

U.S. Environmental Protection Agency
Environmental Financial Advisory Board
Stormwater Infrastructure Finance Task Force
Workgroup

Held by Teleconference
December 18, 2019, 12:00-2:00 pm EST

The minutes that follow reflect a summary of remarks and conversation during the meeting. The Board is not responsible for any potential inaccuracies that may appear in the minutes. Moreover, the Board advises that additional information sources be consulted in cases where any concern may exist about statistics or any other information contained within the minutes.

Meeting Purpose

The Environmental Financial Advisory Board (“EFAB” or “Board”) held a workgroup teleconference on December 18, 2019. EFAB is an Environmental Protection Agency (“EPA” or “the Agency”) advisory committee chartered under the Federal Advisory Committee Act (FACA) to provide advice and recommendations to EPA on creative approaches to funding environmental programs, projects, and activities. The purpose of this meeting was to bring together the Evaluating Stormwater Infrastructure Financing Task Force Workgroup (“the workgroup”) to discuss the drafted recommendations to be included in the final workgroup report and to determine necessary revisions prior to submitting the report to EFAB in January 2020.

Attendees

EFAB Members

- Lori Beary, Iowa Finance Authority
- Ted Chapman, S&P Global Ratings
- Lisa Daniel, Public Financial Management
- Ted Henifin, Hampton Roads Sanitation District
- Craig Holland, The Nature Conservancy
- Prabha Kumar, Black & Veatch
- Pam Lemoine, Black & Veatch
- Chris Meister, Illinois Finance Authority
- Bill Stannard, RAFTELIS
- Joanne Throwe, Throwe Environmental LLC

EFAB members unable to attend the meeting

- Rudy Chow, Department of Public Works, City of Baltimore
- Yvette Downs, Sewerage & Water Board of New Orleans
- Eric Rothstein, Galardi Rothstein Group
- Angie Sanchez, FCS Group

Expert Consultants

- Jerry Bradshaw, SCI Consulting Group
- David Bulova, Member, VA House of Delegates, 37th District
- Janet Clements, Corona Environmental Consulting
- Carrie Evenson, City of Norman, OK
- Laurie Hawks, Brown and Caldwell
- Lisa Kay, Alta Environmental
- Drew Kleis, City of San Diego, CA
- Rebecca Losli, Metropolitan St. Louis Sewer District
- Fernando Pasquel, Arcadis
- Elizabeth Treadway, Wood
- Chuck Walter, City of Sarasota, FL

Expert Consultants unable to attend the meeting

- Bethany Bezak, Tetra Tech
- Matthew Fabry, Redwood City, CA
- Carol Haddock, City of Houston Public Works
- John Lundell, City of Coralville, IA
- Ewelina Mutkowska, Ventura County Public Works Agency
- Mike Personett, City of Austin, TX

- Andrew Reese, AMEC Earth and Environmental

EPA Support Attendees

- Ellen Tarquinio, alternate EFAB Designated Federal Official, EPA
- Tara Johnson, EPA
- Britney Vazquez, EPA

Additional Attendees

- Seth Brown, Storm & Stream Solutions
- J.B. Dixon, Felsburg Holt & Ullevig
- Kevin Driscoll
- Ryan Frazier, Frazier Global Strategies
- Shannon Frede, Senator Cardin's Office, MD
- Elise Gout, notetaker, Cadmus Group
- Michael Hunt, Nashville, TN Metro Water Services
- Charles Job, National Groundwater Association
- Charlotte Katzenmoyer, Capital Region Water (Harrisburg, PA)
- Jason Kauffman, City of Goshen, GA
- Mark Matlock, Pennsylvania Department of Environmental Protection
- Spencer Peck, City of Atlanta, GA
- Suzanna Perea, EPA
- Therese Pogge, City of Omaha, NE Stormwater Program
- Jayshika Ramrakha, EPA
- Claire Richer, Senator Edward J. Markey's Office, MA
- David Schultz, Bloomberg Environment
- Elizabeth Skane, EPA
- John Stephen, Negley Run Watershed Task Force (Pittsburgh, PA)
- Andy Szatko, City of Omaha, NE Environmental Services
- Michael Trainque, Hoyle Tanner
- Rachel Urban, EPA

Welcome and Key Dates

Ellen Tarquinio welcomed the members of the workgroup and thanked them for joining the call. She informed them *Edward Chu*, the Designated Federal Official (DFO), was unable to attend, so she would be standing in as the alternate DFO. She reminded those on the phone that this is a call for the Stormwater Infrastructure Finance Task Force Workgroup under the EFAB, a FACA run by EPA.

Ms. Tarquinio also noted the call is a public meeting as listed in the federal register notice. She welcomed the members of the public who were on the call and asked that they refrain from participating during the workgroup discussion. Members of the public were reminded they could share any comments with the workgroup by emailing waterfinancecenter@epa.gov. Those who registered to speak during the public comment period would have an opportunity to speak for up to three minutes at the end of the call. She also informed everyone that notes, being taken by a designated notetaker, would be made publicly available at a later date.

Joanne Throwe, Co-Chair of the workgroup, thanked Ms. Tarquinio for her support.

Ms. Throwe proceeded with roll call. She asked that workgroup members unmute themselves and acknowledge their attendance upon hearing their name.

Updated Timeline and Key Dates of Report

Ms. Throwe then moved to reviewing the timeline for the workgroup report.

Ms. Throwe noted workgroup members would have until December 24, 2019 to provide feedback on the report. The workgroup will receive the final draft of the report on January 7, 2020 and will have until January 13, 2020 to provide their last round of comments.

Ms. Throwe stressed all comments from the workgroup will have to be incorporated into the final report by January 15, 2020. On January 15th, the final report will be submitted to the workgroup Co-Chairs who will then send it to EFAB. EFAB will conduct a three-week review of the report and provide comments by January 31, 2020. The workgroup will have the first week of February to address their feedback. During the February 2020 EFAB meeting in Washington D.C., EFAB members will vote on the workgroup report.

Ms. Throwe asked if there were any questions from the workgroup about this timeline. Hearing none, she moved on to discussing the recommendations of the report.

Recommendations

Ms. Throwe explained the workgroup would read through and discuss the recommendations in the order presented in the draft document which was shared with workgroup members before the call. Ms. Throwe said everyone would have an opportunity, after providing comments for each recommendation, to vote in a poll as to how they would like the workgroup to proceed.

Ted Chapman confirmed those on the call could see his shared screen and the draft recommendations document.

Ted Henifin noted some of the text in the draft recommendations document was in a lighter, grey font. He asked if there was any significance to this difference in color.

Ms. Tarquinio explained the lighter grey font signifies any textual changes or additions made by workgroup members during the previous round of revision. Ms. Tarquinio also carried over any comments left by workgroup members. She acknowledged several people had asked for the workgroup to discuss how to best order the recommendations during this call. She said the way the recommendations were presented in the current draft document reflects the order in which they were submitted, rather than an order of preference or importance.

Ms. Throwe read the first recommendation.

Educate communities that the creation of sustainable funding sources (for example, a stormwater utility with standalone rates and charges) can build financial capacity and improve operational capabilities and long-term savings.

Ms. Throwe said there were several comments made in response to this recommendation and opened discussion to the workgroup.

Mr. Henifin noted there was a recent addition of the phrase “and long-term savings” to the end of the recommendation. He asked how that could result from educating communities about the creation of sustainable funding sources.

Mr. Chapman said the phrase is referring to building overall financial capacity at the community level and making communities aware that there are best management practices, including those for financial management.

Prabha Kumar said, while she understood Mr. Chapman's point, she is concerned that the language of the recommendation makes long-term savings sound like a direct outcome of educating communities, rather than something that could have the effect of long-term savings.

Bill Stannard agreed with Mr. Henifin and Ms. Kumar.

Chris Meister noted the addition of this language to the recommendation was his contribution. He suggested "and create long-term savings" could be a better way to phrase the sentiment. He said, in his experience leading a finance agency, the local decision makers may not always be aware of the options they have for long-term savings. He explained there tends to be, at least in Illinois, a bias towards attempting to receive grant dollars to solve the problem, rather than creating financial solutions that, in his view, are more sustainable in the long term, have more accountability, and impose more organizational discipline. He said there may not be a direct correlation but building capacity will lead towards decisions that result in long-term savings.

Ms. Throwe asked how the workgroup could reword the recommendation to better capture Mr. Meister's comment.

Ms. Kumar suggested they add the words "could enable" to the phrase, so the end of the recommendation reads, "and could enable long-term savings."

Ms. Throwe asked if incorporating Ms. Kumar's proposed language would address workgroup members' concerns.

Mr. Stannard and Mr. Henifin said it would.

Chuck Walter noted they could also consider using language along the lines of "financial sustainability" or "fiscally sustainable."

Laurie Hawks suggested it may be helpful for the workgroup to follow the discussion if they numbered the recommendations. With regards to the first recommendation, Ms. Hawks said the subsequent description would be clearer if the workgroup deleted the first two sentences. The first sentence in the description of the recommendation would then be, "Communities that have laid out a path towards identifying funding needs over a multi-year planning horizon, executed a feasibility study and aligned the implementation of that plan with the requisite financial resources are more likely to have better managed their risks." She also wondered if the workgroup should combine the first two recommendations in the draft as they both pertain to education.

Ms. Throwe noted she had also thought about combining the first two recommendations. In response to Ms. Hawk's first suggestion, Ms. Throwe explained that the workgroup had chosen to remove the numbering for the recommendations, so it was not misconstrued as a priority list.

Ms. Tarquinio noted attendees were no longer able to see Mr. Chapman's screen and shared her screen to resolve the technical difficulty.

Ms. Throwe returned the discussion to Ms. Hawks' suggestion that the workgroup remove the first two sentences of the recommendation description.

Lisa Kay said she agreed with Ms. Hawks.

Craig Holland also agreed. Mr. Holland said one area in which he is struggling with this recommendation, and the one that follows it, is who, specifically, is leading the education and who is creating an up-to-date, central repository of that education for communities. He said it could be a role for the Water Infrastructure and Resiliency Finance Center (WIRFC).

Ms. Throwe asked if Mr. Meister would be open to revising this recommendation to incorporate the workgroup member's feedback.

Mr. Meister said he would.

Ms. Throwe asked if the workgroup could move to a poll to determine if workgroup members are comfortable with this recommendation, pending modifications from Mr. Meister.

Ms. Tarquinio asked those from the public to refrain from participating in the workgroup voting.

Mr. Chapman noted he would need a few more minutes to finalize the poll prior to sending it to those on the call.

In the meantime, Ms. Throwe read the next recommendation.

Educate elected officials, public works officials and the public on the need to build and maintain reliable stormwater infrastructure and treat its importance to public health and safety as on par with drinking water and sanitary sewer infrastructure and that the investment results in a payback many times over.

Ms. Throwe returned to Ms. Hawks' suggestion that the workgroup combine this recommendation with the one that preceded it.

Ms. Kumar agreed these recommendations could be revised into one succinct recommendation that emphasizes the need to build and maintain reliable stormwater infrastructure and the importance of having dedicated funding sources.

Ms. Kay also agreed with combining the recommendations.

Fernando Pasquel said he is comfortable with combining the recommendations. The primary statement of the recommendation should be to educate communities and elected officials to understand that stormwater is a utility operation that needs a dedicated funding source. The workgroup could then include examples in the rest of the recommendation of how the funding would be used. Mr. Pasquel noted they should be careful not to fixate on maintenance. He said, while maintenance is a good example of how funding can be used, he finds a recommendation that only addresses maintenance to be outside of the scope of the workgroup, unless it is linked to funding.

Mr. Henifin said he is struggling with how these recommendations fit the charge of the workgroup in general. He wondered how education clearly addresses or solves the gap in stormwater funding across the country.

Mr. Pasquel agreed they do not address the charge unless the recommendations to improve education are related to educating people about the need for funding.

Mr. Walter noted there are three different audiences at play – the general public who will be paying for stormwater management, the elected officials who must vote for it, and the professional community. He said he would support combining the recommendations if the workgroup recognizes the differences between these audiences. Otherwise, he finds wrapping the two recommendations together would make them less meaningful. He said the workgroup needs to identify that education comes with different methods of outreach to the different stakeholders.

Ms. Throwe asked if anyone would be willing to take ownership in developing this recommendation in partnership with Mr. Meister.

Mr. Walter volunteered to work with Mr. Meister.

Ms. Throwe asked Mr. Chapman to send out the survey poll for the recommendation.

The workgroup voted on the recommendation as follows:

- I agree with the recommendation as is – 0%
- I agree with the recommendation, but with comments – 10%
- I agree with the recommendation, but by combining it with the previous recommendation – 85%
- I do not agree the recommendation should be included – 5%

Ms. Throwe moved on to the next recommendation.

Provide for a common application for different federal grants across all federal agencies.

Mr. Walter said the workgroup should specify in the recommendation that they are referring to water quality or water grants. He noted there are housing and development block grants as well which could create confusion.

Ms. Throwe agreed the workgroup should be specific.

Ms. Kumar suggested making some distinction between federal grant applications geared towards smaller communities and federal grants applicable to larger communities. She noted she distinguishes between small and large communities in terms of population.

Janet Clements said the workgroup should not specify water quality grants within the recommendation as there are potentially a lot of other grant programs that may be interested in funding certain stormwater solutions or green infrastructure projects, including grants from the Department of Housing and Urban Development (HUD). She said she was not sure the workgroup should limit themselves.

Ms. Throwe responded it would be a large undertaking for the federal government to implement this recommendation in such a way that encompasses everything they are doing. She said, for the state of Maryland, adding restoration grants to the common application required a significant amount of effort. She asked how the workgroup could frame the recommendation in a way that would be reasonably manageable.

Ms. Kay said one of the frustrations people encounter is different agencies – United States Department of Agriculture (USDA) Office of Rural Development, HUD, EPA – each have different applications. She suggested that the common application, rather than spanning across different agencies related to water, could instead relate to water from different federal agencies. That is, they could apply the water concept to the applications, rather than to the federal agencies. She noted such a recommendation would also serve to break down silos across the federal agencies.

The workgroup voted on the recommendation as follows:

- I agree with the recommendation as is – 59%
- I agree with the recommendation, but with comments – 32%
- I do not agree the recommendation should be included – 9%

Mr. Chapman said he was the one to develop this recommendation and could work on incorporating the workgroup comments.

Ms. Throwe moved on to the next recommendation.

Use federal funding or technical assistance to help pay fees for individuals who have gotten behind on utility fees, including all water utilities (similar to the low income home energy assistance program (LIHEAP)).

Ms. Kumar noted, if the workgroup does choose to organize the recommendations by priority, she considers this to be a high priority recommendation.

Mr. Walter agreed with Ms. Kumar. He asked if they should go further and provide next steps in the recommendation, like a pilot project or an evaluation of what it would cost to implement. He said he does not think this recommendation would cost a lot, but it would provide considerable political cover.

Mr. Henifin noted the electrical program, which this recommendation was modeled after, costs about \$4 billion/year nationwide.

Mr. Meister said he also agreed with Ms. Kumar. One of the reasons he finds this recommendation to be important is that it would provide a predictable revenue stream to the entities that deliver water and are tasked with stormwater challenges. He said that would then build capacity and sustainable financing.

Ms. Kumar noted the recommendation as it is currently written, with the language of “help pay fees for individuals who have gotten behind,” makes it sound as though the program is only for delinquency relief. She suggested the workgroup change the language to “help pay fees for individuals in need”. She said they do not want people to become delinquent and then seek assistance, but rather they want people proactively seeking assistance before they become delinquent.

Ms. Throwe asked if anyone would be willing to work on incorporating the workgroup members’ feedback into this recommendation.

Ms. Kumar volunteered.

Ms. Tarquinio noted *David Bulova*, not yet on the call, volunteered on the last workgroup teleconference to provide the rewrite for this recommendation.

Ms. Throwe thanked Ms. Tarquinio and suggested Ms. Kumar reach out to Mr. Bulova about her revisions to the language of the recommendation.

The workgroup voted on the recommendation as follows:

- I agree with the recommendation as is – 24%
- I agree with the recommendation, but with comments – 76%
- I do not agree the recommendation should be included – 0%

Ms. Throwe read the next recommendation.

Provide technical assistance for grant applications and other activities such as utility capacity building, provide a shared resource for several communities or a “circuit rider” that serves several communities.

Ms. Throwe noted this recommendation is particularly relevant in the areas in which she has worked. She asked if there were any suggested comments or changes from members of the workgroup. In hearing none, she asked Mr. Chapman to move forward with the poll.

The workgroup voted on the recommendation as follows:

- I agree with the recommendation as is – 95%
- I agree with the recommendation, but with comments – 5%
- I do not agree the recommendation should be included – 0%

Ms. Throwe proceeded to the next recommendation.

Expand and modify 319(h) grant program to allow and encourage local capacity building, utility fee study, asset management, remove permit restrictions.

Ms. Kumar asked if the workgroup could reserve a few minutes to discuss whether the recommendations should be ordered or categorized in some fashion.

Ms. Throwe said she would make a point to leave time at the end of the call to discuss the organization of the recommendations.

Lori Beary noted the workgroup does not currently state there is a need to increase the funding for the 319 program. Instead, the recommendation is about how the 319 program can be used. She said she finds the 319 program to be a well-known and understood program for nonpoint source and stormwater needs and suggested they include a point about increasing the level of funding.

Ms. Throwe agreed the use of the word “expanding” makes it unclear if the recommendation is referring to the expansion of programmatic criteria or of funding.

The workgroup voted on the recommendation as follows:

- I agree with the recommendation as is – 35%
- I agree with the recommendation, but with comments – 65%
- I do not agree the recommendation should be included – 0%

Ms. Throwe read aloud the next recommendation.

New construction grant program specifically for stormwater projects, federal investment in wastewater infrastructure, need similar investment in stormwater infrastructure, include user fee study to make sure repayment and O&M future costs are funded.

Ms. Kumar said she finds the recommendation could use some rephrasing.

Ms. Throwe asked Ms. Kumar to describe how it could be rephrased.

Ms. Kumar suggested, instead of using “include user fee study,” the workgroup could use a word more along the lines of “require.” She explained the workgroup wants to convey that the grant recipients also need to be involved in some way. In return for grant funding, recipients should have to at least conduct a user fee study to see if they can establish a dedicated funding mechanism.

Ms. Beary said the recommendation does not currently read smoothly and may have too many phrases separated by commas. She reminded the workgroup that the intent of this recommendation was to create a new construction grant program specifically for stormwater projects, similar to the former construction grant program for wastewater infrastructure. She suggested there may be a phrase missing from the recommendation which is making it read strangely.

Mr. Henifin noted the first sub-bullet of the recommendation references one of the stormwater state revolving fund (SRF) options recommended elsewhere by the workgroup. He said they would need to either tie the recommendations together or eliminate that connection.

Ms. Throwe asked who was responsible for writing this recommendation.

Ms. Clements said she had initially written the recommendation and could work on redrafting it to include the comments from the workgroup.

The workgroup voted on the recommendation as follows:

- I agree with the recommendation as is – 15%
- I agree with the recommendation, but with comments – 85%
- I do not agree the recommendation should be included – 0%

Ms. Tarquinio noted the previous recommendation regarding the 319(h) grant program had 65% of voters requesting an integration of workgroup comments, but the workgroup did not designate anyone to work on rewriting it.

Elizabeth Treadway said she participated in part of the review of the previous recommendation and would be happy to work on it.

Ms. Throwe thanked Ms. Treadway and moved on to the next recommendation:

Require a small percentage of Farm Bill Subsidies (10%) to be re-directed towards stormwater/nonpoint impacts in same watershed as allocation.

Ms. Kumar said she finds this recommendation interesting. If it does not rise to the top when the recommendations are reorganized, the workgroup could consider listing it under a section entitled, "Other Key Recommendations."

Ms. Beary noted there was a change in the 2018 Farm Bill to require Farm Bill programs to use a certain percentage of their subsidies on source water protection. She said she is not sure if the creation of this recommendation was tied to that change, but she could find the exact language for the workgroup.

Ms. Tarquinio said she could provide Ms. Beary with the specific language of the Farm Bill. She explained that the language states 10% of Farm Bill Subsidies can be used for source water protection, but it is not a requirement.

Mr. Stannard suggested removing the word "small" from the recommendation. He noted what classifies as "small" will be relative depending on the person; for some, 10% is a significant amount.

Mr. Henifin noted, in response to Ms. Beary and Ms. Tarquinio, this recommendation also requests that the money go to the same watershed as where the farm is located. He said, in the current Farm Bill, that is not defined.

The workgroup voted on the recommendation as follows:

- I agree with the recommendation as is – 33%
- I agree with the recommendation, but with comments – 57%
- I do not agree the recommendation should be included – 10%

Ms. Throwe read aloud the next recommendation.

The State Revolving Fund (SRF) is an integral tool among the many infrastructure financing options available to communities. Whether stormwater receives consideration of its own through a new SRF program, or receives less restrictive eligibility considerations and larger appropriations within the Clean Water SRF (CWSRF), it is the view of the Task Force that stormwater would benefit from an additive – not zero-sum – recurring financial commitment from EPA.

This could be achieved by the implementation of one or more of the following, each of which is outlined below with the associated risks and opportunities:

- A. *Create a new SRF program exclusive to stormwater programs and projects.*
- B. *Create a specific stormwater set-aside in the existing CWSRF framework and increase awareness/ guidance on the CWSRF for stormwater projects, including the Green Project Reserve program.*
- C. *Create a "One Water" SRF with equal weighting among drinking water, clean water and stormwater*

Ms. Thrope acknowledged this recommendation has been discussed at length in previous workgroup meetings.

Ms. Kumar noted this recommendation has implications for legislative action. She wondered if, from a practical standpoint, Option B would be a more accessible approach in terms of implementation. Then, as a subsequent, phased action, there could be a new SRF for stormwater programs and projects.

Pam Lemoine asked if Ms. Kumar was suggesting reordering the options and then editing the language to further recognize that Option B is an easier, more near-term direction that could be taken.

Ms. Kumar confirmed she was suggesting the workgroup reorder the options. She said they could then add a statement to explain the options could be implemented in a phased manner with creating a set-aside first, followed by an evaluation for creating a new SRF program. She noted doing so would give Congress more of a proposed pathway.

Mr. Chapman explained that is why the workgroup had included the different options within one recommendation, as some are more realistic than others. He agreed with Ms. Kumar that requiring the act of Congress to implement a recommendation means there is a much smaller likelihood of it happening. He also agreed that the workgroup may want to reorganize the options and said he could take responsibility for modifying this recommendation.

Mr. Stannard reminded the workgroup this is a report that will eventually reach Congress, and he wondered if it is prudent to presuppose what Congress may or may not do.

Mr. Henifin said he is concerned with how the recommendation provides a menu of options as opposed to taking a strong stand in one particular direction.

Ms. Lemoine responded the menu of options is a product of combining three SRF-related recommendations as there was concern they conflicted with one another when separated. She asked if Mr. Henifin was concerned that providing a menu of options watered down the recommendation as a whole.

Mr. Henifin confirmed that was his concern. He suggested, if they want to provide a recommendation, they should pick one option and present a case for it.

Ms. Beary said she liked the recommendation including options, given the seriousness and complexity of the issue.

Mr. Holland agreed with Ms. Beary. He said the recommendations should be substantive and provide various options for a roadmap to any sort of major policy change. He fears going forward with something like the "One Water" SRF, given the potential political or legislative lift concerns, could result in the recommendation being dead on arrival. That might prevent the possibility for incremental progress.

Drew Kleis agreed with Mr. Henifin that the workgroup should be clear and strong in the presentation of this recommendation. He wondered if the members of the workgroup could rally around the point that this recommendation should be an additive rather than a zero sum. They may not need to decide on one approach, but this recommendation should aim to strengthen the concept that there needs to be more funding.

Mr. Meister thanked everyone for their discussion on this recommendation. He noted all the options create their own challenges, and there are advantages and disadvantages to presenting a menu of options over selecting one. In reviewing this recommendation again, he said he agreed with Mr. Kleis that the workgroup should focus on the point of additive, not zero-sum.

Mr. Stannard agreed with Mr. Meister. He said the workgroup is in agreement that more funding is necessary and that Congress can play an important role in providing it. He said how the funding is made available is of less importance compared to getting more funding to cover stormwater.

Mr. Henifin noted there are several experts within the workgroup who work closely with the SRF. He asked them if the country is currently drawing down the entire SRF funding available.

Ms. Beary responded it depends on the state; some states struggle to get their loans out while others could use twice the amount of funding. She explained there is less of an issue on the wastewater side as there is on the drinking water side. Nationally, she said the wastewater funds are pulled down relatively quickly, but she does not know the specifics.

Mr. Meister said he also did not have the specifics to respond to Mr. Henifin's question.

Mr. Chapman pointed out the last sentence in the recommendation does note that decision makers could implement one or more of the options the workgroup presents.

The workgroup voted on the recommendation as follows:

- I agree with the recommendation as is – 53%
- I agree with the recommendation, but with comments – 47%
- I do not agree the recommendation should be included – 0%

Ms. Tarquinio said she would designate Mr. Henifin to work on modifying this recommendation. She also asked that Ms. Throwe find volunteers to modify the recommendation pertaining to the Farm Bill.

Mr. Henifin said he would be willing to work on the Farm Bill recommendation. He also noted he has been voting in the polls based on the comments that Ms. Tarquinio is adding to the draft recommendation document as the workgroup deliberates. He asked if others were voting according to those comments as well.

Ms. Throwe said she had the same impression that the polling option to agree with comments referred to the comments from the discussion and what Ms. Tarquinio was capturing in the draft recommendations document.

Mr. Chapman agreed.

Lisa Daniel said it occurred to her, as the workgroup discussed how every state taxes differently, that one of the natural responses from the federal government could be to add on to Water Infrastructure and Finance and Innovation Act (WIFIA). She noted the workgroup does not currently refer to WIFIA in the recommendations or address whether adding to it would be a good idea.

Mr. Chapman said, to date, Indiana is the only state that has chosen to leverage their SRF through WIFIA. He noted the Army Corps of Engineers has a WIFIA-like program called the Water Infrastructure Program. It was not funded in the most recent budget, but their mission as stated on their website is to "enable local investments and projects and enhance community resilience to flooding, promote economic prosperity, and improve environmental quality." Mr. Chapman said it is worth considering that there is another program out there that could complement WIFIA.

Ms. Daniel agreed. She said, when she thinks of the SRF, she thinks of states having their own discretion. She wondered if the workgroup should refer to the possibility of a federal or state program that would allow the government to expand a WIFIA-like program that does not necessarily involve loans to states. Instead, loans could be at their discretion to fund specific drainage or stormwater projects.

Ms. Throwe said, if workgroup members do not object, Mr. Chapman could work on incorporating Ms. Daniel's suggestion. She asked if Ms. Daniel would be a sounding board as Mr. Chapman revised the recommendation.

Ms. Daniel said she would be happy to contribute to the recommendation with Mr. Chapman.

Ms. Throwe moved on to the next recommendation.

Require utility fee evaluation as part of NPDES¹ permit, provide grant to conduct evaluation.

Ms. Thrope noted one comment on this recommendation asks, “Question on the legality of this section of the recommendation. Even rich communities can show no money so do they get a waiver? What happens to water quality when everyone can show there is no new funding available?”

Mr. Stannard noted that was his comment.

Ms. Hawks said she is concerned about the use of the word “require.” She said she agrees that evaluating funding sources and finding a sustainable source of funding is key. She is not sure that requiring a utility fee evaluation is the right recommendation. She thinks providing grants or technical assistance to look at utility structure and funding needs would be more helpful.

Mr. Kleis said he agreed with Ms. Hawks. He said he is not comfortable with making this a requirement through the integrated planning framework and is not sure what the benefit would be.

Mr. Henifin said his challenge with the recommendation is how it would apply to those with existing permits. He said if they are going to permit any kind of new discharge, requiring a utility fee evaluation would work. He finds the time to be tough with a requirement is before a community can build something new with a discharge that requires a permit.

Ms. Thrope noted the recommendation does not currently specify that the requirement would apply to new permits. She asked if doing so would make workgroup members more comfortable. She said the other options would be to change the way the recommendation is delivered which would be in line with Ms. Hawk’s comment.

Ms. Kumar said she is concerned the recommendation could be perceived as giving a pass to those with an existing permit and being draconian to those seeking new permits. She agreed that providing a utility fee evaluation, even with the word “require,” may result in someone doing it for the sake of meeting the requirement. She said it is not just about requiring a fee evaluation; it is also about having the political will to implement a funding mechanism. She noted one suggestion would be to require a funding mechanism evaluation, rather than a utility fee evaluation specifically. She said they are trying to convey that, as part of a permit, it is not just about meeting compliance requirements, but also about being cognizant of the need for dedicated funding. She reminded the workgroup that permittees often point out a lack of dedicated funding as the reason for failing to meet compliance.

Mr. Walter responded he believes permits already require what Ms. Kumar described, both in annual reports and in the initial application. He said the new addition to this recommendation had been to incorporate the utility.

Ms. Hawks noted the workgroup agrees that a dedicated, sustainable funding source is key. She wondered if it is a matter of addressing that point elsewhere with education and technical assistance as opposed to through the permit requirement in this recommendation.

Mr. Holland said he wrote this recommendation and welcomed the comments. He said he looked through the other recommendations in the report and found there is a tremendous data gap in trying to determine the best way to fund compliance and water quality initiatives around the country. He noted this recommendation is not requiring utilities to implement a fee; it is just requiring an evaluation. He said, if implementing a fee is impossible for a permittee, then they need more information as to why that is the case. Mr. Holland explained they cannot provide education or technical assistance until there is more data as to why things are not happening. He noted once such an evaluation happens, the regional office or state regulator could be in a place to provide better technical assistance to be able to implement the recommendations coming out of the evaluation process. Mr. Holland reiterated he feels strongly about this recommendation, primarily because of the current lack of data and the multiple recommendations by the workgroup talking about sustainable funding sources.

Jerry Bradshaw said he views this recommendation partly as a data gathering requirement. He wondered if this requirement could go down to the states, given their different environments, for them to develop some sort of promulgation of this recommendation.

Ms. Thrope asked if Mr. Bradshaw thinks the requirement would happen if it was handed down to the states.

¹ National Pollutant Discharge Elimination System (NPDES)

Mr. Bradshaw responded it could happen if there is a requirement for the local or regional permittees within each state to report something back. He noted there could be some level of uniformity across the whole state with some local or regional variation built in. He said that approach may satisfy the data side without putting an undue burden on those at the local level.

Ms. Thrope acknowledged the workgroup was not arriving at a consensus. She asked that they move to taking a vote on the recommendation to better understand the current position of the group.

Mr. Holland said if the workgroup members disagree with the nomenclature of the recommendation but not necessarily the general sentiments, it would be helpful to differentiate between the two. He agreed with Ms. Kumar's suggestion that, if there is a way to change the vocabulary to make the recommendation more universal, they should consider doing so.

Ms. Kumar said she would be happy to coordinate with Mr. Holland on rewording the recommendation on a separate call.

The workgroup voted on the recommendation as follows:

- I agree with the recommendation as is – 16%
- I agree with the recommendation, but with comments – 53%
- I do not agree the recommendation should be included – 32%

Mr. Bradshaw said he would be happy to join Ms. Kumar and Mr. Holland in revising the recommendation.

Ms. Thrope asked the three of them to connect with Ms. Tarquinio after reworking the recommendation so she can share it with the rest of the group.

Mr. Bulova said he would be happy to help with this recommendation as well. He said he would be concerned about mandating a particular approach, but he does think there is a lot of utility to looking at the costs, understanding them, and then ensuring there is some kind of financial adequacy analysis. He noted Maryland has done so with their Phase I municipalities and Virginia with their Chesapeake Bay Total Maximum Daily Load (TMDL) work. He agreed with the previous comments about broadening the recommendation so it is applicable to each state.

Ms. Thrope thanked Mr. Bulova and noted Ms. Tarquinio would follow up with him about editing the language of a previous recommendation he had written.

Ms. Thrope moved on to the last recommendation.

Help communities create sustainable funding sources such as a stormwater utility fee, communities need help setting up feasibility studies, needs assessments, organization analysis, financial analysis.

Ms. Beary noted the reference to technical assistance in this recommendation makes it seem similar and potentially redundant to the previous recommendation that suggests building technical assistance through providing a shared resource, like a circuit-rider.

Mr. Chapman agreed with Ms. Beary.

Ms. Kumar noted utilities, even after conducting feasibility studies and having some consensus in establishing a program, tend to struggle with implementation because of a one-time implementation fee. Small communities, in particular, are often not able to afford it. She said she finds this recommendation to be important and she would not want it to get watered down in being merged with others. She said for small communities to have some kind of grant funding for conducting a feasibility study and launching a utility puts them on a track for dedicated funding; the only excuse then is lack of political will rather than a lack of money to conduct the feasibility study in the first place.

Ms. Beary said it is not clear the recommendation is asking for money, particularly because the first word is "help." She said, to her, that refers to technical assistance which is why she thought it to be similar to the other recommendation. She said if the intention is to create a grant fund for conducting feasibility studies, then they need to be more explicit.

Ms. Kumar said she agrees with rewording this recommendation.

Mr. Stannard seconded Ms. Beary, stating that adding the funding element changes the meaning of the recommendation.

Ms. Thrope asked Mr. Chapman to adjust the response options for the poll to reflect their discussion.

Ms. Lemoine said the workgroup does reference utility fee studies in the previous recommendation about the 319 grant program. She noted they do not, however, reference the implementation costs of the studies to which Ms. Kumar referred.

Ms. Meister said Ms. Lemoine's comment speaks to the need to combine this recommendation with the 319 recommendation. He said there are emerging themes within the workgroup discussion on weaving together revenue capacity and regulatory enhancement to result in a sustainable outcome.

The workgroup voted on the recommendation as follows:

- I agree with the recommendation as is – 5%
- I agree with the recommendation, but with comments – 29%
- I do not agree that this recommendation should be included – 0%
- Consider combining this recommendation with related recommendation(s) – 67%

Mr. Chapman said, in light of the poll responses, the workgroup will have to determine which recommendations to combine.

Ms. Hawks shared the team responsible for drafting the Introduction previously summarized some of the recommendations. Rather than refer to them specifically, they grouped the recommendations under four headings: education, technical assistance, new funding sources, and policy changes.

Ms. Throwe asked if there were workgroup members who would be willing to help combine this recommendation with another.

Ms. Hawks and Ms. Clements volunteered to help.

Recommendation Organization

Ms. Throwe transitioned into discussing the order of the recommendations and whether the workgroup should position key recommendations upfront.

Mr. Stannard said he likes the idea of having three or four categories. He finds it will be more difficult to develop priority lists within those categories as that may require a fair amount of polling to establish an order reflective of the workgroup members' preferences.

Mr. Chapman said there are some thoughts on initial popularity. He asked if it would make sense to order them by consensus.

Ms. Kumar agreed with Mr. Stannard. She said having categories makes it easier for the reader. She suggested potential categories could be education, technical support, funding process, and something akin to augmenting regulatory requirements.

Mr. Meister said, on the point of relative weighting, they should be striving for consensus. He said he believes EFAB will give weight to the consensus of the workgroup, whether it is consensus about prioritization or the relative topic areas that Ms. Kumar introduced.

Mr. Bradshaw noted, when they had these recommendations in a spreadsheet, people initially voted on them. He said he was not sure if that ranking still applies now, but he sees the earlier voting process as another source of ranking.

Ms. Throwe said they would look at the response to this poll and then, as needed, could ask Ms. Tarquinio to refer to that earlier voting process.

Mr. Chapman asked if it would make sense to organize the recommendations by perceived cost to the federal government.

Ms. Daniel said the struggle with Mr. Chapman's suggestion would be determining which government they should consider – the Treasury, the Internal Revenue Service (IRS), EPA, and so on.

The workgroup voted on how to prioritize the recommendations, with the majority selecting to organize them by categories. Exact results of the poll were not captured but are reflected in the conversation that follows:

Ms. Hawks noted the workgroup could both present the recommendations by category and then determine which recommendation(s) within those categories have priority.

Ms. Kay and Ms. Kumar said they liked Ms. Hawks' suggestion.

Ms. Throwe said the workgroup would proceed with organizing the recommendations by categories. She asked if they should consider Ms. Hawks' suggestion of prioritizing within the categories.

Mr. Chapman agreed with Ms. Hawks' suggestion.

Public Comment

Ms. Throwe asked the workgroup members to shift their attention to the public comment period. She introduced *Charles Job* from the National Groundwater Association (NGWA) who had registered in advance of the call to provide comments.

Mr. Job thanked the workgroup for their time and said he has been very interested in their conclusions. He said the NGWA is supportive of providing financial assistance to communities needing stormwater infrastructure. He noted EPA research on the effects of stormwater infiltration on groundwater quality have found those effects are not well understood by the current research program. The program has never been fully funded and recently received significant budget cuts. As a result, Mr. Job said the research being done is not representative of the variable and complex subsurface conditions that exist within communities across the country. He noted there are several places where the workgroup recommendations could address this issue and educate elected officials and the public. He referred to the recommendation on the multiple benefits of green infrastructure projects as one place where the workgroup could include language that the design and implementation of stormwater infiltration projects should provide adequate protection and monitoring of groundwater quality to minimize future remedial costs. He noted 80% of community water systems serving 10,000 or fewer people are reliant on a groundwater supply; if those communities use infiltration techniques to capture stormwater, such stormwater management practices would be important to them. Mr. Job concluded by recognizing that the impacts to groundwater may not be observed as immediately as impacts to surface water, but should they occur, they will be more costly in the long term. He thanked the workgroup for the opportunity to comment.²

Ms. Throwe thanked Mr. Job and confirmed with Ms. Tarquinio that there were no other individuals registered for public comment.

Wrap-Up and Next Steps

Ms. Tarquinio asked if there was a preference for what categories the workgroup would like to use for the recommendations as the Introduction presents one set of categories and Ms. Kumar listed another.

Mr. Bradshaw shared that the categories in the Introduction are as follows: education/technical support, simplification of federal grant and loans programs, and dedicated federal funding assistance. He suggested these categories may be a starting point. He said he would like for new funding to show up as a category as well, as several of the workgroup's recommendations pertain to it.

Ms. Throwe asked Ms. Tarquinio when she would need the revised recommendations from the workgroup members.

Ms. Tarquinio said she would send the recommendation draft document with her comments from the call later that day. She recognized the upcoming holidays and asked workgroup members to quickly work on turning around the recommendation rewrites. She said she would be available over the holidays and noted workgroup members could send their recommendations over as soon as they finish them. However, if they could send the revisions by Friday, December 20th, she could then send the recommendations back out to the workgroup on Monday for another review. She noted a technical editor would be looking at the draft recommendation document for grammatical errors and sentence fragments, but EPA would not otherwise be making any textual changes.

Mr. Chapman asked if the workgroup needed to discuss the Executive Summary and the larger structure of the report. He noted they had previously considered different options for where to place the recommendations themselves (e.g., up front, in the Executive Summary).

Ms. Throwe asked Ms. Tarquinio if the workgroup had designated any members to draft the Executive Summary.

Ms. Tarquinio said they had not.

Ms. Throwe asked if there were any volunteers who would be willing to help draft the Executive Summary.

² Mr. Job and the National Groundwater Association (NGWA) also submitted written comments. Please see those comments in Appendix 1.

Mr. Bradshaw noted that, as they wrote the Introduction, they did so with a consideration for what the Executive Summary might look like. Their impression was the Executive Summary would be a short, one- to two-page document, almost in the form of a transmittal letter. He said the Introduction is becoming fairly long at eight pages and it currently covers what some Executive Summaries might cover. For example, the Introduction does not list the recommendations, but instead lists the three categories of the recommendations the reader will find later in the report.

Ms. Throwe thanked Mr. Bradshaw and noted there seems to be a lot of information that could be pulled out of the Introduction into the Executive Summary. She asked if any workgroup members would be willing to take some of what the Introduction team has written and begin developing the Executive Summary.

Ms. Hawks seconded Mr. Bradshaw's comment and said they wrote the Introduction assuming parts of it would be used for the Executive Summary.

Mr. Chapman volunteered to help.

Mr. Meister also volunteered to help with the Executive Summary.

Mr. Bradshaw said he would be happy to be the liaison between the Introduction and the Executive Summary.

Mr. Stannard volunteered to join Mr. Chapman and Mr. Meister.

Ms. Throwe asked the workgroup members to pay attention to a future request for feedback on the material in the Introduction and Executive Summary.

Mr. Bradshaw said, in reading through the recommendations, he had one more point that he would want to bring into the Introduction. He noted there is often a disconnect between the federal role and the local role as regulations come from the federal side. He said they could include in the report that the solution to funding is a sustainable, dedicated revenue source which almost always has to be local in nature. He said the provision of a circuit rider, technical support, and grant assistance is not only a way to better communicate with the local level, but also a way for EPA to hear back from the locals about their current issues. That is, there is a two-way education process that can come from implementing these recommendations and it will help improve processes for both ends of the spectrum.

Ms. Throwe asked if that language would come out of the Introduction and be put into the Executive Summary.

Mr. Bradshaw said he may place a few sentences in the Introduction before the short paragraph about the recommendations that refer to this two-way education process; that way, as one reads the recommendations, they have it in mind. Mr. Bradshaw said there are a few additional themes that could be pulled into the Executive Summary, including those about the new paradigm of stormwater and the lack of understanding about stormwater management.

Ms. Throwe thanked Mr. Chapman for his support in managing the polling during this meeting. She also thanked the members of the workgroup for their continued engagement and hard work.

Ms. Tarquinio thanked everyone for joining the call and adjourned the meeting at 1:57pm.

Appendix 1

Written Public Comments



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**National Ground Water Association
Comments to the
USEPA Environmental Financial Advisory Board Stormwater Financing Task Force
December 18, 2019**

The National Ground Water Association supports federal and state financial assistance to communities needing stormwater infrastructure.

1. Response to EFAB/Stormwater Financing Task Force Recommendations: Of the EFAB Stormwater Financing Task Force recommendations addressed on the December 18, 2019, conference call, #2 (Educating public officials and the public on stormwater infrastructure need), #7(g) (multiple benefits including green infrastructure projects), and #9(B) (green project reserve) could be modified to include wording to the effect that “the design and implementation of stormwater infiltration projects should provide adequate protection and monitoring of groundwater quality to protect human health and minimize future remedial costs and financing needs.”
2. Factors Contributing the Response
 - a. The MS4 permit program under the Clean Water Act allows infiltration of stormwater as one technology approach using collection drains, dry wells, infiltration basins, LID and other means to reduce discharges to surface waters, but potentially impacting groundwater quality because there are no groundwater discharge standards or treatment required and may result in changed groundwater chemistry and release of contaminants to groundwater. The UIC Class V regulations might apply in some circumstances but are not often used for municipal stormwater control. Stormwater may be used as an important source of water for managed aquifer recharge projects.
 - b. The EPA review of research by EPA/Office of Research and Development has concluded that the effects of stormwater infiltration on groundwater quality are not well understood. EPA’s own research program on this subject only started in 2015, is incomplete and has been cut to the point of monitoring at 3 infiltration sites not representative of the variable and complex subsurface conditions that may exist within a community nor across the country.
 - c. 80 percent of community water systems serving 10,000 or fewer people and nearly all nontransient and transient noncommunity water systems are groundwater supplied with larger surface water systems often having backup groundwater wells as an alternate source.

For followup, contact: Charles Job, NGWA Regulatory Affairs Manager., cjob@ngwa.org, 202-660-0060

Stormwater Management: When Is Green Not So Green?

by A. Scott Andres¹, Thomas P. Ballesteros², and Mary L. Musick³

Current national stormwater policy may have adverse effects on public and private water supplies. Shallow groundwater, which is increasingly being relied on for drinking water, irrigation, stream baseflow, and drought relief, is now becoming a sink for unwanted stormwater contaminants to avoid direct discharge to surface water. This policy of infiltration without properly considering implications for groundwater quality should be improved so that society's contaminants are not transferred from one water resource to another just to avoid paying the full cost of today's stormwater management.

Stormwater regulatory programs and green infrastructure practices focus first on reducing pollutant loads to surface water, with minimal consideration of pollutant load diverted to groundwater. Best management practices, which provide direct recharge, such as porous pavement, retention ponds, shallow injection wells, as well as agricultural and roadway drains, are commonly used. Frequently the only design criterion for stormwater infiltration is the infiltration rate. Infiltrated stormwater can carry pollutants (nitrogen; pesticides; metals, oil, and grease from road surfaces and gas stations; hazardous waste spills; and salts used in road deicing) as well as cause hydraulic problems (mounding, slope stability, and subsurface flooding of infrastructure).

Governmental and professional organizations, including the National Research Council (<https://doi.org/10.17226/12465>), USEPA Underground Injection Control Program, and Water Environment & Reuse Foundation (www.werf.org), have examined the groundwater impact issue, but issued often vague, general cautions about the risks. For instance, the guidance for the

Underground Injection Control program only notes that infiltration through stormwater drainage wells has the potential to adversely impact groundwater supplies. State and local stormwater infiltration guidance typically focuses on avoiding "hotspots" already contaminated so as not to move contaminated groundwater in unanticipated directions.

Most guidance documents recommend fixed-distance setbacks for infiltration sites instead of empirically determined or engineered structures to preclude adverse subsurface effects. While these structures may initially function as designed, without guidance and implementation of routine maintenance, they will not continue to do so. Guidance and regulation rarely include mention of groundwater monitoring. We understand that USEPA is starting to identify some key concerns regarding groundwater impacts. These include recognizing aquifer complexity and long-term groundwater monitoring needs near stormwater facilities.

Finally, using shallow groundwater for the disposal of today's stormwater problems may only be delaying a problem rather than solving it. Hydraulic loading by managed stormwater infiltration can overload natural treatment processes. Impacted groundwater can ultimately discharge to surface waters resulting in long-term degradation, especially under low flow conditions. This concept was recently addressed in a U.S. Ninth Circuit Court of Appeals decision (February 1, 2018, *Hawaii Wildlife Fund v. County of Maui*). The panel found that the disposal wells were "point sources" that discharged "pollutants" into groundwater, that eventually entered surface water and therefore these wells fell under the purview of the National Pollutant Discharge Elimination System. On February 20, 2018, the U.S. Environmental Protection Agency issued a request for comment regarding the adequacy of its regulatory programs under the Clean Water and Safe Drinking Water Acts addressing stormwater discharges to groundwater "in direct hydrologic connection to surface water" (83 FR 7126 comments due May 21, 2018).

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doi: 10.1111/gwat.12653

With the complexity of the subsurface, a single approach to managing stormwater infiltration and protecting groundwater quality will not be appropriate. Most guidance documents do note that additional research into groundwater contamination is warranted. Scientific research is needed to identify less risky stormwater infiltration practices, quantify impacts on groundwater quality

and quantity, develop appropriate monitoring practices, improve pollutant removal prior to infiltration, and discern sound hydrogeologic and engineering design practices in the siting and design of stormwater facilities. Research is also needed to understand the future effects and costs of stormwater disposal practices and to develop a more advantageous and desirable policy for all water users.

The Influence of Green Infrastructure Practices on Groundwater Quality: The State of the Science

Contact

National Risk Management Research Laboratory
<https://www.epa.gov/aboutepa/about-national-risk-management-research-laboratory-nrmrl>

Citation:

Brumley, J., C. Marks, A. Chau, R. Lowrance, J. Huang, C. Richardson, S. Acree, R. Ross, AND D. Beak. The Influence of Green Infrastructure Practices on Groundwater Quality: The State of the Science. U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-18/227, 2018.

Impact/Purpose:

Green infrastructure (GI) is increasingly being used to manage urban stormwater runoff. How the soils and subsurface geology/sediments interact with the stormwater runoff constituents has received little attention and the possible risks of groundwater quality impairment is poorly understood. The goal of literature review is to provide the current understanding of potential impacts or impacts to groundwater quality that could result from the use of GI to manage stormwater runoff. The results of the literature review were mixed; in some cases, there were impacts or potential impacts, and in other cases there were no impacts found. Many of the studies' results were problematic. In most cases, the results—reflected only what occurs in the vadose zone or the infrastructure—were extrapolated to predict what may occur to the groundwater. This extrapolation ignores other processes that could facilitate the transport of contaminants to the groundwater, such as preferential flow. In other cases there was no attempt made to measure concentrations of contaminants in aquifers or deeper in the vadose zone, and therefore, no definitive evidence for changes in groundwater quality. These results indicate that more research is needed to address potential risk of groundwater contamination that could result from the use of GI. These results will

inform decision makers in EPA Office of Water, EPA Regional Staff, States and Local Governments of the potential for groundwater impacts resulting from the use of GI for stormwater management.

Description:

Green infrastructure (GI) technologies applied to stormwater are developed to mimic natural infiltration and hydrologic processes. GI is a design strategy that enhances runoff storage volume, infiltrates runoff, and contributes to groundwater recharge. Urban development often leads to the removal of vegetation and soil, and replacing them with large stretches of impervious surfaces. This disturbance of the natural hydrologic cycle due to urbanization is closely connected to deteriorating urban water quality and enhanced flood risks. When GI is used for urban runoff, there are concerns as to how the soils and subsurface geology/sediments interact with the stormwater runoff constituents, thus providing possible risks of groundwater quality impairment. Groundwater can be contaminated by many constituents: nutrients, metals, dissolved minerals, pesticides, other organics, and pathogens. This review provides insight into the current state of knowledge of the influence of GI on the subsurface environment and groundwater. All types of GI were assessed, both surface and subsurface infiltration infrastructures from peer-reviewed literature, published reports, and conference proceedings. Issues addressed include: 1) pollutant risks that need further research, 2) new infrastructure that has not been researched in depth, and 3) determining local considerations when planning for green infrastructure. When managing water resources, the tendency for contaminants to move between the ground and surface water needs to be considered. This requires an understanding of the native soil characteristics in the unsaturated zone and saturated zone as well as the hydrology. The primary geochemical processes that need to be considered as stormwater infiltrates are dissolution and precipitation, redox, ion exchange, adsorption/desorption, complexation/chelation, kinetics, mixing relationships, and colloid-facilitated transport. Simulation models are a potentially affordable way to predict risk as well as provide a decision-making tool for implementing GI. While many models are used to assess surface water and groundwater transport, few integrate GI; those that do integrate GI do not address groundwater contaminant transport. The biology of the system can have various impacts. Microorganisms such as bacteria, viruses, and parasites can be a contamination risk depending on the unsaturated and saturated zone conditions, incubation time, and native microbial populations. Macrobiological organisms can enhance or cause complications for green infrastructure, but research on these is limited. Riparian zones do not have any studies specific to urban GI, but previous studies on riparian zone restoration show they could restore denitrification to urban streams, induce recharge, and serve as a less manipulative approach for enhancing infiltration into alluvial groundwater. Overall, a better understanding of the risks associated with GI is needed to recognize the implications of GI on a longer temporal scale and wider spatial scale. When implementing GI, the local geology, climate, hydrology, biology, geochemistry, type of infrastructure, and contaminant loads need to be carefully considered to reduce risks to groundwater.

URLs/Downloads:

ORD-027426 EPA600R18227_508.PDF (PDF,NA pp, 6350.325 KB, [about PDF](#))

Record Details:

Record Type: DOCUMENT (PUBLISHED REPORT/REPORT)

Product Published Date: 08/31/2018

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OMB Category: Other

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The Influence of Green Infrastructure Practices on Groundwater Quality: The State of the Science

by

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8.0 Conclusions/ Future Research Needs

8.1 Conclusions

Stormwater reclamation for eventual reuse is triggering a paradigm shift from stormwater seen as a contaminant and a flood risk to a resource that can solve these risks. GI design strategy retains storage, infiltrates runoff, and contributes to the renewed groundwater recharge to more closely resemble the hydrology before urban development. The disturbance of the natural hydrologic cycle due to urbanization is closely connected to deteriorating urban water quality. This creates an increased risk to groundwater quality because of new pathways for contaminant introduction into groundwater, chemicals associated from anthropogenic activities, and wastewater exposure. This literature review determined what research that has been done on GI practices with respect to groundwater quality and the risks and impacts to the subsurface environment. The issues addressed include: 1) contaminant risks that need further research, 2) new infrastructure that has not been researched in depth, and 3) determination of local considerations when planning for green infrastructure.

Any pollutant found in stormwater could be a potential groundwater contaminant when used with GI infiltration technology. GI can return the urban hydrology to a more natural hydrologic cycle through retention and infiltration methods. Surface and subsurface infiltration can influence the impact the infiltrating stormwater has on the groundwater chemistry. Retention techniques can influence the water table depth through mounding, which have been seen in restoration projects, bioretention cells, and regenerative stormwater conveyance systems. Concern with GI for stormwater infiltration include fluctuations in groundwater levels, limitations with large precipitation events, clogging, and soil limitations. The infiltration is dependent on the clogging rate of the infrastructure.

Depending on the water's chemical, biological, and physical conditions, there is the risk of potential contaminants leaching from native soils and geology. When it comes to managing water resources, the tendency for contaminants to move between the ground and surface water needs to be considered. Urbanization can introduce contaminants that are otherwise not an issue in natural stormwater hydrology. Groundwater can be contaminated by many constituents: nutrients, metals, dissolved minerals, pesticides, other organics, and pathogens; the sources of which include residues from automobiles, lawn treatments though fertilizers and pesticides, sewer overflows, and road deicing salts. Due to risks affecting groundwater quality, it is suggested that infiltrating GI not be implemented in areas with potentially high contaminant loading, i.e. recycling centers, gas stations, and brownfields. When infiltrating devices are installed and used for urban runoff, there are concerns as to how the soils interact with the stormwater runoff pollution while infiltrating into the subsurface, thus providing possible risks of groundwater quality impairment from areas with potentially high contaminant concentrations.

The chemical interactions between surface water and groundwater are controlled by the type of geologic materials present and the amount of time the water is in contact with these materials. The various chemical reactions that affect the biological and geochemical characteristics of the basin are acid-base reactions, precipitation and dissolution of minerals, sorption, ion exchange, oxidation-reduction reactions, biodegradation, and dissolution and exsolution of gases. It is concluded that when implementing green stormwater infrastructure for infiltration, the properties of the unsaturated and saturated zones interacting with the infiltrating water need to be considered. These considerations encompass the understanding of the native soil texture, structure, and organic matter content of the

unsaturated zone, as well as considering the porosity and permeability of the saturated zone and the flow of the groundwater. Kinetics and mixing relationships also require examination. Colloidal transport also needs to be considered as a mechanism that can transport contaminants through the soil, by either being a contaminant itself or having a contaminant sorb to a benign colloid. Colloids can be restricted by capture, sorption and static interaction. As discussed previously, colloid-facilitated transport could be an important mechanism for the movement of contaminants into groundwater (de Jonge et al., 2004).

The potential and actual impacts to groundwater quality as the results of GI practices were reviewed. The results presented were mixed; in some cases, there were impacts or potential impacts, and in other cases there were no impacts found. Many of the studies' results were problematic for several reasons. In most cases, the results—reflecting only what occurred in the vadose zone or the infrastructure—were extrapolated to predict what may occur to the groundwater. This extrapolation ignores other processes that could facilitate the transport of contaminants to the groundwater, such as preferential flow. Since there was no attempt made to measure concentrations of contaminants in aquifers or deeper in the vadose zone, there is no definitive evidence of changes in groundwater quality.

In studies that did include groundwater monitoring, it is unknown in some cases if the sampling strategy would detect changes in groundwater quality. Information on groundwater flow direction was not included, therefore the relationship of monitoring points to the potential transport of contaminants could not be ascertained. Another potential problem was that the studies did not account for lag between the time of water infiltration and the time it takes to transport the infiltrated water to the aquifer. In most studies, that sampling occurred at or very close to the precipitation event. Because lag time was not considered, transient changes to groundwater quality were not accounted for, even in systems that were monitored for decades.

The only system that consistently showed impacts to groundwater quality was ASR. The ASR impacts fell into one of two categories: unintended consequences, or the mixing of two waters with different composition and characteristics.

Simulation models can be an affordable way for predicting quality and quantity changes, as well as a decision-making tool for implementing green infrastructure. While there are many models in use for surface water and groundwater transport, there are few that integrate green infrastructure, and those that have do not address groundwater contaminant transport. Green infrastructure models have been implemented in various formats, but none specifically addressed groundwater contamination from this infrastructure. Problems associated with implementing models for assessing green infrastructure technologies and influence on groundwater include the amount of data available for calibration and validating these models, indicating a need for more field research to obtain this data.

Microbiological organisms such as bacteria, viruses, and parasites can be a contamination risk depending on the unsaturated and saturated zone conditions, incubation time, and native microbial population behavior. Microbial contaminants are a concern primarily if they present a public health threat from consuming contaminated groundwater, with the most common waterborne disease being acute gastrointestinal illness. While gut-associated microbial contaminants are not expected to grow and thrive within the groundwater environment, their rates of removal are affected by several, often interdependent, environmental factors. Research has shown there is a general trend of differential survival for the various contaminant organism types. Viruses tend to have the longest persistence times within any groundwater environment; enteric eukaryotes (*Cryptosporidium* spp. and *Giardia* spp.) and enteric bacteria typically have die-off rates of five to ten times, and over one hundred times larger than enteric viruses, respectively. Pathogen removal or die-off rates are typically reported based upon first

order decay models; however, field and laboratory experiments have shown that biphasic models better approximate the removal behavior of fecal eukaryotes and viruses within groundwater systems. Hence, these studies have shown that there is an initial rapid removal phase for the first few days after introduction, followed by a slower phase two to hundreds of times less than the initial phase that can lead to months or years of persistence.

In saturated zones, factors influencing pathogen survivals in groundwater are temperature, water chemistry, and biological processes. Aquifer hydrogeology can influence the mechanical filtration, adsorption, wedging, and straining processes that can remove pathogens. There is also the potential of competition for nutrients and predation by indigenous microorganisms can play a significant role in the removal of introduced enteric pathogens. In unsaturated zones, the same processes from the saturated zone can apply but the air phase within the unsaturated zones can create two new interfaces, air-water and air-sediment that do not exist in saturated conditions which can both adsorb and entrap organisms. The decreased moisture can subject microorganisms to die-off or inactivation through desiccation. The highest native microbial populations are going to be in the rooting zone of the soil profile. Below the rooting zone, microbial populations and activity decrease with depth.

Macrobiological organisms can enhance or cause complications with green infrastructure. Vegetation is often used to retain nutrients and metals, enhance ecosystem service, increase filtration, and mimic the natural hydrology. The selection of the plants is important because they need to survive potentially toxic contaminants and the perturbations of the GI systems. There are few studies on how various macroorganisms can influence the green infrastructure. Bioturbator species that live in the sediment can increase the possible risk of nutrient contamination, and burrowing activity of worms can increase the macropores in the sediment and influence the infiltration. Macrobiological organisms can enhance or cause complications for green infrastructure, but research on these effects is limited.

Urban riparian zones can function as green infrastructure, but few studies have been done on their influence on groundwater. Previous studies on riparian zone restoration show that they could be useful to restore denitrification to urban streams. By serving as “natural filtration,” the practice may have beneficial effects on surface water if the water is discharged back to surface sources. This induced recharge can also be used for either drinking water supply or to re-water floodplains. This is also a less manipulative, more feasible way to create opportunities for filtration into alluvial groundwater.

8.2 Future Research

Analogous to what the Pitt et al. (1999) and the recent Kabir et al. (2014) reviews concluded, we concur that more research is required to understand the potential groundwater quality impacts that can result from the implementation of GI. Apart from conservative chemical species such as chloride, a more complete understanding of what conditions are likely to cause groundwater quality impairment is necessary to mitigate or prevent these potential impacts. This review also indicates there is an apparent risk to the vadose zone “quality.” Stormwater infiltration is causing the soil and vadose zone sediments to degrade, and the potential future impacts and risks to groundwater quality because of this are unknown—making long-term GI studies crucial.

Since land use and environmental conditions are likely to change, future groundwater risks are possible at many current GI sites if the infrastructure is not properly maintained. Further research is needed to determine the best monitoring methods for groundwater at these sites throughout their lifetime. Changing conditions will likely change the chemical and physical properties which can alter the retention properties in the soil/vadose zone. These potential land use changes and maintenance problems

need to be addressed in future research. Another issue encountered is that, once the GI system is no longer functional or is “decommissioned,” what practices should then be implemented to mitigate the potential environmental issues created by trapping the contaminants in the vadose zone. This emphasizes the need for long term monitoring methods that addresses placement of sampling points and timing of sampling to determine the long-term impacts to the subsurface. Currently GI performance standards are not included into the National Pollutant Discharge Elimination System (NPDES) permits, including impacts on groundwater. Including this into the NPDES system may be beneficial to protection groundwater quality.

Additional research is needed to understand the impacts and benefits that various macrobiological organisms have on GI, and how these affect the hydrology, fate, and transport of contaminants in GI systems. Vegetation is the most common addition to GI, but there is an inadequate understanding as to how this vegetation influences groundwater quality over time. Addressing whether preferential flow increases over time or if nutrient and metal concentrations change over time is a necessity. Previous studies on riparian buffer zones have shown various benefits to restoring these in non-GI situations, but further studies are needed to determine the benefits and potential issues with implementing them as part of urban GI.

Simulation modeling of GI systems needs to be addressed to help users understand the potential groundwater impacts. Further research of simulation models is needed to address the location and spacing of GI stormwater practices to determine if there are diminishing returns on the quantity of stormwater controls. Simulation models are necessary to determine how large GI projects can be designed to effectively reduce runoff and have the least environmental impact (Brown et al., 2012; Eckart et al., 2017). Research on the use of models to demonstrate how GI performs under different temporal scales, spatial scales, and climatic conditions is needed since there is a lack of data on the performance of these technologies. Simulation research and improvements in modeling techniques are also needed so that they can assist in understanding the role of GI in restoring the water balance, reducing contaminants over the long term, evaluating various GI performance, as well as acting as decision support tools (Dietz, 2007; Ahiablame et al., 2012; Fletcher et al., 2013; Eckart et al., 2017).

Overall, there are several research areas necessary for a better understanding of the risks of a GI infiltration technology that have been proposed as the result of this effort. There needs to be more investigations looking at the GI interactions on a longer temporal scale and wider spatial range. When implementing GI, the local geology, climate, hydrology, biology, geochemistry, type of infrastructure, and contaminant loads need to be carefully considered to reduce the risk to groundwater quality.