Board Workshop

Draft Report to Legislature on Feasibility of Developing Uniform Water Recycling Criteria for Direct Potable Reuse

October 6, 2016 1:00 – 4:00 pm

CalEPA Headquarters

Sacramento, CA

Workshop Overview

- **Welcome & Review of Workshop Rules**
  Cindy Forbes, SWRCB-Division of Drinking Water, Deputy Director
- **Overview of State Water Board Process**
  Mark Bartson, SWRCB-DDW, Chief – Technical Operations Section
- **Advisory Group: Highlights and Recommendations**
  Garry Brown, Advisory Group Chair
- **Expert Panel: Findings and Recommendations**
  Adam Olivieri & Jim Crook, Expert Panel Co-Chairs
- **Draft Report to Legislature on DPR & Moving Toward Criteria**
  Randy Barnard, SWRCB-DDW, Chief – Recycled Water Unit
  Robert Hultquist, SWRCB-DDW, Recycled Water Specialist
- **Potable Reuse Public Health Protection Research**
  Brian Bernados, SWRCB-DDW, Recycled Water Specialist
- **Conclude and Open for Public Comments**

Public Workshop

Draft Report to Legislature on Feasibility of Developing Uniform Water Recycling Criteria for Direct Potable Reuse

October 4, 2016 9:00 – Noon

Metropolitan Water District of Southern California Headquarters

Los Angeles, CA

Workshop Overview

- **Welcome & Review of Workshop Rules**
  Kurt Souza, SWRCB-Division of Drinking Water, Assistant Deputy Director
  Gita Kapahi, SWRCB-OPP, Workshop Facilitator
- **Overview of State Water Board Process**
  Mark Bartson, SWRCB-DDW, Chief – Technical Operations Section
- **Advisory Group: Highlights and Recommendations**
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WELCOME &
WORKSHOP OVERVIEW

Review of Workshop Rules

- Please sign in
- Remember to silence your electronic devices
- Fill out a speaker card if you wish to comment
- Comments may be limited to a set amount of time based on the number of people wishing to speak
- Please save questions for end of each presentation segment
- Only written comments addressed to the Board Clerk will be considered, address will be provided in presentation slides

OVERVIEW OF STATE WATER BOARD PROCESS

Mark Bartson P.E.
Division of Drinking Water
Chief – Technical Operations Section

Statutory Requirements

Task	Deadline	Status
Adopt Groundwater Recharge Regulations	Dec 31, 2013	✓
Adopt Surface Water Augmentation Regulations	Dec 31, 2016	On track
Prepare Draft Report on Expert Panel Recommendations & Research Status	June 30, 2016	✓
Release Public Review Draft Report on Feasibility of Developing Direct Potable Reuse Criteria	Sept 1, 2016	✓
Submit Final Report to the Legislature	Dec 31, 2016	On track

Schedule

- Public Comment Period for Draft Report
  - 45 days per CWC § 13563
  - Draft Report posted Sept 8, 2016
  - Comments are due **Oct 25, 2016, at noon**
- Public Workshops
  - Oct 4, 2016 at Metropolitan WD, Los Angeles
  - Oct 6, 2016 at CalEPA HQ, Sacramento
- Final Report to the Legislature: Dec 31, 2016

Submission of Written Comments

- Written comments are due **Oct 25, 2016, at noon**
- Send comment letters addressed to:
  Jeanine Townsend, Clerk to the Board
- Indicate on subject line:
  "Comment Letter – Report to the Legislature on DPR"
- By e-mail: (PDF format, max 15 MB)
  commentletters@waterboards.ca.gov
- By fax: (916) 341- 5620
- By mail:

Hand/ Courier Delivery	U.S. Mail
1001 I Street, 24th Floor	P.O. Box 100
Sacramento, CA 95814	Sacramento, CA 95812-0100

Subscribe to SWRCB Listserve for updates:

http://www.waterboards.ca.gov/resources/email_subscriptions/swrcb_subscribe.shtml

Drinking Water → "Recycled Surface Water Augmentation & Direct Potable Reuse"

DDW Report to the Legislature:

http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/rw_dpr_criteria.shtml

DDW Contact

Randy Barnard, (619) 525-4022

randy.barnard@waterboards.ca.gov

Investigation must include

1. Recommendations of the Expert Panel;
2. Recommendations of the Advisory Group;
3. Regulations and guidelines on DPR from jurisdictions in other states, federal government, and other countries;

Investigation must include

4. Research by the State Water Board regarding unregulated pollutants (Recycled Water Policy)

5. Water quality and health risk assessments associated with existing potable water supplies subject to discharge from municipal wastewater, storm water, and agricultural runoff;

Investigation must include

6. Results of the State Water Board's investigations pursuant to CWC §13563
   - Reliability of treatment to protect public health.
   - Multiple barriers that may be appropriate.
   - Health effects.
   - Mechanisms to protect public health if problems occur.
   - Monitoring needed to ensure protection of public health.
   - Any other scientific or technical issues, including the need for additional research.

Expert Panel Charge

Advise State Water Board on public health issues and scientific and technical matters regarding:

- Development of uniform water recycling criteria for indirect potable reuse through surface water augmentation
- Investigation of the feasibility of developing uniform water recycling criteria for DPR
- Assess needs for additional research and recommend an approach for completion

Tasks of the Advisory Group

- Advise the Expert Panel regarding investigation of the feasibility of developing uniform water recycling criteria for DPR
- Make recommendations to DDW on any other relevant topics such as:
  - Practical considerations for regulations that are protective of public health and achievable by project proponents

ADVISORY GROUP HIGHLIGHTS AND RECOMMENDATIONS

Garry Brown
Advisory Group Chair

Advisory Group Members

- **Chair:** Garry Brown, Orange County Coastkeeper
- Randy Barnard, SWRCB Division of Drinking Water
- Amy Dorman, City of San Diego
- Conner Everts, Environmental Justice Coalition for Water
- Jim Fiedler, Santa Clara Valley Water District
- Julie Labonte, San Diego Regional Chamber of Commerce
- Al Lau, Padre Dam Municipal Water District
- Bruce Macler, U.S. EPA
- Traci Minamide, LA Sanitation
- Edward Moreno, MD, MPH, Health Officer, Monterey County Health Dept.
- Keith Solar, San Diego County Taxpayers Association
- Fran Spivy-Weber, State Water Resources Control Board
- Ray Tremblay, Sanitation Districts of Los Angeles County
- Andria Ventura, Clean Water Action
- Mike Wehner, Orange County Water District

Advisory Group Recommendations

- Consensus on 19 recommendations
- DPR, when implemented appropriately, has the potential to provide a reliable source of water supply that is protective of public health for communities in California
- Two types of recommendations:
  - Related to the feasibility of developing criteria
  - Not related to the feasibility of developing criteria

Advisory Group Recommendations Examples by Type

Related to the Feasibility of Developing Criteria	Not Related to the Feasibility of Developing Criteria
• Wastewater source control, operation optimization, and planning requirements for DPR • Operator training and certification • Technical, Managerial, and Financial (TMF) capacity • Changes to Consumer Confidence Report • Research priorities	• Communications and public outreach • Phasing of potable reuse regulations • Potable reuse terminology • Environmental justice • Environmental impact • Impact to water rates

Operator Certification Recommendations

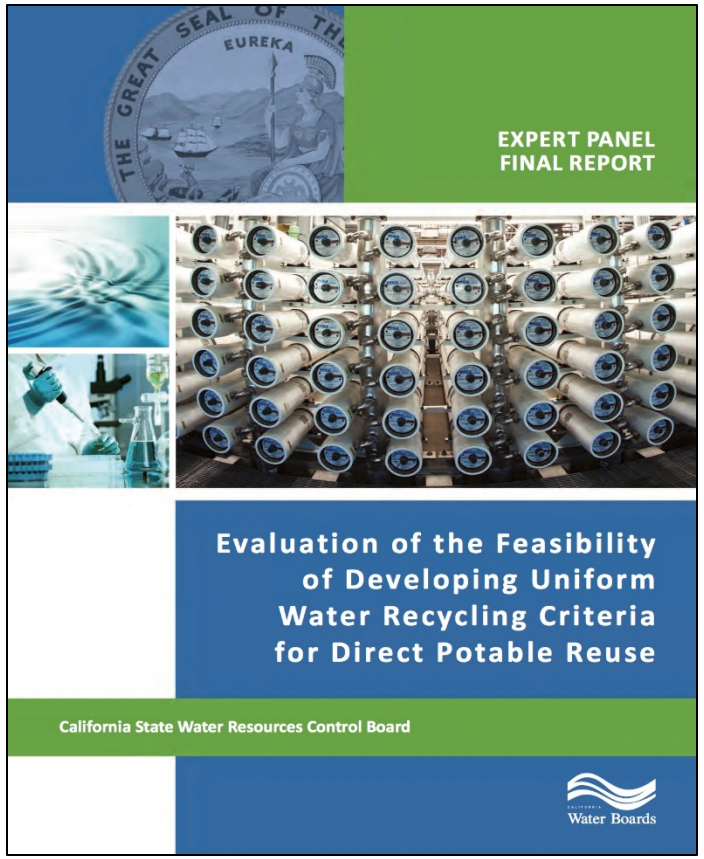
- A training and certification program is needed for operators employed at advanced water treatment facilities (AWTF)
- Protection of public health is paramount for successful implementation of DPR projects
  - Operation by experienced and well-trained staff to make sure the treatment processes function properly, regulatory requirements are met consistently, and water produced is safe for public consumption

Operator Certification Recommendations

- Reflected in the white paper entitled “Potable Reuse Operator Certification Framework” prepared by the California Urban Water Agencies (CUWA)
- Provides nine (9) recommendations on program elements and considerations
- Recognizes the need for interim certification program
  - Potential collaboration with CWEA and AWWA ad hoc committees

State Water Board DPR Expert Panel

Summary of Expert Panel Report on Direct Potable Reuse in California



Adam Olivieri and Jim Crook

Expert Panel Co-Chairs

CALIFORNIA Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

NWRI

Expert Panel Members

- **Co-Chair: Adam Olivieri, Dr.P.H., P.E.,** EOA, Inc. (CA)
- **Co-Chair: James Crook, Ph.D., P.E.,** Environmental Engineering Consultant (MA**)**
- **Michael Anderson, Ph.D.,** University of California, Riverside (CA)
- **Richard Bull, Ph.D.,** MoBull Consulting (WA)
- **Dr.-Ing. Jörg Drewes,** Technische Universität München (Germany)
- **Charles Haas, Ph.D.,** Drexel University (PA)
- **Walter Jakubowski, M.S.,** WaltJay Consulting (WA)
- **Perry McCarty, Sc.D.,** Stanford University (CA)
- **Kara Nelson, Ph.D.,** University of California, Berkeley (CA)
- **Joan Rose, Ph.D.,** Michigan State University (MI)
- **David Sedlak, Ph.D.,** University of California, Berkeley (CA)
- **Tim Wade, Ph.D.,** U.S. Environmental Protection Agency (NC)

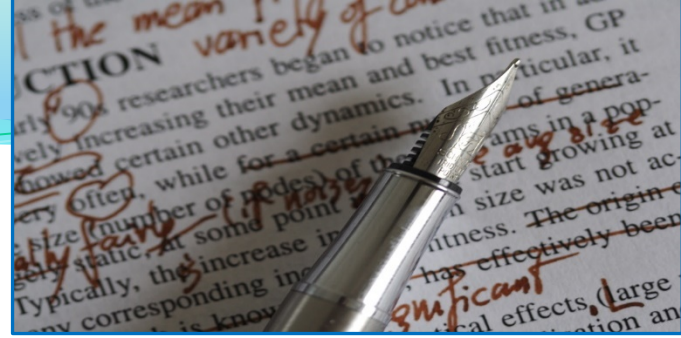
Forms of Potable Reuse

Indirect potable reuse (IPR):

Augmentation of a drinking water source **(surface water or groundwater)** with reclaimed water followed by an **environmental buffer** that precedes normal drinking water treatment

Direct potable reuse (DPR):

Introduction of reclaimed water **directly into a potable water supply** distribution system downstream of a water treatment plant or **into the raw water supply** immediately upstream of a water treatment plant (California Water Code)



Topics of Panel Report

- Public health surveillance tools/methods to quantify/mitigate risks (**Chap 3**)
- Analytical approaches for measuring chemical water quality (**Chap 4**)
- Application of bioanalytical tools to water analyses (**Chap 5**)
- Traditional/molecular methods for assessing microbial water quality (**Chap 6**)
- Antibiotic resistant bacteria and antibiotic resistance genes (**Chap 7**)
- Performance of DPR systems (**Chap 8**)
- Potable reuse regulatory feasibility analysis to compare an example DPR system against an existing Calif. potable water supply that is protective of public health (**Chap 9**)
- Management controls **(Chap 10)**

Findings Covered in Presentation

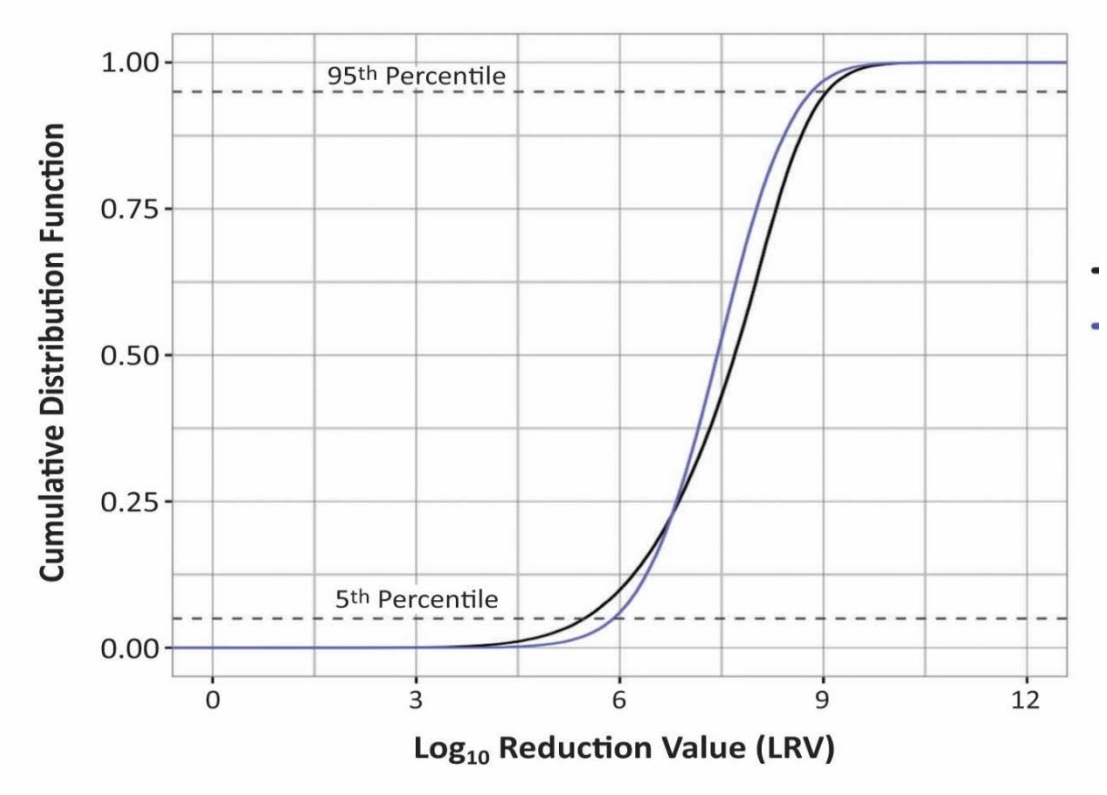
- Pathogen Log Reduction Approach
- Public health surveillance tools
- Short-duration releases of chemical contaminants
- Routine application of bioanalytical tools
- Antibiotic resistant bacteria and antibiotic resistance genes
- Performance of DPR systems and Potable reuse regulatory feasibility analysis
- California-Specific Research Recommendations (included within subject slides)

Summary of Panel Key Findings

Findings

Review Performance Criteria for Pathogens

- State LRV assumptions are acceptable basis to evaluate DPR feasibility
- Probabilistic is a robust approach and consistent with the SWB approach
- The probabilistic approach recommended for evaluating DPR feasibility and for future use to measure (baseline) overall plant performance
- Approach used to assign unit process LRV credits is feasible for DPR



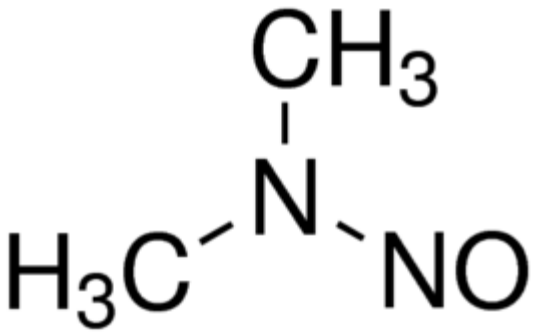
Recommendations to State Water Board

Public Health Surveillance Tools and Methods

- **Inform local public health partners** when a DPR project is being considered
- **Identify points of contact** and review available surveillance data sources
- **Establish processes for regular engagement**, information sharing, and notification
  - Emphasis on tracking, reporting, and communicating notifiable acute (primarily) waterborne diseases
- Work with DPR project sponsors and local health agencies to **consider the feasibility** of enhanced public health surveillance for communities with DPR systems
  - **Power analysis -** not feasible for well operated systems; gross failure maybe

Chemical Water Quality Monitoring

- Short-duration releases of chemical contaminants of commercial or industrial origin
  - Solvents and other chemicals commonly used in relatively large quantities in commercial or industrial activities (e.g, Acetone, MEK, methanol)
  - Highly toxic contaminants used in small amounts or that are present as trace impurities or byproducts of another process
- Indicator chemicals and surrogate parameters

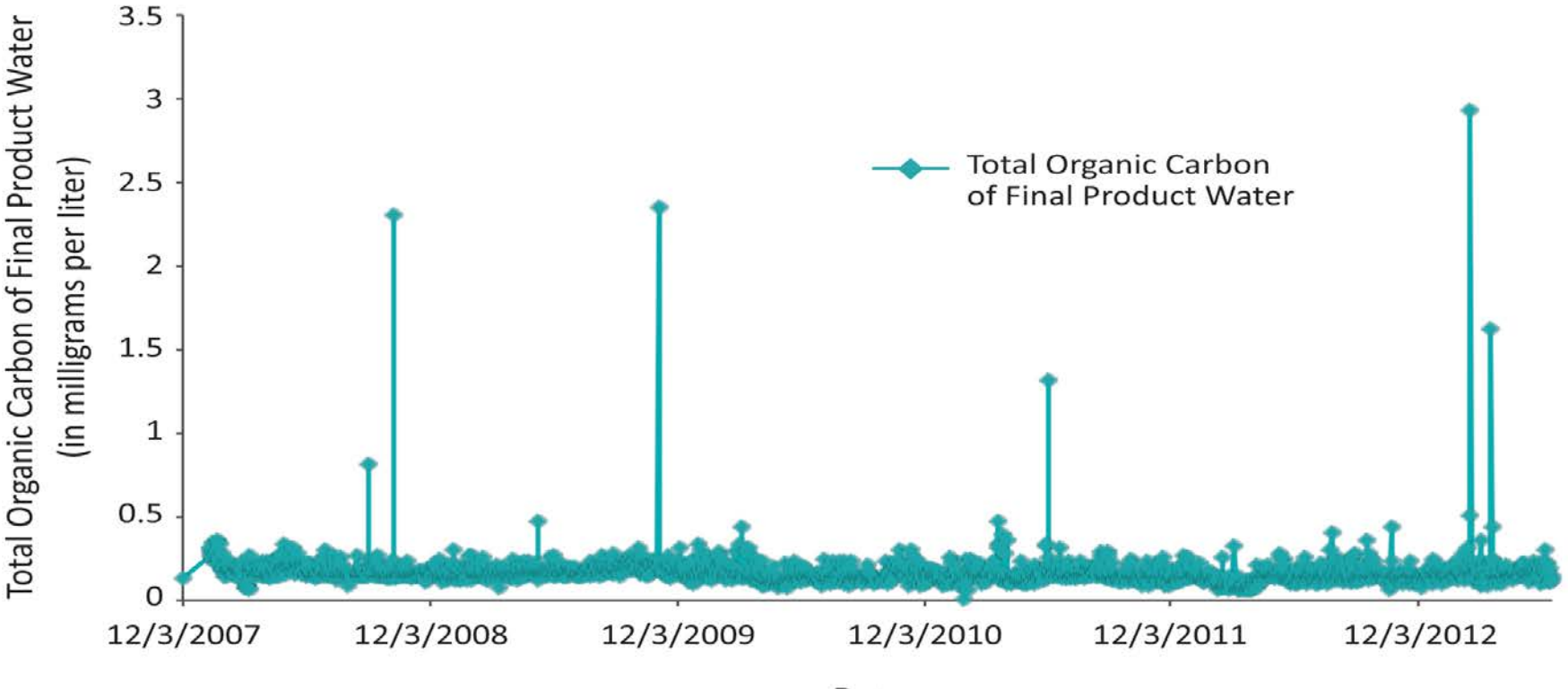


NDMA

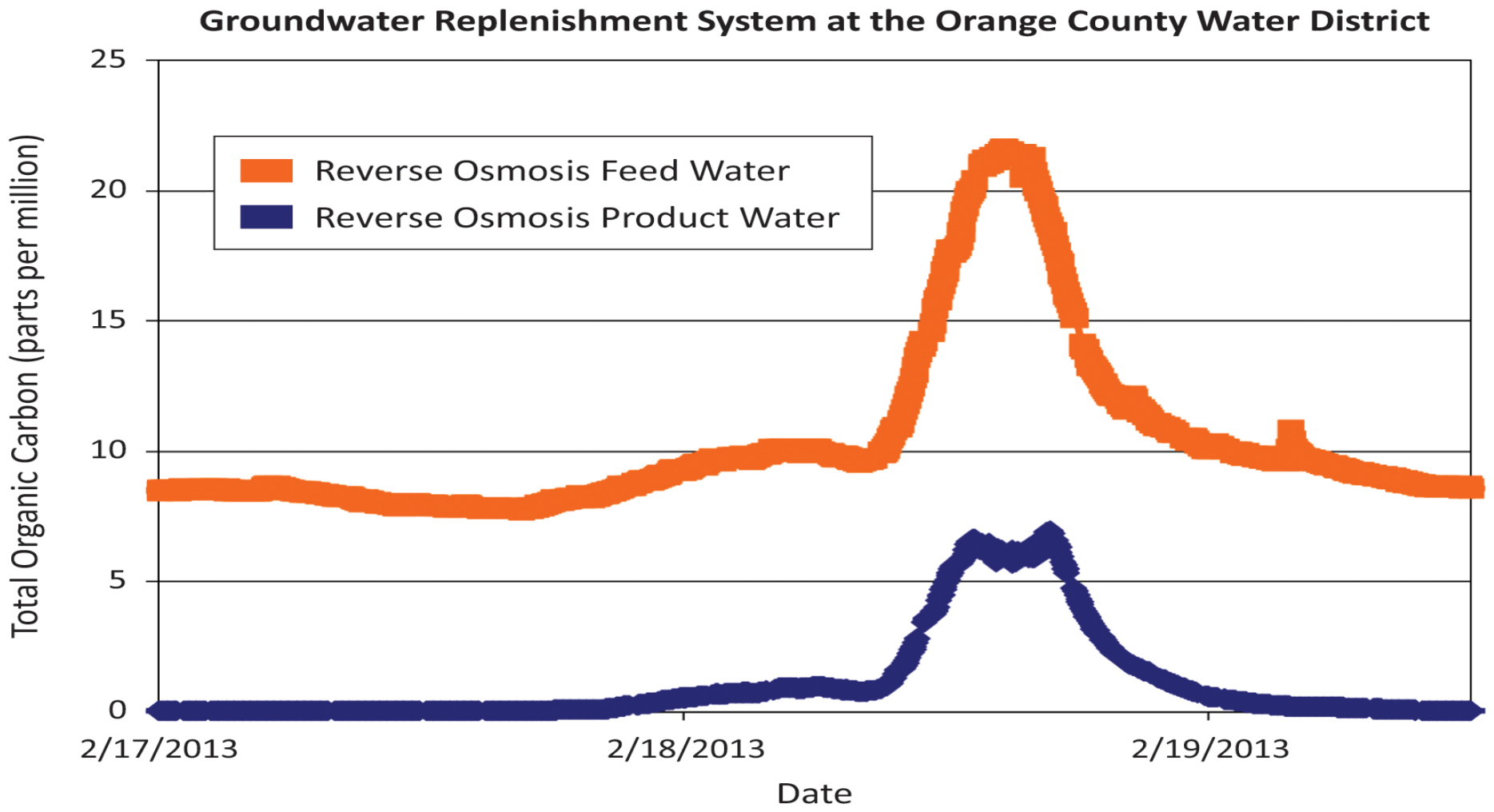
Monitoring Results Relevant to DPR

Groundwater Replenishment System (GWRS) at Orange County Water District

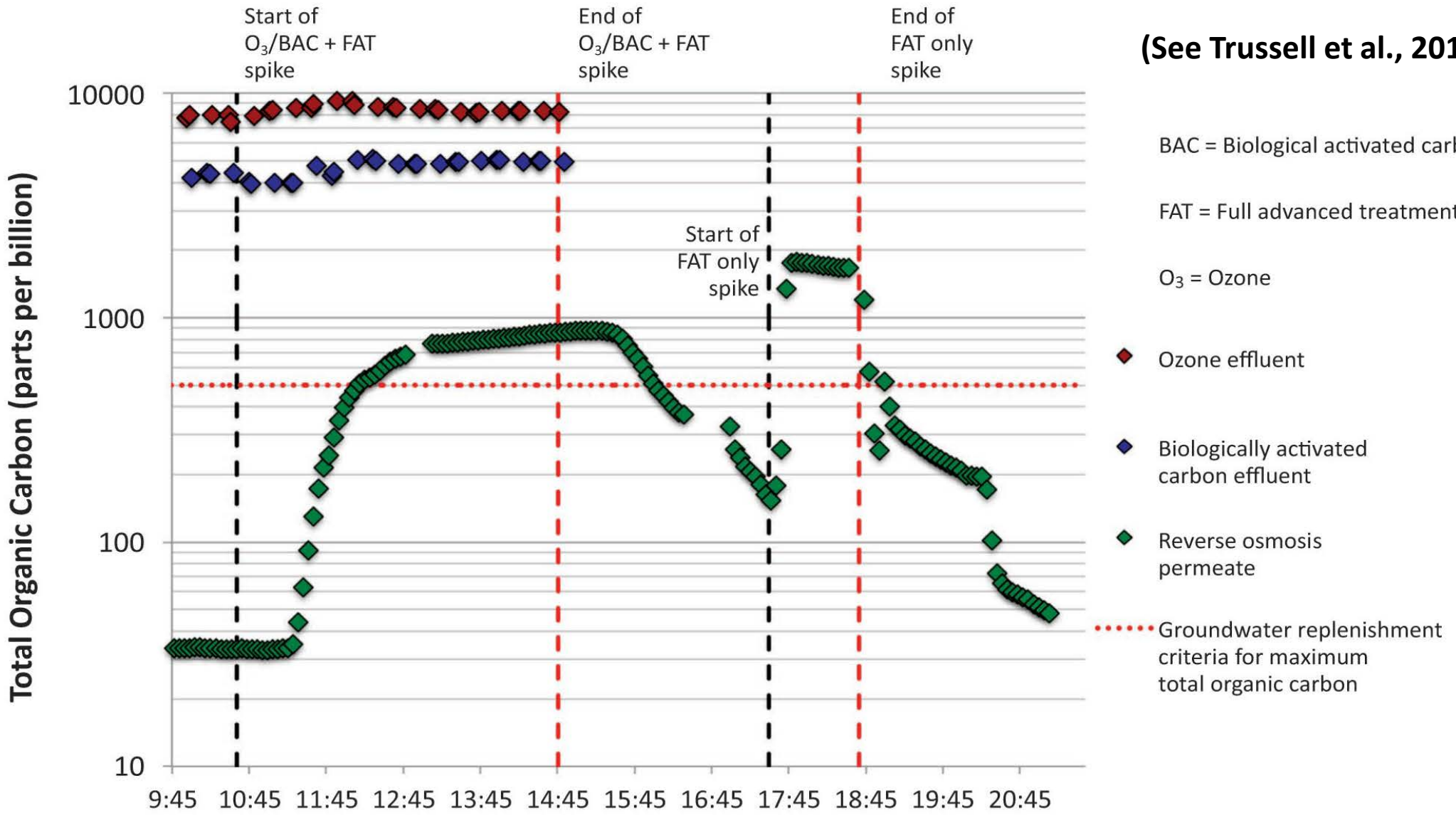
- Despite an exemplary industrial source control program and few industrial dischargers (<5% of stream), GWRS observed at least 6 TOC spikes between 2007–2012 **(Patel, 2013)**



Results of Online TOC Monitoring Before and After RO at GWRS (Dadakis and Dunivin, 2013)



Spiking of Acetone and Formaldehyde at San Diego Demo Facility



(See Trussell et al., 2016)

Monitoring Results Relevant to DPR

- GWRS observed conditions of >5 mg/L of acetone present for over 4 hours after RO treatment
- The peak concentrations of acetone likely were attenuated by subsequent biotransformation and mixing in the aquifer
  - CONCERN: If this pulse occurred in a DPR system using the same treatment processes, little further attenuation would be likely
- Without the use of a high-frequency TOC analyzer capable of detecting acetone, the pulse would not be detected at the AWTF in time to avoid introducing water with elevated acetone concentrations to a DWTF or drinking water distribution system

Key Findings

Chemical Monitoring - TOC Surrogate

- In Calif., most AWTFs currently under consideration for DPR include RO
  - Uncharged, low molecular weight compounds tend to be poorly rejected by RO
    - Examples: NDMA, chloroform, and low molecular weight aldehydes
  - Under normal operating conditions, the concentrations of low molecular weight, neutral compounds in product water generally are below the low TOC method detection limits observed in RO permeate (<0.1 mg/L)
  - **Chemical monitoring plans for DPR systems need to include high-frequency monitoring of TOC or other surrogate parameters capable of detecting pulses of compounds that are poorly removed in RO and subsequent treatment with advanced oxidation**

Key Finding & Research

Chemical Monitoring – Averaging of Potential Peaks

- AWTFs sometimes employ an oxidant (e.g., ozone, chlorine, chloramines) prior to or after treatment with RO
  - This practice can result in the formation of toxic byproducts, some of which are low molecular weight compounds that are not removed well during RO or might remain after subsequent treatment with advanced oxidation
- Encourage short-term research on identifying suitable treatment options for final treatment processes that can provide some “averaging” with respect to potential chemical peaks for chemicals that have potential to persist through AWTF systems

Key Findings

Chemical Monitoring – Targeted Monitoring

- Inform targeted monitoring for **source control and final water quality**
  - Establish an internal process to monitor the literature and
  - Establish an external peer review process to address the results of the internal efforts to maintain a high level of awareness of these issues

Findings

Application of Bioanalytical Tools to Water Analyses

- Bioassays **have potential role** in identifying yet-to-be-discovered contaminants
- Bioassays are **not recommended as part of routine monitoring** programs for DPR projects **at this time**
- Bioassay-directed fractionation is useful for identifying compounds in recycled water that merit further evaluation
  - **Research efforts employing bioassays and non-target screening analysis simultaneously are encouraged** to be used to discover new contaminants of concern

Findings

Antibiotic Resistant Bacteria and Genes

- AR is a valid and serious worldwide public health concern & are found in wastewater and other environments like soils and source waters not necessarily impacted by wastewater
- **Risk levels** associated with ARB/ARG in water have **not been determined**
- Concentrations of ARB/ARG in waters subject to DPR treatment processes **would likely be lower than that from current water sources** entering DWTFs
- A combination of secondary wastewater treatment and advanced water treatment processes (i.e., a sequence of treatment train processes like MF/UF, RO, UV/AOP) leading to **(DPR) finished potable water likely will reduce ARB/ARG concentrations in recycled water to levels well below those found in conventional treated drinking water.**

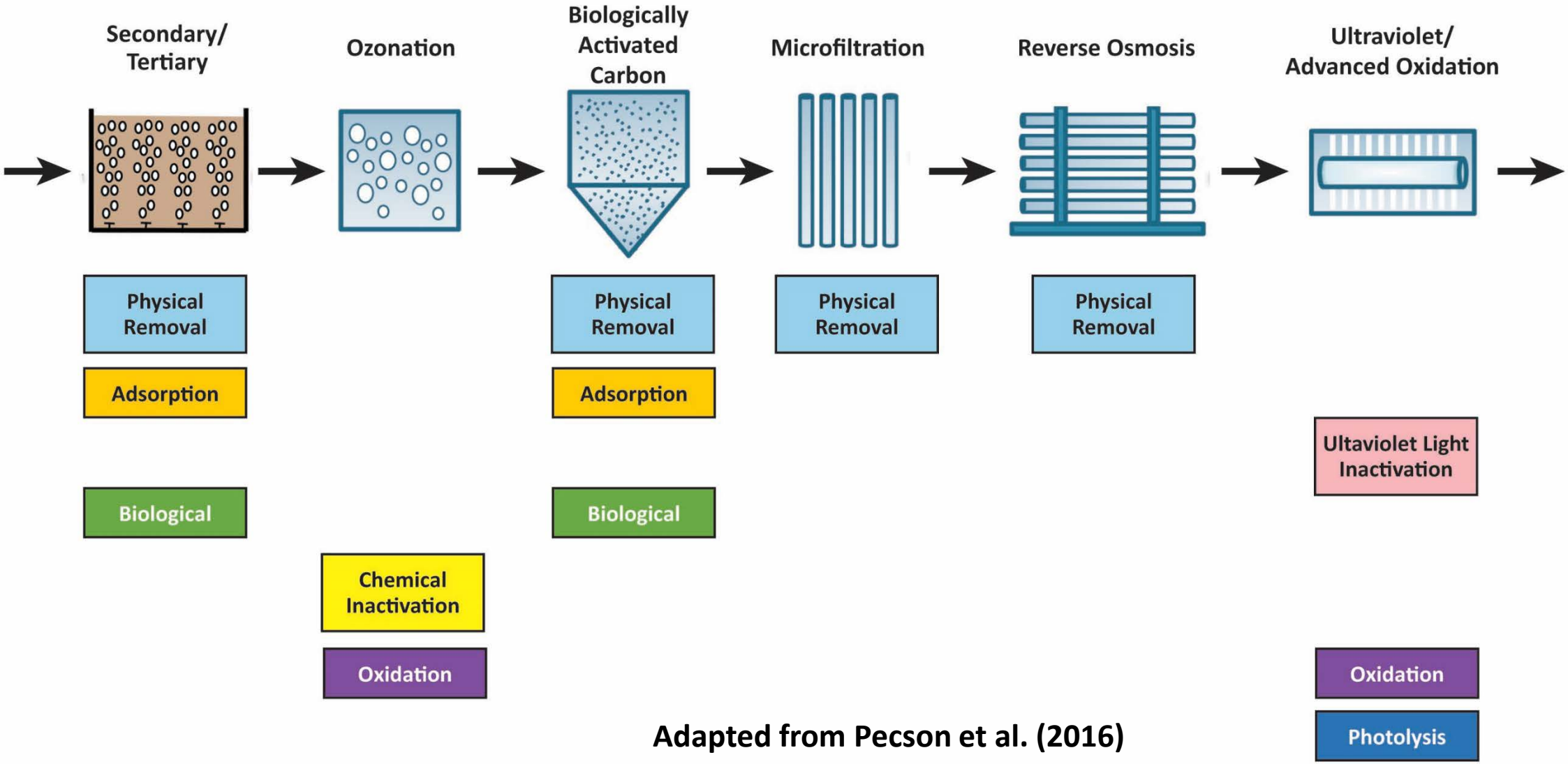
Performance of DPR Systems & Feasibility Analysis

- **Quantifying treatment facility reliability**
  - Performance and mechanical
- Enhanced source control
- **DPR alternative treatment systems**
- **Performance analysis (approach concepts)**
- Operation and maintenance

Underlying Reliability Assumptions

- **Reliability:** Ability to verifiably deliver water quality that consistently exceeds public health protection expected of conventional drinking water supplies
  - **Redundancy**: Addition of measures beyond minimum requirements to ensure treatment goals are met reliably and performance targets are achieved or exceeded consistently
    - Independent parallel operations of one or more similar treatment trains, permitting continuous operation
  - **Robustness:** Ability to address broad variety of contaminants and resist catastrophic failures
    - Diverse group of barriers to control a variety of contaminants
  - **Resilience:** Capacity to successfully adapt/respond to failure

Schematic of Concept of Robustness



Adapted from Pecson et al. (2016)

Evaluating System Reliability- Source to Tap

Application of **"multiple-barrier"** concept (core design principle in which redundancy, robustness, and resilience can be demonstrated)

- Source control
- Conventional wastewater treatment
- Advanced water treatment
- Management of environmental (engineered) buffer
- Drinking water treatment, including management of drinking water distribution system

The expectation is that a multi-barrier system can maintain treatment goals even if a single unit treatment process fails

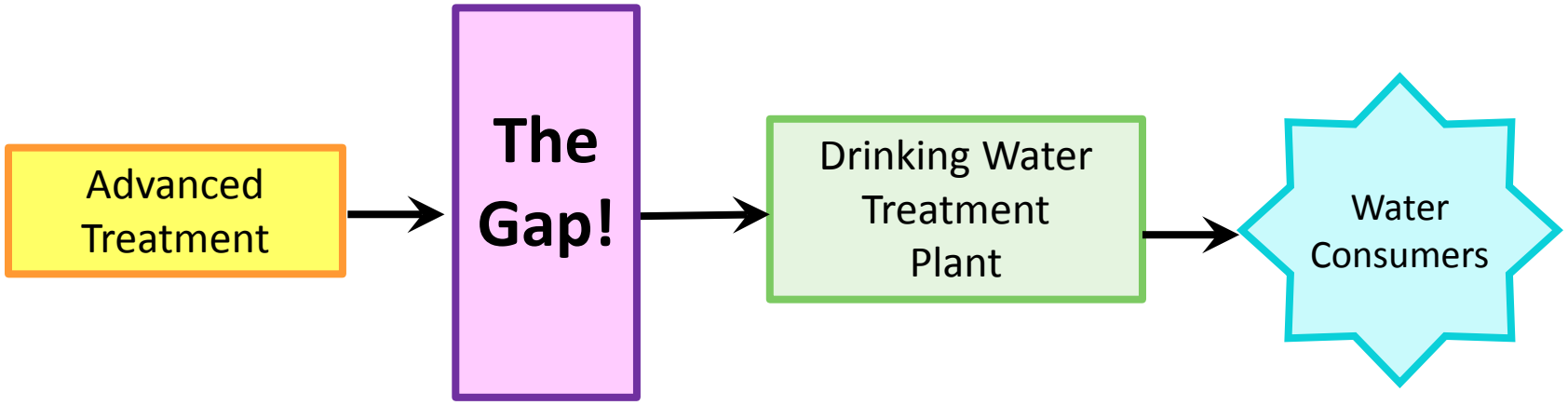
Potable Reuse Regulatory Feasibility Analysis

Comparative approach: Relative comparison of alternative supplies

- Baseline – Sacramento-San Joaquin River (Delta)
- Baseline – IPR alternatives (GWR and SWA)
- "Source water supply" – Reduced environmental buffer – **The Gap**
- DPR alternatives (several)- one evaluated

Potable Reuse with Reduced Environmental Buffer

Reduced environmental buffer!



Maintain <u>functionality</u> of environmental buffer (the "Gap")

Maintaining the “Gap’s” Functionality

Means to maintain positive attributes of the environmental buffer:

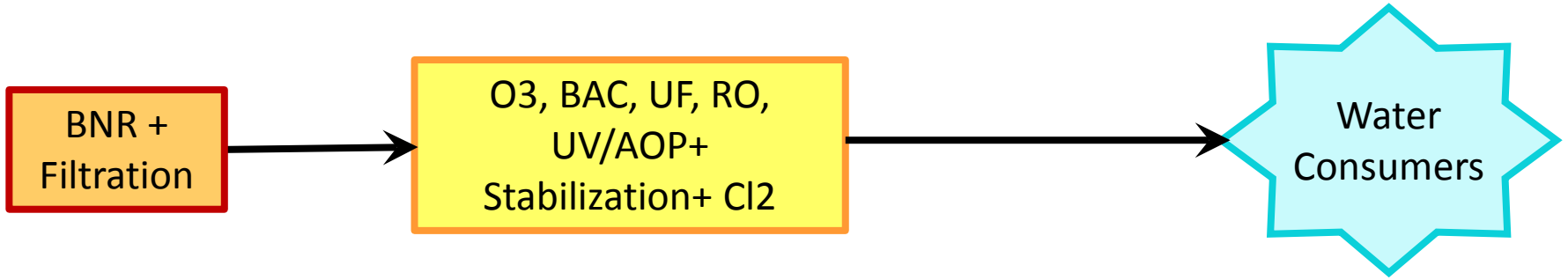
- More robust treatment barriers
- Additional treatment barriers (redundancy)
- Enhanced monitoring for chemicals, pathogens, or surrogates
- High frequency (near real-time) monitoring capability
- Storage of product water to provide time (engineered storage buffer)
- Alternative water supply source
- Means to quickly respond to off-spec water (time to respond)

Reduced Environmental Buffer

- Regulatory **"Gap"** between IPR projects with smaller environmental buffers and DPR projects with no environmental buffers
- Gap covers IPR-SWA projects with **hydraulic retention times of ≥2 months and <4 months**
- **Demonstrate – through hydrodynamic and public health risk modeling –** public health protection equivalent to that achieved by full compliance with criteria
- **Establish a consistent framework** for preparation and review of engineering reports
- **Conduct peer review of several Gap project proposals**
- Encourage State Water Board to consider potential benefits of environmental buffers, irrespective of size

Direct Potable Reuse

Advanced Treated Water as Approved Finished Drinking Water



Key Assumptions of DPR Reliability Analysis

Tolerable Risk Goal

- Safe Drinking Water Act: 10^{-4} or "1 in 10,000" people per year annual risk of infection
- Reference pathogen*: Cryptosporidium*

Probabilistic Approach

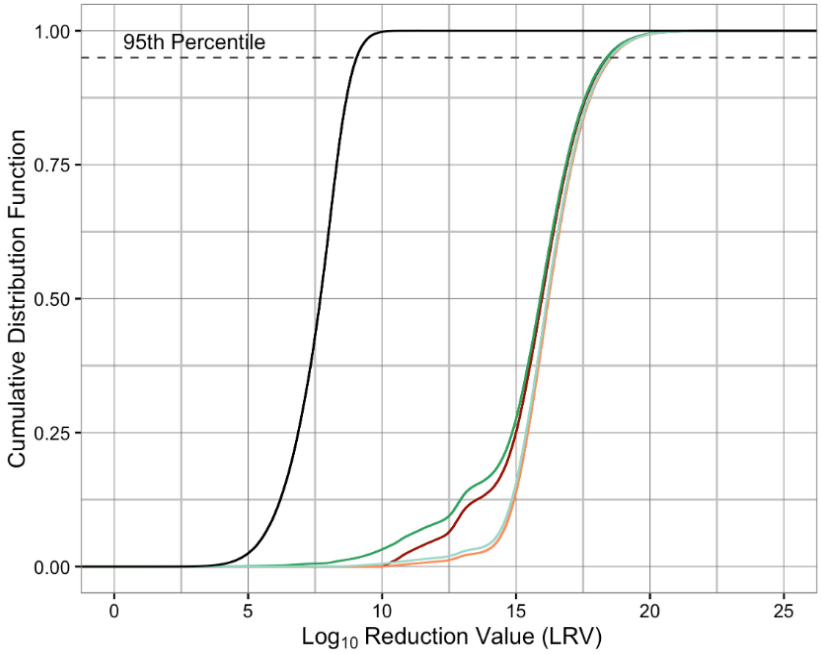
- Utilizes Unit process (treatment) performance (probability distribution functions) and mechanical reliability (production of off-spec water)
- Combines multiple independent treatment barriers to generate an overall facility PDF (e.g., required LRVs)
- Compare distribution of LRV criteria for *Cryptosporidium* (SDWA Goal) relative to DPR system LRVs performance

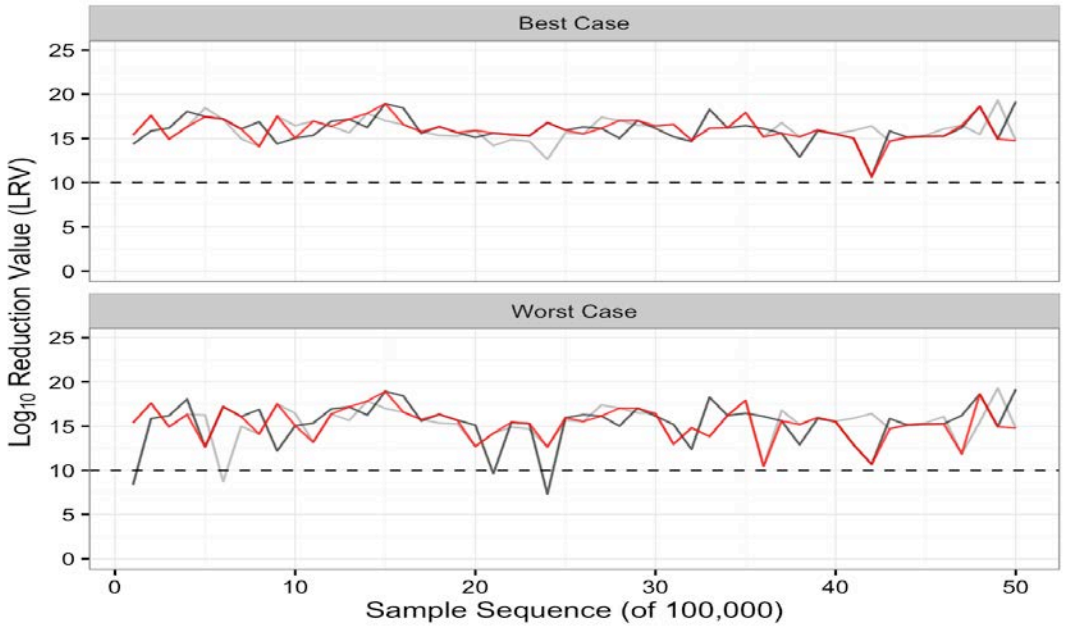
Unit Performance and Mechanical Reliability Approach

- Characterize treatment facility reliability with respect to:
  - Variability of treatment process effectiveness under normal operation (San Diego 1 yr data)
  - Probability of observed mechanical failures (off-spec water) (3 CA projects, >8 yrs data)
  - Impacts of projected mechanical failures on DPR system performance
- Independence of unit performance
- Unit performance distributions for ozonation, MF, RO, and UV/AOP
- No performance credits given for secondary wastewater treatment and final disinfection
- Generated ATWF cumulative performance distribution and adjusted for mechanical reliability

Comparison of DPR Facility LRV performance vs. *Cryptosporidium* Tolerable Risk

- Unit performance distributions for ozonation, MF, RO, and UV/AOP
- No performance credits given for secondary wastewater treatment and final disinfection
- Generated ATWF cumulative performance distribution and adjusted for mechanical reliability (illustrated in time series)





Overall Expert Panel Finding

Feasible to develop uniform water recycling criteria for DPR that would incorporate a level of public health protection as good as or better than what is currently provided in Calif. by conventional drinking water supplies, IPR systems using groundwater replenishment, and proposed IPR projects using surface water augmentation

Summary of Overall Feasibility Findings for Developing Uniform DPR Criteria

Regulations specifying DPR practices need to provide the following features in addition to the requirements already specified in IPR regulations for Calif.

- Implement rigorous response protocols (such as a formal Hazard Analysis Critical Control Point system)
- The State Water Board should not codify a specific set of treatment processes as part of developing DPR criteria, as it could stifle technological innovation
- Project sponsors must show technical, managerial, and financial (TMF) capacity
- Consider an approach to stage the introduction of recycled water from a DPR system into a drinking water supply
- Establish a formal internal and external review process of DPR projects/operations (on a 5-year cycle)

California Research Recommendations – DPR Performance

- **Adopt the use of probabilistic QMRA to confirm the necessary LRVs** of viruses, *Crypto,* and *Giardia* needed to maintain a risk of infection equal to or less than 10^{-4} ppy
- Include **monitoring requirements in regulatory permits** to measure **pathogens in the raw wastewater** feeding a DPR system to provide more complete information on concentrations and their variability
- **Investigate the feasibility of collecting pathogen concentration data** for raw wastewater associated with **community outbreaks** of disease and collect such data where possible
- NOTE: CA research supported directly by the State of California and **could be done either before and/or concurrently** with the development of uniform water recycling criteria for DPR

Thank you for listening!

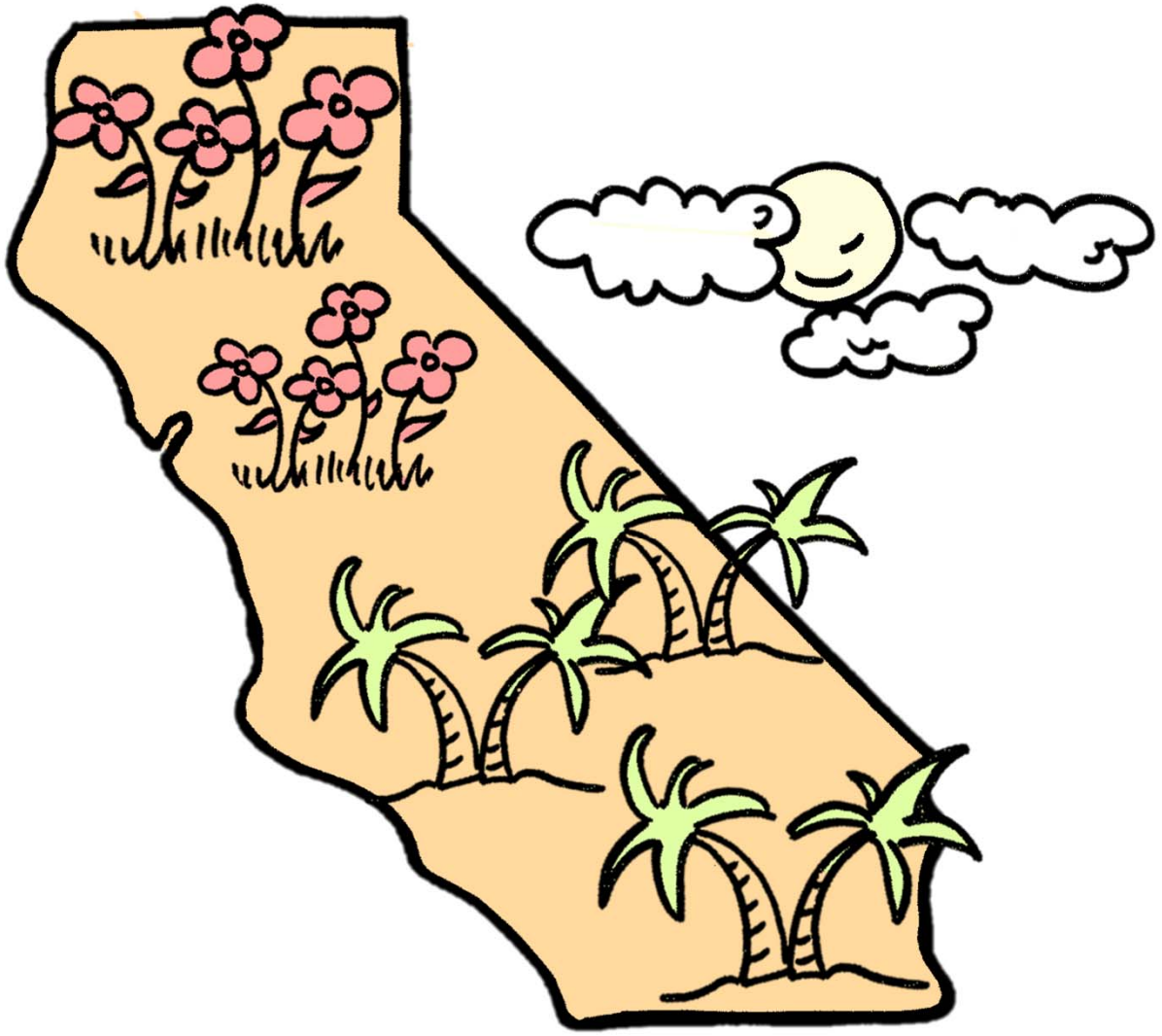
DRAFT REPORT TO LEGISLATURE ON DPR

Randy Barnard, P.E.
Chief – Recycled Water Unit
Division of Drinking Water

Report Contents

- Exec summary
- Introduction, history, projects
- Independent input
- Feasibility
- Conclusions
- Implementation plan
- Appendix

Background



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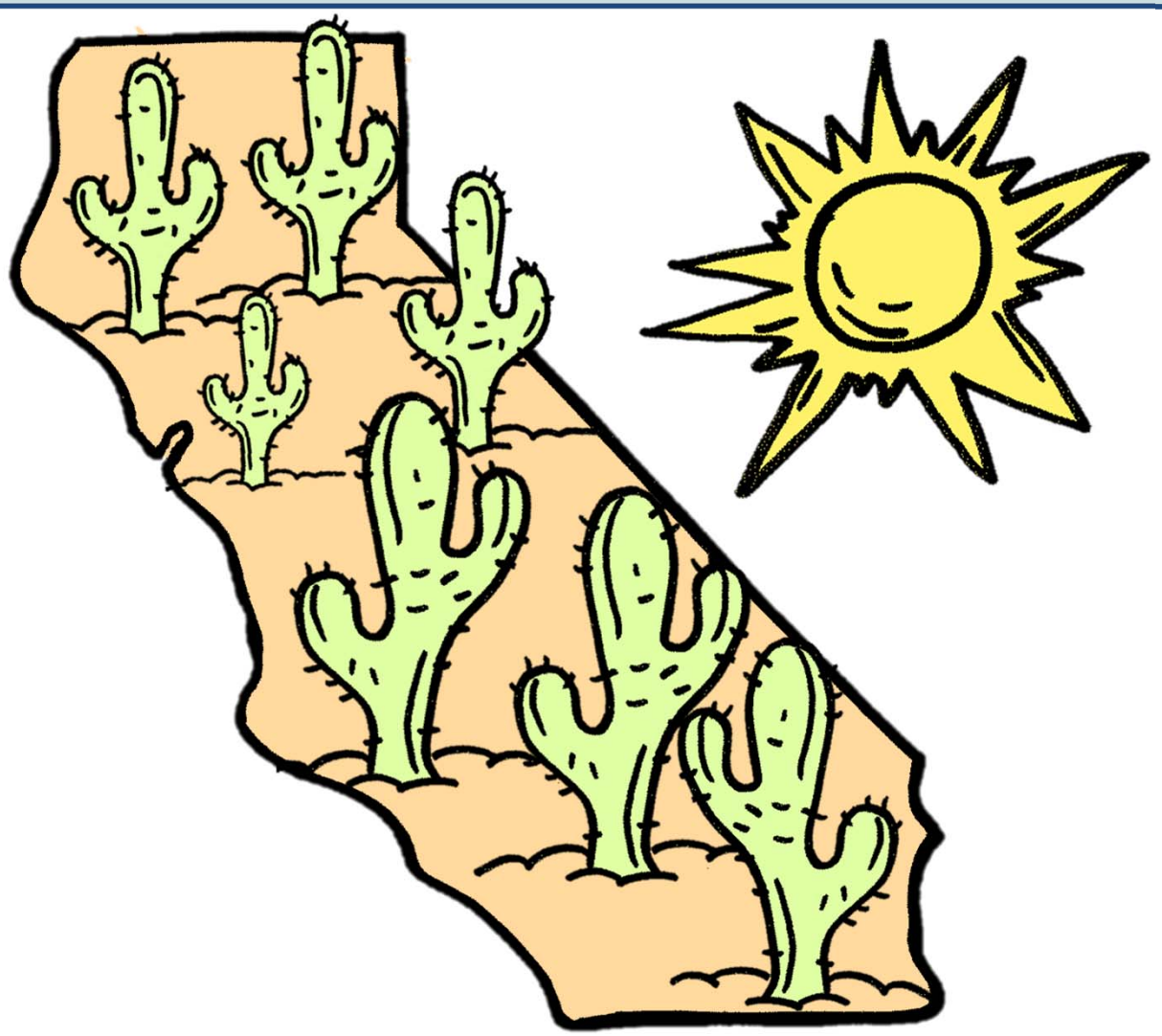

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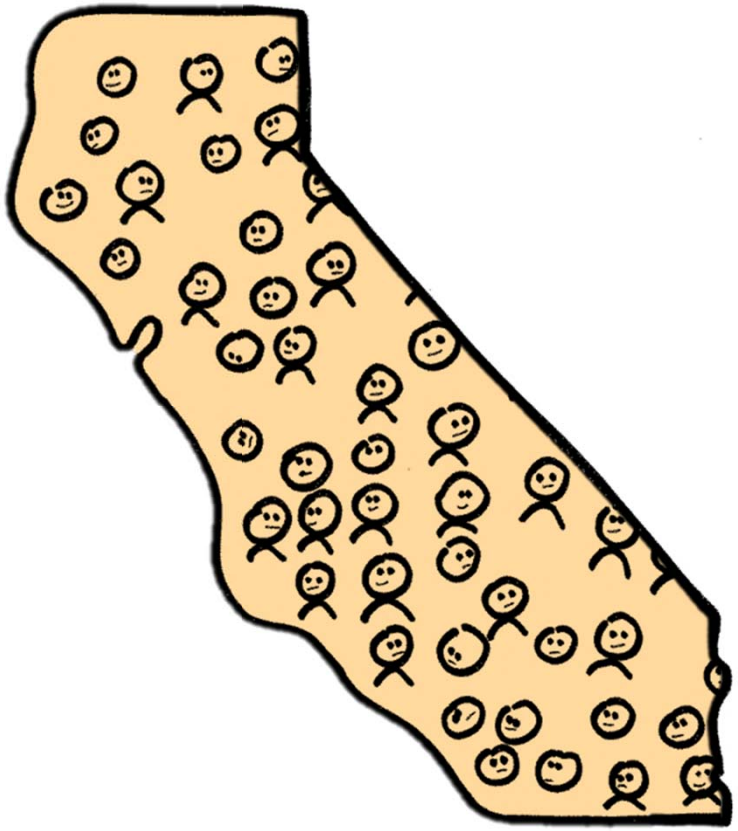
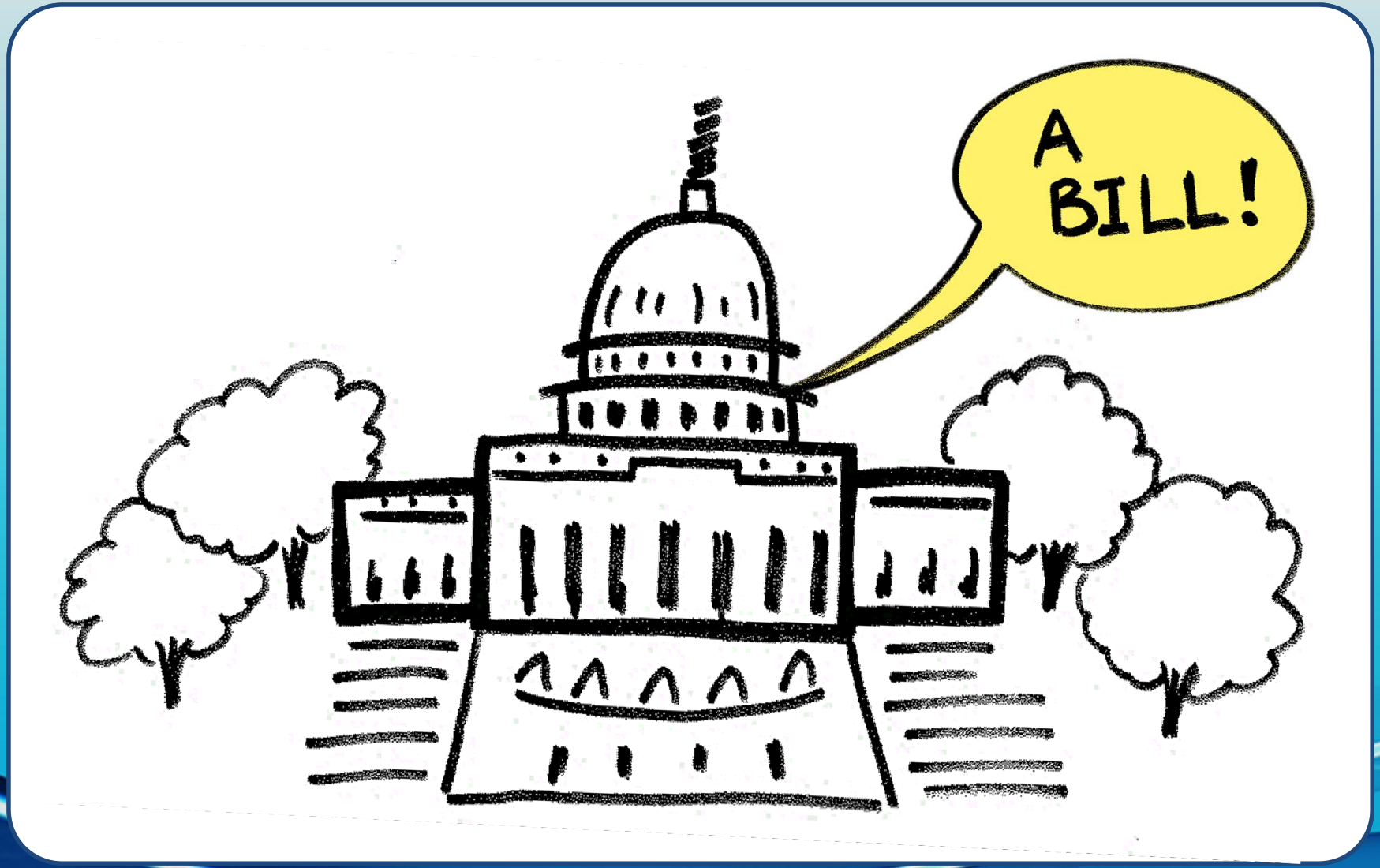


New Water Sources

New Water Sources

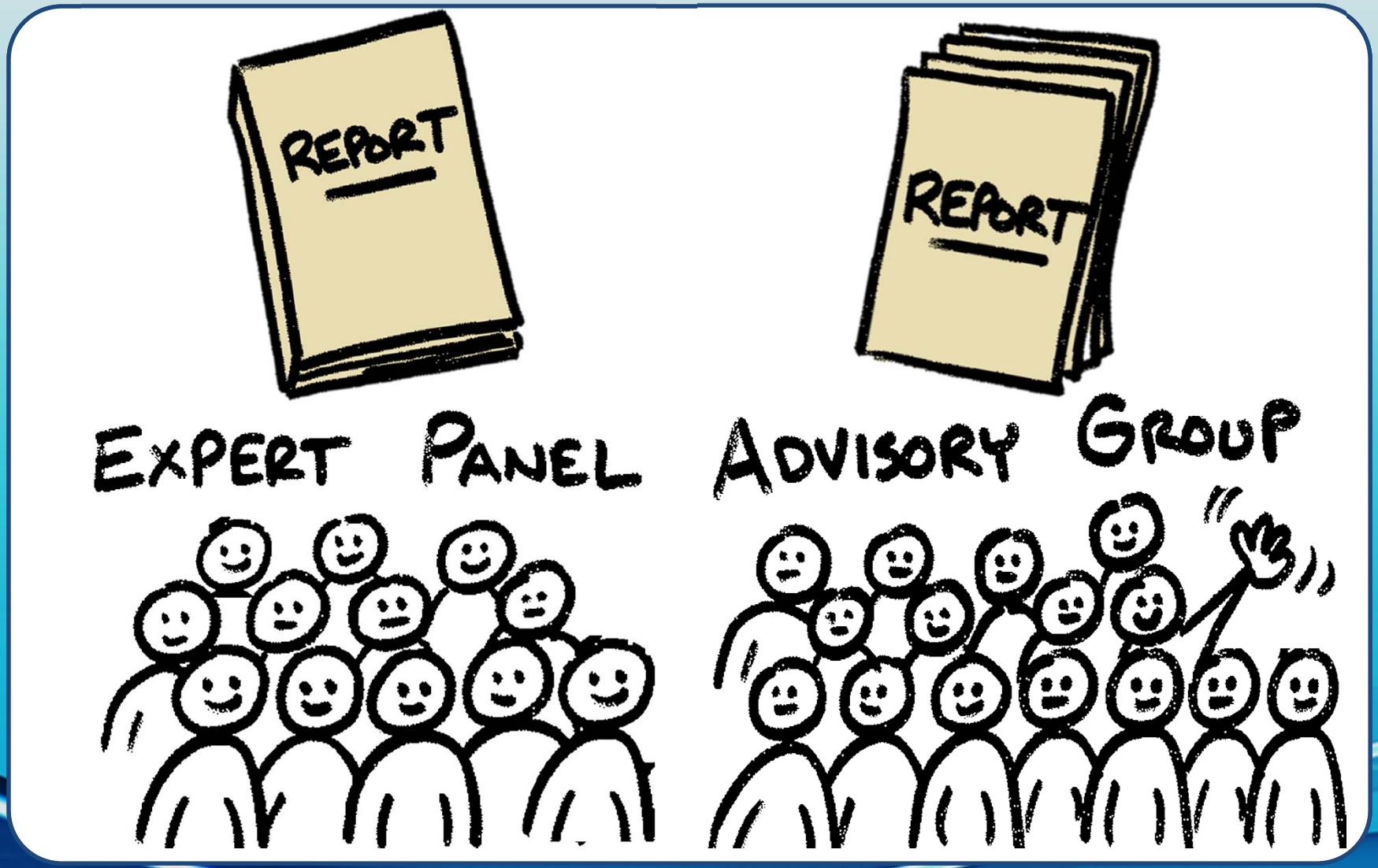


Other Parts of the Bill

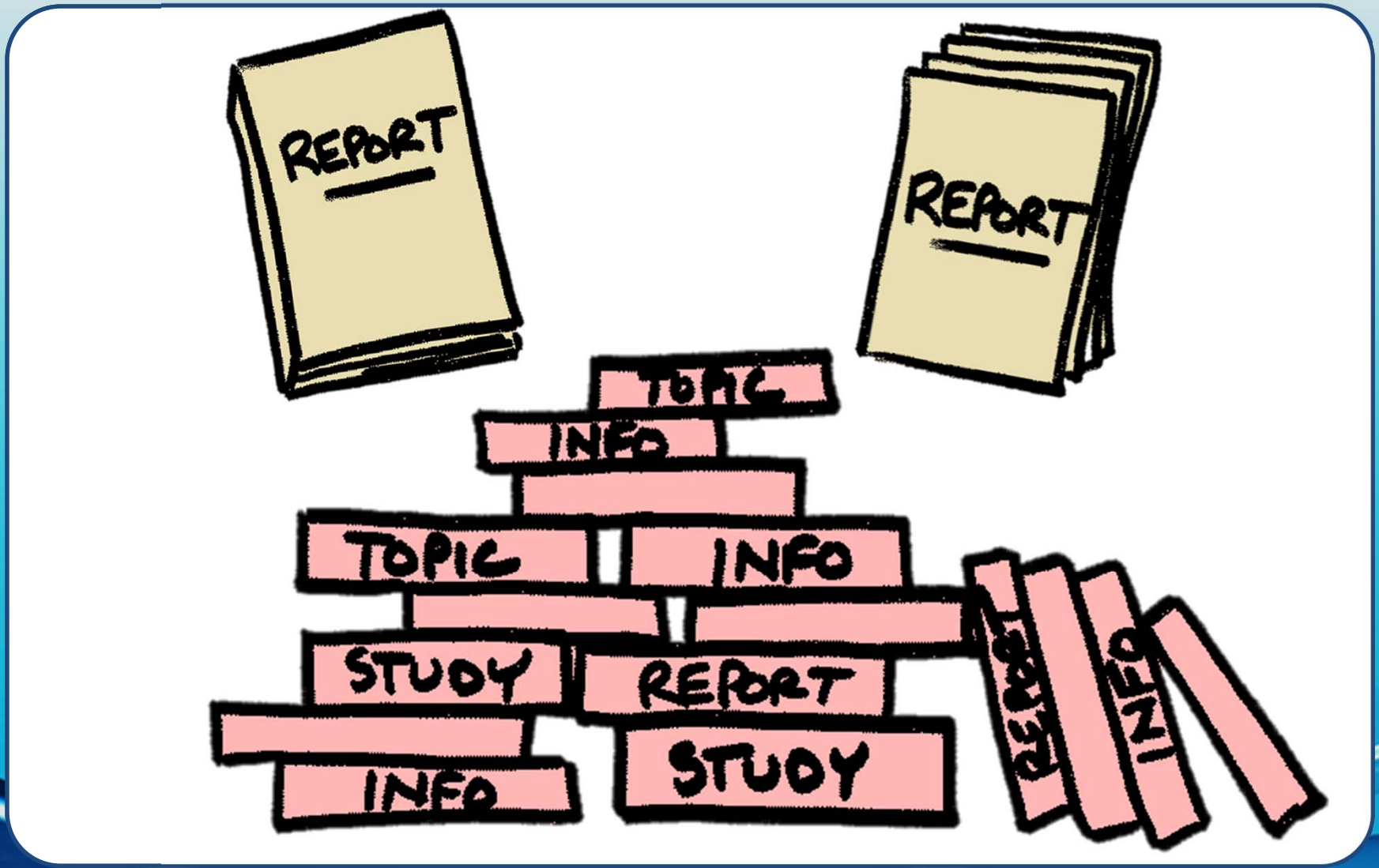
- GRRP Regs
  - ✓ – Done July 2014

- SWA Regs
  - ✓ – Drafted
    - – Expert Panel review
    - – Public review
    - – Adopt

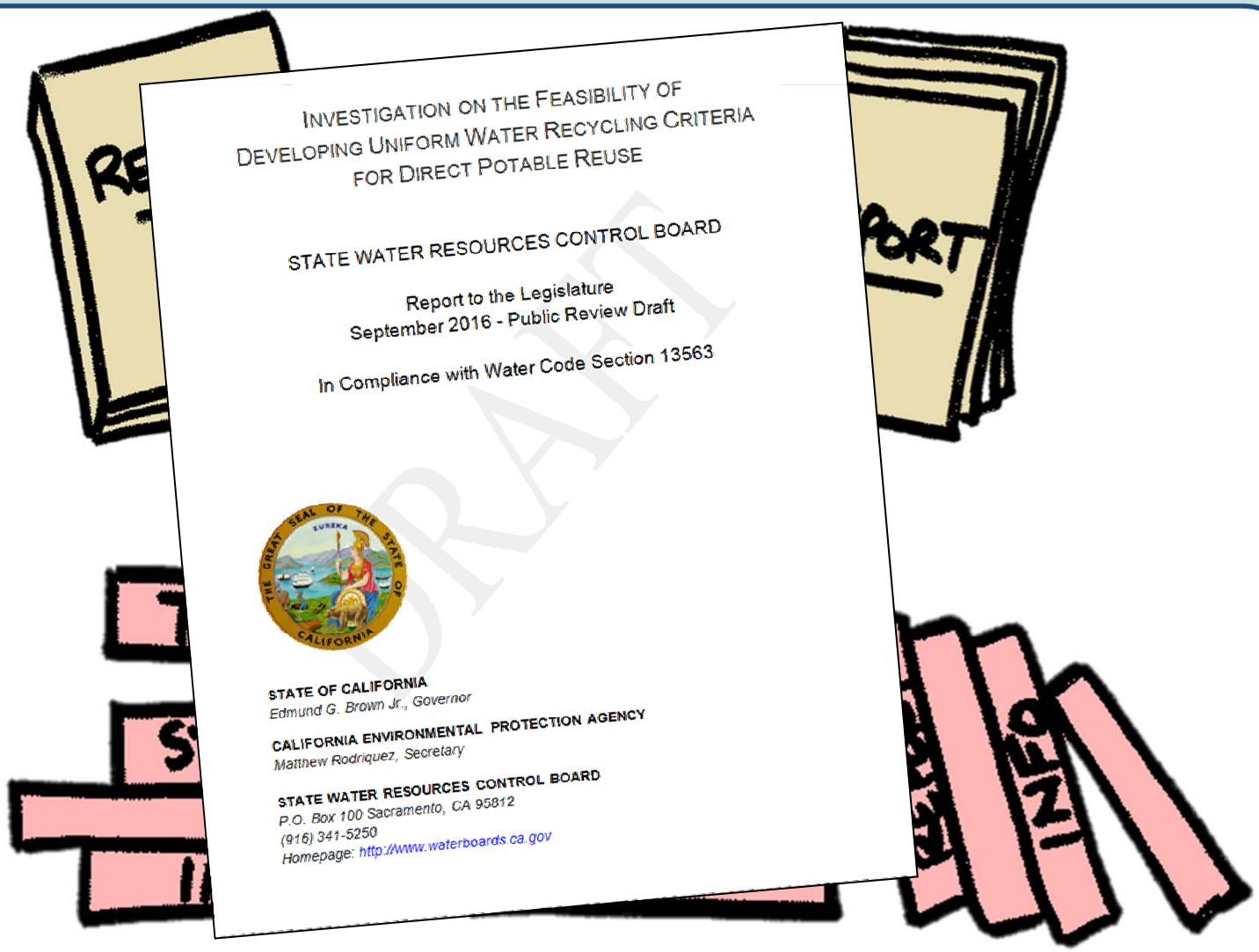
Report Development



Report Development



Report Development



EP Findings

IT'S

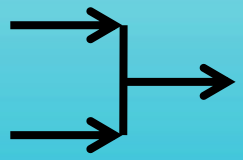
TECHNICALLY

FEASIBLE

EP Findings

Multiple barriers (A+B+C+D=Good)

Diverse TREATMENT **PROCESSES**

Parallel trains
Parallel trains 

CHeMICaLS => **CHEMICALS**

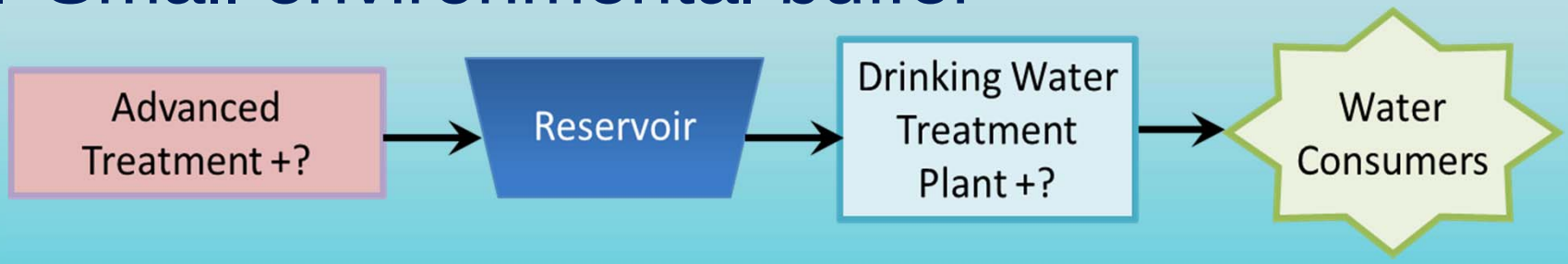
Diversion *of off-spec water*

Further Research

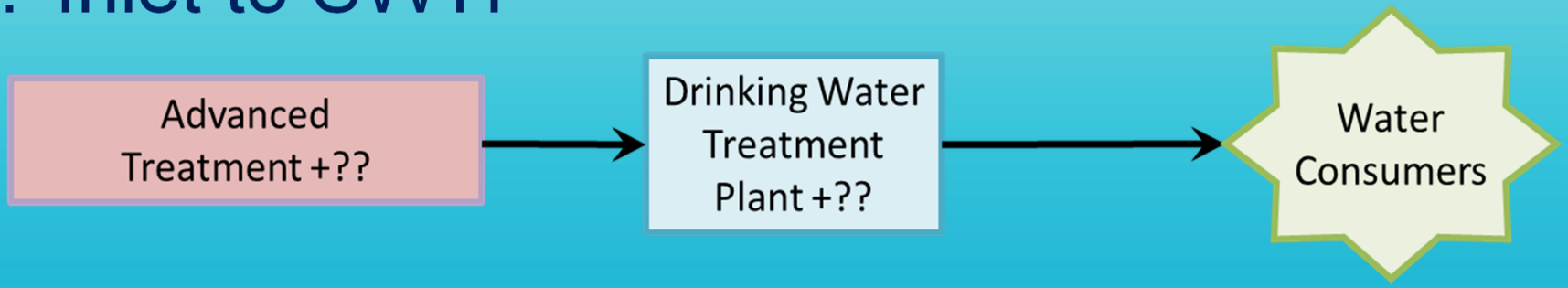
1. Source control and monitoring
2. LRV risk assessment
3. Confirm wastewater data
4. Outbreak data
5. Average peaks
6. Identify unknowns

DPR Types

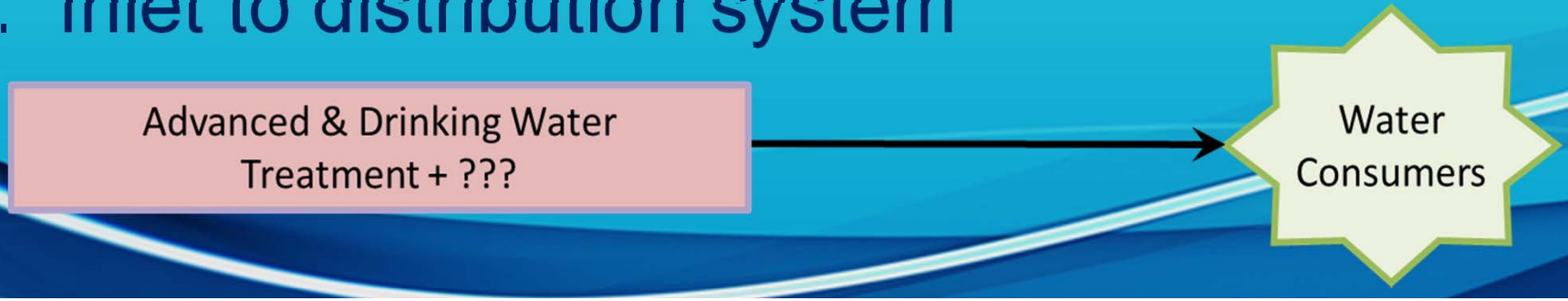
1. Small environmental buffer



2. Inlet to SWTP

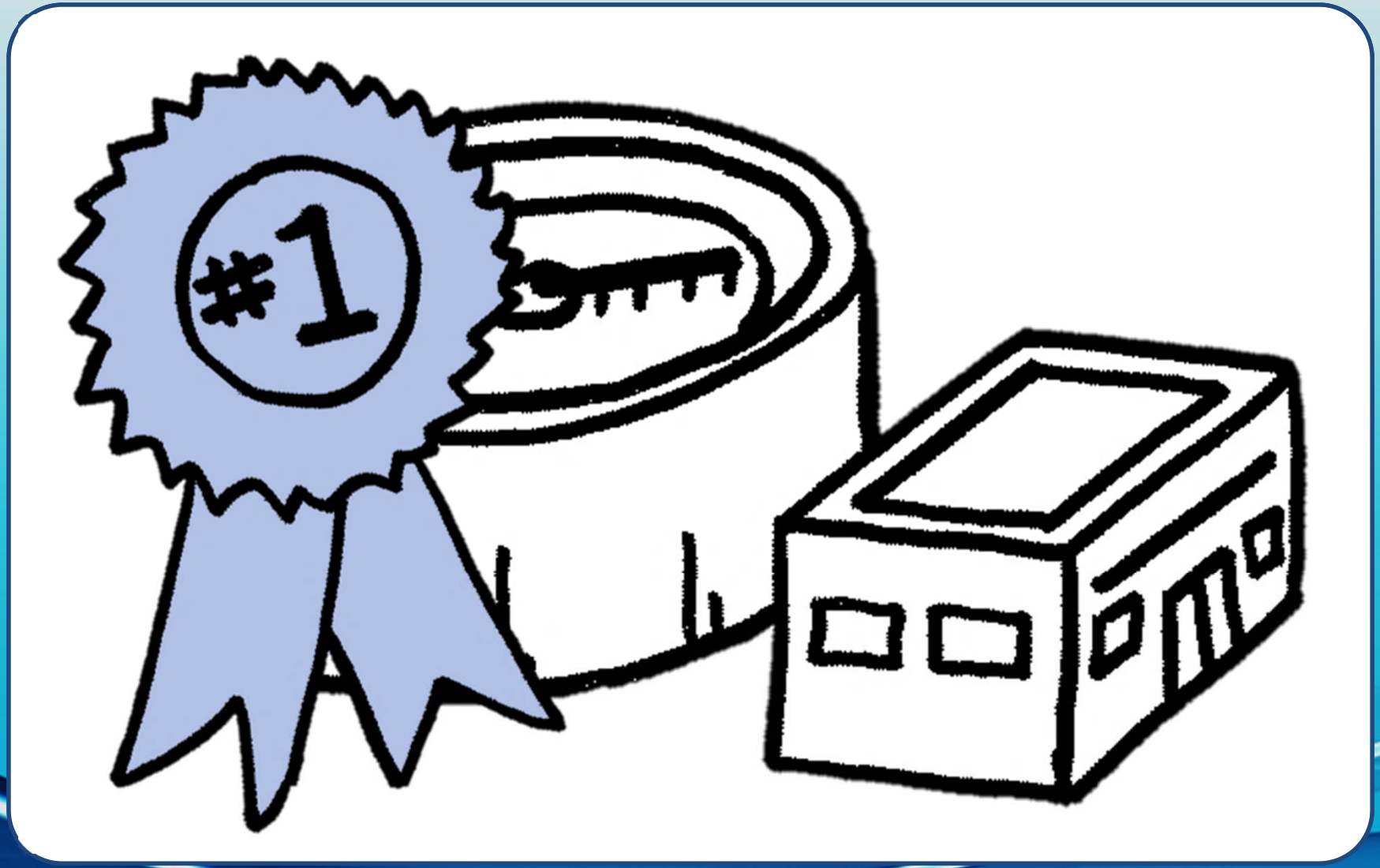


3. Inlet to distribution system



AG Findings

AG Findings



AG Findings

AG Findings

Technical

Managerial

FINANCIAL

AG Findings

Conclusions

Path Forward

- Draft regs concurrently

Path Forward

- Technical workshops

Path Forward

- Monitor research

Path Forward

- Phased regs

MOVING TOWARD CRITERIA

Bob Hultquist, P.E.
Recycled Water Specialist
(Retired Annuitant)
Division of Drinking Water

A Good Basis

- Expert Panel, Advisory Group, WateReuse DPR research initiative, other research products, and experience with IPR have provided an understanding of how DPR might be done safely
- Panel identified the critical aspects of criteria and have described research areas that could inform criteria development

Safe Practice to Criteria

- Our experience with the development of IPR criteria has shown that it is a sizable step, however,
  - from being confident that something can be safe
  - to producing criteria that assure that it will be accomplished safely, in every case, all the time.

Criteria Objectives

- When the Expert Panel embarked we offered several objectives for criteria. The criteria:
  - Must be enforceable (enable an objective compliance determination);
  - Must be unambiguous regarding the critical protective features; and
  - Must assure that any proposal that can comply will actually produce safe water continuously.

Criteria Development Questions

- We posed several questions to the Panel we would face when developing criteria - questions that relate to writing objective criteria to address system reliability

- The questions have been pared down and the Panel has provided us with scientifically valid means to evaluate the efficacy of barriers

Knowledge Gaps Remain

- Key Panel findings on DPR performance and reliability lead to further questions.
- **Extra LRV Capacity**

  "Use a treatment train … with multiple, independent treatment barriers … that meet performance criteria greater than the public health threshold goals … for microorganisms"

  – How much additional LRV capacity is necessary?

Knowledge Gap
Treatment Diversity

- "Ensure the independent treatment barriers represent a diverse set of processes … in the treatment train that are capable of removing particular types of contaminants by different mechanisms."
  - How do we define treatment "diversity"?
  - Is there a way to identify the degree of diversity necessary?

Knowledge Gap
Chemical Peak Attenuation

- Regarding short-term discharges of chemicals into the wastewater collection system -
- "… incorporating a final treatment process … after the advanced water treatment train may result in some "averaging" of these potential chemical peaks."
  - How much "averaging" is necessary and how do we specify it?

DPR Criteria Framework

- Criteria framework that encompasses the three possible types of DPR and recognizes the foundation of *de facto* potable reuse and IPR.
  The three forms are:
  - What the Expert Panel calls “reduced environmental buffer” (<IPR)
  - Delivering water to a surface water treatment plant
  - Delivering finished water to the distribution system

Framework Purpose

- Whether or not criteria for all types are developed simultaneously criteria should be coordinated
- A framework across the various types will avoid discontinuities in the risk assessment/risk management approach, especially if progressively more difficult situations are addressed sequentially

Finally …

- Draft criteria and then challenge them with all imaginable proposals to make sure they will always assure safe DPR projects

POTABLE REUSE PUBLIC HEALTH PROTECTION RESEARCH

Brian Bernados, P.E.
Recycled Water Specialist
Division of Drinking Water

Coordination with Division of Water Quality

- Recycled Water Research Workshops:
  - Monitoring and Treatment
  - Performance for Constituents of Emerging Concern
    - Tuesday October 27th and Wednesday October 28th, 2015
  - Use of in vitro Bioassays to Assess the Safety of Recycled Water and Drinking Water
    - February 17-18, 2016

Replacing the Environmental Barrier

- WRRF 12-06: *Guidelines for Engineered Storage for Direct Potable Reuse*
- "DPR has inherent risks that differ from . . . indirect potable reuse (IPR).
- One alternative for DPR is to replace the environmental buffer with an engineered storage buffer that provides real time monitoring of the actual microbes before distribution.

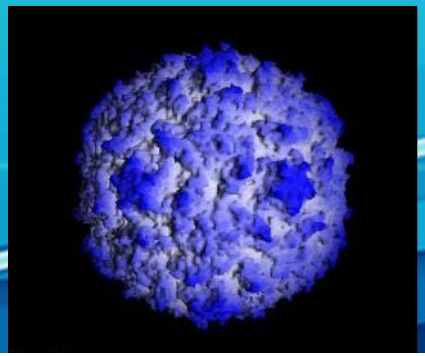
LADWP Valley Generating Station has four 7 MG tanks unused

Real-Time Pathogen Monitoring Technologies

- *WateReuse Research Foundation (WRRF) Project 11-01, "Monitoring for Reliability and Process Control of Potable Reuse Applications*".
- Generally, the ability to detect virus and protozoa to the levels needed to ensure 10^{-4} risk of illness, are not yet available.
- Need to overcome issues with
  - robustness,
  - sensitivity,
  - precision, and
  - reliability.

Research New Molecular Methods

- WRF Project 4508 Literature Review states, “Online monitoring for pathogens is particularly crucial to capture acute threats to public health”
- bulk indicators may or may not directly correlate to the safety of the water.”
- Newer analytical methods are examined in detail.
- Expert Panel report recommends **collecting pathogen concentration data** via:
  - quantitative polymerase chain reaction (qPCR),
  - digital droplet PCR (ddPCR) and
  - flow cytometry.



Redundant Treatment 12-06

- “Another approach to mitigating the inevitable process failures in a DPR scenario is to build in **redundant** treatment.
- The challenge with allowing redundancy to stand in for process monitoring is that,
- if improperly monitored, redundant processes may fail unnoticed and simultaneously,
- thus process redundancy alone does not provide for failsafe operations.”

Rapid Response to a Failure

From “Application of Risk Reduction Principles to Direct Potable Reuse,” WRRF 11-10

Critical characteristics of monitoring are:

- **Independence**. Dependence on the performance of other elements creates risk. So, need to adequately monitor each process step independently.
- **Response Time**. Need to identify the failure, make a decision about the response & implement the response.
- **Sensitivity**. The monitoring method must confirm the level of treatment achieved by the process.

Hazard Analysis Critical Control Point (HACCP)

- 13-03 "*Critical Control Point Assessment to Quantify Robustness and Reliability of Multiple Treatment Barriers of a DPR Scheme*"
- HACCP was developed by the food industry
- Specific monitoring for each process:
  - Critical control points.
  - Parameters for each.
  - Failure mode = at what point has it stopped functioning?
  - Follow-up actions – automatic or operator initiated?
  - Hazards – what can go wrong upstream?
  - Plans tailored to each site.

Operations

- DPR depends on the capability of the operator
- Specialized initial and on-going training
- 15-05 *Developing Curriculum and Content for DPR Operator Training*
- High level of expertise needed
- Appropriate setpoints - meaningful
- Verification – frequent checks to a bench unit
- Proper interpretation of info

DPR Expert Panel Report Chapter 8 Chemicals Source control

In progress, is WRRF 13-12,

Evaluation of Source Water Control Options and the Impact of Selected Strategies on DPR

Expert panel states, “Because of the lack of an adequate environmental buffer …, **short-duration releases** of chemical contaminants could be problematic for DPR projects.

Contaminants that are difficult to remove . . . such as acetone, methyl ethyl ketone, and methanol . . . “

Research - Bioassays

- WE&RF 15-02

  Creating a Roadmap for Bioassay Implementation in Reuse Waters: A cross disciplinary workshop

- Near Term
  - Review & improve concentration methods
  - Selection of appropriate health endpoints
  - Adapt bioassays for recycled water
  - Standardize methods, procedures, and QA/QC
  - Assess treatment performance
- Long Term
  - Link to human health significance

CONCLUDE & OPEN FOR PUBLIC COMMENT

Next Steps

- Comment period ends **Oct 25, 2016, at noon**
- Review of public comments and preparation of an updated Draft Report
- State Water Board December 6, 2016 meeting (Information Item)
- Submit Final Report to Legislature: December 31, 2016

Submission of Written Comments

- Written comments are due **Oct 25, 2016, at noon**
- Send comment letters addressed to:
  Jeanine Townsend, Clerk to the Board
- Indicate on subject line:
  "Comment Letter – Report to the Legislature on DPR"
- By e-mail: (PDF format, max 15 MB)
  commentletters@waterboards.ca.gov
- By fax: (916) 341- 5620
- By mail:

Hand/ Courier Delivery	U.S. Mail
1001 I Street, 24th Floor	P.O. Box 100
Sacramento, CA 95814	Sacramento, CA 95812-0100