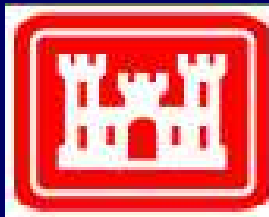


FLOOD INUNDATION MAPPING SCIENCE



Gardner Bent, U.S. Geological Survey, New England Water Science Center



FEMA



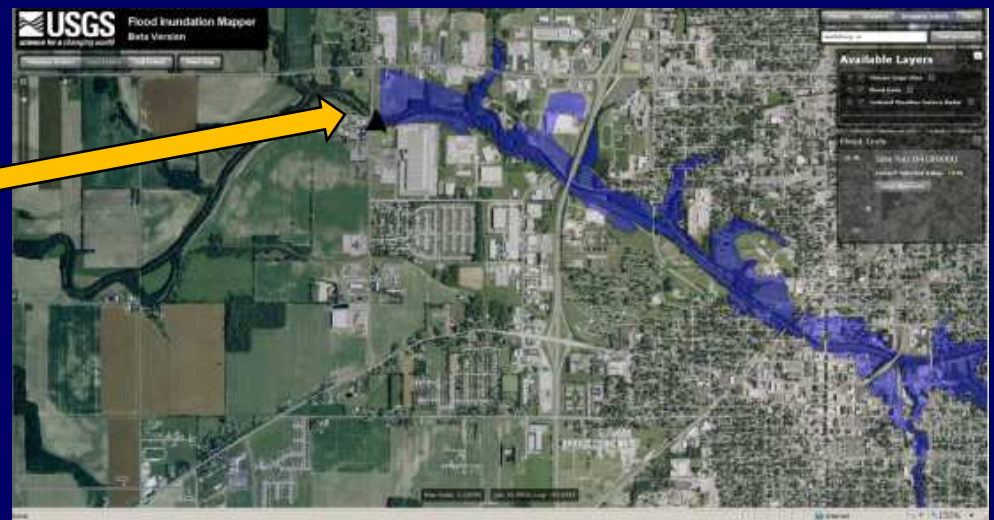
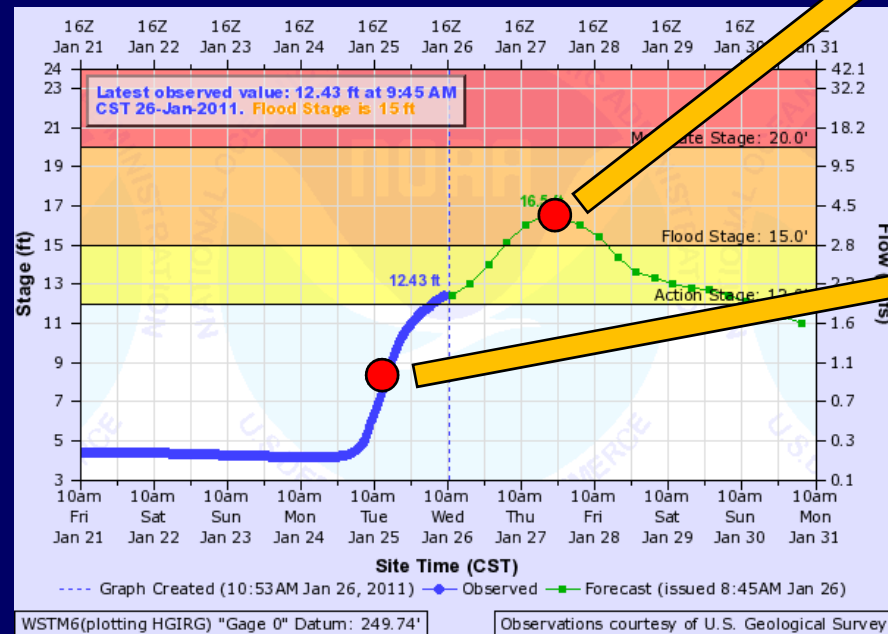
What is Flood Inundation Mapping?

Flood Inundation Mapping (FIM) is a real-time, operational tool that visually relates USGS streamgage data and NWS forecasts to flood risk for the primary purpose of ***public safety***, but also has significant benefits of:

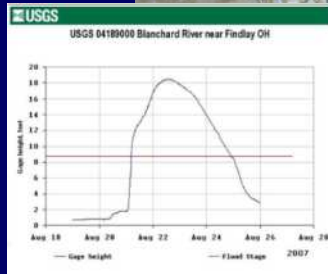
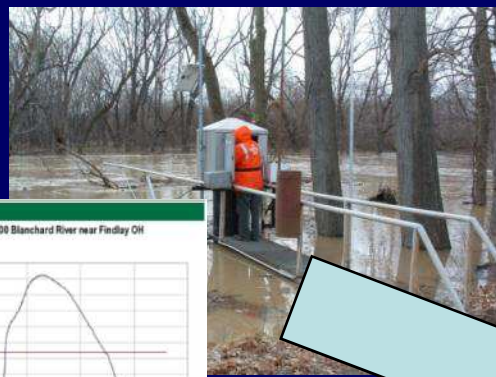
- Understanding changing natural processes that produce hazards
- Development of hazard mitigation strategies and technologies
- Effectively reduce vulnerability and repetition of loss to infrastructure
- Promotion of risk-wise behavior

Flood Inundation Maps (FIM)

- Translate a hydrograph into operational maps that communicate risk and consequences



Flood Information – from a point on the landscape to geospatial products



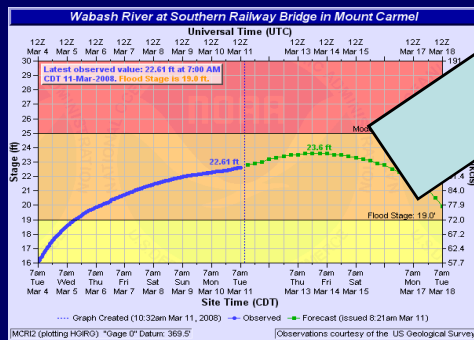
USGS Real-time streamgage data



High-water marks



Lidar and hydraulic model



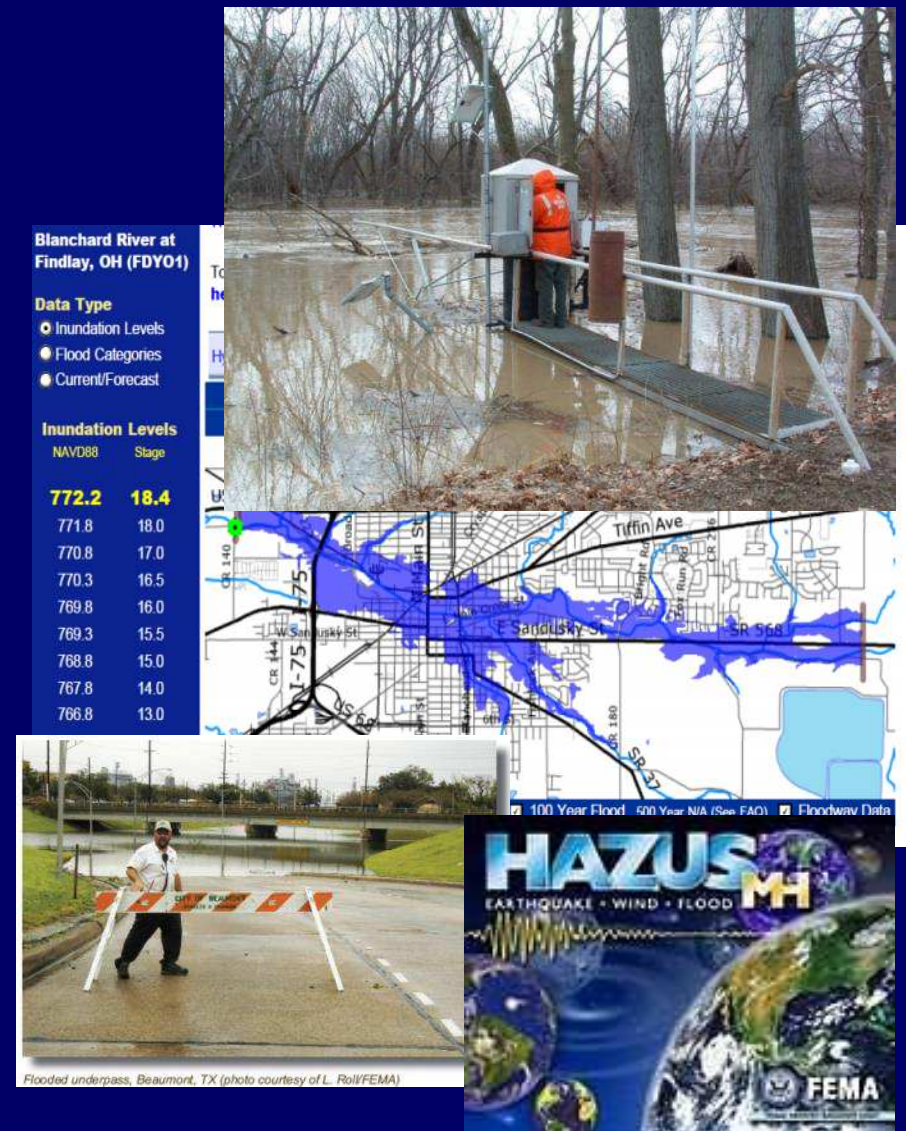
National Weather Service flood forecasts

Flood-Inundation Map



Inundation Mapping becomes a tool for flood...

- Preparedness
 - “What-if” scenarios
- Response
 - Tied to streamgauge and forecast data
- Recovery
 - Damage assessment
- Mitigation and planning
 - Flood risk analyses
- Environmental and ecological assessments



Creation of Flood Inundation Maps

Chose Reach and Data needed

- Critical infrastructure, populations, escape routes needed
- Streamgauge and flood forecast
 - Stable high-end rating, peakflow analyses
 - Can also do with stage-only
- Elevation data availability
 - Topography - lidar
- Recent survey
 - Hydraulic structures and x-sections
- High-water marks
 - Recent or historic flood



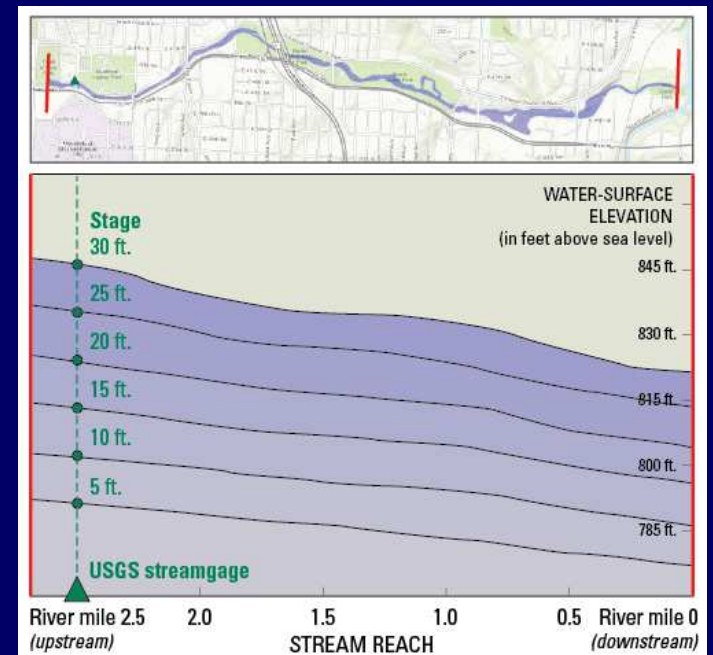
Creation of Flood Inundation Maps

Calibrated Hydraulic model

- FEMA approved hydraulic model (typically using HEC-RAS, 1-D, steady state)

Stage increments

- 1 or 2 ft increments from bankfull to 0.2 percent chance flood
- Associated with peakflow annual exceedance probabilities (AEPs) such as 50-, 10-, 4-, 2-, 1-, 0.5-, and 0.2-percent (2-, 10-, ... 500-year flood)



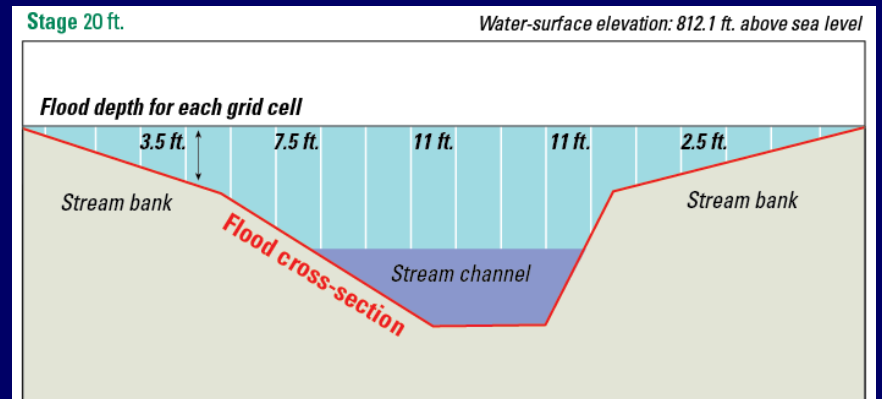
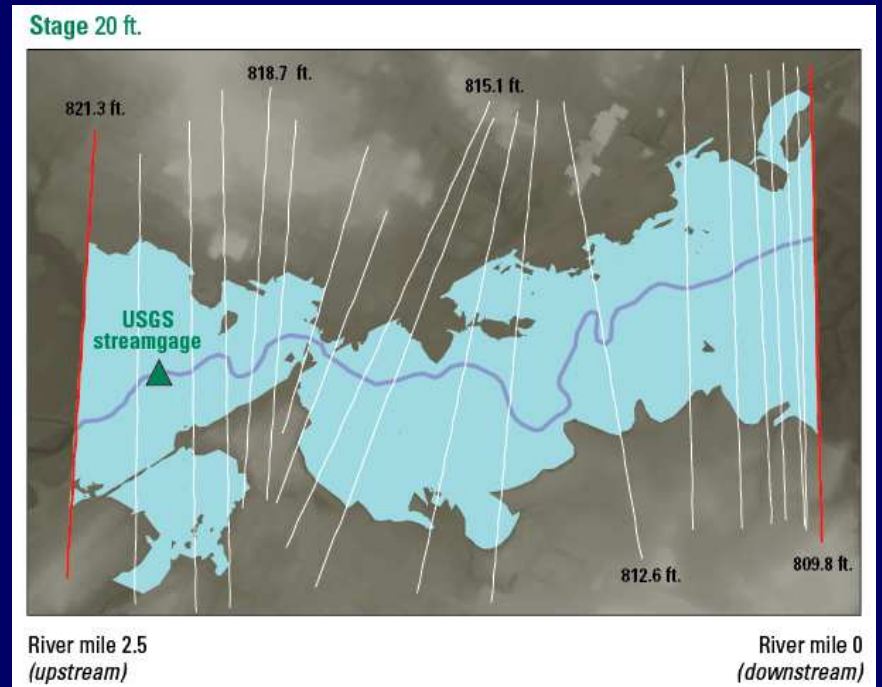
Creation of Flood Inundation Maps

Delineation of inundation

- Data for incremental stages are combine with Lidar – based DEM
- Spatial grid of where flooding occurs based on stages

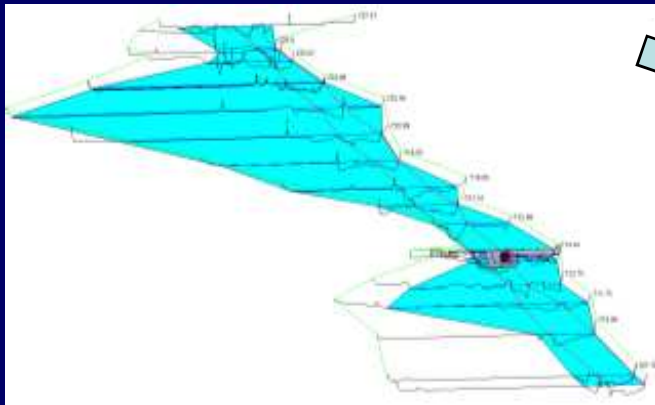
Inundation depth

- Depth grids are determined for stage increments

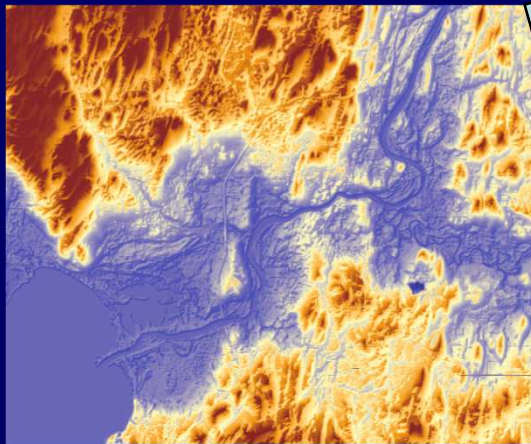


Creation of Flood Inundation Maps

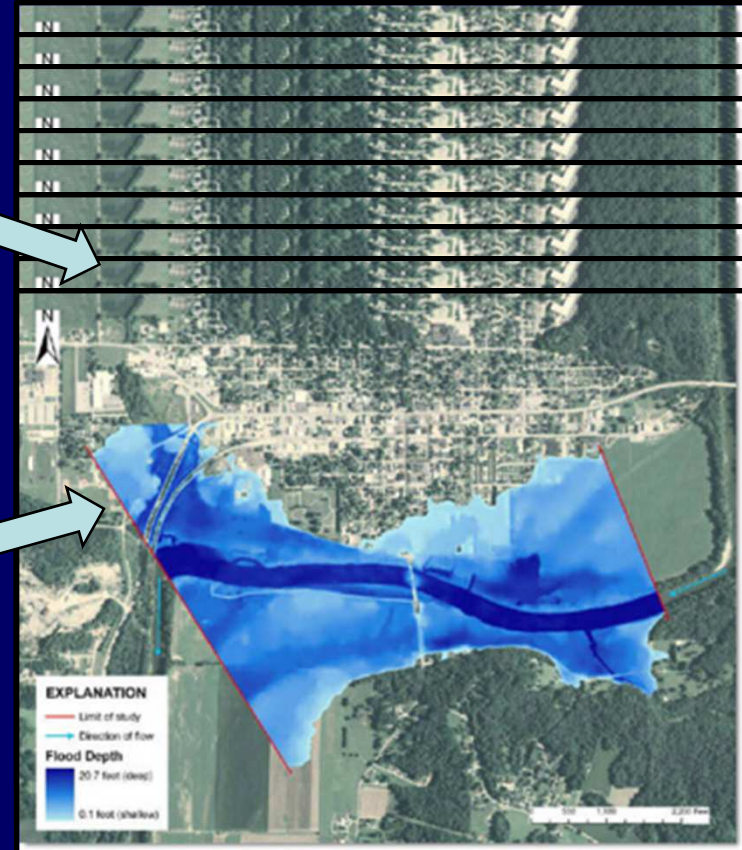
Hydraulic Modeling



Geospatial Processing

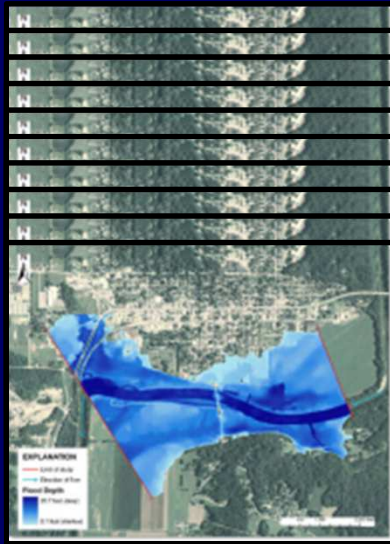


Digital Elevation Model

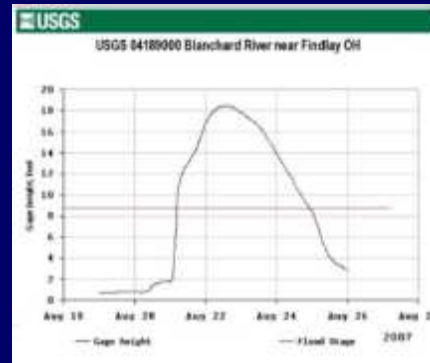
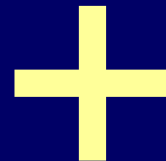


Series of sequential maps showing probable areas of flooding

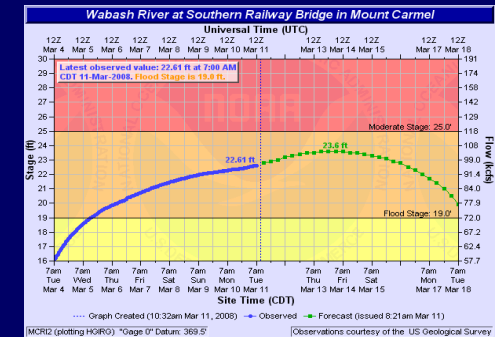
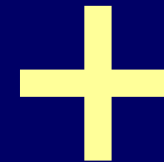
FIM Mapper – more than just maps



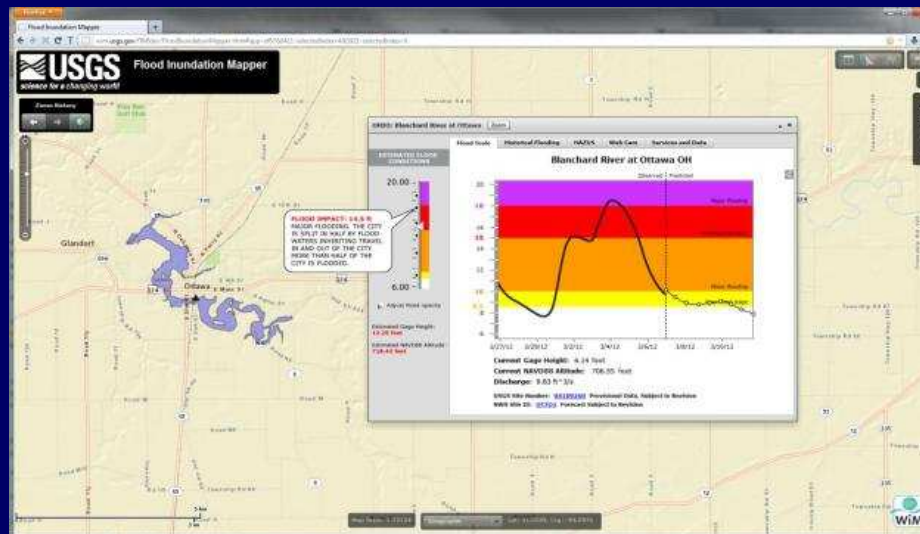
Flood Library



USGS Real-time streamgauge



NWS Flood Forecast



<http://wim.usgs.gov/FIMI/>

FIMs Studies in New England

Published and on USGS FIM mapper

- Hoosic River near Williamstown, MA
- Deerfield River at Charlemont, MA
- Deerfield River near West Deerfield, MA
- St. John's River below Fish River near Fort Kent, ME
- Fish River near Fort Kent, ME
- Suncook River at North Chichester, NH
- Winooski River above Crossett Brook at Waterbury, VT



FIMs Studies in New England

On USGS FIM review mapper

- North River at Shattuckville, MA
- Green River near Colrain, MA

USGS FIM studies started

- Lake Champlain – Vermont and New York

USGS FIM studies to start soon

- Pawtuxet River at Cranston, RI

Proposed USGS FIM studies

- Deerfield River at Buckland/Shelburne Falls, MA
- Green River at Greenfield, MA
- Deerfield River at Greenfield/Deerfield, MA

FIMs Studies in Massachusetts

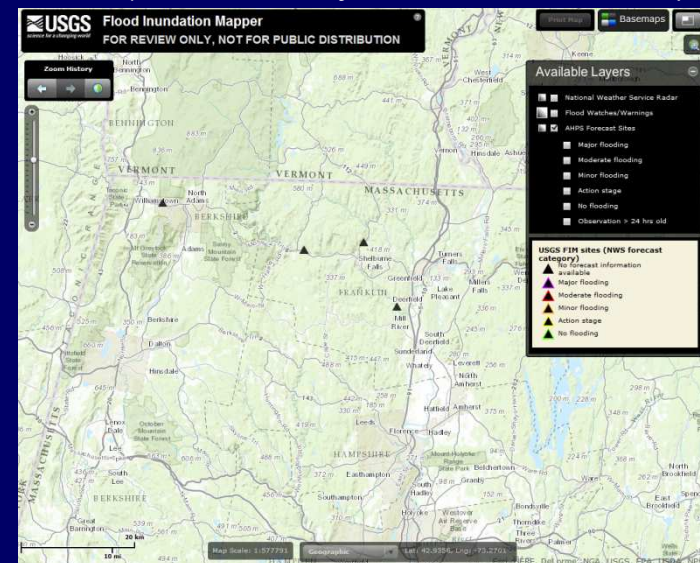
FEMA Flood Recovery Study

Deerfield and Hoosic Watersheds

- Lidar collected
- HWMs surveyed for 2011 (tropical storm Irene flood)
- Surveyed hydraulic structures (bridges and dams)
- Updated flood flows
- New hydraulic models
- Flood-inundation maps



Aug. 28, 2011 – Deerfield River at Dam #3 at Shelburne Falls, MA (Photo Courtesy of John Elder Robison)



FEMA – MA Riverine Studies

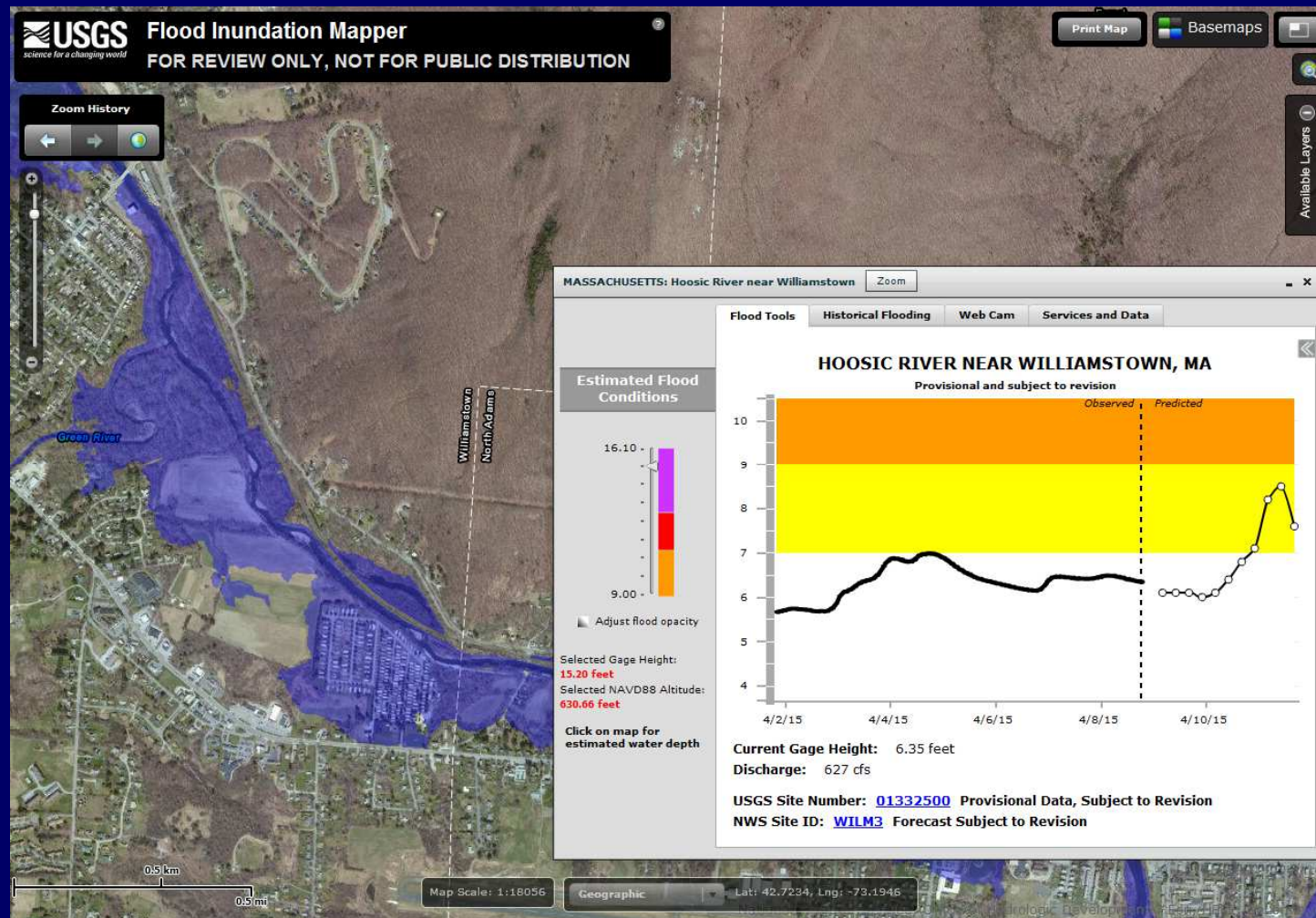
Watershed's with river reaches studied in detail

- RiskMAP completed for Narragansett Watershed in July 2015
- Discovery meetings for Charles Watershed in April 2015
- Discovery meetings for Merrimack Watershed (MA and NH) in July 2015
- Discovery meetings for Cape Cod Watershed – Buzzards Bay and South Coastal Basins in November 2015
- Discovery meetings for Nashua Watershed – tributary to Merrimack River (*Spring 2016?*)

Possible FIMs in Massachusetts

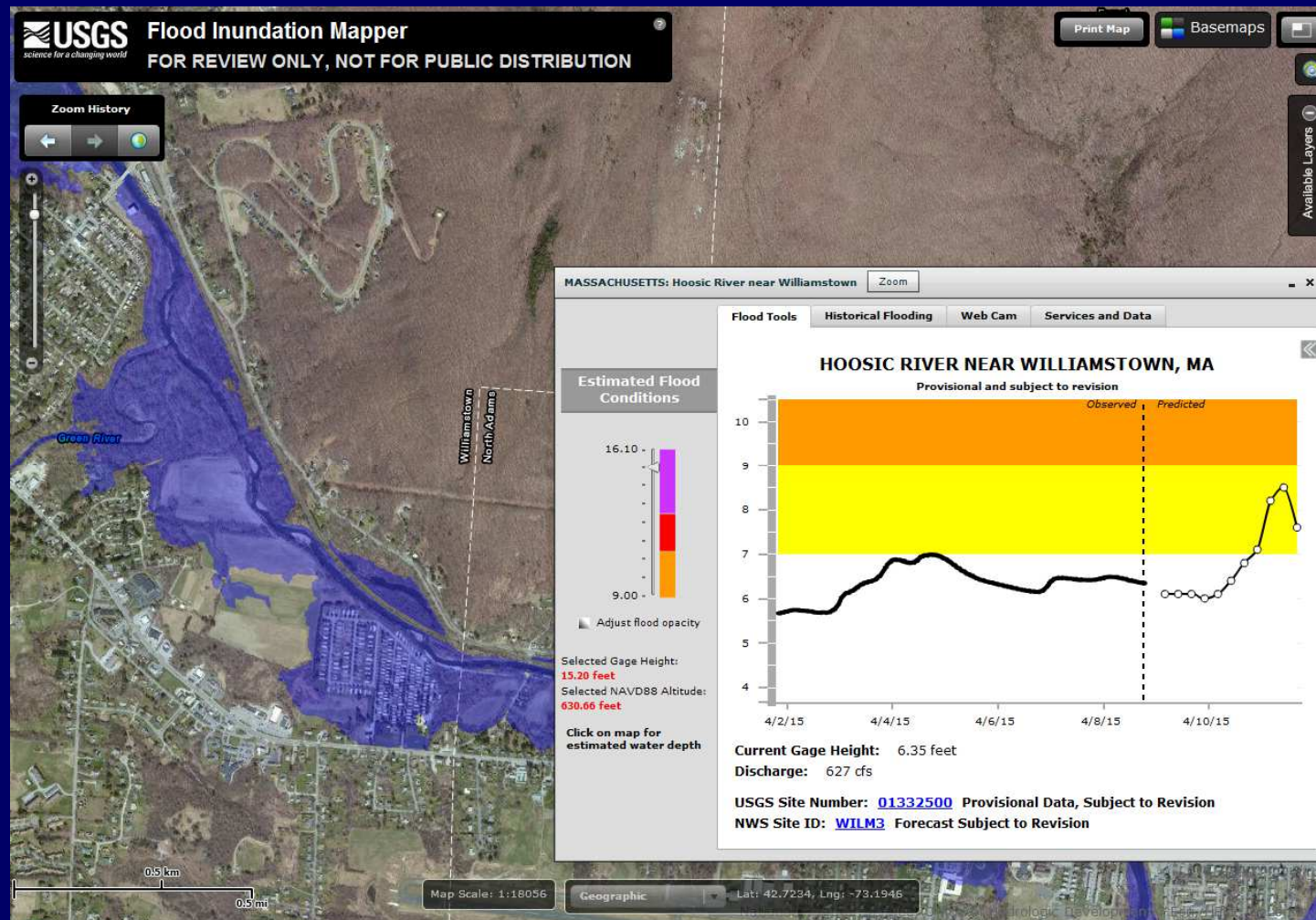
- Any river reach with a USGS streamgage (stage-only also)
- Possible river reaches:
 - Aberjona River - Winchester
 - Blackstone River
 - Charles River – Medway, Dover, Wellesley, and Waltham
 - Connecticut River – Montague and Holyoke (Northampton and Springfield – but not USGS operated gages)
 - Merrimack River – Lowell and Lawrence
 - Muddy River – Brookline
 - Mystic River (*new streamgages*)
 - Neponset River – Norwood, Canton, and Milton Village
 - North River – Peabody (no current gage)
 - Shawsheen River – Wilmington and Andover
 - Taunton River – Bridgewater and Taunton

FIM Web Mapping Application



<http://wimcloud.usgs.gov/apps/FIM/FloodInundationMapper.html>

Review Flood Inundation Mapper





<http://wimcloud.usgs.gov/apps/FIMReview/FloodInundationMapper.html>

FIM Benefits

- Helps with preparedness, response, recovery, and mitigation and planning
- Interactive tools give users a better understanding of flood risk areas
- Data can be shared by many users simultaneously to make decisions to reduce flood losses (before, during, and after)
- Help assess cost and damages of floods (*HAZUS*)
- USGS report documenting flood flows, hydraulic model, calibration, lidar, mapping, and map libraries
- Potentially helps communities with their NFIP community rating, and consequently lower flood insurance premiums

Questions

http://water.usgs.gov/osw/flood_inundation/



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USGS Flood Inundation Mapping Science

[Home](#) [Science](#) [Mapper](#) [Toolbox](#) [FIM Libraries](#) [About FIM](#) [Contact](#) [internal](#)

Flood Inundation Mapping (FIM) Program

Floods are the leading cause of natural-disaster losses in the United States. More than 75 percent of declared Federal disasters are related to floods, and annual flood losses average almost \$8 billion with over 90 fatalities per year. Although the amount of fatalities has declined due to improved early warning systems, economic losses have continued to rise with increased urbanization in flood-hazard areas. The **USGS Flood Inundation Mapping (FIM) Program** helps communities protect lives and property by providing tools and information to help them understand their local flood risks and make cost-effective mitigation decisions.

The **USGS Flood Inundation Mapping Program** has two main functions:

- 1) Partner with local communities to assist with the development and validation of flood inundation map libraries.**

A flood inundation map library is a set of maps that shows where flooding may occur over a range of water levels in the community's local stream or river. The USGS works with communities to identify an appropriate stream section, gather the necessary data to model where flooding will likely occur, and verify that the maps produced are scientifically sound. To learn more about the scientific process of developing a map library, visit the [FIM Science section](#).

Inundation maps can be used for:

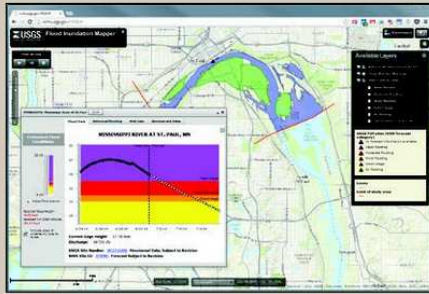
 - *Preparedness* - "What-if" scenarios
 - *Timely Response* - tied to real-time gage and forecast information
 - *Recovery* - damage assessment
 - *Mitigation and Planning* - flood risk analyses
 - *Environmental and Ecological Assessments* - wetlands identification, hazardous spill cleanup

To help communities create a flood inundation map library, the USGS created the [FIM Toolbox](#), which contains development resources and contact information.

- 2) Provide online access to flood inundation maps along with real-time streamflow data, flood forecasts, and potential loss estimates.**

Once a community's map library is complete, it is uploaded to the [USGS FIM Mapper](#), an online public

Flood Inundation Mapper



Visit the [Flood Inundation Mapper](#) to explore flood inundation maps, streamflow conditions, flood forecasts, potential loss estimates, and more...

FIM Toolbox

Visit the [FIM Toolbox](#) to learn more about developing a flood inundation map library for your community.

Download

Download the [FIM Information Sheet](#) to share information about the flood libraries and the FIM Program with others.