United States
Environmental Protection Agency

Office of Wastewater Management
Washington, D.C. 20460

May 2015

Summary of June 19–20, 2014, Experts Forum on Public Health Impacts of Blending

This summary is not a transcript of the event; rather, it identifies major themes expressed at the forum by the experts. Statements in this document do not represent the consensus of the experts attending the forum, but rather may be the opinion of one or more of the experts. This document does not represent the views of EPA.

Summary of June 19–20, 2014, Experts Forum on Public Health Impacts of Blending

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Experts

The public health experts participating in the forum were:

Dr. Samuel Dorevitch, University of Illinois, Chicago

Gregory Goblick, U.S. Food and Drug Administration

Dr. Anwar Huq, University of Maryland

Dr. Joseph Jacangelo, MWH Global, Johns Hopkins University Bloomberg School of Public Health

Dr. Adam Olivieri, EOA, Inc.

Dr. Betsy Reilley, Massachusetts Water Resources Authority

Dr. Joan B. Rose, Michigan State University

The engineering experts participating in the forum were:

Dr. Kati Bell, CDM Smith

Jim Fitzpatrick, Black & Veatch

Dr. Donald Gray, East Bay Municipal Utility District

Dr. Julian Sandino, CH2M HILL

Dave Wagner, City of Lawrence, KS

Selection of Human Health and Engineering Experts

On April 18, 2014, the U.S. Environmental Protection Agency (EPA) published a *Federal Register* notice that provided the public with an opportunity to recommend public health experts who would be interested and qualified to participate in the forum. In addition, EPA provided the public with an opportunity to recommend wastewater treatment plant design and operation experts to serve as advisors to the public health forum participants.

Background

During and immediately after periods of wet weather, flows at municipal wastewater treatment plants typically increase. Significant increases in flows at a treatment facility can create operational challenges and potentially adversely affect the treatment efficiencies. Activated sludge systems are particularly vulnerable to high-volume peak flows.

Many municipal wastewater treatment systems have been designed and built with more primary treatment capacity than biologically based treatment capacity. During extreme flow events caused by wet weather, treatment plant operators sometimes send the portion of the flows that have received primary treatment but that exceed the capacity of biologically based treatment units around the biologically based treatment units. At some treatment facilities, flows that do not receive biologically based treatment are disinfected and discharged directly to a surface water from a separate outfall. Other facilities blend the flows that do not receive biologically based treatment with flows that receive biological-based treatment and discharge the combined flow after it has been disinfected. Some facilities that blend flows provide some type of auxiliary treatment of the flows that do not receive biologically based treatment prior to blending with flows from the biological based treatment units while other facilities that blend flows provide no additional treatment other than effluent disinfection which may occur before or after blending.

Purpose of the Public Health Experts Workshop

The purpose of this forum was to enlist nationally recognized public health experts to provide the U.S. Environmental Protection Agency (EPA) with appropriate health-based information associated with different engineering options available to address wet weather blending at publicly owned treatment works (POTWs) served by separate sanitary sewers. The public health experts were asked to respond to the topics and questions identified in the meeting agenda, which is included in Appendix C.

The meeting was not a forum for debating the application of the Agency's bypass regulation at 40 CFR 122.41(m) going forward. Rather, the forum was solely concerned with the potential public health impacts of blended discharges from POTWs. Further, it was not EPA's objective during the forum to establish consensus among the parties or to obtain a collective set of recommendations. It was EPA's intention to obtain individual input from knowledgeable experts so that the Agency can better understand the differences and commonalities among the individual recommendations.

EPA focused the discussion at the forum to blending at POTWs served by separate sanitary sewers. However, some data from POTWs served by combined sewers was presented by the experts at the forum. Given the different hydraulic conditions associated with combined sewers and the ability to limit or direct flows to a treatment plant (with other wet weather flows being discharged via combined sewer overflows), risk and engineering considerations for POTWs served by combined sewers may differ from those at POTWs served by only separate sanitary sewers.

This document does not represent any EPA determination with respect to any policy and legal matters that may have been discussed at the meeting and described in this document and is solely intended to reflect the discussions at the June 19–20, 2014, forum.

Experts Forum on Public Health Impacts of Blending Summary
June 19–20, 2014
Fairfax, VA

On June 19 and 20, 2014, the U.S. Environmental Protection Agency held a meeting in Fairfax, Virginia, to discuss the potential risks to human health from wet weather flow blending.

This summary describes the resulting discussions among the experts participating in the forum. EPA has conferred with the experts to ensure that representations in this summary are portrayed accurately. In numerous places, comments from several experts are combined and summarized into one bullet.

The summary is organized into the following major sections, which correspond to the meeting agenda:

- Opening Remarks
- Blending and Wet Weather Operations: The Engineering Experts' Perspective
- Discussion 1: Knowledge Gaps and Major Areas of Uncertainty
- Discussion 2: Characterization of Pathogens and Pollutants and Associated Impacts
- Discussion 3: Key Factors Affecting the Human Health Risks of Wet Weather Discharges from POTWs
- Observer Comments/Questions
- Discussion 4: Understanding the Public Health Risks of Blended Discharges (much of this will fall into the category of knowledge gaps, since there is so little information available in the epidemiologic literature to answer these questions)
- Observer Comments/Questions
- Discussion 5: Using Indicators to Evaluate Human Health Risks
- Discussion 6: Additional Data Needs
- Observer Comments/Questions
- Closing Remarks

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Opening Remarks

Dr. Andrew Sawyers – Director, Office of Wastewater Management, Office of Water, EPA

and

Rob Greenwood – Facilitator

Dr. Sawyers opened the meeting by welcoming the participants to Fairfax, Virginia, and introduced himself to the group. Dr. Sawyers thanked the expert panelists for agreeing to participate. Dr. Sawyers indicated that blending is a critical issue and that it is important to have a forum to receive valued input from experts and the public. Dr. Sawyers indicated that many advances have been made in sewage collection and treatment in recent years, but there are still many technical issues to address. Dr. Sawyers thanked everyone in advance for valued input and discussion.

Rob Greenwood, the facilitator of the forum, described the forum format and ground rules for the 2-day forum. He thanked everyone in attendance—in person and on the phone—for taking the time to discuss this important issue. Rob asked the forum experts to introduce themselves (by name, organization, background).

Blending and Wet Weather Operations: The Engineering Experts' Perspective

The forum began with an introductory presentation from the engineering experts that were invited to participate at the forum, *Blending and Wet Weather Operations: An Engineering Perspective*, which was divided into the following topics:

- Executive summary
- The challenge of managing wet weather flows in POTWs
- Wet weather flow management options
- Recent case studies of wet weather flow management
- Recent guidance documents
- Conclusions

The PowerPoint slides used in the presentation are provided in Appendix D.

The Executive Summary for the presentation addressed the following points:

- Wet weather events have a short duration and are infrequent. Risks tend to be acute, not chronic.
- Site-specific variables result in site-specific impacts and thus require site-specific solutions.
- Blended discharges from POTWs may have a lesser impact on water quality than nonpoint source (NPS) contributions.
- Reducing peak flows to POTWs to a level that allows for effective treatment by traditional biological processes alone might not always be practical.
- If needed, wet weather flows could be treated effectively by physical and/or chemical methods to address acute water quality concerns.

The engineering experts indicated that blending was just one part of a larger public health issue.

Challenges of Managing Wet Weather Flows in POTWs

- The evaluation of the impact on receiving water involves a significantly different set of drivers and risks than is used for dry weather, requiring consideration of different parameters (e.g., 7Q10 flows not appropriate for wet weather).
- Wet weather influent characteristics are significantly different than normal design ranges used for dry weather.
    - Wet weather flows are intermittent, dynamic, and unpredictable.
    - Influent flow rates change during wet weather events and from event to event. Influent flow rates during wet weather can be much higher than "normal" dry weather flows.
    - Pollutant concentrations can also be highly variable during wet weather.
    - The variability associated with wet weather creates challenges for the engineer.
        - Should engineers look at average flow, peak flow, etc.?
        - What is the appropriate design load?

    - How do you characterize the "first flush"? Wet weather influent pollutant concentrations tend to decrease rapidly after "first flush".
    - What indicator(s) are we going to use and what water quality-based or technology-based effluent limits will be set?
    - What time basis will the design be based on?
- A site-specific public health analysis should consider the state of receiving waters during wet weather conditions, including influence of NPS pollution.
- There can be great variability from POTW to POTW and, therefore, no one-size-fits-all solutions.
- Cannot rely on past rainfall data as much as has been done in the past since climate change seems to be changing historic rainfall patterns.

Conclusion: For a given plant, a design based on simple steady-state considerations is not likely to adequately address wet weather conditions given the number of variables involved.

- Rate-payer investments should be sustainable (e.g., life-cycle costs, benefits and risks, asset management, appropriate level of service).
    - Knowing the true risks and benefits is the first step toward making sustainable investments.
    - Wet weather has to be considered holistically in developing an optimal solution.

<u>Wet Weather Flow Management Options</u>

- Reducing peak flows through infiltration/inflow (I/I) reduction.
    - I/I reduction and O&M must be ongoing programs (not one and done).
    - Challenges for reducing I/I on private property are significant.
- Reducing peak flows through additional storage. This has been tried in the past, but are tanks really big enough to capture the volume? Treatment efficiencies can be impacted when storage facilities are dewatered.
- Maximizing use of existing treatment facilities.
- Biological processes have inherent risks and limitations. Biomass quantity and quality limit capacity even if more infrastructure is available.
- Some wastewater resource recovery facilities (WRRFs) might be able to temporarily reconfigure activated sludge trains to "weather the storm" to some extent. Reconfiguring activated sludge trains can reduce wash-out of the secondary clarifier, but may decrease treatment effectiveness.
    - Temporary contact stabilization mode relies on physicochemical mechanisms (not biological mechanisms). In all these processes, you are capturing the solids and bringing them back to the normal "dry-weather" flow treatment process.
- Good solids removal is a key for wet weather treatment.
- Disinfection often presents site-specific challenges calling for site-specific solutions.

<u>Effluent Disinfection Alternatives</u>

- Disinfection is not the same as sterilization. It does not kill all pathogens.

- Efficacy of any disinfection system depends on effluent quality.
  - Providing auxiliary treatment before disinfection provides microbial quality indistinguishable from biological treatment and disinfection.
- Ultraviolet (UV) disinfection and chemical oxidants are major disinfection options.
- Design of a disinfection system requires knowledge of target organisms, inactivation rate, and water quality.
- Typically, disinfection systems are designed to comply with limits for one or more indicator organisms. However, disinfection that is designed to reduce bacteria indicators might have variable performance with respect to addressing viruses and protozoa.
  - For example, using chloramination for disinfection requires a much higher dose to inactivate viruses and *Giardia* than that used to inactivate *E. coli*.
- When evaluating risks, blending treatment goals should be put in context of other risks to the public.
  - Cyanobacteria toxins have been recently identified as a major source of recreational exposures.
- Pathogen inactivation is site-specific. Total suspended solid (TSS) levels impact pathogen inactivation.
- Based on a review of data from Lawrence, Kansas; Akron, Ohio; Toledo, Ohio; and other locations, facilities using auxiliary treatment prior to blending and disinfection can provide microbial removal that is better or indistinguishable from wet weather effluent from plants with activated sludge units that do not blend.

Auxiliary Treatment

- Many options are available for providing clarification to flows that are treated in parallel with biological treatment process trains. An overview of some of the major clarification technologies was provided.
- Understanding disinfection needs and the influent solids are the keys to treating wet weather flows.
- A summary of clarification technologies was provided that addressed conventional sedimentation, chemically enhanced sedimentation, compressed media filtration, and ballasted flocculation.

Case Studies

The presenters noted that only *select* case studies were discussed and that other data, often unpublished, may be available. The following case studies were discussed:

- A 2009 Water Environment Research Foundation (WERF) study on blending that included data from East Bay Municipal Utility District (EBMUD). The WERF study involved collecting sampling data during both blending and non-blending (including both wet-weather and dry weather non-blending) events to characterize wastewater treatment plant influent, primary and secondary effluent, final effluent (which comprises the full blended flow during blending events), and

receiving water quality; and a computer model that predicted pathogen dispersion and die-off in the receiving water allowing a public health risk associated with the blended discharges into San Francisco Bay to be estimated. The WERF project also included a guidance document that suggested a protocol for monitoring at facilities that blend.

- The performance of the Actiflo ballasted flocculation unit at Lawrence, Kansas. Background and milestones for the wet weather facility were discussed. Treatment summaries and performance data were presented from 10 years of operation with the ballasted flocculation system.
- An ongoing case study from Toledo, Ohio, including background and milestones for the Toledo waterways initiative. The focus of the study was on auxiliary treatment. Preliminary results and data were presented from 5 years of operation with the high-rate clarification system.
- A case study from Milwaukee, Wisconsin, that discussed a chemically enhanced clarification demonstration pilot at the facility. Preliminary results were presented.

Summary Points

- Wet weather events have a short duration and are infrequent. Risks tend to be acute, not chronic.
- Reducing peak flows to POTWs to a level that allows for effective treatment by traditional biological processes alone may not always be practical.
- If needed, wet weather flows could be treated effectively by physical and/or chemical methods to address acute water quality concerns.
- POTWs' blended discharges may have a lesser impact than NPS contributions.
- Site-specific variables result in site-specific impacts and, thus, require site-specific solutions.
- The known risks to public health from well-designed and operated blending facilities appear to be relatively low.

Public Health Experts Discussion Session 1: Knowledge Gaps and Major Areas of Uncertainty

This introductory session was intended to provide some initial thoughts about how the available literature addresses the topics in the various discussion sessions below. This was an underlying theme for the forum and was revisited in different discussion sessions. The following questions were provided on the agenda to introduce the session:

- *What is known about health risks of exposure to surface water impacted by wet weather flows (overall or for specific treatment approaches)?*
- *Where are the major areas of uncertainty and knowledge gaps in the literature about health risk of wet weather flows?*

Specific comments from both public health and engineering experts:

- Data indicate that floods and heavy precipitation events are important factors causing breakouts of infectious disease. Data are not available, however, to correlate specific pathogen sources with outbreaks of infectious disease. Many sources may play a role in infectious disease occurring because of wet weather events, including cyanobacteria associated with algae blooms, NPS, and point sources.
  - In recreational waters, typically a mix of pathogens can cause illness. We often don't know the specific pathogen(s) that are responsible for specific outbreaks of gastrointestinal illness.
  - Massachusetts Water Resources Authority (MWRA) studies tend to show that combined sewer overflows (CSOs) are not the predominant source of viruses in ambient waters (other sources are predominant).

- We have limited data describing cyanobacteria in ambient water.

- Very little data, such as epidemiology studies, are available to directly characterize the health risks associated with blended discharges or more generally with the health risks associated with wet weather conditions.

- However, site-specific risk assessments can be done using information such as pollutant concentrations in discharges and exposure routes. Data have been gathered at some facilities, but are difficult to access; it would be helpful if the data were more accessible.

- NPSs often have a significant role if not the most dominant role in the high levels of bacteria indicators during wet weather conditions.
  - Data generally show that bacteria indicators in disinfected point source discharges, including blended discharges, are significantly lower than levels in the ambient water column. An example would be the *E. coli* Total Maximum Daily Load (TMDL) for the Kansas River.
  - For the purpose of this discussion, blended discharges are disinfected point source discharges that should be subject to permit limits.

- Bacteria indicators are not very good indicators for assessing the risk of viruses. Often, data are not available for virus levels in disinfected point source discharges. Disinfection greatly reduces the levels of bacteria indicators (which are measured), but, depending on the operation of the treatment plant, may have less of an impact on the levels of viruses (which typically are not measured).
    - A Food and Drug Administration (FDA) study showed that treatment plants were effectively removing viruses during dry weather, but not during wet weather.

- Most data on treatment plant performance focus on normal operation and, to a lesser degree, on extreme events leading to bypasses, overflows, or upsets. We need better data associated with wet weather conditions causing a treatment plant to be less effective than normal, but not at crisis conditions.

- More site-specific pathogen data from treatment plants—including analyzing for viruses, *Cryptosporidium, Giardia*, and enterococci—are needed for both dry weather and wet weather conditions. EPA could obtain this information via a national information collection request.

- Pathogens associated with particles are a concern.

- Many studies do not distinguish between pathogens/pollutants coming from blending and those coming from sewage overflows and other sources. Sometimes models can be used for estimating pathogen loads from various sources.

- We do not have data to compare normal biological treatment with physical/chemical treatment used for treating blended flows for removal of pharmaceuticals and personal care products.

- It is difficult to identify the source(s) of nutrients impacting a water body. We have tools to determine if they are coming from septic systems or wastewater, but other sources may be more difficult to characterize.

- FDA is in the process of conducting norovirus assessments to evaluate the risks of wastewater, including bypassed flows, on shellfish.
    - This work will include epidemiological data and data from people getting sick from eating food that may have been impacted from wastewater discharges.
    - The work assessments will look at data from treatment plants, including facilities that blend.

- FDA has looked at effluent from treatment plants where norovirus levels are low during dry weather, but can become significantly higher during wet weather events even though the wet weather effluent meets indicator bacteria limits.

- Some facilities that bypass do not provide disinfection or even primary treatment prior to discharging. Data from these facilities should not be used as a surrogate for data from facilities that blend.

- For beaches impacted by NPSs but not by point sources, bacteria indicators have generally been found to be poor predictors of health risks. For those waters, it is difficult to identify the parameters of water quality and their threshold values needed to protect public health.

- The relationship between water scarcity and wet weather flows was briefly discussed. Several engineering experts indicated that where wastewater was used for recharging ground water supplies that were used for drinking water, typically wet weather flows from treatment plants were diverted away from the recharge area. The technologies required to allow the use of wet weather discharges to supplement surface waters as an indirect source water, however, are available.

- The impacts of climate change on treatment are expected to be site-specific with increasing extreme events in some areas (e.g., the Midwest and North East) and decreasing extreme events in others. For some facilities, climate change is expected to increase the variability in flows and pollutant concentrations. It was suggested that the variability of concentrations and flows associated with blended effluent was currently large and that increases in variability associated with climate change could be adequately addressed through appropriate engineering planning.

Public Health Experts Discussion Session 2: Characterization of Pathogens and Pollutants and Associated Impacts

This discussion session focused on identifying key pollutants associated with discharges of blended effluent. The following question was provided on the agenda to introduce the session:

- *In addition to pathogens, what are the major classes of pollutants of concern for human health associated with wet weather flows/blending at POTWs?*

Specific comments from both public health and engineering experts:

Additional Concerns with Pathogens

- For shellfish, the pathogen of most concern is norovirus. Shellfish bioaccumulate viruses and other pathogens, so relatively short pulses of viruses can have an impact. Shellfish can retain norovirus for at least 21 days, possibly longer.

- Need to be careful in using the term "bioaccumulate" since it implies accumulation in tissue rather than attachment to tissue of bacteria and viruses.

- Data from Toledo, Ohio, indicate that it is possible for the correct system of treatment and disinfection to adequately control adenoviruses.
  - The wastewater industry should be thinking about using multiple barriers and disinfection processes.

- Alternative approaches might exist to regulating pathogens that do not rely heavily on indicators, such as looking at CT values or otherwise focusing on the parameters associated with the disinfection process. These approaches could be considered for nonblended flows as well as for blended flows. There is no single perfect bacteria indicator.

- Chlorination can lead to issues with byproducts. Monitoring for disinfection byproducts should be considered.

- The Clean Water Act (CWA) and EPA regulations do not specify requirements for disinfection, which are different at different plants depending state regulations. Consequently, plant and design and performance are different at different plants.

- The engineers believe that if they are given clear targets, they can achieve them with a high degree of probability.

Other Pollutants

- Some studies, including the EBMUD study, have looked at some pollutants other than pathogens. The issue of pollutants other than pathogens, however, can be a very broad topic.

Very limited data are available for emerging pollutants in discharges from sewage treatment plants. For these pollutants and others, like metals, data distinguishing between blending and nonblending conditions are probably not available.

- Antibiotics and antibiotic-resistant bacteria may be an issue. There should be greater monitoring to determine sources (e.g., agricultural NPS, point source).

- Data are available on pharmaceuticals and personal care products and other emerging constituents of concern in effluent. Data show there can be a small increase in some compounds during wet weather.

- Analytic methods have gotten better, so it is possible to detect more pollutants.

- Nutrients are a complex issue. They are primarily a dry weather issue, and it is unclear how they fit into the blending discussion.

- Issues with nonmicrobial pollutants, including emerging pollutants, may be issues with wastewater treatment in general, not specifically related to blending scenarios. The major concerns with some pollutants, such as pharmaceuticals and personal care products, are associated with chronic impacts, and short-duration, infrequent discharges that may occur with blending, may be less important than typical baseline concentrations in receiving waters.

- Biological processes might play an important role in reducing the concentration of some pharmaceuticals and personal care products. Residence time in the biological reactor is usually an important variable. We are not suggesting that short-term exposure to pharmaceuticals and personal care products is a major concern, but we do not have good data comparing the treatment of those chemicals during blending relative to normal biological treatment.

- Data are inadequate to determine whether normal dry weather treatment and stressed biological treatment provide comparable levels of treatment for endocrine disruptors.

- In the absence of performance data, it was reasonable to expect degradation of the treatment plant performance when flows exceeded the design capacity of the plant.
    - Where available, however, local performance data provide a more accurate assessment of when plant performance degrades as the design capacity is only the starting point for looking at performance.

- For some pollutants with chronic impacts, you want to focus on having the biological treatment units operate effectively for as long as possible. The current regulatory framework works against maintaining the most effective biological treatment by requiring operators to force high wet

weather flows through their biological treatment units, which leads to less effective biological treatment during dry weather conditions.

Public Health Experts Discussion Session 3: Key Factors Affecting the Human Health Risks of Wet Weather Discharges from POTWs

This discussion session focused on the human health risks of wet weather discharges, including blended and nonblended discharges, from POTWs. The following questions were provided on the agenda to introduce the session:

- *What are the key factors that affect public health risk associated with the discharge of these pathogens and pollutants (e.g., frequency of discharge, duration, use of auxiliary wet weather treatment, receiving water uses, exposure pathways, temperature, climate)?*
- *What emerges as high-risk scenarios?*
- *What emerges as low-risk scenarios?*

Specific comments from both public health and engineering experts:

- Some recent studies of dose-response curves appear to show that it might be better to blend than to bypass directly. Other considerations might be the costs and performance of auxiliary disinfection units that are needed for direct bypasses.

- Concentration of pathogens and dilution (or lack of dilution) are two of the most significant factors in determining the risk of bypasses and other wet weather discharges.

- Cultural methods of measuring *E. coli* might not pick up stressed cells and, therefore, could underestimate true *E. coli* levels.

- A high-risk scenario would be a combined sewer system with frequent overflows and bypasses with very little treatment. A low-risk scenario would be limited potential exposure (e.g., recreational uses are many miles downstream and waters are posted for hazards). Risks might be lowered by public notification, education, and handwashing.
    - The difference in risk scenarios shows that each treatment plant should be treated differently.

- The uses in the receiving water that might be impacted (e.g., drinking water intakes, shellfish, recreation) are important for evaluating the risk of blending. This information can be used to identify exposure pathways.

- Risk must be evaluated on a case-by-case basis. A site-specific risk-based framework is appropriate.

- It is very risky to assume that blending at different facilities is the same and will lead to the same results. The specific circumstances of a facility must be evaluated.

- The value of plant operation and operator training cannot be underestimated. It takes a lot of skill to deal with treating wet weather flows. A risk-based framework should consider how well a plant is run.

- Blending seems a better option than washing out biological treatment units or bypassing without blending. Auxiliary wet weather treatment can be used to lower risks.

- Given operational and design differences, operational targets need to be provided.

- Given site-specific factors that impact risk, it might not be a top priority to invest limited wastewater/water quality resources into reducing/eliminating blending.

- Existing discharge monitoring reports might provide data describing only dry weather plant performance.

- It is important to give plants flexibility to optimize their performance. One-size-fits-all does not work.

Public Health Experts Discussion Session 4: Understanding the Public Health Risks of Blended Discharges

This discussion session focused on how different blending scenarios, including blending with and without auxiliary wet weather treatment, affect the human health risks of discharges from POTWs. The risks associated with discharges associated with different blending scenarios were compared to other wet weather discharges. The following questions were provided on the agenda to introduce the session:

- *How do the health risks from blended discharges without auxiliary wet weather treatment compare to the health risks of blended discharges with auxiliary wet weather treatment?*
- *How do the health risks from blended discharges (with and without auxiliary wet weather treatment) compare to the health risks of discharges that occur under wet weather conditions from facilities that provide conventional biological treatment followed by disinfection?*
- *How do the health risks from blended discharges (with and without auxiliary sidestream treatment) compare to the health risks of other wet weather discharges from NPSs (e.g., rural, agricultural, and urban runoff) and POTWs (e.g., collection system overflows, bypasses that are discharged directly without blending)?*

Question 1: *How do the health risks from blended discharges without auxiliary wet weather treatment compare to the health risks of blended discharges with auxiliary wet weather treatment?*

Specific comments from both public health and engineering experts:

- There was general consensus in earlier discussion sessions that the greatest health risks associated with blending come from pathogens and that some infectious agents, such as viruses and protozoa, seem to be of greater concern and are more difficult to treat than bacterial pathogens.

- There are no epidemiological studies that compare the health risks of blended flow with and without auxiliary treatment. Therefore, data describing indicators and pathogens in blended discharges with and without auxiliary treatment to evaluate risk must be reviewed. Site-specific data on viruses from facilities with and without auxiliary treatment would be very useful. The potential for exposure also comes into play. The collection of epidemiological data specific to blending would be challenging for a number of reasons, including the short and infrequent events.

- If you base risk estimates on data on the concentrations of indicator bacteria, one hypothesis would be to consider “normal” sewage treatment plant effluent during dry weather periods as a baseline, effluent that receives secondary treatment during wet weather conditions (with no blending, but holding flows with storage) is higher risk because the biological treatment unit is less effective during high flow conditions, and wet weather blending without auxiliary treatment

is higher risk still. It is not clear where blending with auxiliary treatment falls on this spectrum. Also, we have not seen good data on the holding flows with storage and no blending scenario.
    - This hierarchy of risk would not always hold true and other factors, such as the efficiency of the treatment unit, could come into play.

- The disinfection unit is the key unit for reducing risk, although the requirements for the disinfection process are undefined or defined in terms of bacteria indicators. Performance of disinfection units is site-specific. Different disinfection units treat viruses differently. UV seems to perform better at controlling viruses than chlorination. If auxiliary treatment lowers the concentrations of key pathogens, risks to the public are reduced.

- The engineering experts indicated that data are available to show that auxiliary treatment removes pathogens and bacteria indicators. This does not mean, however, that auxiliary treatment is necessary in all cases.

- When considering the question of whether auxiliary treatment is necessary, a lot of site-specific factors come into play, including exposure potential during wet weather conditions.

- It is a major assumption that meeting permit limits based on bacteria indicators adequately reduces risk regardless of the treatment process. The performance of all treatment processes at high plant flows needs be considered.

- Using auxiliary treatment during wet weather blending can improve performance of the disinfection unit as the quality of the influent to the disinfection unit is important. Other factors can be more important, too, such as the treatment train and how it is operated, the duration and frequency of the discharge, potential human exposure, and background concentrations.

- Disinfection might be the most important variable. A strong disinfection unit might be a more important factor than whether auxiliary treatment is provided prior to blending. Virus removal will also depend on the type of disinfection (e.g., UV, chlorination).

- Concerns were raised about relying on epidemiological data because they are not always accurate, are hard to measure, and might not address extreme variations in treatment plant performance.

- In the wastewater area, parameters for disinfection are poorly defined. The drinking water model for defining disinfection parameters is better because disinfection is defined in terms of order of magnitude of inactivation or removal.

- Using multiple disinfection processes (e.g., UV and chlorination) might be appropriate to address a broader spectrum of pathogens. It would be helpful to identify the reduction thresholds for specific pathogens necessary to protect human health.

- Data from EBMUD, a facility that does not provide auxiliary treatment prior to blending, indicate that *Cryptosporidium* levels were similar with blending and without blending. *Giardia* levels were higher in blended effluent. Adenovirus levels in blended flows were slightly higher, but not statistically different.

Question 2: *How do the health risks from blended discharges (with and without auxiliary wet weather treatment) compare to the health risks of discharges that occur under wet weather conditions from facilities that provide conventional biological treatment followed by disinfection?*

Specific comments from both public health and engineering experts:

- The options for avoiding blending are storage, increased biological treatment capacity, and I/I removal. We are being asked if blending with auxiliary treatment is better than those options. We should not be comparing blending data with dry weather (i.e., nonstressed, nondiluted) conditions.

- When comparing blending and nonblending scenarios, it is important to consider that stored wastewater changes with time. The longer the wastewater is held, the more it changes and the harder it is to treat it.

- Wastewater might be very difficult/expensive to put in storage at an urban setting.

- Reducing I/I from private laterals might be an appropriate long-term solution, but it will take a long time to implement that approach.

- Looking at the EBMUD plant, when peaking factors were about 3, the risks between blending and forcing water through the biological unit were about the same. Biological treatment units, however, could be damaged at the peaking factors at other sewage treatment plants that are not operated as well as at EBMUD. The risks of damaging the biological unit and discharging more pathogens rise when flows above those levels are put through biological units.

- Specific site-specific factors (e.g., treatment train, energy use, costs, benefits, location of discharge) must be reviewed to determine if auxiliary treatment is appropriate.

- Existing studies, including at Lawrence, Kansas, provide justification for auxiliary treatment over stressed biological systems, based on protection of public health considerations. The issue of

whether auxiliary treatment is appropriate for a given site should be based on data. Proper engineering and operation are necessary.

- There are data gaps regarding microbial composition of effluent from facilities that blend compared with effluent from comparable facilities that do not.

- It is difficult to fully characterize blending as a uniform impact on health because it can occur with rain events of varying magnitude, which likely present different risks.

- Energy use associated with increased biological treatment units is a consideration. One study justifies auxiliary treatment based on energy use of alternatives.

- Auxiliary treatment units do a good job on bacteria indicators like *E. coli*. In some cases, auxiliary treatment units perform better than biological treatment units operating during dry weather conditions.

- Determining whether auxiliary treatment is appropriate for a facility that uses blending is a site-specific question. One option should be to improve the disinfection unit rather than to put in auxiliary treatment.

- When doing risk assessment models, it is important to look at the loadings of pollutant parameters.

- More facilities are providing nutrient controls, such as biological nutrient removal (BNR). This trend might create more of a need to blend as BNR units are more sensitive to high, wet weather flows.

- Getting flows to the plant is better than collection system overflows and backups.

- There are little or no data showing a public health impact associated with blending.

- The basis for plant design should be providing disinfection. The plant also should prepare flows for disinfection.

- Plant operator variability is a significant factor. Plant operation is almost an art and can dramatically impact the quality of the effluent during high-flow conditions.

- Concerns about the regulatory endpoints that are typically used include the potential for a false sense of security associated with relying too heavily on permit requirements that might not address all public health risks.

- When the costs of blending are being evaluated, the costs associated with public health should be considered at the same time.

- When public health impacts are being evaluated, the frequency and duration of blending should be considered at the same time.

- The MWRA study looking at ambient concentrations of bacteria indicators showed increases close to shore, which are probably caused by NPSs and CSOs, and not by discharges from the treatment plant.

Question 3: *How do the health risks from blended discharges (with and without auxiliary sidestream treatment) compare to the health risks of other wet weather discharges from NPSs (e.g., rural, agricultural, and urban runoff) and POTWs (e.g., collection system overflows, bypasses that are discharged directly without blending)?*

Specific comments from both public health and engineering experts:

- Flows that are untreated (e.g., overflows, septic systems, NPSs) are generally more dangerous than blended flows. As a general rule, untreated flows (e.g., NPS flows) pose greater risks than treated flows.

- There is a lot of uncertainty and limited data associated with the risks of NPSs.

- Comparing the health risks from NPSs with those of blending is difficult. It will be very case-specific. We do not have good data on pathogens in some sources of NPS. Some recent studies have been conducted by WERF and others.

- We typically assume that pathogens from a human source (including from septic tanks and biosolids that are NPS) are of greater risk than pathogens from animal sources.

- The following scenarios were ranked, as a general guide, by increasing risk:
  1. POTW with blending with auxiliary treatment and disinfection.
  2. POTW with blending with disinfection but no auxiliary treatment.
  3. NPS.
  4. The highest risk scenarios were sewage overflows, where risk depends on where it is released and volume.
  5. Bypasses coming off the initial screen, which are essentially raw wastewater.

- Toxics from blue-green algae are being recognized as a significant risk, particularly for drinking water, but also in recreational water. Nutrient control is important for reducing blue-green algae risks and is becoming a higher priority for both point and nonpoint sources. Auxiliary treatment can be used to reduce phosphorus from treatment plants during wet weather.

- Risks depend on the use of the water. Shellfish bioaccumulate viruses and other pathogens.

- Most outbreaks caused by shellfish are associated with noroviruses that come from human sources. A sanitary survey or fecal coliform test can be used to look at other nonhuman sources of pathogens.

- Utilities should try to maximize flows to sewage treatment plants since dealing with issues at the plant is more desirable than sewage overflows and basement backups. Blending is lower risk than overflows. In addition to the discharge being better quality, the discharge location of blended flows is controlled.

- MWRA did a study that looked at indicator levels in the area around the plant outfall and did not record increases in indicators associated with blending. We need to use our money to address the most pressing problems.

- Site-specific fate and transport factors need to be considered. FDA has tracked virus particles over 3 nautical miles from a small-volume discharge. Wet weather can lead to varying dynamic ambient conditions.

Additional Observations from Session 4

- A site-specific risk-based framework is the best way to address blending. Communities might have to invest in things that are not helpful if the risk of blending is not evaluated on a case-by-case basis.

- We need to understand the specific scenario of blending that is being used at a plant and place it into the context of its overall treatment objectives.

- Risks associated with pathogens dominate the blending issue. Pathogens might be 95–98 percent of the problem.

- Acute, rather than chronic, public health concerns should be the primary concern when evaluating potential blending impacts.

- Auxiliary treatment is a good tool in the toolbox. We need to explore when and how it should be used.

- It appears that solutions exist for wet weather treatment plant problems. They could reduce health risk relative to bypassing disinfection or disinfecting poor quality effluent.

- Treatment goals and endpoints must be understood when treatment trains are being evaluated for blending.

- Given the options that sewage treatment plant operators have during wet weather, it would be better from a risk perspective to look at high-flow treatment to protect public health rather than just blending. Blending is not the only wet weather issue for sewage treatment plants.

- Looking at pathogen data in effluents and receiving water is helpful for evaluating risks since no epidemiological data exists that directly address blending. Public health surveillance is important.

- Blending can be a practical control strategy but it is very site-specific based on treatment plant capacity and performance as well as on expected human exposures.

- Trying to make general comparisons of the health risks of overflows, bypasses, and blending is difficult. The risk comparisons must be made on a site-specific basis looking at factors like location, potential exposure, and frequency. If they are not evaluated on a case-by-case basis, results may not be helpful.

- Wet weather flows decrease the efficiency of biological treatment units.

- It is unclear whether auxiliary treatment units should be used during dry weather or other flow scenarios to provide additional treatment.

- While pathogens are the greatest risk, other potential risks about which less is known cannot be ignored.

- No one is saying that blending is worse than overflows or bypasses without disinfection.

Public Health Experts Discussion Session 5: Using Indicators to Evaluate Human Health Risks

This discussion session focused on the suitability of commonly used water quality indicators to characterize the health risks associated with blended discharges from POTWs. The following questions were provided on the agenda to introduce the session:

- *Are the 2012 Recreational Water Quality Criteria (RWQC) appropriate indicators for the bacteria/pathogen risks to human health associated with blending? Can those indicators be used to characterize an acceptable risk of blending? Is the 2012 RWQC approach of establishing targeted risk levels relevant to protecting the health of the public from exposure to wet weather flows? Does it matter if the blending scenario includes auxiliary treatment?*
- *Are permit limits based on the secondary treatment regulations appropriate indicators?*
- *What representative monitoring locations (e.g., end-of-pipe, prior to blending) and parameters are adequate for characterizing and evaluating the risks of blended discharges to human health?*

Sharon Nappier (EPA) provided background on the RWQC released in November 2012. The EPA issues ambient water quality criteria recommendations for recreational waters under the authority of the Clean Water Act (CWA) section 304(a). The CWA, as amended by the Beaches Environmental Assessment and Coastal Health (BEACH) Act in 2000, requires the EPA under sections 104(v) and 304(a)(9) to conduct studies associated with pathogens and human health, and to publish new or revised criteria recommendations for pathogens and pathogen indicators based on those studies. The 2012 draft CWA section 304(a) recreational criteria are new or revised CWA section 304(a)(9) criteria.

EPA 2012 RWQC are health-based, drawn upon the latest research and science, and based on epidemiological studies showing a link between gastrointestinal illness and fecal indicator bacteria in recreational waters. They are based on two sets of numeric concentration thresholds for bacterial indicators: *E. coli* and enterococci. The RWQC consist of three components: magnitude, duration, and frequency. Water quality criteria recommendations are intended as guidance to the states for establishing new or revised water quality standards.

The 2012 RWQC were based on studies used in creating the 1986 RWQC and more recent information, including the National Epidemiological and Environmental Assessment of Recreational Water (NEEAR) data. The NEEAR study was a prospective cohort epidemiological study and enrolled participants at the beach at nine study sites and followed them for an appropriate period of time to compare the incidence of gastrointestinal illnesses between swimmers and unexposed groups. The study sites included seven temperate beaches primarily impacted by wastewater treatment plants, a temperate beach impacted by urban runoff sources, and a tropical beach. EPA also considered other research and studies relevant to the development of the 2012 criteria[1].

[1] "Criteria Document: Recreational Water Quality Criteria" 2012, Office of Water 820-F-12-058. (http://water.epa.gov/scitech/swguidance/standards/criteria/health/recreation/upload/RWQC2012.pdf)

EPA's research indicates that the source of contamination appears to be an important factor for understanding the human health risk associated with recreational waters and that the potential human health risks from human versus nonhuman fecal sources can vary. The risk presented by fecal contamination from nonhuman sources has been shown in some cases to be potentially less than the risk presented by fecal contamination from human sources. EPA's research indicates that some nonhuman fecal sources (cattle in particular) may pose risks comparable to the risks from human sources. Other nonhuman fecal sources (e.g., pigs, chickens, birds) may pose less risk than human sources[2].

Specific comments from both public health and engineering experts:

Use of 2012 Recreation Water Quality Criteria

- The general concept of starting at a quantified risk level and working backwards to develop appropriate levels of indicators makes a lot of sense from a public health point of view. The NEEAR studies can correlate human health to indicator presence. The 2012 bacteria indicators for recreational waters, however, may not fully protect public health in the context of blending because they can lead to a false sense of security if disinfection focuses on bacteria, but does not adequately address other pathogens (e.g., viruses or protozoa).

- The wastewater industry should be looking at diagnostics as well as additional tools (e.g., male-specific coliphage).

- Some treatment facilities have used quantitative microbial risk assessments (QMRAs) to track sources of fecal pollution.

- A risk-based framework allows for looking at more parameters.

- Bacteria indicators are best used to characterize process performance.

- Bacteria indicators have—and will continue to have—an important role in protecting shellfish. They have limitations, however, when they, by themselves, do not work well. Treatment plants that use chlorine disinfection run the risk of having significant levels of viruses discharged when the plant has a failure or efficiency issue or when the disinfection process kills most bacteria, but not viruses. After a release, viruses live longer than bacteria, so measuring the concentration of bacteria in ambient waters can lead to a false sense of security under certain conditions, including wet weather, when the bacteria levels are safe but viruses remain.

[2] Schoen, M.E., Ashbolt, N.J. 2010. Assessing Pathogen Risk to Swimmers at Non-Sewage Impacted Recreational Beaches. Environmental Science and Technology 44 (7): 2286-2291. Soller, J.A., Schoen, M.E., Bartrand, T., Ravenscroft, J., Wade, T.J. 2010b. Estimated Human Health Risks from Exposure to Recreational Waters Impacted by Human and Non-Human Sources of Faecal Contamination. Water Research 44(16): 4674-4691

- The FDA is conducting research to define a potential role for male-specific coliphage in the shellfish program. Male-specific coliphage might provide a better indicator than bacteria for evaluating treatment efficiency.

- Bacteria indicators have been questioned for decades. It would be helpful to develop better pathogens indicators or to measure pathogens directly.

- Developing nonbiological indicators of reducing risk to certain risk levels might be helpful for looking at disinfected flows (e.g., setting minimum disinfection levels based on log removal). The key to looking at log removal is to verify through monitoring an appropriate parameter. Designing for log removal is not enough.

- A Milwaukee demonstration study showed that physical/chemical high-rate treatment followed by UV disinfection provided log reductions for *E. coli,* fecal coliform, and F^+ coliphage similar to an existing full-scale primary treatment, activated sludge, and chloramination facility. Results also indicated that reduction of adenoviruses and enteroviruses by UV disinfection at 40 mJ/cm^2 was similar to chloramination.

- While bacteria indicators are not perfect, they have withstood the test of time. The wastewater industry needs treatment targets for which to design.

- FDA has data on norovirus levels for at least 20 plants; however, the data have not been analyzed yet.

<u>Secondary Treatment Criteria</u>

- TSS and biochemical oxygen demand (BOD) are related to the treatment process and are not related to human health, although TSS can be used when evaluating log reductions of pathogens because pathogens attach to particles.

- Seven-day averages are not good for evaluating acute risks associated with 1-day events.

- Questions exist about whether TSS and BOD can be correlated with pathogens.

- TSS can be used as an indicator to show that wastewater is ready to be disinfected.

- Ammonia could be the single most important parameter for ensuring consistent disinfection. Plants can experience large peaks in ammonia during the day. Continuous monitoring of ammonia might be important.

- BOD is irrelevant when evaluating whether effluent can be disinfected.

- A recent WERF study of seven reclaimed water facilities showed that removal of *Cryptosporidium* is correlated to TSS removal, as *Cryptosporidium* removal rate increases as removal of TSS increases, but this is a correlation and does not give you prediction.

- EBMUD has data to show that giardia levels go up when TSS levels go up, but not enough data to determine whether there is a mathematical relationship.

- Data on pathogen removal are available. Data from plants served by combined sewers should be considered.

- The WERF study showed that ammonia levels are important for chlorination disinfection.

- The results for bacteria indicators, which use culturable test methods, do not come back soon enough to identify acute events or to influence managing the treatment process. Sampling for a 1- or 2-hour event is unsatisfactory, in part because the operator is focusing on other activities besides sampling. Continuous data are needed. Continuous data collection for TSS is better than for BOD.

- The shellfish protection program is a preventative program that requires a trigger to force action. FDA uses a flow-based trigger to close shellfish beds. The flow-based trigger looks at plant design capacity or performance data.

- Looking at process control and management of the treatment system can provide additional information not picked up by other indicators.

- States that use daily maximum values in water quality-based effluent limitations (WQBELs) should base the limit on acute—not chronic—water quality standards.

Public Health Experts Discussion Session 6: Additional Data Needs

This discussion session focused on additional data needs that could help improve the characterization of the health risks of blended discharges from POTWs. The following questions were provided on the agenda to introduce the session:

- *When evaluating a facility that blends, what representative site-specific data would help to evaluate the health risks associated with the facility's blended discharges?*
- *What national-level data would give a better picture of blending?*

Specific comments from both public health and engineering experts:

- One public health expert indicated that since EPA has limited this discussion to blending at sewage treatment facilities that are served by sanitary sewer collection systems, then data from treatment plants that are served by combined sewers should not be considered in this forum. The expert indicated that it would be best to broaden the scope of the forum to discuss the risks of blending from sewage treatment facilities that are served by sanitary sewers and those served by combined sewers.
    - Several engineers indicated that some of the data in their presentation came from sewage treatment facilities that were served by combined sewers, while other data (e.g., Lawrence and EBMUD) came from sewage treatment facilities served by sanitary sewers. However, a wealth of good data from CSO communities would be missed if it was not considered.

- Three levels of monitoring should be considered: 1) compliance monitoring, 2) operational efficiency, and 3) log reductions.

- Monitoring has several purposes: end-of-pipe monitoring for compliance, receiving water data for evaluating water quality, and operational data to determine efficiency. Receiving water data from key exposure locations might be better than end-of-pipe monitoring because it gives a more realistic view of exposure.

- Using multiple biological and nonbiological indicators would be an improvement over the current approach.

- End-of-pipe data should be used for regulatory/compliance purposes. Plant operators can evaluate plant performance from internal sampling locations, but compliance should be based on end-of-pipe data.

- End-of-pipe data are critical because they ultimately impact the public's exposure to pollutants.

- EPA needs to issue a comprehensive information collection request (ICR) to the wastewater industry for current data, including data on blending.

- End-of-pipe data by itself might not be the best data to use to evaluate exposure risk because, hopefully, people are not standing at the outfall. Ambient monitoring at appropriate locations can be more useful in evaluating exposure.

- End-of-pipe monitoring is important for characterizing the performance of a treatment plant. *Cryptosporidium* and norovirus are important to gauge overall pathogen risk and could be monitored, in the context of research, along with other parameters, like turbidity, that can be analyzed inexpensively.

- Given the complexity of water quality impairment issues in general and the complexity of wet weather blending, tools like a diagnostics approach could help take the next step in CWA implementation.

- Enterococci is more resistant to chlorine disinfection and can help evaluate health risks.

- In the Great Lakes, many indicators are used.

- There doesn't appear to be a major public health issue associated with blending.

- More performance monitoring would be helpful, particularly for taking into account the site-specific nature of different plants. The use of male-specific coliphage data to evaluate disinfection performance should be explored. Measuring male-specific coliphage uses rapid methods, which would be more helpful.

- Male-specific coliphage might not be a good indicator for noroviruses. It is not necessarily correlated with norovirus, but can be an indicator of pathogen risk because the two are similar in size and shape and might give an idea of how norovirus behaves.

- Determining log removals of pathogens can be done by measuring predisinfection and postdisinfection.

- It would be helpful to see more data on the removal of specific organisms.

- Plants can experience large peaks in ammonia during the day. Continuous monitoring of ammonia at chlorine disinfection plants is important given the impact of ammonia on disinfection. It would be helpful to see more emphasis on how to measure ammonia in nonblending and blending scenarios.

- For plant operators, better data on removal rates of individual unit processes would be helpful.

- The significant amount of data currently in the regulated community should be collected before it is lost.

Data at the National Level

- As medical data become more available because of electronic data systems, disease outbreaks could be looked at more carefully. On a national scale, more accessible data associated with electronic data systems have potential for helping FDA improve public health protections in shellfish growing areas.

- It would help to have a better compilation of data and then to look for data gaps.

- UV manufacturers have data on their equipment.

- It was suggested that EBMUD expand its study to 40 sites across the country.

Forum Conclusions

Key Take-Away Points for EPA from Public Health Experts

- One size does not fit all.
- Look at other priorities of facilities when looking at wet weather issues.
- Develop targets (effluent limits) and let the engineers design a solution. Targets based on log removal should be considered.
- Consider the technical challenges of operating auxiliary treatment, particularly for very large facilities (e.g., MWRA would need over 700 MGD of auxiliary capacity if all wet weather diversions needed treatment).
- If blending results in pathogen concentrations comparable to those achieved by disinfected biological treatment, no compelling reason exists to question the public health impacts of blending under those conditions.
- No single parameter can be used to evaluate whether blended effluent is "safe". Blending data should be compared with data from other treatment scenarios.
- The uses of receiving waters should be considered when evaluating the appropriateness of blending.
- Climate change will increase the wet weather challenge.
- Although we know a lot about the blending issue, there is much we do not know. EPA should develop a research agenda for key areas.
- Blending is a small part of the wet weather flows universe—blending should be evaluated in the context of other wet weather flows. Other wet weather problems typically are occurring before flows at the plant are sufficient to cause blending.
- Viruses are the biggest public health concern with blending; however, existing bacteria indicators are not the best tool for evaluating viruses.
- Wet weather flows, including blending, can have a downstream affect. More work should be done on how this affect ties into other elements of EPA programs (e.g., mixing zones).
- EPA and FDA should talk about how their respective programs tie together.

- Better indicators are needed to better characterize health risks.
- Different monitoring locations would help more accurately characterize public health risks.
- Evaluate data from different treatment plants that blend as treatment plant design and operation are site-specific.

Key Take-Away Points for EPA from Engineering Experts

- Site-specific solutions are needed. No one approach is best for all facilities.
- Blending events have a short duration and are infrequent. The risks tend to be acute, not chronic.
- When conducting site-specific risk assessments, look at how NPSs impact background pollutant levels of receiving streams.
- Microbial pathogens are the primary concern with blending.
- Wet weather treatment at the plant can be designed to remove pathogens better than overflows.
- New guidance for applying site-specific criteria to wet weather challenges has been developed for watershed planning and collection system and treatment plant design and operations.
- Design capacity of a treatment plant is only one indicator of performance problems. Actual plant performance must also be evaluated.
- There is a low likelihood of using epidemiological studies to characterize the health impacts of blending. Comparing pathogen levels in discharges from various blending and nonblending scenarios is important.
- While some data on blending are available, more are needed. EPA should provide funding to collect additional data.

Appendix A: Forum Attendees

Attendee	Affiliation
Fred Andes	Barnes & Thornburg
Yaping Ao	U.S. FDA
Emily Ashton	U.S. EPA (ORISE)
Dr. Kati Bell	Engineering expert
Connie Bosma	U.S. EPA
Paul Buellesbach	Eastern Research Group, Inc.
Gary Cohen	Hall & Associates
Andy Crossland	U.S. EPA
Loren Denton	U.S. EPA
Dr. Samuel Dorevitch	Public health expert
Cynthia Finley	NACWA
Jim Fitzpatrick	Engineering expert
Holly Galavotti	U.S. EPA
Stefanie Gera	Tetra Tech
Matthew Gigliotti	Kansas City Water Services
Curtis Glenn	U.S. EPA
Gregory Goblick	Public health expert
Joseph Goergen	Genesee County WWS-ARTP
Dr. Donald Gray	Engineering expert
Jessica Gray	Eastern Research Group, Inc.
Rob Greenwood	Moderator, Ross Strategic
John Hall	Hall & Associates
Becky Hammer	Natural Resources Defense Council
Gregory Heath	AECOM
Chris Hornback	NACWA
Dr. Anwar Huq	Public health expert
Dr. Joseph Jacangelo	Public health expert
Dr. Joh Kang	Tetra Tech
John Kosco	Tetra Tech
David LaRoss	Inside EPA
Mary Ellen Levine	U.S. EPA
Deborah Nagle	U.S. EPA
Sharon Nappier	U.S. EPA
Adrienne Nemura	Geosyntec Consultants
Sharon Nicklas	Hampton Roads Sanitation District
Dr. Adam Olivieri	Public health expert
Thomas Perry	Veolia
Mark Pollins	U.S. EPA
Dr. Betsy Reilley	Public health expert

Attendee	Affiliation
Cindy Roberts	U.S. EPA
Sean Rolland	ACWA
Dr. Joan Rose	Public health expert
Marian Rutigliano	U.S. EPA
Amena Saiyid	Bloomberg BNA
Dr. Julian Sandino	Engineering expert
Andrew Sawyers	U.S. EPA
Susan Shinkman	U.S. EPA
Stanley Suel	Little Rock Wastewater
Christopher Tabor	Hazen and Sawyer
Claudio Ternieden	Water Environment Federation
Jim Vinch	U.S. EPA
Dave Wagner	Engineering expert
Robert C. Weaver	Kelly & Weaver, P.C.
Kevin Weiss	U.S. EPA

Appendix B: Federal Register Notice

The Federal Register notice is available at:

http://www.gpo.gov/fdsys/pkg/FR-2014-04-18/pdf/2014-08925.pdf

Appendix C: Agenda

Experts Forum on Public Health Impacts of Blending

DRAFT AGENDA

1:00 p.m.–5:30 p.m. Thursday, June 19, 2014
8:30 a.m.–4:00 p.m. Friday, June 20, 2014

10306 Eaton Place, Suite 340
Fairfax, VA 22030

Facilitator: Rob Greenwood, Ross Strategic

Public Health Experts	Engineering Experts
Dr. Joan Rose	Dr. Julian Sandino
Gregory Goblick	Dave Wagner
Dr. Anwar Huq	Jim Fitzpatrick
Dr. Joseph Jacangelo	Dr. Donald Gray
Dr. Adam Olivieri	Dr. Kati Bell
Dr. Betsy Reilley	
Dr. Samuel Dorevitch	
Dr. Charles Gerba	

Day 1—Thursday, June 19, 2014

Welcome

1:00 p.m.–1:10 p.m. Dr. Andrew Sawyers—Director, Office of Wastewater Management, Office of Water, U.S. EPA

- Welcome
- Purpose of forum
- Charge to the public health experts and engineers

1:10 p.m.–1:20 p.m. Rob Greenwood—Facilitator

- Introductions
- Purpose of forum
- Agenda review
- Logistics and ground rules

Expert Discussion

1:20 p.m.–2:40 p.m. Blending and Wet Weather Operations: An Engineering Perspective
(*A complete outline of this session is available at the end of the agenda.)*

- Executive summary
- The challenge of managing wet weather flows in POTWs
- Wet weather flow management options
- Recent case studies of wet weather flow management
- Recent guidance documents
- Conclusions

2:40 p.m.–2:50 p.m. 10-minute break

2:50 p.m.–3:45 p.m. Discussion Session 1: Knowledge Gaps and Major Areas of Uncertainty

- What is known about health risks of exposure to surface water impacted by wet weather flows (overall or for specific treatment approaches)?
- Where are the major areas of uncertainty and knowledge gaps in the literature about health risk of wet weather flows?
- This is an introductory session that will provide some initial thoughts about how the available literature addresses the topics in the various discussion sessions below. This is an underlying theme for the forum and may be revisited in different discussion sessions.

3:45 p.m.–4:30 p.m. Discussion Session 2: Characterization of Pathogens and Pollutants and Associated Impacts

- In addition to pathogens, what are the major classes of pollutants of concern for human health associated with wet weather flows/blending at POTWs?

4:30 p.m.–5:15 p.m. Discussion Session 3: Key Factors Affecting the Human Health Risks of Wet Weather Discharges from POTWs

- What are the key factors that affect public health risk associated with the discharge of these pathogens and pollutants (e.g., frequency of discharge, duration, use of auxiliary wet weather treatment, receiving water uses, exposure pathways, temperature, climate, etc.)?
- What emerges as high-risk scenarios?
- What emerges as low-risk scenarios?

5:15 p.m.–5:30 p.m. Observer Comments/Questions

Day 2—Friday, June 20, 2014

8:30 a.m.–9:30 a.m. Continue Discussion Session 3

9:30 a.m.–10:30 a.m. Discussion Session 4: Understanding the Public Health Risks of Blended Discharges (much of this will fall into the category of knowledge gaps, since there is so little information available in the epidemiologic literature to answer these questions)

- How do the health risks from blended discharges without auxiliary wet weather treatment compare to the health risks of blended discharges with auxiliary wet weather treatment?
- How do the health risks from blended discharges (with and without auxiliary wet weather treatment) compare to the health risks of discharges that occur under wet weather conditions from facilities that provide conventional biological treatment followed by disinfection?
- How do the health risks from blended discharges (with and without auxiliary sidestream treatment) compare to the health risks of other wet weather discharges from NPSs (e.g., rural, agricultural, and urban runoff) and POTWs (e.g., collection system overflows, bypasses that are discharged directly without blending)?

10:30 a.m.–10:40 a.m. 10-minute break

10:40 a.m.–11:40 a.m. Continue Discussion Session 4

11:40 a.m.–12:50 p.m. Lunch

12:50 p.m.–1:10 p.m. Observer Comments/Questions

1:10 p.m.–2:40 p.m. Discussion Session 5: Using Indicators to Evaluate Human Health Risks

- Are the 2012 Recreational Water Quality Criteria appropriate indicators for the bacteria/pathogen risks to human health associated with blending? Can these indicators be used to characterize an acceptable risk of blending? Is the 2012 RWQC approach of establishing targeted risk levels relevant to protecting the health of the public from exposure to wet weather flows? Does it matter if the blending scenario includes auxiliary treatment?
- Are permit limits based on the secondary treatment regulations appropriate indicators?
- What representative monitoring locations (e.g., end-of-pipe, prior to blending) and what parameters are adequate for characterizing and evaluating the risks to human health of blended discharges?

2:40 p.m.–2:45 p.m. 5-minute Break

2:45 p.m.–3:35 p.m. Discussion Session 6: Additional Data Needs

- When evaluating a facility that blends, what representative site-specific data would help to evaluate the health risks associated with the facility's blended discharges?
- What national level data would give a better picture of blending?

3:35 p.m.–3:50 p.m. Observer Comments/Questions

3:50 p.m.–4:00 p.m. Summary / Wrap-Up

4:00 p.m. Adjourn

The forum is open to the public to attend as observers. Because the seating will be limited, members of the public who wish to attend the forum must preregister at http://water.epa.gov/polwaste/npdes/sso/Experts-Forum-on-Public-Health-Impacts-of-Wet-Weather-Blending.cfm.

A call-in phone number will be provided to interested parties to allow off-site observers listen to the forum. If you would like to listen in, please email Adam Orndorff (adam.orndorff@tetratech.com) to obtain a call-in number.

Complete session outline for Blending and Wet Weather Operations: An Engineering Perspective (Day 1, 1:20 p.m.–2:50 p.m.)

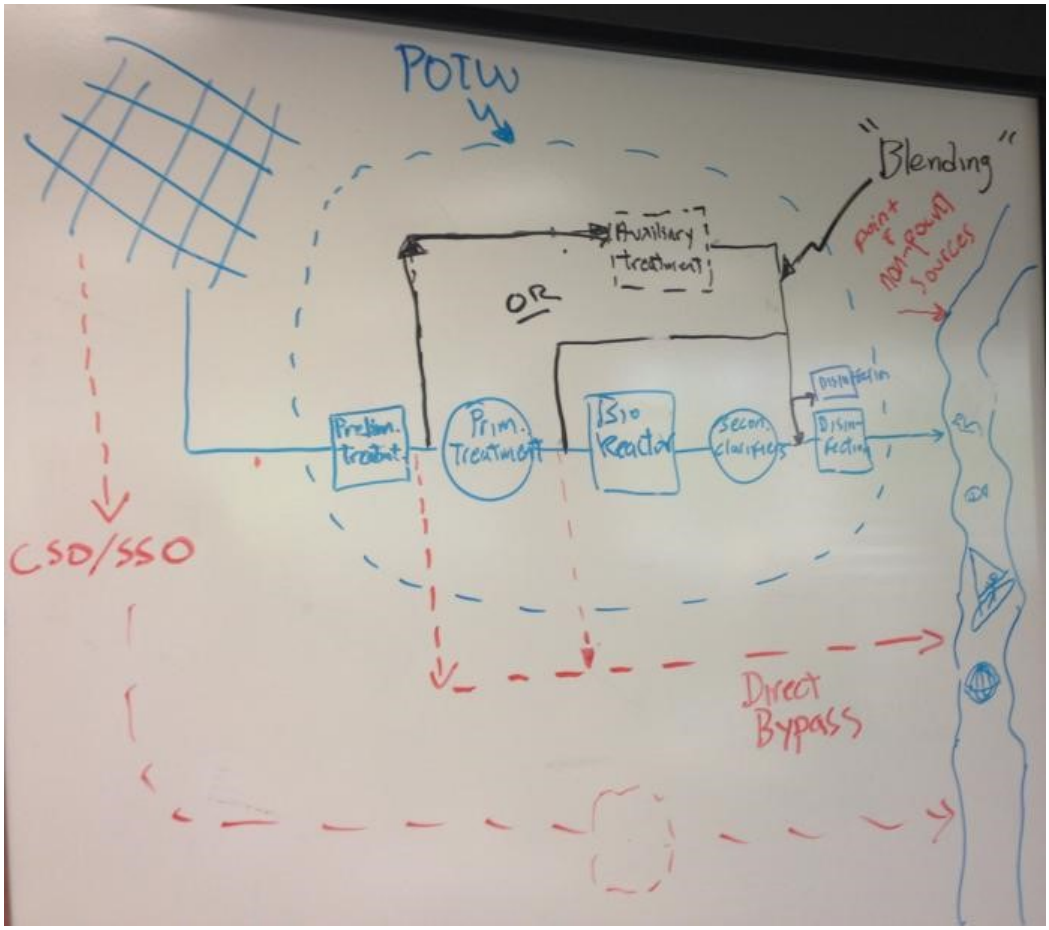
- Executive summary
- The challenge of managing wet weather flows in POTWs
  - NPSs vs. point sources
  - Flows resulting from I/I often exceed existing treatment capacity
  - Why established dry weather flow management approaches are not applicable
  - The dynamic nature of wet weather events
    - Receiving waters: low-flow vs. high-flow, chronic vs. acute risks
    - Defining influent flows, loads and concentrations: continuous vs. intermittent, steady-state vs. dynamic
  - Defining treatment objectives
  - Sustainable infrastructure investments
- Wet weather flow management options
  - Reducing peak flows through collection system improvements and storage
  - Maximizing use of existing treatment facilities
    - Limitations and risks to biological processes
    - Blending
  - Providing auxiliary treatment capacity
    - Overview of effluent disinfection processes and technologies
    - Overview of clarification processes and technologies

- Recent case studies of wet weather flow management
  - Milwaukee MSD Enhanced Clarification and Disinfection Demonstration Program (2006)
  - Impact of Wet Weather Peak Flow Blending on Disinfection and Treatment: A Case Study at Three Wastewater Treatment Plants—Interstate Environmental Commission (IEC 2010)
  - Characterizing the Quality of Effluent and Other Contributory Sources during Peak Wet Weather Events—EBMUD (WERF 2009)
  - Akron, OH, BioActiflo Testing Program (2012)
  - City of Toledo Pathogen Study (2013)
  - City of Lawrence, KS, Wet Weather Flow Management and Performance (2014)
  - Draft Summary of Blending Practices and the Discharge of Pollutants for Different Blending Scenarios (EPA 2014)
- Recent guidance documents
- Conclusions

Appendix D: Engineering Experts PowerPoint Used for Presentation

Note: The PowerPoint presentation is available at
http://water.epa.gov/polwaste/npdes/sso/upload/sso_forum_presentation.pdf

Appendix E: White Board Sketch



During the forum, several of the engineering experts created the diagram shown above to illustrate typical blending scenarios and to illustrate several overflow and bypass scenarios. The diagram was referred to several times during the forum and served as an aid to clarifying concepts.

APPENDIX F: Observer Comments

- We work with states to have a basis of design for blending. In Michigan, it's once in a 25 year/24-hour event or about 4 inches in southeastern Michigan. The same event in other cities might be 10 inches. If we treat everything up to that frequency event, than anything exceeding that flow we will bypass and bring it back to the disinfection treatment. How often does it occur, varies state to state for a 25-year/24-hour event. It's not a frequent thing. If it's below th25 yr/24 hr event, you have to provide full treatment. The coliform standard solves the problem of needing an appropriate indicator. Everyone has to start somewhere. Once you come up with a design standard, we'll then figure out how to meet it.

- Biological processes used for secondary treatment do not do much for virus removal. So treatment plant operators have to disinfect effluent that has gone beyond secondary treatment. Our current treatment and disinfection standards don't necessarily result in sufficient virus removals. My conclusion is that risk potential increases during wet weather. There are a lot of variables in wet weather events. Sometimes those systems just get overwhelmed. I'm curious to see if research has been done to track events and correlates to outbreaks based on data.

- Wet weather events change influent concentrations as well as flow rates. Biological nutrient removal (BNR) systems are going to be negatively impacted by wet weather events. When you push high flows through a BNR system, you will have slower recovery after the event.

- Even when a state sets an arbitrary design standard such as the 25 years/24-hour event, we have potential for washout. The other factor is how quickly facilities respond after the event. Everything can't be solved by secondary treatment. There are lots of engineering tools that can be cost- and engineering-effective. Global warming and climate change might lead to greater intensity and frequency of storms. Historically, when the state first adopted the 25 years/24 hour event storm, they had to demonstrate that the flow could be transported to the plant. One month before the report was finalized, they finally had that size event, and since then, there have been many more. We are seeing the landscape change and storm size increase. Let's build a system that can respond to these larger events and anticipate the events of the future.

- A question to the public health experts: A lot of the discussion upfront was unfocused and speculative because there isn't a lot of data. So you're left with "what if's". They are not always that helpful. All treatment plants performance-degrade under high flow. They perform adequately, but not optimally. The first question is: Do we have data that indicate that blending presents significant public health concern? If the answer is no, that would be good to know. Meeting water quality standards is the requirement under the CWA. That's what the engineers design to. If someone thinks that the water quality standards are not protected, the solution should be to change the water quality standards and let engineers proceed to design something that fits, not to prohibit blending. The engineers did show they can design to meet targets.

- I agree that the focus needs to be on receiving water characteristics and using realistic assumptions. Shellfish is regulated by the state setting an exclusion zone. We might want to look at certain thresholds just for shellfish.

- Most of the epidemiological studies will show the impacts of untreated sources like NPS, stormwater, or overflows, not blended discharges.

- EPA has told CSO communities that their blending is an illegal bypass. We have a large concern about that. CSO communities should not be taken off the table in this discussion.

- Discussion on risk is interesting, but the CWA does not provide for risk-based action. It's a standards-based program. Water quality standards should assess risk. If EPA wants to address pathogens in the secondary treatment regulation, they can. But under the current regulatory framework, we have a responsibility to focus on water quality standards.

- We are concerned about inconsistencies between states on how issues related to separate vs. combined systems are dealt with. We have some systems where the agencies have approved advanced flow. We have those communities that have been authorized in consent decrees and others where similar circumstances have been prohibited.

- It's important to protect designated uses. This means we need to get the water quality standards right, and let that standard drive what happens at the treatment plant.

- We can't have a one-size-fits-all approach. Disinfection should be based on site-specific needs.

- In Figure 1, what's in black described as blending would be described as an illegal bypass under the current approach, although that approach was generally supported by the experts.

- Plea to EPA: Please release information from this workshop. We'd love to see the output.

- There was a lot of uncertainties from yesterday and today. Please come up with a target for us, and we will come up with a solution. I see a need for additional data that we can collect once you specify what the target is. This will answer a lot of questions. Tell us what is the most critical aspect for you.

- Some of the conversation might lead to thinking that one side was for and one side against public health. I can say with confidence that public health is important for permittees, equipment manufacturers, and consultants.

- From a supplier standpoint, necessity drives innovation. Set a standard, and equipment manufacturers will spend money to meet it. If there is no need, no one wants to spend money to solve a phantom problem.

- There was a discussion that no data are available on conventional vs. blended with auxiliary treatment. I encourage experts to look at Akron, OH, data based on 20 wet weather events. Data compare before and after disinfection.

- The questions posed are unprecedented. Questions arise about why data (such as virus in treatment plant effluent, CSOs, etc.) and studies are not available when EPA never asked for them. I'm not shocked that the data don't exist for CSOs, stormwater, and physical/chemical treatment.

- The CWA establishes water quality standards to establish a protective level. That is the target we should use for blending.

- Dr. Rose was correct that a discussion on blending is not a non-CSO or CSO issue. Both types of communities blend, and any data developed are certainly valid. There should be no distinction made between data from CSO communities and data from communities without combined sewers.

- The Bio-Actiflo pilot in Akron, OH, was focused on the wrong question; the public health question should have focused on investing potentially billions of dollars for people getting sick from overflows from the service area and plant. Installing a full-scale Bio-Actiflo unit at the plant will cost on the order of $110 million. Preliminary analysis indicates that alternative approaches focusing on the collection system and plant could provide more reduction in raw sewage from the plant sooner for less money. My point is that it is less efficient to have EPA look at a particular technology and ask the community to install it. A much better approach would be for EPA to provide certain limits and give the engineers flexibility to meet the limits.

- For wet weather technologies that use bio-solids, like Bio-Actiflo, will they impact the performance of the plant? Do you want to put bio-solids that you have already removed with lots of other chemicals that have been added for physical/chemical treatment back into the plant?

- The outcome of this effort will drive the next dialog in terms of data. It was important to hear that more data are needed, and there is good data we can build on. The Water Environment Federation has been thinking about doing a literature review to better understand the body of information out there. I don't know what the timeframe is for that, but it will be on our agenda.