



**PLANNING INFORMATION EXCHANGE (PIE)
QUARTERLY WEBINAR SERIES PRESENTS:**

*Increasing Our Resiliency to
Urban Flooding*



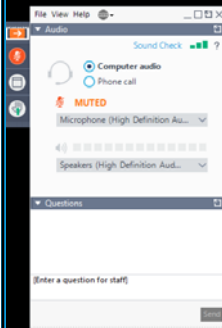
November 21, 2019

Logistics



Participation
Please use the **Questions panel** to answer:

Where are you connecting from today?



Certificates, CMs & CECs



- Attendees must participate in the entire event in order to receive a certificate, CMs or CECs.
- CFMs are eligible for 1 CEC for participating in this webinar. AICPs are eligible for 1.5 CM.
- You must have registered individually. Attending the webinar in a group setting or viewing the recording does not make you eligible for Certificates, CMs or CECs.

Presenters





Gerald Galloway, Ph.D.
Glenn L. Martin Institute Professor of Engineering
University of Maryland




Chad Berginnis, CFM
Executive Director
ASFPM



Doug Plasencia, P.E., CFM
Chief Operating Officer
Moffatt & Nichol

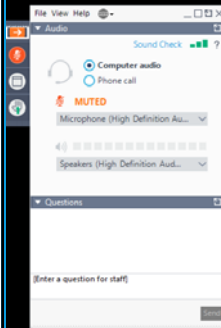
Logistics



Participation
Open and close your control panel using the orange arrow at top left corner

- Choose "Computer audio" to use computer speakers or headphones
- Choose "Phone call" to dial in using the information provided

*Submit questions & comments via the **Questions panel***




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QUARTERLY WEBINAR SERIES PRESENTS:**

*Increasing Our Resiliency to
Urban Flooding*



Detroit Michigan - 2014

- Largest Flood Event in US in 2014
- 4-6 Inches Rain in 4 hours
- Overwhelmed Drainage System
- 75,000 Homes and Business Flooded
- \$1.5 Billion in Damages





URBAN FLOODING

The inundation of property in built environment areas caused by **rain falling** on increased amounts of impervious surfaces and **overwhelming the capacity of drainage systems**.

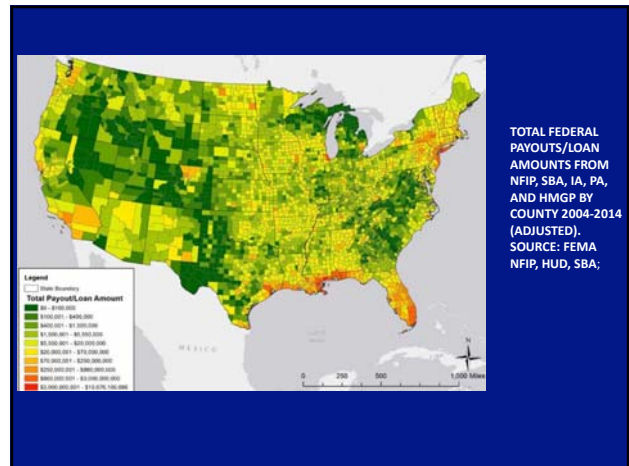
KEY SURVEY RESULTS

- 83% of respondents experienced urban flooding.
- 46% of urban flooding occurred in numerous or most areas.
- 85% experienced urban flooding outside the SFHA.
- 65% reported less than 10% damages were covered by the NFIP
- 41% of communities reported that mitigation activities are impeded by lack of funding and 32% by lack of political will
- 34% of elected officials and 28% of the public were seen by respondents to have significant concern over urban flooding.



US Urban Areas

- 9 Cities over 1 million population
- Largest City – New York, 8.3 million
- 52 metro Areas over 1 million - Largest New York, 20 million
- 19,522 Municipalities (> 90% population under 25,000).



URBAN FLOODING

THE REPORT

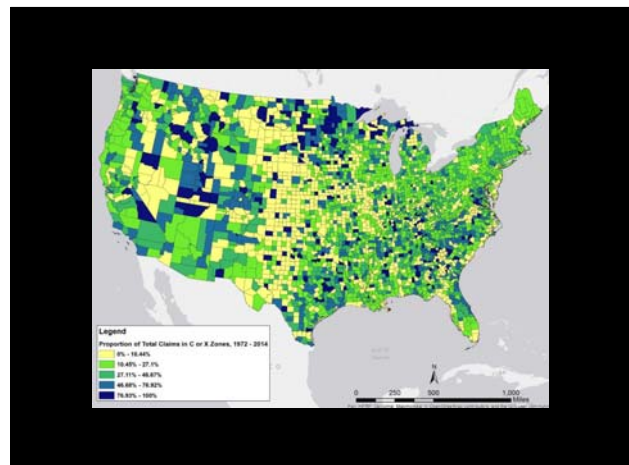
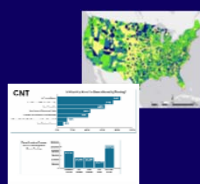
Outreach

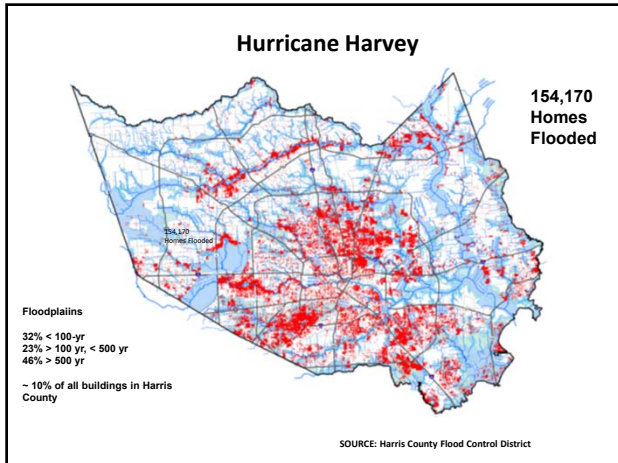


Survey



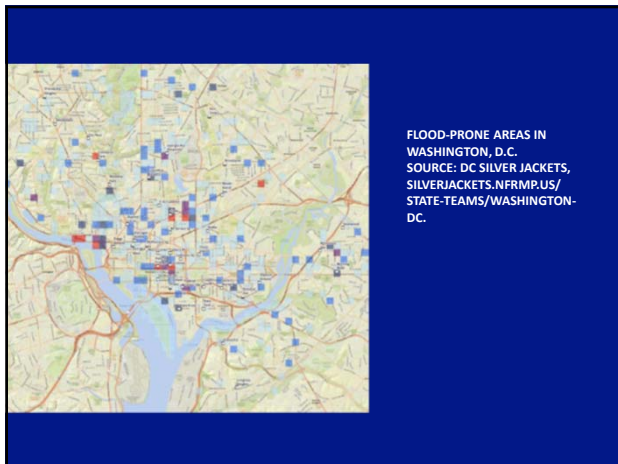
Data Analysis





ECONOMIC COSTS URBAN FLOODING

- Frequent low-cost intense rainfall events that don't rise to Presidential Declarations
- Damages to community infrastructure
- Increasing human resources support costs
- Unquantified secondary costs
- Limited federal support
- Limited programs to identify costs
- High impact on small businesses
- Loss in property values



SOCIAL COSTS URBAN FLOODING

- General affordability
- Insurance affordability
- Low level of municipal support
- Minimal resilience
- At risk areas

LOUISIANA
 Median income of homeowners:
 \$33,000 (Non-policyholders: 243,000 households)
 \$73,000 (Policyholders: 221,000 households)

UNITED STATES

Open Drainage Ditch Service Areas in Houston, Texas

TRIGGERS OF URBAN FLOODING

- Increasing episodes of intense rainfall events
- Aging and inadequate drainage infrastructure
- Lack of Information - H&H, Asset Conditions, Future Meteorology
- Upstream expansion of impervious surfaces
- Development that does not recognize natural drainage patterns—overland flow
- Sprawling development patterns that fragment natural hydrological processes
- Poor drainage maintenance
- Fragmentation/degradation/removal of natural functions
- Development that places obstacles (walls, roads, buildings) or buries (box culverts, drains) streams and creeks

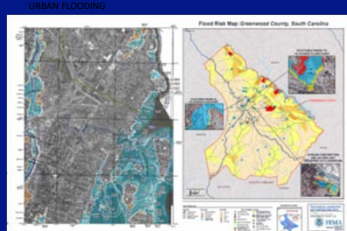
ELIMINATING URBAN FLOODING

Observation:
 There are many strategies for tackling urban flooding, but in all cases, it is the combination of tool selection, funding, and a public's will to proceed that determines the level of success.

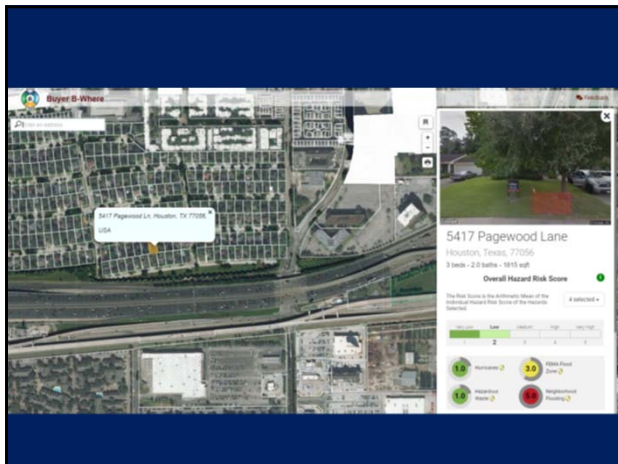
- Comprehensive Planning
- Capturing Rain Where It Falls
- Upgrading Of Capacity Standards
- Providing Adequate Maintenance
- Exploiting Science And Engineering
- Risk Communication: Gaining Public Understanding

COMMUNICATING URBAN FLOODING

Improving Risk Awareness
Disclosing Risks In User-friendly Ways
Mapping Urban Flood Zones
Insuring At-risk Properties

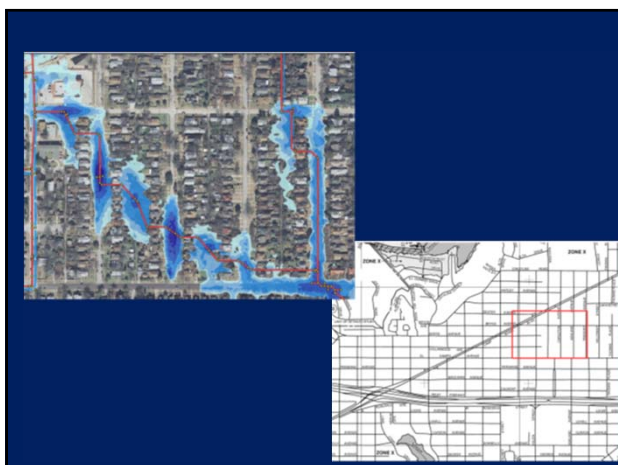


Swiss National Mapping



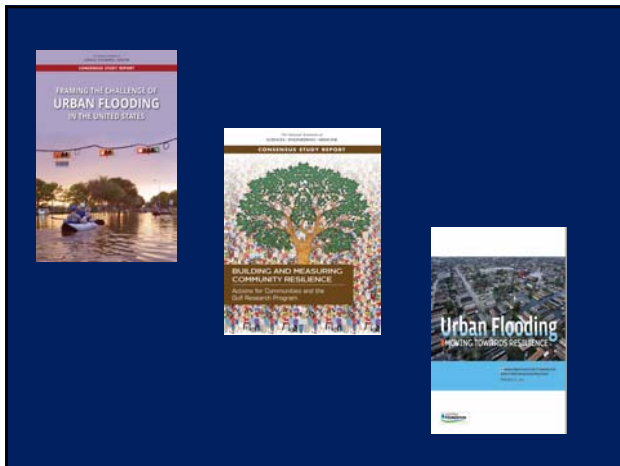
Vol 1 - Report
Vol 2 - Survey Extracts

<https://cdr.umd.edu/urban-flooding-report>



TAKE-AWAY MESSAGES

- Urban flooding is a growing national problem and we do not have a handle on its **present and future extent**, consequences and solutions
- The consequences of urban flooding are economic loss, social disruption, and housing inequality
- Urban flooding has a disproportionately large effect on those who are least able to deal with it
- Urban flooding is a national issue, but also a local responsibility. Governance is badly fragmented




Scope of Study


An ad hoc committee will organize a series of regional workshops or case studies to explore the issue of urban flooding in 3 to 8 metropolitan areas (locations to be determined). These case study/information gathering sessions will provide information from federal, state, and local government agencies, and other relevant stakeholders responsible for flood control, flood response, recovery, or mitigation on questions related to urban flooding both outside and inside the floodplain, such as:

- How big is the problem of flooding in each metropolitan area; i.e., how bad can floods be or have floods been and how much do floods cost?
- What causes the worst impacts of flooding, including structural and human impacts?
- How could the worst impacts be avoided or mitigated?
- Who is affected most by floods in the metropolitan area?
- Which regions of the metropolitan areas see the longest lasting or most costly effects of flooding?

Presenter



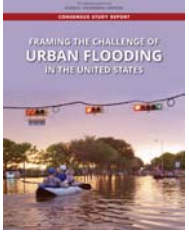
Chad Berginnis, CFM
Executive Director
ASFPM



Study Overview

The Committee conducted workshops in 4 metropolitan areas to gain an initial understanding of the causes and impacts of urban flooding and to help address 3 tasks:

1. Identify commonalities and differences among the case study areas
2. Estimate of the size or importance of flooding in those urban areas
3. Relate the causes and actions of urban flooding to existing federal resources or policies




Committee Members

David Maidment, Chair, University of Texas at Austin
 Chad Berginnis, Association of State Flood Plain Managers
 Lt. Gen. (Ret.) Thomas P. Bostick, Intrexon
 Samuel Brody, Texas A&M University
 Jeffrey Czajkowski, University of Pennsylvania and National Association of Insurance Commissioners
 Dara Entekhabi, Massachusetts Institute of Technology
 Harriet Festing, Anthropocene Associates
 Katherine Greig, University of Pennsylvania
 Jo Ann Howard, H2O Partners Inc.
 Conor Jensen, Renegade Science
 Eric Tate, University of Iowa
 Claire Welty, University of Maryland, Baltimore County
 James Wescoat, Massachusetts Institute of Technology


What is Urban Flooding?


Caused when the *inflow of storm water* in urban areas *exceeds the capacity of drainage systems* to infiltrate storm water into the soil or to carry it away

Heavy rainfall and riverine flooding




Complex urban environment impedes flow







Storm surge, high tides



Inadequate storm water systems




Flooding in Urban Areas

- Flooding is the natural hazard with the **greatest economic and social impact** in the United States
- Within cities, flood damage can occur **anywhere**
 - 280 million people in urban areas are potentially affected
 - impacts can be highly localized
- Flood problems reflect the **history** of a city and generally increase with **urbanization**

Dimensions of Urban Flooding


- Physical**—the built and natural environments
- Social**—impacts on people
- Information**—data used to understand or communicate flood events
- Actions** and decision making—steps and policies for managing flooding


Four groups for each workshop

Flood Waters Come From ...


Direct impact of rainfall (or pluvial flooding, critical for urban areas)



Inundation from rivers



Coastal storm surge



Four Case Studies



Two older cities from Northeast and Midwest
Two younger cities from South and West

- Workshops
- Stakeholder meetings & interviews
- Field trips



76 Participating Organizations

Local Government

- Alabama Department of Transportation
- Baltimore City, Office of Sustainability
- Baltimore County Public Works
- Chicago Metropolitan Agency for Planning
- Chicago Metropolitan Agency for Planning
- City of Baltimore, Department of Public Works
- City of Chicago, Department of Planning and Development
- City of Chicago, Department of Water Management
- City of Houston
- City of Houston, Mayor's Office
- City of Phoenix
- City of Scottsdale
- Community and Environmental Planning Research Institute
- Area Council
- David County Bureau of Economic Development
- Florida Center for Urban and Suburban Equity
- North Carolina
- North Carolina Office of Community Sustainability
- Metropolitan Planning Council of Chicago region
- Metropolitan Water Resources Council of Greater Chicago
- North American Electric
- Transportation and Strategic Operations

Non-Governmental Organizations/Non-Profit Organizations

- American Planning Association
- Association of Baltimore Area Governments
- Episcopal Diocese
- Center for Neighborhood Technology
- Center for Progressive Reform
- Community Health Resilience for Baltimore
- Environmental Health Perspectives
- Houston Habitat for Humanity
- Houston Urban League
- League of Women Voters
- Leland and Blanche B. Buckner Foundation
- Long Star Capital And
- Maryland Environmental Health Network
- Milwaukee Regional Climate Center
- Nation for Wellness
- Operation IGH
- Park and People Foundation
- RedHawks
- Residents Against Flooding
- The Nature Conservancy
- United Way of Greater Houston
- West Monroe Network

State and Federal Agencies

- Alviro Disher
- Department of Natural Resources
- Division
- DRM Flood Action Program
- FEMA, Insurance Analysis and Policy Branch
- Missouri Department of Transportation
- FEMA, Risk Analysis Branch
- Illinois Office of State Resources
- Maryland Department of Planning
- Maryland Department of the Environment
- Maryland Department of Transportation
- Maryland Emergency Management Agency
- Maryland Port Administration
- NAPSA
- NOAA
- NOAA, National Weather Service
- U.S. Army Corps of Engineers
- U.S. Geological Survey

Industry/ For Profit Organizations

- ACCOR
- Albion Insurance Company
- Beth ABBE Builders
- Houston Professional Services, Inc.
- Kaiser Permanente
- Mahan River Associates
- IGREC
- Jurich North America

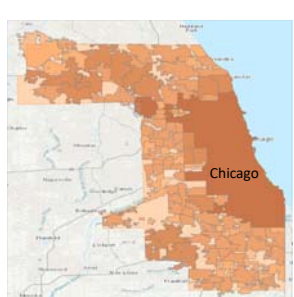
Academic and Research Institutions

- BARC Research
- Illinois State University
- Maryland Institute College of Art
- Rice University
- Texas A&M University
- University of Chicago
- WU (Vienna)

Congressional Offices


- Office of Congressman Bill Grayley
- Office of Senator Dan Claitor

City of Chicago and Cook County



- Combined storm and sanitary sewage system
- Overwhelmed in large storms leading to sewage backups flowing into basements
- Huge Tunnel And Reservoir Plan (TARP) to convey and store stormwater flow
- Marked geographic response differences across city
- High annual flood losses

Baltimore City and County



- City and County are geographically distinct
- Strong influence of water quality management in Chesapeake Bay
- Sinkholes from collapsing storm sewers in city
- Historical buildings in steeply sloping floodways
- Low annual flood losses
- Limited flood management

State Concern in Illinois



REPORT FOR THE Urban Flooding Awareness Act


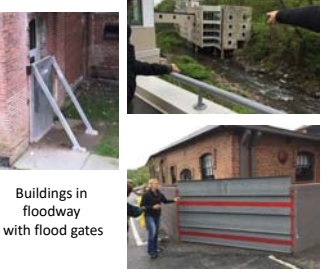
Widely distributed flood damage across city



Aggregated Claims by ZIP Code, 2007-11

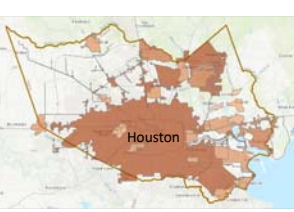
Source: Center for Neighborhood Technology

Flooding in Baltimore

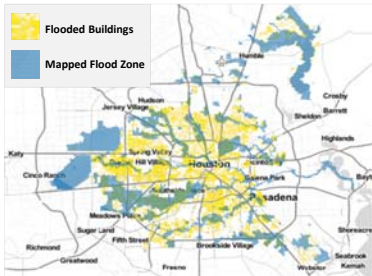
Buildings in floodway with flood gates

City of Houston and Harris County



- Flat terrain with almost all surface water drainage
- Large engineering commitment to flood mitigation
- Vulnerability to storm surge, riverine, and pluvial flooding
- High annual flood losses
- Catastrophic impact of Hurricane Harvey
- Committee visited Houston one month before Harvey occurred

Flooded Buildings in Harvey



Half flooded buildings outside mapped flood zones

Source: City of Houston, Housing Department


Task 1: Similarities and Differences Among Study Cities

Similarities

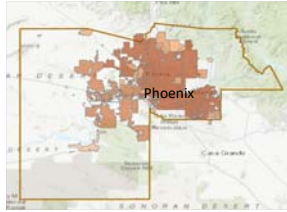
- **Multiple sources** of flood water
 - river overflow, storm surge, flash floods, pluvial floods, sewer backups
- **Disenfranchised groups** disproportionately affected by flooding
 - Poor, minority, elderly, non-native English speakers, low mobility
- **Lack of data** on flood hazard, social impacts, and economic costs
- Desire for **improved** urban flood management

Differences

- Natural environment, development, **storm water and sewer infrastructure**
- Level of **citizen empowerment**
- Capability to fill **data gaps**
- Ability to forge **cross-jurisdictional agreements** for major mitigation



City of Phoenix and Maricopa County






- **Flat terrain** in city with sloping hills outside
- **Flood irrigation** used to water landscape in older areas (ponded yards)
- Sophisticated 2D flood modeling of **sheet flow**
- Extensive use of **green infrastructure** to infiltrate stormwater
- **Low** flood losses

Finding: Similarities and Differences in Case Study Areas

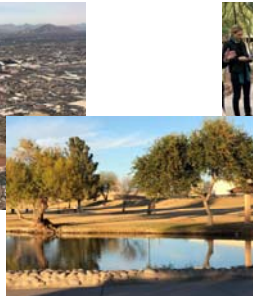
- Each metropolitan area has a **unique flood hazard** and manages urban flooding **in its own way**, using a tailored mix of federal, state, local, and nongovernmental financial and information resources
- In each metropolitan area, the impacts of flooding are particularly felt by **disenfranchised populations**
- **All four dimensions** (physical, social, information, and actions and decision making) are needed to understand and manage urban flooding

Flooding in Phoenix



River park for flood control



Green infrastructure

Task 2: Magnitude of Urban Flooding

- Methods for estimating magnitude:
 - Evaluation of **historical flood impact data** (retrospective estimate)
 - Urban **flood risk assessment** (prospective estimate)
- Types of data available:
 - **Direct impacts** — Immediate effect of the disaster (e.g., loss of life; damage to buildings, roads, agriculture, and infrastructure; monetary loss)
 - **Tangible impacts**—Impacts that have a market value and can generally be measured in monetary terms (e.g., structural losses)

Committee made an exhaustive study of available data sources

Historical Estimates of Urban Flood Losses

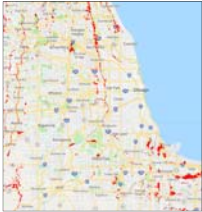
Available Data (FEMA)

- NFIP claims
- Small Business Assistance loans
- Individual Assistance grants (immediate unmet recovery needs)
- Public Assistance grants (publicly owned facilities)
- Hazard Mitigation Grants (projects and buyouts)

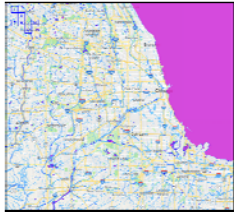
Data Limitations

- Exclude uninsured property
- Major flood events (presidential disaster declarations)
 - miss less extreme, more frequent events

Comparison of Chicago Floodplains (1% annual chance)




FEMA riverine flood study
Population exposed: 135,000 (1%)



Wing et al. (2018) riverine & pluvial flood model
Population exposed: 945,000 (10%)

Historical flood losses highest in populous coastal counties



Total Payout/Loan Amount from NFIP, SBA, IA, PA, and HMOG by County, 2004-2014 (Adjusted)

Losses in Harris and Cook counties are 2 orders of magnitude higher than losses in Baltimore and Maricopa counties

Finding: Magnitude of Urban Flooding

- Existing data are **inadequate** to provide an accurate monetary estimate of the magnitude of urban flooding.
- Historical loss estimates for the counties that include **Chicago and Houston average \$200 million per year** (for 2004–2014) in each county.
- Losses likely **far exceed** these estimates—possibly on the order of a few billion dollars per year—when pluvial flooding, uninsured property and indirect losses, declines in GDP, and the millions of urban residents exposed to flooding are considered in a flood risk assessment.
- Historical **flood losses are lower** in the counties that include **Baltimore and Phoenix** (few million dollars per year), but actual losses are likely much higher when the other contributing factors are considered.

Flood Risk Assessments

- More comprehensive** picture of urban flooding
 - Flood hazard—probability and magnitude of the urban flood hazard
 - Exposure—population and economic assets at risk
 - Vulnerability—damage relationship between hazard and exposure
 - Performance—accounts for flood mitigation measures such as levees
- Yield **much higher estimates** of flood losses and population affected
- Limitations
 - Relatively **few** flood risk assessments, often black box or missing pluvial flood hazard
 - Insufficient historical data** for calibration

Task 3: Connect Federal Resources to Urban Flooding


Key needs with a strong federal connection:

- Understanding and **communicating urban flood hazard** and risk
- Understanding and mitigating **social impacts**
- Coordinating organizations** with a role in managing urban flooding

Urban Flood Hazard

Finding: An established method for analyzing urban flood hazard is needed

- Incorporate **urban components** and small-scale effects
 - topography, drainage, building design
- **FEMA** lead due to mission and experience
- **Partners**
 - **Local government agencies** for storm water systems and land characteristics
 - **Modelers** accounting for **pluvial flooding**



Ft Worth map from FEMA and local data, models

Agency Coordination

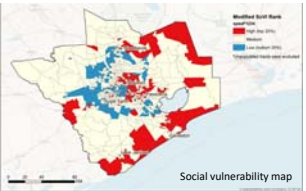
Finding: **Stronger coordination** is needed across agencies that have a role in managing small or large urban floods

- More than a **dozen agencies** may be involved
 - urban flood preparation, response, recovery, mitigation
- **FEMA** statutorily obligated to coordinate mitigation, response, and short-term recovery during major floods
- Floods **too small** to trigger federal resources are managed at state & local level
- **Vertical** (federal, state, local) and **horizontal** integration (local agencies) is needed

Socially Vulnerable Populations

Finding: Greater investments are needed to research, understand, and develop interventions to mitigate the **social impacts of urban flooding** and their **disparate effects across populations**

- Research needs
 - Communities affected by **urban floods**
 - Indirect and intangible impacts (health, unemployment)
 - Building social networks and capacity
- NSF primary social science funder
- FEMA, USACE, CDC contribute experience with hazards and socially vulnerable groups



Social vulnerability map


Conclusions

- High costs and impacts of urban flooding merit **national attention**
- Flood problems will get worse with continued **urban development and climate change**
 - More people in harm's way, sea-level rise, more frequent heavy precipitation events
- Urban flooding is a **complex problem** that manifests across **multiple dimensions**
 - Requires multi-agency and multi-jurisdictional efforts to address

Communicating Flood Risk



Finding: A **new generation of flood maps and visualizations** that integrate predictions and local observations of flood extent and impact is needed to communicate urban flood risk. Improved methods for updating the maps to keep pace with urbanization and climate change are also needed

- Flood risk maps & visualizations
 - **Flood hazard** (depth & extent of flooding for different scenarios)
 - **Consequences of flooding** (building damage, population exposure)
- **Understandable** to the public
 - relative risk, address lookup
- Contributors
 - FEMA, NOAA, NSF, Census, HUD




"Buyers B-Where"

Presenter

Doug Plasencia, P.E., CFM
Chief Operating Officer
Moffatt & Nichol




Urban Flooding

A report of the ASFP Foundation's Gilbert F. White Flood Policy Forum

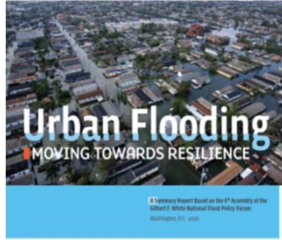
PIE Webinar Series

Doug Plasencia P.E. CFM
ASFP Foundation President
Moffatt & Nichol
 November 21, 2019





WHY THIS TOPIC?

- Climactic Projections
- Observational Trends
- Recognition of Dramatic Change in Risk Profile
- View of Practitioners
 - Third Report
 - NAS
 - TX AM & U of MD




- *Game Changer*

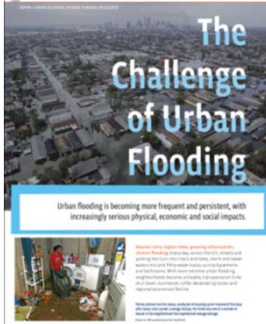
THE ASFP Foundation


- Independent arm of ASFP
- Funds Projects, Events, Scholarships
 - Student Paper Competition
 - Future Leaders Scholar (\$25K/Year for 2 years)
 - <https://www.youtube.com/watch?v=KcPq1p16984>
 - Larry Larson Speakers Series
 - State Symposia
 - Projects
 - NAI support and toolkits
 - Urban Flooding Tool Kit
 - Elected Officials Guide
 - Joint Wetland Managers and Floodplain Managers flood risk mapping
 - Many others



Urban VS. Flooding

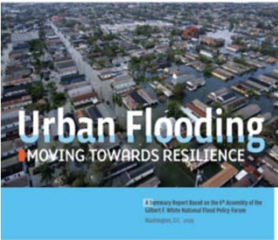
- Flooding is the Risk, but Urban makes it Complex
- We are facing unprecedented impact to communities and people
- Simultaneously frequency goes up while levels of protection erodes
- We will have to prioritize and triage this problem








THE GFW FORUM

- Signature Foundation Event
- Named After Gilbert F. White
- Forward Looking by Design
- Assembly of 100 Invited Participants
- Report That Captures the Event
- Includes Recommendations and Next Steps



Major Findings



- Flooding is Flooding Irrespective of Source
- It is Chronic AND Extreme
- The Risk to the Nation is Concentrated in Metro Areas but We Can Not Ignore Lesser Populated Urban Like areas.
- Socially Vulnerable Populations Add to the Complexity
- The Public Health Implications are Profound

