U.S. Environmental Protection Agency (EPA) Board of Scientific Counselors (BOSC)

Safe and Sustainable Water Resources Subcommittee

Face-to-Face Meeting Minutes

August 27–28, 2015

Dates and Times: August 27, 2015, 8:30 a.m. to 5:30 p.m.; August 28, 2015, 8:30 a.m. to 2:15 p.m. Eastern Time

Location: EPA Andrew W. Breidenbach Environmental Research Center Facility, 26 Martin Luther King Drive West, Cincinnati, Ohio

Meeting Minutes

Provided below is a list of the presentations and discussions that took place during the meeting with hyperlinked page numbers. The minutes follow. The agenda is provided in Appendix A, and the participants are listed in Appendix B.

Thursday, August 27, 2015

The meeting generally followed the issues and timing as presented in the agenda provided in Appendix A of this meeting summary.

Welcome, Introduction, and Opening Remarks

Ken Reckhow, Chair

Ms. Cindy Roberts, Designated Federal Officer (DFO) for the Board of Scientific Counselors (BOSC) Safe and Sustainable Water Resources (SSWR) subcommittee, formally opened the meeting. Dr. Ken Reckhow, chair of the BOSC SSWR subcommittee, welcomed the subcommittee members and noted that the purpose of this meeting was to address the six charge questions in order to provide EPA's Office of Research and Development (ORD) with meaningful input on water resources.

Dr. Reckhow asked each subcommittee member to introduce him or herself. Dr. Reckhow shared that he has retired from Duke University and is currently Professor Emeritus of Water Resources at Duke. He has a background in statistical analysis and water quality monitoring from a decision analytics perspective. His interests include uncertainty and decision making analysis.

Dr. Shane Snyder is a professor of chemical and environmental engineering at the University of Arizona. He is also a professor at the National University of Singapore for one third of the year. His research is focused on water pollution, specifically water reuse and recycling in treatment processes.

Dr. Joseph Rodricks is a principal and co-founder of ENVIRON, a consulting firm specializing in the assessments of hazardous chemicals. His background is in risk analysis toxicology and its application to decision making.

Dr. Bruce Aylward is the director at Ecosystems Economics LLC and is a professor at Oregon State University. He specializes in the economics and policy behind water quality issues and has experience with environmental water transactions and planning in the Western United States.

Mr. Scott Ahlstrom noted that he was the former Manager of Engineering Services for the Lower Colorado River Authority, which is responsible for providing power and water to 1.5 million people in Texas. He recently moved to BW Primoris, a company that owns and operates water systems.

Mr. John Lowenthal is a Senior Biologist at Cardno TEC where he conducts research on the construction of wetlands in order to treat wastewater, industrial runoff, and airport runway runoff, among other water sources. He has over 20 years of long-term monitoring experience and supports projects all over the continental United States.

Mr. Shahid Chaudhry is a Senior Engineer at the California Energy Commission. He has a background in chemical engineering and currently supports water resource sustainability efforts in California.

Dr. Inez Hua is a professor of civil engineering and environmental and ecological engineering at Purdue University. She provides the subcommittee with a molecular perspective. She wrote her dissertation on the use of ultrasound to destroy contaminants, and her current research is focused on water pollution control techniques.

Dr. Lawrence Baker is a Research Professor in bio-products and bio-systems engineering at the University of Minnesota. His research is focused on biogeochemistry and the examination of sustainable and resilient water systems within urban environments. He has experience with long-term geochemical projects in human impacted systems, specifically with respect to nutrient flows in urban environments. He is currently creating tools that establish a connection between water quality stakeholders.

Designated Federal Officer (DFO) Welcome and Federal Advisory Committee Act (FACA) Rules

Cindy Roberts, Designated Federal Officer

Ms. Roberts introduced herself as the DFO for the BOSC SSWR subcommittee. She explained that the BOSC is a federal advisory committee established and operated under the request of the ORD under the authority of the Federal Advisory Committee Act. As the BOSC SSWR DFO, she is responsible for ensuring that all BOSC activities comply with the FACA, which requires all meetings: publish a meeting announcement in the *Federal Register* at least 15 days prior to any meeting; are open to the public and all substantive subcommittee and EPA discussion will be had in an open forum; include opportunity for public comment; and the meeting minutes, being taken by EPA's contractor, would be made publicly available after being certified by the chair and within 90 days after meeting commencement on the BOSC website. Ms. Roberts noted that all federal advisory committee documents are also available to the public. The BOSC SSWR subcommittee published the meeting announcement in the *Federal Register* on July 30th and an electronic public comment docket was established in the *Federal Register* on August 10th. She reminded the audience that all meetings involving substantive issues—whether in person, by phone, or by email—are open to the public. This applied to all group communications that include at least half of the subcommittee. As the liaison between the subcommittee and EPA, Ms. Roberts (or any DFO) is required to attend all meetings.

Ms. Roberts explained that the purpose of the SSWR subcommittee is to provide advice to the technical and management aspects of ORD's SSWR research and noted that she and EPA officials worked to ensure that all members meet the requirements of the Ethics and Government Act. Subcommittee members and attendees needed to inform her of any conflicts of interest in any of the topics under discussion during any subcommittee deliberations, and she asked members not to discuss topics that have the potential to be federally funded. No member of the public requested to make a public comment, but one public comment was submitted electronically. Ms. Roberts will read the comment and provide an opportunity for anyone participating in person or on the phone to make public comments at 10:45 AM EDT on August 28, 2015. Public comments are limited to three minutes.

Program Summary and Discussion of Materials Provided

Suzanne van Drunick, National Program Director for EPA's SSWR Research Program

Dr. Suzanne van Drunick explained that the subcommittee held a teleconference and circulated public materials prior to the meeting to introduce and discuss the fiscal year (FY) 2016 budget for EPA and SSWR Strategic Research Action Plan (StRAP) for 2016–2019. The StRAP includes 12 projects that span ORD's four major water research topics. The four research topics, or SSWR project charters, include green infrastructure, nutrients, water systems, and watershed

sustainability. She added that the poster session, which will be held later in the day, will include each of the 12 projects included in the StRAP.

Under the watershed sustainability project charter, the projects include:

- Project 1. Assess, map and predict the integrity, resilience and recovery potential of the Nation's water resources.
- Project 2. Science to support new or revised water-quality criteria to protect human health and aquatic life.
- Project 3. Protecting water while developing energy and mineral resources.
- Project 4. National water-quality benefits.

Under the nutrients project charter, the projects include:

- Project 1. Reducing impacts of harmful algal blooms.
- Project 2. Science to inform the development of nutrient thresholds and targeting actions.
- Project 3. Science to improve nutrient management practices, metrics of benefits, accountability and communication.

Under the green infrastructure project charter, the projects include:

- Project 1. Green infrastructure models and tools.
- Project 2. Support increased adoption of green infrastructure into community stormwater management plans and watershed sustainability goals - information and guidance through community partnerships.

Under the water systems project charter, the projects include:

- Project 1. Current systems and regulatory support.
- Project 2. Next steps—technology advances.
- Project 3. Transformative approaches and technologies for water systems.

Dr. van Drunick noted that this was the first BOSC SSWR subcommittee meeting, and ORD is happy to have the opportunity to work with the subcommittee. The purpose of this subcommittee meeting is to address the six general BOSC and SSWR subcommittee specific charge questions in a report for ORD. There will be an opportunity to address additional charge questions in the future.

Dr. van Drunick explained that the StRAP includes the project charters and projects but the task descriptions under the projects are still being developed so the subcommittee assignment to address the charge questions may require live information on the status of the projects from ORD as it becomes available. The projects were drafted by an initial team of seven but input has been received from internal partners, including EPA's regional offices. She stated that she looks forward to the subcommittee's feedback on these projects.

Dr. Reckhow noted that the subcommittee is reviewing EPA's internal ORD research and asked if the subcommittee will review any externally funded research and current Request for Proposals (RFPs) under EPA programs such the Science to Achieve Results (STAR) research grant programs. Dr. van Drunick replied that the Science Advisory Board (SAB) is charged with determining if ORD is "doing the right science" whereas the BOSC SSWR subcommittee is charged with determining if ORD is "doing the science correctly." Thus, subcommittee input on the science implemented through the ORD STAR grant projects and other external research

projects would be useful as well. Dr. Reckhow added that he would like to provide input on external research projects but would need project information in order to do this. Dr. van Drunick suggested that the subcommittee's review of external EPA funded research projects be included as a future subcommittee-specific charge question. ORD could provide background information on EPA's grant programs, research project topics, grant awardees, funding values, project return on investment, and complications/lessons learned from these projects. This would prepare the subcommittee to answer this question. Dr. Reckhow supported this approach.

Review of Charge Questions

Ken Reckhow, Chair

Dr. Reckhow summarized the charge to the BOSC. Dr. van Drunick elaborated that this charge can include input on problem formulation, if ORD has engaged the appropriate partners, and if the research can be completed within an appropriate timeframe. The charge is what differentiates the SAB and the BOSC.

Dr. van Drunick explained the process for developing the research objectives, which began three years ago. ORD and the Office of Water (OW) met monthly meetings to discuss the problems that OW is trying to solve. OW and ORD Directors meet quarterly to discuss research focus areas. ORD also solicited input from the lead region for water that rotates every two years. Through these discussions, ORD learned that there were numerous water research projects that they could be doing but recognized the reality of a shrinking budget. The questions became "what are the research that we really should focus on? What are the upcoming guidance documents and regulations that could raise research questions? And what are the problems that we can address now that either address current problems or prepare EPA to address issues down the road?" ORD then developed research priorities to answer OW's questions and created a color-coded spreadsheet that contained hundreds of OW research question from the five OW offices. The EPA regional offices also provided input on the spreadsheet, which served as a starting point for ORD. The OW Deputy Assistant Administrator (Mike Shapiro) reviewed and created a list of ranked research questions based on need from the color-coded spreadsheet. This was then given to EPA regional offices to gather feedback on project prioritization. The resulting list of prioritized research projects served as the foundation for the StRAP.

ORD conducted a workshop for each of the four topics. Representatives from EPA regions, ORD, and OW reviewed the spreadsheet, and from this exercise 12 project areas were identified as ORD's focus areas. ORD then sought input from the SAB and the BOSC Executive Committee (EC) on a draft StRAP that included the 4 project charters and 12 projects. ORD developed the projects further to produce a revised StRAP. ORD is currently in the process of developing tasks to implement the 12 projects that fit within the EPA template (i.e., address what the research is, who is if for, why is it needed, why is it important, and when is it needed) to ensure that the projects are responsive to national and Agency needs and requirements. Next, ORD held Chautaugua, in-person meetings with ORD researchers and OW policy implementers, to ensure that ORD understands OW's focus issues and that OW understands ORD's research limitations.

Dr. Rodricks summarized the parts of the StRAP including the objective, topics, projects, and tasks and asked for clarification on the tasks. Dr. van Drunick and Mr. Joe Williams explained that the StRAP serves as the overarching command document. Within the StRAP, there are topics that include two to four projects that implement the StRAP. These project plans are further

broken down into manageable work plans made up of tasks. The purpose of the tasks is to create a work plan for achieving the project objective. For example, tasks under one project for water quality in a distribution system could include a chemical task and a separate microbial task; both tasks could be carried out in a laboratory and would support the same project. Once the project is implemented through the tasks, the project product(s) are produced. The products are usually something that can be achieved in a laboratory such as developing a manuscript. From there, EPA synthesizes outputs from the various products across StRAP topics and sometimes across other federal agency projects. These outputs are the science that is translated and disseminated to stakeholders and the community.

Dr. van Drunick explained that at the time of the meeting, ORD was in the process of developing the StRAP's project tasks that will eventually go into ORD's internal research management database, but none of the tasks were available for public release. EPA could develop a definition sheet that explains the StRAP process of how EPA goes from topic, to project, to task, to product, and to output. The subcommittee agreed that this would be helpful.

Dr. Baker observed that ORD discusses research priorities with stakeholders who have similar research interests (i.e., research laboratories, program offices, and regions) which might create a "preaching to the choir" situation. He asked if there is a process for allowing states to provide community input into EPA research projects. He also asked if EPA has a long-term research strategy that identifies the important but time consuming research projects that will have major public health impacts and, if so, how OW fits into that strategy, how ORD identifies the problems that need to be addressed and translates them into research questions, how ORD solicits feedback on the utility of their project outcomes, and how ORD translates the importance of their research to a broader audience. Dr. Baker added that he is disturbed by the 20 percent decline in EPA funding and size. He recognized the importance of educating the public on the importance of environmental research. He asked what EPA's long-term strategy is and what they expect to achieve over the next 20 years. He asked what pathways and research are needed to achieve this long-term strategy. Strategizing is an ongoing process that needs to be modified over time. Innovation in environmental research is needed in order to further our understanding of the biochemistry of earth's systems.

Dr. van Drunick agreed that EPA needs to be more strategic and efficient in the face of a shrinking budget. This includes more external partnerships and looking for new ways to solve old problems. ORD could also review the EPA strategic plan for ways ORD research can support the Agency as a whole. There has been more of a willingness for agencies to recognize common problems and collaborate across federal, regional, and state organizations to learn from each other, combine tools, and leverage funds. For example, EPA has partnered with the National Aeronautics and Space Administration (NASA) and the United States Geological Survey (USGS) to monitor wetlands and address harmful algal blooms. The group discussed the movement of EPA's research outputs from publishing papers towards answering what problems the research has solved and translating the value of that work.

Dr. Reckhow introduced the charge questions and explained that three of the charge questions were for the BOSC in general and three of the questions were specific to the SSWR subcommittee. These questions include:

General Charge Questions

1. Given the research objectives articulated in the StRAP, are the topics and project areas planned and organized appropriately to make good progress on these objectives in the 2016-2019 time frame?
2. How effective are the approaches for involving the EPA partners in the problem formulation stage of research planning?
3. How well does the program respond to the needs of EPA partners (program office and regional).

SSWR Charge Questions

4. How can SSWR streamline model and tool development within the program and across other national programs and partners to improve utility, interoperability, and accessibility, and what are some ways we can measure metrics of success?
5. What are the unique aspects of resource recovery and water reuse that SSWR is best able to address? What research products are envisioned to maximize impact?
6. How SSWR can better translate its research products and disseminate such knowledge to a broader community of stakeholders?

Dr. Reckhow reminded the subcommittee that the expectation is for the subcommittee to draft a report in the near future that addresses these six charge questions. The subcommittee informed Dr. van Drunick that they would like to provide input on the future subcommittee charge questions. Dr. van Drunick added that materials were circulated to the subcommittee prior to the meeting and are available on the public BOSC website.

Program Communication and Quality (General Charge Questions 1 and 2)

Suzanne van Drunick and Subcommittee

Charge Question 1: Given the research objectives articulated in the StRAP, are the topics and project areas planned and organized appropriately to make good progress on these objectives in the 2016-2019 time frame?

Dr. van Drunick began the discussion of charge question 1 by asking whether, based on the project areas described in the StRAP and project charters, ORD is on target with completing its objectives in four years or has it overcommitted. She asked the subcommittee to consider if the balance of work was realistic and if ORD was prepared to get this work done in a timely manner.

Dr. van Drunick requested that the project leads specifically discuss how they organized their own tasks and priorities and how they would rate their past ability of delivering their projects in the promised time frames.

Dr. Anne Rea leads the nutrients project. She discussed her experiences in organizing project tasks and priorities. She stated that she had a specific list of three high priority nutrient projects. The first project is titled “Reducing Impacts of Harmful Algal Blooms.” A topic workshop was held and the outcomes were used to develop the project. The other two major nutrients projects are titled “Science to Inform the Development of Nutrient Thresholds” and “Targeting Actions and Science to Improve Nutrient Management Practices, Metrics of Benefits, Accountability and

Communication." These two projects came from a StRAP discussion of four cross cutting research roadmaps reviewed by the BOSC Executive Committee. Nitrogen and co-pollutants were identified as problems associated with air, water, and the community as a whole. A workshop was held last fall that included representatives from ORD and OW, as well as the laboratory directors. The participants were divided into groups and discussed different project areas. These groups decided to create writing teams that included both OW and Office of Air and Radiation (OAR) staff who worked together to draft project objectives based on research focus areas that came from the workshop dialogue. In the next year, EPA is working to flesh out the projects and tasks.

Dr. Reckhow expressed concern that the StRAP is overly ambitious. He requested more information on the background and qualifications of staff working on these projects.

Dr. van Drunick noted that the charter for the work on nutrients had to be written broadly enough to meet the needs of both OW and OAR. The specifics, such as targeting actions and thresholds, were developed by the taskforce.

Dr. Reckhow asked if they should consider whether or not the project objectives can be accomplished with the provided resources. Dr. van Drunick answered that ORD had considered this and had to estimate assuming the present budget. Proposals had to be within those means. EPA had to determine the priorities and financial commitment by preparing for the worst and hoping for the best. Estimated resources were then directed toward these priorities. Collaborative writing and discussion between the OW and OA developed an ideal budget and identified what could be cut if necessary and what was feasible under the budget.

Dr. Reckhow expressed his belief that a lot of the nutrient research necessary for these projects cannot be done with the current resources. He thought that EPA has rarely done uncertainty analysis for projects outside of research models. For example, estimating uncertainty for total maximum daily load (TMDL) models is almost never done. Without performing these analyses, the work proposed in these reports is not feasible. He suggested that EPA follow the prescriptive model for decision analysis, which is a highly accepted approach that uses probability models to accurately capture uncertainty. He asserted that it was not acceptable that uncertainty analysis was missing from EPA tools. Furthermore, when questioned, he stated that it is difficult to know whether these analyses can be performed without knowing the backgrounds of the researchers and their capacity to perform uncertainty analysis on their assessments and models. He is worried that the projects do not include qualified individuals to prepare these analyses. Uncertainty estimates are not provided for routine models that EPA supports, which is essential. Dr. van Drunick suggested including his concerns in the subcommittee's report.

Dr. Reckhow observed that select EPA modeling areas have some attempts to do uncertainty analysis but the analysis is not widely done. Dr. van Drunick responded that the EPA topic leads could answer these questions more appropriately. She suggested that this be a future subcommittee charge question. Before they closed the topic, Dr. Rick Greene asked if Dr. Reckhow meant uncertainty analysis in terms of the traditional sense of decision making rather than in regards to the scientific and statistical sense. Dr. Reckhow responded that the academic discipline of decision analysis requires estimation of uncertainty with a probability model. He said EPA does not provide the necessary estimates of uncertainty for routine EPA-supported models, but it's essential that these analyses be included.

Dr. Reckhow stated that the next crucial step is determining how to inform state regulators and stakeholders about the decision making process in lieu of this uncertainty is to show how it will improve decision making. Dr. Greene replied that SSWR is not currently involved with this analysis. However, ORD is collaborating with EPA's Sustainable and Healthy Communities (SHC) program to learn what the program is doing to help communities and what additional work can be done in order to help with the community decision making process. This is a regional and local issue and the community needs to properly understand the trade-offs in order to make the best decisions. Dr. Reckhow responded that he thinks this is an ORD responsibility and OW also needs to be involved in forming a decision analytical model. It is not an easy task to provide stakeholders with a decision analytical model approach. Therefore, ORD has to think about how to provide guidance for conducting uncertainty analysis on models and how to properly present the information to decision makers so they can make better decisions. Dr. Greene recognized the difficulty associated with addressing uncertainty in models and noted that most decision makers examine and weigh the supporting evidence in order to make a decision instead of using difficult and complex models. Dr. Reckhow expressed his opinion that the weight of is an *ad hoc* decision making process that can be improved.

Dr. Baker noted that nutrient problems and repair are dealt with at the local level, but there is very little community engagement. This is not a top down approach and stakeholders need information at the local level because that is where the decisions are being made. There is currently not a lot of communication occurring at the local level, especially about what models are being used and how they perform. TMDLs are not usually performed at the local level and those performed would not meet the criteria for being published. There is massive statistical and mechanistic uncertainty as the analyses are missing all kinds of information. For example, most of the nutrients enter the water sources in June via storms, but nutrient sampling is performed in May. Thus, major pollutants are not accurately captured. Dr. Rodricks noted that ongoing research is trying to reduce these uncertainties. Dr. Reckhow replied that the formal approach is to conduct uncertainty analyses and not to take *ad hoc* approaches. Dr. Rodricks replied that proper communication of the science is very important. There are parts of EPA that conduct good uncertainty analyses and these might not be properly communicated. Dr. Reckhow stated that these analyses are not performed well for water issues.

One subcommittee member brought up his concern that ORD's research would develop a criterion that that would imply a harmful algal bloom had occurred when certain parameters were met instead a model with an error rate that would present the likelihood of a harmful algal bloom occurring based on the parameters. Probabilistic approaches are being developed at the National Oceanic and Atmospheric Administration (NOAA), but they are not currently being used regularly.

Dr. Hua asked for clarification of Charge Question 1. She wanted to know how "good progress" is being defined and who decided this definition. Dr. van Drunick replied that "good progress" is defined as delivering what was promised on time. She clarified that certain project details such as timelines and tasks are not provided, so certain questions cannot be answered to a fine level of detail. Therefore, an answer is provided with the caveat that it is based on currently available information. The subcommittee noted that EPA should develop a criterion or definition for what is good progress and how it relates to project objectives.

Dr. van Drunick asked if the project charters are appropriate for aiding in answering the first charge question. Mr. Chaudhry asked whether or not solutions developed by the project charters

can feasibly solve real world problems and scenarios. Dr. Rodricks framed the question in relation to a real world scenario, referring to the project that aims to quantify the sources, transport, and fate of nutrients in the water and air shed. He asked what would be defined as progress in terms of this project. Mr. Chaudhry added that there should be criteria to evaluate the outcome of the project otherwise there are no appropriate measures of success. Dr. Baker noted that the real challenge is to think about what products are wanted, which groups need to be engaged, what kinds of materials should be referenced, what kinds of deliverables will be used, and how to evaluate what the users think of the tools. The tools can be modified based off on the feedback received. Success should be evaluated using targeted audiences.

Dr. Rodricks commented on the issue of the SSWR program objectives. He asked how these topics were determined and if other topics were considered and rejected. He requested clarification on how these four topics (watershed sustainability, nutrients, green infrastructure, and water systems) became the main discussion topics. Dr. van Drunick clarified that the four selected topics are consistent with EPA's strategic plan. Topics were discussed with the previous and current EPA Administrator. These topics are consistent with the directive to protect America's waters. Logistically, it made sense to have four topics. Previously, there were two topics that had overlap. There were also regional projects and STAR grants, so one topic was all over the portfolio. These four topics are the four pillars of the ORD SSWR program and streamline projects and reduce overlap. These decisions were made at a high level within EPA. The Assistant Administrator of the program office cares about research that supports EPA policy.

Charge Question 2: How effective are the approaches for involving the EPA partners in the problem formulation stage of research planning?

Dr. Reckhow asked for comments on General Charge Question 2. Earlier, Dr. van Drunick asked whether or not they started off on the right foot by trying to understand potential problems with partners through dialogues at the problem formulation stage before writing the projects and tasks. Dr. Hua observed that the approach used appears to be holding workshops. Dr. van Drunick responded that internally there are workshops, Chautaquas, quarterly meeting, SSWR webinars monthly, weekly meetings with OW, and monthly meetings with point of contacts (POCs) that continue the dialogue of long-term and near-term planning. Externally, there are many more approaches. At the federal level there are 20 different agencies that have monthly meetings on water resources and there is also a global water research community to hear international progress to fill knowledge gaps. They also attend professional conferences, read peer-reviewed journals as well as work with states. There is a list of research problems that states are trying to resolve and to which ORD has formally responded. There was a tools workshop that presented stakeholders tools. Stakeholders were asked to be beta testers. Receipt of product feedback is dependent on the situation. For the StRAP, the document was reviewed and feedback was collected. This ensured that the research is not being duplicated.

Dr. Bruce Aylward noted the partnerships between ORD and other federal agencies, especially in regard to Charter 3.01. Dr. Greene responded that EPA also partners with an environmental modeling assessment program. ORD developed a national probabilistic assessment of water resources with USGS to assess coastal waters. This assessment evolved into the formation of other national assessments of water types (e.g., lakes, reservoirs, and streams). Five years ago the national aquatic resource survey program was transitioned from a research program in ORD to OW, who now manages it and works with states and other federal partners, like USGS and NOAA. ORD now provides technological support for that program in terms of design, data

analysis, etc., and is a good example of internal partnership as well as partnerships with states and other federal agencies. In response, a question was asked about how ORD interacts with an agency like USGS and other agencies that have a lot of sampling data for rivers, streams, lakes, and reservoirs. A participant responded that ORD just signed a five year agreement with the U.S. Department of Agriculture (USDA), to collaborate with the health community. This partnership is focused on human health related to water reuse and resources at a national level. She stated that this provides an opportunity to leverage funding from other agencies to build stronger partnerships and programs. Dr. Aylward asked about the budget variability for each of these projects. Dr. van Drunick responded that the budget varies for each project. For example, watershed sustainability has four projects while nutrient-based work has three projects so resources are allocated differently across topics.

Dr. van Drunick noted that the Air, Climate, and Energy (ACE) subcommittee also struggled with General Charge Question 1 as they discussed how to assess progress made when the project has not started and the budget is unknown. EPA has asked us to do what can with the information provided with project descriptions and preliminary tasks. Dr. Rodricks points out that the question does not ask about budget and only asks if they are planed and organized appropriately. Dr. van Drunick answered that planning and organizing appropriately includes resource allocation, which is dependent on budget. Addressing this question will be challenging, but hopefully can be answered as more prospective. Furthermore, she asked the subcommittee to consider the task description, the partners, and the metrics of success to answer the questions and if needed. Progress can be re-evaluated in 2 years. The subcommittee was told to put in a caveat in their answers that they assumed funding was available through the perpetuity of the project.

A question was asked about whether or not the StRAPs and project charters are a list of what ORD hopes to do rather than a distinct plan. ORD staff responded that EPA is not seeking comments on a task or product level, but only at the topic and project level. Dr. Hua asked if SSWR puts out an annual report of objectives and outreach activities. Dr. van Drunick replied that the subcommittee received project highlights that provide insight on partner engagement and outreach activities. ORD annual reports can also be provided to the subcommittee.

Mr. Chaudhry asked if feedback has been received on engagement at the group level. Dr. van Drunick responded feedback is available for some projects and specific problems (e.g., stormwater management implementation, small drinking water systems workshops at the state water utility operator level). The SSWR program operates at the federal level on other projects and interacts with states to understand the problem at a higher level. The SHC Program interacts directly with the communities. The SSWR does not want to duplicate their efforts.

Dr. Rodrick asked if the partners and stakeholders were given the StRAP report and if so, whether or not they agreed with the problem formulation given their earlier contributions. Dr. van Drunick responded that they received multiple comments from partners and ORD's responses to these comments were incorporated into the document. A subcommittee member noted that this provided an extraordinary opportunity for the EPA regional offices to respond to the draft StRAP draft and participate in the development off the charters. At the beginning of FY15, Region 4 was EPA's lead region for water. Every two years the regional offices divide the programs up to lead the process of aggregating regional responses. It is important that input is solicited and received from all EPA regions. This topic will be further discussed later in the afternoon.

Research Translation and Responsiveness (General Charge Question 3 and SSWR Charge Question 3)

Suzanne van Drunick and Subcommittee

Charge Question 3. How well does the program respond to the needs of EPA partners (program office and regional).

Dr. van Drunick reviewed General Charge Question 3. This question addresses ORD's ability to address the unexpected. The long-term planning approach does not necessarily address the ability to be nimble and responsive to our partners. The Toledo incident is a good example of EPA's ability to be flexible in its response to a regional issue. ORD staff summarized the Toledo incident. EPA received a call on Saturday morning that the Toledo utility water had issues with water contamination. The facility is older and can't bring water in from another plant. Different handling techniques for sampling at different places in the distribution systems made data interpretation difficult. EPA had to work with the State of Ohio to determine how to interpret the data. The major issue was associated with the facility's dechlorination process. After the data were interpreted, treatment options were developed in collaboration with the state. This approach resulted in correcting the water treatment. This incident represents a good example of a response to algal toxins. Issues associated with algal toxins are more complex than other issues. EPA is working with the State of Ohio to develop protocol for handling algal toxin contamination in the future as well as with method development and how to interpret algal toxin concentration data.

Dr. Baker emphasized that a protocol should be available before a disaster so that the appropriate parties are aware of and understand how to respond according to the protocol. The incident in Toledo represents an example of the need for research to get out to the local stakeholders, in this case, the water utility. Mr. Baugh noted that this was a major issue discussed at the Asset Management Workshop for Small Water Systems. Dr. Rodricks asked if the research plan includes direction that ORD's should be on standby to complete a contingency plan. Dr. Impellitteri responded that water research projects are broken into a continuum. Each project responds to the needs of the program office and within a project, ORD tries to account for unpredictable situations. Within the green infrastructure project, there is a task dictating that field research is to be included. Field research is very fluid, but EPA project setup is very rigid and it can be challenging to write this element into the project description. This is more at a task level.

Dr. van Drunick noted that ORD can be flexible enough to address crises and unexpected events in real time. This is supported by evidence from recent ORD responses, specifically the Toledo response, and the successful collaboration with local offices.

SSWR Charge Question 3: How SSWR can better translate its research products and disseminate such knowledge to a broader community of stakeholders?

Dr. van Drunick asked that the subcommittee review the SSWR program highlights as well as highlights from the small systems workshop. In 2015, the SSWR started a webinar series to reach out to various stakeholders (i.e., utilities, water resource groups). Attendance has been in the high hundreds. A free workshop on Asset Management for Small Water Systems was also held. Mr. Baugh added that the workshop included a breakout groups and attendees included EPA regional, OW, and ORD directors. The breakout groups discussed needs based on what has been observed in the field as well as what research can be done by ORD to address these concerns. The EPA regions identified available sites where research could be potentially

conducted. Breakout groups focused on specific topics, including how algal toxins, drought, and weather changes impact small water systems. There was a breakout group focused on communications.

Dr. Baker pointed out that states permit water treatment facilities and small systems. It would be valuable for large systems to also receive this information as they can help develop improved water treatment systems. Mr. Baugh replied that EPA also coordinates with large water systems as well. EPA is developing algal toxin methods in collaboration with a large Cincinnati utility. ORD also collaboration with Water Research Foundation (WRF) to coordinate research efforts and direction.

Dr. Rodricks noted that this is an example of the importance of feedback from large utilities and improving communication on the limitations of tools. He asked how ORD decides that a tool is ready for "prime time" use. Dr. Impellitteri responded that ORD must remain cautious of results with respect to regulations as well as guidance as defined by OW. ORD must coordinate closely with OW so as not to reach into the regulatory space. ORD provides OW with research support, but OW is in charge of regulation. All ORD activities must go through the EPA program offices. Dr. Thomas Speth added that states can be very conservative in permitting novel technology, so the focus has been on how to bring novel technology to the marketplace.

Dr. Baker stated that guidance documents are considered to be support tools rather than true guidance documents. ORD supports the development of tools that improve decision making at the local level. Dr. Impellitteri added that products are often referred to as technical research documents.

Dr. van Drunick shared with the subcommittee another tool developed by ORD—the Stormwater calculator. This tool is interactive and web-based. Users enter their location and the calculator pulls in data on precipitation and the amount of impervious surfaces. The user receives information on how to reduce stormwater runoff. Users can select different climate scenarios to determine changes in stormwater capture. The tool also takes into consideration transfer and temperature and is considered to be very user-friendly. She offered to try to set-up a demonstration of the stormwater calculator. The tool went through the validation process and was peer reviewed so there is a quality control element to the tool. The SWIM model is not as user-friendly, so it is not as frequently used by local decision makers.

Dr. van Drunick asked for examples of local outreach tasks and for guidance on what else ORD can do. There are restrictions on what the federal government can do. A metric of success would be to ensure that all ORD products are in the hands of the users and that users can benefit from ORD work. She asked what stakeholders have found to be useful to inform the forward momentum of research.

Mr. Ahlstrom asked ORD to identify the audience for publicly available models and tools. He noted that there may be ways to leverage existing organizations to disseminate ORD's products. For example, professional engineers may be reached through the state licensing Boards. Similarly, plant operators could be reached via operating and licensing organizations. Dr. van Drunick agreed that it is important for ORD to determine how they can be the most useful and disseminate information and tools to the correct audience. Mr. Ahlstrom pointed out that the American Water Works Association (AWWA) could be a key partner and ORD attendance at their conferences would be valuable. An EPA staff member shared that EPA attends water innovation workshops to disseminate information on their research and tools.

Dr. Baker pointed out that the groups discussed thus far are easy stakeholders to reach. It is more difficult to reach people working on water quality who are not engineers as well as the general public. The hegemony of engineering is a problem. A broader audience needs to be reached. In addition tools developed by ORD need to be run in a platform that is easily accessible by a broader audience, such as Microsoft Excel. Dr. Baker suggested that ORD assess whether or not their current outreach efforts are adequate and identify failures in the current approach. ORD should identify the tools that are useful and truly work and then determine whether or not these tools are too technical for their intended audience. Feedback from the users of these tools would be valuable. Dr. Baker acknowledged the challenges associated with outreach.

Examples of communications and outreach activities providing current information and training include:

Webinars:

- Safe and Sustainable Water Resources Research Monthly Webinar Series
- Small Drinking Water and Wastewater Systems Monthly Webinar Series
- Annual Workshop for Small Drinking Water Systems
- Water Sensor Workshop
- Water Technology Innovation Cluster Innovation Showcase

Workgroups:

- Small Drinking Water Systems Technical Communications Workgroup
- EPA Water Sensor Working Group
- OW Regulation Workgroups
- Energy-Water Workgroup

Quarterly Science Meetings:

- Chautauqua with Internal Partners
- EPA-USGS Collaborative Research Meeting

Newsletters:

- SSWR Internal Highlight Newsletters
- Science Matters External Newsletters

Program Office and Regional Perspectives

Mary Reiley (OW/OST), Ellen Gilinsky (OW/IOAA), and Tom Baugh (ORD/Region 4)

Ms. Roberts introduced the individuals participating over the phone: Dr. Ellen Gilinsky (OW/IOAA), Ms. Mary Reiley (OW/OST), and Dr. Brenda Rashleigh (EPA/National Health and Environmental Effects Research Laboratory, SSWR Matrix Interface). Dr. Reckhow explained that during the BOSC Air, Climate, and Energy subcommittee meeting in July, the energy-water nexus and related questions were the focus of the water resource discussion. The Subcommittee would like a dialogue with OW to discuss why this particular topic was selected as the focus of SSWR's analysis rather than nutrients, which Dr. Reckhow explained is more important right now and will get far more funding for research and application. Dr. Reckhow suggested that the energy-water nexus might be a priority for the following year but asked why nutrients isn't the number one focus.

Dr.van Drunick clarified nutrients is a long standing problem that ORD is making incremental progress on and that researching the energy-water nexus and nutrients are not mutually exclusive and that the energy-water nexus is a new focus area. Dr. van Drunick explained that Dr. Gilinsky was invited to speak to the Subcommittee to identify the research needs for EPA and if OW and EPA Regions are receiving the proper assistance from ORD to address their nutrient responsibilities. Nutrients are a historical problem that will remain a focus area. Nutrient-related work makes up 25 percent of the SSWR ORD portfolio. ORD is also identifying emerging areas where EPA can use their resources and unique position to collaborate with other stakeholders. Dr. Baker added that the National Science Foundation (NSF) has an $80 million portfolio on energy, water, and food with the first RFP expected within the next year. There is a large scale effort to address this issue. Dr. Reckhow asked Dr. Gilinsky if OW feels that ORD is meeting their research needs for nutrients.

Dr. Gilinsky discussed why OW was asked to take on water problems in addition to nutrients. OW is looking into a multi-pronged, multi-partner approach that examines a wide range of economic, environmental, and social factors to reduce nutrient pollution and to help people understand why addressing nutrient pollution is so important. OW has multiple efforts to reduce nutrient pollution, including: a collaborative effort with states and tribes to develop nutrient reduction frameworks and measures of progress in nutrient management; efforts with organizations such as ACWA, the WRF, Agricultural Departments, and USDA to improve understanding of economics of nutrients in water which includes recent publications summarizing the cost associated with not controlling nutrient pollution and the influence of harmful algal blooms on safe drinking water; the OW hazard communication team; developing criteria for algal toxins; the interagency workgroup, in collaboration with NOAA, on a harmful algal bloom and hypoxia control act that expects to put out a report to Congress this fall outlining workgroup plans; collaboration with OAR to reduce nitrogen loading from the air, the OW and OAR's EPA Nitrogen Pollution and Co-pollutants Roadmap that looks at sources, factors, and controls of nitrogen pollutants and provides a comprehensive and organized approach to what and where the causes of pollution are. OW has asked states to prioritize sources of nutrients to develop nutrient criteria help cleanup waterways.

Dr. Reckhow noted that the subcommittee has good documentation on the OW efforts Dr. Gilinsky was describing and clarified that the subcommittee asked for a presentation on OW's nutrient efforts because the impression was the energy-water nexus was the focus. This does not appear to be the case; thus this is no longer a Subcommittee concern. Dr. Reckhow explained that a strong statement will come from the Subcommittee regarding the lack of uncertainty analysis with the majority of modeling assessment down the road.

Dr. Reckhow opened the floor to questions. The Subcommittee asked if OW is getting the support needed from ORD. Dr. Gilinsky responded that they are and that Ms. Reiley will discuss this further.

Ms. Reiley discussed the partnership between ORD and the National Water Programs (NWP). NWP and ORD are collaborating to develop the ORD planning development and implementation of NWP's strategic research action plan. ORD has an Executive Committee (NWP EC) of Research within NWP that is chaired by Mike Shapiro and made up of the regional office directors and staffed by the NWP research POC. The NWP EC has outlined the environmental health problems that OW is charged with trying to address, which are then shared with ORD's

National Programs Director to ensure there nothing has been overlooked during problem formulation and output product development.

Ms. Reiley described that the StRAPs were developed based on needs compiled by NWP and then reviewed by OW and NWP through a series of meetings, workshops, webinars, and conference calls to ensure that the four objectives were included. The StRAP had considerable input from NWP point of contacts and scientists throughout the drafting process. The draft projects were then reviewed by the EC within the Water Program. A response table was developed based on NWP's ideas and feedback on the charters which helped track NWP's comments and their incorporation into the StRAP.

Ms. Reiley explained that the SSWR StRAP is now at the point of project planning and tasks. The project plan is developed at laboratory centers and the project leads at the laboratory centers engage with a number of national programs. The NWP will see the draft project plans and tasks for the first time on October 1st after they have been entered into the research management system. There is hope that OW and ORD can discuss the research plan and make any adjustments necessary in October.

Ms. Reiley addressed the question of how well ORD responds to the needs of its partners. The alignment and awareness of NWP's goals and ORD's goals has occurred for a number of years. These efforts prepare both ORD and NWP to discuss the current science impacts and policies accurately and consistently in potential press conferences and ensure that research is complimentary and doesn't duplicate efforts.

The final question Ms. Reiley was asked to address is how SSWR can better translate research projects to disseminate knowledge. SSWR developed a report that describes all the work that done over the last year as well as perspectives on future work. OW has a standing monthly webinar series with ORD that updates everyone on the science that is progressing and also has a quarterly dialog on the signature areas with the principle investigators at ORD and the program office that facilitates more in-depth discussion about the science, its applications, and how it can be used to solve a problem. In addition, the research management system allows access to important information about current projects and tasks. Ms. Reiley explained that the most important communication point between ORD and the NWP is discussion on how the projects should move forward to ensure that the final products are aligned with water resource needs.

Dr. Reckhow opened up the discussion to questions and comments. Mr. Chaudhry asked about the end-user and stakeholder perception of the products and if they are willing to deploy the products in the real world, and were there any reservations to doing this. Ms. Reiley responded that the end-users are OW and the products are used in a variety of ways. For example, some products are incorporated into programmatic site documents or regulatory tools while other products are more external and are used by stakeholders or communities, such as a municipality or water protection interest groups. There has been a lot of enthusiasm surrounding tools with monitoring capabilities that allow for the use of remote sensing for real time adjustments within systems in order to manage discharges and understand what is happening in waterways and the project where ORD is collaborating with states to determine water basin-wide activities have been well received thus far.

Mr. Chaudhry noted that social factors come into play in order to meet regulatory requirements and asked if implementation could be enhanced if social factors are combined with the science. Ms. Reiley replied that social science components of sustainability and management of

ecological resources was posed as one of the questions for the review of the StRAP in October. Stakeholder communities are looking for a variety of alternative scenarios with reduced costs so they can make an informed decision.

Mr. Baugh addressed the same three questions that Ms. Reiley addressed but from a regional perspective. Mr. Baugh explained that he has been involved in the approach for involving partners in problem formulation stage of research and planning from the start of FY15 in last October when the workshop to draft the project charter was held. As part of the lead region and acting region point of contact, Mr. Baugh was responsible for ensuring that all regional offices participated in the problem formulation process through the EPA's formal regional communication process. ORD employees are in every regional office and serve as ORD liaisons that make regional outreach much easier.

Mr. Baugh explained the ways in which regions were involved in the project charter development process. SSWR held regional outreach workshops that consisted of pre-workshop involvement, workshop opportunities, and post workshop involvement. The pre-workshop efforts provided an opportunity for EPA regions to review and comment on draft documents and participate in any pre-workshop calls. During workshops, regions were provided the opportunity to participate in the plenary session and breakout groups in person as well as remotely. After each workshop, regions were provided an opportunity to review and provide input on the planning program and draft project charters which were the products of the workshops. Mr. Baugh received input from nine of the ten regional offices at some point during the project drafting process and noted that region participation was highest during review of the project charters. Regional offices were engaged as the project charters were drafted by assembling, tracking, and responding to all regional comments to ensure that regions knew their comments were being read and incorporated.

Mr. Baugh addressed the question about how well ORD responds to the needs of program offices and EPA partners. The Regional Applied Research Effort (RARE) Program is a program run at the ORD level that sets aside $2.6 million a year for ORD research that addresses more short term issues distinct to a particular region. The database for RARE products illuminated that about half of the research projects being conducted are water related and ORD SSWR has been working closely with regional offices to address their water needs. For example, EPA Region 4 is working with ORD to develop models for harmful algal blooms. The Regional Research Project Program (RRPP) is another program at the ORD level that provides regional staff scientist with the opportunity to be detailed to an ORD laboratory and work on a project of interest to their region. EPA Region 4 currently has 15 participants in the RRPP program and almost half of those projects are water related. ORD management has also made an effort in recent years to participate in regional management meetings and regional office and state director meetings to facilitate a dialogue between regional needs and ORD SSWR.

Mr. Baugh also spoke to the question of how to translate ORD research to the broader community and noted that the issue of making ORD and regional knowledge and information useful to the stakeholders and citizens from various audiences is a big issue among the regions. SSWR is pursuing various avenues of increasing understanding of their research, at least among the regional offices. Mr. Baugh suggested that the RARE and RRPP programs, the state directors meetings, and ORD's webinars and newsletters offer opportunities for research translation and highlighted the importance of engaging clients at the beginning of the project planning process so ORD can have regional feedback on the utility of a potential project and develop a partnership

that leads to effective product translation. Region 4 is hoping to collaborate with the SHC Subcommittee that will research how to best deliver an effective science message to the community and emphasized the need for not just SSWR but all of ORD to address the translation issue.

Mr. Chaudhry agreed with Mr. Baugh that the best project approach is to have stakeholder involvement in the beginning of project planning and involvement continued throughout the process to ensure projects are need-based, provide appropriate solutions, and are well communicated to stakeholders.

Dr. Baker explained that tools for disseminating messages are available and the issue lies with how and what tools are received. He suggested that posting information is not helpful and web-based communications such as webinars are much more effective and allow for constant evaluation of who and to what extent the information or tool is being used. Mr. Baugh added that webinars are great at the state and regional level but are not always effective in local communities.

Mr. Chaudhry observed that there is a lot of funding and research coming from ORD, but a lot of these efforts do not have any follow up process, so they don't know how effective the product is. He suggested that project follow up be an aspect of all projects. Dr. Baker responded that about 25 percent of a research project is typically geared towards outreach efforts and Mr. Baugh added that about 20 percent of the RARE budget is allocated to outreach.

Dr. Rodricks asked Mr. Baugh what he would change about receiving feedback from regions if he were to go through the project planning process again. Mr. Baugh responded that if outreach was done at a higher level, then the process may receive more support from management which would allow responders more time to provide project feedback.

Dr. Aylward asked if regional responses were provided by the regional point of contact or was there consultation among the entire region before providing feedback. Mr. Baugh explained that the feedback was not structured and responses were not always a collaborative effort. The assumption is that the person reading and providing the voluntary feedback is the person with the most interest and therefore expertise on the topic that is likely a good reflection of regional input. Dr. van Drunick added regional science liaisons play an important role as ORD interface but where the liaison sits within the region, and therefore their access to the regional administrator, varies. Mr. Baugh is working to strengthen the ORD and Regional Office communication process in hopes of increasing involvement.

Dr. Rodricks asked about ways to improve ORD's collaboration with external partners. Dr. Rea explained that ORD research programs are targeted towards a particular EPA program office and SSWR is targeted to OW and EPA regional needs. The workshop on nutrients was unique in that OAR, OW, and regions attended resulting in a thorough discussion that addressed both program offices' research needs in the project charters with respect to nutrients. OAR provided the feedback that this cross office discussion is an excellent way to address research needs moving forward. Dr. Rea suggested that there be a focus on keeping participants in the project charter development process updated through pre-meeting activities so participants arrive at the workshops already knowing the current activities and project objectives so the workshop can be used solely to write key components of the project charter.

Dr. Rodricks followed up by noting that ORD would like suggestions for improving the project charter process, but the StRAP doesn't include any of the challenges encountered in the process. One ORD representative responded that other EPA offices and federal agencies are brought into the project charter planning process but these are internal documents which limits outside party involvement. One EPA member clarified that the project charters are developed in collaboration with other Agency offices but the documents are internal and the process does not include external partners. The development of these project charters was the most internal collaborative effort with ORD, OW, and regions thus far and reiterated the suggestion that more pre-workshop preparation would be advantageous. The NWP and OW point of contacts have a monthly meeting and this is where most of the collaboration during project charter development occurs. Mr. Baugh added that the regional liaisons are funded by ORD which speaks to ORD's recognition of their role in facilitating understanding of the science in the regions.

Dr. Rodricks brought the subcommittee's attention to the subcommittee Charge Question 3 about SSWR translating its research and noted that regional outreach is not covered by that charge question. Dr. van Drunick responded that there is a difference between what research the SSWR program needs to translate versus what the regions need to translate. Dr. van Drunick noted that a growth area for ORD is to work more closely with states, and ORD SSWR recently hired Ms. Michelle Latham to assist with information dissemination. How ORD disseminates the 80 products that it generates each year internally and to external communities varies. Dr. van Drunick raised the question of how to repackage technical information and combine it with the appropriate work products so the information is effectively translated for the biggest impact. Mr. Baugh added that ORD research is typically more technical than regional research making it more difficult to translate and disseminate.

Subcommittee members discussed useful aspects of translating and communicating research. Dr. Baker suggested the use of webpages and webinars to disseminate information. Mechanisms that can track the use of tools and provide a platform for feedback from users and the community are also useful. Mr. Baugh and Dr. Rodricks agreed and recommended including this suggestion in future project charters. Mr. Chaudhry added that ORD should solicit feedback from current product users with the intent of revising existing tools based on stakeholder feedback in addition to including follow-up on product usage as part of the research process.

One subcommittee member suggested reaching out to high school and college students to test and provide feedback on products and tools. Dr. van Drunick clarified that student outreach is already an agency wide effort and is done through a separate EPA unit. She suggested the water quality cartoon developed in Lake Tahoe, California as an example of effective research information dissemination. She noted the EPA STAR grant program provides an opportunity for research into effective public outreach. Dr. Baker suggested using a pilot group to test products early on and throughout the development process so the final product is already tailored to the user audience.

Dr. Snyder shared that he also served on the SAB Drinking Water Committee involved in the Drinking Water Contaminant Candidate List (CCL) 3 and CCL 4. This group identified data gaps in the CCL that could be addressed by ORD. He asked why these data gaps are not being addressed, especially when data for some of the suggested analysis is available and robust. He asked how the CCL is used by the ORD decision makers and what communication within ORD is taking place to ensure that work is completed in a timely manner. EPA explained that the OW workgroup consists of ORD staff and method development discussions occur through this

workgroup. However, method development takes a considerable amount of time and is contingent on what OW determines as highest priority.

Dr. Snyder commented that often by the time the technology becomes available it is too late. One EPA representative responded that there is a validation metric effect that slows down tool development. One suggestion could be to work with the matrix during the tool development process so the matrix is not a hurdle when the final product is complete.

One Subcommittee member asked about changing the methods so EPA can demonstrate that tools are valid and robust in real time as opposed to developing tools in individual components that can delay use. EPA responded that collaboration between OW and ORD scientists on projects is not formal, but rather an ORD expert is identified and pulled into a project in an *ad hoc* manner. This question would be more appropriate for OW.

Dr. Reckhow explained that there was one charge question at the BOSC SAB meeting that addressed water issues and asked where EPA can make a significant research contribution for moving towards sustainable water resources, specifically in regards to the food-water-energy nexus. Dr. Reckhow asked how project priorities are determined.

Dr. Rodricks added that page eight of the StRAP in the water sustainability section, Project 3.03, notes that the project objective is to make water safe and sustainable which he does not view as a priority. Dr. van Drunick clarified that the questions posed to the BOSC SAB last year asked if ORD was doing the right science. These questions were asked prior to the formation of the SSWR subcommittee, when there was only a BOSC Executive Committee. The question asked if ORD should invest in this new research area in water reuse and recovery; the section on nutrients was in relation to nutrient recovery to facilitate sustainable water resources which is separate from ORD's nutrients efforts and was not intended to use resources from current projects. Dr. van Drunick added that other federal agencies are addressing the food-water-energy nexus and ORD is interested in how their research can make unique contributions to the effort. The efforts in the food-water-energy nexus are being conducted in addition to the nutrients efforts that ORD recognizes as a historical, ongoing, and critical issue. ORD is responsive to near term needs but also has responsibility to look at research needs down the road that fit into a long-term vision. Subcommittee members appreciated Dr. van Drunick's clarification of a source of confusion that had arisen during the subcommittee pre-meeting teleconference.

Dr. Baker expanded on Dr. van Drunick's comments, noting that both solid and water nutrients can be recovered in water reuse efforts that are currently underutilized. This creates additional research and engineering opportunities surrounding nutrients and would be an appropriate place for EPA to make a considerable contribution. Dr. van Drunick added that the EPA is open to feedback and suggestions of how the Agency can contribute to the large water initiative that is already being coordinated among federal agencies and posted to the water reuse board.

Mr. Chaudhry noted that the food-water-energy nexus is a multi-agency effort and that there is a lot of background research occurring that has commended the nexus approach to pool federal and stakeholder resources together to address this problem.

Streamline Model and Tool Development (SSWR Charge Question 1)

Suzanne van Drunick and Subcommittee

SSWR Charge Question 1: How can SSWR streamline model and tool development within the program and across other national programs and partners to improve utility, interoperability, and accessibility, and what are some ways we can measure metrics of success?

Dr. van Drunick said she had addressed this topic throughout the day. She referenced a supplemental highlight sheet of publicly available references and tools. There are many models and tools throughout EPA and at other federal agencies. She mentioned these were tools developed in isolation of each other. EPA wants feedback on: a streamlining model tool developed to improve utility, interoperability, and accessibility, and ways they can measure metrics of success/how useful these tools are. Dr. van Drunick questioned how they know models and tools are useful, how they can engage stakeholders, what opportunities are there to make current models more interoperable and accessible to a broader audience, and if they seem to be using the science correctly.

Mr. Lowenthal noted that when setting up models for a target audience, general models may dilute results, but complex models can often be overwhelming. It is beneficial to have models at different levels of complexity. He added that some models need the complexity to get finite results that are typically utilized by an educated audience. Other tools can be more generalized and simplified to target a broader audience. Mr. Lowenthal said the target audience and the model user need to be identified in order to determine their intentions and to define desired results or outcomes. EPA can then work backwards to build the model.

Dr. Baker pointed out that one tool that appears to be missing is a non-point source model. The interventions that need to be accounted for are more subtle and pertain to behavioral and cultural changes (i.e., land use changes). These changes are incidental. Surveys could help determine if the response is delayed and how behavior in the landscape is changing. Legacy-type research would help understand if the soil concentrations are changing or decreasing across watersheds. They need and should be able to develop intermediate metrics that tell them if they are moving in the correct direction. This issue is observed with road salt, nitrogen, etc.

To assess the impact of controls on nonpoint sources, Dr. Reckhow noted that the long lag time before a water quality response is observed is a challenge to maintain funding for monitoring. Money may be wasted on monitoring in the early years when no results are yet observed, but if a monitoring program is temporarily discontinued in the early years, it may be difficult to obtain approval to begin monitoring again. The second problem Dr. Reckhow addressed is the measures of success. He mentioned the need of metrics of success to relate to the meaningful endpoint. It is difficult to see the result through the “environmental noise.” He discussed the struggle of not knowing the impact and how long it will take when efforts are done to make the watershed improvements. The measure of success may be implementation of a pollutant control practice, or water quality improvement in the nearby stream, or attaining compliance with the water quality standard. It is, of course, the last success measure (compliance assessment) that matters most.

Dr. Rodricks commented that there are models for economics, markets, and classifying chemical contaminants to express that all models have different objectives. Dr. van Drunick continued the discussion by explaining they are trying to avoid a proliferation of tools and models for the sake of developing tools and models. She noted the importance of looking for outside perspectives for

publicly available models and determining how to link them to other tools or models. This approach could increase the strength and utility of these tools and models. For example, the storm water calculator is impressive because it incorporates climate change in the assessment tool. Including a land use application would also be beneficial.

Dr. Reckhow suggested advocating multiple models. For Chesapeake Bay example, EPA uses the Army Corps of Engineers three-dimensional Chesapeake Bay model to inform decisions with deterministic predictions. They could consider also supporting a second simple model for uncertainty analysis. He stated that similar models are a promising pathway forward because of their simple nature; most of the complex models supported by EPA are overparameterized, which prevents uncertainty analyses from being performed. He suggested EPA look into developing aggregate modes that use already existing models rather than developing new models and disseminate the models to stakeholders for use.

Dr. Rodricks asked how a decision is made regarding a particular application or what they need. Dr. Reckhow replied by saying they don't necessarily need or want the uncertainty analysis. He mentioned they need more experience in field and regions to see how decision makers and stakeholders are thinking about modeling. He asked if they would be more comfortable operating with a model that assumes "x" is going to happen or using a modified or adapted model that looks at uncertainty over time.

Dr. Baker explained there aren't models that can predict the future well. There are no models for observing a single lawn's impact on watersheds (only average lawn impact), there are missing data for models, and the fundamental chemistry of biogeochemistry is not known. He said there needs to be an approach of adaptive management and asked if the changes were being made. Dr. Baker then addressed water quality and asked if those changes were related to practical analysis. A tool needs to be developed to analyze changes in behavior. He suggested they could use a model to predict what will happen in the future and have it measure what is happening. Tools are needed to measure over the future because some ecological questions address long periods of time. Dr. Baker concluded by saying urban and agricultural studying sites that are tracking human ecosystems are predicting the 100-years effect.

Dr. Reckhow noted EPA's unique niche would be to help be a model to the community by making uncertainty analyses the most important criteria for models that will be recommended for public use. EPA would then provide webinars and workshops to demonstrate how to use the model. Dr. Rodricks suggested more energy to be spent on data that goes into each model. Monitoring is needed so data going in and out are high quality.

Mr. Ahlstrom mentioned software development has come a long way and recommended ORD take advantage of current software development methodologies, such as Scrum, for managing the development of new software.

Dr. Brenda Rashleigh commented that in the environmental modeling community, Scrum is being discussed and they are trying to bring that into the models. Dr. Rodricks also commented that OAR has been developing several models and have already developed models that are used universally. Dr. Baker mentioned there are not many nonpoint source models available and the ones that exist are not as reliable.

Dr. Hua asked if there were liaisons between projects. Dr. van Drunick replied yes and that each project has a project lead and a deputy project lead. The topic leads connect at a higher level and

the project and deputy project leads connect at a lower level. Dr. Hua suggested tools should be explicitly discussed at the liaison meetings. Dr. Aylward also noted they need to sit with users to figure out what would be most beneficial to them.

Mr. Chaudhry explained one approach would be to start with one model and build modular models so the end user can perform with complex models. Dr. Reckhow noted there are well established models that address water quality issues of all kinds. The only issue is that virtually all of the models available are deterministic, which needs to be addressed. Mr. Ahlstrom continued by saying they need to identify the models that exist and then identify areas of vulnerability in existing models and then address those.

Dr. Reckhow said there are excellent models and guidance available and if a deterministic model is needed, many are available. Dr. Baker disagreed by saying if assumptions about the inputs into the system are known, what Dr. Reckhow said is true, but he didn't think the models account for what is being managed. Data input currently being used are averages, so the models that exist typically only provide averaged outputs of what is actually there. Dr. Baker noted averaging data can have big effects and they are source reductions. The reliance on BMPs is heavy, but they are not strong models. He suggested the subcommittee needs to start thinking about pollutants from nonpoint source models. Effective aggregate models can be made to provide an opportunity to improve the models by making them more location based. He concluded by saying the EPA SWMM model can be built out to be applied to nonpoint source models.

Dr. van Drunick asked the subcommittee to read through the project charters again to make specific model suggestions. Dr. Rodricks suggested EPA further research, explore, and synthesize model applications so existing models can be aggregated and so the aggregate model relies on multiple models from multiple scales. Mr. Chaudhry agreed to keep adding models on a modular basis.

In summary, nonpoint source characterization needs to be improved and essentially all EPA-supported simulation models are deterministic.

Poster Session (*AWBERC – Main Lobby*)

All

The BOSC SSWR subcommittee members viewed the following SSWR Research Program's posters:

1. FY16-19 Program Overview and Roadmap
2. Assess, Map and Predict the Integrity, Resilience, and Recovery Potential of the Nation's Water Resources
3. Water Quality Criteria for Human Health and Aquatic Life
4. Protecting Water While Developing Energy and Mineral Resources
5. National Water Quality Benefits
6. Harmful Algal Blooms
7. Science to Improve Nutrient Management Practices, Metrics of Benefits, Accountability, and Communication
8. Thresholds and Targeting Actions
9. Green Infrastructure Models and Tools
10. Information and Guidance through Community Partnerships
11. Current Systems and Regulatory Support

12. Next Steps: Technology Advances
13. Transformative Approaches and Technologies for Water Systems

Wrap Up and Adjourn

Ms. Roberts reminded meeting participants that posters will be left up overnight and tomorrow's meeting will begin at 8:30 AM. She also provided a taxi sign-up sheet for tomorrow and then dismissed the group for the day.

Friday, August 28, 2015

DFO Reconvene Meeting, Attendance

Cindy Roberts, Designated Federal Officer

Ms. Roberts welcomed subcommittee members back and opened the meeting at 8:30 AM. She invited Dr. Alice Gilliland to introduce herself following Dr. Reckhow's overview of the Day 2 agenda. Ms. Roberts then turned the meeting over to Dr. Reckhow.

Overview of Day 2 Agenda

Ken Reckhow, Chair

Dr. Reckhow reviewed the day 2 agenda, noting that the subcommittee had one more SSWR specific charge question to review with EPA and discuss before the subcommittee alone deliberated how they would address the six charge questions. Following the subcommittee discussion, EPA will rejoin the meeting to provide the members an opportunity to ask question or make comments and to determine writing assignments, deadlines, and a timeline for completing the subcommittee report that addresses the charge questions. Dr. Reckhow asked for any questions or comments on the agenda and, hearing none, turned the meeting over to Dr. Gilliland.

National Stormwater Calculator Demonstration

Alice Gilliland and Subcommittee

Dr. van Drunick reviewed yesterday's discussion on the stormwater calculator and introduced Dr. Alice Gilliland, the Acting Division Director in ORD's National Risk Management Research Center in Cincinnati, who provided a demonstration of the stormwater calculator.

Dr. Gilliland explained that the SWMM model is the cornerstone of hydrologic modeling, using gray and green infrastructure, water infrastructure, and a climate assessment tool to simulate urban stormwater runoff and sewer runoff at multiple scales. However, the SWMM model requires site-specific screening tools and is an investment, so the National Stormwater Calculator (a.k.a. the stormwater calculator) was created as a more general tool.

The stormwater calculator uses the SWMM resources and data in the background and already has a developed screening level version of the model. The option to use the climate change assessment tool is a recent additional and was not included in the first version of the stormwater calculator that was released in 2013. Dr. Gilliland explained how the calculator works and walked the subcommittee through the ten tabs of the calculator. The user can type in any U.S. address in the *Location* tab and the calculator uses a Bing map as a locator, allowing the user to change the size and location of interest. In the *Soil* and *Conductivity* tabs, the user can input soil type and drainage or use soil survey data from the internet, allowing a wide range of user

expertise. The *Slope* tab also allows the user to input site-specific data or pull in tomography data from public sources. The *Rainfall* and *Evaporation* tabs pull data from nearby weather stations. The *Land Cover* tab estimates the percent of lawn, forest, pavement, etc. within the calculator's applied radius to estimate land cover. The climate change model uses downscaled climate change scenarios, with the options of selection hot and dry, medium, and wet and allows the user to look at the short and long-term outcomes. Dr. Gilliland added that the climate change scenarios are an adjustment of current weather patterns but, if the user is interested in a more robust model, the scenarios can be changed by the user or adjusted to compare different scenarios' impact on future stormwater runoff. The biggest difference the user will see between using historical versus climate scenarios is 5 percent; One reason behind this limited change is due to the fact that the climate change models are rough downscaled so it is difficult to capture extreme weather events. However, the calculator developers are looking to use the Intergovernmental Panel on Climate Change (IPCC) assessment that will have a better reflection of future precipitation changes than the earlier models.

Dr. Gilliland explained that the output of the tool provides frequency plots and a summary of outputs. The *LID Controls* tab allows the user to select from seven green infrastructure practices and, once the model is run, compare the stormwater outcomes in different scenarios. This allows the user to adjust the green and gray infrastructure (i.e., rain gardens, green roofs, permeable pavements, etc.) and rerun the model to determine the most effective runoff reduction technique and to meet the desired stormwater outcome. Dr. Gilliland noted the example of Kentucky students who used the calculator to show the potential reduction of stormwater runoff when using low impact development methods for a local library. The students' plans were then incorporated into the library building plan, showing the broad audience and utility of the tool.

Questions

Dr. Gilliland opened the discussion up to questions. Mr. Chaudhry asked for confirmation that the climate change scenarios used in the tool do not capture all of the future scenarios. Dr. Gilliland confirmed this and noted that the calculator uses three climate scenarios selected from IPCC's GCM 3 that capture the climate envelope but not all possible scenarios. However, the tools does allow the user to input precipitation predictions but there is no guidance on precipitation changes with this model which could pose an issue. She added that there are new downscaled GCM 5 scenarios that have not yet been included.

Mr. Lowenthal asked if EPA has a plan to reevaluate and upgrade the tool in the future. Dr. Gilliland responded that a main criticism to the calculator is that it is not compatible with Apple products. EPA is working to make the calculator a web-based tool so it can be used on various platforms. The SWMM model is currently being updated, and, because the SWMM model is used in the background of the stormwater calculator, those updates will be reflected in the calculator. In addition, the National Renewable Energy Laboratory (NREL) is developing downscaled climate scenarios to determine if stormwater events are captured which could benefit the calculator in the future.

Dr. Michael Tryby reiterated that the only negative comment that EPA has received on the stormwater calculator is its incompatibility with Mac software, and the tool has been used by a lot of communities and has received a considerable amount of positive feedback. Dr. Gilliland added that the calculator is now a Leadership in Energy and Environmental Design (LEED) credit and Ms. Latham noted that the stormwater calculator has been downloaded about 12,000

and the SWMM model has been downloaded about 25,000 times within the last calendar year, making it the second most used model in the Agency.

Dr. Rodricks asked if EPA has a method for systematically seeking comments from users of the SWMM model. Dr. Gilliland responded that there is a comment area and EPA is currently working on the SWMM model's request for applications (RFA). There is also an RFA, under the STAR grants program, to develop a model center for sustainable water infrastructure. The water infrastructure model RFA required proposals to identify the models that would be included, is a cross Agency effort, and is in the process of being awarded. The project would contribute to three project areas equally, including: research at the core of model development that would engage the community in order to build a community aspect and experts; develop more mathematical algorithms and codes; and commit to outreach development. Dr. Gilliland explained that the SWMM model was included in many RFAs, and any improvement to the SWMM model will be captured in the stormwater calculator.

Dr. Gilliland further explained that the development of a model support center has been done before with EPA's Community Multiscale Air Quality (CMAQ) model. The CMAQ model has had a support center for 10 years so this process can be used to help inform the water model RFP. The models selected for the water infrastructure modeling support center and where the project will be based depends on the selected proposal. Dr. Gilliland added that, like EPA's cooperative agreements with the two national centers for research and innovation in small to medium sized drinking water systems at the University of Massachusetts, Amherst and the University of Colorado, Boulder, the grantees will work with EPA's technical leads to develop the model support center.

Dr. Baker asked about how EPA anticipates dealing with the Mac compatibility issues. One EPA representative responded that the best solution they have is to make the stormwater calculator web-based. The SWMM model is in C++ and poses a bigger challenge, so there are no efforts in progress for making the model compatible with the Mac operating system. Dr. Gilliland circled back to the discussion on the RFA for developing a model center for sustainable water infrastructure, noting that the RFA focuses on development of math and science algorithms, software, and community outreach. If the community is interested in making the SWMM model into a community tool, EPA could look into sharing the models in an open sourced way.

Dr. Rodricks asked what prompted the decision to develop the National Stormwater calculator. Dr. Gilliland explained that, during the stormwater rule development, OW wanted to develop a tool more general than SWMM to estimate stormwater runoff for a broader audience, specifically property site developers, who will have either stormwater runoff requirements or incentives.

Mr. Chaudhry asked if there is a significant difference in outcomes between short term versus long-term climate scenarios in the stormwater calculator. Dr. Gilliland was unsure but noted that she would expect a larger percent change in long-term climate scenario stormwater outcomes compared to short term climate scenario outcomes. EPA is currently looking into regional variations in climate change assessments in order to identify extremes, so Dr. Gilliland would need to look into the difference between short and long-term climate scenario outcomes.

Dr. Gilliland summarized that the climate change data came from the IPCC's 4th Assessment. Three GCM results were selected from IPCC models and statistically downscaled for a subset of 9 scenarios that are used in the calculator.

Resource Recovery and Water Reuse (SSWR Charge Question 2)

Suzanne van Drunick and Subcommittee

SSWR Charge Question 2: What are the unique aspects of resource recovery and water reuse that SSWR is best able to address? What research products are envisioned to maximize impact?

Dr. van Drunick explained that resource recovery and water reuse is a new area for SSWR and their contributions would be a continuation of other federal agency and stakeholder efforts. SSWR has received advice on how EPA, particularly SSWR, can uniquely contribute to the resource recovery and water use efforts from the Science Advisory Board (SAB) and the BOSC Executive Committee. One effort EPA could contribute to is the food-energy-water nexus that include numerous players such as the NSF. Dr. van Drunick asked the subcommittee how EPA can make the biggest contributions to this effort without duplicating work.

Dr. Impellitteri provided the subcommittee with background on SSWR's resource recovery and water reuse program and plans. Resource recovery and water reuse is not regulated at the federal level and there are no imminent plans in place to begin federal regulation. The program is very new to ORD and its creation was largely driven by OW's interest in the subject, and ORD and OW are currently discussing where ORD research can inform OW's water reuse and recovery decisions.

Dr. Impellitteri explained that SSWR's planed research efforts in water reuse mainly focus on microbial contaminants, which includes efforts in improving indicators for assessing the efficacy of water reuse. For example, in gray water (i.e. water from showers or laundry) tracking bacteria associated with human skin may be a better indicator than traditional fecal indictors used in wastewater. SSWR also plans to conduct research to develop indicators such as phage or viral pathogens in water reuse systems and improve detection methods for opportunistic pathogens such as legionella bacteria. SSWR is interested in including research on testing and evaluation of novel treatment technologies that consume less energy such as low dissolved oxygen systems, anaerobically run systems, light emitting diodes, and ultraviolet (UV) treatment systems.

Chemical contaminants in wastewater are a concern but a lot of this work has been done over the past 20 years by organizations such as the Water Reuse Research Foundation (WRRF). EPA is collaborating with the WRRF and developing a partnership with WRF members, whose subscribers consist of large water treatment systems, to assist with their water reuse initiatives, including WRF's primary research focus to find, establish, and maintain reliable and resilient alternative sources of water. Water Environment Research Foundation (WERF) is also interested in water reuse and interest in the topic has been increasing across the country, even outside of dry areas where water scarcity is an issue.

Dr. Impellitteri summarized that SSWR's planned water reuse research focus is mainly on microbial, specifically viral, pathogens with some work on contaminants of emerging concern. The planned resource recovery of post-use water research is focused on capturing and recovery nutrients and energy from post-use water treatment operations. One example includes recovering metals such as iron and aluminum used in coagulation treatments and reusing them to treat drinking water. In addition, some research focuses on the broader picture of advancing community water systems to unite water reuse and resource recovery with drinking water issues at the community level.

Dr. Impellitteri explained SSWR's research projects in more detail. The projects under the water systems topic are on a time continuum. The first project aims to determine what the immediate program offices' needs are within the context of the current systems and regulatory framework. Under this project, SSWR is exploring:

- Microbial and viral community dynamics throughout the treatment process and in treated post-use water;
- Developing, verifying, and proving methods for detecting microbacteria through quantitative polymerase chain reactions (qPCR) and updating existing EPA methods such as Method 1602 to include phage assays as indicators for waterborne human viruses; and
- Toxicological characterization of disinfection by-products for *in vitro* and short term assays. Current work in EPA's Research Triangle Park (RTP) that supports this goal is the effort to conduct assays on harvested and propagated colon cells from one mouse rather than conducting traditional toxicology studies.

The next project aims to identify 'next steps' and ascertains what new technologies are available to achieve topic objectives. Under this project, SSWR is exploring:

- Developing and advancing anaerobic membrane bioreactor technology for domestic post use water treatment.
- Reassessing the state of the science to determine the status of using membrane technology for water resource recovery, particularly with handling concentrated brines in desalination or water reuse operations. Brine water is a big issue in inland areas with brackish ground water and limited disposal options. EPA is interested in the possibility of separating out the salt and making it into a marketable product, similar to a hydraulic fracking operation that separated out and produced marketable calcium chloride and sodium chloride.
- Phosphate recovery from wastewater treatment plants using phosphate accumulating bacteria in low dissolved oxygen (DO) systems.
- The use of light emitting diodes to induce ultraviolet light inactivation of adenovirus, coxsackievirus, and echovirus.
- Using effect directed analysis such as a tiered bacteria screening approach to determine if infectious contaminants have been treated in water for indirect potable use and if not, what contaminants were not treated and how this problem can be addressed in the system.
- Applying genomics (i.e., genomics, individual genes, transcriptomics, and messenger ribonucleic acid [mRNA]) and proteomics (i.e., proteins and peptides) as biomarkers and improving EPA's aerosolization models for opportunistic pathogens.

The third project examines transformative approaches for technologies for water system. Under this project, SSWR is exploring:

- Developing new revenue models for water systems that include revenue, or potential revenue, and cost savings from nutrient and energy recovery and water reuse.
- Examining the impacts of social behavior and regulatory impacts on water reuse and implementations without duplicating any current efforts from organizations such as the WRF; and
- Developing and examining new technologies (i.e., bioassays and cells on a chip, etc.) in order to develop sensors to put in human wastewater treatment systems that can monitor for quality issues in real-time.

Mr. Lowenthal explained that states are responsible for regulating water reuse which results in little overview or consistency across regions. Dr. Impellitteri responded that there are some states that are looking for standardization across the board and noted that the WRF Director is of the opinion that the federal government should not regulate water reuse. There are some advantages to standardization but there is also a lot of locational variation in water reuse. In addition, EPA needs to keep up with current science and determine how to incorporate new approaches and technologies such as bioassays and exposure effects into updated guidelines and regulations.

Dr. Snyder explained that areas being explored under water reuse are not water reuse specific and suggested some of the microbial and water tracking tools also be applied to conventional water systems. Success in both systems should be compared so this technology can be applied to a much broader range of water treatment systems as soon as possible. Dr. Impellitteri responded that a lot of the new technology was developed to respond to viruses. There is a need to know more about the cycles and the relations between biofilms and opportunistic pathogens to better understand when and why there are bacteria in the plumbing system. Dr. Snyder clarified his comment by explaining that water from water reuse treatment facilities have been shown to be 'cleaner' than ambient water in terms of chemical contaminants and suggested that EPA add control sites to their microbial studies to see if this holds true for viruses and bacteria. Dr. Impellitteri added that bioscreening and other bacteria and virus testing is already included in a lot of the proposed projects.

Dr. Impellitteri asked the subcommittee for their comments on changing the term "wastewater" to "post-use water" to imply that the water is a resource and not a waste. Mr. Chaudhry asked if EPA planned to use the term 'post-use water' rather than 'resource water' Dr. Impellitteri was not sure if the terms were interchangeable. Mr. Chaudhry noted that wastewater is treated to a level that is higher quality than drinking water so the issue of 'post-use water' is physiological. Dr. Impellitteri agreed noting that a lot of effort goes into public perception. The term 'toilet to tap' is often used and water reuse stakeholders have been working to change this perception. The terms 'enriched water' has been discussed as a potential term but EPA is open to any suggestions. Mr. Chaudhry suggested using the term 'resource water' and noted that the term came from public communication research. One subcommittee member raised the concern that all water could be considered 'resource water' but Mr. Chaudhry clarified that resource water has nutrients, biogas, and other enrichments in it.

Dr. Baker asked how much resource water or post-use water is redirected for urban use. Dr. Impellitteri explained that in the past he would have said post-use water was for urban irrigation but this is changing. For example, in Orange County California it is a simple engineering fix for their Department of Parks and Recreation (DPR) to use post-use water for urban irrigations. Orange County's has the goal of 20 percent reuse and 20 percent desalination by 2020 and Texas already has water reuse facilities up and running but the biggest challenge that faces water reuse is public perception. There has been important research conducted showing that people are fine with post-use water once they know the treatment process and level of cleanliness.

Dr. Baker raised the issue of salt. He explained that salt build ups can occur when water is continuously recycled. For example, salt retention of up to 70 percent has been observed in Phoenix due to reuse of water from a brackish aquifer. This poses an issue to crops that are sensitive to salt. Dr. Impellitteri explained that this goes back to the idea of fit for purpose. EPA would like to get involved, in particular with WRF, to identify long-term impacts of water reuse. He clarified that EPA is not involved in desalination efforts because it falls under the

responsibilities of the Bureau of Reclamation and added that EPA is working to avoid duplicating efforts with other federal agencies and the WRFs. Mr. Chaudhry added that WRF has conducted excellent desalination research.

Dr. Impellitteri explained that EPA has put a large emphasis on method and modeling development for water treatment systems to prevent and allow quick identification and response to system failures to ensure public safety. The objective is to identify and notify the public of water quality issues in real time. Mr. Chaudhry and Dr. Impellitteri agreed that water treatment systems are over engineered due to public perception. Mr. Chaudhry explained that water reuse is not the problem but rather the chemicals added to the water from urban runoff and other sources that make it so challenging to treat.

Dr. van Drunick explained some of EPA's fit for purpose work. Committees have been working with the drought network and the Smart Water Application Technologies (SWAT) committee to support the initiative from the big water quality and consumption users to expand the use of nontrade waters (i.e., gray water and water from the natural gas industry) in order to relieve pressures on fresh water sources. EPA has been working with the USDA on desalination efforts and with the Department of Energy (DOE) and the USDA to address water quality issues from water reuse on crops and livestock. The water reuse and fit for purpose effort has 20 federal agencies with over 200 water resource programs working to determine how clean the water needs to for each particular use and how to make smarter more efficient water management systems.

Dr. Rodricks asked if the StRAP projects are focused on drinking water and Dr. van Drunick explained that the StRAP was written with drinking water in mind but considers alternative uses, such as agricultural use, that does not require the same water quality as drinking water.

Dr. Snyder explained that water reuse is cheaper to implement in urban areas rather than pumping it out for agricultural use and asked if EPA is looking into contributing to a full lifecycle water reuse assessment. Dr. van Drunick explained that one of the USDA subcommittees had the idea to create a map with the locations of nontraditional water sources, the source users, and location of vulnerable ecosystems to make an agency level effort to further alleviate demands on fresh water sources.

Dr. Jay Garland explained that the last RAP cycle began working on a more broad intergraded sustainable assessment on drinking water and stormwater resources (e.g. urban water use) that included lifecycle cost, exposure assessment, and resiliency. The current RAP plans to expand the water reuse services in EPA's water reuse portfolio.

Dr. Snyder suggested that nutrients and water reuse may be the low hanging fruit and added that water reuse could prevent other issues such as eutrophication. Dr. Impellitteri agreed but added that EPA does not want to duplicate efforts such as ReNUWIt's work in urban water reuse. Dr. Snyder commented that he is not aware of anyone working on offshore discharges and suggested this as a potential topic EPA could contribute to.

Mr. Chaudhry responded that technologies and research to address ocean discharge exist and, in the United States, water reuse is a political issue not a technical one. Dr. Baker added that in the Midwest, the community doesn't think about reuse and has no water reuse culture. This results in a lot of missed water reuse opportunities that could be implemented by simply changing the direction of a pipe. Water scarcity is becoming an issue in less arid areas where it was not an

issue before. Dr. Baker proposed a high level evaluation of locations and existing tools in order to take advantage of water resource opportunities. He agreed with Mr. Chaudhry that there needs to be a better political and community attitude towards water reuse. Dr. Impellitteri concluded that EPA's water reuse objectives are still in the planning phase and are not in the research process yet.

Subcommittee Discussion of Charge Questions

Ken Reckhow, Chair, Subcommittee, Suzanne van Drunick, NPD & SSWR Team

The subcommittee did not have any questions for EPA at this time.

Public Comments

All

Ms. Roberts noted that no requests were received to a public comment in-person, but one comment was submitted electronically by Mr. Steve Via from AWWA.

Ms. Roberts asked the subcommittee for responses to the public comments and hearing none, turned the meeting over to Dr. Reckhow.

Subcommittee Discussion and Writing

Ken Reckhow, Chair and Subcommittee

The subcommittee discussed the overall approach for answering the charge questions and agreed that the report should be question based and not project based. Mr. Ahlstrom suggested that the subcommittee include whether or not the project meets each of the objectives laid out in the StRAP. Not all of the tools described are ready for prime time use. In general, some of the research objectives are very well addressed, but in other areas the research objectives are not being met. The duration of each project needs to be clearly articulated (e.g., long or short term) and the subcommittee should encourage EPA to do more long-term projects.

Dr. Baker provided his comments on the presentations by the SSWR group. He noted that more information is needed on whether or not there is a communication plan between ORD and the researchers, as well as the level of communication that occurs within research groups. He noted that there is a strong connection between the program and the RSLs but EPA's partnership are very insular. Dr. Baker noted the lack of EPA communication with a broader audience as a challenge that should be addressed.

Dr. Reckhow provided his comments on the presentations by the SSWR group. He noted that there is a lack of uncertainty analysis in modeling and assessments, and if EPA used a prescriptive decision analytic approach for scientific assessment, they would recognize that uncertainty is needed in EPA's assessments. Dr. Rodricks added that problems arise when multiple sources are integrated and wondered if the subcommittee should second guess their research needs.

Dr. Rodricks noted that with respect to General Charge Question 1, it is not clear how the research topics were selected and more clarification is needed on this selection process. It does not appear that there was any involvement of outside partners. This should be changed as it would have served EPA better if partners had been involved. With respect to SSWR Charge Question 1, a promise of collaboration and integration is not enough. There is a need for a strong way to ensure collaboration is carried out. A more formal plan for collaboration and partner

engagement should be developed. With respect to General Charge Question 2, more up front disclosure before EPA meets with partners is needed. The process on how EPA engages with partners is limited. It is not clear how the partners were involved in the problem formulation process. Dr. Rodricks added that he is not sure how to suggest improvements for the process if the process is not clear. He pointed out that General Charge Question 3 seems redundant with General Charge Question 2. He offered to assist with developing a response to SSWR Charge Question 3.

Mr. Chaudhry provided his comments on the presentations by the SSWR group. He commended EPA's efforts on developing the StRAP and roadmaps. He recommended using the term "resource water" in place of "wastewater." With respect to General Charge Question 1, the definition of "good progress" and how EPA evaluates its progress on the StRAP objectives are unclear. He asked if the measure of success is in reference to the project itself or the end user's perspective. Mr. Lowenthal recalled that Dr. van Drunick said that this was with respect to "delivering what was promised." Dr. Baker stated that progress towards the tools is needed. Mr. Chaudhry said that ORD needs to reach out to the outside stakeholders. If EPA's progress meets the expectations of stakeholders, this it serves as the measure of success.

Dr. Baker suggested that the subcommittee include a recommendation that a small group from ORD attend specific meetings. There is a lot of work being done in Europe and it would be beneficial for EPA to consult this body of work to ensure that there is not overlap. Europe is more advanced in their work on resource recovery. Desalination, brackish groundwater sources, zero liquid discharge, and improving cost effectiveness are topics that will be playing a larger role and focus on these areas should be increased. An economic way to address solid disposal (desalination) is needed. Additionally, regulations for water reuse (e.g., minimum criteria) are needed. If states want more stringent requirements they can do so. Communication does not appear to trickle down to the end users and more effective communication strategies with important stakeholders are needed. ORD needs more exposure to workshops, regulatory meetings, and conferences. On a regular basis, ORD should hold coordination meetings with national and regional water resources agencies (i.e., CASA. ACWA, state groups).

Dr. Aylward provided his comments on the presentations by the SSWR group. He shared that he was also unclear on how the problems in the StRAP led to the objectives and how the topics came out of these objectives. He expressed concern that certain items could have been left off of these lists. He expressed curiosity with how all of EPA's work links into the water resource problem more generally. He stated that the project proposals lacked theory of change. It seems that there are a lot of topics to be researched because they are interesting. A linkage to the desired change and outcome is needed. Some projects are more focused on developing scientific improvements and others are clearly to inform regulatory requirements. Projects also have different users. It would be helpful to categorize what level each of these things is aimed at. This will help with the translation and addressing the question "How do you want the behavior of the community to change?" This could be an insular decision and come from EPA, but there may be other items that come from the bottom up. He suggested digging deeper into this issue to gain a better explanation on what they are trying to change, which would lead to better outputs. He noted that a gap analysis is missing. This would provide a list of things that ORD does deal with along with prioritization of these issues. An increased emphasis on cost is needed rather than consideration of the level of protection or putting out useful information. More information on the economics considering cost and externalities is also needed.

Dr. Snyder stated that he will provide comments on General Charge Question 3. He suggested using specific projects as examples but not speaking to each specific project individually. He pointed out that the BOSC should focus on whether or not ORD is doing the science right. He will primarily address the water systems question and added that addressing this question is challenging because it's unclear if enough data is available to know if the science is correct. The information provided is too broad. He expressed concern with EPA's engagement of state regulators. He noted that at water reuse meetings, EPA's national program office is not represented, but state water boards are present. EPA regulation is not in the intended forecast, so water reuse regulations will come from the state. It would be good to know that ORD is in communication with state water boards. He wondered how many ORD projects are considered ongoing rather than repackaged/recycled. Dr. Reckhow responded that the nutrients projects are ongoing. Mr. Lowenthal noted that some of these projects represent the next phase of ongoing projects and tie together things that have already been done. Dr. Baker added that he wants to know where the project starts (what were the knowledge gaps from the last time) and where do we want to go.

Mr. Ahlstrom stated that with respect to General Charge Question 2, the process of working within EPA is maturing but the process of stepping out and being less insular is in need of improvement. It would be valuable if groups worked together. Dr. Baker shared that he plans to write something about ORD providing technical support for emergency response and environmental crises. He noted that he does not support general broadband source supply studies. They are not valuable at a local level because local entities have more experience with their area than ORD. Focus should be placed on barriers and limits to reuse applications. The use of terms like resource water versus post treatment water can be addressed in General Charge Question 2. More information is needed on additional health effects and how to measure health effects.

Mr. Ahlstrom stated that with respect to General Charge Question 3, the subcommittee should focus on pages 5 and 6 of the StRAP and look at whether or not the program is responding to these problems and purposes. ORD needs to identify the target audiences and the ways that they can be reached. He suggested ORD connect with licensing boards and take advantage of those processes. He wondered how EPA makes its research more available via Google or social media. In addition technology transfer should be built into a project plan from the beginning.

The subcommittee discussed the writing assignments for the six charge questions. The following assignments were made:

- General Charge Question 1: Mr. Ahlstrom
- General Charge Question 2: Mr. Lowenthal
- General Charge Question 3: Drs. Baker and Snyder
- SSWR Charge Question 1: Dr. Reckhow
- SSWR Charge Question 2: Mr. Chaudhry
- SSWR Charge Question 3: Dr. Rodricks and Mr. Chaudhry

Wrap Up and Adjourn

Ms. Roberts thanked subcommittee the members for their participation. She is looking forward to working with the subcommittee and receiving input on the SSWR materials in the near future. Ms. Roberts also thanked Dr. van Drunick and everyone at EPA ORD who helped develop the meeting materials and adjourned the meeting.

Appendix A: Agenda

United States Environmental Protection Agency Board of Scientific Counselors (BOSC)
Safe and Sustainable Water Resources (SSWR) Subcommittee

Meeting Agenda – August 27–28, 2015

Cincinnati, Ohio

TIME	TOPIC	PRESENTER
Thursday, August 27, 2015		
8:30 – 9:00	Registration	
9:00 -- 9:15	Welcome, Introduction, and Opening Remarks	Ken Reckhow, Chair
9:15 -- 9:30	DFO Welcome and FACA Rules	Cindy Roberts
9:30 -- 9:45	Program Summary and discussion of materials provided	Suzanne van Drunick
9:45 -- 10:00	Review of Charge Questions	Ken Reckhow, Chair
10:00 -- 10:45	Program Communication and Quality (General Questions 1& 2) • EPA Overview • Sub-Committee Discussion	Suzanne van Drunick Subcommittee
10:45-11:00	Break	
11:00 – 12:00	Research Translation and Responsiveness (General Question 3 & SSWR Question 3) • EPA Overview • Sub-Committee Discussion	Suzanne van Drunick Subcommittee
12:00 – 1:00	Lunch	
1:00 – 3:00	Program Office and Regional Perspectives	TBD
3:00 – 3:15	Break	
3:15 – 4:00	Streamline Model and Tool Development (SSWR Question 1) • EPA Overview • Sub-Committee Discussion	Suzanne van Drunick Subcommittee
4:00 – 5:00	Poster Session	SSWR TBD
5:00 – 5:30	Wrap Up and Adjourn	Ken Reckhow, Chair and Cindy Roberts, DFO

TIME	TOPIC	PRESENTER
Friday, August 28, 2015		
8:30 – 8:35	DFO Reconvene meeting, attendance	Cindy Roberts, DFO
8:35 – 8:45	Overview of Day 2 Agenda	Ken Reckhow, Chair
8:45 – 9:45	Resource Recovery and Water Reuse (SSWR Question 2) • EPA Overview • Subcommittee discussion	Suzanne van Drunick Subcommittee
9:45 – 10:30	Subcommittee discussion EPA response to subcommittee questions	Subcommittee Suzanne van Drunick
10:30 – 10:45	Break	
10:45 – 11:00	Public comments (if any)	
11:00 – 2:00	Subcommittee discussion and writing (working lunch)	Ken Reckhow, Chair Subcommittee
2:00 – 2:15	Wrap Up Adjourn	Ken Reckhow, Chair and Cindy Roberts, DFO

Breaks at the discretion of the chair.

Appendix B: Participants

BOSC SSWR Subcommittee Members:

Kenneth Reckhow, *Chair*
Shahid Chaudhry, *Vice Chair*
Scott Ahlstrom
Bruce Aylward
Lawrence Baker
Inez Hua
John Lowenthal
Joseph Rodricks
Shane Snyder

EPA Designated Federal Officer (DFO): Cindy Roberts, *Office of Research and Development*

EPA Presenters:

Suzanne van Drunick, *Office of Research and Development, National Program Director for the SSWR Research Program*
Tom Baugh, *Office of Research and Development, Region 4*
Ellen Gilinsky, *Office of Water*
Alice Gilliland, *Office of Research and Development*
Mary Reiley, *Office of Water*

Other EPA Attendees:

Ellen Ashbee	Chris Impellitteri	Fred Redersen
Hiba Ernst	Michelle Latham	Thomas Speth
Lindy Farrar	Sylvana Li	Hale Thurston
Jay Garland	Maya Pachnowski	Michael Tryby
Rick Greene	Brenda Rashleigh	Matt Weber
Matthew Heberling	Anne Rea	Joe William
Matthew Hopton		

Other Participants:

None

Contractor Support:

Maureen Malloy and Amanda Ross, ICF International