FLOOD INUNDATION MAPPING SCIENCE

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USGS science for a changing world

NATIONAL WEATHER SERVICE U.S. DEPARTMENT OF COMMERCE NOAA

FEMA

Integrated Water Resources Science and Services SUMMIT TO SEA

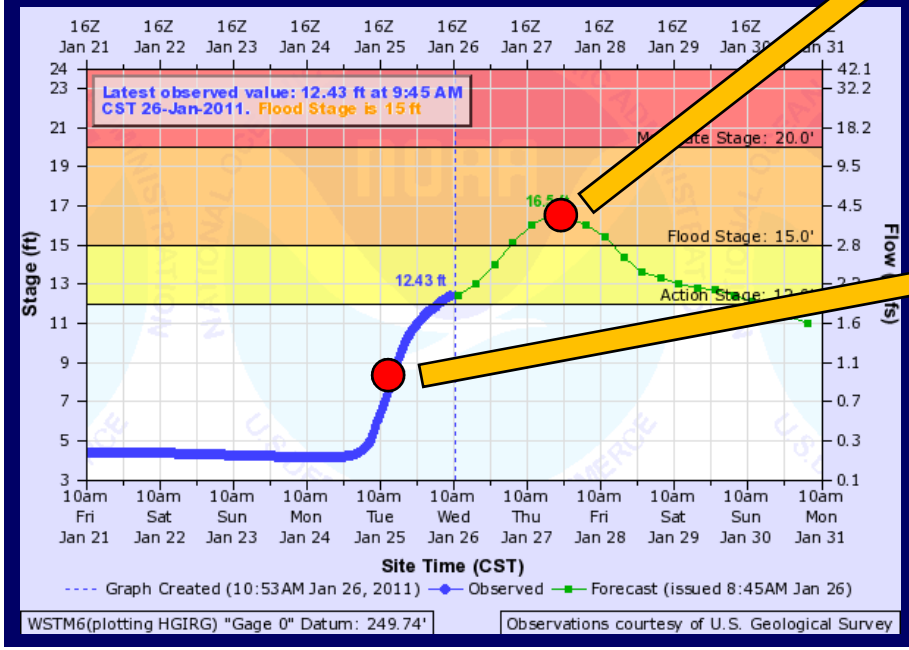
What is Flood Inundation Mapping?

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)

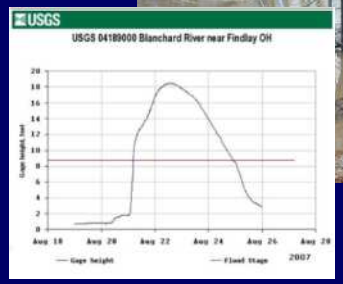
- Translate a hydrograph into operational maps that communicate risk and consequences



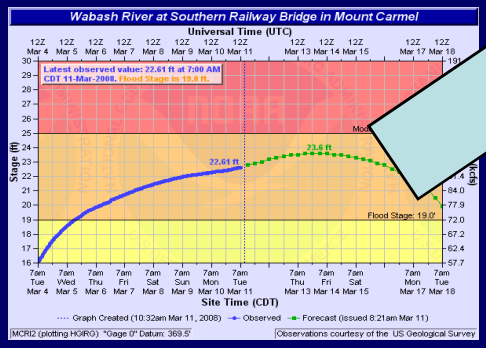
Flood Information – from a point on the landscape to geospatial products

High-water marks

Lidar and hydraulic model



USGS Real-time streamgage data

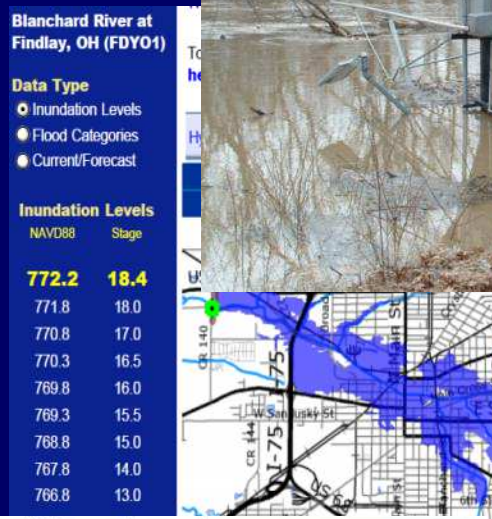


National Weather Service flood forecasts

Flood-Inundation Map

Inundation Mapping becomes a tool for flood…

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

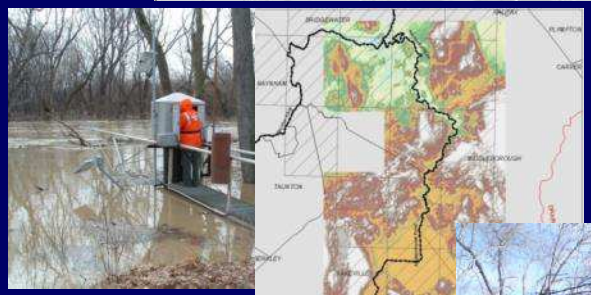


Flooded underpass, Beaumont, TX (photo courtesy of L. Roll/FEMA)

Creation of Flood Inundation Maps

Chose Reach and Data needed

- Critical infrastructure, populations, escape routes needed
- Streamgage 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



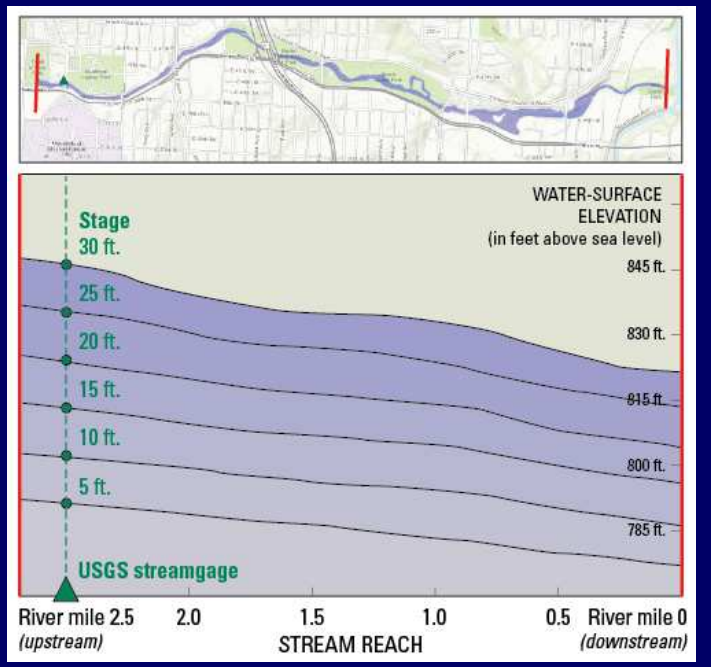
Creation of Flood Inundation Maps

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)



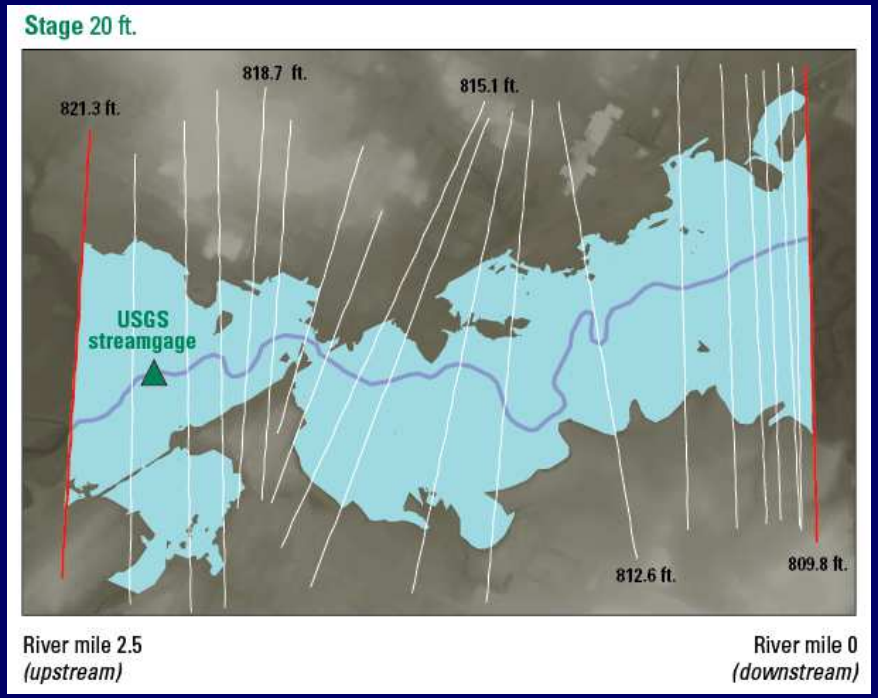
Creation of Flood Inundation Maps

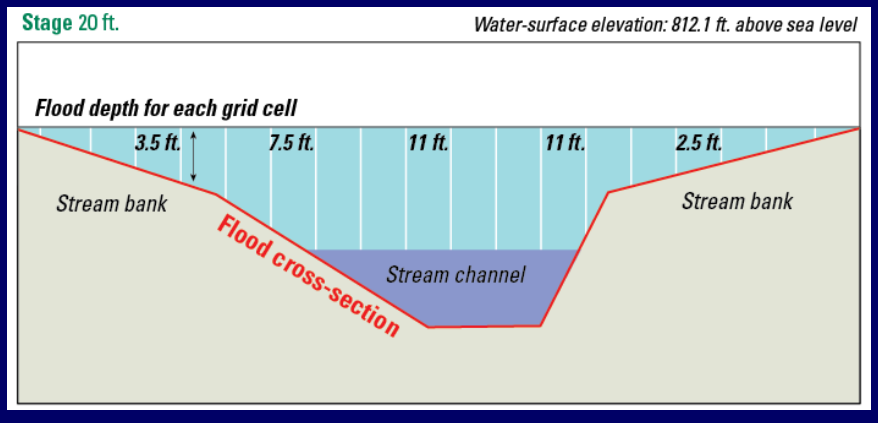
Delineation of inundation

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

Inundation depth

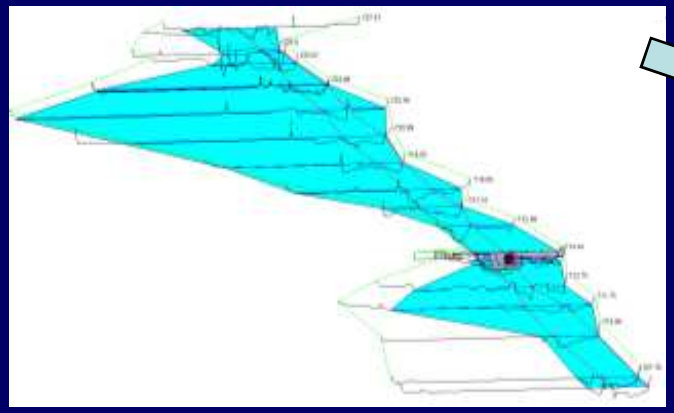
- Depth grids are determined for stage increments



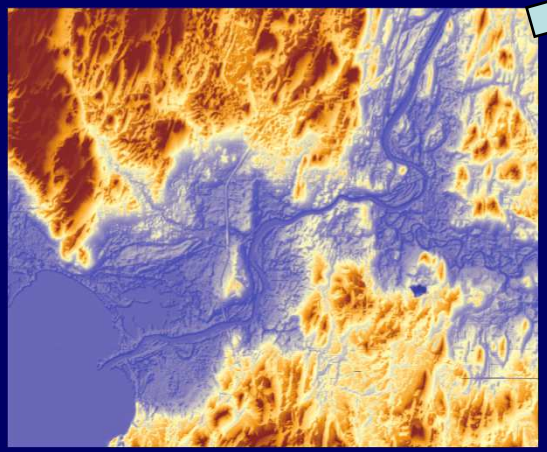


Creation of Flood Inundation Maps

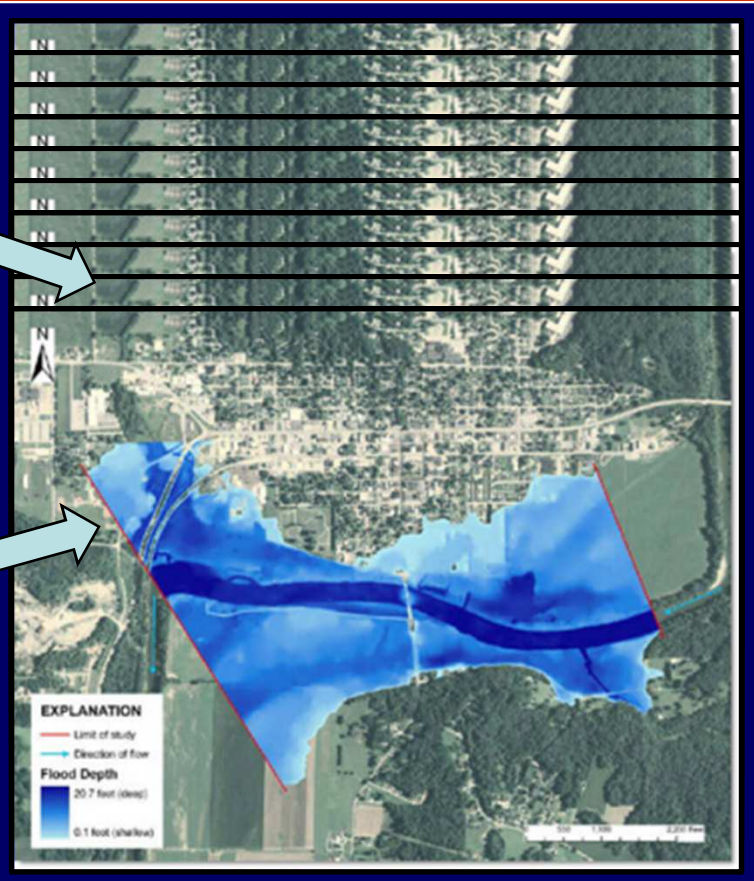
Hydraulic Modeling



Geospatial Processing

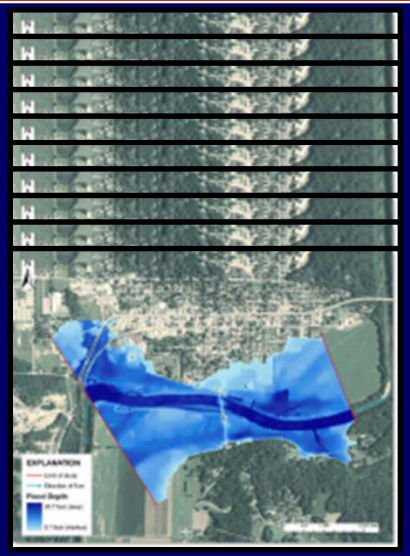


Digital Elevation Model



Series of sequential maps showing probable areas of flooding

FIM Mapper – more than just maps



Flood Library

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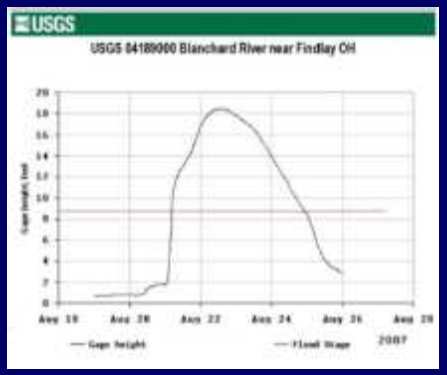

USGS Real-time streamgage

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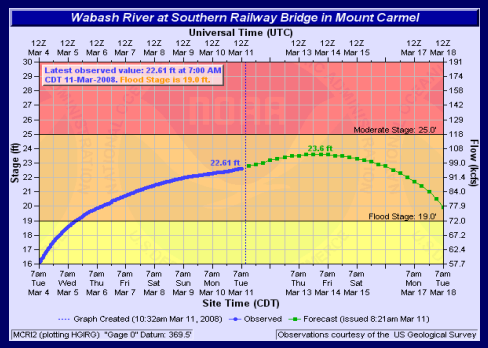

NWS Flood Forecast

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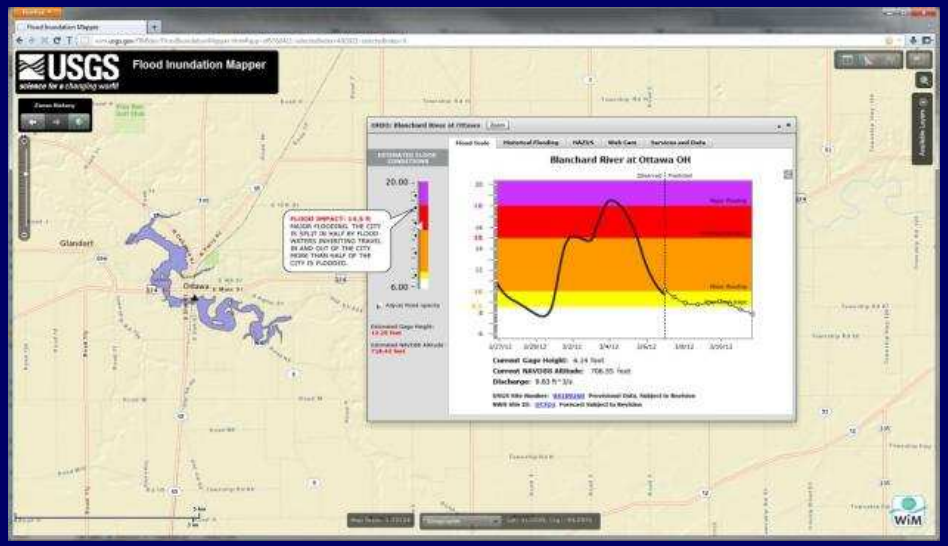
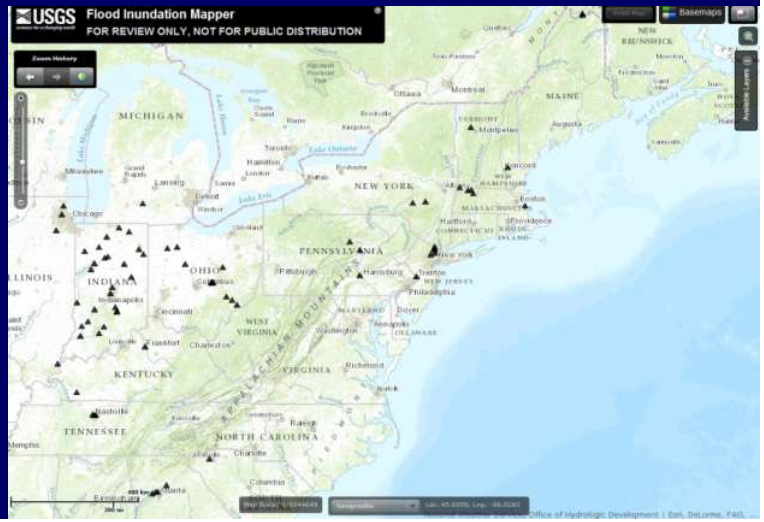


http://wim.usgs.gov/FIMI/

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

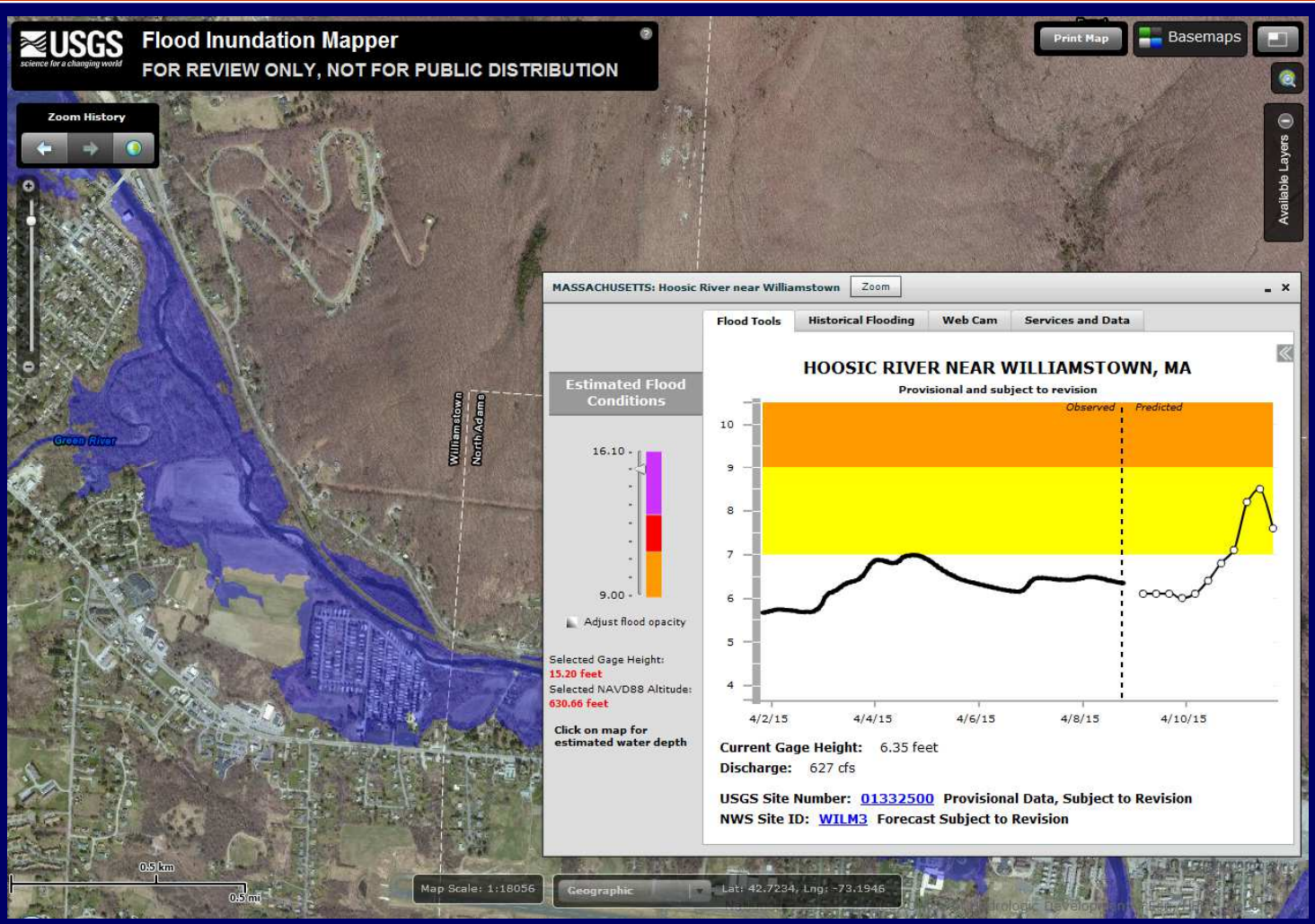
Watershed's with river reaches studied in detail

- 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

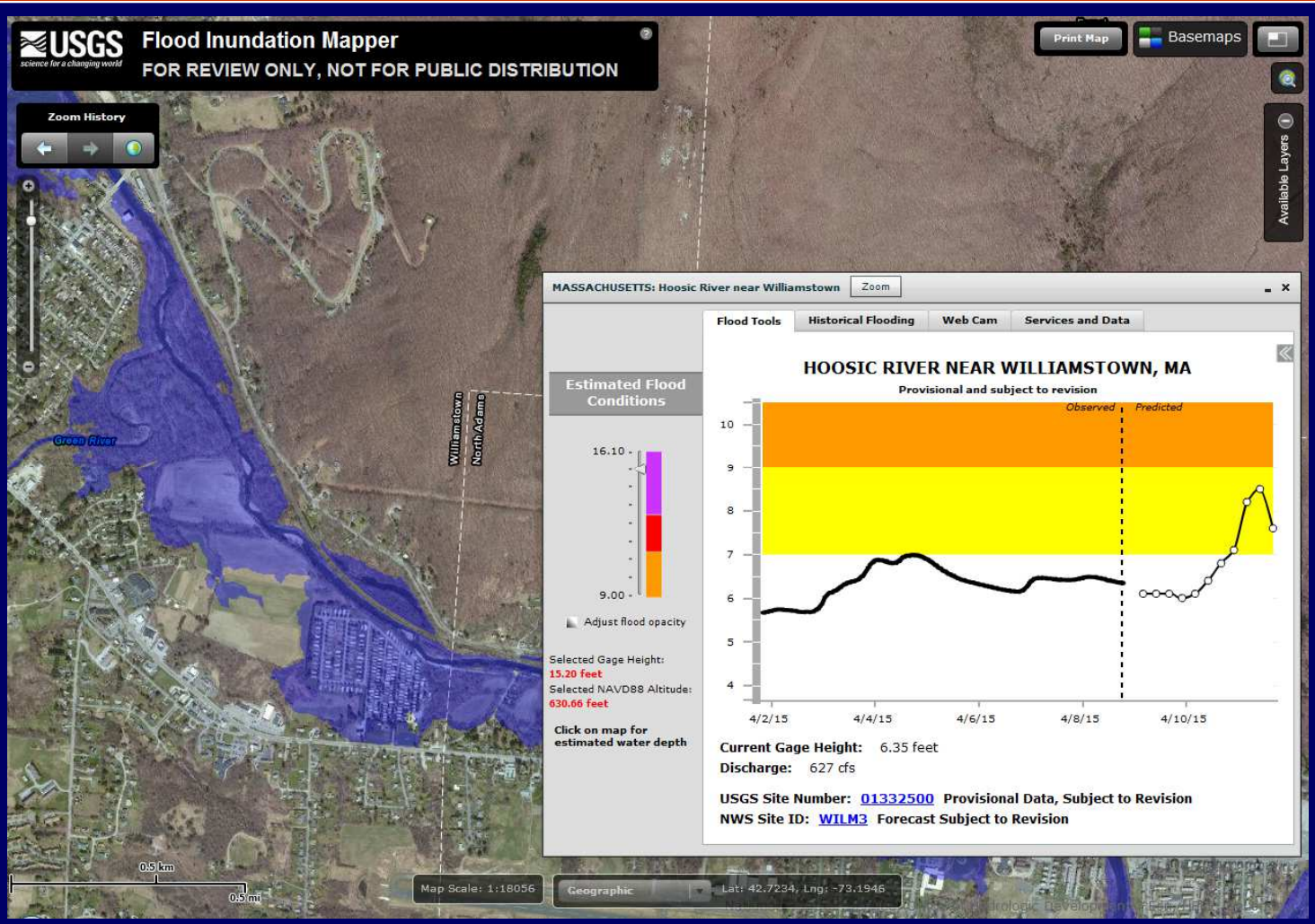
- Any river reach with a USGS streamgage (stage-only also)
- Possible river reaches:
  - Aberjona River - Winchester
  - Blackstone River
  - Charles River – Medway, Dover, Wellesley, and Waltham
  - Connecticut River – Montague and Holyoke (Northampton and Springfield – but not USGS operated gages)
  - 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 loses *(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 preminums

Questions

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