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March 1, 2017

Flood Control Infrastructure: Safety Questions Raised by Current Events

Committee on Environment and Public Works, United States Senate, One Hundred Fifteenth Congress, First Session

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DEPARTMENT OF THE ARMY

U.S. ARMY CORPS OF ENGINEERS

COMPLETE STATEMENT

OF

LIEUTENANT GENERAL TODD T. SEMONITE

COMMANDING GENERAL AND CHIEF OF ENGINEERS

BEFORE THE

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

UNITED STATES SENATE

ON

"The Status of The Nation's Dam, Levee and Other Flood Control Infrastructure"

MARCH 1, 2017

Chairman Barrasso, Ranking Member Carper, and Members of the Committee, I am Lieutenant General Todd Semonite, Commanding General and Chief of Engineers. I am pleased to be here today to discuss the role of the U.S. Army Corps of Engineers (Corps) in dam and levee safety. Generally, our objective in this area is to reduce risks to public safety associated with dams and levees. Our efforts in this area are part of a larger system of management practices by the Corps, aimed at ensuring that our Nation is positioned to deliver a greater objective: to safely provide a range of water resources benefits to the Nation. For dam and levee safety, the Corps uses a risk-informed approach to assure that this objective is met in a transparent and disciplined manner.

Water plays a central role in the economy, the health of our communities, and the diversity of our ecosystems and natural landscapes. Unfortunately, many in our Nation have also experienced what happens when we have too little or too much water, or water that is not fit to sustain natural habitats. In many ways, the decisions that we have made as a Nation in developing, managing, and protecting our water resources have influenced how the Nation developed and where its people now live. The Nation's water resources infrastructure includes dams and levees built by the Federal government, states, local authorities, and the private sector over many years. Sustaining the benefits that these structures provide, where warranted, requires the proper management of the risks that come with those benefits.

Although often planned and constructed as individual projects, many of our Nation's dams and levees now operate as integrated components of a larger water resources management system. The Corps owns and operates only a small fraction of the dams and levees in the Nation – 715 dams (less than 1% of the 90,580 dams in the 2016 national inventory of dams) and roughly 2,500 miles of levees (less than 10% of the roughly 30,000 miles now in the national levee inventory). From a functional perspective, the Corps generally constructed the dams and levees that it owns and operates primarily to provide navigation and/or flood risk reduction benefits, but many of them also support other uses such as hydropower, water supply, and recreation.

Infrastructure designed and constructed for the conditions and practices of two generations ago now delivers its benefits in an ever-changing world. We know the infrastructure embeds the decisions and practices of the past in its construction, but what changes? Over time, all infrastructure ages and deteriorates, unless it is properly maintained and periodically rehabilitated. Our understanding of the frequency and intensity of hydrologic and seismic events also changes, as do the sizes of the populations living and working near the infrastructure. Meanwhile, the practice of engineering and science leaps ahead. Also, consider that in the last six years, the Nation has experienced five flood events that exceeded a 1 in a 1,000 chance of occurring.

The Corps is addressing these changes in a risk-informed manner. We make informed adjustments to ensure that our investments in safety going forward are appropriate. For example, our dam safety program enables the Corps to extend the period that a project

can provide some or all of its authorized benefits, by investing in measures that reduce the principal safety risks at our dams to an acceptable level.

For many dams and levees, the costs, responsibilities, risks, and benefits are now shared. As we make choices as to which of these structures warrant an improvement for safety and who should bear the costs, we must be careful to not create divides with one group bearing the costs, another gaining benefits, others being held responsible, and yet others absorbing the risk. Such a divided system is neither fair nor sustainable, in my view, and would complicate the task of establishing a better set of incentives to reduce these risks in the future.

When it comes to addressing our Nation's dam and levee safety challenges, major Corps responsibilities generally follow project-specific authorities for managing infrastructure that the Corps owns and operates. The Corps also has programmatic authorities for participating in the national community of dam and levee safety. In reaching decisions on potential safety measures at the dams or levees that it owns and operates, the Corps considers the public safety, economic, and environmental risks posed by the infrastructure, the costs of reducing these risks, and the authorized project benefits that a proposed safety improvement would enable the project to continue to provide to society. The Corps authorities for dams and levees are varied and include:

- Project-specific authorities for projects that include dams and/or levees. To date, the Corps has designed and constructed over 3,000 such projects.

- For 715 of the dams that the Corps constructed, the Corps is a self-regulated owner. For these dams, the Corps operates, maintains, and repairs the dams, including rehabilitation. In addressing potential safety concerns, the Corps uses a modern risk management framework to assess and characterize the risks, establish priorities, select risk reduction measures, and communicate the risks.

- For other dams that the Corps constructed, which are owned, operated, maintained, and repaired by non-federal entities, we rely on the qualified state dam safety programs to regulate the structures. Forty-nine of the States now have such a program. For these dams, the Corps may provide technical assistance on a reimbursable basis, when requested. The Corps also participates in the National Dam Safety Program, which is hosted by the Federal Emergency Management Agency. The National Dam Safety Program supports state dam safety programs and contributes state-of-the-art policies, practices, and training to state and other federal partners.

- The Corps owns roughly 2,500 miles of levees, which it maintains.

- The Corps constructed roughly another 10,000 miles of levees that local authorities own and maintain. Under its Public Law 84-99 program, the Corps also inspects periodically approximately 2,500 miles of levees constructed by local authorities.

There are few state levee safety programs and no recognized standards at the national level for those programs. In the absence of effective regulatory regimes at the state level (comparable to the ones at the state level for non-federal dams), the repair and rebuilding of many locally owned levees after a flood often falls on the Federal government and the U.S. taxpayer. Title IX of the Water Resources Development Act of 2007, and section 3106 of the Water Resources Reform and Development Act of 2014, may provide a way to address this concern. A primary purpose of these provisions was to build capabilities within the states for levee safety, as well as to develop national guidelines and align federal programs. The Corps has been working on a key part of this effort, by developing a national levee inventory.

In summary, dams and levees are an important part of the Nation's water resources infrastructure. Management practices aimed at ensuring our Nation is well-positioned to safely monitor and manage water resources infrastructure involve many parties, including Federal, state, and local agencies, and the private sector. For the dams and levees that the Corps owns and operates, we are working to align the costs, responsibilities, risks and benefits, in order to inform our decisions on providing for the safe operation, proper maintenance, and effective management of risk. A similar framework of risk-informed management may help meet these objectives for decisions on the safety of other dams and levees across the Nation.

This concludes my testimony. Thank you for allowing me to testify about the challenges we face together in the area of dam and levee safety. I would be happy to answer any questions you may have.

Testimony of the Honorable Terrence D. Wolf
Chairman, Washakie County Board of County Commissioners and;
Past President, Wyoming County Commissioners Association

United States Senate Committee on Environment and Public Works Hearing on
"Flood Control Infrastructure: Safety Questions Raised by Current Events"
March 1, 2017

Good morning Chairman Barrasso, Ranking Member Carper, and distinguished members of the committee. Thank you for the opportunity to speak to you today about a very local flood control challenge my small community has faced over the last several years.

My name is Terry Wolf, I am the Chairman of the Board of County Commissioners in Washakie County, Wyoming. Washakie County is located in rural northwest Wyoming, and with annual revenue of only $8 million it is the third poorest county in Wyoming. Washakie is one of four counties in the Big Horn Basin. It is a semi-arid basin nestled between mountain ranges that is prime agricultural land. This area of Wyoming is well known for its sugar beets that are grown and processed into pure, U.S. made sugar for consumption. The high yield of agricultural production is dependent upon the Big Horn River that flows south to north out of Wind River Canyon through our basin.

Unfortunately, this same river that brings so much life also brings destruction to our communities in the spring when ice blocks the size of trucks and weighing up to 300,000 pounds jam up and block the flow of the river. The ice jams push the water over the banks and into the communities of Worland, Manderson, Basin, and Greybull, flooding homes and businesses and threatening the sugar processing plant I've already mentioned.

Mr. Chairman, I want to direct your attention to Appendix B at the end of my written testimony. Appendix B shows before and after photos of the flooding that occurred in Worland on February 11th of this year. In the before photos you can see in the foreground an island in the middle of the river that has formed from sediment buildup over the course of years. In the after photos you get a clear picture of the ice blocks creating a dam at that island and causing the flooding. There is a fantastic high definition drone video available here of the flood as it is occurring at this link: https://www.youtube.com/watch?v=ZK9OaoVR6nY.

Over the course of the week city, county, and state officials, the Wyoming National Guard, and numerous volunteers worked tirelessly to protect public and private property. Critical infrastructure threatened by the flood includes US Hwy 20, BNSF railroad, and critical energy and communications infrastructure. We are still evaluating the total costs to our communities in damage and clean-up costs, but estimates of state and local costs will likely exceed $150,000.

While this flood is heartbreaking by itself, what is important for the Committee to know is that what happened in Worland a couple weeks ago is almost identical to the flooding in 2014. That same island gathered and held ice blocks and pushed the Big Horn River into Worland costing state and local governments nearly $200,000 in recovery costs. For a rural county like Washakie, these costs are difficult to bear.

For a clear picture of the sediment build-up on this island I direct your attention to the aerial photos in Appendix C that show the 20-year build-up of that island. We at the local level must confront this issue or the exact same flooding is likely to occur year after year depending on the severity of the winter. Following the 2014 flood we pursued the possibility of removing the island. Initial estimates at the time indicated that removal of about 1.7 acres of area at a depth of at least 5 feet, requiring about 1,700 truckloads would ensure free-flowing passage of ice blocks.

While a project like this is very small for an agency like the Army Corps, it is much too large for a community as small as ours to tackle on our own. Section 205 of the Flood Control Act of 1948 authorizes the Army Corps of Engineers to partner with local and state agencies on small flood damage reduction projects not specifically authorized by Congress. While we initially pursued a Section 205 project in 2015, we backed off after inquiries uncovered the likelihood of difficult and expensive bureaucratic hurdles, and the potential of more stringent and expensive environmental permits to remove the sediment island. Additionally, while the federal share of costs associated with these small projects is significant, we were concerned that the local share was still more than a rural agricultural-based county could meet. Finally, it appeared that the Army Corps simply hadn't used the Section 205 program for ice jams to the extent it had for other, more traditional flood damage control measures in other areas of the country and therefore may not have believed it had the flexibility necessary to deal effectively with the problem.

With that in mind we were pleased to see Congress include language specific to ice jams in the Water Infrastructure Improvements Act for the Nation, passed just two months ago, in December of 2016. Specifically:

> **SEC. 1150. ICE JAM PREVENTION AND MITIGATION.**
> *(a) IN GENERAL.—The Secretary may carry out projects under section 205 of the Flood Control Act of 1948 (33 U.S.C. 701s), including planning, design, construction, and monitoring of structural and nonstructural technologies and measures, for preventing and mitigating flood damages associated with ice jams.*
> *(b) INCLUSION.—The projects described in subsection (a) may include the development and demonstration of cost-effective technologies and designs developed in consultation with—*
>
> > *(1) the Cold Regions Research and Engineering Laboratory of the Corps of Engineers;*
> > *(2) universities;*
> > *(3) Federal, State, and local agencies; and*
> > *(4) private organizations.*
>
> *(c) PILOT PROGRAM.—*
>
> > *(1) IN GENERAL.—During fiscal years 2017 through 2022, the Secretary shall identify and carry out not fewer than 10 projects under this section to demonstrate technologies and designs developed in accordance with this section.*
> > *(2) PROJECT SELECTION.—The Secretary shall ensure that the projects are selected from all cold regions of the United States, including the Upper Missouri River Basin and the Northeast.*

Removal of the island appears to be the solution to our flooding in Worland, but at the local level we are flexible enough to explore other options if the Army Corps is flexible enough to make use of this new language to research and explore cost effective technologies to mitigate what is likely to be a repeated disaster in our area. We remain concerned about the monetary and human capital costs associated with these projects. However, Washakie County stands ready to work alongside the Army Corps of Engineers on any viable and cost-effective solution for the protection of our community. We hope that Washakie County and the Big Horn River will be among the first of the cold region pilot projects.

Seasonal runoff or unique weather events are things over which we have no control, but the floods caused by ice jams and a sediment island in the Big Horn River is something we can control with assistance from the Army Corps of Engineers. I am here to ask for both the Corps and your help to ensure that as you move forward with funding infrastructure projects of great importance to the nation, that you do not forget these small projects in rural areas that are of critical importance to our local communities.

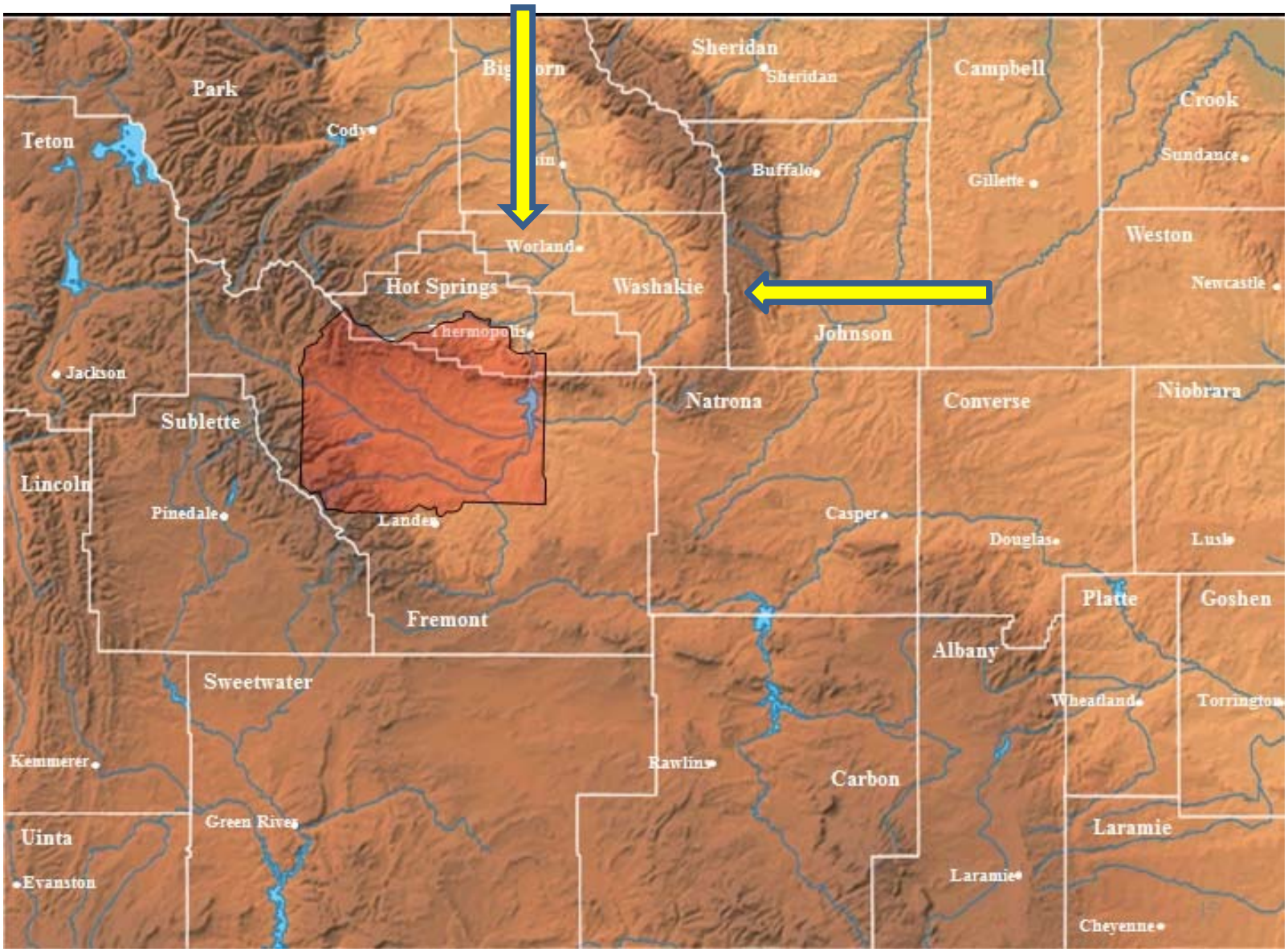
Thank you, Mr. Chairman.

Appendix A - Map

Washakie County, Wyoming

Location:
North Central Wyoming

Worland sits directly on the Bighorn River



Appendix B - 2017 Worland Flood

Before

After

Before

After

Appendix C - Worland Sediment Island

Mayor Ron Corbett
Cedar Rapids, Iowa
ron.corbett@cedar-rapids.org
319-286-5051

Chairman Barrasso, Ranking Member Carper, Senator Ernst and members of the Committee, thank you for the opportunity to testify today.

In June 2008, the Cedar River in Cedar Rapids, Iowa crested more than 11 feet above any previous floods at 31 feet. The flood waters covered 10 square miles—14 percent of our city. 6865 residential properties, 754 commercial and industrial properties and 310 City facilities were damaged totaling more than $5.4 Billion in losses. This flood devastated our residents, businesses and entire community.

The 2008 Flood was catastrophic, but our recovery has been impressive by any standard. We have rebuilt our city facilities, including our City Hall, Central Fire Station, Police Station, Library, and many others. We adopted a flood mitigation plan, raised two bridges, and have also not only rebuilt, but took measures to protect our damaged water system, pumps and waste water facilities. These services are critical to supporting industry in Cedar Rapids. In 2016 we began construction of a levee and pump station that will provide immediate protection for one of our low lying districts, eliminating the need for temporary protection up to a 20 foot crest. When the entire system is completed this levee will protect to the 2008 flood volume. A second pump station is underway and will be completed in 2018. These combined efforts represent a 20 million dollar investment in permanent flood control.

The rebuilding of many city facilities and our plan for permanent flood protection has increased confidence from the business sector. But any financial investment made in the flood impacted area carries a higher risk due to the lack of permanent flood control. This could discourage or limit the amount of future investment in our City. Continued success will depend on us maintaining our momentum and avoiding losses from future flood events. Federal funding for flood mitigation is critical to maintain and grow the economy of Cedar Rapids.

The current Benefit Cost Ratio used to appropriate funding puts Cedar Rapids—and mid-west cities like us— at an extreme disadvantage. The BCR Risk formula favors higher valued properties outside of the mid-west. We believe the BCR should consider adjusting for property values of similar structures to account for this discrepancy.

Just this past September, our community once again faced a record high flood event. During that flood fight, the City spent over $10 million on temporary flood protection measures.
Our business community reported a loss of over $27 million. This didn't include costs from some of our largest employers. We provided you with a copy of this report, which clearly outlines the enormous impact these flood events have on our business community.

If a flood happens in Cedar Rapids again, will our businesses be able to recover? The BCR formula should take into account a community's tolerance for such an event. Cedar Rapids is the second largest economic generator in Iowa, making our recovery critical not only for the City's survival but also for the State of Iowa. Quaker Oats, one of the largest food suppliers in our country is located in Cedar Rapids right near the river within our flood zone. If they flood again, we stand to lose this large industry, not just from the State of Iowa, but potentially from the country.

Despite experiencing the two largest recorded flood events in our City's history within just eight years, this recent flood did not increase our Benefit Cost Ratio by any meaningful amount. FEMA provided $643 million in disaster recovery aid to our community for the 2008 flood, and will likely provide millions more for our 2016 flooding. How many more times will we have to receive millions in recovery aid before we finally receive funding for permanent protection that will eliminate the need for recovery funding?

Cedar Rapids has not been sitting back waiting for federal help. We have secured State and local funding, and have begun moving forward to protect our city. We are asking the Federal Government to step in and provide the remaining $78 million needed to build a complete flood mitigation system to protect the City of Cedar Rapids.

Thank you.

Cedar Rapids Industry Impact Fact Sheet

- Breakfast cereal manufacturers in Cedar Rapids, Iowa produce **13%** of total U.S. output.[1]
- Wet corn milling in Cedar Rapids, Iowa accounts for **8%** of U.S. domestic ethanol production.[2]
- Cedar Rapids based industry produces almost **6%** of U.S. manufactured search, detection, and navigation instruments.[3]
- The amount of packaging machinery manufactured in Cedar Rapids accounts for **1.5%** U.S. production totals annually.[4]
- Industry based in Cedar Rapids manufactures **1%** of US copper rolling, drawing, extruding and alloy related products in the United States.[5]
- The quantity of corn processed each year in Cedar Rapids exceeds the size of the domestic corn crop of Canada, the Republic of South Africa, or the Russian Federation.[6]
- In 2014, the amount of ethanol produced in Cedar Rapids, Iowa was greater than the total quantity manufactured in Canada or the People's Republic of China.[7]
- Worker productivity per employee in Cedar Rapids is **29%** higher than the United States national average.[8]
- Industry in Cedar Rapids, Iowa processes as much as **19%** of the global oat crop in value added manufacturing per year.[9]
- Cedar Rapids maintains the highest ranking in Human Capital and Knowledge Creation of any metropolitan area in Iowa. [10]
- Ethanol production in Cedar Rapids yields a quantity of Distillers Dry Grains (DDGs) equal to about 20% of annual U.S. exports.[11]

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[1] Cedar Rapids Economic Development Services (September, 2016). *Linn County, Iowa Industrial Output as Percent Share of Total United States Industrial Production.*
[2] Ibid.
[3] Ibid.
[4] Ibid.
[5] Ibid.
[6] Cedar Rapids Economic Development Services. (December, 2016). *USDA Foreign Agricultural Service: Corn Production Statistics.* *Retrieved online.*
[7] Cedar Rapids Economic Development Services. (December, 2016). *US Department of Energy, Alternative Fuels Data Center: World Fuel Ethanol Production by Country or Region 2015*. Retrieved online.
[8] Cedar Rapids Economic Development Services. (July, 2016). *Workforce Productivity Analysis*.
[9] Cedar Rapids Economic Development Services, (December, 2016).
[10] Economic Development Administration. (December, 2016). *Innovation Index 2.0.* Retrieved online.
[11] Cedar Rapids Economic Development Services (December, 2016). *US Grains Council Website*. Retrieved online.

Prepared Testimony of John Laird, Secretary
Natural Resources Agency
State of California

before the

Committee on Environment and Public Work
United States Senate

Oversight Hearing on "Flood Control Infrastructure: Safety Questions Raised by Current Events"

March 1, 2017

Good morning Chairman Barasso, Ranking Member Carper, Senator Harris, and members of the Committee. On behalf of the state of California, Governor Brown, and over 16,000 dedicated state employees of the 25 departments, conservancies, and commissions that comprise the California Natural Resources Agency, I thank you for the opportunity to provide testimony before this Committee on a critical and timely topic.

As you know, our nation's aging infrastructure is at a crossroads. One path is characterized by continued inaction; insufficient funding; a lack of local, state, and federal cooperation; and further deterioration, putting human lives, our natural resources, and economy at risk. Another path is shaped by deliberative policies, meaningful investment, coordination across all levels of government, and the incorporation of new science that can provide multiple benefits to common outcomes. California approaches this situation with a sense of urgency. I hope my testimony helps provide some insight into California's flood control and water infrastructure systems, answers questions raised, and contributes constructively as Congress considers how best to address the nation's significant infrastructure needs and the safety of our citizens.

Current Events

Droughts and floods have always driven the evolution and growth of California water policy, investment, and scientific/technical understanding. This year is no different.

After five years of severe drought, California is in the midst of what is likely to be the wettest water year (Oct-Sept) on record. Severe winter storms—powered by atmospheric rivers—have brought torrential amounts of rain and significant snow to the state, particularly in the Northern Sierra (fig. 1). On satellite images the aptly named ribbons of moisture are fed by warm equatorial waters (fig. 2) and stream into the state with the equivalent of 7.5-15 times the rate of water at the mouth of the Mississippi River. California often receives a significant amount of its yearly precipitation from a handful of these weather events. But their number, size, and severity this water year has strained the state's flood control and water management infrastructure; forcing evacuations, damaging roads, destroying homes, communities, and livelihoods.

Impacts to California are ongoing, and a myriad of local and state agencies are at this moment working to address emergency needs, battling swollen rivers, surveying troubled levees, and making necessary repairs. It's estimated that damage to California's highways alone from storms this year is over $595 million so far. In San Jose, 50,000 residents had to be evacuated as the worst flooding in a century there inundated neighborhoods when local dam releases overwhelmed a creek's capacity.

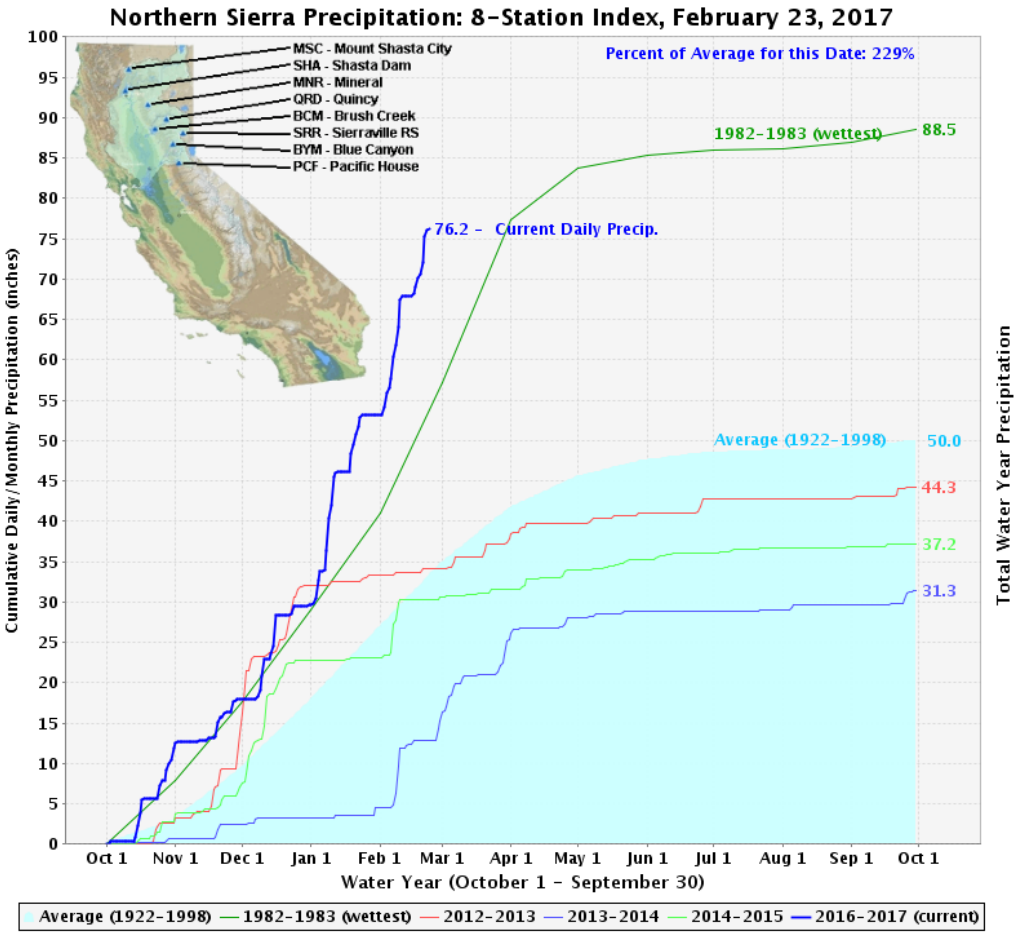

Northern Sierra Precipitation: 8-Station Index, February 23, 2017
MSC - Mount Shasta City
SHA - Shasta Dam
MNR - Mineral
QRD - Quincy
BCM - Brush Creek
SRR - Sierraville RS
BYM - Blue Canyon
PCF - Pacific House
Percent of Average for this Date: 229%
1982-1983 (wettest)
88.5
76.2 - Current Daily Precip.
Average (1922-1998)
50.0
44.3
37.2
31.3
Cumulative Daily/Monthly Precipitation (inches)
Total Water Year Precipitation
Oct 1
Nov 1
Dec 1
Jan 1
Feb 1
Mar 1
Apr 1
May 1
Jun 1
Jul 1
Aug 1
Sep 1
Oct 1
Water Year (October 1 - September 30)
Average (1922-1998)
1982-1983 (wettest)
2012-2013
2013-2014
2014-2015
2016-2017 (current)

fig. 1

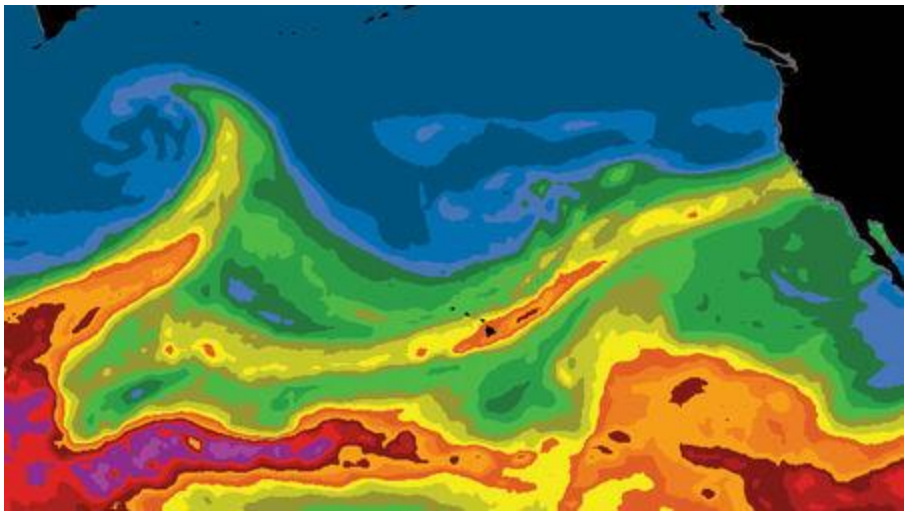


fig. 2

Most dramatically, damage to the main spillway on Oroville Dam—the tallest dam in the United States and the second largest reservoir in California that serves as the keystone of the State Water Project—was observed on February 7th by water managers. The damage diminished the capacity for safe reservoir releases, and relentless inflows from storms continued to fill the lake. These conditions led to the use of the dam's emergency spillway for the first time since the project was completed in 1968. Significant erosion of the emergency spillway began to occur as water flowed over the feature, though it was working as designed and engineered to prevent overtopping and damage to the dam itself. Yet, the possibility of the emergency spillway's rapid failure if the erosion continued warranted the emergency evacuation of nearly 200,000 downstream residents in Yuba, Sutter and Butte counties.

In an effort to prevent catastrophe, dam operators made a critical trade-off and drastically increased releases through the damaged main spillway, knowing that further deterioration of the spillway would occur with months of use still needed through the season. While there was additional damage to the main spillway, and the situation is ongoing, the spillway is holding up to intense use. After a three-day mandatory evacuation, residents were allowed to return to their homes on February 14. With the reservoir's water level now 50 feet below the emergency spillway, the immediate danger has passed. The situation has stabilized, but the emergency conditions and heightened awareness remain. Crews have been working around the clock, pouring tons of rock and concrete to fill erosion and secure the emergency spillway in case it needs to be used again. Dam operators are managing the reservoir's elevation to well below the top of the emergency spillway and balancing inflow and releases to remain prepared for future storms and the melting of the heavy snowpack that remains higher in the watershed. Debris removal operations at the base of the main spillway and dam are also under way in order to restore the function of the hydroelectric plant and its outlets. (fig 3)

California continues to prioritize the protection of human life, public safety, and property, while preparing for the possibility of additional severe winter storms. Local, state, and federal communication, coordination, and resources have benefited from critical investments and planning in previous years. Over the last decade alone over $11 billion has been spent by federal, state and local agencies in California on flood control projects. And experience battling California's cyclical floods has developed critical expertise in our community's flood managers, scientists, engineers and emergency responders. The request and granting of a major federal disaster declaration for affected counties was important, and augments local and state resources overwhelmed by the scale of the storms, emergency response activities and costs for recovery. California's extraordinary response to this year's storms was only possible due to local, state and federal cooperation, and significant prior investments in the state's water, flood control, safety and emergency response systems.

California's dam safety program, one of the oldest in the nation, came into being after the 1928 collapse of the St. Francis Dam, which killed more than 450 people. The program is widely recognized as the best in the nation. But we can and must always do better. While the exact cause and circumstances that led to the damage to Oroville's main spillway are yet unknown, this event has drawn needed attention to the age, condition, maintenance and financial needs of California and the nation's flood control and water management systems. Critically, we must not simply view infrastructure through the lens of single purpose, single function undertakings, but instead should use the opportunity to fund innovative projects that leverage science to meet the challenge of extreme weather and variable precipitation, and accomplish multiple benefits and goals with the investment.

Bolstering Dam Safety and Immediate Investments in Water Infrastructure

While we welcome the partnership, California is not waiting for the federal government to alone meet this urgent need and real opportunity. As a first step, last Friday, Governor Brown redirected $50 million from the state's General Fund and requested a $387 million Proposition 1 appropriation from the state Legislature to fund near-term flood control and emergency response actions. In 2014, more than 67 percent of voters statewide passed Proposition 1. This $7.5 billion water bond was put on the ballot through a bipartisan effort in the state Legislature that involved only two "no" votes. Proposition 1 advances the California Water Action Plan, the five-year blueprint of near- and long-term actions pursued by the Brown Administration in order to create more resilient, reliable water systems and to restore important ecosystems. If the Legislature grants the Governor's requests on General Fund and Proposition 1 spending, California will be set to invest $1.2 billion over the next two years in multi-benefit projects.

While California already boasts a model dam safety program, Governor Brown has proposed the passage of state legislation that would additionally direct the California Department of Water Resources (DWR) Division of Safety of Dams to require the owners of all 1,250 dams under its jurisdiction to complete an emergency action plan that is updated every ten years (subject to exemption by DWR for smaller, low risk dams) and to map inundation zones every ten years or sooner if local development patterns change. The Governor also proposes to require the DWR to identify additional scenarios beyond a complete dam failure that warrant separate inundation maps and to provide supplemental appropriations totaling $7.5 million to forward fund the necessary staffing to do immediate, more extensive evaluations of dams and their ancillary components.

These investments are an important start, but more is needed to satisfy the $50 billion in flood project needs statewide that DWR and the U.S. Army Corps of Engineers estimate exist.

To complement the immediate actions of our state agencies, as Secretary of Natural Resources, I have requested the following actions from our partner federal agencies:

- Expand inspection and review of all federally-owned dams in California. The inspections should parallel state efforts, including review of ancillary structures such as spillways.
- Update the federal operating manuals for key California reservoirs. It is imperative to revise these manuals to reflect current scientific knowledge. The Corps needs to be fully funded to complete these updates or allow non-federal authorities to finance this work.
- Fund the recently enacted Water Infrastructure Improvements for the Nation Act, which authorizes a program for rehabilitation of high hazard dams at the Federal Emergency Management Agency. Also, prioritize the publication of the programs rules to assist California and other states in this rehabilitation effort.

Understanding California's Flood Control/Water Infrastructure

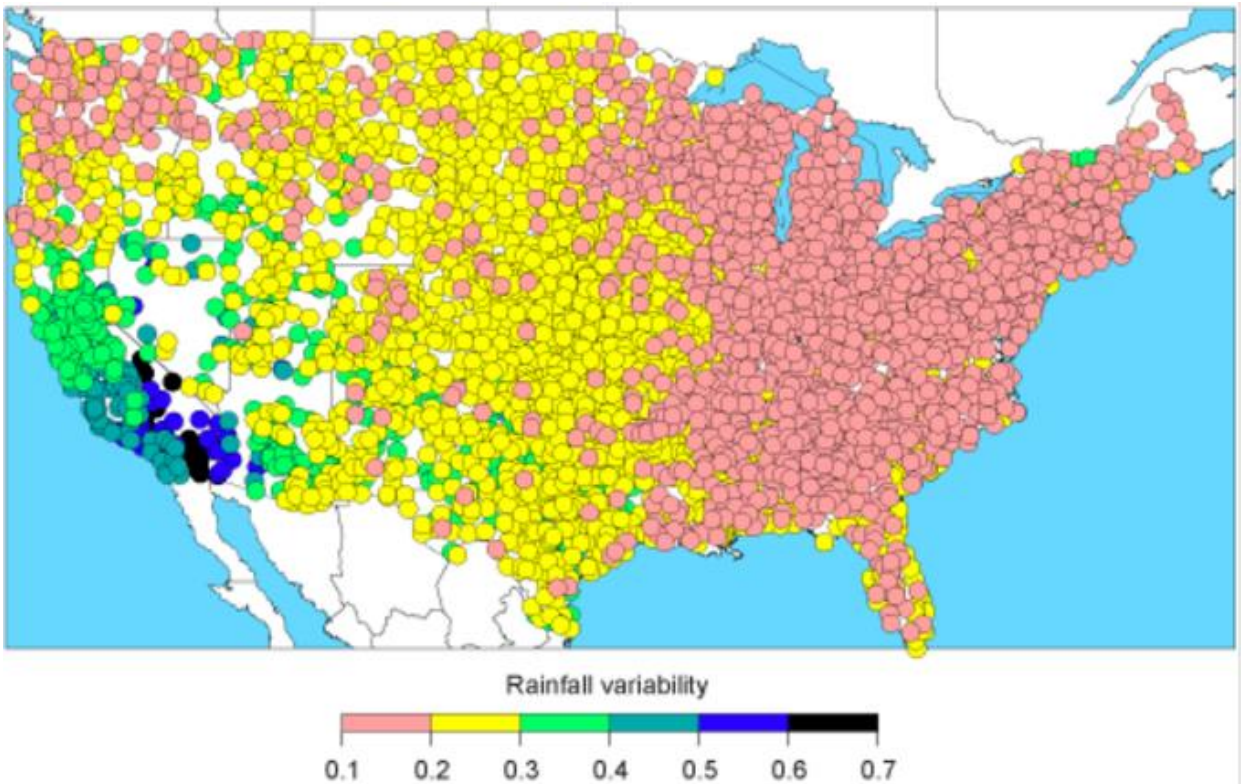
"Flooding in the midst of drought is likely... Nothing focuses Californians' attention on our water resources like the extremes of flood and drought." – California Water Action Plan 2016 Update

Through five years of historic drought in California, thousands of rural drinking water wells went dry from groundwater depletion, urban and agricultural water deliveries were reduced or eliminated,

streams and rivers dwindled, fish and wildlife populations declined, and millions of trees died and fed catastrophic forest fires. This year's change in hydrology is welcome, but it presents its own set of difficult, yet related, challenges.

The dramatic shift from drought to deluge is a familiar pattern for Californians, and one that has shaped the development of our state and its water infrastructure.

No other state in the nation has a more varied and uncertain climate and hydrology than California (fig. 4). That variability in precipitation extends within the water year (Oct-Sept), between water years, and also to the geographic distribution of precipitation. The vast majority of California's snow and rain falls on the northern and eastern parts of the state during the winter months, with vast stretches of its southeast corner a hydrologic desert. While nearly two-thirds of the state's precipitation falls in the north and on the eastern slope of our state, the majority of Californians – who represent nearly 1 in 12 Americans – live far to the south and west.. Much of that precipitation falls on and along the Cascade range and the Sierra Nevada range as moisture-rich storms are forced up its slopes, condense, and shed their cargo as rain or snow. The Sierra Nevada snowpack acts as the state's largest natural reservoir, accumulating vast amounts of precipitation through the winter, and melting during the warm dry spring and summer months.



SOURCE: Michael Dettinger, 2011. "Climate Change, Atmospheric Rivers, and Floods in California—A Multimodel Analysis of Storm Frequency and Magnitude Changes." *Journal of the American Water Resources Association* 47(3):514-523.

NOTES: Dots represent the variation of total annual precipitation at weather stations for 1951-2008, as measured by the coefficient of variation. The larger the value, the greater the year-to-year variability.

fig. 4

Before California was settled by westerners, the cycles of dry and wet periods that dominate California's hydrology fed and shrank vast wetlands that covered the Great Central Valley and the Sacramento-San Joaquin River Delta (Delta), and would fill Lake Tulare at the southern end of the San Joaquin Valley—once the largest lake west of the Mississippi. The discovery of gold in California in 1849 changed California's landscape forever. The Gold Rush ushered in settlers and miners who set to work building hundreds of miles of flumes and ditches to divert water so it could be used to sluice out gold. In the following years, as the precious metal became more difficult to find, miners turned to farming, spurring significant levee construction in the Central Valley, San Francisco Bay, and Delta as land was reclaimed for cultivation. And local water systems were first built in the early part of the 20th century to bring water to cities that were developing into booming metropolitan centers like San Francisco and Los Angeles. From the 1920's through the 1950's, the U.S. Army Corps of Engineers and U.S. Bureau of Reclamation ushered in an era of significant federal investment in California water conservation, water supply, flood management and wildlife protection projects. And it was the construction of the Bureau of Reclamation's Central Valley Project, originally a project by the state of California before the Great Depression hit, and California's development of the State Water Project in the 1960's, that time capped the most ambitious and expansive water system in the world. (fig. 5)

Californians today are the inheritors of a water system born from the necessity of building certainty into California's hydrologic variability. Now, our state population is growing. Our hydrology and climate are changing. Our infrastructure is aging. As the assumptions and understandings of the earlier eras give way to better science, advances in technology, and new understandings, the limitations of today's failing water infrastructure means we must invest in the infrastructure of tomorrow.

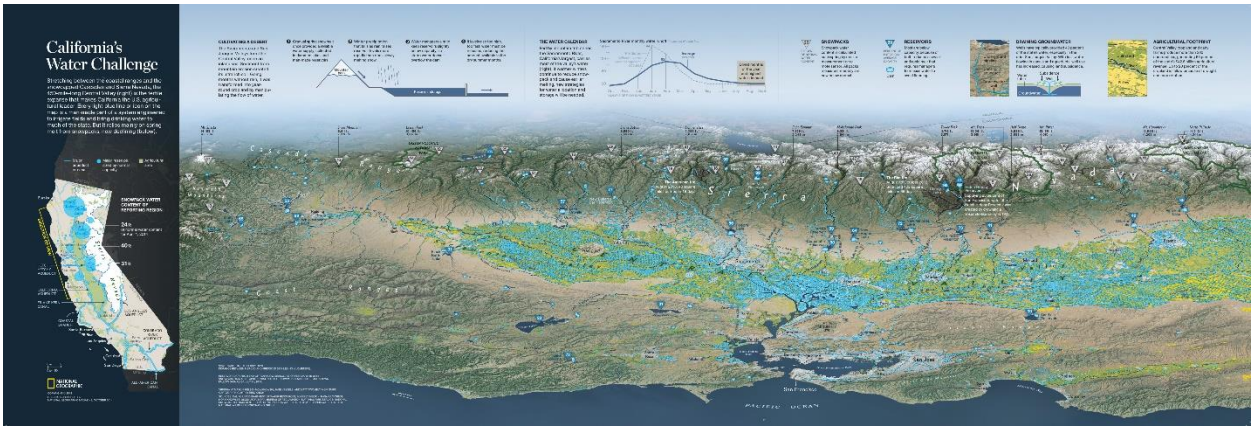


fig. 5

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TESTIMONY
Flood Control Infrastructure: Safety Questions Raised by Current Events

Before the
Senate Committee on Environment and Public Works

By
Larry A. Larson, CFM, P.E.
Director Emeritus

Association of State Floodplain Managers

March 1, 2017

Introduction

The Association of State Floodplain Managers (ASFPM) is pleased to participate in this hearing about flood risk management and the safety of our nation's flood control infrastructure. We appreciate the opportunity to discuss our views and recommendations for improvement and for implementation of comprehensive flood risk management. We thank you, Chairman Barrasso, Ranking Member Carper and members of the Committee for your interest in this subject that has recently vividly presented itself as a problem.

ASFPM and its 36 chapters represent more than 17,000 state and local officials, as well as private sector and other professionals engaged in all aspects of structural and nonstructural flood risk management. This includes floodplain management and flood hazard mitigation, management of local floodplain ordinances, flood risk mapping, engineering, planning, community development, hydrology, forecasting, emergency response, water resources development and flood insurance. All ASFPM members are concerned with reducing our nation's flood-related losses. For more information on the association, its 14 policy committees and chapters, visit *www.floods.org*.

The extreme flooding in West Virginia, Louisiana, Missouri, South Carolina and California vividly illustrates the potential threat to public safety of inadequately maintained infrastructure, limitations of engineered flood control structures, the importance of public awareness of potential flooding and challenges of a changing climate. Dramatic rainfall events have led to failures of numerous smaller high hazard dams – notably 80 dam failures in South Carolina just in 2015 and 2016. The problem exists nationwide and we have received a wake-up call. Much of our infrastructure has exceeded its originally intended design life, which requires assessment, remediation or replacement.

One of the key issues the nation has chosen to ignore is the issue of residual risk. We have trillions of dollars of investment in this nation protected in some fashion by flood control infrastructure. We have seen in New Orleans and most recently in northern California the dramatic impacts failure or the threat of failure might bring. The failure consequences in New Orleans were dramatic and perhaps we were not far from a failure in northern California that would have immediate flooding consequences for tens of thousands of people and left the state's water supply vulnerable to severe shortage. Yet when FEMA attempts to show these residual risks on maps, they are overridden by concerns about releasing security information, even though nature continues to fail dams and levees each year while we have seen none of that from terrorists. When people mention that residual risk flood insurance is a good idea, they are shouted down for suggesting people are even at risk. Due to aging infrastructure, underfunded maintenance, significant development and population (and hence rapidly escalating risk) within "protected" areas, and finally an uncertain understanding of flood risk in the future due to climate, our nation and citizens perhaps have never been more at risk than they are today, and it will only be worse tomorrow

As the nation considers substantial investment in infrastructure, the undertaking must involve attention to flood control structures and their maintenance, upgrading and repair as well as conscious integration

with non-structural flood risk management techniques. These flood threats to public safety cannot be met by private financing alone, but will continue to require substantial federal investment.

Mapping of flood risk areas is woefully incomplete and requires a major commitment of resources to assure the availability of reliable, accurate flood risk information. ASFPM has estimated a further investment of $4.5 billion to $7.5 billion is needed to provide maps for every community in the nation that would cover all unmapped areas and to update existing, but very outdated maps.

The ongoing use of the 100-year event as the basis for both insurance risk and infrastructure design is placing communities at risk, especially when we consider the very real changes in future conditions that will occur from land use change and climate. We see many instances where protection of property with levees based on the 100-year standard means that we free up land for development that will be at risk to people and to the federal taxpayers.

Overview of Managing Flood Risk in America

Flooding is the most costly and most frequent cause of disasters in America. Flood damage has cost the nation's taxpayers more than $200 billion since 2005.We are seeing years with up to 14 separate billion dollar disasters, 85-90% of them from flooding. The recent and ongoing flooding in California is an example we can learn from, even though California probably manages flood risk better than most states in the nation.

The U.S. has a varied history of how we manage flood risk. Until the early 20th Century, managing flood risk was handled by local governments or private property owners. During this period, Congress authorized the Corps of Engineers to construct levees in Sacramento and on the Mississippi River.

The Corps' role expanded greatly with the devastating 1927 flood on the Ohio and Mississippi Rivers that saw hundreds of miles of levees overtopped and thousands of people in the lower Mississippi River basin displaced. Congress authorized a plan to provide flood protections from Cairo, Illinois to the Gulf of Mexico called the Mississippi River and Tributaries (MR&T) project. The Corps constructed a couple thousand miles of levees and included a number of relief outlets along the route to divert extreme flood flows into backwater areas to relieve pressure on the levees to prevent levee failure. The Corps purchased flowage easements in those overflow areas to allow them to be occasionally flooded. For example, the Birds point (opened in 1037) and New Madrid Floodway (opened 2011) to save the levees downstream. Other by-pass systems exist on the MR&T to utilize the approach the Dutch call "Room for Rivers." In other words, we accept that Mother Nature can always throw a larger flood at us than we can afford to design. So instead we can plan for emergency overflow areas that allow the river to flow into historical floodplain areas where damage is limited. These by-pass areas can be used for lower damage activities like farming that will not experience long-term damage from occasional flooding. Surprisingly, this approach is seldom used in the U.S., but MR&T and the Yolo by-pass on the Sacramento River are two successful examples.

In the 1936 Flood Control Act, Congress authorized the Corps to construct levees and other flood control structures. Most of the projects were only constructed by the Corps after a non-federal sponsor stepped up to acquire the right-of-way and promise to operate and maintain (O&M) the project after it was constructed. Since 1986, the non-federal sponsor must also cost share the construction, usually 35% of the cost. Unfortunately, many of those non-federal sponsors did not perform the necessary O&M and the "protected" populations cannot be assured the structures will protect them during flooding to the design level of protection. The Corps has a program called Rehabilitation and Inspection (RIP) in PL 84-99 that allows the Corps to come in and repair a levee that has been damaged or fails in a flood, at either 100% or 80% federal taxpayer cost. Concern has been expressed that some non-federal sponsors put off needed O&M, hoping the Corps will do some of that work under PL 84-99 after the levee is damaged.

In the 1950s and 1960s, visionaries like Gilbert F. White were proposing a new approach to managing flood risk: that is to adjust where and how people build instead of adjusting our rivers and ecosystems. The NFIP was designed to do that and ensure people living at risk paid at least some part of the cost of that risk. The NFIP would map the flood risk areas and make flood insurance available, and in return communities and states would guide new development and redevelopment to be less at risk. While the concept of that program makes sense, some elements, like subsidized flood insurance and its approach to managing average events (only the 100-year flood, but not extreme events) have led to a $24.6 billion program deficit. Most of this debt comes from extreme flooding events, such as Hurricanes Katrina, Rita, Wilma, Irene and Sandy, and the rainfalls that are becoming more extreme and frequent in the last decade, such as the one in Baton Rouge just recently.

The NFIP is the nation's primary flood risk reduction tool. The program helps to identify and map flood hazard areas, assess flood risk, implement strong land use and building standards to prevent future disaster losses, and undertake mitigation to reduce damage to older at-risk buildings. Other agencies like the Corps, USGS, NOAA and others work with the NFIP to collect and develop data and integrate federal actions. The adoption of floodplain management standards by more than 22,000 NFIP participating communities results in $1.7 billion in flood losses avoided every year according to FEMA data. The mitigation programs within the NFIP, Increased Cost of Compliance (ICC) and Flood Mitigation Assistance (FMA) have mitigated, on average, 1,850 buildings annually between 2010 and 2014. The NFIP is not an insurance program; rather it is a comprehensive flood risk reduction program that happens to also sell flood insurance as one of its tools.

Many federal agencies are involved in managing flood risk, and many programs promote using nature to reduce flooding. Examples include the conservation programs in USDA, coastal management programs in NOAA and water quality/stormwater programs in EPA. Agencies like HUD and DOT recognize the advantage of building in a way that will ensure housing, bridges and roads that are safe and resilient now and in the future.

In the past 30 years there has been a trend toward using more nature-based or nonstructural approaches. Important advantages of this trend are that communities and states can implement these approaches on their own due to smaller costs and the ability to integrate them into holistic approaches

that address more than just flood loss reduction. Especially important are social issues, local economic issues and long-term environmental considerations that are attractive to local residents and tourists.

Managing flood risk in the rest of this century

For decades, floodplain managers have been studying and seeing how flood risks change over time. When a watershed develops, unless there are sufficient land use and design standards in place, downstream flooding often gets worse due to a watershed that that is "hardened" with more concrete and other impervious surfaces. Because we have not mapped dam failure inundation areas, inadvertent development downstream of dams results in a formerly low hazard dam becoming a high hazard dam, triggering necessary – but costly - upgrades to the dam. Intense development in vacant lands protected by levees greatly increases the risks associated with catastrophic failure; yet we have no national levee design standards. All of these development related concerns are challenges for managing flood risk.

Perhaps a more significant challenge is the impact of climate change. The fact is, today, we are seeing flooded roads in residential subdivisions during regular high tide, storm drains flowing backwards, and buildings that are islands along our coasts. This is not a theoretical or abstract "what might happen" scenario; rather local floodplain managers are dealing with the conditions as they are happening today and those conditions are getting worse. In addition to sea level rise projections that are getting higher as we better understand the causal factors including the melting of the Greenland ice sheet, we are also witnessing more intense rainfall and extreme flood events in several areas of the nation. ASFPM is trying to do its part by assisting communities in preparing for these conditions. One project we have underway right now is to identify and mainstream techniques for incorporating future conditions into local capital improvement planning (CIP) so communities can account for the full costs and potential impacts of hundreds of billions of dollars in infrastructure investment along the coasts over the next several decades.

Investing in America's Flood Risk Reduction Infrastructure

We are keenly aware of the alarming state of infrastructure overall in this nation pointed out by the Report Card put out by the American Society of Civil Engineers—much flood control infrastructure is a "D". We are reminded of this problem every day when we use our roads, bridges and public transportation or drink water and use the bathroom. ASFPM is pleased that Congress and the Administration are contemplating a significant infrastructure investment package. ASFPM strongly recommends that a priority be placed on America's flood risk reduction infrastructure. This infrastructure includes the following types of projects:

- Data (mapping, topography)
- Dams
- Levees
- Stormwater management
- Nonstructural flood mitigation

Investment in these types of projects should be guided by the following principles:

- *Greater incorporation of nature based approaches.* Sometimes, a nature based approach is an effective alternative to a more traditional structural approach. However, far more often nature based approaches can be effectively incorporated into a flood risk reduction project to bring additional benefits to the community as well as the environment. For example, in Hamilton City, California a setback levee project is allowing for the reconnection and restoration of over 1,300 acres of floodplain riparian habitat. Making "room for the river" in this way reduced the construction cost of the levee and made the project cost-effective.
- *Account for future conditions and build in resiliency.* Flood risk changes over time. Given that our infrastructure projects are often nursed long past their expected design life, standards applied to infrastructure development must include full accounting of future conditions, as reasonably and scientifically possible. Otherwise, the federal taxpayer will be on the hook again and again for flood damage that repeats over and over. A basic resiliency standard that would be easily applied is a flood protection level that is at least 2 feet above (3 feet above for critical facilities) the existing 100-year flood elevation where appropriate. Critical facilities need added protection because they must be operational and accessible during major flood events.
- *No adverse impacts*. A basic legal principle in America is that one property owner cannot do something on their property that will adversely impact another person's property. Sometimes this legal principle has been ignored when building flood control structures. There are illustrations that property owners are seeing those impacts. For example, in floods along the Mississippi River, which splits Illinois and Missouri, property owners in one state attempt to breach the levee on the other state to relieve the pressure on their own levee. For structural projects like levees, these can have adverse impacts not only across the river, but also on properties upstream or downstream. It is important that all flood mitigation activities ensure the activity does not impact other properties or that the impact has been mitigated financially or by some other means.

Financing vs. Funding

We are pleased to see the strong discussion on the need for investing in repairing and improving that infrastructure, but our experience does not show that financing alone (i.e., private-public-partnerships (P3)) is a path to success. We believe there needs to be real dollar investments of taxpayer funding to save our crumbling infrastructure. Current taxpayers benefit, so we should not pass this cost to future generations.

In conversations we have had with large global capital investors, they indicate a hesitancy to invest in infrastructure like levees. They say it's because they have no way to determine if the levee is designed, constructed, operated or maintained to quality standards or if it will withstand expected future conditions. They indicate that if adequate national standards existed, and they were assured these kinds of projects meet all those standards, and that the owner has an assured source of revenue to pay off loans, they could be a partner. Similarly, a P3 roundtable hosted by USEPA in 2012 found that while P3

arrangements are somewhat common with some forms of water infrastructure (drinking water and wastewater systems), to help finance the construction, retrofit and/or operations of such systems they are essentially non-existent for urban stormwater retrofits, which is another kind of flood risk management infrastructure. The report noted that the P3 model is highly complex, needing expertise in contracting at the public level and is not a panacea for all types of infrastructure. So while financing is one tool in the toolbox, it is a minor one as applied to flood risk management infrastructure. Funding is a much more immediate and widespread need and a more successful tool.

What is included in infrastructure? While most consider any public transportation systems or water and sewer systems might be appropriate, we would urge all federal taxpayer investments in those or other systems must account for future conditions expected during the lifetime of that infrastructure. It will be costly enough to do this once. We cannot afford to rebuild that infrastructure time and again because we did not take into account expected sea level rise, future watershed development that increases runoff and floods, or predictable increased rainfall that creates the kind of extreme flood events we have seen in the last decade.

Furthermore, if any of this infrastructure is privately owned, the federal taxpayer investment must be tailored to provide only partial funding, and only then if it is conditioned on verifiable future funding by the responsible entity.

- **For the infrastructure package under consideration by the Administration and Congress, ASFPM recommends robust funding of infrastructure in addition to any financing incentives**

Data Infrastructure

Fundamental to any flood risk reduction infrastructure is data to understand how floods may occur (flood studies), where floods will impact people and property (topography and flood maps) and how any new infrastructure (both large flood control structures and smaller, non-structural measures) affects flooding. The data is important for the purposes of flood preparedness, response, recovery and mitigation. While significant investments have been made to better understand flooding and map such areas, we have a long way to go to identify all flood risks and how they will impact people and property.

Acquiring LiDAR Topography for the Entire Nation

One program ASPFM wishes to highlight is the 3D Digital Elevation Program (3DEP) at USGS. The primary goal of 3DEP is to systematically collect enhanced elevation data in the form of high-quality light detection and ranging (LiDAR) for the nation. With better topography, FEMA flood map updates could take much less time, flood maps would be far more precise, and flood forecasts can be more accurate and timely. Beyond flood, LiDAR based topography is helpful for infrastructure project planning of other hazards as well. For example, 3DEP data was used to discover a surface rupture along the Tacoma fault in the State of Washington. This discovery led to a redesign of the structural elements of a $735 million suspension bridge across the Tacoma Narrows, to mitigate against potential catastrophic failure.

- **ASFPM recommends completion of the 3DEP Program for the nation in 8 years by providing the necessary funding to accomplish that goal**

Mapping All Flood Risks for the Entire Nation

Communities and citizens need maps showing where and to what extent an area will flood. This is needed by the community to help direct new development and plan for notification and evacuation when it floods, and to inform property owners of their level of risk. This enables them to decide if and how to build, whether to buy flood insurance and how to evacuate when needed. Banks and real estate agents need that data so they can advise prospective buyers.

The NFIP has mapped about 1/6 of the nation's 3.5 million river and coastal miles. Most of those maps were completed where people already live in order to determine flood insurance rates. What are the aspects of flood mapping that need improvement?

- Map ahead of development so people and property are protected. Often people are surprised when they build, and then are told later that they are in a floodplain. That means we need to map cornfields and cow pastures because that is the land that will be developed next
- We must map residual risk areas, like dam failure zones and levee failure zones. People need to know they are living or buying in a residual risk area so they are not surprised when told to suddenly evacuate and they know where to go. NFIP maps do not show these failure zones because DHS has a fear terrorists will blow up dams! The actual probability of this occurring is very low; in the meantime, nature is failing dams every year and people have lost or may lose their lives and property. In just the last two years, South Carolina alone has had 80 dam failures due to back to back flooding events.
- Flood maps must be publically available. Unfortunately, most federal dam failure and inundation maps of emergency or uncontrolled spillway releases are classified as For Official Use Only (FOUO – see the Corps of Engineers Letter at the end of this testimony). While it is useful for the emergency manager to know the dam or levee failure zone, citizens who live there also need to know so they can take appropriate risk reduction actions (such as plan for evacuations or purchase flood insurance). It is almost unthinkable that the first time a citizen knows they are at risk is when law enforcement knocks on their door at 2 a.m. and tells them they have to evacuate NOW.
- The NFIP finally has a good process to acquire LiDAR for topography and updated computer modeling techniques to produce accurate flood mapping. What it lacks is financial resources and direction from Congress to get every one of the 22,000 NFIP communities an updated and accurate map in the next 10 years. A recent national survey by ASFPM of local floodplain managers indicates that the number one tool/data need is updated flood maps.
- Consideration of major infrastructure investment—public and private—highlights the urgency of providing accurate flood risk data and accelerating the pace of current mapping work at FEMA and the LiDAR data collection work at USGS.

ASFPM's *Flood Mapping for the Nation Report* estimates that the cost to provide flood mapping for the entire country will be between $4.5 billion and $7.5 billion.

- **ASFPM recommends full funding (to the authorized amount) for FEMA to implement the National Flood Mapping Program and complete flood mapping for the entire nation in 12 years**
- **ASFPM recommends that dam failure and inundation maps from emergency or uncontrolled spillway releases be publically available and no longer be classified as FOUO**

Dam Infrastructure

There are 90,580 dams in the nation, and about 3,300 of them are considered major dams (50-feet deep and store 5,000 acre-feet of water or a dam of any height with storage of 25,000 acre-feet). An acre-foot of water is enough for two families for an entire year. By 2025, 70% of the dams in the U.S. will be more than 50 years old, which is one reason ASCE gave U.S. dams a grade of "D" in 2013. Dams are classified by the hazard they present if they fail. A dam is classified "high hazard" if it is likely a person could die if the dam fails. As our population grows and development continues, the overall number of high-hazard potential (HHP) dams increases, with the number climbing to nearly 15,500 in 2016. Due to the lack of investment, the number of deficient high-hazard potential dams has also climbed to an estimated 2,170 or more. The Association of State Dam Safety Officials estimates it will require an investment of nearly $22 billion to repair aging, yet critical, high-hazard potential dams.

The federal government has built many dams and is responsible to maintain the ones it owns. While the federal portfolio is relatively small in number, it contains many of the most important and largest dams in the nation. FEMA and the Corps also have an inventory of dams in the U.S. called the National Inventory of Dams. Federal agencies suffer for lack of financial resources to maintain their dams, just as other owners do.

There are no national standards for the design, construction, operation and maintenance of dams and levees in the U.S. Different federal agencies may use the standards the Corps uses for its own dams or levees, but there is no agreed upon national standards. This practice must not continue.

ASFPM applauds Congress for creating a national dam grant program in FEMA in the 2016 WINN Act/WRDA to provide grants for the repair or removal of small dams. That program was also wisely designed to integrate such activities with ongoing local hazard mitigation planning and flood risk reduction programs and act as an incentive for states to maintain strong state dam safety programs. However, <u>it has not been funded.</u>

- **ASFPM recommends fully funding to the dam repair/removal program to its fully authorized limit**

Levee Infrastructure

The Corps of Engineers levee inventory seems to show about 2,000 miles of levees owned and maintained by the Corps; 12,000 miles of levees owned and maintained by non-federal entities that are in the Corps PL 84-99 program; and perhaps as many as 30,000-35,000 total miles of levees. FEMA coordinates its information of levees with the Corps, so those levees are included in these numbers. There are many small levees built by private owners to reduce flooding of agriculture lands, but there may now be people living behind those levees thinking they are somehow protected. There are also miles of levees with no known owner.

The ongoing use of the 100-year event as the basis for insurance risk and infrastructure design is placing communities at risk, especially when we consider the very real changes in future conditions that will occur from land use change and climate. We see many instances where protection of property with levees based on the 100-year standard means that we free up land for development that will be at risk from flooding in events that exceed the project design standard and often to depths of flooding that are greater than they would have been without the protection measure. A good example of this is leveed areas that receive overtopping upstream and fill the interior area like a bathtub to depths greater than would have been experienced without the levee system.

Congress created a National Levee Safety Program in the 2014 WRRDA. In that program, the Corps, in addition to a national inventory of levees, is to establish a Levee Safety Committee of national experts to work with the Corps, states and other federal agencies to establish national standards for design, construction, operation and maintenance of levees. This is an important first step, but it has not been funded. These standards must also take into account the population and land use in the residual risk areas to establish standards for public notification of risk and for emergency action plans. The nation is losing valuable time to get this effort of establishing standards underway.

Then national levee design standards must include design planned failure sections into the levee or overflow areas such as that employed in MR&T. Most countries utilize this approach, but in this nation we have not, meaning that any levee failure is likely to become catastrophic because everything in the failure zone is not designed for flooding, so it is extensively damaged. This and other forms of resilience in structural measures, such as designing for future conditions are critically important standards.

- **ASFFPM recommends immediate and full funding of the National Levee Safety Program at The Corps of Engineers**
- **ASFPM recommends that the national levee safety standards include programmed resiliency for all levees (such as failure sections), standards for managing land use and residual risk for areas protected by levees and areas subject to flooding if a levee fails, and a minimum protection standard of the 500-year flood or probable maximum flood for all levees protecting populated areas**

State Role in Dam and Levee Safety

Only states have the authority to enforce dam and levee standards directing owners to repair or remove non-federal dams or levees. The Corps and other federal agencies must operate and maintain the dams they own, but have no authority to force other entities to properly build or maintain those dams. There are some effective state dam safety programs, but all states need such programs.

The National Dam Safety Program in FEMA has been successful in assisting states set priorities for increasing the number of dam inspections and developing Emergency Action Plans. ASDSO indicates annual inspection percentages for high hazard dams have been near 100% for the past several years. Those inspections have shown that many dams are deficient and need repair, upgrading or removal. Funding for rehabilitation/removal of high hazard dams is often necessary to assist dam owners in making these necessary public safety upgrades.

The emergency action plans (EAP) percentage for state-regulated high hazard dams has reached 78%, a significant improvement from less than half about 10 years ago. Important work remains. The incident at Oroville Dam in California illustrates the importance of a strong EAP to help protect people in situations when operation of a dam does not go as planned. The NDSP has developed tools that provide low-cost alternatives to states and dam owners in the development of EAPs and also supported training on EAPs and dam safety emergency preparedness for dam owners, regulators and local officials.

Full funding of the NDSP is important to public safety to help ensure continued progress in inspection and identification of deficient dams and in the development of EAPs.

States should get credit for effective dam and levee safety programs under any disaster deductible that is being discussed as part of the Disaster Relief Act aimed at reducing federal disaster costs. Effective state dam safety and levee safety programs definitely reduce the cost and need for federal disaster declarations. Those state programs can be evaluated to provide credit for those that reduce risk of failure to the structure itself, and even more credit for those that address the flood risk associated with the residual risk failure zones.

- **ASFPM recommends that Congress fully fund the National Dam Safety Program to its authorized level**
- **ASFPM recommends Congress develop incentives for the creation of state laws that make inundation maps publically available and that address land use downstream of dams to prevent the intensification of downstream risk similar to the laws in Virginia and Wisconsin**

Appropriate Federal Role with Regard to Dams and Levees

The federal government has a role to help develop and oversee national standards and to provide technical assistance for the proper design, construction, operation and maintenance of dams and levees. Maintaining an inventory of dams and levees at the national level is a key data need.

We see that maintaining a structure like a dam or levee is so important, yet there is a huge failure to do that effectively by non-federal owners/sponsors nationally. This demonstrates that we should only permit dams and levees that are owned by an entity that has taxing authority and to obtain bonds or other assurances at the time of permitting to ensure that O&M and emergency repairs will be done. The federal taxpayer should not be responsible for repairing these structures if the owner/sponsor fails to do what they promised.

Stormwater Management Infrastructure

Stormwater is the accumulation of water from rainfall that is not from the overflow of streams or rivers. Most communities have stormwater systems that funnel water into pipes and usually into water bodies like rivers or streams. Managing stormwater is one of the biggest and most expensive problems facing cities across the nation. Damage due to urban stormwater flooding is increasing significantly. Consider that in Illinois and Michigan, the most costly flood events were urban stormwater events in the greater Chicago and greater Detroit areas (which is amazing in Illinois given past floods along the Mississippi River that runs along the entire western border of the state). The majority of flood insurance claims in the Chicago metro area are stormwater related. The EPA estimates funding needs for stormwater management and projects to correct sewers that overflow is in excess of $100 billion over the next 20 years.

Stormwater management infrastructure was initially developed to satisfy water quality standards and reduce pollutant loads. However, it also can reduce or increase flood risk. If undersized (as many old systems are) the stormwater management infrastructure can exacerbate flooding. However, with consideration of an area's flood potential stormwater management infrastructure can be designed to have co-benefits that improve water quality and reduce flooding impacts. Further, stormwater management infrastructure is often categorized as gray or green. "Traditional" gray stormwater infrastructure consists of engineered structures such as pipes, storm drains and concrete paved channels. Green infrastructure harnesses the power of nature to contain some of the initial runoff and includes things like permeable pavement, bio-swales, green streets, stormwater parks, etc. Green infrastructure can be paired with grey infrastructure to effectively meet a community's water quality goals and flood loss reduction goals. For example, with green infrastructure, demand on the existing gray infrastructure is reduced thereby raising the capacity of the gray systems.

Too often, stormwater programs and floodplain management programs are not integrated, even at the local level. This may be partly due to the programs coming to the local community in separate stovepipes—stormwater from EPA focused on water quality and flooding concerns focused on water quantity from either FEMA or USACE. An example of this disconnect is that the NFIP will provide flood insurance for stormwater flooding, but it does not map these risk areas or require communities to ensure development in them is properly protected.

- **ASFPM supports USEPAs ongoing leadership in developing tools and data as it relates to stormwater management, green infrastructure and flood loss reduction**

- **USEPA, USACE and FEMA should collaborate to address the disconnect between water quality and quantity that results in exacerbating current problems for one while mitigating the other**

Nonstructural Flood Mitigation Infrastructure

Aside from the three major categories above, there are other important components to the nation's overall flood risk reduction infrastructure that don't involve large flood control structures:

- Environmental restoration. These projects can be done in conjunction with other infrastructure projects such as levees. An example of such a project is when an existing deficient levee is replaced by a levee set back from a river channel and the land between the new levee and river is restored to a natural floodplain. Such natural floodplains serve to store, slow and filter water while providing water resources and the setback levee cost is reduced because it is subject to less erosion from the river and because it is on higher ground doesn't have to be as high to provide a specified level of protection.
- Floodproofing. Utilities such as water and wastewater treatment plants, as well as public buildings and other facilities can often be floodproofed through elevation, or making them watertight through floodproofing, or can be relocated to safer areas. Many of these may be critical facilities and if they are not functional during and after a flood the community greatly suffers. A source of largely shovel ready projects that have also been found to be cost effective is the FEMA Hazard Mitigation Assistance Program[1]. Typically there are about three times the numbers of projects submitted for HMA grants than there are funds available to implement these cost saving measures.

- **For the infrastructure package under consideration by the Administration and Congress, ASFPM recommends the inclusion of environmental restoration projects that help reduce flood losses as well as projects eligible under FEMA's Hazard Mitigation Assistance program**

Other Ways the Federal Government Can Help

While mapping flood risk areas and investing in flood risk reduction infrastructure are two major ways the federal government can help with reducing flood risk in the nation, there are other important ways the federal government can help.

First is to focus on building state-capability to manage flood risk. One trend we are seeing overall is that while the federal and local governments (and some states) are investing in flood risk management, many other states are not. ASFPM believes federal programs that help build state capability such as the National Dam Safety Program, National Levee Safety Program and the Community Assistance Program-State Services Support Element (CAP-SSSE) should be not only funded to their full authorized amounts, but also ensure they are being administered in such a way to incentivize states to bring as much as possible to the table. As stated earlier in this testimony, states have the ultimate authority over land use

[1] FEMA HMA projects also can include stormwater management projects and smaller/localizes flood protection projects such as retention/detention basins, channel modifications, etc.

(it is often delegated by states to communities) and many flood risk reduction programs are coordinated at the state level.

Second is providing technical assistance. FEMA's CAP-SSSE program helps build state capability by using states to provide technical assistance to communities. The Corps' Silver Jackets program is an innovative way of bringing the technical know-how of the federal family of agencies to states. Finally, small technical assistance programs like the USACE's Planning Assistance to States (PAS) and Floodplain Management Services (FPMS) are often oversubscribed, yet allow the Corps expertise to be applied in states and communities nationwide. ASFPM also supports the newly introduced Digital Coast Act (S. 110), which provides data and tools to coastal managers dealing with flooding and other coastal risks.

- **ASFPM recommends that technical assistance programs of the USACE (FPMS, PAS, and Silver Jackets) be expanded to meet demand from states and communities**

Third, there are many federal programs that actually act as disincentives to states, communities and individuals in reducing flood risk. For example, if a community does not participate in the NFIP – the most basic action any community can take to reduce flood risk, most forms of disaster assistance are still available. And even if it were unavailable, communities have six months after a disaster declaration to join the program and receive the assistance retroactively. Instead, what if federal policy were such that no disaster assistance in any form for anywhere in the community was available if the community didn't participate in the NFIP? This is why ASFPM is so supportive of the FEMA disaster deductible concept. At its core, it tries to incentivize states to take its share of responsibility of reducing flood risk and those that do more pay less of a deductible. Another example of a disincentive is the Corps of Engineers PL 84-99 program, which allows non-federal levee owners to shift much of the cost of ongoing maintenance of the levee after a disaster to the federal taxpayer without really requiring much of anything in return in terms of actions to more permanently reduce flood risk.

Finally, recognizing that Congress and the administration are looking to reform the U.S. Tax Code, ASFPM believes that tax incentives can be very beneficial. ASFPM is supportive of any of the following six ideas:

1. Exempt all flood loss reduction projects at the federal, state and local level from federal taxation.
2. Reform the casualty loss deduction to better target the deduction as well as incentivize those that have mitigated.
3. Develop a hazard mitigation tax credit much like the energy efficiency tax credits that are given to property owners.
4. Revise the historic rehabilitation tax credit to authorize hazard mitigation and extend to private historic homes.
5. Support the concept of a disaster savings account to support mitigation activity.
6. Develop a tax deduction to reduce flood insurance premiums for low to moderate income property owners who struggle with flood insurance affordability.

Conclusion

Flood risk reduction in the U.S. has relied on a multi-faceted set of measures. This includes structural approaches, such as levees, flood walls, dams and channels. Nonstructural methods such as ensuring development in flood hazard areas are built to reduce flood damage; using regional or watershed based stormwater retention ponds; land use management and hazard mitigation for individual structures in the form of elevation, buyouts or flood proofing. The nonstructural programs involve elements of the National Flood Insurance Program and Hazard Mitigation Grant Program authorized by the Stafford Act. They also include programs from agencies like USDA and others whose watershed conservation programs support utilizing nature-based approaches to reduce flooding. The Corps of Engineers works with non-federal sponsors on water resources projects to reduce flood losses and provide technical assistance to states and communities through programs such as Silver Jackets.

ASFPM recently updated our publication *National Flood Programs and Policies in Review* (*http://www.floods.org/ace-images/NFPPR_2015_Rev8.pdf*), which puts forth our positions on a variety of national programs and policies that can either help or hurt the nation's ability to reduce flood risk and damage. Section 2, beginning on page 24, highlights multiple flood loss reduction programs and policies in a variety of agencies, and on page 40, section *Structural Projects—Balancing Economics, Environment and Equity* discusses levees, dams and PL 84-99 Rehabilitation and Inspection Program (RIP) in USACE. We encourage you to read our positions and recommendations on the challenges of our national flood programs and infrastructure needs.

The Association of State Floodplain Managers appreciates this opportunity to share our observations and recommendations with the Committee. For any further questions on this testimony, contact Larry Larson ASFPM Director Emeritus at larry@floods.org (608) 828-3000 or Meredith Inderfurth, ASFPM Washington Liaison at (703) 448-0245.

DEPARTMENT OF THE ARMY
[redacted]

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The Point of Contact for the [redacted] Corps of Engineers is [redacted]

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