Guidance Framework Document for Direct Potable Reuse in Arizona

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About NWRI

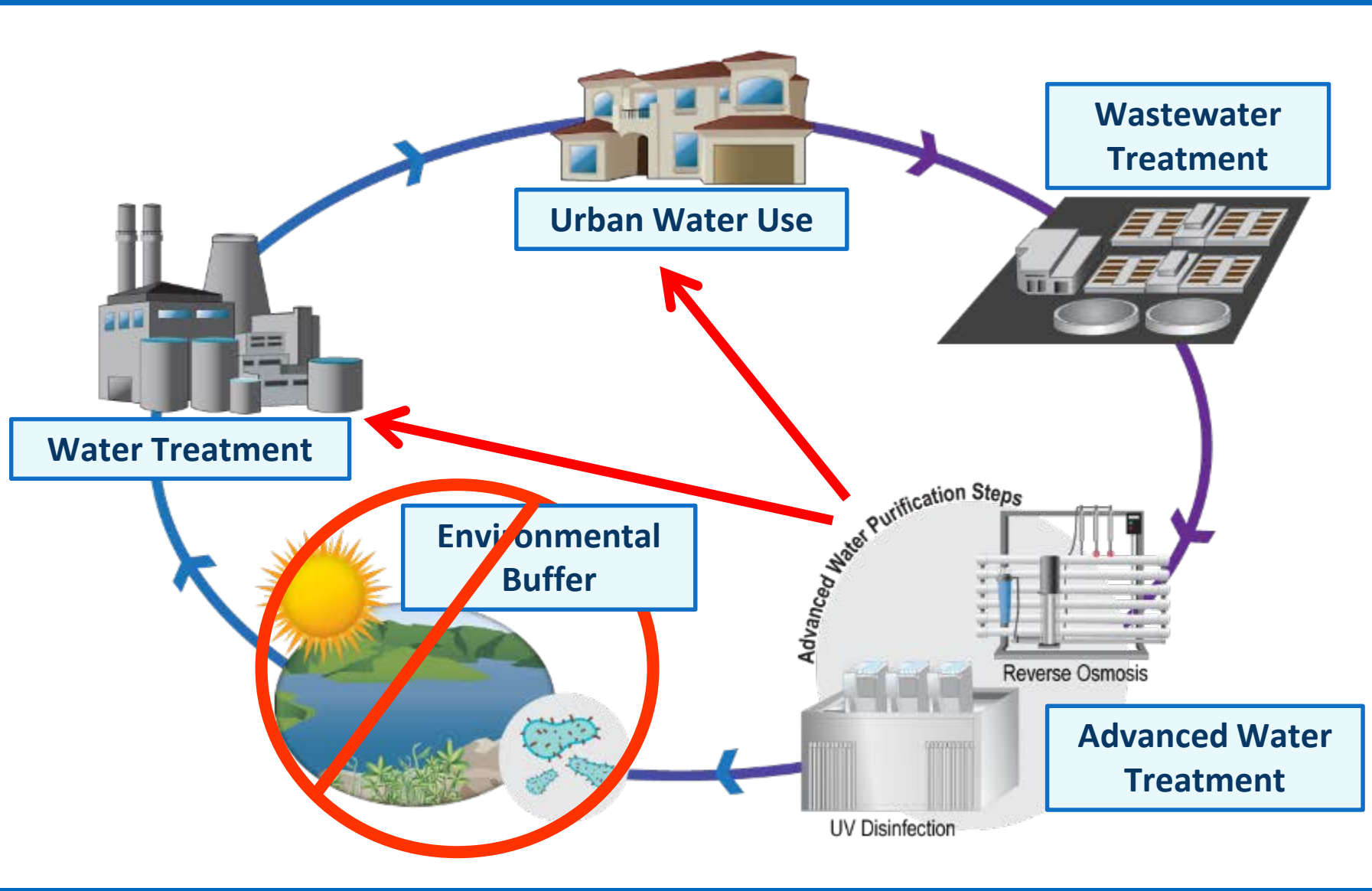
- 501c3 Nonprofit located in Fountain Valley, CA
- Experience with potable reuse
  - White papers
  - Research projects
  - Independent Advisory Panels
- DPR Expert Panel for California State Water Board
  - Feasibility of criteria for DPR

Sponsors:
WateReuse Arizona
AZ Water

Acknowledgements:

Channah Rock – WateReuse AZ President
Tim Thomure – AZ Water SCAPR
Lisa Culbert – WateReuse AZ Executive Administrator
Gina Vartanian – NWRI

Direct potable reuse



Purpose of Report:

Provide recommendations regarding the development of regulations on DPR in Arizona

Scope of Work:

Based on input from stakeholders, develop a document that provides specific recommendations on the range of topics needed for implementing DPR in Arizona

Goals

- Develop science-based recommendations
- Protect public health
- Provide a path for permitting DPR projects in Arizona

Why now?

ADEQ Reclaimed Water Rulemaking

Revisions Needed

Process to revise AZ rules on reuse of reclaimed water and gray water

New Info Available

ADEQ last updated its reuse rules in 2001

- **Expansion in reuse of treated wastewater**
- **Research and technology have moved forward**
- **New uses of reclaimed water have been proposed**

ADEQ will rely on stakeholder involvement and expertise in developing the revisions to the reuse rules

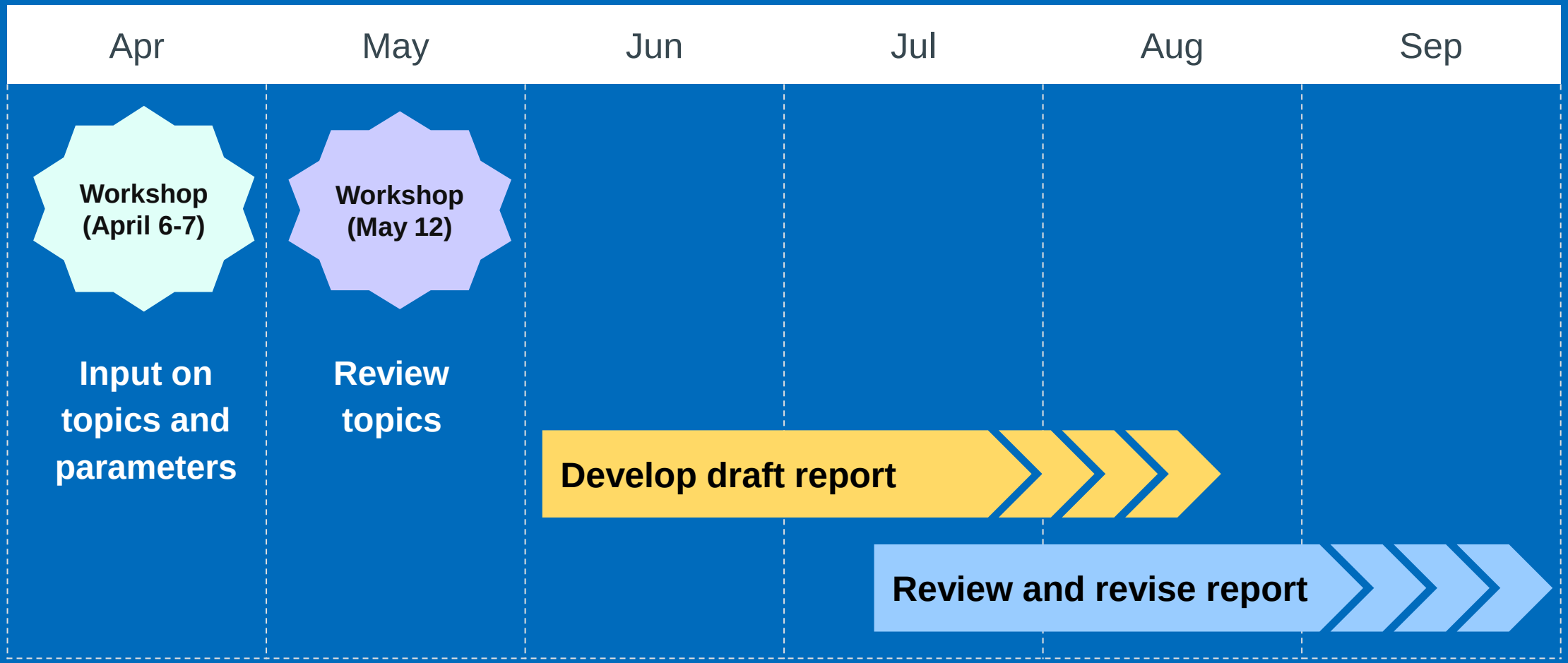
NWRI Approach
to develop the framework

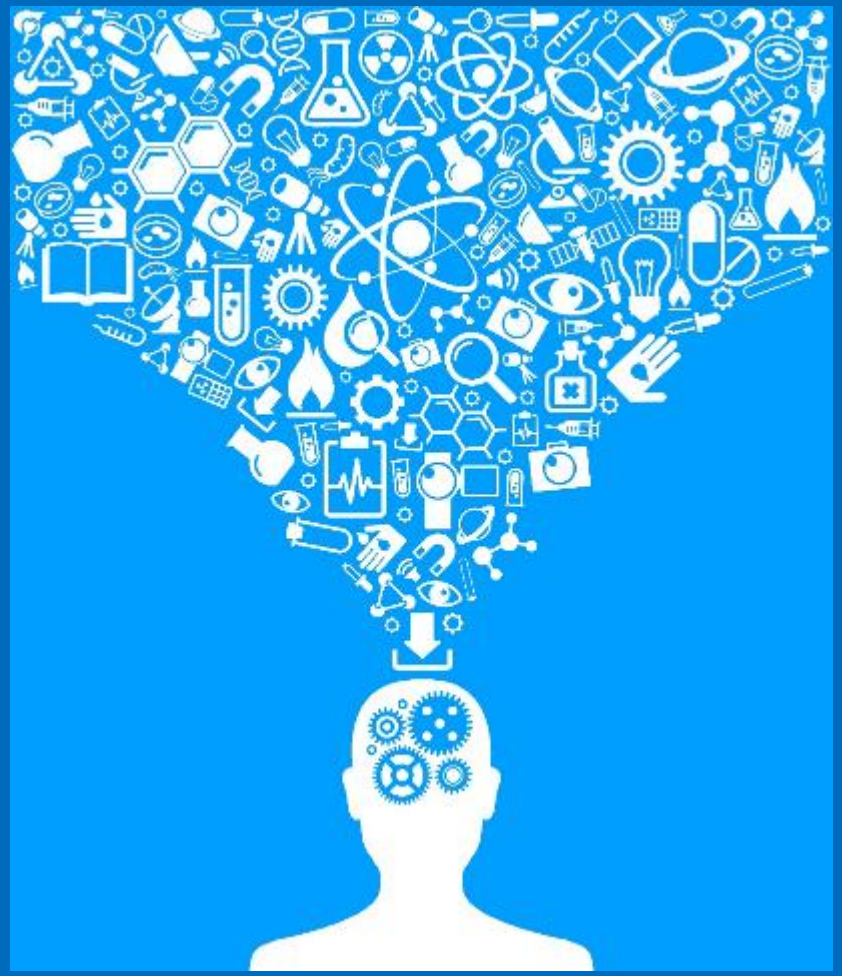
Identify topics

Collect input at stakeholder workshops

Review public draft

Framework Activities

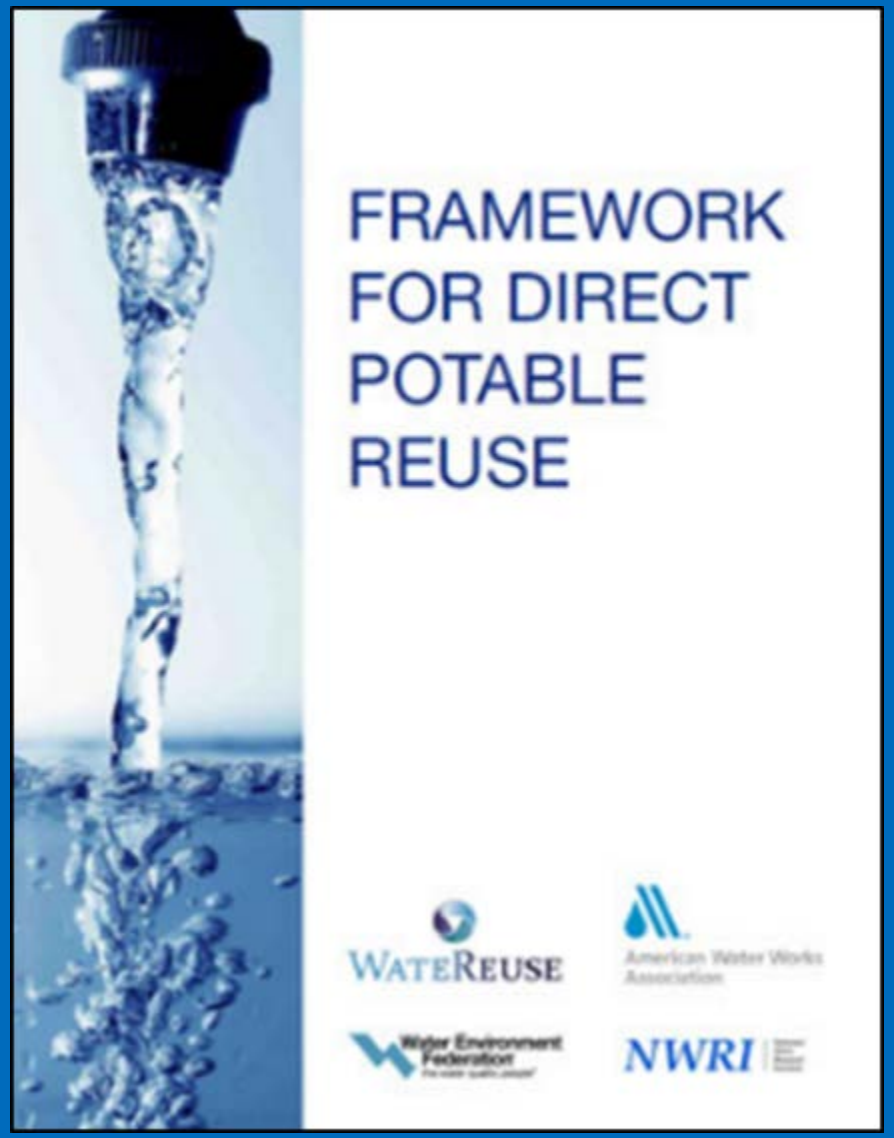




sources of information

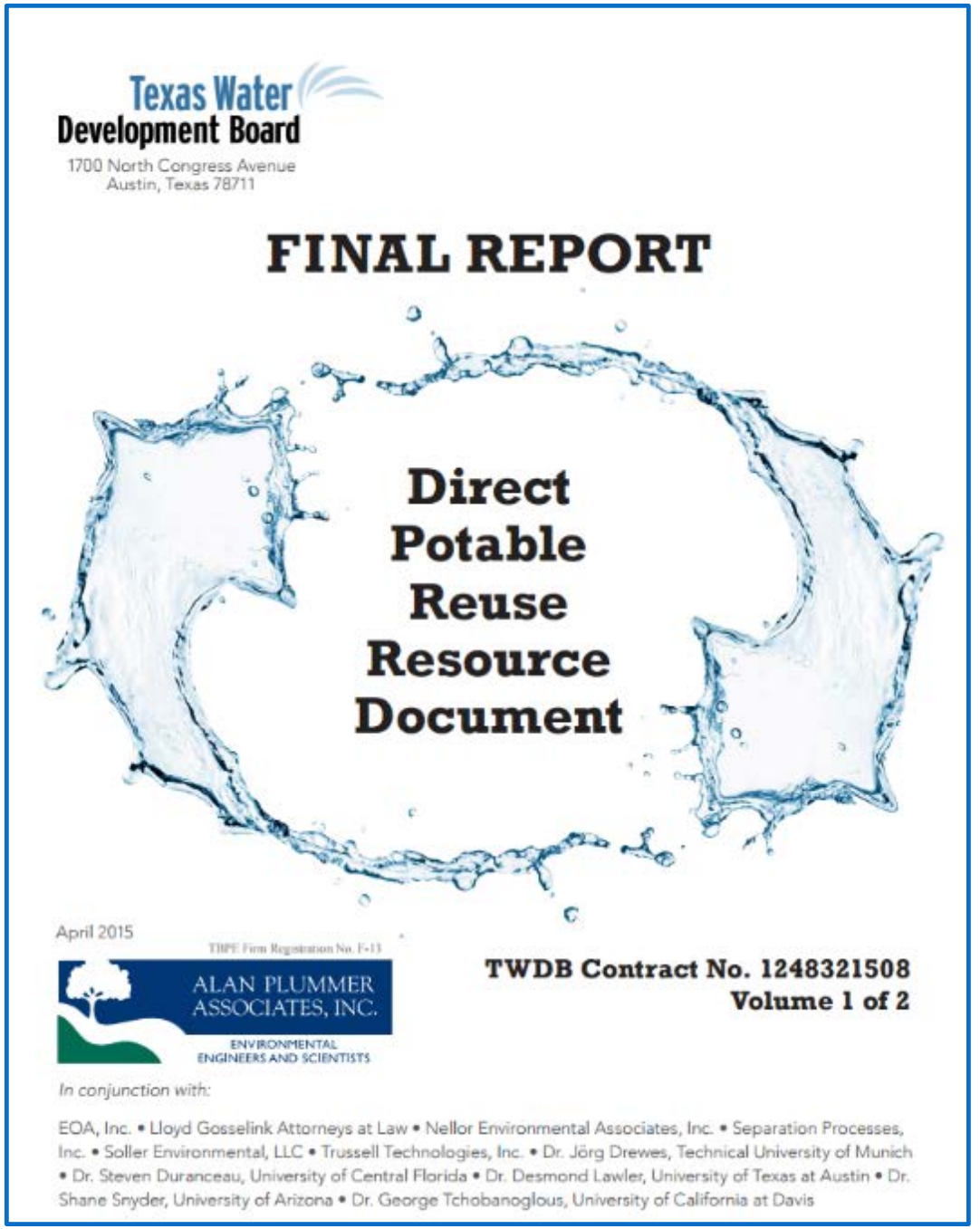
Framework for DPR

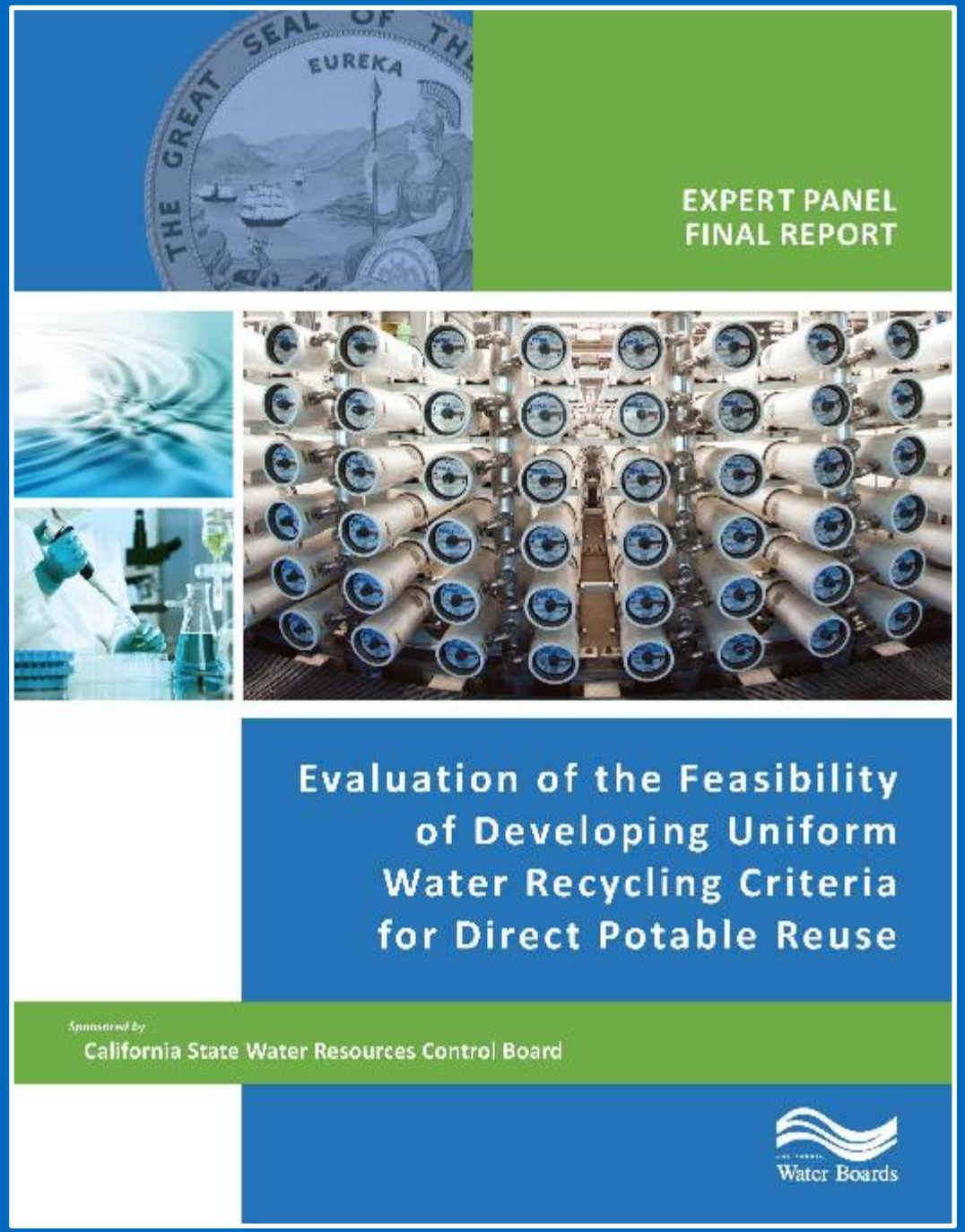
- **Published by WateReuse (2015)**
- **Sponsors:**
  WateReuse, AWWA, and WEF
- **Developed by an NWRI Expert Panel**
- **Available at www.watereuse.org**



Texas projects

- DPR projects
- Direct Potable Reuse Resource Document

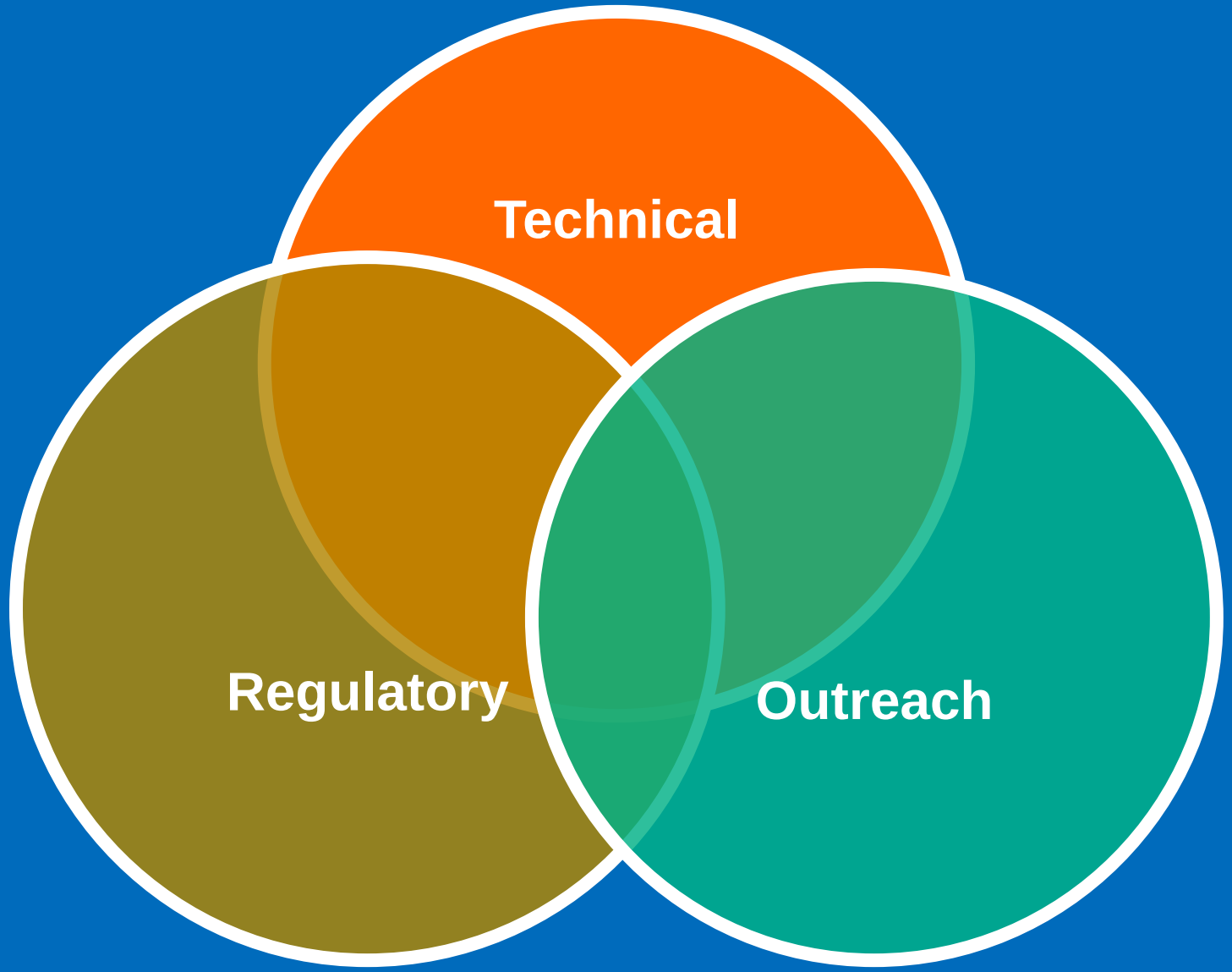




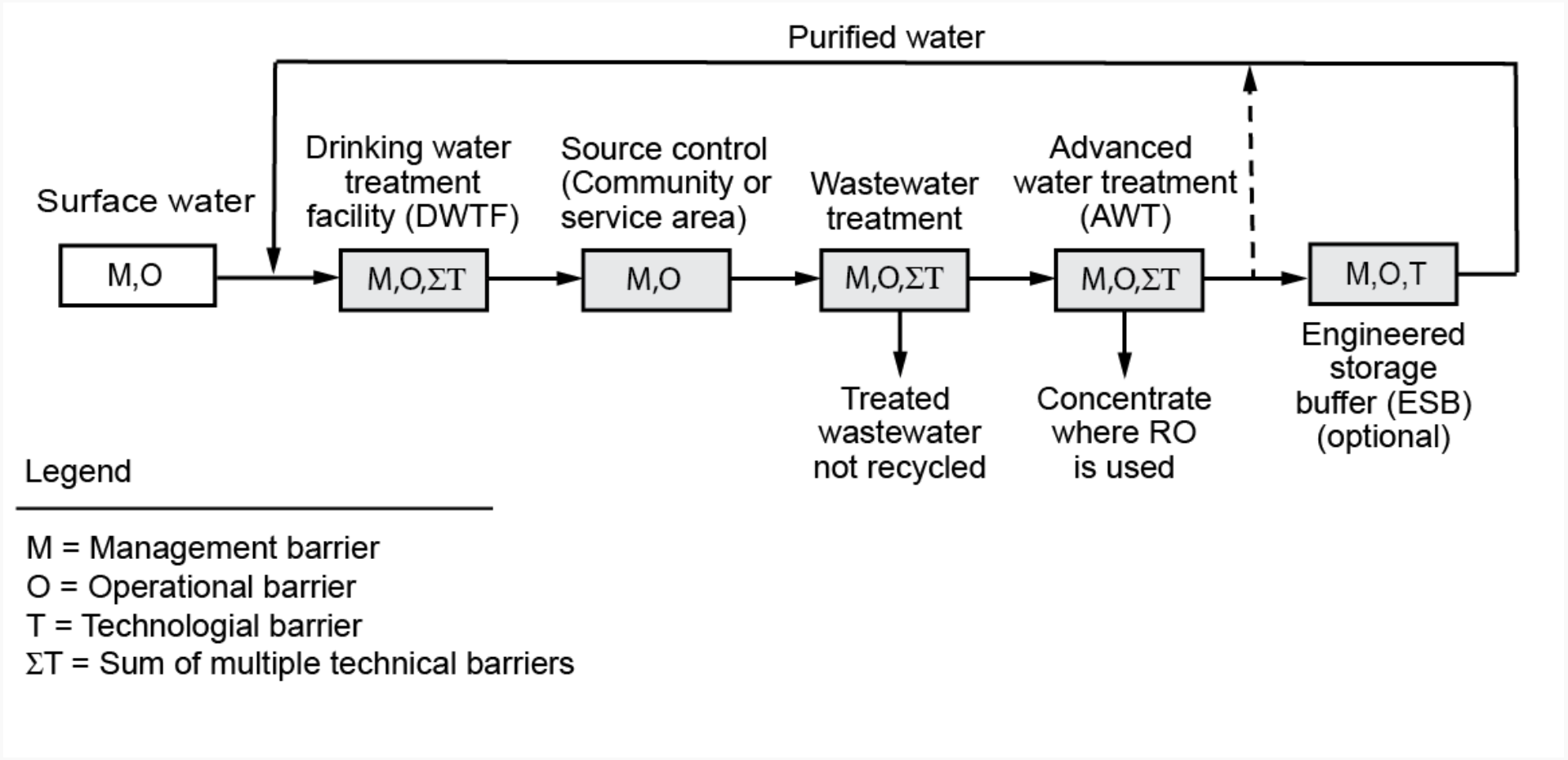
California regulations

- Groundwater replenishment (final)
- Surface water augmentation (draft)
- Expert Panel Report on Feasibility of Developing DPR Criteria for Calif. (draft)

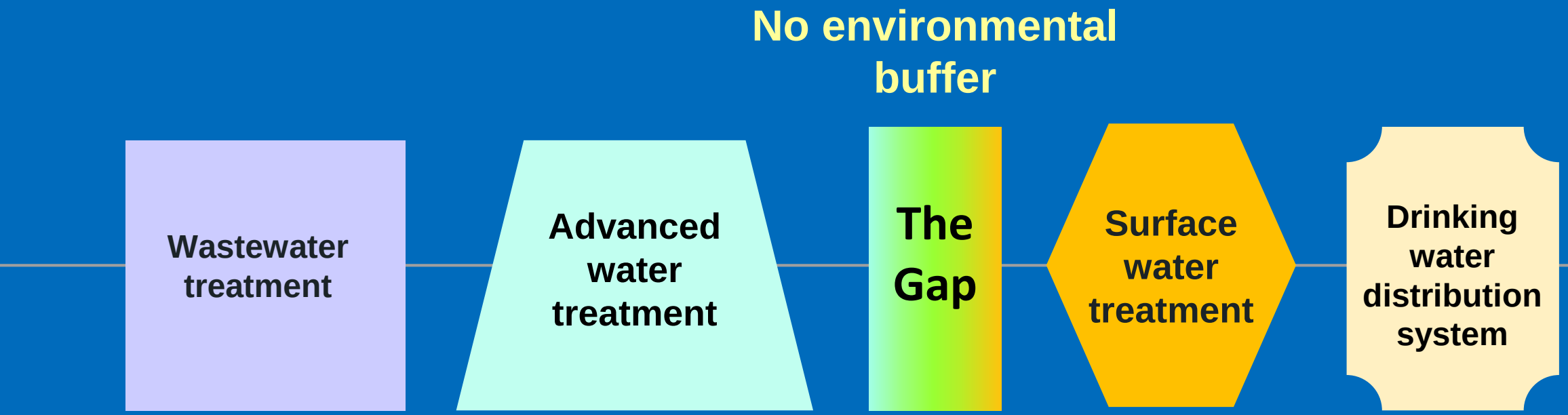
Key components of DPR



Technical, Operational, and Management Barriers



Direct potable reuse



Important considerations

1. Consistent with current regulations in Arizona
2. Terms and definitions
3. Regulations or permitting or guidance
4. Regulatory flexibility (alternatives provision)
5. DPR lacks an environmental barrier
6. Multiple barrier approach (drinking water concept) to control pathogens and chemicals
7. Technical, operational, and managerial barriers
8. Protective of public health

Draft Guidance Framework Document

Chap. 1: Introduction

overview

Water reuse in AZ

Nonpotable reuse

Planned potable reuse

Potable reuse

- IPR
- DPR

Terminology

studies

NRC Report 1998

NRC Report 2012

Risks from microbial and chemical constituents

organization

Chapter summaries

Recommended resources

Chap. 2: Public Health Considerations

overview

Public health considerations

Drinking water regulations

pathogens

Pathogen reduction criteria:

- TCEQ approach
- NWRI Expert Panel/WRRF 11-02 approach
- Calif. IPR approach

chemicals

Targets:

- MCLs
- Trace organics
- TOC
- 1,4-dioxane and NDMA
- DBPs

Chapter 3: Potable Reuse Recommendations

Disclaimer:

Hey, this is all preliminary!

And is intended for discussion purposes only!

There will be a draft for public comment!

Topics

1. Rescind DPR prohibition
2. Applications
3. Outreach
4. Source control
5. Water quality classes
6. Microbial control
7. Log removal targets
8. Chemical control
9. Wastewater treatment
10. Wastewater optimization
11. Employ BADCT
12. Treatment performance
13. Long-term monitoring
14. Critical Control Points
15. Facility operations
16. TMF Capacity
17. Other considerations

Regulation	Permit	Guidance

X. Key

- **What**? What is the topic.
- **Why?** Why are we interested in this topic for DPR.
- **Specific recommendations:**
  - List of specific recommendations for Framework document.

1. Rescind DPR Prohibition

- **What?** DPR is currently prohibited in Arizona.
- **Why?** The prohibition needs to be rescinded by the Arizona legislature.
- **Specific recommendations:**
  - Simple: Rescind DPR prohibition (but do we need to make the case?)

R18-9-704 General Requirements
G. Prohibited activities.
1. Irrigating with untreated sewage;
2. Providing or using reclaimed water for any of the following activities:
a. Direct reuse for human consumption;
b. Direct reuse for swimming, wind surfing, water skiing, or other full-immersion water activity with a potential of ingestion; or
c. Direct reuse for evaporative cooling or misting.

Regulation	Permit	Guidance

2. Potable reuse applications

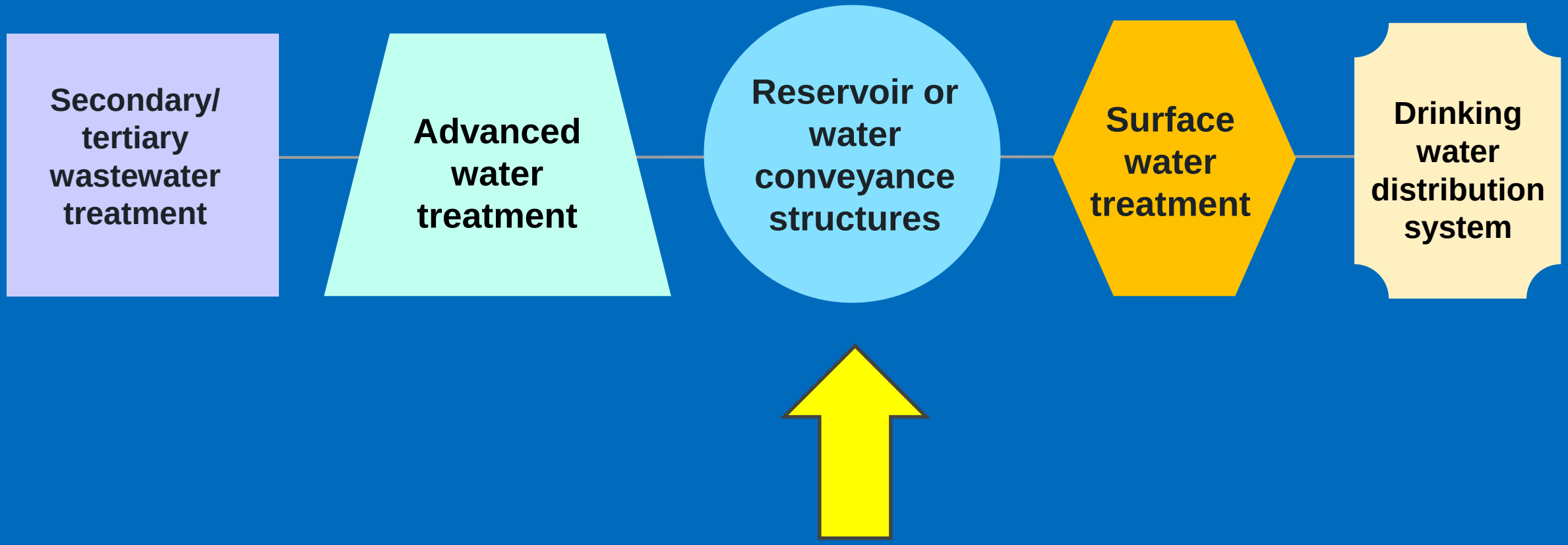
Direct Potable Reuse

- With a surface water treatment plant (produces advanced treated water)
- Without a surface water treatment plant (produces finished drinking water)

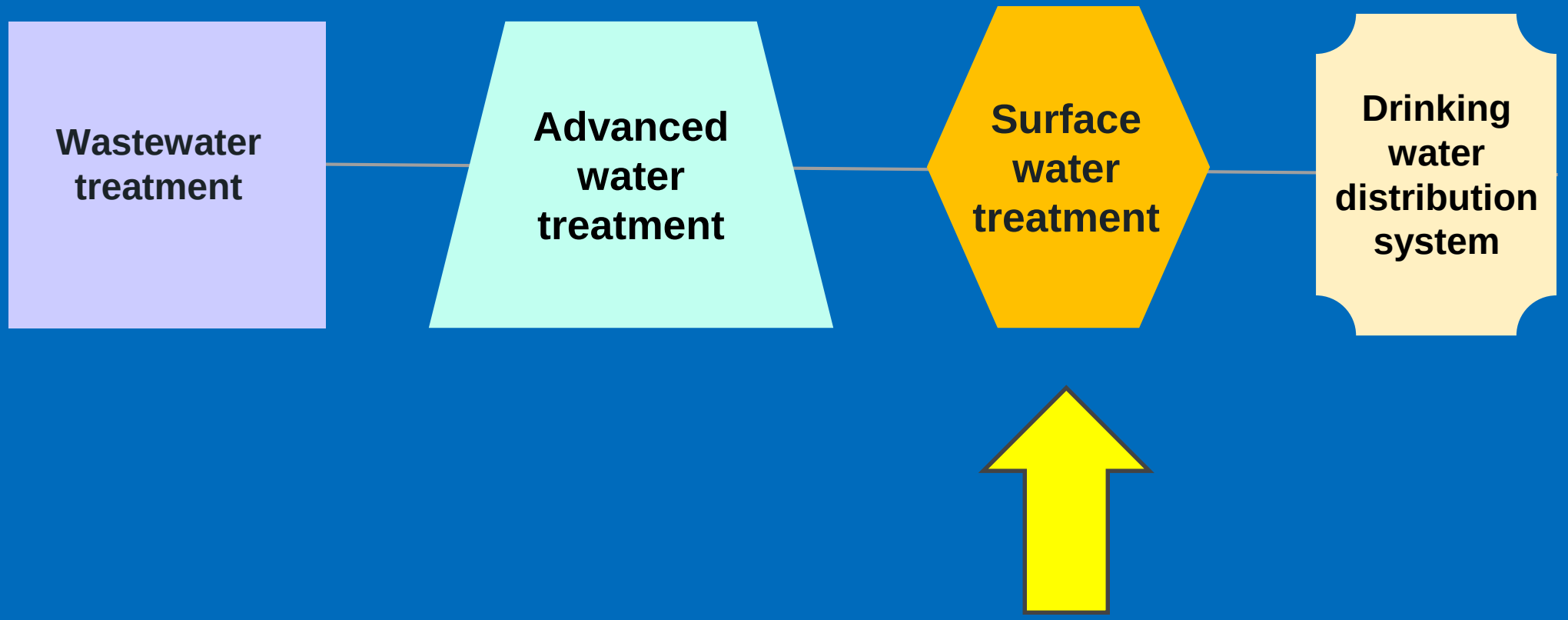
Surface Water Augmentation

- Reservoirs, lakes, and water conveyance structures
- See AZ Administrative Code R18-9-601 (open water conveyance and pipeline conveyance)

Surface water augmentation



Direct potable reuse (first type) producing advanced treated water



Direct potable reuse (second type) producing finished drinking water

Regulation	Permit	Guidance

3. Outreach

- **What?** Outreach programs are strategic, transparent, and thorough.
- **Why?** Public confidence and support is critical to the implementation of potable reuse projects.
- **Specific recommendations:**
  - Not the role of regulators.
  - Start early. Continue throughout project. Terminology is important.
  - Use proven techniques. Develop consistent messages.
  - Use of a communications plan. Prepare for tough questions.
  - Build relationships.

Regulation	Permit	Guidance

4. Source control

- **What?** Control of the discharge of constituents (chemicals) into a wastewater collection system that:
  1. Can impact wastewater treatment.
  2. Are difficult to treat.
  3. May impair the water quality entering an advanced treatment facility.
- **Why?** Beneficial, efficient, and cost effective strategy for managing chemicals by keeping them out of the wastewater system.
- **Specific recommendations:**
  - Understand the sewershed and sources of chemicals.
  - Minimize discharge of harmful or difficult to treat chemicals.
  - Improve wastewater water quality. Provide public with confidence.

Regulation	Permit	Guidance

5. Public health protection

What? Demonstrate public health protection through appropriate pathogen and chemical control based on treatment technologies, treatment performance, and monitoring.

Why? Potable reuse involves a highly impaired source – wastewater. Regulators require that a certain level of risk protection is achieved and the public will need confidence.

Specific recommendations:

- Pathogen control (viruses, protozoa, and bacteria)
- Chemical control (regulated and unregulated)
- Treatment technologies and monitoring (indicators and surrogates)

Regulation	Permit	Guidance

5. Water quality classes

- **What?** Base DPR criteria on level of wastewater treatment.
- **Why?** The level of wastewater treatment, and the resulting water quality, varies by class in AZ.
- **Specific recommendations:**
  - Not using RO: require A+ or B+ (+ refers to NDN)
  - Using RO: can use A, B, A+, or B+
  - The pathogen log removal credits provided for the different classes may vary.
  - The pathogen log removal targets for the advanced treatment may vary based on class.

Regulation	Permit	Guidance

6. Microbial control

- **What?** For DPR, public health protection requires that pathogens in wastewater be removed or inactivated.
- **Why?** Pathogens in recycled water include bacteria, viruses, and protozoan parasites. Pathogenic microorganisms present significant acute risks to the consumer and are the most important design and operating concern for DPR systems.
- **Specific recommendations:**
  - An appropriate goal is 1 in 10,000 annual risk of infection.
  - A log removal target approach (including a log removal credit system) is needed since it is not possible to measure directly.

Regulation	Permit	Guidance

7. Log Removal Targets

- Comply with the following minimum log removals (including SWTR credits for the PSW) starting from the raw wastewater (California):
  - 12-log reduction of enteric virus,
  - 10-log reduction of *Giardia* cysts, and
  - 10-log reduction of *Cryptosporidium* oocysts
- Log removals can be adjusted based on an approved pathogen removal study of the wastewater treatment plant that assigns conservative log reduction credits (Texas)
- Apply credits to wastewater facility, advanced water treatment facility, and drinking water facility based on regulatory review.

Regulation	Permit	Guidance

8. Log Removal Credits

- CA has assigned maximum credits at unit processes at IPR projects.
- Specific unit processes with LRVs are (V/C/G):
  - Wastewater (2/1/1)
  - Microfiltration/ultrafiltration (0/4/4)
  - Reserve osmosis (1.5/1.5/1.5)
  - AOP (6/6/6)
  - Chlorination 6/3/0)
- Process monitoring is needed for verification.

DPR Log_{10}-Reduction Values (WRRF 11-02)

Microbial Group	Criterion (log_{10} reduction)	Possible surrogates	Source used to develop criteria
Enteric virus	12	MS2 bacteriophage	SWTR (U.S. EPA, 1989a); CDPH (2011); NRC (2012); NRMMC–EPHC–NHMRC (2008)
Cryptosporidium spp.	10	Latex microspheres, AC Fine Dust, inactivated *Cryptosporidium* oocysts, aerobic spores	Interim ESWTR (U.S. EPA, 1998); LT2 ESWTR (U.S. EPA, 2006); CDPH (2011); NRC (2012); NRMMC–EPHC–NHMRC (2008)
Total coliform bacteria	9	NA[c]	Total Coliform Rule (U.S. EPA, 1989b); NRC (2012) risk assessment for salmonella

Example Pathogen Log Reduction Credits (Tchobanoglous et al., 2015)

Process	Monitoring	Log Reduction Credits			Notes
		V	G	C	
Secondary treatment	Study needed	0 - 1.9	0 - 0.8	0 - 1.2	"0" is the default.
MF or UF	Daily PDT	0[a]	4.0	4.0	Pressure decay test (PDT) should be done daily to verify proper performance.
RO	Online EC	1.5	1.5	1.5	Electrical conductivity (EC) should be monitored in RO influent and effluent. Log reduction in system control must be based upon measured values.
UV-AOP	Intensity sensors	6	6	6	UV sensors should be calibrated per U.S. EPA (2006).
ESB with free chlorine, CL_2,	Online Cl_2	6	3	0	System control is based on maintaining a minimum free residual of 0.4 mg/L.
Total		**13.5**	**14.5**	**11.5**	

Regulation	Permit	Guidance

8. Chemical Control

- **What?** Chemicals in wastewater must be removed to appropriate levels.
- **Why?** Chemicals in recycled water include both regulated and unregulated chemicals. Chemicals are typically chronic (nitrate is a notable exception). Trace organics (e.g., CECs) are often discussed.
- **Specific recommendations:**
  - Meet all MCLs and any additional state requirements (regulated chemicals)
  - Meet relevant health criteria established for unregulated chemicals.
  - Monitor for surrogates and indicators of treatment (performance monitoring) and water quality (verification monitoring).
  - Possibly use TOC as a measure for unknown chemicals.

Regulation	Permit	Guidance

8. Chemical Control

A tiered approach for chemical criteria based on the type of monitoring:

- **Tier 1: Regulated chemical constituents, including DBPs**
  - MCLs, other state requirements
- **Tier 2: Unregulated chemical constituents with public health interest**
  - Including CECs based on public health
- **Tier 3: Unregulated chemical constituents that provide information on the effectiveness of treatment**
  - Including CECs
  - Detected frequently and at sufficient concentrations to make them useful measures of the removal of health-significant organic chemicals

Regulation	Permit	Guidance

8. Chemical Control - Salinity

- **What?** TDS and individual constituents.
- **Why?** Salinity is not a public health issue, but salinity must be managed to maintain acceptable aesthetics and for recycled water quality. Individual constituents (chloride, bromide, etc) are also important.
- **Specific recommendations:**
  - Salinity is often a regional issue.
  - Include salinity as a consideration in planning and design.
  - Understand the long-term changes in salinity.
  - Removing salinity requires advanced treatments such as RO.

Regulation	Permit	Guidance

8. Wastewater treatment

- **What?** Provide a consistent, high-quality effluent.
- **Why?** As a source water for DPR, WWTPs should produce an effluent optimized for further processing by AWTP.
- **Specific recommendations:**
  - Source control
  - Wastewater should be B+ or A+ (NDN), unless full-stream RO is used for advanced water treatment.
  - Assignment of log removal credits (different between B+ and A+)
  - There are benefits with using a higher quality effluent in a potable reuse treatment train. As a result, enhancements should be considered.

Regulation	Permit	Guidance

9. Wastewater optimization

Possible measures to improve performance and enhance reliability:

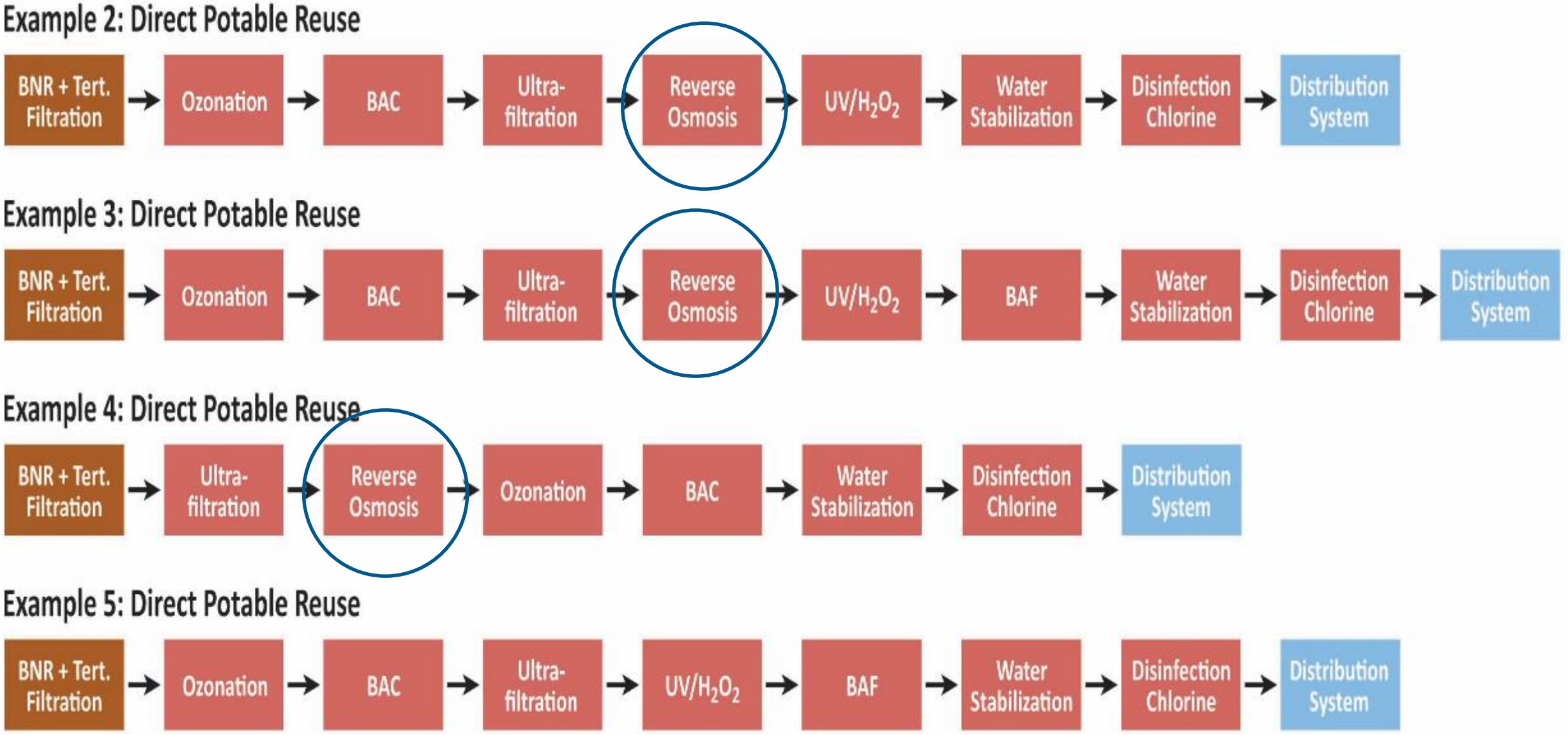
- Enhanced screening process and, possibly, fine screening.
- Influent flow and load equalization.
- Elimination (or equalization) of untreated return flows.
- Operational mode for biological treatment process to improve reliability and produce an effluent of consistent quality.
- Improved disinfection while preventing DBP formation.
- Post-treatment filtration (suspended solids can present a major challenge to AWTF processes, such as RO and AOP).
- Improved online and offline process monitoring.

Regulation	Permit	Guidance

10. Advanced water treatment (AWT)

- **What?** Involves unit processes (a range exists) for treating wastewater effluent to produce a drinking water source of supply.
- **Why?** Must meet regulatory review (pathogens and chemicals) and public scrutiny.
- **Specific recommendations:**
  - Define the objectives (pathogen log removals and chemical control).
  - Do not list specific treatment trains (avoid the notion of prescribed trains).
  - Instead, provide lists of advanced treatments and the capabilities.
  - Use of pilot testing and/or demonstration studies.
  - Final water quality will vary based on the treatments employed.
  - Track research and field experience. Understand reliability (performance of treatment).
  - Role of “environmental storage buffer”

Example treatment trains



From the draft Expert Panel Report on the Feasibility of Developing DPR Criteria for Calif. (2016)

Regulation	Permit	Guidance

11. Employ BADCT

- **What?** ADEQ has stringent APP technology standards for WWTPs (Best Available Demonstrated Control Technology or BADCT) that involves:
  - Engineering controls, processes, operating methods or other alternatives, including site-specific characteristics, to manage chemicals/pathogens.
- **Why?** Expanded use of this approach may provide design criteria and validated technologies for DPR.
- **Specific recommendations:**
  - Use BADCT in the design, construction and operation of DPR.
  - Use of “prescriptive approach” (pre-approved demonstrated technologies) and “individual process” (performance based)

Regulation	Permit	Guidance

12. Treatment performance

- **What?** Process control and monitoring
- **Why?** Document system performance and monitor chemical and pathogen reduction or measure specific criteria.
- **Specific recommendations:**
  - Automated system control
  - Start-up performance
  - Performance monitoring (long-term monitoring; surrogate and indicator monitoring)
  - Frequency, locations, regulatory vs. process, online vs. periodic
  - Use of Critical Control Points

Regulation	Permit	Guidance

13. Long-term monitoring

- **What?** Performance monitoring.
- **Why?** Demonstrate continuous production of high-quality water protection of public health.
- **Specific recommendations:**
  - Online where possible.
  - Rapid surrogate measures.
  - Assure log-removal targets are met.
  - Develop periodic sampling requirements.
  - Use of alarms, shutdowns, and flow diversions.

Performance Monitoring: Example Online and Calibration Sampling

(Tchobanoglous et al., 2015)

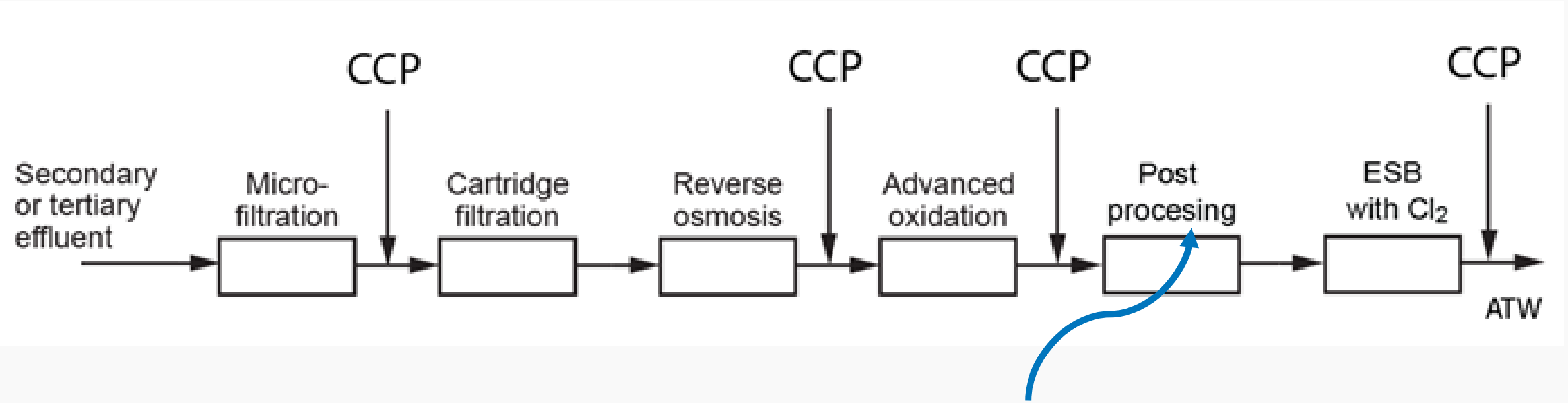
Process	Test	Type and Frequency of Sampling
Secondary effluent	Turbidity and microbial indicators	Turbidity: online (continuous) and grab (weekly); microbial: grab (weekly)
	Ammonia, TSS, and BOD	Grab (weekly)
MF or UF	PDT	Offline testing (daily)
	Turbidity	Online (continuous) and grab (weekly)
RO	Influent and effluent EC and TOC	Online (continuous) and grab (weekly)
UV-AOP	UV sensors	Online (continuous) and verification (weekly)
	Influent UVT	Online (continuous) and grab (weekly)
	Influent and effluent chloramine	Online (continuous) and grab (weekly)
ESB with free chlorination	Effluent free chlorine residual	Online (continuous) and grab (weekly)

Regulation	Permit	Guidance

14. Critical Control Points

- **What?** Point in the treatment train (i.e., a unit treatment process) that is designed to reduce, prevent, or eliminate a human health risk and for which controls exist to ensure the proper performance of that process.
- **Why?** Systematic approach to inform the effective operation of AWTF through performance-based monitoring (augment end-of-pipe monitoring)
- **Specific recommendations:**
  - Steps:
    - Identify hazards
    - Identify CCPs
    - Identify monitoring procedures
    - Identify corrective actions and procedures

Example: Control Control Points



Robin, I know it's misspelled! I'm missing the second "s"!

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Regulation	Permit	Guidance

15. Facility operation

- **What?** Operation and maintenance (O&M) for DPR system to operate consistently and reliably.
- **Why?** Appropriate O&M is needed to ensure that all public health objectives are met.
- **Specific recommendations:**
  - Commissioning and initial start up
  - Shutdown plan
  - O&M Plan (critical item)
  - Operator Training and Certification
  - Reporting

Components of an O&M Plan for a DPR System (Tchobanoglous et al., 2015)

- Staffing (i.e., for daily operations and emergencies)
- Operator training and certification
- Checklists for operations procedures (daily, weekly, and monthly)
- Routine maintenance of equipment
- Critical spare parts and failure training
- Control system (e.g., SCADA, shutdown procedures, and alarms)
- Process monitoring and control
- Regulatory compliance
- Frequency of monitoring
- Distribution System
- Response time to treatment failures or non-compliant water quality

Regulation	Permit	Guidance

16. TMF Capacity

- **What?** Technical, Managerial, and Financial Capacity – ability of a water utility to provide safe and dependable water (required by SDWA)
- **Why?** Regulators can assess a utilities potential or existing weaknesses to provide safe and reliable advanced treated water.
- **Specific recommendations:**
  - Build on existing capacity develop program for PWSs
  - Expand current TMP program to address DPR
  - Ability to review small systems

17. Other considerations

- Inter-agency coordination
- Blending water into drinking water supply
- Bioassays
- Antibiotic resistant bacteria and genes
- Reliablity, robustness, resiliency, and redundacy
- Managing concentrate from RO
- Research

NEXT

- **Develop draft document for review (August)**
- **Revise document - public review draft (August)**
- **Finalize document (September)**

Thank You!

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