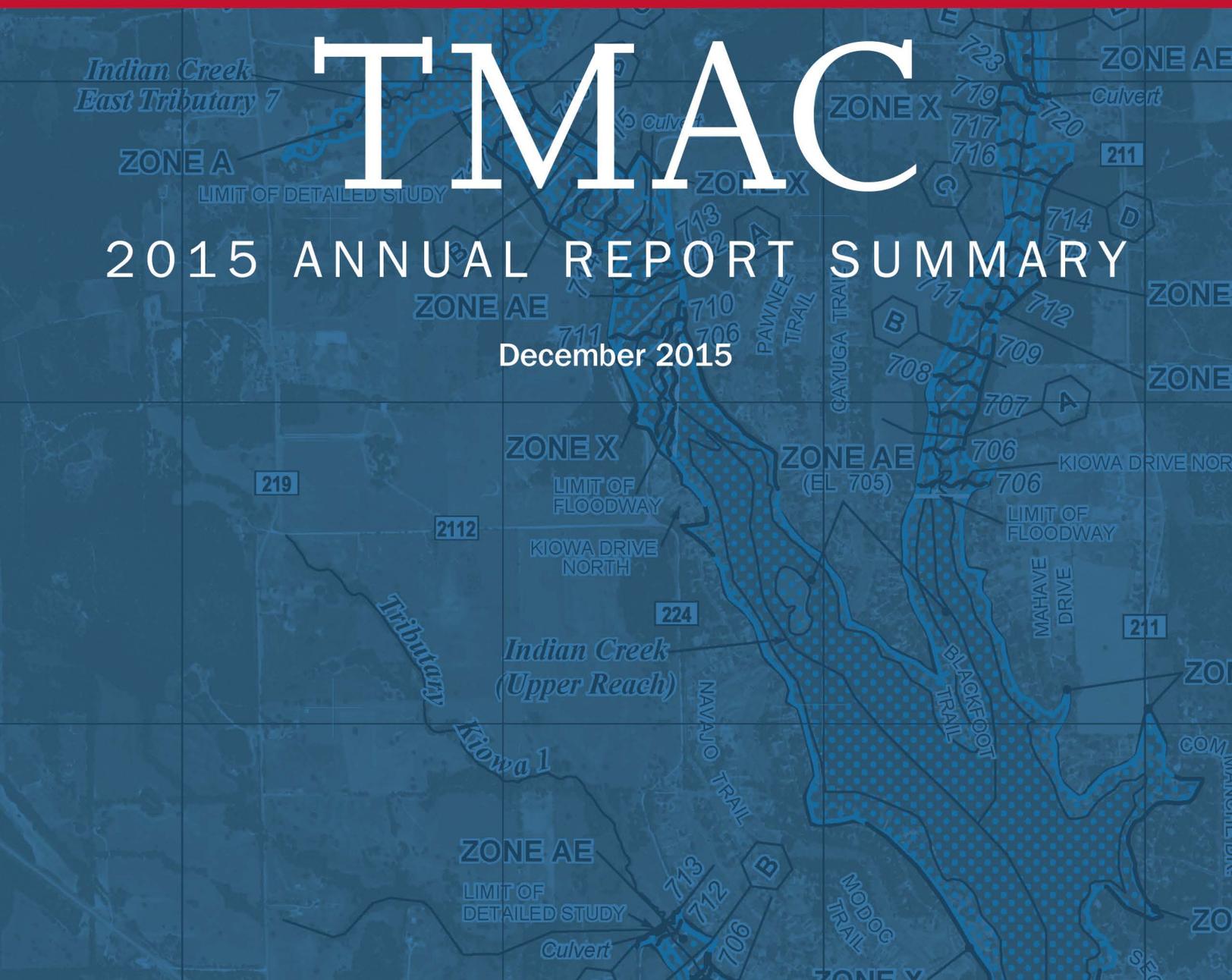




TECHNICAL MAPPING ADVISORY COUNCIL



TMAC

2015 ANNUAL REPORT SUMMARY

December 2015



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TECHNICAL MAPPING ADVISORY COUNCIL

TMAC

2015 Annual Report Summary

December 2015

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Deputy Director for Planning, New York City Mayor's Office of Recovery and Resiliency

Mr. Christopher P. Jones, P.E.

Registered Professional Engineer

Dr. Howard Kunreuther

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President and Owner, Cadastral Consulting, LLC

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Program Manager, Floodplain Management Program, Urban Drainage and Flood Control District, Denver, Colorado

Mr. Robert Mason

Chief, Office of Surface Water, Department of Interior, USGS

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Ms. Christine Shirley, CFM

NFIP Coordinator, Oregon Department of Land Conservation and Development

Ms. Cheryl Small

President, Small Consulting LLC

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Cape Fear, North Carolina



Importance to the Nation

CONTINUAL, DEVASTATING LOSSES FROM FLOODING compel us to become more resilient to the effects of this natural hazard. Our National Preparedness Goal is to be “a secure and resilient nation with the capabilities required across the whole community to prevent, protect against, mitigate, respond to and recover from the threats and hazards that pose the greatest risk.”²

The key to our ability to become more resilient to the effects of flooding is our national flood mapping program, which is part of the National Flood Insurance Program (NFIP) and administered by the Federal Emergency Management Agency (FEMA). Through the national flood mapping program, areas that are at risk of flooding are identified and the level of risk is determined. Decision-makers use the hazard and risk information to manage development in floodplains, mitigate flood risk, communicate flood risk to the public, and administer flood insurance.

The importance of resilience to flooding increases as the population in floodprone areas increases. Much of the projected 30 percent increase in population between 2014 and 2060³ is expected to occur in coastal and other floodprone areas. As our population grows, it is critical that communities across our Nation are provided with updated and long-term projections of flood hazard and risk information if we are going to achieve our National Preparedness Goal. Toward this goal, the national flood mapping program must continue to create and maintain accurate and comprehensive flood hazard identification and risk assessment information to guide sound planning, management, and mitigation decisions.

The Nation’s losses from flooding have been and continue to be devastating. Every year, the homes of thousands of families are destroyed or damaged by flooding, leaving the families permanently or temporarily displaced.

Flood-related damage between 1980 and 2013 totaled \$260 billion, but the total impact to our Nation was far greater—more people lose their lives annually from flooding than any other natural hazard.¹

1. FEMA, “Federal Flood Risk Management Standard (FFRMS)” (2015), <http://www.fema.gov/federal-flood-risk-management-standard-ffrms>; accessed January 5, 2016.
2. FEMA, *National Preparedness Goal*. First Edition (2011), <https://www.fema.gov/pdf/prepared/npg.pdf>.
3. U.S. Census Bureau, *Projections of the Size and Composition of the U.S. Population: 2014 to 2060* (2015), <https://www.census.gov/content/dam/Census/library/publications/2015/demo/p25-1143.pdf>.

Introduction

THE TECHNICAL MAPPING ADVISORY COUNCIL (TMAC or Council) is a Federal advisory committee established to review and make recommendations to the FEMA on matters related to the national flood mapping program. The Biggert-Waters Flood Insurance Reform Act of 2012, as amended (BW-12) (42 U.S.C. §§ 4001–4130),⁴ established the Congressional Charter that outlines the principles and functions of the TMAC. The TMAC is charged with providing recommendations on how to effectively and efficiently map flood risk areas, mapping standards and guidelines, map maintenance activities, delegation of mapping activities, interagency coordination and leveraging, and other requirements mandated by the authorizing BW-12 legislation.

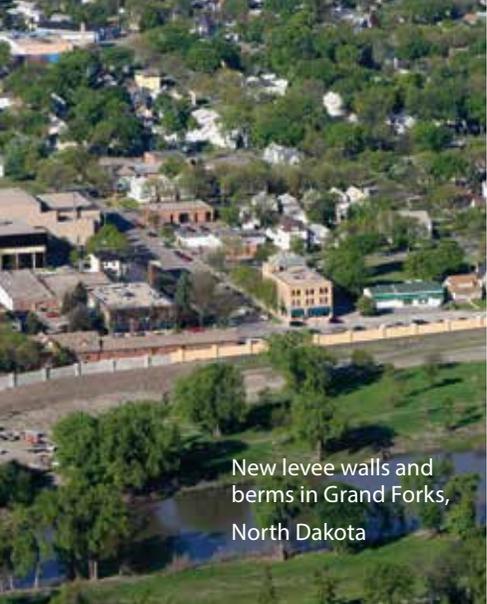
The TMAC is also required to consult with scientists, technical experts, FEMA and other Federal agencies, States, and local communities to develop recommendations on how to ensure that the assessment of flood risk and the development of national Flood Insurance Rate Maps (FIRMs) use the best available climate science and to ensure that FEMA uses the best available methodology for examining the impact of sea level rise and future developments on flood risk. The recommendations are presented in the *TMAC Future Conditions Risk Assessment and Modeling* report, which complements the *TMAC 2015 Annual Report*, and the two reports should be considered together.

The *TMAC 2015 Annual Report Summary* highlights the findings and recommendations of the TMAC as described in the *TMAC 2015 Annual Report*.⁵

TMAC DUTIES

The TMAC's duties as mandated by BW-12 are as follows:

- “(1) recommend to the Administrator how to improve in a cost-effective manner the –
- (A) accuracy, general quality, ease of use, and distribution and dissemination of flood insurance rate maps and risk data; and
 - (B) performance metrics and milestones required to effectively and efficiently map flood risk areas in the United States;



New levee walls and berms in Grand Forks, North Dakota



2008 flooding in Cedar Rapids, Iowa



Vulnerable levee walls in an urban area

4. BW-12 was amended by the Homeowner Flood Insurance Affordability Act of 2014 (HFIAA) (Public Law 113–89, 128 Stat. 1021–22).

5. Technical Mapping Advisory Council, *TMAC 2015 Annual Report* (2015).

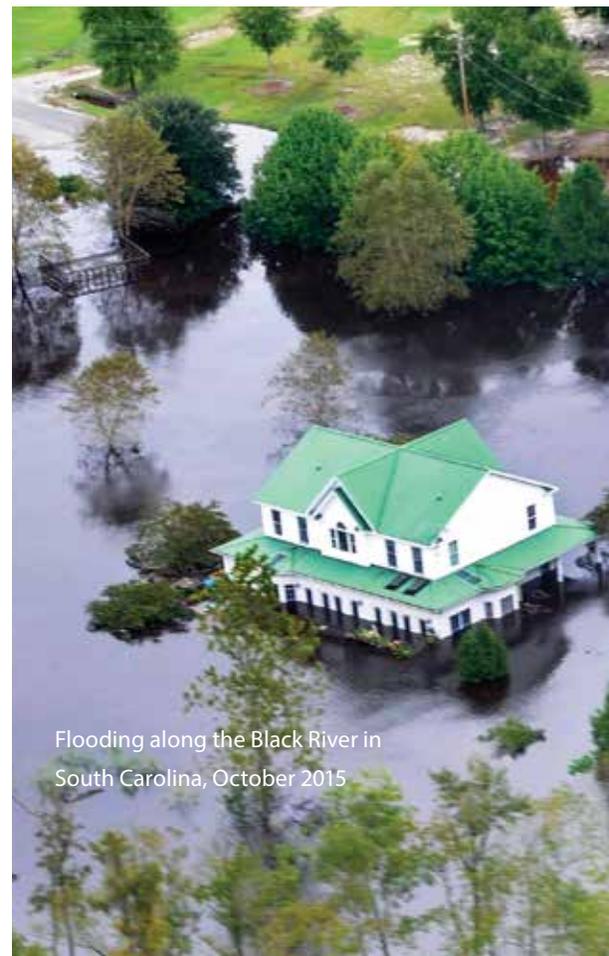
- (2) recommend to the Administrator mapping standards and guidelines for –
 - (A) flood insurance rate maps; and
 - (B) data accuracy, data quality, data currency, and data eligibility;
- (3) recommend to the Administrator how to maintain, on an ongoing basis, flood insurance rate maps and flood risk identification;
- (4) recommend procedures for delegating mapping activities to State and local mapping partners;
- (5) recommend to the Administrator and other Federal agencies participating in the Council –
 - (A) methods for improving interagency and intergovernmental coordination on flood mapping and flood risk determination; and
 - (B) a funding strategy to leverage and coordinate budgets and expenditures across Federal agencies; and
- (6) submit an annual report to the Administrator that contains –
 - (A) a description of the activities of the Council;
 - (B) an evaluation of the status and performance of flood insurance rate maps and mapping activities to revise and update flood insurance rate maps, as required under section 4101b of this title; and
 - (C) a summary of recommendations made by the Council to the Administrator (42 U.S.C. § 4101a(c))”

The TMAC is also required by BW-12 to:

- “... consult with scientists and technical experts, other Federal agencies, States, and local communities to –
- (A) develop recommendations on how to –
 - (i) ensure that flood insurance rate maps incorporate the best available climate science to assess flood risks; and
 - (ii) ensure that the Federal Emergency Management Agency uses the best available methodology to consider the impact of –
 - (I) the rise in the sea level; and
 - (II) future development on flood risk; and
 - (B) not later than 1 year after the date of enactment of this Act, prepare written recommendations in a future conditions risk assessment and modeling report and to submit such recommendations to the Administrator (42 U.S.C. § 4101a(d)).”



Seawall along the New Jersey beach



Flooding along the Black River in South Carolina, October 2015

TMAC VISION STATEMENT AND GUIDING PRINCIPLES

The TMAC created the following statement as an end-state vision for flood hazard mapping and risk assessment:

A Nation more resilient to flood hazards through the effective identification and communication of flood hazards and risk.

The TMAC encourages the use of the following guiding principles to underpin the future of risk assessment and the national flood mapping program:

1. **Credible products**
2. **Efficient implementation**
3. **Stakeholder acceptance**
4. **Effective leveraging**
5. **Financial stability**

Breezy Point, New York,
after Hurricane Sandy



TMAC GOALS

The *TMAC 2015 Annual Report* presents the TMAC's recommendations by topic area, while the *TMAC 2015 Annual Report Summary* presents the TMAC's recommendations in accordance with the following seven goals, which were developed in accordance with TMAC's five guiding principles (see text box). The TMAC believes the following goals and subsequent recommendations should be established and monitored:

- Goal 1:** Accurate, comprehensive data, models, displays and risk assessments associated with present and future flood hazards.
- Goal 2:** Time- and cost-efficient generation and process management of flood hazard and risk data, models, assessments and displays.
- Goal 3:** Effective utilization of efficient technologies for acquisition, storage, generation, display, and communication of data, models, displays, and risk.
- Goal 4:** Integrated flood risk management framework of hazard identification, risk assessment, mitigation, and monitoring.
- Goal 5:** Strong confidence, understanding, awareness, and acceptance of flood hazard and risk data, models, displays, assessments, and process by the public and program stakeholders.
- Goal 6:** Robust added value coordination, leveraging and partnering with local, state, federal, and private sector organizations.
- Goal 7:** Permanent, substantial funding that supports all program resource requirements.

Background

NATIONAL FLOOD INSURANCE PROGRAM

FEMA administers the NFIP through the Federal Insurance and Mitigation Administration. Created with the passage of the National Flood Insurance Act of 1968, the NFIP is an insurance, mapping, and floodplain management program that makes federally backed flood insurance available to home and business owners and renters in communities that participate in the program. Since 1968, a number of laws have strengthened the NFIP to improve its fiscal soundness and inform its mapping and rate setting. In 2012, Congress passed BW-12, which authorized and funded the national flood mapping program.⁶ By participating in the NFIP, communities agree to adopt ordinances and enforce minimum building requirements that reduce the risk of flooding.

The NFIP comprises three central interconnected activities:

Flood insurance – Making flood insurance available to help property owners recover following a flood

Floodplain management – Minimizing the economic impact of flood events using a combination of mitigation efforts and community-adopted floodplain ordinances

Floodplain analysis and mapping – Identifying and mapping community areas that are subject to flooding

Currently, more than 22,000 communities across the Nation participate in the NFIP⁷ and 5.1 million flood insurance policies are in force.⁸ The program has grown to include more than 138,000 FIRM panels that include 1.13 million miles of riverine and coastal flood mapping.⁹

Since 1978, the NFIP has paid out a total of \$51 billion on more than 2 million flood damage claims. For Hurricane Katrina and Hurricane Sandy, the two costliest storms in the history of the NFIP, the NFIP paid out nearly half of these claims, with \$16.3 billion for Hurricane Katrina and \$8 billion for Hurricane Sandy.¹⁰

6. FEMA, "Flood Insurance Reform – The Law" (2015), <http://www.fema.gov/flood-insurance-reform-law>; accessed November 9, 2015.

7. FEMA, *Community Status Book Report: Communities Participating in the National Flood Program* (2015), <http://www.fema.gov/cis/nation.pdf>.

8. FEMA, "Guidelines and Standards Policy" (2015), <https://www.fema.gov/media-library/assets/documents/35313>; accessed January 5, 2016.

9. Rick Sacbibit, "Maintaining, on an Ongoing Basis, Flood Insurance Rate Maps and Flood Risk Identification" (FEMA presentation to TMAC, October 1, 2014).

10. FEMA, "Significant Flood Events" (2015), <https://www.fema.gov/significant-flood-events>; accessed December 2, 2015.



High-risk waterfront properties along coastal North Carolina

FLOOD INSURANCE STUDIES AND FLOOD INSURANCE RATE MAPS

The National Flood Insurance Act of 1968 directed the Federal Insurance Administration (FIA) to identify all floodprone areas within the United States and establish flood-risk zones within those floodprone areas. To meet these obligations, FEMA produces Flood Insurance Studies (FISs) and FIRMs. FISs analyze the terrain and the factors that affect flood hazards using specified models and the physical, hydrologic, and climate conditions in effect at the time the studies are conducted. FIRMs use the information from the FISs to delineate floodplain boundaries. FIRMs and FISs are a “snapshot” of flood risk at a certain time, and can become outdated as topographic, hydrologic, or climate conditions change, or as engineering methods and models improve. These products also show projected flood elevations, flood velocities, floodway dimensions, and insurance rating zones. The FIS, FIRM, and associated flood data adopted by the community are referred to as “Effective” until replaced by a new FIRM. Only Effective FIRMs are used for insurance rating and NFIP regulatory purposes.

FEMA is required to revise and update all floodplain areas and flood-risk zones identified, delineated, or established based on an analysis of all natural hazards affecting flood risks on a 5-year cycle. FEMA uses the New, Valid, or Updated Engineering (NVUE) metric to measure data quality by ensuring flood hazard data are new, have been updated, or are deemed still valid through a continuous review and update process.

In an effort to improve the quality of its mapping products, FEMA has engaged in several initiatives to take advantage of changing technology and data collection methods.

Flood Hazard and Flood Risk Identification

For TMAC purposes, the effects of flooding are divided into two categories: flood hazard and flood risk. Flood hazard generally refers to physical flood conditions, and is defined as flood conditions (e.g., depth, wind, velocity, duration, waves, erosion, debris)

with the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, damage to the environment, interruption of business, or other types of harm or loss.¹¹

Flood hazard identification is an integral part of the NFIP. FEMA provides flood hazard information in five regulatory mapping products (see Section 2.2.1 of the Annual Report), which are used to carry out NFIP functions related to floodplain management, flood insurance, mitigation, and flood provisions of building codes. Flood hazard identification consists of identifying and mapping the flood zone that will be inundated by a flood event that has a 1 percent annual chance of being equaled or exceeded in a given year.

Flood risk generally refers to losses and other consequences of flooding and is defined by the TMAC as the expected flood losses based on the likelihood and severity of flooding, the natural and manmade assets at risk, and the consequences to those assets.¹²

Map Mod

The Flood Map Modernization Initiative, commonly referred to as Map Mod, was created in 1997 to convert existing flood maps to a digital format and to ensure that all new flood maps were produced in a digital format. Map Mod improved and updated the Nation’s flood maps and provided 92 percent of the Nation’s population with FIRMs. Before Map Mod, 70 percent of the Nation’s FIRMs were over 10 years old due to the lack of funding for map maintenance. Through Map Mod, FEMA established a technology-based, cost-effective process for updating, validating, storing, and distributing flood risk data.

Risk MAP

In 2009, at the request of Congress, FEMA produced a plan titled *Risk Mapping, Assessment, and Planning (Risk MAP) Multi-Year Plan: Fiscal Years 2010–2014* (Risk MAP).¹³ The plan outlines FEMA’s vision for building on the data produced during Map Mod to enhance and maintain the Nation’s map inventory and recommended significant changes to how risk is communicated to the public. The vision of the Risk MAP program is to “deliver quality data that increases

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11. FEMA, *Multi Hazard Identification and Assessment: A Cornerstone of the National Mitigation Strategy* (1997), <http://www.fema.gov/media-library/assets/documents/7251>.
 12. J. Schwab, K.C. Topping, C. Eadie, R. Deyle, and R. Smith, *Planning for Post-Disaster Recovery and Reconstruction*, PAS Report 483/484 (Chicago: American Planning Association, 1998).
 13. FEMA, *Risk Mapping, Assessment, and Planning (Risk MAP) Multi-Year Plan: Fiscal Years 2010–2014* (2009), http://www.fema.gov/media-library/data/20130726-1650-20490-4732/fema_risk_map_plan.pdf.

public awareness and leads to action that reduces risk to life and property.”¹⁴ Additional products were created under Risk MAP to help communicate both the flood hazard and the associated risk. The Risk MAP lifecycle is shown below.



Risk MAP Lifecycle

FEMA’s Risk MAP program produces a number of products referred to as flood risk products.¹⁵ Flood risk products are non-regulatory resources that can be developed as part of a Risk MAP project (referred to as a flood risk project by FEMA) and supplement the five regulatory mapping products. While some of the flood risk products convey flood hazard information, not flood risk information, they are intended to help community officials and the public view and understand their flood risk.

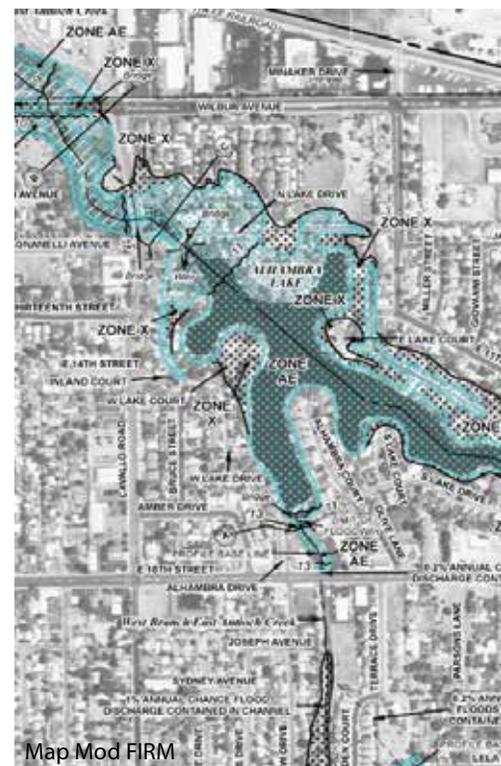
USES OF NFIP PRODUCTS

A variety of professionals and lay persons rely on accurate flood hazard and flood risk data and products produced by FEMA’s flood mapping program to support decision-making, including avoiding high-risk areas, determining whether flood insurance is needed, pricing flood insurance premiums, identifying cost-effective mitigation, and conducting emergency planning, response, and recovery. Users of these products include lenders, insurance agents, community floodplain managers, land use planners, building officials, surveyors, design professionals, home and building owners, real estate agents, developers, elected officials, emergency management officials, flood determination companies, and various Federal, State, and local agencies. Members of the general public may also use these tools to understand patterns of flooding for avoidance and evacuation.

14. FEMA, “What is Risk MAP?” (2012, p. 1), http://www.fema.gov/media-library-data/20130726-1731-25045-5094/what_is_risk_map.pdf.
 15. FEMA, “Hydrologic Models Meeting the Minimum Requirement of National Flood Insurance Program” (2015), <http://www.fema.gov/hydrologic-models-meeting-minimum-requirement-national-flood-insurance-program>; accessed January 5, 2016.



Pre Map Mod FIRM



Map Mod FIRM



Risk MAP FIRM

GOAL 1

Accurate, comprehensive data, models, displays and risk assessments associated with present and future flood hazards.



RECOMMENDATIONS RELATED TO GOAL 1

Recommendation 2	Develop a national 5-year flood hazard and risk assessment plan and prioritization process that aligns with program goals and metrics.	Page 10
Recommendation 3	Develop National Flood Hazard and Risk Assessment Program goals that include well-defined and easily quantifiable performance metrics.	Page 12
Recommendation 4	Work with Federal, State, local, and tribal partners to ensure topographic, geodetic, water-level, and bathymetry data for the flood mapping program are collected and maintained to Federal standards.	Page 14
Recommendation 5	Document the horizontal and vertical accuracy of topographic data input to flood study models and the horizontal and vertical accuracy of topographic data used to delineate the boundaries of the flood themes. These data should be readily available to users, and clearly reported with products.	Page 14
Recommendation 6	Periodically review and consider use of new publicly available statistical models, such as the proposed Bulletin 17C, for flood-frequency determinations.	Page 16
Recommendation 7	Develop guidelines, standards, and best practices for selection and use of riverine and coastal models appropriate for certain geographic, hydrologic, and hydraulic conditions.	Page 17
Recommendation 8	Develop standards and best practices related to coastal 2-D storm surge modeling in order to expand the utility of the data and more efficiently perform coastal flood studies.	Page 19
Recommendation 9	Review and update existing coastal event-based erosion methods for open coasts, and develop erosion methods for other coastal geomorphic settings.	Page 20

The above recommendations are abbreviated. See the discussion of each recommendation for the unabbreviated version.

GOAL 1

SINCE ITS INCEPTION, participation in the NFIP has grown to more than 22,000 communities, with 5.1 million flood insurance policies in effect. The NFIP has paid nearly \$51 billion for flood insurance claims and related costs since 1978 and from 2005 to 2014, annual flood insurance claims averaged more than \$3.5 billion.¹⁶ The growth in NFIP participation correlates to increases in construction and land development across the Nation. The increased land development can alter natural runoff patterns and increase flood risk. Residential construction statistics released by the U.S. Census Bureau and the Department of Housing and Urban Development indicate that privately owned housing units authorized by building permits in August 2015 increased by 12.5 percent from the August 2014 estimate.¹⁷ According to the American Institute of Architects, overall nonresidential building activity was up 16 percent in the first 5 months of 2015, with an 18 percent increase in commercial construction activity.¹⁸

With construction and development increasing annually to support an increasing U.S. population, accurate flood hazard identification and risk assessment data are essential to support current and future decision making. Accurate models and data that depict the hazard and risk are also critical to reducing our Nation's vulnerability to aging infrastructure. Aging and unmaintained bridges, dams, and levees increase our vulnerability to flooding, some of which can be countered with sound floodplain management using accurate flood mapping data.

To create a Nation more resilient to flood hazards, future development must consider flood resiliency. Flood-resistant development is only possible if local governments issue policies and standards that are based on accurate flood data and maps that show

current and future flood hazards and current and future risk assessments. After the completion of Map Mod in 2008, FEMA provided digital flood hazard information through modernized FIRMs for 92 percent of the Nation's population. As of March 2015, FEMA had Preliminary or Effective FIRMs available for nearly 98 percent of the Nation's population. The remaining 2 percent reside in largely unpopulated regions of the Nation. Although less populated, these unmapped areas represent a large number of stream miles (over 1 million miles).

Although FEMA has made progress in mapping the Nation, approximately half of the FISs are out of date and may not indicate the current flood risk. Accurately identifying the hazard and maintaining current flood hazard information is essential for communicating the risk of flooding and minimizing the damage to property and loss of life caused by floods.

Further, analyzing coastal flooding and riverine flooding requires vastly different approaches to performing flood studies, and many models and methodologies are available to simulate the flood hazards for both. Different models and methods can produce different results, which leads to controversy, challenges, and a lack of confidence in the results. Users need mapping and data products that are consistent and supported by sound science and engineering from trusted, credible, and verifiable sources. Authoritative studies and maps and *transparent application of best practices* will build confidence in the results and the NFIP as a whole.



This house in Mantoloking, New Jersey, was destroyed by the storm surge of Hurricane Sandy

16. FEMA, Resources: Flood Facts (2015), <https://www.floodsmart.gov>.

17. U.S. Census Bureau News and U.S. Department of Housing and Urban Development, *New Residential Construction in August 2015* (2015), http://www.census.gov/construction/nrc/pdf/newresconst_201508.pdf.

18. Kermit Baker, "Nonresidential Construction in Full Recovery Mode" (The American Institute of Architects, Vol. 22, July 24, 2015), <http://www.aia.org/practicing/AIAB106916>; accessed January 6, 2016.

GOAL 1 | Recommendation 2

FEMA should develop a national 5-year flood hazard and risk assessment plan and prioritization process that aligns with program goals and metrics (see Recommendation 3). This should incorporate a rolling 5-year plan to include the establishment and maintenance of new and existing studies and assessments in addition to a long-term plan to address the unmapped areas. Mapping and assessment priorities should be updated annually with input from stakeholders (e.g., Multi-Year Hazard Identification Plan). The plan should be published and available to stakeholders.

The TMAC's key findings and a recommendation related to prioritizing studies and updates are provided below and are followed by a discussion of the recommendation, benefits, and potential issues related to implementing the recommendation, as applicable. Additional discussion of this recommendation can be found in Section 4.2 of the *TMAC 2015 Annual Report*.

Key Findings

- The national metrics and goals developed during Map Mod were a driver for the development of multi-year planning efforts and led to the development of 5-year business plans that are still being developed and maintained by Cooperating Technical Partners (CTPs). The 5-year business plans can still be used by CTPs to provide input into prioritizing projects within their jurisdictions.
- Prior to Risk MAP, communities were able to identify mapping and FIS needs through an online portal known as the Multi-Hazards Information Portal (MHIP), and these study needs were considered when prioritizing areas for funding. The MHIP has been replaced by the Coordinated Needs Management Strategy (CNMS) in which a more detailed analysis is used to determine the validity of existing studies, but no information is provided on how these needs will be met.
- Since flood hazard studies must be re-evaluated for validity and categorized as either valid, unverified, or unknown, they have a shelf life of approximately 5 years. The process is continually evolving as new studies are conducted and development and/or new data invalidate existing studies.

BW-12 Mandate **Pub. Law 112-141, Section 100215(c)**

The Council shall —

- (1) recommend to the Administrator how to improve in a cost-effective manner the —
 - (B) performance metrics and milestones required to effectively and efficiently map flood risk areas in the United States;
- (3) recommend to the Administrator how to maintain, on an ongoing basis, flood insurance rate maps and flood risk identification;

- Uniform assessment and application of goals and priorities are more difficult when the responsibility for setting local priorities is largely placed within the discretion of each FEMA Regional Office. Each Region is given discretion on how to weight the funding priorities between identifying mitigation actions and conducting detailed flood studies. The discretion has led to wide variations between Regions in how priorities are set.

Discussion of Recommendation 2

In 1997, FEMA conducted a benefit-cost analysis of Map Mod that showed a benefit to the taxpayer of over \$2 for every \$1 invested in flood hazard analysis and mapping.¹⁹ The State of North Carolina used the same methodology in a later analysis and calculated a Benefit-Cost Ratio of 2.3 to 1,²⁰ and the benefit is expected to increase with technological advances.

19. FEMA, *Report on Costs and Benefits of Natural Hazard Mitigation* (1997).

20. Association of State Floodplain Managers, *Flood Mapping for the Nation: A Cost Analysis for the Nation's Flood Map Inventory* (2013), http://www.floods.org/ace-files/documentlibrary/2012_NFIP_Reform/Flood_Mapping_for_the_Nation_ASEPM_Report_3-1-2013.pdf.

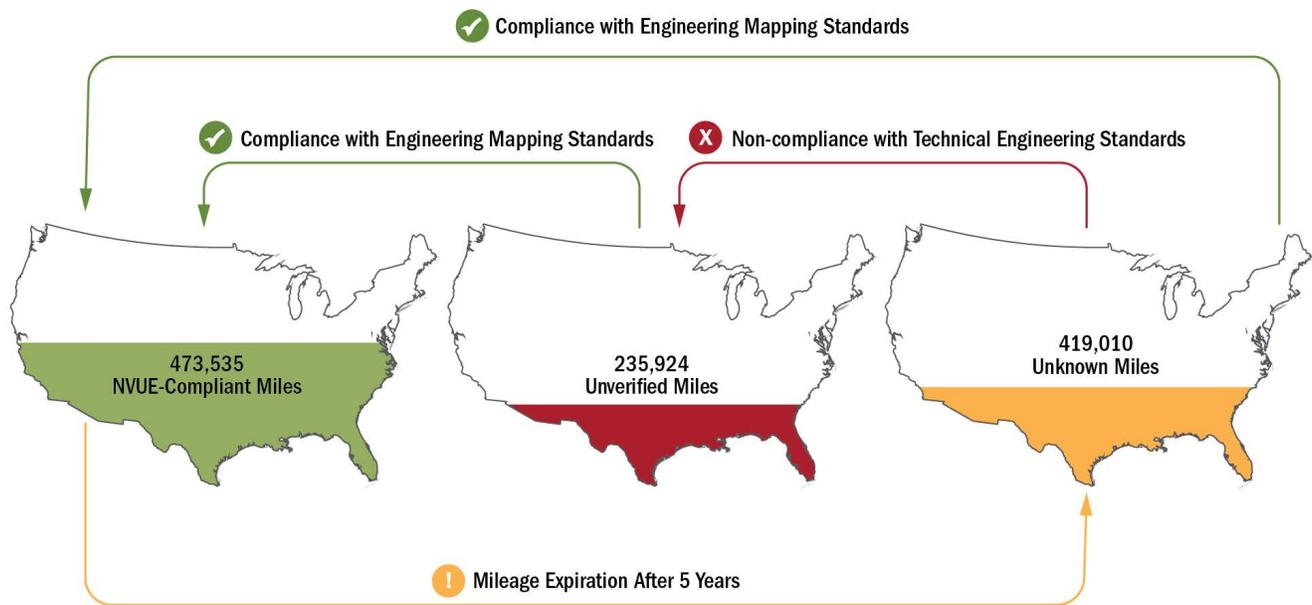
GOAL 1 | Recommendation 2 (continued)

Flood hazard analysis and mapping also reduces disaster costs, with approximately \$1.5 billion in avoided damage every year for buildings constructed in compliance with NFIP standards.²¹ The investment in flood mapping is offset by losses avoided in just over 4 years.

While the cost benefits of flood mapping are significant, more transparency and planning in how these limited funds are spent is needed. Projects should be prioritized based on clear, understandable criteria that include factors such as the number of highly populated flood hazard areas and areas with a large number of NFIP policies and/or structures in the floodplain, CNMS information, and repetitive loss

properties, supported by locally identified priorities. These criteria should be applied in a uniform manner across the Regions.

The development of a national 5-year flood hazard and risk assessment plan that is updated annually to reflect the actual projects that were initiated and the sequencing of future projects would help both mapping partners and communities to plan better for leveraged data, such as elevation or study data, and cost sharing. While the Risk MAP process focuses on community engagement once a study is underway, the lack of multi-year planning results in a lack of community and State involvement in prioritizing which studies are selected.



FEMA uses the CNMS to identify and track the lifecycle of mapping requests and FIS needs for national the flood mapping program. FEMA uses a validation process to assess the inventory of miles maintained in the CNMS to determine if the flood study meets FEMA’s technical currency standards. If a study meets technical standards, it is deemed “valid” or “NVUE-compliant.” Of the 1.13 million miles of riverine flood hazard information currently in FEMA’s inventory (as of FY15 Q4), 473,535 miles are valid (NVUE-compliant) and 235,924 are unverified (does not meet technical currency standards) with 419,010 miles unknown.

21. Ibid.

GOAL 1 | Recommendation 3

FEMA should develop National Flood Hazard and Risk Assessment Program goals that include well-defined and easily quantifiable performance metrics. Specifically, the program goals should include metrics for the following:

- a) Maintaining an inventory of valid (verified), expiring, unverified, and unknown flood hazard miles;
- b) Addressing the non-modernized areas of the Nation and unstudied flood hazard miles;
- c) Conducting flood risk analysis and assessments on the built environment; and
- d) Counting population having defined floodplains using a stream level performance indicator for a better representation of study coverage.

The TMAC's key findings and a recommendation related to the program goals are provided below and are followed by a discussion of the recommendation, benefits, and potential issues related to implementing the recommendation, as applicable. Additional discussion of this recommendation can be found in Section 4.2 of the *TMAC 2015 Annual Report*.

Key Findings

- FEMA identified new strategies and products designed to achieve the Risk MAP vision and created four performance measures to assess Risk MAP progress: Deployment, Quality Data, Awareness, and Actions.
- FEMA's current performance measures are focused too heavily on mitigation, resulting in the loss of an accurate metric to measure and track the effectiveness of the flood mapping and risk assessment program and the remaining unmapped areas.
- The method used to develop the deployment metric is easily misunderstood and can lead policymakers to believe that more of the Nation's population is covered by modern flood maps than is actually the case. This overcounting can lead to a belief that more of the Nation's flood risk has been identified than is the case.
- The method used to determine the quality data metric is not consistent and is not updated based on project funding. The concept of tracking both

BW-12 Mandate **Pub. Law 112-141, Section 100215(c)**

The Council shall —

- (1) recommend to the Administrator how to improve in a cost-effective manner the —
 - (B) performance metrics and milestones required to effectively and efficiently map flood risk areas in the United States;
- (3) recommend to the Administrator how to maintain, on an ongoing basis, flood insurance rate maps and flood risk identification;

initiated and attained study miles for new studies is unclear, and counting all prioritized studies as initiated, whether funded or not, leads to confusion on the actual number of newly studied stream miles and the impact on the NVUE status.

- While a significant number of mapping partners are going beyond the minimal requirements for flood risk assessments, FEMA currently does not have goals or performance metrics related to flood risk analysis and assessments on the built environment.

Discussion of Recommendation 3

Developing clear, measurable goals for the future National Flood Hazard and Risk Assessment Program that include metrics to track the maintenance of the current inventory of flood hazard miles would

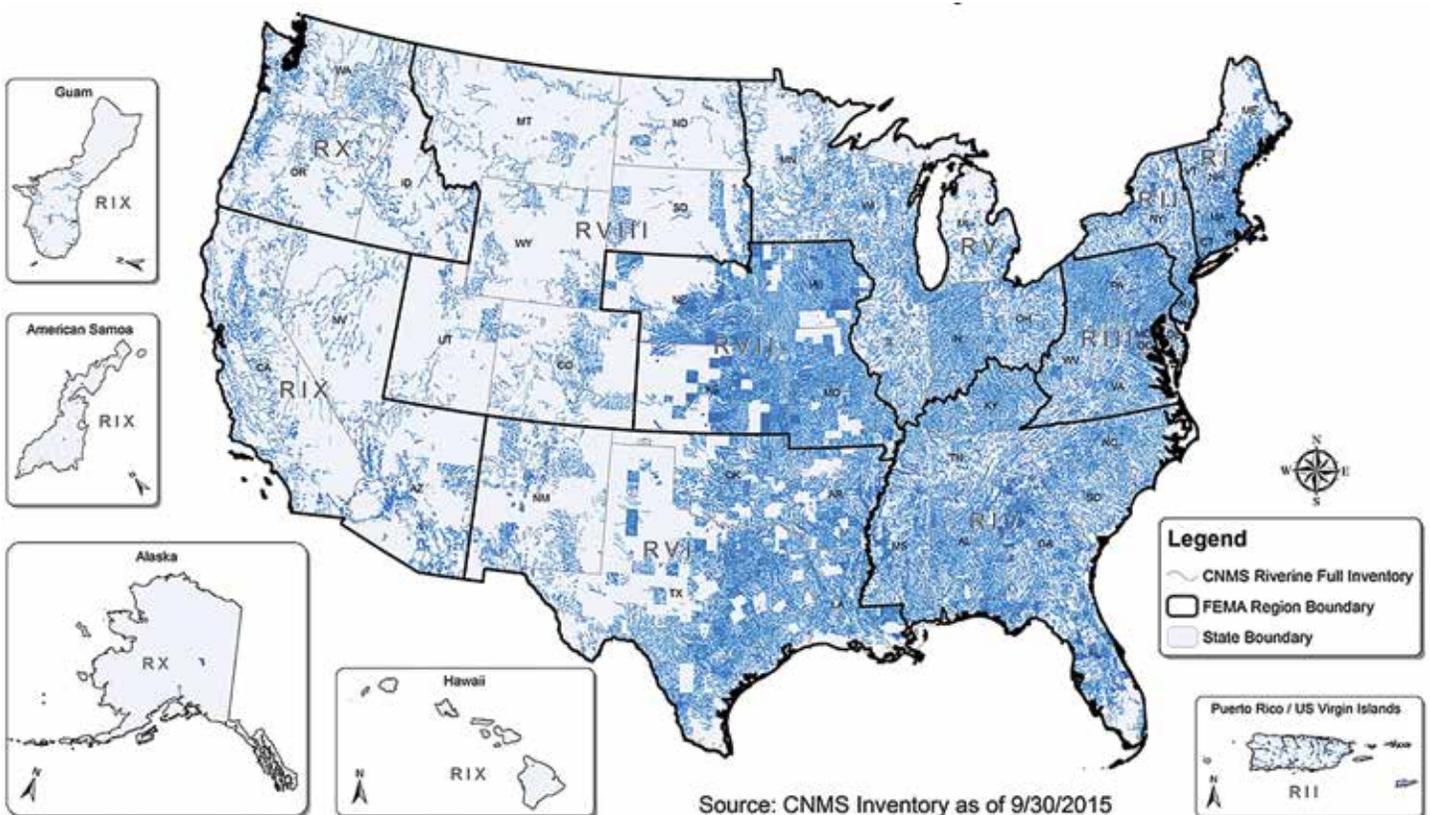
GOAL 1 | Recommendation 3 (continued)

improve the validity and utility of the program. While FEMA's current Risk MAP performance metrics have validity, they are based on the entire hydrologic unit code 8 (HUC8) watershed level and can overcount population coverage and the stream miles studied.

The impact area performance metrics should be measured at the stream level, rather than at the watershed level, for a better representation of study coverage.

FEMA should consider a stream level Key Performance Indicator (KPI), as defined in Section 4.4, that relates to population.

Many populations across the Nation are not covered in updated, valid flood studies and are therefore subject to unknown flood risk. Completion of converting the paper inventory to a digital product and mapping the unstudied streams should continue. The suggestion is not that FEMA allocate a significant portion of its limited resources to studying and mapping stream miles across the Nation that are not currently mapped using modern methods but rather that FEMA develop a goal to address these areas.



The Nation's flood map inventory. There are currently 1.13 million miles of study in FEMA's inventory of flood hazard mapping needs. However, the National Hydrography Dataset encompasses the drainage area of 3.5 million miles of streams in the Nation, of which approximately 1 million miles are entirely on Federal lands.²²

This leaves approximately 1.4 million miles of streams where the flood hazard has yet to be determined.

22. U.S. Geological Survey, "National Hydrographic Dataset" (2014), <http://nhd.usgs.gov/>; accessed January 5, 2016.

GOAL 1 | Recommendations 4 and 5

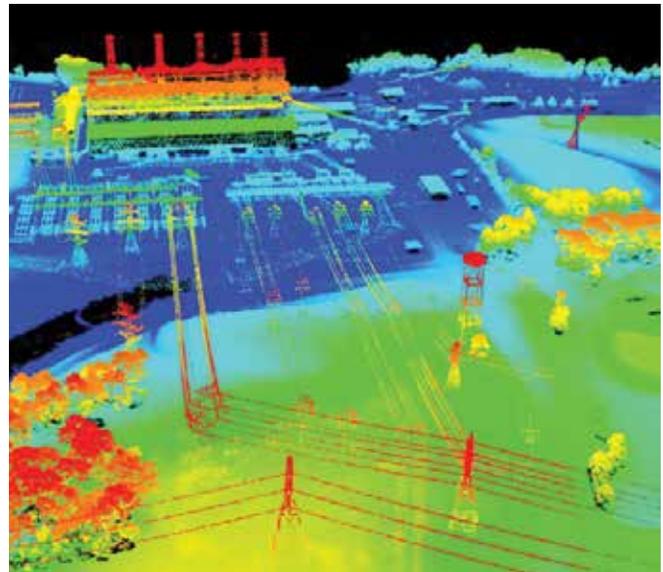
FEMA should work with Federal, State, local, and tribal partners to ensure topographic, geodetic, water-level, and bathymetry data for the flood mapping program are collected and maintained to Federal standards. Future FEMA topographic and bathymetric LiDAR acquisition should be consistent with 3DEP and Interagency Working Group on Ocean and Coastal Mapping standards, and all geospatial data for the flood mapping program should be referenced to current national datums and the National Spatial Reference System. Water level gage datums for active gages should be referenced to current national datums and the National Spatial Reference System, and to the extent practical, datums for inactive gages should be converted to meet these standards.

FEMA should document the horizontal and vertical accuracy of topographic data input to flood study models and the horizontal and vertical accuracy of topographic data used to delineate the boundaries of the flood themes. These data should be readily available to users, and clearly reported with products.

The TMAC's key findings and a recommendation related to core data and methodology are provided below and are followed by a discussion of the recommendation, benefits, and potential issues related to implementing the recommendation, as applicable. Additional discussion of this recommendation can be found in Section 4.3 of the *TMAC 2015 Annual Report*.

Key Findings Related to Recommendations 4 and 5

- Legacy FIRMs and FIS Reports that reference superseded geodetic datums are still in use, and new maps that reference North American Datum of 1983 and North American Vertical Datum of 1988 will be superseded in the coming years as more accurate referencing datums are adopted by NGS.
- It is important to require and store complete metadata for all mapping products. Original data such as point clouds should be retained for reprocessing.
- Light Detection and Ranging (LiDAR) data collection must include tying to the National Spatial Reference System as part of the quality assurance and quality control procedures.
- Currently, the National Coastal Mapping Strategy adopts 3DEP recommended topographic LiDAR standards and defines bathymetric LiDAR that will



Terrestrial LiDAR

- foster the collection of interoperable datasets by all the Interagency Working Group on Ocean and Coastal Mapping member agencies involved in LiDAR collection, including FEMA.
- Substantial benefits for other flood-management activities may result from tying current operational, real-time U.S. Geological Survey (USGS) streamgages, particularly those in coastal areas, to national datums and the National Spatial Reference System.

GOAL 1 | Recommendations 4 and 5 (continued)

Discussion of Recommendation 4

Topography, also referred to as land surface elevations, along with bathymetry, or underwater elevations, and water level information are core data types that are critical in evaluating flood hazards. These data must be related to an accurate geodetic reference frame that ties them to the Earth’s surface. Technologies exist today that can provide these data for the entire United States but require substantial investment. It is important for FEMA to collaborate with other Federal agencies, States, and local agencies in funding, collecting, and maintaining these important core data and geospatial metadata. Data collected according to Federal standards and best practices will yield high-quality, cost-efficient mapping.

Discussion of Recommendation 5

The inventory of flood hazard studies and mapping has been created over decades under changing quality standards and a variety of both horizontal and vertical datums. Understanding the basic data upon which flood hazards have been delineated is fundamental to understanding the accuracy of the presentation. Communicating this basic information about NFIP products is needed to assist users with comparisons and for updates to improved datums.

Users, both technical and non-technical, must be informed and educated regarding data quality and limitations. Full documentation of data accuracy should be available both inside and outside metadata for better recognition by all users. Documenting the accuracy of the topographic aids in communicating uncertainty and can help users understand the limitations of the map display.

BW-12 Mandate **Pub. Law 112-141, Section 100215(c)**

The Council shall —

- (1) recommend to the Administrator how to improve in a cost-effective manner the —
 - (A) accuracy, general quality, ease of use, and distribution and dissemination of flood insurance rate maps and risk data; and
- (2) recommend to the Administrator mapping standards and guidelines for—
 - (B) data accuracy, data quality, data currency, and data eligibility;
- (5) recommend to the Administrator and other Federal agencies participating in the Council—
 - (A) methods for improving interagency and intergovernmental coordination on flood mapping and flood risk determination;

BW-12 Mandate **Pub. Law 112-141, Section 100215(c)**

The Council shall —

- (1) recommend to the Administrator how to improve in a cost-effective manner the —
 - (A) accuracy, general quality, ease of use, and distribution and dissemination of flood insurance rate maps and risk data; and
- (2) recommend to the Administrator mapping standards and guidelines for—
 - (A) flood insurance rate maps; and
 - (B) data accuracy, data quality, data currency, and data eligibility;

GOAL 1 | Recommendation 6

FEMA should periodically review and consider use of new publicly available statistical models, such as the proposed Bulletin 17C, for flood-frequency determinations.

The TMAC's key findings and a recommendation related to riverine hydrology are provided below and are followed by a discussion of the recommendation, benefits, and potential issues related to implementing the recommendation, as applicable. Additional discussion of this recommendation can be found in Section 4.3 of the *TMAC 2015 Annual Report*.

Key Findings

- About half of FEMA riverine flood studies depend on either direct analysis of USGS flood data or regional regression equations derived from them.
- Ultimately, the accuracy of the flood-frequency estimates depends primarily on the length and representativeness of the flood records; many flood records are too short to ensure accurate flood-frequency estimates of the 1-percent-annual-chance flood.
- The release of the proposed flood-frequency guidelines in Bulletin 17C²³ in 2016 will provide tools for improving flood-frequency estimates at many locations, but its use will require the development and coding of other nontraditional data from public and private documents and formidable field work in many cases.

BW-12 Mandate **Pub. Law 112-141, Section 100215(c)**

The Council shall —

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 - (A) accuracy, general quality, ease of use, and distribution and dissemination of flood insurance rate maps and risk data; and
- (2) recommend to the Administrator mapping standards and guidelines for—
 - (A) flood insurance rate maps; and
 - (B) data accuracy, data quality, data currency, and data eligibility;
- (5) recommend to the Administrator and other Federal agencies participating in the Council—
 - (A) methods for improving interagency and intergovernmental coordination on flood mapping and flood risk determination;

Discussion of Recommendation 6

The pending release of Bulletin 17C will provide better statistical tools and techniques that could greatly improve flood-frequency estimates on which FEMA flood maps are based. The USGS, the U.S. Army Corps of Engineers, and the U.S. Bureau of Reclamation are already adopting the tools and techniques in Bulletin 17C, and other agencies appear ready to follow.

However, the new tools will require training of FEMA personnel and contractor resources. In addition, the new tools can only process data that are available. Making the data available could involve considerable effort and significant expense, particularly if performed on a case-by-case basis. A better strategy would be to work with the USGS and other agencies to develop and share the information on a systematic and regional basis.

23. U.S. Geological Survey, *Guidelines for Determining Flood Flow Frequency*, Bulletin 17C (forthcoming).

GOAL 1 | Recommendation 7 (Riverine)

FEMA should develop guidelines, standards, and best practices for selection and use of riverine models appropriate for certain geographic, hydrologic, and hydraulic conditions.

- a) Provide guidance on when appropriate models would be 1-D vs 2-D, or steady state vs unsteady state,
- b) Support comparative analyses of the models and dissemination of appropriate parameter ranges; and
- c) Develop quality assurance protocols.

The TMAC's key findings and a recommendation related to riverine hydraulic models are provided below and are followed by a discussion of the recommendation, benefits, and potential issues related to implementing the recommendation, as applicable. Additional discussion of this recommendation can be found in Section 4.3 of the *TMAC 2015 Annual Report*.

Key Findings

- FEMA has minimal or nonexistent guidance for the use and quality assurance review of 1-D unsteady and 2-D models used to support riverine flood studies.
- The FIRM database and FIS reporting options are ill suited to documenting these complex modelling approaches.
- There is insufficient information and best practice guidance from FEMA on parameter selection and applicability of these models for given conditions.
- Floodway specifications developed under limitations of 1-D steady flow are not applicable in unsteady and 2-D flow simulations.
- Current regulations allow fill to be placed in the riverine floodplains and the base flood elevation (BFE) increased by 1 foot, even though current minimum NFIP regulations allow construction to the lower, un-encroached BFE (elevation without the fill).

BW-12 Mandate **Pub. Law 112-141, Section 100215(c)**

The Council shall —

- (1) recommend to the Administrator how to improve in a cost-effective manner the —
 - (A) accuracy, general quality, ease of use, and distribution and dissemination of flood insurance rate maps and risk data; and
- (2) recommend to the Administrator mapping standards and guidelines for—
 - (A) flood insurance rate maps; and
 - (B) data accuracy, data quality, data currency, and data eligibility;

Discussion of Recommendation 7 (Riverine)

There are many acceptable riverine models and methodologies available to simulate flood hazards. Different models and methods can lead to different results; while there are technically justifiable reasons for these differences, multiple results can lead to controversy, challenges, and a lack of confidence in study products. Developing clear guidelines, standards, and best practices for model selection—and applying them consistently and transparently in riverine flood studies nationwide—will increase user confidence in the results.

Additionally, given limited resources, such guidelines, standards, and best practices help ensure that the models selected are appropriate for the level of study required, meet the users' needs, and clearly communicate accuracy, precision, and uncertainty of the results.

GOAL 1 | Recommendation 7 (Coastal)

FEMA should develop guidelines, standards, and best practices for selection and use of coastal models appropriate for certain geographic, hydrologic, and hydraulic conditions.

- a) Provide guidance on when appropriate models would be 1-D vs 2-D,
- b) Support comparative analyses of the models and dissemination of appropriate parameter ranges, and
- c) Develop quality assurance protocols.

The TMAC's key findings and a recommendation related to coastal models are provided below and are followed by a discussion of the recommendation, benefits, and potential issues related to implementing the recommendation, as applicable. Additional discussion of this recommendation can be found in Section 4.3 of the *TMAC 2015 Annual Report*.

Key Findings

- Coastal wave modeling is difficult, and there are trade-offs between the accuracy and uncertainty of wave results and the number of model runs needed to properly characterize wave conditions in sheltered water bodies.
- 1-D and 2-D models both have advantages and disadvantages.
- Many wave runup models have been used in FEMA coastal flood studies.
- There is currently a lack of guidance on the appropriate selection and implementation of coastal wave models in FISs.

BW-12 Mandate **Pub. Law 112-141, Section 100215(c)**

The Council shall —

- (1) recommend to the Administrator how to improve in a cost-effective manner the —
 - (A) accuracy, general quality, ease of use, and distribution and dissemination of flood insurance rate maps and risk data; and
- (2) recommend to the Administrator mapping standards and guidelines for—
 - (A) flood insurance rate maps; and
 - (B) data accuracy, data quality, data currency, and data eligibility;

Discussion of Recommendation 7 (Coastal)

Many models and methodologies are available to simulate coastal flood hazards, but using different models and methodologies can lead to different results. Although there may be technically justifiable reasons for the differences, multiple results can lead to controversy, challenges, and a lack of confidence in study products. Developing clear guidelines, standards, and best practices for model selection and applying them consistently and transparently in coastal flood studies nationwide will increase user confidence in the results. Additionally, given limited resources, guidelines, standards, and best practices will help ensure that the selected models are appropriate for the required level of study, meet the user's need, and clearly communicate accuracy, precision, and uncertainty of the results.

GOAL 1 | Recommendation 8

FEMA should develop standards, guidelines, and best practices related to coastal 2-D storm surge modeling in order to expand the utility of the data and more efficiently perform coastal flood studies.

The TMAC's key findings and a recommendation related to coastal surge modeling are provided below and are followed by a discussion of the recommendation, benefits, and potential issues related to implementing the recommendation, as applicable. Additional discussion of this recommendation can be found in Section 4.3 of the *TMAC 2015 Annual Report*.

Key Findings

- Current 2-D coastal storm surge modeling is difficult, time-consuming, and expensive.
- Modelers often reduce the number of production run storms for efficiency, but it is unclear whether these storm sets are sufficient to define water surface elevations throughout the study area.
- The ability to identify and evaluate ways to extend and validate the results of the complex models, such as ADCIRC, would be useful.

Discussion of Recommendation 8

The data development, modeling, and statistical analyses that comprise most of FEMA's new coastal flood studies are highly resource intensive. Despite the substantial level of effort invested in these studies, questions remain concerning the statistical validity of the current modeling and statistical methods used to produce final 1-percent-annual-chance (and other) stillwater elevations. By implementing Recommendation 8, FEMA would be

BW-12 Mandate **Pub. Law 112-141, Section 100215(c)**

The Council shall —

- (1) recommend to the Administrator how to improve in a cost-effective manner the —
 - (A) accuracy, general quality, ease of use, and distribution and dissemination of flood insurance rate maps and risk data; and
- (2) recommend to the Administrator mapping standards and guidelines for—
 - (A) flood insurance rate maps; and
 - (B) data accuracy, data quality, data currency, and data eligibility;

able to address these questions, improving study technical defensibility, and realize greater return on surge modeling investments. Among the technical approaches FEMA could consider as the basis of new standards and best practices are:

- Using less complex, but fast and efficient numerical models calibrated against the ADCIRC results
- Calculating storm surge response functions for certain areas
- Leveraging studies performed by other Federal agencies, such as the *North Atlantic Coast Comprehensive Study Report*²⁴

24. U.S. Army Corps of Engineers, *North Atlantic Coast Comprehensive Study Report* (2015), <http://www.nad.usace.army.mil/compstudy>.

GOAL 1 | Recommendation 9

FEMA should review and update existing coastal event-based erosion methods for open coasts, and develop erosion methods for other coastal geomorphic settings.

The TMAC's key findings and a recommendation related to coastal event-based erosion are provided below and are followed by a discussion of the recommendation, benefits, and potential issues related to implementing the recommendation, as applicable. Additional discussion of this recommendation can be found in Section 4.3 of the *TMAC 2015 Annual Report*.

Key Findings

- Coastal experts recommend that FEMA reevaluate its 540 sq ft criterion (originally adopted in 1988), and revise regulations and guidance, as needed, to ensure that storm-related erosion hazards are effectively mapped and managed.
- FEMA does not have any formal guidelines, standards, or best practices to guide event-based erosion analyses in areas outside of open-coast, dune-dominated settings, which may render the parent coastal flood studies vulnerable to technical and scientific challenges.
- Erosion and sediment transport occur with the rise and fall of floodwaters. However, current FEMA FIS practice is to consider erosion only after storm surge modeling, despite the potential for the loss of dunes and other natural features to affect surge propagation.

Discussion of Recommendation 9

Scientific review and revision, as warranted, of the 540 sq ft criterion would help ensure accurate identification of coastal flood and erosion hazard areas and facilitate community management and protection of dunes (including Primary Frontal Dunes, as required by NFIP regulations). The analysis of pre- and post-storm data necessary to address this issue would also permit FEMA to determine the appropriate

BW-12 Mandate **Pub. Law 112-141, Section 100215(c)**

The Council shall —

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 - (A) accuracy, general quality, ease of use, and distribution and dissemination of flood insurance rate maps and risk data; and
- (2) recommend to the Administrator mapping standards and guidelines for—
 - (A) flood insurance rate maps; and
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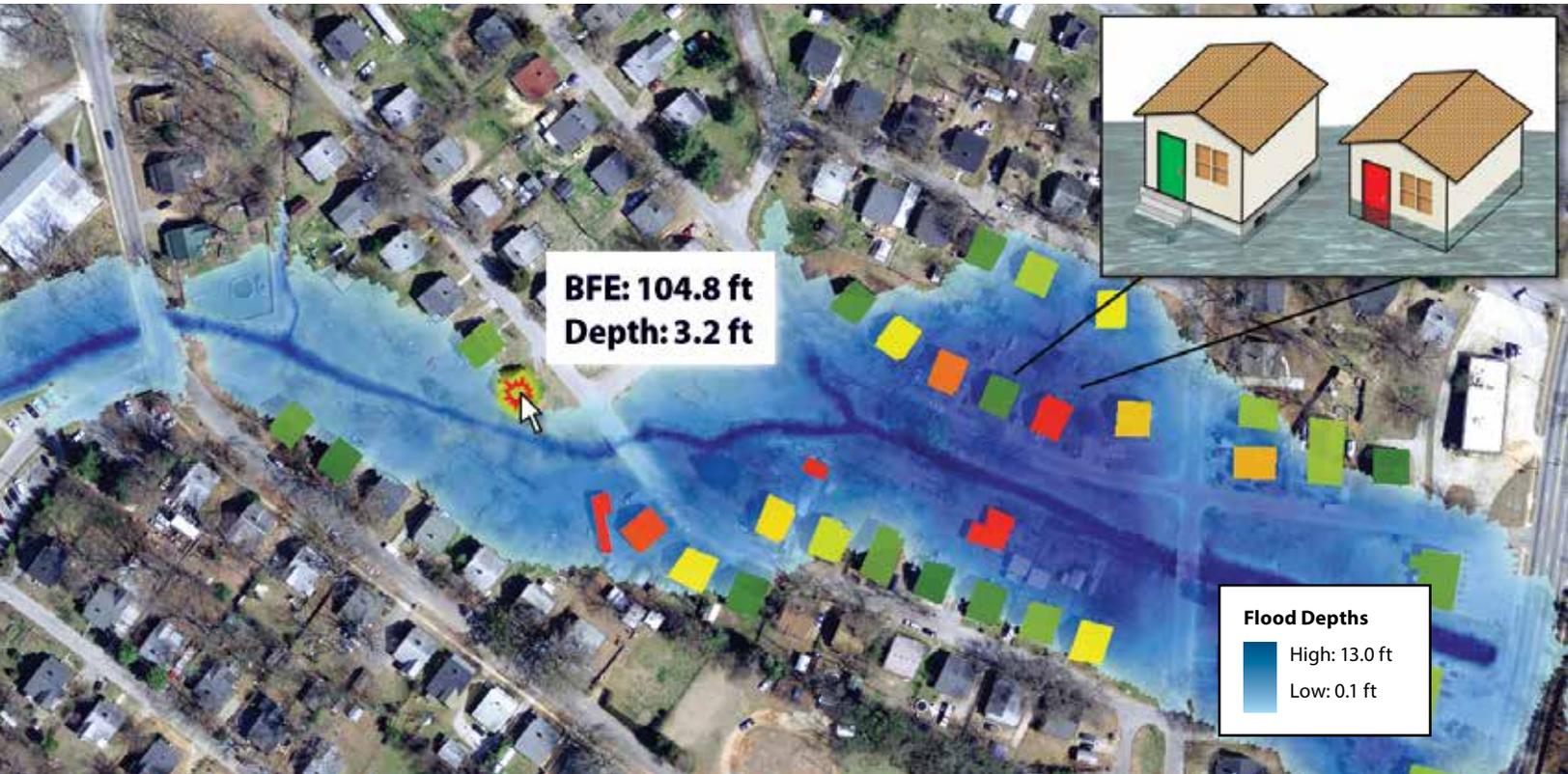
dune reservoir volumes for events beyond the base flood, which is essential to comprehensive coastal risk assessments.

Expansion of FEMA's event-based erosion guidance to encompass other coastal settings beyond the open coast (e.g., sheltered waters, bluffs, mixed-sediment beaches) would provide consistent, technically sound guidance for all coastal studies, reducing the potential for technical challenges.

Because of concerns about the impacts of storm-related erosion on surge propagation, FEMA's erosion methods may warrant further revision to shift application of event-based erosion prior to surge modeling in the study process. As a first step, a sensitivity analysis (comparing surge model output using eroded- and non-eroded dunes in the digital elevation model [DEM]) would provide critical data for FEMA to assess whether such a change in methods and guidance would improve the accuracy and technical credibility of coastal flood studies.

GOAL 2

Time- and cost-efficient generation and process management of flood hazard and risk data, models, assessments, and displays.

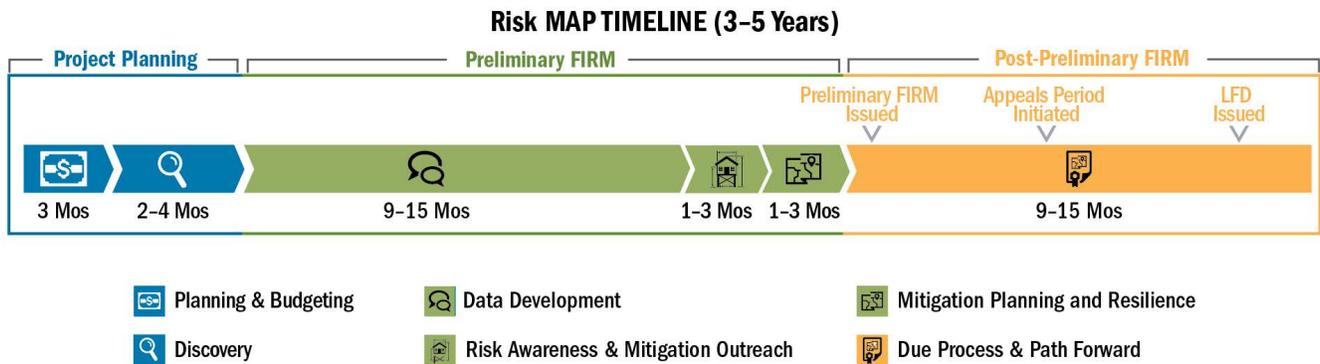


RECOMMENDATIONS RELATED TO GOAL 2

Recommendation 11	Modify the current work flow production process and supporting management system, Mapping Information Platform, to reduce unnecessary delays created by redundant tasks and inflexibility of the system. Modify the system to enable flexibility in project scope and size, such as in the choice of watershed size, not limiting projects to only the hydrologic unit code 8 (HUC8).	Page 24
Recommendation 12	Determine the cost impact when new requirements are introduced and provide guidance to consistently address the cost impact to all partners.	Page 25
Recommendation 13	Develop guidelines and procedures to integrate a mass LiDAR-based LOMA process into the National Flood Hazard and Risk Assessment Program. As part of this process, FEMA should also evaluate the feasibility of using parcel and building footprint data to identify eligible out as shown structures as an optional deliverable during the flood mapping process.	Page 26

The above recommendations are abbreviated. See the discussion of each recommendation for the unabbreviated version.

GOAL 2



Ideal timeline for the three phases of the Risk MAP project process: project planning, Preliminary FIRM, and post-Preliminary FIRM

RISK MAP PRODUCTION has evolved into a process that increasingly requires numerous stakeholders and many different levels of FEMA approval to start the next phase of work. The multi-year process integrates outreach and coordination, survey and engineering studies, mapping and database generation, and regulatory requirements. Increased coordination and engagement mandated by various NFIP reform efforts has made it difficult to complete the Risk MAP process in the 3 to 5 years originally envisioned. Flood studies can take from 3 to 10 years, resulting in a product that is already outdated when it is released. In some instances, pertinent newer data that were developed during the production cycle is not incorporated in the map release, and it may be many years before updated information is incorporated and published. A Letter of Map Change (LOMC) process exists to provide for map changes outside the larger FISs conducted as part of Risk MAP, but the process does not provide a complete solution to the issues of timeliness and completeness of data.

The idealized Risk MAP study timeline results in the hydrologic and hydraulic study being 11 to 19 months old when the FIRM reaches the effective date and at least 25 to 41 months old from identification of the flood study need in the Discovery process. Given the NVUE update cycle is 5 years from the Effective data, studies can be as old as 6.5 years at the NVUE review. Any additional increases in the study length result

in the technical data having an increased age at the Effective date and the NVUE update. Furthermore, when a FIRM becomes Effective for regulatory and insurance purposes within a community, conditions represented on that map do not remain static. There is a possibility that conditions represented are already out of date given the time between the collection of field data and publication of the map, no matter how short that timeframe. These disparities mean that the Effective FIRM may not represent the most current and most accurate depiction of flood hazard and risk status, even if completed within the Risk MAP timeline.

Further, the processes of data collection, analysis, and reporting do not always proceed linearly. The planning for a study, local review, FEMA review, and final approval stages stretch over months or up to several years. When FEMA announces new procedural requirements, a significant number of studies are usually underway, each following existing guidelines. After announcing new procedural requirements, FEMA typically requires new procedural, administrative, and specifications to be implemented immediately and retroactively upon release. FEMA generally does not relax the requirements or provide relief from the increased cost even though the new requirements can result in rework, increasing the study cost and delaying the schedule.

GOAL 2

FEMA implemented the Mapping Information Platform (MIP) to manage and track the progress of studies initiated in the Map Mod effort and it has continued the MIP as a requirement for Risk MAP studies, including regulatory and non-regulatory products as well as LOMC processing. The MIP is used as a management tool to help mapping partners track and record progress of their studies. Based on the programming in place currently, the MIP has a rigid infrastructure and users must meet strict work flow requirements for the MIP to function properly. The MIP has made it difficult for Mapping Partners and CTPs to implement projects that require unique processes or schedules, as any project with deviations from the established work flow faces unanticipated consequences based on rigidity of the MIP work flow. The current production process and management framework makes it difficult to both produce and maintain accurate flood hazard and risk data. Without current flood hazard data and risk maps, local governments are ill equipped to issue flood development standards that will ensure flood-resilient development.



Hierarchy of FEMA's Guidelines and Standards

GOAL 2 | Recommendation 11

FEMA should modify the current work flow production process and supporting management system, Mapping Information Platform, to reduce unnecessary delays created by redundant tasks and inflexibility of the system. The process and system are currently not designed to properly manage non-regulatory products or products that do not fit predefined footprints. FEMA should modify the system to enable flexibility in project scope and size, such as in the choice of watershed size, not limiting projects to only the hydrologic unit code 8 (HUC8).

The TMAC's key findings and a recommendation related to production timeline for flood mapping products are provided below and are followed by a discussion of the recommendation, benefits, and potential issues related to implementing the recommendation, as applicable. Additional discussion of this recommendation can be found in Section 4.4 of the *TMAC 2015 Annual Report*.

Key Findings

- There is considerable concern about the length of time between identifying an area that is in need of updated assessment and producing a final product.
- Procedural changes to the Risk MAP process have extended the timeline of projects from 3 to 5 years to 5 to 7 years or longer.
- Flood studies are at least 9 to 15 months old before the flood maps are adopted by communities and become Effective. The NVUE process for addressing the validity of flood studies every 5 years considers the age of the FIS to be the same as the Effective date of the FIRM. Due to the length of the regulatory adoption process and the FEMA-implemented procedural changes through the Key Decision Point (KDP) process, the studies are approximately 1 year older than the Effective date of the FIRM.
- The MIP is too rigid for many of the projects in Risk MAP, and any project that requires any deviation from the standard workflow process requires the intervention of FEMA, either through MIP Help or the Regional Service Center.

Discussion of Recommendation 11

The engagement of and collaboration with the communities affected by a Risk MAP project throughout the study process are clearly beneficial to FEMA and its mapping partners. However, interaction should not be indiscriminately reduced due to internal administrative tasks and workflow processes that unnecessarily lengthen the process.

BW-12 Mandate **Pub. Law 112-141, Section 100215(c)**

The Council shall —

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 - (A) accuracy, general quality, ease of use, and distribution and dissemination of flood insurance rate maps and risk data;

Eliminating redundant tasks and correcting the workflow to avoid unused and unneeded tasks will save time, be more efficient, and reduce costs. Specifically:

- Allowing greater flexibility in the process will allow adaptation to the particular project and avoid spending time on unnecessary tasks to “trick” the MIP into allowing the project to advance.
- The use of the HUC8 for the watershed footprint does not fit in all areas of the country. In highly populated areas, its use can make it impossible to work with dozens of communities and complete multiple studies in a timely manner. Allowing alternative watershed footprints will allow projects to be designed to an effective and appropriate scale.
- Although the KDP process has strengths, it does not integrate smoothly with other processes such as quality assurance checks. The result is a stop/start stuttering that impedes projects from advancing efficiently. For example, delaying the preparation of Federal Register notices for KDP 4 can delay the project by 2 months.
- Providing an updated work flow production process and management system that provides adequate storage capabilities and enforces file storage protocols will better support the move to a database-driven environment (see Recommendation 16).

GOAL 2 | Recommendation 12

FEMA, in its update of guidance and standards, should determine the cost impact when new requirements are introduced and provide guidance to consistently address the cost impact to all partners.

The TMAC's key findings and a recommendation related to FEMA's *Guidelines and Standards* are provided below and are followed by a discussion of the recommendation, benefits, and potential issues related to implementing the recommendation, as applicable. Additional discussion of this recommendation can be found in Section 4.4 of the *TMAC 2015 Annual Report*.

Key Findings

- FEMA has undertaken a much needed update to the *Guidelines and Standards*. These *Guidelines and Standards* are now updated twice a year on an established maintenance cycle.
- Currently, new standards and guidance are retroactively applied to all current FIS and Risk MAP projects, and many of the updated standards result in considerable schedule delays and increases in cost due to the additional rework and changes that are required.

BW-12 Mandate **Pub. Law 112-141, Section 100215(c)**

The Council shall —

- (2) recommend to the Administrator mapping standards and guidelines for—
 - (A) flood insurance rate maps; and
 - (B) data accuracy, data quality, data currency, and data eligibility;

Discussion of Recommendation 12

When new requirements are introduced, FEMA should evaluate the new process to determine its cost impact to the mapping partners. FEMA should provide guidance regarding the cost impact to CTP and other mapping partners.

GOAL 2 | Recommendation 13

FEMA should develop guidelines and procedures to integrate a mass LiDAR-based LOMA process into the National Flood Hazard and Risk Assessment Program. As part of this process, FEMA should also evaluate the feasibility of using parcel and building footprint data to identify eligible “out as shown” structures as an optional deliverable during the flood mapping process.

The TMAC’s key findings and a recommendation related to using LiDAR to make mass Letter of Map Amendment (LOMA) determinations are provided below and are followed by a discussion of the recommendation, benefits, and potential issues related to implementing the recommendation, as applicable. Additional discussion of this recommendation can be found in Section 4.4 of the *TMAC 2015 Annual Report*.

Key Findings

- FISs are conducted on a watershed basis using available elevation data. In projects that are conducted on a large scale, sometimes the elevation data for the study areas do not reflect the slight undulations of land surface on all properties.
- The LOMA process provides property owners a way of amending the flood map for a property that was inadvertently mapped as being in the floodplain but is actually located above the BFE based on localized elevation data. While there is no review or processing fee for FEMA to review a LOMA request, the property owner is required to submit elevation information certified by a licensed land surveyor or registered Professional Engineer. The cost of acquiring this information is not insignificant to the property owner.
- More and more communities and regional areas are committing resources to update their elevation data (LiDAR), and as these datasets are being finalized, these communities are requesting map updates based on the new data. There is a need to process mass LOMA outside the Risk MAP process due to its scale and complexity.
- An opportunity exists during the Risk MAP process to capitalize on the additional data collected on flood depth, building footprints, and other community-supplied parcel information to remove certain structures from the floodplain as part of the mapping process.

BW-12 Mandate **Pub. Law 112-141, Section 100215(c)**

The Council shall —

- (1) recommend to the Administrator how to improve in a cost-effective manner the —
 - (A) accuracy, general quality, ease of use, and distribution and dissemination of flood insurance rate maps and risk data; and
- (2) recommend to the Administrator mapping standards and guidelines for—
 - (A) flood insurance rate maps; and
 - (B) data accuracy, data quality, data currency, and data eligibility;

Discussion of Recommendation 13

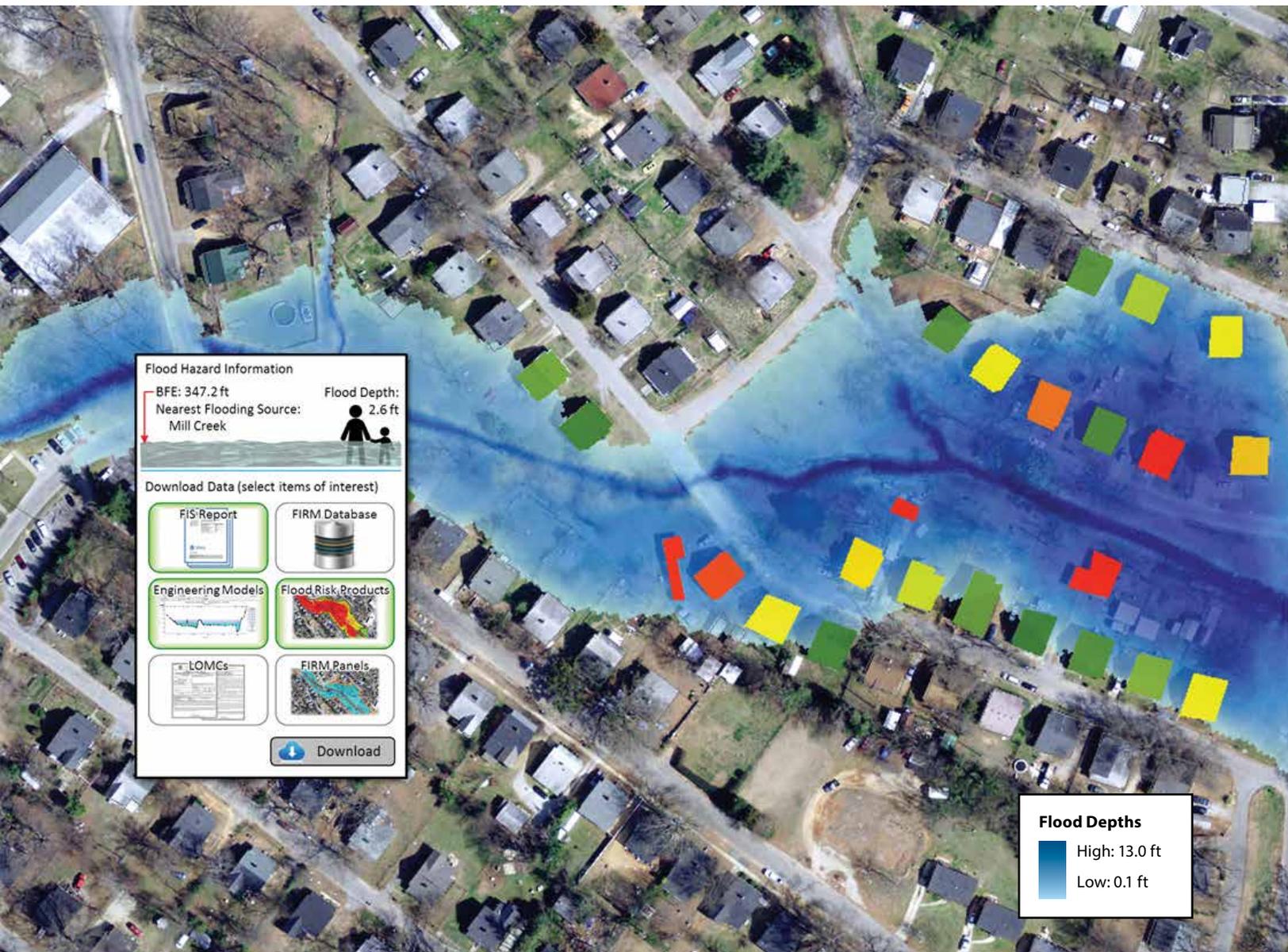
Implementing this recommendation could greatly reduce both the burden on homeowners and the costs to FEMA for LOMC processing under the NFIP and result in a reduction in the number of congressional inquiries associated with structures newly mapped into the Special Flood Hazard Area (SFHA). Providing a way for communities to use their own LiDAR data to make SFHA determinations would not only help provide a sense of ownership of the study results, encouraging the use of LiDAR to make SFHA determinations would also be an incentive to collect LiDAR data that could be leveraged for other studies.

One effect of this recommendation could be an increase in the number of LOMA requests that FEMA would receive. The added requests could prove costly to process if not anticipated and planned for accordingly.

Due to the potential impacts to the determination and lending industry, processing mass LiDAR-based LOMAs should be coordinated with these groups. Mapping partners and/or communities would also need to coordinate early and often with FEMA when processing any type of mass LOMAs.

GOAL 3

Effective utilization of efficient technologies for acquisition, storage, generation, display, and communication of data, models, displays and risk.



RECOMMENDATIONS RELATED TO GOAL 3

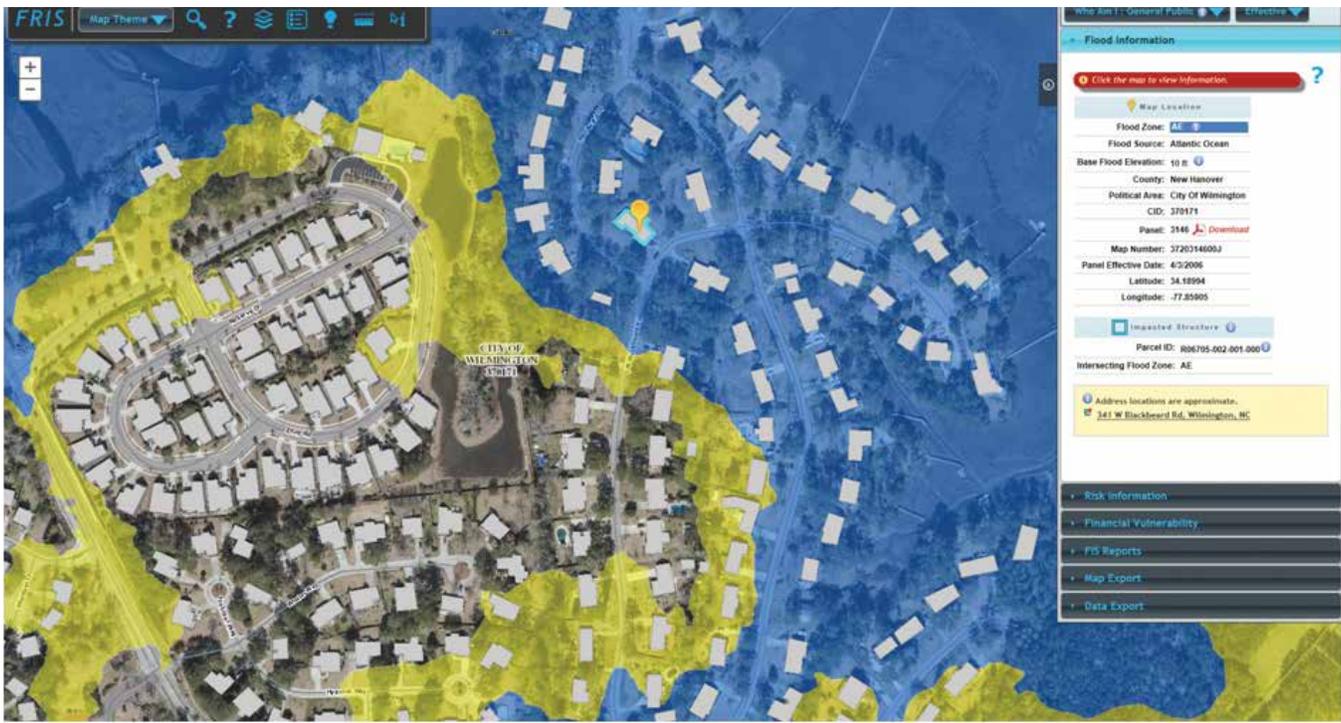
Recommendation 16

FEMA should transition from the current panel-based cartographic limitations of managing paper maps and studies to manage NFIP data to a database-derived, digital-display environment that are fully georeferenced and relational, enabling a single digital authoritative source of information and database-driven displays.

Page 29

The above recommendations are abbreviated. See the discussion of each recommendation for the unabbreviated version.

GOAL 3



North Carolina Flood Risk Information System (FRIS) contains digitally accessible flood hazard data, models, maps, risk assessments, and reports that are database driven

TECHNOLOGY IS A CONTINUALLY moving target in today's world as evidenced by rapid advances in the remote sensing industry and increasingly sophisticated uses of smartphones. New technologies are making geospatial technology more accessible. The combination of advanced geospatial technology and the ubiquitous presence of smartphones allow the use of integrated spatial data and analytics by a wide variety of stakeholders, including the general public.

In contrast, NFIP data are fragmented across products and access points. Flood hazard data for much of the Nation are still in paper format (or scanned images), yet both technical and non-technical users rely on the Internet to learn more about flood hazards and flood risks. Flood hazard and flood risk data depend on spatial relationships; thus, data must be georeferenced for integration and display in the digital environment. Cost-effective and efficient dissemination of flood hazard and flood risk data requires the transition to a fully georeferenced, relational digital format for all data, nationwide.

"The remote sensing industry has reached a critical mass in terms of global collection capacity, processing and delivery"

—"State of the Industry Report: Technology Heats Up, Tracking the Trends Shaping the Remote Sensing Industry," 2014. *Earth Imaging Journal*, February 14, 2014.

FEMA must leverage data sharing at multiple levels by various partners to efficiently manage NFIP data and to prepare fully georeferenced digital data for all flood hazards. Fully georeferenced, relational NFIP data can be integrated with other national data sets to serve the needs of various users. Relational digital data will facilitate rapid searching and dissemination of data for both professional and non-professional users.

GOAL 3 | Recommendation 16

FEMA should transition from the current panel-based cartographic limitations of managing paper maps and studies to manage NFIP data to a database-derived, digital-display environment that are fully georeferenced and relational, enabling a single digital authoritative source of information and database-driven displays. Towards this transition, FEMA should:

- a) Prepare a multi-year transition plan to strategically transition all current cartographic and/or scanned image data to a fully georeferenced, enterprise relational database.
- b) Update required information for map revisions (MT-2 forms) and LOMC applications to ensure accurate geospatial references, sufficient data to populate databases, and linkages to existing Effective data.
- c) Adopt progressive data management approaches to disseminate information collected and produced during the study and revision process, including LOMCs.
- d) Ensure that the data management approach described in (c) is sufficiently flexible to allow efficient integration, upload, and dissemination of NFIP and stakeholder data (e.g., mitigation and insurance data that are created and maintained by other Federal agencies), and serve as the foundation for creating all digital display and mapping products.
- e) Provide a mechanism for communities to readily upload jurisdictional boundary data, consistent with requirements to participate in the NFIP, as revised, allowing other stakeholders access.

The TMAC's key findings and a recommendation related to distribution and management are provided below and are followed by a discussion of the recommendation, benefits, and potential issues related to implementing the recommendation, as applicable. Additional discussion of this recommendation can be found in Section 4.6 of the *TMAC 2015 Annual Report*.

Key Findings

- Digital exchanges have already broadened the distribution of information throughout the NFIP. Detailed policy guidance is sent to flood insurance agents, and design professionals have the ability to submit applications for map changes online. However, more is possible. The TMAC sees a fully digital environment as a means of achieving the following goals:
 - Time- and cost-efficient generation and process management of flood hazard and risk data, models, assessments, and displays.

BW-12 Mandate **Pub. Law 112-141, Section 100215(c)**

The Council shall —

- (1) recommend to the Administrator how to improve in a cost-effective manner the —
 - (A) accuracy, general quality, ease of use, and distribution and dissemination of flood insurance rate maps and risk data; and
- (2) recommend to the Administrator mapping standards and guidelines for—
 - (A) flood insurance rate maps; and
 - (B) data accuracy, data quality, data currency, and data eligibility;

- Effective use of efficient technologies for acquisition, storage, generation, display, and communication of data, models, displays, and risk.
- Integrated flood risk management framework of hazard identification, risk assessment, mitigation, and monitoring.

GOAL 3 | Recommendation 16 (continued)

- Flood hazard and risk assessment data are currently maintained on an array of platforms and formats. Transitioning to a fully georeferenced, relational digital format for all data would be a cost-efficient method providing easily accessible data to all floodplain data users: community officials, engineers, surveyors, emergency responders, property owners, flood insurance agents, realtors, and appraisers.
- The public and other agencies are increasingly using NFIP data for a variety of non-floodplain management purposes, and these users need data that are easily searchable and can be linked to other datasets. The data are currently stored across multiple platforms and lack common linkages that are needed to meet the needs of the expanding user groups. The development of a fully digital environment would provide an opportunity for broader sharing of current and historical NFIP data to other stakeholders while expanding the services to meet local community needs by providing a mechanism for uploading community-supplied data, such as jurisdictional boundaries.
- Flood hazard and flood risk data should be managed and disseminated using industry standard protocols and web services to allow for ready integration with other data.

Discussion of Recommendation 16

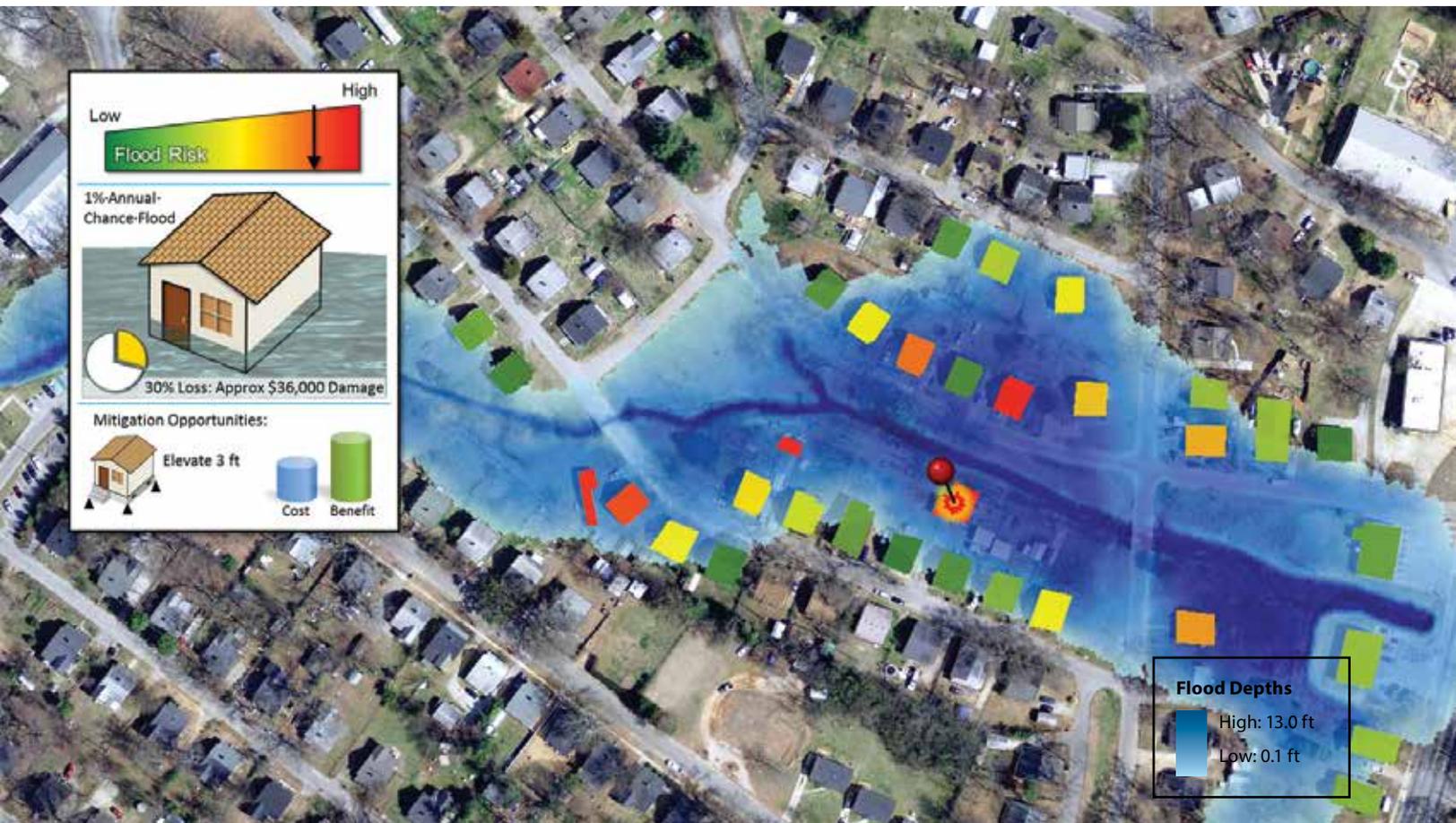
The digital environment offers many advantages for keeping flood data current. LOMCs provided to communities as Geographic Information System (GIS) data offer a direct means of incorporating the information into their own systems of flood mapping rather than having to scan the paper copies currently provided. The resulting database and displays should answer needs beyond the strict confines of NFIP, such as for local zoning, planning, and other State and local regulations related to but not legislatively part of the NFIP.

The timeliness of data and product availability are critical to the ability to manage flood hazards and flood risks. As one example, the ability to process an online electronic LOMA instantaneously does not include simultaneous community notice of the change to its FIRMs. Thus, the coordination of digital data availability and distribution directly affects community floodplain management and welfare.

While the possibilities for cost savings in data acquisition, analysis, dissemination, and storage are clear in the long term, the immediate costs to transition to a fully digital environment are far from negligible. States, local, and tribal communities can begin to prepare their documents and data to be integrated into a seamless national system if fully informed of the incremental steps required to reach this goal. FEMA should establish guidelines and provide appropriate technical assistance relating to sequencing/phasing in of processes and changes that will facilitate integration of data, quality assurance of the data and of the means of accessing the data, and determining how to preserve data in future transitions related to software and hardware.

GOAL 4

Integrated flood risk management framework of hazard identification, risk assessment, mitigation, and monitoring.



RECOMMENDATIONS RELATED TO GOAL 4

Recommendation 10	FEMA should transition from identifying the 1-percent-annual-chance floodplain and associated base flood elevation as the basis for insurance rating purposes to a structure-specific flood frequency determination and associated flood elevations.	Page 33
Recommendation 14	FEMA, and its mapping partners including the private sector, should transition to a flood risk assessment focus that is structure specific. Where data are available, FEMA and its partners should contribute information and expertise consistent with their interests, capabilities, and resources.	Page 34

The above recommendations are abbreviated. See the discussion of each recommendation for the unabbreviated version.

GOAL 4

FEMA MUST COMMUNICATE flood hazard and risk considering the wide variety of stakeholders. This means communicating with clear and accessible terminology and symbology that addresses the dynamic nature of flooding and the true nature of the risk at various locations in the floodplain. The current system of a line on a static map does not meet this objective, nor does the use of the 1-percent-annual-chance approach. Although the 1-percent-annual-chance flood standard currently provides the basis for floodplain management, it does not communicate risk adequately to ensure people and property to get out of harm's way as many fail to understand that it communicates both frequency and magnitude.

The current FEMA insurance rating approach groups buildings into categories based on the level of the lowest floor above or below the base flood elevation (BFE) derived from the 1-percent-annual-chance event floodplain (or 100-year event). This approach does not account for the risk associated with more frequent or less frequent flood events. Despite the availability of multiple recurrence interval profiles for detailed study streams, flood insurance premiums and regulatory requirements for development are based solely on the 1-percent-annual-chance floodplain and BFE unless the local community chooses to regulate development to a higher standard. FEMA's current insurance rating

approach may lead to incorrect estimations of risk and related insurance premiums, and may discourage the purchase of flood insurance for buildings outside the 1-percent-annual-chance floodplain even when the building may be at substantial risk of flooding from large flood events.

Flood risk is unique to the hydrologic and hydraulic response of each flooding source as well as the attributes of each building located along the flooding source. Detailed flood data as well as building-specific data are now generally available as communities are starting to collect and maintain this information as part of their GIS inventory.

Map Mod and Risk MAP have increased the number of detailed study streams, increasing the amount of multiple profile flood data that are available. At the same time, the growth of technology and data collection techniques have greatly increased the amount of building data available at the local, State, and national level. The goal of a digital flood mapping platform that delivers flood hazard and risk information at the structure level is to enhance the public's understanding of flood risk, improve risk assessments in local hazard mitigation plans, and lead to better decisions on how to mitigate risk.



This older home in Mandeville, Louisiana, sustained only minor flood damage during Hurricane Isaac because it had been elevated after Hurricane Katrina



This elevated home in Milford, Connecticut, sustained minimal damage from Hurricane Sandy while neighboring homes were destroyed

GOAL 4 | Recommendation 10

FEMA should transition from identifying the 1-percent-annual-chance floodplain and associated base flood elevation as the basis for insurance rating purposes to a structure-specific flood frequency determination and associated flood elevations.

The TMAC's key findings and a recommendation related to FEMA's process for determining SFHAs are provided below and are followed by a discussion of the recommendation, benefits, and potential issues related to implementing the recommendation, as applicable. Additional discussion of this recommendation can be found in Section 4.4 of the *TMAC 2015 Annual Report*.

Key Findings

- The current FEMA insurance rating approach, which groups buildings into whole foot rating categories based on the level of the lowest floor above or below the BFE, does not account for the risk associated with other flood events, which may lead to over- or underestimating the risk and related insurance premium based on expected damage from more frequent flood events or unique floodplain flooding characteristics.
- Risk MAP has increased the number of Detailed Studies, increasing the amount of multiple recurrence interval flood profile data that are available.
- Advances in data collection techniques have greatly increased the amount of building data that are available at the local, State, and national levels, and data sharing or data federation could greatly increase the amount of building data that are available to FEMA. This type of data can “enable the development and use of comprehensive risk assessments, which could improve NFIP estimates of flood loss.”²⁵

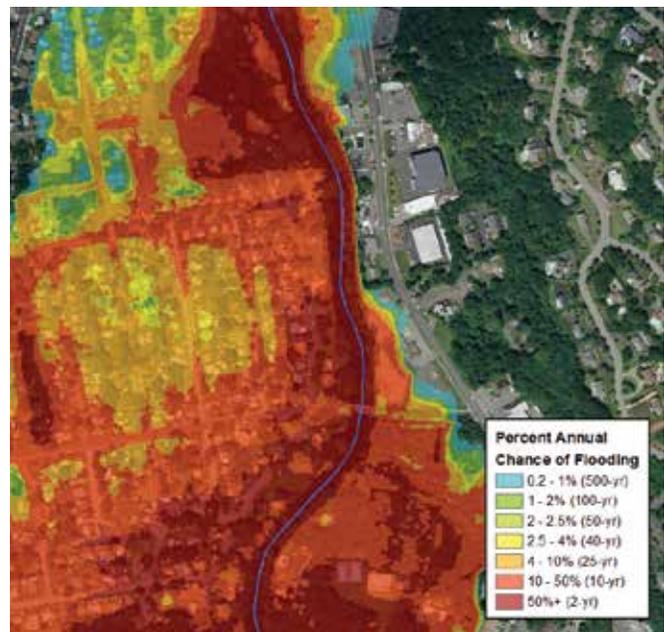
Discussion of Recommendation 10

For areas in which multi-profile data exist, transitioning to frequency-based determinations would increase the detail and precision in the actuarial models used for premium rating. The increased level of precision may be useful for increasing policyholder confidence since the insurance rating would be based on more detailed data. Additionally, the development of multiple flood frequency data provides the foundation for structure-centric flood-frequency determination.

BW-12 Mandate Pub. Law 112-141, Section 100215(c)

The Council shall —

- (1) recommend to the Administrator how to improve in a cost-effective manner the —
 - (A) accuracy, general quality, ease of use, and distribution and dissemination of flood insurance rate maps and risk data; and
- (2) recommend to the Administrator mapping standards and guidelines for—
 - (A) flood insurance rate maps; and
 - (B) data accuracy, data quality, data currency, and data eligibility;



One of FEMA's non-regulatory datasets provides the percent annual chance of flooding for a watershed

25. National Research Council, *Tying Flood Insurance to Flood Risk for Low-Lying Structures in the Floodplain* (Washington, DC: The National Academies Press, 2015).

GOAL 4 | Recommendation 14

FEMA, and its mapping partners including the private sector, should transition to a flood risk assessment focus that is structure specific. Where data are available, FEMA and its partners should contribute information and expertise consistent with their interests, capabilities, and resources towards this new focus:

- a) A necessary prerequisite for accurate flood risk assessments is detailed flood hazard identification, which must also be performed to advance mitigation strategies and support loss estimations for insurance rating purposes.
- b) FEMA should initiate dialogue with risk assessment stakeholders to identify potential structure-specific risk assessment products, displays, standards, and data management protocols that meet user needs.
- c) FEMA and its partners should develop guidelines, best practices, and approaches to implementing structure-specific risk assessments.

The TMAC's key findings and a recommendation related to structure-specific flood risk assessments are provided below and are followed by a discussion of the recommendation, benefits, and potential issues related to implementing the recommendation, as applicable. Additional discussion of this recommendation can be found in Section 4.5 of the *TMAC 2015 Annual Report*.

Key Findings

- Flood risk assessments with a capability for producing accurate, individual structure, flood risk estimates would more effectively communicate flood risk at the local level.
- Developing a system that allows structure-specific risk assessment is within FEMA's resources and capabilities and could build on capabilities developed by its mapping partners, including the private sector.
- Local, State, and national building and tax record data, including many critical building attributes, have become increasingly available in GIS format and are currently being used in several Risk MAP projects. An updated methodology to accommodate structure-specific risk assessments could support the areas where the structure-specific data are readily available.
- Structure-based risk assessments will require coordination with various stakeholders to determine the needs of the users and to develop standards and data management processes.

BW-12 Mandate **Pub. Law 112-141, Section 100215(c)**

The Council shall —

- (1) recommend to the Administrator how to improve in a cost-effective manner the —
 - (A) accuracy, general quality, ease of use, and distribution and dissemination of flood insurance rate maps and risk data; and
 - (B) performance metrics and milestones required to effectively and efficiently map flood risk areas in the United States;
- (3) recommend to the Administrator how to maintain, on an ongoing basis, flood insurance rate maps and flood risk identification;

Discussion of Recommendation 14

The purpose of this recommendation is to develop an online mapping program capable of conducting structure-based risk assessments. Numerous State and local mapping partners have the data to analyze risk at the structure level and use GIS and web-based platforms to provide this information to property owners and communities. The Flood Risk Information System (FRIS) used by North Carolina, Alabama, and Virginia is an excellent example of a flood mapping platform that provides structure level risk information.

This system provides the property owner with a wealth of information beyond "Am I in or out of

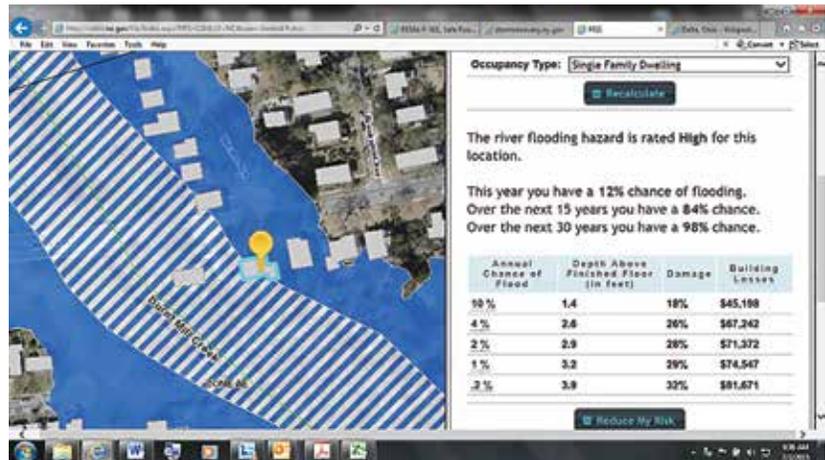
GOAL 4 | Recommendation 14 (continued)

the floodplain?” The FRIS provides information on flood depths at the property owner’s structure for various flood recurrence intervals and a dollar estimate of the damage that the flood event would cause to the structure. Being able to envision one’s home and personal property under water communicates the risk far more effectively than a line on a map. The percent chance of flooding is calculated for the structure for the current year, and 15 and 30 years out. These calculations help the property owner to move beyond the common misconceptions communicated by the term “100-year flood” and better understand their probability of experiencing flooding.

A better understanding of flood hazard and individual flood risk will result in property owners and local governments taking action to reduce the risk. The FRIS provides the property owner with an estimate of the benefits and costs of a range of common flood mitigation actions. Some of the mitigation actions evaluated include elevating the structure, relocating the structure, implementing dry and wet flood proofing, and elevating utilities.

The FRIS compares the estimated cost of each mitigation action to the future losses avoided and generates a ratio of the cost to the benefit. These data can be used by the property owner to begin exploring possible mitigation action alternatives. In this regard, the National Research Council (NRC) recently issued a report that concluded that the NFIP can strive for risk-based premiums to encourage investment in loss reduction measures while addressing affordability by implementing a combination of policy measures, including means-tested mitigation grants, mitigation loans, vouchers, and encouragement of higher premium reductions.²⁶

Moving towards assessing flood risk at the individual structure level would also assist communities in developing local hazard mitigation plans and result in more accurate flood risk analyses in the community. Standardizing a structure-based risk assessment



North Carolina’s FRIS provides risk information at the structure level

methodology would also make it easier for States to meet the requirement to provide an overview and analysis of potential losses to vulnerable structures based on estimates provided in local risk assessments (44 CFR 201.4(c)(2)(ii)).

Providing flood hazard and risk assessment at the structure level would greatly enhance the public’s understanding of flood risk, improve flood risk assessments in local hazard mitigation plans, and lead to better land use decisions at the local level. The increased level of precision of providing flood risk information for individual structures may also be useful for adding confidence to policy holders, given their insurance rating is based on more detailed, localized data.

FEMA should create an online tool to capture and display structure-level risk assessment data and use the Risk MAP program to encourage communities to provide/develop data. As the result of Map Mod, highly populated areas were targeted for the development of detailed mapping (flood profiles containing multiple recurrence intervals). These areas also tend to have detailed data at the structure level (e.g., location, building foundation type, structure value). The Risk MAP Discovery process is one coordination point FEMA should use to seek and leverage this information from mapping partners to populate the online risk assessment tool. Incentives should be developed in the Community Rating System to reward communities for sharing/developing and maintaining the data.

26. National Research Council, *Affordability of National Flood Insurance Premiums: Report 1* (Washington, DC: The National Academies Press, 2015).

GOAL 5

Strong confidence, understanding, awareness and acceptance of flood hazard and risk data, models, displays, assessments, and process by the public and program stakeholders.



RECOMMENDATIONS RELATED TO GOAL 5

Recommendation 1	Establish and implement a process to assess the present and anticipated requirements of flood hazard and flood risk products to meet the needs of the various users.	Page 38
Recommendation 15	Leverage opportunities to frame and communicate messages to stakeholders in communities so they understand the importance of addressing the flood risk today and consider long-term resilience strategies. Messages should be complemented by economic incentives such as low-interest loans and mitigation grants that lead community leaders and individuals to undertake cost-effective risk reduction measures.	Page 40

The above recommendations are abbreviated. See the discussion of each recommendation for the unabbreviated version.

GOAL 5

SINCE 2010, FEMA HAS CONDUCTED an annual nationwide study of flood risk awareness among local officials. Data from the survey are used to improve FEMA's general understanding of flood risk perceptions, inform community engagement strategies, and evaluate Risk MAP progress in identifying, mitigating, and communicating risk. The most recent survey revealed that only "half of the local officials reported that their administration communicates flood risk information to the public at least once per year."²⁷ The survey responses also showed that "citizens are much less aware of their community's flood risk than their local officials and local officials do communicate risk but not by the modes where people would prefer to receive their information."²⁸ This is a problem when one of FEMA's primary goals for Risk MAP is to deliver quality data that increases public awareness and leads to action that reduces risk to life and property.

But even when the information is communicated to citizens, the information is not always accessible. Flood hazard and risk data are used by many different stakeholders and must be understandable to all of them, across a wide range of applications. With 5.1 million flood insurance policies in effect and 22,000 communities participating in the NFIP, both professionals and lay persons—from insurance agents to design professionals to the general public—rely on accurate flood hazard and flood risk data and products produced by the Risk MAP program. The public at large—residents in or near the floodplain (both owners and renters) as well as non-resident property owners, buyers, and sellers—need flood risk data and products that are reliable, accessible, understandable, and actionable. Flood risk data and products for the public must support informed decision-making about the level of flood hazards/risks where people are located and connect to the options available to them to mitigate that risk.

27. FEMA, Local Official Survey Findings on Flood Risk (2014), www.fema.gov.

28. Stacy Langsdale, "National Flood Risk Awareness Survey Highlights Opportunities to Improve Risk Communication with Communities" (October 2014), <http://silverjackets.nfrmp.us/Get-Involved/More-Information/Silver-Jackets-Newsletter/The-Buzz-October-2014/National-Flood-Risk-Awareness>.

"While the engineering and floodplain management constituency of the NFIP need a statistical definition, the average consumer, who is risk-averse to buying flood insurance, needs a risk assessment definition that can be put into perspective."

—Ogle, 2004. "Communicating What the 1% Chance Flood Means," *Reducing Flood Losses: Is the 1% Chance (100-year) Flood Standard Sufficient?*, Gilbert F. White National Flood Policy Forum 2004 Assembly, September 21–22, 2004.



Residents pore over FIRMs at a meeting with Federal, State, and local officials in Marshfield, Massachusetts (September 4, 2013)



Accurate and precise data are the foundation of effective flood risk communication and mitigation action

GOAL 5 | Recommendation 1

FEMA should establish and implement a process to assess the present and anticipated flood hazard and flood risk products to meet the needs of the various users. As part of this process, FEMA should routinely:

- a) Conduct a systematic evaluation of current regulatory and non-regulatory products (data, maps, reports, etc.) to determine if these products are valued by users, eliminating products which do not cost effectively meet needs;
- b) Consider user requirements prior to any updates or changes to data format, applications, standards, products, or practices are implemented;
- c) Proactively seek to provide authoritative, easy to access and use, timely, and informative products and tools; and
- d) Consider future flood hazards and flood risk.

The TMAC's key findings and a recommendation related to the community of users and uses are provided below and are followed by a discussion of the recommendation, benefits, and potential issues related to implementing the recommendation, as applicable. Additional discussion of this recommendation can be found in Section 4.1 of the *TMAC 2015 Annual Report*.

Key Findings

- There are many users and uses of flood hazard and flood risk data. These practitioners make daily decisions that cumulatively work toward reducing damages due to flooding. It is key to program success that these users be provided with authoritative, easy to access and use, timely, and informative data and tools. FEMA's efforts in reaching various user groups must be ongoing and evolve as products and methods of presentation change.
- There are differences in the accuracy, precision, resolution, and type of information needed, and different platforms for dissemination must be considered for the various users.
- Effective and successful flood risk reduction requires that appropriate tools be provided to the practitioners who make the daily decisions.

- Data and products naming should be carefully considered, and consistent practices adopted. Given the broad application of the products, the names "Flood Insurance Rate Map" and "Flood Insurance Study" are no longer appropriate. The distinction between the terms "hazard" and "risk" should be clearly articulated. Appropriate naming of data and products would help provide clarity and improve communication.
- FEMA must address whether different formats of data presentation are legal equivalents and if modifications/extracts change legal status. While some products are clearly identified as to their legal weight for regulatory purposes (e.g., FIRMettes), not all are.
- While the subject of how FEMA relates the flood hazard to frequency and expected damage to risk was not researched in depth for this annual TMAC report, subsequent TMAC reports may consider both the Government Accountability Office (GAO) findings and the findings of the NRC.

Discussion of Recommendation 1

FEMA should consult with multiple stakeholder groups to understand data needs and formats and work to ensure that displays from databases are helpful, useful/applicable, and easy to use. Such meetings should be for both collaboration and brainstorming. Data products should be designed

GOAL 5 | Recommendation 1 (continued)



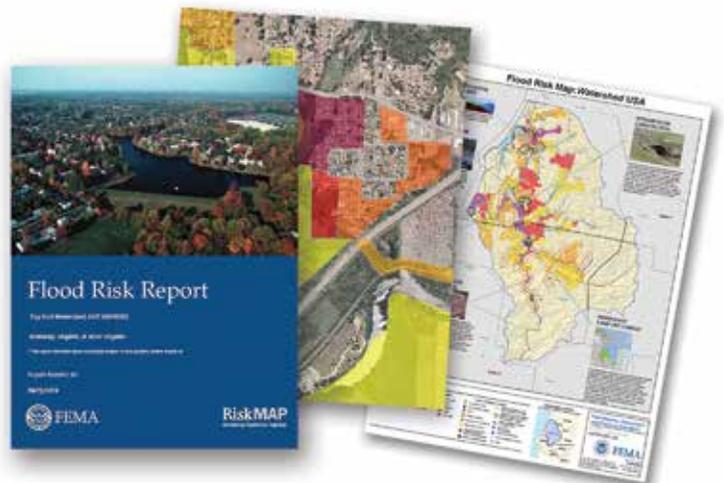
An enhanced non-regulatory dataset that can be provided as part of a Risk MAP project is a velocity grid or dataset. Velocity grids can provide valuable information for emergency responders and building science professionals

giving consideration to multiple platforms for display and use now and into the future.

Flood hazard and risk data are used by many different stakeholders, and should be understandable to all of them, across their wide ranges of applications. FEMA should develop a communication strategy for the community of users, giving consideration of how information is disseminated, with clear explanations of the appropriate use of that information and its limitations.

Further, due to the range of NFIP products available, FEMA should clearly identify what constitutes a legal equivalent of a digital product. Do different formats of digital products carry the same legal weight, or do modifications/extracts change that? For example, there is a note on the title block of FIRMettes indicating that "this digital derivative is a legal equivalent to the full FIRM." Other products and derivatives should be as clearly identified as to legal status.

Expanding the level of understanding across stakeholder groups would serve to improve the implementation of sound floodplain management practices, appropriate use of data, and public awareness of flood hazards and risks.



Non-regulatory products (referred to as Flood Risk products by FEMA)

GOAL 5 | Recommendation 15

FEMA should leverage opportunities to frame and communicate messages to stakeholders in communities so they understand the importance of addressing the flood risk today and consider long-term resilience strategies. Messages should be complemented by economic incentives such as low-interest loans and mitigation grants that lead community leaders and individuals to undertake cost-effective risk reduction measures.

The TMAC's key findings and a recommendation related to communicating flood risk are provided below and are followed by a discussion of the recommendation, benefits, and potential issues related to implementing the recommendation, as applicable. Additional discussion of this recommendation can be found in Section 4.5 of the *TMAC 2015 Annual Report*.

Key Findings

- Transitioning to a structure-specific depiction of flood hazard and flood risk would greatly help FEMA with communicating flood hazard and flood risk beyond the “in-or-out” type of discussions, but a structure-specific depiction is only the technical portion of communicating flood risk.
- An open dialogue about flood risk beyond the requirements for flood insurance is needed.
- The public needs to understand flood risk in terms of their individual needs and priorities. If homeowners fully understand their risk, they will be in a better position to decide if they should allocate their limited resources to mitigating or reducing this risk.

Discussion of Recommendation 15

In communicating flood risk to residents and property owners, the message should focus on how flood risk affects them, their responsibilities, and ways they could reduce the risk to their lives and property. When faced with deciding whether to invest in flood loss reduction measures, property owners need information they can understand to be able to weigh their options.

Residents in hazard-prone areas often ignore the flood risk until after suffering losses from a disaster. Many discount the 100-year flood event as impossibly far away or unlikely, so discussion of even larger but less frequent events—such as the 500-year

BW-12 Mandate **Pub. Law 112-141, Section 100215(c)**

The Council shall —

- (1) recommend to the Administrator how to improve in a cost-effective manner the —
 - (A) accuracy, general quality, ease of use, and distribution and dissemination of flood insurance rate maps and risk data;
- (3) recommend to the Administrator how to maintain, on an ongoing basis, flood insurance rate maps and flood risk identification;

flood—may be even less psychologically effective in conveying the likelihood of a future disaster. Following are actions FEMA could take to encourage residents to consider their risk more carefully:

- FEMA could consider stretching the time horizon in presenting information on the likelihood of a flood occurring by indicating, for example, that the chances of one or more 100-year floods occurring in a 25-year period is greater than 1 in 5.
- FEMA could better communicate the personal loss and property damage caused by flooding and encourage property owners to take actions such as investing in mitigation and purchasing insurance to reduce the flood risk to their households and assist them if they suffer damage from a future flood.
- Individuals are reluctant to invest in loss reduction measures because of the high upfront costs and budget constraints. FEMA mitigation grants and long-term loans could spread the cost of the measure over the life of the property to make these measures affordable. The grants and loans could promote individual and community safety and resilience and reduce taxpayer dollars spent on disaster response and recovery.

GOAL 6

FEMA FLOODPLAIN MAPPING ACTIVITIES depend on numerous datasets, analytical methods, models, studies, and other information (e.g., topography, hydraulic, hydrologic) produced by a host of agencies and programs, generally for their own unique mission objectives and subject to agency collection and sharing policies. Source agencies are often unaware of FEMA needs for specific data, notifications, or documentation. Within the Federal establishment and across State and local agencies, various coordination councils, non-government organizations, and private-sector groups could inform, coordinate, and improve the flow of information needed to deliver FEMA floodplain maps and further the vision of Risk MAP—to deliver quality data that increases public awareness and leads to action that reduces risk to life and property. Improved coordination and delivery of this information could result in improved workflows, cost savings, credibility, and more timely development of FIRMs.

There are numerous national data sets that could be leveraged to support more efficient flood plain mapping. TMAC identified the major datasets, models, and methods needed to produce floodplain maps, and mapped each to the primary source agencies, coordination groups, and major agency initiatives that provide strategic opportunities for FEMA to engage the agencies to leverage existing or planned activities. In general, the data and information needed to support floodplain mapping are highly varied and the sources are discrete and driven by disparate but reconcilable missions.

FEMA's Risk MAP process integrates hazard identification with risk assessment, communication, and mitigation. CTPs are considered valued partners in this process. The CTP Program is an innovative approach for creating partnerships between FEMA and participating NFIP communities in good standing, regional agencies, State agencies, Tribes, approved national non-profit associations, and universities that have expressed interest and have the capability to become more active participants in the FEMA flood hazard mapping program to support the NFIP. CTPs play a vital role in communicating



Federal agencies working together

and supporting local communities that benefit from sharing information and data, receiving feedback on FIS products, and acting a liaison with various stakeholders and partners to address community feedback. CTPs are in a better position to work with local community officials and other agencies to collect and leverage data and cost-sharing opportunities. The broad range of levels of participation and success demonstrates a need for the program to evolve from its current “one size fits all” model to a tiered structure.

GOAL 6 | Recommendation 17

FEMA should consider National Academy of Public Administration recommendations on agency cooperation and federation (6, 7, 8, 9, 13, and 15) and use them to develop more detailed interagency and intergovernmental recommendations on data- and program-related activities that can be more effectively leveraged in support of flood mapping.

The TMAC's key findings and a recommendation related to interagency and intergovernmental coordination are provided below and are followed by a discussion of the recommendation, benefits, and potential issues related to implementing the recommendation, as applicable. Additional discussion of this recommendation can be found in Section 4.7 of the *TMAC 2015 Annual Report*.

Key Findings

- National Academy of Public Administration (NAPA)²⁹ provides several recommendations on interagency and intergovernmental coordination.
- Sharing geospatial and hydrologic and hydraulic (H&H) data across Federal, State, local, and tribal organizations is an issue that transcends FEMA. Effectively using high-resolution data generated locally to complement national data sets is a massive coordination effort and difficult to manage nationwide.
- NAPA³⁰ recommendations are a good start, but more work needs to be done to develop workable mechanisms to facilitate the coordination and ultimate repurposing of program-specific data to support flood mapping.

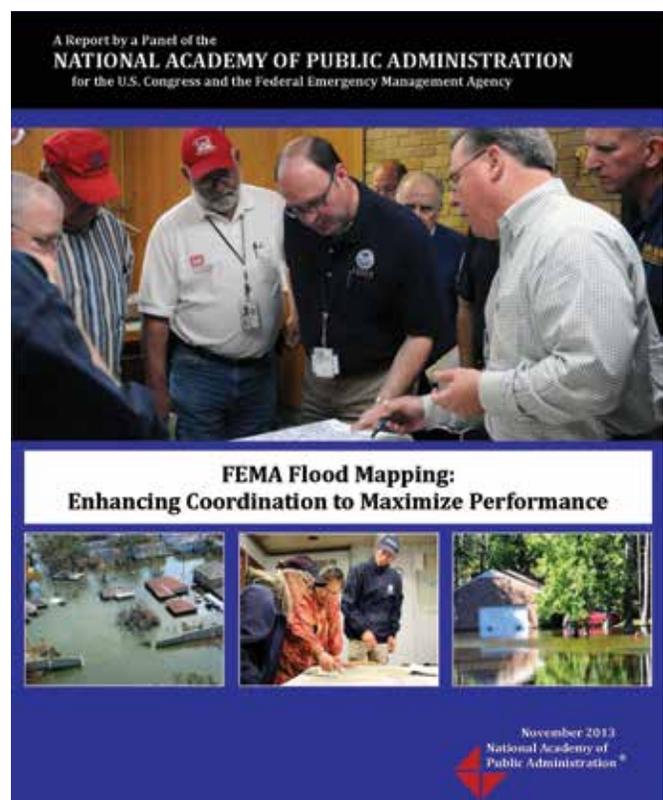
Discussion of Recommendation 17

The TMAC may use the NAPA³¹ recommendations to develop more detailed intergovernmental and interagency coordination recommendations for the TMAC 2016 Annual Report, looking at the alignment of geospatial and H&H data being generated by specific agency programs across Federal agencies with flood mapping missions. Of the two, coordination and standardization of H&H data have received less attention and will prove the more difficult. However, interagency consortiums, such as the Integrated Water Resources Science and the Services and Consortium of Universities for the Advancement of Hydrologic Sciences, Inc., have the potential to lead the effort to make progress on the issue and improve the efficiency of flood mapping studies.

BW-12 Mandate Pub. Law 112-141, Section 100215(c)

The Council shall —

- (5) recommend to the Administrator and other Federal agencies participating in the Council—
 - (A) methods for improving interagency and intergovernmental coordination on flood mapping and flood risk determination;



National Academy of Public Administration report, FEMA Flood Mapping: Enhancing Coordination to Maximize Performance

29. National Academy of Public Administration, *FEMA Flood Mapping: Enhancing Coordination to Maximize Performance* (2013), <http://www.napawash.org/images/reports/2013/FEMAFloodMappingEnhancingCoordinationtoMaximizePerformance.pdf>.

30. Ibid.

31. Ibid.

GOAL 6 | Recommendation 18

FEMA should work with Federal, State, local, and tribal agencies, particularly the USGS and National Ocean Service, to ensure the availability of the accurate water level and streamflow data needed to map flood hazards. Additionally, FEMA should collaborate with the USGS to enhance the National Hydrography Dataset to better meet the scale and resolution needed to support local floodplain mapping while ensuring a consistent national drainage network.

The TMAC’s key findings and a recommendation related to leveraging datasets are provided below and are followed by a discussion of the recommendation, benefits, and potential issues related to implementing the recommendation, as applicable. Additional discussion of this recommendation can be found in Section 4.7 of the *TMAC 2015 Annual Report*.

Key Findings

- H&H datasets are critical to characterizing the flood hazard, mapping the floodplain, and assessing flood risk, yet they are often hard to work with, fragmented across agencies in terms of indexing and storage, and lack standardization.
- While 10 or more flood observations are needed to compute a flood frequency, accurate estimates of large floods require more observations. Current datasets are inadequate for such analyses at many locations due to their relative short record length and scarcity. The TMAC has identified several potential strategies to help address the data shortage. Broadly stated, the strategies are to grow the USGS network, develop and use record extension techniques based on “paleoflood” and other historical information, upgrade and standardize State and local streamgauge networks to acquire more flood information, expand the National Oceanic and Atmospheric Administration (NOAA) National Water Level Observation Network tide gage network, and update and modernize NOAA’s Atlas 14 product.

Discussion of Recommendation 18

Various national geospatial datasets needed for accurate flood mapping and continued coordination will both improve the quality of national datasets and prevent duplication of effort.

BW-12 Mandate Pub. Law 112-141, Section 100215(c)

The Council shall —

- (1) recommend to the Administrator how to improve in a cost-effective manner the —
 - (A) accuracy, general quality, ease of use, and distribution and dissemination of flood insurance rate maps and risk data; and
- (5) recommend to the Administrator and other Federal agencies participating in the Council—
 - (A) methods for improving interagency and intergovernmental coordination on flood mapping and flood risk determination;

Because H&H datasets are particularly challenging to assimilate nationally, improvements require streamflow data coordination bodies to work diligently across data types as well as across Federal, State, and local scales. This collaboration will ultimately take better advantage of river stage data already being collected and improve the characterization flood hazards, mapping floodplains, and assessing flood risk.



NOAA provides flood forecast, stage, and peak flow data available for flood hazard analysis³²

32. National Weather Service, “Advanced Hydrologic Prediction Service” (2015), <http://water.weather.gov/ahps2/hydrograph.php?wfo=ilm&gage=PDES1>; accessed January 5, 2016.

GOAL 6 | Recommendation 19

FEMA should develop and implement a suite of strategies to incentivize communities, non-government organizations, and private-sector stakeholders to increase partnering and subsequent contributions for flood hazard and risk updates and maintenance.

The TMAC's key findings and a recommendation related to CTPs are provided below and are followed by a discussion of the recommendation, benefits, and potential issues related to implementing the recommendation, as applicable. Additional discussion of this recommendation can be found in Section 4.8 of the *TMAC 2015 Annual Report*.

Key Findings Related to Recommendation 19

- FEMA recognizes CTPs as valued partners in carrying out its Risk MAP vision.
- Because of their role at the State and local levels, CTPs are in a unique position to encourage local partnerships in collecting and leveraging data and identifying cost-sharing opportunities.
- Local partnerships and contributions to projects encourage local ownership of the products and a better understanding of the flood hazards and risk.
- During Map Mod and Risk MAP, FEMA successfully identified several CTPs that could not only serve as qualified mapping partners but could also work to increase partnering and cost-sharing at the State and local levels.
- Many CTPs have demonstrated capabilities beyond the technical aspects of flood mapping and have taken on additional activities, such as Letter of Map Revision delegation.
- The establishment of the CTP Program and the growing list of successful partner programs clearly demonstrate the need for continuation of the program.

BW-12 Mandate Pub. Law 112-141, Section 100215(c)

The Council shall —

- (3) recommend to the Administrator how to maintain, on an ongoing basis, flood insurance rate maps and flood risk identification;
- (4) recommend procedures for delegating mapping activities to State and local mapping partners;

Discussion of Recommendation 19

The contributions of CTPs that have demonstrated successful implementation of the program and have proven capability to have increased responsibilities in implementing FEMA's vision should be better leveraged so that CTPs are better positioned to:

- Strengthen the program overall
- Promote local ownership of flood risks
- Communicate the flood hazards and related risks
- Contribute to program planning and priorities

GOAL 6 | Recommendation 20

FEMA should work with CTPs to develop a suite of measures that communicate project management success, competencies, and capabilities of CTPs. Where CTPs demonstrate appropriate levels of competencies, capabilities, and strong past performance, FEMA should further entrust additional hazard identification and risk assessment responsibilities to CTPs.

The TMAC's key findings and a recommendation related to CTPs are provided below and are followed by a discussion of the recommendation, benefits, and potential issues related to implementing the recommendation, as applicable. Additional discussion of this recommendation can be found in Section 4.8 of the *TMAC 2015 Annual Report*.

Key Findings Related to Recommendation 20

- The success of the CTP Program has demonstrated the value of delegating a range of activities to partner entities that have a strong commitment and interest in implementing key aspects of the program.
- CTPs are most effective when they can leverage local relationships to promote better communication and understanding of flood risk and identification of mitigation actions.
- As the flood mapping program has evolved, many CTPs have built on their long-term relationships with local communities and property owners to better identify mitigation needs and break down the divide between flood mapping and effective mitigation strategies.
- CTPs are required to meet certain performance standards based on anticipated and actual cost and schedule of projects; however, this is only a small measure of the value of CTPs. Many CTPs have demonstrated capabilities and taken on additional activities that add value to the NFIP, risk reduction efforts, and community engagement.
- The broad range of participation and success from the various CTPs demonstrates the clear need for the program to evolve from its current “one size fits all” model to a tiered structure with increasing levels of responsibility associated with successfully proven programs that continue to demonstrate the commitment to the program.
- Development of a tiered structure for the CTP Program can assist FEMA in realizing greater return

BW-12 Mandate **Pub. Law 112-141, Section 100215(c)**

The Council shall —

- (3) recommend to the Administrator how to maintain, on an ongoing basis, flood insurance rate maps and flood risk identification;
- (4) recommend procedures for delegating mapping activities to State and local mapping partners;

on its investment and help drive more action at the local/partner level through an increased ownership stake in the program.

Discussion of Recommendation 20

FEMA would benefit from a more flexible program that allows for increasing responsibility and autonomy for mapping partner-level CTPs with a successful, proven track record. Many CTPs are already providing additional value-added activities to local communities and property owners. This could easily be expanded to further FEMA's vision for delivering quality data that increases public awareness and leads to action that reduces risk to life and property.

For the communities that are newer or have demonstrated challenges with effectively carrying out the CTP Program, FEMA can maintain the existing framework and structure to ensure effective monitoring and oversight of the Federal dollars committed to the program.

Regardless of the level of participation or success of an individual CTP, FEMA must still be able to demonstrate both progress and value for the grant money that is provided. Ideally, FEMA would use a larger percentage of its monitoring and oversight efforts on CTPs that have less experience or are underperforming and provide more flexibility and autonomy to higher performing CTPs that have a proven track record.

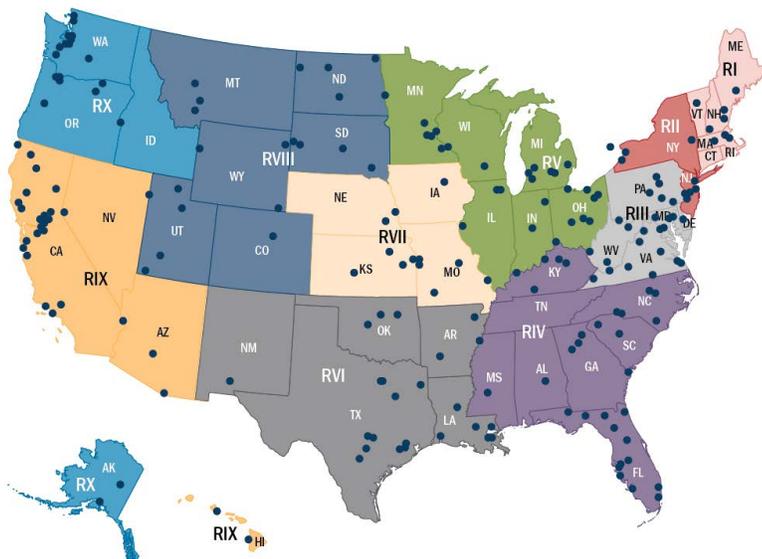
GOAL 6 | Recommendation 21

To ensure strong collaboration, communication, and coordination between FEMA and its CTP mapping partners, FEMA should establish a National Flood Hazard Risk Management Coordination Committee. The role of the committee should be focused around the ongoing implementation of the 5-year Flood Hazard Mapping and Risk Assessment Plan. FEMA should add other members to the committee that have a direct bearing on the implementation of the plan.

The TMAC's key findings and a recommendation related to community of users and uses are provided below and are followed by a discussion of the recommendation, benefits, and potential issues related to implementing the recommendation, as applicable. Additional discussion of this recommendation can be found in Section 4.8 of the *TMAC 2015 Annual Report*.

Key Findings Related to Recommendation 21

- Over the last 15 years, FEMA has partnered with many CTPs and benefited from many best practices and lessons learned and shared by CTPs.
- While CTPs have provided FEMA with lessons learned and helped to refine the mapping and risk assessment process, consistent, bidirectional, programmatic collaboration between FEMA and CTPs has not been present.
- Allowing CTPs to have a collaborative role in the decision-making progress for programmatic changes will ensure that changes are informed by key implementation challenges prior to adoption.



There are currently more than 231 Cooperating Technical Partners in FEMA's CTP program

BW-12 Mandate Pub. Law 112-141, Section 100215(c)

The Council shall —

- (3) recommend to the Administrator how to maintain, on an ongoing basis, flood insurance rate maps and flood risk identification;
- (4) recommend procedures for delegating mapping activities to State and local mapping partners;

Discussion of Recommendation 21

FEMA would benefit from establishing a National Flood Hazard and Risk Management Coordination Committee that includes CTP mapping partners. As the flood mapping program has evolved over the years from Map Mod and Risk MAP, CTPs have been valuable partners and have shared numerous best practices and lessons learned that FEMA has used to refine the *Guidelines and Standards*. Until recently, CTPs were not able to participate in the *Guidelines and Standards* update process, and currently no process exists for CTPs to be engaged in the planning and implementation of the overall program.

Establishing a National Flood Hazard and Risk Management Coordination Committee would benefit FEMA and the national flood mapping program by providing a process to fully evaluate programmatic changes. Allowing CTPs to serve on this committee would not only provide a voice for valued CTP mapping partners, it would also help FEMA identify challenges to programmatic changes and develop solutions prior to implementation.

GOAL 7

Permanent, substantial funding that supports all program resource requirements.



RECOMMENDATIONS RELATED TO GOAL 7

Recommendation 22	Define the financial requirements to implement the TMAC's recommendations and to maintain its investment in the flood study inventory.	Page 50
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The above recommendations are abbreviated. See the discussion of each recommendation for the unabbreviated version.

GOAL 7

FUNDING LEVELS SUPPORTING the national flood mapping program operations, hazard mapping, and risk assessments have not been stable. Funding has been inconsistent and inadequate for short- and long-term programmatic operations and for the updating and maintenance of flood hazard and risk data, models, assessments, maps, and displays nationwide.

Over the years, funding to support the flood mapping program (Mad Mod and Risk MAP) has come from a combination of policy fee's and direct appropriations. From Fiscal Year (FY) 2004–2008, the Policy Fee accounted for an average of \$56 million per year in funding to the program. Direct appropriations have varied widely from FY04–FY15 with a high of \$249 million in FY04 down to a low of \$90 million in FY13 (FY15 appropriations are \$100 million). Consequently, the Policy Fee has gone from accounting for less than 25 percent of the program funding prior to FY09 to more than 50 percent of the total funding in FY12–FY15.

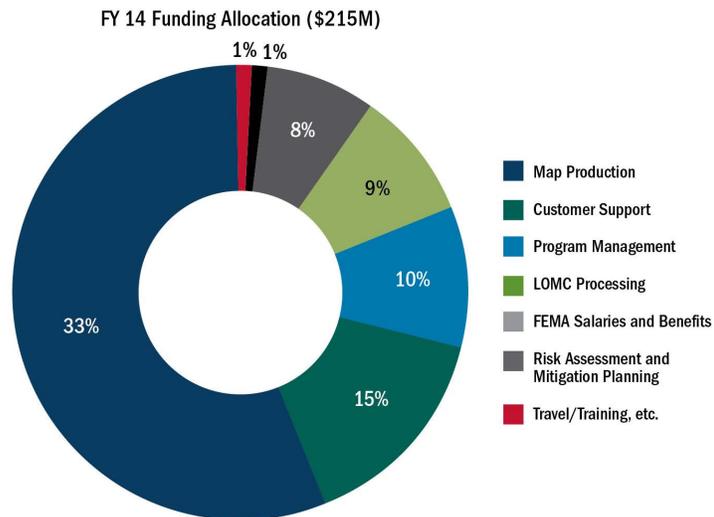
In FY14, approximately \$215 million was allocated to the FEMA Risk MAP program: 56 percent is used for map production and the rest is used for program areas such as customer support, program management, LOMC processing, risk assessment and mitigation planning, salaries and benefits, and travel and training.

Current estimates indicate that approximately 1.13 million miles of stream have been mapped (paper and digital) with slightly less than 50 percent of the inventory considered NVUE-compliant (valid). FEMA's target within the next 5 years is to progress toward a full maintenance phase of the existing inventory, in which the map inventory is assessed

The NFIP is in jeopardy of not being able to maintain the engineering and mapping products that have been developed to date. Current funding levels do not support the short-term and long-term projected needs associated with programmatic operations and updating and maintaining flood hazard and risk data, models, assessments, maps, and displays nationwide.

within a 5-year cycle and 80 percent of the miles are identified as valid. Significant additional funding beyond current levels will be required to reach the 80 percent target and maintain that level on an annual basis.

Despite the increased funding levels since 2000, the 2013 Association of State Floodplain Managers (ASFPM) report *Flood Mapping for the Nation*³³ estimates that between \$4.5 and \$7.5 billion is required to update the current mapping inventory nationwide. The estimated cost does not include the annual funding needed to meet the ongoing maintenance goals of the NFIP.



FY14 funding allocation of \$215 million shows just over 50 percent of the Risk MAP program allocation is used for map production

33. Association of State Floodplain Managers, *Flood Mapping for the Nation: A Cost Analysis for the Nation's Flood Map Inventory* (2013), http://www.floods.org/ace-files/documentlibrary/2012_NFIP_Reform/Flood_Mapping_for_the_Nation_ASFPM_Report_3-1-2013.pdf.

GOAL 7 | Recommendation 22

FEMA should define the financial requirements to implement the TMAC's recommendations and to maintain its investment in the flood study inventory.

The TMAC's key findings and a recommendation related to communicating flood risk are provided below and are followed by a discussion of the recommendation, benefits, and potential issues related to implementing the recommendation, as applicable. Additional discussion of this recommendation can be found in Section 4.9 of the *TMAC 2015 Annual Report*.

Key Findings

- There has been a significant decrease in funding levels for the Risk MAP program since 2012, when the funding decreased from \$325 million at its inception to a low of \$208 million in 2013. The current funding level for 2015 is \$221 million.
- Present funding levels are not sufficient to keep pace with the number of miles requiring new study on an annual basis.
- Funding has been inconsistent and inadequate for short- and long-term programmatic operations and for the updating and maintenance of flood hazard and risk data, models, assessments, maps, and displays nationwide.
- ASFPM estimates that between \$4.5 and \$7.5 billion is required to update the current mapping inventory (including coastal flood studies) nationwide. ASFPM also estimates that the annual maintenance of the mapped inventory would cost up to \$275 million annually, combining this cost with the average annual policy fees (approximately \$119 million over the last 5 years) would require a total national flood mapping program budget of nearly \$400 million on an annual basis.
- FEMA funded less than 7 percent of the total inventory of miles to update to an existing study. For FEMA to achieve its 80 percent target of valid

BW-12 Mandate **Pub. Law 112-141, Section 100215(c)**

The Council shall —

- (3) recommend to the Administrator how to maintain, on an ongoing basis, flood insurance rate maps and flood risk identification;
- (5) recommend to the Administrator and other Federal agencies participating in the Council –
 - (B) a funding strategy to leverage and coordinate budgets and expenditures across Federal agencies; and

miles, an additional 350,000 miles of study would need to be funded. This would cost an estimated \$2.3 billion.

- ASFPM estimates that updating the inventory (including coastal miles) would cost from \$4.5 to \$7.5 billion.³⁴ This estimate does not include the funding needed to meet the ongoing maintenance goals of the mapped inventory. The same report estimates that annual maintenance of the mapped inventory would cost up to \$275 million annually. Combining this cost with the average annual policy fees (approximately \$119 million over the last 5 years) would require a total national flood mapping program budget of nearly \$400 million on an annual basis.

Discussion of Recommendation 22

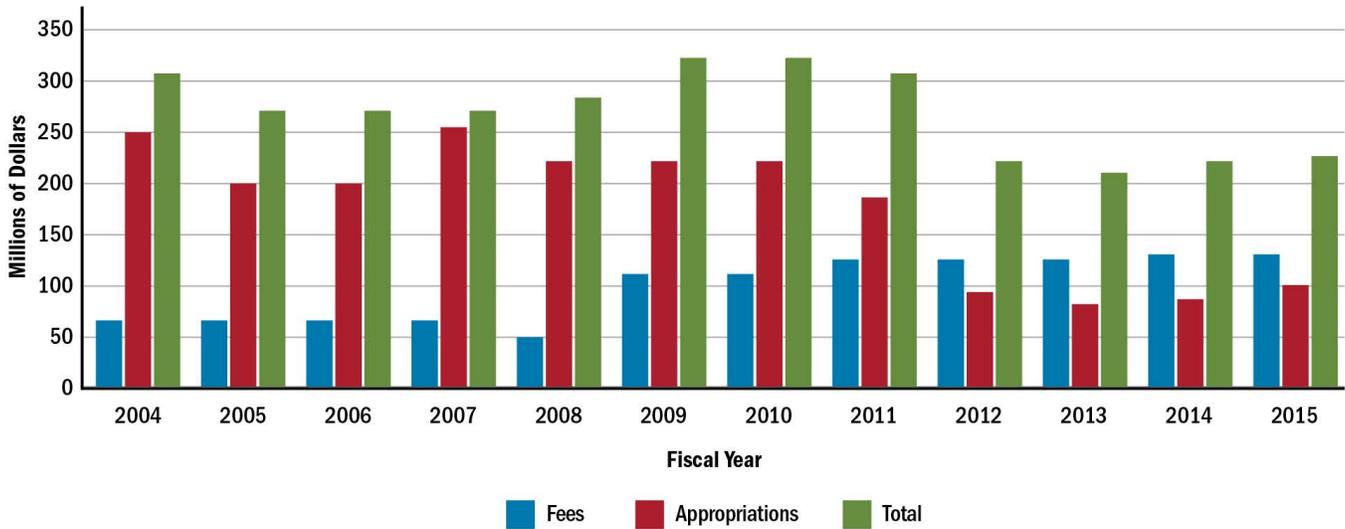
The financial requirements to implement the recommendations of the *TMAC 2015 Annual Report* should be evaluated and considered when developing the short- and long-term implementation plan and evaluated against maintaining high quality flood hazard data (riverine and coastal).

34. Ibid.

GOAL 7 | Recommendation 22 (continued)

FEMA should consider the cost of updating the mapping inventory to achieve its goal of 80 percent NVUE-compliance and the cost of maintaining the inventory once in a full maintenance phase of the program. As stated previously, ASFPM estimates the update alone could cost as much as \$7.5 billion. With the current financial state of the NFIP, which includes the continuing effect of the debt from post-disaster costs from events such as Hurricane Katrina and Hurricane Sandy, new ways of providing additional funding to the NFIP must be considered. For example, some flood insurance policy fees could be amended to pay for NFIP operations and engineering/mapping

maintenance. ASFPM’s report, *Flood Mapping for the Nation*, explains that approximately \$400 million per year is needed to fund the program support and maintenance of the FISs and associated products.³⁵ With annual Federal funding ranging from \$208 million to \$221 million in recent years, the NFIP is in jeopardy of not being able to maintain the engineering and mapping products that have been developed.



Historical annual investment in the national flood mapping program

35. Ibid.

Glossary

Definitions are from FEMA³⁶ unless otherwise noted.

1-percent-annual-chance flood – Flood with a 1 percent chance of being equaled or exceeded in any given year.

Base flood – Flood with a 1 percent chance of being equaled or exceeded in any given year.

Base flood elevation (BFE) – The elevation of a flood with a 1 percent chance of being equaled or exceeded in any given year.

Biggert-Waters Flood Insurance Reform Act of 2012 (BW-12) – Legislation that was later revised by the Homeowner Flood Insurance Affordability Act of 2014 requiring FEMA and other agencies to make a number of changes to the way the NFIP is run. Key provisions of the legislation required the program to raise rates to reflect true flood risk and make the program more financially stable. The legislation also authorized the Technical Mapping Advisory Council to re-convene.

Coastal Flooding – Flooding that occurs along the Great Lakes, the Atlantic and Pacific Oceans, and the Gulf of Mexico.

Code of Federal Regulations (CFR) – The codification of the general and permanent rules published in the Federal Register by the Executive Departments and agencies of the Federal Government. NFIP are printed in 44 CFR Parts 59–77.

Community – Any State or area or political subdivision thereof, or any Indian Tribe or authorized tribal organization, or Alaska Native village or authorized native organization, that has the authority to adopt and enforce floodplain management regulations for the areas within its jurisdiction.

Cooperating Technical Partners (CTP) Program – A FEMA program to create partnerships between FEMA and participating NFIP communities, regional agencies, and State agencies that have the interest and capability to become more active participants in the FEMA national flood mapping program.

Flood – A general and temporary condition of partial or complete inundation of 2 or more acres of normally dry land area or of two or more properties (at least one of which is the policyholder’s property) from one of the following:

- Overflow of inland or tidal waters
- Unusual and rapid accumulation or runoff of surface waters from any source
- Mudflow

36. FEMA, “FEMA Dictionary” (2015), <https://www.fema.gov/national-flood-insurance-program/definitions#F>; accessed November 6, 2015.

Flood hazard – Flood conditions (e.g., depth, wind, velocity, duration, waves, erosion, debris) that have the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, damage to the environment, interruption of business, or other types of harm or loss.³⁷

Flood Insurance Rate Map (FIRM) – The insurance and floodplain management map produced by FEMA that identifies, based on detailed or approximate analyses, the areas subject to flooding during a 1 percent-annual-chance (100-year) flood event in a community. Flood insurance risk zones, which are used to compute actuarial flood insurance rates, also are shown. In areas studied by detailed analyses, the FIRM shows BFEs to reflect the elevations of the 1-percent-annual-chance flood. For many communities, when detailed analyses are performed, the FIRM also may show areas inundated by 0.2 percent-annual-chance (500-year) flood and regulatory floodway areas.

Flood Insurance Study (FIS) – A compilation and presentation of flood hazard data for specific watercourses, lakes, and coastal flood hazard areas within a community. When a flood study is completed for the NFIP, the information and maps are assembled into an FIS.

Floodplain – Any land area that is susceptible to being inundated by water from any source.

Floodplain management – The operation of an overall program of corrective and preventive measures for reducing flood damage, including but not limited to, emergency preparedness plans, flood control works, and floodplain management regulations.³⁸

Flood profile – A graph showing the relationship of water-surface elevation to location, with the latter generally expressed as distance above the mouth for a stream of water flowing in an open channel.

Flood risk – Expected flood losses, based on the likelihood and severity of flooding, the natural and manmade assets at risk, and the consequences to those assets.³⁹

Floodway – See Regulatory Floodway.

Geographic Information System (GIS) – A system of computer hardware, software, and procedures designed to support the capture, management, manipulation, analysis, modeling, and display of spatially referenced data for solving complex planning and management problems.

37. FEMA, *Multi Hazard Identification and Assessment: A Cornerstone of the National Mitigation Strategy* (1997), <http://www.fema.gov/media-library/assets/documents/7251>.

38. FEMA, *Flood Insurance Manual* (2015), <https://www.fema.gov/flood-insurance-manual>.

39. J. Schwab, K.C. Topping, C. Eadie, R. Deyle, and R. Smith, *Planning for Post-Disaster Recovery and Reconstruction*, PAS Report 483/484 (Chicago: American Planning Association, 1998).

Hazard – An event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, damage to the environment, interruption of business, and other types of loss or harm.

Hydrograph – A graph showing the rate of flow (discharge) versus time past a specific point on a river, or other channel or conduit carrying flow.

Hydrology – The science encompassing the behavior of water as it occurs in the atmosphere, on the surface of the ground, and underground.

Letter of Map Amendment (LOMA) – An official determination by FEMA that a property has been inadvertently included in an SFHA as shown on an Effective FIRM and is not subject to inundation by the 1-percent-annual-chance flood. Generally, the property is located on natural high ground at or above the BFE or on fill placed prior to the Effective date of the first NFIP map designating the property as within an SFHA. Limitations of map scale and development of topographic data more accurately reflecting the existing ground elevations at the time the maps were prepared are the two most common bases for LOMA requests.

Letter of Map Change (LOMC) – A collective term used to describe official amendments and revisions to NFIP maps that are accomplished by a cost-effective administrative procedure and disseminated by letter.

Levee – A manmade structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding.

Light Detection and Ranging (LiDAR) System – An airborne laser system, flown aboard rotary or fixed-wing aircraft, that is used to acquire x, y, and z coordinates of terrain and terrain features that are both manmade and naturally occurring. LiDAR systems consist of an airborne Global Positioning System with attendant base station(s), Inertial Measuring Unit, and light-emitting scanning laser.

Mapping Information Platform (MIP) – The geospatial system that provides easy access to flood hazard information to enable the management, production, and sharing of flood hazard data and maps in a digital environment.

Mapping Activity Statement (MAS) – An agreement signed by FEMA and a participant (community, regional agency, or State agency) in the CTP Program under which the participant will complete specific mapping activities.

Mitigation – A sustained action taken to reduce or eliminate long-term risk to people and property from flood hazards and their effects. Mitigation distinguishes actions that have a long-term impact from those more closely associated with preparedness for, immediate response to, and short-term recovery from specific events.

National Academy of Public Administration (NAPA) – An independent, non-profit, and non-partisan organization established in 1967 to assist government leaders in building more effective, efficient, accountable, and transparent organizations.⁴⁰

National Flood Hazard Layer (NFHL) – A digital database that contains flood hazard mapping data from FEMA's NFIP. The map data are derived from digital FIRM DBs and LOMRs.⁴¹

National Flood Insurance Program (NFIP) – Federal program under which flood-prone areas are identified and flood insurance is made available to the owners of the property in participating communities.

National flood mapping program – An ongoing program under which the FEMA Administrator shall review, update, and maintain NFIP rate maps in accordance with 42 U.S.C. § 4101b.

National Hydrography Dataset (NHD) – The surface water component of The National Map that represents the drainage network with features such as rivers, streams, canals, lakes, ponds, coastline, dams, and streamgages.⁴²

Non-regulatory – Unlike regulatory flood hazard products (e.g., FIRM, FIS Report, FIRM DB), non-regulatory products are not intended to be used as the basis for official actions required under the NFIP, such as determining mandatory insurance purchase requirements for a property. Non-regulatory flood risk products work alongside regulatory products and can be adopted by local communities wishing to regulate floodplain development to a higher standard.

Structure – For floodplain management purposes, a walled and roofed building, including a gas or liquid storage tank that is principally above ground, as well as a manufactured home. For flood insurance purposes, a walled and roofed building, other than a gas or liquid storage tank, that is principally above ground and affixed to a permanent site, as well as a manufactured home on a permanent foundation.

Technical Mapping Advisory Council (TMAC) – A Federal advisory committee established to review and make recommendations to FEMA on matters related to the national flood mapping program; authorized by BW-12.

Vertical Datum – National Geodetic Vertical Datum of 1929 (NGVD 29) or North American Vertical Datum of 1988 (NAVD 88) for which the property elevations are referenced. If the datum being referenced is different than the datum used to produce the effective FIRM, provide the datum conversion.

Watershed – An area of land that drains water to a particular stream, river, or lake. It is a land feature that can be identified by tracing a line along the highest elevations between two areas on a map, often a ridge.⁴³

40. National Academy of Public Administration, "Who We Are" (n.d.), <http://www.napawash.org/about-us/who-we-are.html>; accessed December 2, 2015.

41. FEMA, "National Flood Hazard Layer" (2015), <https://www.fema.gov/national-flood-hazard-layer-nfhl#>; accessed January 5, 2016.

42. U.S. Geological Survey, "NHD User Guide" (2015), <http://nhd.usgs.gov/userguide.html>; accessed January 5, 2016.

43. U.S. Geological Survey, "What Is a Watershed?" (2015), <http://water.usgs.gov/edu/watershed.html>; accessed January 5, 2016.

