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Flood Risk Management Newsletter

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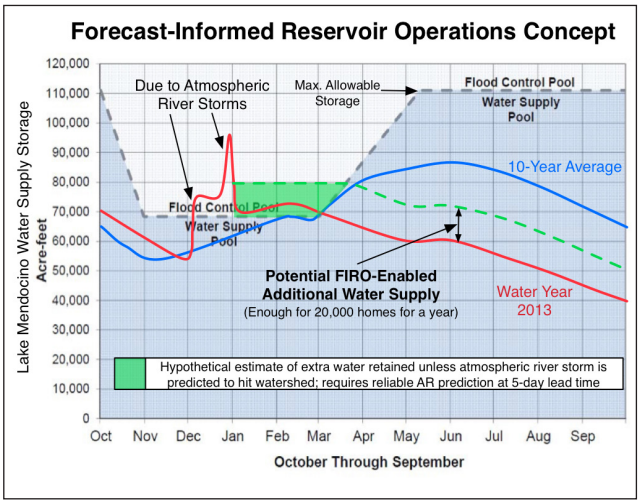

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Life-Cycle Flood Risk Management

By Mark Roupas, Deputy Chief, Office of Homeland Security

Greetings and a Happy New Year to all of you. Thank you for taking the time to review this edition of the Flood Risk Management Newsletter. As we start the New Year, let me take the opportunity to discuss the life-cycle of disaster management, often a topic of discussion in many forums.

When we talk about the National Flood Risk Management Program (NFRMP) and the Silver Jackets Program, we often characterize them as full life-cycle programs. This implies these programs are present in all four phases of the disaster management life-cycle (i.e., preparedness, response, recovery, and mitigation). Interestingly, in addition to serving as the Director of the NFRMP, I also oversee the Emergency Management (EM) Community of Practice. This is an area where we also discuss the four phase life-cycle, although in this case, it's not necessarily specific to flood events, but focuses on all hazards disaster response.

I am not entirely certain that implementation matches this expectation. Although there are exceptions, my observations suggest the Silver Jackets Team, comprised of USACE and interagency partners, typically focus on either preparedness or mitigation activities. Although some activities and examples of NFRMP or Silver Jackets involvement can be identified in the response or recovery phases, this seems to me to be less typical. Similarly, the Emergency Managers have a very strong, active role in disaster response, some role in preparedness and immediate recovery activities, but may be less focused on mitigation.

> "To really understand what the life-cycle represents, we need to expand our thinking and include the quadrants outside those in which we typically operate."

I believe these programs and missions within USACE are playing to their strengths and focusing on areas where they have the most expertise. This has caused me to wonder if our discussion of the life-cycle approach needs to be revisited. Perhaps we should consider how USACE can leverage the strength of each program, by focusing on key targets within the life-cycle phases of preparedness, response, recovery, and mitigation. Each phase of the life-cycle requires a different set of skills and expertise. As an agency, USACE has significant expertise in managing floods and disasters, but that expertise does not necessarily reside directly in the NFRMP or Emergency Management Program. We can draw on our different strengths and expertise in different focus areas – with the caveat that we must be committed to the interdependencies among our various personnel and efforts.

The following is hardly an exhaustive list, but it does reflect my perspective about where various sets of skills and expertise needed throughout the life-cycle may be found within USACE. Though it's a cycle, when you think through the phases, it makes sense to begin with the preparation phase. Many areas of USACE have a role to play here, including EM, Dam and Levee Safety, Planning, NFRMP, and Silver Jackets. The most relevant expertise to consider first depends on the event being prepared for, of course. Then, an event happens, and the agency moves into the response phase. Here, EM plays a primary role and provides much of the required skills and expertise for this phase. Additional technical expertise may be needed, depending on the event. For instance, assistance from the Levee Safety Program will be required when there is risk of a levee breach. Additionally, we rely on the expertise of our Hydraulics and Hydrology subject matter experts to better assist us in monitoring and estimating river crests and flows. As response transitions into recovery, EM continues to play a role in moving the immediate recovery forward. But as longer-term recovery begins to take focus, other areas within USACE have significant skills and expertise to offer. Engineering and Construction assist in rebuilding damaged infrastructure, the NFRMP and Silver Jackets may assist in identifying longer-term recovery options, typically flood events, and Planning may also have significant expertise to offer in developing a long-term recovery plan or process. Finally, that brings us to the mitigation phase, which is relevant throughout the other phases of the life-cycle, in order to improve resiliency to the next event. Mitigation is an area where EM has not historically played a strong role, but it is an area where the

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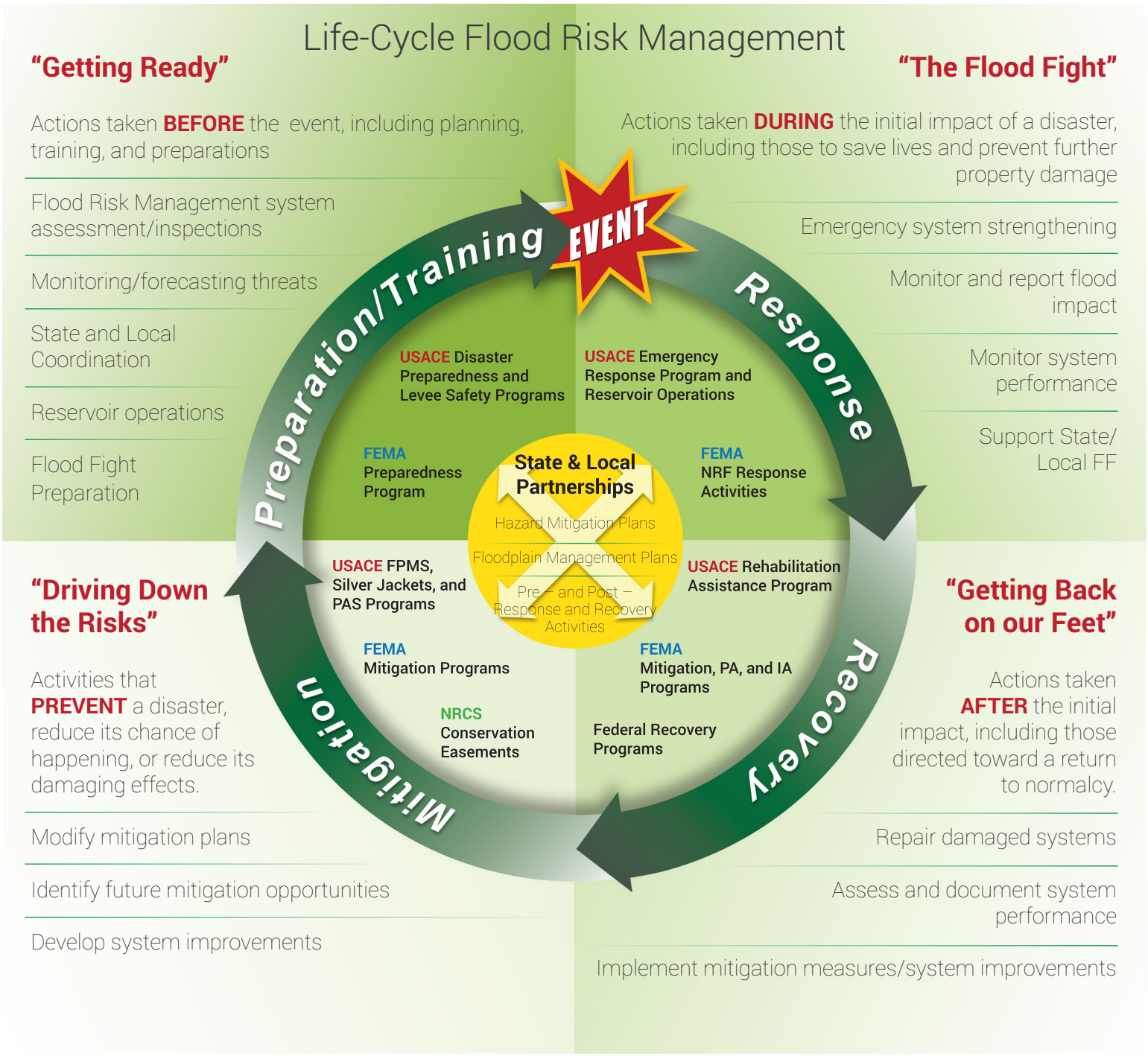
NFRMP and Silver Jackets have been very active. Additionally, Planning has a role to play in mitigation, as do many other areas of USACE. Operations and Maintenance activities play a role in every phase of the life-cycle as these activities will determine how USACE projects are managed before, during, and after an event.

The above begins to outline my perspective on how the life-cycle of disaster management, or flood risk management more specifically, is accomplished. As you can see, there is no one program which has the ability to be solely responsible for any one of the phases. For this reason, I'm no longer sure we should consider individual programs to be life-cycle in nature, but rather how do they contribute to the larger agency-wide life-cycle approach. What I hope you will take from this initial analysis is the importance of broadening our perspective when we think about and talk about the life-cycle management concept. To really understand what the life-cycle represents, we need to expand our thinking and include the quadrants outside those in which we typically operate. I think the old cliché, the sum of the parts really is greater than the whole, is highly relevant in this case. Others may disagree with the perspective offered, and I look forward to future discussion and debate on the topic. With that, I'll close, and hope you enjoy the rest of this edition of the FRM Newsletter.



Team Has Eagle Eye on Floodplain Project

By JoAnne Castagna, Ed.D., New York District

A group of people are wading slowly through high grass under a hot summer sun as they begin a guided walking tour of the Walton Floodplain in Delaware County, New York.

Suddenly there's excitement in the air as an Eagle perches on a nearby branch hanging over the West Branch Delaware River. The group swiftly changes its focus, and cameras, from the tour to this majestic bird.

It seems the group is no longer interested in what their guide has to say. On the contrary, this group is an inter-agency team that is looking over the land because they're starting a reclamation project that will improve the floodplain's environment for that Eagle, reduce flooding for the local community and protect New York City's drinking water.

The Walton Floodplain Reclamation Project is part of the U.S. Army Corps of Engineer's New York City Watershed Environmental Assistance Program.

"The program funds projects that are protecting the water quality of New York State's watersheds that provide drinking water to millions of New York City residents and businesses," said Rifat Salim, project manager, U.S. Army Corps of Engineers, New York District.

On this project, the Army Corps is working in collaboration with the Delaware County Soil and Watershed Conservation District, New York State Department of Environmental Conservation, New York City Department of Environmental Protection, Village of Walton and the Town of Walton.

Over the years the 13-acre Walton Floodplain that borders the West Branch Delaware River has been filled with gravel that has raised and hardened the floodplain and degraded the natural vegetation.

Walton's resident Eagle is perched above the West Branch Delaware River that feeds into the Cannonsville Reservoir. Credit: JoAnne Castagna, Public Affairs, U.S. Army Corps of Engineers, New York District.

Graydon Dutcher, stream program coordinator with the Delaware County Soil and Water Conservation District who was the team's guide on the floodplain tour said, "The floodplain has been filled through the years one dump truck at a time as a place of easy disposal of materials."

As a result, floodwater backs up because of the over-filled floodplain and stays trapped on the streets of the Village of Walton, flooding businesses and homes, especially Delaware Street and the ironically named Water Street.

When this high volume of stormwater runoff floods the streets, it sweeps up contaminates and carries them to the West Branch Delaware River that feeds into the Cannonsville Reservoir. The reservoir supplies 97 billion gallons of water to New York City's drinking water supply. * See the sidebar on New York City Watershed System.

This project will return the floodplain to its natural state and as a result it will reduce flooding and improve water quality.

Dutcher said, "We are going to remove the gravel creating a more natural floodplain elevation." This work will include removing and relocating a New York State Electric & Gas line to a deeper elevation and recycling the gravel and moving it outside of the floodplain.

During the walking tour, Dutcher pointed to a McDonald's golden arches sign several yards away. He said, "We are at the same height as the golden arches. This is how high the floodplain has grown over the years!"

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The team at the water's edge of the West Branch Delaware River. Credit: JoAnne Castagna, Public Affairs, U.S. Army Corps of Engineers, New York District.

The project includes restoring the floodplain's vegetation. The invasive plant species that the group has been walking through will be removed and grass will be planted.

He said where the team is standing along the river, a riparian buffer or hardwood forest is going to be created that will include a mix of native Maples, Ash and a mix of shrubs.

"Flood waters will drain from the town's streets, building rooftops and parking lots and filter through the restored vegetation and the riparian buffer before entering the river," said Dutcher.
The riparian buffer traps sediment and pollutants like harmful phosphorus and nitrogen particles from entering the river. This improves the quality of the water, maintain the river's temperature and fosters the creation of fish and aquatic habitats. The project will treat stormwater runoff from 2.8 acres of impervious area including businesses and parking lots.

Dutcher said, "This project is a big thing in Walton. It benefits the community in several ways."

The project will lessen the damages of flooding. When completed, the project will provide flood reductions for a 100-year storm event. In addition, it will also be useful for lesser, 10-year storm events and will also connect and drain the newly built green space in the center of Walton's Main Street.

Dutcher added that this project, which is expected to be completed by 2018, will also potentially give the land back to the community for other uses like athletic fields and park land.

That Eagle never left the branch the entire time the team was walking the floodplain and it seemed to be keeping a steady eye on them. Some in the group saw it as nature's way of reminding them to keep focused on this project that has multiple benefits for locals, city dwellers and Eagles who just happen to make Walton their home.

Dr. JoAnne Castagna is a Public Affairs Specialist and Writer for the U.S. Army Corps of Engineers, New York District. She can be reached at joanne.castagna@usace.army.mil.

New York City Watershed System

The New York City watershed region encompasses approximately 2,000 square miles of land north of New York City.

The land includes three watershed systems – The Catskill, Delaware, and Croton Systems - that are located in the counties of Greene, Schoharie, Ulster, Sullivan, Westchester, Putnam, Dutchess and Delaware.

The New York City Watershed System provides more than 90 percent of New York City's water supply. This comes to approximately 9.5 million people.

New York City makes sure that this water is safe by treating it at the source rather than building a costly filtration plant. The source is the land that surrounds the streams, rivers, lakes and reservoirs.

"In 1996, all of the municipalities in the New York City watershed region came to an agreement. They wanted to avoid the creation of a huge filtration plant. Instead of a plant they agreed to have small projects throughout the region to provide the public with clean water with minimal filtration. This is how our New York City Watershed Environmental Assistance Program came about," said Rifat Salim, project manager, U.S. Army Corps of Engineers.

Imminent Coastal Storm Threat Prompts Emergency Action

By Kayla Stull, Seattle District

"Explosive cyclogenesis" and "bad boy cinnamon roll" were just a few phrases used to describe the remnants of Cyclone Songda off the coast of the Pacific Northwest on October 15th, 2016. With the likelihood of up to 90 mph winds and 30+ foot waves coinciding with the spring tide cycle, the threat to coastal communities was significantly increased and prompted voluntary evacuation notices. Large wave activity and high water levels typically cause erosion and flooding along the coast in events of a lesser magnitude, so the Seattle District, U.S. Army Corps of Engineers (NWS) felt pressure to closely monitor coastal flood control structures with the threat of the impending storm.

Of particular concern was the spit located off of Rialto Beach on the Quileute Indian Reservation in La Push, Washington. An inspection report from April outlined damage to a 300 foot section of the revetment that slid into the intertidal zone due to toe scouring. This prior damage to the revetment on the spit prompted NWS to implement emergency measures. The underlying gravel berm was left exposed and about 4-6 feet shorter than the rest of the structure's design elevation. With the weakened condition of the structure and the storm stirring, a breach of the impacted area was highly likely. This would expose the Reservation, Coast Guard Search & Rescue Station, and the local marina to heavy wave action and impact the Federal Channel's navigability.

> "With the weakened condition of the structure and the storm stirring, a breach of the impacted area was highly likely."

The issue with these repairs was access. With anticipated wave height continuing to increase, cost, material, and safety considerations, water access was ruled out. Mora Road, a National Park Service road, was the only access point available to reach the spit by land. This option was not without its own issues. Portions of the road were deteriorating and sliding into the river due to erosion, therefore the National Park Service placed jersey barriers reducing the road to one lane. NWS Emergency Management deployed two Geotechnical Engineers to assess the road damage and ensure safe passage for heavy equipment and materials in order to reach the site. The road needed stabilization measures and daily monitoring during the construction period.

Essentially, this project needed provisional repairs to Mora Road, construction of a temporary access road on the spit, and repairs to the damage on the revetment – a three-phase project that would not be completed in time for the storm. The decision was made to wait out the storm and inform the impacted communities. Some of the tribes sent out evacuation notices, and NWS' flood team members took shelter in Forks, WA until the storm cleared that Saturday. Fortunately, the coastal storm was more compact than forecasted and remained

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farther offshore than anticipated. Despite the storm's outcome, NWS realized the urgent need to make the repairs before the next coastal storm, so construction work began right away. The road was widened according to the geotechnical assessment during the first phase, and the access road on top of the revetment made for an easy second phase. The most time consuming and material-demanding was filling the hole in the revetment.

"In the end, the collaborative effort between NWS' Navigation Section and Emergency Management Section proved to be a great success."

Many of these coastal communities are vulnerable and constantly threatened during the fall flood season. Most people don't realize that many of these impact sites are remote, and resources aren't readily available. The amount of material needed for this project was substantial.

Using an excavator, contractors load a large cap stone onto a 30-ton truck to be placed at the repair site.

The need to find 8,000 tons of armoring stone proved to be difficult. The closest quarry that carried the required 10-20 ton stones was nearly 200 miles southeast of the site in Vail, Washington. These cap stones could only be hauled one or two at a time. Between the cap stones and the underlayment, the contractors were only able to deliver 400 tons per day. Once the material arrived at the staging area, each stone had to be rigged to the excavators and placed on 30-ton Volvo rock trucks to be dumped at the repair site before another excavator was waiting to place them in the optimal location. The overall repair of the revetment took a little over a month, 16,000,000 pounds of material, and cost about $1.75 million. In the end, the collaborative effort between NWS' Navigation Section and Emergency Management Section proved to be a great success.

California Team Reaffirms Commitment by Signing Silver Jackets Charter

By Corrine Stetzel, Sacramento District

California Signing Ceremony at the 2016 Floodplain Management Association conference

After many years of hard work, over a dozen local, state, and federal agencies came together to officially sign the California Silver Jackets Charter. Led by the California Department of Water Resources, California became the 40th state to develop a Silver Jackets program in 2013 and has been working toward an official team agreement since then. The ceremonial charter signing took place on September 9, 2016, and served as a formal demonstration of the team's willingness to continue to move forward with interagency flood risk reduction projects.

A video of the signing ceremony captured the team's enthusiasm and good intentions. Not only was there full participation during the event with all but one of the federal agencies in attendance, but there was also a strong contingent of regional and local groups at the partnership table as well.

Rob Hartman from the National Weather Service said, "Our joint mission is the protection of life and property. There are so many agencies and groups in the nation that are involved in flood risk management and water resources such that we can clearly see that none of us can do it alone. Given the National Weather Service's vision of a weather-ready nation, we understand that the only way we are going to get there is in the car-pool lane. This Silver Jacket program is one of the ways we can build the relationships and partnerships to achieve that, so we are very supportive and honored to sign the charter."

Although California is in a drought, agencies continually work to identify risks and plan before an event occurs. "Flood risk is not something that goes unnoticed even amidst fires and drought in California," said Deputy Director Curry. "Going forward with flood risk, partnerships like this is critical." The team also aims to promote flood hazard risk education and information sharing, identify and eliminate flood risk management barriers, build on existing efforts for potential future actions, and focus on the life-cycle of floods.

The California Silver Jackets Team charter members now include:

- California Department of Water Resources
- U.S. Army Corps of Engineers (supported by Sacramento District, San Francisco District, Los Angeles District, and South Pacific Division)
- Federal Emergency Management Agency
- California Governor's Office of Emergency Services
- Bay Area Flood Protection Agencies Association
- San Joaquin Area Flood Control Agency
- Sutter Butte Flood Control Agency
- West Sacramento Area Flood Control Agency
- Sacramento Area Flood Control Agency
- U.S. Geological Survey
- National Weather Service
- California Geological Survey
- Coalition of 7 Southern California Counties: Santa Barbara, Ventura, Los Angeles, Orange, San Diego, Riverside, and San Bernardino
- Natural Resources Conservation Service
- Central Valley Flood Protection Board

Everyone shares responsibility in managing flood risk. The idea is that one agency may not have all the answers nor the resources for managing flood risk, but multiple agencies can combine strengths and resources to identify a solution. "California's Silver Jackets program has a unique opportunity to bring together emerging leadership at the regional level with a broad membership of state and federal partners," said Mary Jimenez, Silver Jackets lead for the State of California. "The program also has potential to help California begin to tackle difficult technical and policy issues needed to move towards sustainability and resilience in our flood systems."

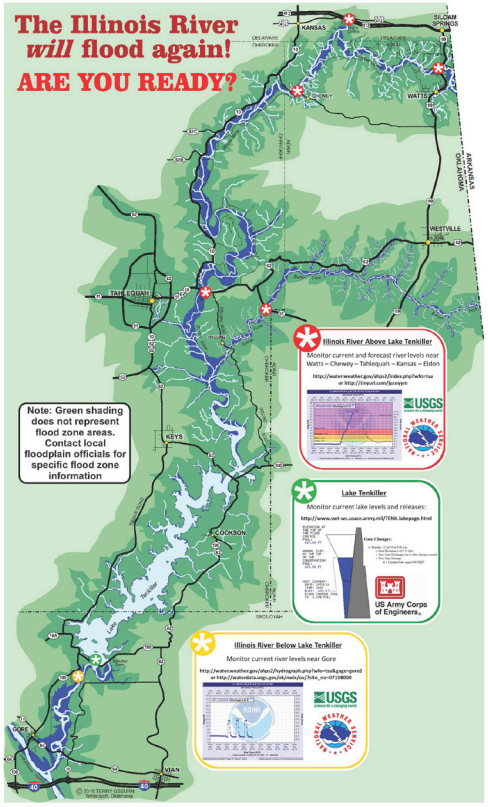
Oklahoma Silver Jackets: Supporting State Flood After Action Items For Community Preparedness and Response

By Bill Smiley, Tulsa District

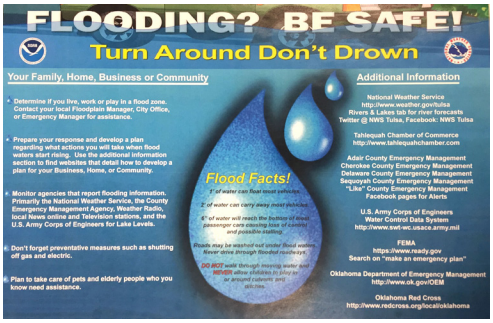
The Oklahoma Silver Jackets Team has completed a number of nonstructural projects related to flood prevention and disaster mitigation over the years. In Silver Jackets the term "Teams" has participants from many areas of communities with diverse social and political backgrounds all with the same overreaching goals of flood risk communication, prevention, elimination and management. Our teams have completed projects relating to Flood Plain Management, Flood Inundation Mapping, Emergency Action Plans, Historical Flood Event Awareness, and recently with Tribal Programs assessing Flood Mitigation and Impact Risk Reduction to support Tribal Preparedness and Response efforts. This program sees excellent growth and will certainly be a future avenue for project development. We have also partnered with and are actively participating in the Oklahoma Inter-Tribal Emergency Management Coalition (ITEMC) with our FEMA Region 6 partners.

> "This team developed an educational tool for the impacted upstream and downstream flooded areas that provides a ready reference of available information and draws attention to the risk of flooding impacts..."

After the major flooding in Oklahoma between May – August and then in December of 2015, a concept was presented by the OK State Mitigation Officer during the 2015 FRM Workshop in Massachusetts. The Oklahoma Silver



Jackets Team developed the concept and put our extensive partnerships to work including the National Weather Service, Red Cross, Oklahoma Emergency Management Mitigation, Preparedness and Response Officers, Chambers of Commerce, Floodplain Managers, and Oklahoma Water Resources Board. This team developed an educational tool for the impacted upstream and downstream flooded areas that provides a ready reference of available information and draws attention to the risk of flooding impacts, where to obtain additional real time flood information, and flood readiness tools for homes, businesses and communities. Additionally the County Emergency Management Offices, FEMA Ready.gov websites, and the State Emergency Management websites are provided so impacted residents and businesses can gather key information



related to first responder points of contacts and how to develop their own flood business continuity or home readiness plan.

For community outreach, we are printing 10,000 copies of this sheet on 11x17 inch sheets that will be distributed to local impacted businesses along the impacted areas. This will be published by the end of 2016.

For education, we are conducting special training classes on Business Resiliency and Continuity Planning through the Chamber of Commerce following the State Emergency Operations Plan and FEMA Comprehensive Preparedness Guide 101, Developing and Maintaining Emergency Operations Plans Version 2.0.

For continuity purposes, the State EM Office will keep this poster on its website and the Chamber of Commerce has agreed to keep the poster and the resiliency training materials on its website.

This project brought together many agencies that were able to impact the regional flood preparedness and response plans for homes and businesses as well as support the social and political systems impacted by flooding during the 2015 flood event.

Forecast Informed Reservoir Operations: Research on Increasing Resiliency for Droughts and Floods

By Cary Talbot, Ph.D, P.E., Engineer Research & Development Center – Coastal & Hydraulics Laboratory

Last winter, as the drought in California dragged on into its fifth year, the potential of an El Niño-fueled rainy season in the west was on the minds of water managers across the region. While northern California and the Sierra's did see an improvement over recent years in both rainfall and snowpack, reaching basically "normal" levels, the amount of rainfall in southern California was again below average, further extending the extreme drought conditions. Yet, as demonstrated recently in Texas, droughts are often broken by extreme events on the opposite end of the spectrum – devastating floods. The need for sound flood risk management policies and procedures is a constant, even in the midst of extreme drought.

In light of this, a research and development (R&D) effort that began in FY15 is seeking to address the question of whether reservoir operations can be optimized to maximize water supply while preserving the level of flood risk management that has been historically delivered by the Corps and others throughout the western region. The key to this optimization lies in improved forecasting skill, particularly as it relates to atmospheric rivers, often called "pineapple express" weather systems in the western US because they tend to stream tropical moisture from the direction of Hawaii towards the western US coast. Atmospheric river (AR) research is a fairly new and growing field of investigation in the meteorological community that shows great promise for understanding when, where and how much tropical moisture will be delivered to affected areas. In the west, this research is of particular interest as recent studies have shown that approximately 50% of the region's precipitation and 85% of the flood events are tied to storms that have AR characteristics. If forecasting skill for these types of weather systems can be improved to provide sufficiently reliable forecasts, water managers can utilize those forecasts to manage reservoir levels in such a way to improve water supply and meet ecological needs while maintaining and possibly improving on the level of flood protection that is provided by current water management practices.

Fig. 1. Location, terrain (shaded), and key characteristics of the Russian River watershed and of Lake Mendocino.

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Funding for the R&D effort was provided to the Corps in the FY15 appropriation for the Water Operations Technical Support (WOTS) program, an O&M R&D program that provides assistance to Districts for support with water operations issues. In providing the additional funding, Congress asked the Corps to conduct "research into atmospheric rivers in an effort to develop and demonstrate better prediction capabilities and apply the science to improve reservoir operations to optimize multi-purpose project objectives and to meet stakeholder water needs." To this end, an R&D program was begun at the Engineer Research & Development Center (ERDC) to investigate the science and tools needed for water managers to utilize forecast information in reservoir operations decisions.

Due to the scope and wide-ranging needs of this effort, an interagency Steering Committee was proposed and formed to explore methods for better balancing flood control and water supply needs, calling this effort the Forecast Informed Reservoir Operations (FIRO) project. It was also proposed that FIRO thoroughly explore the potential viability of using forecasts in operation of Lake Mendocino in the Russian River watershed (Fig. 1). This reservoir is one of two reservoirs co-managed by the Sonoma County Water Agency (SCWA) and USACE. The steering committee is made up of leading civil engineers, hydrologists, meteorologists, climatologists and biologists, including those responsible for day-to-day operation of Lake Mendocino. These operations focus on flood control, water supply and salmon recovery, with SCWA overseeing water supply decisions, USACE flood control decisions, and both working together to meet the objectives of recovering endangered salmon species native to the river.

The FIRO steering committee is co-chaired by Dr. Marty Ralph, the director of the Center for Western Weather and Water Extremes, located at UC San Diego/Scripps Institution for Oceanography and one of the foremost experts on atmospheric rivers research, and Jay Jasperse, the chief engineer at SCWA. In addition to the co-chairs, participating on the committee are representatives from NOAA's Office of Atmospheric Research, the National Weather Service's California-Nevada River Forecast Center (CNRFC) and NOAA's National Marine Fisheries Service, the United States Geological Survey, the US Bureau of Reclamation's Research and Development Office, the California Department of Water Resources' Office of the State Climatologist, USACE water managers from the San Francisco and Sacramento Districts with research program management and R&D provided by ERDC's Coastal and Hydraulics Laboratory.

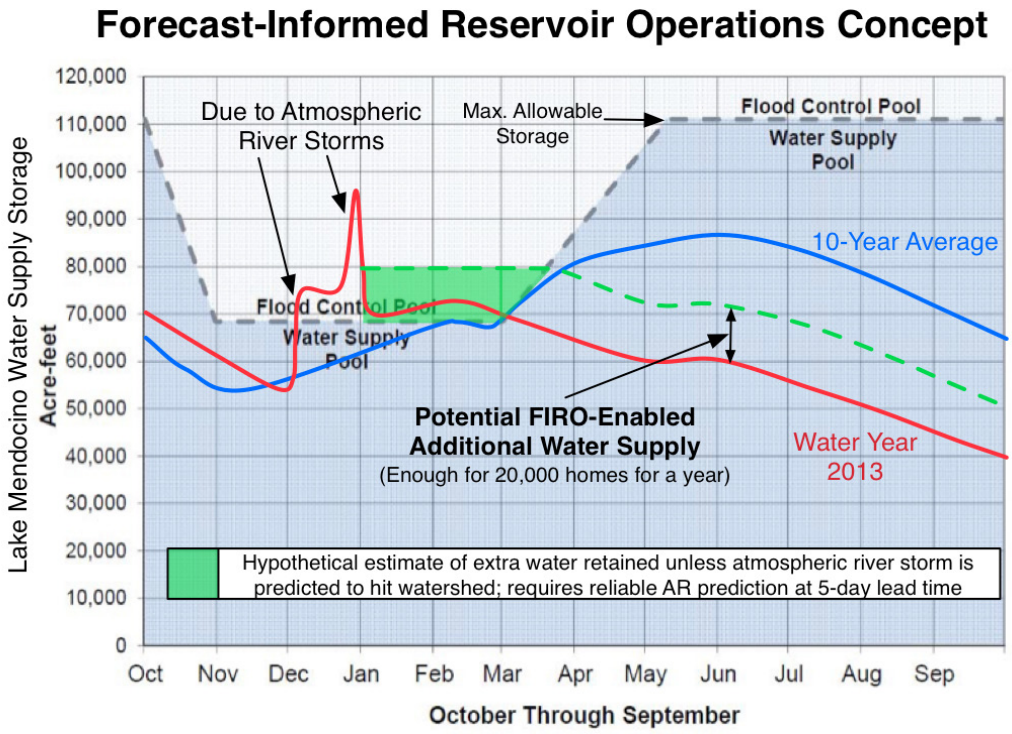

Fig. 2. Water storage in Lake Mendocino, from Water Year 2013 (red), 10-year average (blue), and hypothetical target of Forecast-Informed Reservoir Operations (FIRO) viability assessment (dashed green). Maximum allowable storage, based on the "rule curve" (dashed gray line) created when the dam was completed in 1959. Green shaded area represents the hypothetical water volume that could have been retained if FIRO had been in place.

The experiences of water year 2013 (WY2013, i.e., 1 October 2012 – 30 September 2013) at Lake Mendocino illustrate the challenges to water management in the west and the potential of FIRO in managing water differently.

The maximum allowable water level at Lake Mendocino varies throughout the year per the "rule curve" as illustrated by the dashed gray line in Figure 2. It ranges from a level corresponding to a storage volume of 68,400 acre-feet (AF) in the winter rainy season, to 111,000 AF in the warm season when heavy precipitation events are historically rare and the corresponding flood risk is very low. Storage below the rule curve at any time of year is considered the "water supply pool" while the space above the rule curve and below 122,400 AF, the maximum possible storage volume of the reservoir, is considered the "flood control pool." The flood control pool is space to temporarily store runoff during heavy storms which is then released after the immediate flood threat has passed, returning to the rule curve storage level so the reservoir is once again ready to store runoff from a future storm event. The Lake Mendocino rule curve was established based on evaluation of the hydrology of the basin and its historical record when the dam was built in 1959. Rule curves are periodically

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evaluated and Lake Mendocino's has been modified twice over the years as conditions have warranted revision.

Another factor influencing Lake Mendocino water levels is a diversion from an adjacent river basin. This "Potter Valley Project" was built a century ago for hydropower, and provided ~160,000 AF/year of inflow into Lake Mendocino. Changes due to rulings supporting salmon recovery on the adjacent watershed have since decreased that inflow to ~70,000 AF/year. These changes, and impacts of a changing climate and population, have significantly altered the water management challenges at Lake Mendocino.

Storage at the beginning of WY2013's flood control season on 1 November 2012 was 60,000 AF, ~8,000 AF below the guide curve (Fig. 2). By 1 December it was 12,000 AF low. Then came a strong AR event (Fig. 3) that struck the area on 1 December and produced over 8 inches of rain in a day in parts of the watershed, followed by a moderate AR that produced 4 inches on 3 December. These caused inflows that raised Lake Mendocino's water level 19,000 AF by 6 December. The next series of landfalling ARs struck between 16 and 26 December, raising the reservoir another 21,000 AF. Because the reservoir level was above the rule curve, the Corps was operating the reservoir for flood control, which by then held 94,000 AF. To restore the full flood control space, 25,000 AF was released over eight days. Note that if either of the two AR episodes that had already hit in December were repeated it could have raised the water level above the maximum allowable operating level (111,000 AF) for the dam. However, only 5 more inches of rain fell through April 2013, when normally another 20 inches would have fallen. This began the driest 15-month period on record for this area.

As drought deepened, it was natural that questions arose from the public and policy circles about that December 2012 release and whether in the future it might become possible to use better forecast capability to keep more of such water – just in case a drought develops. This question is the key driver for the FIRO viability assessment effort.

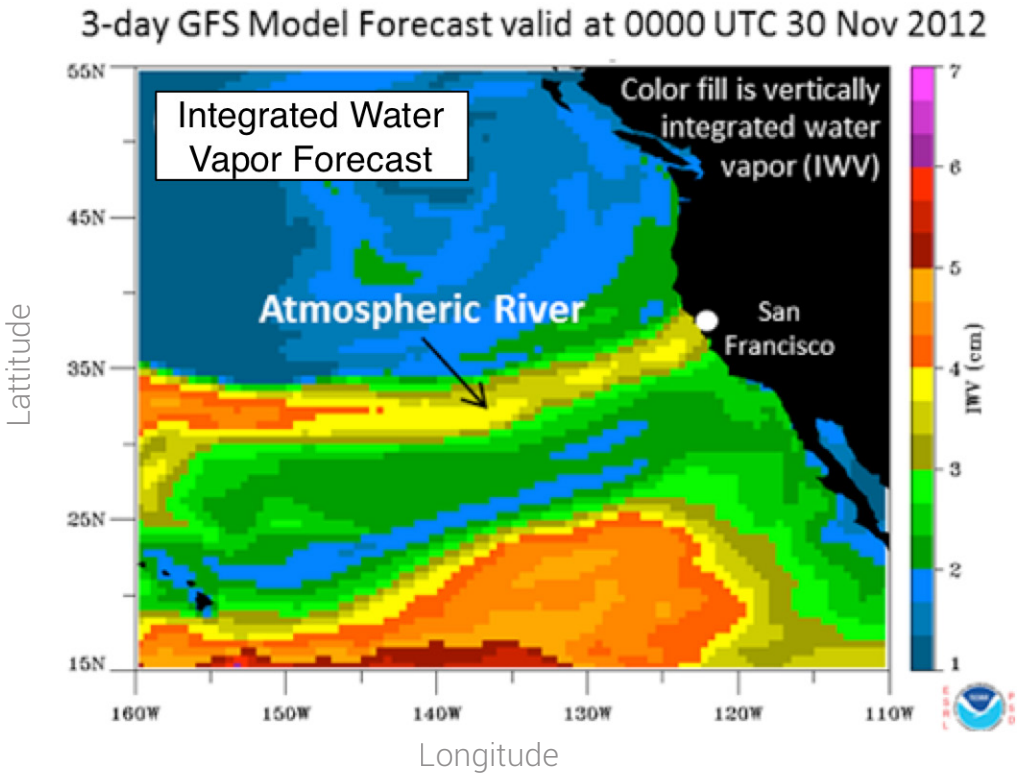

Fig. 3. 3-day National Weather Service forecast of an atmospheric river (AR) predicted to strike the coast near the Russian River on 2 Dec 2012. A strong AR caused heavy precipitation and high stream flows that increased volume in Lake Mendocino by 20,000 AF, encroaching into the flood-control space. That encroachment increased with the next AR storm, which led to the release of 25,000 AF of water to restore flood control capacity. Although unknown at the time, this was the start of a major multi-year California drought. Reservoir storage was unable to recover above that level for more than 3 years, while mandatory water conservation measures were implemented.

In September 2015, the FIRO steering committee produced a 5-year comprehensive work plan to assess the viability of FIRO for Lake Mendocino while also laying out a plan for transferability of the capability to other reservoirs in the region and beyond. The work plan describes current technical and scientific capabilities, and outlines analyses and programs to develop the needed forecasting capability to demonstrate the potential of FIRO to improve reservoir management. The first step in the work plan is a preliminary viability assessment that was jointly conducted by the Corps' Hydrologic Engineering Center (HEC), SCWA and CNRFC. The preliminary viability assessment is now complete and a report is being prepared with expected release in the Spring of 2017. The results of the preliminary viability assessment are being used to define the roadmap for the full viability assessment, which will be conducted as the atmospheric research progresses and eventual tools for improved forecast capability are produced.

If deemed viable, FIRO-developed capabilities will be evaluated by USACE for possible incorporation into the water management practices without increasing the risk to flood protection or dam safety. It is anticipated that FIRO may improve both water supply and environmental outcomes as well. The decision to incorporate these FIRO-developed capabilities into Lake Mendocino's water control management strategy ultimately remains with USACE water management policy makers to ensure that this and all other dams are operated safely without placing lives and property downstream at additional risk.

Spotlight on Souris River, ND: Collaborative Flood Risk Mitigation Success Story

By Terry R. Zien, St. Paul District

The North Dakota Silver Jackets Team has been active since 2009, and was first chartered in 2010. The team has dealt with many flood-related issues across North Dakota, including initiating a series of inter-related Silver Jackets interagency projects and Flood Plain Management Services studies focused on flood risk mitigation in the Souris (Mouse) River basin.

The Souris (Mouse) River flows from Saskatchewan, Canada, into North Dakota through the communities of Burlington, Minot, Sawyer, Velva and then into Manitoba, Canada. See Figure 2 for a basin map and other useful information. While only the area highlighted in green is in the United States, significant portions of the watershed are in Canada upstream and downstream of North Dakota, which requires coordination with the International Joint Commission (IJC) critical for regulating water quantity and quality.

Figure 1 – The ND Silver Jackets Team Annual Meeting in September 2016

The Souris River experienced a flood of record in 2011 with flows of 27,400 cubic feet per second at Minot. These flows devastated the basin's urban and rural communities, caused evacuations of more than 11,000 residents, and approximately $1 billion in damage to private and public property including over 4,000 structures. The Souris River channel shown in the foreground of Figure 3 did not exist before the 2011 flood. The original channel can be seen covered in snow and ice in the background of the photo at the toe of

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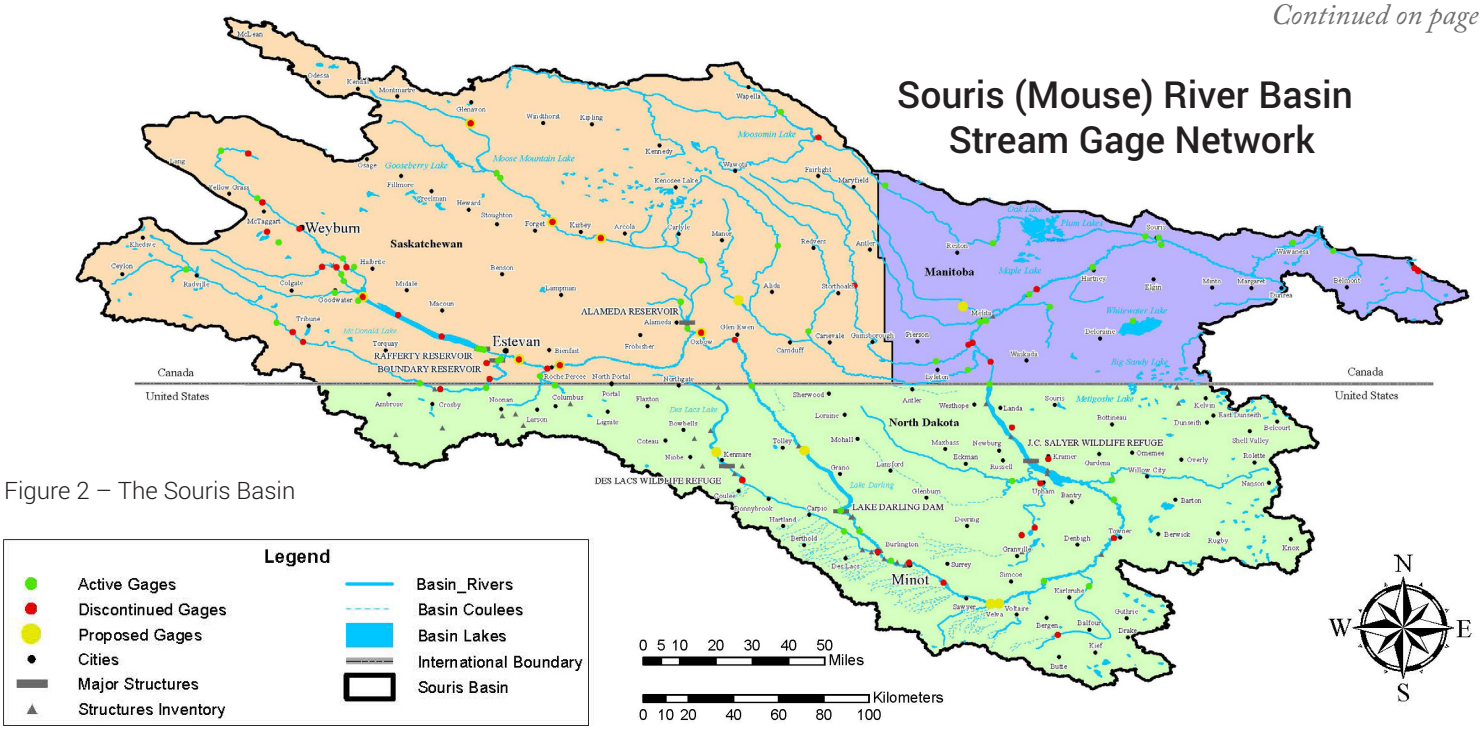

Figure 2 – The Souris Basin

the rip-rapped levee bank at Velva. The erosion represented a significant property loss for the homeowner. The house (not shown) was not flooded, but was stranded on a temporary island when the driveway road was inundated.

A number of very significant knowledge gaps in the hydrology and hydraulics of the Souris River basin were revealed by this flood. These gaps led to difficulty in dealing with the rising floodwaters as well as planning for wise use of the floodplain in the recovery process. USACE, in collaboration with the ND Silver Jackets interagency team, developed a white paper to define the gaps. Seven major studies were identified: basin-wide hydrology, updated hydraulic models that included the headwaters in Canada and the downstream reach in Manitoba, areal coverage of the flow and stream gage network, interim risk reduction measures for the existing federal project features, non-structural mitigation, emergency action plan development, and a reservoir system analysis. An additional project to provide AHPS-quality flood inundation mapping has begun. The development of all of these products has involved continual engagement of the federal and state Silver Jackets team members, Canadian agency representatives, the Souris River Joint Board (SRJB), consultants, and the IJC. This has enabled one common set of engineering models to be developed and used by all parties, with on-going updates. Other basin-wide-studies are in progress and will use the existing engineering products.

Figure 3 – Souris River at Velva, ND, looking upstream

Figure 4 – Key members of the ND SJ Team discuss mitigation strategies with the Souris River Joint Board

In December of 2014, key members of the ND Silver Jackets team met with the Souris River Joint Board to form a strategy for engaging rural residents in the basin and developing a flood risk mitigation plan. See Figure 4. In April of 2015, a series of public meetings was conducted for property owners in the rural ranch areas outside of the municipal boundaries in the basin, which has resulted in the implementation of a $23 million non-structural flood risk mitigation project using non-federal funds. The project followed the public meetings, and consisted of site visits to obtain elevation and photographic documentation of structures in the flood plain subject to inundation. Structures recorded at each parcel included homes, outbuildings in good repair, well heads, grain bins, barns, electrical service, septic systems, and above-ground tanks.

One of the main issues that had to be overcome was to get basin residents to trust the process enough to participate, which began with a public information campaign prior to the public meetings. There were 165 targeted rural land owners, of which about 150 showed up to the meetings. This was accomplished by providing clear, simple, and objective information on the goals of the flood

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"These partnerships last way beyond the project time scale, and become part of the life-cycle FRM solution."

risk reduction program, delivered by known local representatives of the Souris River Joint Board, accompanied by USACE and State team members to fill in the details. Consideration of issues important to the residents and local officials included; which facilities to record and protect at each site, the perception by land owners that their property is worth more than market value, providing rights of entry, sentimental value of property and land use from generation to generation, international boundary treaties for water use, land is private property up to the water's edge, and permanent deed restrictions at sites of relocation and removal. This must be followed up with strong land use zoning rules and flood plain ordinances. The participation rate immediately after the meetings was about fifty percent of the land owners who granted the required rights of entry, but that rose dramatically as the survey crew was approached by residents who saw their neighbor's participation during performance of the field work.

The mitigation work funded by the Souris River Joint Board and the State of North Dakota began in the summer of 2016 and will continue until complete. The relationships developed through Silver Jackets promote strong long-term partnerships that lead to action, and the sponsor's commitment can dwarf the federal investment. These partnerships last way beyond the project time scale, and become part of the life-cycle FRM solution.

Figure 5 - A typical rural parcel.

Figure 6 - Another typical rural parcel.

SWIF – Initiating Success through Collaboration

By Kayla Stull, Seattle District

There's more to the System-Wide Improvement Framework (SWIF) than engineering, construction, and flood risk mitigation. Seattle District, Corps of Engineers' (NWS) local sponsor, Whatcom County, quickly made this discovery when they initiated interagency meetings after starting the SWIF program back in spring of 2013. The SWIF is a fairly new tool implemented by the U.S. Army Corps of Engineers (USACE) to assist local sponsors whose levees were rated "Unacceptable" in a continuing eligibility inspection and would, otherwise, become inactive under the PL 84-99 Levee Rehabilitation Program. It provides a process for levee sponsors to implement plans that prioritize longer term capital projects in order to reduce the flood risk. The SWIF process requires sponsors to create a stakeholder list and ensure a collaborative effort is executed in order to develop the overarching SWIF plan over a two-year period to be reviewed and approved by USACE. Keep in mind, that during this two-year period, additional deficiencies are likely to be identified as flood events occur, that local sponsors will need to incorporate into their SWIF planning.

Workers on the Bertrand Creek levee in the Nooksack River system.

The SWIF program creates new challenges and opportunities for local sponsors and stakeholders, which means branching out from the comforts of normal business practices. "As an engineer, I found the SWIF requirement to establish and utilize an Interagency Coordination Team (ICT) a bit daunting," said Paula Harris, PE; River and Flood Manager for Whatcom County. "Bringing together opposing viewpoints and trying to get them to agree is not what we learn about in engineering school," but after receiving an "Unacceptable" rating on the Nooksack River Basin in 2010, Whatcom County was determined to meet those challenging requirements and maintain an "Active" status in the PL 84-99 program.

Whatcom County's SWIF covers 14 levee systems and 33 levee segments, with Whatcom County Flood Control Zone District being the local sponsor for 30 of those levee segments. The other three segments are sponsored by the City of Ferndale, the City of Everson, and Diking District #2. Many of the levee deficiencies include: erosion, encroachments, animal burrows, depressions/rutting, and vegetation. These typical deficiencies are time consuming for the County's maintenance program. The real challenge was compromising on what the ICT deemed as "The Three Fs": Flooding, Farming, and Fish. Because Whatcom County faced these conflicting challenges, many different organizations were involved in the planning process, including: Diking Districts, Farmers, Cities of Ferndale & Everson, the Nooksack Tribe, Lummi Nation, National Fisheries Service, U.S. Fish & Wildlife, NWS, Puget Sound Partnership, Washington Department of Ecology, Washington Fish & Wildlife Department and more. Despite this daunting task, Harris described the ICT as, "one of the biggest benefits of the SWIF planning process, as it enabled members of our community to get to know each other as humans and understand each other's points of view," which made untangling the challenges associated with the levee improvement far less intimidating.

The ICT started working on their collaboration process from day one.

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To get a better idea of the participants working styles, the team conducted a communications workshop and team building exercise based on the Tuckman Model. From there, smaller groups were formed to tackle the levee concerns including a Vegetation/Habitat Team, five levee Reach Teams, and a Glacier Creek Team. The entire ICT met monthly where they discussed progress, current issues, and the way ahead. These planning meetings became the first step toward integrated management. Before the SWIF, Whatcom County struggled to develop a comprehensive approach to flood risk reduction planning. The SWIF has given the County an opportunity to focus on those kinds of revisions with interagency input.

Each organization and stakeholder was able to bring their own expertise to the planning process, and through collaboration the ICT produced a SWIF plan that is acceptable to the whole team. Not only did the SWIF benefit the county by maintaining eligibility in the PL 84-99 program, it enhanced working relationship with stakeholders and counterparts. "We intend to keep using the ICT not only as we implement the SWIF but also to update our comprehensive flood plan in a manner that integrates it with the needs of salmon," said Harris as she explained the significance of the SWIF on her outlook of the broader complexities of flood risk mitigation. With the vast array of knowledge and ideas brought forth in these planning meetings, it is clear that working relationships with all the stakeholders is key to success. Whatcom County won Washington State's Community Award for Excellence in Floodplain Management at the Northwest Regional Floodplain Management Association Conference in September 2016 citing the SWIF as a contribution to the river and flood initiatives. As Whatcom County shifts from planning to execution of their SWIF, Seattle District will continue monitoring the County's progress on improving their levee systems.

Randy Behm Recognized for Excellence in Nonstructural Floodproofing

ASFPM Executive Director Chad Berginnis, Randy Behm, and ASFPM Chair Ceil Strauss. Photo by Dan Sherwood.

"For more than 30 years, Behm has advocated reducing flood risk via the use of nonstructural floodproofing measures..."

Randy Behm, chief of Floodplain Management Services program in the Army Corps of Engineers' Omaha district since 2001, received the John R. Sheaffer Award for Excellence in Floodproofing. This award was created to honor its namesake for his pioneering work in demonstrating floodproofing as a viable flood loss reduction measure, and for his decades of work in promoting and advancing the knowledge of these measures.

For more than 30 years, Behm has advocated reducing flood risk via the use of nonstructural floodproofing measures, with structural methods being implemented only when nonstructural measures are infeasible.

To that end, he has led teams to conduct Army Corps of Engineers feasibility analyses of nonstructural measures to reduce flood risk from Montana and the Dakotas to Pennsylvania and Maryland. Behm also advocates for nonstructural methods through providing training workshops and webinars, and has long been an ardent supporter and invaluable national advocate of flood risk management through nonstructural methods.

Risk Communication – Some Concepts and Challenges to Consider

By Katie Noland, Institute for Water Resources

Flooding is a perennial problem, claiming approximately 20,000 lives and adversely affecting at least 20 million people worldwide each year, according to Kellens, Terpstra & De Maeyer, 2013. As a result, the imperative for actively communicating risk in an accessible and actionable manner remains. This issue of prevalent flooding is not unfamiliar to us as members of an organization that strives to support actions to mitigate risks posed by flooding and who are called upon to respond and assist with recovery from such events when they occur.

Risk communication is inextricably linked to this primary issue our agency strives to address every day and remains an inherent challenge for a myriad of reasons. An online search for tips and "how to" recommendations yields multiple resources focused on a variety of risks including health, natural hazards, agriculture, etc. Organizations like the Center for Disease Control, the National Institutes of Health, the Food and Drug Administration and the World Health Organization, to name a few, all host a series of resources and write ups on efforts they conduct to communicate risks to the average person.

What remains difficult in looking at the body of resources and examples from these agencies is that it is not always immediately evident how to apply the techniques used to our mission areas. Certainly there is no quick and easy translation as there are authority and policy issues that add layers of difficulty at times to the task of informing affected individuals and parties about the risks. Even more challenging is the fact that we are often unsure whether it is our job to inform, to educate or to persuade an individual to take action.

Regardless of the traps and difficulties we face, there are several underlying concepts to keep in mind when faced with the task of communicating risks to affected parties. The first concept I would challenge you to consider is that each individual invariably holds a different definition of "risk." We are an organization familiar with calculating and measuring risks. However, I would ask you to consider how many of those analyses and measurements have been made based on an assumption grounded in our mission as an organization.

Certain aspects of flooding certainly do not necessarily seem like topics where values or perceptions are at play, but allowing yourself to consider that technical topics do in fact have inherent values that will naturally be at odds with definitions, thoughts and perceptions based upon other embedded values is key in risk communication. Risk is by nature a value-laden topic as evident through a multitude of studies and researchers' findings in the field of psychology and sociology. As a result, it is important that we do not come to the table on unequal footing; no definition or understanding is more right than the other.

Allowing yourself to consider that there is no one definition of risk might also help you to consider another key concept, which is to know your audience. When I say, "know your audience," I do not mean from the perspective of using less jargon or contacting them through a familiar means of communication, although those are components of knowing your audience – what I mean is to intimately know your audience by considering what it is like to be in their shoes and imagining how your communication might connect with the core of what that person cares about and values. What is their background? How long have they lived there? What experiences might they have that affect the way they would react to a given situation? When we start seeing the people we are attempting to communicate risk to as people and not just a recipient of a key message, we will begin to be more able to connect with those at risk and those who receive the repercussions of decisions made.

So often it is easy to default to the belief that "they just don't understand," or "they just don't care." One last consideration I would challenge of you as risk communicators is to delete these statements from your dialogue and only use them as evaluations of the credibility, effectiveness and success of your efforts. Certainly people may choose to ignore a message or to not take an action that might be recommended due to the nature of the risk, but it is important that we do not discredit our audiences and assume what we do not know. Risk communication should not be checking the box and it also should not be developed in a way that devalues the perceptions and decisions made by individuals. Risk communication should be a bridge by which we can develop a shared understanding of what the risk might mean to an individual.

We have to be willing to accept that sometimes that understanding may not be congruent with the outcome we had hoped for, but unfailing in our efforts to ensure those who make decisions in response to or affecting risk do so informed of the effects. As risk communicators, we must continue to strive to understand our audiences' perspectives, involve them where possible, act as interpreters and clarifiers, and to ensure that our communication remains two-way, interagency, and persistent.

Kellens, W., Terpstra, T., & De Maeyer, P. (2013). Perception and communication of flood risks: A systematic review of empirical research. Risk Analysis, 33(1), 24–49. doi:10.1111/j.1539-6924.2012.01844.x.

Other Important Information

Events

This listing is for information only and is not a complete list of FRM-related meetings. These meetings are not endorsed by the Corps of Engineers unless specifically stated. If we have failed to list a conference/meeting/symposium that would be of interest to the Flood Risk Management community, please forward the conference details to us.

22-26 January 2017 – **97th American Meteorological Society Annual Meeting** – Seattle, WA

17-20 April 2017 – **National Hurricane Conference** – New Orleans, LA

24-26 April 2017– **2nd International Conference on Coastal Cities and their Sustainable Future** – Cadiz, Spain – witconferences.com/coastal2017

30 April-5 May 2017 – **Association of State Floodplain Managers 41st Annual Conference** – Kansas City, MS – http://floods.org/index.asp?menuID=223&firstlevelmenuID=181&siteID=1

5-7 Sept 2017 – **7th International Conference on Flood Management** – Leeds, UK – http://www.icfm7.org.uk/

5-9 November 2017 – **Annual American Water Resources Association Conference** – Portland, OR – http://awra.org/index.html

Be sure to check out floods.org for the dates of state conferences and training opportunities: http://www.floods.org/n-calendar/calendar.asp?date=3/12/2016

FRM Statements of Need: Submitting "Statement of Need" is the first step in the process of a concept becoming a requirement for research and development. If USACE District personnel have problems or situations they feel should be addressed by research, the Flood Risk Management Gateway, http://operations.usace.army.mil/flood.cfm, is the place to submit these research Statements of Need (SoNs).

Past issues of this newsletter, various links, news items, and presentations, are all available on the Flood Risk Management Gateway, https://operations.erdc.dren.mil Check it out!

This newsletter is a product for and by the Flood Risk Management Community. The views and opinions expressed in this unofficial publication are not necessarily those of the U.S. Army Corps of Engineers or the Department of the Army.

If you would like to submit an article or an idea for an article for the next edition of the newsletter, or if you have any comments or questions about articles in this edition, please email ***Stephanie.N.Bray@usace.army.mil.***

FRM Flood Risk Management Newsletter

US Army Corps of Engineers