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Regulatory Affairs Division
Office of Chief Counsel
Federal Emergency Management Agency, 8NE-1604
500 C Street SW.
Washington, DC 20472-3100.

Re: ASCE Comments for Docket ID: FEMA-2015-0006

Introduction and Background

The American Society of Civil Engineers is pleased to submit the following comments to the Federal Emergency Management Agency on its proposed rule re: "Updates to Floodplain Management and Protection of Wetlands Regulations To Implement Executive Order 13690 and the Federal Flood Risk Management Standard."

ASCE was founded in 1852 and is the country's oldest national civil engineering organization. It represents more than 145,000 civil engineers in private practice, government, industry and academia who are dedicated to the advancement of the science and profession of civil engineering. Our organization sets standards related to Flood Resilient Design and Construction. Our members are dedicated professionals who design, build, construct, operate and maintain infrastructure in and around floodplains. For decades ASCE has advocated for public policies that reduce risk and hold paramount public safety and welfare. Given our responsibility to ensure the public remains safe and that infrastructure is designed to maximize the public interest, including cost considerations, we provide the following comments as FEMA finalizes the FFRMS Rule.

ASCE supports the federal government's efforts to mitigate risk and require pre disaster mitigation. Between 1980 and 2013, the United States suffered more than $260 billion in flood-related damages. Since 1980 the U.S. has sustained 196 weather and climate related events where damage exceeded $1 billion. Almost all these disasters are paid for via emergency supplemental appropriations, whereas under normal Congressional budget rules the U.S. spends less than $100 million a year on disaster mitigation. It's an unsustainable model, and fiscally irresponsible to continue responding after the fact, without taking steps to deter disaster up front.

Having considered the role of the professional engineer, reviewed the history of disaster response and analyzed the proposed actions of FEMA, ASCE supports FEMA's approach and proposed method of adopting FVA to implement FFRMS. However, we do believe there are areas of the proposed rule that could be strengthened.

ASCE 24-14

ASCE Standards provide technical guidelines for promoting safety, reliability, productivity, and efficiency in civil engineering. Many of our standards are referenced by model building codes and adopted by state and local jurisdiction. They also provide guidance for design projects around the world. Accredited by the American National Standards Institute (ANSI), ASCE has a rigorous and formal process overseen by the Codes and Standards Committee (CSC). Standards are created or updated by a balanced, volunteer standards committee, followed by a public review period.

All standards are updated or reaffirmed at least every 5 years. ASCE's standards program is regularly audited to ensure compliance with the ASCE Rules for Standards Committees and that it is consistent with ANSI requirements.

Prepared by the Flood Resistant Design and Construction Committee of the Codes and Standards Activities Division of the Structural Engineering Institute of ASCE

Flood Resistant Design and Construction, ASCE/SEI 24-14, provides minimum requirements for design and construction of structures located in flood hazard areas and subject to building code requirements. Identification of flood prone structures is based on flood hazard maps, studies, and other public information. This standard applies to new structures, including subsequent work, and to work classified as substantial improvement of existing structures that are not historic. Standard ASCE/SEI 24-14 introduces a new concept, Flood Design Class, that bases requirements for a structure on the risk associated with unacceptable performance.

FFRMS and its reference to ASCE 24-14 is in adherence to OMB Circular A-119. Furthermore, agencies more adopt higher standard where justified in the federal interest. We support FEMA's approach to requiring additional freeboard to infrastructure projects relying in whole, or in part on federal assistance.

ASCE Policy

Please find embedded below two of ASCE's organization-wide adopted public polices related to floodplain management.

ASCE Policy Statement 421

FLOODPLAIN MANAGEMENT

Approved by the Energy, Environment, and Water Policy Committee
on December 18, 2014
Approved by the Public Policy Committee on May 18, 2015

Adopted by the Board of Direction on July 18, 2015

Policy

The American Society of Civil Engineers (ASCE) urges governments at all levels to adopt proactive floodplain management policies that:

- Hold paramount the public's safety, health, and welfare.
- Protect and restore natural floodplains in situations where the benefit is greater than the costs.
- Enact and enforce land use policies, ordinances and building codes that consider life safety and account for increased risk due to development or major redevelopment of communities in floodplains.
- Inform residents and community planners of the risk associated development in the floodplain.
- Develop flood disaster mitigation and relief plans commensurate with residual risk.
- Develop and exercise flood disaster preparedness and evacuation plans commensurate with residual risk.
- Support creative partnering between federal, state and local governments to adopt floodplain management policies.
- Fund the design and implementation of floodplain management policies and flood mitigation projects.
- Incorporate the concept of building disaster resistant communities consistent with sustainable development.
- Encourage risk appropriate, multiple-uses of flood prone areas.
- Pursue nonstructural flood mitigation facilities, including river restoration and wetland restoration that include improvements in habitat, ecosystems, recreation and open space use.
- Incorporate floodplains into comprehensive watershed management programs.

Issue

Development and associated infrastructure in flood prone areas has increased rapidly as people are attracted to historically fertile floodplains and coastal areas. Even though the benefits of preserving the natural floodplains as flood storage areas and wildlife habitat have been recognized, the floodplains continue to be developed and new inhabitants are subjected to periodic flooding and related devastation, as shown by Hurricanes Katrina and Sandy. People living and working in flood prone areas often have developed a false sense of security. Once a flood occurs, residents and businesses often expect government to reduce or eliminate the risk of flooding through large capital projects. These populations need the protection of an efficient floodplain management program implemented before the flood occurs. By recognizing the likelihood of future flooding and the beneficial aspects of the natural floodplain, areas can be protected and communities can become disaster resistant.

Floodplain management includes the operation of an overall program of corrective and preventive measures for reducing flood damage, including, but not limited to, emergency preparedness plans, flood management_works, and floodplain management regulations. Methods for evaluating the benefits and costs of mixed systems allow for the consideration of both tangible and intangible benefits and costs and should permit formulating programs, including both structural and nonstructural elements, which provide the greatest return on society's investment.

Rationale

Civil engineers are largely responsible for the implementation of floodplain management programs and the design and maintenance of flood mitigation systems. Civil engineers recognize the benefits of both floodplain management and flood mitigation and develop projects to educate the public about the importance of first, preserving the natural floodplain, and second, integrating floodplain regulations and flood mitigation projects into comprehensive floodplain management programs.

ASCE Policy Statement 421
First Approved in 1994

<u>ASCE Policy Statement</u> 545

FLOOD RISK MANAGEMENT

Approved by the Energy, Environment and Water Policy Committee on July 11, 2014
Approved by the Public Policy Committee on August 13, 2014
Adopted by the Board of Direction on October 5, 2014

Policy

The American Society of Civil Engineers (ASCE) urges all federal, state and local government agencies, in collaboration with the private sector, to adopt flood-risk management policies that provide for:

- A consistent definition of flood risk and an accepted framework for how risk should be estimated
- Effective and sustainable management of risks posed by floods to life safety, human health, economic activity, cultural heritage and the environment;
- Collaborative risk sharing and risk management at all levels of government and by all stakeholders;
- Risk informed communication, policies and funding priorities; and
- The use of natural processes to mitigate the consequences of flooding.

Issue

Flood risk is defined as the potential of a loss from flooding, and is measured by both the consequences and their probability of occurrence. There is no common vision of how the nation should organize and coordinate to reduce its flood risk. Proposals to deal with this challenge have languished in multiple congressional committees of Congress. The Unified National Program for Floodplain Management, called for by Congress, was last revised in 1994 and its recommendations lie dormant. We do not have a sound analysis of the potential risk to the nation from flooding.

Collaborative risk management requires continued operation and maintenance of our flood infrastructure. Currently our flood infrastructure remains in marginal condition and there is no realistic plan in place to deal with or improve these conditions. Federal funding is minimal, and local communities lack the resources with which to address the problem.

Federal, state and local governments share the responsibility for continued non-sustainable development within flood prone areas. Unintended consequences of flood insurance, rebuilding funds, tax incentives and political pressures provide a mixed message to the citizens and local governments that are responsible for land-use regulation. Unless more is done to reduce risk, we are creating a potentially insurmountable challenge for future generations.

An effective national risk assessment and risk management initiative will require a consistent definition of flood risk and an accepted framework for how risk should be estimated for different scales and purposes. It needs to incorporate sensitivity to the economic activity and the history of place. While risk is a relatively simple concept, it is far from simple to apply given the dearth of relevant input information and the variety of methods available for its estimate. In reality, there exists a broad spectrum of risk estimation options, some very general and even qualitative and others highly sophisticated.

Climate change and population growth will further stress this already difficult situation. The Federal Emergency Management Agency reported in 2013 that as a result of this change and growth, the 100-year floodplain in the contiguous states could expand by 45 percent by the end of the 21st century.

Rationale

Among the great challenges the U.S. faces today is recognizing the magnitude of risk posed by flooding and motivating the public and decision-makers to make the investments required to reduce flood risk. This includes making emergency preparations, strengthening our flood protection systems and finding new ways to reduce our vulnerability to flooding.

Ignoring the challenges is not an option. Brought to focus by Hurricane Katrina, the nation has slowly begun to shift from a mind-set of controlling floods to one of recognizing that absolute protection against these natural hazards is not possible. It is clear that when such action is justified and feasible our efforts must be focused on identifying our risks and developing and implementing a portfolio of approaches to deal with these risks—a portfolio referred to collectively as flood risk management (FRM). Despite the continuing tension between development and FRM, limited steps have been taken and progress has been made in some communities to reduce and more effectively deal with flood risk. Awareness on the part of the public has also increased, especially in light of recent catastrophic flooding events.

Risk management is a powerful tool in the decision-making process where the conclusions of risk assessment and comparative risk analysis are weighed among other considerations such as statutory requirements, costs, public values and politics, expectations, and exposure to hazards. For engineers, risk assessment is a guide that directs proper land use and engineering planning, design, construction and operation, and maintenance practices. While it is important to plan for possible failure (including provisions for insurance, emergency evacuation, flood proofing, etc.), it is equally important to adequately address risk in how systems are planned and designed and how consequences are managed.

ASCE Policy Statement 542
First Approved in 2014

General Support/Feedback for FFRMS (including: Nature Based Solutions)

According to the 2010 U.S. census Bureau, 39 percent of the U.S. population is concentrated in counties directly on the shoreline, constituting less than 10 percent of the total U.S. land area excluding Alaska. Additionally, 52 percent of the total population lives in counties that drain to coastal watersheds, constituting less than 20 percent of U.S. land area, excluding Alaska.

Current population trends in the U.S. would result in an estimated population from 123 million people to nearly 134 million people by 2020. This increase surpasses the overall population increase. As a result, exposures in terms of population and property at risk would increase leading to greater future risks due to hazards, such as hurricanes, storms, wave action, and global climate change effects such as sea level rise, extreme precipitation, drought, and salt-water intrusion. Coastal areas are at the interface or transition from land to sea, including wetlands and large inland lakes. Wetlands play a critical role in protecting the shore from flooding in addition to providing important habitats for many plant and animal species, e.g., the Everglades as wetlands in southern Florida are home to diverse ecosystems.

Coastal infrastructure has critical roles in providing life and property security and safety. It can be grouped into four categories of interacting features as follows:

- Natural Features
  Such features are the product of natural processes that created and have evolved them over time through the actions of physical, biological, geologic, and chemical processes. Examples include reefs, e.g., coral and oyster, barrier islands, dunes, beaches, wetlands, and maritime forests.
- Nature-Based Features
  These engineered and built features have the purpose to mimic the characteristics of natural features to provide specific services such as coastal risk reduction, e.g., dunes and beaches.
- Structural Features
  These engineered and built features support a range of objectives, including erosion control and storm risk reduction, e.g., seawalls and levees, as well as infrastructure providing economic and social functions, e.g., navigation channels, ports, harbors, and residential housing.
- Nonstructural Features
  They include policy and management features to support a range of objectives, such as storm risk reduction, e.g., floodplain policy and management, flood-proofing and impact reduction, flood warning and preparedness, and relocation.

The relationships and interactions among these features of coastal systems are important in determining coastal vulnerability, reliability, risk and resilience.

The development of nature-based solutions should account for the non-stationary nature of underlying physical processes that could lead to flooding and by also including increases in the sizes of population and property at risk.

Relating flood plain definition to resilience and sustainability are not clearly articulated in the proposed rule. Quantifications of resilience, exposures, vulnerabilities risks, and sustainability are essential steps toward rational management and resource allocations. Measurement science relating to these concepts is lacking. FEMA's proposed rule should highlight this need for further research and development.

Feedback on FEMA's Approach w/ Regard to Flood Maps

To better inform the future planning efforts in flood prone communities, ASCE highly recommends FEMA provide the resources necessary to the Technical Mapping Advisory Council (TMAC). FEMA should carefully consider the TMAC recommendations and, where feasible, require the use of Climate Informed Science Approach (CISA) for certain coastal regions of the U.S.

As recommended by the TMAC, the Agency should use the scenarios set out in the U.S. National Climate Assessment for coastal regions of the United States for future coastal flood hazard estimation. We urge FEMA to examine the age and the New, Valid, or Updated Engineering (NVUE) status of any maps used as the basis for project reviews and make corrections or updates where FIRMs are found to be inadequate. New flood maps should be developed using the best technology available, with granularly that can assist with parcel by parcel determinations of risk.

Feedback on Climate Informed Science

As a practical matter, we accept FEMA's hesitation to adopting the Climate Informed Science Approach as its default method of implementing FFRMS. However, as climate science models continue to improve, we are faced with the conundrum of needing to start somewhere. When will it be too late to implement the best practices that models are beginning to forecast? As additional agencies consider which method to adopt, we challenge them to give serious consideration to adopting in whole, or in part, Climate Informed Science Approaches moving forward.

Although there are geographic variations across the US, precipitation patterns associated with future climate are expected to change as the climate continues to evolve. Of particular relevance to floodplain mapping are concerns that future precipitation may include periods of greater intensity or changes in overall storm volumes associated with a given storm frequency. In simple terms, existing rainfall intensity-duration-frequency (IDF) curves can be expected to evolve with continuing climate change.

One pathway to producing actionable science is to develop a systematic approach to produce future rainfall IDF curves as a data product similar to the existing NOAA Atlas 14 dataset which represents current climate. Researchers have begun to do exactly this (see e.g., Mirhosseini et al., 2013; Moglen and Rios Vidal 2014; Mirhosseini et al., 2015). A common approach is to use time series realizations of future precipitation at 3-hour time increments available from NARCCAP (see Mearns et al. 2009) for the US. Frequency analysis is then applied to such time series information producing future climate IDF curves at a location. Repeated applications in space produces information similar in format to that from NOAA Atlas 14, but for future instead of current climate. Once IDF curves have been developed, traditional rainfall-runoff modeling approaches (e.g. HEC-HMS, WinTR20) can be employed to estimate future hydrology (flood peaks) which can then be pushed through hydraulic models (e.g. HEC-RAS) to estimate future floodplain elevations.

Limitations to this approach do exist. There are uncertainties in the general circulation models, regional climate models, and downscaling methods associated with the climate projections themselves. Further application of frequency analysis to such climate model output adds new uncertainties. Primary among such frequency analysis uncertainties is the development of estimates of 100- or 500-year frequencies from what is typically just 30 years of simulated precipitation. Finally, the IDFs that are output from the frequency analysis are then subject to the longstanding uncertainties inherent to rainfall-runoff modeling. This is not to say that such modeling activities are of no value, only that this approach has its limitations. As far as actionable science, this is probably the approach with the greatest potential for estimating future floodplain elevations.

Finally, FEMA's proposed rule addresses adaptation to a changing climate in a manner that is consistent with ASCE policy; however FEMA does not address the non-stationary nature of the underlying physical processes that could produce extreme precipitation and flooding. We would urge continued research and development in this area.

Feedback on Benefit Costs Analysis

FEMA has requested information and studies that examine the benefits of freeboard (essentially, increased level of protection) for different types of projects, including non-residential structures, retrofitting substantial improvements, and projects in non-coastal floodplains. Provided below are methods for evaluating these benefits, as well as case studies from the State of Florida and Hurricane Sandy affected region.

Methods to Justify Actions

There are a number of analyses that help substantiate the benefits of flood protection policy and measures pre- and post- implementation. These include post-disaster loss avoidance assessment, jobs creation (economic impact) analyses based on project expenditure, and pre-project implementation benefit cost analyses. A summary of the elements of such analyses, as well as links to resources and past studies, is provided below.

Loss Avoidance Assessment

A loss avoidance assessment evaluates, post-disaster, the benefits of a project as compared to the expected losses had the project or action never been implemented. Loss avoidance assessments can be completed for projects or planning and policy mechanisms that affect community vulnerability and potential consequences post disaster. The State of Florida, as a case study, completes loss avoidance assessments to substantiate the value of mitigation after each presidentially declared disaster; the reports, specifically for flood-related presidentially declared disasters, can be found at www.floridadisaster.org. The reports present results at the individual project level, as well as for the entire area and all applicable projects known to have been implemented within the event's damage swath and whose benefitting properties could have been impacted by the event. Results differ based on the severity of impact that would have been expected, project cost, and level of protection. Loss avoidance reporting can be used to evaluate the beneficial value of freeboard compared to other types of flood protection measures.

The table below provides a short synopsis of the State of Florida's loss avoidance reports, including the event and event name / year, project types evaluated, total cost of the projects, and total losses avoided (principally, direct physical damage costs avoided). Results of Florida's flood-related loss avoidance reports indicate that flood protection measures have been extremely cost effective since 2008, when Florida began conducting regular loss avoidance reporting.

It should be duly noted that the cost of mitigating development at the time of construction is significantly less than the cost of retrofitting existing development. As the projects evaluated for the example flood loss avoidance assessments below are based entirely on increasing level of protection for pre-existing development, it can be deduced that mitigation at the time of construction, for example, in the form of freeboard requirements, would result in significantly greater cost savings.

Loss Avoidance Report	Project Types Evaluated[1]	Total Cost of Projects Evaluated*	Estimated Losses Avoided*
Tropical Storm Fay, 2008 (1785); the North Florida Flood Event, 2009 (1831); the Unnamed June Flood Event, 2012; Tropical Storm Debby, 2012 (4068)	Acquisition Drainage Elevation Flood-proofing Mitigation reconstruction Second Story Conversion Other flood mitigation	$18,990,020	$21,991,852
Severe Storms and Flooding, 2013 (4138); Hurricane Isaac, 2012 (4084)	Acquisition Drainage	$12,620,711	$50,125,455
Florida Severe Storms, Tornadoes, Straight-line Winds, and Flooding, 2014 (4177)	Acquisition Drainage Elevation Flood-proofing Roadway / Infrastructure	$18,422,686	$24,066,329

*Dollars current to the year of the report

Economic Impact Analysis

Investment in flood protection measures can have a positive economic impact in addition to direct loss avoidance benefit. For example, activities associated with implementing flood

[1] Reports also present results by project type

protection measures often require planning, engineering, and construction management expertise, as well as the purchase of materials and rental of equipment. This activity supports jobs throughout the entire spectrum of incomes and supports industries that were struggling during the recession. Florida has captured this benefit in an Economic Impact Analysis. The results of the analysis indicate that mitigation activities in Florida created about 12,000 jobs between 2004 and 2011. Moreover, results demonstrate that the total project investment of $810 million created $1.6 billion in additional economic output. An economic impact analysis can be used to demonstrate the economic ripples caused by the implementation of a freeboard standard in a variety of forms.

Benefit Cost Analyses

Benefit cost analysis (BCA) is used to evaluate a project's benefit compared to its cost prior to implementation. Benefit cost analysis can also be used to compare the benefits of different flood protection measures, such as comparing floodproofing projects to elevation projects. ASCE is providing a list of a number of case study BCA's that are within FEMA's records for review and have been conducted to evaluate the benefits of flood mitigation projects for hospitals, utilities, and residential structures. Each of the BCAs referenced in the list (provided separately, as these entities have not made their evaluations publicly available) demonstrate that increased levels of protection can be extremely cost beneficial, particularly when applied to public service facilities. The value of a public or critical facility is often more accurately expressed in the value of the service provided by the facility than in the cost of the facility's assets.

Co-benefits

There are a number of co-benefits related to flood protection measures, such as prevented disruption to residents and businesses. The table below provides example co-benefits of flood protection actions that can be measured. These methods can be applied to better understand the different benefits provided by flood protection measures.

Benefit Type	Benefit Description	Sources
Property Value Increase	Research indicates that as the perception of flood risk decreases, property values increase due to increased desirability and perceived reduced risk / operating costs of owning the property.	• Streiner, C.F., and Loomis, J.B. 1995. • Bin, O., Brown Kruse, J., and C.E. Landry. 2008. • Johnston, D.M. and J.B. Braden. 2004.
Insurance Rate Decrease	Measurable lower risk often equates to lower flood insurance premiums.	• Great Miami River Watershed in Ohio • Sacramento- San Joaquin Delta
Displacement	Flood impacts can disrupt the daily lives of residents and businesses. Businesses can lose potential income or inventory, experience property damage, and potentially incur relocation costs, all of which can cause significant financial impacts	• FEMA Benefit Cost Analysis Re-engineering Guide

Benefit Type	Benefit Description	Sources
	that may never be overcome.	
Avoided Business Interruption and its effects on the local, regional, and national economy	Businesses may close for a period of time after a disaster event. Loss of economic output and impacts to the local, regional, and national economy due to flood impacts can be measured using economic models.	• FEMA Hazus Flood Technical Manual
Mental Stress and Anxiety	Flood impacts can damage residential, non-residential, and personal belongings, which can have a negative impact on a person's psychological health. Research has been conducted post-disaster to better understand the rate at which residents experience mental stress post disaster, as well as to better understand what stressors cause mental health impacts.	• FEMA Final Sustainability Benefits Methodology Report
Lost Productivity	Work productivity can be affected by mental stressors post disaster. This impacts economic output after a disaster.	• FEMA Final Sustainability Benefits Methodology Report

Summary

The benefits of flood protection policy and measures pre- and post- implementation can be substantiated by economic impact analysis, benefit cost analysis, loss avoidance reports, and consideration of co-benefits. Loss avoidance assessments can be completed for projects or policy mechanisms that affect community vulnerability and potential consequences post disaster in order to evaluate a return on investment. Benefit cost analysis can also be used to compare the benefits of different flood protection measures or policy mechanisms. Co-benefits can be evaluated to further demonstrate and compare the benefits of flood protection projects and/ or policy in addition to loss avoidance benefits.

Conclusion

ASCE recognizes the difficult task FEMA faced writing a rule that would apply across all regions, with vastly different geographic, hydrologic and weather variabilities. However, given the financial, property and human loss caused by flood related events in this country, we commend the Agency for taking steps to ensure infrastructure is built in a more sustainable and resilient manner.