

Flooding: Management and risk mitigation

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Virginia Smith, a water resource engineer and researcher focused on flooding dynamics, asked in her 2021 TED talk, “Have you or a loved one ever been affected by flooding?... Chances are...you, or someone you know, has been impacted by flooding. There’s a powerless feeling in a flood. You can’t stop the rivers from rising. But for the first time [in history], we’re in a place where we can shift the power paradigm of flooding” (Smith 2021).

It has been estimated that 14.6 million US properties, homes, and businesses are exposed to elevated risk of flooding, which results in billions in economic losses annually (First Street Foundation 2021). Extreme floods are more common since the 1980s and may occur more frequently with climate change (Prein et al. 2015; Union of Concerned Scientists 2018; Vogel et al. 2011). Since 1980, the United States has experienced 32 major flood events costing an estimated US\$146 billion and resulting in more than 500 deaths (NOAA National Centers for Environmental Information 2022; Wiener and Sassenrath 2021).

Flooding of the Missouri and Mississippi river basins, in particular, has extensively damaged land and property of the Midwest in the last twenty years, with many record water levels set since 1993 (Criss and Luo 2016). Experts argue that these floods can no longer be called “natural disasters” because the destruction is caused by our floodplain development and waterway management decisions (Klein 2019; McKay 2009). Craig Fugate, a past administrator of the Federal Emergency Management Agency, said, “Floods and hurricanes happen. The hazard itself is not the disaster—it’s our habits, our building codes. It’s how we build and live in those areas—that’s the disaster” (McKay 2009; Ripple 2020).

Current climate will differ from past patterns, and adaptation requires an understanding of unfolding precipita-

tion-flooding trends and preparation for changes (Union of Concerned Scientists 2018). Though affected by climate change, the issue of flooding is not new, and by identifying solutions and making changes to current flood management practices, we can minimize damages, costs, and lives lost (Smith 2021).

Other researchers agree that “improved floodplain management can help optimize land management and flood damage reduction” (Theiling and Burant 2013). Local municipalities, cities, counties, and soil and water districts need to accept the leadership role to serve their constituents by shaping wiser land use. This starts with the adoption of new flood level prediction models and more active research dissemination. The Soil and Water Conservation Society, a long-time contributor to conversations and scientific publications related to flood management, can continue to serve as a leader in this space. Here, we briefly review needs and challenges as well as outline recommendations for Soil and Water Conservation Society (SWCS) action to help reduce flooding and minimize related damages.

WORK TO REDUCE FLOODING AND FLOOD DAMAGE

Levees and Floodways. Levees have long been used as a tool for flood management. However, research shows these structures may not be effective, or in some cases, including recent Mississippi River flooding, can worsen the flood impacts (Hersher 2018).

Pinter et al. (2016) showed overbuilt levees near floodplain margins can increase flood risk causing greater flood levels. Additionally, while levees have been beneficial structures for developing floodplains for agricultural use and may have been well built for past conditions, they may be inadequate for more intense rains associated with climate change (Morton and Olson 2016; Olson and Morton 2014;

Olson and Speidel 2021). Despite these concerns about their effectiveness, levees continue to be built (Hersher 2018).

The term “levee effect” is an often used to explain increased investment behind levees, thought to be flood-free places. The “levee effect” fits for the increased channelization of the Mississippi River and its separation from floodplain by levees, as stated by Charles Belt over 40 years ago (Belt 1975). The construction of miles of levees has constrained the Mississippi, Missouri, and other rivers in the pursuit of a “floodless floodplain,” promoting development behind the levees (Klein 2019). In reality, structures in the leveed floodplains may experience greater damage due to increased flood levels caused by the extensive levees themselves. “National levee policies and plans for local projects are unbalanced, crediting levee benefits but rarely fully planning for adverse impacts or considering alternatives” (Pinter et al. 2016).

Only the lower Mississippi River uses floodways, an alternate management tool of the Mississippi River Commission (MRC), built since the 1930s (Olson and Speidel 2021). The four MRC-managed floodways on the lower Mississippi are the Birds Point–New Madrid, Atchafalaya River, Bonnet Carre, and Morganza. The levee effect, caused by using levees as the only tool for flood risk and river management, should now be changed, and alternative management plans should be considered for river stretches vulnerable to flooding (Criss and Luo 2016).

Flood Risk Analysis. Recent analyses of flood level predictions recognize trends of river stage to estimate current flood risk at locations in the Mississippi Basin that have more than a century of continuous river stage record (Criss and Luo 2016). Official

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United States Army Corps of Engineers (USACE) estimates are based on discharge, but the new method requires only data on river stage. Using such methods, analysis shows the oversight of trends has resulted in the use of undersized means and standard deviations in calculating flood risk. Thus, official “base flood” levels critical to locating buildings above flood levels are underestimated at many locations in mid-America. In addition to improved water management structure planning, better regulations informed by realistic, current calculations of flood levels can decrease flood damages (Criss and Luo 2017).

DEVELOPING AND IMPLEMENTING A BETTER FLOOD CONTROL STRATEGY

It is now clear that a need exists for improved flood control strategies, but this shift will require cooperation at the local, state, and federal levels (Bratspies et al. 2018; Klein 2019). A great challenge for the USACE and other river managers is the consideration of variable river conditions while balancing diverse stakeholder interests (Morton and Olson 2016; Camillo 2012). The forces of a growing population, increased urbanization, and a changing climate will exacerbate the current flooding problem and require improved risk modeling and prediction methods as well as adjusted floodplain management and flood control plans.

A recent American Rivers report (Dorothy 2019) suggests that to end the “circle of absurdity” that affects environments and communities along the Mississippi River, we must do the following:

1. Strictly enforce floodplain development laws and regulations to protect people.
2. Consider floodplain development proposals, including levee modifications, through the legally required public process that reviews the impacts to public safety and the environment.
3. Invest in the completion of a robust watershed study that identifies and frames the issues of flooding, landscape changes, and future climate conditions.
4. Work together to determine shared flood risk management goals, and actions for communities, states, and the federal government. (Dorothy 2019)

THE ROLE OF THE SOIL AND WATER CONSERVATION SOCIETY

Members of the SWCS have long been concerned about flooding. Since 1992, the *Journal of Soil and Water Conservation* (JSWC) has published at least 40 papers dealing with flooding and floodplain management. For example, McHarg (1997) wrote, “As we have seen, natural calamities cost thousands of lives annually, billions of costs, and enormous insurance claims. . . . why not achieve economies by diminishing the pain and cost of floods.” Manale (2000), also in the JSWC, suggested a program for temporary storage of runoff from extreme precipitation by developing contracts with landowners to provide flood protection. More recently, Olson and Morton (2017) present plans for managing the upper Missouri River for many purposes including flood control.

Recommendations for mitigation of flood damage detailed in the papers discussed above provide a realistic path forward and demonstrate that the SWCS can play a part in solving the growing problem of flooding.

So, what can the SWCS now do? Here are a few suggestions:

1. Serve as a facilitator/moderator/publisher to organize a forum with goals of working to reduce flood and flood damage by bringing city managers, staff of departments of natural resources, US Environmental Protection Agency, USACE, and competing partner stakeholders together to develop improved strategies for flood control. The group would include but not be limited to:
 - USACE
 - US Environmental Protection Agency
 - USDA Natural Resources Conservation Service
 - US Forest Service
 - Soil and water conservation districts
 - Cooperative extension system
 - First Street Foundation
 - Audubon
 - National Wildlife Federation
 - The Nature Conservancy
 - Union of Concerned Scientists
 - The Land Trust
 - American Rivers
 - Great Rivers Greenway District

- East-West Gateway Council of Governments
 - Associations, e.g., Association of State Floodplain Managers, Floodplain Mitigation Industry Association, and Floodplain Management Association, National Recreation and Park Association
 - Urban Adaptation Assessment
2. Promote funding for development and implementation of tools to estimate combined effects of increased urbanization and climate change on flood risk.
 3. Promote improved use of nonstructural and structural restoration solutions to water resource challenges to increase resiliency to climate change:
 - Greentree reservoirs
 - Agricultural Conservation Easement Program
 - Enhanced riparian zone management
 - Wetland forestry on private lands
 - Development of improved guidelines for construction of soil water holding and infiltration of rain in urban riparian zones
 - Call for the adjustment of the rainfall factor used by Revised Universal Soil Loss Equation 2 – Water Erosion Prediction Project (RUSLE2 – WEPP) to anticipate increases in heavy rainfall
 4. Advise on the most suitable location for relocation for flood mitigation (Wise 2019).
 5. Educate and communicate with federal, state, and municipal resource managers for developing holistic ecosystem restoration to moderate flood damage.
 6. Encourage the National Association of Conservation Districts to include floodplain management education outreach in their education programs.
 7. Encourage the development of a comprehensive ecological, economic, and hydrodynamic model to estimate the impact of floodplain management alternatives on flood risk (Suttles et al. 2018; Theiling and Burant 2013).
- McHarg (1997) wrote in the JSWC, “There is a mood for economy present in Congress but economies in environmental protection are not popular so, why not achieve economies by diminishing the pain and cost of hurricanes; floods, tor-

nadoes, fires, and other catastrophes.” To accomplish such economies the SWCS should help lead an undertaking of ecological inventory as suggested decades ago by the Interagency Floodplain Management Review Committee (1994). One way to do this could be to use the Soil and Water Resources Conservation Act (USDA NRCS 2022). By selectively increasing the number of data points in the flood zones of concern, a better picture of land use and potential problems should be gained. Monitoring the environment improves both our understanding and ability to predict natural phenomena outcomes. This will give us new data that may be employed by the partnerships and creative solutions developed from the six first actionable flood mitigation education and partnership building activities listed above. Improved ecological planning processes can then be effectively incorporated as part of improved conservation planning by city managers, departments of natural resources, USACE, and conservation district planners who work with floodplain land users.

Hugh Hammond Bennett initiated the conservation planning process to improve our land use (Bennett 1939). SWCS needs to continue that leadership by encouraging adoption of conservation plans and installing practices that mitigate flood damage.

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