

California Direct Potable Reuse Initiative

# REPORTING ON SIGNIFICANT PROGRESS

Fall/Winter 2015-2016



The Foundation, in partnership with WaterReuse California, launched the Direct Potable Reuse (DPR) Initiative in June of 2012 to advance DPR as a water supply option in California. This was driven by the establishment of statewide goals for the use of recycled water, and a mandate from the California legislature to come up with a feasibility of DPR criteria study by 2016 to investigate developing uniform water recycling criteria for DPR.

Since 2012, the DPR Initiative has raised over \$6 million for cutting edge DPR research. This includes \$500,000 in matching funds from the Metropolitan Water District of Southern California (MWD) and a partnership with Water Research Foundation for \$600,000. Not included in that total is a \$2.1 million grant from the Department of Water Resources and San Diego County Water Authority for a DPR demonstration project in San Diego launched in September, 2014.

To date, the Foundation has allocated over \$6 million to fund [34 DPR research projects](#). This important research to address the regulatory, technical, and community concerns facing DPR is valued at over \$20 million.

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graph TD; SAP([Stakeholder Advisory Panel]) --> DEP([DDW Expert Panel]); RO([Research Outcomes]) --> DEP; DEP --> DPRP([DPR Research Program]); subgraph DPRP; RAC[Research Advisory Committee] -- proposes --> BD[Board of Directors]; BD -- approves --> RAC; end; DPRP --> RO;
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Since our last [update](#), there has been significant progress on ongoing and new DPR research projects, including the launch of a DPR synthesis document to better summarize topics and key concepts for the Expert Panel (WRRF-15-01). This will be key as the panel is now shifting its focus from the first part of their mission (developing criteria for surface water augmentation) to the second (determining the feasibility of DPR criteria).

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- **Launch of New and Improved Website.** In September, WaterReuse launched its new website, including newly organized and easily searchable research – past and current, and educational/outreach engagement tools and videos.

- **New Animations and videos.** Through a partnership with the Australian Water Recycling Centre of Excellence, we have excellent educational resources for utilities and the general public available on our website. These include ‘Think and Drink’ animations, clips on various treatment technologies, and a global map of potable reuse.

Members can embed these videos onto their own website.

## Research Projects

WaterReuse has conducted more than 150 research projects worth more than \$60 million to safeguard water quality, protect human health, reduce costs and improve efficiency. The science has advanced the implementation of water reuse around the globe. There are four types of research:

- **Scientific Investigations** which provide groundbreaking new science based on laboratory and on-site testing.
- **White Papers** which explore policy, regulations, planning and other social science factors.
- **Decision Making Tools** which provide operators with guidelines and frameworks to improve outcomes.
- **Communications Tools** which provide information and strategies for increasing public acceptance of water reuse.

## Search Research Projects

Search:

Status: 
Topics: 
Type:

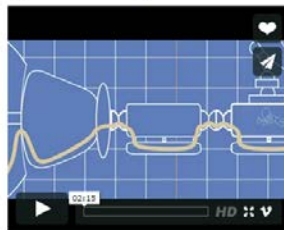
Uses:

Clear Filters Apply

Sustainability



Systems Thinking



Designed for Purpose



Assessing Information



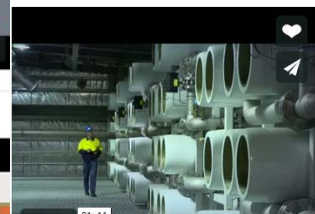
Water Futures



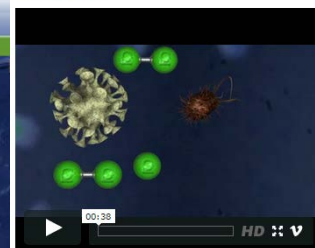
Water Citizenship



Reverse Osmosis



Ozonation



- **Research Reports to be available free of charge.** In its May meeting, the Board of Directors unanimously approved to make Foundation research reports free of charge. Members will benefit from a six month preview of these products, and then they will be available for all on our website. Tools, framework/guidance manuals, and outreach pieces will be priced on a case by case basis.
- **Altered timing of Principal Program.** At their last meeting in September, the Board of Directors recommended a shift of the two key research programs at WaterReuse. The Tailored Collaboration timing will remain the same, with a call for pre-proposals in early January and eventual award in May/June. Following the approval of the TC program, the Research Advisory Committee will hold its annual meeting to determine the research agenda of the Principal Program. This will allow the RAC to better strategize and consider the newly approved TC projects. The Principal Program will be approved by the Board in September, and PACs formed/RFPs developed in the fall/winter.
- **DPR Seminar.** There was a Seminar on DPR in California held on Sept. 23, 2015, in Berkeley in advance of the Expert Panel closed session. The purpose of the seminar was to discuss issues that will be addressed by the DPR Expert Panel organized for the California State Water Resources Control Board's Division of Drinking Water. The slides presented at the seminar are now available (as PDFs) for download from the event website at <http://www.nwri-usa.org/dpr-seminar.htm>.
- **Newly announced funding support from various agencies.** We are pleased to report that the Foundation was recently awarded additional funding for six DPR projects.

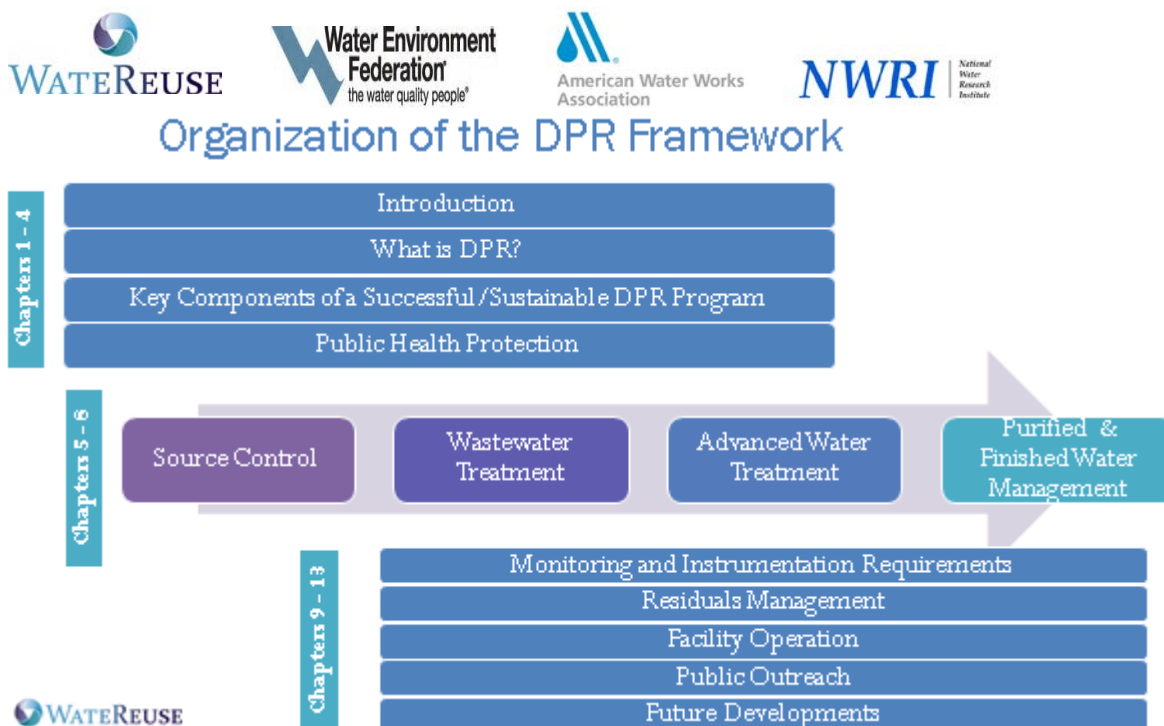


WRRF Project	Project Title	Partner and Funding Contribution
WRRF-14-01	Integrated Management of Sensor Data for Real Time Decision Making and Response	USBR: \$150,000
14-03	Develop Methodology of comprehensive (fiscal/triple bottom line) analysis of alternative water supply projects compared to DPR	USBR: \$98,905
WRRF-15-01	Potable Reuse Compilation: Synthesizing Research	SWRCB:\$150,000; Singapore PUB: \$15,000
WRRF-15-02	Creating a Roadmap for Bioassay Implementation in Reuse Waters: A cross disciplinary workshop	Singapore PUB: \$15,000
WRRF-15-07	Molecular Methods for Measuring Pathogen Viability/Infectivity	Singapore PUB: \$50,000



WRRF-15-13	NDMA Precursor Control Strategies for DPR	Singapore PUB: \$20,000
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- **Collaboration with CUWA on DPR and Potable Reuse Operator Certification.** WaterReuse CA co-funded a workshop on October 19-20 hosted by OCWD and lead by CUWA. Identified as a priority area by the Advisory Panel, WaterReuse CA helped with the survey and will continue to participate with CUWA to develop a consensus on a standardized potable reuse certification approach.
- **DPR Framework publication.** The DPR Framework document was officially released on September 14 at the WaterReuse Symposium and is available now on our [website](#). This was a collaborative effort by WaterReuse, the American Water Works Association, and the Water Environment Federation through an independent advisory panel administered by the National Water Research Institute. The panel convened over a period of almost two years to identify the subject areas and topics that future DPR guidelines will need to address. The panel was chaired by Dr. George Tchobanoglous, reviewed by a Project Advisory Committee comprised of technical experts in water and wastewater treatment, as well as state and federal regulators.



- **DPR Communication pieces available.** Several [outreach products](#) as recommended by the Model Communications plan (WRRF-13-02) were made available. These materials and strategies lay out a path for utilities to move potable reuse forward in their community.
- **DPR Principal Investigator meeting.** On September 16, 15 WRRF PIs gathered in Seattle to discuss the DPR research they are leading and the commonalities and collaborative opportunities between the research. This is the seventh such meeting, which takes place twice a year.
- **2016 Research Needs Survey.** Each year, WaterReuse offers our members an opportunity to weigh in on the research program and submit ideas for new projects for RAC consideration. Please keep an eye out for this survey in December, and contact us if you have ideas to include in the survey.

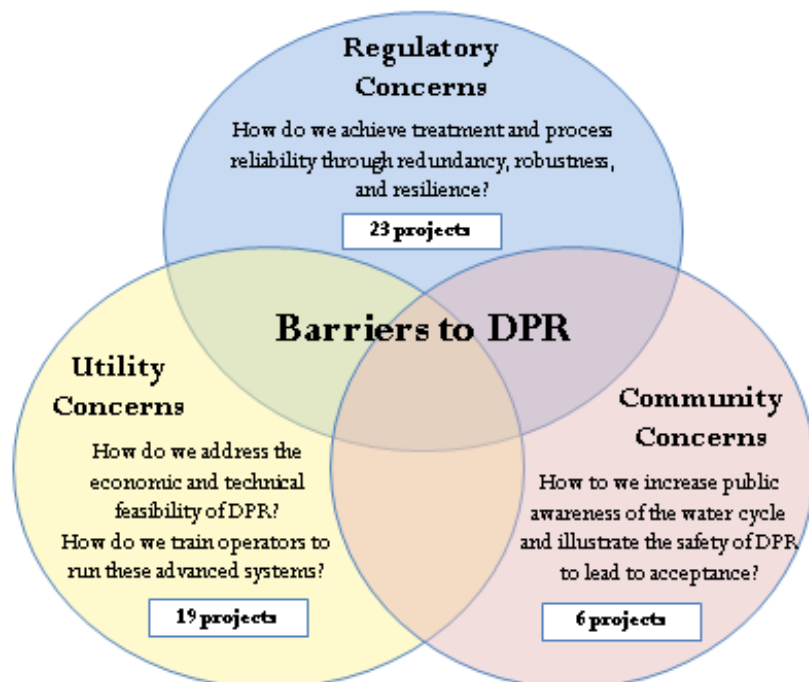


## Upcoming Activity

- **State Water Resources Control Board Research Needs Workshop on October 27-28.** SWRCB, in coordination with SCCWRP, NWRI, and WRRF, are hosting a Research Needs Workshop that will focus on the state of the science, monitoring techniques, and water treatment reliability for constituents of emerging concern (CECs). The overarching goal of the workshop is to help the State Water Board identify knowledge gaps to better identify and prioritize CEC monitoring and treatment activities that will ensure water supplies from recycled water are protective of public health and the environment.
- **20<sup>th</sup> Annual WaterReuse Research Conference.** This annual event will take place on May 23-24 in Denver, CO. [Abstracts](#) are now being accepted until December 8. As in past years, DPR will inevitably fill over half the program, so please submit your research and presentation ideas!
- **Tailored Collaboration Program.** A call for pre-proposals will be issued in the beginning of 2016 for this program, a great opportunity for Foundation members to receive a cash match for an applied research project of local interest.

## ***WRRF Research***

WRRF has funded numerous DPR projects addressing regulatory (23), utility (19), and community (6) concerns.



Most of the work is in progress; however several reports have been published and are available now. With the new website, each project has a dedicated page providing details on the project and a link to download the report (if available).

Below is a table of research themes identified by the DDW Expert Panel, and the Foundation research that is addressing these important topics.

Project #	DPR vs. alternatives, Economics	Evaluation of potential DPR trains	Demonstration of reliable, redundant treatment performance	Critical Control Points	Pathogens: surrogates, credits	Pathogens: Rapid /continuous monitoring	Failure and resiliency	Public perception and acceptance	CEC removal and risk	Operations Training, Framework	Source Control
WRRF-11-01		x	x		x	x					
WRRF-11-02		x	x		x				x		
WRRF-11-05			x								
WRRF-11-10		x	x				x				
WRRF-12-06		x	x		x	x		x			
WRRF-12-07			x								
WRRF-13-02								x			
WRRF-13-03		x	x	x	x		x				
WRRF-13-12											x
WRRF-13-13							x			x	
WRF4508*			x		x	x			x		
WRF4536*					x						
WRRF-14-01			x		x	x					
WRRF-14-02					x						
WRRF-14-03	x	x									
WRRF-14-08	x										
WRRF-14-10		x	x	x	x	x					
WRRF-14-12	x	x	x	x	x		x		x		
WRA-14-01										x	
WRRF-14-13		x	x		x		x				
WRRF-14-14									x		
WRRF-14-15									x		
WRRF-14-16		x	x	x	x	x	x			x	
WRRF-14-17			x		x	x					
WRRF-14-18					x	x					
WRRF-14-19			x						x		
WRRF-15-01	x	x	x	x	x	x	x	x	x	x	x
WRRF-15-02									x		
WRRF-15-04		x	x								
WRRF-15-05							x			x	
WRRF-15-07					x	x					
WRRF-15-10		x	x				x				
WRRF-15-11		x	x				x				
WRRF-15-13									x		

\*funded and managed by Water Research Foundation



## ***Project Status Summaries***

Prior to the DPR Initiative's start, the Foundation funded 6 projects valued at \$4M, 4 of which are ongoing.

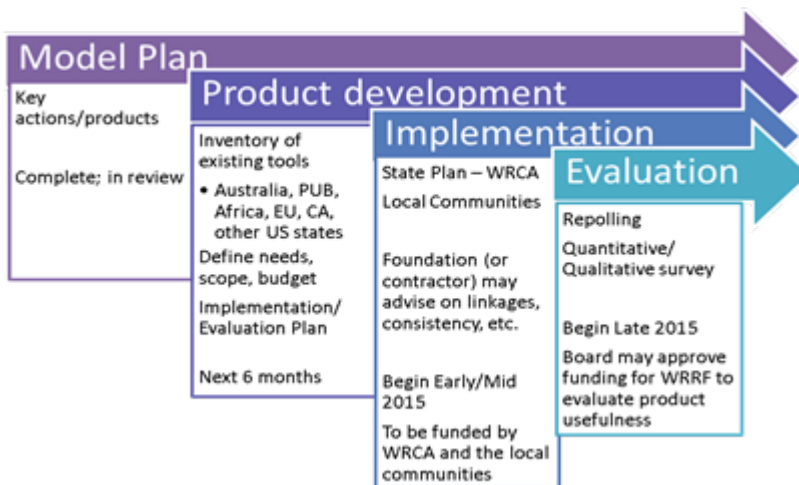
Project #	Research Project Title	Principal Investigator	Expected Publication
WRRF-11-01	Monitoring for Reliability and Process Control of Potable Reuse Applications	Ian Pepper, University of Arizona	Mar-2016
WRRF-11-02	Equivalency of Advanced Treatment Trains for Potable Reuse (early reports: Examining the Criteria for DPR; Potable Reuse: State of the Science Report; Treatment Train Toolbox)	Rhodes Trussell, Trussell Technologies	Mar-2016
WRRF-11-05	Demonstrating the Benefits of Engineered DPR versus Unintentional Indirect Potable Reuse Systems	Glen Boyd, The Cadmus Group Inc	published May-2014
WRRF-11-10	Risk Reduction Principles for DPR	Andy Salveson, Carollo	published Jul-2014
WRRF-12-06	Guidelines for Engineered Storage for Direct Potable Reuse	Andy Salveson, Carollo	Nov-2015
WRRF-12-07	Methods for Integrity Testing of NF and RO Membranes	Joe Jacangelo, MWH	Jun-2016

## Projects Initiated in 2013 – funded by the DPR Initiative and the Metropolitan Water District

### **WRRF-13-02: Communication Plans Increasing Awareness and Fostering Acceptance of DPR**

The Foundation and WRCA are taking a three-phased approach to gain public acceptance of DPR in California:

1. Develop Strategic Communication Plans (state and local)
2. Develop Messaging Material and Methods
3. Implement, Evaluate and Refine Plan



As part of Phase I, focus groups and surveys were conducted mid-2014 to develop key messages critical to educational, awareness and outreach efforts. This phase has been accomplished, and the local and statewide communication plans were published in January 2015.

To kick off Phase II, the Foundation held a workshop in November to develop and refine outreach tools and informational collateral materials as outlined in the Plans. These products will be available for utilities and other groups for use with their constituents, to educate and inform, and to expand their outreach and awareness programs. Work is continuing to draft FAQs, white papers and public outreach materials. Several items are currently available on the website, including a brochure, fact sheets, timeline, guidance and tips for outreach. The global map tool and “think and drink” videos, developed with the Australian Water Recycling Centre of Excellence is now available on the website.

### **WRRF-13-03: Critical Control Point Assessment to Quantify Robustness and Reliability of Multiple Treatment Barriers of DPR Scheme**

*Duration: December 2013 – April 2016*

The **Hazen and Sawyer** project team (led by Troy Walker and Ben Stanford) is well underway:

To date, the project has followed in the sequence of the HACCP process with a HACCP team convened and critical control points identified in a workshop for both the full advanced treatment

#### **Objectives:**

1. Conduct hazard assessment for key unit operations for two or more direct potable reuse (DPR) treatment trains, including the following:
  - a. MF/UF – RO – UV/H<sub>2</sub>O<sub>2</sub> – Cl<sub>2</sub> – Engineered Storage
  - b. O<sub>3</sub> – BAC – GAC – UV – Cl<sub>2</sub> – Engineered Storage
2. Develop best design, monitoring, and operational practices by evaluating critical process control points in each of the DPR treatment trains evaluated to meet overall system robustness and reliability.
3. Develop standard design approaches and response strategies (i.e., operations plan and standard operating procedures) to mitigate upset events to strive towards ‘fail-safe’ operation of a DPR plant.

(MF-RO-AOP-Cl<sub>2</sub>-Engineered Storage) and alternate non-RO (Ozone/BAC-GAC-UV-Cl<sub>2</sub>-Engineered Storage) treatment trains.

A Monte Carlo analysis has been conducted using data from a number of participating utilities including Orange County, Goreangab Namibia, West Basin, and Scottsdale. The project team has developed probability distribution functions for numerous data, and conducted Monte Carlo analysis to determine expected removal distribution across CCP barriers. Full-scale challenge testing was completed in February at the Scottsdale Water campus with testing conditions and analyses consistent with the procedures described in the original project proposal. A draft report is expected to be submitted shortly.

### **WRRF-13-12: Evaluation of Source Water Control Options and the Impact of Selected Strategies on DPR**

*Duration: July 2014 – June 2016*

The goals are to evaluate upstream wastewater treatment impacts (e.g. N/dN-nitrification/denitrification, industrial source control) on DPR source water quality and DPR process, and to evaluate impact of hydraulic control mechanisms (e.g. flow equalization and source water storage buffers) on influent water quality and flow variations that "stress" the DPR process.

This project kicked off in July, and the **Black & Veatch** project team (PIs Alan Rimer and Sunny Wang) is currently focused on completing the literature review and finalizing the case studies. The second portion of the literature review, requesting and analyzing operating data/information from our utility partners, has also been completed and has been integrated into the case studies. Three of the four case studies

have been completed and are being reviewed internally and by our utility partners. Due to the late arrival of the Singapore data, the Singapore case study will be forwarded on to Singapore you be in late August for their review.

### **WRRF-13-13: Development of Operation and Maintenance Plan and Training and Certification Framework for DPR Systems**

*Duration: May 2014 – April 2016*

The contractor-led portion of the project officially commenced on May 5, 2014. The **Hazen and Sawyer** project team is led by Troy Walker and Ben Stanford. The project started with providing detailed reviews of both the local Californian code of regulations and certification & training requirements, respectively. This has provided a useful set of gap analyses prior to engagement directly with utilities to develop case studies on managing within the existing regulatory framework.

The objective of this project is to develop a standard operations and maintenance plan for various DPR treatment processes, including appropriate portions of the upstream secondary wastewater treatment processes providing feedwater to the DPR processes. A DPR Training and Certification framework for DPR system operators will also be developed.

A workshop has been conducted with the City of Los Angeles Bureau of Sanitation at their Terminal Island Facility to both act as a review of our recommendations on DPR regulation and to provide valuable information as to the current operations framework, important items to consider for DPR, and operator certification and training program. The continued development of the operational framework based on review of existing IPR plans (Australia and Orange County). We have incorporated modifications to the treatment process schemes as a result of the critical control point (WRRF 13-03) project that is beginning to finish. A

draft report is expected shortly. In addition, this project is coordinating with ongoing efforts from the CA/NV section of AWWA who have developed a committee looking at advanced water treatment certification.

### **WRF 4508: Assessment of techniques for evaluating and demonstrating safety of DPR product water**

*Duration: October 2014 – December 2016*

The objectives of this project are to evaluate known techniques/methodologies (and potentially develop new technologies) for the assessment of DPR water safety (work with public outreach group to identify key criteria by which public would evaluate safety); to evaluate the effectiveness of currently accepted and alternative treatment trains for the production of DPR water using the developed techniques; and to develop tools and methods for utilities to demonstrate water safety to the public, elected officials, etc.

This project lead by **University of Arizona and CDM Smith** is just kicking off, with one quarterly report completed, which included a draft literature review. Once minor comments from the PAC are addressed, WRF will publish the literature review as an interim deliverable on its website. A workshop was held in Orange County in August to evaluate the suite of potential techniques and methodologies for removing microbial and chemical constituents from advanced treated water. The draft report is scheduled for July of 2016 with the final complete by December 2016.

### **WRF 4536: Blending Requirements for Water from DPR Treatment Facilities**

*Duration: October 2014 – August 2016*

This project lead by Andrew Salveson at **Carollo Engineers** has just completed its second quarterly report and is in the process of setting up the pilot systems. The testing plan to guide these pilots and a literature review was completed during the first quarter. Extensive PAC comments on the antibiotic resistant genes testing plan were resolved by the project team. Currently, bench testing is underway, which includes sampling from full-scale and pilot scale treatment systems as well as bench-scale testing, blending, and distribution system simulations. In addition, operations have begun at the pilot system at Ventura, CA. The draft report is expected May of 2016 and the final report by August of 2016.

The objective of this project is to optimize with respect to water quality, the blending of DPR water with existing water supplies based on existing information. Phase II will conduct case studies of selected blending strategies.

## Projects Initiated in 2014 – funded by DPR Initiative

There were two rounds of **2014 DPR projects** approved by the Board last year. Two projects have already been published (WRRF-14-08 and 14-20), and all projects are contracted or underway, with the exception of one (14-15).

### **WRRF-14-01: Integrated Management of Sensor Data for Real Time Decision Making and Response**

*Duration: May 2015 – November 2017*

The objectives of this project are to develop an operations support tool that integrates sensors within the treatment process for immediate feedback/alerts. Existing sensors will be integrated into an early warning system for a Direct Potable Reuse (DPR) treatment process. This will provide a real time sensor network for tracking system performance and key quality parameters using a tool for early detection of system anomalies prior to any compromise in water quality.

An award for this project was made in April 2015 to **Black and Veatch** with a team lead by Jeff Neeman. A contract has been signed and work will begin in May. The first report detailing the

progress of the project is expected to be submitted shortly.

### **WRRF-14-02: Establishing additional log reduction credits for WWTPs**

*Duration: May 2015 – April 2018*

The objectives are as follows:

- Obtain more accurate picture of the microbial treatment requirements by addressing the major source of uncertainty—the concentration of pathogens in raw wastewater and secondary effluent.
- Establish if there is any correlation between the number of pathogens in raw wastewater and secondary effluent.
- Establish removal credit for biological treatment provided (e.g., activated sludge) for protozoa, bacteria, and viruses.
- Determine validity of pathogen log-removal requirements identified by CA for potable reuse projects.

An award for this project was made in April 2015 to **American Water** with PI Zia Bukhari. The project officially kicked off on May 1. During this first quarter the team initiated the literature review for the database development and participated in several phone calls to refine the database development. In the next quarter, the team expects to further progress on collation of Literature, communications with industry experts and continued refinement of the proposed framework for the literature review. They will also begin work on developing quantitative QC criteria for assessing method(s) performance.

### **WRRF-14-03: Methodology for a comprehensive (fiscal/triple bottom line) analysis of alternative water supply projects compared to DPR**

*Duration: January 2015 – December 2016*

The objective of this project is to develop and demonstrate an assessment method (spreadsheet, database, or other) to provide information to decision makers in considering the full economic, social, and environmental impacts of a DPR water supply versus other alternative supplies.

An award for this project was made in January 2015 to **Hazen and Sawyer** with a team lead by Ben Stanford along with the University of New South Wales.



Work on this project began with a workshop in Australia to develop the economic, environmental, and social criteria that will be used to evaluate different water supply options. Since then the project team has further refined its list of water supply options as well as indicators to be included in the triple bottom line assessment. The project team is now developing a novel and comprehensive triple bottom line life cycle assessment model capable of comparing a host of water supply options.

#### **WRRF-14-08: The Opportunities and Economics of Direct Potable Reuse**

The objective of this project is to determine how much DPR will cost in comparison to other sources of water. In addition, this project also looks at the amount of water in California that is potentially available for potable reuse.

*Duration: April 2014 – November 2014*

This project began in April and was conducted by **Bob Raucher of Stratus Consulting** and **George Tchobanoglous**. The result of this project was a [white paper](#) in which DPR is described and compared – in terms of cost,

technical feasibility, reliability, energy requirements, carbon footprint, and potential yields – to other water supply alternatives. Case study information is also provided, to indicate typical “complete advanced treatment” process flow diagrams and indicate costs and site-specific factors in field applications at the municipal utility scale. This white paper was completed and is available on our website.

#### **WRRF-14-10: Enhanced Pathogen and Pollutant Monitoring of the Colorado Water Municipal Water District Raw Water Production Facility at Big Spring, Texas**

*Duration: August 2014 – November 2016*

##### **Objectives:**

- To expand the project scope and statistical accuracy of the state-of-the-art sampling campaign for the DPR plant at Big Spring, including trace chemical analyses for pharmaceuticals, hormones, and other compounds of interest, a full suite of pathogens (virus, protozoa, and bacteria), and a comprehensive set of both chemical and microbial indicators and surrogates.
- This large data set will enable the creation of a comprehensive, technically sound, and independent verification that potable reuse, as implemented at Big Spring and proposed by others, can be a safe and reliable source of high-quality drinking water.

This project, led by Eva Steinle-Darling at **Carollo Engineers**, began in August. The project will provide an evaluation of the current treatment process and develop a testing protocol (part of the TWDB funded project).

The project team has completed two out of four

total sampling events, one in July 2014, and one in February 2015. The funding from WRRF has been used to support this sampling effort by adding samples (both additional analyses and limited additional sampling locations) to the original scope. Results from these two sampling events have been analyzed and will be completed in the next progress report. The project team also held a conference call with the PAC on September 11, 2015 to provide updates and receive PAC feedback.

## WRRF-14-12: Demonstrating Redundancy and Monitoring to Achieve Reliable Potable Reuse

*Duration: September 2014 – November 2016*

This project will develop and examine a conceptual framework for a DPR facility for the Department of Drinking Water (DDW) and Expert Panel at the City of San Diego's newly upgraded Advanced Water Purification Demonstration Facility (AWPF). This conceptual framework will address issues beyond the treatment plant, such as source control, required operator training and certification, product water delivery and mixing strategies/requirements, as well as a plan to provide an alternative potable water supply in emergency scenarios and to ensure that extreme events do not compromise public health.

A main initial deliverable of this seminal project lead by **Trussell Technologies** is a comprehensive test plan for DPR, which was developed by an Independent Advisory Committee. As of April 1, it is being implemented at San Diego's Advanced Water Purification Demonstration Facility DPR Demonstration, and will be in operation for 52 weeks.

## WRRF-14-13: From Collection System to Tap: Resiliency of Treatment Processes for Direct Potable Reuse

An award for this project was made in September 2015 to Sharon Waller of **Sustainable Systems, LLC**. Work began in early October.

The objectives of this project are to assess the resiliency of unit treatment processes while mapping the interdependency of these processes to trace failures and impacts. Both potential acute and chronic impacts affecting performance reliability will be identified including water quality and production capacity along with public health

A design guide will be developed incorporating information from the wastewater source, wastewater treatment, and advanced water treatment assessments including the most practical design features, control systems, maintenance programs, and standard operating procedures.

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

The objectives of this project are to determine the feasibility of acquiring specific kind of health data required to address the health issues adequately with implementation of DPR; to aid in the planning the means and methods used in collecting the required data; and to recommend on necessary action to move the framework towards implementation.

Contract negotiations are currently underway with an estimated project start date in November 2015.

## WRRF-14-15: Application of Bioanalytical Tools for a Comparative Assessment of Water Sources for DPR

The purpose is to evaluate applicability of current bioanalytical tools for monitoring of source waters for direct potable reuse (DPR) as well as indirect potable reuse (IPR) projects.

The project Request for Proposals is currently being refined by the PAC in collaboration with the Australian and Singaporean initiatives to utilize bioassays in water monitoring.

## **WRRF-14-16: Operational, Monitoring, and Response Data from Unit Processes in Full-Scale Water Treatment, IPR, and DPR**

An award for this project was made in June 2015 to

**Carrollo Engineers**

with a team lead by Andrew Salvesson. A

contract has been signed and work will begin in July. A workshop is being held in October with a progress report to be submitted shortly afterward.

The objectives of this project are to assess the failure mechanisms of potential DPR processes that could impact water quality/health risk and the range of times to a failure event associated with specific unit processes. Qualitative operational information will be obtained regarding failure or anomalous events to better understand failures. Recommendations for improving operational and response procedures will be developed along with potential regulations

## **WRRF-14-17: White Paper on the Application of Molecular Methods for Pathogens for Potable Reuse**

Develop a white paper assessing the application and need for using molecular methods for detecting pathogens in evaluating water quality in potable reuse facilities. The white paper will assess the potential applications as well as limitations and challenges to implementation in a purified water matrix.

The project Request for Proposals was released July 9, 2015. Proposals are currently under review by the PAC and a team will be awarded in October 2015.

## **WRRF-14-18: Ensuring Stable Microbial Water Quality in Direct Potable Reuse Distribution Systems**

This workshop is currently being planned in conjunction with the PAC for November 10-11 2015 at West Basin.

Determine if DPR presents unique risks to the stability of the DWDS microbiome due to differences in the seed organisms, the type of organic carbon and other nutrients, and the effect of blending different water types.

## **WRRF-14-19: Predicting RO Removal of Toxicologically Relevant Unique Organics**

The objectives of this project are to predict removal efficiency of compounds identified by state or federal regulatory agencies of potential public health concern by reverse osmosis (RO), and predict removal of compounds that may be precursors of disinfection byproducts (DBPs) of potential health concern.

Contract negotiations are underway with an expected project start date in December 2015.

## **WRA-14-20: Developing a Direct Potable Reuse Framework**

*Duration: April 2014 – July 2015*

The DPR Framework document was officially released at our Symposium and was developed through a collaborative effort between WaterReuse, the American Water Works Association, and the Water Environment Federation through an

The objective of this project is to develop a framework focusing on issues such as public health protection, sufficient multiple barriers, risk assessment, water quality monitoring, and operation management that states can use to develop guidelines for Direct Potable Reuse.

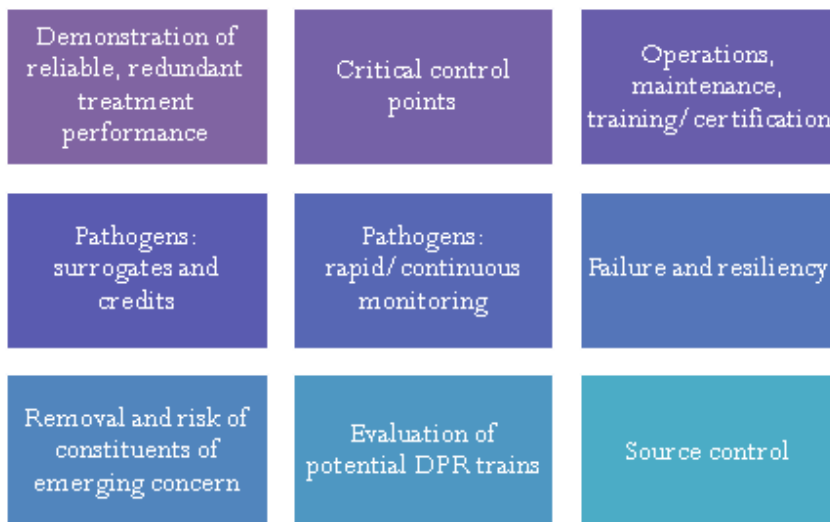
independent advisory panel administered by the **National Water Research Institute**. The panel, chaired by Dr. George Tchobanoglous, convened over a period of almost two years to identify the subject areas and topics that future DPR guidelines will need to address.

## **Projects Initiated in 2015 – funded by DPR Initiative**

The 2015 DPR program includes 8 DPR projects, half of which are underway.

### **WRRF-15-01: Potable Reuse Research Compilation: Synthesis of Findings**

The goal of this project is to summarize and synthesize DPR results, pulling from outside research where needed, and package this information by topic into a cohesive document. NWRI is administering the project, and George Tchobanoglous has been selected as technical lead and head editor. Expert authors are being selected for each of the 9 topics. This summary report will be presented to the DDW Expert Panel as part of the



Foundation's ongoing efforts to provide relevant DPR research findings and will also be useful to other regions interested in Potable Reuse.

### **WRRF-15-02: Creating a Roadmap for Bioassay Implementation in Reuse Waters: A cross disciplinary workshop**

WateReuse is working with experts in bioanalytical tools for water in Australia and Singapore

This project will engage experts that have focused on bioassays in a variety of applications and matrixes (cosmetic, pharmaceutical, oil/gas industry). Federal government regulators that have integrated bioassays into risk assessment will also be examined to identify lessons learned and best practices from previous studies.

to properly scope this project to build off of former and ongoing work. The project may become part of an international workshop to be held in March 2016.

#### **WRRF-15-04: Characterization and Treatability of TOC from DPR Processes Compared to Surface Water Supplies**

To develop framework for determination of site-specific TOC guidelines for utilities considering alternative treatment for potable reuse and determine the range of acceptable TOC concentrations and characteristics from alternative advanced water treatment approaches on potable water reuse projects.

The RFP is currently under development and is expected to be released in the winter of 2015.

#### **WRRF-15-05: Developing Curriculum and Content for DPR Operator Training**

The RFP is currently under development and is expected to be released in the fall of 2015.

This project will build on the framework being developed in WRRF-13-13 to create curriculum and content for operator training program in DPR. Curriculum will be developed that can be used by universities and colleges to become a part of their undergraduate training programs.

#### **WRRF-15-07: Molecular Methods for Measuring Pathogen Viability/Infectivity**

The aim of this project is to improve sensitivity, reduce analysis turnaround time and reduce cost of measuring pathogens in sewage, treated wastewater and reuse water including IPR and DPR produce water. Ultimately use methods developed in project to replace measurement using viability/infectivity assays, with a specific focus on validating treatment performance and providing starting microbial concentrations for QMRA.

The RFP is currently under development and is expected to be released in late Fall 2015.

#### **WRRF-15-10: Optimization of ozone-BAC treatment processes for potable reuse applications**

This tailored collaboration project is led by American Water by Principal Investigator Zia Bukhari. The project began in August and a workshop is being held in Reno October 27-28.

This project will establish baseline relationships between ozone-BAC effluent TOC levels and disinfection byproducts (DBPs) and/or their formation potential; To conduct pilot scale testing to optimize BAC design variables to maximize nitrosamines (e.g., NDMA) and emerging contaminants (especially flame retardant) removal; To Develop a comprehensive guidance manual for BAC system operators and regulators.

#### **WRRF-15-11: Demonstration of High Quality Drinking Water Production Using Multi-Stage Ozone-Biological Filtration (BAF): A Comparison of DPR with Existing IPR Practice**

The objectives of this project are to develop a process control strategy for biologically active filtration that can be applied to DPR. This project will integrate the monitoring framework being developed in WRF 4508 and provide an in-depth validation of these tools to provide data allowing rigorous analysis of the practicality and functionality of these monitoring parameters.

This tailored collaboration project is being conducted by a team lead by Denise Funk of the Gwinnett County Department of Water Resources. Work began in August and pilot operations are expected to begin in late 2015.



### WRRF-15-13: NDMA Precursor Control Strategies for DPR

This tailored collaboration project is led by Roshanak Aflaki at LASAN. Contract negotiation is in progress and the project is expected to start in November.

This project will investigate the fate and transport of *N*-nitrosodimethylamine (NDMA) precursors (e.g. organic nitrogen compounds) through secondary treatment and potential direct potable reuse (DPR) treatment trains and to develop control strategies to optimize removal of NDMA precursors and minimize NDMA formation.

