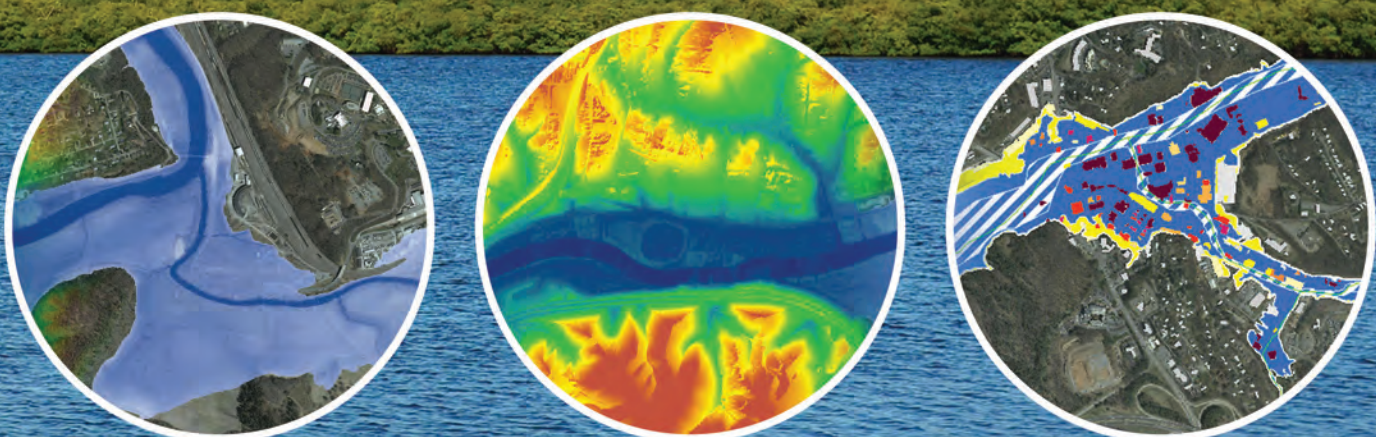
TMAC

TECHNICAL MAPPING ADVISORY COUNCIL

Annual Report

December 2016




Indian Creek East Tributary 7
ZONE A
LIMIT OF DETAILED STUDY
Culvert
ZONE X
ZONE AE
PAWNEE TRAIL
CAYUGA TRAIL
ZONE AE (EL 705)
LIMIT OF FLOODWAY
KIOWA DRIVE NORTH
219
2112
224
Indian Creek (Upper Reach)
Tributary Kiowa 1
NAVAJO TRAIL
BLACKFOOT TRAIL
MAHAVE DRIVE
MODOC TRAIL
HURON TRAIL
FM ROAD 3496
Indian Creek East Tributary No. 2
COCOPA DRIVE W.
COCOPA DRIVE
Lake Kiowa
295

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All illustrations in this document were created by the Technical Mapping Advisory Council or a contractor unless otherwise noted.

Executive Summary

Flooding poses a significant threat to life and safety and is the most costly natural hazard in the United States. Since 1978, the National Flood Insurance Program (NFIP) has paid nearly $52 billion in flood insurance claims. Further, flood damage is increasing as a result of sea level changes, changing climatological patterns, and increased development in floodplains.[1]

The Federal Emergency Management Agency (FEMA) plays a crucial role in helping communities reduce the risk of loss of life and damage to property from flooding by assessing flood risk through its National Flood Mapping Program and by disseminating this information.

History

In 2014, FEMA established the Technical Mapping Advisory Council (TMAC), as mandated by the Biggert-Waters Flood Insurance Reform Act of 2012 (BW-12), to review the National Flood Mapping Program (Program), recommend improvements to the Program, and assess projected future conditions as they relate to flooding. Congress has directed that the TMAC submit an annual report to the FEMA Administrator.

In 2015 and early 2016, the TMAC provided FEMA with 45 recommendations for improvements to the Program on a broad range of topics.[2]

Prioritization of 2015 TMAC Recommendations

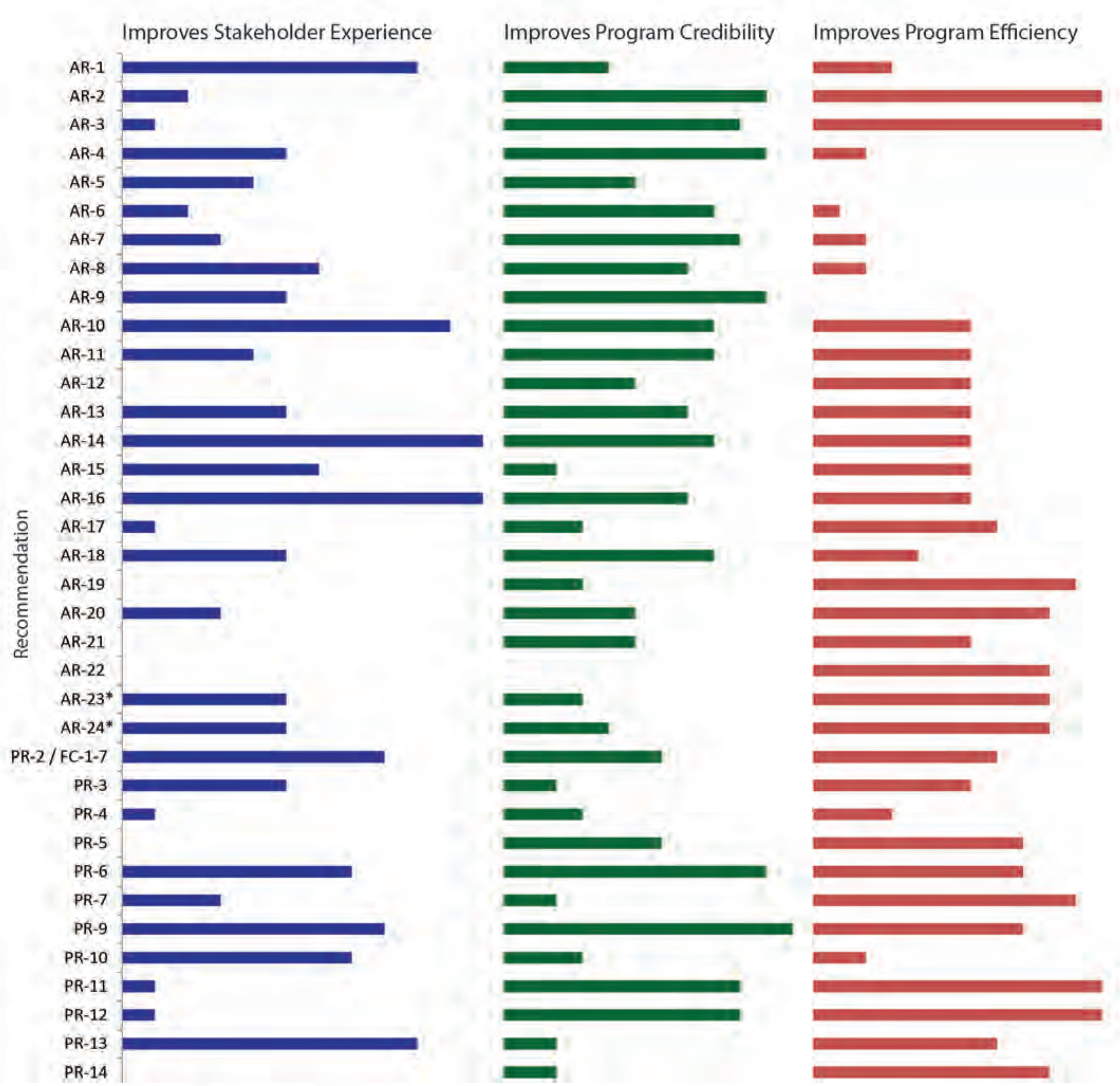
The TMAC was concerned that its recommendations do not have equal potential impact on the Program. To address this concern, the TMAC developed a procedure for prioritizing its recommendations according to their potential impact on the Program. The criteria the TMAC used to assess potential impact were based on the primary directives Congress gave FEMA when the TMAC was formed, namely, improvements to (1) the stakeholder experience, (2) Program credibility, and (3) Program efficiency.

Each criterion had three or four factors, and each factor was assigned 0 to 3 points (0 = no impact on the Program). The factors were weighted so that the maximum score of each criterion was 100 points with a total maximum score of 300 points for each recommendation. Figure ES-1 shows the scores for the recommendations.

1 FEMA. FloodSmart.gov (2016). https://www.floodsmart.gov/floodsmart/pages/flooding_flood_risks/ffr_overview.jsp.

2 The recommendations are provided in the following three reports:

- *TMAC 2015 Annual Report*, https://www.fema.gov/media-library/assets/documents/111853.
- *TMAC Future Conditions Risk Assessment and Modeling* (December 2015), https://www.fema.gov/media-library/assets/documents/111853.
- *TMAC National Flood Mapping Program Review* (January 2016), https://www.fema.gov/media-library-data/1474555532007-c063547f6f48026feb68c4bcfc41169d/TMAC_2016_National_Flood_Mapping_Program_Review_Updated.pdf.



AR *TMAC 2015 Annual Report*
* *TMAC 2016 Annual Report*
FC *TMAC Future Conditions Risk Assessment and Modeling* (2015)
PR *TMAC National Flood Mapping Program Review* (2016)

Figure ES-1: Recommendation Scores

The TMAC then categorized the recommendations as transformative, strategic, or tactical based on their scores.

The recommendations with a score of 150 to 300 were categorized as transformative. These recommendations are likely to require the most significant change to how the Program operates, but would improve the Program the most in stakeholder experience and Program credibility and efficiency.

The seven recommendations that the TMAC identified as transformative are listed in Table ES-1. All of the recommendations are summarized in Table ES-2 at the end of the Executive Summary.

Table ES-1: TMAC 2015 Transformative (Highest Scoring) Recommendations

RANK	SUMMARY OF RECOMMENDATION	
1	PR-9	**Levees and other flood control structures**. FEMA should work to identify residual risk areas behind levees and other flood control structures and downstream of dams.
2	AR-14	**Structure-specific flood assessment**. 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.
3	AR-16	**Digital environment**. 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 is fully georeferenced and relational, enabling a single digital authoritative source of information and database-driven displays.
4	PR-6	**Topographic data**. FEMA should facilitate, partner, and leverage current high-resolution topographic data (e.g., Light Detection and Ranging [LiDAR] data, other new and emerging technologies).
5	AR-10	**Structure-specific flood frequency determination**. 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.
6	AR-2	**National 5-year flood hazard and risk assessment plan**. 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 process 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.
7	PR-2/ FC-1-7	**Future conditions**. FEMA should adopt the future conditions recommendations from the 2015 TMAC Future Conditions Risk Assessment and Modeling report.

AR = TMAC Annual Report (2015)
FC = TMAC Future Conditions Risk Assessment and Modeling (2015)
PR = TMAC National Flood Mapping Program Review (2016)

New Recommendations

In 2016, the TMAC developed two new recommendations (Recommendations 23 and 24).

TMAC Recommendation 23

FEMA should develop, in conjunction with others in the public and private sectors, flood risk-rated insurance premiums for all structures within and outside the identified Special Flood Hazard Area. These premiums should be based on the nature and severity of the flood hazard, structure elevation, and other characteristics, as well as structure damage functions and vulnerability.

TMAC Recommendation 24

FEMA should communicate to the property owner and other interested parties on the cost of risk-rated insurance today and over time for new and existing structures to make the risk transparent. The data should include the benefits and cost that mitigation measures will have on these premiums.

These new recommendations highlight the importance of accurate flood hazard maps to provide relevant information for determining flood risk-rated insurance premiums (FRIPs) and communicating the cost of those premiums over time to residents in areas subject to inundation and water damage.

Current static NFIP maps do not communicate to residents the dynamic nature of flooding and the true nature of the risk at various locations on the floodplain. In other words, current flood insurance premiums do not reflect risk, and as a result of BW-12 and the Homeowner Flood Insurance Affordability Act of 2014, premiums are expected to rise. Hence, accurate flood hazard maps and supporting information are needed to determine FRIPs. The technology exists to estimate the likelihood of floods of different frequencies and the resulting damage to the individual structure to achieve this goal.

A recent National Research Council report (2015) reviewed the current NFIP method for calculating risk-based rates, notably, the floodplain analysis and mapping that support insurance rate setting. The report noted that "many NFIP methods were developed decades ago and do not take advantage of modern technological and analysis capabilities." The report concluded that "the NFIP methods for setting risk-based rates do not accurately and precisely describe critical hazard and vulnerability conditions that affect flood risk for negatively elevated structures."[3]

Accurate maps and FRIPs can encourage current property owners to invest in cost-effective mitigation measures. Property owners are often reluctant to adopt these measures because of their high upfront costs. However, long-term home improvement loans can reduce the annual cost of investing in these measures by spreading the upfront cost over time. If flood insurance premiums were risk rated, the annual reduction in insurance premiums, if one invests in cost-effective mitigation measures to reduce future losses, may be greater than the annual home improvement loan repayment. More generally, long-term loans to homeowners and businesses for mitigation would encourage them to invest in attractive risk-reduction measures.

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

Core stakeholders concerned with floodplain management can use FRIPs to:

- Facilitate more informed decision making by property owners and home buyers
- Enforce requirements that property owners have flood insurance
- Ensure that clients are aware of the flood risk to their properties when they are reviewing existing insurance portfolios
- Inform the borrower or the property owner of their flood risk or their insurance premium
- Increase transparency of flood risk to a potential home buyer
- Support the design, construction, and location of structures by design professionals
- Incentivize new development and improvements on existing property in flood-prone areas
- Enforce local flood damage reduction regulations
- Incentivize State and community officials to make their communities more resilient with respect to flood damage
- Reduce taxpayer burden due to disaster relief following future floods.

The public sector at all levels of government and the private sector (e.g., banks, financial institutions) can use FRIPs to communicate flood risk more effectively.

Implementation Actions

The TMAC developed further suggestions on how to implement the recommendations (referred to as implementation actions) for 17 of the 2015 recommendations, including the seven top-scoring (transformative) recommendations. The implementation actions are intended to help FEMA complete plans for implementing the recommendations, sequencing implementation activities as needed, and meaningfully engaging mapping partners and stakeholders over the next several years.

The implementation actions are shown in Table ES-2.

Summary

The TMAC believes that implementing the recommendations and implementation actions in the TMAC 2015 and 2016 Annual Reports will make for a safer and better prepared Nation. The TMAC believes that the Nation needs to move toward structure-based risk assessments, have full transparency with a 5-year rolling plan, and try to minimize building future problems. The stakeholders and the U.S. Treasury will benefit for generations.

The seven transformative recommendations and their associated implementation actions shown in Figure ES-2a will help the Program overcome its current challenges and realize future benefits. Future benefits include protecting current and future generations from flood risk, increasing transparency to FEMA's stakeholders, leveraging Federal funds, and preventing future risk problems from being built. As shown in Figure ES-2b, the TMAC has provided FEMA with a total of 45 recommendations and 28 implementation actions to improve the delivery of the National Flood Mapping Program.[4]

Figures ES-2a and ES-2b have been used in poster format at presentations and meetings to help summarize where the Program was and is, where it is going, and how it will get there.

4 The recommendations and implementation actions are provided in the *TMAC Annual Report* (2015), *TMAC Future Conditions Risk Assessment and Modeling* (December 2015), and *TMAC National Flood Mapping Program Review* (January 2016).

Table ES-2: Implementation Actions with Associated TMAC 2015–2016 Recommendations

IMPLEMENTATION ACTION		ASSOCIATED RECOMMENDATION	
1.1	**State GIS Standard Operating Procedures.** FEMA should publish the State GIS Standard Operating Procedures on a graphical web interface so that sources of local geospatial information are readily available to everyone.	AR-2	National 5-year flood hazard and risk assessment plan
1.2	**Building footprints and first floor elevations.** FEMA should develop a strategy for obtaining the building footprints and relevant building elevations of properties throughout the Nation to be used in determining structure-based flood risk.	AR-10	Structure-specific flood frequency determination
2.1	**Public communication strategies.** FEMA should construct, implement, and measure the effectiveness of public communication strategies that reflect how individuals acquire and process information on low-probability, high-consequence events. The strategies would include: • Using a variety of media to illustrate and communicate flood hazard and risk information to different audiences and generational groups; • Illustrating location-specific inundation levels by working with the private-sector mapping companies and other partners to integrate street-level photos with overlays of flood levels at multiple return intervals into FEMA's mapping platform; • Working with real estate listing services to display flood hazard and risk information data for their customers; and • Displaying historical flood information, including flood boundaries and depths, where available.	AR-1	Assess flood hazard and risk products
3.1	**Prioritizing flood hazard and risk assessment studies.** FEMA should develop, with input from stakeholders, a list of factors to be used for prioritizing flood hazard and risk assessment studies across the country.	AR-2 AR-3	National 5-year flood hazard and risk assessment plan National Flood Hazard and Risk Assessment Program
3.2	**Merging the Coordinated Needs Management Strategy (CNMS) and the Risk Mapping, Assessment, and Planning (Risk MAP) websites.** FEMA should merge the CNMS and Risk MAP Progress websites so users can see in one place what needs updating and what is being updated.	AR-2 AR-3	National 5-year flood hazard and risk assessment plan National Flood Hazard and Risk Assessment Program
3.3	**Letters of Map Amendment (LOMAs).** FEMA should evaluate whether adding the number or density of LOMAs to Secondary Element contributes to the CNMS metric effectiveness.	AR-2 AR-3	National 5-year flood hazard and risk assessment plan National Flood Hazard and Risk Assessment Program
4.1	**Flood insurance studies (FIS) workflow and procedures.** FEMA should develop a process for reviewing various aspects of the FIS workflow and procedures to: • Encourage workflow efficiencies and cost-effectiveness, including during the Key Decision Point (KDP) process; • Integrate complementary reporting systems; • Revise the FIS workflow and procedures, and incorporate a dynamic, digital display environment system; • Review all internal paperwork required for publishing the notice in the Federal Register; • Incorporate Best Management Practices; and • Document and share guidance from FEMA Headquarters (HQ) and/or Regional offices.	AR-14 AR-11	Structure-specific flood assessment Mapping Information Platform

<table>
<tr><th colspan="2">IMPLEMENTATION ACTION</th><th colspan="2">ASSOCIATED RECOMMENDATION</th></tr>
<tr><td>4.2</td><td>Mapping Information Platform (MIP) workflow. FEMA should take into consideration the following items at the next review of the MIP system:
• Integrate the MIP and KDP process into one system;
• Provide mapping partners more visibility on Data Validation Tasks (i.e., who is responsible for these tasks at the Regional office) and ensure more proactive coordination is implemented before and after the data validation tasks;
• The MIP should take into account the uniqueness of Cooperating Technical Partners (CTPs) and enable more flexibility in all areas of the flood production process, product upload, geographic areas, metadata requirements, quality control (QC) reviews, etc.;
• Transition the MIP to a geodatabase system, similar to the CNMS, in which information is saved geospatially and is used to run customized queries and reporting for Regional offices, mapping partners, and CTPs;
• Enhance functionality to create auto-generation of template correspondence (e.g., Summary of Map Actions [SOMA] letters);
• Provide greater flexibility in user controls;
• Provide additional user access to related information;
• Add risk product workflows; and
• Integrate an efficient solution to provide seamless mapping using hydrologic unit code (HUC) or State geographic areas.</td><td>AR-11</td><td>Mapping Information Platform</td></tr>
<tr><td>4.3</td><td>MIP validation. FEMA Regions should clearly document and communicate MIP workflow validation and quality assurance (QA)/QC procedures, correspondence protocols and approvals, documentation requirements and other Region-specific guidance expectations of the flood study process. Additionally, FEMA Regions should regularly update partners as to staff changes, as well as the roles and responsibilities of Regional staff.</td><td>AR-11</td><td>Mapping Information Platform</td></tr>
<tr><td>4.4</td><td>Training for mapping partners. FEMA HQ should develop additional guidance and training for mapping partners related to the Code of Federal Regulations (CFR) requirements for due process and Federal Register notifications. Regions should also be encouraged to create addendums that communicate their specific requests and internal timelines for their coordination activities with Production and Technical Services (PTS) contractors and CTPs.</td><td>AR-11</td><td>Mapping Information Platform</td></tr>
<tr><td>4.5</td><td>Customer & Data Services. FEMA should work with the Customer and Data Services (CDS) contractor to evaluate the ability to migrate the MIP into a relational database system that can access data from other components of the flood insurance study program, such as a revised version of the Flood Insurance Rate Map (FIRM) database. Further efficiencies in reporting, data integration, and archival processes can occur if the MIP database and FIRM database systems can relate to one another.</td><td>AR-16/
PR-8

AR-11</td><td>Digital environment / database-derived display

Mapping Information Platform</td></tr>
<tr><td>5.1</td><td>Database-derived, digital display environment. FEMA should implement the following features into a future, dynamic, database-derived, digital display environment to manage the update, maintenance, and dissemination of all flood hazards and risk data across the country:
a. Data are geospatial and captured in a relational geodatabase;
b. Data can be dynamically queried and displayed (point and click);
c. A new website is developed that features user-specific inputs, and where data provides one access point for multiple sources of flood hazard data and risk assessment information;
d. Products are developed on-the-fly using dynamic data calling features; and
e. The new website and database support scalability, based on data availability, population, flood frequency and population impacted, and flood insurance penetration.</td><td>AR-16/
PR-8</td><td>Digital environment / database-derived display</td></tr>
<tr><td>5.2</td><td>Demonstrations. FEMA should perform a demonstration(s) to learn from and document data requirements, processes, and standards necessary for nationwide implementation of geodatabase-derived, digital display environment.</td><td>AR-16/
PR-8</td><td>Digital environment / database-derived display</td></tr>
</table>

IMPLEMENTATION ACTION		ASSOCIATED RECOMMENDATION	
5.3	**National Flood Hazard Risk Management Coordination Committee.** FEMA should use the National Flood Hazard Risk Management Coordination Committee to implement TMAC's vision, including the new database-derived, digital display environment.	AR-16/ PR-8	Digital environment / database-derived display
6.1	**Structure-specific flood risk estimates.** FEMA and its partners should identify data needs and standards for developing and maintaining accurate, location-specific flood frequency information, including associated flood conditions (e.g., velocity, waves, erosion, and duration for both present and future flood conditions).	AR-10	Structure-specific flood frequency determination
6.2	**Flood-damage functions.** FEMA and its partners should identify data needs and standards for developing and maintaining the accurate structure characteristics needed for risk estimation. Included in this should be a review of building characteristics data in existing flood risk estimation models, projects, programs, and databases.	AR-14	Structure-specific flood assessment
6.3	**Structure-specific damage in flood-damage functions.** FEMA and its partners should review and, if needed, modify flood damage functions to better capture structure-specific damage resulting from various flood hazards.	AR-14	Structure-specific flood assessment
6.4	**Structure-based risk assessment.** FEMA should perform a demonstration(s) to learn from and document data requirements, processes, and standards necessary for nationwide implementation for structure-based risk assessment.	AR-10	Structure-specific flood frequency determination
7.1	**Letter of Map Revision (LOMR) pilot program.** FEMA should evaluate the Letter of Map Change (LOMC) Review Partnership pilot program and develop clear program requirements, responsibilities, and performance metrics. This information should be used to formally establish the LOMC Review Partnership program, and increase the number of designated communities, where appropriate.	AR-19 AR-20	Incentives Cooperating Technical Partners
7.2	**Multi-year funding cooperative agreements.** FEMA should investigate opportunities and obstacles to implementing multi-year funding cooperative agreements that complement the 5-year CTP Plan.	AR-19 AR-20	Incentives Cooperating Technical Partners
7.3	**Demonstration projects.** FEMA should facilitate and fund demonstration projects for CTPs to incentivize program innovation and efficiencies	AR-19 AR-20	Incentives Cooperating Technical Partners
8.1	**Future conditions modeling and nationwide mapping projects.** FEMA should identify and summarize relevant future conditions-related modeling and mapping projects nationwide (Federal or non-Federal sources) that have technical relevance to the NFIP's mapping program, and capture any data standards, modeling and mapping methods, and/or best practices that can inform FEMA's future conditions mapping program.	PR-2/ FC-1-7 AR-1	Adopt future conditions recommendations Assess flood hazard and risk products
8.2	**Riverine erosion hazard mapping.** FEMA should review existing State-level riverine erosion hazard mapping programs to determine what data standards, modeling and mapping methods, and/or best practices are transferable (i.e., broadly applicable) for potential nationwide implementation of riverine erosion hazard mapping. FEMA should also capture those standards and methods that are applicable to specific geographies or physical settings (analogous to coast-specific models and guidance used in FEMA's current coastal flood study process).	PR-2/ FC-1-7 AR-1	Adopt future conditions recommendations Assess flood hazard and risk products
8.3	**Coastal erosion.** FEMA should include consideration of both sea level rise (SLR) and long-term coastal erosion in the modeling and mapping of flood hazards in all new coastal future conditions pilots.	PR-2/ FC-1-7 AR-1	Adopt future conditions recommendations Assess flood hazard and risk products

IMPLEMENTATION ACTION		ASSOCIATED RECOMMENDATION	
8.4	**Gap analysis of data standards and methodological elements**. FEMA should leverage completed FEMA pilot studies and other relevant coastal and riverine future conditions projects and programs nationwide to prepare a gap analysis that captures outstanding data standards and methodological elements critical to implementing future conditions mapping nationwide.	PR-2/ FC-1-7 AR-1	Adopt future conditions recommendations Assess flood hazard and risk products
8.5	**Future conditions modeling and mapping standards and guidelines**. FEMA should use the existing body of knowledge gained through completed future conditions pilots, evaluation of existing future conditions-related programs, and other relevant Federal and non-Federal efforts to commence development of future conditions modeling and mapping standards and guidelines.	PR-2/ FC-1-7 AR-1	Adopt future conditions recommendations Assess flood hazard and risk products
8.6	**Review of future conditions modeling and mapping standards and guidelines**. FEMA should convene stakeholders and subject matter experts in the initial scoping, development, and review of new future conditions modeling and mapping standards and guidelines (Implementation Action 8.5). This effort should begin as soon as possible to inform the gap analysis and gap prioritization (Implementation Action 8.4), and enable use of any near-term pilots to address critical information needs.	PR-2/ FC-1-7 AR-1	Adopt future conditions recommendations Assess flood hazard and risk products
8.7	**Visualizing future conditions flood risk**. FEMA should develop and test multiple approaches for visualizing future conditions flood risk in one or more future mapping pilots, drawing on relevant social science expertise and lessons learned from prior pilots and other completed mapping projects.	PR-2/ FC-1-7 AR-1	Adopt future conditions recommendations Assess flood hazard and risk products

AR = TMAC Annual Report (2015)
FC = TMAC Future Conditions Risk Assessment and Modeling (2015)
PR = TMAC National Flood Mapping Program Review (2016)
CDS = Customer and Data Services
CFR = Code of Federal Regulations
CNMS = Coordinated Needs Management Strategy
CTP = Cooperating Technical Partner
FEMA = Federal Emergency Management Agency
FIRM = Flood Insurance Rate Map
FIS = Flood Insurance Study
GIS = Geographic Information Systems
HQ = Headquarters
HUC = hydrologic unit code
KDP = Key Decision Point
LOMA = Letter of Map Amendment
LOMC = Letter of Map Change
MIP = Mapping Information Platform
NFIP = National Flood Insurance Program
QA = Quality Assurance
QC = Quality Control
Risk MAP = Risk Mapping, Assessment, and Planning
SLR = sea level rise
SOMA = Summary of Map Actions
TMAC = Technical Mapping Advisory Council

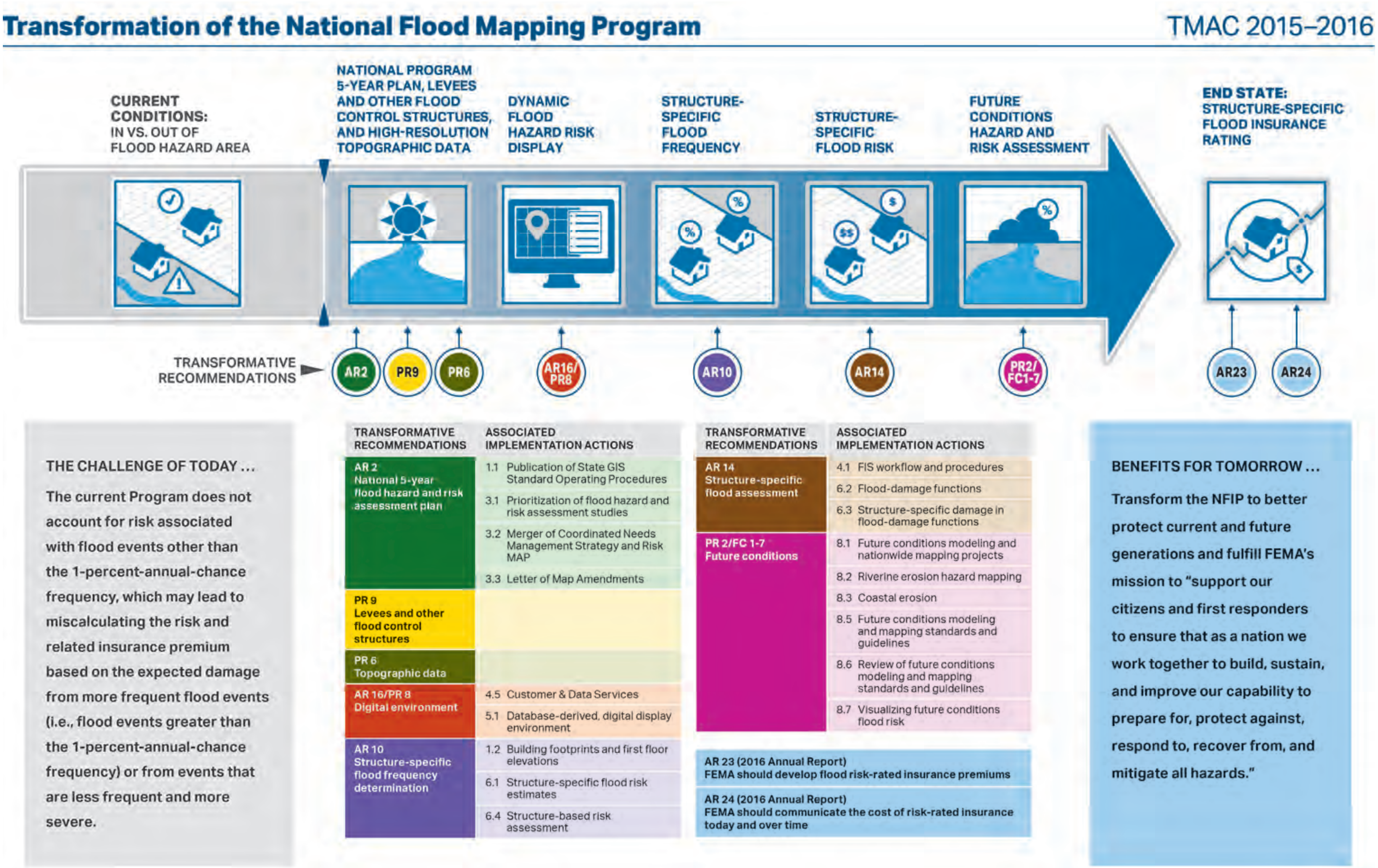


Figure ES-2a. Transformation of the National Flood Mapping Program (front)

TMAC Goals and Recommendations

GOAL 1: ACCURATE DATA, MODELS, AND RISK ASSESSMENTS

AR 2
Develop National program 5-year plan.

AR 3
Develop National program goals and metrics.

AR 4
Work with partners to ensure topo data is collected to Federal standards.

AR 5
Document HV accuracy of topo data.

AR 6
Review updated statistical models (Bulletin 17C).

AR 7
Develop guidance for selection and use of riverine and coastal models.

AR 8
Develop guidance related to coastal 2D storm surge modeling.

AR 9
Update coastal event-based erosion methods.

FC 1
Provide future conditions flood risk products using standardized timeframes.

FC 2
Identify and quantify accuracy and uncertainty of data.

FC 3
Provide flood hazard products for coastal areas that includes erosion and SLR using scenario approach.

FC 4
Provide flood hazard products for riverine areas that includes future conditions.

FC 5
Generate future conditions data to frame and communicate messages.

FC 6
Perform demonstration projects.

FC 7
Future conditions should be consistent with existing conditions analysis and future conditions scenarios.

PR 1
FEMA should adopt TMAC's 2015 recommendations that relate to the National Flood Mapping Program's technical credibility from the TMAC 2015 Annual Report.

PR 2
FEMA should adopt the future conditions recommendations from the 2015 TMAC Future Conditions Risk Assessment and Modeling report.

PR 3
FEMA should complete the implementation of the statutory requirements of the National Flood Mapping Program.

PR 4
FEMA should continue to enhance communication and transparency with program stakeholders by, for example, including organizational and contact information on the Internet.

GOAL 1 (continued)

PR 5
FEMA should investigate offering multi-year program management grant periods (versus annual) to Cooperating Technical Partnerships (CTPs).

PR 6
FEMA should facilitate, partner, and leverage current high resolution topographic data (e.g., Light Detection and Ranging [LiDAR] data, other new and emerging technologies).

PR 7
FEMA should work with Congress and MAPPING partners to examine ways to shorten the study process, including the time added to the mapping process by QRs, KDPs, and legislated due process, as identified in Recommendation 11 in the *TMAC 2015 Annual Report*.

PR 8
FEMA should move to a database-derived display, as outlined in the TMAC 2015 Annual Report Recommendation 16.

PR 9
FEMA should work to identify residual risk areas behind levees, and other flood control structures and downstream of dams.

PR 10
For non-accredited levees, FEMA should replace the Zone D designation in levee-protected areas with risk zones that are more appropriate for the level of risk.

PR 11
FEMA should evaluate the current metrics to better measure the efficient production, valid inventory, and stakeholder acceptance of the National Flood Mapping Program.

PR 12
FEMA should have an inventory metric that reports quantity, quality, and time aspects on national, regional, tribal, state, and watershed levels.

PR 13
FEMA should have a metric that shows progress towards meeting a digital platform goal by area of the nation to complement FEMA's current population metrics. This metric could include the total area of the country, as well as progress towards Goal 3 and Recommendation 16 in the TMAC 2015 Annual Report.

PR 14
FEMA should evaluate the benefits and costs and its value to the nation as a result of different levels of funding to the National Flood Mapping Program.

AR 23 (2016 Annual Report)
FEMA should develop, in conjunction with others in the public and private sectors, flood risk-rated insurance premiums for all structures within and outside the identified Special Flood Hazard Area. These premiums should be based on the nature and severity of the flood hazard, and structure elevation and other characteristics, as well as structure damage functions and vulnerability.

AR 24 (2016 Annual Report)
FEMA should communicate to the property owner and the relevant interested parties on the cost of risk-rated insurance today and over time for new and existing structures to make the risk transparent. The data should include the benefits and cost that mitigation measures will have on these premiums.

GOAL 2: TIME AND COST-EFFICIENT GENERATION OF DATA

AR 11
Update MIP to add greater flexibility.

AR 12
Determine cost impact due to new program requirements.

AR 13
Integrate process for mass LIDAR-based LOMA.

GOAL 3: UTILIZATION OF COST-EFFICIENT TECHNOLOGIES

AR 16
Transition to database-derived, digital display environment.

GOAL 4: INTEGRATED FLOOD RISK MANAGEMENT FRAMEWORK

AR 10
Transition to structure-specific flood frequency determination.

AR 14
Transition to structure-specific risk assessment.

GOAL 5: AWARENESS OF FLOOD HAZARD AND RISK DATA

AR 1
Implement process to assess needs of users.

AR 15
Communicate messages that consider long-term resilience strategies.

GOAL 6: ADDED VALUE PARTNERING AND LEVERAGING

AR 17
Consider NAPA recommendations on agency cooperation and federation.

AR 18
Partner to ensure availability of accurate water level and stream flow data and enhance the NHD.

AR 19
Implement strategies to incentivize stakeholders to increase partnerships.

AR 20
Develop measures to evaluate CTP capabilities and competencies and increase responsibilities.

AR 21
Establish National Flood Hazard Risk Management Coordination Committee.

GOAL 7: PERMANENT, SUBSTANTIAL PROGRAM FUNDING

AR 22
Define financial needs to implement recommendations.

KEY

Recommendation Sources:

AR	TMAC Annual Report (2015) or TMAC 2016 Annual Report
FC	TMAC Future Conditions Risk Assessment and Modeling (2015)
PR	TMAC National Flood Mapping Program Review (2016)

Acronyms:

CTP	Cooperating Technical Partner
FEMA	Federal Emergency Management Agency –
GIS	Geographic Information Systems
KDP	Key Decision Point
LIDAR	Light Detection and Ranging
NAPA	National Academy of Public Administration
NFIP	National Flood Insurance Program
NHD	National Hydrography Dataset
QR	quality review
Risk MAP	Risk Mapping, Assessment, and Planning
SLR	sea level rise
TMAC	Technical Mapping Advisory Council

Transformation of Mapping

INITIATIVES

Structure-Based Risk Assessments

BENEFIT: Transform the NFIP to protect current and future generations

National Program 5 Year Plan

BENEFIT: Increase transparency and leveraging of Federal funds

Future Conditions

BENEFIT: Stop building future problems

Figure ES-2b. Transformation of the National Flood Mapping Program (back)

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S HIGHWAY

1. Introduction

Flooding poses a significant threat to life and safety and is the most costly natural hazard in the United States. Since 1978, the National Flood Insurance Program (NFIP) has paid nearly $52 billion in flood insurance claims. Further, flood damage is increasing as a result of sea level changes, changing climatological patterns, and increased development in floodplains (National Wildlife Federation, n.d.).

The Federal Emergency Management Agency (FEMA) plays a crucial role in helping communities reduce the risk of loss of life and property damage from flooding by assessing flood risk through its National Flood Mapping Program (Program) and by disseminating this information.

As mandated by the Biggert-Waters Flood Insurance Reform Act of 2012, as amended (42 U.S.C. §§ 4001–4130) (BW-12)[1], FEMA established the Technical Mapping Advisory Council (TMAC), a Federal advisory committee, to review and recommend improvements to the Program and to assess projected future conditions as they relate to flooding.

1.1 Congressional Charter

Pursuant to BW-12, the charter filed with Congress on July 29, 2013, formally established the TMAC. The TMAC was established in accordance with and operates under the provisions of the Federal Advisory Committee Act of 1972, as amended (5 U.S.C. App 2).

The TMAC's Charter outlines the principles and functions of the TMAC, including the objectives and scope of TMAC activities, description of duties, member composition, frequency of meetings, and other pertinent items relating to the TMAC's establishment and operation.

1.2 TMAC Responsibilities

The TMAC provides advice and recommendations to the Administrator of FEMA to improve the preparation of Flood Insurance Rate Maps (FIRMs) and flood hazard information. Congress has directed that the TMAC submit an annual report to the Administrator.

Among its responsibilities, the TMAC provides recommendations to FEMA on how to cost-effectively improve the accuracy, quality, ease of use, and distribution and dissemination of FIRMs and risk data as well as other requirements mandated by the authorizing BW-12 legislation.

The TMAC's bylaws establish and describe rules of conduct, regulations, and procedures regarding its membership and operation.

The 2016 TMAC members, subcommittee members, and Designated Federal Officers are listed in Tables 1-1, 1-2, and 1-3, respectively.

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

Table 1-1: 2016 TMAC Members

TMAC Member	BW-12 TMAC Membership Requirement
Mr. John Dorman, CFM (TMAC Chair) Assistant State Emergency Management Director for Risk Management, North Carolina Emergency Management	State Cooperating Technical Partner Representative
Mr. Scott Edelman, P.E. (TMAC Vice Chair)* Senior Vice President AECOM	Mapping Member
Mr. Jeffrey L. Sparrow, P.E., CFM (TMAC Vice Chair) Federal Civilian Market Lead, Michael Baker International	Mapping Member
Mr. Christopher J. Bender, Ph.D., P.E., D.CE Senior Coastal Engineer, Taylor Engineering, Inc.	Engineering Member
Ms. Juliana Blackwell* Director, National Geodetic Survey, National Oceanic and Atmospheric Administration	National Oceanic and Atmospheric Administration/ Commerce for Oceans and Atmosphere Designee
Ms. Nancy Blyler U.S. Army Corps of Engineers Geospatial Community of Practice Lead	U.S. Army Corps of Engineers Designee
Mr. Richard Butgereit, GISP Chief Information Officer, Florida Division of Emergency Management	State Geographic Information System Representative
Mr. Mark DeMulder Director, U.S. Geological Survey National Geospatial Program (Ret.)	U.S. Geological Survey Representative
Ms. Leslie Durham, P.E. Floodplain Management Branch Chief, Office of Water Resources, Alabama Department of Economic and Community Affairs	State Cooperating Technical Partner Representative
Mr. Steve Ferryman, CFM* Mitigation Branch Chief, Ohio Emergency Management Agency	State Mitigation Officer
Mr. Gale Wm. Fraser, II, P.E.* General Manager and Chief Engineer, Clark County (Nevada) Regional Flood Control District	Regional Flood and Stormwater Member
Mr. Jeffrey L. Giering, CFM State Hazard Mitigation Office, Louisiana Governor's Office of Homeland Security and Emergency Preparedness	State Hazard Mitigation Officer
Ms. Carrie Grassi Deputy Director for Planning, New York City Mayor's Office of Recovery and Resiliency	Local Cooperating Technical Partner Representative
Ms. Suzanne Jiwani, P.E., CFM Floodplain Mapping Engineer, Member of Association of State Floodplain Managers	Floodplain Management Member

TMAC Member	BW-12 TMAC Membership Requirement
Mr. Christopher P. Jones, P.E.* Registered Professional Engineer	Engineering Member
Dr. Howard Kunreuther James G. Dinan Professor and Co-Director, Risk Management and Decision Processes Center, Wharton School, University of Pennsylvania	Risk Management Member
Ms. Wendy Lathrop, PLS, CFM President and Owner, Cadastral Consulting, LLC	Surveying Member
Mr. Tony LaVoi Geospatial Information Officer (GIO), National Oceanic and Atmospheric Administration (NOAA)	National Oceanic and Atmospheric Administration/ Commerce for Oceans and Atmosphere Designee
Mr. David Mallory, P.E., CFM* Program Manager, Floodplain Management, Urban Drainage & Flood Control District, Denver, Colorado	Local Cooperating Technical Partner Representative
Mr. Robert Mason, P.E. Chief, USGS Office of Surface Water and Delaware River Master	U.S. Department of the Interior Designee
Ms. Sally Ann McConkey, P.E., CFM, D. WRE* Principal Engineer, Illinois State Water Survey Prairie Research Institute, University of Illinois	State Floodplain Management Member
Mr. Salomon Miranda, P.E., M.S. NFIP Coordinator, California Department of Water Resources, Southern Region Office	State National Flood Insurance Coordination Office Representative
Mr. Tim Murphy, P.E., CFM Manager of Mitigation Planning and Technical Programs, Flood Control District of Maricopa County	Regional Flood and Stormwater Management Member
Mr. Ngoc Nguyen, P.E. Interim Deputy Operating Officer, Santa Clara Valley Water District	Local Cooperating Technical Partner Representative
Mr. Luis Rodriguez, P.E. Director, Engineering and Modeling Division, Federal Insurance and Mitigation Administration, Federal Emergency Management Agency	FEMA Designee
Mr. Javier E. Ruiz Acting Director, National Geospatial Center of Excellence, Natural Resources Conservation Service	U.S. Department of Agriculture Designee
Ms. Christine Shirley, CFM* NFIP Coordinator, Oregon Department of Land Conservation and Development	National Flood Insurance Coordination Office Representative
Ms. Cheryl Small President, Small Consulting LLC	Flood Hazard Determination Firm Member

* Indicates past TMAC members who contributed to the TMAC 2016 Annual Report during their term .

Table 1-2: TMAC 2016 Annual Report Subcommittee Members

Mr. John Dorman, CFM (TMAC Chair)
Assistant State Emergency Management Director for Risk Management, North Carolina Emergency Management

Mr. Scott Edelman, P.E. (TMAC Vice Chair)
Senior Vice President, AECOM

Ms. Juliana Blackwell
Director, National Geodetic Survey, National Oceanic and Atmospheric Administration

Ms. Nancy Blyler
U.S. Army Corps of Engineers Geospatial Community of Practice Lead

Mr. Richard Butgereit, GISP
Chief Information Officer, Florida Division of Emergency Management

Mr. Mark DeMulder
Director, U.S. Geological Survey National Geospatial Program (Ret.)

Ms. Leslie Durham, P.E.
Floodplain Management Branch Chief, Office of Water Resources, Alabama Department of Economic and Community Affairs

Mr. Steve Ferryman, CFM
Mitigation Branch Chief, Ohio Emergency Management Agency

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

Ms. Suzanne Jiwani, P.E., CFM
Floodplain Mapping Engineer, Member of Association of State Floodplain Managers

Mr. Carey Johnson
Environmental Scientist Consultant, Kentucky Division of Water Director's Office

Ms. Theresa Johnston
President and Co-founder, Torrent Technologies, Inc.

Mr. Christopher P. Jones, P.E.
Registered Professional Engineer

Dr. Howard Kunreuther
James G. Dinan Professor and Co-Director, Risk Management and Decision Processes Center, Wharton School, University of Pennsylvania

Ms. Wendy Lathrop, PLS, CFM
President and Owner, Cadastral Consulting, LLC

Mr. David Mallory, P.E., CFM*
Program Manager, Floodplain Management, Urban Drainage & Flood Control District, Denver, Colorado

Mr. Robert Mason, P.E.
Chief, USGS Office of Surface Water and Delaware River Master

Ms. Sally Ann McConkey, P.E., CFM, D. WRE
Principal Engineer, Illinois State Water Survey Prairie Research Institute, University of Illinois

Mr. Tim Murphy, P.E., CFM
Manager of Mitigation Planning and Technical Programs, Flood Control District of Maricopa County

Mr. Luis Rodriguez, P.E.
Director, Engineering and Modeling Division, Federal Insurance and Mitigation Administration, Federal Emergency Management Agency

Ms. Christine Shirley, CFM
NFIP Coordinator, Oregon Department of Land Conservation and Development

Ms. Cheryl Small
President, Small Consulting LLC

* Indicates Designated Federal Officer through September 2016.

Table 1-3: TMAC Designated Federal Officers

TMAC Designated Federal Officer	TMAC Role
Mr. Mark Crowell Physical Scientist, Federal Emergency Management Agency	TMAC Designated Federal Officer
Ms. Kathleen Boyer* Program Specialist, Federal Emergency Management Agency	TMAC Alternate Designated Federal Officer
Mr. Michael Nakagaki Program Specialist, Federal Emergency Management Agency	TMAC Alternate Designated Federal Officer

* Indicates Designated Federal Officer through September 2016.

1.3 TMAC Mission and Guiding Principles

The TMAC's mission is to provide counsel to FEMA on strategies and actions that will efficiently and effectively advance the identification, assessment, and management of flood hazards and risk.

The TMAC believes the following guiding principles should underpin the future of the Program:

- Credible products
- Efficient implementation
- Stakeholder acceptance
- Effective leveraging
- Financial stability

1.4 Purpose of the TMAC 2016 Annual Report

The TMAC 2016 Annual Report (hereafter referred to as 2016 Annual Report) is integrally related to the following three 2015–2016 reports in which the TMAC provided FEMA recommendations on a broad range of National Flood Insurance Program (NFIP) topics:

- ***TMAC Annual Report*** (December 2015) (hereafter referred to as 2015 Annual Report): Includes 22 recommendations on improvements to the following aspects of the Program:
  - Framework data management plan
  - Effective communications of flood hazards and risk
  - Maintenance methodology for the national 5-year flood hazard and risk assessment plan
  - Flood hazard identification and risk assessment process
  - Geodatabase-derived digital display implementation plan
  - Transition from 1-percent-annual-chance flood determination to location-specific flood frequency and structure-specific flood risk determination
  - Cooperating Technical Partners (CTPs): Metrics, process, and delegation methodology
  - Advancing future conditions modeling and mapping
- ***TMAC Future Conditions Risk Assessment and Modeling*** (December 2015) (hereafter referred to as Future Conditions report): Includes 7 recommendations and 37 sub-recommendations to help FEMA ensure that FIRMs incorporate the best available climate science to assess flood risks and ensure that FEMA may use the best available methodology to consider the impact of the rise in sea level and future development on flood risk.
- ***TMAC National Flood Mapping Program Review*** (June 2016) (hereafter referred to as 2016 Program Review): Provides a review of the National Flood Mapping Program with regard to its ability to provide technically credible flood hazard information, when the Program is implemented as designed, in areas where FIRMs are prepared or updated. It also includes 14 recommendations to FEMA to assist the Agency to provide technically credible flood hazard data into the future. Recommendation 2 of this report is to implement all of the recommendations in the Future Conditions report.

The purpose of the 2016 Annual Report is threefold: (1) prioritize the recommendations already provided in the above-referenced 3 reports, (2) give FEMA further suggestions on how to implement the TMAC's recommendations by proposing 28 implementation actions, and (3) provide 2 new recommendations. The new recommendations are related to flood risk-rated insurance and how flood hazard and risk data, models, and methodologies tie into the NFIP.

2. Prioritization of TMAC Recommendations

In 2015 and 2016, the TMAC provided FEMA with recommendations related to a broad range of NFIP-related topics in the following three reports:

- **2015 Annual Report** – Includes 9 topic areas and 22 recommendations
- **Future Conditions report** – Includes 7 recommendations and 37 sub-recommendations
- **2016 Program Review** – Includes 14 recommendations, including one to implement all of the recommendations in the Future Conditions Report report.

Including the two new recommendations presented in Chapter 3 of this 2016 Annual Report, the significant challenge is the development of an implementation strategy for 45 recommendations of varying degrees of complexity and impact to the Program. With this large number of recommendations, the TMAC is concerned that the most important transformative recommendations could be lost within the significant strategic and tactical recommendations provided in these reports. The TMAC therefore established a procedure for ranking the recommendations. The procedure is based on the primary directives Congress gave FEMA when the TMAC was formed. This chapter scores the recommendations based on the TMAC's assessment of their overall impact to the Program, described in Sections 2.1 and 2.2.

All of the TMAC's recommendations are included in the prioritization. While there are a total of 45 recommendations, a total of 37 are included in the prioritization for the following reason:

- Recommendation 1 from the 2016 Program Review (i.e., FEMA should adopt the TMAC's recommendations that relate to the National Flood Mapping Program's technical credibility from the 2015 Annual Report) is not included in this assessment because it is encompassed in the 2015 Annual Report.
- The Future Conditions report recommendations were not independently scored as they are encompassed in Recommendation 2 from the 2016 Program Review (i.e., FEMA should adopt the future conditions recommendations from the Future Conditions report).

2.1 Prioritization Process

The prioritizations of the TMAC's recommendations are based on the TMAC's duties as mandated by BW-12. The priority areas are to:

- Improve stakeholder experience
- Improve Program credibility
- Improve Program efficiency

Each impact criterion aligned to the TMAC's duties was assigned factors (see Table 2-1). The TMAC's 44 recommendations were then each given a score of 0 to 3 for each factor, as follows:

- A score of 0 indicates that implementing the recommendation would have no impact on the Program's stakeholder experience, credibility, or efficiency under the given factor.
- A score of 1 indicates that implementing the recommendation would have a low indirect impact on the Program.
- A score of 2 indicates that implementing the recommendation would have a medium-high indirect impact on the Program or a low direct impact on the Program.
- A score of 3 indicates that implementing the recommendation would have a medium-high direct impact on the Program.

A weighting factor was then applied to each score so that the maximum score potential for any of the three impact criteria (i.e., improves stakeholder experience, improves Program credibility, and improves Program efficiency) was 100. The scores for each impact criterion were then summed for an overall potential maximum score per recommendation of 300.

Table 2-1: Program Impact Criteria and Factors Used to Score Recommendations

IMPACT CRITERIA ALIGNED TO TMAC DUTIES	SCORING FACTORS
Improves Stakeholder Experience	• Improves ability for end-users to understand hazard and risk data • Improves ability for end-users to access and use hazard and risk data • Improves functionality/utility of flood hazard and risk data • Improves the Program's ability to communicate risk
Improves Program Credibility	• Reduces or explains uncertainty in flood hazard and risk data • Increases or maintains the valid flood hazard and risk inventory • Increases flood hazard and risk products accuracy via new or updated Program standard or guidance • Improves transparency in planning and data development • Enhances mapping partner capabilities
Improves Program Efficiency	• Improves the Program's ability to leverage funding to maintain and enhance flood hazard and risk inventory • Introduces new or streamlined process and/or reduces or eliminates manual process • Improves the Program's ability to achieve Flood Insurance and Mitigation Administration (FIMA) goals, objectives, and initiatives • Improves the Program's ability to coordinate with Other Federal Agencies (OFAs) and other stakeholders • Promotes emerging science and technology

2.2 Recommendation Scoring

The prioritization model indicating the scoring of each recommendation for each factor is shown in Appendix A. Figure 2-1 shows the scoring results for each recommendation per impact criterion The cumulative listing of recommendations is from the 2015 Annual Report, the 2016 Program Review (and, by proxy, the Future Conditions report), and the two recommendations in this report (discussed in Chapter 3, Recommendations 23 and 24). Figure 2-2 shows a comparison of the recommendations in their scores in each impact criterion.

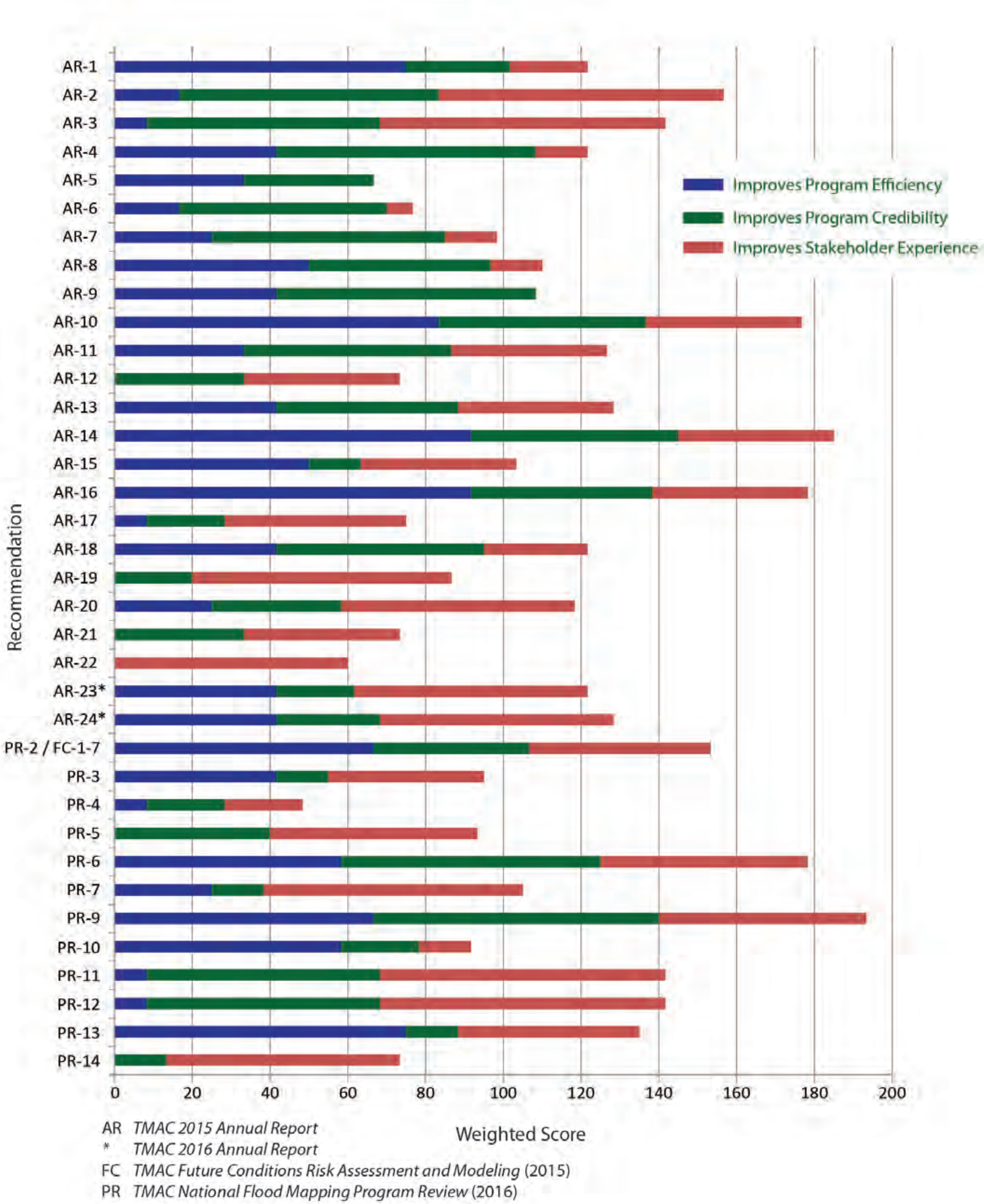


Figure 2-1: Weighted Scores for the Three Impact Criteria for 2015–2016 TMAC Recommendations

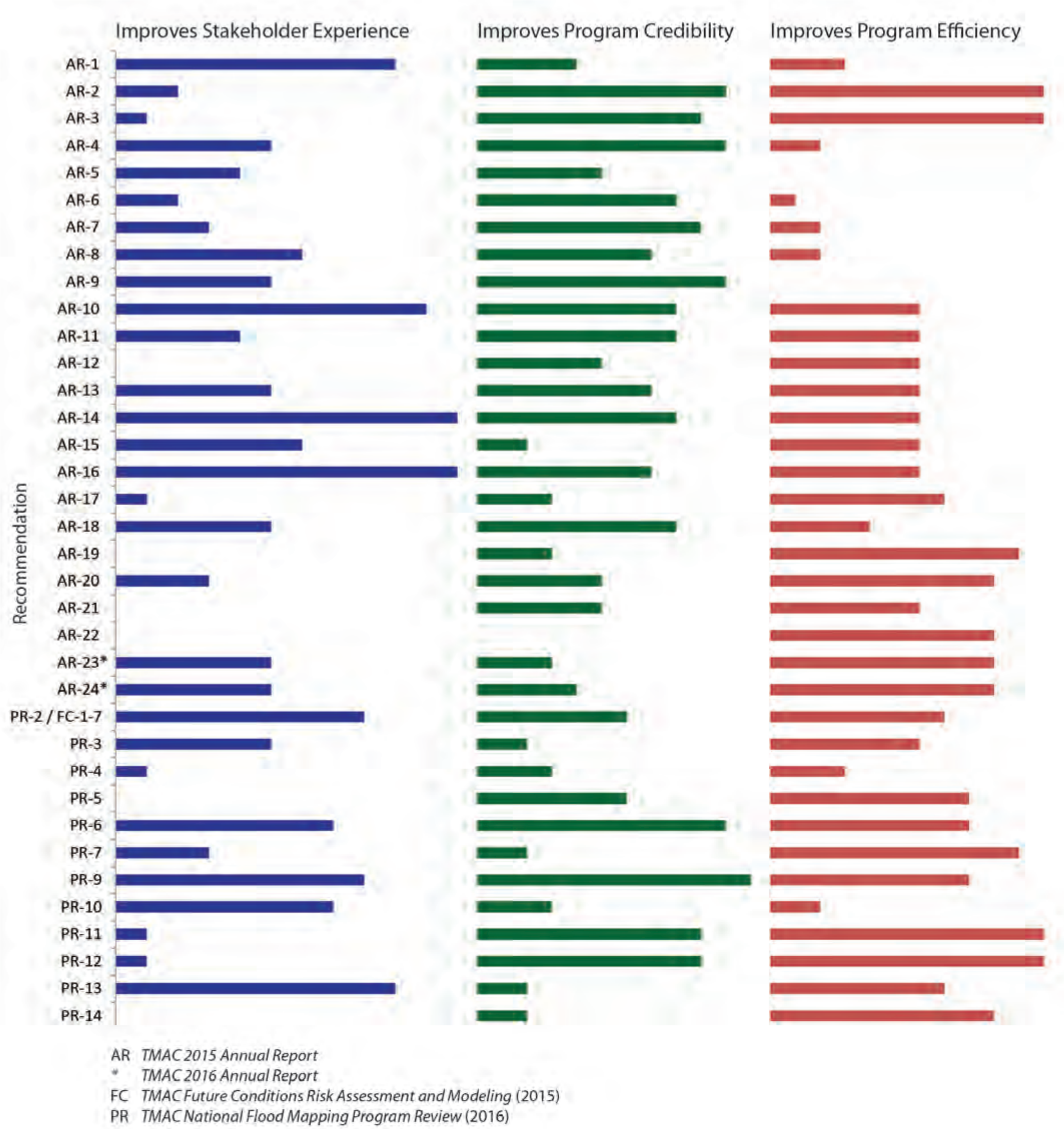


Figure 2-2: Comparison of the 2015–2016 TMAC Recommendation Impact Criteria Scores

Table 2-2 shows the scoring for all the TMAC recommendations, ranked from highest to lowest. The implementation actions in this 2016 Annual Report were not scored as they are aligned to specific recommendations from the 2015 Annual Report and the Future Conditions report, so their priority should be considered the same as their associated recommendation.

The TMAC further categorized the scored recommendations as follows and as shown in Table 2-2:

- **Transformative** – Recommendations that received an impact score greater than 150 are referred to as transformative. These recommendations likely require the most significant changes to how the Program operates, yet they have the highest net benefit to the Program in terms of improving stakeholder experience, credibility, and efficiency. Transformative recommendations imply a positive return on investment required to implement due to their high Program impact.
- **Strategic** – Recommendations that received an impact score between 100 and 150 are referred to as strategic. These recommendations require some level of planning before they can be implemented, but do not imply significant changes to how the Program currently operates.
- **Tactical** – Recommendations that received an impact score less than 100 are referred to as tactical. These recommendations can be implemented based on FEMA's current processes and don't require up front planning or investment. While tactical recommendations have a lower net impact to the Program individually, when implemented collectively, they can have a high impact to the Program with little investment.

Table 2-2: TMAC Recommendations – Impact Score Results

RECOMMENDATION NUMBER	RECOMMENDATION (SHORTENED)[(1)]	SCORE	CATEGORY BASED ON SCORE
PR-9	FEMA should work to identify residual risk areas behind levees and other flood control structures and downstream of dams.	193.3	Transformative
AR-14	FEMA … should transition to a flood risk assessment focus that is structure specific.	185.0	Transformative
AR-16	FEMA should transition … to a database-derived, digital-display environment …	178.3	Transformative
PR-6	FEMA should facilitate, partner, and leverage current high resolution topographic data (e.g., Light Detection and Ranging [LiDAR] data, other new and emerging technologies).	178.3	Transformative
AR-10	FEMA should transition … to a structure-specific flood frequency determination and associated flood elevations.	176.7	Transformative
AR-2	FEMA should develop a national 5-year flood hazard and risk assessment plan …This should incorporate a rolling 5-year plan …	156.7	Transformative
PR-2(2)	FEMA should adopt the future conditions recommendations from the *TMAC Future Conditions Risk Assessment and Modeling* report (2015).	153.3	Transformative
AR-3	FEMA should develop National Flood Hazard and Risk Assessment Program goals that include well-defined and easily quantifiable performance metrics.	141.7	Strategic
PR-11	FEMA should evaluate the current metrics to better measure the efficient production, valid inventory, and stakeholder acceptance of the National Flood Mapping Program.	141.7	Strategic
PR-12	FEMA should have an inventory metric that reports quantity, quality, and time aspects on national, regional, tribal, State, and watershed levels: A. Quantity: Quantity should be tracked through the life of a floodplain from no study through to detailed study. Statistics should be provided annually. B. Quality: Quality should be measured by retaining the existing NVUE metric of the current inventory and adding an NVUE metric for coastal flood hazard miles. C. Time: Timing should be measured from Discovery to the issuance of Preliminary maps, and from the issuance of Preliminary maps to Effective maps for active projects.	141.7	Strategic
PR-13	FEMA should have a metric that shows progress towards meeting a digital platform goal by area of the nation to compliment FEMA's current population metrics. This metric could include the total area of the country, as well as progress towards Goal 3 and Recommendation 16 in the 2015 Annual Report.	135.0	Strategic
AR-13	FEMA should develop guidelines and procedures to integrate mass LiDAR-based LOMA process …	128.3	Strategic
AR-24(3)	FEMA should communicate to the property owner and other interested parties on the cost of risk-rated insurance today and over time for new and existing structures to make the risk transparent.	128.3	Strategic

RECOMMENDATION NUMBER	RECOMMENDATION (SHORTENED)[1]	SCORE	CATEGORY BASED ON SCORE
AR-11	FEMA should modify the … Mapping Information Platform (MIP) to reduce unnecessary delays created by redundant tasks and inflexibility of the system.	126.7	Strategic
AR-1	FEMA should establish and implement a process to assess … products to meet the needs of the various users.	121.7	Strategic
AR-4	FEMA should work with … partners to ensure topographic, geodetic, water-level, and bathymetry data … are collected and maintained to Federal standards.	121.7	Strategic
AR-18	FEMA should work with … [partners] to ensure the availability of … accurate water level and stream flow data … Additionally, FEMA should collaborate with the USGS to enhance the National Hydrography Dataset.	121.7	Strategic
AR-23(3)	FEMA should develop in conjunction with others in the public and private sectors, flood risk-rated insurance premiums for all structures within and outside the identified Special Flood Hazard Area.	121.7	Strategic
AR-20	FEMA should work with CTPs to … develop measures [to evaluate CTP capabilities and competencies]. Where CTPs demonstrate appropriate levels of competencies …FEMA should [increase responsibilities].	118.3	Strategic
AR-8	FEMA should develop [guidance related to] coastal 2-D storm surge modeling …	115.0	Strategic
AR-9	FEMA should review and update existing coastal event-based erosion methods …	108.3	Strategic
PR-7	FEMA should work with the Congress and other partners to examine ways to shorten the study process, including the time added to the mapping process by QRs, KDPs, and legislated due process, as identified in Goal 2, Recommendation 11. in the TMAC Annual Report (2015).	105.0	Strategic
AR-15	FEMA should … frame and communicate messages … and consider long-term resilience strategies.	103.3	Strategic
AR-7	FEMA should develop guidelines, standards, and best practices for selection and use of coastal models …	98.3	Tactical
PR-3	FEMA should complete the implementation of the statutory requirements of the National Flood Mapping Program ...	95.0	Tactical
PR-5	FEMA should investigate offering multi-year program management grant periods (versus annual) to CTPs.	93.3	Tactical
PR-10	For non-accredited levees, FEMA should replace the Zone D designation in levee-protected areas with risk zones that are more appropriate for the level of risk.	91.7	Tactical
AR-19	FEMA should develop and implement … strategies to incentivize [stakeholders] to increase partnering …	86.7	Tactical
AR-6	FEMA should periodically review … new publicly available statistical models, such as the proposed Bulletin 17C …	76.7	Tactical
AR-17	FEMA should consider National Academy of Public Administration recommendations on agency cooperation and federation …	75.0	Tactical
AR-12	FEMA … should determine the cost impact when new requirements are introduced …	73.3	Tactical
AR-21	… FEMA should establish a National Flood Hazard Risk Management Coordination Committee.	73.3	Tactical

RECOMMENDATION NUMBER	RECOMMENDATION (SHORTENED)(1)	SCORE	CATEGORY BASED ON SCORE
PR-14	FEMA should evaluate the benefits and costs and its value to the nation as a result of different levels of funding to the National Flood Mapping Program.	73.3	Tactical
AR-5	FEMA should document the horizontal and vertical accuracy of topographic data input to flood study models …	66.7	Tactical
AR-22	FEMA should define the financial requirements to implement the TMAC's recommendations and to maintain its investment in the flood study inventory.	60.0	Tactical
PR-4	FEMA should continue to enhance communication and transparency with program stakeholders by, for example, including organizational and contact information on the Internet.	48.3	Tactical

(1) Refer to original document for full recommendation
(2) PR-2 (Recommendation 2 in the 2016 Program Review) encompasses all of the 7 recommendations and 37 sub-recommendations in the Future Conditions report
(3) TMAC 2016 Annual Report

AR = TMAC Annual Report (2015)
CTP = Cooperating Technical Partnership
KDP = Key Decision Points
LOMA = Letter of Map Amendment
NVUE = New, Validated, and/or Updated Engineering
PR = TMAC National Flood Mapping Program Review (2016)
USGS = U.S. Geological Survey

2.3 Results for Highest Priority Recommendations

Based on the results of the scoring, the TMAC identified eight recommendations as the most important, visionary, and transformational. These recommendations are shown in Table 2-3, cross-walked with the implementation actions described in Chapter 4. PR Recommendation 9 received the highest score due to its potential impact across all criteria. While this recommendation is not discussed further in this 2016 Annual Report, it should not be overlooked as an important recommendation for FEMA to implement.

Beyond the top scoring seven recommendations, the implementation actions developed by the TMAC provide actions for Recommendations 1, 3, 9, and 11 of the 2015 Annual Report, shown in Table 2-4.

Table 2-3: Seven Transformative Recommendations and Crosswalk to Implementation Actions

RANK	RECOMMENDATION	IMPLEMENTATION ACTIONS	2016 ANNUAL REPORT SECTION NO.
1	**PR-9** – FEMA should work to identify residual risk areas behind levees and other flood control structures and downstream of dams.	N/A	N/A
2	**AR-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.	6.2, 6.3	Section 3.6
3	**AR-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 is fully georeferenced and relational, enabling a single digital authoritative source of information and database-driven displays.	4.5 5.1, 5.2, 5.3	Section 3.4 Section 3.5
4	**PR-6** – FEMA should facilitate, partner, and leverage current high resolution topographic data (e.g., LiDAR data, other new and emerging technologies).	N/A	N/A
5	**AR-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.	1.2 6.1, 6.4	Section 3.1 Section 3.6
6	**AR-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 process 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.	1.1 3.1, 3.2, 3.3	Section 3.1 Section 3.3
7	**PR-2/FC-1-7** – FEMA should adopt the recommendations from the 2015 TMAC Future Conditions Risk Assessment and Modeling report.	8.1, 8.2, 8.3, 8.5, 8.6, 8.7	Section 3.8

AR = TMAC Annual Report (2015)
FC = TMAC National Flood Mapping Program Review (2016)
PR = TMAC National Flood Mapping Program Review (2016)

Table 2-4: Additional 2015 Annual Report Recommendations Addressed by Implementation Actions in 2016 Annual Report

RECOMMENDATION	IMPLEMENTATION ACTIONS	2016 ANNUAL REPORT SECTION NO.
AR-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 their various users.	2.1 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 8.7	Section 3.2 Section 3.8
AR-3 – FEMA should develop National Flood Hazard and Risk Assessment Program goals that include well-defined and easily quantifiable performance metrics.	3.1, 3.2, 3.3	Section 3.3
AR-11 – FEMA should modify the current work flow production process and supporting management system, MIP, 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 the choice of watershed size, not limiting projects to only the hydrologic unit code 8 (HUC-8).	4.1, 4.2, 4.3, 4.4	Section 3.4
AR-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.	7.1, 7.2, 7.3	Section 3.7
AR-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.	7.1, 7.2, 7.3	Section 3.7

AR = TMAC Annual Report (2015)
FC = *TMAC Future Conditions Risk Assessment and Modeling* (2015)
PR = TMAC National Flood Mapping Program Review (2016)

3. New Recommendations: Flood Risk-Rated Insurance

This chapter of the 2016 Annual Report addresses two new recommendations by the TMAC that are numbered sequentially to the recommendations from the 2015 Annual Report. These new recommendations highlight the importance of accurate flood hazard maps to provide relevant information for determining FRIPs and communicating the cost of those premiums over time to residents in areas subject to inundation and water damage. This chapter covers the following topics:

- Ineffectiveness of current NFIP methods for determining FRIPs
- Data needed to determine FRIPs
- Role of FRIPs in encouraging investment in mitigation measures
- Impact of communicating FRIPs to interested parties
- Proposed plan for developing FRIPs

3.1 Issue: Ineffectiveness of Current NFIP Methods for Determining Risk-Rated Insurance Premiums

This chapter details the features of the current NFIP mapping process indicating that the current flood insurance premiums do **not** reflect structure-based risk. It elaborates on the point made in the 2015 Annual Report that the current static NFIP maps do not communicate to residents the “dynamic nature of flooding and the true nature of the risk at various locations on the floodplain.” Hence, the 2015 Annual Report addresses the need for accurate flood hazard maps to determine FRIPs.

3.2 Key Findings

A recent National Research Council report (NRC, 2015) reviewed the current NFIP method for calculating risk-based rates, notably the floodplain analysis and mapping that support insurance rate setting. The report focuses on the methods for calculating FRIPs, not on what those premiums should be. The report notes that “many NFIP methods were developed decades ago and do not take advantage of modern technological and analysis capabilities.” It concluded that “the NFIP methods for setting risk-based rates do not accurately and precisely describe critical hazard and vulnerability conditions that affect flood risk for negatively elevated structures” (structures for which the lowest floor is below the Base Flood Elevation [BFE]) for the following reasons:

- The determination of the flood hazard, using water surface elevation probability functions referred to by FEMA as probability elevation (PELV) curves, is based on floods having an annual likelihood of occurrence between 10 percent and 1 percent. In reality, a significant portion of potential losses are caused by floods with an annual likelihood of occurrence greater than 10 percent and less than 1 percent.
- The average annual loss component is based on the calculation of 30 PELV curves that represent the flood hazard nationally, rather than the flood hazard at the structure’s location. As a result, NFIP insurance premiums charged are too high for some policyholders and too low for others.

- The vulnerability of a structure is determined by a function that relates damage to depth of inundation via a depth-percent damage relationship referred to by FEMA as a damage elevation (DELV) curve. The DELV curve, which expresses damage as a percentage of the structure's replacement value, blends NFIP claims data and U.S. Army Corps of Engineers (USACE) damage functions weighted according to their credibility. NFIP claims data for a given depth of flooding are highly variable, suggesting that other drivers of damage (e.g., duration of inundation, flow velocity, water contamination and debris content) may also be important.

In addition to these conclusions from the NRC report, property owners in areas where FEMA has concluded that the annual probability of a flood is less than 1 percent are not required to purchase flood insurance. These homeowners reside in Zone X and may conclude they are safe from future flood damage. In reality they may suffer severe damage from a flood whose annual probability is less than 1 percent. In fact, the likelihood of a flood next year may exceed 1 percent if FEMA has underestimated the flood hazard probabilities in some areas that are classified as Zone X.

With the passage of the BW-12, followed by passage of the Homeowner Flood Insurance Affordability Act of 2014 (HFIAA) (Public Law 113–89, 128 Stat. 1021–22) in March 2014, flood insurance subsidies for many properties are being phased out. These premiums are expected to rise to a level that eventually should reflect the full risk of flooding. Premium increases for many negatively elevated structures (i.e., structures with the lowest floor below the BFE) are likely to be substantial given their high flood risk and the loss of the large premium subsidy currently provided to some of these residents under the NFIP.

3.3 Recommendations

TMAC Recommendation 23

FEMA should develop, in conjunction with others in the public and private sectors, flood risk-rated insurance premiums for all structures within and outside the identified Special Flood Hazard Area. These premiums should be based on the nature and severity of the flood hazard, structure elevation and other characteristics, as well as structure damage functions and vulnerability.

TMAC Recommendation 24

FEMA should communicate to the property owner and other interested parties on the cost of risk-rated insurance today and over time for new and existing structures to make the risk transparent. The data should include the benefits and cost that mitigation measures will have on these premiums.

3.4 Discussion

Risk-rated flood insurance premiums would communicate information to residents regarding the likelihood and severity of damage to their property and contents. Today, the technology exists to estimate the likelihood of floods of different water elevation and the resulting damage to the individual structure. These data enable the determination of the average annualized loss (AAL) to the property, which forms the basis for a FRIP. Risk-rated flood insurance premiums, coupled with long-term mitigation loans, can encourage property owners to invest in cost-effective loss reduction measures when the decrease in annual premiums to reflect lower claims payments is greater than the annual costs of the mitigation loans. Core stakeholders concerned with floodplain management can use FRIPs to encourage or require residents in hazard-prone areas and their communities to reduce losses from future floods and provide relevant data for FEMA to address the insurance affordability issue.

3.4.1 DATA NEEDED TO DETERMINE FLOOD RISK-RATED INSURANCE PREMIUMS

In contrast to current flood risk insurance determinations, which are based on location in or out of Special Flood Hazard Areas (SFHAs), FRIPs could be determined for individual structures, recognizing that there is uncertainty in estimating the likelihood of floods of different water surface elevations and the resulting damage to specific structures from each of these floods. This type of determination would require collection or calculation of the following information:

- **Elevation of the Structure** – The relevant building elevations of each structure as identified on its Elevation Certificate in relation to the BFE. This facilitates a determination of the potential damage to the structure from floods of different water surface elevations.
- **Nature of the Hazard** – The likelihood of floods of different water surface elevations that could cause damage to the structure. Define p_i as the likelihood of water surface elevation in inches from the lowest water surface elevation level (i= 1 inch) to the highest water surface elevation level (i= n inches) where n will vary from one river or coastal area to another.
- **Damage to the Structure** – An inundation depth-damage function for the structure. Developing this function requires data on the relevant structure elevations of the structure in relation to the BFE to estimate the impact on the structure of floods of different water surface elevations, velocities, and waves. Let D_i be the damage to the structure and its contents if the water surface elevation is i.
- **Average Annualized Loss (AAL)** – The anticipated annual loss to a structure by considering the likelihood of floods of different water surface elevations that could cause damage to the structure. Multiply the likelihood of floods of water surface elevation (p_i) by its damage to the structure (D_i) over all values of i (i=1…n) to obtain the AAL to the structure, which is given by $\mathbf{AAL}=\sum \boldsymbol{p}_i\boldsymbol{D}_i$. The AAL is the basis for determining the FRIP for a structure. An example of how to calculate the average annualized loss for a structure given different water surface elevations is shown in Figure 3-1. If the NFIP used the AAL as a basis for setting a premium, it would likely add a loading charge (Z) to reflect the administrative costs associated with estimating the premium, providing insurance, and processing claims. In other words the FRIP = (1+Z) AAL.

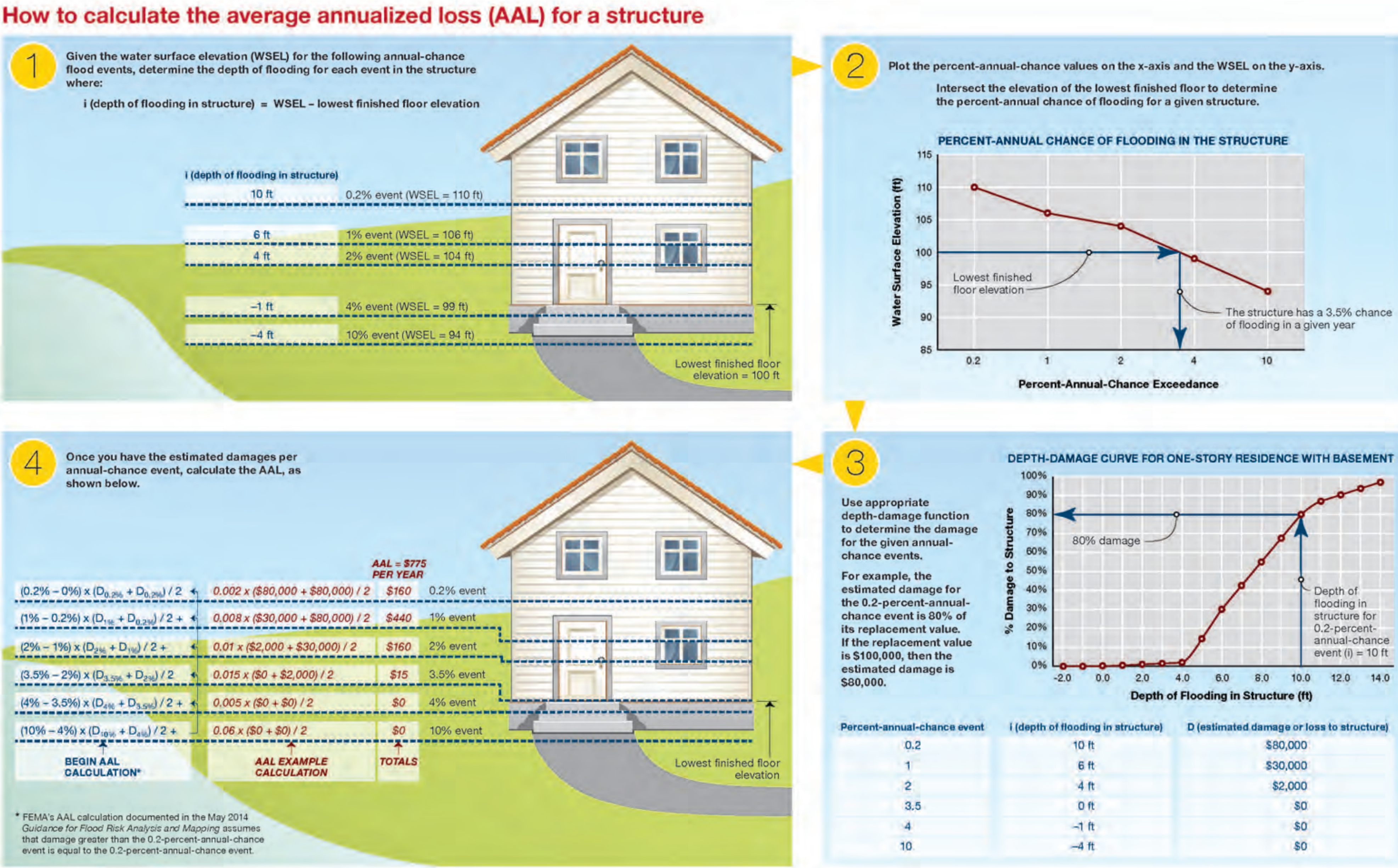


Figure 3-1: Example of Different Flood Levels and Resulting Average Annualized Loss Calculations

Recognizing there is uncertainty associated with the likelihood of floods of different water surface elevations (pi) and the resulting damage to the structure (Di), it would be useful to provide key interested parties concerned with the risk of flooding to individual structures with a range of premium estimates to indicate the degree of accuracy in computing the AAL.

One way to do this is to provide confidence intervals associated with pi and Di. Let pi* and pi**, respectively, represent the 5 percent and 95 percent likelihood of flood water surface elevation of i feet, and D i*and D i**, respectively, represent the 5 percent and 95 percent likelihood of the resulting damage to the structure. These estimates can be used to calculate low and high estimates of AAL. These values may be the basis for determining a minimum and maximum FRIP for the structure. More specifically, $\mathbf{AAL}_{min} = \Sigma \boldsymbol{p}_i^{*} \boldsymbol{D}_i$ and $AAL_{max} = \Sigma \boldsymbol{p}_i^{**} \boldsymbol{D}_i^{**}$.

3.4.2 ROLE OF FLOOD RISK-RATED INSURANCE PREMIUMS IN ENCOURAGING INVESTMENT IN MITIGATION

Accurate maps and FRIPs can encourage current property owners to invest in cost-effective mitigation measures. Property owners are often reluctant to adopt these measures because of their high upfront costs. However, long-term home improvement loans reduce the annual cost of investing in these measures by spreading the upfront cost over time. For example, consider a property owner who has to pay $25,000 to elevate his coastal property from 3 feet below the BFE to 1 foot above the BFE to reduce storm surge damage from hurricanes. If flood insurance is risk rated, the annual premium for $250,000 coverage would decrease by $3,480 from $4,000 to $520. A 20-year loan for $25,000 at an annual interest rate of 3 percent would result in annual payments of $1,680. The savings to the homeowner each year from elevating the property would be $1,800 (that is, $3,480 – $1,680).[1] In general, if flood insurance premiums are risk rated, the annual reduction in the cost of insurance if one invests in cost-effective mitigation measures to reduce future losses would most likely be greater than the annual home improvement loan payment. More generally, long-term loans to homeowners and businesses for mitigation would encourage them to invest in attractive risk-reduction measures.

FEMA has long had a role in encouraging floodplain residents and businesses to invest in flood mitigation measures. FEMA created the Hazard Mitigation Assistance (HMA) grant programs to reduce flood damage to people and property. These programs provide funding to States, territories, federally recognized Tribes, and local communities for projects and planning that reduces or eliminates long-term risk of flood damage to structures insured under the NFIP. All HMA grant programs support loss reduction measures, such as elevation or acquisition/demolition of repetitively flooded structures, floodproofing commercial structures, or demolition and code-compliant rebuilding of structures that have received damage from a flood event.

States, too, can take part in encouraging investment in flood mitigation measures. For example, in July 2014, Connecticut initiated its Shore Up CT program, which is designed to help residential or business property owners elevate buildings, retrofit properties with additional flood protection, or assist with wind-proofing structures on property that is prone to coastal flooding. This State program, the first in the United States, enables homeowners to obtain a 15-year loan ranging from $10,000 to $300,000 at an annual interest rate of 2¾ percent.[2] If property owners have a better understanding of their flood risk, they may be more interested in adopting cost-effective mitigation measures. Other states may follow Connecticut's lead in initiating a program to encourage homeowners to undertake these investments.

1 For more details on this example and the role that long-term loans can play in encouraging cost-effective mitigation measures and addressing affordability issues, see Kousky and Kunreuther (2014).

2 For more information on Connecticut's Shore Up CT program, visit http://shoreupct.org/.

3.4.3 IMPACT OF COMMUNICATING FLOOD RISK AND RISK-RATED INSURANCE PREMIUMS TO INTERESTED PARTIES

As discussed in Section 3.2, there are core stakeholders concerned with floodplain management. This section addresses how FRIPs can assist each of these and other key interested parties concerned with the flood risk. It also notes concerns that some of these stakeholders may have, highlighting why it is important that accurate flood risk information be presented to the public in a transparent manner.

Property owners and home buyers – Section 28 of HFIAA states "[t]he Administrator [of FEMA] shall clearly communicate full flood risk determinations to individual property owners regardless of whether their premium rates are full actuarial rates." Property owners and home buyers will benefit from having accurate information on the flood risk communicated to them in a transparent manner via FRIPs. Without these data, individuals are likely to misestimate the flood risk associated with the property they own or that they are considering purchasing. A better understanding of structured-based flood risk will facilitate more informed decision-making by both these groups. However, some property owners are likely to be concerned with the impact that this information may have on their property value. If property owners invest in cost-effective mitigation measures, they can highlight the lower flood risk they now face, as reflected in a reduced FRIP. They can use these data as a selling point for their property if they decide to move elsewhere.

Lenders – Lenders can encourage property owners to invest in cost-effective loss reduction measures by providing them with home improvement loans to complement FEMA and State programs (e.g., Connecticut's Shore Up CT program). Further, the cost of flood insurance, coupled with their mortgage payment, will likely be a factor in the ability of some homeowners to stay current on their loan obligations if their total monthly payments dramatically increase. Lenders should review the guidance in the *National Flood Insurance Program's Mandatory Purchase Requirements* (Tobin and Calfee, 2005) to determine how data on the elevation of the house may impact their requirements with respect to flood insurance and whether changes to this guidance should be recommended to support this effort.

Flood determination companies – Flood determination companies are concerned that the maps contain accurate data because most lenders and insurance professionals rely on determinations from these companies to inform the borrower or the property owner of the flood hazard impacting their property. New maps and revised maps should be issued on a timely basis so that an accurate flood zone can be determined for each property.

Insurance professionals – Insurance agents and their companies rely on the timeliness and accuracy of data provided on the FIRMs to ensure clients are aware of the flood risk to their properties and the corresponding flood insurance premiums when they are reviewing existing insurance portfolios or at the time of a new purchase. Additionally, information on the nature of the flood hazard and the flood damage to the structure will be necessary to determine the FRIPs for properties they insure.

Real estate agents – This important stakeholder is likely to have mixed feelings about having data on FRIPs because it makes the flood risk transparent to a potential homeowner, which may decrease the sale price of a property. On the other hand, if the real estate agent makes the case that the property is well designed and that its flood risk is relatively low, this could be an attractive selling point. The communication of risk to a homeowner should be made during an early stage in the home buying process and not by the lender after a contract has been signed between the buyer and seller.

Design professionals – Surveyors, engineers, and architects are concerned with obtaining accurate flood risk information from available NFIP resources, primarily the BFE and the horizontal extent of specific inundation levels of different recurrence intervals. Because elevation data are critical to designing, constructing, and locating structures, and because elevation data are so intimately linked to the risk rating of flood insurance, this is likely to be the most crucial information for design professionals. Therefore, clear communication of the FRIP, its level of accuracy, and its inherent uncertainties is important for successful floodplain management and protection of the health, safety, and welfare of the community.

Developers and construction industry – These stakeholders have an economic incentive to undertake new developments and improvements on existing property (e.g., floodproofing or elevating property) in flood-prone areas. They can highlight the impact that improvements or mitigation measures will have on reducing the owner's flood risk and, hence, their FRIP.

Floodplain managers – Floodplain administrators are responsible for enforcing local flood damage reduction regulations to maintain compliance with the NFIP. Flood insurance rates for post-FIRM structures are based on the lowest floor elevation compared to the 1-percent-annual-chance of damage to the structure from inundation. FRIPs would help to incentivize the demand for flood mitigation and, as a result, enhance community resilience.

State, Tribal, and local officials – Community leaders have an economic incentive to make their community more resilient with respect to flood damage, but may have concerns if flood risk information curtails economic development and reduces property values, thus lowering the community's tax base.

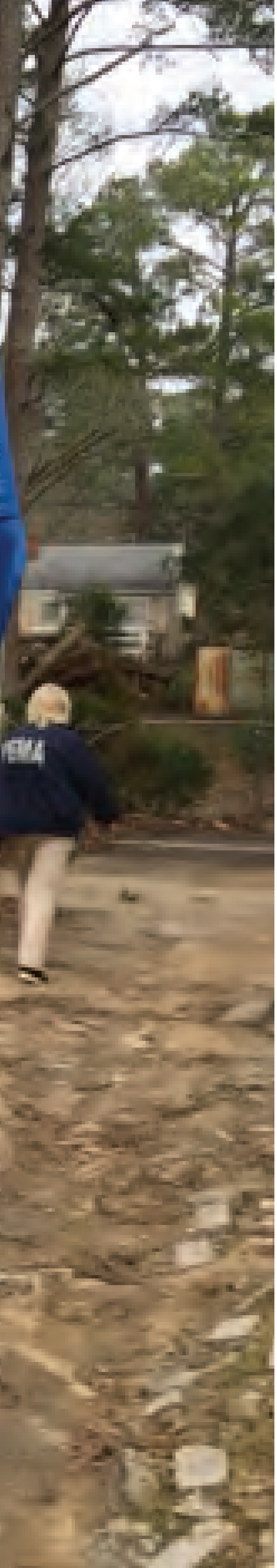
General taxpayer – To the extent that property owners in flood-prone areas invest in mitigation measures and pay insurance premiums that reflect risk, taxpayers will benefit by having lower expenditures by the Federal Government on disaster relief following future floods. On the other hand, there may be a need for Federal and State assistance to deal with affordability issues if FRIPs are significantly higher than current premiums.

3.5 Proposed Plan for Communicating Flood Risk and Developing FRIPs to Reduce Future Flood Losses

FEMA, in conjunction with public-sector agencies and the private sector, can develop accurate flood hazard maps and FRIPs to reduce future flood losses. Risk-rated insurance premiums can be used to communicate the flood risk rates more effectively, encourage investment in cost-effective mitigation measures, and address the NFIP affordability issue. The public and private sectors can play the following roles in this regard:

- **FEMA** – Communicate the flood risk in ways that residents/businesses and communities can understand. Provide low-interest loans and grants for mitigation and determine the cost of these loss reduction measures.
- **FEMA, U.S. Department of Housing and Urban Development, and State programs** – Address NFIP affordability issues for those property owners requiring special treatment because their FRIPs have increased significantly from their current levels.
- **USGS, National Oceanic and Atmospheric Administration (NOAA), USACE, and geographic information companies** – Provide input and assist FEMA in creating accurate and detailed flood hazard maps.
- **Banks and financial institutions** – Provide home improvement loans for mitigation and require property owners with federally insured mortgages to purchase flood insurance.


FEMA



4. Implementation Actions for 2015 Recommendations

Chapter 4 describes 28 implementation actions, grouped into eight topics that provide further suggestions to FEMA on how to implement the TMAC's priority recommendations from the previous three reports:

- **2015 Annual Report** – Includes 9 topics and 22 recommendations
- **Future Conditions report** – Includes 7 recommendations and 37 sub-recommendations
- **2016 Program Review** – Includes 14 recommendations; Recommendation 2 encompasses all of the recommendations in the Future Conditions report

4.1 Framework Data Management Plan

In the 2015 Annual Report, the TMAC made several recommendations to FEMA regarding the framework of a data management plan. The recommendations are provided below for reference.

> **2015 Annual Report 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.

> **2015 Annual Report 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.

In 2016, TMAC developed the following implementation actions as further suggestions to FEMA on implementing the above recommendations.

4.1.1 IMPLEMENTATION ACTION 1.1

IMPLEMENTATION ACTION 1.1

FEMA should publish the State GIS Standard Operating Procedures on a graphical web interface so that sources of local geospatial information are readily available to everyone.

(Supports 2015 Annual Report, Recommendation 2)

The Department of Homeland Security memorandum "Geospatial Data Coordination Policy" (2005) and the accompanying *Geospatial Data Coordination Implementation Guide* (FEMA, 2011) established the principles for coordinating, communicating, documenting, and reporting existing and proposed geospatial data that are collected, produced, or manipulated under the FEMA Risk Mapping, Assessment, and Planning (Risk MAP) program.

The policy is intended to help ensure that FEMA:

- Protects its investment in geospatial data by requiring the data to be documented, compliant with standards, and easy for the public to access
- Maximizes the use of partnerships, including Federal, State, Tribal, and local partners in the acquisition and production of geospatial data
- Uses existing data to the extent possible and minimizes the number of duplicate requests State, Tribal, and local data stewards get from Federal agencies
- Recognizes the value of existing coordination at the State, Tribal, and local levels to identify and/or develop geospatial data
- Complies with all Federal requirements for coordinating and reporting geospatial activities

To work toward implementing the policy, FEMA develops a document titled *Geospatial Coordination Standard Operating Procedures* for each State and territory. The procedures include key contacts and the most recent geographic information system (GIS) data (e.g., topography, political layers, streams) that should be used for developing FIRMs and other FEMA products. The procedures are updated on a regular basis. Locally produced data may have the most temporal relevancy and highest resolution and, therefore, could be the best available data. FEMA should continue to leverage State spatial data infrastructures and Tribal and local data to support flood mapping.

Currently, the information in the Geospatial Coordination Standard Operating Procedures is only available in a table format. Providing the information as a graphical web interface would increase its usability. The interface should be part of the combined Coordinated Needs Management Strategy (CNMS) and the Risk MAP Progress website (see Implementation Action 3.2). The information is needed for making funding decisions and prioritizing studies for Risk MAP funding. Having information on coverages of available geospatial data, CNMS, and ongoing Risk MAP projects in one place would make the annual and 5-year planning process more accurate and more efficient.

4.1.2 IMPLEMENTATION ACTION 1.2

IMPLEMENTATION ACTION 1.2

FEMA should develop a strategy for obtaining the building footprints and relevant building elevations of properties throughout the Nation to be used in determining structure-based flood risk.

(Supports 2015 Annual Report, Recommendation 10)

Currently, national Hazards U.S. (Hazus) results are provided to communities at a coarse national scale (census block) using data from the 2000 census. Coarse-scale risk assessment results are typically not sufficient for local planning and are not ideal for communicating flood risk to homeowners. Flood risk assessments by census block average flood loss estimates across a large geographic area and a large number of structures with minimal localized data. When local structure-specific data are available, more accurate structure-based flood risk assessments can be developed for individual structures.

A methodology for national flood risk assessment—with a capability for producing accurate, individual structure, flood risk estimates with elevation information—should be pursued. Local, State, and national building and tax record data, including many critical building attributes, have become increasingly available in GIS database format and distributable through web-based systems. Data sharing or data federation could greatly increase the amount of building data available to FEMA. Coordinating with State, Tribal, and local partners would be required to obtain individual structure flood risks assessments on a national or large-area basis. Building footprints and relevant building information for the Nation are essential information for structure-specific risk assessments across the Nation (see the 2015 Annual Report, Recommendation 10).

Obtaining individual structure risk assessments could be a daunting and inefficient task if not properly planned. FEMA should work with State, Tribal, and local communities and the private sector to develop a strategy for obtaining building footprints and relevant building floor elevations for the Nation. The strategy should include:

- Methods for identifying data developed by others, quality assurance/quality control (QA/QC) of the data, and identifying any limitations on the data
- Methods for collecting and storing the data
- Need and methods for normalizing the data to perform structure-specific risk assessments
- Methods for updating the FEMA stored data

4.2 Effective Communication of Flood Hazards and Risk

The goal of the NFIP is to reduce the impact of flooding on private and public structures by providing affordable insurance to property owners and encouraging communities to adopt and enforce floodplain management regulations.[1] Effectively communicating flood hazard and flood risk information is an essential part of trying to achieve this goal. Flood hazard generally refers to physical flood conditions, and flood risk generally refers to losses and other consequences of flooding.

The flood hazard mapping component of the NFIP is an effective way of communicating flood hazard and risk data to the public and the individuals in many disciplines and professions who work together to help achieve

1 For more information on the NFIP, see https://www.fema.gov/national-flood-insurance-program.

the NFIP's goal. FEMA provides flood hazard and flood risk information in a variety of regulatory products (e.g., FIRMs) and other flood risk products (e.g., Discovery Maps). For more information on these products, refer to Sections 2.2.1 and 4.1.1 of the 2015 Annual Report, respectively.

The TMAC has compiled a list of users of FEMA flood hazard and risk products and a description of how they use the products (refer to Table 4-3 in the 2015 Annual Report). The TMAC's 2015 Recommendation 1 was that FEMA establish and implement a process to assess the present and anticipated needs of these users to ensure the TMAC that the products are meeting the users' needs. The entire recommendation is presented below.

2015 Annual Report 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:

- 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;
- Consider user requirements prior to any updates or changes to data format, applications, standards, products, or practices are implemented;
- Proactively seek to provide authoritative, easy to access and use, timely, and informative products and tools; and
- Consider future flood hazards and flood risk.

In 2016, the TMAC developed the following implementation actions as further suggestions to FEMA on implementing the above recommendation.

4.2.1 IMPLEMENTATION ACTION 2.1

IMPLEMENTATION ACTION 2.1

FEMA should construct and implement, and measure the effectiveness of public communication strategies that reflect how individuals acquire and process information on low-probability, high-consequence events. The strategies would include:

- Using a variety of media to illustrate and communicate flood hazard and risk information to different audiences and generational groups;
- Illustrating location-specific inundation levels by working with the private-sector mapping companies and other partners to integrate street-level photos with overlays of flood levels at multiple return intervals into FEMA's mapping platform;
- Working with real estate listing services to display flood hazard and risk information data for their customers; and
- Displaying historical flood information, including flood boundaries and depths where available.

(Supports 2015 Annual Report, Recommendation 1)

Effectively communicating flood hazard and flood risk information to the variety of users of this information is critical to public safety, reversing the trend of escalating recovery costs, and making communities more resilient. Deriving the maximum benefit of the information requires regularly evaluating how effective the communication is and how the information is provided to make sure it reflects the users' needs and preferences.

It is the TMAC's intention that the additional information will inform Implementation Action 2.1, which was developed to support Recommendation 1 in the 2015 Annual Report. Taking action will improve flood hazard and risk communication and lead to actions that reduce flood impacts.

Five core stakeholders are addressed in detail in this report (see text box). Communication with these stakeholders is described below.

4.2.1.1 Public

Historically, FEMA flood mapping and outreach efforts have focused mostly on communicating risk information to property owners through newspaper notices, public meetings, and maps that depict the hazard using contour lines. This section contains information for FEMA's consideration on possible alternative ways to present and communicate the information (e.g., geodatabase-derived, digital display environment, FIRMs, types of media) and a discussion of several considerations that can be used to improve the existing methods of communication (e.g., systematic biases and decision rules, hazard comparisons, visual flood risk information).

CORE STAKEHOLDERS (USERS) OF FLOOD HAZARD AND RISK PRODUCTS ADDRESSED IN THIS SECTION

- Public
- Lenders and flood zone determination companies
- Insurers and insurance agents
- Floodplain managers
- Design professionals

Use geodatabase-derived, digital display environment – The TMAC has recommended that FEMA provide greater resolution of flood hazard and risk information and present it at the structure level on a geodatabase-derived digital display. In addition, the TMAC sees great value in exploring the geodatabase-derived, digital display environment of other risk information, such as historical flood and flood-inundation data, water depth grids, and financial loss estimates for various flood-damage severity levels of the hazard at the structure level. Street-level property photos with flood depths indicated on the structure (or property if no structure exists) could make the risk "real" and personal for property owners, who may then be more motivated to take steps to reduce their flood risk.

Similar products have been developed for other hazards – For instance, Temblor is a mobile web application that calculates structure seismic risk (see Figure 4-1).[2] The app displays the location of nearby faults and risk of earthquake damage to structures in the area and provides a cost-benefit analysis of retrofitting a structure to mitigate the potential for future damage. An application that communicates flood risk and mitigation benefits and costs would be beneficial.

2 For more information about Temblor, see http://temblor.net/.

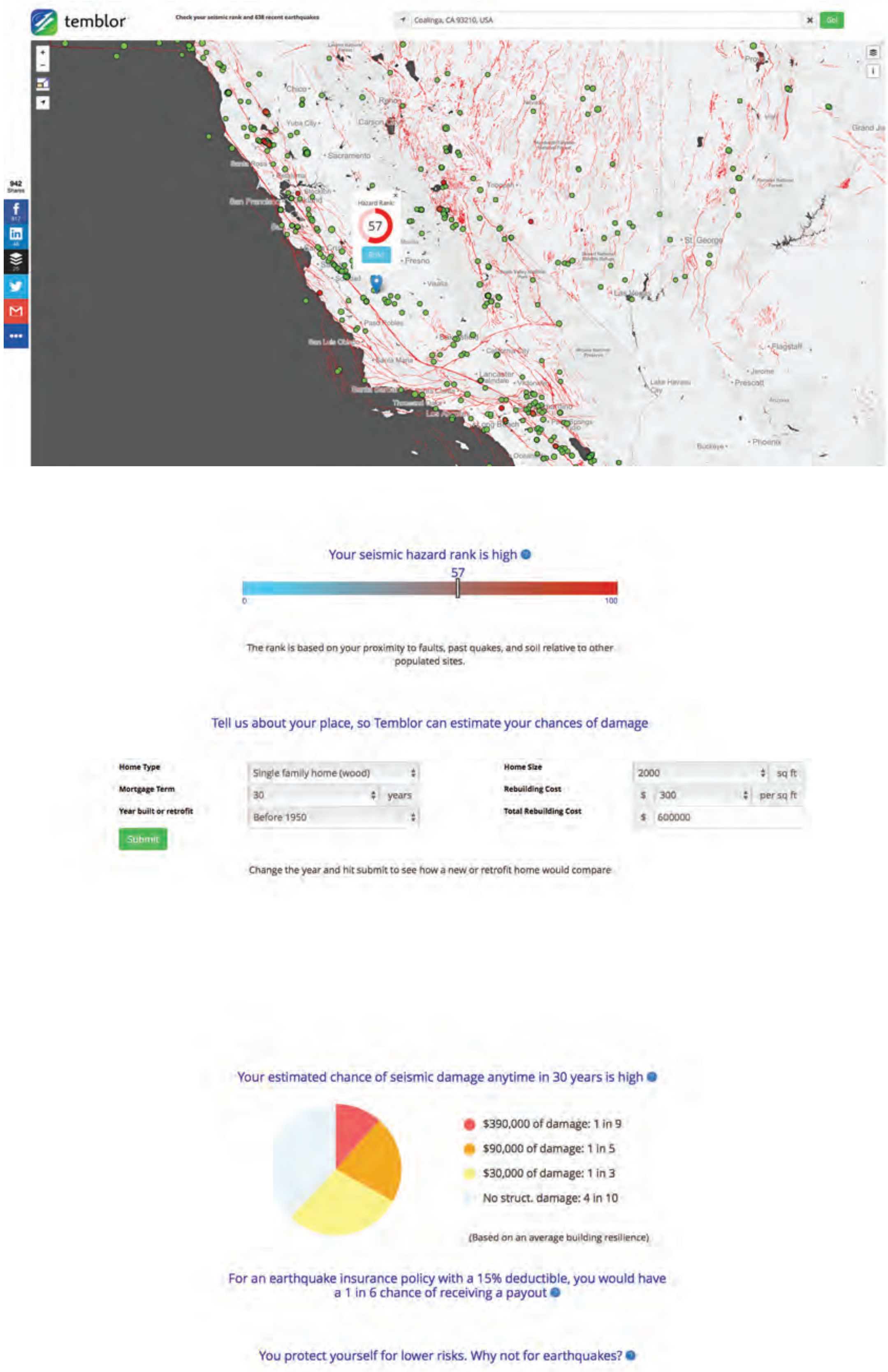


Figure 4-1: Screen Shots Showing Temblor Application

Expand awareness of FIRMs – FIRMs have been very effective in helping local communities establish land use policies and in insurance requirements and rating. However, they are not widely used by the public to inform flood risk. The potential for FIRMs to be a powerful tool in the communication of risk to property owners is not being realized. Most property owners have never seen a FIRM or even know they exist. Typically, only a small percentage of property owners in communities that are affected by the update of a FIRM attend the community outreach meeting. Many studies have shown a general misunderstanding of flood risk. In addition, flood insurance policy intake is low, and flood recovery costs are escalating. The use of FIRMs must be part of FEMA's plans for an effective communication and awareness strategy.

Expand use of other types of media – FEMA could consider using communication that targets different generational and demographic segments of the public. Each generation responds to different messaging and types of media and may not get the message if not delivered on the preferred type of media.

For example, millennials use cell phones to communicate through text, emails, websites, and apps. The website floodsearch.com has created a phone app that can locate the position of a structure on the current FIRM (see Figure 4-2). The user simply takes a photo of the structure of interest using a cell phone and submits the photo to the application. The application uses the cell phone GPS to locate the structure on the FIRM. This application is geared to potential property owners and has tremendous potential to influence their decision-making process when shopping for real estate.

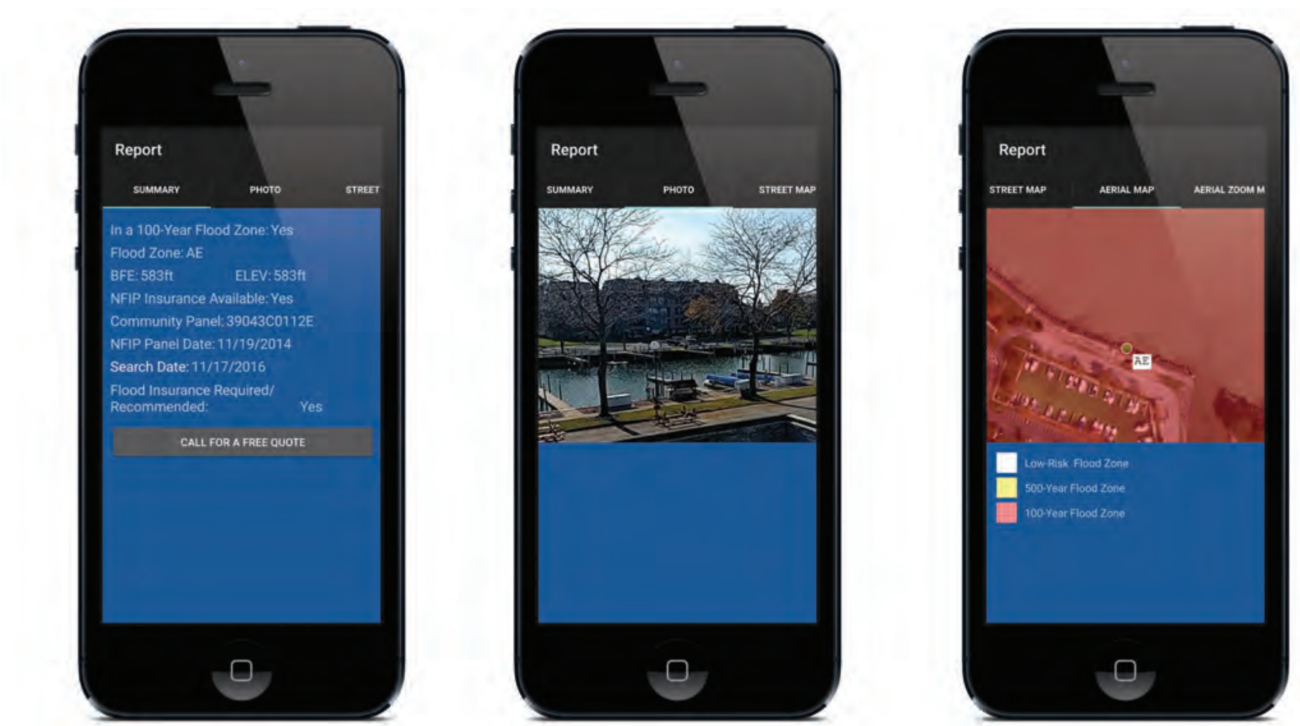


Figure 4-2: Screen Shots Showing FloodSearch Web Application

Rephrase risk statements to improve communication – Extensive empirical evidence has revealed the systematic biases and simplified decision rules the public uses in dealing with low probability–high consequence (LP-HC) events, such as floods and hurricanes. In the following paragraphs, these biases are described and risk communication strategies are suggested for making the flood risk more transparent to the affected public so they have an interest in purchasing flood insurance and reducing their risk prior to the next flood.

In *Thinking, Fast and Slow*, Daniel Kahneman (2011) characterizes the differences between intuitive and deliberative thinking based on 30 years of research. Intuitive thinking operates automatically and quickly with little or no effort and no voluntary control. It is often guided by emotional reactions and simple rules of thumb that are based on personal experience. Deliberative thinking allocates attention to effortful and intentional mental activities in which individuals undertake trade-offs and make well-informed decisions. People normally make choices using a combination of these two modes of thinking, and their choices generally lead to good decisions when there is experience to base the decisions on.

The same cannot be said, however, for behavior related to LP-HC events, such as the flood hazard. One of the systematic biases that most people exhibit in regard to LP-HC events is the availability heuristic (Tversky and Kahneman, 1973) in which the judged likelihood of an event depends on its salience and memorability. Flood risk tends to be underestimated before a disaster occurs and overestimated after a disaster occurs. The results of a recent field survey of the risk perception of property owners in New York City showed that most property owners underestimate the likelihood of water damage to their property from hurricanes (Botzen et al., 2015), which may partly explain why only 20 percent of those who suffered damage from Hurricane Sandy had purchased flood insurance before the storm occurred. After Hurricane Sandy, there was a much greater interest in buying flood insurance coverage.

Given the lack of interest in protective measures until it is too late, there is a need to communicate risk so individuals are more likely to pay attention to it before flooding occurs. Presenting the likelihood of a future flood in shorter time horizons may help property owners understand the risk better. For example, according to Weinstein et al. (1996), a property owner is far more likely to take the risk of a 100-year flood seriously if told the chance of at least one flood occurring over a 25-year period is nearly 1-in-4 rather than 1-in-100 in any given year.

REPHRASE RISK TO IMPROVE COMMUNICATION

A property owner is far more likely to take the risk of a 100-year flood seriously if told the chance of at least one flood occurring over a 25-year period is nearly 1-in-4 rather than 1-in-100 in any given year.

Compare flood risk to other hazards – Comparing flood risk to other risks in a concrete manner, instead of specifying the probability of a loss or providing an insurance premium, is an effective way of communicating the risk of LP-HC events to decision makers (Kunreuther et al., 2001). For example, a structure in the 1-percent-annual-chance flood hazard area is far more likely to suffer damage from a flood than a fire.

Provide flood risk information visually – Providing visual information on flood risk may also make people more aware of the risk they face. For instance, a powerful image for property owners who do not have map interpretation skills or engineering knowledge is one that shows flood depths superimposed on street-level photographs of structures in flood hazard areas. Such images are can be provided by a structure-level flood risk assessment tool (see Figure 4-3).

Figure 4-3: Example of Graphic that Could be Displayed on a Phone to Communicate Flood Risk to Property Owner

Improve positive interaction with FEMA hazard and risk products – Most of the public's understanding of FEMA's hazard and risk products is acquired by interacting with the other core stakeholders (users) identified in this section. The opportunities for interaction occur during real estate and insurance transactions. When the public comes into contact with other core stakeholders, the experience is often perceived as negative because it involves an additional cost of purchasing flood insurance, limitations on land use, or an additional cost of developing more accurate data than are available on the current FIRM. To transition public perception to a more positive framework, it would benefit FEMA to have general, positive access to hazard and risk products so its interactions with users are not limited to real estate and insurance transactions. In general, the public would benefit from hazard and risk products that are accessible and easy to understand.

4.2.1.2 Lenders and Flood Zone Determination Companies

Financial institutions are required by law to verify that a structure has flood insurance if the structure is determined to be in a high-risk flood hazard area (i.e., SFHA) and will serve as collateral for a federally insured mortgage. Lenders rely on flood determination companies to determine whether the structure is in an SFHA and to provide this information, but not until the time of transaction (property purchase, mortgage renewal, refinance, or equity loan). When a structure is located in the SFHA, the lender is required to notify the homeowner/borrower by 10 days prior to closing by issuing a "Notice of Special Flood Hazard and Availability of Federal Disaster Relief Assistance," which provides information on the flood zone the structure is in, a description of the flood insurance requirements, and the availability of flood insurance coverage.

However, by the time potential borrowers receive the notice informing them that flood insurance is required, they have typically already put an offer on the property and signed a commitment to purchase the property. Potential borrowers need to get flood risk information much earlier—when they are looking for properties. Most potential buyers do not see the FIRM before committing to purchase a property and may not know how to interpret the FIRM or even know that FIRMs exist.

The real estate industry is in a unique position to educate potential property owners about flood risk to ensure they are aware of the property's flood risk and the requirement to buy flood insurance if the property mortgage is federally backed.

4.2.1.3 Insurers and Insurance Agents

Insurers and insurance agents rely on FIRMs to determine the flood insurance policy rating, and they rely primarily on flood determination companies to provide flood data on the Standard Flood Hazard Determination Form (SFHDF) when the insurance application is completed. Although lenders use FIRMs to determine whether flood insurance is required, insurers and agents must have flood zone information when they request a rating for a flood insurance policy. If the FIRM has been updated, insurers and agents need to know the flood zone at the time the structure was constructed to determine whether grandfathering may provide better rates. Insurers and agents must be able to calculate rates to determine the most advantageous rating for the property.

Section 28, Clear Communication of Risk, of the HFIAA requires insurers and agents to re-underwrite all existing flood insurance policies to ensure that the current flood zone and BFE are being reported to FEMA. Re-underwriting is triggered when the community information, flood zone, and/or BFE on the existing flood policy record does not match the current community information, current flood zone, or current BFE. The underwriting file must contain a copy of a current SFHDF, a copy of the FIRM with the property location clearly marked, a LOMA or Letter of Map Revision (LOMR), or an Elevation Certificate referencing the current map.

Insurers and agents need access to digital copies of past, current, and future FIRM and Letter of Map Change (LOMC) data. Where maps are being updated, access to this information 30 days prior to the map Effective date will allow better service to users. Early access to updated FIRM digital data will help ensure that the current flood zone and current FIRM are reported to FEMA when the flood insurance policy is renewed and that the lowest available premiums are used.

4.2.1.4 Floodplain Managers

Floodplain managers are State, Tribal, and local officials with regulatory authority to review and permit compliant development in flood hazard areas. Since the NFIP is designed as a voluntary national floodplain management program, it provides flexibility in how local and State programs are implemented to allow for the various approaches to land use control and insurance regulation among States. The NFIP sets minimum standards that all NFIP-participating communities must enforce in order to maintain eligibility for the program.

Local and State floodplain managers may have a variety of educational backgrounds and professional skills and knowledge. Many communities do not have an employee who is designated solely as the floodplain manager. Rather, the local floodplain manager is an additional role designated to the zoning or building code official, engineer, planner, mayor, or other position within local government.

The local floodplain manager's tasks involve reviewing permit applications for proposed development in identified flood hazard areas. Since "development" is defined in the NFIP as "any manmade change," permit applications include, for example, building construction, filling/grading, and infrastructure. Floodplain managers are the frontline communicators of FEMA's flood hazard and flood risk products.

Even with the best maps that science can produce, some property owners have trouble accepting that their property is at risk of flooding. For property owners who have not experienced a flood, the map may be a representation of an event that is not likely to happen to them. Because memories of floods fade fast, it is important that communities be reminded of historical floods that have caused damage. Reminders are especially important when the historical flood was larger than the 1-percent-annual-chance flood shown on the FIRM.

One way to increase risk awareness is to digitally map historical floods events, which reinforces that the property is floodprone and has flooded. It also provides an opportunity for FEMA to have a discussion about the fact that floods larger than the 1-percent-annual-chance flood have happened and will happen again.

4.2.1.5 Design Professionals

The designation of "Design Professional" encompasses the members of disciplines that are involved in designing projects and who understand design principles and have other specialized knowledge. Generally, the disciplines are engineering, surveying, architecture, planning, and landscape architecture. The design professionals who are most involved with flooding and mitigation are engineers, surveyors, architects, and planners. These practitioners both develop and use data identifying the depth, horizontal extent, and velocity of water at various flood frequencies. They must be able to use the best available science to develop products that accurately and precisely identify flood hazard and risk and be able to communicate that risk to other core users and the public.

Engineers – The engineering discipline has many subdisciplines. Civil engineering and structural engineering are integral to the wise use of floodplains. Civil engineering encompasses the design, construction, and maintenance of the built and natural environments. Structural engineering includes the design of buildings and infrastructure for structural integrity, function, or safety. Other subdisciplines related to flooding and mitigation are coastal, environmental, and geotechnical engineering.

In conjunction with scientists from multiple disciplines, hydrologic and hydraulic engineers (who are specialized civil engineers) develop hydrologic and hydraulic modeling, which delineates floodplain boundaries and establishes flood elevations. The results of the modeling are displayed on FIRMs and in Flood Insurance Studies (FISs), which are used to site and design new buildings and infrastructure to minimize flood risk.

Surveyors – In some jurisdictions, surveying is defined as a subdiscipline of engineering, but surveyors are always licensed and regulated separately from engineers because of the unique relationship between surveying and property boundaries. Surveyors rely on topographic, bathymetric, reference mark, and other elevation data in FEMA flood hazard and risk products to perform tasks like completing FEMA elevation certificates, completing LOMC application forms, and determining the location of the development in relation to a flood boundary and/or elevation.

Architects – Architects are generally thought of as the designers of buildings, but they may also oversee construction. Architects may consult with engineers and surveyors for their technical and environmental expertise to assist with the horizontal and vertical placement of buildings and structural integrity. Architects use FEMA flood hazard and risk data to design structures to be elevated above known flood levels and/or be properly designed to withstand hydrodynamic and hydrostatic flood forces.

Planners. Planners help government officials, business leaders, and citizens create communities that offer better choices for where and how people work and live. Needs for flood data are on a macro scale because planning relating to floodplain management is concerned primarily with the identification of floodprone areas and general levels of inundation to establish, for example, land use, zoning, and emergency evacuation routes. Planners use FEMA flood hazard and risk data to establish policy on land use, including housing, transportation, and the environment.

4.3 Maintenance Methodology for the National 5-Year Flood Hazard and Risk Assessment Plan

FIRMs provide flood hazard information tied to flood risk reduction activities (e.g., floodplain management) and programs (e.g., NFIP) in participating NFIP communities. The Flood Insurance Reform Act of 1994, as amended (42 U.S.C. §§ 4001 et seq.), requires the following:

> *Once during each 5-year period (the 1st such period beginning on September 23, 1994) or more often as the Administrator determines necessary, the Administrator shall assess the need to revise and update all floodplain areas and flood risk zones identified, delineated, or established under this section, based on an analysis of all natural hazards affecting flood risks (42 U.S.C. § 4101(e)).*

In accordance with the Flood Insurance Reform Act of 1994, as of the end March 2016, the status of the map inventory and NFIP participation[3] was as follows:

- More than 93 percent of the population is covered by digital Effective or Preliminary FIRM panels, and approximately 52 percent of the land area of the country is covered Effective FIRM panels.
- Approximately 6 percent of the population is covered and approximately 20 percent of the land area of the country by non-digital Effective FIRM panels.
- Approximately 1 percent of the population and approximately 28 percent of the land area of the country (primarily in the sparsely populated areas) is not covered by Effective FIRM panels.

FEMA's Flood Map Modernization (Map Mod) initiative, funded by Congress from FY03 to FY08, improved and updated the Nation's flood maps. Funding priorities for Map Mod were based on what FEMA calls the "Atlanta Factors"—projected population growth, population density, number of repetitive loss claims, number of flood insurance policies, and the ability to leverage State, Tribal, and local resources (FEMA, 2006).

To help achieve Map Mod's goals, FEMA developed a *Multi-Year Hazard Identification Plan* (MHIP) (2006) using the Atlanta Factors to identify the priorities for digitizing paper flood maps. The plan was a rolling 5-year plan that was updated annually with input from stakeholders. The MHIP was beneficial for the Map Mod initiative in general, but resulted in unrealistic expectations among communities whose FIRM updates were not funded on the expected timeline.

FEMA has made modernizing the paper inventory of flood maps a priority where supplemental technical data are available for FY16 and FY17, and FEMA and its mapping partners are making progress.[4]

The 2015 Annual Report provided FEMA with two recommendations (Recommendations 2 and 3) related to the development of a 5-year plan for prioritizing flood hazard studies and updates and to the setting of goals for the National Flood Hazard and Risk Assessment Program (the TMAC's future vision of the Program). The two recommendations are presented below. See the 2015 Annual Report for a detailed discussion of the recommendations, including their benefits and potential issues.

3 Does not include Preliminary FIRM information in FEMA's inventory.

4 The Map Mod program proceeded FEMA's Risk MAP program. The results of Map Mod formed the basis for the Risk MAP program and are now in the results reported for FEMA's Risk MAP Program. For more information on mapping progress, see http://riskmapprogress.msc.fema.gov/.

2015 Annual Report Recommendation 2: FEMA should develop a national 5-year flood hazard and risk assessment plan and prioritization process that align 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., MHIP). The plan should be published and available to stakeholders.

2015 Annual Report 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:

- Maintaining and inventory of valid (verified), expiring, unverified, and unknown flood hazard miles;
- Addressing the non-modernized areas of the Nation and unstudied flood hazard miles; and
- Counting population having defined floodplains using a stream level performance indicator for a better representation of study coverage.

In 2016, the TMAC developed the following implementation actions as further suggestions to FEMA on implementing the above recommendations.

4.3.1 IMPLEMENTATION ACTION 3.1

IMPLEMENTATION ACTION 3.1

FEMA should develop, with input from stakeholders, a list of factors to be used for prioritizing flood hazard and risk assessment studies across the country.

(Supports 2015 Annual Report, Recommendations 2 and 3)

As part of the development of a national 5-year flood hazard and risk assessment plan, FEMA should develop national metrics and goals for updating flood hazard data that align with the Risk MAP goals of improving the quality of the data, increasing public awareness of flood risk, and supporting actions that reduce risk to life and property. The plan should include a clear prioritization process for updating flood hazard maps; the factors used to prioritize the updating should include stakeholder input. A discussion of an approach for a prioritization framework follows.

FEMA has proposed that the flood hazard mapping inventory be divided into tiers to support flood hazard data maintenance planning. Prioritization factors could be different for the different tiers and should be considered as appropriate in developing the factors.

Maintaining the validity of the mapped stream miles is a good start on developing a 5-year plan for prioritizing studies and updates, but there is still a need for long-term planning to identify study needs and develop funding priorities. As discussed in Section 3.2, the number of stakeholders in floodplain management is considerable, and they use flood hazard and risk assessment data for various purposes. These stakeholders should be considered during the development of multi-year planning. FEMA's priorities for conducting studies and updates should allow for community input and align with the program goals and the priorities of the States and multi-jurisdictional mapping partners.

4.3.2 IMPLEMENTATION ACTION 3.2

IMPLEMENTATION ACTION 3.2

FEMA should merge the CNMS and Risk MAP Progress websites so users can see in one place what needs updating and what is being updated.

(Supports 2015 Annual Report, Recommendations 2 and 3)

As FEMA develops the 5-year plan, it is likely that viewers and evaluation tools for States and CTPs will need to be developed. As the viewers and tools are developed, FEMA should consider merging information so mapping partners can provide input and view flood hazard data, update needs, planning information, and funding decisions in one place.

FEMA has developed the Risk MAP Progress website to show users the status of CNMS (valid, UNVERIFIED, or unknown miles) for communities, and a separate viewer that shows the status of ongoing and planned Risk MAP projects.[5] Currently, States and Regions identify projects annually to increase and/or maintain the amount of valid miles. When developing annual plans, State and Regional users identify a project to update a stream's flood hazard information based on the CNMS viewer. However, the user then needs to review the status of the ongoing and planned projects by switching to the Risk MAP Progress website to determine whether the project is already in progress or planned.

Figure 4-4 and Figure 4-5 show the Risk MAP Progress website and the CNMS viewer website, respectively.

5 For more information about the CNMS viewer and Risk MAP Progress website, see www.riskmapprogress.msc.fema.gov.

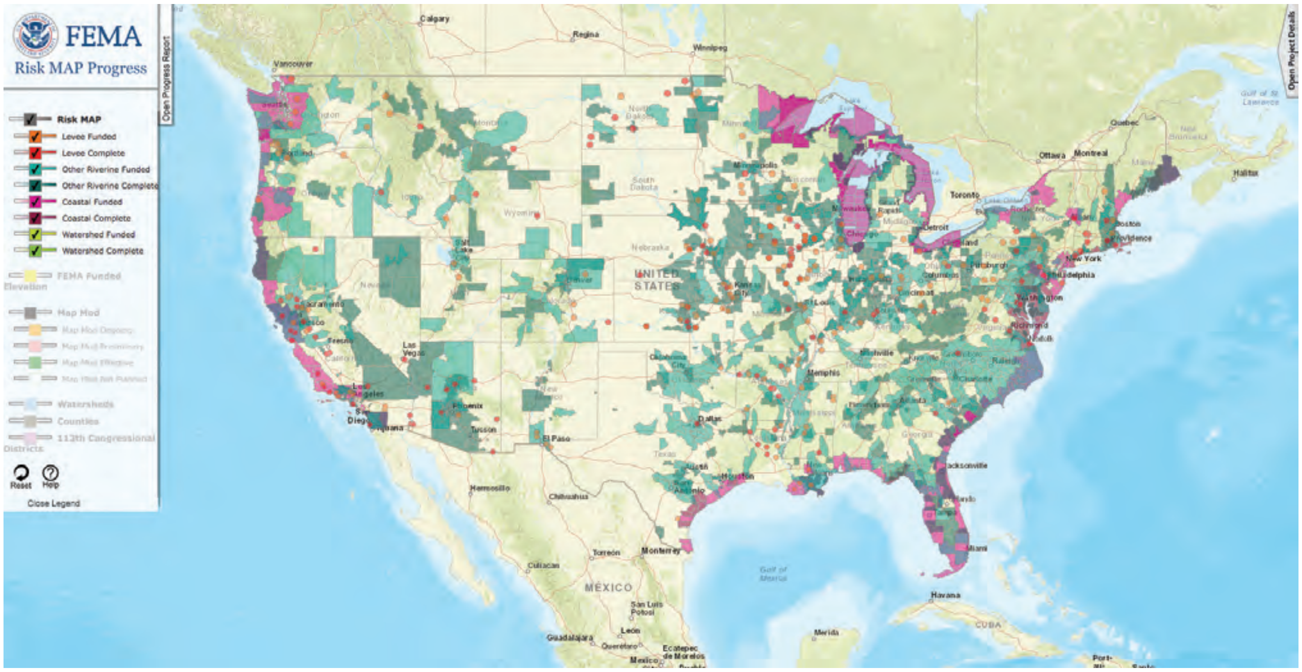


Figure 4-4: Risk MAP Progress Website

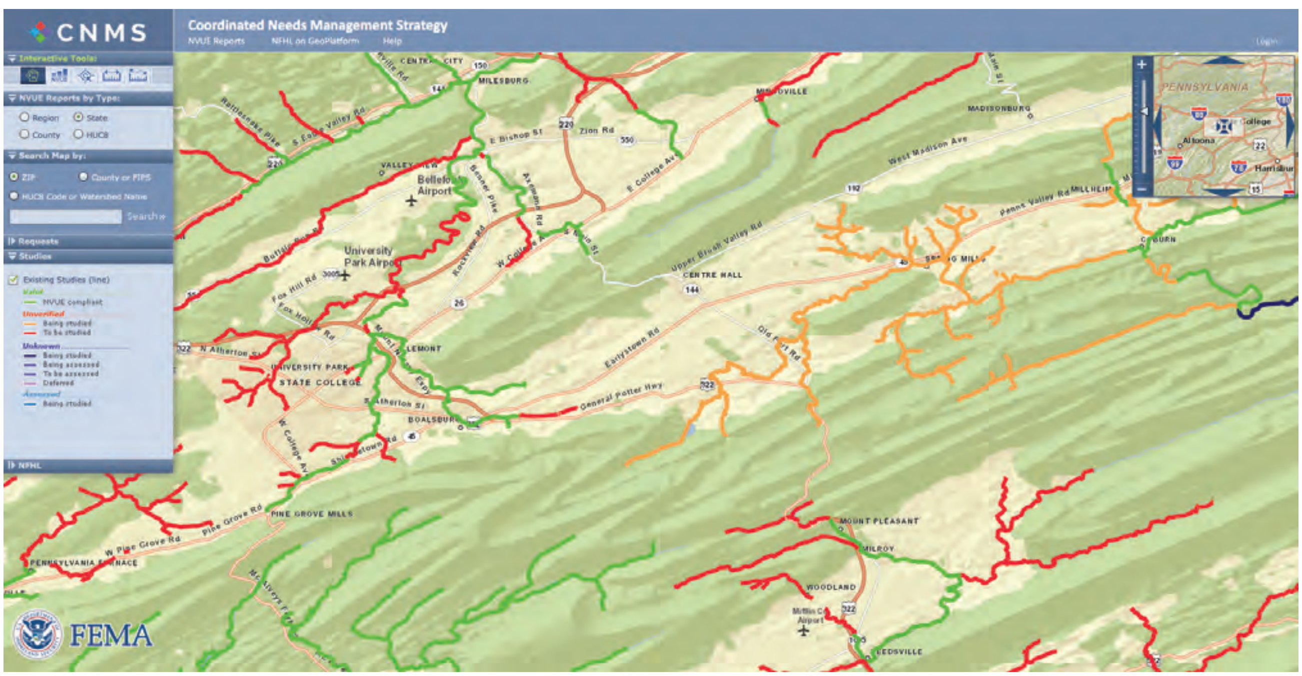


Figure 4-5: CNMS Viewer Website

For annual planning, the need to switch between the Risk MAP website and the CNMS viewer website is inconvenient at a minimum. Having to switch will become more than inconvenient as FEMA transitions to multi-year planning and as projects are projected and tracked through various stages of the Risk MAP lifecycle in the Risk MAP Progress website over a 5-year period.

As FEMA implements a rolling 5-year plan to include establishing and maintaining new and existing studies and assessments, in addition to developing a long-term plan to address the unmapped areas with input from stakeholders (e.g., MHIP), FEMA may need to create a viewer that allows the simultaneous identification of the status of miles from CNMS and the ongoing/planned activities over a 5-year period. As a rolling 5-year process is implemented, it may be more critical to provide stakeholders with tools to more easily manage the process and not lead to confusion and rework.

4.3.3 IMPLEMENTATION ACTION 3.3

IMPLEMENTATION ACTION 3.3

FEMA should evaluate whether adding the number or density of LOMAs to Secondary Element contributes to the CNMS metric effectiveness.

(Supports 2015 Annual Report, Recommendations 2 and 3)

Under the National Flood Insurance Act of 1968, as amended (42 U.S.C. § 4101(e)), FEMA is charged with revising and updating all flood hazard studies on a 5-year cycle. As a result, FEMA has established a process to track mapping needs and maintain the currency of the existing studies on the 1.13 million miles of riverine and 43,291 miles of coastal flood hazard studies.

FEMA uses the CNMS database to maintain the flood hazard mapping inventory. As discussed in Section 4.2.1.1 of the 2015 Annual Report, FEMA evaluates 16 NVUE elements (seven critical and nine secondary) to determine the validity of each flood hazard study in the inventory.

A critical element is one of seven elements documenting Physiological, Climatological, and Engineering (PCE) methodology changes reviewed during the engineering study validation process. If any critical element is evaluated as "YES" as a result of the identification of a deficiency, that is significant enough to trigger an UNVERIFIED Validation Status.

A secondary element is one of nine additional elements, secondary to the Critical Elements, which document PCE changes reviewed during the engineering study validation process. These elements, if evaluated to "YES" as a result of identification of deficiencies and totaling four or more secondary element deficiencies, are significant enough to trigger an UNVERIFIED Validation Status. A secondary deficiency is considered less impactful than a critical deficiency.

CRITICAL NVUE ELEMENTS	SECONDARY NVUE ELEMENTS
• Major change in the gage records	• Use of no longer appropriate regression equations
• Significant changes in discharges	• Repetitive losses outside the SFHA
• No Longer appropriate model methodology	• Significant changes in watershed impervious area
• Removal of major flood control structure	• One to four new or removed hydraulic structures
• Channel reconfiguration	• Channel improvements
• Five or more new or removed hydraulic structures	• Better available topographic data
• Significant channel fill or scour	• Significant changes in land use
•	• Significant storms with high watermarks
	• New regression equations available

NVUE elements are used to determine whether the underlying data and analysis meet FEMA's technical and currency standards. If a stream reach has one critical element or four secondary elements, the stream miles in the reach are categorized as UNVERIFIED.

Large-scale mapping efforts can sometimes result in small areas that are above the BFE but are still shown within the SFHA on the FIRM. The LOMA process exists to address this situation, and it is valuable for affected property owners. LOMAs are issued when property owners provide information to FEMA certifying that a structure or parcel is above the BFE although mapped in the SFHA.

However, a large number of LOMAs in a small area can indicate that the topographic information may need to be updated. Regardless of whether or not the information is accurate, a large number of LOMAs, or any type of LOMC, can degrade the credibility of flood hazard data from the perspective of community officials and property owners in the SFHA.

Implementation Action 3.3 is to add the number or density of LOMAs since the date of the last Effective map to the secondary elements. The density of certain types of LOMAs can indicate that delineation with better topographic data may show the SFHA more accurately, but at some locations, such as steep bluffs, the delineation would remain the same.

FEMA currently tracks LOMAs using latitude and longitude coordinates, and recent enhancements to the MIP have allowed this tracking to include a higher level of precision than in the past. This tracking should allow LOMAs to be used as a geospatial element in the CNMS viewer website. The number and density of LOMAs may prove to be a beneficial secondary element because they indicate that the topographic basis of the flood hazard data is inaccurate.

When evaluating whether to include the various types of LOMAs as secondary elements, FEMA should also assess whether the difference between the Lowest Adjacent Grade (LAG) or Lowest Lot elevation compared to the BFE is important in understanding the level to which a LOMA cluster shows that the underlying topographic information needs to be updated. For example, an area with a large cluster of LOMAs for which the LAG or Lowest Lot elevation is the same as the BFE may indicate that the topographic information does not need to be updated. When a cluster of LOMAs has a large difference in LAG or Lowest Lot elevation compared to the BFE (several feet), the area may have such steep bluffs that the SFHA depiction would not change, even with better topographic data.

4.4 Flood Hazard Identification and Risk Assessment Process

The TMAC included two recommendations on the flood study workflow production process (FIS process) in the 2015 Annual Report: Recommendation 11 on the supporting management system and Recommendation 16 on enhanced, geodatabase-derived digital display environment. The recommendations are provided below for reference:

> **2015 Annual Report Recommendation 11:** FEMA should modify the current work flow production process and supporting management system, Mapping Information Platform (MIP), 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 the choice of watershed size, not limiting projects to only the hydrologic unit code 8 (HUC-8).

> **2015 Annual Report 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 is fully georeferenced and relational, enabling a single digital authoritative source of information and database-driven displays.

In 2016, the TMAC developed the following implementation actions as further suggestions to FEMA on implementing the above recommendations.

4.4.1 IMPLEMENTATION ACTION 4.1

IMPLEMENTATION ACTION 4.1

FEMA should develop a process for reviewing various aspects of the FIS workflow and procedures to ensure that:

- Workflow efficiencies and cost-effectiveness, including during the KDP process, are encouraged;
- Complementary reporting systems are integrated;
- Revisions to the FIS workflow and procedures incorporate a dynamic, digital display environment system;
- All internal paperwork required for publishing the notice in the Federal Register is reviewed;
- Best Management Practices are incorporated; and
- Guidance from FEMA HQ and/or Regional offices is documented and shared.

(Supports 2015 Annual Report, Recommendation 11)

The time to generate maps has increased significantly from the Map Mod to the Risk MAP Program. The reasons for this increase are: (1) longer compliance periods to increase local acceptance, (2) the inclusion of more complex coastal studies, (3) dealing with complex levee issues, and (4) the implementation of the incremental work ordering process.

The TMAC believes that a credibility issue is created when time periods of greater than 3 years are needed to advance an FIS from the first Discovery meeting to Effective maps. The TMAC is encouraging FEMA to examine all aspects of the map lifecycle to look for innovations to shorten the time that is needed to create the products. The examination should include statutory changes that could be changed during the NFIP reauthorization that will occur in 2017, as well as regulatory and policy changes that are within the control of the Agency. These initiatives should include the use of technology to reduce data generation time, as well as standardized paperwork that is required to produce the final products.

Determination of the time required to produce the Preliminary maps should include an evaluation of the incremental work process and determine whether the additional time created by this process would result in the benefits that were anticipated when this process was introduced. In addition, the time required for post-Preliminary processing is shown in Table 4-1. The 1.5-year process to progress from Preliminary to Effective maps seems excessive to the TMAC. This part of the process should be examined carefully for innovations that may require regulatory of legislative action.

Table 4-1: Statutory-, Regulatory-, and Policy-Related Time Periods during the Post-Preliminary Phase

TASK	REGULATION/STANDARD/GUIDANCE**	DAYS
Issue Preliminary maps (initiation of PPP)	Standard 164	—
30-Day Comment Period	Standard 166	30
Schedule and hold CCO Meeting *(assuming meeting held after comment period)*	Regulation 66.5/Standard 384/*Guidance for Flood Risk Analysis and Mapping: Post-Preliminary Deliverables*	30
KDP4 (submittal and approval) – 4 weeks *Time may vary depending on Region*	Standard 612/*Guidance for Flood Risk Analysis and Mapping: Key Decision Point (KDP) Process Guidance Document*	28
Standard 622: Stakeholder Engagement *(assumed timeframe; has not been encountered as this is a new standard on all FY15 studies and beyond)**	BW-12/Standard 622 (June 2016)/*Guidance for Stakeholder Engagement: Due Process Phase*	21
QR4 - Part 1 (FHD notice) – 2 weeks (includes the following) • Creating and reviewing FHD Notice • Creating, reviewing and submitting Proposed Notice • Identifying newspaper for publications to start appeal period	Standards 387 and 508/*Guidance for Flood Risk Analysis and Mapping: Appeal and Comment Processing*	14
Federal Register publication: 4-6 weeks	Regulation 67.4/Standard 387/*Guidance for Flood Risk Analysis and Mapping: Appeal and Comment Processing*	35
QR4 - Part 2 (Appeal Start): 6 weeks (includes the following) • Contact newspaper to verify publication dates • Creation and review of appeal start dockets, letters and newspaper notices • Docket coordination/approval from FEMA Headquarters (HQ) • Mailing of letters and publication of notices in local papers	Regulation 67.4 (newspaper publication time period/Standards 508 and 514/*Guidance for Flood Risk Analysis and Mapping: Appeal and Comment Processing*	42
Statutory appeal period: 90 days	Regulation 67.5/Standards 515 and 600/*Guidance for Flood Risk Analysis and Mapping: Appeal and Comment Processing*	90
KDP5 (submittal and approval): 4 weeks *Time may vary depending on the Region*	Standard 612/*Guidance for Flood Risk Analysis and Mapping: Key Decision Point (KDP) Process Guidance Document*	28
Prepare, submit and review QRs 5-6-7 (plus FEDD File) – 90 days (includes the following) • Submit and review FEDD File • Submit and review database, panels, inventory worksheet and 179 letters • Submit and review LFD Summary, questionnaire, LFDs, and SOMA • Submit Federal Register Final Notice	Regulation 67.3 – FEDD file/Standards 187, 395, 396, 397, 398, 401, 508, 509, 518, 519, 520, 521, 522, and 523-529/ *Guidance for Flood Risk Analysis and Mapping: Quality Management, Guidance for Flood Risk Analysis and Mapping: Technical Support Data Notebook and Flood Elevation Determination Docket*	90
LFDs Issued	Regulation 67.11/Standard 519/LFD Guidance Document	—
QR8 and TSDN Reviewed (occurs within timeframe of compliance period so not counted in total days)	Standards 187, 394, 397, 508, 509, 510/*Guidance for Flood Risk Analysis and Mapping: Technical Support Data Notebook and Flood Elevation Determination Docket*	30
Adoption period with suspension notices: 6 months	Regulation 60.3/Standard 409/*Guidance for Flood Risk Analysis and Mapping: Post-Preliminary Due Process*	180

TASK	REGULATION/STANDARD/GUIDANCE**	DAYS
Publication of *Federal Register* Final Notice (occurs within timeframe of compliance period so not counted in total days)	Regulation 67.11/Standard 409/Federal Guidance for Flood Risk Analysis and Mapping: Register Notices†	—
Revalidation (occurs during compliance period so not counted toward total days)	Standards 405 and 523-529/Guidance for Flood Risk Analysis and Mapping: Revalidation	30
Final FEDD File Compilation (occurs after maps go Effective for the study so not counted in total days)	Regulation 67.3/Standards 395, 396, 397, 398/Guidance for Flood Risk Analysis and Mapping: Technical Support Data Notebook and Flood Elevation Determination Docket	30
	Total Days	**588**

* Time frame assumes that a CCO meeting is held, the proposed Federal Register notice is published in 5 weeks, and a regular appeal period lasting 90 days with no appeals received or an SRP initiated. Appeals can delay projects potentially 6 months or longer. Contractual parameters and limitations can also delay a project outside the timeline shown.

** Regulation = Title 44 Code of Federal Regulations

Standards = FEMA, *FEMA Policy Standards for Flood Risk Analysis and Mapping* (FEMA Policy #FP 204-078-1, Rev 6, 2016b). https://www.fema.gov/media-library-data/1480449548025-4736d89b89d30fbf102228680c1f8acd/Standards_for_Flood_Risk_Projects_(Nov2016).pdf

Guidance documents are available at https://www.fema.gov/media-library/assets/documents/34953.

BW-12 = Biggert-Waters Flood Insurance Reform Act of 2012

CCO = Consultation Coordination Officer

FEDD = Flood Elevation Determination Docket

FHD = Flood Hazard Determination

KDP = Key Decision Point

LFD = Letter of Final Determination

PPP = Post-Preliminary Process

QR = Quality Review

SOMA = Summary of Map Actions and Revalidation

SRP = Scientific Resolution Panel

TSDN = Technical Support Data Notebook

4.4.2 IMPLEMENTATION ACTION 4.2

IMPLEMENTATION ACTION 4.2

FEMA should take into consideration the following items at the next review of the MIP system:

- Integrate the MIP and KDP process into one system.
- Provide mapping partners more visibility on Data Validation Tasks (i.e., who is responsible for these tasks at the Regional office) and ensure more proactive coordination is implemented before and after the data validation tasks.
- The MIP should take into account the uniqueness of CTPs and enable more flexibility in all areas of the flood production process, including product upload, geographic areas, metadata requirements, and QC reviews.
- Transition the MIP to a geodatabase system, similar to the CNMS, in which information is saved geospatially and run customized queries and reporting for Regional offices, mapping partners, and CTPs.
- Enhance functionality to create auto-generation of template correspondence (e.g., SOMA letters).
- Provide greater flexibility in user controls.
- Provide additional user access to related information.
- Add risk product workflows.
- Integrate an efficient solution to seamless mapping or HUC or State geographic areas.

(Supports 2015 Annual Report, Recommendation 11)

FEMA has made strides since the beginning of Risk MAP in updating the MIP, using lessons learned and performance feedback from mapping partners. However, because the updates have been limited in scope and have often not enhanced the user experience, techniques have been developed to circumvent issues. One example is the development of dummy metadata, which helps the project continue through the MIP workflow.

Many CTPs across the country complete activities in the flood study production cycle differently from what FEMA HQ requires through the MIP system. Examples of differences are as follows:

- Base data collected in various formats and levels of detail
- Engagement with local communities and property owners
- Data capture requirements
- Customization of flood study products
- Timeline/schedule efficiencies

In March 2017, a redesigned studies work environment will be deployed within the MIP. The primary objective of the redesign is to replace the current, rigid studies workflow with a more flexible way to track the progress and performance of flood risk projects.

The redesigned studies work environment will feature the following improvements:

- **A "business-driven" workflow –** Business needs will determine which activities are added to a project, the watershed, and other geographic details for those activities, and the order in which tasks are assigned and completed. Instead of every series of tasks being linear, users will be able to purchase and complete tasks independently of other tasks, based on the project's needs.
- **Improved functionality** will include the following items:
  - **New tasks for additional studies activities –** To eliminate the need for existing workarounds and to improve data quality, new tasks will be added for activities such as Discovery, flood risk product development, levee analysis and mapping procedures (LAMP) planning and outreach, LiDAR acquisition and processing, and community outreach efforts. Additionally, general tasks are being created to capture other efforts related to mapping, such as CNMS assessments.
  - **Updated functionality within existing data capture tasks –** The redesign will capture more detailed leverage data and will be able to accommodate revised Preliminary processing without requiring users to create a separate project. Data capture improvements will also be made within existing tasks such as coastal, hydraulic, and floodplain mapping, as well as to all of the post-Preliminary processing tasks.
  - **Updated validation and QA/QC tasks –** The new system will introduce dedicated tasks for each quality review, improve communication between producers and reviewers for validation and QA/QC tasks, and allow reviewers to locate project files and upload any required checklists.
  - **Updated Summary of Map Actions (SOMA) tool –** The updated SOMA tool will add efficiencies to SOMA production and improve the user experience by making the revalidation letter easier to understand.
  - **New ad-hoc reporting system –** The new ad-hoc reporting system will improve visibility of task ownership and project status and will be open to all MIP studies users.
  - **GIS web services –** Geography and project status information will also be available in a seamless national GIS dataset exposed to external users through common GIS web services. By embracing the spatial component of the data, the GIS service will provide new, powerful, and enhanced ways of tracking, analyzing, and visualizing the significant investments in purchased data.
  - **Incorporation of the Appeals Tracker and the Authenticated Flood Hazard Determinations (FHDs) on the web tool –** This effort will eliminate the need to enter duplicate data into multiple tools, allow for more detailed appeals information to be tracked and reported, and add efficiencies to the production and review of proposed and final Federal Register notices.
- **Seamless integration with components of the MIP that will not be redesigned –** Tools and features such as the Data Upload and Flood Risk Study Engineering Library (FRISEL), File Explorer, Database Verification Tool (DVT), and Metaman validations will continue to function within the new studies work environment. Additionally, the new system will maintain integration with the Map Service Center (MSC) for product delivery and with the Community Information System (CIS) for adoption and compliance activities.

The MIP studies enhancements outlined above will improve the experience for those who use the system to capture or retrieve data and will align the MIP to better accommodate the evolving needs of the Risk MAP program and its diverse mapping partners. The new system is also built to remain flexible and to accommodate future process changes. Existing studies data and artifacts will be automatically migrated over to the new system, and redesign of the MIP studies work environment will not impact the MIP revision or amendment workflows.

Although the March 2017 deployment of the redesigned studies work environment will not integrate the MIP with the KDP tool, the CNMS tool, or the Project Planning and Purchasing Portal (P4), the possibility of integrating these systems in the future will be evaluated.

4.4.3 IMPLEMENTATION ACTION 4.3

IMPLEMENTATION ACTION 4.3

FEMA Regions should clearly document and communicate MIP workflow validation and QA/QC procedures, correspondence protocols and approvals, documentation requirements, and other Region-specific guidance expectations of the flood study process. Additionally, FEMA Regions should regularly update partners with staff changes and roles and responsibilities for the Regional staff.

(Supports 2015 Annual Report, Recommendation 11)

Many FEMA Regional offices have provided mapping partners with information on executing Risk MAP flood studies and implementing strategies for various activities, but these practices and procedures are not adequately standardized or documented. The lack of standardization can cause delays in completing tasks and getting needed approvals. For example, one Regional office may require that the Regional manager assigned to KDP reviews be alerted by email that a KDP form has been posted and is ready for review. Other Regional offices may request a phone call instead.

This type of Region-specific guidance is rarely documented and shared with Production and Technical Services (PTS) contractors or CTPs, and can delay reviews of correspondence or inquires for assistance. Therefore, the TMAC suggests that Regional offices focus on creating new guidance and releasing it to mapping partners. This documentation should communicate the differences that Regional offices have in their undertaking of tasks such as product QC reviews, correspondence approvals, and MIP data validations.

4.4.4 IMPLEMENTATION ACTION 4.4

IMPLEMENTATION ACTION 4.4

FEMA HQ should develop additional guidance and training for mapping partners related to the CFR requirements for due process and Federal Register notifications. Regions should also be encouraged to create addendums that communicate their specific requests and internal timelines for their coordination activities with PTS contractors and CTPs.

(Supports 2015 Annual Report, Recommendation 11)

Regional processes, staff roles and responsibilities, and requirements for *Federal Register* notifications, MIP and KDP procedures, congressional reporting, and other requirements vary significantly across the Nation. To facilitate the development, tracking, and acceptance of these deliverables, FEMA HQ may need to develop a documentation requirement for each FEMA Region. The documentation and coordination activities would need to be flexible to fit into each Regional office's needs. The TMAC believes that issues listed below need clarification in the form of written guidance:

- Requirements for *Federal Register* notifications
  - Official/regulatory documentation
  - Coordination guidance

  - Workflows and/or schedules that show correspondence routing timelines and staff roles
  - Additional training for mapping partners on the requirements
  - Risk product and Quality Review (QR) processes
  - Roles, routing procedures, and related workflows
- Requirements for MIP and KDP procedures
  - Coordination guidance
  - Workflows and/or schedules that show correspondence routing timelines and staff roles
  - Additional training for mapping partners on the requirements
  - Risk product and QR processes
- Regional office activities and miscellaneous requirements
  - CTP Mapping Activity Statements – internal coordination and overall milestone expectations
  - Congressional reporting expectations
  - PTS or other contracting – workflow and milestone expectations
  - Regional Task Order Change Requests

The use of a SharePoint site could be the focus of capturing and posting updates to this documentation. Too often, expectations are only expressed during a conference call, in individual emails, or at in-person meetings, and are not communicated to others in an efficient format. A review of these materials should also be completed at the Regional offices annually as changes occur in funding, regional focuses, Regional office staff, and other areas.

4.4.5 IMPLEMENTATION ACTION 4.5

IMPLEMENTATION ACTION 4.5

The TMAC recommends that FEMA work with the Customer and Data Services (CDS) contractor to evaluate the ability to migrate the MIP into a relational database system that can access data from other components of the flood insurance study program, such as a revised version of the FIRM database. Further efficiencies in reporting, data integration, and archival processes can occur if both a MIP database and FIRM database systems can relate to one another.

(Supports 2015 Annual Report, Recommendation 16)

As with the development of the engineering models and data, the SFHA development process should be largely unchanged by the use of a new dynamic database. Since the TMAC supports creating a more robust database to hold all flood hazard mapping and risk analysis data, there should be increased efficiencies with populating data and the QA/QC reviews. For new mapping, these efficiencies are mostly recognized during the QA/QC review stage.

Incorporating all flood hazard mapping and risk analysis data into one database that can release various products on the website should reduce the number of individual QA/QC steps because more products can be reviewed together. In addition, various stages of production can overlap with more work occurring at the same time.

Future QA/QC reviews should focus on confirming the integrity of the data captured in the database by reviewing:

- Modeling outputs
- Depth grid rasters
- Water Surface Elevation Grids
- Flood hazard mapping information
- Community information
- Field survey data
- Topological relationships

Extensive QA/QC reviews may also not be needed on the Preliminary FIRM panels or FIS reports because they will be automatically developed on the new website.

The transition of this activity may be rolled into the new MIP system implementation discussed above (see Implementation Action 4.2), and FEMA HQ will need to develop a plan for ensuring that the MIP design works correctly with the dynamic, geodatabase-derived digital display environment system and within an efficient workflow. Details on the integration of the Topic “Database-Derived, Digital Display Implementation Plan” should be used as a basis for understanding how the FIS process may change.

4.5 Geodatabase-Derived Digital Display Implementation Plan

One of Risk MAP's goals is to provide enhanced digital platforms, which involves improving the dissemination of risk data and risk-related products (FEMA, 2009). The 2015 Annual Report states that a "key to the Program's success is providing users with authoritative, easy to assess and use, timely, and informative data and tools" (page 4-21). However, as discussed in Section 4.6 of the 2015 Annual Report, current NFIP data are fragmented across products and access points, core data and models are not linked, research is required to identify the data of interest, and there is limited ability to retrieve information. These items do not promote a user-friendly experience for stakeholders.

The TMAC recommended in 2015 that FEMA develop an integrated digital display geodatabase and web-based system for storing and displaying natural hazard risks to the public, community officials, and decision makers. By implementing this recommendation, FEMA would be further advancing its goal of enhancing the digital platform while also making their flood hazard and risk information more user friendly to their stakeholders. For reference, the recommendation is provided below.

> **2015 Annual Report 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 is fully georeferenced and relational, enabling a single digital authoritative source of information and database-driven displays.
>
> To support this transition, FEMA should do the following:
>
> - Prepare a multi-year transition plan to strategically transition all current cartographic and/or scanned image data to a fully georeferenced, enterprise relational database.
> - 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.
> - Adopt progressive data management approaches to disseminate information collected and produced during the study and revision process, including LOMCs.
> - Apply a flexible data management approach that allows 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.
> - 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.

Implementing this recommendation would involve creating an interactive website that would provide users with flood hazard risk data at the U.S. Census Block or property level for locations with available data. Flood hazard risk would be based on enterprise geodatabases, natural hazard risk datasets, and loss estimates.

In 2016, the TMAC developed the following implementation actions as further suggestions to FEMA on implementing the above recommendations.

4.5.1 IMPLEMENTATION ACTION 5.1

IMPLEMENTATION ACTION 5.1

FEMA should implement the following features into a future, dynamic, database-derived, digital display environment to manage the update, maintenance, and dissemination of all flood hazards and risk data across the country:

- Data are geospatial and captured in a relational geodatabase.
- Data can be dynamically queried and displayed (point and click).
- Development of a new website that features users-specific inputs, and where data provides one access point for multiple sources of flood hazard data and risk assessment information.
- Products are developed on-the-fly using dynamic data calling features.
- The new website and database support scalability, based on data availability, population, flood frequency and population impacted, and flood insurance penetration.

(Supports 2015 Annual Report, Recommendation 16)

Simply making data available is not necessarily good communication. The TMAC stressed this point in its discussion of last year's Recommendation 1, noting that "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" (TMAC, 2015b, p. 4-22). The TMAC again underscores the need for FEMA to consult with various user groups before developing new or improving existing means of accessing flood hazard and risk data.

The TMAC provides the following implementation considerations as they relate to geodatabase design, website design, and the leveraging of web services and other data sources.

4.5.1.1 Geodatabase Design

A new FIRM geodatabase schema should be developed from the current FIRM geodatabase specifications. Adjustments would be needed to support all-digital NFIP products, store all of the data that are required to support FIRM and FIS displays, and provide an on-demand print capability from a website, thus eliminating legacy cartographic and paper products. The geodatabase schema should account for capturing LOMC information. There should also be an element of versioning for old Effective data, new Preliminary data, and LOMC cases included in the new geodatabase schema.

The geodatabase should allow submittals to be integrated efficiently and become visible as new data become available for communities, counties, LOMR areas, HUC-8s, and multi-county areas. Such a system may make it easier for mapping partners to support various user needs.

The geodatabase should also include smart design features such as storage of information via primary and foreign key relationships, no data duplication, and no summarized data. Additionally, standard design features, such as coded domains, should be used to enforce data integrity. The geodatabase should be designed to

capture the highest level of data, but functional enough to house varying amounts of information to account for variability in source data availability.

The geodatabase could have three data population scenarios that relate directly to website functionality. The three levels of functionality could be Basic, Enhanced, and Enhanced + Risk Digital Display Levels, as shown in Table 4-2.

Table 4-2: Examples of Proposed Three Tiers of Geodatabase-Derived Digital Display

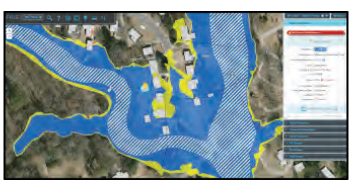
DIGITAL DISPLAY LEVEL	FUNCTIONALITY	EXAMPLE
Basic Level 	The interactive website allows for pan-and-scan flood risk viewing and data download. The translation of individual county FEMA FIRM geodatabases into an Enterprise geodatabase format may provide this basic functionality. The website could also show LOMR cases.	61 Florida counties currently shown as a Basic Level
Enhanced Level 	The Enhanced Level could be provided to communities where more data are available. The interface could be more interactive and allow users to specify the geographic areas they want to view or download data for, such as FIS report tables or point-and-click BFEs from water-surface elevation rasters.	67 Alabama counties currently shown as an Enhanced Level
Enhanced + Risk Level 	The Enhanced + Risk Level could be based on the availability of building-specific financial data and could link building financial information to flood hazard risk to help communicate financial vulnerability and potential migration strategies to property owners. The enhanced + risk flood hazard information could be provided via point-and-click functionality. The highest functionality available would be used to show Preliminary and Effective data across the State. Building footprints could be combined with estimated flood loss information and made available for most of the counties in the State. Providing the point-and-click BFE feature with building-specific information could allow users to obtain a complete understanding of their flood risks and potential financial vulnerability associated with a particular structure. LOMRs could also be included as a visual function, and the LOMR models could be available for download. The website could be user-friendly. It could provide more detailed flood hazard data for local community officials, which would assist communities in planning for and mitigating flood hazards.	All 100 North Carolina counties currently shown as an Enhanced + Risk Level

Table 4 3 shows the data source and data requirements as they correlate to these proposed three levels of geodatabase-derived digital display. The table also assumes the required datasets may only be functional if the corresponding website is developed to recognize specific datasets and built with the capability to display these features.

Table 4-3: Proposed Geodatabase-Derived Digital Display Data Requirements and Sources

LEVEL	DATA REQUIREMENTS	SOURCE DATA
Basic	• Imagery or base map service • Flood hazard polygons and boundaries • Political areas • FIRM panel schema • Community/county Federal Information Processing Standards (FIPS) codes • FIRM panels and FIS Report in PDF	• Imagery providers • FEMA flood insurance study-derived data
Enhanced	• Basic Level data requirements • Additional data requirements – Comprehensive engineering modeling features: cross sections, summary of discharges, etc. – Water names – FIS table footnotes – Engineering models – Coastal data such as wave crest, wave run-up, dune erosion, and primary frontal dunes (PFDs) – 10x10-foot cell elevation and depth rasters	• Basic Level data requirements •
Enhanced + Risk	• Enhanced Level data requirements • Additional data requirements: – Building footprints (spatial) with first floor elevations – Structural damage loss calculations – Multiple recurrence interval flood hazard elevation rasters	• Basic Level data • Additional data – USGS/National Hydrography Dataset (NHD) stream data – Community-derived building footprint FFE – Building financial data – Damage functions

4.5.1.2 Website Design

The main objective of developing a new FEMA website is to be able to use database-derived content to support a paperless, all-digital FIS program. Advanced functions, such as the dissemination of FIS products and data, point-and-click BFE determinations, and building-specific risk assessments, could also be realized, depending on data availability.

The TMAC suggests that FEMA take a phased approach to providing various levels of flood hazard risk data and products on a new website. Data availability in specific geographic areas may dictate what level of geodatabase-derived digital display and functionality could be provided on the website.

Examples of functionalities based on geodatabase-derived digital display level within this new proposed website are listed in Table 4-2. The examples show it is possible to develop this system successfully and meet the needs of various geographic areas with differing data availability levels.

4.5.1.3 Leveraging Web Services and Other Data Sources

A set of standards may be defined and established for shareable and interchangeable web and map services. These services may access and query the common relational flood and hazard risk geodatabases and would provide flexibility in supporting national, regional, and local data integration. As long as the inputs and outputs are the same, the application would not need to change, and the appropriate service would be selected based on the user's area.

The following types of services may need to be included:

- **Map services** – Map services function primarily as the presentation tier of the application. They are used to serve up map images as a user pans and zooms. Many agencies and mapping partners have standardized geospatial platforms for creating these services, which allows sharing information across a wide variety of platforms.
- **Data services** – Data services typically provide on-the-fly query access to relational data or computed data from the geodatabase and do not usually require a geospatial component. These services represent the "business logic" tier of the application and are typically built using custom programming.
- **Report services** – Report services provide printer-friendly document output, such as a PDF, Word document, or Excel spreadsheet containing the data from the data or map service.
- **Print and geolocation services** – Other services such as print and geolocation services may be needed for map printing and address and location queries.

Additionally, FEMA should assess available base data for use in the geodatabase-derived digital display environment from various Federal, State, and local entities to determine the most suitable orthoimagery, topographic, and building-specific datasets. Example data sources are as follows:

- **Federal agencies** – Federal agencies already provide many data and mapping services that could be easily integrated into the final platform to provide pertinent information, such as weather, radar, NHD stream information, hydrology, soils or real time stream status, water quality information, and the National Levee Database. Examples of agencies that should be consulted include NOAA, USGS, the USACE, and other partner mapping agencies. These datasets would not be stored but only accessed to supplement the user experience and understanding.
- **Cooperating Technical Partners** – CTPs often have the latest and most detailed data for mapping hazards. CTPs may incorporate their data into the new digital geodatabase standard and periodically share that data using the standards for sharing data and services. Requirements would be established to make information sharing most effective and maintainable by all parties using the standards established in the data model and for the service types. Some CTP data services would be similar to those used by Federal agencies and not need be stored by FEMA but only accessed within the application. Examples include local imagery, roads, parcels, buildings, and dam information services.
- **Private sector** – Many private-sector data and map services could be considered for integration or linkage into the seamless geodatabase-derived digital display. These partner services may provide contextual information, such as Street View from Google and lists of nearby homes, neighborhoods, and schools from real estate websites.

4.5.2 IMPLEMENTATION ACTION 5.2

IMPLEMENTATION ACTION 5.2

FEMA should perform a demonstration(s) to learn from, and document data requirements, processes and standards necessary for nationwide implementation of geodatabase-derived, digital display environment

(Supports 2015 Annual Report, Recommendation 16)

The TMAC suggests that FEMA define pilot areas, investigate geographic scalability, and capture Effective flood study data into the new system. FEMA should be prepared to assess all portions of the country either by county or HUC-8 to decide which geographic areas should be displayed in the three proposed geodatabase-derived digital display website interfaces discussed in Section 4.5.1.1. The TMAC suggests that FEMA consider the following characteristics when selecting pilot areas:

- Data availability to support the Enhanced or Enhanced + Risk Level
- Population – changes in population over time, major population centers
- Flood frequency and population impacted – intervals of previous years
- Flood insurance policy penetration – policy saturation, repetitive losses
- Mitigation projects implemented

The following areas should also be considered as pilots for the geodatabase-derived digital display system:

- **Regional HUC-8 areas in the western United States** – Because this geographic area experiences flash flooding alluvial fan flooding and features levees, these areas would serve as a good example for an Enhanced or Enhanced + Risk Level pilot.
- **Entire State** – Piloting an entire State with a large population would test the functionality of a new geodatabase-derived digital display system.
- **Dense urban area** – These urban areas could be used to make certain that areas of dense buildings and streets can be displayed efficiently and effectively.
- **Regional HUC-8 areas that include a major river system or recent coastal revisions** – The areas should have experienced recent flooding events in the past 5 years within one of the major river systems and/or a significant coastal revision. Because of the network of streams and economic aspects that impact the neighboring counties and States, this type of area could be an excellent pilot for the Enhanced or Enhanced + Risk Level.
- **North Carolina data test** – The TMAC also suggests that FEMA pilot some of the North Carolina CTP's Enhanced + Risk Level datasets to test how the detailed data would perform in the geodatabase and website used to create a national dynamic, geodatabase-derived digital display system.

These pilot areas would step through a process of taking the current Effective flood hazard information and LOMRs and populating them into the pilot's geodatabase schema. The pilot data areas should not be limited by countywide data extents or political boundary constraints and should explore variable data extents, such as HUC-8 or larger river basin areas. In addition, smaller areas, such as LOMR extents, should also be loaded. The population of newly required datasets would involve capturing modeling and FIS Report information in addition to the previous Effective FIRM geodatabase data. Automated GIS tools could be developed to help perform this task efficiently.

4.5.3 IMPLEMENTATION ACTION 5.3

IMPLEMENTATION ACTION 5.3

FEMA should utilize the National Flood Hazard Risk Management Coordination Committee to implement the TMAC's vision, including the new database-derived, digital display environment.

(Supports 2015 Annual Report, Recommendation 16)

The TMAC understands that implementation of this geodatabase-derived digital display environment is a large effort, and a transition plan may need to be put in place for the development, testing, and implementation of a dynamic, geodatabase-derived digital display system. A Coordination Committee may be established to help guide FEMA in the initial planning and piloting of the new system and related websites, databases, datasets, procedures, etc. The Coordination Committee may also be responsible for developing at least one lessons learned document that includes best practices.

The Coordination Committee may also investigate the statutory notification requirements that limit FEMA's ability to transition to a fully digital system without regulatory changes. For instance, in order to meet Federal statutory requirements, the way communities are notified of BFE changes within their communities cannot change without action from Congress. Other statutory due process requirements that must be provided formally in writing and maintained as evidence that FEMA met the due process requirements of the program are as follows:

- Statutory 90-day appeal period initiation letters
- Letters of Final Determination
- 90- and 30-day suspension letters

Currently, FIRMs show wide areas with a general zone designation (e.g., Zone V, Zone AE) that imply the flood hazards are similar throughout the designated flood hazard zone when, in fact, flood conditions may vary significantly across the zone.

Nonetheless, there are opportunities outside the statutory requirements to change the way NFIP products are viewed, obtained, and distributed. For instance, it is possible to adapt certain correspondence prepared by FEMA or CTPs. This would include distribution of the letters of invitation to community coordination meetings and open house meetings and notice of the issuance of Preliminary maps on an official website, which may be adapted to a digital notification process, including potential email notification.

4.6 TRANSITION FROM 1-PERCENT-ANNUAL-CHANCE FLOOD DETERMINATION TO LOCATION-SPECIFIC FLOOD FREQUENCY AND STRUCTURE-SPECIFIC FLOOD RISK DETERMINATION

Users of FIRMs generally focus on the SFHA boundary and whether a property is in or out of the SFHA. This focus leads to an inadequate understanding of actual flood hazards and risk for properties, both inside and outside the SFHA. Too often, property owners and other stakeholders think being outside the SFHA means the property is safe from flooding, when in fact this is not the case. As stated in the 2015 Annual Report, "The focus on the 1-percent-annual-chance floodplain may give a false sense of safety and discourage flood insurance purchase for buildings outside the 1 percent-annual-chance floodplain with a substantial flood risk from large flood events." Similarly, simply determining that a property is inside the SFHA does not sufficiently capture the exact nature and severity of flood hazards. The current in versus out method of determining risk does not identify at which flood frequency a particular parcel or structure may flood, other than at the 1-percent-annual-chance flood condition.

To determine a specific risk, information is needed concerning the frequency and severity of the hazard, as well as the type of structure construction and location relative to the flood hazard, both horizontally and vertically. It is the TMAC's intention that "location-specific" refers to the hazard at a specific location. It is also the TMAC's intention that structure-based risk assessments may include both existing and proposed structures.

Another issue is that the current FEMA insurance rating approach, which uses average flood frequency curves and groups buildings into whole-foot rating categories (based on the level of the lowest floor above or below the BFE), does not account fully for spatial variations in flood risk. Use of this approach may lead FEMA to over- or underestimate the flood risk and related insurance premium for a particular structure. For example, under the current system, two buildings that are identical, in the same flood hazard zone, and flooded to the same depth during the 1-percent-annual-chance flood have the same flood insurance premium. However, the 10-percent-annual-chance flood event may inundate one structure and not the other. Therefore, the two buildings clearly are exposed to different flood hazards and have different levels of flood risk.

The TMAC concluded that a more robust flood hazard characterization is needed that considers flood frequency information, structure characteristics, and functions that relate flood hazards and structure characteristics to predict structure damage under various flood frequencies. The TMAC recommends that FEMA require demonstration projects to better define data needs, guidelines, standards, and models for structure-based risk assessments. However, since lenders currently are required by law to determine whether a structure is in or out of the SFHA, any new hazard characterization method must preserve the ability of lenders to make such determinations. The TMAC's assessment led to Recommendations 10 and 14 in the 2015 Annual Report, shown below for reference:

> **2015 Annual Report 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.
>
> **2015 Annual Report 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 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.
> - 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.
> - FEMA and its partners should develop guidelines, best practices, and approaches to implementing structure-specific risk assessments.

In 2016, the TMAC developed the following implementation actions as further suggestions to FEMA on implementing the above recommendations.

4.6.1 IMPLEMENTATION ACTION 6.1

IMPLEMENTATION ACTION 6.1

FEMA and its partners should identify data needs and standards for developing and maintaining accurate, location-specific flood frequency information, including associated flood conditions (e.g., velocity, waves, erosion, duration, for both present and future flood conditions).

(Supports 2015 Annual Report, Recommendation 10)

Data standards and requirements should be driven by inputs needed for structure-specific flood risk estimates and structure-specific flood insurance rating. Determining estimated loss for a structure requires determining the potential flood inundation depth and flood damage using flood damage functions. Damage functions relate the depth of flooding (and sometimes other flood parameters) to the fraction of structure value lost due to flooding. If significant, the velocity and/or wave and other flood conditions may be considered and have their own damage functions applied.

Determining the depth of flooding at a given structure requires location-specific knowledge of flood elevations and associated flood conditions for multiple flood frequencies (also called recurrence intervals). FEMA standards for such information are focused on the base flood (1 percent-annual-chance recurrence interval). As discussed in Section 4.4 of the 2015 Annual Report, FEMA's *Guidelines and Standards for Flood Risk Analysis and Mapping* (2016e) requires that all riverine studies include the 10-, 4-, 2-, 1-, and 0.2-percent and "1 percent plus" annual-chance recurrence intervals (Standard ID 84). Flood studies completed under Risk MAP contain flood elevations and associated flood conditions (e.g., depth, velocity, waves, erosion during floods) for multiple frequencies, but this information is not shown on the FIRMs. Some of the multi-frequency information may be included in the FIS report, Digital FIRM database, and flood risk products, but the information in these products has been developed with varying methods and may not be understandable to many users.

Exceptions to the above are riverine Zone A studies that were developed prior to Risk MAP that likely do not have multi-frequency flood data. Similarly, current standards for coastal FIS only require calculation of the 1- and 0.2-percent-annual-chance floodplain and associated flood elevations. As a result of these exceptions, there is a gap in multi-frequency information in FEMA's riverine and coastal flood hazard inventory. This information is needed before FEMA can move towards multi-frequency structure-specific risk determinations.

As FEMA evaluates closing the above-described data gap, the endpoints for multi-frequency FISs should be evaluated. Complete analyses for frequencies up to 0.2-percent-annual-chance (500-year) could be incorporated in new, detailed studies at nominal additional cost. Incorporating such information into new, less detailed studies should also be evaluated. Additionally, the benefits and level of effort and cost required to include less frequent (higher return period) floods into both detailed and less detailed studies should be evaluated.

4.6.2 IMPLEMENTATION ACTION 6.2

IMPLEMENTATION ACTION 6.2

FEMA and its partners should identify data needs and standards for developing and maintaining accurate structure characteristics needed for risk estimation. Included in this should be a review of building characteristics data in existing flood risk estimation models, projects, programs, and databases.

(Supports 2015 Annual Report, Recommendation 14)

Implementation Action 6.1 discussed the need to have multi-frequency data to determine the flood depth and flood characteristics at a defined location. Estimating risk also requires knowledge of the building location, building characteristics, building value, and building flood vulnerability.

Various programs and data sets have been developed to estimate flood losses (e.g., Hazus, private loss estimation models) and these data sets should be reviewed to determine how best to employ them to characterize individual structures. Most of current tools are applied to large numbers of buildings to determine aggregate flood losses during a given scenario or on an annualized basis.

At a minimum (e.g., in cases where flood depth is the only flood parameter needed for flood risk estimates), the following data should be considered:

- **Building location** – Can be obtained from building footprint data or from other building data sources.
- **Building occupancy and characteristics (e.g., residential, commercial; number of stories)** – Needed to select appropriate flood damage functions. These data can be obtained from permit files, field surveys, or various local and national data sets.
- **Building floor elevation** – Needed to determine flood depth. These data can be obtained from Elevation Certificates (where they exist), field surveys, or estimates using ground elevations and building characteristics.
- **Building value** – Can be obtained from local or national data sets.
- **Building foundation** – Building foundation (e.g., slab, crawlspace, pile, other) information can be obtained from permit files, field surveys, or local and national databases.
- **Other building characteristics** – Other building characteristics (e.g., type of construction [wood, steel, masonry, concrete], building age and building code used) can be obtained from permit files, field surveys, or local and national databases.

4.6.3 IMPLEMENTATION ACTION 6.3

IMPLEMENTATION ACTION 6.3

FEMA and its partners should review and, if needed, modify flood damage functions to better capture structure-specific damage resulting from various flood hazards.

(Supports 2015 Annual Report, Recommendation 14)

Damage functions should be developed so they correctly relate flood hazards and building damage, even when using a minimum amount of flood and building information. In cases where flood energy is minimal and damage results primarily from the wetting of building components, simple depth-damage functions (DDFs) should be adequate to estimate damage. However, in cases where flood energy leads to flood damage beyond that caused by wetting, more complex damage functions will be needed.

Existing DDFs are based on post-flood damage assessments, insurance claims data, and expert opinion. There are two main issues with these DDFs: (1) they represent expected average flood damage for large numbers of similar structures and may not capture the true range of damage to those structures, even when subject to the same flood depth; and (2) they use flood depth as a proxy for other flood conditions (e.g., velocity, waves, erosion), but those flood conditions can vary significantly for a given flood depth. Therefore, calculating structure-specific flood risk estimates will require better damage functions than are currently available.

Some work has been carried out developing improved damage functions that include depth, velocity, waves, and other flood characteristics. These studies, which have been conducted by FEMA, USACE, the National Academy of Sciences, and various universities, should be reviewed. A partial annotated list is provided below:

- "Supporting Documentation for D.4.9.2.1 High Velocity Flow VE Zone" (Jones, 2004): Summarizes the state of the art in damage functions based on flood depth and velocity.
- *North Atlantic Coast Comprehensive Study: Resilient Adaptation to Increasing Risk (USACE, 2015):* Includes a chapter on updated flood damage functions.
- *Tying Flood Insurance to Low-Lying Structures in the Floodplain (NRC, 2015):* Research would be required to determine the most important drivers of flood damage to a structure and develop appropriate damage functions for use in rate calculations.
- University publications: In recent years, many universities (e.g., Colorado State University, Louisiana State University, University of Notre Dame) have performed research on building vulnerability to flood and have developed specialized damage (fragility) functions for flood effects.

4.6.4 IMPLEMENTATION ACTION 6.4

IMPLEMENTATION ACTION 6.4

FEMA should perform a demonstration(s) to learn from and document data requirements, processes, and standards necessary for nationwide implementation for structure-based risk assessment.

(Supports 2015 Annual Report, Recommendation 10)

FEMA should perform demonstration projects to assess the best procedures for moving toward structure-specific risk calculations and insurance premiums and for measuring success towards this goal. The demonstration projects should consider how best to:

- Produce location-specific multi-frequency flood hazard information (the required resolution will need to be determined based on user needs) for both riverine and coastal environments
- Modify FIRM, FIS, database, and Flood Risk Report/Maps to satisfy user needs
- Obtain user feedback that can refine/improve hazard and risk identification products
- Incorporate structure-specific risk information into real estate, property purchase, insurance rating, and mitigation decisions

4.7 Cooperating Technical Partners: Metrics, Process, and Delegation Methodology

For more than 17 years, FEMA and eligible State, Tribal, and local agencies have been establishing partnerships through FEMA's CTP Program to work toward achieving the goals of Map Mod and the Risk MAP program. Section 4.8 of the 2015 Annual Report includes an overview and detailed assessment of the CTP Program.

BW-12 (42 U.S.C. § 4101a(c)(4)) requires that the TMAC provide FEMA with recommendations for "procedures for delegating mapping activities to State, Tribal, and local mapping partners." The TMAC developed two recommendations in 2015 and provided them in Section 4.8 of the 2015 Annual Report. They are presented below for reference.

2015 Annual Report 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.

2015 Annual Report 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.

In response to Recommendations 19 and 20, FEMA published a draft *CTP Program Five-Year Operations Plan* (5-year CTP Plan) in November 2016 for review by CTPs. The draft 5-year CTP Plan:

- Lays out the following five goals:
  - **Goal 1** – Develop and implement a training program to train CTP stakeholders and FEMA staff on topics relevant to the program
  - **Goal 2** – Evaluate and improve Risk MAP tools and resources, as well as CTP Program processes and pilot initiatives
  - **Goal 3** – Leverage feedback mechanisms to share CTP Program best practices and information
  - **Goal 4** – Integrate performance measures, outcomes, and metrics into the CTP Program to improve and/or evaluate Risk MAP Program planning and grant processes
  - **Goal 5** – Evaluate and integrate, as needed, the Community Engagement and Risk Communication (CERC) program goals
- Proposes a tiered approach to CTP membership. The methodology, metrics, and levels of responsibility for States, local governments, and non-governmental entities vary with the tier that matches the CTP's capabilities and interests.
- Contains a discussion about implementing a format for sharing information—from FEMA to CTPs, peer-to-peer, and from CTPs to FEMA—through the CTP Community of Practice group and the CTP Collaboration Center.

The TMAC agrees with the draft 5-year CTP Plan and FEMA's planned implementation actions. The tiered approach has merit, but will likely need to be refined as it is implemented. The TMAC supports the notion that CTP capacity and efficacy should be built or enhanced through peer-to-peer mentoring and CTP training as outlined in the draft 5-year CTP Plan.

In 2016, the TMAC developed the following implementation actions as further suggestions to FEMA on implementing the above recommendations.

4.7.1 IMPLEMENTATION ACTION 7.1

IMPLEMENTATION ACTION 7.1

FEMA should evaluate the LOMC Review Partnership pilot program and develop clear program requirements, responsibilities, and performance metrics. This information should be used to formally establish the LOMC Review Partnership program, and increase the number of designated communities, where appropriate.

(Supports 2015 Annual Report, Recommendation 19)

The first CTP agreement was signed on May 19, 1999, between FEMA and the Urban Drainage & Flood Control District (UDFCD), which serves the greater Denver metropolitan area. The first LOMC Review Partnership program (formerly LOMC Delegation) Mapping Activity Statement (MAS) was signed, again with UDFCD, on June 4, 2001. LOMC processing by the CTP began on July 1, 2001. LOMC reviews have been changed substantially since then by the creation of the MIP, Map Mod, Risk MAP, digital LOMR attachments, and online submittals.

Over the last 15 years, the LOMC Review Partnership program has expanded to include a total of seven CTPs:

- Urban Drainage & Flood Control District (Colorado)
- State of North Carolina
- City of Charlotte and Mecklenburg County (North Carolina)
- State of Illinois
- State of Alabama
- Harris County Flood Control District (Texas)
- San Antonio River Authority (Texas)

LOMC review partners have different caseloads, funding levels, and workflows, but all partners work from the same MAS template, which means the methods, metrics, and workflows are the same across the program.

To formally establish the LOMC Review Partnership program, FEMA needs develop clear program requirements, roles and responsibilities, and performance metrics. The results of the evaluation can be used to strengthen the partnership path and increase the number of capable CTPs.

4.7.2 IMPLEMENTATION ACTION 7.2

IMPLEMENTATION ACTION 7.2

FEMA should investigate opportunities and obstacles to implementing multi-year funding cooperative agreements that complement the 5-year CTP Plan.

(Supports 2015 Annual Report, Recommendation 19)

CTP activities are funded through grants rather than contracts. The grants generally align with the Federal fiscal year. Funds appropriated near the beginning of the fiscal year are obligated near the end of the year with the period of performance starting at the beginning of the next fiscal year. This means FY15 grants commenced on October 1, 2015. Each year is a new grants cycle with a new Notice of Funding Opportunity, MAS (or Scope of Work for non-profit CTPs), budget narrative, and other relevant documents.

The TMAC finds this process time consuming and burdensome. The CTP Program would benefit from a multi-year MAS, with associated metrics and performance standards, that would extend the grant for a prescribed period provided the outputs are acceptable and timely. The multi-year period of performance could align with and complement the 5-year CTP Plan.

4.7.3 IMPLEMENTATION ACTION 7.3

IMPLEMENTATION ACTION 7.3

FEMA should facilitate and fund demonstration projects for CTPs to incentivize program innovation and efficiencies.

(Supports 2015 Annual Report, Recommendation 19)

In addition to the value of the CTP Program that is described in the 2015 Annual Report, the CTP Program adds value to the Risk MAP Program by:

- **Bringing credibility to communications** – Because CTPs are local, State, and regional partners, they have relationships with and deep knowledge of local communities and communication strategies that bring more program and mapping credibility than the Federal Government can bring by itself.
- **Helping to further Risk MAP goals** – Risk MAP seeks to change behavior at the community level as a result of raising awareness of flood and natural hazard risk and through land use decision-making. Because land use is the nearly exclusive jurisdiction of local government, local and regional CTPs can help further this goal.
- **Supporting State, Tribal, and local capabilities** – The program helps develop State and local expertise and knowledge.
- **Promoting connections between water quantity and water quality** – The agencies that become CTPs are also often involved in stormwater management, environmental conservation, natural resources, resilience, land use planning, and other areas and can promote the connection between floodplain (water quantity) and stormwater (water quality).
- **Increasing local acceptance** – Effectively leveraging CTP relationships may increase local engagement and acceptance of the flood hazard information.

Many CTPs share the same mission, goals, and expected outcomes as FEMA—a more flood-resilient Nation—making them FEMA's partners in the truest sense. However, not all CTPs share the same resources, technical capabilities, or political will. In light of this, FEMA should continue to support CTPs in all three tiers (as defined in the draft 5-year CTP Plan) in a variety of demonstration projects. These projects should be undertaken to align with FEMA's and CTPs' priorities to produce cost-effective and timely flood risk products, minimize overlapping duties and responsibilities with FEMA's PTS and CERC providers, and spur innovation and efficiency for future flood risk identification and assessment needs.

FEMA has made recent strides in increasing collaboration and communication with the CTP community because of the value it offers the Risk MAP Program and has increased the scope available to CTPs to include not only mapping MASs, but also project management MASs and CERC activities. The scope increase is a positive change in that many CERC tasks are well suited to CTPs because they are able to leverage relationships to enhance technical credibility; provide a more customized user service approach via CTP outreach plans, strategic communication, and training to State, Tribal, and local officials; and reduce or manage the number of appeals, Scientific Resolution Panels (SRPs), and other feedback mechanisms. FEMA has also implemented a CTP Community of Practice, CTP Steering Committee, and a CTP Collaboration Center and newsletter, and has included CTPs in other communications channels like the monthly Risk Management Directorate calls.

4.8 Advancing Future Conditions Modeling and Mapping

As described in the Future Conditions report, the NFIP generally does not consider future conditions hydrology or hydraulics for the identification of SFHAs on FIRMs. Some consideration for future conditions in the NFIP occurs via: (1) the Community Rating System; (2) insurance premiums, where flood insurance premium rate setting considers limited future conditions-based actuarial loading; and (3) mapping future conditions for informational purposes (i.e., community use of future conditions hydrology resulting from land use development, applied for non-regulatory mapping purposes).

While these initial actions have been important in supporting State and community efforts to manage both current and future flood risks, FEMA, Congress, and other stakeholders have recognized the need for more comprehensive integration of future conditions information into the NFIP. To that end, the TMAC provided numerous recommendations in its 2015 Annual Report and Future Conditions report on how to ensure that FIRMs incorporate the best available climate science to assess flood risks and advises FEMA to use the best available data and methods to consider the impacts of sea-level rise (SLR), long-term erosion (coastal and riverine), climate-impacted hydrology, and future development on flood risk.

As FEMA responds to the TMAC 2015 reports and begins planning implementation of future conditions modeling and mapping, the timing is opportune for the TMAC to provide further discussion and guidance (in the form of implementation actions) for Recommendation 1 from the 2015 Annual Report and sub-recommendations from the Future Conditions report (shown in Table 4-4).

In 2016, the TMAC developed the following implementation actions as further suggestions to FEMA on implementing the above recommendations.

Table 4-4: Recommendations and Sub-Recommendations Related to Implementation Actions in Section 4.8 of the 2016 Annual Report

2015 ANNUAL REPORT RECOMMENDATION	
Recommendation 1: 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 consider future flood hazards and flood risk.	
FUTURE CONDITIONS REPORT	
RECOMMENDATION*	**SUB-RECOMMENDATIONS***
Recommendation 1 – Provide future conditions flood risk products, tools, and information for coastal, Great Lakes, and riverine areas. The projected future conditions should use standardized timeframes and methodologies wherever possible to encourage consistency and should be adapted as actionable science evolves.	**Sub-Recommendation 3-5 –** FEMA should take into account future development (excluding proposed flood control structures for the base condition/scenario) for future conditions mapping. An additional scenario can be generated that does include future flood control structures. **Sub-Recommendation 4-11 –** FEMA should develop a policy and standards on how to consider and determine erosion zones that are outside of the SFHA, as they ultimately affect flooding and environmental conditions within the SFHA.
Recommendation 2 – Identify and quantify accuracy and uncertainty of data and analyses used to produce future conditions flood risk products, tools, and information.	**Sub-Recommendation 3-7 –** FEMA should publish multiple future conditions flood elevation layers that incorporate uncertainty so as to provide a basis for building designs that lower flood risk.
Recommendation 3 – Provide flood hazard products and information for coastal and Great Lakes areas that include the future effects of long-term erosion and sea/lake level rise.	**Sub-Recommendation 4-6 –** FEMA should develop guidance for incorporating future conditions into coastal inundation and wave analyses. **Sub-Recommendation 4-8 –** FEMA should develop consistent methods and models for long-term coastal erosion hazard mapping. **Sub-Recommendation 5-4 –** FEMA should use Parris et. al (2012) or similar global mean sea level scenarios, adjusted to reflect local conditions, including any regional effects (Local Relative Sea Level) to determine future coastal flood hazard estimates **Sub-Recommendation 5-5 –** FEMA should work with other Federal agencies (e.g., National Oceanic and Atmospheric Administration, U.S. Army Corps of Engineers, U.S. Geological Survey), the U.S. Global Change Research Program, and the National Ocean Council to provide a set of regional sea-level rise scenarios, based on the Parris et al. (2012) scenarios, for the coastal regions of the United States out to the year 2100 that can be used for future coastal flood hazard estimation. **Sub-Recommendation 5-7 –** FEMA should prepare map layers displaying the location and extent of areas subject to long-term erosion and make the information publicly available.

2015 ANNUAL REPORT RECOMMENDATION	
Recommendation 4 – Provide future conditions flood risk products and information for riverine areas that include the impacts of: future development, land use change, erosion, and climate change, as actionable science becomes available.	**Sub-Recommendation 4-9 –** FEMA should determine long-term riverine erosion hazard areas for areas subject to high erosion and provided to the public in a digital layer. **Sub-Recommendation 4-10 –** FEMA should use a national standard for riverine erosion zone delineations that reflects geographic variability. **Sub-Recommendation 5-6 –** FEMA should take the impacts of future development and land use change on future conditions hydrology into account when computing future conditions for riverine areas. **Sub-Recommendation 5-8 –** FEMA should implement riverine erosion hazard mapping (channel migration zones), leveraging existing data, models, and approaches that reflect site-specific processes and conditions.
Recommendation 5 – Generate future conditions data and information such that it may frame and communicate flood risk messages to more accurately reflect the future hazard in ways that are meaningful to and understandable by stakeholders. This information should enable users to make better-informed decisions about reducing future flood-related losses.	—
Recommendation 6 – Perform demonstration projects to develop future conditions data for representative coastal and riverine areas across the Nation to evaluate the costs and benefits of different methodologies or identify/address methodological gaps that affect the creation of future conditions data.	**Sub-Recommendation 5-3 –** FEMA should conduct future conditions mapping pilots to continue to refine a process and methods for mapping and calculating future flood hazards, and capture and document best practices and lessons learned for each.

For brevity, latter portions of some recommendations and sub-recommendations have been omitted.
For the full text, refer to the Future Conditions report.
NOTE: Recommendation 2 in the 2016 Program Review encompasses all of the recommendations in the Future Conditions report.

In response to the TMAC's two 2015 reports, FEMA established a framework for evaluating and implementing the recommendations, including assessing estimated resources, level of effort, timeframe, challenges, impacts, and other considerations.[6] To implement future conditions mapping specifically, FEMA recognizes the need for "significant resources" and planning that considers:

- Scientific research investments
- Transition of state-of-the-art science to national-scale application
- Federal, State, and local coordination
- Political coordination and outreach

6 FEMA, "TMAC Future Conditions Recommendations" (August 8, 2016), presentation to the TMAC.

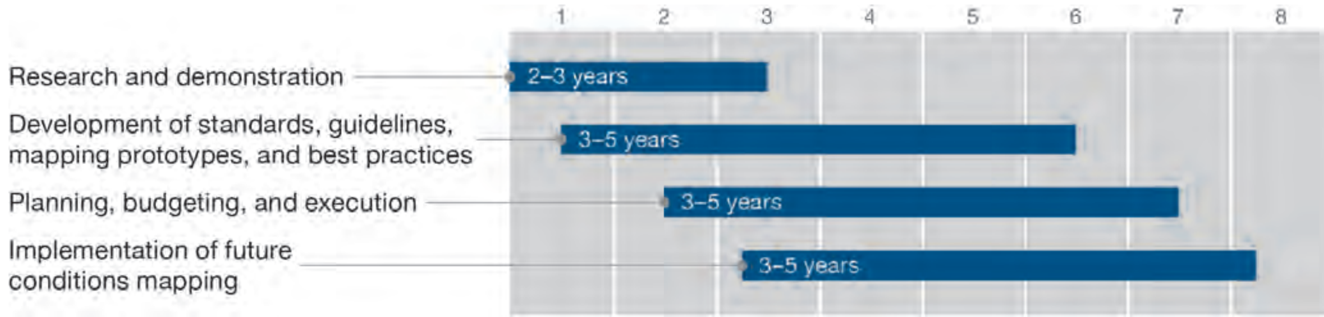


Figure 4-6: Potential phased approach to incorporating future conditions into flood hazard identification and mapping information derived from presentation to the TMAC (FEMA, 2016)

In 2016, the TMAC developed the following implementation actions as further suggestions to FEMA on implementing the above recommendations. Implementation Actions 8.1 to 8.7 are grouped into the following topic areas:

- Completed and Ongoing Future Conditions Mapping Projects
- Implementation Action 8.1
- Recent Advances in Modeling and Mapping Future Conditions
- Implementation Actions 8.2 and 8.3
- Advancing Consideration of Future Conditions in FEMA's Mapping Program
- Implementation Actions 8.4 to 8.7

These implementation actions draw from recent developments in the climate-related research and policy communities. These actions will strengthen the technical and programmatic foundation of any new future conditions flood hazard modeling and mapping that FEMA implements over the coming years.

4.8.1 COMPLETED AND ONGOING FUTURE CONDITIONS MAPPING PROJECTS

As described in this section, multiple flood hazard modeling and mapping projects have been completed by various entities. Most assess the impacts of SLR on future flooding. Several are FEMA-funded SLR proof of concept or pilot studies, completed specifically in the context of the NFIP's mapping program and intended to explore particular scientific and engineering issues. Other projects were conducted by other Federal, State, local, and academic entities for varying purposes.

FEMA Puerto Rico Study (Batten et al., n.d.) – FEMA's Puerto Rico study evaluated the feasibility of producing a SLR advisory layer that could be added to a FIRM. The selected study areas consisted of two reaches totaling 10 miles of coastline. Various analytical methods were evaluated for accuracy against a baseline established through a typical Flood Insurance Study-type approach ("direct approach") using the Advanced Circulation (ADCIRC) Model for Oceanic, Coastal, and Estuarine Waters. Methods for estimating changes to storm surge included the Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model, as well as linear superposition. The Puerto Rico study also evaluated overland wave height methods, including Wave Height Analysis for Flood Insurance Studies (WHAFIS), the FEMA Hazus coastal Flood Information Tool (FIT) and Coastal Flood Model software, geospatial application depth-limited wave relationships, and simple calculation of BFE changes based on BFE representation and simple wave equations.

The Puerto Rico study found that linear superposition was a suitable proxy in lieu of the direct approach for SLR-induced changes in storm surge return period elevations for the Puerto Rico study areas. In addition, the study showed that attempts at deriving wave hazard zone boundaries using the Hazus FIT/Coastal Flood Model consistently over-predicted the boundaries as compared to modeled baseline results. However, the derivation of SLR-related BFE changes using simple relationships based on the distribution of wave elevations across flood zones and through simple wave equations was found to be effective.

North Carolina (2014) – The North Carolina Sea Level Rise Impact Study evaluated the exposure and potential impacts associated with SLR along North Carolina's coast (North Carolina Office of Geospatial and Technology Management, n.d.). The study was structured to quantify changes to the coastal flood hazard environment, assess possible exposure of the built environment at the structure level, and evaluate strategies to reduce long-term losses. The study modeled the response to SLR scenarios of 0.7 feet and 1.3 feet that were based on future projections of observed historical trends across the State.

Study results showed that these scenarios would result in substantial increases (on the order of 20 percent) to the regulatory (1-percent-annual- chance) floodplain and even larger increases to the 10-percent-annual-chance floodplain. The 1.3 feet scenario caused a 47 percent increase to the regulatory floodplain. In addition, the study concluded that when sea level increased, the flow dynamics of the estuaries changed and ultimately resulted in inundation of the land separating Albemarle and Pamlico sounds, causing the storm surge characteristics to change. The change in storm surge characteristics resulted in a non-linear relationship between SLR and the BFE.

Post-Sandy Mapping – New York and New Jersey (2013) – In the aftermath of Superstorm Sandy, FEMA partnered with NOAA, USACE, and the U.S. Global Change Research Program (USGCRP) to develop a Sea Level Rise Tool.[7] The Sea Level Rise Tool uses linear superposition methods to add SLR elevations to best available percent-annual-chance flood elevations as developed by FEMA. The Sea Level Rise Tool consists of two components: a map tool and an elevation calculator.

The map tool is an interactive map developed by NOAA's Office for Coastal Management that allows users to apply either NOAA SLR curves or SLR scenarios developed by the New York City Panel on Climate Change (NPCC) to visualize the future horizontal expansion of the existing floodplain over broad spatial scales and over long-range planning horizons (i.e., up to 100 years). The maps do not depict future site-specific flood depths or elevations within this horizontal extent, nor do they reflect recalculated wave effects or depict future Coastal High Hazard Areas.

The elevation calculator, developed by USACE, complements the map tool by calculating site-specific projected flood depths based on BFEs (current conditions) combined with a user-specific projected rise in sea levels, out to 100 years.

New York City Panel on Climate Change (2013 and 2015) – The NPCC, first convened in 2008 as a body of leading climate and social scientists charged with developing local climate projections, released climate and SLR projections in a 2009 report (NPCC, 2009). In the wake of Superstorm Sandy, the city reconvened the NPCC on an emergency basis to update its projections to inform planning for rebuilding and resiliency. The updated projections presented information about future climate hazards (including SLR) for the 2020s and 2050s, and provided future coastal flood risk maps (NPCC, 2013). In 2015, the NPCC extended the SLR projections to the 2080s and 2100, and presented new future coastal flood risk maps for those time slices (NPCC, 2015).

7 For more information on the Seal Level Rise Tool, visit http://www.globalchange.gov/browse/sea-level-rise-tool-sandy-recovery.

The NPCC reports use the FEMA FIRM as the base dataset for New York City because the FIRM is used for building code regulations and floodplain management. The 2015 report includes a study comparing the dynamic modeling of SLR on storm surge with linear superposition (or bathtub) modeling. The linear superposition approach used the 90th percentile for the time slices, added those values to the modeled flood elevations and then used GIS to map the floodwater landward until reaching a corresponding topographical elevation.

The NPCC also conducted a study to explore whether there were differences between dynamic modeling of SLR and linear superposition mapping approaches.[8] For New York City, the Panel found that in most cases dynamic and static approaches produce very similar results (plus or minus 2 inches), though there were some exceptions. For the New York City region, future flood uncertainties are much larger than the differences between the dynamic and static flood mapping methods.

USACE North Atlantic Coast Comprehensive Study (USACE, 2015) – The USACE North Atlantic Coast Comprehensive Study (NACCS) was a 2-year study to assess coastal storm and flood risk to vulnerable populations, property, ecosystems, and infrastructure affected by Superstorm Sandy in the northeast of the United States. The study included inundation mapping to support an assessment of vulnerability and resilience and a determination of areas of high risk. The study mapped inundation areas affected by future sea level using the USACE low, intermediate, and high scenarios, and the NOAA high scenario for 26 NOAA gauge locations across the study area at time slices of 2018, 2068, and 2100 (Parris et al., 2012; USACE, 2015). The NACCS also mapped areas exposed to the current 1-percent-annual-chance flood plus a 3-foot relative sea level change allowance. The 3-foot allowance was closely aligned with the USACE/NOAA high scenario for projected relative SLR by year 2068, as well as New York City's recent recommendations (NPCC, 2015).

Flood Insurance Study, City and County of San Francisco, California (FEMA, 2015) – The main purpose of FEMA's San Francisco City and County study was to test whether linear superposition is an adequate alternative to a "direct" (or modeled) approach in areas dominated by wave runup rather than storm surge. In addition, the study investigated methods for incorporating long-term shoreline change into coastal flood studies. Previous FEMA pilot studies of the effect of SLR on future coastal flooding have often failed to consider long-term shoreline change. The San Francisco County study included an 8-mile segment of the open Pacific coast using two scenarios, both out to 2050 and 2100: mid-range SLR projections of 12 and 36 inches and high-range projections of 24 and 66 inches (NRC, 2012).

Study findings indicate that the direct analysis approach to incorporate SLR into the determination of wave runup elevations for coastal floodplain mapping often captured wave runup feedback processes that would not have otherwise been captured by a linear superposition approach for certain shore types. The finding was particularly applicable to steep and erosion-resistant shorelines such as rocky cliffs and coastal structures. In addition, the study found the use of a GIS-based buffering technique to be a viable method to efficiently map future SFHA limits and produce geospatial datasets.

Flood Insurance Study for Prince George's County, Maryland (FEMA, 2016c) – The main purpose of FEMA's Anacostia River pilot study was to investigate approaches to incorporate climate change into future flood predictions at and above the intersection of tidal and riverine floodplains. The study evaluated the future 1-percent-annual-chance flood with a focus on riverine flooding, looking at conditions in 2050 and 2100. A unique aspect of this study was its consideration of the impacts of climate change on riverine flooding. The pilot

8 Philip Orton, "Hydrodynamic Modeling of Future Coastal Flood Hazards for New York City" (presentation to the TMAC Future Conditions Subcommittee, Washington, DC, March 26, 2015).

study included an 8-mile segment of the Anacostia River from its confluence with the tidal flooding along the Potomac River in Washington, DC, to the split of its branches in Prince George's County, Maryland.

The Anacostia River pilot study evaluated a range of flood projection approaches, from simple to complex. In one application of a simpler approach, existing flood study data were used to project future flood conditions. Downscaled Coupled Model Intercomparison Project 3 (CMIP3) and CMIP5 climate and hydrology projection data were used to determine relative rainfall depth increases for future 1-percent-annual-chance floods. Applying these to the hydraulic model, climate change-influenced flood conditions were determined to be equivalent to the existing conditions 0.79-percent-annual-chance (126-year) and 0.70-percent-annual-chance (142-year) floods. Future 1-percent-annual-chance flood profiles were interpolated via regression from existing multi-frequency flood profiles and adjusted for future tidal flooding, and future conditions floodplains were mapped.

FEMA West Florida Sea Level Rise Study – The FEMA West Florida Sea Level Rise study (scheduled for completion in 2017) will provide estimates of future flood risk mapping to Pinellas and Hillsborough Counties in the Tampa Bay area of Florida. The study will also provide information on cost-effective methods to obtain comparable flood risk information in other parts of the United States. The study is investigating 50 miles of coast, divided into two 25-mile reaches: an open ocean coast in Pinellas County and a bay coast in Hillsborough County. The effort leverages an existing FEMA flood study in the area, using the same methods and inputs, but under an SLR scenario of 4.27 feet, which corresponds to a moderate-to-high SLR scenario for the year 2100. The primary questions under investigation are how linear the flooding response is to SLR, and under what conditions the nonlinearity becomes large.

Preliminary findings from the West Florida Sea Level Rise study indicate that surge response is generally linear under the selected scenario, with the 1-percent-annual-chance flood elevation lying within 0.5 foot of that predicted by linear superposition. Some areas, however, show strong nonlinearity, exceeding 1.5 feet. The general pattern indicated is that areas where flooding is shallow or where the 1-percent-annual-chance flood elevation changes rapidly are where stronger nonlinearity can be expected. This finding is consistent with the physical drivers underlying flooding. If the final report confirms this finding, desktop-based estimations using existing FEMA datasets may be feasible. However, larger levels of nonlinearity are, at times, difficult to predict, indicating that more detailed analyses hold some benefits. Continued work in the West Florida study will evaluate changes to overland wave hazards and how alternate methods may be able to similarly predict these changes.

USGS Coastal Storm Modeling System (CoSMoS) (USGS, 2013; ongoing) – The USGS has developed a Coastal Storm Modeling System (CoSMoS v2.0) to predict coastal flooding due to both SLR and storms driven by climate change (Barnard et al., 2014). The wind output from Global Climate Models (GCMs) is fed into a global wave model (e.g., WaveWatch3) to develop wave conditions for the west coast of the United States through 2100. Those offshore wave conditions, combined with tides and storm surge, are modeled down to the local level using a suite of numerical modeling tools (e.g., Delft 3D) to determine coastal water levels that are then projected onto a 2-meter Digital Elevation Model (DEM) to estimate the extent of flooding. Scenarios feature the full spectrum of SLR (0 to 2 meters, 5 meters) and coastal storms (daily conditions, annual, 20-year return period, and 100-year return period) to meet most management planning horizons and degrees of risk tolerance. The associated mapping product tool, available on the "Our Coast, Our Future" project website,[9] allows the user to select from 40 combinations of SLR and storms to visualize the flooding depth, extent, and uncertainty associated with each event, in addition to predictions of wave heights, current strength, and event-based

9 The mapping tool associated with the USGS CoSMoS is available on the "Our Coast, Our Future" project website at http://data.pointblue.org/apps/ocof/cms/.

shoreline change. This information can be overlain with a large database of ecology, land use, and infrastructure attributes.

The latest iteration of CoSMoS (v3.0), currently under development for Southern California (from Point Conception to the U.S./Mexico border), will include long-term coastal evolution projections for sandy beaches and cliffs. These projections will integrate available historical coastal change information and a suite of models to project future coastlines. To meet management needs, the sandy beach and cliff projections will be provided assuming two conditions: (1) "hold the line" – where current armoring at the urban interface continues to function and prevents landward erosion of the structures and (2) "don't hold the line" –where current armoring is not present and coastal erosion is allowed to proceed unencumbered. For sandy beaches, CoSMoS will also provide two nourishment scenarios: (1) historical rates of nourishment are assumed to continue into the future and (2) no further nourishment will continue into the future. The final flooding projections will include an evolved DEM that incorporates the long-term evolution of the coast under the "hold the line" and no nourishment scenario.

The CoSMoS 100-year storm is based on a synthetic future wave climate derived from GCMs and combined with SLR and is thus different from the FEMA 100-year storm, which is derived from historical wave conditions. Future storm conditions are likely to evolve in a fashion that is unlike past conditions and is ultimately dependent on the complicated interaction between the Earth's atmosphere and ocean systems, which GCMs simulate. For that reason, the past several decades of wave measurements may not be indicative of the future wave climate.

4.8.1.1 Implementation Action 8.1

IMPLEMENTATION ACTION 8.1

FEMA should identify and summarize relevant future conditions-related modeling and mapping projects nationwide (Federal or non-Federal sources) that have technical relevance to the NFIP's mapping program, and capture any data standards, modeling and mapping methods, and/or best practices that can inform FEMA's future conditions mapping program.

(Supports recommendations as cited in Table 2-3 of this report)

While the future conditions mapping projects described above are informative in terms of exploring engineering questions and applying various analytical techniques and mapping approaches, they reflect only those projects known to the TMAC during preparation of the Future Conditions report and this report; there may be newer efforts underway across the Federal Government (e.g., in support of implementation of the Federal Flood Risk Management Standard [FFRMS] or led by State/local governments, academic/research institutions, non-profits, or other private sector organizations). Though the body of knowledge around future conditions mapping has grown, there still has not been a concerted effort to comprehensively evaluate and extract from these projects any pertinent standards, methods, or techniques that FEMA could use as a foundation for its own efforts to model and map future conditions.

To act on Implementation Action 8.1, FEMA should focus on casting a wider net to capture the most scientifically or technologically significant studies. Such an analysis would inevitably reflect a snapshot in time, with new science or mapping projects likely to be released before the analysis is complete. While beneficial for FEMA to continue to monitor this field for advances, the primary aim of this implementation action is to equip FEMA with the most robust technical basis possible as early as possible in the implementation planning process.

4.8.2 RECENT ADVANCES IN MODELING AND MAPPING FUTURE CONDITIONS

The Future Conditions report provides a comprehensive overview of the key scientific and engineering aspects of assessing and quantifying future flood hazards, as well as existing technical gaps and challenges. This section summarizes recent advances, which include research studies, publications, and other scientific and/or engineering advances in identifying riverine and coastal future conditions since the publication of the Future Conditions report.

4.8.2.1 Riverine Erosion Hazards

As discussed in the Sections 2.3.2 and 4.5 of the Future Conditions report, riverine erosion is a complex physical process involving the interaction of numerous factors, including fluvial hydraulics, geotechnical stability, sediment transport, watershed characteristics, land use, and vegetation. Riverine erosion can dramatically alter the landscape within and outside the mapped floodplain, not only during large flood events but also over time via a sequence of smaller floods.

Despite a finding in FEMA's riverine erosion hazard mapping feasibility study (FEMA, 1999) that "…there are scientifically sound procedures for delineating riverine erosion hazard areas," such hazards are not mapped comprehensively across the United States. While the NFIP regulations (44 CFR 59.1) provide for designation of a Zone E for "flood-related erosion," the zone has never been implemented. Many states and municipalities have, however, moved forward and developed erosion hazard identification and mitigation programs using local knowledge to develop erosion risk information for land-use planning and construction regulations (ASFPM, 2016). For example, the States of Vermont, New Hampshire, Washington, and Indiana have robust erosion mapping programs (ASFPM, 2016), and Colorado is exploring delineation of planning-level channel migration zones (TMAC, 2015b).

4.8.2.1.1 Implementation Action 8.2

IMPLEMENTATION ACTION 8.2

FEMA should review existing State-level riverine erosion hazard mapping programs to determine what data standards, modeling and mapping methods, and/or best practices are transferable (i.e., broadly applicable) for potential nationwide implementation of riverine erosion hazard mapping. FEMA should also capture those standards and methods that are applicable to specific geographies or physical settings (analogous to coast-specific models and guidance used in FEMA's current coastal flood study process).

(Supports recommendations as cited in Table 2-3 of this report)

Recognizing the maturity of the field of riverine erosion hazard identification and management, the TMAC provided multiple recommendations for FEMA in its Future Conditions report to establish standards and procedures for determining erosion hazard areas and to disseminate such information. While there are published reports and other resources available that provide guidelines or methods for risk assessment and mapping reflecting State and local efforts, there has been no comprehensive analysis of the suite of available methods

(ASFPM, 2016), nor an assessment of what approaches may have broader applicability elsewhere in the United States versus those that are more appropriate for addressing regional or localized physical processes. Such an assessment, described in Implementation Action 8.2, is a necessary first step for FEMA to address the TMAC FY15 recommendations.

4.8.2.2 Riverine Hydrology

Understanding and modeling riverine future conditions remains an active area of research and development, with a myriad of governmental, academic, non-profit, and private sector entities working to identify and apply approaches to determine future conditions flood hazards based on best available science and information.

Climate-change impacts on flood frequency and magnitude remain largely unknown, especially at the watershed scale. Although some regions of the country exhibit changes in flood frequency, the direction and magnitude of these changes diverge (Ryberg et al., 2015; Archfield et al., 2016). Given the broad and substantial influence of land-use and land-cover change, attribution of observed peak flow trends is difficult. Where changes have been detected, their spatially variable nature across the United States implies that a uniform adjustment in flood-frequency estimates across the country is not viable. New tools, such as the USACE Nonstationarity Detection Tool, address some limitations in FEMA's understanding and make new avenues of investigation possible. These advances, alongside the emerging needs to implement the new FFRMS and the updated engineering guidance issued by the Federal Highway Administration (2016), are prompting more concerted efforts towards addressing the issue.

The impacts of urbanization are much better understood and more easily incorporated into future flood-frequency determination and mapping. Several communities already use zoning plans and "full build-out" conditions to map future flood extent.

Even where such plans are not available, new tools permit the projection of urbanization and land-use change that might be incorporated into flood models and regional flood-frequency equations. Nationally applicable urban flood-frequency equations have not been updated since the early 1980s (Sauer et al., 1983). New equations that take into account more recently collected hydrologic and land-use data would enable a broad and consistent estimation of the impacts of urban development on flood frequencies.

4.8.2.3 Sea-Level Rise

Sub-recommendation 5-5 in the Future Conditions report encouraged FEMA's engagement in interagency activities to develop regional sea-level rise scenarios that can be used for estimating future flood hazards. The USGCRP and the National Ocean Council jointly convened the Sea Level Rise and Coastal Flood Hazard Scenarios and Tools Interagency Task Force. Comprising representatives from NOAA, USACE, USGS, FEMA, and USGCRP, this task force was established to develop regional SLR scenarios based on input from the U.S. Department of Defense report, *Regional Sea Level Scenarios for Coastal Risk Management* (Hall et al., 2016). The task force is expected to complete the scenarios by fall 2017. These refined scenarios will be incorporated into the Fourth National Climate Assessment,[10] and will enable more localized SLR analyses that not only take into account global SLR and local subsidence, but also other geophysical and oceanographic processes known to affect regional sea level. The refined scenarios will serve as an important resource for future FEMA-sponsored future conditions

10 The Fourth National Climate Assessment is in development. This quadrennial report will include regional SLR scenarios developed by the Sea Level Rise and Coastal Flood Hazard Scenarios and Tools Interagency Task Force. For more information, visit http://www.globalchange.gov/engage/process-products/fourth-national-climate-assessment.

demonstration projects and, ultimately in flood studies completed under any new future conditions mapping program.

4.8.2.4 Long-Term Coastal Erosion Hazards

As noted in the Future Conditions report, long-term coastal erosion (LTCE) fundamentally alters coastal landscape over time, and can lead to substantial shifts in flood hazards. Although influenced by SLR (among many physical processes), LTCE is typically depicted and managed as a separate hazard. As described in Section 5.4.1 of the Future Conditions report, there are myriad approaches to identifying LTCE. USGS has a national approach and products, and States have approaches that support coastal management and regulatory programs. The research community, including Federal agencies and non-profit partners, is working on process-based modeling that encompasses landscape change (including shoreline retreat) driven by SLR and other processes, but actionable science and information from these efforts are not yet available (Elko et al., 2015; Holman et al., 2015).

While having a separate layer of information on LTCE can be helpful to communities, what many users seek are maps that show flood hazards that already incorporate the effects of LTCE. The scientific community, however, has not developed consensus on technically defensible ways to integrate LTCE and SLR into modeling of coastal flood hazards and coastal floodplain mapping.

FEMA's San Francisco study (see Section 4.8.1) considered both processes, but ultimately factored LTCE into the mapping using historical erosion rates that included an acceleration factor and were extrapolated into the future and mapped as a buffer to the existing floodplain. The North Carolina study (see Section 4.8.1) evaluated geomorphic change associated with event-driven erosion and SLR, but did not specifically factor in LTCE. The USGS's CoSMoS modeling effort (see Section 3.4.1) integrates all relevant factors dynamically, but its underlying flood model differs from those used in FEMA's coastal studies and CoSMoS's geographic applicability is currently limited to the West Coast.

Thus, there is still a need to find credible and technically defensible approaches for combining analysis of SLR and LTCE with flooding in the context of FEMA's coastal flood study process for all coasts, an effort that will require further engagement with subject matter experts in this field, including other Federal experts.

4.8.2.4.1 Implementation Action 8.3

IMPLEMENTATION ACTION 8.3

FEMA should include consideration of both SLR and long-term coastal erosion in the modeling and mapping of flood hazards in all new coastal future conditions pilots.

(Supports recommendations as cited in Table 2-3 of this report)

Any such new pilot studies would be well suited to address several other long-standing questions concerning the various methods to evaluate LTCE hazards. For example, efforts could include sensitivity analyses of a range of erosion rates as a means for testing the potential impact of varying erosion rate information (i.e., do variations in rate-calculation methods ultimately influence final flood elevations and zones; what issues may be associated with extrapolating long-term erosion rates, which reflect impacts of past rates of SLR, in light of observed and/or projected acceleration of SLR).

4.8.3 ADVANCING CONSIDERATION OF FUTURE CONDITIONS IN FEMA'S MAPPING PROGRAM

The above sections have addressed the need for FEMA to capture and synthesize existing information, namely the findings and lessons learned from pilot studies, other relevant mapping projects and programs, and recently issued research and data that are foundational to the development of standards and guidelines for future conditions mapping. This section describes other information gaps and challenges that must be addressed at the outset of FEMA's implementation planning to enhance the new program's technical credibility and engagement with and transparency to external partners and stakeholders.

4.8.3.1 Implementation Action 8.4

IMPLEMENTATION ACTION 8.4

FEMA should leverage completed FEMA pilot studies and other relevant coastal and riverine future conditions projects and programs nationwide to prepare a gap analysis that captures outstanding data standards and methodological elements critical to implementing future conditions mapping nationwide.

(Supports recommendations as cited in Table 2-3 of this report)

While FEMA has invested in multiple, localized future conditions pilot studies since 2010, it is difficult for the TMAC to determine what, if any, additional pilots or other research- or demonstration-oriented actions are needed without a complete assessment of the gaps in available science, engineering, and mapping technology. This is the impetus for Implementation Action 8.4.

In the gap analysis, FEMA should assign relative priorities to the gaps identified, use this information as the basis to prioritize follow-on activities (e.g., new pilot studies, stakeholder workshops, establishment of ad-hoc or standing panels of experts), and work towards resolving the highest priority gaps as quickly as possible. Other Federal agencies, external stakeholders, and the research community should be engaged substantively in the planning and conduct of both the gap analysis and prioritization.

4.8.3.2 Implementation Action 8.5

IMPLEMENTATION ACTION 8.5

FEMA should use the existing body of knowledge gained through completed future conditions pilots, evaluation of existing future conditions-related programs, and other relevant Federal and non-Federal efforts to commence development of future conditions modeling and mapping standards and guidelines.

(Supports recommendations as cited in Table 3-6 of this report)

While all of the information desired for developing and issuing future conditions-related products may not yet be available, the findings reported in the Future Conditions report and in the studies and programs described herein suggest there exists a substantial enough body of knowledge for FEMA to begin to outline standards and guidelines.

Rather than waiting for all research efforts and pilots to be completed, standard and guideline development could begin now as a multi-year, stakeholder-informed process. It is highly likely that additional gaps and priorities will be identified through scoping of standards and guidelines, so it would be advantageous for FEMA to commence guidelines work while the gap analysis (Implementation Action 8.4) is underway.

4.8.3.3 Implementation Action 8.6

IMPLEMENTATION ACTION 8.6

FEMA should convene stakeholders and subject matter experts in the initial scoping, development, and review of new future conditions modeling and mapping standards and guidelines (Implementation Action 8.5). This effort should begin as soon as possible to inform the gap analysis and gap prioritization (Implementation Action 8.4), and enable use of any near-term pilots to address critical information needs.

(Supports recommendations as cited in Table 3-6 of this report)

In its preliminary response to the Future Conditions report, FEMA stated it intends to engage with other Federal agencies and stakeholders throughout the anticipated multi-year implementation process.[11] Engaging these partners and end-users in guidelines scoping (and the gap analysis, as noted in Implementation Action 8.4) would provide meaningful opportunities for input, much greater transparency, and increased potential for stakeholder support for the final products.

4.8.3.4 Implementation Action 8.7

IMPLEMENTATION ACTION 8.7

FEMA should develop and test multiple approaches for visualizing future conditions flood risk in one or more future mapping pilots, drawing on relevant social science expertise and lessons learned from prior pilots and other completed mapping projects.

(Supports recommendations as cited in Table 3-6 of this report)

While the TMAC is not recommending that FEMA pursue specific, new future conditions pilot studies, the TMAC remains supportive of FEMA identifying opportunities to partner with communities to explore and resolve technical gaps and programmatic challenges.

Among the issues likely to emerge in the gap analysis and prioritization (Implementation Action 8.4) is the difficulty in depicting future conditions flood risk in ways that are understandable and meaningful to FEMA's diverse target audiences. Findings from the Future Conditions report (as well as FEMA's preliminary response)[12] point to the need to develop mapping prototypes—that is, standardized ways of depicting future flood hazards that are readily interpretable by users and complement the regulatory (existing conditions) data shown today on FIRMs.

11 FEMA, "TMAC Future Conditions Recommendations" (August 8, 2016), presentation to TMAC.
12 Ibid.

5. Glossary

The glossary is based in part on the glossary in the 2015 Annual Report except.

0.2-percent-annual-chance recurrence interval – Flood with a 0.2 percent chance of being equaled or exceeded in any given year.

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

2-percent-annual-chance recurrence interval – Flood with a 2 percent chance of being equaled or exceeded in any given year.

4-percent-annual-chance recurrence interval – Flood with a 4 percent chance of being equaled or exceeded in any given year.

10-percent-annual-chance recurrence interval – Flood with a 10 percent chance of being equaled or exceeded in any given year.

Average Annualized Loss (AAL) – Maximum potential losses for a given year based on five return periods (10, 50, 100, 200, and 500 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.

Base map – The planimetric, or horizontal representation, of map features that show georeferenced locations and contain attribute information (i.e., names) about the items. A base map does not include topographic or elevation data.

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.

Coastal High Hazard Area – An area of special flood hazard extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high-velocity wave actions from storms or seismic sources.

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 rules 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.

Community Rating System (CRS) – A FEMA initiative, established under the NFIP, to recognize and reward communities that have implemented floodplain management measures beyond the minimum required by NFIP regulations. Under the CRS, those communities that choose to participate voluntarily may reduce the flood insurance premium rates for property owners in the community by taking these additional actions.

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

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.

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.

Flood Insurance Study Report (FIS Report) – The FIS Report contains detailed information of the FIS including flood elevation data in flood profiles and data tables.

Flood Insurance Rate Map Database (FIRM database) – The FIRM database stores the digital GIS data used in the FIRM production process, as well as tabular information inside the FIS Report. The FIRM database provides a standard, systematic method for FEMA to distribute comprehensive details of flood hazard identification studies to the public and others in digital format.

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.

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.

Floodway – See Regulatory Floodway.

Geodatabase – Database or file structure used primarily to store, query, and manipulate spatial data that are conveyed through geometry, a spatial reference system, attributes, and behavioral rules for data. The data may be stored in a Relational Database Management System or a system of files. Many types of geographic datasets can be collected within a geodatabase, including feature classes, attribute tables, raster datasets, network datasets, and/or topologies.

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.

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.

Hazus – A nationally applicable standardized methodology that contains models for estimating potential losses from earthquakes, floods and hurricanes. Hazus uses GIS technology to estimate physical, economic, and social impacts of disasters.

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

Letter of Final Determination (LFD) – The letter in which FEMA announces its final determination regarding the flood hazard information, including (when appropriate) proposed and proposed modified BFEs, presented on a new or revised FIRM and FIS Report for a particular community. In the LFD, FEMA begins the compliance period and establishes the Effective date for the new or revised FIRM and FIS Report.

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.

Letter of Map Revision (LOMR) – FEMA's modification to an Effective FIRM. LOMRs are generally based on the implementation of physical measures that affect the hydrologic or hydraulic characteristics of a flooding source and thus result in the modification of the existing regulatory floodway, the BFEs, or the SFHA. The LOMR officially revises the FIRM and sometimes the FIS.

Letter of Map Revision Based on Fill (LOMR-F) – An LOMC issued by FEMA when FEMA determines that a legally defined parcel of land or structure has been elevated above the BFE based on the placement of earthen fill after the date of the first NFIP map.

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.

Levee analysis and mapping procedure (LAMP) – Document created to outline the process used by FEMA to analyze and map areas on the landward side of non-accredited levee systems that are shown on FEMA's FIRMs.

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.

Lowest floor – Lowest floor of the lowest enclosed area (including basement). An unfinished or flood resistant enclosure, usable solely for parking of vehicles, building access, or storage in an area other than a basement area is not considered a building's lowest floor provided that such enclosure is not built so as to render the structure in violation of the applicable non-elevation design requirements of 44 CFR § 60.3.

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.

Map Service Center (MSC) – The official public source for flood hazard mapping produced in support of the NFIP. The MSC can be used to find official flood maps, access a range of other flood hazard products and take advantage of tools for better understanding flood risk.

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 are 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.

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 stream gages.

Negatively elevated structure – Structures for which the lowest floor is below the BFE.

Non-regulatory – Unlike regulatory flood hazard products (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.

Polygon – A two-dimensional figure with three or more sides intersecting at a like number of points. (In GIS, a polygon is an area.)

Regulatory floodway – A floodplain management tool that is the regulatory area defined as the channel of a stream, plus any adjacent floodplain areas that must be kept free of encroachment so that the base flood discharge can be conveyed without increasing the BFEs more than a specified amount. The regulatory floodway is not an insurance rating factor.

Special Flood Hazard Area (SFHA) – Area delineated on an NFIP map as being subject to inundation by the base flood. SFHAs are determined using statistical analyses of records of river flow, storm tides, and rainfall; information obtained through consultation with a community; floodplain topographic surveys; and hydrologic and hydraulic analyses.

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.

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.

Zone A – The flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the FIS by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no BFEs or depths are shown within this zone.

Zone D – The flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined but possible.

Zone E – An area of flood-related erosion hazards, defined by the NFIP, but as yet unused on FIRMs.

Zone V – The flood insurance rate zone that corresponds to the 100-year costal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no BFEs are shown within this zone. Mandatory flood insurance purchase requirements apply.

Zone VE, V1-30 – The flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.

Zone X (shaded), Zone B – The flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500- year floodplain, and areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from 100-year flood by levees. No BFEs or depths are shown within this zone.

Zone X (unshaded), Zone C – Areas determined to be outside the 1-percent-annual-chance and 0.2-percent-annual-chance floodplains. Flood insurance is not federally mandated, but lenders can require the purchase of flood insurance in these areas. No minimum Federal floodplain management standards apply.

6. Acronyms and Abbreviations

AAL	Average Annualized Loss
ADCIRC	Advanced Circulation Model for Oceanic, Coastal, and Estuarine Waters
ASFPM	Association of State Floodplain Managers
BFE	Base Flood Elevation
BW-12	Biggert-Waters Flood Insurance Reform Act of 2012
CCO	Consultation Coordination Officer
CDS	Customer and Data Services
CERC	Community Engagement and Risk Communication
CFR	Code of Federal Regulations
CMIP	Coupled Model Intercomparison Project
CNMS	Coordinated Needs Management Strategy
CoSMoS	(USGS) Coastal Storm Modeling System
CRS	Community Rating System
CTP	Cooperating Technical Partner
DDF	depth-damage function
DELV	damage elevation
DEM	Digital Elevation Model
DVT	Database Verification Tool
FC	2015 TMAC Future Conditions Risk Assessment and Modeling
FEDD	Flood Elevation Determination Docket
FEMA	Federal Emergency Management Agency
FFE	first floor elevation
FFRMS	Federal Flood Risk Management Standard
FHD	Flood Hazard Determination
FIPS	Federal Information Processing Standards
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FIT	Flood Information Tool
FRIP	flood risk-rated insurance premium
FRISEL	Flood Risk Study Engineering Library
FY	Fiscal Year
GCM	Global Climate Model
GIS	geographic information system
GPS	global positioning system
Hazus	Hazards U.S. (loss estimation software)
HFIAA	Homeowner Flood Insurance Affordability Act of 2014
HMA	Hazard Mitigation Assistance
HQ	Headquarters
HUC	hydrologic unit code
KDP	Key Decision Point
LAMP	levee analysis and mapping procedure
LAG	Lowest Adjacent Grade
LFD	Letter of Final Determination
LiDAR	Light Detection and Ranging
LOMA	Letter of Map Amendment

LOMC	Letter of Map Change
LOMR	Letter of Map Revision
LOMR-F	Letter of Map Revision Based on Fill
LP-HC	low probability–high consequence
LTCE	long-term coastal erosion
Map Mod	Flood Map Modernization
MAS	Mapping Activity Statement
MHIP	Multi-Year Hazard Identification Plan
MIP	Mapping Information Platform
MSC	Map Service Center
NACCS	North Atlantic Coast Comprehensive Study
NAPA	National Academy of Public Administration
NFIP	National Flood Insurance Program
NHD	National Hydrography Dataset
NOAA	National Oceanic and Atmospheric Administration
NPCC	New York City Panel on Climate Change
NRC	National Research Council
NVUE	New, Validated, and/or Updated Engineering
PCE	Physiological, Climatological, and Engineering
PELV	probability elevation
PFD	primary frontal dune
PPP	Post-Preliminary Process
PTS	Production and Technical Services
QA	quality assurance
QC	quality control
QR	Quality Review; Quarter
Risk MAP	Risk Mapping, Assessment, and Planning
SFHA	Special Flood Hazard Area
SFHDF	Standard Flood Hazard Determination Form
SLOSH	Sea, Lake, and Overland Surges from Hurricanes
SLR	sea level rise
SOMA	Summary of Map Actions
SRP	Scientific Resolution Panel
TMAC	Technical Mapping Advisory Council
TSDN	Technical Support Data Notebook
UDFCD	Urban Drainage & Flood Control District
USACE	U.S. Army Corps of Engineers
U.S.C.	U.S. Code
USGCRP	U.S. Global Change Research Program
USGS	U.S. Geological Survey
WHAFIS	Wave Height Analysis for Flood Insurance Studies

7. References

Archfield, S. A., R. M. Hirsch, A. Viglione, and G. Blöschl. (2016). "Fragmented patterns of flood change across the United States," *Geophys. Res. Lett.*, 43, doi:10.1002/2016GL070590. http://onlinelibrary.wiley.com/doi/10.1002/2016GL070590/abstract?campaign=wolacceptedarticle.

ASFPM (Association of State Floodplain Managers). (2016). *ASFPM Riverine Erosion Hazards White Paper*, ASFPM Riverine Erosion Hazards Working Group, February 2016. http://www.floods.org/ace-images/ASFPMRiverineErosionWhitePaperFeb2016.pdf.

Barnard, P. L., M. van Ormondt, L.H., Erikson, J. Eshleman, C. Hapke, P. Ruggiero, P.N. Adams, and A.C. Foxgrover. (2014). "Development of the Coastal Storm Modeling System (CoSMoS) for predicting the impact of storms on high-energy, active-margin coasts." *Natural Hazards*, doi:10.1007/s11069-014-1236-y.

Batton, B., P. Weberg, M. Mampara, L. Xu. (n.d.) *Evaluation of Sea Level Rise for FEMA Flood Insurance Studies: Magnitude and Time-Frames of Relevance*. http://www.dewberry.com/docs/default-source/documents/evaluation_of_sea_level_rise_for_fema_flood_insurance_studies.pdf. Presentation to the TMAC Future Conditions Subcommittee, February 27, 2015.

Botzen, W., H. Kunreuther, and E. Michel-Kerjan. (2015). "Divergence between Individual Perceptions and Objective Indicators of Tail Risks: Evidence from Floodplain Residents in New York City." *Judgment and Decision Making* 10(4): 365-385.

DHS (Department of Homeland Security). (2005). "Geospatial Data Coordination Policy." Memorandum. https://hazards.fema.gov/femaportal/docs/GeoDataCoord.pdf.

Elko, N., F. Feddersen, D. Foster, C. Hapke, J. McNinch, R. Mulligan, H.T. Ozkan-Haller, N. Plant, and B. Raubenheimer. (2015). "The future of nearshore processes research." *Shore and Beach*, 83(1): p. 13-38.

FEMA (Federal Emergency Management Agency). (1999). *Riverine Erosion Hazard Areas Mapping Feasibility Study*. Technical Services Division, Hazards Study Branch. http://www.fema.gov/media-library-data/20130726-1545-20490-3748/ft_rivfl.pdf.

FEMA. (2006). *Multi-Year Hazard Identification Plan*. Version 2.0. https://www.fema.gov/media-library/assets/documents/6961.

FEMA. (2009). "Feasibility for Providing Flow Depth and Velocity Data within FEMA 1%-Annual-Chance-Flood Special Flood Hazard Areas (SFHAs)." Building Science Technical White Paper (unpublished).

FEMA. (2011). *Geospatial Data Coordination Implementation Guide*. https://hazards.fema.gov/femaportal/docs/GeoDataImplem_V3.pdf.

FEMA. (2015). *Flood Insurance Study, City and County of San Francisco, California. Preliminary*. http://msc.fema.gov.

FEMA. (2016a). *CTP Program Five-Year Operations Plan*. Draft.

FEMA. (2016b). *FEMA Policy Standards for Flood Risk Analysis and Mapping*. FEMA Policy #FP 204-078-1 (Rev 6). https://www.fema.gov/media-library-data/1480449548025-4736d89b89d30fbf102228680c1f8acd/Standards_for_Flood_Risk_Projects_(Nov2016).pdf

FEMA. 2016c. *Flood Insurance Study: Prince George's County, Maryland, and Incorporated Areas*. http://msc.fema.gov.

FEMA. (2016d). FloodSmart.gov. https://www.floodsmart.gov/floodsmart/pages/flooding_flood_risks/ffr_overview.jsp.

FEMA. (2016e). *Guidelines and Standards for Flood Risk Analysis and Mapping*. https://www.fema.gov/guidelines-and-standards-flood-risk-analysis-and-mapping.

FEMA. (2016f). "Tracking the Map Inventory." Presentation to the TMAC, August 2016.

FHWA (Federal Highway Administration). (2016). Hydraulic Engineering Circular No. 17, 2nd Edition: *Highways in the River Environment — Floodplains, Extreme Events, Risk, and Resilience*, FHWA-HIF-16-018. http://www.fhwa.dot.gov/engineering/hydraulics/pubs/hif16018.pdf.

Hall, J.A., S. Gill, J. Obeysekera, W. Sweet, K. Knuuti, and J. Marburger. (2016). *Regional Sea Level Scenarios for Coastal Risk Management: Managing the Uncertainty of Future Sea Level Change and Extreme Water Levels for Department of Defense Coastal Sites Worldwide*. U.S. Department of Defense, Strategic Environmental Research and Development Program. https://www.serdp-estcp.org/content/download/38961/375873/version/3/file/CARSWG+SLR+FINAL+April+2016.pdf.

Holman, R.A., M.C. Haller, T.C. Lippmann, K.T. Holland, and B.E. Jaffe. (2015). "Advances in nearshore processes research: Four decades of progress." *Shore and Beach*, 83(1): p. 39-52.

Jones, C. (2004). "Supporting Documentation for D.4.9.2.1 High Velocity Flow VE Zone" (unpublished paper).

Kahneman, D. (2011). *Thinking, Fast and Slow*. New York: Farrar, Straus and Giroux.

Kousky, C. and H. Kunreuther. (2014). "Addressing Affordability in the National Flood Insurance Program." *Journal of Extreme Events* 1(01):1-28.

Kunreuther, H., N. Novemsky, D. and Kahneman. (2001). "Making Low Probabilities Useful." *Journal of Risk and Uncertainty* 23(2): 103-120.

National Wildlife Federation. (n.d.). *Global Warming and Floods*. http://www.nwf.org/wildlife/threats-to-wildlife/global-warming/global-warming-is-causing-extreme-weather/floods.aspx, Accessed December 11, 2016.

North Carolina Office of Geospatial and Technology Management. (n.d.). *North Carolina Sea Level Rise Impact Study*, Final Study Report (prepared 2014—not released), North Carolina Division of Emergency Management.

NPCC (New York City Panel on Climate Change). (2009). *Climate Risk Information*. New York City Panel on Climate Change, Release Version. http://www.nyc.gov/html/om/pdf/2009/NPCC_CRI.pdf.

NPCC. (2013). *Climate Risk Information 2013: Observations, Climate Change Projections, and Maps*. http://www.nyc.gov/html/planyc2030/downloads/pdf/npcc_climate_risk_information_2013_report.pdf.

NPCC. (2015). "Building the Knowledge Base for Climate Resiliency: New York City Panel on Climate Change 2015 Report." *Annals of the New York Academy of Sciences*, vol. 1336. http://onlinelibrary.wiley.com/doi/10.1111/nyas.2015.1336.issue-1/issuetoc.

NRC (National Research Council). (2012). *Sea-Level-Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future*. Washington, DC: National Academies Press.

NRC. (2015). *Tying Flood Insurance to Flood Risk for Low-Lying Structures in the Floodplain*. Committee on Risk-Based Methods for Insurance Premiums of Negatively Elevated Structures in the National Flood Insurance Program. The National Academies Press, Washington, D.C. https://www.nap.edu/read/21720/chapter/1.

Parris, A., P. Bromirski, V. Burkett, D. Cayan, M. Culver, J. Hall, R. Horton, K. Knuuti, R. Moss, J. Obeysekera, A. Sallenger, and J. Weiss. (2012). *Global Sea Level Rise Scenarios for the U.S. National Climate Assessment*, NOAA Technical Report OAR CPO-1 (2012), http://cpo.noaa.gov/sites/cpo/Reports/2012/NOAA_SLR_r3.pdf.

Ryberg, K.R., F.A. Akyüz, G.J. Wiche, and W. Lin. (2015). "Changes in Seasonality and Timing of Peak Streamflow in Snow and Semi-Arid Climates of the North-Central United States, 1910–2012." *Hydrol. Process*., 30(8): 1208–1218. doi: 10.1002/hyp.10693.

Sauer, V.B., W.O. Thomas, Jr., V.A. Stricker, and K.V. Wilson. (1983). *Flood Characteristics of Urban Watersheds in the United States*. U.S. Geological Survey Water-Supply Paper 2207.

TMAC (Technical Mapping Advisory Council). (2015a). *Future Conditions Risk Assessment and Modeling*. December 2015. https://www.fema.gov/media-library/assets/documents/111853.

TMAC. (2015b). *TMAC 2015 Annual Report*. December 2015. https://www.fema.gov/media-library/assets/documents/111853.

TMAC. (2016). *TMAC National Flood Mapping Program Review*. June 2016. https://www.fema.gov/media-library-data/1474555532007-c063547f6f48026feb68c4bcfc41169d/TMAC_2016_National_Flood_Mapping_Program_Review_Updated.pdf.

Tobin, R.J. and C. Calfee. (2005). *National Flood Insurance Program's Mandatory Purchase Requirements: Policies, Processes, and Stakeholders*. Washington, DC: American Institutes for Research. https://www.fema.gov/media-library-data/20130726-1602-20490-9257/nfip_eval_mandatory_purchase_requirement.pdf.

Tversky, A. and D. Kahneman. (1973). "Availability: A Heuristic for Judging Frequency and Probability." *Cognitive Psychology* 5(2), 207-232.

USACE (U.S. Army Corps of Engineers). (2015). *North Atlantic Coast Comprehensive Study: Resilient Adaptation to Increasing Risk*, Final Report. http://www.nad.usace.army.mil/Portals/40/docs/NACCS/NACCS_main_report.pdf.

USGS (U.S. Geological Survey). (2013). *Coastal Storm Modeling System:* CoSMoS. https://walrus.wr.usgs.gov/coastal_processes/cosmos/.

Weinstein, N.D., K. Kolb, and B.D. Goldstein. (1996). "Using Time Intervals between Expected Events to Communicate Risk Magnitudes." *Risk Analysis* 16, no. 3: 305-308.

Appendix A: Prioritization Model

Table A-1: Prioritization Model (page 1)

Score: 0 – No Impact
1 – Low Indirect Impact
2 – Med/High Indirect Impact or Low Direct Impact
3 – Med/High Direct Impact

Report and Recommendation		Improves Stakeholder Experience								Improves Program Credibility					
Report	Recommendation #	Improves Ability for End-Users to Understand Hazard and Risk Data		Improves Ability for End-Users to Access and Use Hazard and Risk Data		Improves Functionality/Utility of Flood Hazard and Risk Data		Improves Program's Ability to Communicate Risk		Reduces or Explains Uncertainty in Flood Hazard and Risk Data		Increases or Maintains the Valid Flood Hazard and Risk Inventory		Increases Flood Hazard and Risk Products Accuracy via New or Updated Program Standard or Guidance	
		8.33		8.33		8.33		8.33		6.67		6.67		6.67	
		Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
AR 2015	1	2	16.67	2	16.67	3	25.00	2	16.67	0	0.00	0	0.00	2	13.33
AR 2015	2	0	0.00	0	0.00	1	8.33	1	8.33	0	0.00	3	20.00	2	13.33
AR 2015	3	0	0.00	0	0.00	0	0.00	1	8.33	0	0.00	3	20.00	2	13.33
AR 2015	4	1	8.33	0	0.00	2	16.67	2	16.67	3	20.00	3	20.00	3	20.00
AR 2015	5	1	8.33	2	16.67	0	0.00	1	8.33	1	6.67	0	0.00	2	13.33
AR 2015	6	0	0.00	0	0.00	1	8.33	1	8.33	3	20.00	0	0.00	2	13.33
AR 2015	7	1	8.33	1	8.33	0	0.00	1	8.33	3	20.00	0	0.00	3	20.00
AR 2015	8	1	8.33	1	8.33	3	25.00	1	8.33	2	13.33	1	6.67	2	13.33
AR 2015	9	1	8.33	1	8.33	2	16.67	1	8.33	3	20.00	2	13.33	3	20.00
AR 2015	10	3	25.00	2	16.67	3	25.00	2	16.67	2	13.33	0	0.00	3	20.00
AR 2015	11	0	0.00	2	16.67	2	16.67	0	0.00	2	13.33	0	0.00	1	6.67
AR 2015	12	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	2	13.33
AR 2015	13	1	8.33	2	16.67	1	8.33	1	8.33	1	6.67	0	0.00	2	13.33
AR 2015	14	3	25.00	2	16.67	3	25.00	3	25.00	2	13.33	0	0.00	3	20.00
AR 2015	15	3	25.00	0	0.00	0	0.00	3	25.00	0	0.00	0	0.00	1	6.67
AR 2015	16	2	16.67	3	25.00	3	25.00	3	25.00	2	13.33	0	0.00	1	6.67
AR 2015	17	0	0.00	0	0.00	0	0.00	1	8.33	0	0.00	0	0.00	1	6.67
AR 2015	18	1	8.33	1	8.33	2	16.67	1	8.33	3	20.00	0	0.00	2	13.33
AR 2015	19	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
AR 2015	20	1	8.33	0	0.00	0	0.00	2	16.67	0	0.00	1	6.67	0	0.00
AR 2015	21	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
AR 2015	22	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
		3	25.00	3	25.00	3	25.00	3	25.00	3	20.00		0.00		0.00

Table A-1: Prioritization Model (page 1 continued)

				Improves Program Efficiency										
Improves Transparency in Planning and Data Development		Enhances Mapping Partner Capabilities		Improves Program's ability to Leverage Funding to Maintain and Enhance Flood Hazard and Risk Inventory		Introduces New or Streamlined Process and/or Reduces or Eliminates Manual Process		Improves Program's Achieve FIMA Goals, Objectives and Initiatives		Improves Program's Ability to Coordinate with OFAs and other Stakeholders		Promote's Emerging Science and Technology		Total Weighted Score
6.67		6.67		6.67		6.67		6.67		6.67		6.67		100.00
Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	
2	13.33	0	0.00	1	6.67	0	0.00	1	6.67	1	6.67	0	0.00	121.67
3	20.00	2	13.33	3	20.00	2	13.33	3	20.00	3	20.00	0	0.00	156.67
3	20.00	1	6.67	3	20.00	2	13.33	3	20.00	3	20.00	0	0.00	141.67
1	6.67	0	0.00	0	0.00	0	0.00	0	0.00	2	13.33	0	0.00	121.67
2	13.33	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	66.67
2	13.33	1	6.67	0	0.00	0	0.00	0	0.00	1	6.67	0	0.00	76.67
2	13.33	1	6.67	0	0.00	1	6.67	0	0.00	1	6.67	0	0.00	98.33
1	6.67	1	6.67	0	0.00	2	13.33	0	0.00	0	0.00	0	0.00	110.00
1	6.67	1	6.67	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	108.33
2	13.33	1	6.67	0	0.00	3	20.00	0	0.00	0	0.00	3	20.00	176.67
3	20.00	2	13.33	0	0.00	3	20.00	0	0.00	0	0.00	3	20.00	126.67
1	6.67	2	13.33	2	13.33	1	6.67	0	0.00	3	20.00	0	0.00	73.33
2	13.33	2	13.33	0	0.00	3	20.00	1	6.67	0	0.00	2	13.33	128.33
2	13.33	1	6.67	0	0.00	3	20.00	0	0.00	0	0.00	3	20.00	185.00
1	6.67	0	0.00	1	6.67	0	0.00	1	6.67	2	13.33	2	13.33	103.33
3	20.00	1	6.67	0	0.00	3	20.00	0	0.00	0	0.00	3	20.00	178.33
2	13.33	0	0.00	2	13.33	0	0.00	2	13.33	3	20.00	0	0.00	75.00
2	13.33	1	6.67	2	13.33	0	0.00	0	0.00	2	13.33	0	0.00	121.67
1	6.67	2	13.33	3	20.00	0	0.00	1	6.67	3	20.00	3	20.00	86.67
1	6.67	3	20.00	3	20.00	0	0.00	1	6.67	3	20.00	2	13.33	118.33
3	20.00	2	13.33	2	13.33	0	0.00	1	6.67	3	20.00	0	0.00	73.33
0	0.00	0	0.00	3	20.00	0	0.00	3	20.00	3	20.00	0	0.00	60.00
	0.00		0.00											120.00
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Table A-1: Prioritization Model (page 2)

Score
0 - No Impact
1 - Low Indirect Impact
2 - Med/High Indirect Impact or Low Direct Impact
3 - Med/High Direct Impact

Report and Recommendation		Improves Stakeholder Experience								Improves Program Credibility					
Report	Recommendation #	Improves Ability for End-Users to Understand Hazard and Risk Data		Improves Ability for End-Users to Access and Use Hazard and Risk Data		Improves Functionality/Utility of Flood Hazard and Risk Data		Improves Program's Ability to Communicate Risk		Reduces or Explains Uncertainty in Flood Hazard and Risk Data		Increases or Maintains the Valid Flood Hazard and Risk Inventory		Increases Flood Hazard and Risk Products Accuracy via New or Updated Program Standard or Guidance	
		8.33		8.33		8.33		8.33		6.67		6.67		6.67	
		Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
RR	2	1	8.33	1	8.33	3	25.00	3	25.00	3	20.00	0	0.00	2	13.33
RR	3	2	16.67	0	0.00	0	0.00	3	25.00	1	6.67	0	0.00	0	0.00
RR	4	0	0.00	1	8.33	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
RR	5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	2	13.33	0	0.00
RR	6	1	8.33	1	8.33	3	25.00	2	16.67	3	20.00	2	13.33	3	20.00
RR	7	0	0.00	2	16.67	1	8.33	0	0.00	0	0.00	0	0.00	0	0.00
RR	8	2	16.67	3	25.00	3	25.00	3	25.00	2	13.33	0	0.00	1	6.67
RR	9	2	16.67	0	0.00	3	25.00	3	25.00	3	20.00	3	20.00	3	20.00
RR	10	3	25.00	1	8.33	0	0.00	3	25.00	2	13.33	0	0.00	0	0.00
RR	11	0	0.00	0	0.00	0	0.00	1	8.33	0	0.00	3	20.00	2	13.33
RR	12	0	0.00	0	0.00	0	0.00	1	8.33	0	0.00	3	20.00	2	13.33
RR	13	0	0.00	3	25.00	3	25.00	3	25.00	0	0.00	0	0.00	0	0.00
RR	14	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	6.67	0	0.00

Table A-1: Prioritization Model (page 2 continued)

				Improves Program Efficiency										
Improves Transparency in Planning and Data Development		Enhances Mapping Partner Capabilities		Improves Program's ability to Leverage Funding to Maintain and Enhance Flood Hazard and Risk Inventory		Introduces New or Streamlined Process and/or Reduces or Eliminates Manual Process		Improves Program's Achieve FIMA Goals, Objectives and Initiatives		Improves Program's Ability to Coordinate with OFAs and other Stakeholders		Promote's Emerging Science and Technology		Total Weighted Score
6.67		6.67		6.67		6.67		6.67		6.67		6.67		100.00
Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	
0	0.00	1	6.67	0	0.00	1	6.67	2	13.33	1	6.67	3	20.00	153.33
1	6.67	0	0.00	0	0.00	0	0.00	3	20.00	0	0.00	3	20.00	95.00
3	20.00	0	0.00	0	0.00	0	0.00	1	6.67	2	13.33	0	0.00	48.33
2	13.33	2	13.33	3	20.00	0	0.00	2	13.33	3	20.00	0	0.00	93.33
2	13.33	0	0.00	1	6.67	0	0.00	3	20.00	2	13.33	2	13.33	178.33
2	13.33	0	0.00	0	0.00	3	20.00	2	13.33	2	13.33	3	20.00	105.00
3	20.00	1	6.67	0	0.00	3	20.00	0	0.00	0	0.00	3	20.00	178.33
1	6.67	1	6.67	1	6.67	0	0.00	3	20.00	1	6.67	3	20.00	193.33
1	6.67	0	0.00	0	0.00	0	0.00	1	6.67	1	6.67	0	0.00	91.67
3	20.00	1	6.67	3	20.00	2	13.33	3	20.00	3	20.00	0	0.00	141.67
3	20.00	1	6.67	3	20.00	2	13.33	3	20.00	3	20.00	0	0.00	141.67
2	13.33	0	0.00	1	6.67	1	6.67	2	13.33	0	0.00	3	20.00	135.00
1	6.67	0	0.00	3	20.00	0	0.00	3	20.00	2	13.33	1	6.67	73.33
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Appendix B: TMAC Charter

The TMAC Charter in this Appendix is the renewed charter, effective July 29, 2015. The original TMAC Charter was effective July 29, 2013.

Department of Homeland Security
Federal Emergency Management Agency
Technical Mapping Advisory Council

1. Committee's Official Designation:

Technical Mapping Advisory Council

2. Authority:

Pursuant to section 100215 of the Biggert-Waters Flood Insurance Reform Act of 2012, Public Law 112-141, 126 Stat. 924, 42 U.S.C. § 4101a ("the Act"), this charter establishes the Technical Mapping Advisory Council (TMAC or Council). This committee is established in accordance with and operates under the provisions of the Federal Advisory Committee Act (FACA) (Title 5, United States Code, Appendix).

3. Objectives and Scope of Activities:

The TMAC advises the Administrator of the Federal Emergency Management Agency (FEMA) on certain aspects of FEMA's flood Risk MAPping activities.

The TMAC recommends to the Administrator:

A. How to improve in a cost-effective manner the:
    1. Accuracy, general quality, ease of use, and distribution and dissemination of flood insurance rate maps and risk data; and
    2. Performance metrics and milestones required to effectively and efficiently map flood risk areas in the United States.
B. Mapping standards and guidelines for:
    1. Flood Insurance Rate Maps (FIRMs); and
    2. Data accuracy, data quality, data currency, and data eligibility;
C. How to maintain, on an ongoing basis, FIRMs and flood risk identification; and
D. Procedures for delegating mapping activities to State and local mapping partners.

The TMAC recommends 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.

The TMAC submits an annual report to the Administrator that contains a description of the activities of the Council, an evaluation of the status and performance of FIRMs and mapping activities to revise and update FIRMs as required by the Act, and a summary of the activities of the Council. In addition, the TMAC must prepare written recommendations in a future conditions risk assessment and modeling report and submit the recommendations to the Administrator. Further, the Homeowner Flood Insurance Affordability Act (HFIAA) of 2014 requires additional flood mapping review requirements for the TMAC.

4. Description of Duties:

The duties of the TMAC are solely advisory in nature.

5. Official to Whom the Committee Reports:

The TMAC provides advice and recommendations to the Administrator of FEMA.

6. Support:

FEMA shall be responsible for providing financial and administrative support to the Council. Within FEMA, the Risk Analysis Division of the Federal Insurance and Mitigation Administration provides this support.

7. Estimated Annual Operating Costs and Staff Years:

The estimated annual operating cost associated with supporting TMAC's functions is estimated to be $1,100,000 for FY2015 and $800,000 for FY2016. This includes surge support for all direct and indirect expenses and 2.0 FTE of staff support. Adequate staffing within the annual operating cost estimate is required to support the TMAC.

8. Designated Federal Officer:

A full-time or permanent part-time employee of FEMA is appointed by the Administrator as the TMAC Designated Federal Officer (DFO). The DFO or an Alternate DFO approves or calls TMAC meetings, approves meeting agendas, attends all committee and subcommittee meetings, adjourns any meeting when the DFO determines adjournment to be in the public interest, and chairs meetings when requested in the absence of the Chair.

9. Estimated Number and Frequency of Meetings:

Meetings of the TMAC may be held with the approval of the DFO. The Council shall meet a minimum of two times each year at the request of the Chairperson or a majority of its members, and may take action by a vote of the majority of the members.

Council meetings are open to the public unless a determination is made by the appropriate DHS official in accordance with DHS policy and directives that the meeting should be closed in accordance with Title 5, United States Code, subsection (c) of section 552b.

10. Duration:

Continuing

11. Termination:

This charter is in effect for two years from the date it is filed with Congress unless sooner terminated. The charter may be renewed at the end of this two-year period in accordance with section 14 of FACA.

12. Member Composition:

Members of the Council are defined by Section 100215(b)(1), and include four designated members and sixteen appointed members.

The four designated members of the Council serve as Regular Government Employees and consist of:

The FEMA Administrator or the designee thereof;

The Secretary of the Interior or the designee thereof;

The Secretary of Agriculture or the designee thereof; and

The Under Secretary of Commerce for Oceans and Atmosphere or the designee thereof.

The sixteen additional members of the Council are appointed by the Administrator or designee. These members are appointed based on their demonstrated knowledge and competence regarding surveying, cartography, remote sensing, geographic information systems, or the technical aspects of preparing and using FIRMs.

To the maximum extent practicable, the membership of the Council will have a balance of Federal, State, local, tribal and private members, and include geographic diversity including representation from areas with coastline on the Gulf of Mexico and other States containing areas identified by the Administrator as at high risk for flooding or as areas having special flood hazard areas.

These members are selected from among the following professional associations or organizations:

a. One member of a recognized professional surveying association or organization;
b. One member of a recognized professional mapping association or organization;
c. One member of a recognized professional engineering association or organization;
d. One member of a recognized professional association or organization representing flood hazard determination firms;
e. One representative of the United States Geological Survey;
f. One representative of a recognized professional association or organization representing State geographic information;
g. One representative of State national flood insurance coordination offices;
h. One representative of the Corps of Engineers;
i. One member of a recognized regional flood and storm water management organization;
j. Two representatives of different State government agencies that have entered into cooperating technical partnerships with the Administrator and have demonstrated the capability to produce FIRMs;
k. Two representatives of different local government agencies that have entered into cooperating technical partnerships with the Administrator and have demonstrated the capability to produce flood insurance maps;
l. One member of a recognized floodplain management association or organization;
m. One member of a recognized risk management association or organization; and
n. One State mitigation officer.

The non-Federal members in a., b., c., d., i., l., m., and n. serve as Special Government Employees as defined in Title 18, United States Code, section 202(a). The members in e., and h., serve as Regular Government Employees. The non-Federal members in f., g., j., and k. serve as representatives of their respective associations or organizations and are not Special Government Employees as defined in Title 18 of United States Code, section 202(a).

The sixteen appointed members serve terms of office of two years. However, up to half (eight) of those initially appointed to the Council may serve one-year terms to allow for staggered turnover. Appointments may be renewed by the FEMA Administrator for an additional one- or two-year period. A member appointed to fill an unexpired term shall serve the remainder of that term and may be reappointed for an additional one- or two-year term. The Administrator has the authority to extend reappoints for an additional one- or two-year period as deemed necessary. In the event the Council terminates, all appointments to the Council will terminate.

13. Officers:

The Council membership shall elect any one member to serve as Chairperson of the Council. The Chairperson shall preside over Council meetings in addition to specific responsibilities authorized under the Act.

14. Subcommittees:

The DFO may establish subcommittees for any purpose consistent with this charter. Such subcommittees may not work independently of the chartered committee and must present their work to the TMAC for full deliberation and discussion. Subcommittees have no authority to make decisions on behalf of the TMAC and may not report directly to the Federal government or any other entity.

15. Recordkeeping:

The records of the TMAC, formally and informally established subcommittees, or other subgroups of the Council, shall be maintained and handled in accordance with General Records Schedule 26, Item 2 or other approved agency records disposition schedule.

16. Filing Date:

July 20, 2015
Department Approval Date

July 29, 2015
CMS Consultation Date

July 29, 2015
Date Filed with Congress

Appendix C: TMAC Bylaws

The FEMA TMAC Bylaws in this Appendix are the updated bylaws, effective April 29, 2015. The original FEMA TMAC Bylaws were effective July 29, 2013.

Federal Emergency Management Agency
Technical Mapping Advisory Council
Bylaws

ARTICLE I AUTHORITY

As required by the *Biggert-Waters Flood Insurance Reform Act of 2012* (BW-12), codified at 42 United States Code Section 4101a, the Federal Emergency Management Agency (FEMA) Technical Mapping Advisory Council (TMAC) is established. The TMAC shall operate in accordance with the provisions of the *Federal Advisory Committee Act* (FACA), as amended (Title 5, U.S.C., Appendix).

ARTICLE II PURPOSE

The TMAC provides advice and recommendations to the Administrator of FEMA to improve the preparation of flood insurance rate maps (FIRM). Among its specified statutory responsibilities, TMAC will examine performance metrics, standards and guidelines, map maintenance, delegation of mapping activities to State and local mapping partners, interagency coordination and leveraging, and other requirements mandated by the authorizing BW-12 legislation. In addition, TMAC provides advice and recommendations to the FEMA Administrator on future risks from climate change, rising sea levels, and FIRM development, as mandated by BW-12.

ARTICLE III MEMBERSHIP AND MEMBER RESPONSIBILITIES

Section 1. Composition.

Members of the Council include designated members and additional members appointed by the FEMA Administrator or his designee. See 42 U.S.C. § 4101a.

The designated members of the Council are:
- The FEMA Administrator or the designee thereof;
- The Secretary of the Interior or the designee thereof;
- The Secretary of Agriculture or the designee thereof; and,
- The Under Secretary of Commerce for Oceans and Atmosphere or the designee thereof.

The appointed members may be selected from among the following professional associations or organizations:
- A member of a recognized professional surveying association or organization;
- A member of a recognized professional mapping association or organization;
- A member of a recognized professional engineering association or organization;
- A member of a recognized professional association or organization representing flood hazard determination firms;
- A representative of the United States Geological Survey;
- A representative of a recognized professional association or organization representing State geographic information;
- A representative of State national flood insurance coordination offices;
- A representative of the Corps of Engineers;
- A member of a recognized regional flood and storm water management organization;

- Two representatives of different State government agencies that have entered into cooperating technical partnerships with the Administrator and have demonstrated the capability to produce FIRMs;
- Two representatives of different local government agencies that have entered into cooperating technical partnerships with the Administrator and have demonstrated the capability to produce flood insurance maps;
- A member of a recognized floodplain management association or organization;
- A member of a recognized risk management association or organization;
- A State mitigation officer.

Subject Matter Experts/Technical Advisors: The TMAC may hear from subject matter experts/technical advisors ("SMEs") who will be asked to provide specialized information or assistance as appropriate and approved by the Designated Federal Officer (DFO). Individual TMAC members may request SMEs, by expertise or skillset, to appear before the TMAC, as needed. Member requests will be made to the Chair for consideration and consultation with the TMAC Designated Federal Officer (DFO). FEMA will not compensate SMEs for their services but they may be reimbursed for travel and lodging expenses.

Section 2. Appointment.

With the exception of the Secretary of the Interior, Secretary of Agriculture, and Under Secretary of Commerce for Oceans and Atmosphere, members of TMAC are appointed by and serve at the pleasure of the FEMA Administrator in an advisory role. Membership is voluntary and members are not compensated for their services. Appointments are personal to the member and cannot be transferred to another individual. Members may not designate someone to attend in their stead, participate in discussions, or vote. In compliance with FACA, members, while engaged in the performance of their duties away from their home or regular places of business, may be allowed travel expenses, including per diem in lieu of subsistence, as authorized by section 5703 of title 5, United States Code.

Section 3. Terms of Office.

Members of the TMAC may serve terms of office of two years; however, up to half of those initially appointed TMAC members may be appointed to serve one-year terms to allow for staggered turnover. The FEMA Administrator or his designee may reappoint serving members for additional terms. When the TMAC terminates, all appointments to the TMAC shall terminate.

Section 4. Certification of Non-Lobbyist Status.

All members of the TMAC must annually self-certify that they are not registered lobbyists under the Lobbying Disclosure Act, Title 2 U.S.C., Section 1603, and must advise the Department of Homeland Security (DHS) through the Federal Emergency Management Agency if they register as a lobbyist while serving on the TMAC. Members who register as a lobbyist after their appointment or re-appointment will be replaced on the Council.

Section 5. Members' Responsibilities.

Because the TMAC's membership is constructed to balance as many perspectives on floodplain mapping and future risk assessment as possible, member attendance and participation at meetings is vital to the TMAC's mission. Members are expected to personally attend and participate in Council, subcommittee meetings, and conference calls. Members will also be expected to provide written input to any final reports or deliverables.

The DFO or Chair may recommend to the FEMA Administrator that any appointed member unable to fulfill their responsibility be replaced on the Council or subcommittee. Members of the TMAC may be recommended for removal for reasons such as, but not limited to:

a) Missing two consecutive meetings, including teleconference calls;

b) Registering as a lobbyist after appointment; or,

c) Engaging in activities that are illegal or violate the restrictions on members' activities as outlined below.

Section 6. Restriction on Members' Activities.

a) Members may not use their access to the Federal Government as a member of this Council for the purpose of soliciting business or otherwise seeking economic advantage for themselves or their companies. Members may not use any non-public information obtained in the course of their duties as a member for personal gain or for that of their company or employer. Members must hold any non-public information in confidence.

b) The Council as a whole may advise FEMA on legislation or recommend legislative action. In their capacities as members of the TMAC, individual members may not petition or lobby Congress for or against particular legislation or encourage others to do so.

c) Members of the TMAC are advisors to the agency and have no authority to speak for the Council, FEMA, or for the Department outside the Council structure.

d) Members may not testify before Congress in their capacity as a member of the TMAC. If requested to testify before Congress, members of the TMAC:

   1. Cannot represent or speak for the Council, DHS, any agency, or the Administration in their testimony;
   2. Cannot provide information or comment on Council recommendations that are not yet publicly available;
   3. May state they are a member of the Council; and,
   4. May speak to their personal observations as to their service on the Council.

e) If speaking outside the Council structure at other forums or meetings, the restrictions in Section (d) also apply.

ARTICLE IV OFFICIALS

Section 1. TMAC Leadership.

TMAC members will elect a Chair through a nomination and formal vote. (The FEMA Administrator, or his designee, shall serve in this capacity until a Chair is elected.) The Chair will be responsible for appointing one or more Vice Chairs. The Chair and Vice Chairs will serve for either a one or two year term, based on their initial appointment. Appointments may be renewed for an additional one-year term. No Chair or Vice

Chair shall serve longer than three years. The Chair will select chairs for any subcommittee established. Only voting members can serve as subcommittee chairs.

Chair Responsibilities:

a) Appoints officers to assist in carrying out the duties of the TMAC;

b) Works with the DFO to develop meeting agendas;

c) Sets and maintains a schedule for TMAC activities (e.g., report development);

d) Works with the TMAC membership to develop the draft annual report;

e) Signs the final reports addressed to the FEMA Administrator;

f) Coordinates with the DFO to form subcommittees with assigned areas of consideration;

g) Selects subcommittee chairs and vice chairs;

h) Resolves member conflicts.

Vice Chair Responsibilities:

a) Works with subcommittee chairs to ensure work is being completed;

b) Coordinates member engagement;

c) Assists Chair in conducting review of meeting minutes and recommendation reports;

d) Elevates any unresolved issues to the Chair;

e) Serves as Chair in absence of the Chair.

Subcommittee Chair Responsibilities:

a) Works with the DFO to develop subcommittee meeting agendas;

b) Facilitates subcommittee discussions;

c) Reports to the Chair and Vice Chair; and

d) Reports out subcommittee work at quarterly TMAC meetings.

Section 2. Designated Federal Officer.

The DFO serves as FEMA's agent for all matters related to the TMAC and is appointed by the FEMA Administrator. In accordance with the provisions of the FACA, the DFO must:

a) Approve or call meetings of the Council and its subcommittees;

b) Approve agendas for Council and subcommittee meetings;

c) Attend all meetings;

d) Adjourn meetings when such adjournment is in the public interest; and,

e) Chair meetings of the Council when directed to do so by the FEMA Administrator.

In addition, the DFO is responsible for assuring administrative support functions are performed, including the following:

a) Notifying members of the time and place of each meeting;

b) Tracking all recommendations of the Council;

c) Maintaining the record of members' attendance;

d) Preparing the minutes of all meetings of the Council's deliberations, including subcommittee and working group activities;

e) Attending to official correspondence;

f) Maintaining official records and filing all papers and submissions prepared for or by the Council, including those items generated by subcommittees and working groups;

g) Reviewing and updating information on Council activities in the Shared Management System (i.e., FACA database) on a monthly basis;

h) Acting as the Council's agent to collect, validate and pay all vouchers for pre-approved expenditures; and

i) Preparing and handling all reports, including the annual report as required by FACA.

ARTICLE V MEETING PROCEDURES

Section 1. Meeting Schedule and Call of Meetings.

TMAC will meet in plenary sessions approximately once or twice per quarter, with additional virtual meetings as needed, at the discretion of the DFO. The Council may hold hearings, receive evidence and assistance, provide information, and conduct research, as it considers appropriate, subject to resources being made available. With respect to the meetings, it is anticipated that some may be held via teleconference, with public call-in lines. TMAC meetings will be open to the public unless a determination is made by the appropriate FEMA official that the meeting should be closed in accordance with subsection (c) of section 552b of title 5, U.S.C.

Section 2. Agenda.

Meeting agendas are developed by the DFO in coordination with the TMAC chair. In accordance with the responsibilities under FACA, the DFO approves the agenda for all Council and subcommittee meetings, distributes the agenda to members prior to the meeting, and publishes the agenda in the Federal Register.

FEMA will publish the meeting notice and agenda in the Federal Register at least 15 calendar days prior to each TMAC meeting or official public conference call. Once published in the Federal Register, the agenda items cannot be changed prior to or during a meeting.

Section 3. Quorum.

A quorum of the TMAC is the presence of fifty percent plus one of the Council members currently appointed. In the event a quorum is not present, the TMAC may conduct business that does not require a vote or decision among members. Votes will be deferred until such time as a quorum is present.

Section 4. Voting Procedures.

When a decision or recommendation of the TMAC is required, the Chair will request a motion for a vote. A motion is considered to have been adopted if agreed to by a simple majority of a quorum of TMAC members. Members vote on draft reports and recommendations in open meetings through a resolution recorded in the meeting minutes. Only members present at the meeting—either in person or by teleconference—may vote on an item under consideration. No proxy votes or votes by email will be allowed.

Section 5. Minutes.

The DFO will prepare the minutes of each meeting and distribute copies to each Council member. Minutes of open meetings will be available to the public on the TMAC website at http://www.fema.gov/TMAC. The minutes will include a record of:

a) The time, date, and place of the meeting;

b) A list of all attendees including Council members, staff, agency employees and members of the public who presented or oral or written statements;

c) An accurate description of each matter discussed and the resolution, if any, made by the Council;

d) Copies of reports or other documents received, issued, or approved by the Council; and

e) An accurate description of public participation, including oral and written statements provided.

The DFO ensures that the Chair certifies the minutes within 90 calendar days of of the meeting to which they relate and prior to the next TMAC meeting.

Minutes of closed meetings will also be available to the public upon request subject to the withholding of matters about which public disclosure would be harmful to the interests of the Government, industry, or others, and which are exempt from disclosure under the Freedom of Information Act (FOIA) (5 U.S.C., section 552).

Section 6. Open Meetings.

TMAC meetings shall be open and announced to the public in a notice published in the Federal Register at least fifteen calendar days before the meeting. Members of the public may attend any meeting or portion of a meeting that is not closed to the public and, at the determination of the Chair and DFO, may offer oral comment at such meeting. Meetings will include a period for oral comments unless it is clearly inappropriate to do so. Members of the public may submit written statements to the TMAC at any time. All materials provided to the Council shall be available to the public when they are provided to the members. Such materials, including any submissions by members of the public, are part of the meeting record.

Section 7. Closed Meetings.

All or parts of TMAC meetings may be closed in limited circumstances and in accordance with applicable law. No meeting may be partially or fully closed unless the component head issues a written determination that there is justification for closure under the provisions of subsection (c) of 5 United States Code 552b, the *Government in the Sunshine Act*. Where the DFO has determined in advance that discussions during a Council meeting will involve matters about which public disclosure would be harmful to the interests of the government, industry, or others, an advance notice of a closed meeting, citing the applicable exemptions of the *Government in the Sunshine Act*, will be published in the Federal Register.

The notice may announce the closing of all or just part of a meeting. If, during the course of an open meeting, matters inappropriate for public disclosure arise during discussions, the DFO or Chair will order such discussion to cease and will schedule it for a future meeting of the Council that will be approved for closure. No meeting or portion of a meeting may be closed without prior approval and notice published in the Federal Register at least 15 calendar days in advance. Closed meetings can only be attended by DFO, Council members, and necessary agency staff members. Presenters must leave immediately after giving their presentations and answering any questions.

Section 8. Other Meetings, No Public Notice Required.

Public notice is not required for meetings of administrative or preparatory work. Administrative work is a meeting of two or more TMAC or subcommittee members convened solely to discuss administrative matters or to receive administrative information from a Federal officer or agency. Preparatory work is a meeting of two or more TMAC or subcommittee members convened solely to gather information, conduct research, or analyze relevant issues and facts in preparation for a TMAC meeting or to draft position papers for consideration by the TMAC.

ARTICLE VI EXPENSES AND REIMBURSEMENTS

Expenses related to the operation of the TMAC will be paid by the Federal Insurance and Mitigation Administration. Expenditures of any kind must be approved in advance by the DFO. All such expense reports will be sent to the DFO for action and reimbursement. The DFO will be responsible for handling the payment of expenses. Members are responsible for submitting expense reports by the deadlines set by the DFO or they may not be reimbursed. The DFO will be responsible for developing the procedures for expense reimbursement.

ARTICLE VII ADMINISTRATION

The Federal Insurance and Mitigation Administration shall be responsible for providing financial and administrative support to the TMAC subject to the availability of appropriations.

ARTICLE VIII SUBCOMMITTEES

Section 1. Establishment of subcommittees.

The DFO may establish standing subcommittees with an overarching mission to work on specific focus areas and provide advice to the TMAC on a continuing basis. The DFO may also establish ad-hoc subcommittees to work and report on specific focus areas. The number, designation, mission, scope, and membership of subcommittees are determined by the DFO in consultation with the Chair and Vice Chairs. The Chair may also request of the DFO to establish (or reorganize) a subcommittee. The creation and operation of the subcommittees must be approved by the DFO on behalf of FEMA.

Subcommittee Members: TMAC subcommittees may consist of TMAC members and non-TMAC members as limited below. TMAC members may be named to serve on a specific subcommittee and may contribute to others as requested.

Subcommittees will not function independently of the TMAC or provide advice or recommendations directly to FEMA. Subcommittees (standing and ad-hoc) must present all advice, recommendations, and reports to the full TMAC during a public meeting or teleconference for discussion, deliberation, and final approval.

In general, the requirements of FACA do not apply to subcommittees of advisory committees that report a parent advisory committee and not directly to a Federal officer or agency. However, minutes must be maintained for the public record and the DFO and/or ADFO must participate in all subcommittee proceedings.

Section 2. Membership.

Subcommittee membership should be balanced in relation to the subcommittee's mission and focus areas. The DFO and the Chair, with input from Council members, identify and determine the membership for the subcommittee, including a chair (and vice chair if deemed necessary).

Subcommittee chairs may request the DFO to invite non-TMAC individuals to serve on the subcommittee, as necessary. Only TMAC members may serve as the chair or vice chair of a subcommittee (standing or ad-hoc). The subcommittee chair can also advise the DFO that briefings from external subject matter experts are needed to provide pertinent and vital information not available among the current TMAC membership or from Federal staff. All such requests shall be made to the DFO who will facilitate the process to obtain subject matter expertise.

Section 3. Subcommittee Quorum

A Subcommittee quorum consists of: (1) the presence (either in person or by teleconference) of fifty percent plus one of TMAC members currently appointed to the Subcommittee; and (2) TMAC members make up more than a third of the Subcommittee members present. In the event a Subcommittee quorum is not present, the Subcommittee may conduct business that does not require a vote or decision among members. Votes will be deferred until such time as a quorum is present.

Section 4. Subcommittee Voting Procedures

When a decision or recommendation of the Subcommittee is required, and a Subcommittee Quorum as defined above is present, the Subcommittee Chair may request a motion for a vote. A motion is considered to have been adopted if agreed to by a simple majority of the TMAC Subcommittee members present. Members may vote on draft reports and recommendations that will be presented to the full TMAC. Only members present at the meeting—either in person or by teleconference—may vote on an item under consideration. No proxy votes or votes by email will be allowed.

Section 5. Focus Areas

Focus Areas are identified areas of consideration for the Council to review, either via subcommittee or by the TMAC through discussion as an entire body. The DFO will determine focus areas in consultation with the TMAC Chair. The DFO will then work with the Chair and Vice Chair to identify whether the focus area should be assigned to a standing subcommittee, an ad hoc subcommittee; or submitted to the TMAC for discussion and review.

Section 6. Workload and meetings.

Subcommittees may have more than one focus area to address. Subcommittee chairs will recommend the appropriate number of conference calls necessary to address focus areas, working in coordination with the DFO.

The subcommittee chair determines what materials are needed to prepare a response and develop a report to the TMAC. The DFO will supply the requested materials to the TMAC subcommittee upon request and resource availability.

ARTICLE IX RECOMMENDATIONS AND REPORTING

P.L. 112-141 directs TMAC to submit an annual report to the Administrator that contains a description of the activities of the Council; an evaluation of the status and performance of flood insurance rate maps and mapping activities to revise and update flood insurance rate maps; and a summary of recommendations made by the Council to the Administrator.

Once the TMAC achieves consensus on a report and recommendations, the TMAC Chair is responsible for providing a final version of the report to the FEMA Administrator. The final report and any accompanying memoranda will be posted on the TMAC website.

ARTICLE X RECORDKEEPING

The DFO maintains all records of the advisory Council in accordance with FACA and FEMA policies and procedures. All documents, reports, or other materials presented to, or prepared by or for the Council, constitute official government records and are available to the public upon request.

ARTICLE XI BYLAWS APPROVAL AND AMENDMENTS

The DFO may amend these bylaws at any time, and the amendments shall become effective immediately upon approval.

Mark Crowell
Designated Federal Officer

Date approved: 10/20/2016

Appendix D: 2016 TMAC Meetings

MEETING DATE	MEETING TYPE	LOCATION	BUSINESS PURPOSE
October 20-21, 2015	Public Meeting	USGS, Reston, Virginia	The TMAC reviewed, commented, and deliberated draft recommendations and narratives for incorporation into the TMAC 2015 Annual Report and the TMAC 2015 Future Conditions Report.
December 9-10, 2015	Public Meeting	Virtual	The TMAC reviewed, commented, and voted on final content for the TMAC 2015 Future Conditions Report and the TMAC 2015 Annual Report. The TMAC approved a motion to submit the reports to the FEMA Administrator. TMAC members also received an SME presentation from the FEMA Flood Mapping Integrated Project Team.
January 19, 2016	Administrive Meeting	Virtual	The TMAC reviewed the schedule of activities for calendar year 2016, including the meeting and reports development schedules for the TMAC 2016 Program Review Report and the TMAC 2016 Annual Report.
February 10-11, 2016	Public Meeting	USGS, Reston, Virginia	The TMAC reviewed their charge as defined under HFIAA to develop the TMAC 2016 Program Review Report and prioritized topics for inclusion in the report. TMAC members also received a briefing from a SME on the National Flood Mapping Program.
March 10-11, 2016	Public Meeting	Virtual	The TMAC reviewed, commented, and deliberated on draft recommendations for incorporation in the TMAC 2016 Review Report.
April 14-15, 2016	Public Meeting	Virtual	The TMAC reviewed, commented, and deliberated on draft recommendations for incorporation in the TMAC 2016 Program Review Report. TMAC members also received briefings from SMEs on Community Engagement Risk Communications, the National Flood Insurance Program, Risk Rating 2.0, and FEMA metrics.
May 9-10, 2016	Public Meeting	USGS, Reston, Virginia	The TMAC reviewed and discussed draft recommendations to be included in the TMAC 2016 Program Review Report.
June 6-7, 2016	Public Meeting	Virtual	The TMAC reviewed, deliberated on, and approved final content for the TMAC 2016 Program Review Report.
August 10-11, 2016	Public Meeting	USGS, Reston, Virginia	The TMAC reviewed and discussed potential recommendations for the TMAC 2016 Annual Report. TMAC members also received an update briefing from FEMA on the National Flood Mapping Program.
September 23 and 26, 2016	Public Meeting	Virtual	The TMAC discussed potential recommendations to be included in the TMAC 2016 Annual Report.
October 26-27, 2016	Administrative Meeting	Virtual	The TMAC welcomed new council members, and deliberated draft language for inclusion in the TMAC 2016 Annual Report.
November 30, 2016	Administrative Meeting	Virtual	The TMAC DFOs provided new TMAC members with an orientation on the administrative aspects of the TMAC and an overview of the first two years of council activity.
December 13-14, 2016	Public Meeting	3101 Wilson Boulevard, Arlington, Virginia	The TMAC reviewed, deliberated on, and approved recommendations and narratives to be incorporated in the TMAC 2016 Annual Report.
January 27, 2017	Administrative Meeting	Virtual	The TMAC conducted an administrative meeting to review technical edits to the TMAC 2016 Annual Report, and to review the TMAC 2017 tasking memo.


Indian Creek
East Tributary 7
ZONE A
LIMIT OF DETAILED STUDY
717
716
715
Culvert
B
ZONE X
713
712
A
714
ZONE AE
711
710
706
PAWNEE TRAIL
CAYUGA TRAIL
723
719
ZONE X
717
716
C
711
B
709
708
707
706
ZONE X
ZONE AE
(EL 705)
706
LIMIT OF FLOODWAY
219
2112
KIOWA DRIVE NORTH
224
MAHAVE
Tributary Kiowa 1
Indian Creek
(Upper Reach)
NAVAJO TRAIL
BLACKFOOT TRAIL
ZONE AE
LIMIT OF DETAILED STUDY
713
712
B
706
Culvert
C
MODOC TRAIL
ZONE X
711
Culvert
A
HURON TRAIL
LIMIT OF FLOODWAY
ZONE X
FM ROAD 3496
M
ZONE AE
Indian Creek East
Tributary No. 2
ZONE X
295
721
717
724
LIMIT OF DETAILED STUDY
295
K
COCOPA DRIVE W.
DRIVE
COCOPA
Lake
Kiowa