence to establish treatment requirements and health protection benchmarks.

Evaporative Cooling
A cooling process that removes heat through the evaporation of water. Evaporative cooling systems may be configured as direct systems, which add moisture to the air stream, or indirect systems, which use a heat exchanger to provide cooling without adding moisture to the conditioned air.

Exposure Pathway
The route by which a person, population, or environmental receptor may come into contact with a constituent present in reused water.

Fit-for-Purpose Water
Water that has been treated to a quality appropriate for its intended use, based on associated health, environmental, and operational requirements.

Guidance
Informational material issued by a government agency or other organization to explain, interpret, or clarify how laws, regulations, or policies may be applied. Guidance is generally nonbinding.

Health Benchmark
A health-based target, risk level, or outcome used to establish treatment requirements, monitoring approaches, or water quality goals intended to protect public health

Indirect Potable Reuse (IPR)
A form of potable reuse in which highly treated wastewater is introduced into an environmental buffer before being withdrawn and treated for potable use.

Industrial Reuse
The use of treated wastewater or recycled process water for industrial and manufacturing applications where water quality requirements are determined by the intended industrial use and operational needs.

Institutional Capacity
The collective ability of regulatory agencies, utilities, and other organizations to implement, administer, support, and comply with water reuse requirements over time.

Jurisdictional Authority
The responsibility and legal authority assigned to a governmental entity to develop, implement, oversee, or enforce requirements related to water reuse.

Liquid Cooling
A cooling approach that uses a liquid, such as water or a dielectric fluid, to absorb and transfer heat from equipment. Examples include cold-plate cooling, immersion cooling, and direct-to-chip cooling.

Log Reduction Target (LRT)
A required level of pathogen reduction established to achieve a specified public health objective for a reuse application.

Log Reduction Value (LRV)
The amount of pathogen reduction credited to an individual treatment process or treatment barrier.

Non-Potable Reuse (NPR)
The beneficial use of treated wastewater for purposes that do not involve drinking water consumption, such as irrigation, industrial uses, environmental restoration, or municipal applications.

Off-Specification Water (Off-Spec)
Water produced when treatment performance, monitoring results, or critical limits indicate that applicable treatment objectives, water quality goals, or regulatory requirements may not be met.

Onsite Reuse / Onsite Non-Potable Water System (ONWS)
A system that treats and reuses wastewater generated at or near the point of use for non-potable purposes.

Ordinance
A law adopted by a local government that establishes legally enforceable requirements within a specific jurisdiction.

Permit
A formal authorization issued by a permitting authority that allows a specific activity to occur under defined conditions and requirements.

Policy
A statement of goals, priorities, or intended direction adopted by a government or organization to guide decision-making.

Policymaking
The process through which governments, agencies, and stakeholders develop, revise, and implement policies, regulations, or related governing frameworks.

Potable Reuse
The use of highly treated wastewater to augment drinking water supplies through indirect or direct potable reuse applications.

Practitioner
An individual or organization that supports, implements, evaluates, operates, regulates, or otherwise participates in water reuse activities or policymaking processes.

Prior Appropriation
A system of water rights in which priority is generally based on the date water was first diverted and applied to beneficial use, often summarized as "first in time, first in right."

Quantitative Microbial Risk Assessment (QMRA)
A systematic risk assessment method used to estimate the likelihood of adverse health outcomes resulting from exposure to pathogens and to inform treatment targets and regulatory requirements.

Regulation
An enforceable requirement adopted by an authorized agency under statutory authority to implement and operationalize legislative intent.

Riparianism
A system of water rights in which the right to make reasonable use of surface water is associated with ownership of land adjacent to a waterbody and is exercised in conjunction with the rights of other riparian landowners.

Rulemaking
The formal process through which regulatory agencies develop, revise, adopt, or repeal regulations and related requirements.

Rulemaking Readiness
The degree to which conditions, incentives, authority, resources, and stakeholder support exist to pursue new or revised regulatory requirements.

Secondary Treatment
Conventional biological wastewater treatment used to remove biodegradable organic matter and suspended solids from wastewater prior to discharge or further treatment.

Source Water
The water source that enters a treatment process before being treated for reuse.

Stakeholder
An individual, organization, agency, community, or other interested party that may influence or be affected by water reuse policies, regulations, projects, or programs.

State Primacy
Authority granted to a state to implement and enforce a federal regulatory program in accordance with federal requirements.

Statute
A law enacted by a legislative body that establishes legal authority, assigns responsibilities, or creates requirements.

Technical Assistance
Services, resources, or support provided to help utilities, organizations, regulators, or stakeholders understand requirements and implement programs or projects.

Treatment Barrier
A natural or engineered feature that reduces or manages pathogens, chemicals, or other contaminants within a reuse system.

Treatment Train
A sequence of treatment processes and barriers that work together to achieve the water quality objectives required for a reuse application.

Water Appropriation
The legal process through which a person or entity acquires the right to divert and beneficially use water under applicable state law.

Water Reuse
The intentional treatment and beneficial use of municipal wastewater, stormwater, or other used water sources for potable, non-potable, industrial, environmental, or other applications.

Section 8

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