NATIONAL WATER RESEARCH INSTITUTE

Final Panel Meeting Reports #9 & 10: Direct Potable Reuse

Based on Expert Panel Meetings Held March 30-31, 2016 (Panel Meeting #9)
and April 13-14, 2016 (Panel Meeting #10)

Prepared By:
Expert Panel on the Development of Water Recycling Criteria
for Indirect Potable Reuse through Surface Water Augmentation and the Feasibility
of Developing Criteria for Direct Potable Reuse

Prepared For:
State Water Resources Control Board Division of Drinking Water
(Agreement No. 13-21041)

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www.nwri-usa.org/ca-panel.htm

ABOUT NWRI

A 501c3 nonprofit organization, the National Water Research Institute (NWRI) was founded in 1991 by a group of California water agencies in partnership with the Joan Irvine Smith and Athalie R. Clarke Foundation to promote the protection, maintenance, and restoration of water supplies and to protect public health and improve the environment. NWRI's member agencies include Inland Empire Utilities Agency, Irvine Ranch Water District, Los Angeles Department of Water and Power, Orange County Sanitation District, Orange County Water District, and West Basin Municipal Water District.

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The Drinking Water Program was officially transferred from the California Department of Public Health to the State Water Resources Control Board (State Board) and renamed as the Division of Drinking Water on July 1, 2014. Financial support for the Panel is being provided by the Division of Drinking Water through Agreement No. 13-21041.

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DISCLAIMER

This Panel Meeting Report was prepared by an Expert Panel administered by the National Water Research Institute. Any opinions, findings, conclusions, or recommendations expressed in this Panel Meeting Report were prepared by the Panel. This Panel Meeting Report was published for informational purposes.

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Appendices

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ACRONYMS

AR	Antibiotic resistance
ARB	Antibiotic resistant bacteria
ARG	Antibiotic resistance genes
ATW	Advanced treated water
CDPH	California Department of Public Health
CWC	California Water Code
DDW	Division of Drinking Water of the State Water Resources Control Board
DPR	Direct potable reuse
IPR	Indirect potable reuse
NWRI	National Water Research Institute
SWA	Surface water augmentation

1. PURPOSE OF THE REPORT

The purpose of this Panel Meeting Report is to provide the Division of Drinking Water (DDW) of the State Water Resources Control Board (State Board) with a summary of the Expert Panel's discussions on the agenda topics and information shared by the Panel at meetings held on March 30-31, 2016, in Newport Beach, California (Panel Meeting #9), and April 13-14, 2016, in Berkeley, California (Panel Meeting #10).

Specifically, both meetings focused on the topic-based Briefing Papers on direct potable reuse (DPR) currently being prepared by the Panel and the conversion of the information contained within these draft papers into the Panel's final product, a "Panel Feasibility Report" on developing criteria for DPR, to address and fulfill the Panel's charge per the California Water Code (CWC).

2. PURPOSE AND HISTORY OF THE EXPERT PANEL

In 2013, the National Water Research Institute (NWRI) of Fountain Valley, California, a 501c3 nonprofit, appointed state and national water industry experts to an independent, third-party Expert Panel to provide advice to the State of California on developing Water Recycling Criteria for indirect potable reuse (IPR) through surface water augmentation (SWA) and determining the feasibility of developing criteria for direct potable reuse (DPR).

The Panel was formed on behalf of the Drinking Water Program of the California Department of Public Health (CDPH). As of July 1, 2014, the Drinking Water Program was officially transferred from CDPH to the State Water Resources Control Board (State Board) and renamed as the Division of Drinking Water (DDW); therefore, hereafter, the State Board will be referred to in this report as the sponsor of the Expert Panel. NWRI administers the Panel for the State Board.

2.1 Expert Panel Charge

The specific purpose of the Panel is provided in Chapter 7.3 – entitled "Direct and Indirect Potable Reuse" – of the California Water Code (CWC)[1]. The exact wording is as follows:

> 13565. (a) (1) On or before February 15, 2014, the department shall convene and administer an expert panel for purposes of advising the department on public health issues and scientific and technical matters regarding development of uniform water recycling criteria for indirect potable reuse through surface water augmentation and investigation of the feasibility of developing uniform water recycling criteria for direct potable reuse. The expert panel shall assess what, if any, additional areas of research are needed to be able to establish uniform regulatory criteria for direct potable reuse. The expert panel shall then recommend an approach for accomplishing any additional needed research regarding uniform criteria for direct potable reuse in a timely manner.

With respect to SWA, the Panel's charge – as stated in Section 13562 of the CWC – is as follows:

> (B) Prior to adopting uniform water recycling criteria for surface water augmentation, the department shall submit the proposed criteria to the expert panel convened pursuant to subdivision (a) of Section 13565. The expert panel shall review the proposed criteria and shall adopt a finding as to whether, in its expert opinion, the proposed criteria would adequately protect public health.

[1] Contained in Appendix A is a copy of Chapter 7.3 of the California Water Code, effective January 1, 2014. http://www.leginfo.ca.gov/cgi-bin/displaycode?section=wat&group=13001-14000&file=13560-13569 (last accessed May 13, 2016).

With respect to DPR, the Panel is working with the State Board to meet the following State-mandated deadlines, as required in the CWC regarding investigating the feasibility of developing uniform water recycling criteria for DPR:

- "On or before June 30, 2016, the department [State Board] shall prepare a draft report summarizing the recommendations of the Expert Panel" [CWC, Section 13565(c)].

- "The department [State Board] shall complete a public review draft of its report by September 1, 2016" [CWC, Section 13563(a)(1)].

- "The department [State Board] shall provide a final report to the Legislature by December 31, 2016" [CWC, Section 13563(a)(3)].

Please refer to Chapter 7.3 of the CWC (provided in Appendix A) for a description of State Board and Panel activities pertaining to this effort.

2.2 Expert Panel Members

The Panel is made up of 12 individuals who meet the requirement in Section 13565 of the CWC that the Panel "shall be comprised, at a minimum, of a toxicologist, an engineer licensed in the state with at least three years' experience in wastewater treatment, an engineer licensed in the state with at least three years' experience in treatment of drinking water supplies and knowledge of drinking water standards, an epidemiologist, a limnologist, a microbiologist, and a chemist."

Panel members include:

- *Panel Co-Chair:* Adam Olivieri, Dr.P.H., P.E., EOA, Inc. (Oakland, CA)
- *Panel Co-Chair:* James Crook, Ph.D., P.E., Environmental Engineering Consultant (Boston, MA)
- Michael Anderson, Ph.D., University of California, Riverside (Riverside, CA)
- Richard Bull, Ph.D., MoBull Consulting (Richland, WA)
- Dr.-Ing. Jörg E. Drewes, Technical University of Munich (Munich, Germany)
- Charles Haas, Ph.D., Drexel University (Philadelphia, PA)
- Walter Jakubowski, M.S., WaltJay Consulting (Spokane, WA)
- Perry McCarty, Sc.D., Stanford University (Stanford, CA)
- Kara Nelson, Ph.D., University of California, Berkeley (Berkeley, CA)
- Joan B. Rose, Ph.D., Michigan State University (East Lansing, MI)
- David Sedlak, Ph.D., University of California, Berkeley (Berkeley, CA)
- Tim Wade, Ph.D., United States Environmental Protection Agency (Durham, NC)

Included in Appendix B is background information on the NWRI Panel process, and included in Appendix C are brief biographies of the Panel members. Additional information about the Panel can be found on the NWRI website at www.nwri-usa.org/ca-panel.htm.

3. APPROACH TO FULFILL THE PANEL'S CHARGE

The Expert Panel is using a "DPR Briefing Paper" approach to assist and fulfill its charge, per the CWC, to investigate the feasibility of developing water recycling criteria for DPR. The CWC states that the Panel will "assess what, if any, additional areas of research are needed to be able to establish uniform regulatory criteria for DPR" and "recommend an approach for accomplishing any additional needed research" in a timely manner. The Briefing Papers will be authored by Panel members and reviewed and accepted by the overall Panel.

The Briefing Papers will focus on one technical or scientific topic and address the following:

- Relevance to the Panel's charge.
- Pertinent available technical and/or research information.
- Overall Panel findings, conclusions, and recommendations (e.g., practical engineering/monitoring solutions and research topics/approach).

Once completed, the Panel will compile and summarize key points from all the Briefing Papers into a "Panel Feasibility Report" on developing uniform water recycling criteria for DPR.

Note that it is the intent of the Panel to convert the results of the topic-based Briefing Papers into chapters of the Panel Feasibility Report and not to finalize the Briefing Papers into stand-alone documents. As such, the Briefing Papers are internal Panel working documents (in draft format) and will not be distributed outside of the Panel.

3.1 Topics to Address

The Panel selected seven key topics for the DPR Briefing Papers. A list of these topics, along with a short summary of potential content, is provided below (note that the order of these topics is not based on priority or significance).

1. **Application of Bioanalytical Tools to Water Analyses** – Issues related to the use of *in vitro* bioassays for advanced treated water (ATW) and drinking water.
2. **Quantifying Treatment Facility Reliability** – Multiple barriers (redundancy, inherent performance, and mechanical reliability); online monitoring tools (sensors, surrogates and indicators); and performance objectives (process and overall facility compliance).
3. **Analytical Approaches for Measuring Chemical Water Quality** – Approaches for assessing chemical water quality in ATW and drinking water (with an emphasis on indicators and surrogates).
4. **Molecular and Other Methods for Monitoring Pathogens in ATW and Drinking Water** – Monitoring indicators, surrogates, and pathogens.
5. **Antibiotic Resistant Bacteria and Antibiotic Resistance Genes** – State-of-the-science, relative sources, potential exposure pathways, and relative significance of concern.

6. **Feasibility Analysis** – Describes the approach and application of the approach used by the Panel to conduct the feasibility analysis of developing uniform DPR criteria.
7. **Public Health Surveillance** – Example programs, ongoing national and state programs, health endpoints, sensitivity and interpretation of data, non-health based data, and feasibility of a DPR surveillance program.

3.2 Schedule and Expectations

The Panel has identified tasks, deadline dates, and meeting dates to facilitate the development and completion of the DPR Briefing Papers and the Panel Feasibility Report on developing uniform water recycling criteria for DPR. A summary of the Panel's internal working documents (i.e., Briefing Papers) is provided in Table 1, which includes the lead author and co-authors, Panel meeting dates in relation to the preparation and internal review of the Briefing Papers, and current status. A summary of Panel deliverables to the State Board, including the Panel Feasibility Report, is provided in Table 2.

Table 1: Expert Panel Internal Working Documents (DPR Briefing Papers)

	Briefing Paper Topic	Panel Lead/ Other Authors*	Panel Review Meeting Dates[a]	Status (as of Meeting #10)
1	Application of Bioanalytical Tools to Water Analyses	Richard Bull*	Done	Insert into Panel Feasibility Report template
2	Quantifying Treatment Facility Reliability	Charles Haas/ Jörg Drewes/ Perry McCarty/ Kara Nelson	Meeting #9 (first draft); Meeting #10 (final draft)	First write-up reviewed at Meeting #9; second review occurred at Meeting #10
3	Analytical Approaches for Measuring Chemical Water Quality	Davis Sedlak/ Jörg Drewes	Meeting #10 (second draft)	Reviewed at Meeting #9; second draft reviewed at Meeting #10
4	Molecular and Other Methods for Monitoring Pathogens in ATW and Drinking Water	Joan Rose and Kara Nelson	Meeting #10 (first draft)	First draft reviewed at Meeting #10
5	Antibiotic Resistant Bacteria and Antibiotic Resistance Genes	Walt Jakubowski/ *Ryan Reinke/ *Kellogg Schwab	Done	Insert into Panel Feasibility Report template
6	Feasibility Analysis	Adam Olivieri and James Crook	Meeting #12 (draft)	Under development
7	Public Health Surveillance	Tim Wade/ Walt Jakubowski/ Michael Anderson	Meeting #11 (outline); Meeting #12 (draft)	White paper under development by WateReuse (Project No. WRRF 14-14) will be used to address some issues in this Briefing Paper; Workshop on 14-14 held in March 2016

[a] Notes on Panel meeting dates:

- Meeting #9: March 30-31, 2016 (Orange County) - completed
- Meeting #10: April 13-14, 2016 (Berkeley) - completed
- Meeting #11: May 11-12, 2016 (Irvine)
- Meeting #12: Early June 2016 (tentative)
- Meeting #13: June 29-30, 2016 (Orange County)

* Indicates invited assistance from non-Panel experts. Drs. Kevin Crofton (U.S. Environmental Protection Agency) and Michael Denison (University of California Davis) provided assistance to Dr. Bull.

Table 2: Expert Panel Deliverables to the State Board

Deliverable	Panel Lead/ Other Authors*	Panel Review Meeting Dates[a]	Status (as of Meeting #10)
Preliminary Findings and Recommendations from Briefing Papers	Adam Olivieri and James Crook/Panel	Meeting #11 (internal draft)	Under development (reliant upon completion of each Briefing Paper); Due to DDW staff on May 30, 2016
Preliminary Research Recommendations from Briefing Papers	Adam Olivieri and James Crook/Panel	Meeting #11 (internal draft)	Under development (reliant upon completion of each Briefing Paper); Due to DDW staff on May 30, 2016
Draft Panel Feasibility Report	Adam Olivieri and James Crook/Panel	Introduction (Meeting #9) Meeting #11 (rough draft): Meeting #13 (revised second draft);	Compile all available chapters into a rough draft for review prior to Meeting #11 (Final draft to be submitted to DDW in mid-July 2016)
Final Panel Feasibility Report	Adam Olivieri and James Crook/Panel		Address DDW clarifications; submit to DDW in Sept. 2016

[a] Notes on Panel meeting dates:

- Meeting #9: March 30-31, 2016 (Orange County) - completed
- Meeting #10: April 13-14, 2016 (Berkeley) - completed
- Meeting #11: May 11-12, 2016 (Orange County)
- Meeting #12: Early June 2016 (tentative)
- Meeting #13: June 29-30, 2016 (Orange County)

4. SUPPORT FOR THE DPR EXPERT PANEL

As part of completing its review of the feasibility of developing DPR criteria for the State, the DPR Expert Panel is receiving support in the form of information and guidance from a number of resources. This information and guidance is being incorporated into the development process for the DPR Briefing Papers and Panel Feasibility Report.

4.1 State Board's DPR Advisory Group

In 2014, the State Board established a DPR Advisory Group of stakeholders to provide advice to the DPR Expert Panel and the State Board. The Advisory Group, which is required by the CWC, is composed of 15 members representing environmental organizations, public health organizations, taxpayer advocate organizations, water and wastewater agencies, government agencies, and others in California. See Appendix D for additional information on the Advisory Group's efforts.

4.2 WateReuse's California DPR Initiative

The WateReuse Research Foundation, in partnership with WateReuse California, launched the "California DPR Initiative" in June 2012 to advance DPR as a water supply option in California. Specifically, the DPR Initiative was meant to assist DDW in its state-mandated task to determine the feasibility of developing regulatory criteria for DPR. WateReuse's DPR research portfolio includes 34 projects valued at over $20 million to investigate different aspects of the technical feasibility of DPR implementation, including the reliability of treatment trains, microbial and chemical water quality, treatment and process monitoring, and facility operations. The DPR Initiative is being led by Ms. Melissa Meeker of the WateReuse Research Foundation and Ms. Jennifer West of WateReuse California.

Currently, two projects are being undertaken under the DPR Initiative that are providing a significant amount of information to assist the Expert Panel with its charge. These projects include WRRF 15-01 and WRRF 14-14, described in Sections 4.2.1 and 4.2.2, respectively.

4.2.1 WRRF 15-01 Project on "Potable Reuse Research Compilation: Synthesis of Findings"

In 2015, WateReuse funded a project titled "DPR Research Compilation: Synthesis of Findings from DPR Initiative Projects" (WRRF-15-01) to (1) summarize and synthesize the key research results of the 34 projects on DPR, pulling from outside research where needed, and (2) package this information by topic. The summary information was presented to the DDW Expert Panel as part of WateReuse's ongoing efforts to provide relevant DPR research findings to assist with the Panel review process and facilitate informed recommendations, which is one of the goals on the DPR Research Initiative. See Appendix E for additional information on WRRF 15-01.

4.2.2 WRRF 14-14 White Paper on the "Feasibility of Establishing a Framework for Public Health Monitoring"

Among its early findings and recommendations, the DPR Expert Panel identified the need to explore the feasibility of using public health surveillance data to evaluate or inform the implementation of DPR. Waterborne disease outbreaks are occasionally detected in conventional water supplies; however, this reporting relies on passive surveillance (e.g., self-reporting by states to the Centers for Disease Control), which is relatively insensitive and often inadequate in detecting less than population-level effects. The subtle nature and the existence of significant background rates for some effects (e.g., reproductive and developmental) are more difficult to attribute to a water supply.

To address this need, WateReuse is now funding project WRRF 14-14 to develop a White Paper on the "Feasibility of Establishing a Framework for Public Health Monitoring for DPR" as part of the California DPR Initiative. The White Paper would meet the following three objectives:

- Determine whether it is feasible technically to identify acute and/or sub-chronic population risks attributable to the consumption of water produced as part of a DPR project (e.g., a public health monitoring framework).
- Evaluate the feasibility of collecting and interpreting information for a public health monitoring framework.
- Evaluate the types of baseline data that would be necessary to inform potential health effects studies resulting from the implementation of DPR.

See Appendix F for additional information on WRRF 14-14.

5. PANEL MEETING #9

A two-day meeting of the Panel (Panel Meeting #9) was held on March 30-31, 2016, at the Newport Beach Marriott in Newport Beach, California. The purpose of the meeting was to review (1) the draft internal Panel DPR Briefing Papers and (2) elements of the Panel Feasibility Report under development.

5.1 Panel Meeting #9 Background Material

Prior to Meeting #9, the following background material was provided to the Panel:

- Hyperlink to the "State Board Survey on Recycled Water Research Survey to Prioritize Research Needs" at https://www.surveymonkey.com/r/DRZJFXP.

- Draft of *Briefing Paper #2 on Quantifying Treatment Facility Reliability*. Key authors include C. Haas, J. Drewes, P. McCarty, K. Nelson, M. Anderson, A. Olivieri, and J. Crook.

- "Table of Contents" and "Draft Introduction" for the Panel Feasibility Report on the *Evaluation of the Feasibility of Developing Direct Potable Reuse Regulatory Criteria for the State of California*. Key authors include J. Crook and A. Olivieri.

- Write-ups with preliminary findings for the following eight chapters from the WRRF 15-01 project on "Potable Reuse Research Compilation: Synthesis of Findings":

    - Chapter 1 – "Source Control Program," prepared by Robert W. Emerick, Ph.D., P.E., Robert Emerick Associates (San Francisco, CA)
    - Chapter 2 – "Evaluation of Potential DPR Treatment Trains," prepared by Larry Schimmoller, P.E., CH2M (Englewood, CO); Jim Lozier, P.E., CH2M (Tempe, AZ); and Ufuk Erdal, Ph.D., P.E., CH2M (Santa Ana, CA)
    - Chapter 3 – "Pathogens," prepared by Philip Brandhuber, Ph.D., HDR, Inc. (Denver, CO)
    - Chapter 4 – "Pathogens (Rapid/Continuous Monitoring)," prepared by Channah M. Rock, Ph.D., University of Arizona (Tucson, AZ), and Daniel Gerrity, Ph.D., University of Nevada, Las Vegas (Las Vegas, NV)
    - Chapter 6 – "Monitoring DPR Systems and the Critical Control Point Approach" prepared by Andrew Salveson, P.E., Carollo Engineers (Walnut Creek, CA)
    - Chapter 7 – "Operations, Maintenance, and Operator Training/Certification," prepared by Debra L. Burris, P.E., DDB Engineering, Inc. (Irvine, CA)
    - Chapter 8 – "Failure and Resilience," prepared by Brian Pecson, Ph.D., P.E., and Sarah Triolo, Trussell Technologies, Inc. (Oakland, CA)
    - Chapter 9 – "Demonstration of Reliable, Redundant Treatment Performance"

Prepared by Ben Stanford, Ph.D., Hazen and Sawyer (Raleigh, NC).

5.2 Panel Meeting #9 Agenda and Logistics

The Panel Co-Chairs and NWRI staff collaborated on the development of an agenda for Panel Meeting #9, which is included in Appendix G. The agenda was based on meeting the following objectives:

1. Review the schedule for Panel deadlines and deliverables to address DPR.
2. Receive a status update on the DPR Briefing Papers not listed on the agenda.
3. Review the second draft of *Briefing Paper #2 on Quantifying Treatment Facility Reliability,* including a draft "feasibility approach."
4. Participate in a follow-up survey from the State Board's October 2016 "Recycled Water Research Needs Workshop: Monitoring and Treatment Performance of Constituents of Emerging Concern."
5. Review and edit the Draft "Introduction" for the Panel Feasibility Report.
6. Determine next steps.

On Day 1, the Panel met in a closed session to (1) provide a status update on the DPR Briefing Papers that have yet to be drafted and (2) review and edit an updated draft of Briefing Paper #2 (Reliability). The authors of Briefing Paper #2 led a detailed discussion about their paper and made a number of edits to the working draft based on input from the Panel. The Panel reviewed and agreed on the feasibility approach, as well as discussed defining the "Gap" (i.e., the middle-ground between surface water augmentation and DPR, according to definitions provided in regulations for the State of California).

On Day 2, again in closed session, the Panel as a group discussed the questions on the State Board's Survey on "Recycled Water Research Survey to Prioritize Research Needs," but did not complete the survey. The rest of the day involved a discussion of the topics to be included in Briefing Papers #3 (Chemical Water Quality) and #4 (Pathogen Monitoring), as well as a review of the "Table of Contents" and draft "Introduction" to the Panel Feasibility Report.

5.3 Panel Meeting #9 Attendees

All but two Panel members attended Meeting #9 in person. Dr. Wade was unable to attend the meeting, while Mr. Jakubowski participated both days using web-enabled conference call services. Dr. Anderson was unable to attend the meeting on Day 2. Other attendees included NWRI staff. The meeting was closed to allow the Panel to make maximum use of its time to review and work on the DPR Briefing Papers. A complete list of attendees at Panel Meeting #9 is included in Appendix H.

6. PANEL MEETING #10

A two-day meeting of the Panel (Panel Meeting #10) was held on April 13-14, 2016, at the Hotel Shattuck Plaza in Berkeley, California. The purpose of the meeting was to (1) review several draft DPR Briefing Papers and (2) provide an update to DDW staff on the status of the Panel's deliverables and schedule.

6.1 Panel Meeting #10 Background Material

Prior to Meeting #10, the following background material was provided to the Panel:

- Draft of *DPR Briefing Paper #3 on Analytical Approaches for Measuring Chemical Water Quality*. Key authors include D. Sedlak and J. Drewes.

- Draft of *Briefing Paper #4 on Molecular and Other Methods for Monitoring Pathogens in Advanced Treated Water and Drinking Water*. Key authors include J. Rose and K. Nelson.

- Write-up with preliminary findings for the following chapter from the WRRF 15-01 project on "Potable Reuse Research Compilation: Synthesis of Findings":

    - Chapter 5 – "Contaminants of Emerging Concern Removal and Risk," prepared by Jean Debroux, Ph.D. and Laura Kennedy, Kennedy/Jenks Consultants (San Francisco, CA), and Megan Plumlee, Ph.D., P.E., Orange County Water District (Fountain Valley, CA)

6.2 Panel Meeting #10 Agenda and Logistics

The Panel Co-Chairs and NWRI staff collaborated on the development of an agenda for Panel Meeting #10, which is included in Appendix I. The agenda was based on meeting the following objectives:

- Review the second draft of *Briefing Paper #3 on Analytical Approaches for Measuring Chemical Water Quality*.
- Review the second draft of *Briefing Paper #4 on Molecular and Other Methods for Monitoring Pathogens in Advanced Treated Water and Drinking Water*.
- Continue discussion on defining the "Gap."
- Determine next steps to complete the DPR Briefing Papers and Panel Feasibility Report.
- Provide DDW staff with a status of the Panel's efforts on the internal DPR Briefing Papers, discuss the schedule for the Panel's the two main deliverables (i.e., research recommendations and the Panel Feasibility Report), and address various DDW staff questions.

On Day 1, the Panel met in a closed session to review and edit the first drafts of Briefing Papers #3 (Chemical Water Quality) and #4 (Monitoring Pathogens). The authors of these Briefing Papers led detailed discussions on their papers. Edits were made, as needed, to the working drafts.

On Day 2, the Panel reviewed an updated draft of Briefing Paper #2 (Reliability) during a brief closed session in the morning. The meeting was then opened to DDW staff, and the Panel used an updated Table of Contents to provide an overview of the expected chapters and sections that will make up the Panel Feasibility Report. In addition, the Panel discussed with DDW subjects such as the schedule for deliverables, input from WRRF 15-01, and the possibility of presenting information from the Panel Feasibility Report at the Annual Meeting of the Society for Risk Analysis on December 11-15, 2016, in San Diego, California.

6.3 Panel Meeting #10 Attendees

Panel members Drs. Wade and Bull were unable to attend Panel Meeting #10, while Dr. Drewes and Mr. Jakubowski participated both days using web-enabled conference call services. Drs. Anderson, Rose, and Sedlak were unable to attend the meeting on Day 2. Other attendees included NWRI staff and DDW staff. A complete list of attendees at Panel Meeting #10 is included in Appendix J.

7. SUMMARY OF PANEL COMMENTS AND RECOMMENDATIONS

The Panel has organized this report to reflect the information, materials, and draft documents presented and discussed at Meetings #9 and #10. Sections include:

- General Statements
- Internal Drafts of the DPR Briefing Papers
- Deliverable to DDW: Panel Feasibility Report

These topic-based comments and recommendations are provided below.

7.1 General Statements

- The Panel appreciates the continued support, responsiveness, and information provided by State Board staff throughout this process.

- The Panel is considering the possibility of submitting abstracts to present information from the Panel Feasibility Report at the Annual Meeting of the Society for Risk Analysis on December 11-15, 2016, in San Diego, California. These abstracts would be part of a "package" to make up a complete session at the conference. The Panel discussed with the State Board the possibility of having a State Board representative make a presentation to provide context as to why the State is interested in DPR.

- The Panel appreciated the opportunity to participate in the State Board Survey on "Recycled Water Research Survey to Prioritize Research Needs." The focus of the workshop, in which the survey was based, was on constituents of emerging concern. With this focus in mind (and noting that research on microorganisms was not listed as an option), the Panel as a group agreed that the top three research priorities to best advance the expansion and development of potable recycled water projects in California (Question #1) would be the following:

    1. Reliability and resiliency of treatment systems.
    2. Non-targeted constituent analysis.
    3. Source control, operations, maintenance, and training.

7.2 Internal Drafts of the DPR Briefing Papers

The following comments pertain to the Panel's efforts to develop DPR Briefing Papers to help fulfill its charge, per the CWC, to investigate the feasibility of developing uniform water recycling criteria for DPR.

As noted in Section 3, the DPR Briefing Papers are not stand-alone documents and will not be published (nor will they serve as appendices to the Panel Feasibility Report). They are draft internal documents for the Panel's use only, created for the purpose of ultimately inserting the information into the Panel Feasibility Report currently under development. Information in the Briefing Papers may be edited as part of drafting the Panel Feasibility Report; however, the Briefing Papers will not be updated to reflect those edits.

7.2.1 Briefing Paper #1 on Application of Bioanalytical Tools to Water Analyses

Dr. Richard Bull has completed a final draft of *Briefing Paper #1 on Application of Bioanalytical Tools to Water Analyses*. The information from this paper will be inserted into the draft Panel Feasibility Report.

7.2.2 Briefing Paper #2 on Quantifying Treatment Facility Reliability

A comprehensive draft of *Briefing Paper #2 on Quantifying Treatment Facility Reliability* (dated February 12, 2016) was reviewed and edited by the entire Panel at Meeting #9. Dr. Charles Haas led the review process, with assistance from Drs. Jörg Drewes, Perry McCarty, and Kara Nelson. Discussions continued at Meeting #10. A final draft is expected by Meeting #11. Topics areas may include:

- Description of Treatment Systems
- Underlying Assumptions for Quantifying Treatment Facility Reliability
- Performance Criteria for Microbial Contaminants
- Performance Criteria for Chemical Contaminants (Regulated and Unregulated)
- Identification of Hazards and Hazardous Events
- Barriers in Indirect Potable Reuse Schemes Providing Reliability
- Quantifying Robustness, Resilience, Redundancy
- Feasibility Analysis
- Source Control

Based on the review of draft Briefing Paper #2, the Panel modified the Table of Contents for the draft Panel Feasibility Report to include a separate chapter that briefly addresses the following topics: operations and maintenance; operator training and certification; institutional issues; and technical, managerial, and financial capabilities.

7.2.3 Briefing Paper #3 on Analytical Approaches for Measuring Chemical Water Quality

Dr. David Sedlak provided an initial first draft of *Briefing Paper #3 on Analytical Approaches for Measuring Chemical Water Quality* for review at Meeting #10. The next draft will be reviewed at Meeting #11. Topic areas in this Briefing Paper, which will focus on elements of chemical contaminant monitoring programs, include:

- Monitoring of Chemical Contaminants (Periodic Monitoring, Monitoring Short-Duration Releases of Chemicals, Monitoring to Maintain Aesthetics, Monitoring Other Chemicals of Commercial or Industrial Origin, and Monitoring Indicators and Surrogates)
- Input on the Frequency and Location of Monitoring
- Responses to Off-Spec Water (which will be linked to Briefing Paper #2 on Reliability)

7.2.4 Briefing Paper #4 on Molecular and Other Methods for Monitoring Pathogens in Advanced Treated Water and Drinking Water

Drs. Kara Nelson and Joan Rose provided an initial draft of *Briefing Paper #4 on Molecular and Other Methods for Monitoring Pathogens* for review at Meeting #10. The next draft will be reviewed at Meeting #11. Topic areas may include:

- Microbial Water Quality of Wastewater
- Measurement of Indicator Organisms and Pathogens
- Water Microbiome
- Distribution System
- Introduction to Monitoring Approaches
- New Methods for Pathogen Characterization
- Online and Real-Time Techniques
- Process Monitoring

7.2.5 Briefing Paper #5 on Antibiotic Resistant Bacteria and Antibiotic Resistance Genes

Mr. Walter Jakubowski and co-authors Drs. Ryan Reinke and Kellogg Schwab have completed the draft of *Briefing Paper #5 on Antibiotic Resistant Bacteria and Antibiotic Resistance Genes*. The information from this Briefing Paper will be inserted into the draft Panel Feasibility Report.

7.2.6 Briefing Paper #6 on Feasibility Analysis

Panel Co-Chairs Drs. Adam Olivieri and Jim Crook are working on an initial draft of *Briefing Paper #6 on Feasibility Analysis*, which will be available in draft format by Panel Meeting #11 in May 2016. As part of that work, the Co-Chairs are collaborating with Dr. Anderson on defining the "Gap," as well as drafting Chapter 2 of the Panel Feasibility Report.

7.2.7 Briefing Paper #7 on Public Health Surveillance

This Briefing Paper will be developed based on information provided from the WRRF 14-14 project on developing a White Paper on the "Feasibility of Establishing a Framework for Public

Health Monitoring," which will focus on defining and describing the role for interaction with public health surveillance programs in relation to DPR projects (see Section 4.2.2).

A meeting was held on March 25, 2016, in Berkeley, California, to help the principal investigators develop an outline for the White Paper; the outline will be based on points made during discussions between the principal investigators, Project Advisory Committee (PAC) members, and other meeting participants, including members of the DPR Expert Panel (i.e., Drs. Crook, Olivieri, and Wade), regarding the three project objectives listed in Section 4.2.2.

The principal investigators are expected to submit an internal draft to the Expert Panel by the end of May 2016 (in advance of Panel Meeting #13 in June). The White Paper will be completed in July 2016.

7.3 Deliverable to DDW: Panel Feasibility Report

The Panel discussed the composition of the draft Panel Feasibility Panel Report under development, including:

- New and Updated Content for the Draft Panel Feasibility Report. The Panel reviewed and provided edits to the draft Panel Feasibility Report under development, including the Table of Contents. A draft version of the Table of Contents is included in Appendix K.

- Draft Meeting Schedule – The following list of actions summarizes the Panel's expectations for preparing and completing the Panel Feasibility Report:

  Action #1 - April 13-14 Panel Meeting (Meeting #10)
  The following actions were completed at Panel Meeting #10: (1) Review of the second draft of Briefing Paper #3 (Chemical Water Quality), including recommendations; and (2) Review of the first draft of Briefing Paper #4 (Monitoring Pathogens), including recommendations.

  Action #2 - By April 30
  The Panel will compile all draft chapters available (with edits responding to comments received to date), along with a brief abstract for each paper. These draft chapters will be inserted into the first draft of the Panel Feasibility Report and distributed to the Panel prior to the Panel Meeting #11 (May 11-12, 2016). The expectation is that Chapters 1, 2 (with the exception of public health surveillance information), 3, 4, and 6 will be included.

  Action #3 - May 11-12 Panel Meeting (Meeting #11)
  The Panel will provide comments on all chapters, with a focus on the review of findings and recommendations, as well as abstracts. The product of Panel Meeting #11 (due to DDW staff on May 30, 2016) will be a summary report of recommendations, with an emphasis on research needs.

Action #4 - May 30
The Panel will submit to State Board staff a summary report of recommendations, with an emphasis on research needs.

Action #5 – May 30
Any additional comments on the first draft of the Panel Feasibility Report will be due.

Action #6 – June 15 (Anticipated Date)
A revised second draft of the Panel Feasibility Report will be distributed to the Panel for review prior to Panel Meeting #13 on June 29-30, 2016.

Action #7 – June 29-30 Panel Meeting (Meeting #13)
Final comments and edits of the second draft of the Panel Feasibility Report will be submitted to NWRI staff for formatting and copy editing.

Action #8 – Mid-July
NWRI will finalize the draft Panel Feasibility Report and submit it to State Board staff.

Action #9 – Early to Mid-September
The Panel will receive and/or address questions and/or clarifications from State Board staff on the draft Panel Feasibility Report.

CALIFORNIA WATER CODE
CHAPTER 7.3 DIRECT AND INDIRECT POTABLE REUSE
SECTION 13560-13569

13560. The Legislature finds and declares the following:

(a) In February 2009, the state board unanimously adopted, as Resolution No. 2009-0011, an updated water recycling policy, which includes the goal of increasing the use of recycled water in the state over 2002 levels by at least 1,000,000 acre-feet per year by 2020 and by at least 2,000,000 acre-feet per year by 2030.

(b) Section 13521 requires the department to establish uniform statewide recycling criteria for each varying type of use of recycled water where the use involves the protection of public health.

(c) The use of recycled water for indirect potable reuse is critical to achieving the state board's goals for increased use of recycled water in the state. If direct potable reuse can be demonstrated to be safe and feasible, implementing direct potable reuse would further aid in achieving the state board's recycling goals.

(d) Although there has been much scientific research on public health issues associated with indirect potable reuse through groundwater recharge, there are a number of significant unanswered questions regarding indirect potable reuse through surface water augmentation and direct potable reuse.

(e) Achievement of the state's goals depends on the timely development of uniform statewide recycling criteria for indirect and direct potable water reuse.

(f) This chapter is not intended to delay, invalidate, or reverse any study or project, or development of regulations by the department, the state board, or the regional boards regarding the use of recycled water for indirect potable reuse for groundwater recharge, surface water augmentation, or direct potable reuse.

(g) This chapter shall not be construed to delay, invalidate, or reverse the department's ongoing review of projects consistent with Section 116551 of the Health and Safety Code.

13561. For purposes of this chapter, the following terms have the following meanings:

(a) "Department" means the State Department of Public Health.

(b) "Direct potable reuse" means the planned introduction of recycled water either directly into a public water system, as defined in Section 116275 of the Health and Safety Code, or into a raw water supply immediately upstream of a water treatment plant.

(c) "Indirect potable reuse for groundwater recharge" means the planned use of recycled water for replenishment of a groundwater basin or an aquifer that has been designated as a source of water supply for a public water system, as defined in Section 116275 of the Health and Safety Code.

(d) "Surface water augmentation" means the planned placement of recycled water into a surface water reservoir used as a source of domestic drinking water supply.

(e) "Uniform water recycling criteria" has the same meaning as in Section 13521.

13561.5. The state board shall enter into an agreement with the department to assist in implementing this chapter.

13562. (a) (1) On or before December 31, 2013, the department shall adopt uniform water recycling criteria for indirect potable reuse for groundwater recharge.

(2) (A) Except as provided in subparagraph (C), on or before December 31, 2016, the department shall develop and adopt uniform water recycling criteria for surface water augmentation.

(B) Prior to adopting uniform water recycling criteria for surface water augmentation, the department shall submit the proposed criteria to the expert panel convened pursuant to subdivision (a) of Section 13565. The expert panel shall review the proposed criteria and shall adopt a finding as to whether, in its expert opinion, the proposed criteria would adequately protect public health.

(C) The department shall not adopt uniform water recycling criteria for surface water augmentation pursuant to subparagraph (A), unless and until the expert panel adopts a finding that the proposed criteria would adequately protect public health.

(b) Adoption of uniform water recycling criteria by the department is subject to the requirements of Chapter 3.5 (commencing with Section 11340) of Part 1 of Division 3 of Title 2 of the Government Code.

13562.5. Notwithstanding any other law, no later than June 30, 2014, the department shall adopt, by emergency regulations in accordance with Chapter 3.5 (commencing with Section 11340) of Part 1 of Division 3 of Title 2 of the Government Code, requirements for groundwater replenishment using recycled water. The adoption of these regulations is an emergency and shall be considered by the Office of Administrative Law as necessary for the immediate preservation of the public peace, health, safety, and general welfare. Notwithstanding Chapter 3.5 (commencing with Section 11340) of Part 1 of Division 3 of Title 2 of the Government Code, emergency regulations adopted by the department pursuant to this section shall not be subject to review by the Office of Administrative Law and shall remain in effect until revised by the department.

13563. (a) (1) On or before December 31, 2016, the department, in consultation with the state board, shall investigate and report to the Legislature on the feasibility of developing uniform water recycling criteria for direct potable reuse.

(2) The department shall complete a public review draft of its report by September 1, 2016. The department shall provide the public not less than 45 days to review and comment on the public review draft.

(3) The department shall provide a final report to the Legislature

by December 31, 2016. The department shall make the final report available to the public.

(b) In conducting the investigation pursuant to subdivision (a), the department shall examine all of the following:

(1) The availability and reliability of recycled water treatment technologies necessary to ensure the protection of public health.

(2) Multiple barriers and sequential treatment processes that may be appropriate at wastewater and water treatment facilities.

(3) Available information on health effects.

(4) Mechanisms that should be employed to protect public health if problems are found in recycled water that is being served to the public as a potable water supply, including, but not limited to, the failure of treatment systems at the recycled water treatment facility.

(5) Monitoring needed to ensure protection of public health, including, but not limited to, the identification of appropriate indicator and surrogate constituents.

(6) Any other scientific or technical issues that may be necessary, including, but not limited to, the need for additional research.

(c) (1) Notwithstanding Section 10231.5 of the Government Code, the requirement for submitting a report imposed under paragraph (3) of subdivision (a) is inoperative on December 31, 2020.

(2) A report to be submitted pursuant to paragraph (3) of subdivision (a) shall be submitted in compliance with Section 9795 of the Government Code.

13563.5. (a) The department, in consultation with the state board, shall report to the Legislature as part of the annual budget process, in each year from 2011 to 2016, inclusive, on the progress towards developing and adopting uniform water recycling criteria for surface water augmentation and its investigation of the feasibility of developing uniform water recycling criteria for direct potable reuse.

(b) (1) A written report submitted pursuant to subdivision (a) shall be submitted in compliance with Section 9795 of the Government Code.

(2) Pursuant to Section 10231.5 of the Government Code, this section is repealed on January 1, 2017.

13564. In developing uniform water recycling criteria for surface water augmentation, the department shall consider all of the following:

(a) The final report from the National Water Research Institute Independent Advisory Panel for the City of San Diego Indirect Potable Reuse/Reservoir Augmentation (IPR/RA) Demonstration Project.

(b) Monitoring results of research and studies regarding surface water augmentation.

(c) Results of demonstration studies conducted for purposes of approval of projects using surface water augmentation.

(d) Epidemiological studies and risk assessments associated with projects using surface water augmentation.

(e) Applicability of the advanced treatment technologies required for recycled water projects, including, but not limited to, indirect potable reuse for groundwater recharge projects.

(f) Water quality, limnology, and health risk assessments

associated with existing potable water supplies subject to discharges from municipal wastewater, stormwater, and agricultural runoff.

(g) Recommendations of the State of California Constituents of Emerging Concern Recycled Water Policy Science Advisory Panel.

(h) State funded research pursuant to Section 79144 and subdivision (b) of Section 79145.

(i) Research and recommendations from the United States Environmental Protection Agency Guidelines for Water Reuse.

(j) The National Research Council of the National Academies' report titled "Water Reuse: Potential for Expanding the Nation's Water Supply Through Reuse of Municipal Wastewater."

(k) Other relevant research and studies regarding indirect potable reuse of recycled water.

13565. (a) (1) On or before February 15, 2014, the department shall convene and administer an expert panel for purposes of advising the department on public health issues and scientific and technical matters regarding development of uniform water recycling criteria for indirect potable reuse through surface water augmentation and investigation of the feasibility of developing uniform water recycling criteria for direct potable reuse. The expert panel shall assess what, if any, additional areas of research are needed to be able to establish uniform regulatory criteria for direct potable reuse. The expert panel shall then recommend an approach for accomplishing any additional needed research regarding uniform criteria for direct potable reuse in a timely manner.

(2) The expert panel shall be comprised, at a minimum, of a toxicologist, an engineer licensed in the state with at least three years' experience in wastewater treatment, an engineer licensed in the state with at least three years' experience in treatment of drinking water supplies and knowledge of drinking water standards, an epidemiologist, a limnologist, a microbiologist, and a chemist. The department, in consultation with the advisory group and the state board, shall select the expert panel members.

(3) Members of the expert panel may be reimbursed for reasonable and necessary travel expenses.

(b) (1) On or before January 15, 2014, the department shall convene an advisory group, task force, or other group, comprised of no fewer than nine representatives of water and wastewater agencies, local public health officers, environmental organizations, environmental justice organizations, public health nongovernmental organizations, the department, the state board, the United States Environmental Protection Agency, ratepayer or taxpayer advocate organizations, and the business community, to advise the expert panel regarding the development of uniform water recycling criteria for direct potable reuse and the draft report required by Section 13563. The department, in consultation with the state board, shall select the advisory group members.

(2) Environmental, environmental justice, and public health nongovernmental organization representative members of the advisory group, task force, or other group may be reimbursed for reasonable and necessary travel expenses.

(3) In order to ensure public transparency, the advisory group established pursuant to paragraph (1) shall be subject to the Bagley-Keene Open Meeting Act (Article 9 (commencing with Section 11120) of Chapter 1 of Part 1 of Division 3 of Title 2 of the

Government Code).

(c) On or before June 30, 2016, the department shall prepare a draft report summarizing the recommendations of the expert panel.

(d) The department may contract with a public university or other research institution with experience in convening expert panels on water quality or potable reuse to meet all or part of the requirements of this section should the department find that the research institution is better able to fulfill the requirements of this section by the required date.

13566. In performing its investigation of the feasibility of developing the uniform water recycling criteria for direct potable reuse, the department shall consider all of the following:

(a) Recommendations from the expert panel appointed pursuant to subdivision (a) of Section 13565.

(b) Recommendations from an advisory group, task force, or other group appointed by the department pursuant to subdivision (b) of Section 13565.

(c) Regulations and guidelines for these activities from jurisdictions in other states, the federal government, or other countries.

(d) Research by the state board regarding unregulated pollutants, as developed pursuant to Section 10 of the recycled water policy adopted by state board Resolution No. 2009-0011.

(e) Results of investigations pursuant to Section 13563.

(f) Water quality and health risk assessments associated with existing potable water supplies subject to discharges from municipal wastewater, stormwater, and agricultural runoff.

13567. An action authorized pursuant to this chapter shall be consistent, to the extent applicable, with the federal Clean Water Act (33 U.S.C. Sec. 1251 et seq.), the federal Safe Drinking Water Act (42 U.S.C. Sec. 300f et seq.), this division, and the California Safe Drinking Water Act (Chapter 4 (commencing with Section 116270) of Part 12 of Division 104 of the Health and Safety Code).

13569. The department may accept funds from nonstate sources and may expend these funds, upon appropriation by the Legislature, for the purposes of this chapter.

APPENDIX B: Panel Background

About NWRI

For over 20 years, NWRI – a science-based 501c3 nonprofit located in Fountain Valley, California – has sponsored projects and programs to improve water quality, protect public health and the environment, and create safe, new sources of water. NWRI specializes in working with researchers across the country, such as laboratories at universities and water agencies, and are guided by a Research Advisory Board (representing national expertise in water, wastewater, and water reuse) and a six-member Board of Directors (representing water and wastewater agencies in Southern California).

Through NWRI's research program, NWRI supports multi-disciplinary research projects with partners and collaborators that pertain to treatment and monitoring, water quality assessment, knowledge management, and exploratory research. Altogether, NWRI's research program has produced over 300 publications and conference presentations.

NWRI also promotes better science and technology through extensive outreach and educational activities, which includes facilitating workshops and conferences and publishing White Papers, guidance manuals, and other informational material.

More information on NWRI can be found online at www.nwri-usa.org.

About NWRI Panels

NWRI also specializes in facilitating Independent Advisory Panels on behalf of water and wastewater utilities, as well as local, county, and state government agencies, to provide credible, objective review of scientific studies and projects in the water industry. NWRI Panels consist of academics, industry professionals, government representatives, and independent consultants who are experts in their fields.

The NWRI Panel process provides numerous benefits, including:

- Third-party review and evaluation.
- Scientific and technical advice by leading experts.
- Assistance with challenging scientific questions and regulatory requirements.
- Validation of proposed project objectives.
- Increased credibility with stakeholders and the public.
- Support of sound public-policy decisions.

NWRI has extensive experience in developing, coordinating, facilitating, and managing expert Panels. Efforts include:

- Selecting individuals with the appropriate expertise, background, credibility, and level of commitment to serve as Panel members.

- Facilitating hands-on Panel meetings held at the project's site or location.
- Providing written report(s) prepared by the Panel that focus on findings and comments of various technical, scientific, and public health aspects of the project or study.

Over the past 5 years, NWRI has coordinated the efforts of over 20 Panels for water and wastewater utilities, city and state agencies, and consulting firms. Many of these Panels have dealt with projects or policies involving groundwater replenishment and potable (indirect and direct) reuse. Specifically, these Panels have provided peer review of a wide range of scientific and technical areas related water quality and monitoring, constituents of emerging concern, treatment technologies and operations, public health, hydrogeology, water reuse criteria and regulatory requirements, and outreach, among others.

More information about the NWRI Independent Advisory Panel Program can be found on the NWRI website at http://nwri-usa.org/Panels.htm.

APPENDIX C: Expert Panel Member Biographies

Adam Olivieri, Dr.PH, P.E. (Panel Co-Chair)
Vice President
EOA Inc. (Oakland, CA)

Adam Olivieri has 35 years of experience in the technical and regulatory aspects of water recycling, groundwater contamination by hazardous materials, water quality and public health risk assessments, water quality planning, wastewater facility planning, urban runoff management, and on-site waste treatment systems. He has gained this experience through working as a staff engineer with the California Regional Water Quality Control Board (San Francisco Bay Region), as staff specialist (and Post-doc fellow) with the School of Public Health at the University of California, Berkeley, project manager/researcher for the Public Health Institute on the City San Diego Health Effects investigations for Aqua II and Aqua III and advanced treatment facility engineering performance and operation reports, and as a consulting engineer. He is currently the Vice president of EOA, Inc., where he manages a variety of projects, including serving as Santa Clara County Urban Runoff Program's Manager since 1998. Olivieri is also the author or co-author of numerous technical publications and project reports. He received a B.S. in Civil Engineering from the University of Connecticut, an M.S. in Civil and Sanitary Engineering from the University of Connecticut, and both an MPH and Dr.PH in Environmental Health Sciences from University of California, Berkeley.

James Crook, Ph.D., P.E. (Panel Co-Chair)
Water Reuse and Environmental Engineering Consultant (Boston, MA)

Jim Crook is an environmental engineer with more than 40 years of experience in state government and consulting engineering arenas, serving public and private sectors in the U.S. and abroad. He has authored more than 100 publications and is an internationally recognized expert in water reclamation and reuse. He has been involved in numerous projects and research activities involving public health, regulations and permitting, water quality, risk assessment, treatment technology, and all facets of water reuse. Crook spent 15 years directing the California Department of Health Services' water reuse program, during which time he developed California's first comprehensive water reuse criteria. He also spent 15 years with consulting firms overseeing water reuse activities and is now an independent consultant specializing in water reuse. He currently serves on several advisory panels and committees sponsored by NWRI and others. Among his honors, he was selected as the American Academy of Environmental Engineers' 2002 Kappe Lecturer and the WateReuse Association's 2005 Person of the Year. Crook received a B.S. in Civil Engineering from the University of Massachusetts and both an M.S. and Ph.D. in Environmental Engineering from the University of Cincinnati.

Michael Anderson, Ph.D.
Professor of Applied Limnology and Environmental Chemistry and Chair
Department of Environmental Sciences
University of California, Riverside (Riverside, CA)

Michael Anderson, a Professor of Applied Limnology and Environmental Chemistry, has taught courses at the University of California, Riverside, since 1990. His research focus includes water and soil sciences, with particular emphasis in applied limnology and lake/reservoir management; surface water quality and modeling; fate of contaminants in waters, soils, and sediments; and environmental chemistry. Current research projects include laboratory, field, and modeling studies in support of the development of species conservation habitat at the Salton Sea, sponsored by the California DWR and DFG, and a survey of organochlorine pesticides and Polychlorinated Biphenyls (PCBs) in McGrath Lake that is funded by the Los Angeles Regional Water Quality Control Board. He and his students also recently completed studies quantifying the abundance and distribution of quagga mussel veligers in the reservoirs of the Colorado River Aqueduct, as well as assessing the ecological and biological conditions at Lake Elsinore. In addition, he has served on various panels and workgroups, including as member of the California Department of Water Resource's Salton Sea Hydrologic Technical Workgroup (2007-2008). Anderson received a B.S. in Biology from Illinois Benedictine College, M.S. in Environmental Studies from Bemidji State University, and Ph.D. in Environmental Chemistry from Virginia Tech.

Richard Bull, Ph.D.
Consulting Toxicologist
MoBull Consulting (Richland, WA)

Since 2000, Richard Bull has been a Consulting Toxicologist with MoBull Consulting, where he conducts studies on the chemical problems encountered in water for water utilities, as well as federal, state, and local governments. Bull is a Professor Emeritus at Washington State University, where he maintains Adjunct Professor appointments in the College of Pharmacy and the Department of Environmental Science. Formerly, he served as a senior staff scientist at DOE's Pacific Northwest National Laboratory, Professor of Pharmacology/Toxicology at Washington State University, and Director of the Toxicology and Microbiology Division in the Cincinnati Laboratories for the U.S. Environmental Protection Agency. Bull has published extensively on research on central nervous system effects of heavy metals, the carcinogenic and toxicological effects of disinfectants and disinfection by-products, halogenated solvents, acrylamide, and other contaminants of drinking water. He has also served on many international scientific committees convened by the National Academy of Sciences, World Health Organization, and International Agency for Research on Cancer regarding various contaminants of drinking water. Bull received a B.S. in Pharmacy from the University of Washington and a Ph.D. in Pharmacology from the University of California, San Francisco.

Dr.-Ing. Jörg E. Drewes
Chair Professor, Chair of Urban Water Systems Engineering
Technical University of Munich (Munich, Germany)

Jörg Drewes joined the Technical University of Munich in 2013. Prior, he was a professor in the Department of Civil and Environmental Engineering at Colorado School of Mines (CSM), where he taught from 2001 to 2013. While at CSM, he served as the Director of Research for the National Science Foundation's Engineering Research Center *ReNUWIt* (which included Stanford University, University of California Berkeley, New Mexico State University, and CSM). He also served as Co-Director of CSM's Advanced Water Technology Center (AQWATEC). Drewes is actively involved in research in the areas of energy efficient water treatment and non-potable and potable water reuse. Current research interests include treatment technologies leading to potable reuse and the fate and transport of persistent organic compounds in these systems. He has published more than 250 journal papers, book contributions, and conference proceedings, and served on National Research Council Committees on *Water Reuse as an Approach for Meeting Future Water Supply Needs* and *Onsite Reuse of Graywater and Stormwater*. He also currently serves as Chair of the International Water Association (IWA) Water Reuse Specialist Group. Drewes received a Cand. Ing. (B.S.), Dipl. Ing. (M.S.), and Doctorate (Dr.-Ing.) in Environmental Engineering from the Technical University of Berlin, Germany.

Charles Haas, Ph.D.
Department Head, L.D. Betz Professor of Environmental Engineering
Drexel University (Philadelphia, PA)

Charles Haas is the Department Head of the Civil, Architectural, and Environmental Engineering at Drexel University since 1991. He is also the L.D. Betz Professor of Environmental Engineering and Director of the Drexel Engineering Cities Initiative. Prior to joining Drexel, he served on the faculties of Rensselaer Polytechnic Institute and the Illinois Institute of Technology. Haas specializes in water treatment, risk assessment, environmental modeling and statistics, microbiology, and environmental health. He received a B.S. in Biology and M.S. in Environmental Engineering, both from the Illinois Institute of Technology. He also received a Ph.D. in Environmental Engineering from the University of Illinois at Urbana-Champaign.

Walter Jakubowski, M.S.
Consultant
WaltJay Consulting (Spokane, WA)

Walter Jakubowski has degrees in Pharmacy from Brooklyn College of Pharmacy, Long Island University; in microbiology from Oregon State University, and graduate training in epidemiology from the University of Minnesota. He has research publications on hospital pharmacy; on microorganisms in oysters and clams under the federal Shellfish Sanitation

Program, and more than 40 peer-reviewed publications on determining the health effects and public health significance of pathogens, especially intestinal protozoa and viruses, in drinking water, waste water and municipal sewage sludge. He has served as a consultant to the World Health Organization on pathogenic intestinal protozoa (for development of the International Drinking Water Guidelines), and to the Pan-American Health Organization on environmental virus methods. He was instrumental in conducting the first international symposium on *Legionella* and Legionnaire's Disease at the Centers for Disease Control. He has more than 48 years of experience working with waterborne pathogens, especially enteric viruses, *Giardia* and *Cryptosporidium.* He initiated landmark studies on the human infectious dose of *Cryptosporidium* and chaired the Joint Task Group on Pathogenic Intestinal Protozoa for *Standard Methods for the Examination of Water and Waste Water* from 1978 to 2005. He was a charter member of U.S. EPA's Pathogen Equivalency Committee and served on that committee until his retirement from the U.S. Public Health Service/Environmental Protection Agency in 1997. Since then, he has been practicing as a private consultant while serving on various professional committees, panels, and boards.

Perry McCarty, Sc.D.
Silas H. Palmer Professor of Civil and Environmental Engr. Emeritus
Stanford University (Stanford, CA)

Perry McCarty is the Silas H. Palmer Professor of Civil and Environmental Engineering Emeritus at Stanford University. McCarty received the Clarke Prize Award in 1997 for his significant contributions to the areas of water treatment, reclamation, groundwater recharge, and water chemistry and microbiology. He is universally recognized for his research on understanding contaminant behavior in groundwater aquifers and sediments. McCarty has received numerous honors, including being elected to the National Academy of Engineering and American Academy of Arts and Sciences, as well as receiving an honorary doctorate from the Colorado School of Mines. He was also awarded the John and Alice Tyler Prize for Environmental Achievement in 1992 and the Stockholm Water Prize in 2007. McCarty received his B.S. from Wayne State University, and both his M.S. and Sc.D. from Massachusetts Institute of Technology.

Kara Nelson, Ph.D.
Professor
University of California, Berkeley (Berkeley, CA)

Kara Nelson is a Professor in Civil and Environmental Engineering at the University of California, Berkeley. She received her B.A. degree in biophysics from U.C. Berkeley, her M.S.E. degree in environmental engineering from the University of Washington, and her Ph.D. in environmental engineering from U.C. Davis. Her research program addresses critical issues at the intersection of public health and the environment, with a focus on reducing the threat posed by waterborne pathogens by improving our engineering infrastructure to make it more effective,

affordable, as well as maximize its environmental benefits. Specific research areas include mechanisms of pathogen inactivation, molecular techniques for pathogen detection, optimizing treatment processes, water reuse, and challenges with providing safe drinking water and sanitation in the developing world. Dr. Nelson has published over 50 articles in peer-reviewed journals, including two invited reviews, and one book chapter. She is the Director of Graduate Education at the National Science Foundation Engineering Research Center for Reinventing our Nation's Urban Water Infrastructure (ReNUWIt), the faculty leader of the Research Thrust Area on Safe Water and Sanitation at Berkeley Water Center. Dr. Nelson was awarded the Presidential Early Career Award for Scientists and Engineers (PECASE) at a ceremony in the White House in 2004. This award is the nation's highest honor for scientists in the early stages of their career.

Joan B. Rose, Ph.D.
Homer Nowlin Endowed Chair for Water Research
Michigan State University (East Lansing, MI)

Joan Rose, a professor at Michigan State University, has made groundbreaking advances in understanding water quality and protecting public health for more than 20 years and has published over 300 articles. She is widely regarded as the world's foremost authority on the microorganism *Cryptosporidium* and was the first person to present a method for detecting this pathogen in water supplies. She examines full-scale water treatment systems for the removal of pathogens. In 2001, she received the Athalie Richardson Irvine Clarke Prize from NWRI for her advances in microbial water-quality issues. She served as the Chair of the Science Advisory Board for the U.S. Environmental Protection Agency's Drinking Water Committee for 4 years, and currently serves on the Science Advisory Board for the Great Lakes. In addition, she is Co-Director of the Center for Water Sciences (which includes work with the Great Lakes and Human Health Center of the National Oceanic & Atmospheric Administration) at Michigan State University, where she is also Director of the Center for Advancing Microbial Risk Assessment. Rose received a B.S. in Microbiology from the University of Arizona, an M.S. in Microbiology from the University of Wyoming, and a Ph.D. in Microbiology from the University of Arizona.

David Sedlak, Ph.D.
Malozemoff Professor, Department of Civil and Environmental Engineering
University of California, Berkeley (Berkeley, CA)

David Sedlak is a Professor of Civil and Environmental Engineering at the University of California, Berkeley. He is also Co-Director of the Berkeley Water Center and Deputy Director of the National Science Foundation's Engineering Research Center for Reinventing the Nation's Urban Water Infrastructure (ReNUWIt). His research focus is on the fate of chemical contaminants, with the long-term goal of developing cost-effective, safe, and sustainable systems to manage water resources. Sedlak's previous experience includes Staff Scientist at ENVIRON Corporation and membership on the National Research Council's Committee on Water Reuse.

He has individually or co-authored over 70 peer-reviewed publications, among many other publications and presentations. Sedlak published a book in 2014 called "Water 4.0: The Past, Present, and Future of The World's Most Vital Resource," where he points out that most of the population gives little thought to the hidden systems that bring us water and take it away and how these marvels of engineering face challenges that cannot be solved without a fundamental change to our relationship with water. Sedlak received a B.S. in Environmental Science from Cornell University and a Ph.D. in Water Chemistry from the University of Wisconsin.

Tim Wade, Ph.D.
Epidemiology Branch Chief
United States Environmental Protection Agency (Durham, NC)

Tim Wade is the Epidemiology Branch Chief at the United States Environmental Protection Agency (U.S. EPA) and Assistant Professor of Epidemiology at the University of North Carolina, Chapel Hill. Wade has been working with the U.S. EPA since 2005, conducting a series of epidemiologic studies to evaluate the health effects of arsenic exposure in well water in Inner Mongolia. As Branch Chief, Wade determines research priorities, directs staff and post-doctoral students, and manages an annual budget of over $1 million annually. In 2011, Wade received the EPA Office of Water Bronze Medal for his exceptional service to the Office of Water in the development of recreational water quality criteria. He received a B.A. in Biological Science from California Polytechnic at Pomona, a B.A. in Psychobiology from Claremont McKenna College, and both an MPH and Ph.D. in Epidemiology from the University of California at Berkeley.

APPENDIX D: State Board's DPR Advisory Group

In 2014, the State Board established a DPR Advisory Group of stakeholders to provide advice to the DPR Expert Panel and the State Board. The Advisory Group, which is required by the CWC, is composed of 15 members representing environmental organizations, public health organizations, taxpayer advocate organizations, water and wastewater agencies, government agencies, and others in California.

D.1 Advisory Group Members

The Advisory Group is administered by NWRI and includes the following individuals:

- Chair: Garry Brown, Orange County Coastkeeper
- Randy Barnard, State Board
- Amy Dorman, City of San Diego
- Conner Everts, Environmental Justice Coalition for Water
- Jim Fiedler, Santa Clara Valley Water District
- Julie Labonte, Water and Energy Committee, San Diego Regional Chamber of Commerce
- Al Lau, Padre Dam Municipal Water District
- Bruce Macler, Ph.D., United States Environmental Protection Agency
- Traci J. Minamide, City of Los Angeles, Bureau of Sanitation
- Edward Moreno, MD, MPH, California Conference of Local Health Officers, Monterey County
- Keith Solar, San Diego County Taxpayers Association
- Frances Spivy-Weber, California State Water Resources Control Board
- Ray Tremblay, County Sanitation Districts of Los Angeles County
- Andria Ventura, Clean Water Action
- Michael Wehner, Orange County Water District

D.2 Topics Being Addressed by the DPR Advisory Panel

The topics that the DPR Advisory Group has been addressing and may document in a final report include:

- Research and Technology
    - Optimization of Wastewater Treatment for DPR
    - Monitoring Related to Public Health and Safety of DPR
    - DPR Research Priorities for California
        - Research on Emerging Contaminants, including:
            - Low-Dose Chemical Exposure to Constituents of Concern and Constituents of Emerging Concern
            - Use of Bioassays to Evaluate Constituents of Emerging Concern and Unknowns in Recycled Water

        - Need for Research/Briefing Papers to be Published in Peer-Reviewed Journals

- Management
    - Advanced Treatment Operator Training and Certification
    - Technical, Managerial, and Financial (TMF) Capacity
        - Building Capacity
        - Determining the Feasibility of a Project (Triple Bottom Line)
    - Effects of DPR Projects on Water Rates

- Potable Reuse Regulations
    - Role of the Advisory Group and the Expert Panel in Developing Future Regulations
    - Phasing of Regulations
    - Permitting for DPR Projects Prior to the State Board's Finalization of the DPR Regulations
    - Regulatory Approach to Environmental Impacts
        - Concentrate Disposal
        - Effects of DPR on Environmental Flows

- Outreach and Public Acceptance
    - Potable Reuse Terminology
    - Potable Reuse Messaging (Related to Public Health and Safety of DPR)
    - Changes to the Consumer Confidence Report
    - Environmental Justice
    - Differences among the Applications of DPR, Ocean Desalination, and Other Source Waters

D.3 Presentations Made by the Expert Panel to the DPR Advisory Group

Members of the Expert Panel has given presentations to the DPR Advisory Panel on four separate occasions, as shown in Table D-1. The presentation slides given by the Panel Co-Chairs at the Advisory Panel meeting on April 8, 2016, are provided below.

Table D-1: Presentations Made by the Expert Panel to the DPR Advisory Group

Meeting Number	Meeting Date	Presentation Title	Speaker(s)
7	October 22, 2015	Overview of IPR/DPR Expert Panel's DPR Briefing Paper Topics	Adam Olivieri
8	January 19, 2016	Status of Expert Panel Efforts DPR - Potable Reuse – (Bioassy Summary)	Adam Olivieri
9	March 3, 2016	Status of Expert Panel Efforts DPR - Potable Reuse – (ARB/ARG Summary)	Adam Olivieri and Jeff Mosher
10	April 8, 2016	Status of Expert Panel Efforts DPR - Potable Reuse – (Feasibility Approach)	Adam Olivieri and Jim Crook (via GoToMeeting)

Presentation Slides

Status of Expert Panel Efforts
DPR - Potable Reuse

Prepared by:
Adam Olivieri and Jim Crook
Panel Co-Chairs

Prepared for:
DPR Advisory Group Meeting
April 8, 2016

Status of Expert Panel Efforts
DPR - Potable Reuse

Adam Olivieri and Jim Crook
Panel Co-Chairs

April 8, 2016
Advisory Group Meeting

Topics Covered

- ***March Panel Meeting Focus***
  - ***Status of Briefing Papers/Chapters***
  - ***Reliability Briefing Paper/Chapter Review***
  - ***Chemical Monitoring Briefing Paper/Chapter***
  - ***Panel Feasibility Report Outline***
- ***Approach for Evaluating Feasibility of DPR Criteria***
- ***Panel Schedule***

DPR Briefing Paper Topics & Status

- ***Expert Panel Feasibility Report Outline – well underway***
- ***Briefing paper topics*** *(Internal)**:***
  - ***Bioassays (Bioanalytical Tools) – NEARING COMPLETION***
  - ***Quantifying Treatment Facility Reliability – Well Underway***
  - ***Analytical Methods/Tools – Well Underway***
  - ***Molecular and Other Pathogen Monitoring Methods - outline***
  - ***Antibiotic Resistant Bacteria (ARB) and Antibiotic Resistant Genes (ARG) in water – NEARING COMPLETION***
  - ***Comparative Health Risks – Well Underway***
  - ***Public Health Surveillance – Underway (rely on WRRF 14-14)***

Panel Feasibility Report -Chapters

- **Executive Summary**
- **1 – Introduction**
  - Overview of Potable Reuse
  - Public Health Considerations as a Condition of Potable reuse
  - NRC report on Potable Reuse
  - Defining Tolerable Level of Public Health Risk
  - Recycled Water as a Potable Water Source/Supply
- **2 – Potential Hazards for Potable Reuse**
  - Potential Hazards
  - Public Health Surveillance Tools

Panel Feasibility Report -Chapters

- **3 – Monitoring Potential Hazards**
  - Analytical methods and tools for measuring chemical water quality
  - Application of bioanalytical tools (i.e., *in vitro* bioassays) to water
  - Molecular and other methods for monitoring pathogens in water.
  - Antibiotic resistant bacteria and antibiotic resistant genes.
- **4 - DPR System Performance:**
  - Description of the DPR alternative treatment systems.
  - Quantifying treatment facility reliability (i.e., performance and mechanical).
  - Feasibility Analysis (Approach & Example)
  - Source Control

Panel Feasibility Report -Chapters

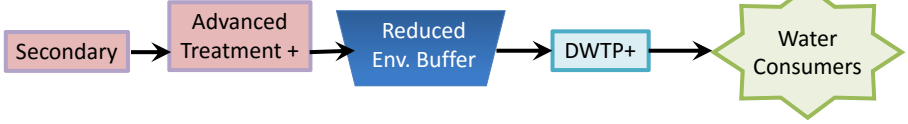
- **5 – Management Controls**
  - operation and maintenance, operator training and certification, and financial/institutional requirements and challenges
- **6 - Panel Findings and Recommendations.**
  - Overall Panel Findings Relative to Charge
  - Recommendations (Feasibility, Implementation and Research Needs)

Feasibility Analysis
Potable Reuse Configurations - Example

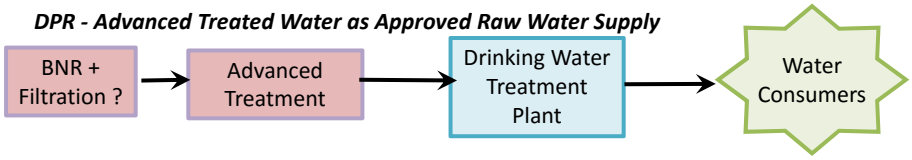
- **Comparative Approach –**
  - **Tolerable Goal:** 10^{-4} ppy, annual risk of infection
  - **Relative comparison:**
    - Baseline - Sacramento-San Juaquin River (Delta) and IPR alternatives (GWR and Surface Water Augmentation)
    - Source Water Supply – Reduced Environmental Buffer
    - DPR Alternatives (several)
  - **Probabilistic approach :**
    - LRV criteria for *Cryptosporidium* relative to DPR Performance
    - Unit process performance and mechanical reliability

Potable Reuse – Potential Water Supply Options

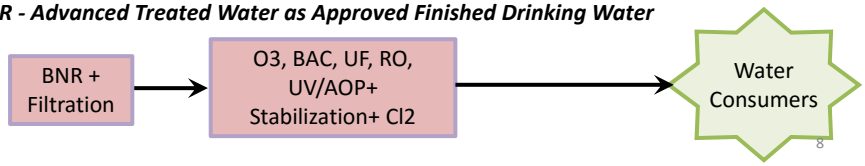
IPR – Surface Source Water Supply – Reduced Retention Time



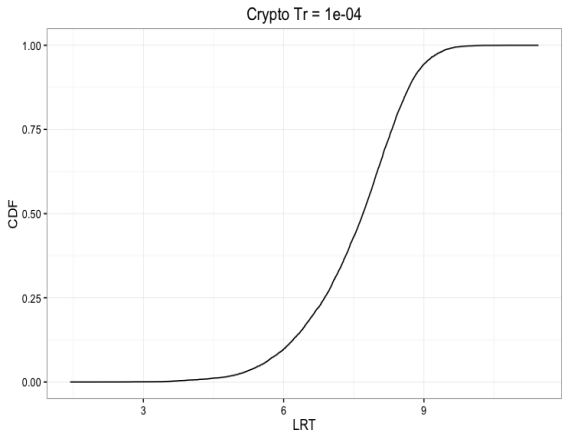
DPR - Advanced Treated Water as Approved Raw Water Supply



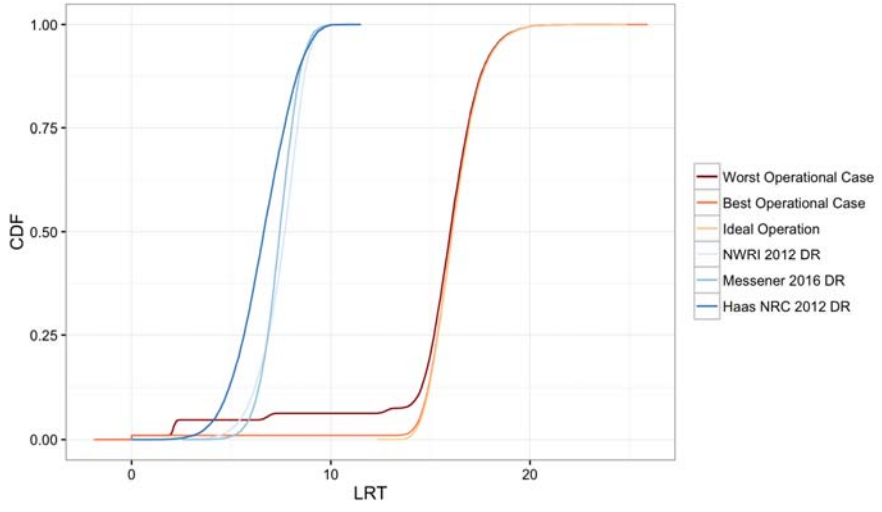
DPR - Advanced Treated Water as Approved Finished Drinking Water



Cumulative Density Plot – Estimated Log Removals to Meet Tolerable Risk of Infection



Operational Analysis vs LRTargets for *Cryptosporidium* to meet 10^{-4} ppy risk of infection EXAMPLE - DPR Treatment (O_3, BAF, MF, ROTOC, UV-AOP, Cl_2)



Update on Meeting Schedule & DPR Feasibility Report

- *Feb 23-24 (DONE) - Bioassay; Reliability; ARB/ARG; Outline*
- *March 30-31 (DONE) -Reliability; Intro. & Comparative Risk (approach)*
- April 13-14 -Chemical & Molecular (pathogen) monitoring
- May 11-12 -Prelim. Research Recommendations; Comparative Risks; Public Health Surveillance (draft notes)
- June (early) -Draft Panel Report; Public Health Surveillance (small workgroup)
- June 29-30 -Final Draft Report
- July (mid) -Final Draft to SWB DDW staff

QUESTIONS ?

APPENDIX E: WRRF 15-01 Project on "Potable Reuse Research Compilation: Synthesis of Findings"

WateReuse is funding a project titled "DPR Research Compilation: Synthesis of Findings from DPR Initiative Projects" (WRRF-15-01) to summarize and synthesize the key research results of 34 projects on DPR. This information is being presented to the DDW Expert Panel as part of the DPR Research Initiative.

E.1 Project Collaborators

The following individuals are involved with the WRRF 15-01 project:

- WRRF 15-01 Project Manager: Julie Minton, WateReuse
- Project Principal Investigator: Jeff Mosher, NWRI
- Report Technical and Editorial Lead: George Tchobanoglous, Ph.D., P.E., University Of California, Davis
- Report Associate Editor: Gina Vartanian, NWRI

- Report Authors:
  - Philip Brandhuber, Ph.D., HDR, Inc. (Denver, CO)
  - Debra L. Burris, P.E., DDB Engineering, Inc. (Irvine, CA)
  - Jean Debroux, Ph.D., Kennedy/Jenks Consultants (San Francisco, CA)
  - Robert W. Emerick, Ph.D., P.E., Robert Emerick Associates (San Francisco, CA)
  - Ufuk Erdal, Ph.D., P.E., CH2M (Santa Ana, CA)
  - Daniel Gerrity, Ph.D., University of Nevada, Las Vegas (Las Vegas, NV)
  - Laura Kennedy, Kennedy/Jenks Consultants (San Francisco, CA)
  - Jim Lozier, P.E., CH2M (Tempe, AZ)
  - Brian Pecson, Ph.D., P.E., Trussell Technologies, Inc. (Oakland, CA)
  - Megan Plumlee, Ph.D., P.E., Orange County Water District (Fountain Valley, CA)
  - Channah M. Rock, Ph.D., University of Arizona (Tucson, AZ)
  - Andrew Salveson, P.E., Carollo Engineers (Walnut Creek, CA)
  - Larry Schimmoller, P.E., CH2M (Englewood, CO)
  - Ben Stanford, Ph.D., Hazen and Sawyer (Raleigh, NC)
  - Sarah Triolo, Trussell Technologies, Inc. (Oakland, CA)

- Project Advisory Committee:
  - Jing-Tying Chao, P.E., State Board
  - Amy Dorman, City of San Diego
  - Serge Haddad, Los Angeles Department of Water and Power
  - Robert Hultquist, P.E., State Board
  - Philip Oshida, U.S. Environmental Protection Agency
  - Michael Wehner, Orange County Water District

E.2 Project Deliverables

The end product of WRRF 15-01 will be a collection of synthesis documents – each addressing a specific research topic or area – that will provide a better understanding of the total state-of-the-science on DPR and identify remaining research needs. They will be packaged together as topic-based chapters within one cohesive summary document and presented to the DDW Expert Panel as part of WateReuse's ongoing efforts to provide relevant DPR research findings to assist with the Panel review process and facilitate informed recommendations. The summaries will also be useful to other regions of the U.S. and abroad interested in DPR.

The chapters include:

- Chapter 1 – "Source Control Program," prepared by R. Emerick.
- Chapter 2 – "Evaluation of Potential DPR Treatment Trains," prepared by L. Schimmoller, J. Lozier, and U. Erdal.
- Chapter 3 – "Pathogens," prepared by P. Brandhuber.
- Chapter 4 – "Pathogens (Rapid/Continuous Monitoring)," prepared by C. Rock and D. Gerrity.
- Chapter 5 – "Contaminants of Emerging Concern Removal and Risk," prepared by J. Debroux, L. Kennedy, and M. Plumlee.
- Chapter 6 – "Monitoring DPR Systems and the Critical Control Point Approach" prepared by A. Salveson.
- Chapter 7 – "Operations, Maintenance, and Operator Training/Certification," prepared by D. Burris.
- Chapter 8 – "Failure and Resilience," prepared by B. Pecson and S. Triolo.
- Chapter 9 – "Demonstration of Reliable, Redundant Treatment Performance," prepared by B. Stanford.

APPENDIX F: WRRF 14-14 White Paper on the "Feasibility of Establishing a Framework for Public Health Monitoring"

WaterReuse is funding a project titled WRRF 14-14 White Paper on the "Feasibility of Establishing a Framework for Public Health Monitoring for DPR" as part of the California DPR Initiative. The White Paper would meet the following three objectives:

- Determine whether it is technically feasible to identify acute and/or sub-chronic population risks attributable to consumption of water produced as part of a DPR project (e.g., a public health monitoring framework).
- Evaluate the feasibility of collecting and interpreting information for a public health monitoring framework.
- Evaluate the types of baseline data that would be necessary to inform potential health effects studies resulting from the implementation of DPR.

The following individuals are involved with the WRRF 14-14 project:

- WRRF 15-01 Project Manager: Kristan Cwalina, WateReuse
- Project Principal Investigators:
    - Andrew Salveson, P.E., Carollo Engineers (Walnut Creek, CA)
    - Mary Schoen, Ph.D., Soller Environmental, LLC (Seattle, WA)
    - Edmund Seto, Ph.D., School of Public Health, University of Washington (Seattle, WA)
    - Jeffrey Soller, Soller Environmental, LLC (Berkeley, CA)

- Project Advisory Committee:
    - Brian Bernados, P.E., State Board (San Diego, CA)
    - Joseph Cotruvo, PhD, BCES, Joseph Cotruvo & Associates, LLC (Washington, D.C.)
    - Karen Levy, Ph.D., MPH, Karen Levy, Ph.D., Emory University (Atlanta, GA)
    - Kristina Mena, M.S.P.H., Ph.D., The University of Texas Health Science Center at Houston (El Paso, TX)
    - Margaret Nellor, P.E., Nellor Environmental Associates, Inc. (Austin, TX)
    - Tim Wade, Ph.D., United States Environmental Protection Agency (Durham, NC)

APPENDIX G: Panel Meeting #9 Agenda

NATIONAL WATER RESEARCH INSTITUTE

Expert Panel for SWRCB's Division of Drinking Water (DDW)
Development of Water Recycling Criteria for Indirect Potable Reuse through Surface Water Augmentation and the Feasibility of Developing Criteria for Direct Potable Reuse

Agenda – Meeting #9
March 30-31, 2016

Meeting Location:	**Contacts:**
Newport Beach Marriott	Jeff Mosher, NWRI (Onsite)
900 Newport Center Drive	714-705-3722 jmosher@nwri-usa.org
Newport Beach, CA 92660	Jaime Lumia, NWRI (Office)
Baycliff Room	714-378-3278 jlumia@nwri-usa.org

Meeting Objectives:

1. Review the schedule for Panel deadlines and deliverables to address DPR.
2. Receive a status update on DPR Briefing Papers not on the agenda.
3. Review the second draft of Briefing Paper #2 on "Reliability."
4. Participate in a follow-up survey from the October 2016 Recycled Water Research Needs Workshop: Monitoring and Treatment Performance of Constituents of Emerging Concern.
5. Receive an update on the status of the State Board's Surface Water Augmentation Criteria.
6. Review and edit the Panel Feasibility Report – Draft Introduction
7. Determine next steps.

DAY 1 - Wednesday, March 30, 2016

8:30 am	Welcome and Introductions	Jeff Mosher, National Water Research Institute
8:45 am	Review Agenda and Meeting Objectives	Adam Olivieri and Jim Crook, Panel Co-Chairs
9:00 am	Activities Overview • Review the Panel's Schedule • Status of Briefing Papers Not Listed on the Agenda	Panel Co-Chairs and Panel Members
10:15 am	**BREAK**	
10:30 am	Review and Edit the Second Draft of Briefing Paper #2 on "Reliability"	Chuck Haas and Jörg Drewes, Panel Members
12:00 noon	**LUNCH (in the Atrium)**	

12:45 pm	Continue to Review and Edit Briefing Paper #2 on "Reliability"	Chuck Haas and Jörg Drewes
2:30 pm	**BREAK**	
2:45 pm	Continue to Review and Edit Briefing Paper #2 on "Reliability" and Identify Next Steps to Finalize	Chuck Haas and Jörg Drewes
4:00 pm	**ADJOURN DAY 1**	

DAY 2 - Thursday, March 31, 2016

8:30 am	Review Agenda and Meeting Objectives	Panel Co-Chairs
8:45 am	Participate in Follow-Up Survey from the October 2016 Recycled Water Research Needs Workshop: Monitoring and Treatment Performance of Constituents of Emerging Concern	Facilitated by Jeff Mosher
10:00 am	**BREAK**	
10:15 am	Review and edit the Panel Feasibility Report – Draft Introduction	Panel Co-Chairs and Panel Members
10:45 am	Briefing Paper Workgroups • Internal Coordination • Onsite review and edits	Workgroups
12:00 pm	**LUNCH (in the Atrium)**	
1:00 pm	Update on the Status of the State Board's Surface Water Augmentation Criteria	Panel Co-Chairs
1:15 pm	Wrap Up • Report Out from Workgroups • Next Steps	Panel Co-Chairs and Panel Members
2:30 pm	**ADJOURN MEETING**	

APPENDIX H: Panel Meeting #9 Attendees

Panel Members:

- *Panel Co-Chair:* Adam Olivieri, Dr.P.H., P.E., EOA, Inc. (Oakland, CA)
- *Panel Co-Chair:* James Crook, Ph.D., P.E., Environmental Engineering Consultant (Boston, MA)
- Michael Anderson, Ph.D., University of California, Riverside (Riverside, CA) (attended Day 1 only)
- Richard Bull, Ph.D., MoBull Consulting (Richland, WA)
- Dr.-Ing. Jörg E. Drewes, Technische Universität München (Munich, Germany)
- Charles Haas, Ph.D., Drexel University (Philadelphia, PA)
- Walter Jakubowski, M.S.., WaltJay Consulting (Spokane, WA) (attended both days via web-enabled conference call)
- Perry McCarty, Sc.D., Stanford University (Stanford, CA)
- Kara Nelson, Ph.D., University of California, Berkeley (Berkeley, CA)
- Joan B. Rose, Ph.D., Michigan State University (East Lansing, MI)
- David Sedlak, Ph.D., University of California, Berkeley (Berkeley, CA)

National Water Research Institute:

- Suzanne Faubl, Water Resources Scientist and Project Manager (Fountain Valley, CA)
- Jeff Mosher, Executive Director (Fountain Valley, CA)
- Gina Vartanian, Outreach and Communications Manager (Fountain Valley, CA)

APPENDIX I: Panel Meeting #10 Agenda

NATIONAL WATER RESEARCH INSTITUTE

Expert Panel for SWRCB's Division of Drinking Water (DDW)
Development of Water Recycling Criteria for Indirect Potable Reuse through Surface Water Augmentation and the Feasibility of Developing Criteria for Direct Potable Reuse

Agenda – Meeting #10
April 13-14, 2016

Meeting Location:	**Contacts:**
Hotel Shattuck Plaza	**Jeff Mosher (On-Site)**
2086 Allston Way	714-705-3722
Berkeley, CA 94704	**Jaime Lumia (Office)**
Boiler Room "B"	714-378-3278

Meeting Objectives:
1. Review the second draft of Briefing Paper # 3 on Analytical Approaches for Measuring Chemical Water Quality.
2. Review the second draft of Briefing Paper # 4 on Molecular and Other Methods for Monitoring Pathogens.
3. Receive an update on the status of the State Water Board's Surface Water Augmentation Criteria.
4. Determine next steps.

Wednesday, April 13, 2016

8:30 am	Welcome and Introductions	Jeff Mosher, NWRI
8:45 am	Review Agenda and Meeting Objectives	Adam Olivieri and Jim Crook, Panel Co-Chairs
9:00 am	Review/Edit the Second Draft of Briefing Paper #3	David Sedlak and Panel Members
10:15 am	**BREAK**	
10:30 am	Continue - Review/Edit Draft of Briefing Paper #3 and Identify Recommendations/Research Topics	David Sedlak and Panel Members
12:00 noon	**LUNCH**	
1:00 pm	Review/Edit the Second Draft of Briefing Paper #4	Joan Rose/Kara Nelson and Panel Members
2:30 pm	**BREAK**	

2:45 pm	Continue discussion on Briefing paper #4 and Identify Recommendations/Research Topics	Joan Rose/Kara Nelson and Panel Members
4:00 pm	**ADJOURN**	

Thursday, April 14, 2016

9:00 am	Review Agenda and Meeting Objectives	Panel Co-Chairs
9:10 am	Break out for Work Groups	Work Groups
10:30 am	**BREAK**	
10:45 am	DDW staff Update on SWA and DPR FWP	Adam and Jim, Panel Members
12:00 noon	**LUNCH**	
1:00 pm	Wrap Up • Report Out from Workgroups • Next Steps	Panel Co-Chairs and Panel Members
2:00 pm	**ADJOURN**	

APPENDIX J: Panel Meeting #10 Attendees

Panel Members:

- *Panel Co-Chair:* Adam Olivieri, Dr.P.H., P.E., EOA, Inc. (Oakland, CA)
- *Panel Co-Chair:* James Crook, Ph.D., P.E., Environmental Engineering Consultant (Boston, MA)
- Michael Anderson, Ph.D., University of California, Riverside (Riverside, CA) (attended Day 1 only)
- Dr.-Ing. Jörg E. Drewes, Technische Universität München (Munich, Germany) (attended both days via web-enabled conference call)
- Charles Haas, Ph.D., Drexel University (Philadelphia, PA)
- Walter Jakubowski, M.S.., WaltJay Consulting (Spokane, WA) (attended both days via web-enabled conference call)
- Perry McCarty, Sc.D., Stanford University (Stanford, CA)
- Kara Nelson, Ph.D., University of California, Berkeley (Berkeley, CA)
- Joan B. Rose, Ph.D., Michigan State University (East Lansing, MI) (attended Day 1 only)
- David Sedlak, Ph.D., University of California, Berkeley (Berkeley, CA) (attended Day 1 only)

National Water Research Institute:

- Suzanne Faubl, Water Resources Scientist and Project Manager (Fountain Valley, CA)
- Jeff Mosher, Executive Director (Fountain Valley, CA)
- Gina Vartanian, Outreach and Communications Manager (Fountain Valley, CA)

Division of Drinking Water of the State Water Resources Control Board: (Day 2 only)

- Randy Barnard, P.E. (via web-enabled conference call)
- Mark Bartson, P.E.
- Brian Bernados, P.E.
- Jing-Tying Chao, P.E. (via web-enabled conference call)
- Bob Hultquist, P.E.
- Michael McKibben, P.E. (via web-enabled conference call)
- Sherly Rosilela, P.E. (via web-enabled conference call)
- Kurt Souza, P.E. (via web-enabled conference call)
- David Spath, Ph.D., P.E. (via web-enabled conference call)
- Erica Wolski, P.E. (via web-enabled conference call)

APPENDIX K: Draft Table of Contents for the Panel Feasibility Report

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Evaluation of the Feasibility of Developing Direct Potable Reuse Regulatory Criteria for the State of California

Draft Final Report
TABLE OF CONTENTS

Prepared by:

Expert Panel on the Feasibility of Developing Criteria for Direct Potable Reuse

Under Agreement No. 13-21041
with the California State Water Resources Control Board
Division of Drinking Water

Prepared For:

National Water Research Institute
Fountain Valley, California USA
www.nwri-usa.org/ca-panel.htm

DATED April 28, 2016
(Working Draft Version)

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