S. HRG. 113–761

FINDING COOPERATIVE SOLUTIONS TO ENVIRONMENTAL CONCERNS WITH THE CONOWINGO DAM TO IMPROVE THE HEALTH OF THE CHESAPEAKE BAY

FIELD HEARING

BEFORE THE

SUBCOMMITTEE ON WATER AND WILDLIFE

OF THE

COMMITTEE ON
ENVIRONMENT AND PUBLIC WORKS
UNITED STATES SENATE

ONE HUNDRED THIRTEENTH CONGRESS

SECOND SESSION

MAY 5, 2014—CONOWINGO, MD

Printed for the use of the Committee on Environment and Public Works

Available via the World Wide Web: http://www.gpo.gov/fdsys

U.S. GOVERNMENT PUBLISHING OFFICE

97–800 PDF WASHINGTON : 2016

For sale by the Superintendent of Documents, U.S. Government Publishing Office
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C O N T E N T S

FINDING COOPERATIVE SOLUTIONS TO ENVIRONMENTAL CONCERNS WITH THE CONOWINGO DAM TO IMPROVE THE HEALTH OF THE CHESAPEAKE BAY

MONDAY, MAY 5, 2014

U.S. SENATE,
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,
SUBCOMMITTEE ON WATER AND WILDLIFE,
Conowingo, MD.

The subcommittee met, pursuant to notice, at 9:57 a.m., in the Conowingo Visitors Center and Recreation Office, Hon. Benjamin L. Cardin (chairman of the subcommittee) presiding.

Present: Senator Cardin.

OPENING STATEMENT OF HON. BENJAMIN L. CARDIN, U.S. SENATOR FROM THE STATE OF MARYLAND

Senator CARDIN. I'm going to do something which is unheard of in the U.S. Senate. We're going to start a few minutes early.

[Laughter.]

Senator CARDIN. So just don't tell my colleagues that we did that, because I know our first panel is ready to go, and I very much appreciate everyone that's here.

This is a particularly glorious day. So it's nice to be able to be up here on the Susquehanna on a beautiful day.

I want to thank Senator Boxer and Senator Vitter, the chair and Republican leader on the Environment and Public Works Committee, for allowing us to have a field hearing. I thought it was important to have the hearing here right at the dam site on the Susquehanna in order to provide the best setting and the most convenient setting for a public hearing as it relates to two very important goals that we have in our country, and that is energy supply and environment, and the two are very much related to our discussion today.

Senator Boozman, who is the lead Republican on the Subcommittee on Wildlife and Water, is recovering from a serious condition. I hope I'll see him this week in Washington. He's the lead Republican on the subcommittee that I have the opportunity of chairing.

So with all of those preliminaries out of the way, welcome, everyone. And as I said, this hearing is scheduled because there's two very important goals that we have. This dam provides an incredible amount of carbon-free energy to our country, which is very important—1.6 billion kilowatt hours of zero-carbon energy annually.

That's very important. It's been here since 1928, so it's been here for a long time.

The energy needs are clear. My staff tells me this is the second largest production of hydroelectric power on the East Coast of the United States, second only to Niagara. So this is a significant facility as it relates to power. It supports a 9,000-acre reservoir that I'm sure that we will be talking about today.

The Susquehanna River is critically important to the Chesapeake Bay and to our environment. It is the largest source of fresh water going into the Chesapeake Bay, starting at Cooperstown, New York, which I've had the opportunity to personally visit. So it's an important environmental issue.

The upstream pollution is not healthy for the Bay. We know that. The sources of the pollution is not the dam. The sources of the pollution is upstream, and we know about the sediment and the issues of the sediment. We also know that there are other pollutants, including the nutrient levels of the Bay. It can be devastating to the aquatic life, the degradation of our oysters, our crab, our rockfish, and hundreds of species are very much impacted by the sediment and nutrients that flow into the Susquehanna and into the Chesapeake Bay.

The environmental problems are well known on the Bay. We've been talking about this for a long time. I started on the Bay program when I was in the State legislature, when Harry Hughes was Governor of Maryland. So it goes back a long time, our efforts to try to deal with the Bay.

The reservoir that was created as a result of the dam provides a trapping source for a lot of those pollutants. They're held in the reservoir. That's a good thing. But now we're talking about reaching the capacity of what the reservoir can handle from the point of view of the sediment control.

Therefore, we're going to talk about a term of dynamic equilibrium. The first time I heard that term was when I was reading the material for this hearing. So we'd like to know what that means and what the impact of dynamic equilibrium is on the Chesapeake Bay and what happens during scouring events, when we have an extreme condition.

I was here a little bit early, so I drove across the dam just to take a look at it. We couldn't help but notice the incredible amount of debris that's being held by the dam today. What impact do scouring events have on this dynamic equilibrium and on the Bay itself? We'll have a chance to talk about that and other issues during this hearing today.

Colonel Jordan, it's a pleasure to have you here. The Army Corps has completed a study, and we thank Exelon and the Nature Conservancy and the State of Maryland for helping facilitate that study. That study dealt with the sediment issue, a very important part of it, and we'll have a chance to review the impact of that study on our work today.

We know that there is a responsibility of all the stakeholders. I want to emphasize that. It's not just one stakeholder, but all the stakeholders. Clearly, what happens upstream and how we handle our waste, how we handle farming operations, how we handle de-

velopment upstream all affect the quality of the Bay and the effectiveness of what can be done here at this dam.

Exelon clearly has a responsibility as the operator of the dam. We'll be able to talk about that. Vicky Will, we thank you very much for being here today. She will be on the second panel.

We have government partners. I particularly appreciate Mayor Gray from Lancaster being here to talk about what you can do at the local level. Secretary Joe Gill from the State is here—we thank him—with the State of Maryland and the impact it has.

This is not the only source of fresh water going into the Chesapeake Bay. How about the other sources and the watershed areas, their responsibility? And, of course, there are other dams on the Susquehanna in addition to here at Conowingo.

All of our policies should be based upon best science, and that's going to be a theme that we'll talk about during today's hearing. Dr. Don Boesch, who is here, is a frequent witness on Chesapeake Bay issues and has been extremely helpful. We very much appreciate your presence here today.

And Genevieve LaRouche is here from the Fish and Wildlife. There are other issues here that we are concerned about, including the fish habitat issue. I've seen the fish passage facility before, and it's very impressive. We'll have a chance again to take a look at it today. But are we doing the best we can for fish habitat? What is the status of that? We'll have a chance today to talk about that issue in addition to others—what impact the sediment has on fish habitat.

And the operation of the dam, which operates two peak periods daily to maximize the energy production—does that have an impact on the health of the fish habitat? That's an issue that we will want to pursue during today's hearing. And are there other steps that can be taken that are appropriate?

We all know that this dam was certified by the FERC process in 1980. FERC certification expires later this year. We're now in the process of the 401 certification mandated by the Clean Water Act. How does that provide us an opportunity to directly deal with some of those issues? I hope that will come out at today's hearing.

We also need to be mindful that there is the State watershed implementation plans and the TMDLs. How does all this fit into those programs that are also clearly aimed at dealing with the health of the Chesapeake Bay, generally?

I hope as a result of today's hearing we'll have a better understanding of the circumstances as to how this hydroelectric dam impacts the issues that we're talking about both on energy and on the environment. What is our overall strategy for dealing with both energy production and environment? How does it affect the surrounding communities? And what are the stakeholders' responsibilities?

The bottom line is we need to work together on this issue, and I'm completely convinced about that. How can all the stakeholders continue to work together to do what's best for our energy needs and our environment?

One last point before I introduce formally our first panel. I really want to thank the staff—they're sitting behind me, the staff from the EPW Committee, both the majority and the Republican staff

people—for the work that they did in making this hearing possible. It's a very busy time for the EPW Committee. We're in the midst of a conference on the Water Resources Development Act. We hope to complete that as early as this week. And yet we're here in Maryland for a field hearing, and I particularly thank them for the work and time that they put in to make this hearing possible.

On a personal note, I thank Josh Klein on my staff who has made the effort to pull all of us together.

One last apology. Obviously, we needed a larger room. I apologize for that. I don't mind people coming in here and sitting if you can find places. So if we can just give you a chance to get to get in here and find a place that's a little bit more convenient for you, that's fine. We have a little bit more room on the sides up here.

I might also put out that the Environment and Public Works Committee is also busy working on a reauthorization of our surface transportation. So this is a very busy time for our committee, and this, obviously, is a very important subject.

So on our first panel, we're very pleased to have Colonel Richard Jordan, who is the Commander and District Engineer, United States Army Corps of Engineers, Baltimore District, in a key position, and Ms. Genevieve Pullis LaRouche, the Field Office Supervisor, U.S. Fish and Wildlife Service—Chesapeake Bay Field Office.

We'll start with Colonel Jordan.

[The prepared statement of Senator Cardin follows:]

STATEMENT OF HON. BENJAMIN L. CARDIN,
U.S. SENATOR FROM THE STATE OF MARYLAND

I want to thank our witnesses for their willingness and interest in testifying at today's hearing.

The Susquehanna River and its tributaries is the single largest freshwater river in the Chesapeake Bay Watershed. Just 10 miles downriver from where we are today, the Susquehanna opens up to become the Chesapeake Bay, the United States' largest estuary.

Where we are today stands the Conowingo Dam—an 86-year-old marvel of engineering (for its time).

The Conowingo Dam is a merchant power production facility that generates 1.6 billion kilowatt hours of zero-carbon energy annually in the State of Maryland, powered by the magnificent public resource that is the Susquehanna River. The Philadelphia Electric Company, now a subsidiary of Exelon Corporation, completed construction of the dam in 1928. PECO and Exelon have sold power and profited from the energy generated by the Susquehanna at this dam for nearly 90 years.

The Conowingo Dam, and the series of dams just upriver from Conowingo on the Lower Susquehanna, effectively control the rate and volumes of water that flow down the river, which has an enormous effect on the river's ecosystem. Some of these effects have been positive, like reducing the flow of sediments and nutrients into the Chesapeake Bay. Others harm the river ecosystems, like restricting the replenishment of natural sediments to the river bed immediately downstream.

The dam's operational procedures that simulate twice daily drought and flood events that are timed based on peak energy demand also affect the health of the river as well as restrict recreational opportunities immediately downriver.

It is incumbent upon the operators of the dam, as well as State and Federal regulators, to ensure that the important public resource powering this dam is also cared for and protected while also meeting our region's energy needs.

It is this fresh water that creates the brackish marine environment that supports Maryland blue crabs, Chesapeake Bay oysters, rockfish, shad and hundreds of other aquatic species.

For many years the dam has provided "incidental" benefits to the Bay of trapping upstream sediments and nutrients that were flowing downstream. These contaminants travel as far away as Cooperstown, New York, and as close as right here in Harford County from Broad Creek.

While the containment of excess nutrients and sediments is significant, the evidence that this benefit is "incidental" is evidenced by the fact that the reservoir is reaching maximum storage capacity because it has not been maintained as if it were a purposeful sediment and nutrient control measure. The accumulated sediments behind the dam are not regularly dredged the way a nutrient and sediment detention basin would be.

Frankly, this isn't surprising. The dam is a hydropower plant, not a stormwater detention basin. But I raise this point because now that the dam is reaching its storage capacity, a better understanding of what a "full reservoir" means is necessary.

Fortunately, Exelon, The Nature Conservancy, and the State of Maryland came together to provide matching and supplemental funds necessary to commission the Army Corps of Engineers to study the effect of the loss of additional capacity of sediment detention behind the dam.

I am looking forward to Colonel Jordan's testimony on the preliminary findings of this study. The Watershed Assessment should help inform the scope of the problem and the feasibility and practicality of "solving," as some have characterized what is necessary, the conundrum of Conowingo Dam.

I think it is important to note, however, that the scope of this study and the models that were run to generate the data were limited to examining sediment. A more complete understanding of the extent of the impact this loss of storage will have on Bay water quality must also assess nutrient pollution.

Maryland has begun the process of developing a section 401 certification for the dam. 401 certification is a regulatory compliance authority delegated to the States by the Clean Water Act that must be completed for any facility requiring a Federal permit or license to operate. In the case of Conowingo, it would be FERC license which is scheduled for relicensing in 2015.

While the Corps' completion of the Lower Susquehanna Watershed Assessment will inform the 401 cert process, Maryland needs more information on scoured nitrogen and phosphorous behind the dam and what continues to come down the Susquehanna is having on Bay water quality.

Maryland and other stakeholders, including Exelon, are interested in helping fund this supplemental study on nutrients. I greatly appreciate this good faith effort on the part of Exelon to help ensure that the 401 certification, and ultimately the FERC license, are informed by the best available science. These regulatory decisions need to be driven by the best science.

Many strong opinions have been expressed on the impact the dam is having on Bay water quality.

Some have said that there is no point in doing anything to address water quality issues on other tributaries of the Bay watershed until Conowingo Dam is "fixed."

Some who hold those opinions also strongly oppose the TMDL and the State Watershed Implementation Plans.

I've also heard Exelon's company line that it does not feel that it is responsible for the pollution that's accumulated behind the dam since Exelon didn't produce it.

Frankly, I take issue and would challenge both of these perspectives. I strongly believe that all stakeholders in the watershed have responsibilities to meet in order to restore water quality to the Bay.

I believe it is irresponsible for one set of stakeholders to point their fingers at Conowingo as an excuse not to make contributions to clean up their part of the watershed. While the Susquehanna may be the largest single source of freshwater into the Bay, the rest of the tributaries combined surpass the volumes of fresh water that flows down the Susquehanna.

The fact is, the excess nutrient and sediments coming down the Susquehanna and are occasionally scoured from behind the dam by events like the storms we experienced in the region last week. But that same storm event caused the fresh water rushing down the Shenandoah, the Monacacy, the Potomac and other rivers of the Chesapeake watershed to run milky brown with sediment and nutrients, and no "fix" at Conowingo Dam would've changed the excess nutrient and sediment levels of these rivers.

The point is, we all have a shared responsibility to work within the our portions of the watershed to improve water quality locally which in turn will improve water quality downstream in the Bay. This is about taking local responsibility for the problems in our communities and avoiding claims of innocence and finger pointing as if the solution or panacea to these problems rest in one place—we share this responsibility.

I want to make it clear that I support the continued and lasting operation of the Conowingo Dam. I believe that there is a balance that must be struck between energy production and environmental stewardship that I want to discuss in this hearing.

Exelon and all stakeholders in the Chesapeake Bay watershed have a responsibility to be good stewards of the waters of the Chesapeake Bay.

The reason I invited Mayor Rick Gray to testify today is that he exemplifies a community that accepts its responsibility in the watershed, and I think there are important lessons that we should learn from his efforts and experience. And Lancaster City does not even reap the direct benefits of the Bay that many of Maryland's communities are so fortunate to have.

The recovery of the Chesapeake Bay is a tremendous undertaking that we all must work together to accomplish. The States have developed Watershed Implementation Plans (WIPs) that show a basin-wide commitment to restoring the basin's water resources. The WIPs spread the burden across all sectors.

The pollution reduction targets set in the WIPs help improve local water quality that in turn results in improved water quality downstream and in the Bay. Because there is no panacea to solving the Bay's water quality challenges.

I look forward to hearing our witnesses' testimony and asking them questions on what responsibilities and actions should be taken not only to address the challenges with a "full" dam but also where the dam fits in the larger basin-wide effort to restore the Bay, and what responsibilities all stakeholders have to reduce the nutrient and sediment pollution to the Bay.

STATEMENT OF COLONEL J. RICHARD JORDAN III, COMMANDER AND DISTRICT ENGINEER, U.S. ARMY CORPS OF ENGINEERS—BALTIMORE DISTRICT

Colonel JORDAN. Chairman Cardin and members of the subcommittee, I'm Colonel J. Richard Jordan, III, Commander of the Baltimore District, U.S. Army Corps of Engineers. Thank you for the opportunity to testify today about our organization's role in addressing the issues of sediment transport along the Susquehanna River and specifically to discuss the Lower Susquehanna River Watershed Assessment.

Throughout this entire process, we have worked with a variety of Federal, State, and local agencies that have been crucial in the assessment's development, as well as various agencies, nongovernmental organizations, and other stakeholders that have provided feedback and information throughout the assessment process. The completion of this assessment would not have been possible without this diverse and vast team.

The Corps of Engineers is a unique organization with a diverse military and civil works mission. Included in our mission is our role in watershed planning, which is more than individual project planning. It is, instead, a more comprehensive strategic evaluation of an entire watershed. This process, starting with an assessment, makes for a more complete range of potential solutions.

In 2011, the Corps partnered with the State of Maryland through its Departments of Environment and Natural Resources to conduct an assessment of the Lower Susquehanna watershed. This watershed assessment, which will be released for public view later this year, will characterize the very complex relationships between river flow, sediment, and ecological resources in the Lower Susquehanna River system, including the series of hydroelectric dams along the river that routinely trap sediment.

The Conowingo has the largest storage capacity of the dams in the series and is closest to the Chesapeake Bay. The effects of sediment on the Chesapeake Bay have been researched, but past studies have not examined from a watershed perspective how dams impact sediment transport from the Lower Susquehanna River to the Chesapeake Bay. Previous studies indicate that the dams have his-

torically acted as sediment and associated nutrient traps, thus reducing the amount of sediments and nutrients reaching the Bay.

To conduct this watershed assessment, we used mathematical modeling and watershed data to analyze sediment management and strategies, as well as examine how the series of dams functioned under various scenarios. These models represent the best tools currently available for evaluating sediment and nutrient dynamics in the Lower Susquehanna River and Chesapeake Bay watershed and have been used extensively with good results. These models have been peer reviewed during previous studies, and their application in this assessment will be peer reviewed again.

When this assessment started in 2011, the concern of the stakeholders was that as the reservoirs behind each dam filled, they would capture no sediments and associated nutrients. Historical records indicate that the trapping of sediments at the Conowingo is limited compared to decades ago. But trapping of more than half of the sediment coming down the river still occurs.

At the current time, each reservoir has reached a state of dynamic equilibrium. This means that after large storm events when mass scour occurs, sediment storage capacity will temporarily increase. Sediment is then deposited again, reducing the overall storage capacity until another mass scour event occurs. As a result, we expect to continue to see periods of trapping followed by scour events. But, overall, the storage capacity of each reservoir is cyclical, and the inflow of sediment will, in the long term, equal the outflow.

The assessment also considered the increased health impacts to the Chesapeake Bay ecosystem. The impacts would be primarily due to attached nutrients, not necessarily the sediment itself. After a mass scour event, estimates showed that the sediment settles quickly and is not the major threat to aquatic life.

Sources to include the watershed and scour from other reservoirs upstream of the Conowingo Dam were also considered. During Tropical Storm Lee in 2011, the Susquehanna River watershed above the Conowingo Dam provided approximately 80 percent of the sediment load delivered to the Bay, only 20 percent scoured from the trapped sediment. These sources deliver more sediment and nutrients and, therefore, more impacts on the Bay ecosystem than do the scoured sediment and associated nutrients from the reservoir behind the Conowingo Dam.

As such, analysis done by the Environmental Protection Agency indicates that the implementation of watershed implementation plans, or WIPs, is estimated to have a far larger influence on the health of the Bay. WIPs manage watershed loads and detail how and when Bay States will meet nutrient load allocations as part of the Chesapeake Bay total maximum daily loads, or TMDLs.

In fact, we've already seen this positive impact. And over the past 30 years, due to regulatory and voluntary nutrient and sediment reduction strategies, nutrient and sediment loads to the Lower Susquehanna River are already significantly lower than they were in the mid-1980s.

The assessment considers a variety of sediment management strategies, including dredging behind the Conowingo Dam. Please note that the assessment does not assign responsibility for imple-

menting those strategies to any party and does not recommend a future Corps project. The implementation of any of these strategies by the Corps would require a specific feasibility study.

Maintenance dredging with upland sediment disposal would be required annually or on some regular cycle to achieve any sustained improvement to the health of the Bay and would likely cost $50 million to more than $250 million for each maintenance cycle with costs continuing to increase as placement sites become less convenient. Further, the positive impacts of dredging may produce are significantly minimized due to the fact that the majority of the sediment during a scour event is coming from the watershed.

Where do we go from here? We're going to continue to work with the report. The report will undergo a series of internal and external reviews, including a public comment period. We remain committed to working in partnership to address the watershed planning needs of the Susquehanna River Basin, and we expect the Lower Susquehanna River Watershed Assessment to provide useful information to help stakeholders and decisionmakers better understand the very complex relationships between the river flow and sediment and ecological resources in the Lower Susquehanna River.

Beyond this assessment, monitoring, research, and further modeling by involved parties can help us understand nutrient processes and their impacts on the Chesapeake Bay and its ecological resources.

Mr. Chairman, thank you for the opportunity to testify here today. This concludes my testimony. I'd be happy to answer any questions you or other members of the committee may have.

[The prepared statement of Colonel Jordan follows:]

U.S. DEPARTMENT OF THE ARMY

COMPLETE STATEMENT

OF

COLONEL J. RICHARD JORDAN, III

COMMANDER AND DISTRICT ENGINEER

U.S. ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT

BEFORE

THE COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS
SUBCOMMITTEE ON WATER AND WILDLIFE

UNITED STATES SENATE

ON

FINDING COOPERATIVE SOLUTIONS TO ENVIRONMENTAL CONCERNS WITH THE CONOWINGO DAM TO IMPROVE THE HEALTH OF THE CHESAPEAKE BAY

MAY 5, 2014

Chairman Cardin and members of the Subcommittee, I am Colonel J. Richard Jordan III, Commander of the Baltimore District, U.S. Army Corps of Engineers. Thank you for the opportunity to testify today about our organization's role in addressing the issues of sediment transport along the Susquehanna River, and specifically, to discuss the Lower Susquehanna River Watershed Assessment. This watershed assessment is being conducted by the Corps in coordination with numerous stakeholders, with the State of Maryland as the project sponsor.

OVERVIEW

The Corps is a unique organization, with a diverse military and civil works mission. The Baltimore District executes a Civil Works mission primarily in the interest of flood risk management, aquatic ecosystem restoration, and navigation throughout the Chesapeake Bay watershed above the Virginia state line, which spans the lengths of the Susquehanna and Potomac Rivers, including parts of New York, Pennsylvania, Delaware, Maryland, Virginia and West Virginia, as well as the District of Columbia.

Included in the Corps' diverse mission -- and related to the topic here -- is our role and responsibility in watershed planning. Watershed planning goes beyond planning for an individual project toward a more comprehensive strategic evaluation of the entire watershed. Watershed planning addresses the identified water resource needs in the watershed and is done collaboratively with other Federal, state, and local entities to determine goals for improving the watershed without regard to who might take specific actions to help meet those goals. While watershed plans may identify potential opportunities for Corps actions, which could not be taken without further analysis, this is not a primary consideration or goal of watershed planning. The planning process helps create a more complete range of potential solutions and is more likely to identify the most technically sound, environmentally sustainable, and economically efficient means to achieve the goals for the watershed over the long term. This information is then made available to local sponsors, other agencies, and organizations within the watershed for their own project planning, to create effective, collaborative, and synergistic improvement throughout the watershed.

LOWER SUSQUEHANNA RIVER WATERSHED ASSESSMENT

In 2011, the Corps partnered with the State of Maryland through its Departments of the Environment and Natural Resources to conduct a watershed assessment of the Lower Susquehanna watershed under Section 729 of the Water Resources Development Act of 1986. A watershed assessment is the first step toward the development of a watershed plan. This watershed assessment (which will be released for public review later this year) will characterize the very complex relationships between river flow, sediment and ecological resources in the Lower Susquehanna River system and the upper Chesapeake Bay. Mathematical modeling and watershed data were used to analyze sediment management strategies and estimate impacts from the use of these strategies to better inform stakeholders undertaking efforts to restore the Chesapeake Bay. This analysis considered the impacts of hydroelectric dams along the River south

of Harrisburg, Pennsylvania that routinely trap sediment. Although a significant amount of information on the system was available, this assessment helped close some data gaps. The completed assessment will provide information to decision makers on sediment transport through the system, which may impact how nutrient, sediment and habitat restoration goals for the Chesapeake Bay are achieved.

Throughout the entire process, we have worked with a variety of Federal, state, and local agencies that have been crucial in the assessment's development. Both the U.S. Geological Survey and the Corps' Engineering Research and Development Center are participating in major technical portions of the assessment along with the Susquehanna River Basin Commission, The Nature Conservancy, the U.S. Environmental Protection Agency – Chesapeake Bay Program, and the Maryland Department of Natural Resources' Maryland Geological Survey. Together, these agencies make up the Lower Susquehanna River Watershed Assessment interagency team.

Outside of the interagency team, there are various agencies, non-governmental organizations and other stakeholders that have attended quarterly meetings and provided feedback and information throughout the assessment process. These include but are not limited to: Pennsylvania Department of Environmental Protection, Pennsylvania Department of Conservation and Natural Resources, Pennsylvania Fish and Boat Commission, Exelon, the Lower Susquehanna Riverkeeper, the National Oceanic and Atmospheric Administration, the University of Maryland Center for Environmental Science, U.S. Fish and Wildlife Service, Chesapeake Bay Commission, Chesapeake Bay Foundation, Chesapeake Conservancy, Chesapeake Research Consortium, Conservation Fund, Coastal Conservation, Maryland Port Administration, Baltimore City Government, the Pennsylvania governor's office, the Maryland governor's office, and the Wildlife Management Institute.

So why is this collaborative effort significant? The Chesapeake Bay is the largest estuary in the United States and the Susquehanna River is its largest tributary, supplying the most freshwater to the Bay as well as serving as its largest source of sediment and nutrient loads. Federal agencies share a renewed commitment to restore the Chesapeake Bay embodied in President Obama's Executive Order 13508, Chesapeake Bay Protection and Restoration. This executive order established the Federal Leadership Committee, which in turn, developed the Federal Action Strategy that set goals and objectives to be accomplished by the federal government, working closely with state, local, and non-governmental agencies, to protect and restore the health of the Chesapeake Bay. The Federal Action Strategy document specifically assigns the Corps the "lead" role to "...advance studies to evaluate the management of sediments..." in the lower Susquehanna River watershed. The interagency team, as well as the various agencies that are providing feedback and information throughout the assessment process, seek to integrate water resources management in the lower Susquehanna River watershed to ensure sustainable restoration of the Chesapeake Bay.

Though the effects of sediment on the Chesapeake Bay have been researched, past studies have not examined, from a watershed perspective, how dams impact sediment

transport from the lower Susquehanna River to the Chesapeake Bay. The assessment area consists of the lower Susquehanna River watershed from Sunbury, Pennsylvania, through the confluence with the Chesapeake Bay and into the upper Chesapeake Bay, where impacts are likely to be the largest.

The series of hydroelectric dams includes: York Haven, constructed in 1904, which forms Lake Frederick; Safe Harbor, constructed in 1931, which forms Lake Clarke; Holtwood, constructed in 1910, which forms Lake Aldred; and Conowingo constructed in 1928, which forms Conowingo Reservoir. The Conowingo has the largest storage capacity of the dams in the series and is the closest to the Chesapeake Bay. Sediments and associated nutrients from the land, floodplain, and streams in the lower Susquehanna River have been transported and delivered to the reservoirs behind the dams over the past century. Previous studies indicate that the dams have historically acted as sediment and associated nutrient traps, thus reducing the amount of sediments and nutrients reaching the Bay.

When this assessment started in 2011, the concern of stakeholders was that as the reservoirs behind each dam fill and reach a steady state, or equilibrium, the dams would no longer capture sediments and associated nutrients. Those stakeholders were concerned that there might be a significant increase in the daily input of sediment and nutrients to the Bay, which could undo the progress made by continued restoration strategies in New York, Pennsylvania, and Maryland. Also, many stakeholders were interested in sediment transport from the watershed during storm events, when previously deposited sediment would be scoured—or moved—from the reservoirs and delivered to the Bay.

To examine how the series of dams functioned, mathematical models are being used to simulate sediment transport through the lower Susquehanna River watershed under various scenarios. The technical work of the assessment is essentially complete; however, the report is in draft and currently undergoing review. The technical work associated with the assessment considered the trapping capacity for the series of reservoirs. Historical records indicate that the trapping of sediments at the Conowingo is limited compared to decades ago, but trapping of more than half of the sediment coming down the river still occurs. At the current time, each reservoir has reached a state of dynamic equilibrium. This means that after high flow storm events large enough to cause mass scour, which, according to historical flow data, occur on average every 4-5 years, the sediment storage capacity will temporarily increase, allowing for more reservoir deposition in the short term. This causes a periodic "cycle" with an increase in load to the Chesapeake Bay from scour also resulting in an increase in storage capacity, followed by reduced loads transported to the Chesapeake Bay due to reservoir deposition. As a result, we expect to continue to see periods of trapping followed by scour events along the Susquehanna River into the Chesapeake Bay. Long-term storage capacity of each reservoir is cyclical and overall the inflow of sediment will equal the outflow.

The assessment also considered the increased health impacts to the Chesapeake Bay ecosystem. These impacts would be primarily due to attached nutrients, not necessarily the sediment itself. After a mass scour event, estimates showed that the sediment

settles quickly and is not the major threat to aquatic life. However, scoured nutrients stimulate algal growth that reduces life-sustaining dissolved oxygen, particularly in the deeper waters of the upper Chesapeake Bay. Modeling and monitoring show this state could persist for multiple seasons. Additionally, the impact to habitat and living resources is tied to the timing of the scour event. That is, a scouring event in spring has greater adverse impacts to water quality and living resources than fall or winter events.

Sources, to include the watershed and scour from the other reservoirs upstream of the Conowingo Dam, were also considered. Modeling estimates of the most recent mass scour event, Tropical Storm Lee in September 2011, indicate that the Susquehanna River watershed located above the Conowingo Dam provided 80 percent of the load delivered to the Bay, with the remaining 20 percent scoured from the sediment trapped in the Conowingo Reservoir. These sources deliver more sediment and nutrients and, therefore, more impacts on the Bay ecosystem, than do the scoured sediment and associated nutrients from the reservoir behind Conowingo Dam.

With or without a Conowingo reservoir that is essentially full of sediment, the watershed contributions of sediment and nutrients during large storm events will have significant effects on the Bay's living resources. Analyses by the Environmental Protection Agency also indicate that implementation of Watershed Implementation Plans (WIPs) that manage watershed loads and detail how and when surrounding Bay states will meet load (nitrogen, phosphorus, and sediment) allocations as part of the Chesapeake Bay Total Maximum Daily Loads (TMDL), are estimated to have a far larger influence on the health of the Bay in comparison to scouring of the reservoirs. In fact, over the past 30 years, due to existing regulatory and voluntary nutrient and sediment reduction strategies in the watershed, nutrient and sediment loads to the Lower Susquehanna River are already significantly reduced from what was delivered in the mid 1980's.

Modeling done for this assessment estimated that under current conditions, which did not include the positive impacts of WIP implementation, more than half of the deep water habitat, and much of the shallow water habitat, in the Bay is frequently not suitable for healthy fish, bottom-dwelling and plant communities based on TMDL standards. Under conditions which include WIP implementation, all Chesapeake Bay habitats meet TMDL standards. However, when WIPs are implemented and a mass scour event occurs, only a limited amount of the deep water habitat within the Chesapeake Bay does not meet TMDL standards due to insufficient dissolved oxygen. Shallow water and non-deep water habitat is minimally impacted and still meets TMDL standards.

In addition to looking at how sediment transport impacts the Chesapeake Bay, this assessment's report will lay out a survey-level screening of management strategies. This will evaluate the management of sediment loads and nutrients associated with those loads.

The assessment considers a variety of sediment management strategies- to reduce the amount of sediment available for a scour event. These include reducing sediment inflow to the reservoirs, minimizing deposition in the reservoirs, and increasing storage capacity of the reservoirs. The assessment report will include an analysis of the

effectiveness, sustainability, and cost-effectiveness of strategies. Note that the assessment does not assign responsibility for implementing those strategies to any party and does not recommend a future Corps project; the implementation of any of these strategies by the Corps would require specific feasibility study.

One such sediment management strategy considered was dredging to increase storage capacity of the reservoirs. Dredging behind the Conowingo Dam with upland sediment disposal would be required annually, or on some regular cycle, to achieve any sustained improvement to the health of the Bay. It was estimated that the annual cost of such a program would likely be on the order of $50 million to more than $250 million, with costs likely increasing in future years as placement sites become less convenient. Further, the positive impacts that dredging may produce are significantly minimized because the majority of the sediment load during a scour event is coming from the watershed.

The management of nutrients, dissolved and attached, is likely more important than management of sediments to the health of the Chesapeake Bay. Therefore, nutrient management options would be more cost effective and provide more flexibility than solely relying on management options focused on sediment only. However, the assessment did not consider these options.

Throughout the assessment process, analytical tools were used. We recognize that, like all mathematical models applied to simulate complex physical processes, the modeling tools used in this effort have uncertainties. However, they represent the best tools currently available for evaluating sediment and nutrient dynamics in the lower Susquehanna River and Chesapeake Bay watershed, and have been used extensively with good results. These models have been peer-reviewed during previous studies and their application in this assessment will be peer-reviewed by various groups including the Chesapeake Bay Program Scientific and Technical Advisory Committee.

So, where do we go from here? The assessment report will undergo a series of internal and external reviews, including a public comment period. Stakeholder outreach will continue and includes a public website, social media outreach, updates at associated meetings, and continued coordination with the various Federal, state and local agencies. When finalized, we expect the Lower Susquehanna River Watershed Assessment to provide useful information to help stakeholders and decision-makers better understand the very complex relationships between river flow and sediment and ecological resources in the Lower Susquehanna River system and the Chesapeake Bay. Beyond this assessment, monitoring, research and further modeling by involved parties can help us understand nutrient processes and their impacts on the Chesapeake Bay's ecological resources.

The Corps remains committed to working in partnership to address the watershed planning needs of the Susquehanna River Basin and specifically as it relates to sediment and nutrient transport and its impact on the Chesapeake Bay. Mr. Chairman, thank you for the opportunity to testify here today and I would be happy to answer any questions you or other Members of the Subcommittee may have.

Questions for Jordan

Questions from:

Senator Ben Cardin

Answers from the Corps of Engineers, Baltimore District are in Bold.

1. Would you please explain the history and past application of the models used in determining the findings of the LWSRA?

Answer: The interagency team selected existing, well understood, well vetted models that have had decades of use, development and peer review.

(1) The 3-Dimensional Chesapeake Bay Environmental Model Package (3-D CBEMP) developed by the U.S. Environmental Protection Agency (EPA) was used in the development of the 2010 Chesapeake Bay Total Maximum Daily Load (TMDL). In addition, the full suite of Chesapeake Bay models have been updated and calibrated based on the most recently available monitoring data every five to seven years over the past three decades.

(2) The 2-Dimensional Adaptive Hydraulics (2-D AdH) model was developed in the 1990's at the U.S. Army Corps of Engineers' (Corps) Engineer Research and Development Center (ERDC) Waterways Experiment Station and has been applied in riverine systems around the country and world.

(3) The 1-Dimensional Hydrologic Engineering Centers River Analysis System (1D HEC-RAS) is a model developed by the Corps in the 1990's. The model has had wide use and applicability in riverine systems around the country and world.

The models are built from theory based on scientific research. All three models have had millions of dollars invested in them and have been applied to many studies around the country and world. The use of the latter two models has resulted in the successful construction and operation of hundreds of water resource management structures and systems.

a. Are these methods peer reviewed?

Answer: Yes. The models have been used for many studies and have been peer reviewed in their usage and application many times over the years.

2. How reliable is the data produced through these models and can you give affirmative examples of how these models have been used in the past to support studies that have proven and tested results with reliability?

Answer: The level of reliability of data produced by the models is mainly a reflection of the quality and quantity of the data put into the model. The more reliable and comprehensive the data inputs, the more accurate and reliable the model outputs are in support of a study. Many existing Corps flood, navigation and environmental projects have been built or modified relying on the results of these models.

A few examples of existing projects constructed utilizing data and application from these models include:

The HEC-RAS model data has been used for the Sacramento River Flood Project (CA); Comprehensive Study of Sacramento and San Joaquin River Basin (CA); White Oak Bayou Federal Flood Damage Reduction Project (TX); Mobile Bed Modeling of the Cowlitz River (WA); Flood Plain Modeling in the Kansas River Basin (KS); Flood Cyclone JFY 2010 Mini-Project Indonesia; and Flood Hazard Mapping in the Nan River Basin, Nan Province, Thailand.

HEC-RAS model data use outside of the Corps includes the following:

Endensco, Inc. used HEC-2/HEC-RAS for hydraulic and hydrologic analysis of Route 1 Neabsco Creek in Prince William County, Virginia. The data was peer reviewed by the Virginia Department of Transportation.

NMP Engineering Incorporated performed a hydraulic study of Terrapin Branch. HEC-RAS was used for three design alternatives for the proposed bridge. The data was peer reviewed by the Maryland State Highway Administration.

WBCM was the lead design consultant for Corman Construction who designed and constructed the Hampstead Bypass Project using HEC-RAS to size bridge openings. The data was peer reviewed by the Maryland State Highway Administration.

The AdH model data has been used to construct the Moose Creek Floodway on the Chena River, a joint effort by the Coastal and Hydraulics Lab at the Engineering and Research Development Center and Alaska District Corps of Engineers; and the Jacksonville Harbor (FL) Navigation Project.

Regarding peer review for any Corps study involving construction of large water resource projects (such as those listed above), the models undergo review by the (1) Corps District conducting the study/modeling, (2) another Corps District (3) an independent (non-Corps) panel of reviewers that are designated experts from private companies and academia (4) any local, state, federal, or non-governmental organization requesting to be a cooperating agency on a study (5) general public and (6) Corps headquarters and division offices.

a. How often have these models and methods been applied in other circumstances and used to support reliable studies?

Answer: All of the models have been applied to hundreds of studies. The models are continually being updated, validated, calibrated and improved. Their development is constant, based upon lessons learned after each use they are improved.

3. Given the number of serious scour events that the Corps could have modeled, including Hurricane Agnes and Tropical Storm Lee, why did the Corps rely on such limited datasets that were on the lower end of the scour event spectrum?

Answer: The use of existing, readily available data for the modeling effort was considered sufficient for meeting the assessment modeling objectives. In the last 40 years, it is estimated

that there were 11 storms with mean peak flows greater than 400,000 cubic feet per second (cfs) which is the estimated flow that generates mass scour of the reservoirs. The January 1996 event of 633,000 cfs mean peak flow ranks as the fourth highest flow in the 40-year record. This event was selected to observe water quality impacts for the Lower Susquehanna River Watershed Assessment (LSRWA) storm event scenarios because it is the highest observed flow within the CBEMP's digitally recorded and modeled 1991-2000 hydrologic period. Given this was the same time period utilized for the development of Bay TMDL, it allowed for a direct analysis of scour impacts on the TMDL.

The 2011Tropical Storm Lee event is the second highest flow event in the 40-year record with 700,000 cfs mean peak flow, but it occurred outside of the 1991-2000 hydrologic record, thus, direct analysis of scour impacts on the TMDL could not be made. However, Tropical Storm Lee sediment transport and flow were evaluated with AdH; TMDL water quality impacts were not.

The 1972 Hurricane Agnes event is the storm of record having the highest flow at 1,130,000 cfs mean peak flow. Agnes occurred in an era before real-time digital data collection. Without this data, modeling is much more expensive and the results would have more uncertainty. Roughly estimated, an Agnes modeling run would cost several hundred thousand dollars due to the additional data collection and recording needs and additional model development to conduct the run. It is unknown if bathymetry directly before and after Agnes exists; at best, there may be hand-drawn maps available but certainly no bathymetry data in a form useable by a 2D model as it was for the 1996 event or the Tropical Storm Lee event. Also, there was no sampling at the Conowingo Dam or Marietta gauge during Agnes, with only records at Harrisburg.

a. Can you speculate on how the study's finding would differ had the Corps used these larger scour events?

Answer: It is likely that the study's major findings would be unaffected, although an increased knowledge of a broader range of conditions would further reduce uncertainty as to outcomes and provide further understanding of Agnes, the Chesapeake Bay "period of record" storm, which is recognized as the worst case scenario (i.e., the highest flow at the most sensitive time of year). That said, the 1996 event represents a more typical mass scour event in terms of frequency, flow magnitudes, scour, and sediment/nutrient passage.

4. What are the more precise impacts, where are the locations of the impacts, and how long will the impacts last?

Answer: When large storm events cause the river to flow above 400,000 cfs, mass scour of sediment and nutrients from the reservoirs occur that impacts the Upper Chesapeake Bay water quality. The greatest long term impact from these mass scour events observed, is primarily from the increase in nutrients going to three deep water segments of the Upper Chesapeake Bay, creating, through a chain of biological interactions, greater oxygen deprivation conditions (i.e., anoxia), especially during the summer. Shorter term impacts from sediment suspension and smothering of fish eggs, bottom-dwelling creatures and submerged aquatic vegetation (SAV) depend heavily upon the time of year and size of the mass scour event; however, SAV

appear remarkably resilient in their survival from these events, and sediment usually tends to settle out of the water column throughout the Bay within about ninety days or less.

CBEMP modeling estimates show that the sediment load from Conowingo scour (not including nutrients they contain) from a 1996 sized event are not the major threat to Bay water quality. For most conditions examined, scoured sediments settle out of the Bay water column before the period of the year during which light attenuation is critical. Although the sediments are subject to some re-suspension, once deposited on the bottom, the effect of mineral sediments (sediment) on the Chesapeake Bay essentially cease

As indicated above, the nutrients associated with the sediment are far more damaging then the sediment. After deposition, biological processes transform the various nutrients into dissolved forms that diffuse into the water. The nutrients are then available for use by algae and affect Bay water quality. When the dissolved nutrients are recycled to the water column, they stimulate algal production. When the algal organic matter decays, it consumes the oxygen in the classic eutrophication cycle. As a consequence, dissolved oxygen, especially in the deep water segments of the Upper Bay, is diminished by reservoir scour events. Because nutrients take years to undergo burial to a depth where they are no longer an influence on surface waters, they recycle between sediment beds and the water column, thus persisting and affecting these deeper waters for two to three years or more. CBEMP modeling does predict, however, that eventually the impacts to water quality decrease after a scouring event.

5. What does dynamic equilibrium mean for regular/normal flows?

Answer: Dynamic equilibrium means that over time the net inflow of sediment into the reservoirs will equal the outflow. The capacity of the reservoirs to trap material is dynamic, such that events creating high river flows scour the deposited sediments in the reservoir beds and release them down river, thus creating additional trapping capacity in the short term.

Currently, the estimated average annual load to the reservoirs (1993-2012 hydrologic periods) is 4.1 million tons of sediment; 2.4 million deposits and is temporarily stored behind the dams, while 1.8 million enters the Bay, representing a 55 to 60 percent trapping rate.

The regular/normal flow in the Susquehanna River is 30,000 cfs. There is some limited scour that occurs at flows of 150,000 to 300,000 cfs for storm events that occur every one to two years, but the modeling indicates that the majority of scour in the Conowingo reservoir occurs when the flow exceeds 300,000 to 400,000 cfs (i.e., a scour threshold). This threshold is reached on average every four to five years based upon the frequency of major storm events. Additionally, the modeling indicates that the volume of sediment scoured today for flows above 150,000 cfs is higher than in the mid-1990's.

Dynamic equilibrium comes into play during these high flow events of 300,000 cfs and higher when the majority of the scour occurs to create increased capacity in the reservoir for future sediment deposition. Mass scouring occurs when the flows are about 400,000 cfs or greater and is the period when the largest amount of sediments are transported to the Bay, thus, the focus for the assessment.

a. How are regular/normal flows on the Susquehanna, given this state of dynamic equilibrium, different from regular/normal flows on a free flowing/unimpeded river?

Answer: A natural river has no long-term net storage of sediment, nutrients or water. In the Susquehanna River during regular/average flows of 30,000 cfs, it is estimated that around 55 to 60 percent of sediment and associated nutrients is trapped in the short-term by the reservoirs.

6. How is this state of dynamic equilibrium affected by scour events?

Answer: See Number 5 above.

a. During a scour event how much of the sediment in the flow is coming from upstream versus sediments that are being stirred up and washed out from the riverbed behind the dam?

Answer: Preliminary findings of the assessment identified that during Tropical Storm Lee (700,000 cfs at mean peak flow) scour from behind Conowingo Reservoir was 20 to 30 percent of the total load. Outside of Tropical Storm Lee, over the last 40 years during storm events large enough to produce scour, it was estimated that scour from behind Conowingo Reservoir comprised, on average, approximately 30 percent of the total loads entering the Bay with the remaining loads from the watershed. It must be noted that during an event large enough to cause scour (300,000 to 400,000 cfs) there is a tremendous increase in erosion and sediment transport throughout the watershed. So, whereas the sediment plumes observed during a large event are impressive, the majority of the material is from above the Conowingo Reservoir.

b. How should the sediment composition disparity during flows events be taken into consideration as action is contemplated to address sediments behind the dam?

Answer: Silts and clays are more easily transported over the dam while heavier sands remains trapped. The LSRWA looked at some sediment management measures, such as bypassing, that might have, coincidentally, had some effect on alleviating this disparity. However, these simpler measures were determined to likely have more detrimental than beneficial effects. Restoring the balance of the historical transport of all sediment sizes could be investigated further in the future.

7. Has bathymetry analysis been conducted to compare the cross sectional measurements taken by the USGS behind the reservoir from Fall 1996 with Fall 2008?

Answer: This analysis was done as part of the assessment. The 1996 bathymetry (depth of reservoir bed) was compared to 2008, 2011 and a calculated "full" bathymetry all based on USGS bathymetry data. Annually, on average 1.5-1.6 million tons of sediment has been deposited over the past 16 years (1996-2012 record).

8. How does the USACE models that are referenced in the LSRWA study account for USGS estimates on sediment amounts behind the dam?

Answer: The 2D AdH model was run using four years of data from 2008 to 2011 and was calibrated and verified by USGS; however, the model was calibrated against 16 years of USGS data. The model was adjusted to ensure it fit within the USGS' 1.5 to 1.6 million tons of

deposition on average a year data range (1996-2012 record). CBEMP utilized modeling outputs from AdH. USGS also reviewed all AdH and CBEMP outputs throughout the study process.

a. How does the USACE account for its data only showing that the flow of sediment passed the dam at 750,000 tons annually when U.S. Geological Survey has estimated this number to be 1.5 million to 2 million tons annually?

Answer: It is unclear where this number 750,000 tons is coming from, however, all estimates from the draft report will be peer reviewed. When numbers this large are considered, absolute numbers will vary, but the relative changes between scenarios are reliable.

More specifically, USGS Average Annual Load to Bay for 1993 to 2012 is 1.5 (up to 1.8) million English tons/annum. This converts to 3.74 million kilograms per day (kg/d). The Watershed Model (WSM) component to the CBEMP model daily average load for 1991 to 2000 under 2010 Progress Run conditions is 3.06 million kg/d. The differences between the two estimates can be attributed to numerous factors including different summary intervals – 1993 to 2012 for USGS vs. 1991 to 2000 for the WSM. It is concluded the two estimates of long-term average loads at Conowingo are in reasonable agreement. Most of LSRWA loads are reported in English tons, similar to USGS reported numbers. CBEMP outputs, however, are in kg/d so some conversions were required in reporting.

i. What is the root of this discrepancy?

Answer: Please see answer above.

9. Can you explain how or if your models compensated or took into consideration the seasonal affects of the scour events that were modeled?

Answer: Modeling runs were made that varied the season of a high flow event to spring, summer and fall and compared seasonal effects. The spring storm effects were estimated, all else being equal (hydrology and sediment loads), to have the greatest detrimental effects.

10. Given the concerns regarding climate change and greater storm surges, how is a major storm event considered if data does not represent storm scour in the past and those predicted and expected in our lifetime?

Answer: Trends observed from scientific research on climate change impacts are described in the report. Of course, it is quite possible that we are already seeing some effects from climate change in the more recent storm events that we were able to record and model for the LSRWA. However, a quantitative analysis of these impacts to detect climate change effects was not completed. It may be possible to do such an analysis in the future, although it was not within the mandate or funding for this assessment. Currently, there is too much unknown data, and thus, too much uncertainty, to reasonably speculate on possible future climate change effects on this particular watershed.

11. If the flow and volume conditions of a winter scour event like the rapid snowmelt from the "Blizzard of 1996" that the Corps modeled occurred in May or June, how it would have a different effect on water quality and aquatic ecosystems?

Answer: Modeling runs varied the season of a high flow event to spring, summer and fall and compared seasonal effects. The seasonal timing of a large storm (i.e., mass scour) event could have a different effect on aquatic life in the Chesapeake Bay. A modeling run accounting for precisely such a seasonal variance was made; the detrimental effects to the Bay of such an event, although similar to those described above, would be far greater and last far longer after a spring event than it did for the original winter event. The spring storm effects were estimated to have the greatest detrimental effects.

a. Does LSWRA accommodate for seasonal variance?

Answer: Yes. The spring storm effects were estimated, all else being equal, to have the greatest detrimental effects.

12. What are the benefits of large scale dredging of sediment from behind the dam?

Answer: The benefits of large scale dredging of sediment from behind the dam would be minimal, at best. Dredging could temporarily increase storage capacity, but it would have little effect on estimated water quality conditions in the Chesapeake Bay (improvements of 0.1 to 0.2% of dissolved oxygen water quality standards were observed). For any long-term dredging program, it must be realized that large volumes of sediment continue to deposit in the reservoir each year; therefore, the net removal of sediment out of the system will always be reduced simply because part of any dredging operation would be "keeping up" with deposition. This reduces the benefits, small to begin with, that may otherwise be anticipated.

13. What are the risks of large scale dredging of sediment from behind the dam?

Answer: A full environmental analysis, or a National Environmental Policy Act (NEPA) analysis, was not in the scope of this assessment; however, a preliminary analysis indicated that dredging could have potential impacts associated with the removal, placement and management of the material dredged including, but not limited to air quality, water quality, noise, traffic, road maintenance, groundwater, and aquatic life.

14. What are the estimated costs of restoring sediment storage capacity to what it was in 1990?

Answer: We do not have the data on the bathymetry in 1990. However, the cost of dredging to bring the reservoir back to 1996 bathymetry (which requires dredging of 31 million cubic yards from the reservoir) was evaluated. The cost for this would be $500 million to $3 billion.

a. What would the annual estimated costs be to maintain this level of capacity?

Answer: USGS record from 1993 to 2012 estimates that 4.1 million tons of sediment on average, annually flows from the Susquehanna River watershed into Conowingo Reservoir; 2.4 million tons of this is deposited in the Reservoir and is temporarily stored behind the dam, while 1.8 million tons of sediment continues on and enters the Bay, representing a 55 to 60 percent annual trapping rate (on average).

It is estimated that annual maintenance of three million cubic yards (2.4 million tons removed annually) is $50 to $250 million a year. This would theoretically allow the reservoir to keep depositing at currently measured rates.

15. If some storage capacity were restored behind the dam behind the dam, would the workload and time spent dredging the Chesapeake Channel be reduced?

Answer: An analysis of the effect on upstream dredging to navigation channel maintenance was not completed specifically, but it is known that the storms are what drive the system and these will dwarf any benefits attained from "relief" dredging from the reservoirs. The high expense and small impact of increasing storage capacity temporarily is minimized significantly by the continued sediment loading into the reservoirs and the storm events which occur on average every four to five years. Mass scour events sending sediment to the upper Chesapeake Bay would have only short-term, and relatively small, impacts on any of the navigation channels. During low flow times, this same effect would be negligible or non-existent. In summary, it is likely that a percentage (most likely a small percentage) of sediment scoured from Conowingo after a storm event would likely settle in the channel. The exact percentage is unknown. However, annual or regular maintenance dredging of navigation channels would be required due to local sediment sources to maintain the navigation channels regardless of dredging done behind Conowingo.

a. If so, would this be adequate justification for the Corps to use some of its annual dredging and maintenance budget to better manage sediments upstream instead of spending it all on direct maintenance on the channels?

Answer: This is unlikely due to the reasons cited above.

16. What can Congress can do to ensure that the full range of issues (the dam's retention of courser beneficial sediments, passing most fine-grained material associated, the dam's operation that simulates daily floods and droughts) with the Conowingo are addressed?

Answer: The assessment report is still being drafted with the public review planned for later this year. The report will lay out those issues associated with the complex relationships between river flow, sediment and ecological resources in the Lower Susquehanna River system and the upper Chesapeake.

17. What new authorities could the Corps use to assist in any shoreline erosion/sediment control work along the Susquehanna?

Answer: Future requirements may come from the assessment. However, the assessment does not assign responsibility for implementation of a project to any party and does not recommend a future Corps project; the implementation of any of the strategies outlined in the final report would require a specific feasibility study for Corps participation.

Senator David Vitter

Question 1:

Your written testimony discusses the Army Corps of Engineers' (Corps) role and responsibility in watershed planning. You state that watershed planning "addresses the identified water resource needs in the watershed and is done collaboratively with Federal, state, and local entities to determine goals for improving the watershed without regard to who might take specific actions to help meet those goals." You state further that information developed during watershed planning is made available to local sponsors, other agencies, and organizations "within the watershed for their own project planning, to create effective, collaborative, and synergistic improvement throughout the watershed."

I appreciate the Corps' environmental stewardship efforts and its commitment to working with other federal, state, and local agencies and stakeholders. At the same time, I am concerned that the concept of "watershed planning" is quickly growing into the federal takeover of state and local land use decision making authority. The Corps' proposed "waters of the United States" rule, issued jointly with the Environmental Protection Agency, only heightens my concerns since it effectively would result in federal regulatory control over thousands of Americans' backyard puddles and ponds.

With these concerns in mind, may the Corps and other federal agencies impose binding, restrictive land use measures upon state and local agencies or private landowners under a watershed plan? How would you anticipate state and local land use authorities, as well as private landowners, having the authority to reject or dismiss information and recommendations provided by the Corps during watershed planning? Do the citizen suit provisions of the Clean Water Act provide the potential for additional litigation under the "waters of the United States" rule? If you do not believe that additional litigation for local and private land use decisions will occur, is the Corps willing to confirm in writing that any expansion of federal jurisdiction will not enable environmental groups to sue private and public landowners under any new or revised jurisdictional definitions?

Answer: Watershed planning, which connotes a number of programs within the Corps' water resources development mission, is statutorily and programmatically separate from the Corps' regulatory program established by Congress under Section 404 of the Clean Water Act, as amended (33 U.S.C. 1344) and Section 10 of the Rivers and Harbors Appropriations Act of 1899 (33 U.S.C. 403). These statutes prohibit certain discharges to waters of the United States and any structures or work affecting navigable waters of the United States without a permit from the Corps. The recent proposed rule published in April for public comment is meant to clarify the definition of the term "waters of the United States" in light of recent Supreme Court decisions. In contrast, watershed planning is performed by the Corps at the request of, and in financial partnership with, States, Tribes and local governments for the purpose of enhancing the use of their water resources.

The most prominent of the Corps' watershed planning programs are: the watershed and river basin assessments program authorized by Section 729 of the Water Resources Development

Act (WRDA) of 1986, as amended (33 U.S.C. 2267a), and the planning assistance to States (PAS) program authorized by Section 22 of WRDA 1974, as amended (33 U.S.C. 1962d-16). ("States" for purposes of the PAS is statutorily defined to include Tribes). These authorities allow the Corps to perform watershed assessments and comprehensive plans with non-Federal governmental interests at a Federal / non-Federal cost share of 25% under the first statute, and 50% under the second statute, to investigate needs as requested by such interests related to such matters as ecosystem protection, flood damage reduction, navigation, watershed protection, water supply, and drought preparedness. Once these assessments or plans are completed, they are used by the non-Federal entities as they see fit.

For the above reasons, it is necessary to completely differentiate the first two questions concerning watershed planning, which is entirely voluntary on the part of non-Federal governmental entities, from the last two concerning Corps/EPA Clean Water Act mandates for controlling the discharge of dredged and fill material.

Question: May the Corps and other federal agencies impose binding, restrictive land use measures upon state and local agencies or private landowners under a watershed plan?

Answer: Corps watershed assessments and plans do not impose any restrictions upon State and local governments, whether related to land use or otherwise. State and land use agencies collaborate in the formulation of watershed plans, and are free to accept or reject them in whole or in part.

Question: How would you anticipate state and local land use authorities, as well as private landowners, having authority to reject or dismiss information and recommendations provided by the Corps during watershed planning?

Answer: The watershed assessments and plans cannot infringe in any manner on State, Tribal and local land use, water use, or zoning powers and authorities. To the contrary, the statutes authorizing such watershed assessments and plans were enacted by Congress to enhance the effectiveness of local planning.

Question: Do the citizen suit provisions of the Clean Water Act provide the potential for additional litigation under the "waters of the United States" rule?

Answer: The proposed EPA and Corps joint rule on the definition of waters of the U.S. under the Clean Water Act was published in the Federal Register for public comment on April 21, 2014. It is the Administration's view that the proposed rule is consistent with the intent of the CWA to protect the Nation's aquatic resources. The definition of the term the "waters of the United States" is the subject of the proposed rule. The CWA leaves it to EPA and the Army to define this term. Current regulations define "waters of the United States" as traditional navigable waters, interstate waters, all other waters that could affect interstate or foreign commerce, impoundments of waters of the United States, tributaries, the territorial seas, and adjacent wetlands. *See* 33 C.F.R. §328.3; 40 C.F.R. §122.2. The proposed rule retains much of the structure of the longstanding definition of "waters of the United States," and many of the existing provisions of that definition where revisions are not required in light of Supreme Court's

decisions or other basis for revision. The agencies are not proposing any new types of waters under the proposed rule; in addition, under the proposed rule, consistent with current regulations and practice, puddles would not be considered waters of the U.S.

Under section 505 of the CWA, any citizen may bring a citizen suit against a person for an alleged violation of an effluent standard or limitation under the CWA. The proposed rule does not modify the scope of rights afforded to citizens under section 505 of the CWA.

Question: If you do not believe that additional litigation for local and private land use decisions will occur, is the Corps willing to confirm in writing that any expansion of federal jurisdiction will not enable environmental groups to sue private and public landowners under any new or revised jurisdictional definitions?

Answer: The statutory authority of the CWA does not convey to the federal government any ownership of or property rights in any private lands. Therefore, we do not believe that private property will be "taken over" by the federal government as a result of the proposed rule. As a general rule, when privately-owned aquatic areas are subject to CWA jurisdiction (e.g., wetlands adjacent to jurisdictional streams), CWA jurisdiction results in little or no interference with the landowner's use of his or her land. It is true that Federal jurisdiction over aquatic areas does regulate and place restrictions on the discharge of pollutants from point sources into waters of the United States, and require that some sort of CWA general permit or individual permit authorize such discharges. For activities that would result in the discharge of pollutants into waters of the United States, the State or Federal agencies that administer CWA programs usually grant permits needed for all reasonable uses or development activities that will not seriously pollute, degrade, or destroy the waters of the United States. In the extremely rare instances where the denial of a Federal CWA permit deprives a landowner of all economically viable use of his or her land, that landowner can seek compensation from the Court of Federal Claims under the Fifth Amendment of the Constitution. Nevertheless, the need to obtain a CWA general permit or individual permit does not preclude the private landowner from pursuing such activities on his or her lands.

Senator CARDIN. Thank you very much, Colonel Jordan. I should have mentioned in the beginning that, without objection, all the written testimony of the witnesses will be made a part of the record. So you may proceed as you wish.

I also would like to place in the record the statement of Senator David Vitter, the Republican leader on the Environment and Public Works Committee, in regards to this hearing.

[The prepared statement of Senator Vitter follows:]

STATEMENT OF HON. DAVID VITTER,
U.S. SENATOR FROM THE STATE OF LOUISIANA

Mr. Chairman, I would like to thank you for calling today's hearing. I would also like to thank our witnesses for testifying before the Subcommittee on Water and Wildlife this morning.

The policy questions and potential solutions related to Conowingo Dam, environmental concerns, and energy production are important and deserve the subcommittee's attention. As we continue to examine these issues, it is critical that we understand the various legal, environmental, and economic challenges and opportunities associated with Conowingo Dam and its relicensing.

The Conowingo Dam is just 10 miles upstream of the Chesapeake Bay, a body of water that has significant historical, ecological, and environmental value for people throughout the United States, especially those who reside in the mid-Atlantic States. I applaud the cooperative and voluntary efforts undertaken by many officials and stakeholders in recent years to protect the Chesapeake Bay.

At the same time, we must recognize that environmental policies and programs related to the Chesapeake Bay and elsewhere must be based on sound science and law and accomplished in a manner which does not jeopardize the livelihoods of hard working Americans. For example, the Chesapeake Bay Total Maximum Daily Load (TMDL) represents a dramatic expansion of the Environmental Protection Agency's authority under the Clean Water Act and threatens State and local land use authority throughout the country, as evidenced by the numerous States that have expressed opposition to the precedent the TMDL could set. As we consider concerns and possible solutions related to the Conowingo Dam, the issues related to the Bay TMDL offer a lesson to policymakers and should lend caution to any top-down regulatory approach.

I appreciate the public and private officials and academics that are here today to provide us with their expertise on these issues. I look forward to the witnesses' testimony and again thank Senator Cardin for holding this important hearing.

Senator CARDIN. Ms. LaRouche.

STATEMENT OF GENEVIEVE PULLIS LaROUCHE, FIELD OFFICE SUPERVISOR, U.S. FISH AND WILDLIFE SERVICE—CHESAPEAKE BAY FIELD OFFICE

Ms. LAROUCHE. Good morning, Chairman Cardin. I'm Genevieve LaRouche, Chesapeake Bay Field Office Supervisor with the U.S. Fish and Wildlife Service, and an Annapolis resident. I appreciate the opportunity to testify today on the Conowingo Dam.

Mr. Chairman, I want to acknowledge your leadership on conservation of the Chesapeake Bay over the years. You were Speaker of the Maryland House of Delegates when the first Bay agreement was signed 30 years ago. You have been an ardent supporter of conservation of the Chesapeake Bay and a foundational leader for Maryland's legislative agenda and support of the Bay. Thank you for your continued support.

I also want to thank some of our other partner agencies, including the National Park Service, the National Marine Fisheries Service, the Army Corps of Engineers, and the Maryland Department of Natural Resources.

My written testimony provides the Service's views on the importance of the dam and its impact on migratory fish, as well as the impact of water flow on wildlife resources. The Service recognizes a balance is needed between hydropower, fish passage, and improving the health of the Susquehanna River system. We have a unique opportunity to work together to strike this balance and restore this mighty river. My oral remarks will provide some quick highlights, and I ask that my written statement be submitted for the record.

It's important to remind ourselves that the Susquehanna River is one of America's largest rivers, beginning in central New York and flowing over 400 miles through central Pennsylvania to Maryland. The largest tributary to the Chesapeake Bay, the Susquehanna River provides over 60 percent of the fresh water to the Chesapeake Bay.

The Susquehanna River was once home to large numbers of migratory fish, including American shad, river herring, and American eel. These fish played a vital role in the Chesapeake region's history. During the Revolutionary War, American shad were described as a savior fish that saved George Washington's troops from starvation after the harsh winter of 1778. Today, as yesterday, shad are essential to the region's economy, supporting one of the most valuable fisheries in the region and providing recreation and tourism opportunities that support local communities throughout the region.

Ecologically, the American eel plays a crucial role as a host fish for the freshwater eastern elliptio mussel. This mussel filters gallons of water daily and is a key element to improving water quality in this heavily populated watershed. Populations of American shad, river herring, and American eel have been reduced or essentially eliminated in the Susquehanna River and other Chesapeake Bay tributaries by dams.

On the Susquehanna River, the American shad population upstream of the Conowingo Dam is at historically low levels, and population estimates downstream below the dam have shown a decrease since 2001. Despite this decrease, population estimates suggest American shad are present downstream of the dam, and more fish would be passing upstream if more suitable conditions were available. While the American shad population below the Conowingo Dam is currently estimated at about 100,000 fish, only 12,733 American shad passed the Conowingo Dam in 2013.

After taking into account the dams upstream of Conowingo Dam, only 2 percent of the American shad attempting to migrate up the Susquehanna River actually made it to their spawning grounds. That translates into only 200 fish passing all the Lower Susquehanna River dams in 2013. The fish passage goal for adult American shad passing into that spawning habitat is 2 million fish.

The day-to-day operations of the Conowingo Dam affect wildlife and habitat downstream. Rapid cycling of rising water during power generation, followed by falling water levels after generation, creates unnatural river conditions. This flow regime creates drought and flood regimes of record proportion and degrades the aquatic habitat downstream for many species, including migratory fish, mussels, and map turtles.

Fish passage technology has improved in recent years. The fish passage facilities at Conowingo Dam can be upgraded to provide the efficient fish passage we need. By building and maintaining fully functioning fish lifts on both sides of the river, our data indicate that we can pass the numbers of fish needed to restore migratory fish populations to the Susquehanna River.

Conowingo is currently undergoing Federal relicensing, which means we have a rare opportunity that happens only once every 30 to 50 years to modernize the fish passage at Conowingo and advance restoration of American shad and river herring at the Susquehanna River. Through this relicensing, the Service works with license applicants, the Federal Energy Regulatory Commission, other agencies, and the interested public to ensure that hydropower projects operate in an environmentally sound manner and the Nation's natural resources are protected.

We recognize and understand there is a balance to strike between energy production and fish passage, and we engage in ongoing conversations with the hydro operator, Exelon, to find that balance. This is a once in a generation opportunity to improve fish populations and habitat in the Susquehanna River, its tributaries, and the Chesapeake Bay.

By applying the best available science and upgraded engineering techniques at Conowingo Dam, we will not only improve fish populations but help to ensure their sustainability for future generations. We believe that all of these goals are not only possible but also realistic and within reach.

Thank you for the opportunity to testify today on the importance of the dam and its impact on migratory fish. I'm happy to answer any questions and look forward to working with the subcommittee.

[The prepared statement of Ms. LaRouche follows:]

TESTIMONY OF GENEVIEVE LAROUCHE,
FIELD OFFICE SUPERVISOR, CHESAPEAKE BAY FIELD OFFICE
U.S. FISH AND WILDLIFE SERVICE, U.S. DEPARTMENT OF THE INTERIOR
BEFORE THE SENATE ENVIRONMENT AND PUBLIC WORKS SUBCOMMITTEE
ON WATER AND WILDLIFE

May 5, 2014

Good morning Chairman Cardin. I am Genevieve LaRouche, Chesapeake Bay Field Office Supervisor, with the U.S. Fish and Wildlife Service (Service). I appreciate the opportunity to testify today on the Conowingo Dam. My testimony provides the Service's views on the importance of the dam and its impact on migratory fish, as well as the impact of water flow and nutrients on wildlife resources. The Service recognizes a balance is needed between hydropower, fish passage, and improving the health of the Susquehanna River system. We have a unique opportunity to work together to strike this balance and restore this mighty river.

Background

The Susquehanna River, one of America's largest rivers, forms in central New York and flows over 400 miles through central Pennsylvania to Maryland. The largest tributary to Chesapeake Bay, the Susquehanna River provides over 60 percent of the freshwater to the Chesapeake Bay. The Susquehanna River was once home to large numbers of migratory fish including American shad (*Alosa sapidissima*), river herring such as alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*), and American eel (*Anguilla rostrata*). These fish played a vital role in the Chesapeake region's history, supporting one of the most valuable finfish fisheries in the region. Throughout the 19th and 20th centuries, fishermen flocked to fishing communities along the Chesapeake's rivers for the annual spring shad spawning run.

Native Americans relied on shad as an important food source. During the Revolutionary War, American shad were described as the "savior fish" that saved George Washington's troops from starvation after the harsh winter of 1778.

Shad form an important link in the Chesapeake Bay food web. They feed on plankton, and in turn are eaten by species higher in the food chain. Shad adults spawn in fresh rivers and streams where the eggs hatch and the fry live for up to 1 year before they migrate downstream to the ocean. These shad spend 3 to 5 years in the ocean as juveniles before maturing and returning to the Chesapeake Bay's freshwater tributaries, such as the Susquehanna, to spawn. Spring shad spawning runs have historically been a major food source for many migratory birds and fish, including bald eagles, ospreys, catfish, bluefish, and species emblematic of the Chesapeake Bay like striped bass—which also support our watermen and their way of life.

American eels, both juvenile and adult, are commercially important in the Susquehanna watershed; they are exported for food and used as fishing bait. American eels migrate from the Chesapeake Bay into the Susquehanna and other rivers as juveniles where they remain until reaching maturity. At that time, they migrate downstream to the Chesapeake Bay and out to the

Sargasso Sea in the Atlantic Ocean east of Florida where they spawn. The eggs hatch, and the larval eels are transported by ocean currents along the East Coast of the United States and randomly enter embayments. The majority of the eels that migrate upstream to grow and mature are females.

Ecologically, the American eel plays a crucial role as the favorite (but not only)[1] host fish for the freshwater eastern elliptio mussel (*Elliptio complanata*). As the most common freshwater mussel in the Susquehanna River, the eastern elliptio mussel filters gallons of water daily and is a key element to improving water quality in this heavily populated watershed. The youngest mussels are distributed throughout the river when the juvenile mussel stage attaches to the eel's gills as the eels move upstream. At some point, they drop off and fall to the river bottom where they mature.

The mouth of the Susquehanna River is a popular recreational area where anglers fish for various herring species, as well as prized striped bass. This area is a major bald eagle area due to the abundance of fish and roosting habitat along the shore. It also attracts visitors who come to see and photograph the bald eagles and other wildlife. Local economies benefit from fishing and other recreational uses of the river.

Susquehanna River Dams and Fish Passage

Populations of American shad, alewife, blueback herring, and American eel were reduced or essentially eliminated in the Susquehanna River and other Chesapeake Bay tributaries by dams. In the early 1900s, four large hydroelectric dams were constructed across the lower Susquehanna. The 95-foot-high Conowingo Dam was built in 1928 between Cecil and Harford counties in Maryland. The other three dams, Holtwood, Safe Harbor, and York Haven are located upstream in Pennsylvania. Together these dams eliminated access to over 1 thousand miles of freshwater spawning and rearing habitat in the Susquehanna River, and these migratory fish runs were lost.

In the 1950s, inspired by improvements in fish passage technology and public interest, resource agencies in Maryland and Pennsylvania began working with dam owners to provide access for migratory fish to spawning habitat upstream of the dams on the Susquehanna River. The focus was on American shad.

In 1972, construction of the west fish lift (fish "elevator") and trap was completed at the Conowingo Dam. The east fish lift was constructed in 1991. Over the next 10 years, fish passage was constructed at the upstream Holtwood, Safe Harbor, and York Haven dams. In addition, the owner of Conowingo worked with Federal and state agencies to capture, transport, and stock fish in quality spawning and nursery habitat in the upper Susquehanna River upstream of the lower river dams.

[1] Other fish species that elliptio mussels successfully use in the Mid-Atlantic region include the brook trout (*Salvelinus fontinalis*), lake trout (*S. namaycush*), mottled sculpin (*C. bairdii*), and slimy sculpin (*C. cognatus*). They are most successful with the American eel, however.

The 1991 Conowingo east lift facility was designed to pass American shad and other river herring. Trapping and upstream transport by truck of adult fish continued until 1997 and stocking of hatchery raised American shad fry has occurred since 1976. Due to the transport and stocking program, the American shad population in the Susquehanna River improved slowly. By 2001, nearly 200,000 adult shad were counted at the Conowingo Dam fish lifts. Due to an agreement that resulted in fishways being installed at all four lower Susquehanna River dams, the shad trap and transport program was discontinued at Conowingo.

While American shad numbers returning to the Susquehanna River showed a modest increase until 2001, they have since declined. While a combination of factors is likely responsible, the inefficiency of the fishways at passing shad without delay is a key reason for the decline. We believe cessation of the program for trapping and transporting shad upstream of York Haven Dam also affected the decline. Consequently, few adult American shad were able to reach the important spawning and rearing habitat in the Susquehanna River. Restarting trap and transport operations, reducing fish passage delays, and improving fish passage efficiency will be paramount for migratory fish restoration in the Susquehanna River.

The day-to-day operation of the Conowingo Dam affects wildlife and habitat downstream. Rapid cycling of rising water during power generation, followed by falling water levels after generation, creates unnatural river conditions and degrades the aquatic habitat downstream. The flow in the river below Conowingo can change as much as 40,000 cubic feet per second per hour or close to 1 foot of river elevation per hour.

Currently at the Conowingo Dam, flow releases are lowest during the winter and spring months and highest in July and August. Daily maximum releases are equivalent to seasonal flood flows. There is no limit to the rate of rise or fall of water between minimum and maximum releases. These unnaturally rapid changes in water levels impact migratory fish by interrupting migratory cues, lengthening migration times, stranding fish, and reducing suitable habitat.

Due to sediment accumulation behind the dams the larger grained sediments do not suspend in the water column and are trapped behind the dam. Unlike the fine sediment, this larger material is critically important for creating high quality instream habitat for bottom dwelling organisms such as oysters, but due to the dam, this sediment is unable to make it downstream and replenish downstream habitats.

Current State of the Fisheries

Historic declines in abundance of American shad on the Atlantic Coast have been attributed to overfishing and degradation of riverine habitat quality. Dam construction and pollution have also been factors contributing to the decline and almost complete disappearance of shad in many watersheds. On the Susquehanna River, the American shad population upstream of the

Conowingo Dam is at historically low levels, and population estimates downstream below the dam have shown a decrease since 2001. Despite this decrease, population estimates suggest American shad are present downstream of the dam and more fish would be passing upstream, if more suitable conditions were available to the fish.

The spawning migration of coastal migratory fish in rivers is a time sensitive event. If fish migration is blocked or delayed, adverse biological impacts can result including re-absorption of eggs, spawning in unsuitable areas, depletion of energy reserves, and fish mortality. All of this results in poor recruitment of juvenile fish to the population, which in turn impacts the sustainability of the fishery. Ideally, fish should be able to pass the Conowingo Dam site within hours. However, recent studies found that 69 percent of shad attempting to pass were blocked at the Conowingo Dam and unable to reach their spawning grounds and the remaining 31 percent of shad took an average of 2 weeks to pass over the Conowingo Dam. While the American shad population below the Conowingo Dam is currently estimated at about 100,000 fish, only 12,733 American shad passed the Conowingo Dam in 2013.

After taking into account the dams upstream of the Conowingo Dam—Holtwood, Safe Harbor, and York Haven—only 2 percent of the American shad attempting to migrate up the Susquehanna actually made it to their spawning grounds. That translates into only 200 fish passing all the lower Susquehanna River dams in 2013. The fish passage goal for adult American shad passing into that spawning habitat is 2 million fish.

The Service has the opportunity to resolve fish passage issues at the end of every 30-50 year FERC license at hydroelectric facilities. Currently, both Conowingo Dam and the York Haven Dams are being relicensed with fish passage improvements. The next two upstream dams will be relicensed in 2030. Fish passage at all dams on the river is measures against the Susquehanna Rivers Fish Management Plan criteria. Currently, only Safe Harbor Dam is close to meeting the fish passage criteria. Conowingo dam is the first dam on the river and this is our opportunity to bring Conowingo's 1972 and 1991 fish lifts in to compliance. Safe, timely and effective fish passage at Conowingo is essential to the American shad restoration on the Susquehanna River.

Two migratory Susquehanna River fish have been considered for special protection. The Service received a petition in 2010 seeking Federal protection under the Endangered Species Act (ESA) for American eel. The Service is currently undertaking a status review for American eel which is scheduled to be completed in 2015. In addition, a determination was made in 2013 not to list river herring under the ESA, however the two species, alewife and blueback herring, are still considered "Species of Concern." Most coastal states, including Maryland, have a moratorium on commercial fishing for river herring and shad.

Recent studies have shown how improved fish passage technology, such as modern fish lifts and fishway entrance attraction systems, can reduce the impacts to migrating fish. Providing a downstream zone of passage by managing flows downstream of the Conowingo Dam will also benefit migrating fish, as well as native mussels and submerged aquatic vegetation.

A New Vision for Susquehanna Fisheries

Conowingo is currently undergoing Federal relicensing, which means we have a rare opportunity to modernize the fish passage provided at Conowingo and advance restoration of American shad and river herring in the Susquehanna River.

In 2010, the Susquehanna River Anadromous Fish Restoration Cooperative's Migratory *Fish Management and Restoration Plan for the Susquehanna River Basin* developed goals for coastal migratory fish restoration. The signatories to this plan included the Service, National Marine Fisheries Service, Susquehanna River Basin Commission, Pennsylvania Fish and Boat Commission, Maryland Department of Natural Resources, and New York State Department of Environmental Conservation. Based on the best available science, the partners agreed to:

- Restore access to historic habitats for juvenile and adult migratory fish.
- Maintain or improve existing migratory fish habitat.
- Enhance migratory fish spawning stocks and maximize juvenile recruitment.
- Evaluate the migratory fish restoration effort and adjust programs or projects as needed.
- Ensure cooperation among all restoration partners while generating support among the general public and potential funding sources.

The plan calls for successful passage of 2 million American shad and 5 million river herring upstream of York Haven Dam. Since American eel have been precluded from the Susquehanna River by the construction of the lower mainstem dams, guidance for their restoration was added via addendum in 2013. It supports a trap and transport program for juveniles so that eels that approach the Conowingo Dam are transported upstream by trucks above the four lower mainstem dams.

Fish passage technology has greatly improved in recent years. The fish passage facilities at the Conowingo Dam can be upgraded to provide multispecies passage. By building and maintaining fully functioning fish lifts on both sides of the river, our data indicate that we can pass the quantity of fish and achieve the fish passage efficiency needed to restore migratory fish populations to the Susquehanna River.

Along with improved fish passage, Conowingo's relicensing offers an opportunity for Exelon to partner with the National Park Service, numerous non-government organizations, and local and state governments to enhance public access for recreation and permanently protect Exelon-owned lands in the Lower Susquehanna River with high ecological, cultural, historic, and scenic values.

The Future

The Service works with license applicants, the Federal Energy Regulatory Commission, other agencies, and the interested public to ensure that hydropower projects operate in an environmentally sound manner and the Nation's natural resources are protected.

We recognize and understand that there is a balance to strike between energy production and fish passage and we are engaged in ongoing conversations with hydro-operators such as Exelon to find that balance.

The relieensing of the Conowingo Hydroelectric Project occurs only once every 30 to 50 years. This is as an opportunity to incorporate the best available science and engineering at the

Conowingo Dam to maintain the energy it provides to our citizens, provide fish passage, and maintain sustainable populations of key ecosystem, recreational, and commercial fisheries. We believe that all of these goals are not only possible, but also realistic.

Migratory fish are barometers of water quality, land, freshwater, ocean connectivity, and ecosystem health. We can ensure fish resiliency and health by maintaining clean, moving water that is free of excess nutrients, sediments, and toxic chemicals. This also promotes human resiliency and health. By reducing inputs from industry and agriculture, restoring streams, and planting streamside buffers, water quality in the Susquehanna River and the Chesapeake Bay improves not just for fish, but also for bay grasses, crabs, and oysters. Actions taken to restore fish populations in the Susquehanna River also provide economic, recreational, ecological and spiritual benefits for residents upstream and downstream. Some of these can also have the added benefit of better protecting communities from seasonal flooding. These actions are vital to sustaining a bountiful Susquehanna River and Chesapeake Bay whose clean waters sustain communities, livelihoods, and a unique way of life.

Collectively, we can affect the future of the Susquehanna River system. With an increasing human population comes economic growth and an increase in demand for energy sources, like hydropower. Generating energy does not have to come at the price of fish for future generations. Anglers could once again fish for shad, herring, and freshwater bass all along the banks of the Susquehanna. Bird watchers can continue to watch bald eagles and other birds dive for fish and other food. We believe energy generation and a robust fishery can be attained while preserving the ecological integrity of the Susquehanna River and the Chesapeake Bay and we are committed to working with our state, Federal, and private partners to see that this is realized.

Conclusion

The Service recognizes and supports that a balance is needed between hydropower, fish passage, and improving the health of the Susquehanna River system. This is a once-in-a-lifetime opportunity to improve fish populations in the Susquehanna River, its tributaries, and the Chesapeake Bay. Applying the best available science and updated engineering techniques at the Conowingo Dam will not only improve fishery populations now but help to ensure their sustainability for future generations.

Thank you for the opportunity to testify today on the importance of the dam and its impaet on migratory fish. I am happy to answer any questions and look forward to working with the Subcommittee.

Questions for the Record
Committee on Environment and Public Works

Hearing on "Finding Cooperative Solutions to Environmental Concerns with the Conowingo Dam to Improve the Health of the Chesapeake Bay"

May 5, 2014

Senator Benjamin Cardin

1. What impact does the dam's operational flow regime, that simulates twice daily floods and droughts, have on habitat for migratory fish and other critical species?

The daily rising and falling of water levels and velocities caused by power generation create unnatural conditions that degrade aquatic habitat downstream of the Conowingo Dam. The water level can change vertically as much as 7 to 9 feet downstream of Conowingo. At the same time, the velocity of the flow can increase above the sustained swim speed of the life stages of fish in the river. When this happens, affected fish are flushed downstream. High velocity flows also flush important elements of the habitat downstream such as sediment, gravel, boulders, and woody debris. This reduces habitat suitability for spawning, rearing, feeding, growth to maturity, staging, resting, and migration. Low flow events during warm weather can increase water and substrate temperatures that degrade habitat suitability. As a consequence of dam operations, these conditions occur more frequently than under natural conditions. For all species of fish, reptiles, amphibians, mollusks, and plants, the dam's operational flow regime negatively alters the suitability of the habitat and reduces the ecosystem services that would otherwise be provided.

Conowingo Dam operations cause extreme water level fluctuations to the point that fish migration can be interrupted; the time required for a fish to swim upstream can be lengthened; fish can be stranded, preyed upon, or die for other reasons; and the suitability of habitat in a given location can be diminished, with no suitable habitat nearby. These migration interruptions may adversely affect egg-bearing-adult American shad, alewife, and blueback herring migrating upstream to spawn. The same is true for juvenile American eel migrating upstream where they will grow to maturity before migrating back to the sea to spawn. In regard to fish migrating downstream that may be affected by generation flows, juvenile American shad, alewife, blueback herring, and adult "silver" American eels are of most concern. To correct this, a "zone of passage" is needed where the hydraulic conditions can be established to allow for safe, timely, and effective migration of fish.

a. How about on the safety of boater and other downstream recreational users.

Recreational boaters need to use considerable caution when boating in the lower Susquehanna River. Conowingo's influence on the river can be observed more than 10 miles downstream at the mouth of the Susquehanna River. Specialized jet outboard boat motors are needed to negotiate the rocks during the low flow periods.

2. Seeing as how this is the largest dam on the largest river of the largest estuary in the United States, what would be a better balance of the production of energy with protecting this critical habitat?

The Susquehanna is the largest watershed on the East Coast. It provides more than 50 percent of the freshwater input to the Chesapeake Bay. It once supported vibrant and economically important fisheries and has the potential to do so again. For there to be a better balance between hydropower generation and a full suite of healthy ecosystem services, operations at Conowingo would have to change.

Millions of sea-run fish, rather than thousands, would have to swim upstream of the dam to spawn and grow, and similar numbers would have to swim safely to the sea to mature and return. These fish would have to pass the dam, up- and downstream, without injury or delay. Comprehensive and enforceable measures necessary to accomplish this would have to be included in any new license issued under the Federal Power Act (FPA) by the Federal Energy Regulatory Commission (FERC), and any water quality certificate issued by the State of Maryland under the Clean Water Act.

Upstream fish passage is currently limited at Conowingo by the incomplete fish lift built in 1972 and a fish lift constructed in 1991. Completing the 1972 fish lift was included in settlement agreements dating back to 1984. A settlement agreement signed more recently identified necessary improvements to the 1991 fish lift. These improvements have yet to be implemented by the dam owner.

The U.S. Fish and Wildlife Service (USFWS) believes that enabling more fish to pass through the dam without injury or delay by improving and upgrading the fish passage structures and ensuring that flow conditions are optimal for fish passage are essential to restoring a better balance.

a. How are you going about ensuring that USFWS concerns and recommendations will be taken into consideration during the FERC relicensing of the dam?

The USFWS will continue to file its comments, fish and wildlife recommendations, and Prescriptions for Fishways under appropriate statutes with each opportunity. For example, the USFWS has filed a proposed preliminary prescription containing a series of alternatives for possible adoption as its Prescription for Fishways under Section 18 of the FPA. This is how the USFWS exercises its mandatory conditioning authority for fish passage. Adoption of a Prescription for Fishways, with or without agreement from Exelon, is the regulatory means available to the USFWS to resolve fish passage concerns. The USFWS has also submitted to FERC its recommendations to protect, mitigate damages to, and enhance fish and wildlife resources (including habitat) under Section

10(j) of the FPA and the Fish and Wildlife Coordination Act. These recommendations must be included in the license unless FERC finds them inconsistent with the purposes of the FPA. The USFWS is actively pursuing settlement with Exelon that would resolve the USFWS's concerns and incorporate appropriate terms into the prescription and license. If a settlement is reached, that agreement will be filed with FERC for its consideration in preparing a new license.

b. What opportunities are there for public input into USFWS's recommendation to FERC?

The FERC has a process for formally providing comments to the administrative record. Anyone can provide comments at any time, but comments have more weight if the commenting entity has intervenor status. FERC provides a process for becoming an intervenor and the Department of the Interior, which includes the USFWS, has been granted intervenor status by FERC for the Conowingo Dam relicensing proceeding. Comments may be filed in response to the comments and recommendations of others, including those of the USFWS.

With respect to the USFWS's Prescription for Fishways, when and if the USFWS adopts a preliminary Prescription for Fishways and files it with FERC, the public will have an opportunity to comment on the proposal and the USFWS can review the comments and modify the prescription as needed..

3. While the infrastructure that has changed the ecosystem is old, as are the lakes it has created, is the ecosystem that the dam has created maintaining a steady state of health and quality (good or bad)?

In the context of the USFWS's interests in the Conowingo and Muddy Run relicensing proceedings, the ecosystem that the dam created is at a steady state of diminished health. The ecosystem is not providing enduring ecological benefits. The USFWS has been actively pursuing settlement with Exelon that would resolve the USFWS's concerns and incorporate appropriate terms into the prescriptions and licenses for these projects.

Conowingo Reservoir, which is about 13 miles long, was created when Conowingo Dam was constructed around 1928. The free-flowing river was flooded and the habitat was transformed from a river system to a lake system. Consequently, American shad and herring must swim further upstream to reach quality spawning habitat. Migrating through the reservoir is costly in terms of energy and time and there is risk of mortality from entrainment and predation by other fish and birds.

The impoundment supports a system of large electric power generation facilities in which Exelon has an ownership interest: Conowingo Hydroelectric Project, Peach Bottom Atomic Power Station, and Muddy Run Pumped Storage Project. These projects are hydraulically linked. A primary use of the reservoir water is to generate over 3,660 megawatts of

electricity. However, the energy facilities have continuing negative effects on the ecosystem created by the dam. The sources of the negative effects are, in part: a) the operation of Conowingo's turbines, b) the operation of Peach Bottom's water-based cooling system, and c) Muddy Run's daily pumping and discharging of large volumes of lake water. The adverse effects are exacerbated when temperatures are warm, river flows are low, and sea-run fish are migrating upstream or downstream.

In addition, the discharge of water at Muddy Run may exceed the sustained swim speed of American shad, alewife, and blueback herring. Fish may expend excessive energy to continue, they may be swept downstream, or they may be delayed as they wait for flows to decline. Consequently, these species may not make it to the spawning habitat in time to reproduce.

When flow is low in the reservoir and Muddy Run is pumping from the reservoir, juvenile and post-spawned adult migratory fish may be entrained and pumped out of the river. They may not be able to detect the direction downstream and be delayed in migration, which increases their exposure to predatory fish and birds. Also, there is some mortality of these fish due to physical strikes, change in atmospheric pressure, and predation as they exit the lake through the turbines at Conowingo Dam. The USFWS has been actively assessing the relative importance of these adverse effects and seeking practical solutions with Exelon.

4. As USFWS contemplates how suitable habitat ought to be managed and conserved, what consideration is given to the fact that this alteration to the ecosystem occurred almost 90 years ago?

The USFWS is not attempting to recreate habitat conditions of the past. Instead, the USFWS is working with others to redesign the way the Susquehanna River will be operated, with Conowingo Dam in place, so the river will provide enduring benefits for fish, wildlife, and people into the future.

Section 10(a)(1) of the FPA requires the FERC to adopt a project that is best adapted to a comprehensive plan for the river. In this case, *The Migratory Fish Management and Restoration Plan for the Susquehanna River Basin* (Plan), is the comprehensive plan; it was prepared by the Susquehanna River Anadromous Fish Restoration Committee (SRAFRC). The SRAFRC is composed of the Maryland Department of Natural Resources, Pennsylvania Fish and Boat Commission, New York State Department of Environmental Conservation, USFWS, National Marine Fisheries Service, and the Susquehanna River Basin Commission. The Plan, which aims to protect and increase the Susquehanna River fishery, was publically noticed and comments were carefully considered by the SRAFRC. The Plan establishes goals and objectives for the fishery that are being applied uniformly to each hydropower project on the lower Susquehanna River as new Federal licenses are prepared. Those licenses will be in effect for 30 to 50 years. Relicensing is a rare opportunity to improve environmental conditions on the lower Susquehanna River.

5. What is the scientific basis supporting the fish population goals set in the USFWS interveners' document?

The USFWS and the states of Maryland and Pennsylvania support the population goals and underlying scientific principles described in the Plan (please see our response to question 4, above). Based on the best available information, the goals recommend that two million American shad and five million river herring need to pass upstream of the York Haven Dam.

Exelon, with input from the resource agencies, developed a population model that suggests that Conowingo Dam needs to pass 85 percent of the American shad that reach the vicinity of the dam in order to achieve restoration within 30 years. The passage goal in the Plan is also 85 percent. The Exelon model assumes that other hydropower dams on the river will also reach their fish passage goals.

The USFWS and the Maryland Department of Natural Resources recommend the same fish passage efficiency at Conowingo Dam identified for other dams on the Susquehanna. The USFWS believes 85 percent efficiency can be achieved at Conowingo based on the successful passage results at Safe Harbor Hydropower Dam just upstream on the Susquehanna River.

6. How is the dam affecting the quality of habitat immediately downstream from the dam and restricting and passing the various types of sediments and nutrients?

The dam has held back sediment, including larger grained substrate that is not available to create in-river habitats downstream of the dam. This material is critically important for creating high quality bay habitat for rockfish and other river fish. Due to the operational regime of the hydropower dam, the habitat immediately downstream is scoured during high flows. The sediment held in the impoundment behind the dam rarely moves downstream except during storm events. Because of the sediment issues and operational conflicts, diminished water quality and habitat quality have resulted in lower fish production and poor spawning success for areas immediately downstream of the dam.

7. What species use the fish elevator?

Anadromous (migrating from salt water to spawn in fresh water) fish using the fish elevator include American shad, hickory shad, alewife, and blueback herring.

Riverine (river) fish using the fish elevator include gizzard shad, smallmouth bass, walleye, white perch, and other freshwater fish.

The fish elevator is not used by American eel. This species requires a fishway specifically designed for it to access habitat.

Striped bass, shortnose sturgeon and Atlantic sturgeon historically used the lower part of the river. However, these species have not been "target species" with regard to using the fish elevator.

a. Is it working well to ensure the passage of key fish species?

No, the fish lifts at Conowingo Dam are inefficient and lack adequate capacity. Currently, there is an incomplete fish lift built in 1972 on the west side of the river and another fish lift on the east side that was built in 1991. Although the east fish lift was designed to release 900 cubic feet per second (cfs) as a near field attraction for fish, it has never been able to release more than 300 cfs. This has adversely affected the ability of migrating fish to find the entrance to the east fish lift.

b. Compared to other fish passage methods on the river, how does Conowingo's compare and is it time for the elevator to be updated?

Of the three other lower Susquehanna River dams, only Safe Harbor is meeting its fish passage goal. However, improvements are being made or are expected at all three of the dams upstream of Conowingo. As outlined in the recent settlement agreement with York Haven, a new fish passage structure and related measures are expected to be included in its new license that will advance restoration. Holtwood Dam has undertaken construction of new fishways and will be relicensed in 2030. Holtwood is already evaluating potential additional improvements. The three hydro dams above Conowingo are being held, or will be held, to the same fish passage efficiency standards as Conowingo.

In comparison with the three dams upstream, Conowingo ranks at the bottom for condition and efficiency. New, modern fish lifts are needed to pass the high numbers of gizzard shad along with lower numbers of American shad and river herring. The size of the Susquehanna River may ultimately require fully operational fish lifts on both sides of the river in order to pass the targeted number of fish in the river migrating upstream to spawn. Conowingo needs to timely pass fish at the peak of the run. With increased capacity, improved efficiency, and new fish passage technology, we believe this is possible. The goal is to pass two million American shad and five million river herring upstream of the fourth dam on the river (York Haven) in a season. To achieve this goal, it is critically important for the Conowingo to provide safe, timely, and efficient fish passage.

c. What additional measures is the USFWS recommending be taken to improve year round fish passage?

We are requiring fish passage facilities to operate only during the upstream migration season (March to June). The states are exploring a wider fish passage season for riverine fish passage. Downstream passage has been through the turbines and will remain so unless that becomes an issue in achieving restoration.

d. What would this cost?

Exelon has estimated the cost of two new fish lifts at $60 million.

8. How is the Exelon working with the USFWS to address concerns about fish and wildlife impacts of the dam?

The USFWS has been closely engaged in settlement negotiations with Exelon. An intensive schedule has been planned through the summer of 2014. A settlement is still a possible outcome.

a. How can this relationship, and levels of cooperation, be improved?

The USFWS remains committed to working with all interested parties to achieve a mutually agreeable outcome. At the start of the relicensing process, Exelon developed a proprietary economic model known as the Oasis Model to determine how changes in the flow through the turbines would affect power generation and revenues. This model could be helpful in determining what the monetary effect of changes to fish passage, habitat, or flow has on the project. By knowing how the model responds to flow modifications at the project, the USFWS would be able to develop solutions that meet the needs of the USFWS and Exelon.

Senator David Vitter

In your written testimony, you state that "[w]ith an increasing human population comes economic growth and an increase in demand for energy sources, like hydropower. Generating energy does not have to come at the price of fish for future generations."

I agree. However, I am concerned the current Administration is targeting traditional and reliable energy sources with unwarranted environmental regulations, while at the same time turning a blind eye to environmental impacts associated with wind, solar, and other so-called "renewable" energy projects.

As a field office supervisor with the USFWS, how do you ensure that Federal environmental laws are applied even-handedly to all energy producers? Are you aware of any renewable energy projects which have received preferential treatment by your office or other USFWS offices during USFWS review of potential environmental impacts?

The USFWS's Chesapeake Bay Field Office is working with hydropower, wind energy, solar, and natural gas pipeline companies to evaluate effects to endangered species, bald and golden eagles, inter-jurisdictional fisheries, and migratory birds.

Since becoming Project Leader of the Chesapeake Bay Field Office, I am not aware of any renewable energy projects that have received preferential treatment by my office or other USFWS offices related to review of potential environmental impacts.

The USFWS developed Land-Based Wind Energy Guidelines in 2012 to provide transparency to industry on what measures they should take to evaluate and address potential impacts of wind power to species of concern.

In Maryland, we worked with Exelon Generation to develop a Habitat Conservation Plan and ultimately issued an incidental take permit for the endangered Indiana bat. We also developed an Avian Protection Plan for migratory birds and bald eagles for the Criterion Wind Project in Garrett County, Maryland and issued an Incidental Take Permit in accordance with Section 10 of the Endangered Species Act for Indiana bat. Exelon owns two other wind projects in Maryland, and has worked with the USFWS to ensure that they are avoiding impacts to Indiana bat. To minimize impacts to migratory birds, bald eagles, and unlisted bat species Exelon has also developed a Bird and Bat Conservation Strategy.

Our office is currently working with two other wind companies on the eastern shore of Maryland to evaluate potential take of bald eagles and determine whether we can issue a programmatic bald eagle take permit. A Bird and Bat Conservation Strategy will also be developed for these two projects.

This office has evaluated several proposed solar facilities but does not anticipate them having any effects on Federal trust species.

Senator CARDIN. Well, let me thank both of you for your testimony, and, particularly, let me also thank you for what you do every day to help in regards to these issues.

Colonel Jordan, I'm going to have some questions for the record because they're kind of technical as to the manner in which the study was done. As I understand it, it was limited to sediment issues. It didn't deal with all of the potential pollutants that are dealt with in the Bay.

I just want to make sure that we understand the methodology that was used and, particularly, how it affects unusual conditions. You already talked about scour events and this dynamic equilibrium, which I want to get a little bit more into. But it seems to me that there are seasonal issues here, and they're becoming more extreme.

Therefore, I want to know how confident we are on your findings as we go to more extreme weather conditions as a reality of where we are as a community. If you want to comment on that now, fine, but I will be asking you some questions for the record.

Colonel JORDAN. Mr. Chairman, I'd like to say that we're very confident because we have used models that have been developed over the last 20 to 30 years, specifically, one of them with regards to the Chesapeake Bay. We can talk about the future projections in your further questions, sir.

Senator CARDIN. Thank you. So let me talk about dynamic equilibrium. I think I understand it to mean that the typical flow of sediment coming from upstream to downstream will be as if the dam was not there on a typical amount of flow since it has reached its maximum capacity of storage in the reservoir. During a scour event, there will be a disruption of that, but within a relatively short period of time, we get back to that equilibrium. Am I describing that right or not?

Colonel JORDAN. Mr. Chairman, I would offer that 100 years ago, the system was in equilibrium. It was without any dams, and there was a certain amount of sediment flowing down the river, on average, every year. In the intervening 100 years, we've placed, in this case, four dams across the river, and they have trapped more sediment than would normally have gone down the river in the 1800s.

Around the year 2000, give or take a little bit, the dams got full. So about every 4 or 5 years, when a major storm event happens, that scour would occur and would reduce the amount of sediment that was trapped behind the dam. So, as you just stated, it gave another 4 or 5 years of somewhat—of trapping capacity. And that's the dynamic nature of the equilibrium.

So we're back at steady state where we were 100 years ago. But you still have these big scour events that are happening down the Chesapeake Bay, which did not happen necessarily 100 years ago, because there weren't all these trapped sediments behind the dams.

Senator CARDIN. So how would you characterize what happened this past weekend on the amount of rainfall that we received? Would that be considered one of these 4-year scour events, or is that just the new reality that we have to confront?

Colonel JORDAN. In Baltimore, it felt like the event from 2011 or 1996, because we had six inches. But if you looked upstream

throughout the Susquehanna River Basin, there was actually minimal impact. The average daily flow for the Susquehanna River right here is 40,000 cubic feet per second. We think that a major scour event occurs at about 10 times that or 400,000 cubic feet per second. We did not reach anything like that this past week.

Senator CARDIN. So when we see all that debris that's being trapped, that's nothing of major concern?

Colonel JORDAN. I am not concerned about that at all. I see that routinely down in the Baltimore harbor and in my dams that are up and down this river system.

Senator CARDIN. It just doesn't look very nice.

Colonel JORDAN. It doesn't. If I could offer, the main concern is the sediment, which is actually not right in front of the dam here. It's about a mile upstream.

Senator CARDIN. So the reservoir today, as we speak, is at capacity, and we have this dynamic equilibrium occurring on a daily basis right now?

Colonel JORDAN. That is correct, sir.

Senator CARDIN. Thank you. I appreciate that.

Ms. LaRouche, let me talk a little bit about the impact of a scour event. It's not just the sediment being released from the reservoir, so you've got more sediment than would normally flow into downstream. You get a surge of pollutants, more than would happen even during a scour event. But you also get an incredible amount of fresh water that's coming down, which also has an impact on the environment.

Can you just tell us, in your view, how the fact that the dam is here so you get the unusual amount of sediment coming from a scour event plus the increased amount of fresh water—how does that impact the habitat?

Ms. LAROUCHE. Well, our primary concern is with the high flow events that come with the dam's operation.

Senator CARDIN. The normal operations.

Ms. LAROUCHE. The normal operations, yes, and that has a big negative impact on the habitat immediately downstream. It scours it. It's not good for the underwater grasses, which we need for all kinds of underwater organisms, such as oysters and rockfish, and it's also not good for organisms such as map turtles.

It also disturbs the fishes' migratory cues that they need to migrate upstream and displaces them and impedes migration. So we're hoping that we can work with Exelon to create a safe zone of passage, so to speak, for fish to migrate safely upstream and downstream.

Senator CARDIN. I want to get to that in one moment. But the dam has been here for almost 90 years. So the fish don't remember when there wasn't any dam here. So tell me—just explain to me how the—if we're dealing with such a longstanding flow of how the water has operated, including the daily surges, the fish never adapt to that? Is this not the new norm for the shad?

Ms. LAROUCHE. We have evidence that they're hanging around, kind of looking to migrate upstream, and time is an issue. We need to get them—if they're going to breed successfully, we need to get them to their spawning habitat as quickly as possible. And although the dams have been there for 90 years, the fish have been

migrating upstream for about 10,000 years, and studies show that they do want to go.

If we can direct them—and there's all kinds of great new technology that directs them to fish passage ladders, et cetera, that can safely move them upstream. But they do get confused when the water stops and they kind of have to move back, and then move around tomorrow, the next day, that kind of thing.

Senator CARDIN. So they haven't adapted even though it's been a long time?

Ms. LAROUCHE. No, not American shad and not river herring and not eels.

Senator CARDIN. And they're the three species that you're most concerned about as far as passage?

Ms. LAROUCHE. Yes. They're the ones that are not doing particularly well with the dams, and they're also the most important economically and ecologically.

Senator CARDIN. So we have these fish lifts that are there.

Ms. LAROUCHE. Yes.

Senator CARDIN. You seem to say that that can work. That's working well.

Ms. LAROUCHE. Yes. Well, it can work. They very much need to be upgraded and improved.

Senator CARDIN. What do you mean by that?

Ms. LAROUCHE. Well, right now, they're at capacity. There's a lot of fish in the river called gizzard shad which like the Conowingo pond. They like to breed in there, so we'll be getting higher and higher populations of them. They tend to fill up the fish passage facilities. So we need to make it so we can get more fish in the elevator, so we can get all the American shad that want to pass above stream so we can meet our fish passage goals.

Senator CARDIN. So we have greater capacity than—greater need than capacity? Is that what you're saying?

Ms. LAROUCHE. We need greater capacity. We need more room in the fish passage lifts to lift them up. You'll see when we go up there that it can get pretty crowded, and we don't have enough volume. We can't get the amount of fish we need in there to get the fish that we're trying to get.

Senator CARDIN. I've been there before. I've seen the flow. It's an incredible sight. I'm looking forward to again seeing it today. I was always amazed at the number that are there. So you're suggesting that it's too crowded and some don't make it?

Ms. LAROUCHE. Yes. There's a lot of—when I've been up there, I've seen like 90 percent gizzard shad, they're called, and they're native fish and they're fine. But they're not, you know, something that's very desirable for fishing or for the economy, and they're doing fine. But the American shad, which need to reach their spawning grounds upstream, are not making it.

Senator CARDIN. And you think that's a capacity issue?

Ms. LAROUCHE. Yes.

Senator CARDIN. It's not so much that it's not——

Ms. LAROUCHE. An efficiency issue, capacity and efficiency.

Senator CARDIN. An efficiency issue. Is that also true with the eel?

Ms. LAROUCHE. We have a different tactic with the eel now where we trap and transport them. We trap them and then transport them up above all the dams.

Senator CARDIN. Is that adequate today?

Ms. LAROUCHE. We think it'll do the trick for now. In an ideal world, we'd have natural passage for them over the dams. But we're not thinking about that in this relicensing right now.

Senator CARDIN. Because they don't particularly like the fish lifts?

Ms. LAROUCHE. They're not—they need their own eel way to go up. We're hoping by 2030 that we'll be building passage for eels.

Senator CARDIN. And what—can you just—can you get that up by yourself?

Mr. SUTHERLAND. Hi. Dave Sutherland, Fish and Wildlife Service.

Senator CARDIN. Would that be a similar type of a lift, or would that be—how would you get past——

Mr. SUTHERLAND. Actually, I'm not the eel expert. I'm right next to the eel expert, though.

Sheila, would you like to——

Ms. EYLER. Hi. I'm Sheila Eyler. The eels that come upstream are small eels, usually about six inches long, and they require a whole different kind of facility. The lifts that you see are for much bigger fish. They actually require a different method of passage. So it's like a ramp they have to climb up on—a different structure.

Senator CARDIN. Like the traditional type of a——

Ms. LAROUCHE. They go up a ramp.

Senator CARDIN. More like an elevator—no, more like an escalator than an elevator.

Ms. LAROUCHE. Right.

Senator CARDIN. OK. I got you.

Colonel Jordan, some have suggested that the most effective way to solve this problem of what happens during a scour event is to just dredge and give greater capacity to trap more even in a scour event. Your thoughts on that?

Colonel JORDAN. Effectiveness can be measured in a variety of ways. If we're just focused on the amount of sediment trapped behind the dam, we've looked at multiple ways of limiting the impacts of that sediment. But I'd remind anybody listening that 80 percent of what's going down and reaching the Bay is coming from upstream. So focusing on the 20 percent that's being scoured from behind the dam during a major storm event will get you some benefit, but not nearly as much as dealing with the first 80 percent.

The benefits of dredging on the overall impact of the health of the Chesapeake Bay are rather limited. The amount of effort that we'd need to put into removing some of the materials behind the dam will get you very little bang for your buck downstream.

Senator CARDIN. I understand what you're saying as far as the amount of pollution that goes in upstream. I didn't quite understand what you meant by dredging upstream.

Colonel JORDAN. Dredging upstream of the dam itself—so we have 80 years of trapped sediment. If I might, there's about 80 football stadiums filled worth of sediment trapped up there. To dredge, even back to the 1996 levels, about 15 percent of what's been

trapped up there, we estimate would cost somewhere between a half and $3 billion, and that's not just a one-time deal, because you need to continually maintain that level of dredging for the years to come at $50 million to $250 million a year.

So when you look at the terms of the cost of removing that material that's upstream of the dam, I can do it much, much cheaper as far as my Federal navigation mission downstream in the Federal channels that I'm required to maintain.

Senator CARDIN. OK. Now I think I understand what you're saying. So you've estimated an initial cost of somewhere between a half a billion to $3 billion to get the capacity back to where it was in the mid-1990s, and that would require maintenance dredging in order to do that. The effect would be to trap the sediment even during scour events upstream rather than letting it come downstream. But the cost-benefit issues is a matter that makes that difficult to justify.

Colonel JORDAN. That's a fair statement. You would get some benefit in terms of creating more capacity behind the dam to trap sediments if you dredged it out. You're still going to get some of the scour happening because you still have another—if you dredge it back to 1996 levels, you've still got stuff that's below there—85 percent of the original material that still could be scoured would be less scoured.

Senator CARDIN. So the advantage is you trap the sediments from ever getting downstream if you have capacity upstream, and you minimize the impact of a scour—lessen the impact of a scour event.

Colonel JORDAN. You will trap some of the sediments. Currently, today, we're trapping somewhere between 55 percent and 60 percent of the sediments on a given day, a day like today.

Senator CARDIN. I thought we had reached this dynamic equilibrium. I thought that meant that it was basically equal to—as if we didn't have a dam there.

Colonel JORDAN. And we're in the period now—the last major storm event was 2011.

Senator CARDIN. Oh, so you're still rebuilding——

Colonel JORDAN. So you're rebuilding a little bit, and then, presumably, in 2016, the next storm will come, thereabouts.

Senator CARDIN. But if the storm doesn't come in 2016, you will have reached that point where, on a daily basis, the sediment flow downstream would be equivalent—if the dam were not there.

Colonel JORDAN. Almost, yes. I can't say with 100 percent everything will flow over. Some will probably drop out.

Senator CARDIN. Sure.

Colonel JORDAN. And my smart folks are saying that there will always be some sediment that spills over the dam, regardless of how empty the dam is.

Senator CARDIN. Oh, that I understood. What I'm trying to judge—I understand the cost-benefit clearly has to be discovered. I'm trying to get the benefit if we were to increase the capacity at the reservoir on a normal basis, so you don't reach capacity. You don't reach that dynamic. What happens there is that in the normal flow, you reduce significantly the amount of sediment that would go downstream, because it would be trapped in the reservoir

on a more permanent basis. You're not just refilling. You have basically unlimited capacity if you continue to dredge. But you will still get some sediment, but not as much going downstream.

Colonel JORDAN. That's correct.

Senator CARDIN. And what you're doing now is that you're dredging downstream, as you said, because you've got to keep channels open.

Colonel JORDAN. Yes, sir.

Senator CARDIN. So you're doing it as it relates to navigation as well as doing it in a way that's friendly toward the environment downstream.

Colonel JORDAN. That's a fair statement.

Senator CARDIN. And that's less costly than dredging the reservoir capacity.

Colonel JORDAN. Extremely less costly. If you're interested in figures, I spend about $10 per cubic yard currently to maintain the Federal channels. If you were to do the same up here, upstream of the Conowingo Dam, the cost is somewhere between $20 and $90 a cubic yard, depending on where you put it once you've taken it out.

Senator CARDIN. And since I've looked at your budgets recently, I know that you're not just sitting there with bank accounts ready to spend. It's been a struggle to get you the dollars that you need.

Colonel JORDAN. Well, we have adequate funds to maintain the Federal channels if we stretch our dollars as far as we can. But we don't have funds to—nor the mission to deal with sediments that are trapped behind the Conowingo or any other dam.

Senator CARDIN. So let me just ask you a question about pollutants other than sediment that the study, as I understand, didn't really focus on. Can you just comment at all about the risk factors we have on nutrient levels and toxics and others?

Colonel JORDAN. The study is focusing mainly on sediments, but it does touch on nutrients, specifically the nutrients that are in and around the sediments that are collected. We estimate that—and we modeled the nutrients, the phosphorus and the nitrogen, that are churned up with this scour and how it impacts the Bay. However, the majority of those nutrient loads that are impacting the Bay are coming from upstream.

So we looked at the—I believe it was the 1996 event, and we have the number of tons of nitrogen and phosphorus that were churned up from behind the dam and scoured and put down into the Bay. And we looked at the impacts on the environment, specifically the sediments that mainly went to the deeper parts of the Bay and settled out relatively quickly. The nutrients remained much longer and impacted the algal growth which tended to restrict the amount of dissolved oxygen in the water which impacted plants and fish habitat.

Senator CARDIN. So let me just ask you, again, about the methodology that you used here. It seems to me when a scour event occurs, the season that it occurs has a direct impact. I think—1996 occurred in the wintertime. If it had occurred in the summer or spring, it would have been a different impact. How do you account for the seasonal variations of these events in your study?

Colonel JORDAN. You're exactly right. If an event happens in the winter months when the algae is not growing down in the Chesapeake Bay, there is much less of an impact as far as the nutrients on the health of the Bay. Our models, as we ran them—we made them run over a 3-year timeframe, so three seasons of growth and activities in the Chesapeake Bay. And we looked at events happening in the winter months as well as the summer months, and we looked at the impacts of how that would happen over a 3-year period inside the Bay.

Senator CARDIN. So if these 3 years were not typical, the results would be different.

Colonel JORDAN. And we varied the—we placed approximately 14 different scenarios into this set of computer models.

Senator CARDIN. I want to talk about worst case scenario. It occurs during the worst possible season, and it occurs more severely. What does that do to your theory of dynamic equilibrium?

Colonel JORDAN. The time of year that the scour happens, the event happens, and the amount of the scour does impact how much is taken from behind the dam. The difference is what happens down in the Chesapeake Bay. So as we looked at the events—could you rephrase the question?

Senator CARDIN. Well, my concern is if you're going to have more nutrient as the result of a scour event that occurs in the spring rather than in another time of the year, your model is using average rather than using extreme, as I understand it, over the last 3 years. What risk factors do we have if we don't have a better way of dealing with nutrient release? And I know your study didn't deal with nutrient release.

Colonel JORDAN. Well, for the part of the model that looked at the Chesapeake Bay itself, we actually used the same model the EPA used in 1991 and 2000. So there was roughly 9 years of data, 9 years of equations that were in there. So during that timeframe, it captured the 1996 event, which happened in the January timeframe.

Senator CARDIN. Right.

Colonel JORDAN. So I don't think it's fair to say that we looked at the average conditions. We consider all the conditions within that 9-year period.

Senator CARDIN. There's no such thing as average, which is also true.

Colonel JORDAN. Yes, sir.

Senator CARDIN. Now, the reason I'm asking these questions is that in regards to the Chesapeake Bay program, it depends upon confidence that all stakeholders are being treated fairly, and that what we're asking someone to do on the Eastern Shore of Maryland is consistent with what's happening on the Susquehanna. It's important that we have the scientific information to reflect that we're making these best policies on a fair sharing of the burden, on a fair cost-benefit analysis.

So, obviously, when you see as much risk factors that are in the Susquehanna being trapped and could be released, it presents concern that—are the stakeholders on the Susquehanna doing everything they can to protect or to preserve the Chesapeake Bay. That's the bottom line question, and your study helps. No question it

helps. It presents some findings that were not expected, and we know that there's a lot of risk factors that are on the Susquehanna, and we know that there are extreme weather events. We just want to know that we're as well prepared as we can be, based upon a reasonable cost-benefit and science, and I think your testimony has helped us try to put those pieces together. So I thank you.

I want to ask one last question to the both of you, and that is the certification process under FERC. You mentioned that in your comments as an opportunity. Can you just, both of you, review as to how you look at the certification process as an opportunity to update and make more efficient and effective our strategies on the Chesapeake Bay?

Ms. LAROUCHE. Well, as you know, at this time of year, many communities are enjoying, you know, shad planking and other seasonal rights of passage. So we see this as an opportunity to restore American shad and river herring and American eel to this great river and to the communities upstream and downstream of the river. We have the technology in hand, both on the new engineering techniques, which are very impressive, that we can make that passage much more efficient and much more cost effective than we have in the past.

Other opportunities also exist besides improving fish passage. We know more about water flow, and if we can alter the regimes a little bit of how the dam operates, we can help improve habitat downstream for many wildlife species.

There's also a great opportunity in this relicensing that the National Park Service has been very engaged in. There's a lot of—Exelon owns a lot of conservation land, and we're in discussions about them providing access and trails, such as the Captain John Smith Trail, which will allow people to see as they're hiking on the trail how the land looked 400 years ago when Captain John Smith was here.

So there's a lot of great conservation opportunities. I think by working hand in hand with Exelon and all the other partners that are here in this room, we can find a good balance here.

Senator CARDIN. Thank you.

Colonel.

Colonel JORDAN. Senator, what I would offer is that I'm not sure that the Corps of Engineers would look at this as an opportunity. I think what we enjoy is that the focus is on the health of the Chesapeake Bay, which has been stated by the President in an executive order, and a lot of great efforts that are going on throughout the Bay States on how this watershed system is operating.

So whereas in earlier years we might not have had any interest in doing a study similar to the one we just did, there was enough interest and enough funding to help us better understand the system which should then lead to future actions taken by all stakeholders and partnership members, one of which is the Corps of Engineers, potentially.

Senator CARDIN. Well, let me thank both of you for your testimony. It very much filled in a lot of the answers to the questions that I had. As I indicated earlier, there may be some questions, particularly, Colonel Jordan, to you in regards to the methodology used so that we can have a full record for our committee.

Thank you all very much.

We'll now move to our second panel. I welcome Dr. Donald Boesch, the President of the University of Maryland Center for Environmental Studies; Ms. Vicky Will, Vice President, Environment and Safety, Exelon Corporation, our hostess for today. And we particularly want to thank Exelon for their cooperation in making this hearing possible. They worked with our committee very closely so that we could have the hearing during this time of the year when the fish lifts are working most effectively.

We also have The Honorable Joe Gill, Secretary, Maryland Department of Natural Resources, a person who has been very much engaged in the Chesapeake Bay program. We appreciate him being here. And we have The Honorable Richard Gray, the Mayor of the city of Lancaster.

Mr. Mayor, it's a pleasure to have you here.

I will just note as a matter of historic accuracy that when Maryland started the Chesapeake Bay program back under Governor Hughes, the State that was the most cooperative of any State since starting the Chesapeake Bay program was Pennsylvania. I will always remember the legislators from Pennsylvania, because they don't have the same direct site of the Chesapeake Bay that we have in Maryland, and yet their understanding of the importance of what happens in Pennsylvania on the Chesapeake Bay was very encouraging and has been one of the real cornerstones of the success of the Chesapeake Bay program.

So it's wonderful having all four of you here. The process that we will use, as I've indicated earlier, will be that you may proceed as you wish. Your full statements will be made part of the record, and then we'll get into a dialog. We'll start with Dr. Boesch.

STATEMENT OF DONALD BOESCH, Ph.D., PRESIDENT, UNIVERSITY OF MARYLAND CENTER FOR ENVIRONMENTAL SCIENCE

Mr. BOESCH. Senator Cardin, thank you very much. I appreciate the opportunity to present perspectives on the solutions to the risk posed by infilling of the Susquehanna Reservoir. I am Donald Boesch. I'm a professor in and president of the University of Maryland Center for Environmental Science.

Just as a bottom line conclusion, looking at the watershed assessment as well as other published information based on the available evidence and analysis, I would conclude that the infilling of the Conowingo Reservoir has created an additional burden of nutrients and sediment pollution to the Chesapeake Bay that requires mitigation as we go forward. However, this burden does not render ineffective or significantly compromise the watershed implementation plans that the State jurisdictions have developed, that, if fully implemented, would achieve the Chesapeake Bay Program's restoration goals.

Now, Colonel Jordan did an excellent job in his testimony and his answers to your question explaining dynamic equilibrium and the whole course of events that led to the present situation wherein this dam periodically discharges large amounts of sediments into the Bay. So I won't go further into that. There's more perspectives in my testimony.

But I'd just like to put it into context in terms of the issues about what this means downstream in the Bay. I'll use the opportunity of a captive classroom here and give you a little understanding of the things that we know and the things that we have uncertainties about that we really probably should better know to understand this phenomenon.

Now, the Colonel indicated that from at least a dredging perspective, the material that comes over the dam, the sediment that comes over the dam, mostly stays in the uppermost part of the Bay. So the sediment pollution, if you will, the additional burden, is an upper Bay issue. With respect to the dredging activities, the channel maintenance, it has to be dealt with. But with respect to water quality, it is not, under usual operations, a significant problem because the upper Bay is fairly turbid to begin with.

Now, there are those situations where we have these floods, and you've seen these pictures of the satellite photographs showing the sediment plume going well down into the Bay, down to Virginia water. So is this a problem for the whole Bay?

The issue, of course, is that, as was discussed, the real challenge is not just the sediment, but, particularly, the nitrogen and phosphorus, these two element nutrients which come over and stimulate excess algal growth, diminish the water quality, reduce the water clarity, deplete the oxygen in the Bay. So does that material get down that far, or is that picture we see from space really looking at the smoke from the muzzle of the gun rather than the bullet?

Well, as it turns out, this requires a little understanding of the biology and chemistry of the Bay. And I want to introduce you to another friend of ours, another element, sulfur, which you have to understand to answer this question. Now, as opposed to nitrogen and phosphorus, which we're putting in—it comes from the land, it comes from the sky—sulfur comes from the ocean. It's part of the salt in sea water as we have the brackish Bay.

So as the nitrogen and phosphorus comes over the dam, mainly in the form of particulate material, it's associated with that sediment that's being disrupted. The question is is that material released and it becomes available to the algae or not? Nitric phosphorus tends to bind very tightly to the sediment particles, and if it were not for a little bit of salinity that it could run into, it would probably do no harm. It would just be buried into the Bay.

If it gets down far enough so that the next year or the next season, as brackish water gets mixed into the situation, sulfur plays a role, because it fuels the decomposition of organic matter by certain bacteria in the sediment, and that really causes a release of a lot of phosphorus from the sediment. So that's very important.

The other issue we have to think about in the particulate nutrients is nitrogen. The models that the colonel referred to show that there was a down Bay, at least mid-Bay, reduction of water quality, because of when these periodic releases took place, manifest in lower oxygen levels in the deeper parts of the Bay, around Kent Island, you know, in that part of the Bay, and in the lower Chester and Eastern Bay, those areas, which would be slightly reduced in the oxygen levels. Below that, we think that we are on the pathway to attain.

So that pattern suggests to our scientists that that's probably a nitrogen phenomenon, so there is an issue of whether that nitrogen associated with particles is also available. So we try to understand all of these complex phenomena and represent them. And, of course, these models that the Colonel talked about—and you'll hear more discussion of—they're really the state of the art. They're the best in the world.

But as the famous statistician George Box said, models are not perfect. All models are ultimately wrong. Some are useful. The Bay Water Quality Model is a useful model, so it could provide guidance. But when we have a special set of circumstances, like we're talking about now, we need to better understand scientifically the processes going on so we can continue to improve our models and our use of them as we move forward.

So we're hopeful that we in the scientific community get the opportunity to help resolve some of these questions. We think there will be better assurance of exactly what we're up against in terms of additional impacts and also what we need to do to mitigate the impacts by upstream source control. So thanks very much.

[The prepared statement of Mr. Boesch follows:]

U.S. Senate Committee on Environment and Public Works
Subcommittee on Water and Wildlife
Finding Cooperative Solutions to Environmental Concerns with the Conowingo Dam to Improve the Health of the Chesapeake Bay
May 5, 2014

Testimony of
Dr. Donald F. Boesch, Professor and President
University of Maryland Center for Environmental Science
Cambridge, Maryland 21613

Chairman Cardin and members of the subcommittee, I appreciate the opportunity to present these perspectives on solutions to the risks posed by the progressive infilling with sediments of the Conowingo Reservoir in the context of the restoration of the Chesapeake Bay. I am Donald Boesch, a Professor in and President of the University of Maryland Center for Environmental Science, the region's leading research and educational institution focusing on the Chesapeake Bay and its watershed. I have been engaged in research or in management of significant research enterprises focusing on the Chesapeake Bay and its watershed for 32 years. I have long experience providing scientific advice to four Maryland governors, a host of state and federal agencies, the National Academy of Sciences, and organizations engaged in large-scale ecosystem restoration in other parts of the world, such as the Baltic Sea.

Based on the available evidence and analyses I would conclude that the infilling of the Conowingo Reservoir has created an additional burden of nutrient and sediment pollution to the Chesapeake Bay that requires mitigation. However, this burden does not render ineffective or significantly compromise the Watershed Implementation Plans that, if fully implemented, would achieve the Chesapeake Bay Program's restoration goals. I believe my perspectives to be widely shared by the scientific community engaged in research and analysis on the subject, although by the very nature of science we will continue to debate the specifics and work toward even better understanding.

In my testimony, I will briefly explain the scientific bases for my perspective and point to how science can improve the framework of effective and efficient management to achieve Chesapeake Bay restoration goals.

As the other panelists at this hearing have described, the Lower Susquehanna River Watershed Assessment Study has—based on monitoring and modeling conducted by the U.S. Geological Survey, the U.S. Corps of Engineers, the Environmental Protection Agency and state and academic scientists—refined our view of the status of the Conowingo Reservoir as a trap for sediments and nutrients transported from the Susquehanna Watershed to the Chesapeake Bay. Since the construction of the dam, the reservoir has retained some portion of these materials. As the reservoir gradually infilled with sediments, reducing the volume of water in the reservoir and allowing sediments that had been deposited behind the dam to be resuspended and flushed out by floods, it had been predicted that sometime around 2025 the reservoir would reach equilibrium,

when sediment load entering the reservoir would equal that leaving. Research has now shown that the proportion of sediments and nutrients, particularly those forms of nutrients associated with particulate material, that enter the reservoir transported downstream has been increasing, particularly in response to storm events[1]. The scour threshold has been reduced from 427,000 cubic feet per second in 1996 to 330,000 cubic feet per second in 2011. Models of these phenomena suggest that the reservoir has already reached a dynamic equilibrium in which there are periods during which exports from the reservoir would exceed imports during scouring floods, followed by periods in which the deepened reservoir would effectively trap nutrients and sediments.

At this point, then, the essential question is how does this overall diminished trapping effectiveness affect water quality downstream in the Chesapeake Bay and our ability to achieve water-quality restoration goals. After all, the Susquehanna is no average river, contributing 47% of the fresh water, 41% of the nitrogen, 25% of the phosphorus and 27% of the sediment entering the Bay from land or air. However, the answer to this essential question is not simple because it requires understanding not only of the characteristics of sediments and nutrients released from the reservoir, but also knowledge of the ultimate fate of the material and its impacts.

Does the sediment settle out mostly in the upper Bay or does it extend well down the Bay? Satellite images following Tropical Storm Lee in 2011 show turbid water extending down into Virginia waters. But is it the bullet or just smoke from the barrel? Recent research has indicated that the vast majority of this sediment remained in the upper Bay[2]. To what degree are the particle-associated phosphorus and nitrogen that have been on the rise available to the plants and microbes that use these nutrients to produce the organic matter that clouds the water and depletes dissolved oxygen? And, how is this affected by the salinity of the estuarine waters and other environmental conditions, particularly the oxygen availability in waters overlying the deposited sediments? This is a particularly important question for phosphorus, as monitoring data show phosphorus loads have not been declining where the Susquehanna discharges to the Bay. Phosphorus is strongly associated with particulate matter. If those particles are deposited on the bottom in the low-salinity and well-oxygenated waters of the upper Bay the phosphorus would largely not be bioavailable. But, if they were deposited in the more brackish and oxygen-limited waters of the middle Bay the phosphorus might be.

Our best current understanding of these processes is incorporated in the Chesapeake Bay Program's Water Quality and Sediment Transport Model (WQSTM). Multiple runs of this model have been conducted by the EPA and Army Corps of Engineers to estimate

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[1] Hirsh, R.M. 2012. *Flux of Nitrogen, Phosphorus and Suspended Sediment from the Susquehanna River Basin to the Chesapeake Bay during Tropical Storm Lee, September 2011, as an Indicator of the Effects of Reservoir Sedimentation on Water Quality.* Scientific Investigations Report 2012-5185. U.S. Geological Survey, Reston, Virginia; Zhang, Q., D.C. Brady and W.P. Ball. 2013. Long-term seasonal trends of nitrogen, phosphorus, and suspended sediment load from the non-tidal Susquehanna River Basin to Chesapeake Bay. *Science of the Total Environment* 452-453: 208-221.

[2] Palinkas, C.M., J.P. Halka, L.P. Sanford and P. Cheng. 2013. Sediment deposition from tropical storms in the upper Chesapeake Bay: Field observations and model simulations. *Continental Shelf Research* doi.org/10.1016/j.csr.2013.09.012

the consequences of the decreased sediment and nutrient trapping efficiency of the Conowingo Reservoir and flood-associated releases on Bay water quality. This model is part of the state-of-the-art suite of models that have been used to estimate the load reductions needed to achieve improved water quality goals. The jurisdictions have developed Watershed Implementation Plans (WIPs) to achieve the Total Maximum Daily Load (TMDL) as determined by the models. Based on our best present understanding, if fully and effectively implemented, the WIPs would result in attainment of the water quality goals.

In a nutshell, what the model results indicate is that because of the increased nutrient loads resulting from the Conowingo Reservoir under its current state, full implementation of all existing WIPs would fail to meet water quality attainment only for dissolved oxygen in three mid-Bay segments and only after scour events. The model estimates that these three segments (in the mainstem Bay, lower Eastern Bay and lower Chester River) would fail to attain deep-channel dissolved oxygen standards by one percent in a January scour event; under a June scour event standard nonattainment would increase about three-fold[3]. More detailed analysis and determination of actions that could be taken to mitigate the impact of this additional nutrient loading should be included in the Chesapeake 2017 Mid-Point Assessment, and such an approach is envisioned under the revised Chesapeake Bay Agreement.

However, it is important to keep in mind that the nonattainment resulting from scour events is not a game-changer that overwhelms or otherwise renders the WIPs being implemented inoperable or ineffective. First, the most important implications concern nutrients not increased sediment loading as it appears that the vast majority of the increased sediment load is retained in the upper estuary. Second, the water quality model indicates that the increased loads have a relatively modest effect on dissolved oxygen in deeper waters near Kent Island, with little or no effects on water quality over vast portions of the estuary, including the larger tributary subestuaries, such as the Choptank and Patuxent rivers. Impaired conditions in the tributaries, including not only water quality but also harmful algal blooms and fish kills, are much more determined by reductions of nutrient pollution loads within their watersheds.

In essence, this new challenge is just one of many unanticipated factors that will confront the Chesapeake Bay restoration effort even after the water quality goals are fully achieved. Other changes, ranging from growth patterns to changes in agricultural practices due to economic forces to climate change, will undoubtedly cause curves in the road through which we must adaptively steer.

Consequently, the management models that are used to draw such conclusions must evolve over time as they incorporate these emerging conditions and advances in scientific understanding. There is no such thing as a perfect model. I like to quote the famous statistician George Box who said: "Essentially, all models are wrong, but some are

[3] Linker, L.C., C. Cerco, P. Wang, R. Tian, G. Yactayo and G. Shenk. 2014. *Estimated Influence on the Conowingo Reservoir Infill on Chesapeake Bay Water Quality*. EPA Chesapeake Bay Program Office, Annapolis, Maryland.

useful." The Chesapeake Bay Program suite of models are extremely useful in guiding our water quality restoration efforts. However, with regard to assessing the consequences of increased nutrient loads leaving the Susquehanna reservoir the models can be made more realistic through research, monitoring and more detailed modeling to better resolve the answers to those questions I posed earlier. More focused monitoring, particularly during and after reservoir scouring events, can better resolve the nutrient loads entering and leaving the reservoir and better characterize the forms of these nutrients. Experiments coupled with field observations can improve understanding of critical assumptions concerning sediment settling, resuspension and mixing and the release and regeneration of nutrients. Placing this knowledge in the context of tidal water flows and mixing via more facile models that can simulate flood and wind events would augment, inform and improve the Chesapeake Bay Program Water Quality Model. Thus, we have the rare opportunity to conduct truly innovative scientific investigations that would directly inform management decisions as they are considered in the Chesapeake 2017 Mid-Point Assessment.

As the other speakers at this hearing have addressed, there are other important issues surrounding the operation of the Conowingo Dam, including fish passage, habitat conditions above and below the dam, and upstream source control. I have focused on the consequences for water quality downstream in the estuary. Despite the revelation that the challenge of decreased retention of nutrient and sediments behind the dams on the lower Susquehanna River is not just something we should anticipate in the future but is with us today, there are many positive signs that the efforts to restore water quality in the Chesapeake Bay are working. Nutrient pollution from sewage treatment plants into both tidal waters and rivers and streams in the watershed are being dramatically reduced. Nitrogen concentrations and loads, once adjusted for variability in river flow, have declined at the mouth of the Susquehanna and most of the major rivers draining into the Bay. The unexpected resurgence of submerged aquatic vegetation on the Susquehanna Flats, not far downstream from Conowingo, provides testament to the resilience of organisms and ecosystems, once given a chance, to sustain themselves in the face of floods and other disturbances[4]. However, there is still much more to do in order to achieve our Chesapeake Bay restoration goals.

Fortunately, we have a highly capable and responsive scientific community in the Bay region to guide our efforts and verify the effectiveness of our actions. The Scientific and Technical Advisory Committee of the Chesapeake Bay Program is undertaking a peer-review of the Lower Susquehanna River Assessment. Moreover, I am confident that the scientific investigations that I have outlined would better resolve the uncertainties regarding the effects of reservoir scour events, lead to effective solutions, and provide critical support for the Chesapeake 2017 Mid-Point Assessment. Thank you for this opportunity to speak on behalf of Bay scientists.

[4] Gurbisz, C. and M. Kemp. 2014. Unexpected resurgence of a large submersed plant bed in Chesapeake Bay: Analysis of time series data. *Limnology and Oceanography* 59: 482-494.

Senate Committee on Environment and Public Works, Subcommittee on Water and Wildlife
Hearing on Conowingo Dam, May 5, 2014
Answers to questions from Chairman Cardin by Dr. Donald F. Boesch

1. *Would dredging sediment behind the dam also remove nutrients?*
    a. *What are the risks with, dredging behind the dam with respect to releasing excess nutrients into the Bay in a similar manner to a scour event?*

Dredging these sediments would remove the nutrients that are sequestered in the sediments, however some of these nutrients could be released and subject to downstream transport through resuspension during the dredging progress or leaching from upland disposal sites. To my knowledge, the portion of sequestered nutrients that would be released has not been quantified. Such losses could, however, be minimized through effective dredging and placement site practices.

2. *How does addressing nutrients at their source, like implementing nutrient management BMPs on farm lands, improving sewage treatment works, and reducing stormwater runoff compare with taking action behind the dam?*
    a. *Which approach is more cost effective?*
    b. *Is there some degree of combined effort that would achieve a reasonable or better cost to benefit results?*

It is generally more efficient to reduce pollutant loads at their source, but in the case of nonpoint source nutrient pollution both source control and management of downstream removal through wetlands, floodplains and reservoirs are required in practice. Greater nutrient load reductions from the Susquehanna River basin are required in order to achieve TMDL loads and the goals of the Watershed Implementation Plans for Pennsylvania and New York. These remaining load reductions greatly exceed those due to sediment trapping lost because of reaching the dynamic equilibrium of the Conowingo Pool, therefore greater implementation and effectiveness of agricultural BMPs, stormwater management, and advanced sewage treatment will be required in any case. Management options for Dam operation and Pool management (release schedules, dredging, etc.) should be considered in the context of overall efficiency that integrates both source controls and downstream nutrient removal in streams, wetlands, floodplains and reservoirs.

3. *From a water quality standards perspective, what should we be concerned about with the infill of the Conowingo?*

I do not think it has any direct consequence on water quality standards, which are set based on requirements for receiving waters. Increased sediment loads resulting from scouring during floods are of consequence in whether water quality standards are actually achieved. As indicated in my testimony, the analysis using the Chesapeake Bay Water Quality Model suggests that such events would exacerbate the nonattainment of dissolved oxygen standards in three upper Bay segments.

4. *How is Maryland, through the Chesapeake Bay Commission, working with other states in the region to address regional water quality?*
    a. *Are other states doing their part and what mechanisms are in place to ensure that everyone is pulling their weight?*

b. Would having specific TMDL on Susquehanna River help improve the data that's driving policy decisions?

While Maryland legislators and agency officials participate in the Chesapeake Bay Commission, it is principally through the Chesapeake Bay Program that the state works with other states and the federal government to address regional water quality. I am not in a position to offer a professional opinion as to whether these other states are "doing their part" or "pulling their weight" other than to point out the Environmental Protection Agency's recent assessment of whether the jurisdictions achieved the 2013 two-year milestones for nutrient and sediment reductions. This assessment concluded that while the overall milestones had been achieved, the following states failed to meet one or more 2013 milestones: Pennsylvania for nitrogen and sediment; Virginia, West Virginia and New York for sediment; and Delaware for nitrogen, phosphorus and sediment.

The Chesapeake Bay TMDL is derived not only from load limits required to achieve water quality standards in the Chesapeake Bay but also from those required to achieve standards in impaired nontidal waters. Therefore, as some level, the water quality requirements of the Susquehanna are already built in. Of course, if new water quality standards are set for the Susquehanna this could have an effect on the TMDL.

5. Computer models supporting Chesapeake restoration have come under a lot scrutiny in the recent past, why should we believe these results?

a. What concerns do you have with the LSRWA study relying on limited data? Like for example the fact that the study didn't model Hurricane Agnes or other significant tropical storms that struck during sensitive times of the years?

As I pointed out in my testimony, the question should be not whether we "believe" in such computer models because they are inherently imperfect representations of complex systems and are appropriately subject to refinement over time. Rather, the issue is whether the Chesapeake Bay Program models provide a useful basis for making management decisions, including geographic targeting and evaluating alternative actions. The answer is yes in my opinion and that of most scientific experts. As a scientist, modeling exercises such as those done for the LSRWA study raise questions as opposed to providing definitive answers. In particular, model assumptions that affect the transport of sediment and nutrients in the estuary and the availability of nutrients limiting water column primary production deserve further attention. It appears that the dam operator and state and federal agencies are ready to support research to address these questions and thereby improve the reliability of the models.

6. What effect does the dam, and the sediments that are churned up by scour events, have on oyster populations and underwater grasses in the northern part of the Bay?

Investigations by the Maryland Department of Natural Resources indicated that oyster mortalities in the northern Bay associated with flooding from Tropical Storm Lee in 2011 were attributable primarily to prolonged low salinity (below levels that oysters, as estuarine organisms, can tolerate) rather than burial or clogging by sediments. Of course, sediment scour behind the dam was of no consequence to the amount of fresh water discharged by the river and, thus, the salinity in the Bay. The sediment load from the flood appeared to have a much greater effect on underwater grasses in some portions of the northern Bay as their coverage was much lower in 2012. It is difficult to determine the portion of these effects attributable to the dynamic equilibrium condition of the Pool

because floods of the magnitude of the Lee flood would have moved large quantities of sediment from the Basin through the Pool and caused some scouring in the Pool even if it had much greater sediment trapping capacity. In my testimony, I noted the remarkable resilience of the extensive grass beds on Susquehanna Flats that were not devastated by this flood as they had been following Tropical Storm Agnes and seem to have recovered.

7. *What would happen to water quality in the Bay if that dam - and the other dams upstream - weren't there?*

   a. *How much of this information is really "new" to the Bay restoration effort?*

   b. *Are impacts from dam (now and in the future) already factored into our efforts to restore the Bay?*

   c. *How much will any loss in trapping capacity at the dam impact our ongoing restoration efforts that the MD and other states are already implementing?*

   d. *Does the Susquehanna suffer disproportionally compared to other rivers during large storms?*

I am not sure whether the question relates to whether the dams had never been built or if they were decommissioned or removed. If they had never been built it is likely that water quality in the Chesapeake Bay would have been somewhat worse over the past half-century and even today, when the reservoirs still trap sediments and nutrients during most years. If the dams were removed there would be no trapping capacity and a significant management challenge to limit the erosion of the sediment deposits currently below the dams.

The new information is that the Conowingo Pool is already "full" in a dynamic sense; we used to think that it would be a decade or more before it would be "full." The other new information is derived from the Bay Water Quality Model and suggests that scour events will modestly undermine the attainment of some water quality goals in some upper Bay segments. This will require further offsets to achieve the TMDL.

Each of the rivers discharging to the Bay differs in its natural characteristics as well as human impacts, so it is hard to say that one suffers during large storms relative to another. Obviously, the Susquehanna is by far the largest of these rivers, so when large floods happen in its basin it is likely to have a larger impact on the Bay. Nonetheless, other rivers, such as the Potomac, discharge large quantities of sediments to their estuaries when their basins experience floods, whether they are dammed on not.

8. *What will happen under full WIP implementation if we do not address the impacts of infill at Conowingo?*

   a. *In contrast, if we only addressed the impact of infill at the Conowingo and did not fully implement the WIP what would be the outcome?*

The analyses using the Chesapeake Bay Water Quality model that I referred to in my testimony address this question. The model projections indicate that after full WIP implementation, impairment of dissolved oxygen would persist in some northern Bay segments following

scouring events. Further steps would have to be taken to alleviate this impairment. If only the increased scouring potential of the Conowingo Pool were addressed, substantial and widespread impairment of water quality, not only in the northern Bay but also in lower Bay and tributary estuaries, would persist.

Senator CARDIN. Well, thank you very much for that testimony. I feel like I'm getting a continuing legislative credit for your presentation.

[Laughter.]

Senator CARDIN. Ms. Will, I want to once again thank you for your hospitality here and for making this possible.

STATEMENT OF VICKY WILL, VICE PRESIDENT, ENVIRONMENT AND SAFETY, EXELON CORPORATION

Ms. WILL. Thank you, Senator, for holding this hearing and inviting Exelon to provide this subcommittee with an overview of the licensing process for Conowingo Dam and certain related issues.

Exelon Generation is one of the Nation's largest competitive power generators with approximately 35,000 megawatts of owned generation. Our fleet is one of the Nation's cleanest and low-cost generators of electricity. Included in that fleet is the Conowingo Hydroelectric Dam and the Muddy Run Pumped Storage Project, which is about 12 miles upstream of Conowingo. The Conowingo Dam is the furthest downstream of the five hydroelectric projects in the Lower Susquehanna River.

To us, Conowingo is more than just a power plant. It is an economic engine for the region, providing vital clean energy while protecting the air and the Bay. As outlined in the written testimony of Exelon, in 2013, Conowingo provided about $33 million in capital and operational spending and $3.9 million in Maryland property taxes.

Conowingo and Muddy Run employ 62 full time employees and over 100 contracted workers annually. The projects inject $273 million into the local economy and create 298 local jobs. And through their recreational facilities, they attract more than 250,000 visitors to Cecil and Harford Counties annually.

Environmentally, Conowingo is Maryland's largest source of renewable energy, producing more clean energy than all other sources in Maryland combined. Conowingo electricity displaces generation from fossil fuel fired sources and prevents 6.5 million tons of greenhouse gases each year, which is the equivalent of taking 1.2 million cars off the road.

Conowingo has provided fish passage since 1972 and operates two fish lifts used for research and to pass American shad, river herring, and other migratory fish during the migration season. We share U.S. Fish and Wildlife Service's interest in improving and enhancing fish passage at the dam.

The current licenses for the Conowingo and Muddy Run expire in the third quarter of 2014, and Exelon formally initiated the FERC licensing process in 2009. Since then, we have conducted 32 FERC approved studies relating to Conowingo and 15 related to Muddy Run. These license processes and associated studies have cost $34 million to date. Throughout this process, Exelon has engaged in extensive outreach to resource agencies and stakeholders, and we continue to work cooperatively to develop solutions and resolve differences.

Earlier this year, Exelon reached a settlement with the Pennsylvania Department of Environmental Protection on the relicensing of Muddy Run. The settlement provides for trapping and trucking

of American eel from below Conowingo Dam to locations above all five of the hydroelectric projects on the Lower Susquehanna River, funding of over $8 million for fish habitat restoration and sediment mitigation, and establishing an eel passage advisory group which will include representatives from the U.S. Fish and Wildlife Service and Maryland Departments of the Environment and Natural Resources.

Exelon has also reached a settlement with the U.S. Fish and Wildlife Service to address fish passage concerns at Muddy Run, which we anticipate will be finalized this quarter. Exelon has been and remains an active participant in the Lower Susquehanna River Watershed Assessment.

Exelon's written comments describe a number of significant licensing issues. In the interest of time today, I just want to talk about the sediment issue. The issue of Susquehanna sediment and its impact on aquatic wildlife and vegetation in the Chesapeake Bay has become a significant issue in the Conowingo licensing.

Susquehanna sediment originates from upstream point and non-point sources, and the dam does trap some portion of the sediment and nutrients generated by these sources. It is estimated that Conowingo has trapped two-thirds of the sediment generated since Conowingo was constructed in 1928. The preliminary results from the Army Corps study indicate that the impacts of Conowingo scour on the Chesapeake Bay may have been overstated, the overwhelming impact of sediment on the Chesapeake Bay is from upstream sources, and that more study is needed to identify and understand better the nutrient loading aspect of storm scour, as well as feasible cost-effective solutions to address these impacts.

As you've recognized by convening this hearing, the Susquehanna sediment issue is a complex problem, and identifying a practical and cost-effective solution is difficult. This is a basin-wide problem that demands that all of the Susquehanna River stakeholders work together, including Exelon, to reduce sediment from point and non-point sources and identify strategies to address.

As a result, Exelon is working with the State of Maryland, U.S. EPA, the U.S. Geological Survey, the Army Corps of Engineers, and the University of Maryland on designing additional studies relating to the Susquehanna sediment and its impact on aquatic wildlife and vegetation in the Chesapeake Bay. These additional studies will build on the significant work already done by these agencies and are anticipated to take several years at a cost of approximately $2 million, which will be funded by Exelon.

Exelon recognizes that the Susquehanna River and the Chesapeake Bay are treasured environmental resources that need to be protected and preserved, and we commit to continue to collaborate with agencies and other stakeholders to do this.

Thank you.

[The prepared statement of Ms. Will follows:]

WRITTEN TESTIMONY OF

EXELON GENERATION COMPANY, LLC

AS SUBMITTED TO THE

U. S. SENATE COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

SUBCOMMITTEE ON WATER AND WILDLIFE

FIELD HEARING ON

FINDING COOPERATIVE SOLUTIONS TO ENVIRONMENTAL CONCERNS

WITH THE CONOWINGO DAM TO IMPROVE

THE HEALTH OF THE CHESAPEAKE BAY

MAY 5, 2014

U. S. SENATE COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS
SUBCOMMITTEE ON WATER AND WILDLIFE HEARING

Exelon Generation Company, LLC, a subsidiary of Exelon Corporation (Exelon), appreciates the opportunity to provide the Subcommittee with an overview of the licensing process for Conowingo Hydroelectric Project (Conowingo) and a description of the status of the licensing.

Exelon is one of the largest competitive power generators in the nation, with owned generating assets totaling approximately 35,000 megawatts of capacity comprising one of the nation's cleanest and lowest-cost power generation fleets. With strong positions in the Midwest, Mid-Atlantic, Texas and California, Exelon is the largest owner and operator of nuclear plants in the United States and maintains a growing renewable energy development business.

Conowingo Dam

Exelon's clean generation fleet includes the Conowingo Hydroelectric Project, located on the Susquehanna River (at river mile 10) in Pennsylvania and Maryland. Conowingo is a 572 megawatt run-of-river hydroelectric power plant, consisting of 11 turbines, which has been in operation since 1928. The Conowingo Project is the furthest downstream of the five hydroelectric projects located on the Lower Susquehanna River, which has a total drainage area of 27,510 square miles. The upstream projects (York Haven, Safe Harbor, Holtwood, and Muddy Run) are located at river miles 56, 32, 24, and 22, respectively.

The reservoir, known as Conowingo Pond and formed by Conowingo Dam, extends approximately 14 miles upstream from Conowingo Dam to the lower end of the Holtwood Project tailrace. The lowermost six miles of the Conowingo Pond are located in Cecil and Harford counties, Maryland. The remaining eight miles of Conowingo Pond are located in Pennsylvania, in York and Lancaster counties. The Conowingo Pond serves many diverse uses including hydropower generation, water supply, industrial cooling water, recreational activities and various environmental resources. Relative to hydropower generation, the Conowingo Pond serves as the lower reservoir for the 1,070-MW Muddy Run Pumped Storage Project (Muddy Run Project), located 12 miles upstream of the Conowingo Dam. The 1,100 MW York Energy Center (formally referred to as the Delta Power Project) withdraws cooling water approximately seven miles upstream of Conowingo Dam as well. In addition, Conowingo Pond is used as a public water supply source, with the City of Baltimore and Chester Water Authority having permitted withdrawals of 387 cfs (250 MGD) and 46 cfs (30 MGD), respectively.

The Project currently operates two fish lifts. The West Fish Lift, adjacent to the dam's right abutment, is operated under an agreement with the United States Fish and Wildlife Service (USFWS) for American shad egg production and other research purposes. The newer East Fish Lift is used primarily to pass American shad, river herring and other migratory fishes during the April-June migration season.

Conowingo Dam Benefits

Conowingo is an economic engine for the region providing vital clean energy while protecting the Chesapeake Bay.

Economic Benefit

Conowingo provides economic benefits to the regional economy. In 2013, Exelon spent approximately $15 million of O&M, $18 million of capital, and $3.9 million in Maryland property taxes associated with operation of the Conowingo station.

Conowingo and Muddy Run are operated and maintained by 62 full-time employees. During periodic outage periods, employment at the facilities can increase substantially. Over the past three years, the projects have employed an average of more than 100 contracted workers per year. These jobs contribute to local employment, resulting in people spending their paychecks on a variety of goods and services in southern Pennsylvania and northern Maryland. According to a November 2012 study commissioned by Exelon Generation, *Socioeconomic Gains to Maryland of the Conowingo Hydroelectric and Muddy Run Projects*, National Economic Research Associates (NERA) concluded that Conowingo and Muddy Run deliver $273 million in annual economic benefits to Maryland and its local communities. These projects directly and indirectly contribute 298 full-time and part-time jobs to the local economy annually.

Annual Economic Contributions of the Projects to the Maryland Economy

Region	Employment (jobs)	Gross Regional Product (million 2012$)	Disposable Personal Income (million 2012$)	Population (people)
Cecil & Harford	298	46	26	366
Maryland	2,060	273	228	2,764
United States	20,857	2,372	1,987	-

Source: REMI Model and calculations as described in Socioeconomic Gains to Pennsylvania of the Muddy Run Pumped Storage Project and the Conowingo Hydroelectric Project prepared by NERA

The projects also contribute to the local and regional economies by increasing the demands for various products and services. Expenditures of the projects in 2013 were $4.4 million in contracting, $1.3 million in materials and supplies and roughly $3.7 million in other operating and maintenance expenditures (not including compensation). In addition, the projects provide popular recreational activities in the surrounding areas including hiking, bird watching and

boating, which helps drive the tourism economy in Cecil and Harford Counties by attracting 250,000 recreational visitors a year.

Electric Grid Benefit

The projects can ramp up generation very rapidly when electricity demand or supply change unexpectedly and, therefore, ensure service reliability and lower costs of electricity for all customers. The projects provide additional important contributions to the electricity grid by supplying ancillary services that are essential for the proper functioning of a regional electricity grid. These services include Black-start, Regulation, Voltage Control and Spinning and Non-Spinning Reserves. These benefits have long been recognized by policymakers and operators of electricity grids.

Reduced Emissions Benefit

Conowingo is Maryland's largest source of renewable energy, producing more clean energy than all other sources in Maryland combined. In 2013, Conowingo supplied over 1.7 million megawatt hours (MWh) of generation to the regional grid. Unlike electricity produced by fossil fuel generation, the electricity produced at Conowingo does not produce harmful emissions of greenhouse gases or other pollutants, such as sulfur dioxide, nitrogen oxide and mercury. Conowingo helps states in PJM, like Maryland, meet renewable portfolio standards that require increased use of renewable electricity. In the PJM system, electricity generation from Conowingo and Muddy Run displaces generation from fossil fuel sources, such as coal and natural gas, which leads to reduced emissions of pollutants including carbon dioxide, sulfur dioxide, and nitrogen oxide. Conowingo prevents 6.5 million tons of greenhouse gas emissions each year. This is the equivalent of taking 1.2 million cars off the road.

Community Involvement

Exelon and its Conowingo employees are very involved in the local community. Conowingo sponsors several community events, including being the lead sponsor of the Lower Susquehanna Heritage Greenway's Riversweep, which brings hundreds of volunteers together each spring to clean up the nearly ten miles of Susquehanna River in both Cecil and Harford County. The site also sponsors the Port Deposit Chamber of Commerce Annual Rockfish Tournament, promoting tourism and youth fishing. Conowingo and its employees give generously to the community through a variety of charitable activities, including the local United Way chapters, the Boys and Girls Clubs of Cecil and Harford Counties and the Plumpton Zoo. Employees conduct annual food and clothing drives and donate their time to support the work of the Ray of Hope Mission in Port Deposit. Each year the staff at Conowingo participates in Exelon's Operation Warm,

providing warm winter coats to area school children. Partnering with the Baltimore County Council of the Boy Scouts of America, employees from Conowingo work to preserve hundreds of hemlock trees in Harford County. Exelon has also donated the 79-acre Roberts Island on the Susquehanna River to the Chesapeake National Historical Trail, administered by the Maryland Department of Natural Resources. In 2009, Exelon invested $4.5 million in a fish wharf at the Conowingo Dam that allows visitors access to the river for fishing, bird-watching, picnics and photography. Located approximately ten miles upstream of the Chesapeake Bay, the 14-mile-long Conowingo Pond behind the dam and the tailrace area provide numerous public recreational facilities and activities. Conowingo's strong community involvement includes a social media network that has more than 25,000 individuals who follow dam operations and recreational events on various social media platforms (such as Twitter, Facebook and YouTube) and contribute to a broad public discussion about the value of the dam on the Support Conowingo Dam website.

Licensing Process

The licensing process for Conowingo and Muddy Run is known as the Integrated Licensing Process (ILP) as set forth in Part 5 of the Federal Energy Regulatory Commission's (FERC or the Commission) regulations (18 C.F. R. Pt. 5). The ILP was developed to integrate the pre-filing consultation with the Commission's scoping pursuant to the National Environment Policy Act (NEPA) (42 USC 4321, et seq.).

Exelon formally initiated the FERC relicensing process for Conowingo with the filing of a Notice of Intent and Pre-Application Document (PAD) on March 12, 2009. Since that time, Exelon has engaged in extensive stakeholder outreach with state and Federal resource agencies, non-governmental organizations, local municipalities, recreational users, and other individuals with an interest in the project. As part of the ILP, Exelon developed and conducted 32 FERC-approved resource studies examining the benefits and impacts of Conowingo. Exelon also conducted 15 resource studies for Muddy Run, many of which also informed development of the Conowingo Final License Application. Together, these ILP processes and associated studies have cost over $34 million. A list of Exelon's filings and studies in connection with the Conowingo licensing process is attached at Appendix A.

Using the information in the Pre-Application Document, the ILP resources studies, and input from stakeholders throughout the relicensing process, including comments received on Exelon's Draft License Application, Exelon prepared the Conowingo Final License Application, which was filed with FERC on August 31, 2012. Where the studies and ILP consultations identified project impacts, Exelon proposed resource protection and mitigation measures. Where studies and ILP consultations identified opportunities to improve Conowingo features, Exelon proposed appropriate enhancements. The Final License Application submitted to FERC reflects Exelon's

efforts to maximize the benefits of Conowingo for the community, the environment, and Exelon's shareholders.

As part of the licensing process, a number of resource agencies, such as U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS) and Maryland Department of the Environment (MDE) have mandatory conditioning authority, which allows them to impose conditions on the FERC license. In addition, in accordance with Section 401 of the Clean Water Act (33 U.S.C. § 1341), before FERC can issue a license for Conowingo, MDE must issue a 401 water quality certification that Conowingo meets applicable Maryland water quality standards.

Since the filing of the Final License Applications for Conowingo and Muddy Run in August 2012, Exelon has continued to engage in extensive stakeholder outreach with state and Federal resource agencies, non-governmental organizations, local municipalities and others. Exelon has engaged in discussions with USFWS, NMFS, the U.S. Army Corps of Engineers (USACE), the National Park Service, MDE, Maryland Department of Natural Resources (MDNR), Pennsylvania Department of Environmental Protection (PADEP), the Susquehanna River Basin Commission, the Nature Conservancy, the Lancaster Conservancy, among others, on issues relating to Conowingo. We continue to work cooperatively to develop solutions and resolve differences.

Earlier this year, Exelon worked with PADEP to reach a negotiated resolution of the fish passage issues identified by stakeholders during the relicensing of Muddy Run. The terms of the agreement between PADEP and Exelon, which have been incorporated into the conditions for the draft water quality certification issued by PADEP, include measures for trapping and trucking American eel from below Conowingo Dam to locations upstream of York Haven Dam, and an annual commitment of $500,000 through 2030 for fish habitat restoration and sediment mitigation. As required by the Federal Power Act, these conditions will be incorporated into the license issued by FERC.

The conditions imposed by PADEP in the proposed water quality certification will provide measurable and immediate benefits to the American eel population and will ensure that any significant impacts to shad associated with Muddy Run operations can be adequately addressed in the future.

Exelon also has reached a conceptual settlement with the USFWS to address fish passage concerns related to Muddy Run. Exelon continues to work with USFWS to finalize a formal settlement agreement, which Exelon believes will be completed in the second quarter of 2014.

Exelon has also been and remains an active participant in the USACE Lower Susquehanna River Watershed Assessment (LSRWA).

American Shad

Various parties have raised concerns regarding Conowingo's impact on upstream and downstream passage of American shad and the current Conowingo fish lifts. Specifically, these parties have advocated increasing the size of the existing east fish lift and constructing additional fish lift facilities on the west side of Conowingo.

Exelon believes that the existing east fish lift has sufficient capacity to facilitate the upstream passage of American shad based on existing and foreseeable population estimates, especially given the coastal-wide decline in the American shad population. The current capacity of the east fish lift is 750,000 American shad and five million river herring per season. In comparison, the maximum passage of American shad at the Conowingo east fish lift, in 2001, was approximately 194,000 fish. In 2013, the east fish lift passed approximately 13,000 American shad. Exelon, however, is in discussions with USFWS, MDE and other stakeholders regarding expansion of and improvements to the existing fish passage facilities to address their concerns.

American Eel

During the relicensing process, parties also raised concerns regarding Conowingo's impact on upstream and downstream passage of American eel. Specifically, these parties have noted that there are currently no upstream passage facilities in place for American eel, and have recommended that Exelon construct upstream volitional passage facilities for American eel. According to these parties, Exelon should engage in trap and truck of American eel upstream until those volitional passage facilities are operational.

As part of the agreement with PADEP, Exelon is putting in place an eel management plan contained in the water quality certification issued by PADEP. Under the plan, Exelon will trap and truck American eel from Conowingo, construct upstream volitional passage facilities, and will establish an Eel Passage Advisory Group, including representatives of USFWS, MDE and MDNR. Exelon believes that these measures address the requests of interested stakeholders regarding upstream eel passage, and demonstrate that immediate and substantial benefits to American shad and eel populations can be achieved through negotiated resolution.

Sediment

The issue of sediment in the Lower Susquehanna River Basin and its impact on aquatic wildlife and vegetation in the Susquehanna River and Chesapeake Bay has become a significant issue in the Conowingo licensing.

Sediment introduced to the Susquehanna River originates from upstream point sources, such as municipal wastewater facilities, and non-point sources such as agricultural lands and storm water runoff. Although Conowingo introduces negligible amounts of sediment as a result of project operations, the dam traps significant amounts of sediment and associated nutrients generated by upstream sources. It has been estimated that Conowingo Pond has trapped two-thirds of the sediment generated upstream in Pennsylvania and New York since Conowingo was constructed in 1928.

Conowingo Pond is reportedly in a state of dynamic equilibrium, in which sediment deposition is periodically interrupted by scour associated with high flow events. Preliminary results from the LSRWA, scheduled for release in late 2014, indicate that water quality impacts on Chesapeake Bay related to Conowingo Pond scour have been significantly overstated by previous studies, and that the overwhelming majority of the impact of sediment in high-water flow events is due to sediment from upstream sources.

During the FERC relicensing process, certain parties have asserted that Exelon should be required to mitigate the impact of sediment passing through Conowingo. Conowingo continues to trap sediment, thus providing an ongoing benefit to the Bay. Further, the preliminary results for the LSRWA released to date indicate that there is no feasible solution to increasing this sediment trapping capacity. Regardless of feasibility, anything done in Conowingo Pond would be addressing the effect and not the cause of the problem. Exelon believes that sediment in the Susquehanna River and Chesapeake Bay should be addressed regionally by continuing to reduce the amount of sediment entering the Susquehanna River upstream of Conowingo by implementing best management practices for point and non-point sources.

Exelon recognizes that the Susquehanna River and Chesapeake Bay are treasured environmental resources that must be protected and preserved. As Senator Cardin has recognized by convening this hearing, the Susquehanna sediment issue is a complex problem and identifying a practical and cost effective solution is difficult. Preliminary results from the LSRWA (the most comprehensive study on Susquehanna sediment to date) confirm this.

Susquehanna sediment is not solely a New York problem, a Pennsylvania problem, or a Maryland problem. It is a basin-wide problem that demands that all of the Susquehanna River stakeholders work together to resolve. As a result, Exelon is with working the U.S.

Environmental Protection Agency (USEPA), USACE, MDE, MDNR, the U.S. Geological Survey (USGS) and the University of Maryland Center for Environmental Science (UMCES) to develop and implement additional studies relating to Susquehanna sediment and nutrients and their impact on aquatic wildlife and vegetation in the Susquehanna River and the Chesapeake Bay, along with additional information relating to the sources of sediment and impacts of scour from high-water flow events. The additional sediment studies will build on the significant work done by the USACE and USGS, and leverage the existing hydrological and nutrient-impact modeling developed by USEPA and USACE. The studies are anticipated to take a few years and cost approximately $2 million, which will be funded by Exelon.

Exelon will continue to collaborate and work with elected officials, Federal and state resource agencies, non-governmental organizations, and other stakeholders to collectively resolve the Susquehanna sediment issue.

Appendix A
List of Exelon Filings and Studies
In Connection with Conowingo Licensing

List of Exelon Conowingo FERC Relicensing Filings

Activity	Deadline
Filed Pre-Application Document (PAD)	March 12, 2009
Filed Proposed Study Plan	August 24, 2009
Filed Revised Study Plan	December 22, 2009
Filed Study Progress Report	September 30, 2010
Filed Initial Study Report	February 22, 2011
Filed Updated Study Report	January 23, 2012
Filed Draft License Application	April 3, 2012
Filed License Application Filed Maryland Coastal Zone Management Act Certification Application	August 31, 2012
Filed FERC Additional Information Request No. 1	December 28, 2012
Filed FERC Additional Information Request No. 2	March 29, 2013
Filed Maryland 401 Water Quality Certification Application	January 31, 2014
Filed Reply to Agency Comments, Recommendations, Preliminary Terms and Conditions, and Preliminary Prescriptions	March 17, 2014

U. S. SENATE COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS
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List of Conowingo Relicensing Studies

RSP 3.1-Water Quality in Conowingo Pool and below Dam

RSP 3.2-Downstream Fish Passage Effectiveness Study

RSP 3.3-Biological and Engineering Studies of American Eel at the Conowingo Project

RSP 3.4-American Shad Passage Study

RSP 3.5-Upstream Fish Passage Effectiveness Study

RSP 3.6-Conowingo East Fish Lift Attraction Flows

RSP 3.7-Fish Passage Impediments Study Below Conowingo

RSP 3.8-Downstream Flow Ramping and Fish Stranding Study

RSP 3.9-Biological and Engineering Studies of the East and West Fish Lifts

RSP 3.10-Maryland Darter Surveys

RSP 3.11-Hydrologic Study of the Lower Susquehanna River

RSP 3.12-Water Level Management (Littoral Zone and Water Level Fluctuation)

RSP 3.13-Study to Assess Tributary Access in Conowingo Pond

RSP 3.14-Debris Management

RSP 3.15-Sediment Introduction and Transport (Sediment and Nutrient Loading)

RSP 3.16-Instream Flow Habitat Assessment below Conowingo Dam

RSP 3.17-Downstream EAV/SAV Study (Water Level Vegetative Cover Study)

RSP 3.18-Characterization of Downstream Aquatic Communities

RSP 3.19-Freshwater Mussel Characterization Study below Conowingo Dam

RSP 3.20-Salinity and Salt Wedge Encroachment

RSP 3.21-Impact of Plant Operations on Migratory Fish Reproduction

RSP 3.22-Shortnose and Atlantic Sturgeon Life History Studies

RSP 3.23-Study to Identify Critical Habitat Use Areas for Bald Eagle

RSP 3.24-Zebra Mussel Monitoring Study

RSP 3.25-Creel Survey of Conowingo Pond and the Susquehanna River below Conowingo Dam

RSP 3.26-Recreational Inventory and Needs Assessment

RSP 3.27-Shoreline Management

RSP 3.28-Archaeological and Historic Cultural Resource Review and Assessment

RSP 3.29-Effect of Project Operations on Downstream Flooding

RSP 3.30-Osprey Nesting Survey

RSP 3.31-Black-crowned Night Heron Nesting Survey

RSP 3.32-Re-evaluate the Closing of the Catwalk to Recreational Fishing

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS FIELD HEARING:

"FINDING COOPERATIVE SOLUTIONS TO ENVIRONMENTAL CONCERNS WITH THE CONOWINGO DAM TO IMPROVE THE HEALTH OF THE CHESAPEAKE BAY"

EXELON CORPORATION
RESPONSES TO FOLLOW-UP QUESTIONS SUBMITTED BY SENATOR CARDIN

JUNE 10, 2014

1. What responsibility does Exelon believe it has to the management of the upstream sourced contaminants and sediments that are impounded by the dam and occasionally flushed out by a scour event?
a. What would be a fair expense that Exelon is willing to incur to help better manage the impounded sediments and nutrients?
b. Would Exelon consider imposing a "Conowingo dredge maintenance" surcharge on its ratepayers to help cover cost of dredging and annual maintenance of sediments behind the dam?

Sediment and nutrient introduction to the Lower Susquehanna River and the Chesapeake Bay is a regional issue that requires a regional solution. As the owner and operator of the Conowingo Hydroelectric Project, Exelon will continue to play a constructive role as regional stakeholders work to address the impacts of sediment and nutrients, including the impacts of scour.

For example, Exelon has participated in, and helped fund, the Lower Susquehanna River Watershed Assessment (LSRWA), a three-year study led jointly by the Maryland Department of the Environment and the Army Corps of Engineers (USACE). Exelon also is working with the State of Maryland to design, implement, and fund a study designed to collect, analyze, and model additional data regarding sediment and nutrients in the Lower Susquehanna River. Once completed, these studies will help identify the most effective and cost-efficient measures to improve the health of the Chesapeake Bay.

As part of Exelon's pending water quality certificate application for the Conowingo Project, representatives from the State of Maryland and Exelon are discussing additional sediment-related measures in the context of a comprehensive settlement agreement that would address issues related to fish passage and water quality. Exelon is not, however, considering the imposition of a "Conowingo dredge maintenance" program because power generated from the Conowingo Project is sold into the PJM wholesale market and is not purchased directly by ratepayers.

2. Is Exelon committed to working with Maryland and other regulatory agencies as it goes through the certification and relicensing process?

Exelon is fully committed to working with Maryland and other regulatory agencies (as well as other interested stakeholders) to achieve a negotiated resolution of relicensing issues similar to what was achieved with the Commonwealth of Pennsylvania and the U.S. Department of the Interior in the Muddy Run relicensing proceeding. Exelon is currently involved in ongoing settlement negotiations with the Department of the Interior and the State of Maryland regarding fish passage and water quality issues associated with the Conowingo Project.

3. What in the way of financial support is Exelon willing to commit to producing the best science available to inform the 401 certification process?

Exelon is working collaboratively with representatives from the State of Maryland to respond to Maryland's request for additional information regarding Exelon's pending water quality certificate application for the Conowingo Project. To that end, Exelon and Maryland are designing an "Integrated Sediment and Nutrient Monitoring Program," which is a multi-year study designed to collect and model additional data related to sediments and nutrients in the Lower Susquehanna River. Exelon will fund this initiative, which is anticipated to cost between $2-4 million.

Additionally, as noted previously, Exelon has participated in and helped fund the LSRWA. The purpose of the LSRWA is to comprehensively forecast and evaluate sediment and associated nutrient loads to the Susquehanna River system and consider options to manage these loads to protect water quality and aquatic life in the Chesapeake Bay. Once completed, the LSRWA study will greatly advance scientific knowledge with respect to sediment and nutrient dynamics and impacts in the Lower Susquehanna River and Chesapeake Bay.

4. What role does land conservation play in a larger mitigation package as part of this relicensing?

Throughout the relicensing process, Exelon has articulated a willingness to consider land conservation measures as part of a comprehensive relicensing settlement. To that end, Exelon provided interested stakeholders with information addressing, among other things, Exelon-owned parcels and adjoining land uses. Exelon remains open to further discussions with stakeholders regarding land conservation.

5. Why is Exelon asking for 2000 acres of downriver buffer lands to be removed from the project boundary?
a. What would Exelon do with these lands if they are taken out of the boundary?
b. What measures is Exelon taking to ensure these lands are kept natural and undeveloped if these lands are taken out of the project boundary?
c. Will Exelon provide assurances that recreation opportunities on these lands are maintained?

Exelon is requesting that the Federal Energy Regulatory Commission (FERC) remove certain lands downstream of the Conowingo Dam from the project boundary because these lands no longer serve a "project purpose," which is the legal standard for including lands within the FERC-designated project boundary. These lands were initially included within the Conowingo boundary because they supported project construction in the 1920s. Since the project is constructed and operating, these lands are no longer needed for project purposes.

Exelon has no plans at this time to change or constrain existing uses of these lands and will consult with interested stakeholders to identify and develop land management plans for future use of these parcels.

6. What impacts are the dam's daily operational procedures having on habitat for migratory fish and other critical species?
a. What responsibility does Exelon feel it has to improve fish passage and operate the dam in ways that may more closely mimic natural flow?
b. Is there a greater balance, between restore a more natural flow to the river versus power generation, that Exelon is willing to accept and implement?

Exelon is committed to facilitating migration of American shad and other migratory fish within the Susquehanna River Basin. Exelon has been an active member of the Susquehanna River Anadromous Fish Restoration Commission since the mid-1960s. From 1972 to 1996, Exelon provided upstream passage via trap-and-transport operations to facilitate migration of American shad until upstream hydroelectric facilities installed fish lifts. In 1991, Exelon also installed a fish lift (the East Fish Lift) at the Conowingo Project. with a design capacity of approximately 2 million American shad per year. A smaller lift on the west side of the dam (the West Fish Lift) continues to support U.S. Fish and Wildlife Service related to studying and protecting this sensitive species of migrating fish, as well as providing support to the U.S. Fish and Wildlife Service for studies of the American eel.

As part of the FERC relicensing process, Exelon conducted several studies regarding the impact of Conowingo operations on fish passage and aquatic habitat. Exelon is now meeting with representatives from the U.S. Fish and Wildlife Service and the State of Maryland to negotiate a comprehensive resolution of fish passage, water quality, and downstream habitat issues. These ongoing settlement negotiations include specific measures to improve fish passage and downstream habitat.

7. Exelon's written response to comments by US Fish and Wildlife Service, Chesapeake Bay Foundation, the Nature Conservancy and others on the FERC relicensing of the Conowingo Dam Exelon seems to assume no responsibility for the downstream water quality and habitat impacts or for needed improvements to fish passage. Would you please clarify Exelon's position on these issues?

Exelon is meeting regularly with representatives from the U.S. Fish and Wildlife Service and the State of Maryland to achieve a comprehensive negotiated resolution of fish passage, water quality, and downstream habitat issues. These settlement negotiations are ongoing and Exelon anticipates the new FERC license for Conowingo will include conditions related to fish passage improvements and water quality.

8. What is the basis for Exelon's assumption that scour events from behind the dam do not occur unless flows exceed 880,000 cubic feet per second?
a. Can you explain the variability between Exelon's assumption and the Corps' analysis of the types of flow rate that cause a scour event?

A draft of the LSRWA-- which represents the most comprehensive assessment of scour events prepared to date -- will be released for comment in June. This document will provide stakeholders with new data and analysis that will inform stakeholders' views on scour events in the Lower Susquehanna River. Exelon anticipates the LSRWA will further inform its understanding of the threshold flows associated with significant scour events.

Senator CARDIN. Thank you very much for your testimony.
Mayor Gray.

STATEMENT OF HON. RICHARD GRAY, MAYOR, CITY OF LANCASTER, PENNSYLVANIA

Mayor GRAY. Thank you, Senator. My name is Rick Gray. I've been the mayor of Lancaster now—I'm in my ninth year as mayor of Lancaster. We appreciate you inviting us here today on an expert panel—I'm not sure I'm an expert—but to tell you what we're doing in the city of Lancaster.

First of all, we appreciate your efforts to improve public understanding of the environmental challenges presented by the Conowingo Dam. We look forward to working together to improve the ecological health of the Chesapeake Bay.

This is not a new problem in Lancaster. In 1906, the city council debated whether or not to separate our stormwater and wastewater system and decided at that time that $2 million was too much to spend on it. Minutes from a 1927 Lancaster city council meeting noted that "The meandering course of the Conestoga Creek formerly was a source of pride and largely used for recreational purposes. The continually increasing discharges of untreated sewage and industrial wastes have polluted this stream to a serious degree."

The minutes cite sludge deposits, oil slicks, and other pollutants that "do not disappear" before reaching the Susquehanna River and flowing into the Chesapeake Bay. That was in 1927. No one did anything.

Nationwide, industrial pollution has been largely eliminated because of the Clean Water Act. That said, stormwater continues to be the main source of pollution of the majority of the 40,000 water bodies that are documented as impaired. Our stormwater engineering practices have not changed in four decades since the Clean Water Act went into effect. It is time to rethink how we approach stormwater management and to protect our most precious resource, clean water.

Today, the city of Lancaster is responsible for between 750 million and a billion gallons of polluted water flowing into the Conestoga River and eventually into the Chesapeake Bay. This is common in historic cities that rely on combined sewer systems to collect and transport both domestic sewage and rainwater flowing from downspouts, streets, sidewalks, parking lots, and over impervious surfaces into storm drains.

There are 50 combined sewer communities in the Chesapeake Bay watershed alone. Eighty-five percent of the time, the city's treatment facility is able to manage and clean the volume of water flowing through this combined system. Still, during heavy rain storms and other wet weather events, the system becomes overwhelmed and, by design, untreated stormwater and sewage are allowed to overflow into the rivers.

The problem of stormwater runoff and combined sewer overflow is not going away, nor will our responsibility to help clean and restore the Bay. To address these issues, we began with two important questions: One, can the city realistically eliminate 750 million to a billion gallons of stormwater runoff in 25 years using green in-

frastructure? Two, can this approach provide more benefits per dollar than traditional gray infrastructure alternatives?

We've found that the answer to both questions is yes. Lancaster's experience shows that green infrastructure can be used to manage and reduce stormwater runoff in a way that is both cost effective and responsible. Simply stated, green infrastructure prevents stormwater from entering the sewer system using natural systems such as absorption or infiltration into the soil or into the atmosphere. This allows stormwater to be treated as intended.

Over the past 3 years, the city of Lancaster has invested in green infrastructure projects to demonstrate the effectiveness of this technology. Lancaster currently, per capita, has more square feet of green roof than any other city in the United States—advantage of being a smaller city with that type of statistic. Still, we're there.

Basically, green infrastructure lets the stormwater go where it would have gone prior to our paving the planet and preventing its absorption into the ground. Efforts are underway in our neighborhoods to engage the community, and the question is how do we pay for the green infrastructure. We've instituted a stormwater utility with a stormwater management fee. The fee is levied on property owners based on the amount of uncontrolled impervious area on their property.

In closing, we can have clean water if we want it, not because of Federal mandates but because we have an ethical and moral obligation to do right by our children and grandchildren. I would say this, Senator. Maryland is extremely important to us from this perspective, those of us who want to do something about it in Pennsylvania. If the people in Maryland don't indicate an urgency with the Chesapeake Bay, the people in Lancaster are not going to care at all about it. They really aren't.

So what happens in Maryland directly affects our political ability to do these things in Pennsylvania, and we look to Maryland for leadership and really being out in front on these types of issues. So, again, technology has given us the power to preserve our water resources and at the same time create a more livable, sustainable, and economically viable future for generations to come.

[The prepared statement of Mayor Gray follows:]

United States Senate
Committee on Environment and Public Works
Subcommittee on Water and Wildlife

"Finding Cooperative Solutions to Environmental Concerns with the Conowingo Dam to Improve the Health of the Chesapeake Bay"
May 5, 2014
Conowingo Visitors Center, Conowingo MD
Testimony of J. Richard Gray
Mayor, City of Lancaster

Thank you, Mr. Chairman. I appreciate your efforts to improve public understanding of the environmental challenges presented by the Conowingo Dam, and I welcome this opportunity to join with other stakeholders who are working to improve the ecological health of the Chesapeake Bay.

Minutes from a 1927 Lancaster City Council meeting note that "The meandering course of the Conestoga Creek... formerly was a source of pride and largely used for recreational purposes. The continually increasing discharges of untreated sewage and industrial wastes have polluted this stream to a serious degree." The minutes cite sludge deposits, oil slicks and other pollutants that "do not disappear" before reaching the Susquehanna River and flowing into the Chesapeake Bay.

Nationwide, industrial pollution has been largely eliminated because of the Clean Water Act. That said, stormwater continues to be the main source of pollution of the majority of the 40,000 water bodies that are documented as impaired. Our stormwater engineering practices have not changed in four decades since the Clean Water Act went into effect. It is time to rethink how we approach stormwater management to protect our most precious resource – clean water.

Today, the City of Lancaster is responsible for about 750 million gallons of polluted water flowing into the Conestoga River and eventually into the Chesapeake Bay. This is common in historic cities that rely on a combined sewer system to collect and transport both domestic sewage and rainwater flowing from downspouts, streets, sidewalks, parking lots and over impervious surfaces into storm drains. There are 50 combined sewer communities in the Chesapeake Bay watershed alone. Eighty-five percent of the time, the City's Treatment Facility is able to manage and clean the volume of water flowing through this combined system. Still, during heavy rainstorms and other wet weather events, the system becomes overwhelmed and, by design, untreated stormwater is allowed to overflow into rivers.

The problem of stormwater runoff and combined sewer overflow is not going away; nor will our responsibility to help clean and restore "the Bay." To address these issues, we began with two important questions:

1. Can the City realistically eliminate 750 million gallons of storm water runoff in twenty-five years using green infrastructure?

2. Can this approach provide more benefits per dollar than traditional gray infrastructure alternatives?

The answer to both questions is "yes." Lancaster's experience shows that green infrastructure can be used to manage and reduce stormwater runoff in a way that is both cost effective and responsible. Simply stated, green infrastructure prevents stormwater from entering the sewer system using natural systems such as as absorption or infiltration into the soil, or evaporation into the atmosphere. This allows stormwater to be treated as nature intended

Over the past three years, the City has invested in Green Infrastructure projects that demonstrate the effectiveness of this technology: Green roofs that absorb rainwater; renovated public parks with underground drainage systems; parking lots that have permeable areas so that stormwater that would run off into our combined system will now infiltrate into the soil. The ways of doing this are simple; let the stormwater go where it would have gone prior to our paving the planet and preventing its absorption into the ground.

Joining with non-profit and other private sector partners, efforts are underway to engage the community in specific green infrastructure projects in our neighborhoods. To date, some 50 demonstration projects around the City serve as examples of how green infrastructure improvements can benefit residents and businesses while enhancing our our quality of life.

At a time when Mayors of communities large and small are struggling to finance core government services, the question of how to pay for green infrastructure becomes more complex.

Most communities do not have a dedicated revenue source to support aggressive stormwater improvements. At the same time, like most cities, 87 percent of land in Lancaster is privately owned. These two factors combined, make the issue of financing stormwater management more challenging. To fund the City's program, Lancaster has established a stormwater utility with a stormwater management fee. After evaluating various funding and policy options, we have determined that an impervious area-based user fee is the most common and equitable funding mechanism. In Lancaster, stormwater management fees are levied on property owners based on the amount of un-controlled impervious area on their property.

In closing, we can have clean water if we want it: not because of federal mandates, but because we have an ethical and moral obligation to do right by our children and grandchildren. We offer Lancaster City's Green Infrastructure Plan and Stormwater Utility as a model for other mid-size cities. Technological advances have given us the power to preserve our water resources and, at the same time, create a more livable, sustainable and economically viable future for generations to come.

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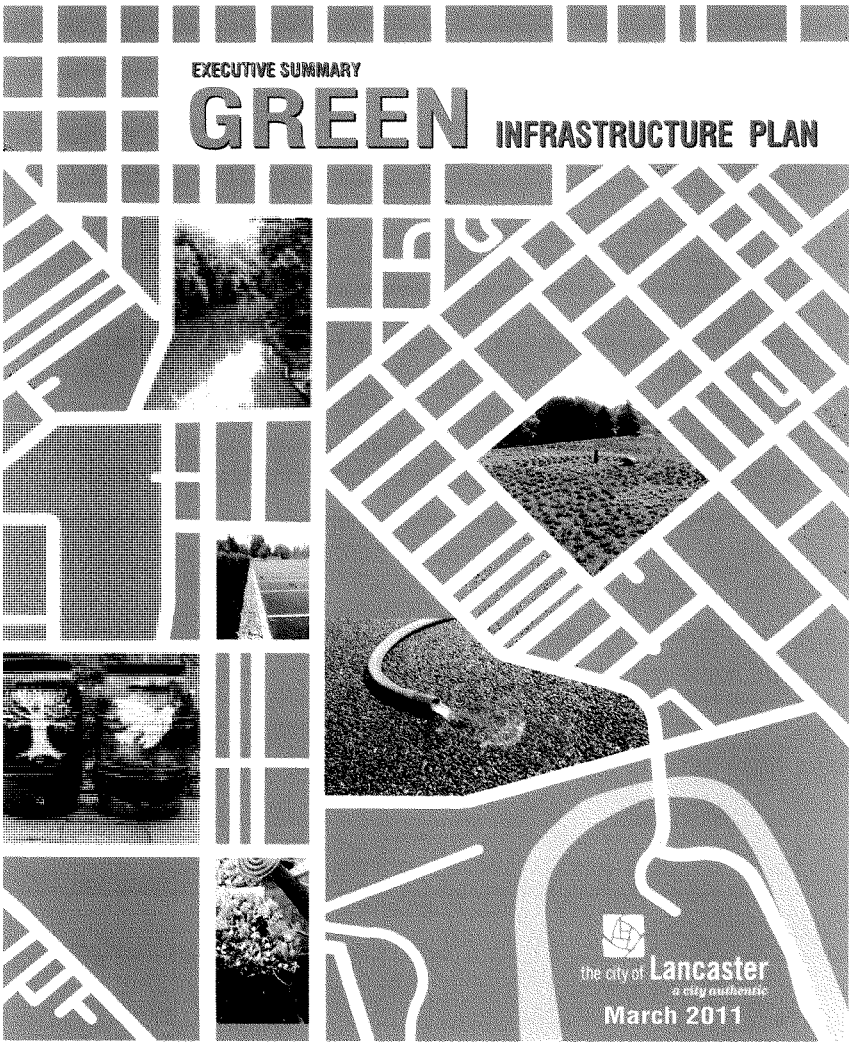
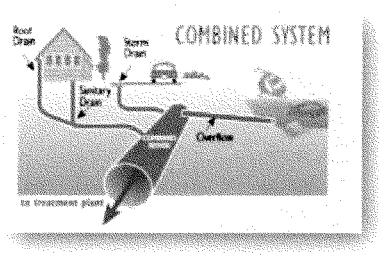

EXECUTIVE SUMMARY
GREEN INFRASTRUCTURE PLAN
the city of Lancaster
a city authentic
March 2011



The City of Lancaster is one of about 770 cities nationwide with a combined sewer system (EPA). Combined sewer systems collect and transport both domestic sewage (wastewater from plumbing in buildings) and rainwater that flows from downspouts, streets, sidewalks, parking lots and other impervious surfaces common in urban areas. Eighty-five percent of the time, the City's Advanced Wastewater Treatment Facility is able to manage and clean the volume of wastewater flowing through this combined system. However, during intense rainstorms and other wet weather events, the system becomes overwhelmed. Each year, this causes about 1 billion gallons of untreated wastewater (mixed sewage and stormwater) to overflow into the Conestoga River. These events are referred to as combined sewer overflows (CSOs) or simply "overflows".

At the time that combined sewer systems were being built across the country 100-200 years ago, they were considered a highly efficient method of treating all forms of waste from urbanized areas since they collected stormwater, sanitary sewage and industrial wastewater all in the same pipe and conveyed them to a treatment plant to be processed before discharging treated water to the nearby streams. What better way to keep streams pristine, fishable and swimmable than to treat **all the waste including runoff**? But as urbanized areas grew and eventually overwhelmed these systems, the methods used did not change or keep up with development. Our forefathers kept adding onto the same system.

Efforts to clean up our local waterways and the Chesapeake Bay have brought renewed federal, state and regional attention on initiatives designed to protect and restore the network of polluted streams and rivers in the Chesapeake Bay watershed, many of which fail to meet water quality standards. The Conestoga River is one such river. The Environmental Protection Agency, for example, has begun enforcing limits on nitrogen, phosphorous and sediment pollution, referred to as a Total Maximum Daily Load (TMDL). The TMDL, or "pollution diet," sets accountability measures for communities located within the 64,000 square mile watershed to ensure that cleanup commitments are kept. The TMDLs are being promulgated not only for combined sewer systems, but also for municipal separate stormwater systems (MS4s) across the Bay watershed. So the costs to comply with these new regulations are going to be felt by every community.

With this backdrop, Lancaster City has been working proactively to reduce combined sewer system overflows and at the same time, to identify economically viable, long-term strategies for mitigating the negative impact of wet weather overflows on our water quality. To date, most of the strategies under consideration have been limited to "gray infrastructure" options, such as increasing the capacity of the City's wastewater conveyance and treatment infrastructure; adding storage or holding tanks to detain wastewater flows until treatment capacity returns; or providing some form of wastewater treatment to the overflow discharges.

Over the past 12 years, the City has aggressively pursued upgrades to its existing gray infrastructure. More than $18 million has been invested in the City's wastewater system including construction of the first wastewater treatment system in the Commonwealth to meet nutrient removal requirements. These nutrient removal projects are being implemented at other treatments plants in the Chesapeake Bay watershed now that the TMDLs are going into effect. Additional capital investment has increased the efficiency of pumping stations to optimize the flow of wastewater to the treatment facility and these investments have resulted in further capture of wet weather flows for treatment.

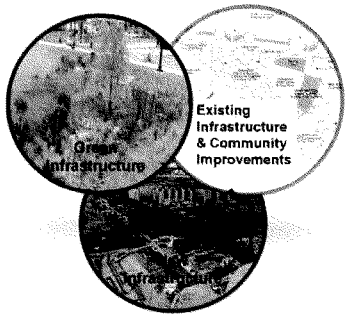
Despite this progress, there remains a significant amount of untreated combined sewage overflowing into the Conestoga River. Based on prior evaluations and experience in many other communities, gray infrastructure options are expensive to construct and maintain. One storage tank alone in the City's Northeast section of the City has an estimated price tag of $70 million and this would only manage 1/10 of the City's annual CSO volume. The estimated price tag to store and treat the billion gallons of annual overflows would be well over $250 million. This cost does not include the annual operational costs in energy and personnel to run the new gray systems.

Given the expense of gray infrastructure modifications, the City has instead opted for a two-prong strategy for reducing the volume of stormwater entering the combined sewer system:

1. Increase the efficiency and capacity of the City's existing gray infrastructure; and
2. Employ "green infrastructure" methods of stormwater management.

Green infrastructure encompasses a variety of technologies that replicate and restore the natural hydrologic cycle and reduce the volume of stormwater entering the sewer system. This, in turn, reduces overflows. Green infrastructure generally includes stormwater management methods that:

- infiltrate (porous pavements, sidewalks, and gutters; linear infiltration systems)
- evaporate, transpire and reduce energy consumption (vegetated roofs, trees, planter boxes)
- infiltrate and transpire (rain gardens and bioretention)
- capture and reuse rainfall (rain barrels, cisterns, irrigation supply systems, and gray water systems)



In contrast to gray infrastructure, a green infrastructure approach often has a higher return on investment and offers multiple benefits:

- *Environmental* – recharges ground water, provides natural storm water management, reduced energy usage, improved water quality.
- *Social* – beautifies and increases recreational opportunities, improves health through cleaner air and water, improves psychological well-being.
- *Economic* – reduces future costs of stormwater management and increases property values.

In May 2010, the City of Lancaster began to develop Pennsylvania's first- Class 3 Green Infrastructure Plan (GI Plan). Building upon the Lancaster County Comprehensive Plan as reported in the Planning Commission's *Greenscapes: The Green Infrastructure Element*, Lancaster City's plan was developed in conjunction with LIVE Green, the Lancaster County Planning Commission, PA Department of Environmental Protection (DEP), PA Department of Conservation and Natural Resources (DCNR) as well as local stakeholders. The City's GI Plan clearly articulates a vision for Lancaster:

To provide more livable, sustainable neighborhoods for City residents and to reduce combined sewer overflows and nutrients.

The goals of the GI Plan are equally clear:

1. Strengthen the City's economy and improve the health and quality of life for its residents by linking clean water solutions to community improvements (e.g. green streets).
2. Create green infrastructure programs that respond comprehensively to the multiple water quality drivers (e.g. TMDL, CSO and stormwater regulations) to maximize the value of City investments.
3. Use GI to reduce pollution and erosive flows from urban stormwater and combined sewer overflows to support the attainment of the Watershed Implementation Plan for the Chesapeake Bay and to improve water quality in the Conestoga River.
4. Achieve lower cost and higher benefit from the City's infrastructure investments.
5. Establish Lancaster City as a national and statewide model in green infrastructure implementation.

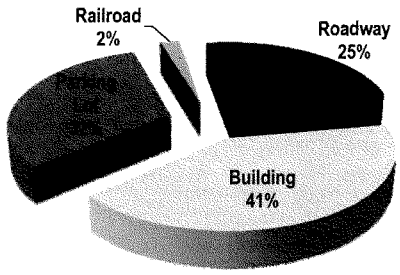
ASSESSMENT

The study involved a three-step process:

(1) evaluate impervious cover by type and land ownership;

(2) identify potential GI project sites and grant funding for early implementation to understand cost/benefit for each; and

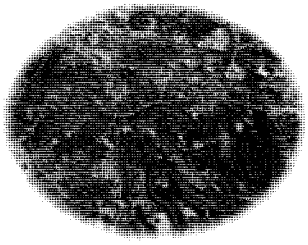
(3) determine potential citywide benefits and provide actions and policy direction to institutionalize GI in the City.



The impervious cover analysis revealed that 41 percent of the city's impervious surface is attributable to buildings, 32 percent to parking lots, 25 percent to roadways and 2 percent to railroads. In addition, most of the impervious area besides roads is on privately held lands which shows why private investment is necessary to make this a successful program. The City cannot solve this problem cost effectively on its own.

Further analysis of land ownership identified more than 50 existing and potential GI projects in various locations:

- Streets, Alleys & Sidewalks
- Parking Lots
- Rooftops
- Parks
- School and City-owned properties



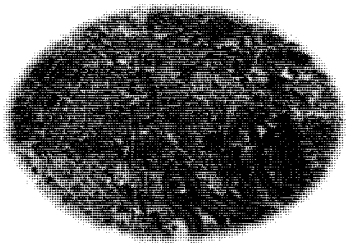
From these locations, the GI Plan provides conceptual designs and cost estimates for 20 initial projects that the City can use to demonstrate each green infrastructure technology. These demonstration projects will remove an estimated 21 million gallons of urban runoff from the combined sewer system per year, and, at the same time the demonstration projects will provide much-needed data on the long-term effectiveness of employing green infrastructure strategies on a broader scale to reduce urban stormwater runoff and combined sewer system overflows. GI project types were determined to be capable of scaling to significant implementation levels when applied to specific land uses common in urban setting such as Lancaster City:

STREETS, ALLEYS AND SIDEWALKS

Green streets, alleys and sidewalks use existing roadways and the public right of way to manage stormwater runoff with tree trenches, porous sidewalks, curb-extensions, and sidewalk planters. Initial demonstration projects are being located at street corners undergoing ADA ramp upgrades and in areas slated for streetscape improvements. The City has identified approximately 20 blocks of streets that are either scheduled for repair or ADA ramp upgrades in 2011. These blocks will serve as green street prototypes that can be incorporated into the City's on-going street repair program. If the City's current rate of road repaving and reconstruction were adapted to include GI, this will result in approximately 468 blocks of green street development over the next 25 years. Another key strategy in developing green streets is enhanced street tree planting. Lancaster City has an estimated 8% tree canopy. Various studies indicate that a 40% tree canopy in urban areas can provide a substantial reduction in stormwater runoff.

This potential is being verified by the City in a separate DCNR funded study to evaluate existing tree canopy using a top down (high resolution aerial imagery) and bottom up approach (walking inventory). This will provide a baseline measure of the city's existing tree canopy, assess the age and health of existing trees, and identify possible locations for additional plantings. The GI Plan proposes to increase the City's urban canopy tree with 6,250 trees or about 250 plantings per year over 25 years. When complete, the enhanced tree canopy will manage stormwater runoff from approximately 45 acres of impervious area.

PARKING LOTS



Green parking lots are usually created by excavating a portion of an existing lot and installing a stone subsurface infiltration bed in conjunction with porous pavement or water quality inlets that redirect stormwater into the stone bed. Runoff from adjacent areas such as streets and buildings can also be redirected into the infiltration bed. Tree trenches can also be integrated with the design to increase the tree canopy and promote evapotranspiration.

These projects are most cost effective when the pavement is in need of replacement or the lot requires reconfiguration for other reasons. The GI Plan includes conceptual designs for four public parking lots in need of restoration. The GI Plan calls for retrofitting and, managing runoff from 130 acres of primarily privately-owned parking lot over 25 years.

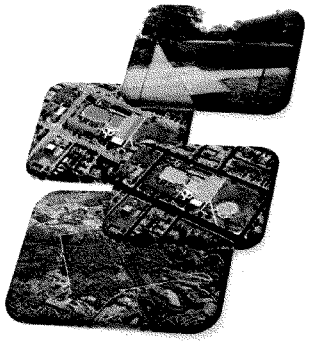
ROOFTOPS

Multiple strategies can be employed to manage the rainwater that falls on rooftops. Lancaster City currently has 51,000 square feet (well over 1 acre) of green roofs. This translates into almost 1 square foot per resident – perhaps more than any municipality in Pennsylvania. Building on the success and lessons learned from the Lancaster County Roof Greening Project administered by the Lancaster County Planning Commission and implemented by LIVE Green, the GI Plan calls for an additional 2 acres of green roofs in the next 5 years and over 30 acres in the long term.

Water from rooftops can also be managed through disconnection of downspouts. Most downspouts in the City go directly into the combined sewer system. Water from downspouts can be redirected to open green space, rain barrels, cisterns, rain gardens or stormwater planters. Through its Urban Watershed Initiative LIVE Green has been providing rain barrels to residents seeking low-cost solutions. The work of LIVE Green demonstrates how the installation of 250 rain barrels and rain gardens can reduce the amount of stormwater that enters the municipal sewer system and local streams by over 3 million gallons per year. The GI Plan calls for an additional 2,000 buildings to disconnect their downspouts.

PARKS

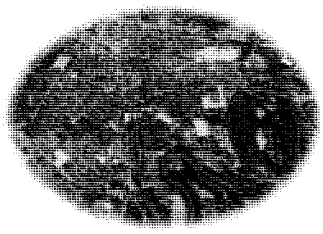
The GI Plan leverages the City's previous investment in the Urban Park, Recreation and Open Space Plan completed in 2009 as it moves forward with recommended park restoration and reconstruction projects. The GI Plan proposes green infrastructure retrofits of 26 of the City's 30 Parks to manage water runoff from 17 acres of impervious surface area. The GI Plan lays out specific concepts for the renovation and restoration of 3 parks and uses these park areas to manage storm water runoff from adjacent roadways and other impervious areas. An example is the recently completed Sixth Ward Memorial Park project that employs a porous basketball court and infiltration bed to reduce runoff from adjacent roadways and other impervious areas by an estimated 700,000 gallons per year. The new court was designed and built at half the cost of separate grey infrastructure designed to achieve the same level of benefit.



1 - The 6th Ward Park porous basketball court provides runoff reduction at 1/2 the cost of separate grey controls, while also providing community improvements

SCHOOLS AND CITY-OWNED PROPERTIES

The GI Plan establishes a long term goal of greening 38 acres of impervious surface area associated with 15 public schools. Implementing a variety of green infrastructure techniques to mange stormwater generated on-site can also manage additional impervious areas from adjacent properties. Libraries and other publicly owned facilities offer the same green infrastructure and storm water management opportunities as schools. The GI Plan includes conceptual designs for the Lancaster Public Library and two public schools.



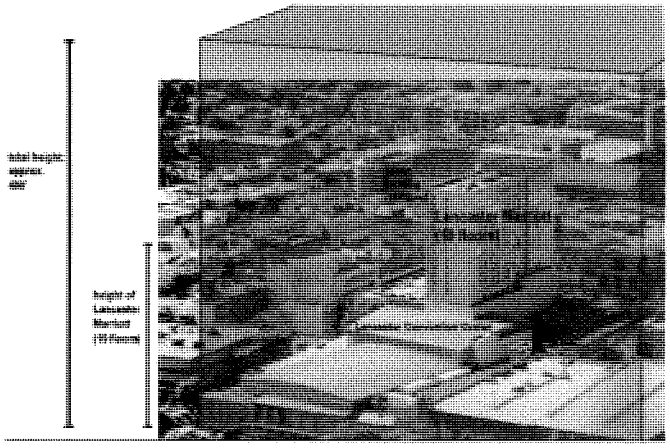
INCENTIVES FOR RESIDENTIAL AND COMMERCIAL PROPERTIES

To fully institutionalize green infrastructure into the City of Lancaster's urban landscape, the GI Plan proposes a combination of policy actions, incentives for residential and commercial property owners, and innovative funding approaches to support ongoing implementation costs.

POLICY ACTIONS: ORDINANCES & STANDARDS- As part of its stormwater ordinance, the City currently has a "first flush" control requirement that requires property owners who are adding new impervious surface areas (e.g., a building addition, driveway, garage or impervious patio) to manage the first 1-inch of rainfall on their property and not allow it to discharge to the combined sewer. The GI Plan recommends that the City's Stormwater regulations be extended to control the first flush from the impervious area within the entire disturbed area of the redevelopment project. For example, if an addition to a building was being built on top of an existing parking lot, runoff from the addition would fall under the ordinance and would need to be managed for the first flush (but runoff from the existing building would not). Over time, this change will gradually reduce stormwater runoff to the combined sewer. In addition to this revision of the storm water ordinance, the GI Plan recommends that the City evaluate other ordinances that may impact green infrastructure implementation, and review its current Streetscape Design Standards to incorporate green infrastructure options.

INCENTIVES - For private properties that may not redevelop in the foreseeable future, the City continues to evaluate programs that can incentivize owners to construct green infrastructure retrofits. The existing efforts have focused on securing grant dollars that can be used to implement demonstration projects on privately-owned property. The GI Plan proposes the establishment of a Green Infrastructure Grant Fund to support the marginal cost (e.g., the cost difference to install a green roof instead of a conventional one) of constructing GI on private property.

FUNDING - The City is evaluating a utility structure that would allocate the costs of stormwater management and water pollution control based on the amount of impervious surface area on each parcel. Known as a "stormwater utility," this would apportion the costs of controlling combined sewer overflows and storm water based on each parcel's proportionate use (as determined by impervious area) of the wastewater collection and treatment facilities. Because controls are now required for wet weather flows, this method of cost allocation would be based on actual use of the sewer system and treatment services and allow reductions in a bill if a property owner installed green infrastructure to manage his or her impervious area and reduce flows to the sewer.



Over 1 billion gallons of stormwater is projected to be removed through long-term implementation of this GI Plan. This would fill a cube 480 feet high over the block containing the convention center and hotel.

BENEFIT AND COST

The GI Plan evaluated the runoff reduction benefits of the initial demonstration projects, a conceptual 5-year implementation scenario and a long-term scenario that might be expected to be achievable over a period of about 25 years or so based on typical rates of redevelopment and renewal rates for other City infrastructure like roads and sidewalks. Based on the characteristics of the demonstration projects, the potential benefits and costs associated with GI were estimated for each implementation scenario. The projected benefits of the program over the long term scenario are summarized below.

Table 1-1 - Summary of GI Plan benefits for 5 year and long-term implementation scenarios

Parameter	5-year Implementation	Long-Term (25-yr) Implementation
Impervious Area Managed by Green Infrastructure (ac)	221	1,265
Average Annual Runoff Reduction (MG/yr)	182	1,053
Average Annual Total Suspended Solids (TSS) Reduction (lb/yr)	252,000	1,457,000
Average Annual Total Phosphorus (TP) Reduction (lb/yr)	4,800	27,800
Average Annual Total Nitrogen (TN) Reduction (lb/yr)	10,700	61,600
Total Marginal Cost	$7,800,000	$77,000,000
Total Capital/Implementation Cost	$14,000,000	$141,000,000
Marginal Cost Per Gallon CSO Reduction ($/gal)	$0.06	$0.10
Total Cost Per Gallon CSO Reduction ($/gal)	$0.10	$0.18

RECOMMENDATIONS

To achieve these benefits and put the GI Plan to action, the following recommendations are made in four key areas described as follows.

1. **Implement a comprehensive demonstration program** to allow the details of each project type and technology to be worked through and adapted for the specific requirements of the City's unique land use types and
   a) **Establish a prioritized capital program for GI implementation** within Department of Public Works;
   b) **Apply a screening process to review existing City capital programs for possible green infrastructure project opportunities** (e.g. roofing, pavement restoration and other projects that restore or reconstruct impervious surfaces);
   c) **Create a Green Infrastructure Grant Fund to incentivize action** by funding the marginal cost of the green portion of improvements on private property.

2. **Implement the recommended policy actions including:**
   a) **Institute a GI advisory committee** comprised of City leaders to discuss and remove implementation barriers and endorse selected implementation programs and projects;
   b) **Convene a review process to evaluate City Codes to include Green Infrastructure Options**
   c) **Revise City Standard Design Guidelines and Details;**
   d) **Evaluate and revise the First Flush Ordinance to manage all impervious area in the full area of disturbance for redevelopment;**
   e) **Implement an impervious cover-based storm water rate to equitably apportion the cost of wet weather controls;**
   f) **Develop a program to utilize vacant land (publicly and privately owned) for management of stormwater runoff.**

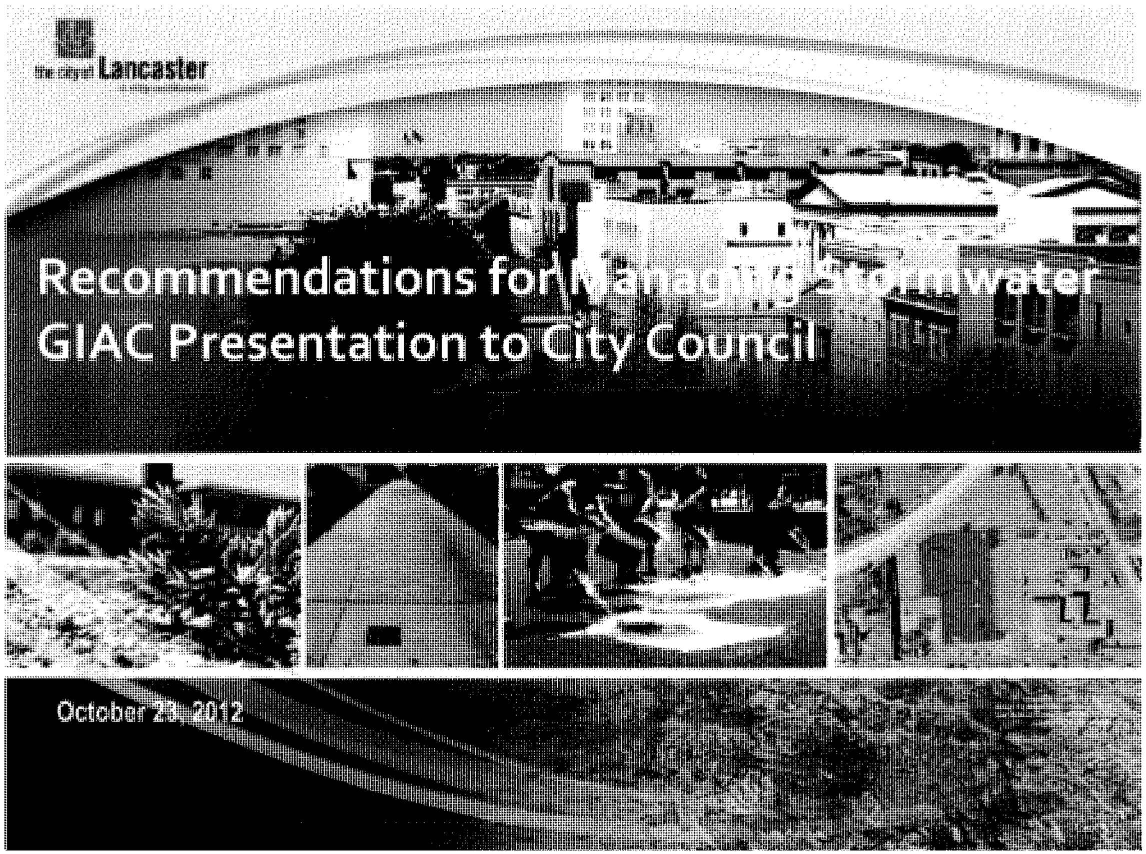
3. **Implement partnering and outreach including:**
   a) **Develop and manage a list of key partners and volunteers** to help deliver outreach messages, host workshops, and provide support for grant funding pursuits;
   b) **Develop partnerships and volunteer efforts to implement the results of the Urban Tree Canopy Project** being conducted by PA DCNR and evaluate additional models for expanding street tree programs;
   c) Coordinate with County efforts to **implement the state and federal pollution reduction requirements;**
   d) Coordinate with County efforts to **implement the Greenscapes Plan;**
   e) **Develop a GI Portal on the City website** to disseminate information to the public about GI technologies, program updates, and what home owners can do to help;
   f) **Develop a homeowner's guide to GI;**
   g) **Provide GI Fact Sheets and education materials** on the Portal and brochures for selected audiences;
   h) **Develop a public outreach plan, presentation materials and schedule** for outreach to key neighborhood groups, business leaders, the Mayor, City Council, and other stakeholders through **public meetings;** and

i) **Leverage learning through local and state key stakeholders** to inform the adoption and implementation of green infrastructure in other urban centers.

4. **Implement other studies & technical tools including:**
   a) **Conduct a Green Streets workshop** to support the selection and development of projects and approaches to demonstrate green streets in various types of road and alley reconstruction practices;
   b) **Update the City Hydrologic and Hydraulic Models to simulate green infrastructure** improvements in relation to other grey infrastructure alternatives;
   c) **Update the CSO LTCP** to include GI Plan recommendations;
   d) **Expand the GI Plan to evaluate the required implementation levels of the Chesapeake Bay TMDL and the nutrient reductions required for Lancaster** in the PA Watershed Implementation Plan (WIP) and **develop an integrated strategy for meeting CSO reduction and nutrient reduction objectives at the least cost and highest benefit to the City;**
   e) **Partner with PA DEP in the development of the revised WIP** for meeting the Chesapeake Bay TMDL requirements;
   f) **Develop a project tracking system** to document GI Implementation projects including the first flush projects and the area that they control; and
   g) **Identify direct stream inflow sources for potential removal from the combined sewer system.**
   h) **Prepare a comprehensive Tree Management Plan** by analyzing and developing a more specific tree planting goal based on the results of the Urban Tree Canopy Project and street tree inventory;
   i) **Address GIS data needs and update** parcel-based landuse data, impervious area data, and parcel ownership information

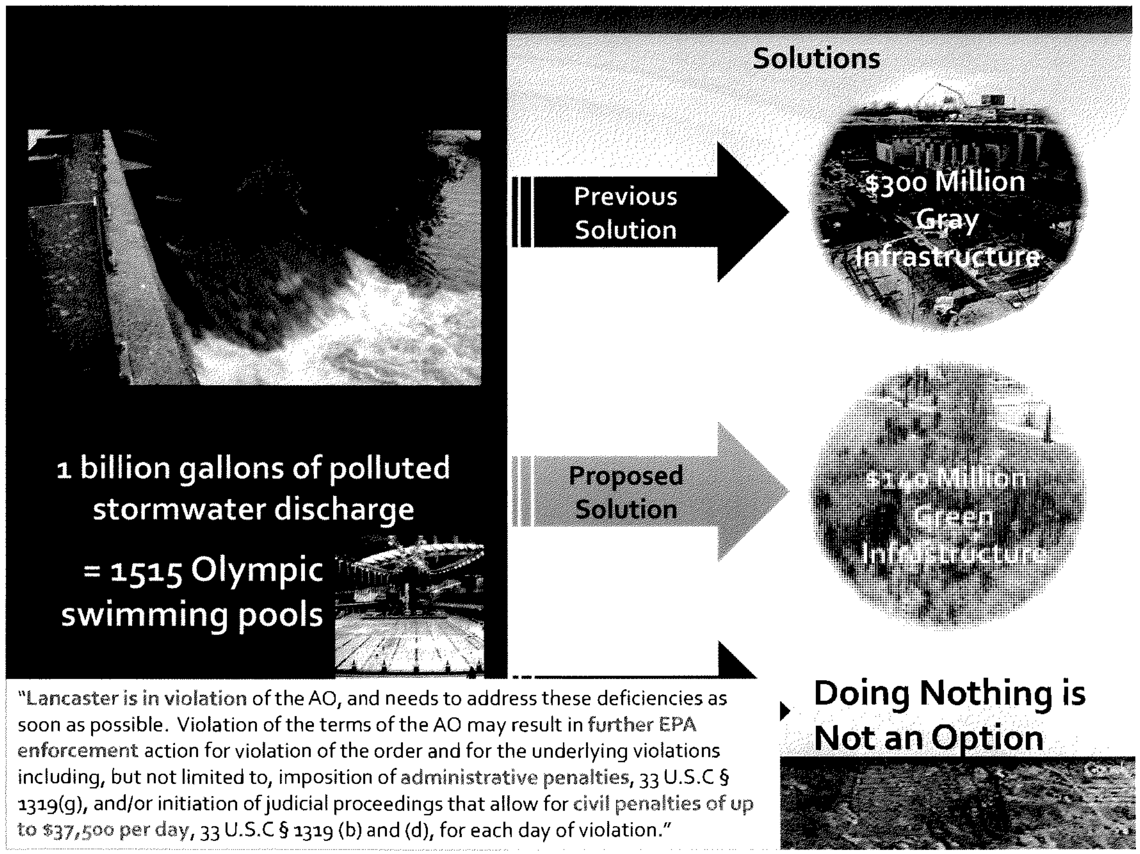
By implementing these recommendations, the needed investment in expensive, separate new grey infrastructure for water quality improvement can be significantly reduced and the City can realize many additional environmental, social and economic benefits.

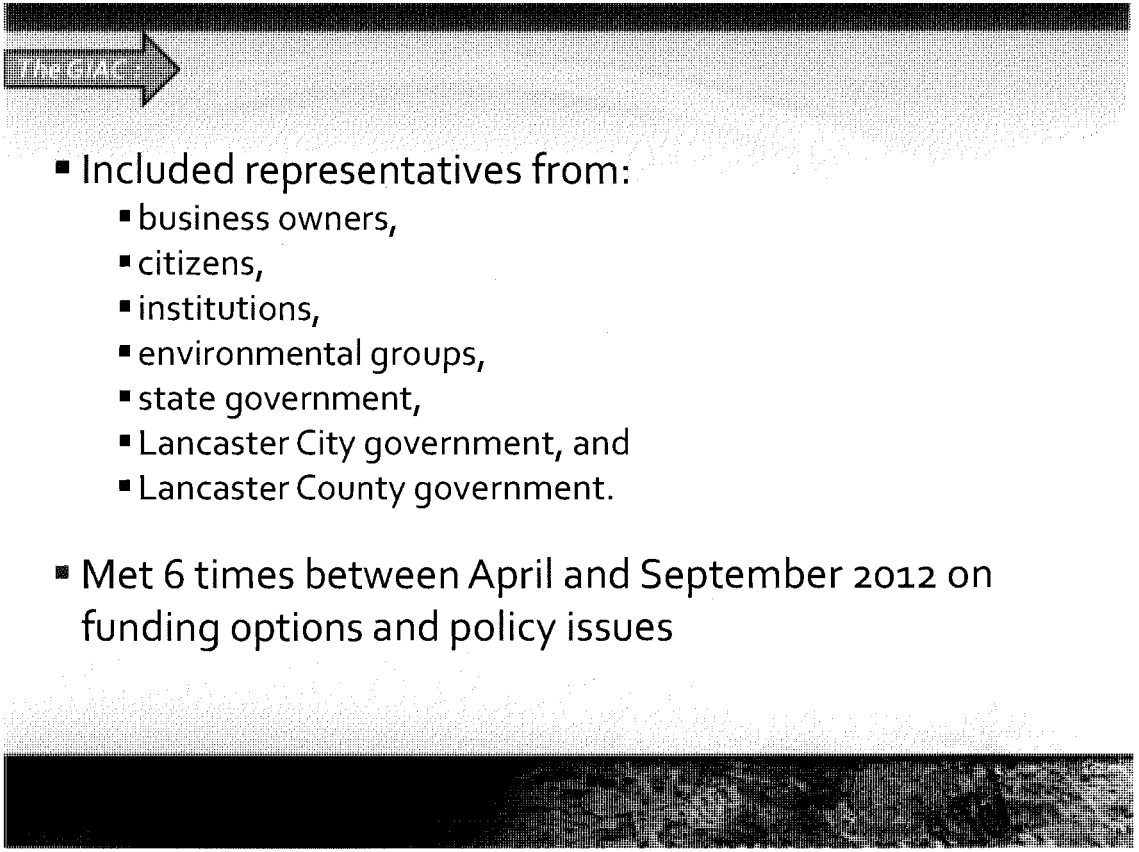
The top map shows the existing City green space that does not contribute significantly to runoff problems. The lower graphic illustrates the 1,265 acres of impervious area proposed to be managed over the long term through the GI Plan.


the city of Lancaster
Recommendations for Managing Stormwater
GIAC Presentation to City Council
October 23, 2012

Meeting Agenda

- Stormwater runoff - what is the problem?
- What does the GIAC recommend to address the problem and to fund it?
- Next steps – outreach and ordinance


Solutions
1 billion gallons of polluted stormwater discharge
= 1515 Olympic swimming pools
Previous Solution
$300 Million Gray Infrastructure
Proposed Solution
$140 Million Green Infrastructure
Doing Nothing is Not an Option
"Lancaster is in violation of the AO, and needs to address these deficiencies as soon as possible. Violation of the terms of the AO may result in further EPA enforcement action for violation of the order and for the underlying violations including, but not limited to, imposition of administrative penalties, 33 U.S.C § 1319(g), and/or initiation of judicial proceedings that allow for civil penalties of up to $37,500 per day, 33 U.S.C § 1319 (b) and (d), for each day of violation."



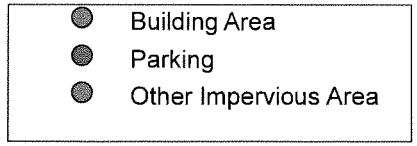
- Included representatives from:
  - business owners,
  - citizens,
  - institutions,
  - environmental groups,
  - state government,
  - Lancaster City government, and
  - Lancaster County government.
- Met 6 times between April and September 2012 on funding options and policy issues

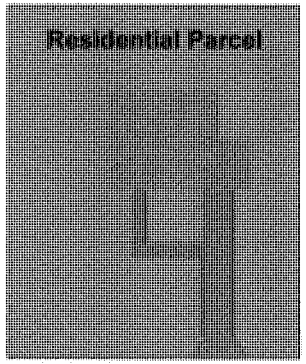
The CAC agreed on criteria for evaluation.

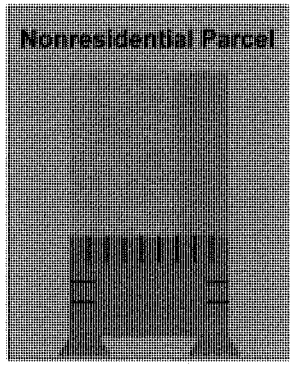
- Equity/Fairness
- Simplicity
- Transparency
- Efficiency/Ease of Implementation
- Consistency with other City goals and objectives

The CAC: was convened to evaluate fair and equitable ways to fund the City's stormwater program.

- **Potential funding sources:**
  - Increase property taxes
  - Raise sewer bills
  - Implement a fee based on stormwater runoff



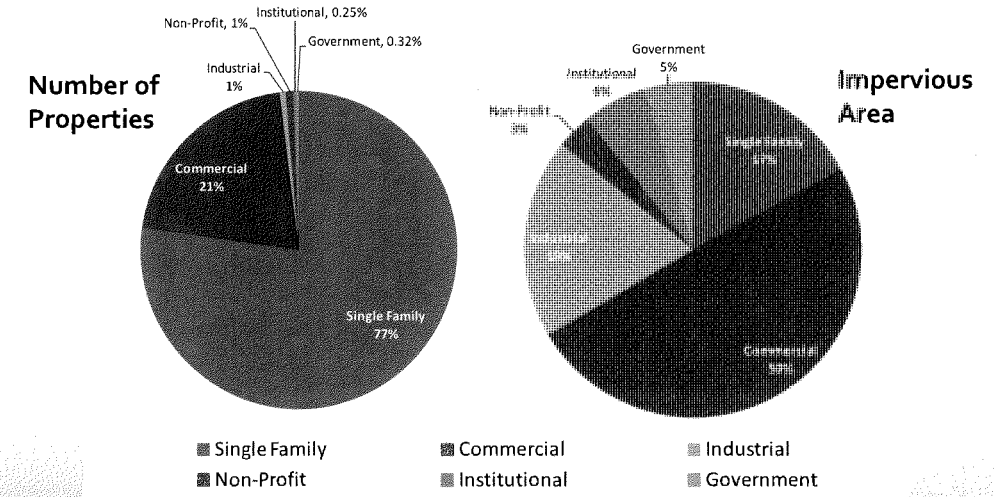




Stormwater runoff is measured by impervious area = roofs and pavement where rain runs off, rather than soaking into the ground

The CIAC recommends:

a stormwater management fee based on impervious area as the most equitable approach.

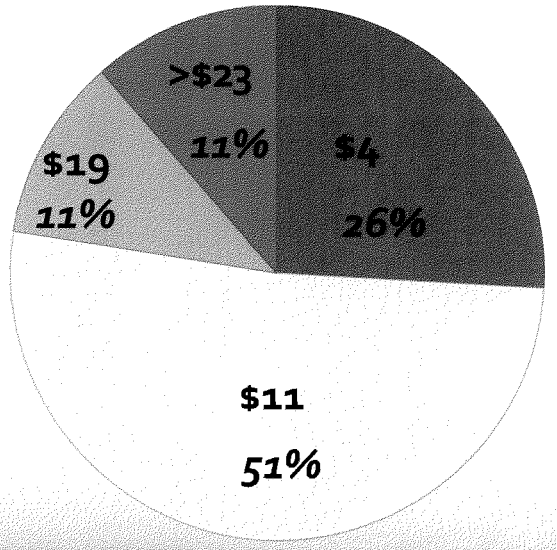


The CIAC recommends **funding the stormwater program at the medium level of service.**

Level of Service Cost Estimate Summary

	Estimated Annual Costs		
	Low (Current/ Status Quo)	Medium	High
Operating and Maintenance			
Green Infrastructure	n/a	$162,000	$202,500
Dry and Wet Ponds (inspection)	$2,300	$2,300	$2,300
Street Sweeping	$168,800	$168,800	$234,100
Catch Basin	$201,000	$201,000	$402,000
Storm Drainage	n/a	n/a	n/a
MS4 Implementation	$451,600	$536,400	$612,400
Program Administration	$142,000	$219,000	$296,000
Capital Costs			
Green Infrastructure	$730,600	$1,909,100	$3,652,400
Storm Drainage	n/a	$1,444,000	$1,926,000
Catch Basin	$164,000	$164,000	$164,000
Total	**$1,860,300**	**$4,806,600**	**$7,491,700**

The GIAC recommends **implementing a rate structure with four "tiers" based on impervious area.**



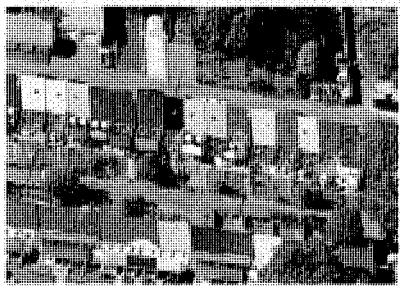
- Tier 1 (0-999 sq. ft.)
- Tier 2 (1,000-1,999 sq. ft.)
- Tier 3 (2,000-2,999 sq. ft.)
- Tier 4 (≥3,000 sq. ft.)

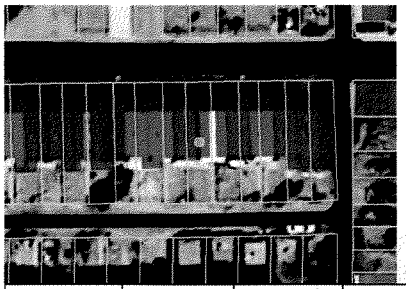
Percentages refer to percent of all properties

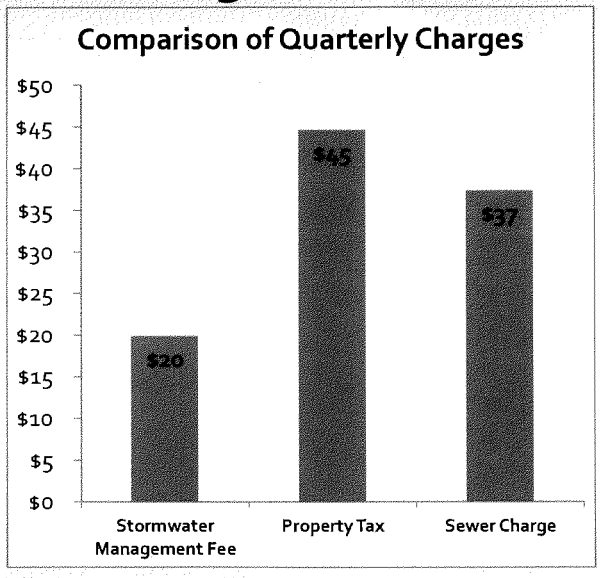
Rates are estimated first year fees per quarter, for Medium Level of Service

For example – average fee per quarter:
Residential: $20
Commercial: $237

Comparison of Charges – Average Residential



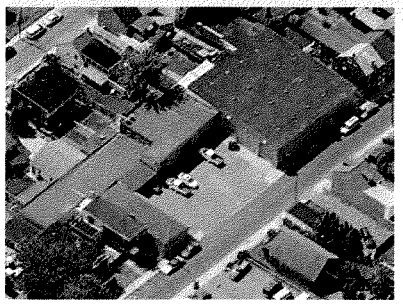


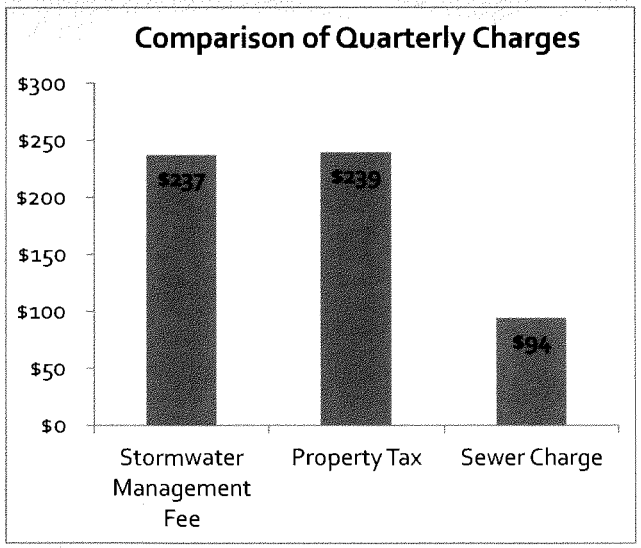


Rates and charges assume medium LOS
($4,800,000 annual program)

Residential	Impervious Area (sq.ft)	Assessed Value ($)	Water Total (x1000 gal)
Min	1	400	1
Avg	1,367	72,558	48
Max	35,441	522,800	912

Comparison of Charges – Average Commercial

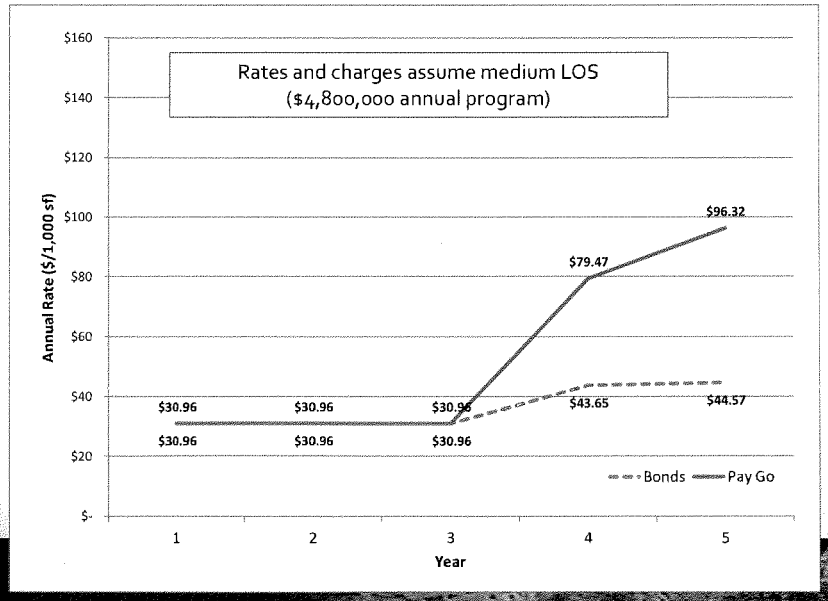




Rates and charges assume medium LOS ($4,800,000 annual program)

Commercial	Impervious Area (sq.ft)	Assessed Value ($)	Water Total (x1000 gal)
Min	7	300	1
Avg	17,882	389,338	120
Max	4,246,304	129,942,300	6,749

The CIAC recommends **leveraging the SWMF by issuing bonds to keep rates low and spread costs over time.**



The CAC recommends including an incentive program to provide fee relief.

- **<u>Rebates or Grants</u> – 1 time assistance with construction cost:**
  - For example up to $1200 for residences, and up to $5000 for businesses to install green infrastructure projects
- **<u>Credits</u> – a percentage reduction in the annual impervious area fee**
  - For example up to 50% for businesses treating impervious area with green infrastructure projects

- **Benefits:**
  - Help property owners reduce their annual stormwater fee, thus
  - Provide incentive for implementing green infrastructure on private property
  - Provide incentive to maintain facilities

City Administration recommends:

billing the SWMF as a new line item on sewer bills.

- Bills are quarterly or monthly depending on class
- Reaches all properties except those with no water/sewer account (e.g. parking lots), which will be billed separately

City Administration recommends

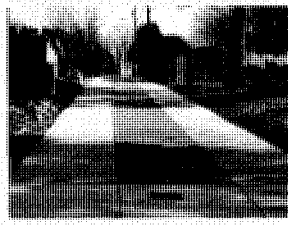
including an appeals system.

- Items that could be appealed:
  - Impervious area
  - Tier category
  - Credit calculation
- Appeals deadline would be 6 months before first bills go out in a given fiscal year
- Estimated first year fee should be sent out before bills are issued, to allow appeals

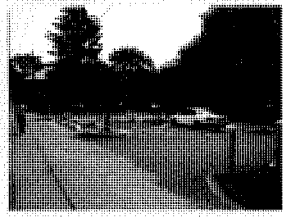
The GIAC recommends:

implementing a stormwater management fee to support regulatory compliance, and continuing to implement the Green Infrastructure Program

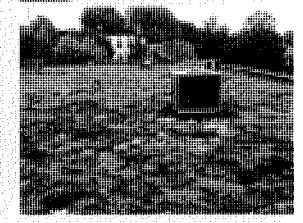
Roads & Alleys



Parking



Rooftops



Next Steps - Targeted Stakeholder Outreach

- Business Community:
  - Chamber of Commerce
  - Commercial
  - Industrial
- Non-profits
- Faith Community
- Neighborhood and Latino Communities
- Landlords
- Environmental groups
- City Council
- County Government
- School District
- Other Media
- Developers
- Realtors
- Parking Authority
- Parking lot owners without water accounts

Next steps – Ordinance Development

- Outreach
- GIAC Review of Feedback
- Ordinance Development
- Presentation to Council

Questions?

www.baltimoresun.com/news/opinion/bs-ed-conowingo-dam-20121217,0,1752299.story

baltimoresun.com

Conowingo Dam is not the problem

County leaders are using the Susquehanna issue to divert attention from their responsibility to protect the Chesapeake

By J. Richard Gray

6:00 AM EST, December 17, 2012

The Susquehanna River and its big dams have been in the news lately. A handful of Maryland county officials would like you to believe the dams are the primary ill of the Chesapeake Bay.

They claim that because sediment reservoirs behind the Conowingo Dam are at capacity, instead of trapping pollutants during storms, the dam now allows two pollutants — phosphorus and sediment — to flow downstream at alarming rates. They argue that years of restoration progress have been erased and that current bay restoration efforts do not address these issues. And finally, these local leaders contend that Maryland's investments in restoring the bay would be "futile" and all of the efforts to help our local waters should now come to a standstill.

Well, as chair of the Local Government Advisory Committee (LGAC) for the Chesapeake Executive Council, which includes the state governors, Environmental Protection Agency administrator and other senior officials who guide the cleanup effort, I write today with good news — every bit of scientific information available says they are wrong on all counts.

First, they claim 80 percent of the pollution to the bay comes from the Susquehanna River. This figure is not in any of the scientific information I've seen, and no expert I've contacted knows where the number comes from.

Second, the nutrients and sediment passing through the Susquehanna's dams, under all conditions, are indeed accounted for in the state-of-the art tools the bay restoration scientists use.

Third, while storms do increase the freshwater and pollutants flowing through the dam, they by no means erase the progress we have made. For example, the large grass bed on the Susquehanna Flats, located right where that river meets the bay, withstood the flow of fresh water and sediment downstream during last fall's storms precisely because we put time and effort into restoring it to health.

And finally, whatever pollutants get past the dam primarily affect the northernmost tidal waters of the bay and its rivers.

So let's talk about things that are true.

The recent introduction of pollution limits in the effort to clean up the Chesapeake Bay recognized that we could no longer point our fingers at someone else. We all have to do more to protect our local streams and, by doing so, help the Chesapeake Bay. Many Pennsylvania and Maryland localities are already investing wisely in projects to restore their own local waters and send cleaner water downstream.

In Lancaster, Pa., even before the clean water blueprint was established, we changed our thinking and began to put projects in place to stop polluted runoff before it reaches local waters. We are continuing to invest our money in sewage treatment and stormwater infrastructure, using green technologies and following our comprehensive green infrastructure plan.

Meeting our local goals will be costly in the short term, but recent studies done in and on our city actually show a cost savings in the long run. In other words, if we postpone what has to be done, future generations will bear an even greater financial burden. So we are building Lancaster into a more appealing, livable community right now, with more trees and gardens and healthier waters, all of which give us a better chance of attracting new residents and economic growth.

So, why, LGAC members wonder, would any county or city spend its citizens' dollars on lawyers to fight against clean water rather than using that money to improve its communities and its local streams?

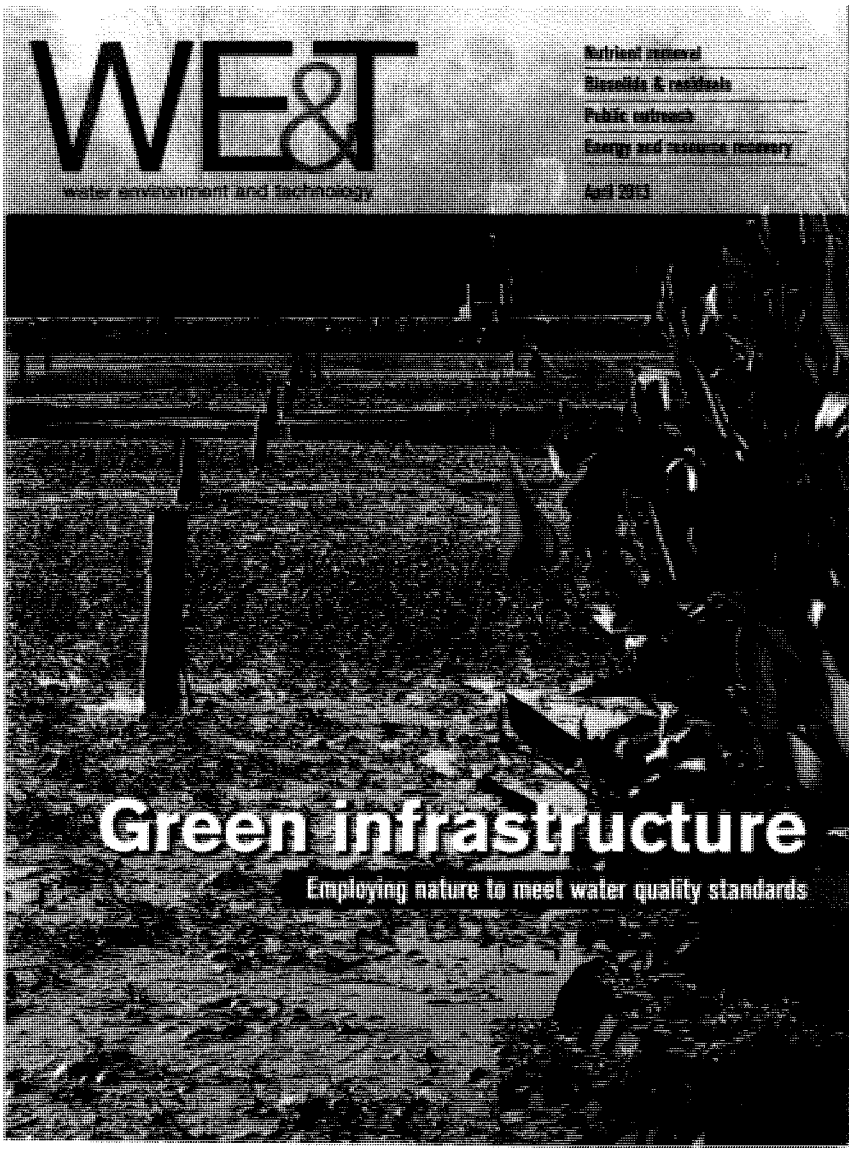
Maryland's local officials should recognize that their counties and towns have the most vital interest in the bay. If they give up their efforts, many in Pennsylvania, Virginia and other states will use that as an excuse to do nothing. Rather than pulling back or arguing, I would expect Maryland localities to fully appreciate the value of clean local waters and set the example for all of those upstream.

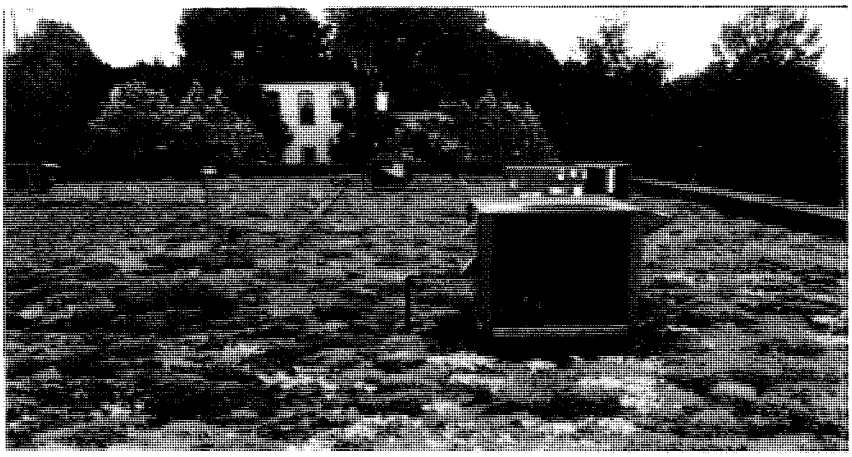
There is so much financial assistance available, so many creative "green" engineering firms at work and so many solid, new ways to manage polluted runoff that we are dumbfounded by the resistance from these local leaders toward cleaner local waters for their communities and the bay.

To the extent the Conowingo Dam is an issue, let's get the right people to the table to talk constructively about the facts and solve the problem. The timing is perfect, because the license for that dam is up for renewal.

Enough of creating diversions and pointing fingers to distract from the work that is so sorely needed. It's time to recognize that we are all in this together. It's time — past time, in fact — to get busy on the work we were entrusted to do as our communities' leaders.

J. Richard "Rick" Gray is Mayor of Lancaster, Pa. and the chairman of the Local Government Advisory Committee, an independent group of elected local leaders from Maryland, Pennsylvania, Virginia and the District of Columbia that advises the Bay Program's Chesapeake Executive Council. This article is distributed by Bay Journal News Service.


WE&T
water environment and technology
Nutrient removal
Biosolids & residuals
Public outreach
Energy and resource recovery
April 2013
Green infrastructure
Employing nature to meet water quality standards



Going green to save green

The City of Lancaster, Pa., develops an integrated green infrastructure plan to reduce CSOs and stormwater and nutrient runoff

Charlotte Katzenmoyer, Brian G. Marengo, Andrew Potts, and Courtney Finneran

The City of Lancaster, Pa., is integrating the use of green infrastructure with its core public works practices to reduce the impacts of pollutant sources and achieve cost savings. The city also is updating its long-term control plan to reduce the frequency and volume of combined sewer overflows (CSOs) and address its stormwater discharges. The hope is to become a model example of the application of the integrated municipal planning and green infrastructure promoted in the U.S. Environmental Protection Agency's Oct. 27, 2011, memorandum, "Achieving Water Quality Through Integrated Municipal Stormwater and Wastewater Plans."

A historic solution with emerging problems

Lancaster is one of about 770 U.S. cities with a combined sewer system (CSS). Eighty-five percent of the time, the city's advanced water resource recovery facility (WRRF) is able to manage and clean the volume of wastewater flowing through the CSS. However, during intense rainstorms and other wet weather events, the system can become overwhelmed. This causes 3.8 billion L/yr (1 billion gal/yr) of CSOs into the Conestoga River.

When CSSs were being built across the country 100 to 200 years ago, they were considered a highly efficient method of treating all forms of waste from urbanized areas, because they collected stormwater, municipal wastewater, and industrial wastewater all in the same pipe and conveyed them to a facility to be processed before the system discharged treated water to nearby streams. But as urbanized areas grew and eventually overwhelmed CSSs, the methods used did not change to keep up with development.

The city's existing CSS has come under further scrutiny because of efforts to clean up Chesapeake Bay. These efforts have brought renewed federal, regional, and state attention to initiatives designed to protect and restore the network of polluted streams and rivers in the Chesapeake Bay watershed, many of which fail to meet water quality standards. The Conestoga River is one such river. There is increased regulatory interest in enforcing limits on the total maximum daily load (TMDL) of nitrogen, phosphorus, and sediment runoff. The TMDL sets accountability measures for communities located within the 166,000-km² (64,000-mi²) watershed to ensure that they keep cleanup commitments. The TMDLs are being promulgated not only for CSSs but also for municipal separate stormwater systems across the watershed.

◀ A photo of a green roof, one of the initiatives of the Lancaster County Roof Greening Project. LIVE Green

Shifting focus from gray to green

Both the inadequacy of traditional CSSs to address modern treatment needs and the new Chesapeake Bay TMDL mandates have led the city to proactively work to reduce CSOs and identify economically viable, long-term strategies for mitigating the negative impact of wet weather overflows on local water quality.

During the past 12 years, the city has aggressively upgraded its existing gray infrastructure, investing more than $30 million in its wastewater system, including making it the first system in the state to meet nutrient removal requirements through a biological nutrient reduction project. The city also used capital investments to increase the efficiency of pumping stations to optimize the flow of wastewater to the WRRF. These investments have resulted in future capture of wet weather flows for treatment.

To date, most of the additional strategies the city has considered have been limited to gray infrastructure options, such as increasing capacity of the city's wastewater conveyance and treatment infrastructure, adding storage or holding tanks to detain wastewater flows until treatment capacity returns, or providing some form of wastewater treatment to the overflow discharges. But prior evaluations and experience in many other communities show that the gray infrastructure option can be expensive to construct and maintain, and it only serves the single purpose of holding CSO volume for later treatment at the WRRF. The cost of one storage tank alone in the city's northeast section is estimated at $70 million. This would manage only 10% of the city's annual CSO volume. To store and treat the current CSO volume is estimated at more than $250 million in constructed costs, not including the annual operational costs in energy and personnel to run the new system.

Given the expense of gray infrastructure modifications, the city has instead opted for a two-pronged strategy to reduce the volume of CSOs: Increase the efficiency of the city's existing gray infrastructure, and employ green infrastructure stormwater management methods. These methods generally include

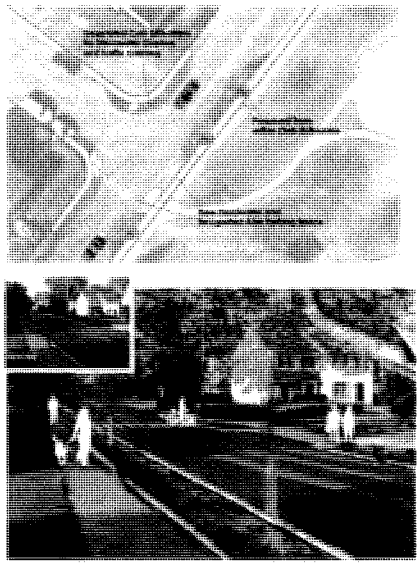
- infiltration (linear infiltration systems and porous pavements, sidewalks, and gutters);
- evaporation, transpiration, and reduction of energy consumption (vegetated roofs, trees, and planter boxes);
- infiltration and transpiration (rain gardens and bioretention); and
- capturing and reusing rainfall (rain barrels, cisterns, irrigation supply systems, and graywater systems).

In contrast to gray infrastructure, a green infrastructure approach often has a higher return on investment and offers multiple benefits. Most importantly, integrating green infrastructure with traditional infrastructure (for example, parks, parking lots, and roads) can decrease implementation costs; decrease the reliance on separate, single-purpose, gray infrastructure needs; and provide triple-bottom-line benefits with regard to

- environmental concerns (such as recharging groundwater, providing natural stormwater management, reducing energy usage, improving water quality, reducing heat-island effects, and increasing habitat);
- social considerations (beautifying and increasing recreational opportunities, improving health through cleaner air and water, and improving psychological well-being); and
- economic concerns (reducing future costs of stormwater management and increasing property values).

In May 2010, Lancaster began to develop Pennsylvania's first Green Infrastructure Plan for a Class 3 city. (Class 3 cities are medium-size communities in Pennsylvania after Philadelphia and Pittsburgh.) Building upon the Lancaster County Comprehensive Plan as reported in the planning commission's *Greenscapes: The Green Infrastructure Element*, the city's plan was developed in conjunction with LIVE Green (Lancaster), the county planning commission, the Pennsylvania Department of Environment, the Pennsylvania Department of Conservation and Natural Resources, and other local stakeholders. The plan clearly articulates that the vision for the city was developed to support the mission to provide more livable, sustainable neighborhoods for city residents and reduce CSOs. The program was developed also to support the following program goals:

- Strengthen the city's economy and improve health and quality of life for its residents by linking clean water solutions to community improvements.
- Create a green infrastructure program to respond comprehensively to the multiple water quality drivers to maximize the value of the city's investments, meeting the numerous overlapping environmental regulations and programs.
- Use green infrastructure to reduce nutrients and erosive flows from urban stormwater runoff and CSOs to support the attainment of Pennsylvania's Watershed Implementation Plan for Chesapeake Bay.



Before and after photos of Brandon Park. This park is part of the Green Parks program of Lancaster, Pa. Brandon Park reduces runoff by 4 million gal/yr at $0.15 per gallon. CH2M HILL

The Mifflin Street lot was one of many projects where the City of Lancaster incorporated green infrastructure design as part of the improvements. CH2M Hill

- Achieve lower cost and higher benefit from the city's infrastructure investments.
- Establish the city as a national and statewide model of green infrastructure implementation.

Analyzing the area

In order to implement its green infrastructure plan, the city conducted an evaluation/study that required a three-step process:

1. Evaluate impervious cover by type and land ownership.
2. Identify potential green infrastructure project sites and grant funding for early implementation to understand the cost and benefit of each.
3. Determine potential citywide benefits, and provide actions and policy direction to institutionalize green infrastructure throughout the city.

The size of the study area, which is 1957 ha (4835 ac), or 19.7 km² (7.6 mi²), was defined as the city and the CSO sewershed area that includes a small portion of the Manheim Township and Lancaster township residing outside the city (see Figure 1, p. 44). About 45% of the city, or 854.7 ha (2112 ac), drains to a combined sewershed, according to geographic information system analysis, and a small portion of the combined sewershed (53.8 ha [133 ac]) drains portions beyond the city boundary. The total land area served by the CSS is 908.5 ha (2245 ac), and more than half of the city (1008 ha [2591 ac]) drains into a separated stormwater sewer system.

Overall, about 363 parcels are owned by a public entity, totaling 256 ha (632 ac), or 13% of the study area (see Table 1, below). Publicly owned parcels are the basis for analysis and overall implementation of the green infrastructure techniques, as these parcels offer a defined process for incorporating green infrastructure into redevelopment or the new land development process.

An impervious-area analysis (see Figure 2, p. 44) revealed that approximately 41% of the city's impervious surface is attributable to buildings, 32% to parking lots, 25% to roadways, and 2% to railroads. Most of the impervious area besides roads is on privately held lands, which shows why private involvement is necessary to make the program successful. The city cannot solve the problem cost-effectively on its own.

Further analysis identified more than 50 existing and potential green infrastructure projects in various locations, such as streets, alleys, sidewalks, parking lots, rooftops, parks, and school and city-owned properties. From these locations, the city included in the green infrastructure plan conceptual designs and cost estimates for 20 initial projects that the city could use to demonstrate each green infrastructure technology. These demonstration projects will remove an estimated 79 million L (21 million gal) of urban runoff from the CSS per year and simultaneously provide much needed data on the long-term effectiveness of employing green infrastructure strategies on a broader scale to reduce urban stormwater runoff and CSOs.

The city determined it possible to scale the projects to significant implementation levels when applied to specific land uses common in urban settings, such as Lancaster. The implementation levels were initially determined using professional judgment based on field surveys, geographic information system analysis, demonstration projects, cost/benefits analysis (see sidebar, p. 45), and other communities seeking to widely implement green infrastructure. They provide a guideline as to what might be possible to achieve within these approximate timeframes and could be increased or decreased depending on a variety of factors, such as capital budget, regulatory need, restoration priorities for the various impervious surfaces, redevelopment rates, the urban tree-canopy assessment, and others.

Each green infrastructure project can be classified into a broader green infrastructure program; for example, all publicly owned school sites can fall within a common classification of green schools and city-owned sites. Classifying the programs helps organize the drivers for implementation and can help shape the priorities for short- and long-term city efforts. The city considered eight program types in relation to the specific land uses common to the city, with an initial focus on public ownership. They were green streets/alleyways, green sidewalks, green parking lots, green roofs, private disconnection/rain gardens and rain barrels, enhanced street tree plantings, green parks, and green schools and city-owned sites.

Making changes

To illustrate how the city is achieving low-cost runoff reduction by using integrated green infrastructure, select implementation examples are provided below.

Green parks program. In 2009, the city completed an Urban Park, Recreation, and Open Space Plan through grant funding from the Pennsylvania Department of Conservation and Natural Resources. The plan lays out specific concepts for city-owned and -managed park renovation and restoration, recommending the implementation of green infrastructure techniques that can be undertaken at a reasonable cost.

Table 1. Total number and area of publicly owned parcels for the study area

Public ownership – major category	Total number of parcels	Total parcel area (ac)
City	195	185
School	20	175
Parks	17	241
Other	131	31
Total	**363**	**632**

Table 2. The 6th Ward Park porous basketball court results

Runoff reduction	694,600 gal/yr
Construction cost	$116,300
Cost of court only	$49,650
Incremental cost of GI	$66,650
Total cost/gallon	$0.17 per gal
Incremental cost/gallon of GI	$0.10 per gal
Comparable grey storage cost	$0.23 per gal

GI = green infrastructure.

Implementation of green infrastructure techniques on park properties manage stormwater from adjacent impervious surfaces, such as surrounding neighborhood streets, and manage stormwater runoff from adjacent roofs through downspout disconnections. They also provide a natural source of irrigation for green spaces.

One example is the 6th Ward Park. The city incorporated a porous-pavement stormwater system with a proposed new basketball court to manage runoff from the park and adjacent streets at a marginal cost of $0.03/L ($0.10/gal; see Table 2, above). Another example is Brandon Park, which is situated in the valley of a former creek where a CSS was constructed during the early 1900s. The city re-envisioned the valley with green infrastructure to capture runoff from the impervious features in the park and adjacent upland areas from Wabank Street. Parking areas and basketball courts were replaced with porous paving. The city used bioretention facilities throughout the park to re-create the historic stream valley. Also, at the intersection of Brandon Court and Wabank Street, the city used curb extension planters to calm traffic at the park entrance and along a main pedestrian thoroughfare to the local elementary school and city recreation center.

Green streets. The city of Lancaster has 217 km (135 mi) of streets, with 43 km (27 mi) classified as alleys within the Conestoga River watershed, a small portion within the Little Conestoga Creek watershed, and a minor portion draining to the Mill Creek watershed. Green streets and alleys use the existing form and construction of roadways to enable the public right-of-way to manage the runoff it creates. Green infrastructure features are incorporated during street repaving or reconstruction. Impervious surfaces can be replaced with porous pavements (asphalt, concrete, or pavers) or with standard pavements with inlets routed into a storage and/or infiltration bed below. Landscaping and vegetation (trees, curb extensions, and sidewalk planters) can be incorporated.

The first alley demonstration project was built by modifying an existing unit-quantity paving contract to include material components and installation services needed to include porous pavers, a subsurface stone storage bed, and perforated drain pipe. Modifying the existing contract made it possible for the alley to be built in 1 month and at a cost of only 10% more than a conventional concrete alley.

Green parking lots. A green parking lot typically is built by excavating an existing lot and installing a stone surface infiltration bed and a porous pavement or stormwater inlets and/or catch basins redirected into the stone bed. Runoff from adjacent areas, such as streets and buildings, can be redirected into the infiltration bed and tree trenches, or the city can integrate bioretention with the design to increase tree canopy, promoting evapotransipiration. These projects are built more cost-effectively when pavements need replacing or when the lot requires reconfiguration for other reasons. The Mifflin Street parking lot not only incorporated green infrastructure in its reconstruction, but the layout improvements and increased tree canopy will provide other benefits to the community, such as improved traffic flow management, increased property values, and reduction in crime. The lot was designed, bid, and recently completed.

Green roof program. The Lancaster County Roof Greening Project is a grant program that provides funding to offset the higher capital cost of green roof construction. The City of Lancaster currently has 10 green roof installations (see Table 3, below) that manage an estimated 3.79 million L (1 million gal) annually of stormwater runoff from the CSS.

Moving forward

To fully institutionalize green infrastructure into the city's urban landscape, the city is moving forward with several policy actions, incentives for residential and commercial property owners, and innovative funding approaches to support ongoing implementation costs. Some examples are described below.

Policies, ordinances, and standards. As part of the stormwater ordinance, the city has a "first flush" control measure that requires property owners who are adding new impervious surface areas – such as building additions, driveways, garages, or impervious patios – to manage the first inch of rainfall on their property and not allow it to discharge to the CSS. To gradually reduce overall stormwater runoff to the CSS, the green infrastructure plan recommends that the city's stormwater regulations be extended to control the first flush from the impervious area within the entire disturbed area of the redevelopment project. For example, if a building addition were being built on top of an existing parking lot, runoff from the addition would fall under the ordinance and would have to be managed for the first flush. In addition to the revision to the stormwator ordinance, the

Table 3. Summary of implemented green roof projects under the county incentive program

Project reference ID	Project name	GI area (ft²)
P-022	Wharton Elementary	13,150
P-023	Lafayette Elementary	11,500
P-024	Ross Elementary	2500
P-025	National Novelty Brush Co.	16,900
P-026	F&M Brooks Bump out	1250
P-027	F&M Wohlson Center for Sustainable Environment	1825
P-029	Groff Family Funeral Home	8910
P-080	Tellus	9600
P-112	F&M Weis Hall	820
P-113	F&M Schnader Hall	9400
Total		**75,855**

GI = green infrastructure.

This project's green infrastructure improvements included an increased tree canopy. CH2M Hill

plan also recommends that the city evaluate other ordinances that might affect green infrastructure implementation and review the current streetscape design standards to incorporate green infrastructure options.

Green incentive programs. The city continues to evaluate programs that can incentivize owners to construct green infrastructure retrofits on private properties that may not be redeveloped in the foreseeable future. It has focused existing efforts on securing grant dollars that can be used to implement demonstration projects on private property. The green infrastructure plan proposes establishing a green infrastructure grant fund to support the incremental cost of adding green features to a project on private property (for example, the cost difference to install a green roof instead of a conventional one). This program is being implemented using funding from the state revolving loan fund, PENNVEST, and property owners are paying for 10% of the project costs for more than 35 projects.

Impervious area fee. The city is implementing an impervious-area-based fee structure that would allocate the costs of stormwater management and water pollution control based on the amount of impervious surface area on each parcel. Known as a "stormwater utility," this would apportion the costs of controlling CSOs and stormwater based on each parcel's proportionate use (as determined by impervious area) of the wastewater collection and treatment facilities. This allows for reductions in a bill if a property owner installs green infrastructure to manage his or her impervious area and reduce flows to the CSS.

Charlotte Katzenmoyer *is director of the City of Lancaster (Pa.) Public Works.* ***Brian G. Marengo*** *is principal water resources technologist,* ***Andrew Potts*** *is senior water resources project technologist, and* ***Courtney Finneran*** *is an environmental planner in the Philadelphia office of CH2M Hill Inc. (Englewood, Colo.)*

The City of Lancaster would like to thank the Pennsylvania Department of Conservation and Natural Resources (DCNR) Environmental Stewardship Fund and the Lancaster County Planning Commission for their financial support in developing the green infrastructure plan. It would also like to thank the National Fish and Wildlife Foundation (Washington, D.C.) for its generous support through three grants for funding demonstration projects and institutionalizing green infrastructure. It would also like to thank

Figure 1. Green infrastructure plan study area

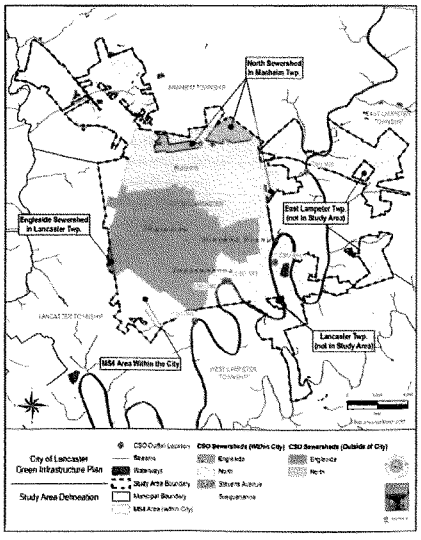
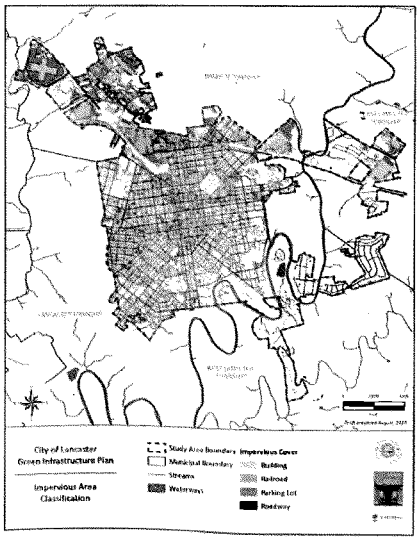


Figure 2. Impervious area classification



Jay Braund of the Pennsylvania Department of Environmental Protection; Green Collins of the School District of Lancaster; Mike Domin and Mary Gattis of the Lancaster County Planning Commission; John Hershey of Thomas Comitta Associates (West Chester, Pa.); Chris Peiffer, Ashley Rebert, and Lori Yeich of DCNR; Rob Ruth of the City of Lancaster Department of Public Works; Fritz Schroeder and Danene Sorace of LIVE Green (Lancaster); and J. Richard Gray, mayor of the City of Lancaster.

Estimating green infrastructure benefits

The City of Lancaster, Pa., developed a green infrastructure calculator to evaluate the potential stormwater benefits and costs associated with green infrastructure implementation in the study area at two implementation levels: approximately a 5-year period and a 25-year period. Major inputs to the calculator included impervious area by type, implementation levels (by percentage managed), capture volume, annual rainfall, annual impervious runoff coefficients, average redevelopment rate, green infrastructure loading ratios, unit green infrastructure costs (total and marginal), and typical event mean concentrations for stormwater and combined sewer overflow (CSO) discharges (see Table A, below).

Table A. Green infrastructure calculator inputs

Area/impervious source	Impervious/ contributing area (ac)	Approx. percent imperv.	Green infrastructure project/program type	Assumed percent of impervious area managed	Impervious area managed (ac)	Assumed BMP capture volume (in.)
Roads/alleys	529	100%	Green streets	2.5%	13.2	1.0
Parks	241	8%	Park improvements/greening	20%	4.0	1.0
Sidewalks	124	100%	Disconnection, porous pavement	2.5%	3.1	1.0
Parking lots	648	100%	Porous pavement, bioretention	1%	6.5	2.0
Flat roofs	218	100%	Vegetated roofs/disconnection	1%	2.2	1.0
Sloping roofs	654	100%	Disconnection/rain gardens	2.5%	16.4	1.0
Street trees	N/A	N/A	Enhanced tree planting	N/A	9.0	0.8
Public schools	175	29%	Green schools	10%	5.1	1.0
Various (ordinance)	1615	100%	First-flush ordinance	10%	161.5	1.0

BMP = best management practices
N/A = not applicable

Some of the outputs generated by the green infrastructure calculator included total annual stormwater runoff by impervious area type, annual stormwater runoff reduction by green infrastructure type, benefit/marginal cost ratio by green infrastructure type, and estimated pollutant removals from stormwater/CSO reductions, as well as total pollutant reductions.

A summary of results from the calculator for both the approximately 5-year and 25-year implementation periods is included in Table B (below). The calculator estimates that the 25-year implementation of green infrastructure can reduce the average annual storm runoff in the study area by more than 3.79 billion L/yr (1 billon gal/yr), total suspended solids by 660,895 kg/yr (1.457 million lb/yr), phosphorus by almost 13,608 kg/yr (30,000 lb/yr), and nitrogen by more than 27,216 kg/yr (60,000 lb/yr).

The total implementation cost of this program for the city in 2010 dollars is estimated at $141 million, although the marginal/increased cost of incorporating green infrastructure as part of other projects is estimated to be $77 million. Perhaps most importantly, the estimated cumulative total cost of CSO reduction ($0.05/L [$0.18/gal]) is competitive with the preliminary cost of a large storage tank in the north basin ($0.06/L [$0.23/gal]). Furthermore, the estimated cumulative marginal cost for green infrastructure, ($0.03/L [$0.10/gal]) is significantly less than the preliminary cost of gray infrastructure.

Table B. Green infrastructure calculator outputs for 5-year and 25-year terms

Parameter	5-year implementation	Long-term implementation
Impervious area managed by green infrastructure (ac)	221	1265
Average annual runoff reduction (million gal/yr)	182	1053
Average annual total suspended solids reduction (lb/yr)	252,000	1,457,000
Average annual total phosphorus reduction (lb/yr)	4800	27,800
Average annual total nitrogen reduction (lb/yr)	10,700	61,600
Total marginal cost	$7,800,000	$77,000,000
Total capital/implementation cost	$14,000,000	$141,000,000
Marginal cost per gallon CSO reduction ($/gal)	$0.06	$0.10
Total cost per gallon CSO reduction ($/gal)	$0.10	$0.18

CSO = combined sewer overflow

Senator CARDIN. Mayor Gray, I particularly appreciate your testimony and your leadership on this issue. You're absolutely right. Maryland is going to do what's right, and what you're doing in Lancaster is really commendable. So I'm glad I take my grandchildren there frequently to see Lancaster.

Mayor GRAY. I'll be sure to come downtown when you do so.

[Laughter.]

Senator CARDIN. Secretary Gill.

STATEMENT OF HON. JOE GILL, SECRETARY, MARYLAND DEPARTMENT OF NATURAL RESOURCES

Mr. GILL. Thank you, Senator. I'm Joe Gill, Secretary of Natural Resources for the State of Maryland. I'm here with my colleague, Dr. Bob Summers, who is Secretary of the Maryland Department of the Environment. You can guess which one of us drew the short straw.

[Laughter.]

Mr. GILL. I'd like to provide a context and a framework and one closing remark on next steps. Here's the context. I heard earlier that even during large storm events like Tropical Storm Lee, which occurred September 2011, even then, only 20 percent of the sediment that comes into the Bay comes from behind the dam, even during those large storm events. The rest of the sediment that comes into the Bay comes from the surrounding watershed.

The land area that drains into the Chesapeake Bay, as we all know, is 64,000 square miles. Therefore, it is critically important that all of the jurisdictions and all of the counties move forward with their watershed implementation plans to address the very issue of upland sediment loading that contributes the majority of the sediment to the Bay.

In my written testimony, I submitted a picture, which I think might illustrate the point. There's a famous photo of the sediment plumes that occurred just after Tropical Storm Lee in the middle of the Susquehanna. This is a picture of sediment plumes occurring from the bottom up on the James River, on the Rappahannock, and on the Potomac. There are no dams on any of those rivers.

This was not a major storm event. This was sometime in February 2013, after an ordinary storm event that occurred in the watershed. I think this picture shows that sediment loading is going to occur throughout the year, throughout the watershed, and that all of us must take steps to address that and not simply what's behind the dam.

You mentioned before about the opportunity that we have with respect to the relicensing process. It's a great opportunity—not only issues involving migratory fish passage, recreation lands, minimum flow of waters, but also, of course, sediment and nutrient loading.

One of the tools that the Clean Water Act provided Maryland with, along with other States, is something known as a clean water certification. Prior to receiving a license to continue to operate the dam for the next 46 years, the dam operator has to certify that continued operation will not impair Maryland's water quality.

The need for that certification is what has called into play the additional studies that have been done to actually quantify the nutrient loading that is occurring that must be addressed for contin-

ued operation of this dam not to impair water quality. So we do have a very good opportunity here with the relicensing process that is now ongoing.

Second, Exelon is correct. We are moving forward with some additional work to quantify the nutrient impacts, working with the Corps of Engineers and our other Federal and State partners. We are confident that that work will build upon what has been done in the Lower Susquehanna River Watershed Assessment Study, and that we will get to a place where we address these impacts while at the same time continue to implement our watershed plans to get the Bay back to the healthy position that we hope it will be 1 day soon.

Thank you.

[The prepared statement of Mr. Gill follows:]

Conowingo Dam Public Hearing Testimony
May 5, 2014

Maryland Department of Natural Resources (DNR), Secretary Joseph P. Gill

I want to thank Senator Cardin for organizing the Public Hearing on the Conowingo Dam, addressing the potential negative impacts of the Dam reaching "dynamic equilibrium" on the Chesapeake Bay water quality, habitat and living resources, fishing industry and recreation, and the Dam Relicensing effort.

I was appointed Secretary of the Maryland Department of Natural Resources in May 2013. I took over the agency's leadership after having served 3 years as DNR's Deputy Secretary and 14 years as the agency's Principal Counsel.

Maryland's Governor, DNR and Maryland Department of the Environment (MDE) are all concerned about the sediment and nutrients behind the Conowingo Dam and their potential impacts to the Chesapeake Bay. Protecting and restoring the Chesapeake Bay, to make it the most productive, vital ecosystem, with good water quality and habitat that supports the diversity of fish, shell fish and other aquatic organism, and safe for all recreational activities such as swimming, boating and fishing is our highest priority.

But Conowingo Dam is not the Bay's only or even its main problem. Scour of sediments from behind the dam in a storm event adds only about 8% to 12% to the load from the watershed. Storm events and sediment and nutrient laden runoff come from every part of the watershed. Just like in the reservoir behind this dam, sediment and nutrients are trapped in every farm pond, stormwater pond and reservoir throughout the Bay and its tributary watersheds, and storm events carry trapped pollutants into local streams and rivers, just as they do in the Bay.

Everyone has seen the infamous satellite photo of the Susquehanna and Upper Bay after Tropical Storm Lee, but just look at the sediment plumes in the below satellite imagery of the James, Rappahannock and Potomac.


February 18, 2013
This Image is Available at
Maryland DNR's
www.eyeonthebay.net
Image courtesy of
MODIS Rapid Response Project
at NASA GSFC
250 meter resolution
http://lance-modis.eosdis.nasa.gov/
imagery/subsets/
?project=terra&subset=Wallops

They look like a smaller version of the Susquehanna during Tropical Storm Lee and there are no dams in the lower part of these rivers. The key to restoring the Bay and its tributaries lies in reducing pollution from sources throughout each watershed – following our Watershed Implementation Plans. Over time, as the Bay watershed is cleaned up and historic deposits behind Conowingo Dam and in other ponds and reservoirs diminish, storms will have less impact and the Bay will be healthier and more resilient.

The Watershed Implementation Plans (WIP) are proven, science-based blueprints already in place that outline pollution reduction strategies needed to improve water quality in our local tributaries and the Chesapeake Bay. Their implementation is critical to a successful Bay restoration. We know that the Conowingo Dam has an impact of meeting our water quality standards, but if we do not meet our watershed implementation plans, we will fail in restoring the Bay. Continued implementation of existing watershed plans is essential for Bay health.

Maryland DNR and MDE are in negotiations with Exelon, the Conowingo Dam operator, on the Conowingo Dam Relicensing process and have been since 2009. The Relicensing participants include the Federal Energy Regulatory Commission (FERC), Exelon, Pennsylvania Department of Environmental Protection and Fish and Boating Commission, USFWS/NOAA Fisheries and other agencies and NGOs such as the National Park Service, the Susquehanna River Basin Commission, The Nature Conservancy and the Lower Susquehanna Riverkeeper.

In 2009, FERC approved 32 environmental and socio-economic studies to be conducted by Exelon covering issues ranging from "Downstream Fish Passage Effectiveness Study" to "Sediment Introduction and Transport (Sediment and Nutrient Loading)" to help inform the relicensing process. These studies are critical in assessing the wide range of topics that must be addressed during the Relicensing process.

The Relicensing issues under consideration are sediment management, fish passage, flow management, water quality, recreation, debris management, freshwater mussels, Rare, Threatened and Endangered species and land conservation. Maryland wants to accomplish efficient and cost effective management of sediment, improved fish passage with an American Shad goal of 2 million fish above York Haven Dam and an American Eel goal of 8.2 million within 10 years. We want to restore freshwater mussels due to their impact on water quality through their filtration capabilities. We need to enhance flow conditions that will improve downstream habitat and reduce fish stranding. All these issues will be addressed before a new license can be approved for Conowingo Dam.

Exelon submitted their application for a Clean Water Act, Section 401 Water Quality Certification (WQC) to the Maryland Department of the Environment (MDE) on January 30, 2014. MDE has one year or until January 29, 2015 to render a decision on the application. FERC's draft Environmental Impact Statement (EIS) is scheduled for release on July 30, 2014. The existing Conowingo Dam license expires on September 1, 2014. FERC will issue a temporary license until EIS is finalized and the State makes a decision on the WQC.

The State's WQC authority has been interpreted broadly by courts. It includes authority to condition the license as necessary to ensure compliance with State water quality standards. The courts have upheld a broad range of requirements based on WQC conditions related to fish passage, habitat, minimum flows, and recreation. FERC cannot grant its license without issuance of a WQC from Maryland. In addition, FERC has little to no authority to reject or modify the State's WQC conditions. We are working very closely with the Maryland Department of the Environment, Exelon and our Chesapeake Bay Program partners to help develop appropriate conditions, and to gather the necessary information and studies that will ensure that all conditions of the WQC are met in a timely fashion to protect all Maryland's waters and the great resources of the Chesapeake Bay.

Understanding the accumulated sediments and nutrients behind Conowingo Dam has been a long-term issue for Maryland and the Chesapeake Bay Program partnership, from the late 1990s with The Susquehanna River Basin Commission's (SRBC), appointment of a special Sediment Task Force to assess the potential increase in sediment delivery by the Susquehanna river to the Bay (http://www.chesapeake.org/stac/Pubs/Sediment_Report.pdf) and the Sediment Task Force recommendations in June 2002 (http://www.srbc.net/programs/docs/Sedi_task_force_rec221.pdf to the ongoing Lower Susquehanna River Watershed Assessment (LSRWA) Study. To that end, we continue working with all our Chesapeake Bay Program partners through the Chesapeake 2017 Mid Point Assessment of the 2010 Bay Total Maximum Daily Load (TMDL), the Conowingo Dam Relicensing effort with Exelon, and Army Corps of Engineers/Maryland Lower Susquehanna River Watershed Assessment study to develop the best science and management solutions to efficiently and cost effectively mitigate for the potential negative impacts from excess sediments and nutrients from the Dam reaching "dynamic equilibrium".

That is why, as part of creating the model for the TMDL, 10 years of data was used – including major and lower level storm events, to determine the pollution reduction targets. And as we study this issue, determine the best strategies for mitigating potential negative impacts and address all of the issues related to the Dam reaching "dynamic equilibrium" during the relicensing process, we are also increasing our monitoring and including all of this data as part of our 2017 mid-point assessment with the Chesapeake Bay Program.

Even during large storm events such as Tropical Storm Lee in 2011, 80% of the sediment load comes from the watershed. This means we have to control the sources of sediment and nutrient inputs before it reaches our tributaries. This is the case for all of the Bay's rivers such as the Potomac, Patuxent, Choptank, Rappahannock, James, and York, not just the Susquehanna.

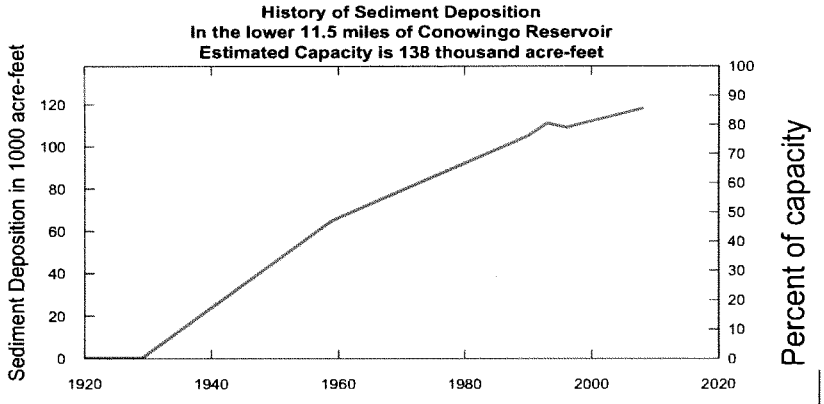
Maryland Governor, Martin O'Malley is Chair of the Chesapeake Executive Council (EC). As Maryland holds the Chair of the EC, the DNR Secretary Chairs the Principals'

Staff Committee (PSC). The PSC acts as the policy advisors to the Executive Council, accepting items for Council consideration and approval, and setting agendas for Council meetings (http://www.chesapeakebay.net/groups/group/principals_staff_committee). The partnership had the foresight to include assessing the Conowingo Dam impacts to the Bay as part of the original TMDL model and looking to the future as part of the 2017 Mid Point Assessment (http://www.epa.gov/chesapeakebaytmdl/).

As Chair of the PSC, I can assure you we are making every effort to assemble the most accurate, comprehensive and scientifically sound information on the status of the Dam, the conditions of the accumulated sediments and nutrients behind the Dam, and their ultimate impacts during various flow conditions from major storms such as Tropical Storm Lee in 2011, to the more frequent, but lesser high flow events that occur 2-3 times per year. All the information, including enhanced monitoring conducted by various partners above, at and below the Conowingo Dam will be assembled, analyzed, modeled and incorporated into the 2017 Mid- Point Assessment. This will allow the Chesapeake Bay Program partnership to determine the most efficient and cost effective sediment and nutrient manage strategies to ensure the protection of the Bay's water quality and habitat necessary to support abundant fish, oysters and crabs.

Maryland Departments of the Environment and Natural Resources, along with the Susquehanna River Basin Commission and The Nature Conservancy entered into an agreement with the US Army Corp of Engineers in September 2011 to conduct a 3-year, $1.3 million LSRWA Study. The study was aimed at assessing the amount of sediment released from Conowingo Pond during extremely high flow (>400,000 cfs) storm events. The preliminary conclusion from the study is that the Dam has reached a "dynamic equilibrium" and that the dam's ability to trap the sediment and our understanding of its impact has changed.

At the time the study objectives were developed, it was generally believed that the Dam would not reach full storage capacity until sometime in the next 10 to 15 years (see figure below). However, it is now believed that the dam scouring events are occurring at much lower levels, potentially less than 300,000 cfs and therefore occur at more frequent intervals - than previously understood. The dam has reached a kind of "dynamic equilibrium," which means that it is expected to regularly scour during lower-level storm events and then trap sediment at normal flows, only to scour again. The LSRWA study was not designed to assess the impact to the Bay of these lower-level storm events.



Source: Langland, 2009
http://pubs.usgs.gov/sir/2009/5110/

Addressing the sediments and nutrients behind Conowingo Dam is a technically and politically challenging problem. The solutions must be long-term and will have a high cost for implementation. The problem is that sediments and nutrients originate throughout the watershed and the Dam no longer has the capacity to trap a portion of those sediments. Also, during more frequent and smaller storm events, scoured sediments and nutrients stored behind the Dam are delivered to the Chesapeake Bay, likely causing water quality standard impairments. We will have to determine which entities have the resources, abilities, and purview to implement sediment and nutrient management strategies.

Maryland is working with all our State, federal, and Chesapeake Bay partners to develop and implement a suite of practices to mitigate the impacts of the Conowingo Dam reaching "dynamic equilibrium" on the Chesapeake Bay. This is one of Maryland's highest priorities. Make no mistake: The key to restoring the Chesapeake Bay and her tributaries lies in reducing the input of pollution sources throughout the watershed. Over time, as the watershed is cleaned up and historic deposits of pollution like those found behind the Dam are diminished, storms will have less and less impact on a healthier and more resilient Bay.

MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

Martin O'Malley, Governor
Anthony G. Brown, Lt. Governor
Joseph P. Gill, Secretary
Frank W. Dawson III, Deputy Secretary

Environment and Public Works Committee Hearing
May 5, 2014
Follow-Up Questions for Written Submission

Questions for Maryland Department of Natural Resources, Secretary Joe Gill

Questions from:
Senator Ben Cardin

1. Would dredging sediment behind the dam also remove nutrients?

YES, DREDGING SEDIMENTS FROM BEHIND THE DAM WOULD REMOVE NUTRIENTS AS WELL, BUT WE DO NOT BELIEVE DREDGING IS THE MOST EFFICIENT AND/OR COST EFFECTIVE MANAGEMENT STRATEGY.

a. What are the risks with dredging behind the dam with respect to releasing excess nutrients into the Bay in a similar manner to a scour event?

THE RISKS IN ANY DREDGING PROJECT ARE MINIMIZED AS WE ONLY ALLOW DREDGING DURING TIMES THAT WILL HAVE THE LEAST IMPACT TO WATER QUALITY, HABITAT AND LIVING RESOURCES, BUT DREDGING OPERATIONS RE-SUSPEND SEDIMENT AND NUTRIENTS, WHICH WOULD BE CARRIED DOWN THE RIVER INTO THE BAY. DREDGED MATERIAL DISPOSAL IS ALSO AN ENVIRONMENTAL PROBLEM. SUITABLE DISPOSAL SITES ARE DIFFICULT TO LOCATE AND EXPENSIVE TO BUILD. DISCHARGES FROM THE DISPOSAL AREA ALSO CAN CAUSE ENVIRONMENTAL IMPACTS ON SURFACE AND GROUNDWATER.

2. From a cost to benefit perspective, how does addressing nutrients at their source, like implementing nutrient management BMPs on farm lands, improving sewage treatment works, and reducing stormwater runoff compare with taking action behind the dam?

PREVENTION OF POLLUTION IS ALMOST ALWAYS MORE COST EFFECTIVE AND EFFICIENT THAN RESTORING AN IMPAIRED WATER BODY LIKE THE BAY OR ADDRESSING LEGACY SEDIMENTS. IF YOU DO NOT ADDRESS THE PROBLEM AT ITS SOURCE, YOU WILL HAVE TO CONTINUE TO REMEDIATE, INCREASING YOUR COSTS, WHICH IS WHY WE ARE DEALING WITH THIS ISSUE TODAY.

a. Is there some degree of combined effort that would achieve a reasonable or better cost to benefit results?

ADDRESSING THE WATER QUALITY IMPACTS OF THE RESUSPENSION OF SEDIMENTS BEHIND CONOWINGO DAM WILL LIKELY REQUIRE MULTIPLE MANAGEMENT STRATEGIES, FUNDED AND IMPLEMENTED BY VARIOUS STAKEHOLDERS. SIMILAR TO THE CHESAPEAEK BAY PROGRAM TMDL WATERSHED IMPLEMENTATION PLANS (WIP), ALL SOURCE SECTORS ARE REQUIRED TO DO THEIR PART TO IMPLEMENT NUTRIENT AND SEDIMENT REDUCTIONS STRATEGIES. THESE STRATEGIES ARE FUNDED BY FEDERAL, STATE, LOCAL GOVERNMENTS, CITIZENS, AND THE PRIVATE SECTOR.

3. What is the State doing to obtain the scientific information it needs on the effects on excess nutrients coming down the Susquehanna and the release of stored excess nutrients that occur during scour events?

THE STATE IS WORKING WITH OUR FEDERAL AND ACADEMIC PARTNERS AND EXELON TO IMPLEMENT AN ENHANCED MONITORING, ANALYSIS AND MODELING PROGRAM AT THE DAMS ON THE LOWER SUSQUEHANNA RIVER – MARIETTA, HOLTWOOD AND CONOWINGO, AS WELL AS THE MAJOR TRIBUTARIES FLOWING INTO CONOWINGO POOL. CAPTURING THE NUTRIENT AND SEDIMENT LOADS DURING LOWER FLOW EVENTS OF BETWEEN 100,000 AND 300,000 CFS NOW THAT CONOWINGO DAM HAS REACHED "DYNAMIC EQUILIBRIUM" AND ASSESSING THEIR IMPACT TO BAY WATER QUALITY IS PRECISELY WHAT IS NEEDED TO INFORM THE 2017 MID POINT ASSESSMENT.

a. How will this information inform the 401 Certification for the dam?

THE INFORMATION FROM THE ENHANCED MONITORING, ANALYSIS AND MODELING EFFORTS WILL BE INTEGRATED INTO THE [CHESAPEAKE BAY PARTNERSHIP] MODELS [WHICH WILL BE] USED TO INFORM THE CHESAPEAKE 2017 MID POINT ASSESSMENT AND WILL PROVIDE A MORE ROBUST ACCOUNTING OF THE CONOWINGO DAM IMPACTS ON MEETING OUR WATER QUALITY STANDARDS.

4. What impact does the dam's operation have on boaters and recreational uses of the river?

THE IMPACTS TO BOATERS AND RECREATION ASSOCIATED WITH DAM OPERATIONS ARE MINOR, BUT HAPPEN ON A SUB-DAILY BASIS. AS A PEAKING GENERATOR, THE CONOWINGO DAM ROUTINELY GOES FROM MINIMUM FLOW (VARIOUS BY TIME OF YEAR) TO FULL GENERATION (86,000 CFS) OR VICE VERSA WITHIN MINUTES. DURING THIS TIME THE DOWNSTREAM RIVER STAGE FLUCTUATES RAPIDLY AND BOATERS, FISHERMAN AND OTHER USERS MUST RESPOND TO THESE CHANGES IN REAL TIME, WHICH AFFECTS THEIR RECREATIONAL EXPERIENCE AND OPPORTUNITIES. UPSTREAM OF THE DAM, LAKE LEVELS ARE MAINTAINED BY A RULE BAND SYSTEM. HOWEVER, IN SOME CASES, BOATERS CAN GET TRAPPED IN TRIBUTARIES OR OUT IN THE POND DUE TO THE RISE OR FALL IN LAKE LEVELS AND LOW BRIDGE CLEARANCE.

5. How is Maryland, through the Chesapeake Bay Commission, working with other states in the region to address regional water quality?

MARYLAND PARTICIPATES IN THE CHESAPEAKE BAY PROGRAM PARTNERSHIP, ALONG WITH ALL THE OTHER BAY WATERSHED STATES TO DEVELOP AND IMPLEMENT BAY RESTORATION AND PROTECTION STRATEGIES. MARYLAND'S GOVERNOR MARTIN O'MALLEY CHAIRS THE CHESAPEAKE EXECUTIVE COUNCIL, TAKING THE LEAD FOR THE

PARTNERSHIP. AS MARYLAND HAS THE MOST TO GAIN BY A CLEAN CHESAPEAKE BAY. MARYLAND TAKES THE LEAD IN SETTING AN EXAMPLE FOR ENVIRONMENTAL STEWARDSHIP. AS CHAIR OF THE PRINCIPAL'S STAFF COMMITTEE (PSC), SECRETARY GILL AND HIS STAFF HAVE MET WITH THE COUNTERPARTS IN ALL THE BAY WATERSHED STATES TO ENSURE THE NEW CHESAPEAKE BAY AGREEMENT TO BE SIGNED THIS SUMMER WILL HAVE MEANING AND SIGNIFICANT MEASURABLE OUTCOMES TO DRIVE BAY WATERSHED RESTORATION EFFORTS WITH A VISION OF CLEAN WATER, ABUNDANT LIFE, CONSERVED LANDS AND ACCESS TO THE WATER, A VIBRANT CULTURAL HERITAGE, AND A DIVERSITY OF ENGAGED CITIZENS AND STAKEHOLDERS." THE CHESAPEAKE BAY PROGRAM'S WATER QUALITY GOAL IMPLEMENTATION TEAM IS RESPONSIBLE FOR EVALUATING, FOCUSING, AND ACCELERATING THE IMPLEMENTATION OF PRACTICES, POLICIES, PROGRAMS THAT WILL RESTORE WATER QUALITY IN THE CHESAPEAKE BAY AND ITS TRIBUTARIES TO CONDITIONS THAT SUPPORT LIVING RESOURCES AND PROTECT HUMAN HEALTH. THIS TEAM IDENTIFIED ADDRESSING THE FILLING AND SUBSEQUENT IMPACTS OF CONOWINGO AS A HIGH PRIORITY.

a. Are other states doing their part and what mechanisms are in place to ensure that everyone is pulling their weight?

ALL BAY WATERSHED STATES ARE REQUIRED UNDER THE EPA'S CLEAN WATER ACT BAY TMDL TO MEET THEIR TARGETED NUTRIENT AND SEDIMENT LOAD ALLOCATION BY THE YEAR 2025. THE BAY TMDL REQUIRES REASONABLE ASSURANCE THAT ALL STATES CAN MEET THEIR LOAD ALLOCATIONS AND MOST IMPORTANTLY INCORPORATES ACCOUNTABILITY THROUGH 2-YEAR MILESTONE DEVELOPMENT AND EPA EVALUATION OF PROGRESS. FEDERAL CONSEQUENCES HAS BEEN EXERCISED FOR STATES NOT MAKING ADEQUATE PROGRESS.

b. Would having specific TMDL on Susquehanna River help improve the data that's driving policy decisions?

THE ENHANCED LOWER SUSQUEHANNA RIVER MONITORING, ANALYSIS AND MODELING EFFORT BEING IMPLEMENTED BY MARYLAND AGENCIES AND THE UNIVERSITY OF MARYLAND CENTER FOR ENVIRONMENTAL SCIENCES, USGS, AND EXELON WILL PROVIDE THE NECESSARY INFORMATION TO ADEQUATELY ASSESS THE IMPACTS OF CONOWINGO DAM REACHING "DYNAMIC EQUILIBRIUM" ON BAY WATER QUALITY, HABITAT AND LIVING RESOURCES.

THE BAY TMDL IS A SYSTEM OF 92 INDIVIDUAL TMDLS AND THE TIDAL SECTION OF SUSQUEHANNA RIVER, ALONG WITH ALL TIDAL TRIBUTARIES FLOWING INTO THE MAINSTEP OF CHESAPEAKE BAY ARE REQUIRED TO MEET WATER QUALITY STANDARDS. THIS IS ACCOMPLISHED BY SETTING NUTRIENT AND SEDIMENT ALLOCATIONS THAT ARE DESIGNED TO MEET BAY WATER QUALITY STANDARDS THAT PROTECT HABITAT AND LIVING RESOURCES. IF A MORE STRINGENT TMDL IS REQUIRED FOR THE SUSQUEHANNA TO MEET LOCAL WATER QUALITY STANDARDS, THEN THIS WOULD SUPERSEDE THE BAY TMDL.

6. What is DNR and the Chesapeake Bay Program doing to assess the impacts to the Bay of the heavy rains like the events we experienced last week?

FOLLOWING THE STORMS FROM APRIL 28TH – MAY 1ST, DNR, USGS AND SUSQUEHANNA RIVER BASIN COMMISSION (SRBC) INITIATED AND ARE CURRENTLY CONDUCTING

COORDINATED ENHANCED STORM EVENT MONITORING AT DAMS ON THE LOWER SUSQUEHANNA RIVER – MARIETTA, HOLTWOOD AND CONOWINGO DAMS, AS WELL AS THE MAJOR TRIBUTARIES FLOWING INTO CONOWINGO POOL. CAPTURING THE NUTRIENT AND SEDIMENT LOADS AT THESE LOWER FLOW EVENTS OF BETWEEN 100,000 AND 300,000 CFS NOW THAT CONOWINGO DAM HAS REACHED "DYNAMIC EQUILIBRIUM" AND THEIR IMPACT TO BAY WATER QUALITY IS PRECISELY WHAT WE NEED TO INFORM THE 2017 MID POINT ASSESSMENT. WE ARE ALSO WORKING TO ASSESS FISH SPAWNING IMPACTS FROM THE HIGH FLOWS AND SHORT-TERM SEDIMENT PLUMES, EVALUATE POTENTIAL SAV IMPACTS FROM SEDIMENT AND POORER WATER CLARITY AND TRACK ANY POTENTIAL ALGAL BLOOMS OR FISH KILLS.

7. What would happen to water quality in the Bay if that dam - and the other dams upstream - weren't there?

IF THE DAMS WERE NOT THERE:

- THE LEGACY SEDIMENTS AND ASSOCIATED NUTRIENTS STORED IN THE RESERVOIRS WOULD BE ERODED AND CARRIED DOWNSTREAM BY FLOOD EVENTS OF ALL SIZES. MILLIONS OF TONS OF SEDIMENT HAVE BEEN TRAPPED BEHIND THE DAM AND ARE AVAILABLE FOR TRANSPORT TO THE CHESAPEAKE BAY DURING HIGH FLOW EVENTS.
- THE RIVER WOULD CONTINUE TO CARRY SEDIMENT, INCLUDING COARSE GRAIN SEDIMENTS THAT CAN PROVIDE GOOD FISH HABITAT.
- FISH PASSAGE WOULD NOT BE AN ISSUE, ALLOWING SHAD AND EELS TO SWIM UPSTREAM AND SPAWN.
- IF THE DAMS WERE BREECHED OR REMOVED, THERE WOULD BE LESS TRAPPING OF PHOSPHORUS AND SEDIMENT DURING LOWER FLOWS AND SCOUR OF THE LEGACY SEDIMENTS AND ASSOCIATED NUTRIENTS DURING THE HIGHER FLOWS WOULD CONTINUE TO OCCUR UNTIL THE SEDIMENTS AND ASSOCIATED NUTRIENTS HAD BEEN REMOVED. THIS WOULD TAKE MANY YEARS.

MARYLAND STATE AGENDIES ARE WORKING WITH USGS, UMCES AND EXELON TO FURTHER ASSESS THE IMPACTS OF THESE LEGACY SEDIMENTS ON BAY WATER QUALITY STANDARDS.

a. How much of this information is really "new" to the Bay restoration effort?

IT HAS LONG BEEN RECOGNIZED THAT THE SEDIMENT BEHIND THE DAM IS A PROBLEM FOR THE BAY. A 2002 SEDIMENT TASK FORCE CONVENED BY THE SUSQUEHANNA RIVER BASIN COMMISSION AND MADE UP OF SCIENTISTS AND ENGINEERS FROM MANY ORGANIZATIONS, INCLUDING THE CHESAPEAKE BAY PROGRAM, CONDUCTED A SCIENTIFIC AND ENGINEERING REVIEW OF POSSIBLE CONTROL MEASURES. THE TASK FORCE CONCLUDED THAT "REGARDLESS OF WHETHER DREDGING TO EXTEND THE LIFE OF SEDIMENT STORAGE CAPACITY IS UNDERTAKEN, REDUCING SEDIMENT LOADING THROUGHOUT THE BASIN IS CRITICAL" AND THEY PROVIDED A SERIES OF RECOMMENDATIONS FOR RIVERINE AND UPLAND MANAGEMENT MEASURES DESIGNED TO IMPROVE POLLUTION CONTROL PRACTICES ALONG THE RIVERS AND IN THE BASIN IN ORDER TO REDUCE THE SEDIMENT FLOW. THIS IS PRECISELY THE FOCUS OF THE WATERSHED IMPLEMENTATION PLANS OF NEW YORK, PENNSYLVANIA AND MARYLAND.

THE 2010 BAY TMDL WAS DEVELOPED USING THE BEST AVAILABLE SCIENCE, HOWEVER, THE BAY PARTNERSHIP HAD THE FORESIGHT TO REQUIRE A 2017 MID POINT ASSESSMENT, KNOWING THAT NEW INFORMATION FROM MONITORING, ANALYSIS, AND MODELING WOULD BE AVAILABLE, PROVIDING US WITH THE OPPORTUNITY FOR ADAPTIVE MANAGEMENT. WE ARE ABLE TO SEE WHAT WORKS AND WHAT DOESN'T WORK AND PLAN ACCORDINGLY IN OUR RESTORATION EFFORTS.

b. Are impacts from dam (now and in the future) already factored into our efforts to restore the Bay?

IMPACTS FROM THE DAM WERE FACTORED INTO THE ORIGINAL BAY TMDL, BUT THAT WAS BEFORE THE DAM REACHED "DYNAMIC EQUILIBRIUM. NOW THAT WE HAVE REACHED "DYNAMIC EQUILIBRIUM", SCOUR EVENTS OCCUR AT MUCH LOWER FLOW EVENTS AND MORE FREQUENTLY. WE WILL NOT MEET OUR BAY TMDL IF WE DO NOT ACCOUNT FOR THESE CHANGES.

c. How much will any loss in trapping capacity at the dam impact our ongoing restoration efforts that the MD and other states are already implementing?

FROM THE LOWER SUSQUEHANNA RIVER WATERSHED ASSESSMENT (LSRWA) STUDY, WE KNOW THAT WE DO NOT HAVE THE TRAPPING CAPACITY OF 15-20 YEARS AGO. WE WILL NOT MEET OUR WATER QUALITY STANDARDS WITH FULL IMPLEMENTATION OF THE WIPS BY 2025 IF WE DO ACCOUNT FOR THE SEDIMENTS AND NUTRIENTS BEHIND THE DAM. WE NEED TO ACCOUNT FOR BOTH THE INCREASE IN SCOUR AND THE LOSS IN TRAPPING CAPACITY.

d. Does the Susquehanna suffer disproportionally compared to other rivers during large storms?

NO, ALL RIVERS CONTRIBUTE THE MAJORITY OF THE SEDIMENT AND NUTRIENT LOADS DURING LARGE STORM EVENTS – JUST LOOK AT THE SEDIMENT PLUMES COMING DOWN THE POTOMAC, PATUXENT AND OTHER MAJOR TRIBUTARIES DURING STORM EVENTS CAPTURED ON SATELLITE IMAGERY AVAILABLE ON DNR'S EYES ON THE BAY WEBSITE, INCLUDING THE HIGH RAIN EVENT LAST WEEK.

8. What will happen under full WIP implementation if we do not address the impacts of infill at Conowingo?

WE WILL NOT MEET OUR WATER QUALITY STANDARDS IN THE CHESAPEAKE BAY.

a. In contrast, if we only addressed the impact of infill at the Conowingo and did not fully implement the WIP what would be the outcome?

AGAIN, WE WILL NOT MEET OUR WATER QUALITY STANDARDS IN THE CHESAPEAKE BAY.

9. What is the correlation or link in water quality impairment that's been linked to scour events at the dam and where these water quality impairments are located in the Bay?

SEDIMENTS AND NUTRIENTS FROM LARGE SCOUR EVENTS, ALONG WITH THE LOAD FROM THE WATERSHED TRAVEL DOWN THE BAY AND CAUSE ALGAL BLOOMS THAT ULTIMATELY RESULT IN LOW DISSOLVED OXYGEN CONDITIONS IN THE DEEP CHANNELS OF THE MID BAY.

a. What is the affect that Conowingo scour events are having on local water quality elsewhere in the Bay?

CONOWINGO SCOUR HAS LITTLE TO NO IMPACTS ON LOCAL WATER QUALITY ELSEWHERE IN THE BAY, MAKING IT IMPERATIVE TO COMPLETE ALL WIPS ON SCHEDULE.

10. Can you please explain how this burden of responsibility has been distributed across sectors?

ALL NUTRIENT SOURCE SECTORS MUST MEET THEIR LOAD ALLOCATIONS. ALLOCATIONS WERE SET UP TO BE FEASIBLE, TO PROVIDE CREDIT FOR EXISTING PROGRESS, TO BE EQUITABLE AND TO TARGET THE MOST EFFECTIVE AREAS FOR IMPLEMENTATION. MARYLAND IS EVALUATING A TRADING PROGRAM THAT WILL LOWER THE OVERALL COSTS BETWEEN SECTORS.

a. Are there some sectors that are facing greater burdens than others?

ALL SECTORS ARE FACING CHALLENGES. STORMWATER MANAGEMENT AND SEPTIC SYSTEMS HAVE THE HIGHEST COSTS AND ARE THE SECTORS THAT CONTINUE TO EXPERIENCE INCREASING LOADING TRENDS.

b. What opportunities exist for cross sector cooperation to improve water quality within a local watershed?

MARYLAND IS DEVELOPING A TRADING PROGRAM THAT WILL ALLOW FOR CROSS SECTOR TRADING, ALLOW FOR FLEXIBILITY, AND REDUCE OVERALL COST FOR WIP IMPLEMENTATION.

11. What impact does the Conowingo dam have on a stormwater induced plume on the Potomac or Patuxent?

CONOWINGO DAM HAS LITTLE TO NO IMPACT ON A STORMWATER-INDUCED PLUME ON THE POTOMAC OR PATUXENT RIVERS, ESPECIALLY IN THE UPPER REACHES OF THE RIVERS. LOCAL SEDIMENT AND NUTRIENT REDUCTIONS HAVE A MUCH GREATER IMPACT IN THEIR SPECIFIC WATERSHEDS.

12. What effect does improving local water quality have on the Bay water quality, especially given the challenges that major point sources around the region present?

LOCAL WATER QUALITY IMPROVEMENT WILL EVENTUALLY PROVIDE GOOD WATER QUALITY AND HABITAT FOR THE BAY AS ALL WATER FLOWS DOWNSTREAM. WE WILL AND DO SEE IMPROVEMENT UPSTREAM SUCH AS THE TIDAL FRESH POTOMAC AND THE UPPER PATUXENT, WHERE NUTRIENT CONCENTRATIONS AND UNDERWATER GRASSES HAVE BEEN IMPROVING DUE TO NUTRIENT REDUCTION STRATEGIES SUCH AS UPGRADES TO WWTPS AND OTHER BMP

IMPLEMENTATION. WE CANNOT RESTORE THE BAY IF WE DO NOT ALSO IMPROVE OUR LOCAL WATER QUALITY.

13. What impact does extreme variability in salinity of the Bay, the kind of variability associated with major storm events, particularly in the coastal waters that are near freshwater rivers have on oysters and other elements of the ecosystem?

PROLONGED FRESHWATER FLOWS CAN HAVE A NEGATIVE IMPACT ON OYSTERS. THE CONOWINGO DAM DOES NOT CONTROL THE FRESHWATER FLOWS. THIS IS CONTROLLED BY NATURE. MOST ESTUARINE SPECIES CAN TOLERATE SOME VARIATION IN SALINITY, WHICH IS WHY THEY ARE FOUND IN ESTUARIES.

14. Do scour events have any bearing on freshwater volumes?

FRESHWATER VOLUMES INCREASE DURING LARGE FLOW EVENTS, BUT AN ESTUARY HAS A 2 LAYER FLOW, WITH THE FRESH WATER ON TOP AND THE DENSER, MORE SALINE WATER ON THE BOTTOM. AS MORE FRESHWATER COMES INTO THE BAY, MORE SALINE WATER FLOWS UP THE BAY. DEPENDING ON HOW MUCH FRESH WATER ENTERS THE BAY, THIS SURFACE FRESHWATER/BOTTOM SALINE WATER WEDGE MOVES FURTHER DOWN THE BAY. DURING 2011, THE SECOND WETTEST YEAR ON RECORD FOR THE BAY, THE FRESHWATER WEDGE WAS AT HISTORICAL LEVELS, EXPOSING UPPER BAY OYSTERS TO PROLONGED LEVELS OF FRESHWATER, ULTIMATELY CAUSING LARGE OYSTER MORTALITY IN THE UPPER BAY. THE CONOWINGO DAM HAS NO CONTROL OF WATER FLOWS INTO THE BAY. THE DAM CANNOT STOP THE WATER FROM MOVING DOWNSTREAM. ALL RIVERS IN 2011 EXPERIENCE HIGHER THAN NORMAL FRESHWATER FLOWS.

IN THE TWO LAYER SYSTEM THE FRESH WATER IS TRANSPORTED ON THE UPPER LAYER ALONG WITH THE SEDIMENT FROM THE WATERSHED (STREAMS AND RIVERS). OUR UNIVERSITIES HAVE PERFORMED MONITORING AND MODELING TO SUPPORTS THIS CONCEPT. FURTHERMORE, THE FINE PARTICLES FLOWING ALONG THE SURFACE HAVE A HIGH REFLECTANCE, MAKING THEM MORE PRONOUNCED IN IMAGES. THIS IS IMPORTANT TO KEEP IN MIND WHEN VIEWING THE SATELLITE IMAGES AND TO RECOGNIZE THAT IN THESE IMAGES WE ARE ONLY LOOKING AT THE SURFACE WATERS OF THE BAY.

15. How will the TMDL be revised, during its scheduled revision in 2017, to account for the Conowingo Reservoir reaching "dynamic equilibrium" and scour events?

THE CHESAPEAKE BAY 2017 MID POINT ASSESSMENT WILL TAKE INTO ACCOUNT THE IMPACTS OF CONOWINGO POOL REACHING "DYNAMIC EQUILIBRIUM" AND ANY POTENTIAL IMPACTS TO MEETING BAY WATER QUALITY STANDARDS. IF THE EXISTING NUTRIENT AND SEDIMENT LOAD ALLOCATIONS WITH THE CONOWINGO AT "DYNAMIC EQUILIBRIUM" ARE INSUFFICIENT TO MEET BAY STANDARDS UNDER VARIOUS FLOW CONDITIONS, INCLUDING SCOURING EVENTS, THE LOAD ALLOCATIONS WILL HAVE TO BE REVISED IN ORDER TO MEET THE WATER QUALITY STANDARDS TO PROTECT HABITAT AND LIVING RESOURCES SUCH AS CRABS, OYSTERS AND FINFISH.

16. Will Maryland insist that FERC take into consideration the changing dynamic on the dam and it future impact on water quality during its relicensing process?

MARYLAND HAS AUTHORITY UNDER SECTION 401 OF THE CLEAN WATER ACT TO ISSUE A WATER QUALITY CERTIFICATION, ENSURING THAT THE CONOWINGO DAM RELICENSING PROCESS WILL MEET THE STATE'S WATER QUALITY STANDARDS. IF MARYLAND DOES NOT GRANT THE APPLICANT'S WATER QUALITY CERTIFICATION, FERC CANNOT ISSUE A LICENSE TO OPERATE THE FACILITY.

17. Why hasn't the Susquehanna River been listed pursuant to the Clean Water Act, 33 U.S.C. § 1313(d), as an impaired water body?
MARYLANDS INTEGRATED REPORT (IR) COMBINES TWO WATER QUALITY REPORTS REQUIRED UNDER SECTIONS 305(B) AND 303(D) OF THE FEDERAL CLEAN WATER ACT. SECTION 305(B) REQUIRES STATES, TERRITORIES AND AUTHORIZED TRIBES TO PERFORM ANNUAL WATER QUALITY ASSESSMENTS TO DETERMINE THE STATUS OF JURISDICTIONAL WATERS. SECTION 303(D) REQUIRES STATES, TERRITORIES AND AUTHORIZED TRIBES TO IDENTIFY WATERS ASSESSED AS NOT MEETING WATER QUALITY STANDARDS (SEE CODE OF MARYLAND REGULATIONS 26.08.02). WATERS THAT DO NOT MEET STANDARDS MAY REQUIRE A TOTAL MAXIMUM DAILY LOAD TO SET THE MAXIMUM AMOUNT OF AN IMPAIRING SUBSTANCE OR POLLUTANT THAT A PARTICULAR WATER BODY CAN ASSIMILATE AND STILL MEET WATER QUALITY CRITERIA.

IN 2004 THE CONOWING POOL WAS DETERMINED TO MEET WATER QUALITY STANDARDS FOR BACTERIA AND MERCURY IN FISH TISSUES. IN 2006 IT WAS DETERMINED THAT THE MARYLAND STREAMS DISCHARGING TO MAINSTEM WERE MEETING THEIR AQUATIC LIFE USE. THE CONOWINGO POOL IS CURRENTLY LISTED AS IMPAIRED BY ELEVEATED PCB CONENTRATIONS IN FISH TISSUE.

18. Why hasn't Maryland petitioned EPA, pursuant to Section 319 of the Clean Water Act, to get involved in addressing PA's contributions to significant pollution that impact Maryland waters?

FOR MULTIJURISDICATIONAL TMDLS, EPA WILL TAKE THE LEAD IN COORDINATING AMONG THE STATES TO DEVELOP THE TMDL. THIS OCCURRED IN THE POTOMAC PCB TMDL AND THE ANACOSTIA TRASH/NUTRIENT/SEDIMENT TMDL. THE EPA'S REGION III, IN COORDINATION WITH THE EPA CHESAPEAKE BAY PROGRAM, LED THE TMDL DEVELOPMENT FOR CHESAPEAKE BAY TMDL. THE CHESAPEAKE BAY PROGRAM PARTNERSHIP PROVIDED THE NECESSARY STRUCTURE TO FACILITATE AN INCLUSIVE PROCESS WHEREBY ALL BAY WATERSHED STATES ALONG WITH THE DISTRICT OF COLUMBIAWERE ACTIVELY ENGAGED IN THE PROCESS. THIS PARTNERSHIP IS FURTHER SUPPORTED THROUGH THE CHESAPEAKE BAY AGREEMENT.

Senator CARDIN. Well, thank you all for your testimony.

Secretary Gill, I want to start with the point that you made about the fact that most of the pollutants, whether it be sediment or whether it be the nutrients, are coming into the Bay not from behind the dam. They're just coming into the Bay as a part of our way of life.

Mr. GILL. Yes.

Senator CARDIN. And the weather conditions that we are now confronting, more extreme weather conditions. So the question is: How do we deal with nutrient planning and programs? How do we deal with our watershed improvement plans? How do we deal with the implementation of the Bay program under TMDLs? How is that fairly shared? And what impact do the Susquehanna and the dam have in regards to that overall strategy?

I think that's the real challenge that we have in dealing with this, so that all stakeholders are treated fairly. I think that was the point that you were stressing in your testimony.

Mr. GILL. Yes. I think it's actually interesting, when you look at the watershed plans, at least for Maryland, that basically assess across sectors, across agricultural, septics, stormwater, point source pollution. We basically assess responsibility for pollutant loading and responsibility for putting in place plans to reduce that loading. That is true of Maryland, and it is true of other jurisdictions as well.

The real question is: What is the impact of the dam on all of this? The TMDL, the Total Maximum Daily Load, when EPA issued it several years ago, assumed that the dam would reach capacity in the year 2025. We know now that, basically, that has changed, that this notion of dynamic equilibrium has set in.

So what do we do? Well, I think what we do is we adaptively manage by understanding what the impact of more frequent scouring is and by seeking to assess responsibility for that impact on the dam operator, where that's the case, and upstream where it's not the case. So I think that's the process we're in right now.

Senator CARDIN. Will that require us, as we revisit the Bay agreement, to understand that the assumption on the capacity of the dam is different today than it was before?

Mr. GILL. One of the elegant points of the way the whole TMDLs were put into place, however inelegant it may have seemed at the time, was that there is a midpoint assessment that will be done by EPA in 2017. And along with that midpoint assessment is ongoing assessment of how effective our water quality management tools are. So what I would suggest, Senator, is that this process of assessing and evaluating and making changes is already in place in terms of our managing our resources going forward.

Senator CARDIN. So that'll be part of that process in revising, perhaps, even the TMDLs.

Mr. GILL. Yes, it will, Senator.

Senator CARDIN. Thank you. I appreciate that.

Mayor Gray, your testimony is very compelling about the fact that if we can reduce the amount of pollutants going in upstream, the problems at the dam are going to be more manageable.

Mayor GRAY. Absolutely.

Senator CARDIN. And it's a lot more cost effective to do it at the local level than it is to try to figure out what happens now that we have all this trapped sediment.

Mayor GRAY. Yes. On the other hand, Senator, it's a cost that financially strapped cities and communities in Pennsylvania have a difficult time realizing. For example, in Lancaster County—and we're considered one of the biggest polluters of the Bay, the county—the farmers will tend to point at the city and say the city is the problem. We've resisted doing the same. Rather than that, we say, "You have a problem. We have a problem. You deal with yours. We'll deal with ours." So rather than point fingers at people, let's just take care of it and get it done.

But other communities in Pennsylvania have looked at our green infrastructure plan, which is about 250 pages long. And it was developed with the idea in mind that smaller communities—not Pittsburgh and Philly, but the rest of our cities—could look at it and use it, not even just in the Chesapeake Bay watershed, but in the entire State.

We're promoting that through the League of Municipalities in Pennsylvania. They've recently started a sustainability program that includes looking at green infrastructure and looking at stormwater disposal. So it's happening upstream, but it's a difficult battle.

One final thing. We don't talk about the Chesapeake Bay, generally, when we go out and talk to neighborhoods. If we green a park—at one park we have, almost 4 million gallons a year was put into stormwater—or with stormwater disposal underneath some basketball courts with a drain field. What we do is put a big sign up for the new park, "Green Infrastructure at Work," so that people equate green infrastructure with a new park or a new intersection.

We use what's called integrated infrastructure. Any public improvement we do, we look at it from a green perspective. How can we incorporate greening into this? And again, even an intersection change—how can we make it green? So it's been successful, and people see improvements in the community. They might not care about the Chesapeake Bay. They care about the park down the street. So it's been working for us so far.

Senator CARDIN. You're absolutely right. People identify with their own community, and the way that you've done that is very successful.

I should point out that when Colonel Jordan was talking about up to $3 billion for the dredge project, I was thinking of how we could use that money in the State revolving fund to help in regards to dealing with wastewater treatment or how we could perhaps put more money into the new regional conservation programs under the Farm Act that help the Bay farmers in dealing with their nutrient control issues. Putting money into those programs will help us a great deal in reducing the ingredients that are going into our fresh water that's causing the problems on the Susquehanna as far as the dam is concerned.

Dr. Boesch, I want to talk a little bit more about—I really do appreciate your explanation. As I understand it, we really don't have good hard evidence on the nutrient issues coming in from the Sus-

quehanna, particularly during scour events, as to the impact it has on the overall health of the Bay. At least, that was not the focus of the study that was done by the Army Corps.

As I understand it, there are two factors here that seem to be coming into play. When you get a rush of fresh water, that sort of mitigates the negative impact of the nutrients. It doesn't quite have the same negative impact because there's not as much brash. Is that accurate, or am I saying that wrong?

Mr. BOESCH. No. I think when you do have one of these floods, it introduces nutrients and it introduces sediments and fresh water into the Bay. That changes a lot of things. It moves the salinity down so that sulfur is pushed away that can release the nutrients, and it also is turbid so that the plant life that would photosynthesize and create the organic matter which degrades water quality is inactive.

So that's why in the analysis that EPA and the Corps did in terms of a winter flood—remember, that was one of the scenarios the Colonel put—it has much less of an impact than if it were a spring or summer flood, when conditions were right, just in terms of the temperature and the metabolic rate of organisms and so on.

However, this doesn't mean there isn't—and this is where the important questions and unknowns come in. There is a residual effect. So if this material comes down, and if it's nutrients associated with sediments and falls down and is deposited on the Bay, does it stay there? Or when it gets warm next year and it gets salty again, the salinity moves back up the Bay, is it released? So these are the questions that have to be addressed that aren't yet adequately addressed in the level of detail necessary in the Bay model.

I was just reflecting on your questions and the discussion thus far. The Susquehanna River is responsible for about 47 percent, on the average, of the fresh water coming into the Bay and about 41 percent—slightly less but almost the same—in terms of the nitrogen. Nitrogen is more soluble. It goes where the water goes. But it's only responsible for 27 percent of the sediment, total sediment, coming into the Bay and, therefore, only 25 percent of the phosphorus.

So we have to look at these other sources. Secretary Gill showed you how the James and the Potomac can contribute particulate matter, the sediment. The other sources, of course, are local sources from erosion of soils that we don't protect properly or urban runoff from Baltimore. If it runs down some of these streams, it just erodes the sediment from the stream bed, degrades the stream—and also shore line erosion as we have sea level rise. That's causing more sediment to come into the Bay from eroding shore lines.

So the challenge is that we can't just look at one source. We have to look at all of these sources. So a place like the Choptank or the Patuxent is not going to attain its water quality from managing the Susquehanna. It requires work in the watershed improvement plans around those tributaries. So all of those tributaries need to work to achieve their goals. Surely, they're influenced by the open Bay itself, but the primary outcomes, not only oxygen but also water clarity, submerged vegetation, harmful algal blooms is going

to be determined by the actions taken on the subwatersheds around the tributaries.

Senator CARDIN. Well, I think you're right. I think the watershed improvement plans are going to be critical in the TMDLs as to how we manage the most effective, most efficient, most cost-effective plans based upon best science to achieve our objectives.

I started the hearing by saying we're very much interested in expanding, not only maintaining, but expanding clean energy sources. That's good for our energy. It's good for our environment. But we also need to have the most cost effective and efficient way to deal with the Bay, and there's so many stakeholders that deal with it.

Let me just relate that on Friday, I was in Frostburg. I mention that because there's two things they're doing there. First, they're building some new buildings for the university, for the college, and they're doing it in a way that will do exactly what Mayor Gray was talking about, with the living roofs and trapping water and dealing with our runoff as, particularly, a public partner should do when they do their construction.

I will be urging as we reauthorize the Surface Transportation to have more sensitivity to our transportation construction as it relates to the runoff issues that we're talking about.

But second, they have a sustainable agricultural project that takes a former strip mine site and is converting it into agriculture, which is very interesting. They have no water, they have no power, and they have no soil, and they're turning it into agriculture.

The way they're doing it is they're trapping the water, using the water. Rather than having it run off and having to have supply water, they're using nature, using that water in a more constructive manner. They're using solar power for the power that they need, and they're composting the soil from waste.

Mr. BOESCH. Senator, about the ability of natural systems to help us, you know, we tend to be focused on problems. And so that we not be discouraged, I'd be remiss if I didn't point out that just downstream here, not far, where the Susquehanna flows into the Bay, is a remarkable success story, and this is the resurgence of submerged aquatic vegetation on the flats at the mouth of the Susquehanna.

In 1972, the storm of record, Tropical Storm Agnes, basically destroyed them—it was such a large event—both the fresh water as well as the sedimentation. It was almost 30 years when there was no vegetation there, very little vegetation.

Now, in the last several years, it's come back remarkably well, and it's withstood the kinds of stresses that took place, like, for example, Tropical Storm Lee. It managed to survive and keep on ticking, because it's now built enough inherent resilience because of the density of those plants that it can still the water, you know, keep the light—cause the sediment to fall out and keep light intensity.

So we should be thinking of recovering the Bay, not like you were titrating it, you know, in a chemistry experiment, but rebuilding the natural system that has the capacity to basically take a licking and keep on ticking, if you will, and to have that inherent resilience back into the system. That's what we're trying to achieve, and I think as scientists, we have confidence that if we can achieve

the water quality over the years, this resilience will improve and return.

Senator CARDIN. Yes, I agree.

Ms. Will, you talked pretty freely about the FERC process and how Exelon has assumed responsibilities to do certain improvements, particularly to fish passageways during the FERC reauthorization process or recertification process. It's interesting that when the dam was originally built, there was very little done for fish passage. Over time, that's been changed and modified. Obviously, we want this based upon best science and cost-benefit analysis.

Can you just tell us how you look at the recertification process and the Clean Water Act as to the areas that Exelon would be interested in working with the community, working with us, in order to take advantage of this recertification to make our community stronger?

Ms. WILL. Certainly. There are numerous issues. We initiated the process, actually, in 2007. We started preparing for our filing in 2009, to notice our intent to relicense Conowingo and Muddy Run. And we identified stakeholders and had a number of stakeholder meetings.

First of all, we know what the water quality issues are and fish passage and such, and we designed studies with stakeholder input that we conducted over a 3-year period to understand the current impact and what the opportunities are for improvement. But then during the course of discussions with stakeholders, other areas of interest have come up, such as land conservation and such.

So it is our desire to come up with a comprehensive settlement that factors in all the information our studies have provided to us, as well as new information we get as additional studies are completed, to help enhance the environmental and recreational benefits provided by the dam.

Senator CARDIN. I think it's absolutely key that we have the best science judge what we can do. The cost issues are clearly going to be a dominant issue. We understand that as one of the realities of limited budgets, generally, for everyone. But the best we can do on science would be helpful.

As I listened to Dr. Boesch, it points out the advantage of the Corps study but also that additional information is needed, that we don't have all the technical information necessary. And we know the Bay is complex. We know that. We know that it's a national treasure, but it's complicated to figure out how we provide the best protection for the Bay for future generations. We know some of the things that work, but there's still a lot of mysteries out there.

So I just would encourage you and thank you for supporting as much of the science information as we can get so that we can make the right decisions. We like to focus on it every year. We do have a Bay program. We do have watershed implementation plans. But this recertification gives us another tool in our toolbox to try to advance this process forward.

Ms. WILL. We agree, and we are committed to funding the study that you heard Secretary Gill and the University of Maryland discuss to inform the 2017 EPA midpoint assessment for the TMDL.

Senator CARDIN. Secretary Gill, on the recertification process, how do you see the State of Maryland in regards to the Clean Water Act with the recertification of this plant moving forward?

Mr. GILL. Well, Exelon filed its water quality certification application at the end of January, this past January. The State has a year from now to decide whether or not what's been filed is complete or incomplete or what-not. We're in the process of reviewing all of that in discussions. So that's the process.

Senator CARDIN. Well, I would appreciate it if you would keep us informed on that. We're very interested, and we have an excellent relationship with the State and with Exelon on this issue.

Mr. GILL. Certainly.

Senator CARDIN. Dr. Boesch, what other types of studies would you like to see in regards to the——

Mr. BOESCH. Never ask a scientist that.

[Laughter.]

Senator CARDIN. No, I understand. I'm trying to help you.

Mr. BOESCH. I think we've tried to think through the issues and think through where the question marks are, and we've done this in a way with partnering with the State agencies and with EPA who have the responsibility of converting complex science, as you said, to management decision tools. But there are some things that we can point to and say, "Well, you know, that would make a big difference if we knew that better." So that's what we're trying to focus on.

I spoke mainly about the downstream impacts and understanding them better. But if you think about it, and you pivot, this is really an upstream problem. So there are all sorts of questions here about our most effective land management practices.

The other thing I think we should point to—and Secretary Gill made the point of having—this is just one more speed bump, if you will, in the road, and we're going to have many more. Even if we're successful and by 2025 achieve the reductions of nutrient inputs, pollutant inputs, that we want, there'll be some surprises. You alluded to one in your questioning, that is, climate change.

You know, we don't know fully what it is. We know the Bay is going to be warmer, and it's going to have more volume because sea level is going to rise. But we don't know that much about the changing in the rainfall regime, the precipitation, and the net result in terms of downstream flow. So I think as we look down the horizon in managing the water resources that we have, but also the pollutant loads we have, that's, I think, a critical question that we should be addressing as well.

Senator CARDIN. It's an interesting point. I hadn't focused on that when the original projections were—as to how long the reservoir would be able to sustain the sediments. It was for a lot longer period of time than it was able to do. So those projections clearly were not accurate, didn't prove to be accurate in reality. As we are seeing more extreme weather events, they may not hit the flow levels that the Colonel was talking about, but we are seeing a lot of extreme conditions.

Mr. GILL. And that's actually part of what we found that has led to the conclusion of dynamic equilibrium, that the dam is scouring at lower level storm events. Formerly, the thought was that the

dam would scour when the rate of velocity of water reached 400,000 cubic feet per second. We now know that the dam scours at much lower rates of 100,000 to 200,000 cubic feet per second.

So we're in the process of measuring what the impacts are from those lower level, more frequent scouring events to understand the impact downstream. That's the nature of the change.

Senator CARDIN. So here's the challenge on the recertification process. We get this chance every 40-something years. Is it——

Mr. GILL. Forty-six.

Ms. WILL. I can explain the rationale for that, actually, and that is because there's five hydroelectric projects on the Lower Susquehanna River. Three of them are up for relicensing now. The two between—the ones just above Conowingo are not up until 2030. But if you really want to address the sediment and fish and eel passage in the river holistically, it would be very helpful to have all five dams working in concert. So their relicensing—a 46-year license for us, plus a 30-year license for them would put us all on the same schedule.

Senator CARDIN. Right. That was explained to me once before, and I appreciate you explaining it for the record, because I had lost that concept. And Exelon has proven to be a very sensitive partner in our community, as far as community needs. I say that as a compliment to the commitments that they made in regards to the merger, and carrying out those commitments have been of the highest caliber, and we thank them. We know that they want to do what's right for the community.

But I also point out that when you only have a certification process every 30 years, and this is an opportunity to do something in regards to clean water, we want to make sure it is visionary and it takes into consideration what we know are challenges, and that we now have an opportunity to deal with it, so let's take advantage of it and get it done right. So the fish passages—absolutely. This is a chance for us to upgrade and to take care of those shad that are particularly important to Maryland's history.

So, once again, let me thank you all. The record will be open for questions for the record if there's any to be asked. And if we do, if you would respond, we would appreciate it.

And once more, I want to thank the Environment and Public Works Committee for allowing us to bring the hearing here in Maryland so that we could make it convenient for the people that are here to talk about an issue, where, as Mayor Gray said, the more information people know about, the more they understand what they're doing, and the more they understand how it affects their lives, the better the policy will be. And I think this hearing has helped us achieve those objectives.

With that, the subcommittee will stand adjourned.

[Whereupon, at 11:33 a.m., the hearing was adjourned.]

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