AUTHENTICATED
U.S. GOVERNMENT
INFORMATION
GPO

S. HRG. 116–88

# OVERSIGHT OF THE U.S. ARMY CORPS OF ENGINEERS' MANAGEMENT OF THE SPRING 2019 MISSOURI RIVER BASIN FLOODING

## FIELD HEARING

BEFORE THE

SUBCOMMITTEE ON SUPERFUND, WASTE MANAGEMENT, AND REGULATORY OVERSIGHT

OF THE

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

UNITED STATES SENATE

ONE HUNDRED SIXTEENTH CONGRESS

FIRST SESSION

AUGUST 28, 2019—NORTH SIOUX CITY, SD

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

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

U.S. GOVERNMENT PUBLISHING OFFICE

38–366 PDF WASHINGTON : 2019

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

ONE HUNDRED SIXTEENTH CONGRESS

FIRST SESSION

JOHN BARRASSO, Wyoming, *Chairman*

JAMES M. INHOFE, Oklahoma
SHELLEY MOORE CAPITO, West Virginia
KEVIN CRAMER, North Dakota
MIKE BRAUN, Indiana
MIKE ROUNDS, South Dakota
DAN SULLIVAN, Alaska
JOHN BOOZMAN, Arkansas
ROGER WICKER, Mississippi
RICHARD SHELBY, Alabama
JONI ERNST, Iowa

THOMAS R. CARPER, Delaware, *Ranking Member*
BENJAMIN L. CARDIN, Maryland
BERNARD SANDERS, Vermont
SHELDON WHITEHOUSE, Rhode Island
JEFF MERKLEY, Oregon
KIRSTEN GILLIBRAND, New York
CORY A. BOOKER, New Jersey
EDWARD J. MARKEY, Massachusetts
TAMMY DUCKWORTH, Illinois
CHRIS VAN HOLLEN, Maryland

RICHARD M. RUSSELL, *Majority Staff Director*
MARY FRANCES REPKO, *Minority Staff Director*

---

SUBCOMMITTEE ON SUPERFUND, WASTE MANAGEMENT, AND REGULATORY OVERSIGHT

MIKE ROUNDS, South Dakota, *Chairman*

JAMES M. INHOFE, Oklahoma
RICHARD SHELBY, Alabama
JONI ERNST, Iowa
JOHN BARRASSO, Wyoming *(ex officio)*

CORY A. BOOKER, New Jersey, *Ranking Member*
KIRSTEN GILLIBRAND, New York
EDWARD J. MARKEY, Massachusetts
THOMAS R. CARPER, Delaware *(ex officio)*

# C O N T E N T S


Page

**AUGUST 28, 2019**

OPENING STATEMENT

Rounds, Hon. Mike, U.S. Senator from the State of South Dakota ..... 1

WITNESSES

Helmlinger, Brigadier General D. Peter, Northwest Division Commander, U.S. Army Corps of Engineers ..... 3
Prepared statement ..... 6
Remus, John, Chief, Missouri River Basin Water Management Division, U.S. Army Corps of Engineers ..... 13

ADDITIONAL MATERIAL

U.S. Army Corps of Engineers Omaha District Levee Breach Status and detail, updated August 21, 2019 ..... 33
U.S. Army Corps of Engineers 2019 Missouri River Flood Event—Request for Assistance ..... 35
Missouri River Basin Regulated Watersheds ..... 36
Communication: We Each Have a Role ..... 37

# OVERSIGHT OF THE U.S. ARMY CORPS OF ENGINEERS' MANAGEMENT OF THE SPRING 2019 MISSOURI RIVER BASIN FLOODING

**WEDNESDAY, AUGUST 28, 2019**

U.S. SENATE,
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,
SUBCOMMITTEE ON SUPERFUND, WASTE MANAGEMENT,
AND REGULATORY OVERSIGHT,
*North Sioux City, SD.*

The Subcommittee met, pursuant to notice, at 2:00 p.m. at City Hall, 504 River Drive, North Sioux City, SD, Hon. Mike Rounds (Chairman of the Subcommittee) presiding.

## OPENING STATEMENT OF HON. MIKE ROUNDS, U.S. SENATOR FROM THE STATE OF SOUTH DAKOTA

Senator ROUNDS. Well, good afternoon. We'll call this Subcommittee hearing to order.

Ladies and gentlemen, this spring, heavy rain and rapid snowmelt across the Midwest produced significant flooding along the Middle and Lower Missouri River Basin. The latest, August 1st, 2019, runoff projections from the Army Corps of Engineers expect 2019 to be the second highest runoff year on record with almost 53 million acre-feet of runoff.

While the total impact and damage assessments are still being conducted, a USDA report has asserted that agricultural producers were not able to plant crops on more than 19.4 million acres in 2019, the most prevented plant acres reported since USDA's Farm Service Agency began releasing the report over a decade ago.

We certainly hope there are not many more wet years quite as significant as this one; however, when wet years do occur, we need to have the ability to manage them.

Unfortunately, years like 2019 are becoming more frequent, near-record levels have occurred 3 out of the last 9 years. During periods of extreme weather conditions, the Corps' management of the Missouri River plays a critical role in mitigating damage. We believe this is best achieved by recognizing trends, making accurate projections, and reacting accordingly.

The Senate Environment and Public Works Committee has the important responsibility to maintain oversight of the U.S. Army Corps of Engineers' Civil Works program, which includes management of the Missouri River Basin. Today's Subcommittee field hearing is an opportunity to hear directly from the leaders of the Army Corps' Northwest Division on the decisionmaking process used to

manage waterflows along the Missouri River in light of the flooding in 2019 in the middle Basin—the middle portion of the Basin.

The Corps of Engineers manages the Missouri River Basin Mainstem Reservoir System, which includes six dams and reservoirs in Montana, North Dakota, and South Dakota. These six reservoirs have a combined maximum capacity of 72.4 million acre-feet in controls runoff, more approximately, half of the Missouri River Basin.

The Corps of Engineers administers the system with the guidance of the Missouri River Basin Mainstem Reservoir System Master Water Control Manual, known as the Master Manual, which outlines how the Corps of Engineers will operate the system to meet its eight congressionally authorized purposes for managing the system.

These include flood control, navigation, water supply, water quality control, irrigation, recreation, hydropower, and fish and wildlife.

In order for the Corps to fulfill its obligation of flood control, it is vital that they are equipped with the proper tools and the authority to take necessary action. Managing the system in accordance with these eight congressionally authorized purposes is always a careful balance when incorporating the needs and concerns of states in the Lower Missouri Basin with concerns of States in the Upper Basin.

However, this year, States in the upper, middle, and lower parts of the system are all asking similar questions: Are we doing the best we can to manage the storage capacity and water levels of the Missouri River system? What do we need to do differently, and how do we make necessary changes to mitigate the damages in years of historic runoff? What authorities need to be changed, and what are we doing that just doesn't make sense anymore when considering that there is a trend of rising average runoff?

As we begin, I want to thank all of the people, the good people of the Corps of Engineers, whose job it is to operate the system and who are committed to the protection of millions of people and billions of dollars in property throughout the Missouri River Basin. They live among us and in many cases are our friends and relatives and neighbors. Thank you.

To those individuals, I just want to let you know that the fact that we must ask these hard questions, these should not cause any doubt that your fellow citizens appreciate the hard work that you do every day.

As I get ready to turn it over to the witnesses for testimony, I want to give a quick overview of how this hearing will unfold. We will be receiving testimony from Brigadier General Peter Helmlinger and Mr. John Remus. And Johnny is the Chief of the Missouri River Basin Water Management Division of the Army Corps of Engineers, Northwestern Division.

Now, then, we're going to move into the questions and the answers. And additionally, I would just simply note that the microphones, as I understand them, are on right now and that they will remain on, so you won't have to look for any switches in this particular case.

Again, I want to thank General Helmlinger and Mr. Remus for traveling to South Dakota to testify and to participate in this hearing, and I look forward to a productive discussion.

With that, General Helmlinger.

**STATEMENT OF BRIGADIER GENERAL D. PETER HELMLINGER, NORTHWEST DIVISION COMMANDER, U.S. ARMY CORPS OF ENGINEERS**

General HELMLINGER. Senator Rounds, thank you for this opportunity to speak with you today about the 2019 flooding along the Missouri River Basin.

And as you mentioned, I am Brigadier General Peter Helmlinger, Commanding General for the Northwestern Division, U.S. Army Corps of Engineers, and I'm joined by Mr. John Remus, Chief of our Missouri River Water Management Division.

Today we would like to discuss how the Corps has operated in the Missouri River Mainstem Reservoir System to reduce flooding during what has been an extremely challenging year, and we also want to highlight our three phase recovery effort as we work to assess the damage and provide initial repairs so that the Lower Basin's levee systems—return those levee systems to their original level of protection and work with impacted States to identify potential ways to improve flood risk management along that reach of the river for future events.

I would first like to acknowledge the widespread devastation and serious impacts this spring's Missouri River flooding has created for many people. The flooding has displaced people in whole communities, damaged infrastructure, and shut down commerce.

Since the flooding began in March, leaders from across the Corps and the Administration have visited the region to understand the scale of the damage and to assure everyone we will do everything within our authorities to help them recover from this tragedy.

The dam and levee systems worked as designed and built. Unfortunately, this event was triggered by a very powerful storm that hit mostly downstream of the Upper Basin dams, and we were largely denied the ability to control the runoff.

Mr. Remus will discuss the mechanics of the storm and the resulting flood. But the runoff quickly overwhelmed the design capacity of the levee systems in the Lower Basin, resulting in extensive overtopping and breaches along the entire system. As a result of the storm, 850 miles of levees in Iowa, and Nebraska, Kansas, and Missouri were damaged. We are working with States and the local levee sponsors to repair the damage, but this will take time and your continued support.

We have approved 64 project information reports thus far, enabling us to obtain funding for engineering, design, and construction. Our running estimate of the cost to repair damages to levees thus far is approximately $1.1 billion, as reflected in those 64 completed project information report cost estimates. This total will most certainly increase based on 30 more projected projects, pending approval within the next few months.

As we move forward, however, we should not simply repair the damaged levees to their pre-flood conditions, which is all we are authorized to do. Instead, we need to use this opportunity to pre-

pare a holistic assessment of what improvements to the Lower Basin levee system are possible.

Let me now explain our three phase approach to recovery. Our first phase one has been the initial response. This includes activities related to identifying and enclosing critical levee breaches; and then, to protect vital infrastructure, population centers; and to stop breach flows so the river can return to its normal banks.

Omaha and Kansas City Districts began this effort through aerial reconnaissance and data collection almost immediately after the skies cleared in March. Since then, we have closed massive breaches, some 1,000 feet wide and up to 72 feet deep, in order to redirect the river into its banks and to enable the evacuation of water from the land side of those levees.

To date, we have closed 13 major breaches, and we are conducting engineering and design on 29 levee sections. And we recently awarded construction contracts for another two levees, that is Levee R–616, near Offutt Air Force Base, Nebraska; and the North Bank Elkhorn River Levee near Pierce, Nebraska.

Our phase two effort is focused on system recovery. This largely consists of our efforts to fully repair damaged levees in the Public Law 84–99 program and to bring them back to their original level of protection, as well as implement minor levee realignments where feasible. We have already received numerous requests from levee sponsors for such repairs.

Some additional levee systems will require water levels to recede further before we can accurately assess damages and complete engineering and design efforts for those levees. Although rainfall in the Midwest is causing waters to remain higher than average, field teams are increasingly able to access damaged levees and refine their assessments.

Our phase three effort is our recovery efforts focused on future actions and the challenges to reduce flood risk long term. The Corps has been meeting with State partners in the Basin all summer to discuss developing studies and products under planning assistance to States, Flood Plain Management Services, Silver Jackets, and other programs. These efforts are intended to help our regional and local partners with their specific flood risk management data, technical, and planning needs in order to inform their recovery efforts and give them the tools and knowledge to help make their flood risk management systems more resilient.

We are also discussing pursuing a more comprehensive cost shared feasibility study on the Lower Mississippi River—I just came from the Mississippi River, please forgive me—along the Lower Missouri River that would evaluate both structural and nonstructural flood risk management measures to reduce flood risk and life safety risks, increase system flood conveyance, and improve system resilience.

The geographic scope of the feasibility study would be the lower 735 miles of the Missouri River from Sioux City, Iowa, to the mouth of the Missouri River and its tributaries. The study would not examine changes to the Master Manual or other Corps Water Control Manuals and would only be looking at flood risk management measures with minimal, if any, negative impacts in navigation and other authorized purposes of the Missouri River projects.

Such a study is critical if we are to prepare for the next major flood in this Basin.

And finally, I'd like to highlight the importance of communication. Our communication with partners, stakeholders, and the public was comprehensive and wide reaching before the March flood event, and became even more robust as a result of the flood. Throughout the flood event, the Corps took numerous actions to ensure effective communication with those affected through a variety of forms.

Since March 14th, Omaha and Kansas City District Commanders have personally engaged with stakeholders on a regular basis including local, State, and tribal governments, as well as with congressional interests, to provide updates on flood conditions and recovery actions.

The Corps also began a daily update to call [unclear] for these groups and the media starting March 15th. Daily press releases also kept the public informed of changes in risk forecast, including information on any changes and releases from Gavins Point Dam. Social media platforms, including Facebook and Twitter, were also used to provide the latest updates to the public.

Stakeholder meetings, informational briefings, and public postings continue today. We understand our duties and obligations to communicate with those who are impacted by our decisions and operations. We will continue to evaluate how and when to maximize the effectiveness of the information that we share.

Senator Rounds, thank you for the opportunity to speak with you today. In closing, I would like to emphasize our No. 1 priority of the Corps in its operations is life and public safety. Our current focus remains to protect life and work with other Federal agencies, and States, and local authorities to help communities recover from this flood and to improve the system to reduce flood risk in the future. And sir, I look forward to your questions.

[The prepared statement of General Helmlinger and Mr. Remus follows:]

DEPARTMENT OF THE ARMY

U.S. ARMY CORPS OF ENGINEERS

COMPLETE STATEMENT OF

BRIGADIER GENERAL PETER HELMLINGER,

COMMANDING GENERAL, NORTHWESTERN DIVISION

AND

JOHN I. REMUS II,

CHIEF OF MISSOURI RIVER BASIN WATER MANAGEMENT

BEFORE

SUBCOMMITTEE ON SUPERFUND, WASTE, MANAGEMENT, AND REGULATORY OVERSIGHT OF THE SENATE COMMITTEE ON ENVIRONMENTAL AND PUBLIC WORKS

ON

OVERSIGHT OF THE U.S. ARMY CORPS OF ENGINEERS' MANAGEMENT OF THE SPRING 2019

MISSOURI RIVER BASIN FLOODING

AUGUST 28, 2019

Mr. Chairman and Members of the Subcommittee, thank you for the opportunity to speak with you today about the 2019 flooding along the lower Missouri River basin. I am Brigadier General Peter Helmlinger, Commanding General for the Northwestern Division, U.S. Army Corps of Engineers (Corps). I am joined by Mr. John Remus, the Chief of our Missouri River Water Management Division from the Corps Northwestern Division. Today we would like to discuss how the Corps has operated the Missouri River Mainstem Reservoir System (System) to reduce flooding during what has been an extremely challenging year from a hydrologic perspective in the basin. The Corps understands many individual have been impacted by the March 2019 flood event. We want to highlight our three phase recovery effort as we (1) assess the extensive damage and provide initial repairs to the lower basin's PL 84-99 eligible levee systems, (2) repair those levee systems, and (3) work with impacted states to identify potential ways that they can help to improve their flood risk management for future events.

Generally, the Corps operates the System consistent with eight authorized project purposes – flood control, navigation, hydropower, water supply, water quality, irrigation, recreation, and fish and wildlife. However, flood control is the highest operational priority of the Corps during periods of significant runoff, when loss of life or property from flooding could occur. The System consists of six large dams on the main stem of the Missouri River: Fort Peck in northeastern Montana; Garrison in central North Dakota; Oahe, Big Bend, and Fort Randall in South Dakota; and Gavins Point along the Nebraska and South Dakota border. Together they comprise the largest reservoir system by storage volume in North America. This System captures runoff from over half of the Missouri River drainage basin. The three largest reservoirs are Fort Peck, Garrison and Oahe. These reservoirs account for 88 percent of the total System storage, and 84 percent of the total flood control storage. Fort Randall Reservoir in south central South Dakota contains 8 percent of the total System storage and 14 percent of the total flood control storage. The Big Bend and Gavins Point projects are relatively small re-regulation projects that contain the remainder of the System storage.

Nearly all of the storage volume (roughly 99 percent) is in the upper five of these dams. While the System is quite large, it cannot hold back runoff that falls in the Missouri River watershed below these five dams. That is where most of the rain from the March 2019 storm, which flooded the lower Missouri River basin, fell.

The Corps designed the Mainstem Reservoir System to capture runoff from mountain and plains snowpack, and rainfall in the upper basin that could otherwise (in the absence of the reservoirs) result in flooding, and then release that water gradually over the year, helping to serve the other seven authorized project purposes. The intent is to do this in a way that will also provide the greatest amount of flood risk reduction downstream. The Corps achieves this objective by evacuating all of the water in the System's designated flood storage space before the beginning of each year's runoff season to create storage space needed for that year's runoff. The 2018 Missouri River Master Water Control Manual describes the operating regime of this System. The master manual guides how much water the Corps will release from the System's six

reservoirs, when it will release that water, and for how long it will release it from the System over the course of the year, consistent with the eight authorized purposes, while maintaining compliance with all Federal laws.

As of July 31, 2019, the runoff in the upper Missouri River basin for this year is 45.3 million acre-feet (MAF), surpassing the 42.2 MAF in 2018, making 2019 already the third highest runoff on record. Including the projected August 2019 runoff forecast for the upper basin, the runoff for the year would total 52.9 MAF, which, if realized, will be the second highest on record. Only the 2011 runoff of 61 MAF would be greater.

In order to make operational decisions, the Missouri River Basin Water Management Division produces a short-range reservoir operations forecast that is commonly referred to as the "3-week forecast." Information contained in the 3-week forecast includes average daily inflows, average daily releases, reservoir elevations and hydropower generation for each of the six mainstem projects, as well as forecasted total System storage. Each forecast extends from the forecast date for a period of 24 days. The 3-week forecast is issued every Wednesday, and more often if conditions require it.

The three week forecast is developed based on a combination of observed tributary flows, Missouri River flows and the long-range monthly reach inflow forecast. Because observed flows can only be routed for a few days into the forecast period, inflows are extrapolated utilizing the monthly reach inflow forecast, and are adjusted based on the most recent conditions. The long range runoff forecast is updated at the beginning of each month, and more often if needed, and is based on current conditions and long-range trends in the upper Missouri River basin. This 3-week forecast is used as a tool to manage risk on a System-wide basis.

In large runoff years, such as 2019, or during an extreme hydrologic event, such as the bomb cyclone that struck Nebraska, Iowa and South Dakota in March 2019, the flood control objective drives the Corps operational decisions for the System. During average or below-average runoff years, the Corps generally operates the System for flood control and to meet flow targets in the lower river, for other purposes, such as navigation.

The flooding that has occurred and continues to occur on the lower Missouri River is not the result of a single event, but rather a series of events as discussed below.

In mid-March 2019 a storm with the characteristics of a "bomb cyclone" struck Nebraska, western Iowa and southeastern South Dakota. This storm dumped 2-4 inches of rainfall on top of a plains snowpack that contained 2-8 inches of snow water equivalent (SWE). Furthermore, the soils in this area were very wet and frozen to depths exceeding two feet. This combination of conditions caused a rapid snowmelt, and extreme runoff. Within 48 hours, over 40 stream gages in the impacted area set records for stage and/or discharge. The level of runoff from the Niobrara River led to the failure of Spencer Dam, a non-Federal dam. The Corps increased releases from Gavins Point Dam to 100,000 cubic feet per second (cfs) for a short period to prevent

overtopping the gates. Discharges from the Platte River, Big Sioux River and streams in western Iowa cause levees downstream of Omaha, Nebraska to overtop and fail. During this event and for several days following it, the Corps stopped releases from Fort Randall Dam completely to lessen flooding downstream of the system.

The bomb cyclone that hit in mid-March 2019 also produced between an additional 2 inches and 4 inches of SWE in western and central South Dakota and southern North Dakota. In April 2019, the plains snowpack began to melt relatively rapidly. This rapid melt, combined with rainfall and frozen soils led to rapidly rising pools at Oahe and Fort Randall reservoirs, required the Corps to release higher than average amounts of water from these projects. Incremental inflows between Fort Randall and Gavins Point Dams remained high due to continued rainfall, primarily in the Niobrara River basin. These circumstances led the Corps to increase System releases from Gavins Point Dam, eventually to 75,000 cfs.

In May 2019, rainfall in South Dakota was 300 to 500 percent of the historic average. This kept the James and Big Sioux Rivers near or above flood stage for most of the month. Runoff into the Oahe and Fort Randall reservoirs was 500 percent and 950 percent of the historic average, respectively. This resulted in the pools at Oahe and Fort Randall entering their exclusive flood control zones. The exclusive flood control zone is the top portion of the flood pools at each reservoir. The pools at Oahe and Fort Randall remained in the exclusive flood control zones for several weeks, and Oahe still remains near the exclusive flood control zone as of mid-August 2019. In response, while the Corps was able to limit the releases from Fort Peck and Garrison Dams to minimal levels, we released higher than average amounts of water from Oahe and Fort Randall. During this period, our objective was to manage the six pools in a way that provided the ability to react to an extreme localized runoff event without significantly increasing the flood risk downstream or creating any dam safety concerns. System releases through Gavins Point Dam reached 75,000 cfs. In the lower basin rainfall in May 2019 was widespread and above normal, particularly in Kansas, which experienced the wettest month on record. This precipitation, combined with the sustained higher than average System releases, led to flooding on the Missouri River from Blair, Nebraska to the mouth.

The mountain snowpack, which was nearly average, began melting in May 2019, but the bulk of the melt took place in June 2019. This began to fill the Fort Peck and Garrison reservoirs. Above average precipitation in the upper basin added to the runoff. Runoff in the upper basin was 160 percent of average, causing the pools at Fort Peck and Garrison to enter their exclusive flood control zones. This led the Corps to increase the average daily outflows from Fort Peck, Garrison, Oahe and Fort Randall. At the beginning of June 2019, System releases at Gavins Point Dam were 75,000 cfs. The Corps was able to reduce them to 70,000 cfs toward the end of the month as the incremental flows from the Niobrara River declined. In the lower basin rainfall in June 2019 continued to be above average. This precipitation, combined with the sustained higher than average System releases, led to flooding on the Missouri River from the confluence of the Platte River to the mouth.

July 2019 runoff in the upper basin was 213 percent of average. Fort Peck and Garrison pools remained in their exclusive flood control zones for the entire month. The Corps maintained System releases at Gavins Point Dam at 70,000 cfs. Rain storms, particularly in Kansas and Missouri, resulted in higher than average inflows from tributaries.

For the first 10 days of August 2019, runoff in the upper basin has trended above the forecast. If this trend continues the current System release of 70,000 cfs will need to be sustained into September 2019 in order to evacuate all the water currently stored in the designated flood control zones, to position the system for runoff next year in the 2020 flood season.

As stated earlier, during high runoff years System operations are driven by the flood control purpose. Due to extreme runoff in 2018 and 2019, the principal and sole focus of our operational decisions for much of the last 18 months has been on using this System of reservoirs to reduce flood risks.

As already described, the March 2019 bomb cyclone storm event resulted in significant discharges from the Platte River, Big Sioux River and streams in western Iowa, which all flow into the Missouri River downstream of our System, and caused many levees downstream of Omaha, Nebraska to overtop and fail. The damage incurred by this event was exacerbated by the continued high runoff throughout the Summer of 2019, resulting in an estimated 1,022 miles of damaged levees (277 miles Federal levees, and 745 non-federal levees), to includes over 134 breaches (51+ breaches in 11 federal levees, 83+ breaches in 43 non-federal levees), throughout the basin.

Phase 1 of the Corps recovery efforts has been the Initial Response. This includes activities related to identifying and then closing levee breaches that we identified as critical, to protect vital infrastructure, population centers, and stop the breach flows so the river would return to its normal banks. Most of the Phase 1 efforts are initial repairs to PL84-99 eligible levees. However, in some cases on non-PL84-99 levees, where breaches are posing a considerable threat to critical infrastructure or large population centers, we have assisted by constructing emergency closures. (For these non-PL84-99 levees, the non-federal sponsor is responsible for follow-on repairs.) Omaha and Kansas City Districts began this effort through aerial reconnaissance and data collection almost immediately after the skies cleared in March 2019. Since then, the Corps has closed massive breaches, some over thousands of feet wide and up to 90 feet deep, in order to redirect the river back into its banks and enable the evacuation of water from the landside of these levees.

For the Omaha District, the current status of Phase I efforts in Iowa and Nebraska include having closed four of six critical breaches on the following levee systems: 1) L594 South of Bartlett in Fremont County, Iowa on June 12, 2019; 2) L611-614 near Council Bluffs, Iowa on June 12, 2019; 3) two large inlet breaches on L575, one on June 20, 2019 and the other on August 16, 2019; and 4) L601, near Bartlett, Iowa on

July 3, 2019; L550 near Watson, Missouri, sustained two critical breaches, one which is anticipated to be closed by the end of August 2019 and the other by the end of September 2019.

For the Kansas City district, the Corps was able to begin work in August 2019 in Holt County, Missouri, near Corning, to execute temporary emergency measures to close massive breaches at Big Tarkio River and Mill Creek. Rock deliveries and placement to nearby Missouri towns will take approximately 10 weeks to complete. The Corps expects the contractor to complete all work at this location in October 2019.

Phase 2 of the Corps recovery efforts is focused on recovery. This largely consists of efforts to repair damaged levees participating in the Public Law 84-99 program (PL 84-99), including the evaluation of minor levee realignments where appropriate. The Corps has already received numerous requests from levee sponsors for such repairs. In some cases, water levels will need to recede further before the Corps can accurately assess damages and undertake engineering and design efforts. Although rainfall in the Midwest is causing waters to remain higher than the average, field teams are increasingly able to access damaged levees to refine the initial damage assessments. The current focus is to develop Project Information Reports, or PIRs, to frame repair strategies and evaluate the economic feasibility of repairs for PL84-99 eligible levees. The Corps has approved 64 PIRs thus far, enabling funding for subsequent engineering, design, and construction. At this time, the Corps is conducting engineering and design on 29 levees. In August 2019, the Corps awarded construction contracts for another two levees -- R616 near Offutt Air Force Base, Nebraska, and the North Branch Elkhorn River Levee near Pierce, Nebraska. The Corps anticipates that contractors will mobilize to those sites before the end of August 2019.

Phase 3 of the Corps efforts working with tribal, state, and local partners in the basin to help them to reduce their flood risks. At this point, the focus of this effort is on identifying assistance that the Corps can provide through our Planning Assistance to States and our Floodplain Management Services program, and through the interagency Silver Jackets program. These efforts can help tribal, state, and local partners with their specific flood risk management data, technical, and planning needs in order to inform their recovery efforts and give them the tools and knowledge to help make their flood risk management systems more resilient.

As part of our normal operations, the Corps regularly shares information with Federal, Tribal, State and Local elected officials, partner agencies, emergency managers, and levee sponsors, and media outlets, as well as the general public through a variety of communication tools including websites, social media, emailed news releases, webinars, conference calls, and public meetings. It is important to identify communication gaps and close them. We work together to ensure an understanding of communication roles such as issuing alerts, warnings and evacuation orders. Throughout this flood event the Corps has strived to quickly communicate information to state, local government and the public, and engage stakeholders at every level to assist with decision making and provide an understanding of developing events. As the March

2019 event unfolded, division and district Representatives began daily engagements with local, state, and regional stakeholders. In addition to the districts' regular face-to-face meeting with local levee sponsors and public officials, they have held weekly telephonic meetings with local stakeholders, to include representatives of the media, congressional delegations, as well as other local public and tribal officials. The Corps has also met with congressional Members and State governors, as well as their respective staff. These meetings are a forum to gain a mutual awareness of ongoing activities, to understand their concerns, and to share perspectives on options for improving management of the flood plain in the future. As such, throughout the year, the Corps plans to continue to reach out to the people who live and work in these river communities and their representatives to provide technical assistance and to help them plan their future actions.

Senator ROUNDS. Thank you.

Mr. Remus, did you have an opening statement as well?

**STATEMENT OF JOHN REMUS, CHIEF, MISSOURI RIVER BASIN WATER MANAGEMENT DIVISION, U.S. ARMY CORPS OF ENGINEERS**

Mr. REMUS. I did, thank you.

Good afternoon, Senator Rounds, and thank you for the opportunity to speak with you today.

I am John Remus, Chief of the Missouri River Basin Water Management Division for the Northwestern Division, U.S. Army Corps of Engineers. My staff and I are responsible for regulating the Missouri River Mainstem Reservoir System.

As General Helmlinger said, I will discuss the conditions that have led to the flooding and our operational responses to these conditions.

However, first, I would like to explain, in general, how the system was designed and is operating to provide flood control for the Basin. The Corps operates the system consistent with the aid authorized purposes of flood control, navigation, hydropower, water supply, water quality control, irrigation, recreation, and fish and wildlife. The system includes six large dams and reservoirs, and comprises the largest reservoir system by storage volume in North America.

While the system is quite large, it is important to note that 98 percent of the system storage is upstream of the Gavins Point Reservoir; therefore, the system cannot capture and manage significant runoff that enters through the river below the storage reservoirs. The Corps designed a system to capture runoff from mountain and plains' snowpack, and rainfall in the Upper Basin that could otherwise, in the absence of the reservoirs, result in flooding, and then release that water gradually over the year. This provides the maximum amount of flood risk reduction while serving all authorized purposes.

The Corps did not design, nor do we operate, the system to carry over floodwater from one year to the next. We operate the system in accordance with the 2018 Missouri River Master Water Control Manual, consistent with the authorized purposes, while maintaining compliance with all Federal laws.

In large runoff years, such as 2019, or during an extreme hydrological event, the flood control objective drives the Corps' operational decisions for the system. During average or below average runoff years, the Corps operates the system for flood control and to need flow targets in the Lower River for other purposes, such as navigation.

As of July 31st, 2019, the runoff in the Upper Basin has been 45.3 million acre-feet, surpassing the 42.2 million acre-feet in 2018, making 2019 already the third highest runoff on record. The projected—as of August 1st, 2019, the projected runoff in the Upper Basin is 52.9 million acre-feet, which, if realized, would be the second highest runoff on record. Only the 2011 runoff of 61 million acre-feet would be greater.

My office uses a number of tools to inform our operations and one of those tools is the Short-Range Reservoir Operation Forecast,

that is more commonly referred to as the 3-week forecast. The information contained in the 3-week forecast includes average daily flows; average daily—excuse me, average daily inflows; average daily releases; reservoir elevations; and hydropower generation for each of the six Mainstem projects, as well as a forecasted total storage volume.

The 3-week forecast is issued every Wednesday, and more often if conditions require it. The 3-week forecast is developed based on the combination of observed tributary flows, Missouri River flows, and the long range runoff forecast. The long range runoff forecast is updated at the beginning of each month, and more often if needed, and is based on the current conditions and long range trends in the Missouri River Basin. The 3-week forecast is usually the tool to manage risk on a systemwide basis.

The flooding that has occurred and continues to occur on the Lower Missouri is not the result of a single event, but rather a series of events. I will briefly discuss these events. In March, a bomb cyclone dumped 2 to 4 inches of rain on top of a plains snowpack that contained 2 to 8 inches of snow water equivalent. Furthermore, the soils in this area were very wet and frozen to depths exceeding 2 feet. This combination of condition caused a rapid snowmelt and extreme runoff.

The runoff, primarily from the Niangua River, require releases from Gavins Point Dam to be increased to 100,000 cubic feet per second for a short period of time to prevent overtopping the gates. The tributary inflow from below the system caused levees downstream of Omaha, Nebraska, to overtop and fail. During this event, and for several days following this event, releases from Fort Randall Dam were shut off completely in an attempt to lessen the flooding downstream of the system.

The bomb cyclone also produced an additional 2 to 4 inches of snow water equivalent in South Dakota and North Dakota. In April, the plains' snowpack began to melt relatively rapidly, leading to rapidly rising pools at Oahe and Fort Randall Reservoirs, which required higher than average releases from these projects. Incremental inflows between Fort Randall and the Gavins Point Dam remain high due to continued rainfall, primarily in the Niangua River Basin. These circumstances required increased system releases from Gavins Point.

In May, rainfall in South Dakota was 300 to 500 percent of average. Runoff into the Oahe and Fort Randall Reservoirs was 500 percent and 950 percent of average, respectively. This resulted in the pools at Oahe and Fort Randall entering their exclusive flood control zones. The pools at Oahe and Fort Randall remained in exclusive flood control zones for several weeks, and Oahe still remains near the exclusive flood control zone.

These circumstances required minimal releases from Fort Peck and Garrison Dams and higher than average releases from Oahe and Fort Randall in order to manage the pools without increasing flood risk downstream or creating any dam safety concerns. System releases reached 75,000 cfs in May.

In the Lower Basin, the rainfall in May was widespread and above normal, particularly in Kansas, which experienced the wettest month on record. This precipitation, combined with the sus-

tained higher than average system releases, led to flooding on the Missouri River from Blair, Nebraska, to the mouth.

The mountain snowpack, which was nearly average for the most part, melted in June. Above average precipitation in the Upper Basin added to the runoff. June runoff in the Upper Basin was 160 percent of average, causing the pools at Fort Peck and Garrison to enter their exclusive flood control zones. This, in turn, required the average daily outflows from Fort Peck, Garrison, Oahe, and Fort Randall to be increased. At the beginning of June, the system releases were 75,000 cubic feet per second and were reduced to 70,000 cubic feet per second as their incremental flows from the Niangua River declined.

In the Lower Basin, the rainfall in June continued to be above average. This precipitation, combined with the sustained higher than average system releases, led to the flooding on the Missouri River from the confluence of the Platte River to the mouth.

The July runoff in the Upper Basin was 213 percent of average. The Fort Peck and Garrison pools remained in their exclusive flood control zones for the entire month. The system releases at Gavins Point were maintained at 70,000 cubic feet per second. The rainstorms, particularly in Kansas and Missouri, resulted in higher than average inflows from tributaries.

For the first 3 weeks of August, runoff in the Upper Basin has trended above the forecast. If this trend continues, the system releases of 70,000 cubic feet per second will need to be sustained well into September and possibly longer in order to evacuate all the water currently stored in the designated flood control zones.

Due to extreme runoff in 2018 and 2019, our operational decisions for the last 18 months have been driven by life safety and loss of property concerns. During this critical period, our principal and sole focus has been on the flood control purpose of the system. For example, considerations related to the endangered species, the endangered fish and birds in the Mainstem did not influence our reservoir operations during this time.

I appreciate this opportunity to be here today and look forward to answering your questions.

Senator ROUNDS. Thank you, sir.

I've got a series of questions. Normally when we're in Washington, we're limited, each member, to 5 minutes. And then, after that, you go around until you're done and then you start over again. These gentlemen aren't that fortunate today because I'm the only one here, and that means that I'm just going to continue on for a while.

[Laughter.]

But I've got a couple formal questions that I want to work my way through, then I'm going to break it down and actually have a conversation with you about how we make this thing better long term.

General Helmlinger, you command the Division and have oversight of the District that will field the snowpack monitoring system in the Upper Missouri River Basin. This capability was authorized in the 2014 Water Resources Development Act. It's also known as the WRDA and has long been a priority of mine.

I had language included in the 2016 WRDA, a bill that directed the U.S. Army Corps to be the lead agency for coordinating the soil moisture and snowpack monitoring network in the Upper Missouri River Basin. I was also able to have an amendment included in the 2017 Senate Energy and Water Appropriations Bill that would have provided the Corps with $2 million to begin implementation of the snowpack monitoring program.

The snowpack monitoring system will provide your water management team with more precise information on the volume of water entering the system, which will enable them to make better decisions on reservoir releases. This is something that was recommended in the 2011 flood review and will make the citizens of every State in the entire Missouri River Basin safer and more secure. And by the way, that was a Corps of Engineers' recommendation.

General HELMLINGER. Yes.

Senator ROUNDS. As I am sure you are aware, I have been working very closely with Assistant Secretary of the Army, R. D. James, to assure that lack of funding will not be a factor in the implementation of the system over the next 2 years.

John is smiling over there, I see.

[Laughter.]

Senator ROUNDS. Funding for the initial procurement of the equipment was put in place months ago. Major General Spellmon gave me his commitment to personally review the plan at a hearing in March, and this will be a priority topic for my meeting with the Chief of Engineers next month.

As the Commander of this area of operations, though, can you provide us with an update of where we currently stand with respect to reaching the execution milestones of implementing the system, and can you tell me when we expect to install and be receiving data from the snowpack monitoring system?

General HELMLINGER. Yes, Senator. So, first, let me thank you for championing this effort because it is an important project that will improve our ability to forecast runoff, and therefore, continue to ensure the safety of the entire system.

As you recognize, Senator, when we first received the authority, we did not have the appropriations with it. But we now have funds supporting it, and we're currently developing our plan for implementation. My District Commander, Colonel John Hudson, will be able to brief you in detail in October once we complete our detailed plan, as to the scope, the cost, and the schedule for implementation.

But I'd like to share with you now just the broad concept to implement that. So, we are pursuing this in a three phase effort. The first phase is the quick win and what we can do soonest, and that's to add additional sensors to the existing mesonet sites across the region. They are across five different States. There are approximately 180 existing sites across the region, and our first plan is to add sensors to those locations.

Our second phase, then, is to focus on the Cheyenne River Basin, to install the snowpack and moisture sensors along that Basin as a priority effort. Once we finish with that Basin, we'll complete the rest of the region.

The end state is to have these stations installed—500, 600 stations installed across the region. The implementation time will take several years to implement on that, and I appreciate that you're championing for funding for this.

But a lesson that we learned from New York is we don't want to rush into this. We want to take the lessons learned as we implement our first stations, so that we can incorporate those into follow on ones. But we'll brief you again in October on our comprehensive plan for this.

Senator ROUNDS. Well, I know that the equipment is being tested at this point at South Dakota State University, and so I know that we're moving forward with the project, but it leads into my next question a little bit, and I think we're talking about the same approach. But there's a maxim in the Army that says that you should be working smarter, not harder. And I think that's an appropriate thing to be looking at here, the Corps of Engineers in this particular issue, as well.

I've been told that there is a great opportunity to leverage the existing monitoring stations operated by universities in the Upper Missouri River Basin. And I'm not sure if that's the same grouping that you're referring to, but I'm very happy to hear, if that is the case, that you are pursuing that at this time. I also understand that they are capable of being upgraded to meet the standards that we would need in this particular case.

I just want to make sure that if that is the case, whether this is the same system that I'm referring to that's operated by the university system that you're referring to as well?

General HELMLINGER. If Mr. Remus can assist me in this.

Mr. REMUS. Yes, Senator, South Dakota has a mesonet, Nebraska does, North Dakota has the same thing. It's not called a mesonet. They are basically soil moisture monitors on sites.

Senator ROUNDS. Right.

Mr. REMUS. We plan to upgrade the soil moisture monitoring where needed and then add to the snowpack to those sites. And we're going to count very heavily on the universities to help us there.

The South Dakota State report is finalized, and we do have that final report in, which really—the testing of the equipment is over. Now we know what we need, what's the best equipment to get. So, that's the next phase is getting that equipment.

The difficulty with that is that this isn't something you go to RadioShack and buy. This is some fairly sophisticated equipment. There is just, you know, the supply issue there. So, that's going to be the initial limiting factor there.

And as General Helmlinger said, we've consulted the State of New York. We put in a snowpack and soil-moisture monitoring. They were very similar to what we've come up with. And their lesson learned was: Do it; learn what you need to learn, and keep going; don't try and do it all in 1 year, because they put it in all in 1 year. Their costs went way up, and then they went back and redid it. So we're——

Senator ROUNDS. Well, I'm pleased, and my understanding is that this is the same system that I'm referring to. It also sounds to me, though, that one of the issues would have been if we were

not using that separate system that's already installed out there as locations, we may very well have had a geographical placement problem that we now can, basically, look at perhaps being not a problem in terms of a slow down, what's regarding to finding and getting permission to place. And some of those have already been placed. And now this is a matter of upgrading and getting these up to the systems' capability that we need in order to get these appropriate measurements completed. Is that correct?

Mr. REMUS. That's correct. And as General Helmlinger said, there's approximately 180 mesonet sites over five States in the Upper Basin. We don't know if all of those 180—plus or minus—sites are going to be adequate for snowpack monitoring. So, we're going through evaluating those. We think that most of them will be.

So, it gives us a good start while we get the process in place for acquiring other areas. So, it's—I don't want to say it jump starts, but it gives us a little bit of a head start here while we're learning some of the other things we need to learn.

Senator ROUNDS. Well, just for the benefit, we've had a mountain pack measuring system up and operational for years. And it has been consistent, and it does a very good job of allowing the Corps to give them a measure of what their mountain snowpack has been.

But in most recent years, the plains' snowpack has been a significant part of the challenge. And one, because in many cases it occurs and changes rapidly in the spring of the year, which is when most of our moisture is received. But it limits their ability right now to be able to determine how quick or how much there is for plains' snowpack to add to the mountain snowpack melt.

And what we've been trying to do now for a number of years is to get this implemented. And I'm very pleased to hear that this is in a position to be expedited with the use of the existing, already installed system that needs to be upgraded. And that we may very well not have to work our way through trying to find additional locations, in terms of where those 180 sites that might be available for us here, that would significantly reduce the amount of trouble in trying to find new geographical locations to install these plains' sites. Is that a fair statement?

Mr. REMUS. It'll give us a head start on that, sir.

Senator ROUNDS. OK.

Mr. REMUS. On the other half of your question, how soon will we be getting data? When we install a site, we're going to be getting data from that site the next day. So, as we install these this fall and into the winter, we should be seeing data from those the next day. The National Oceanic and Atmospheric Administration has already agreed to manage the database for us, so.

Senator ROUNDS. Very good.

And General Helmlinger, historical average runoff into the Missouri River system, based on 120 years of recorded data, is, as testimony has already indicated, just over 25 million acre-feet. However, over the past 10 years, the average runoff into the Missouri River system is 33.5 million acre-feet, and this does not include 2019, which projects to be the second highest year runoff ever recorded and more than doubles the average annual runoff.

Yet in March of this year, your projected total runoff was 28.4 million acre-feet for the year. As of August 1st, the total runoff was already 52.9 million acre-feet, which is 186 percent over your March estimate.

And this is not a new trend. In 2011, the Corps projected 29.8 million acre-feet of runoff, yet the actual total runoff was 61 million acre-feet, 145 percent over the March estimate. Last year, those numbers were 29 million acre-feet projected and 42 million acre-feet actual, 145 percent over.

And I've got some charts up here, and I just want to point out, just in terms of these wet years, the difference between what you're projecting, then, maybe versus—what, this is the third one over, the one closest to me, showing the annual runoff—over—above Sioux City in terms of the projections versus the actuals.

In your estimation, are there improvements that can be made to your method for predicting runoff, and can those changes be made today, or will they require an update to the Master Manual?

And Mr. Remus, I know that you follow this regularly. Your 3-week projections are typically released once a week and tend to be the most accurate in the first few days after the projection, naturally. How difficult would it be to put out those projections more often, and would it be worthwhile to do? And to what extent are the 3-week forecasts, in an effort to provide transparency in decisionmaking, compare to being methods of producing the decisions with regard to waterflow, or are they the same thing?

General Helmlinger.

General HELMLINGER. Well, Senator, so I'll begin. And the water events in the Midwest are becoming more frequent and intense. The National Weather Service has documented it.

We do incorporate each year's weather pattern into our total running record of 128 years—121 years that—and we compare—and so we adjust our new average baseline every year based on that. But we are making incremental improvements every year as we get more data on there.

One of our other improvements will be, as you've alluded to, is the installation of the soil moisture and snowpack monitoring. We'll get more timely data on that. But for more detailed feedback on our projections, I have to turn to Mr. Remus.

Mr. REMUS. I just have to start with when we develop our annual runoff forecast beginning in December, we look at the conditions in the Basin, what we call water on the ground, that's snow; what we know about the mountain snowpack; what we know about the plains' snowpack; soil conditions.

And we look at the Climate Prediction Center's long range—I don't want to call it a forecast. It's their outlook as far as is it going to trend toward a wetter or a dryer 3 months, or is it equal chances, is what they call the we don't really know type situation. And that's how we build our runoff forecast.

We don't, you know, try to fit it to some average or some curve. We go with our conditions there. And an example of that: This year our March runoff forecast was 28.4 million acre-feet, which is, you know, about 3 million acre-feet above normal. And that was based on the fact that on March 1st, the plains' snowpack was about average. The bomb cyclone added quite a bit of water there, the

mountain snowpack was about average, and we had wet soil conditions.

So, we figured in the long range outlook was equal chances: Maybe it's dry; maybe it's wet. We don't know. So, that's how we build our runoff forecast on April—or excuse me, March 1st this year. We only say, well, does it averag e a little more, a little less. We look at the conditions on the ground.

Senator ROUNDS. Let me just—because there's part of this which I don't understand yet, and this is General Helmlinger, in your letter to Stakeholders and Concerned Citizens that accompanied the 2018–2019 Annual Operating Plan to explain that the Operating Manual creates guidelines by applying the Master Manual to, and I quote this, "computer simulations of the reservoir system regulation assuming five statistically derived inflow scenarios based on an analysis of water supply records from 1898 to 2011." Now, this is in 2018.

Data show that average runoff into the system in the years, these scenarios, but disregarding years 2012 through 2018, 13 percent higher than the average runoff into the system. Additionally, if you look at the runoff just from the past 10 years, runoff average is, over that time, is 33.5 million acre-feet, 25 percent above the historical average.

Why does the Corps project, do they use projections that disregard runoffs totals that we accumulate after the 2012 year from their analysis? And additionally, why doesn't the Corps use trending runoff averages?

And General, if you want John to answer that, that's fine.

Mr. REMUS. We use the process I explained to you and then to bracket that with what would be an upper quartile or an upper decile, or a lower quartile or lower decile runoff year, and that's where we use the statistical averages to move—once we develop our annual runoff projection, our forecast, then we use statistics to say, well, you know, statistically, an upper decile would add this many million acre-feet or so. That's how we——

Senator ROUNDS. Sir, are you telling me that you are taking into account from 2012 to 20—no?

Mr. REMUS. Now, I'm getting to that.

Senator ROUNDS. OK.

Mr. REMUS. The reason why we ended at 2012 is there's the Bureau of Reclamation develops what we call holdouts. So, basically, it's irrigation diversion.

So it's a depletion from the reservoirs or from the runoff in the system. They only update that every—about every 10 years, so they're due to do that again in 2020. So, that's why we really don't have any—and because we have to use those same statistics from the Bureau in our holdouts.

We don't—you know, just because 2019 is going to be a very large runoff year, that doesn't mean 2020 will be a large runoff year.

Senator ROUNDS. Well, that's what I want to get into this a little bit.

Mr. REMUS. Because—2011 was the record, and 2012 was a drought.

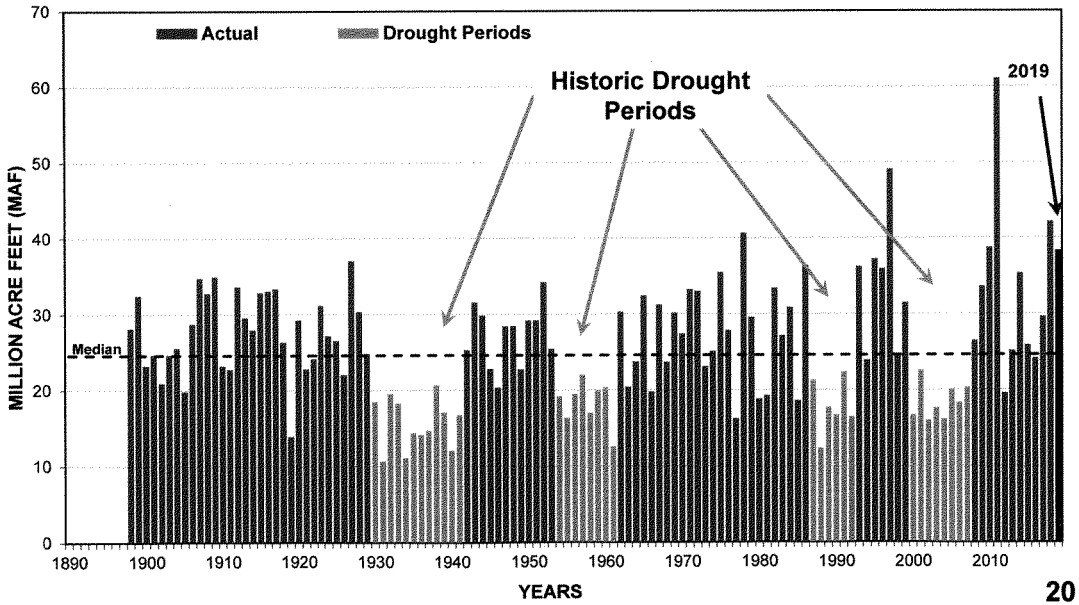
Senator ROUNDS. Yes.

Mr. REMUS. So we——

Senator ROUNDS. But let's look at this just a little bit because I want to go into the fact that—well, let's just—take a look at the trends that have occurred, and I'm going to point out beginning with my slide, the farthest one away from you, the Annual Runoff Above Sioux City, Iowa.

[The referenced information follows:]

# ANNUAL RUNOFF ABOVE SIOUX CITY, IA



Senator ROUNDS. This is a Corps' chart. The blues are where we have above average; the browns are where it's below average. There's a consistency to the inconsistency.

There's wet periods, and then they move into a dry period, and then back into a wet.

Now, granted, it is cyclical. There's a clear cyclical. We've broke it down right next to it, and I've handed out, I think, charts of the annual runoff. This is above Sioux City, Iowa. How come 1898 to 2019?

And I'm just going to work through this because I think this is worth looking at. From 1898 to 1929, the average was 27.53. From 1930 to 1941, dry period, average 15.64. From 1942 to 1953, wet year, 27.25 was the average runoff. From 1954 to 1961, down to 18.33, dry year. Up again to the next trend.

From 1962 to 1986, 27.46, above average. And then right back down to 17.81 on 1987 to 1992. And then back, turned around again, now we have a trend from 1993 to 1999; we're at 34.20 million acre-feet that have been received. And then right beginning in 2000, we go down for 7 years in drought cycle. And then coming back up again in 2008 to 2019, we're back up to 34.46.

What I'm pointing out is there is a consistency to these trending years. And yet, we always move if we're in dry years, we assume back to average. And in wet years, we still assume back to average when we start out, even if the trend is moving wetter or if the trend is moving dryer.

And it would appear to me that it would give you a lot bigger tool chest if you could, rather than always assuming average, which it appears that you do when you begin your forecast, if you could make the assumption that we are in a wet cycle. Or if we are in a drought—what, because I think the same formula or the same approach should work whether you're talking a dry year or a wet year. There's going to be a time period in which we're going to have a drought appear. When that drought comes, we don't want everybody saying, gee, everything is always assumed wetter.

But if there is a change in there—because right now when you're average, there's only a couple times that you're actually correct in your estimates, and that's during the change in the cycle, up or down. But is there a reason, or is there a possibility that in this day and age with more and more resources available to us, that we can actually begin trending earlier in the year whether we need to be releasing amounts of water from the reservoirs earlier at a higher rate, and during dry years, recognizing that in order to conserve that water for a long term purpose, upstream and downstream, that we release a lower amount during those dry years. I'm just asking the question——

Mr. REMUS. Can you explain what you mean by trending to average?

Senator ROUNDS. Yes. My understanding right now is that—and I can go all the way back—when I was working with this Governor, we had discussions about the fact that we had droughts in South Dakota. And there was a time period in which out of our reservoir systems where the Missouri River was actually back, in some case, into the original banks of the Missouri River, particularly up in the Fort Yates area in North Dakota.

During that time period, we chased water. We had water reservoirs or we had water intakes for the Cheyenne River Indian Reservation and so forth. And we actually had to extend down in deeper into the Mainstem of the Missouri because the water levels were being depleted because at that point we were still pushing water out, not at a normal rate, but it took us an extended period of time before we started to reduce because we had lower levels than anticipated as average.

But during that same time period, we were pushing out more water than what was coming in over an extended period of time. In doing so, we put a lot of folks in the Upper Basin at risk. At the same time, during times of wet periods, now we have an average that we appear to be using to start out with each year, but we're not recognizing early on that there is significant snowpack.

In fact, this year we had multiple conversations with the offices where folks on the ground up in the Upper levels were saying, We got lots of snowpack. We got lots of moisture up here. Why aren't we at least starting to release some water because we've got a huge amount that we're going to be storing up here.

And yet it appeared that we weren't in a position to be able to respond and average that water out, so that you don't end up with an increase in the amount of water coming down from the Missouri River at a time, in which it sure would have been nice if we could have slowed down the release during a time of very high water coming in from the Platte and other locations.

Mr. REMUS. Are you talking about more of the water we have stored?

Senator ROUNDS. Yes.

Mr. REMUS. OK. All right. Thank you.

Senator ROUNDS. Because that's really the only tool that you have. And let's face it, the bomb cyclone that hit this time around where the vast majority of it impacted Gavins Point and below, Gavins Point is really not a flood control device. It's a regulating device, but it doesn't have storage capacity in it. Whatever comes into it really has to come out of it.

And everything down below that, the flood control devices you've got, the levees and dikes and so forth that you have, they can control some. But when you were as impacted as you were this particular year, you really don't have a lot of tools available to you, other than what you could stop from coming through from the Upper Mainstem—the reservoirs.

If those reservoirs would have had perhaps just a slightly less amount in, recognizing that we're in a wet sequence, there may very well have been a time there in which you could have retained more for a period of time, or if you started early enough, released a higher percentage rate coming through during this wet cycle period so that you didn't have larger amounts coming through during a time in which you have the, for lack of a better term, the Oh, crap moment when we have the bomb cyclone. And this year, I recognize, clearly, you had more water down there than you could ever handle with the limited amount of capacity in the Gavins Point reservoir system itself. It just simply isn't there.

But most certainly to be able to slow down into, as we say, meter that water out, it seems to me would have been very helpful in the

locations down below, and particularly in the Omaha area, if we could have slowed down some of the releases coming out—for a longer period of time. And I just want your thoughts in terms of being able to look at, rather than average amounts, actually trending those a little bit earlier in the year that it's occurring.

Mr. REMUS. Well, as you know, Senator Rounds, no matter how warm the winter gets in Pierre, South Dakota, you get ice on the river below Oahe Dam.

Senator ROUNDS. Yes.

Mr. REMUS. And ice below Oahe, ice in the Bismarck-Mandan area, it really limits our ability to evacuate storage in the wintertime. If we push it, and right up to the limit, we can maybe get 25,000 cubic feet per second out of Garrison or Oahe. But that's running at awfully close to the limit where we are risking ice jams, which then you're not releasing anything, and you're flooding people in the time when it's going to put water in their front yard or their home and freeze.

So, we really can't begin to overdraft or do preemptive releases until the ice is gone, which is usually around the first of March in the Pierre, Fort Pierre area; in the middle of March up in Bismarck and which——

Senator ROUNDS. Let me ask a question on that, though, because——

Mr. REMUS. Yes. OK.

Senator ROUNDS. What do you use for your ice dates in the Upper Basins?

Mr. REMUS. In the Bismarck-Mandan area, it generally is the second week in December. Now this last year, December was a warm month all over the Basin. We had 80 degrees days in December. So, but they still had ice there, and it did freeze over eventually.

So, you can't count on a warm December or a warm February. So, we have to plan to have the system down to maybe a million extra feet because that's what we can get out of the——

Senator ROUNDS. Yes.

Mr. REMUS [continuing]. With the ice. So, we really need to know if we're going to start overdrafting that. We need to really kind of know that in July, really. Particularly last year because we had a very high runoff. If we were going to plan for 52.9 million acre-feet this year, we would have to have known that very early to make it around, so.

Senator ROUNDS. I won't belabor the point. But the reason why I ask the question, you do have a certain amount in which you most certainly do let out, whether it's 5,000 cubic feet or 7,000 or 9,000 or 12,000. But whatever that is, that's the amount you need to maintain during that ice period.

But if you know that in the later part of December, that might very well be 5,000 more or 7,000 more for that same time period because your ice is going to form on whatever you do put out. That's my question.

Mr. REMUS. The ice will probably not form. It's really on how much you could freeze in. And we try to freeze in at higher stages, and we just can't get it to freeze in, particularly in the Bismarck-Mandan area, about 25,000. And a little bit has to do with the

backwater effect from Lake Oahe and Bismarck and Lake Sharpe in the Pierre, Fort Pierre area.

Senator ROUNDS. Very good.

Look, thank you, and I do appreciate that.

Just a couple more questions that I've got on this that I kind of wanted to work my way through. And that is, is with regard to the infrastructure down below, the folks in the room here today, I think, have concerns about some of the infrastructure and how you're going to work this.

And General Helmlinger, you discussed this a little bit with regard to the three phase approach that you want to do. But I want to work my way through this a little bit.

And I just want to begin with talking about Public Law 84–99. In your professional military judgment, what do you need to get us out of this continual loop where the Corps rebuilds at the same standard after every significant flood even though you know that the improvements should be made to the system?

Are the constraints that Public Law 84–99 place on rebuilding too restrictive to permit an innovative reconstruction effort? Do you need additional authorities? Should any existing authorities be changed? How much does the Federal cost share and requirement from, we're at 86, slow down the pace of producing reports and engineering analysis that might be integrated into contracts that very well could provide a more resilient system?

And are there common sense improvements that you could add to designs right now with—that would not exceed the constraints of the law or the policy that Congress would have to help you with? In other words, where are we going with—you've seen it this year where you had a bomb cyclone hit. It inundated some of those areas. If you were to do them today, you would do them differently if you were starting from scratch?

Is there a restraint within the law that limits your ability? And is there something that Congress needs to do? Or is this the case of we're doing the best we can, and until such time as we have all phases ready to go, and there's really not much we can do?

General HELMLINGER. Senator, that's an excellent question. And first let me address that Public Law 84–99 and emphasize that it is an expeditionary tool to rebuild after disaster strikes. And it's a very useful tool used on many situations. There are some areas where it's cumbersome on that. One area that was recently lifted on that was the flexibility that was given through WRDA 2016, section 1176, which allows for non-Federal sponsors to pay for betterments on what repairs.

And that there are examples where rebuilding to the preexisting conditions may not be the preferred alternative for the non-Federal sponsor. And this now gives them an opportunity to pay for the difference between what the Federal Government would pay and what they are willing to pay, and [unclear] the protections required.

This, I think, this was driven off of some of the repairs that were necessary in Puerto Rico where, very fragile, and the structure was repaired, and we invested a lot of money to repair what was there, but what was there was fragile to begin with. So, if you could put a little bit more money into it for a more robust and resilient de-

sign, you won't have to spend money twice on the same repairs. So, first I'd say, we've been given a very flexible and useful tool with Section 1176 on that.

One authority that I would recommend as useful, which does not exist right now, is the authority for reimbursement of non-Federal sponsors for the Federal share of rebuilding when we know that that non-Federal sponsor has the financial and technical abilities to do the repairs themselves. At this incident alone, we had some non-Federal sponsors that had the funding, had the technical know-how and the capability to get to work right away to restore their levees. But because of——

Senator ROUNDS. Are you talking in this case counties or municipalities or other public entities?

General HELMLINGER. Yes, sir, other public entities there, but we have to wait for our funds to come online so the Federal Government can do the work. But it would be I believe, effective—it would be more efficient and faster if this work had met all of our criterias, only we didn't have the Federal funds on hand, that they could accomplish the work and that we would reimbursement them for our Federal share afterwards.

Senator ROUNDS. Let me ask this. With regard to where the levees are and the protections that are in place right now in the Middle Basin areas, areas where literally the only protection has been the building of these levees and so forth, are there areas right now, and I know that you've indicated—first of all, you've needed to do some remedial work on those today. Does that limit, then, your ability to go back in and analyze or do the studies that would suggest different placement is, perhaps, not appropriate today? Do you have the tools and resources to reevaluate the location of those? And can you talk a little about what the public discussions are that go on prior to a decision along that line being made?

General HELMLINGER. So, Senator, we have the authority to do minor realignments on levees where it makes sense. You may have one case where you had a large scour hole that covered a long length, and it may be a shorter distance to rebuild a new levee behind that scour hole so you don't have to fill that back in with material. And in doing that, we're actually improving the conveyance of the river because we're putting more distance between the two sides of the river and the levees or the banks that may be there. So that's an example of a minor improvement.

But I believe, you know, what you're alluding to is if we needed to do a larger realignment on that. We don't have that authority or ability right now to do that. Where possible, in our three phase implementation on here, we're trying to eliminate redundant work. If we can accomplish something in phase one that won't have to be redone or realigned in phase two or in our long term plan, we want to expedite those decisions so that we can get to the long term solution up front.

But we are pressed against a clock, and that clock is next year's flood season. So we want to work with our partners here to make sure that we've got a minimum of 10- to 25-year flood protection for next season so that we're prepared. And due to the timeliness of the situation, we're not really able to get into that.

Further, I want to talk about one of the cautions of P.L. 84–99 and prompt rebuilding is where it may seem intuitive to make a broader change on that. We really need time to do our due diligence and study the second and third order effects of that.

Senator ROUNDS. And that's part of why I wanted to it bring up because it seems to me that if I was a landowner or someone living along this part of the river, I'd be concerned that, No. 1, if the flood control systems that are in place right now are not adequate, I may very well have had property damage.

General HELMLINGER. Yes.

Senator ROUNDS. But second of all, if I live along this river and I have property along this river, I would be concerned about whether or not I may lose some of my property based upon a new recommendation. It seems to me, and I'm not sure whether you're prepared to discuss this or not, but could you speak to the process used and the amount of public advisory that occurs should one of these types of studies occur and recommendations coming through, what type of advanced notice and input would the public have for those types of modifications?

General HELMLINGER. Well, first, we want to gain consensus from all of the impacted States and their non-Federal sponsors that a Lower Basin flood risk management study is necessary. I do believe it is necessary, as have been demonstrated during the floods in 1993 and 2011 and this year, that the system simply does not have the capacity to carry the waters that enters the system just from the tributaries of the Lower Basin.

So, we need to do something different than simply rebuild the system that we have now. What that something different looks like, I can't speak to details on. I can speak to the generalities on the structural, which is levee rebuilding or realignment, and non-structural measures such as building heights or moving structures outside of the flood plain would be.

If we were to do that, we would certainly do the whole series of public meetings and consultation to get the plan right, and where we would want to work with willing individuals that were ready to sell land to improve the flood plain. And we know that there would be individuals that were against that. So, that's where we'd go through our deliberate planning process to make sure that we come up with the most acceptable plan possible.

Senator ROUNDS. Thank you.

Mr. Remus, I'm just going to finish with just a couple of questions and just a conversation, if we could.

This year I think you found yourself in a really tough predicament in that you had huge amounts of water coming through a system that started out with a bomb cyclone that clearly really impacted a lot of people down below the reservoir system. And I think you found yourself in a position trying to explain why you didn't really have the tools available to you to fix that. And this is an area that you live.

And at the same time, trying to explain that without the tools available to you from the Mainstem Dams because this occurred below the Mainstem Dams primarily, that there wasn't a lot that the Corps could do.

And yet, at the same time, I know that my office and other offices were making contact with your office about what you were going to be doing to try to respond to an increasing amount of precipitation and water moving into the Upper Mainstem Dams that, eventually, it's all going to come through this system.

I live on the Missouri River. I have multiple [unclear] and friends who make contact with me every day. I, personally, check the reservoir systems up and down every single day in how many cubic feet per second you're averaging out, what the water levels are on every single reservoir, how much it's going up or how much it's going down, and the total amount of flood capacity you are using. I think right now it's 10.3 million acre-feet as of this afternoon, or as of this morning.

But as I watch this, I would commend you in that with the tools that you had, I think your team has done a very good job using the tools of the Upper Mainstem Dams, you've done a very good job of keeping—not a single one of them has been run to the point where you've had to run one over the top, or that you've had to release items outside of using the traditional capacity of the power plants unless they've been down for repair, such as what will happen next week on the Oahe units. But that's been good because that meant that folks upstream from here have seen very, very high levels, but they have been manageable levels down and throughout this.

But in December and in January and in February, I think our office continued to make contact and ask whether or not there was capacity available to look at higher releases because we could see, that in case it actually rained in the Upper Basin in the spring of the year, that you could might very well be in trouble. Even without that bomb cyclone hitting, we were going to have an excess capacity of water in the Upper Basin.

What I'm looking for is within the Master Manual, within the operating constraints that you have, isn't there some way to be able to look at these very clear trends, where we have wet trends that are continuing to occur and until such time as it actually stops and moves into that drought cycle, which we will have again someday, isn't there some way to be able to, with the tools that you got, to be able to trend some of that out so that you're not sitting within inches of going over the top of Peck and Garrison and Oahe hoping that it doesn't rain in April, May, and June?

Mr. REMUS. Well, first of all, we don't ever hope that it doesn't rain in April, May, or June. We know it's going to rain in April, May, or June. I don't think we've ever had a year where it never rains there. And that we factor in, like I said earlier, we look at the Climate Prediction Center's long range outlook. I don't want to call it a forecast because they don't really forecast anything. They just kind of look at what they think it's going to be: wetter, dryer, and so on and so forth.

So, we factor that into our forecast. And then every month we develop what we call a storage check. And in that, we look at all the water that we know is in the Basin, water we have in storage, and what we think our runoff will be based on the conditions, as I've explained earlier.

OK, what do we need to be releasing from the system? That gives us a release from Gavins Point Dam for them. You know, and of

course, that will always change through the year. And if we are projecting of a wetter year, we will release more water out of that beginning as soon as we can start getting it out of the reservoirs in North and South Dakota. Once we have the release from Gavins Point Dam, then we say, OK, where do we have to take that out of the system? How do we get it from Fort Peck to Gavins Point? And that's what we use the 3-week forecast for.

And you're right, it's good for a couple of days, and then, depending on what happens—and what we do use that for is if—and then I'll give you the example: In April, when the plains' snowpack started to come off very quickly, and the pools of Oahe and Fort Randall rose very quickly, we were saying, OK, what do we need to be doing at Fort Peck and Garrison to help manage this? You know, we cut flows back to minimum out of those. So, that's what we can do in our system. Can——

Senator ROUNDS. And you hardly got Fort Peck over 15,000, if you even got it over 15,000.

Mr. REMUS. Well, we even—it's running at 15,000 now.

Now, can we say, OK, we're in a dry cycle so maybe we should release more, try to get more out in December, January, and February——

Senator ROUNDS. You mean a wet cycle.

Mr. REMUS. Or a wet cycle.

Senator ROUNDS. Wet cycle, yes.

Mr. REMUS. Yes, I'm sorry.

Senator ROUNDS. No.

Mr. REMUS. I'm just hoping, I guess.

Again, we are kind of limited, physically, as to what we can take out. And we, you know, we generally planned it, move to evacuate a million acre-feet in those 3 months. In some years we get a million out and some years we can get a little more out, but it's not really significant.

And in this year, just on where the runoff came from and how fast, it really would not have made a difference in our system releases, as we got that—you know, but up until March 15th, the plains' snowpack, although we had pockets of very heavy snow, we didn't really have overall an above average plains' snowpack.

The bomb cyclone dumped another 2 to 4 inches of water over most of South Dakota and most of southern North Dakota, which by that time it was, you know, we were in a reactionary mode.

Senator ROUNDS. Well——

Mr. REMUS. I'd actually read—so, was there something in the Master Manual? We can look at that and release more water. If we're going to start, you know, doing a trends analysis and not operating on an annual cycle, that would require a change to the Water Control Plan.

Senator ROUNDS. But on an annual cycle, you could look at where the trends are moving.

Mr. REMUS. We could look at what our runoff forecast is, and if we have a wet Basin, we generally predict more water, and we can release more if we can get it out under the ice.

Senator ROUNDS. I think I should stop while I'm ahead. Look, that's what I'm looking for. I just think that when we're trending this and there's an average and then there's a trend. And I think

if we're averaging it over the life cycle of this system, what we're finding is, is that we go either wet or we go dry, but we don't seem to take into account that we're wet and we're in a wet cycle versus dry and we're in a dry cycle. And I just think that's worthwhile in looking at the trending that's the capability now with the new abilities that we're going to have, to be able to look at what our snowpacks are and so forth.

And I understand that the ice does play a role in it, but it appears to me that we actually were able to increase by several thousand cubic feet per second beginning fairly early in the year for this year. And we were in touch with your office on March 8th, March 20th, March 28th, and April 10th of this year suggesting that we get those up faster than what we did.

Mr. REMUS. And we did that this year and last year——

Senator ROUNDS. Yes.

Mr. REMUS [continuing]. When we saw that we—the storage check gives us—basically, it sets targets downstream in Omaha, Nebraska City, and Kansas City, and there's a floor and a ceiling to those. And we can manage to the minimum, or we can manage to the maximum. We always try to manage, or at least last year and this year, to get to that maximum.

So, we knew we were going to have an above average. We didn't know it was going to be 53 million acre-feet, but we did know that, and we released toward the top of that ceiling early on as much as we could. But we did have a lot of constraints downstream.

Senator ROUNDS. Very good.

Gentlemen, is there anything that we have not touched on that you wanted to address today?

General HELMLINGER. Senator, I would just say that I appreciate the support from Congress and from our non-Federal sponsors, that as we work together to restore the levees here.

One thing we will need in the future is sufficient appropriation to continue our restoration work, our phase two effort.

And then, perhaps more importantly, is our long term phase three that we need continued support from all of our non-Federal sponsors, as well as Congress, to implement our Lower Basin flood risk management study, with the understanding that we're focusing just on the Lower Basin and its tributaries, so that we can improve the capacity or conveyance of water through that because it's clear now, as was demonstrated, that we have insufficient capacity to carry water safely through the Lower Missouri River.

Senator ROUNDS. And John.

Mr. REMUS. I just want to thank you for allowing us to come here today. And thank you for your engagement in our Basin operations.

Senator ROUNDS. I think there are days you don't appreciate that engagement.

[Laughter.]

Mr. REMUS. No, and I—no, I do. I want to thank you. I don't think I got a chance to thank you for bringing a meeting in Pierre, and getting it rescheduled, and getting us a place. I want to thank you for that because the weather kind of prevented that. But you and your staff really helped us out there, so thank you.

Senator ROUNDS. Thank you.

And General Helmlinger, I know that as you folks work through the Chairs and you, you know, coming in and out, you rely on the folks that are there doing the day-to-day work, such as John is doing and—

John, how many years have you been working now with the Corps of Engineers doing this type of work?

Mr. REMUS. I've been working for the Corps of Engineers 34 years, but I just had my second anniversary in this particular job.

Senator ROUNDS. Yes. But before that, you were working in Omaha doing——

Mr. REMUS. Water resources engineering in the Missouri River Basin.

Senator ROUNDS. It takes a while to get to the point of being able to do it. I presume you've already got other people that you're beginning to train to work through this process as well.

Mr. REMUS. Are you hinting at something?

Senator ROUNDS. No, not yet.

[Laughter.]

Senator ROUNDS. It's just when you guys come in as rookies, it takes us some time to get you up to speed. That's all.

Mr. REMUS. I have a very good staff, yes.

Senator ROUNDS. Very good.

Look, thank you. And once again, I said this earlier, and I mean it, you are neighbors and friends, and you live with this river as well. And it is appreciated, the work that you do, even in times in which sometimes you don't have all the tools necessary to be able to protect all the property and the livelihoods down here that you want to. And part of our responsibility is to make sure that you have as many of those tools available to you as we can possibly get to you and that the management tools are also available to you as well.

Now, if there are no more questions or comments that we want to make today—and I do not have the other members with me today. Other members may very well want to submit questions for the record, and that will be allowed for the next 2 weeks as well.

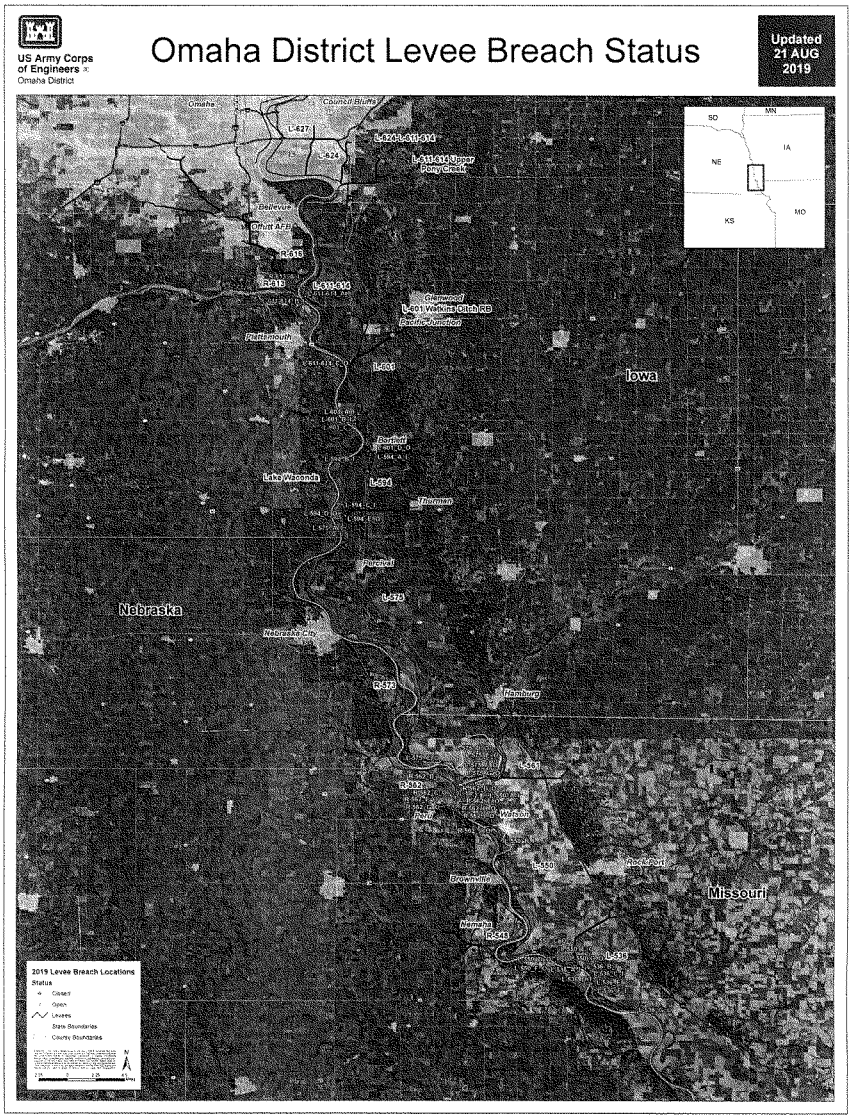
I want to thank General Helmlinger, and Mr. Remus, and the Corps of Engineers for traveling and taking part in this hearing and for their hard work and dedication in managing the Missouri River Basin. Your thoughtful participation in this conversation as to how we can improve the management of the system is an important step to protecting homes and businesses and communities along the Missouri River.

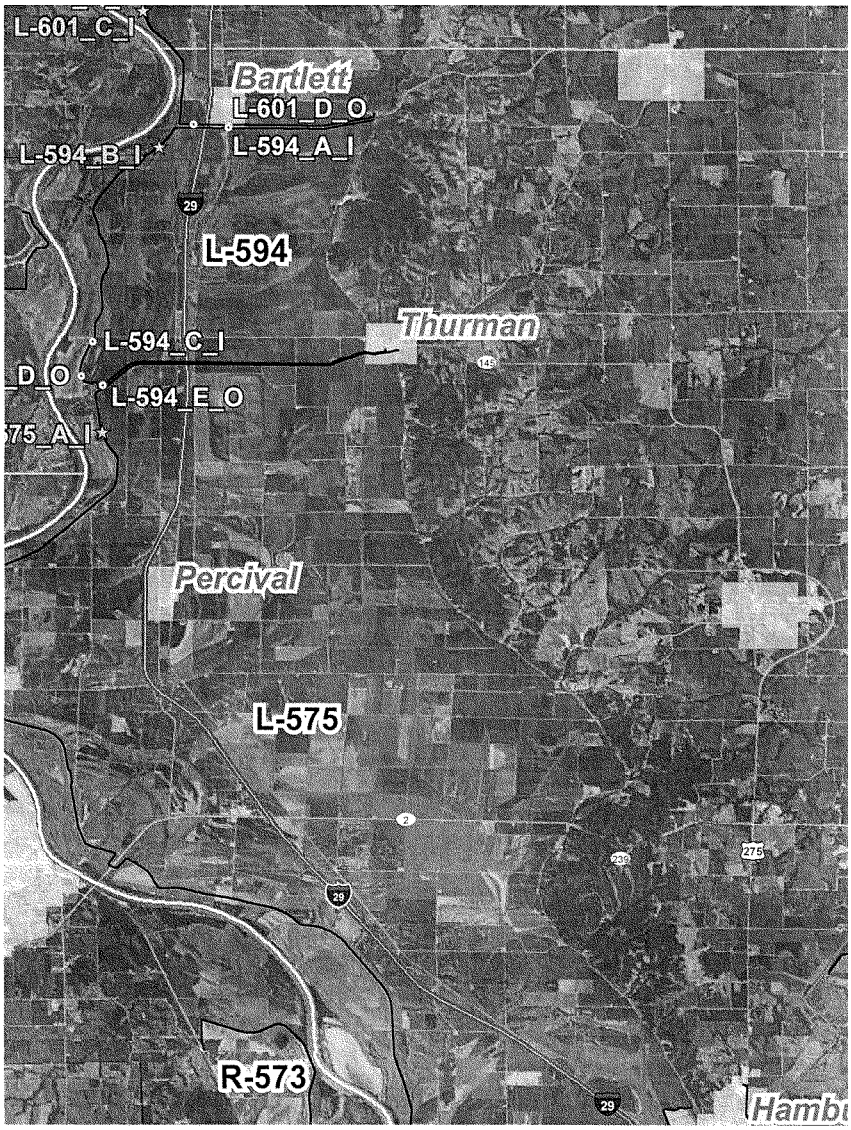
Again, I want to thank everybody for your time today and for traveling to South Dakota to take part in this hearing.

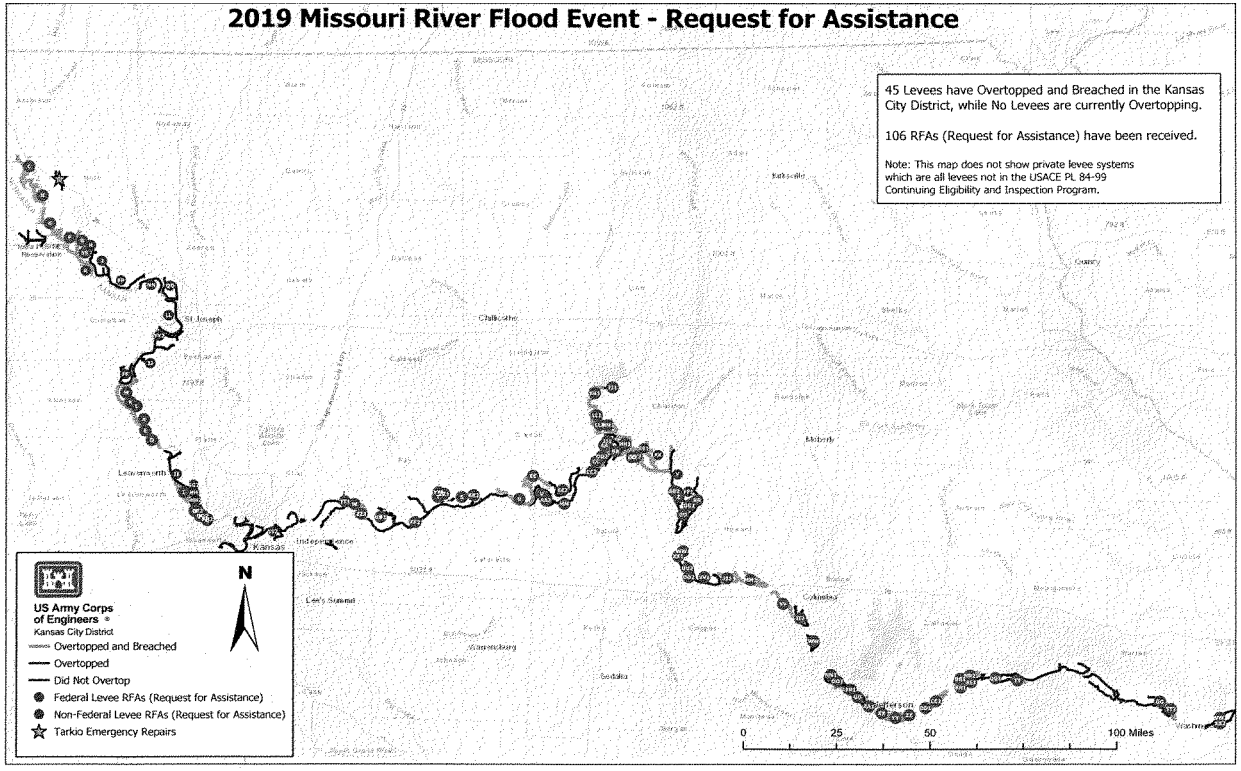
And with that, this hearing is closed.

[Whereas, at 3:15 p.m., the hearing was adjourned.]

[Additional material submitted for the record follows:]

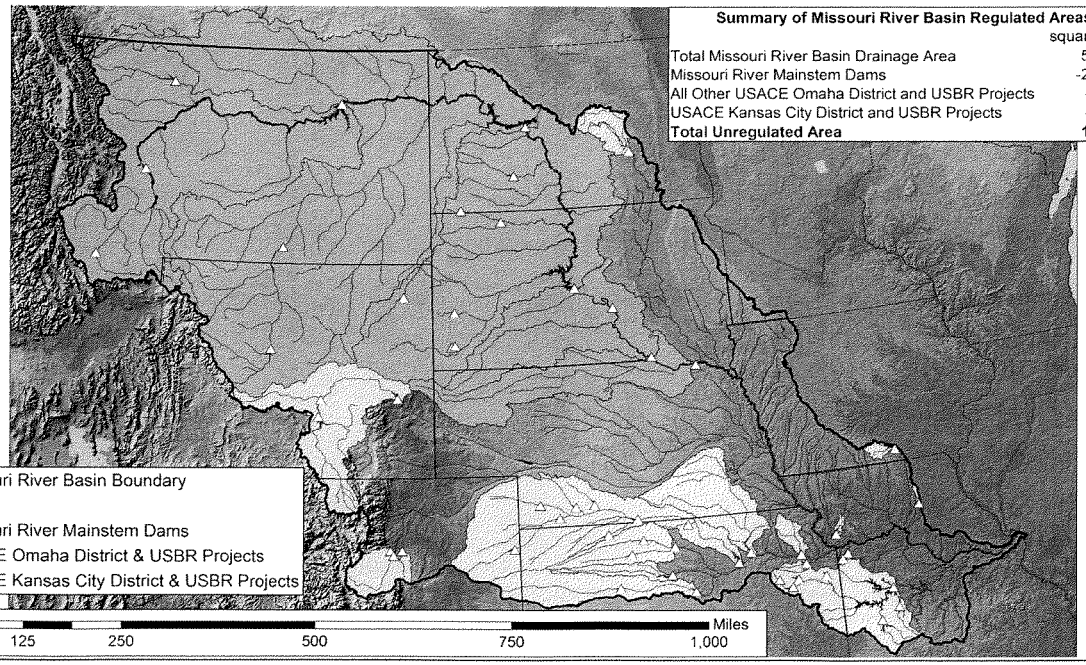

US Army Corps of Engineers
Omaha District
Omaha District Levee Breach Status
Updated 21 AUG 2019
Omaha
Council Bluffs
L-427
L-424
L-431-434 Upper Papillion
Bellevue
Offutt AFB
R-418
R-419
L-439-440
Gilmore
L-441 Walnut Creek RB
Papillion
L-441
Iowa
Bellevue
Lake Wanahoi
L-434
Thurman
Percival
L-423
Nebraska
Nebraska City
R-17
Nashburg
L-441
R-10
Rulo
Watson
L-436
Hamburg
Brownville
Missouri
Nemaha
L-438
L-431
SD
MN
IA
NE
KS
MO
2019 Levee Breach Locations
Status
Closed
Open
Levees
State Boundaries
County Boundaries
N


L-601_C_I
Bartlett
L-601_D_O
L-594_A_I
L-594_B_I
29
L-594
Thurman
L-594_C_I
_D_O
L-594_E_O
575_A_I
Percival
L-575
2
236
275
29
R-573
29
Hambu




Map Current as of 20 August 2019.

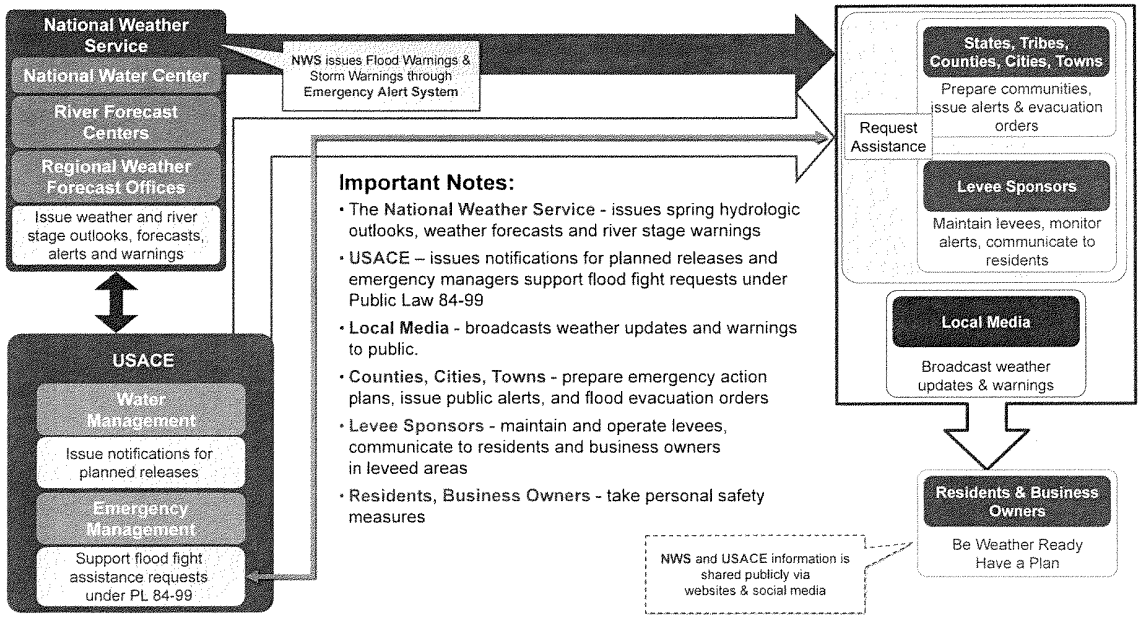
# MISSOURI RIVER BASIN REGULATED WATERSHEDS




**Summary of Missouri River Basin Regulated Areas**

| | square miles |
|---|---|
| Total Missouri River Basin Drainage Area | 529,350 |
| Missouri River Mainstem Dams | -279,480 |
| All Other USACE Omaha District and USBR Projects | -21,500 |
| USACE Kansas City District and USBR Projects | -63,300 |
| **Total Unregulated Area** | **165,070** |

# COMMUNICATION: WE EACH HAVE A ROLE




**Important Notes:**

- The **National Weather Service** - issues spring hydrologic outlooks, weather forecasts and river stage warnings
- **USACE** – issues notifications for planned releases and emergency managers support flood fight requests under Public Law 84-99
- **Local Media** - broadcasts weather updates and warnings to public.
- **Counties, Cities, Towns** - prepare emergency action plans, issue public alerts, and flood evacuation orders
- **Levee Sponsors** - maintain and operate levees, communicate to residents and business owners in leveed areas
- **Residents, Business Owners** - take personal safety measures