USGS Inundation Mapping — National and State Perspective

Elizabeth Murphy

IAFSM conference

March 7, 2013-Bloomington

Overview

- National USGS Flood Inundation Mapping (FIM) Program
- Integrated Water Resources Science and Services (IWRSS)
- USGS gage-linked inundation sites in Illinois

USGS
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USGS and NWS Data Networks

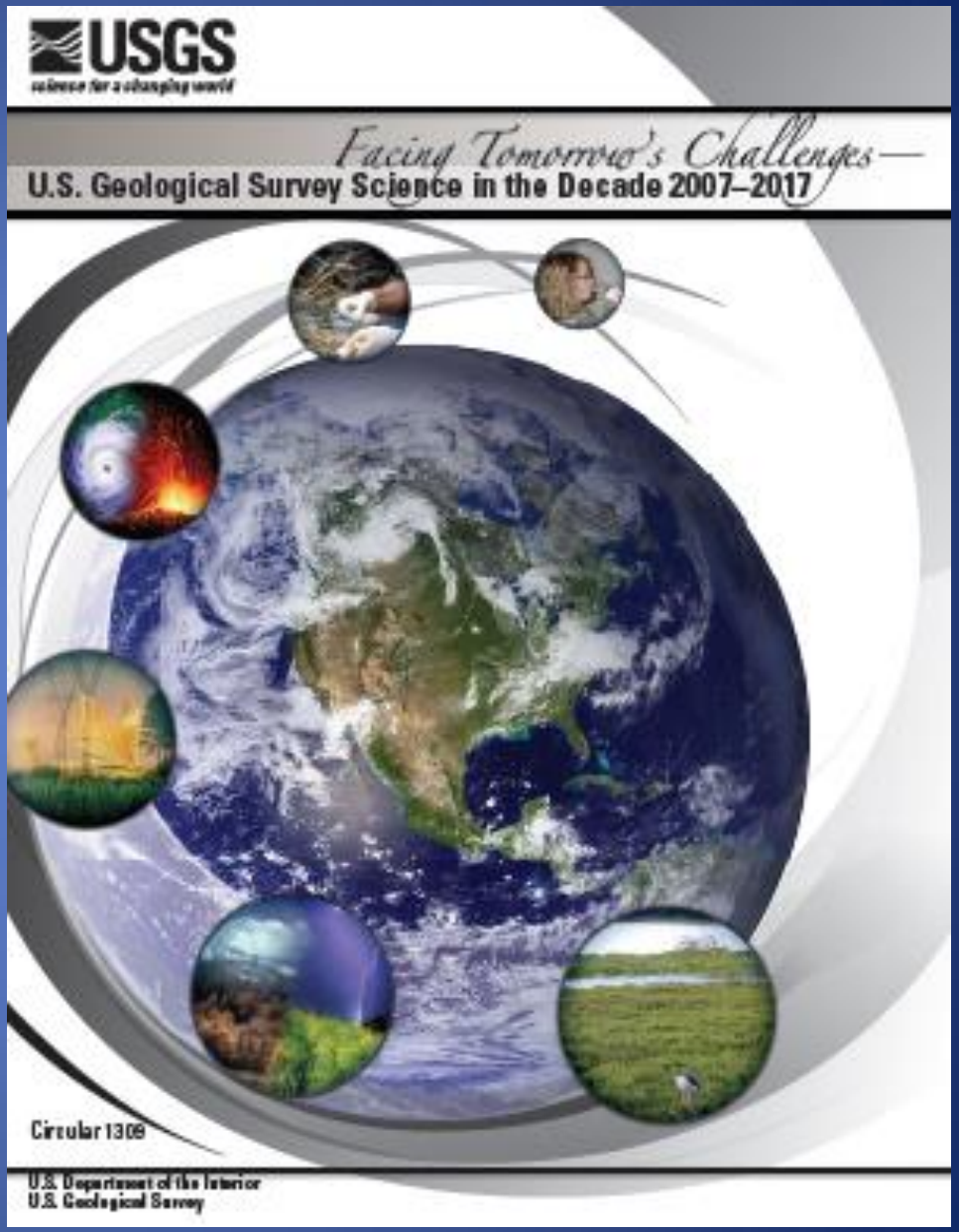
Over 9,000 USGS Gages reporting current stream conditions in NWIS

Over 4,000 NWS Flood Forecast/Warning locations in AHPS

USGS Hazards

A National Hazards Risk and Resilience Assessment Program

- Enhance our ability to collect and deliver real-time info from earth-observation networks
- With our partners, assess the vulnerability of cities and ecosystems
- Ensure science is effectively applied to reduce losses



Facing Tomorrow's Challenges, USGS Science in the Decade 2007—2017, Circular 1309

USGS FIM Program

- USGS Flood Inundation Mapping Program (FIM) provides support and guidelines for gage-linked inundation mapping

- FIM group interacts with our partners in the NWS, USACE, and FEMA through the Integrated Water Resources Science and Services consortium (IWRSS)

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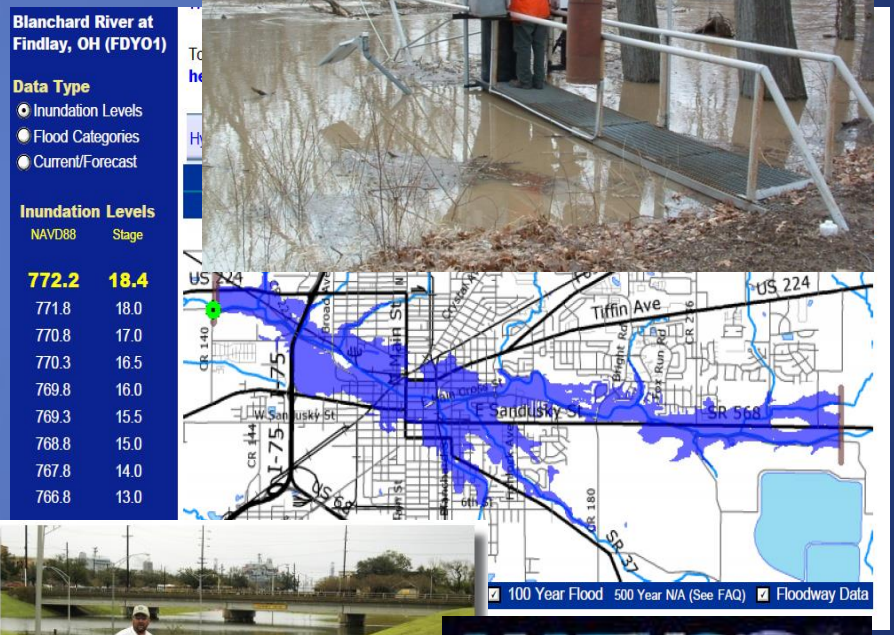
FIM becomes a tool for flood…..

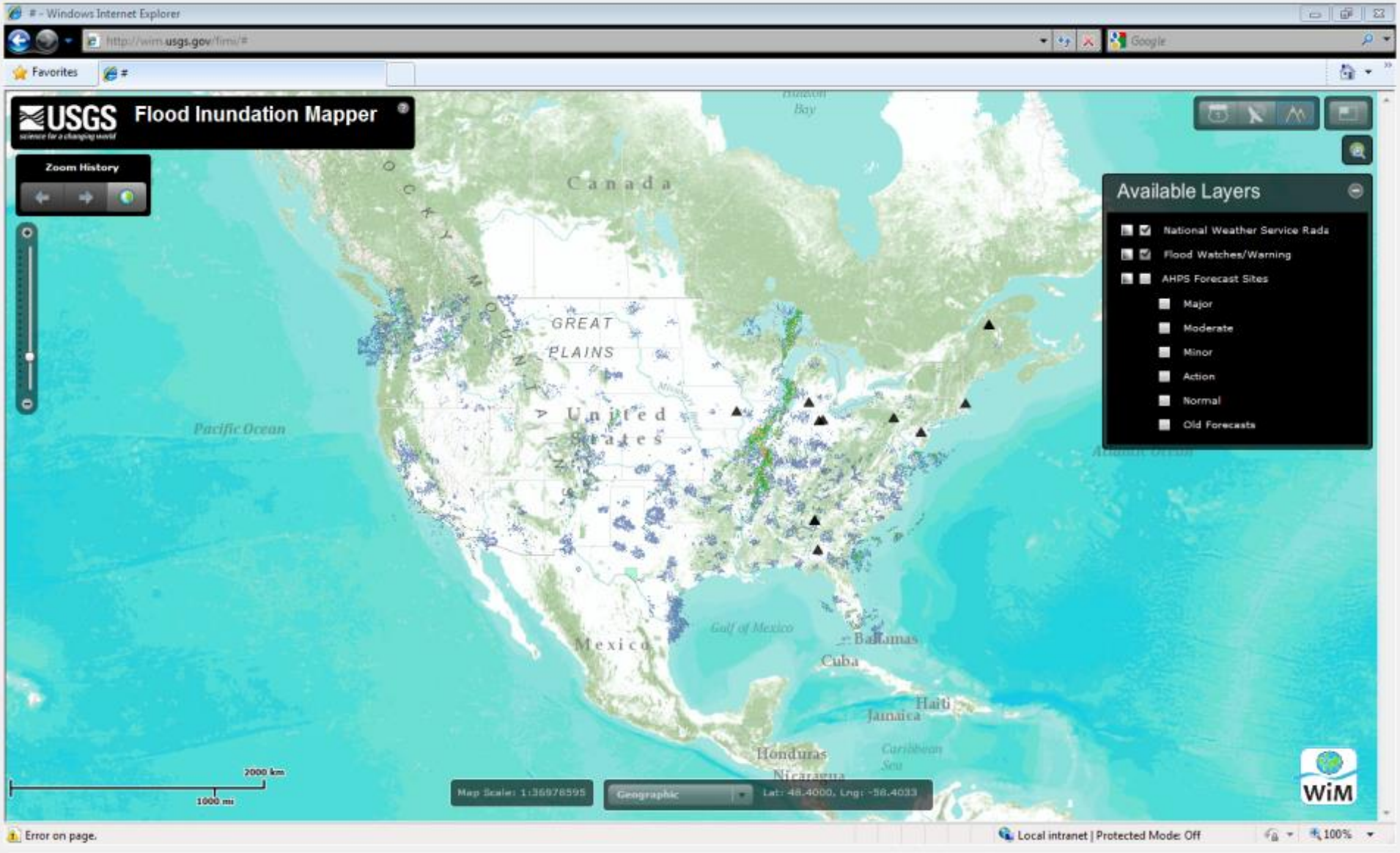
- Preparedness
  - "What-if" scenarios
- Response
  - Tied to gage & forecast data
- Recovery
  - Damage assessment
- Mitigation & planning
  - Flood risk analyses
- Environmental & ecological assessments

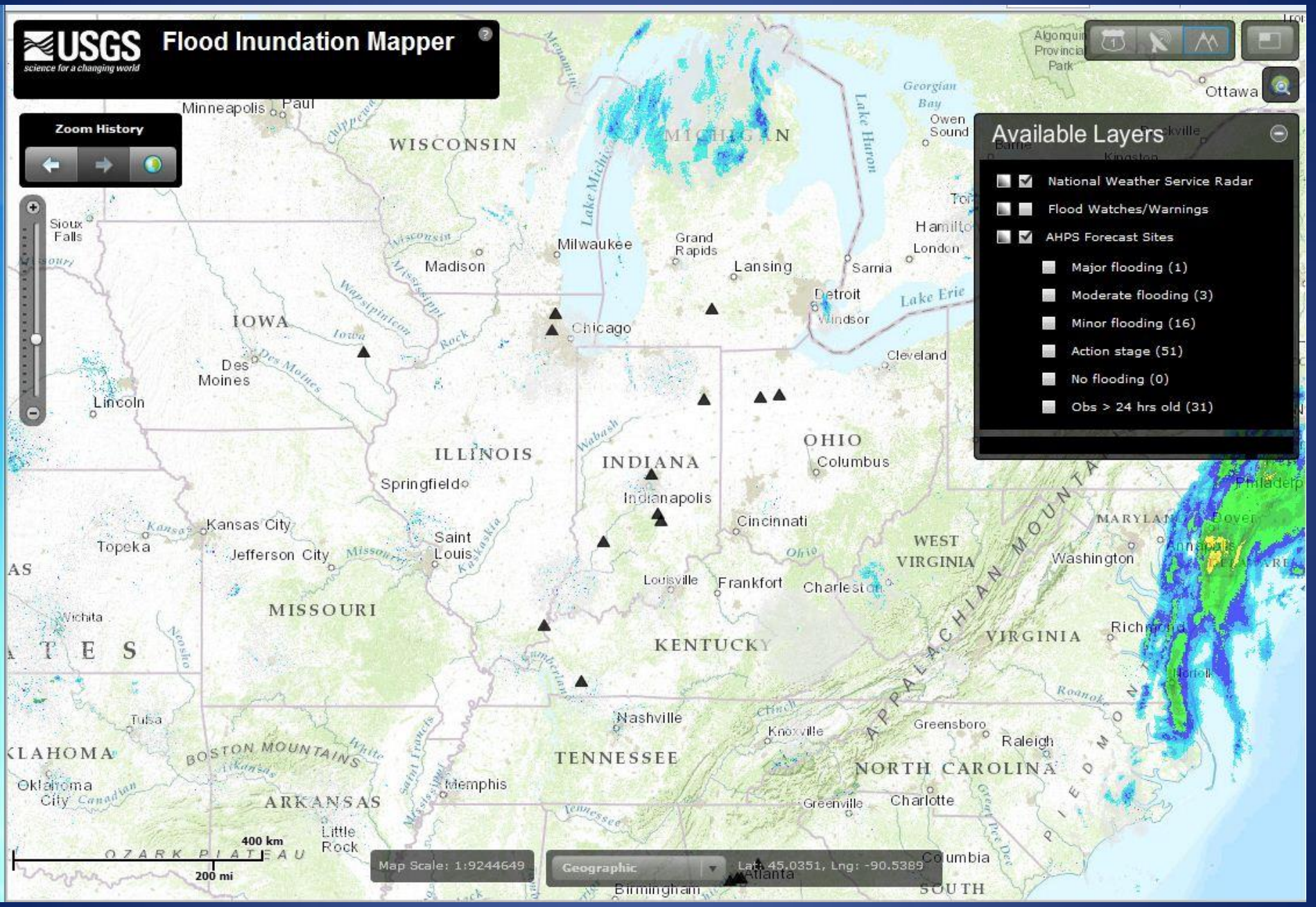


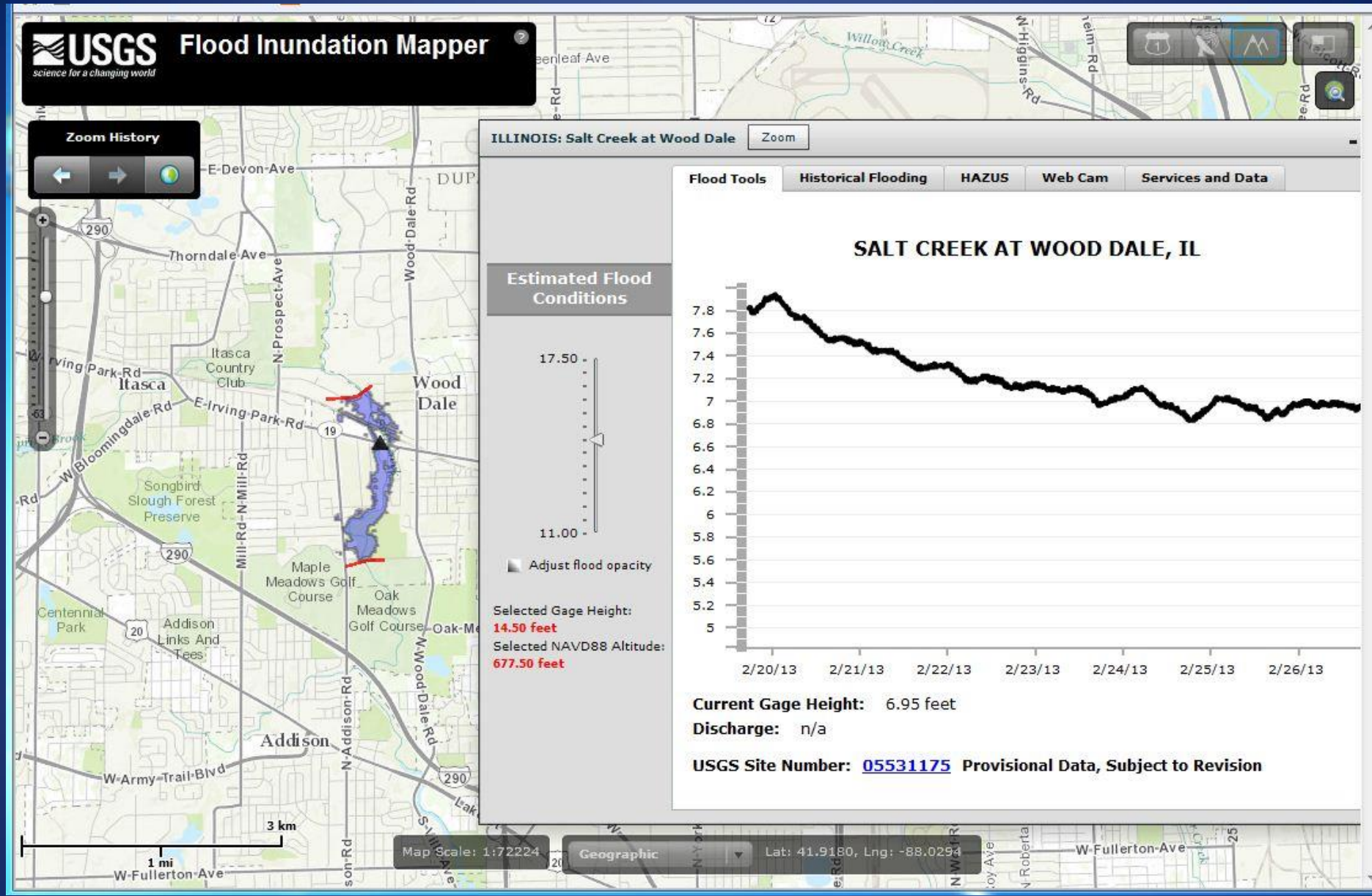
Flooded underpass, Beaumont, TX (photo courtesy of L. Roll/FEMA)

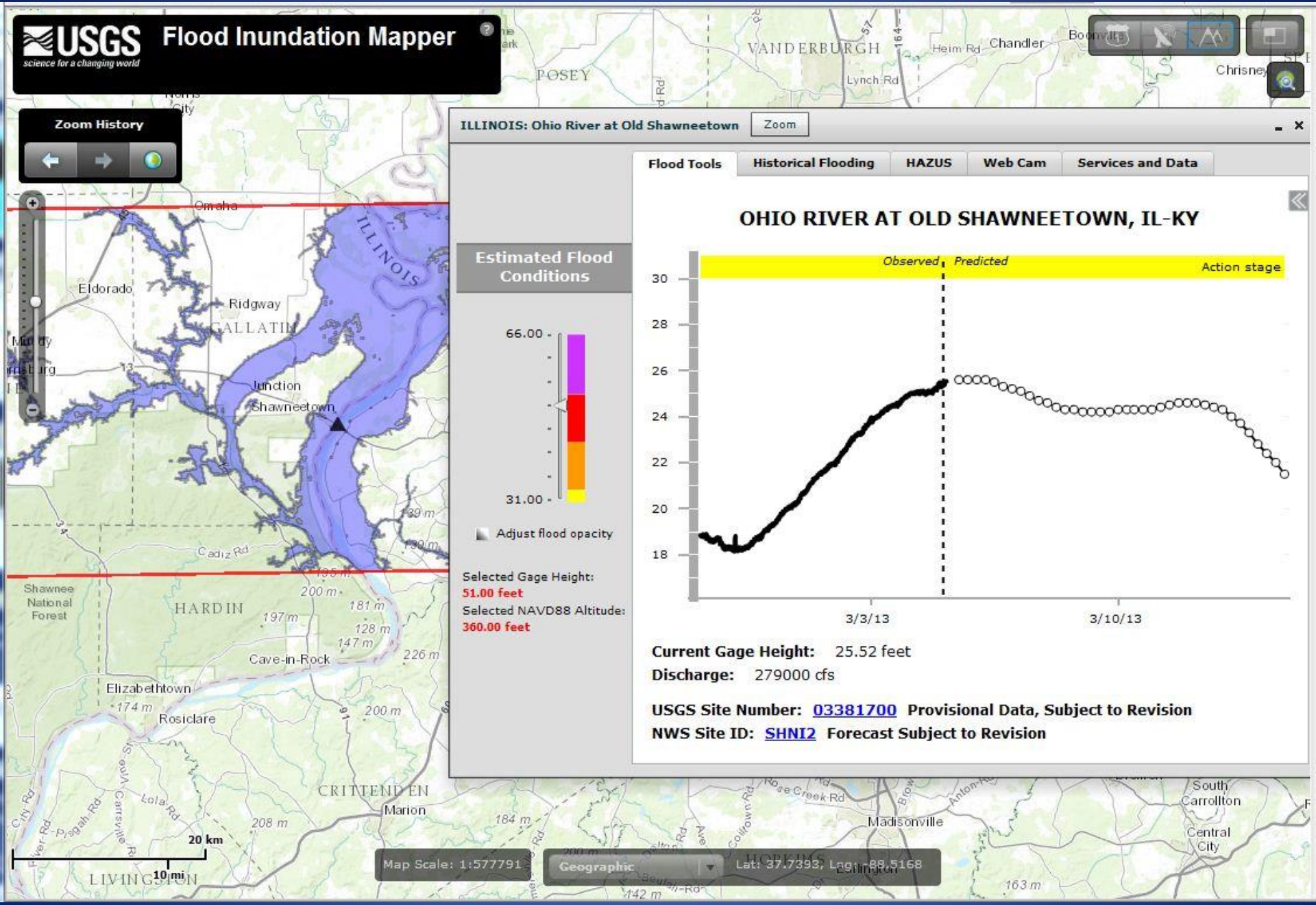
Environmental Aspects

- Ecological studies of floodplains
  - E.g. frequency of inundation
- Riparian wetland applications
  - 7-day inundation areas for Wetland Reserve Program
- Hazardous substance spills
  - MI Kalamazoo River Oil Spill


USGS
Flood Inundation Mapper
Zoom History
Available Layers
National Weather Service Rada
Flood Watches/Warning
AHPS Forecast Sites
Major
Moderate
Minor
Action
Normal
Old Forecasts
Canada
GREAT
PLAINS
United
States
Mexico
Pacific Ocean
Gulf of Mexico
Cuba
Haiti
Jamaica
Honduras
Nicaragua
Caribbean
Sea
2000 km
1000 mi
Map Scale: 1:36978595
Geographic
Lat: 48.4000, Lng: -58.4033
WiM


USGS
science for a changing world
Flood Inundation Mapper
Zoom History
Available Layers
National Weather Service Radar
Flood Watches/Warnings
AHPS Forecast Sites
Major flooding (1)
Moderate flooding (3)
Minor flooding (16)
Action stage (51)
No flooding (0)
Obs > 24 hrs old (31)
Minneapolis
Paul
WISCONSIN
MICHIGAN
Ottawa
Owen Sound
Sioux Falls
Madison
Milwaukee
Grand Rapids
Lansing
Sarnia
London
Detroit
Windsor
Chicago
Cleveland
IOWA
Des Moines
Lincoln
ILLINOIS
INDIANA
OHIO
Columbus
Springfield
Indianapolis
Cincinnati
Kansas City
Topeka
Jefferson City
Saint Louis
WEST VIRGINIA
Washington
Louisville
Frankfort
Charleston
MISSOURI
KENTUCKY
VIRGINIA
Richmond
Nashville
Knoxville
Greensboro
Raleigh
TENNESSEE
NORTH CAROLINA
Memphis
Charlotte
Greenville
ARKANSAS
Little Rock
Tulsa
Oklahoma City
Columbia
Atlanta
Birmingham
400 km
200 mi
Map Scale: 1:9244649
Geographic
Lat: 45.0351, Lng: -90.5389


USGS
science for a changing world
Flood Inundation Mapper
Zoom History
ILLINOIS: Salt Creek at Wood Dale
Zoom
Flood Tools
Historical Flooding
HAZUS
Web Cam
Services and Data
Estimated Flood Conditions
17.50
11.00
Adjust flood opacity
Selected Gage Height:
14.50 feet
Selected NAVD88 Altitude:
677.50 feet
SALT CREEK AT WOOD DALE, IL
7.8
7.6
7.4
7.2
7
6.8
6.6
6.4
6.2
6
5.8
5.6
5.4
5.2
5
2/20/13
2/21/13
2/22/13
2/23/13
2/24/13
2/25/13
2/26/13
Current Gage Height: 6.95 feet
Discharge: n/a
USGS Site Number: 05531175 Provisional Data, Subject to Revision
E-Devon-Ave
Thorndale-Ave
Wood-Dale-Rd
N-Prospect-Ave
Itasca
Itasca Country Club
Wood Dale
E-Irving-Park-Rd
W-Bloomingdale-Rd
Songbird Slough Forest Preserve
Mill-Rd-N-Mill-Rd
Maple Meadows Golf Course
Oak Meadows Golf Course
Centennial Park
Addison Links And Trees
Addison
W-Army-Trail-Blvd
N-Addison-Rd
W-Wood-Dale-Rd
W-Fullerton-Ave
3 km
1 mi
Map Scale: 1:72224
Geographic
Lat: 41.9180, Lng: -88.0294


USGS
science for a changing world
Flood Inundation Mapper
Zoom History
ILLINOIS: Ohio River at Old Shawneetown
Zoom
Flood Tools
Historical Flooding
HAZUS
Web Cam
Services and Data
Estimated Flood Conditions
66.00
31.00
Adjust flood opacity
Selected Gage Height:
51.00 feet
Selected NAVD88 Altitude:
360.00 feet
OHIO RIVER AT OLD SHAWNEETOWN, IL-KY
Observed
Predicted
Action stage
30
28
26
24
22
20
18
3/3/13
3/10/13
Current Gage Height: 25.52 feet
Discharge: 279000 cfs
USGS Site Number: 03381700 Provisional Data, Subject to Revision
NWS Site ID: SHNI2 Forecast Subject to Revision
Omaha
Eldorado
Ridgway
GALLATIN
Junction
Shawneetown
ILLINOIS
Shawnee National Forest
HARDIN
Cave-in-Rock
Elizabethtown
Rosiclare
Marion
CRITTENDEN
LIVINGSTON
VANDERBURGH
POSEY
Chandler
Heim Rd
Lynch Rd
Madisonville
South Carrollton
Central City
Cadiz Rd
20 km
10 mi
Map Scale: 1:577791
Geographic
Lat: 37.7393, Lng: -88.5168

USGS science for a changing world

Flood Inundation Mapper

Zoom History

ILLINOIS: Des Plaines River at Lincolnshire | Zoom

Flood Tools | Historical Flooding | HAZUS | Web Cam | Services and Data

Estimated Flood Conditions

19.10

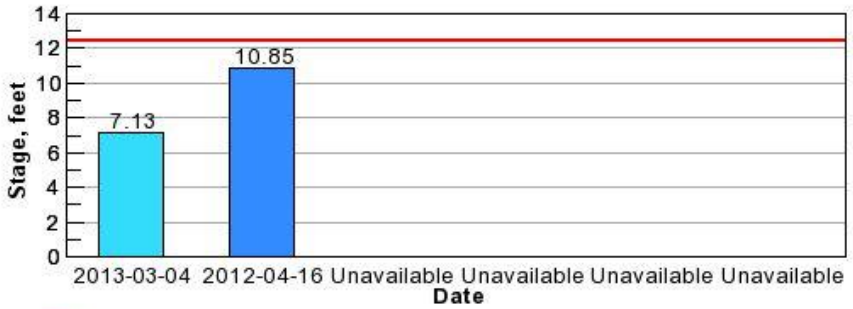
13.20

Adjust flood opacity

Selected Gage Height:
14.90 feet
Selected NAVD88 Altitude:
644.90 feet

Please visit the full USGS NWIS Site page for full site information.

05528100 DES PLAINES RIVER AT LINCOLNSHIRE, IL



Current Stage 7.13 feet on 2013-03-04 21:45:00 (provisional)
Recent Maximum Stage (previous 365 days) 10.85 feet on 2012-04-16 (provisi
Highest Recorded Peak Stages Unavailable
National Weather Service Flood Stage 12.5 feet

USGS WaterWatch

Map Scale: 1:72224 | Geographic | Lat: 42.1697, Lng: -87.9547

3 km
1 mi

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Flood Inundation Mapper

Zoom History

ILLINOIS: Des Plaines River at Lincolnshire | Zoom

Flood Tools | Historical Flooding | HAZUS | Web Cam | Services and Data

Sign up for WaterAlert for this site

Water information texted directly to you...
simply subscribe to WaterAlert!

Project Contacts for more information

Maps created by
Illinois Water Science Center

Maps reviewed by
New Mexico Water Science Center
Maine Water Science Center

Estimated Flood Conditions

19.10

13.20

Adjust flood opacity

Selected Gage Height:
14.90 feet
Selected NAVD88 Altitude:
644.90 feet

Data Downloads

Download Data

References

Download Report

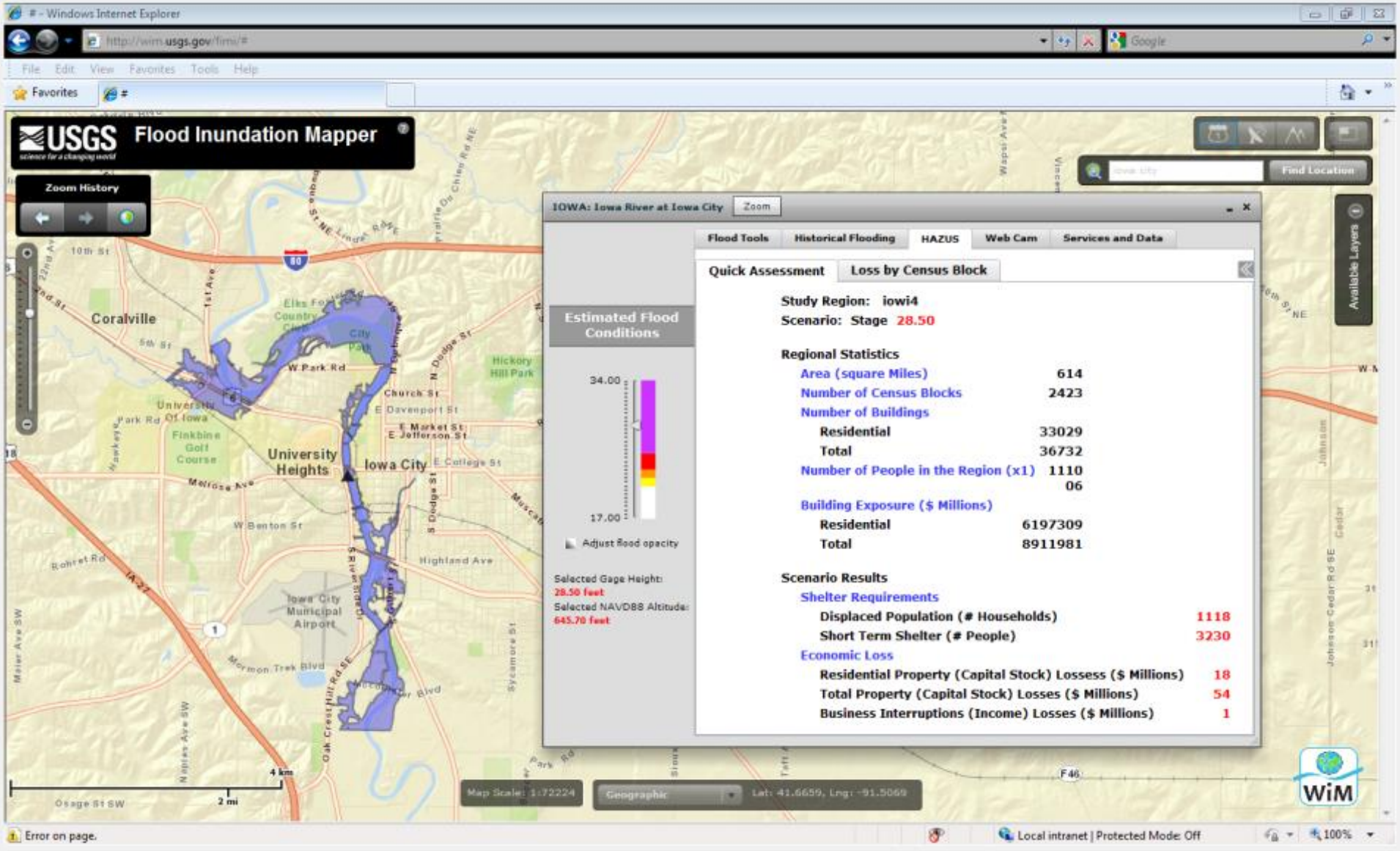
Mettawa
Lincolnshire
Deerfield Pky
W Aptakisic Rd
N Prairie Rd
W Half Day Rd
W Everett Rd
Hawthorn
Vernon Hills Athletic Complex
Wright Woods Forest Preserve
Bob O Link Golf Club

3 km
1 mi

Map Scale: 1:72224

Geographic

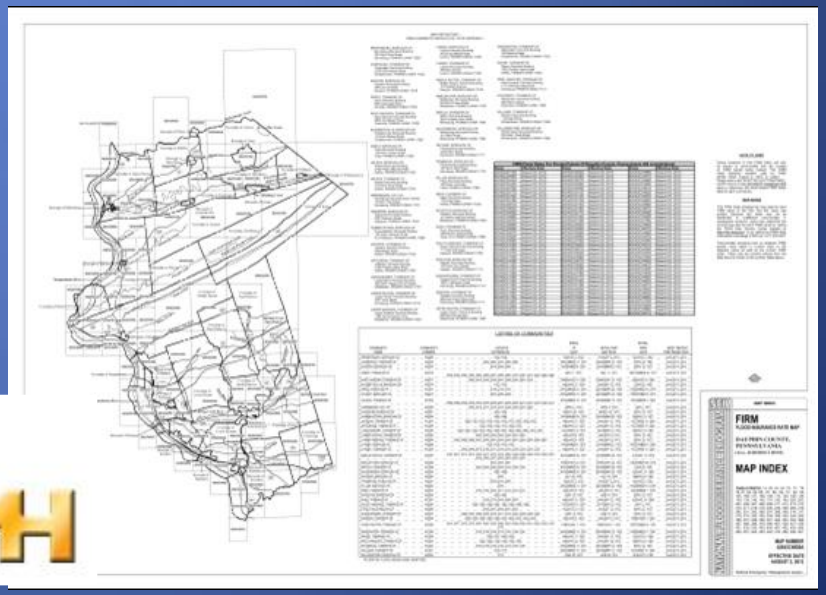
Lat: 42.2373, Lng: -87.9719


USGS Flood Inundation Mapper
Zoom History
Find Location
Available Layers
IOWA: Iowa River at Iowa City
Zoom
Flood Tools
Historical Flooding
HAZUS
Web Cam
Services and Data
Quick Assessment
Loss by Census Block
Estimated Flood Conditions
34.00
17.00
Adjust flood opacity
Selected Gage Height:
28.50 feet
Selected NAVD88 Altitude:
645.70 feet
Study Region: iowi4
Scenario: Stage 28.50
Regional Statistics
Area (square Miles) 614
Number of Census Blocks 2423
Number of Buildings
Residential 33029
Total 36732
Number of People in the Region (x1) 111006
Building Exposure ($ Millions)
Residential 6197309
Total 8911981
Scenario Results
Shelter Requirements
Displaced Population (# Households) 1118
Short Term Shelter (# People) 3230
Economic Loss
Residential Property (Capital Stock) Lossess ($ Millions) 18
Total Property (Capital Stock) Losses ($ Millions) 54
Business Interruptions (Income) Losses ($ Millions) 1
Coralville
University Heights
Iowa City
Finkbine Golf Course
Iowa City Municipal Airport
Elks Country Club
City Park
Hickory Hill Park
Map Scale: 1:72224
Geographic
Lat: 41.6659, Lng: -91.5069
WiM

FIM Program project activities

- Testing boundaries/Methods development:
  - Archived images
  - Hazus hydraulic models
  - FEMA Flood Insurance Rate Map (FIRM)

HAZUS MH
EARTHQUAKE • WIND • FLOOD



Next steps for the FIM program

- Continue to enhance the mapping application
  - Discharge as primary variable option
  - Incorporate Flood Impacts and other consequences information
  - Enhance the Historical tab to include the full POR
- Create a database and submission method for libraries and all supporting information
- Continue to add communities and work with the other federal, state and local agencies

IWRSS

- Designed to bring together Federal agencies working on water resources and natural hazards
- National Water Center being built in Tuscaloosa, AL
- First priority is interoperability and data transfer

IWRSS-Requirements Team

- Define technical specifications for flood inundation mapping products and services
- Define the role of each agency in flood-mapping to leverage each agency's strength
- Specify requirements for the modeling and information services framework to support the flood mapping

ILWSC Flood Inundation websites

- Salt Creek near Wood Dale, IL
  - 1.6 mile reach developed with FEQ modeling
  - Depth grids to be added
- Des Plaines River at Lincolnshire, IL
  - 9 mile reach developed with Hec-2 modeling
  - Updates made to structures from as-built plans
  - Surfaces generated including depths
- Saline and Wabash Rivers–referenced to Ohio River at Old Shawneetown, IL
  - Backwater from Ohio River controls flooding

Salt Creek at Wood Dale, IL (05531175)—Inundation Map Subject to Revision

Elevation & Gage Height

674.0 (11.0)
674.5 (11.5)
675.0 (12.0)
675.5 (12.5)
676.0 (13.0)
676.5 (13.5)
677.0 (14.0)
677.5 (14.5)
678.0 (15.0)
678.5 (15.5)
679.0 (16.0)
679.5 (16.5)
680.0 (17.0)
680.5 (17.5)

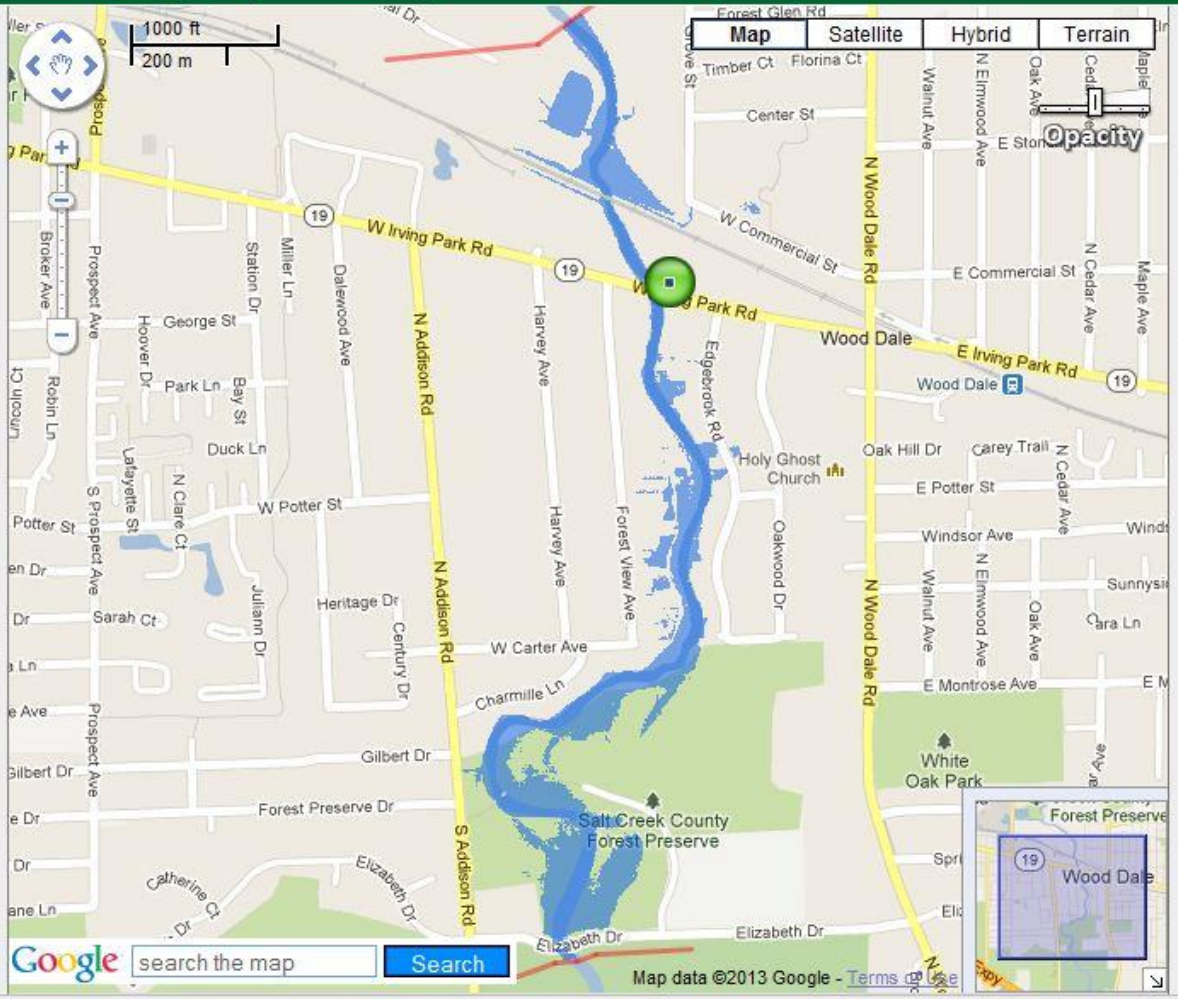
NWS Precip Estimations

- [ ] 1 Hour
- [ ] Storm Total

(zoom out to view)

Report

Disclaimer



This site is operated in cooperation with the

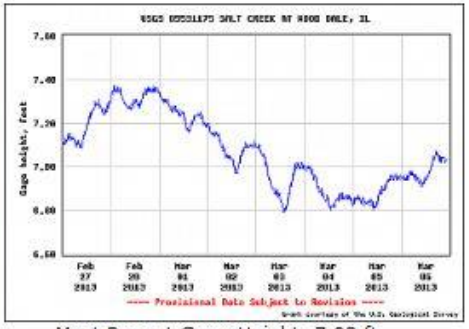
DuPage County, Illinois
Department of Economic Development & Planning

Explanation

- Salt Creek at Wood Dale, IL
- Extent of Study
- Other Inundation Mapping Gages

Gage Data

Hydrograph | Cam 1 | Cam 2



Most Recent Gage Height: 7.03 ft.
Date: 2013-03-06 22:15

Salt Creek at Wood Dale, IL (05531175)—Inundation Map Subject to Revision

Elevation & Gage Height

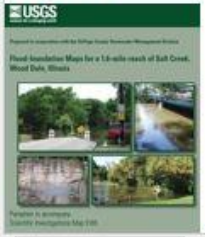
674.0 (11.0)
674.5 (11.5)
675.0 (12.0)
675.5 (12.5)
676.0 (13.0)
676.5 (13.5)
677.0 (14.0)
677.5 (14.5)
678.0 (15.0)
678.5 (15.5)
679.0 (16.0)
679.5 (16.5)
680.0 (17.0)
680.5 (17.5)

NWS Precip Estimations

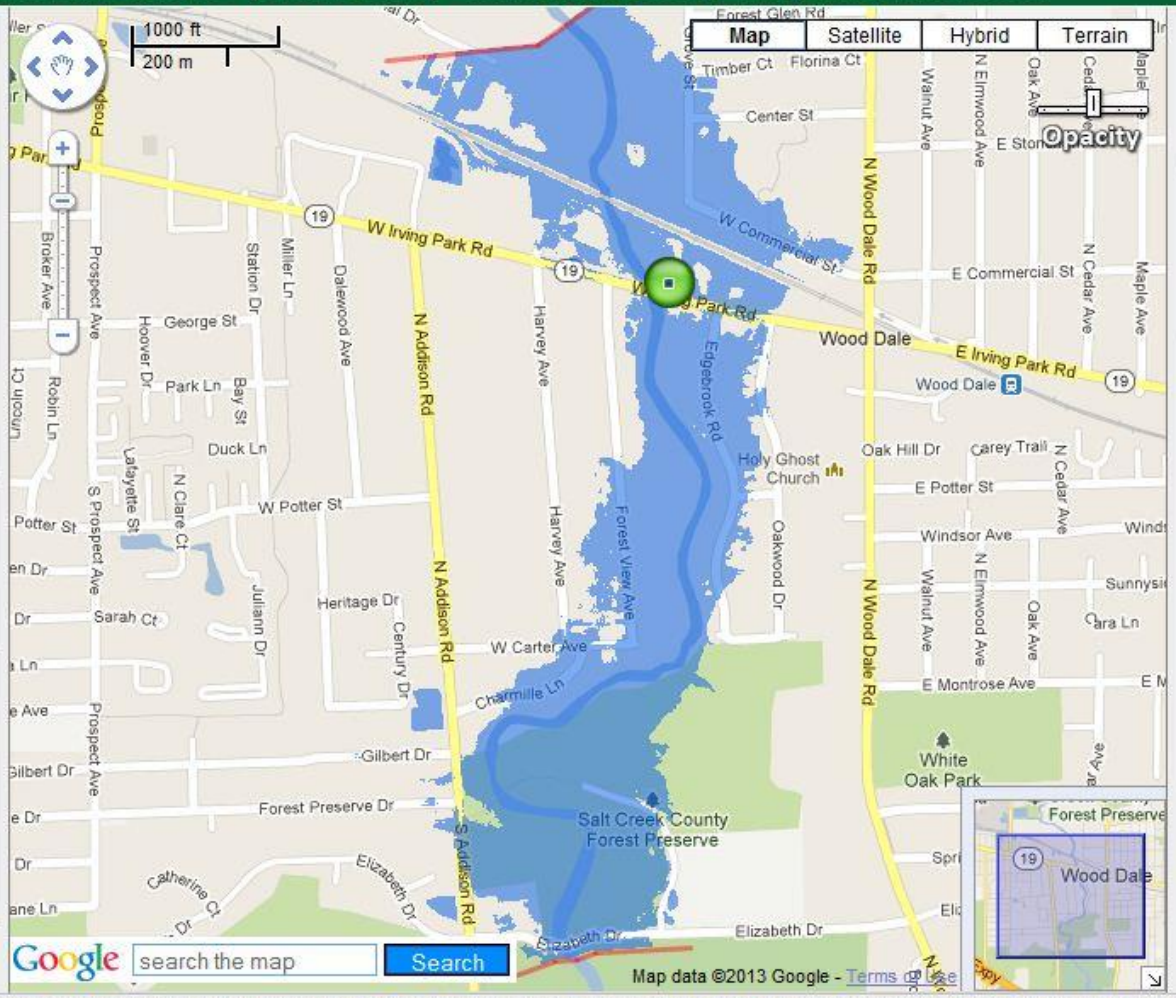
- [ ] 1 Hour
- [ ] Storm Total

(zoom out to view)

Report



Disclaimer



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DuPage County, Illinois
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Explanation

- Salt Creek at Wood Dale, IL
- Extent of Study
- Other Inundation Mapping Gages

Gage Data

Hydrograph | Cam 1 | Cam 2

Des Plaines River at Lincolnshire, IL (05528100)—Inundation Map Subject to Revision

Elevation & Gage Height

- Flooded area
- Flooded depth

643.2 (13.2)
644.0 (14.0)
644.9 (14.9)
646.0 (16.0)
647.0 (17.0)
648.0 (18.0)
649.1 (19.1)

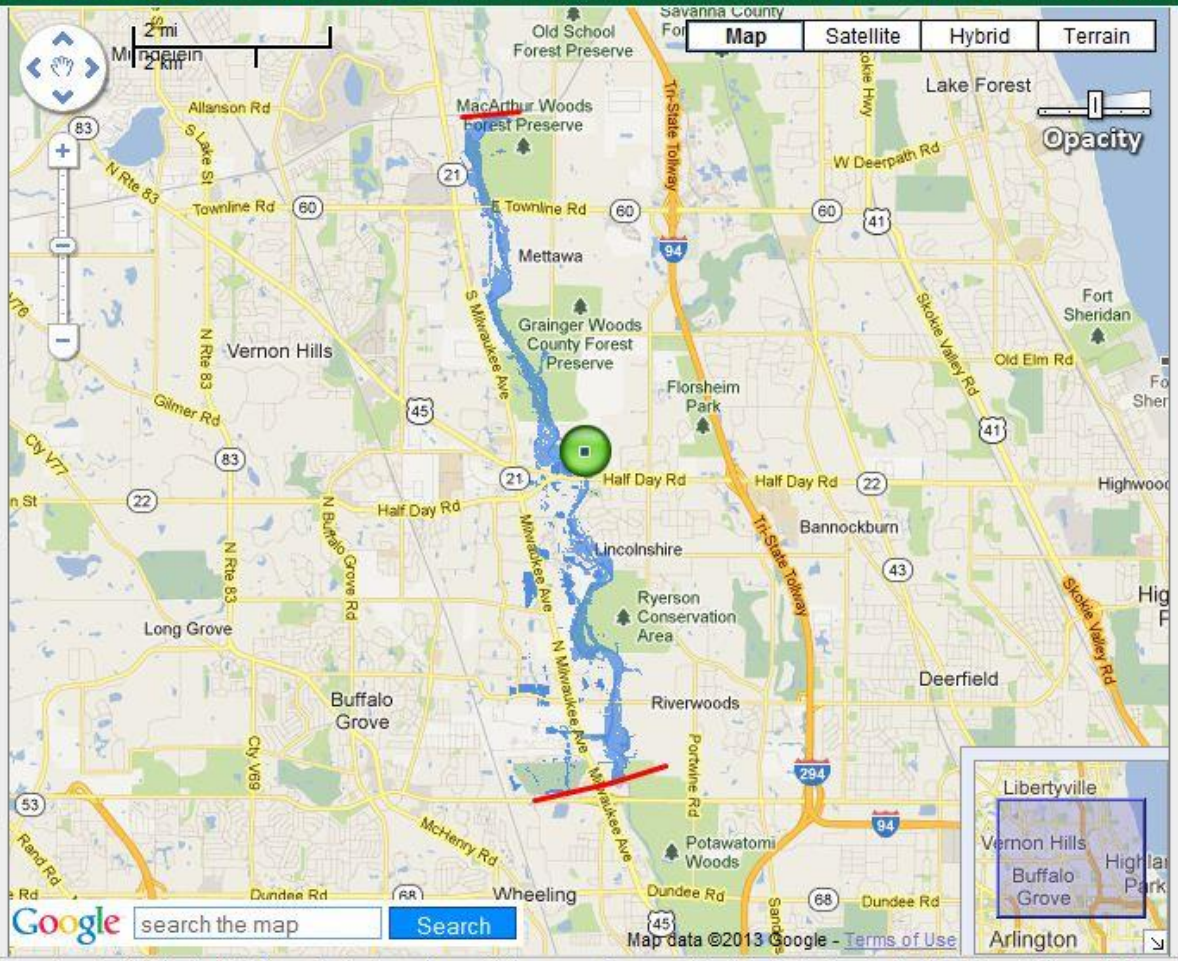
NWS Precip Estimations

- 1 Hour
- Storm Total

(zoom out to view)

Report

Disclaimer



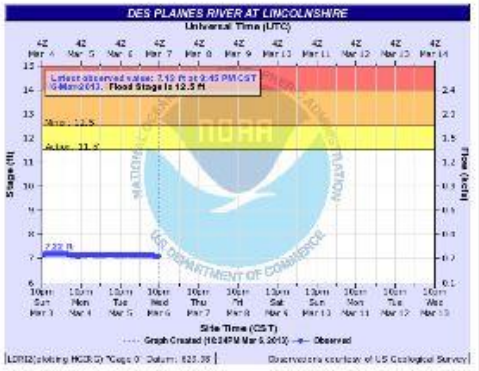
This site is operated in cooperation with the Lake County, Illinois Stormwater Management Commission

Explanation

- Des Plaines River at Lincolnshire, IL
- Extent of Study
- Other Inundation Mapping Gages

Gage Data

Hydrograph | Forecast



Gage Height / NWS Forecast (if available)

Des Plaines River at Lincolnshire, IL (05528100)—Inundation Map Subject to Revision

Elevation & Gage Height

- Flooded area
- Flooded depth

643.2 (13.2)
644.0 (14.0)
644.9 (14.9)
646.0 (16.0)
647.0 (17.0)
648.0 (18.0)
649.1 (19.1)

Depth in feet

(Color scale applies at 100% opacity)

- 0.1 to 1.0
- 1.1 to 2.0
- 2.1 to 5.0
- > 5.0

Report

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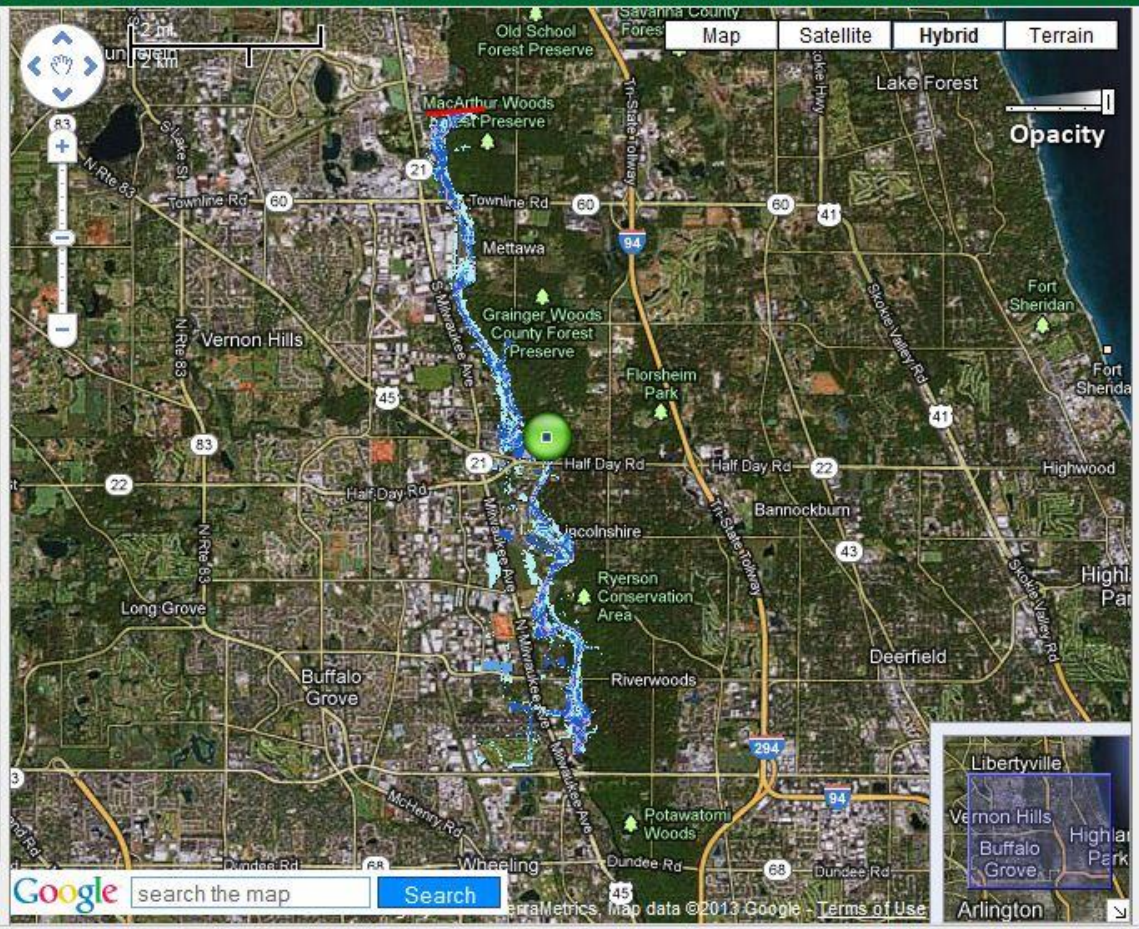

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Explanation

- Des Plaines River at Lincolnshire, IL
- Extent of Study
- Other Inundation Mapping Gages

Gage Data

Hydrograph | Forecast

Most Recent Gage Height: 7.20 feet.
Date: 2013-03-04 10:45

Des Plaines River at Lincolnshire, IL (05528100)—Inundation Map Subject to Revision

Elevation & Gage Height

- Flooded area
- Flooded depth

643.2 (13.2)
644.0 (14.0)
644.9 (14.9)
646.0 (16.0)
647.0 (17.0)
648.0 (18.0)
649.1 (19.1)

Depth in feet

(Color scale applies at 100% opacity)

- 0.1 to 1.0
- 1.1 to 2.0
- 2.1 to 5.0
- > 5.0

Report

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Explanation

- Des Plaines River at Lincolnshire, IL
- Extent of Study
- Other Inundation Mapping Gages

Gage Data

Hydrograph | Forecast

Most Recent Gage Height: 7.20 feet.
Date: 2013-03-04 10:45

Ohio River at Old Shawneetown, IL-KY (03381700)—Inundation Map Subject to Revision

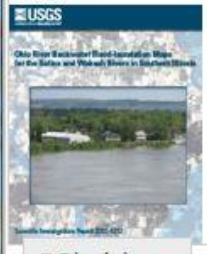
Elevation & Gage Height
for Ohio River at Old Shawneetown, Il-KY (03381700)

340 (31)
345 (36)
350 (41)
355 (46)
360 (51)
365 (56)
370 (61)
375 (66)

NWS Precip Estimations

☐ 1 Hour
☐ Storm Total(zoom out to view)

Report



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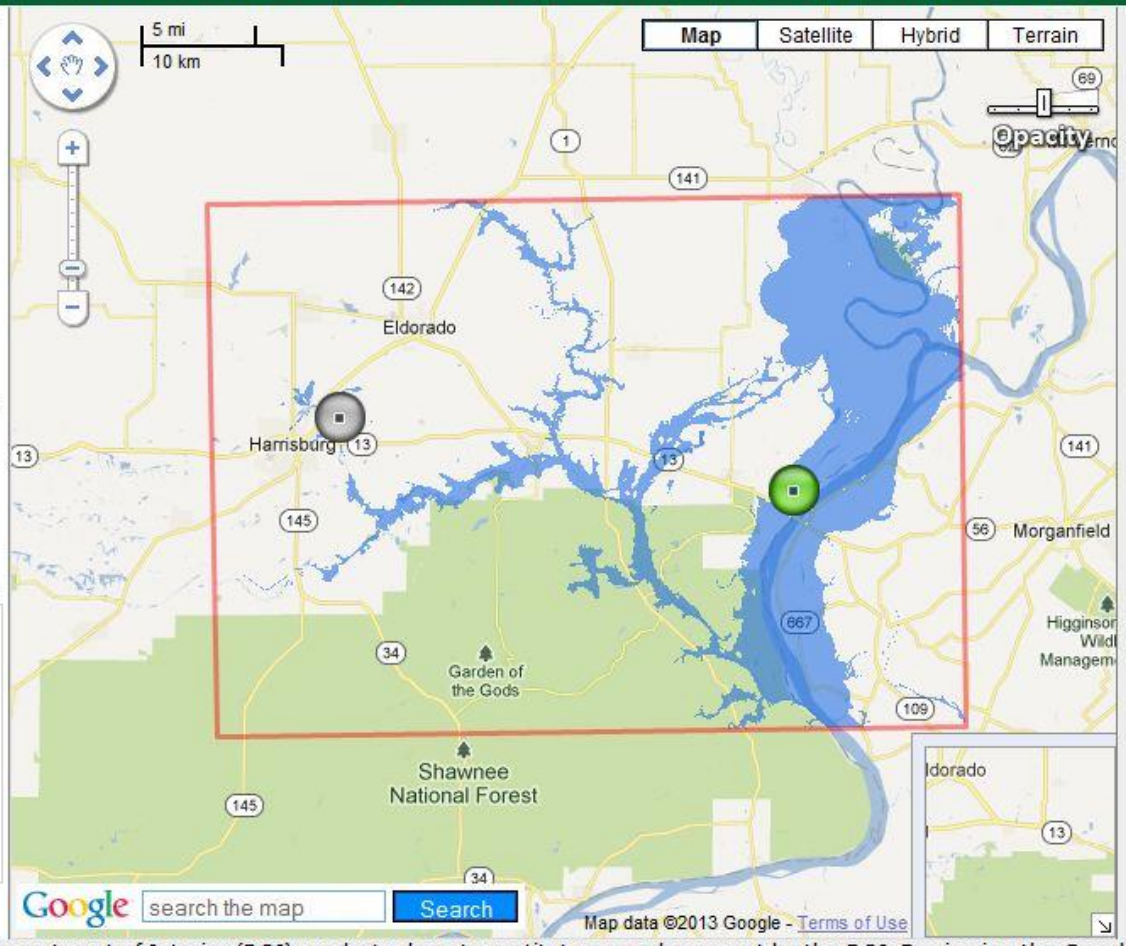

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Office of Surface Water

Explanation

- Ohio River at Old Shawneetown, Il-KY (03381700)
- Extent of Study
- Middle Fork Saline River near Harrisburg, IL (03382200)

Gage Data

Hydrograph | Forecast

03381700

Most Recent Gage Height: 24.04 feet.
Date: 2013-03-06 21:30

Ohio River at Old Shawneetown, IL-KY--Provisional Inundation Map Subject to Revision

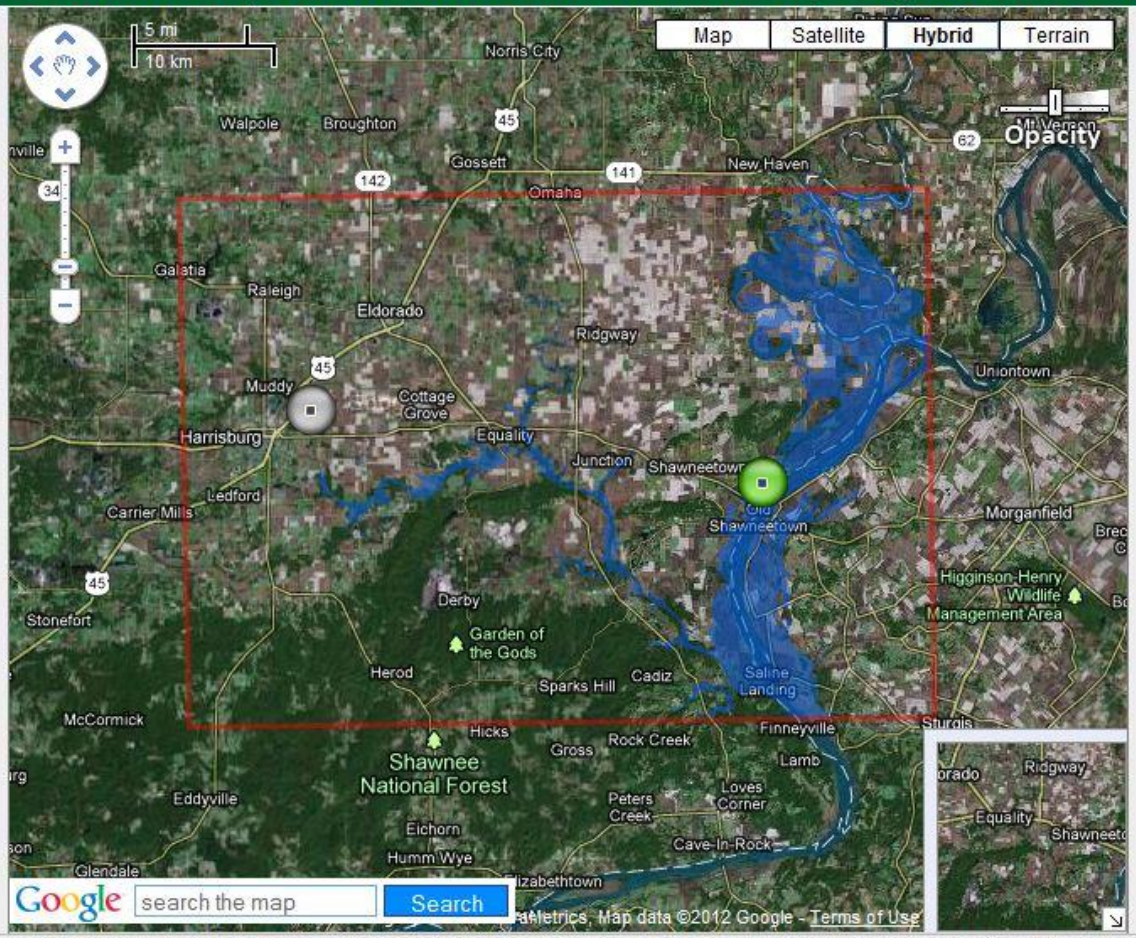
Elevation & Gage Height
for Ohio River at Old Shawneetown, Il-KY (03381700)

340 (31)
345 (36)
350 (41)
355 (46)
360 (51)
365 (56)
370 (61)
375 (66)

NWS Precip Estimations

- [ ] 1 Hour
- [ ] Storm Total

Disclaimer



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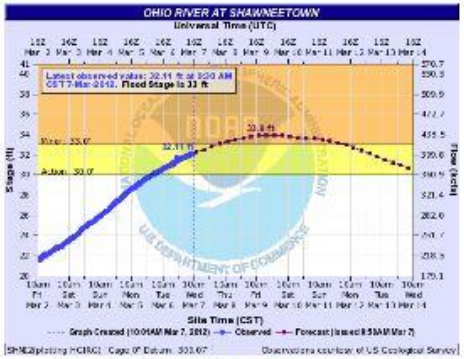
Office of Surface Water

Explanation

- Ohio River at Old Shawneetown, Il-KY (03381700)
- Extent of Study
- Middle Fork Saline River near Harrisburg, IL (03382200)

Gage Data

Hydrograph | Forecast



Gage Height / NWS Forecast (if available)

Ohio River at Old Shawneetown, IL-KY--Provisional Inundation Map Subject to Revision

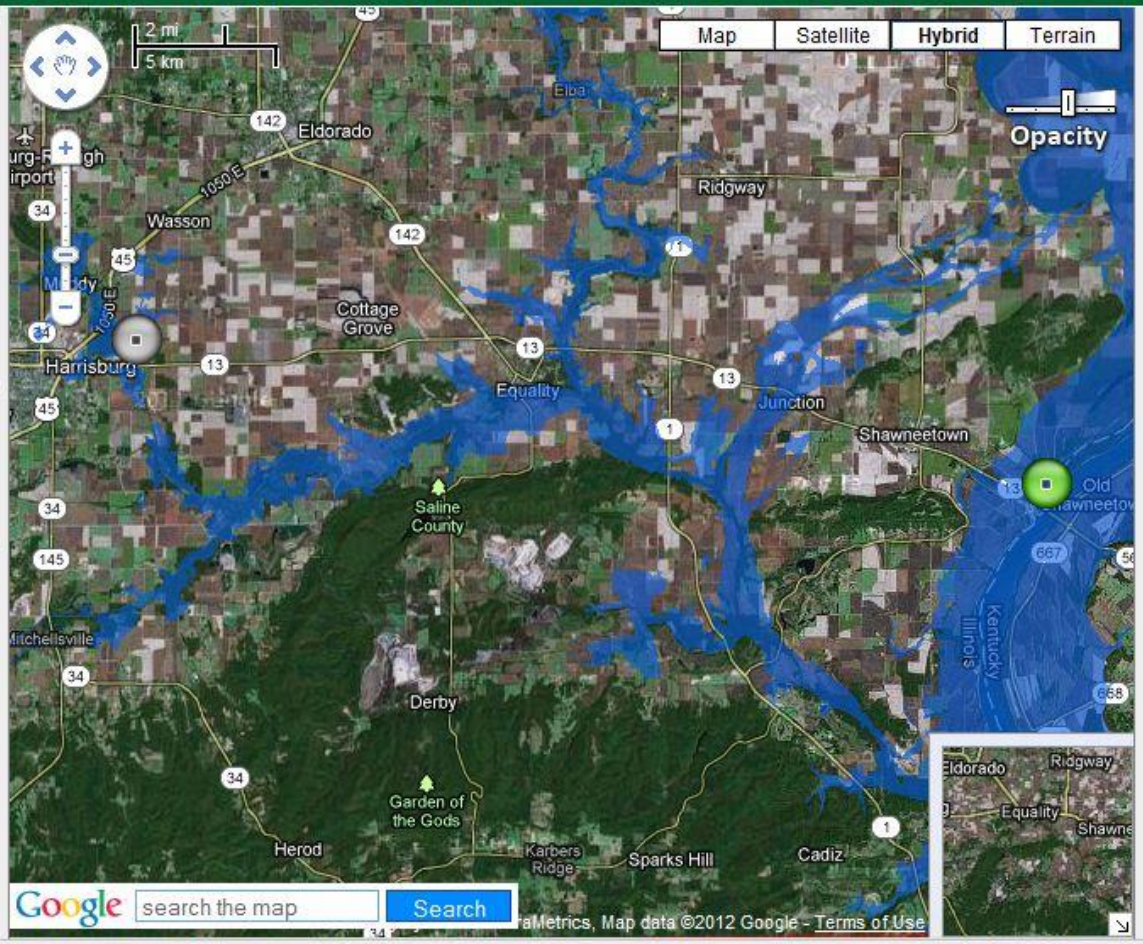
Elevation & Gage Height
for Ohio River at Old Shawneetown, Il-KY (03381700)

340 (31)
345 (36)
350 (41)
355 (46)
360 (51)
365 (56)
370 (61)
375 (66)

NWS Precip Estimations

☐ 1 Hour
☐ Storm Total(zoom out to view)

Disclaimer



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Office of Surface Water

Explanation

- Ohio River at Old Shawneetown, Il-KY (03381700)
- Extent of Study
- Middle Fork Saline River near Harrisburg, IL (03382200)

Gage Data

Hydrograph | Forecast

03381700

Most Recent Gage Height: feet.
Date: 2012-03-07 09:30

Reports and Downloads

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science for a changing world

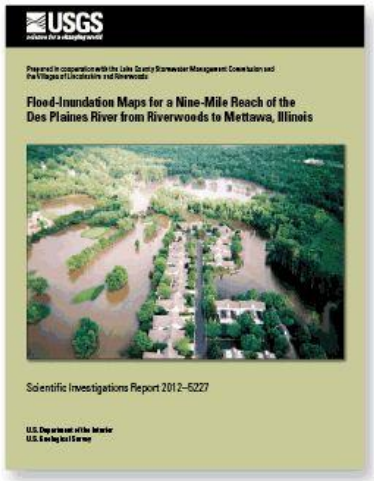
Scientific Investigations Report 2012–5227

>> Pubs Warehouse > SIR 2012-5227

Prepared in cooperation with the Lake Coun

Flood-Inundation Map
Riverwoods to Mettav

By Elizabeth A. Murphy, David T.



areas of flood inundation.

In this study, flood profiles were comput
model. The hydraulic model was then use
intervals referenced to the streamgage c
probability flows. The simulated water-su
(GIS) Digital Elevation Model (DEM) (deri
area flooded at each water level.

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Next steps in Illinois?

- DuPage River between Plainfield and Shorewood in Will County
- Continue to build program cooperatively with communities
- Work with Illinois Flood Response Management Team on how USGS gages and inundation maps can improve response and help reduce risk

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Questions?

http://il.water.usgs.gov/ifhp/

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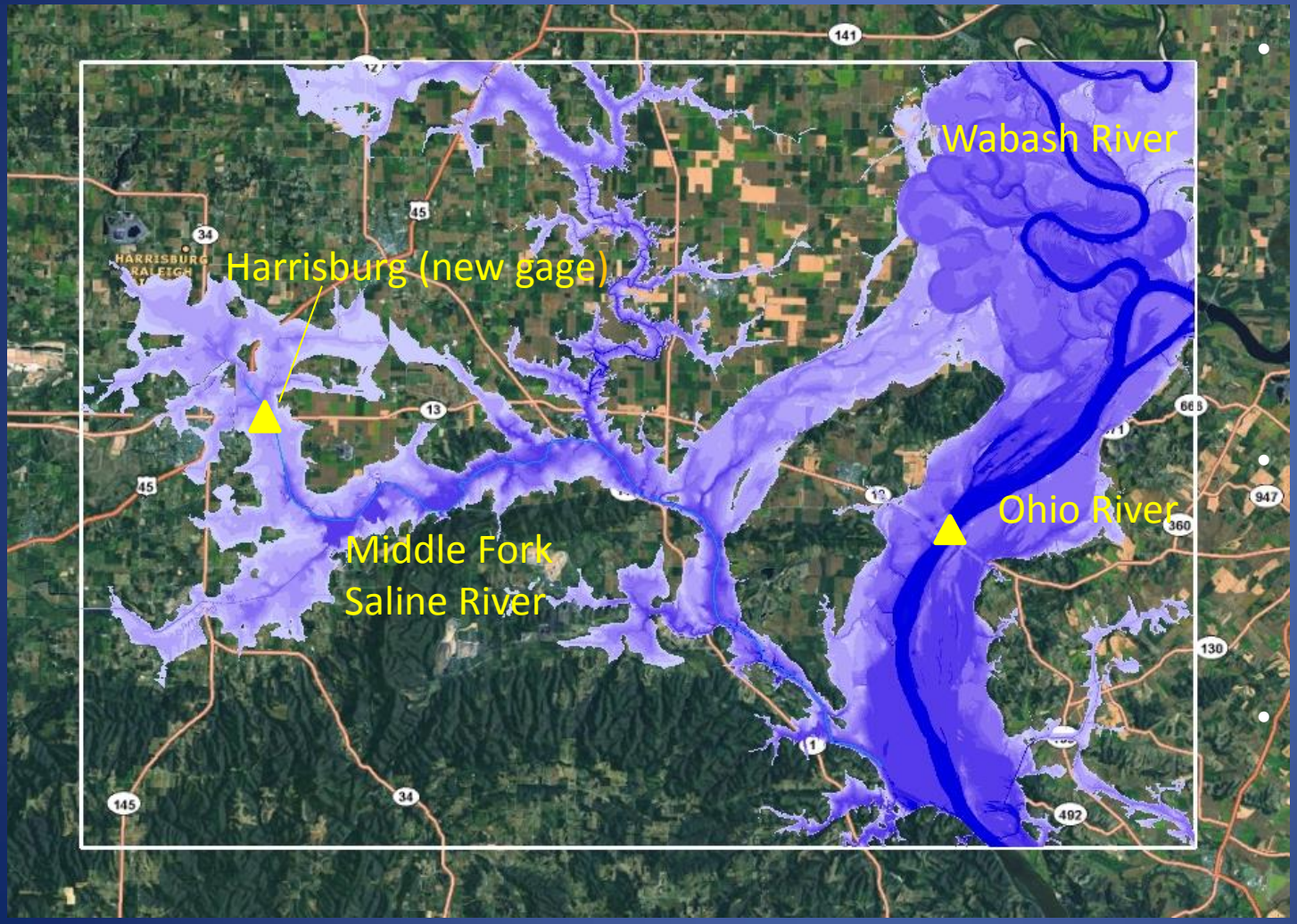
Flood Inundation Map of Saline River



Inundation surface at WSE of 365 ft

- Flood Inundation study of Saline River brought about by the extreme flooding in Southern Illinois Spring 2011.
- 30-mile stretch from confluence with the Ohio River up to Harrisburg
- Backwater from the Ohio River is usually the source of the flooding

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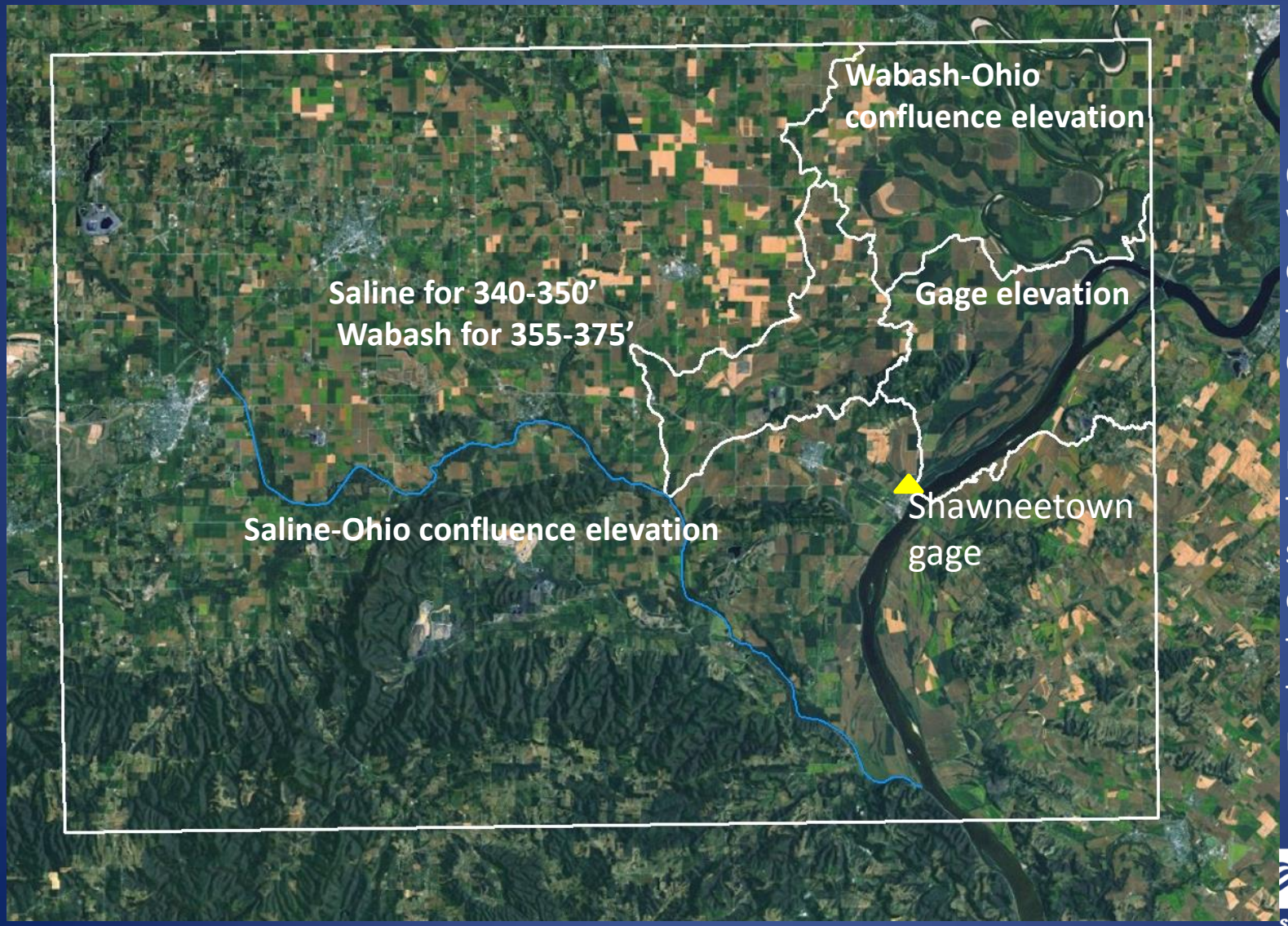
Inundation Surface generation for the Saline



Used slope of Ohio River WSE calculated from the Corps Ohio River HEC-2 model to vary the water-surface elevation over the study area for inundation mapping

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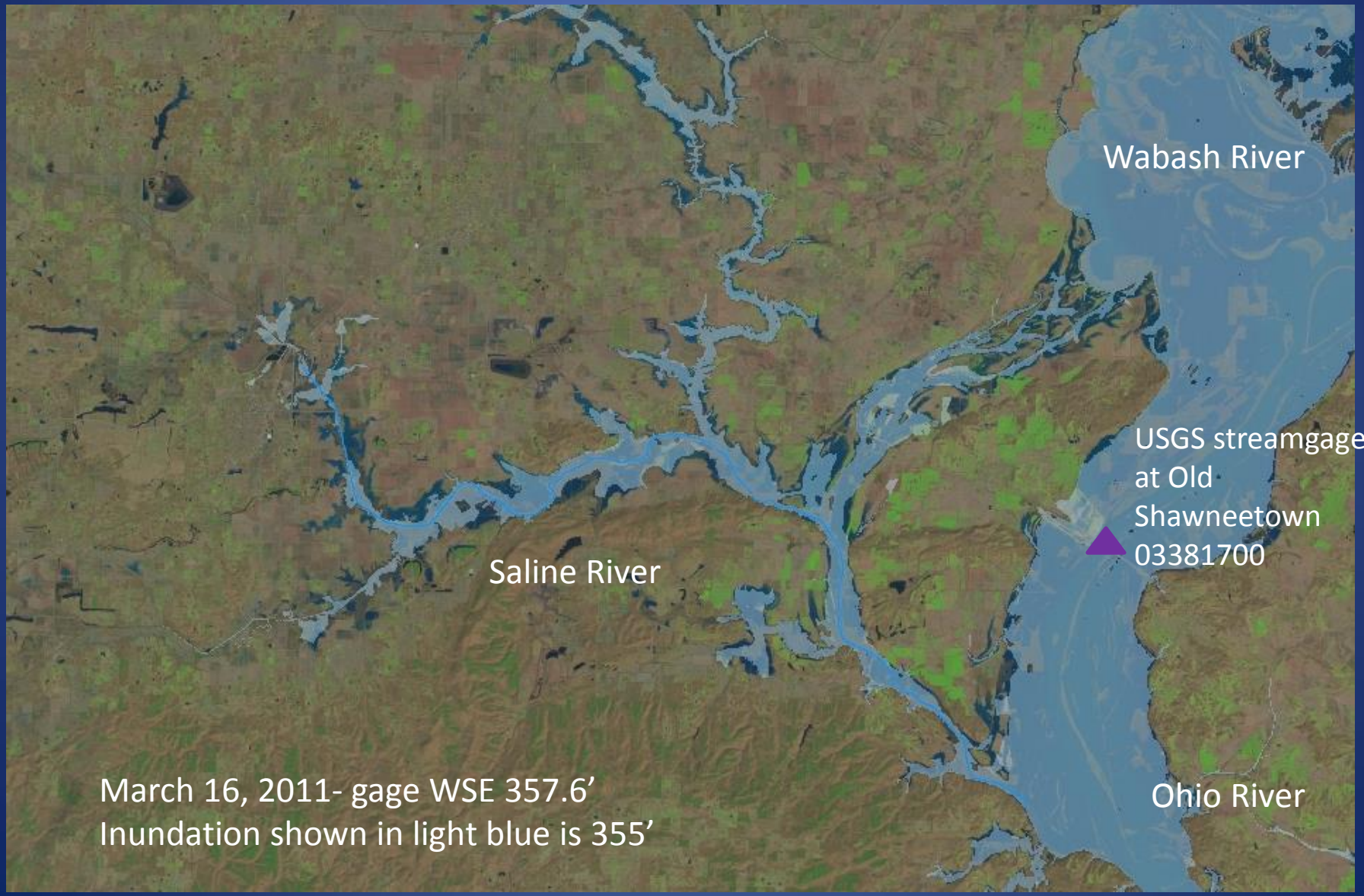
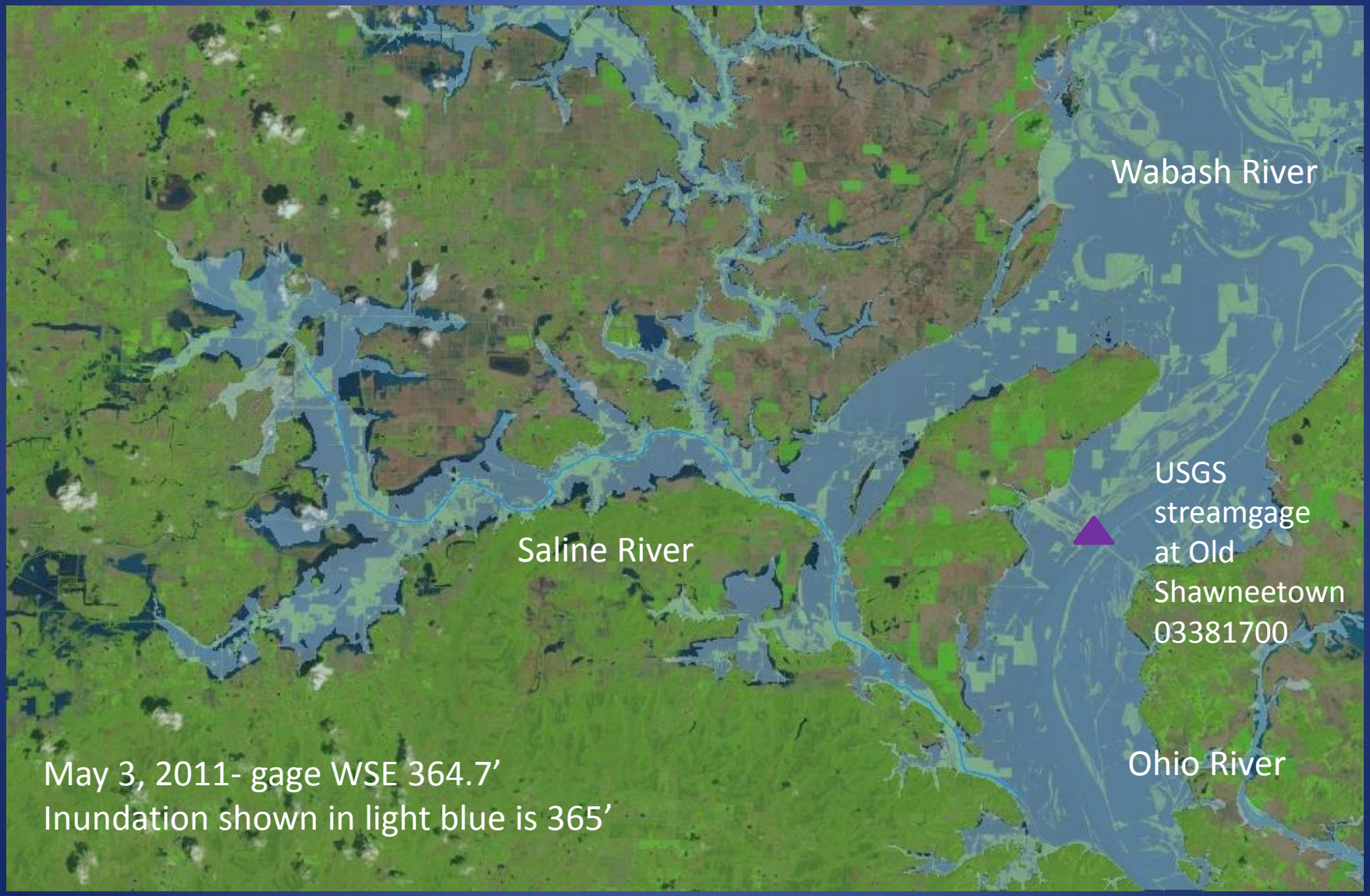
Saline River Inundation Verification



Saline River Inundation Verification



USGS - Illinois Flood Hazards Program - Salt Creek at ...

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Salt Creek at Wood Dale, IL -- Provisional Inundation Map Su

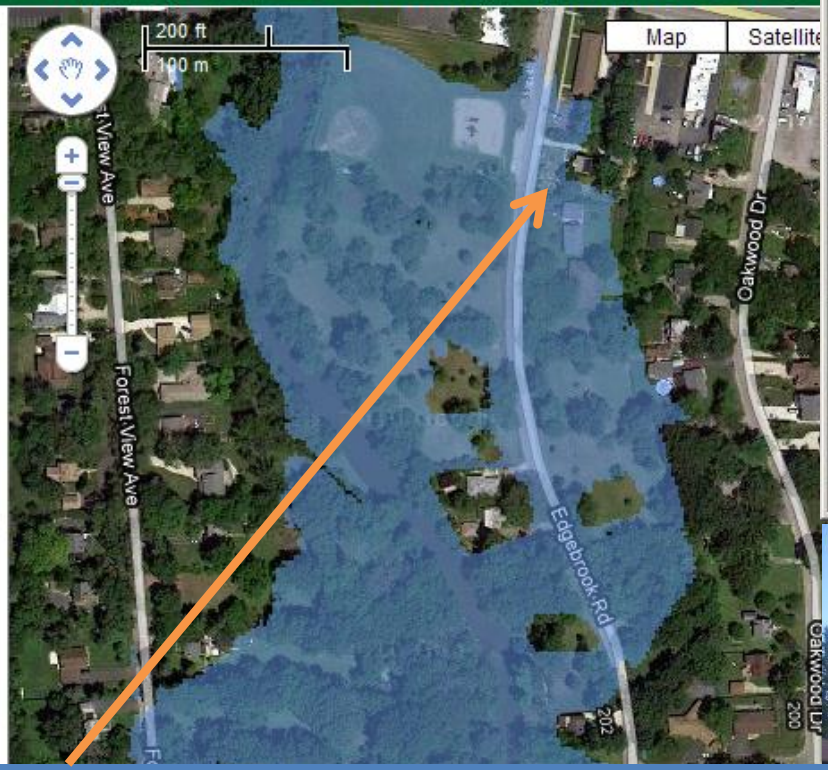
Elevation & Gage Height

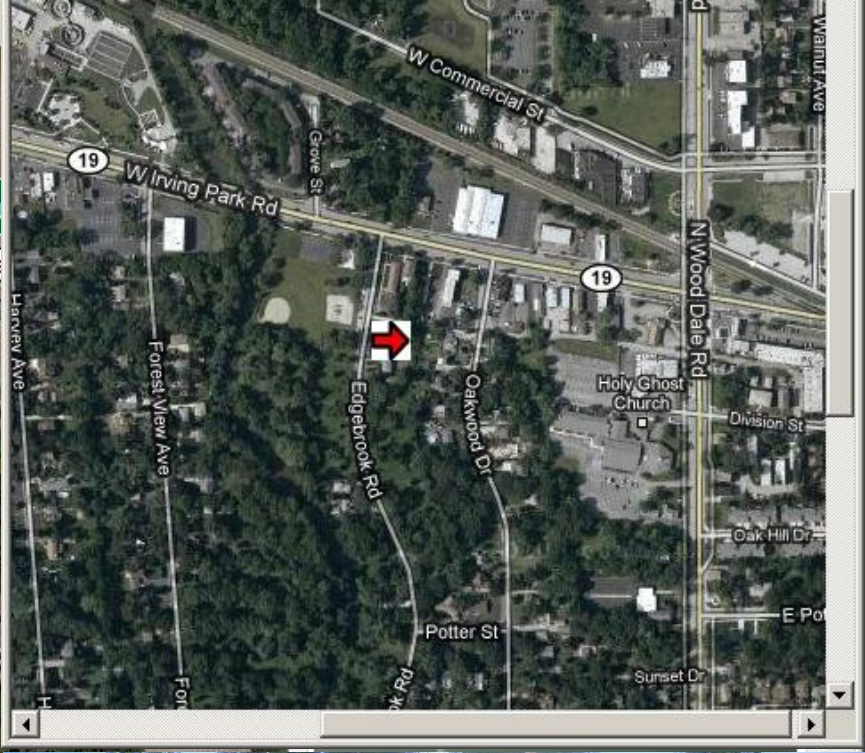
- 674.0 (11.0)
- 674.5 (11.5)
- 675.0 (12.0)
- 675.5 (12.5)
- 676.0 (13.0)
- 676.5 (13.5)
- 677.0 (14.0)
- 677.5 (14.5)
- 678.0 (15.0)
- 678.5 (15.5)
- 679.0 (16.0)
- 679.5 (16.5)
- 680.0 (17.0)
- 680.5 (17.5)

NWS Precip Estimations

- ☐ 1 Hour
- ☐ Storm Total

(zoom out to view)



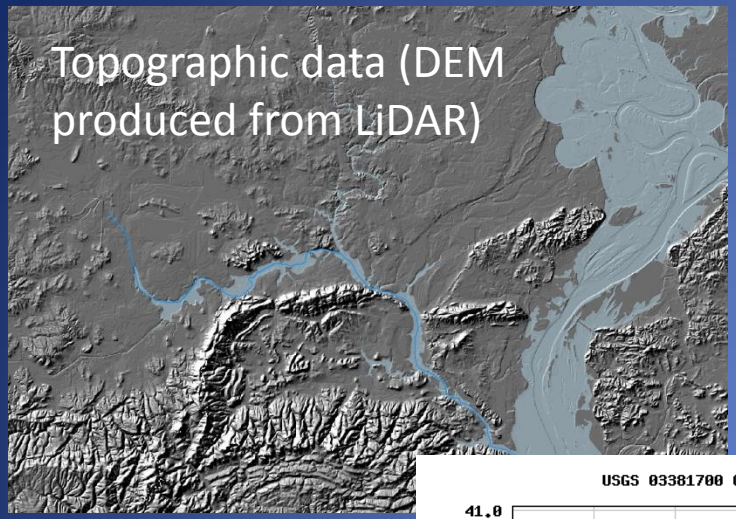


This house above water is the house on the right in the photo — the HWM is the lower orange mark on the electrical box, indicating that the parking lot to the left was inundated as shown in the map.

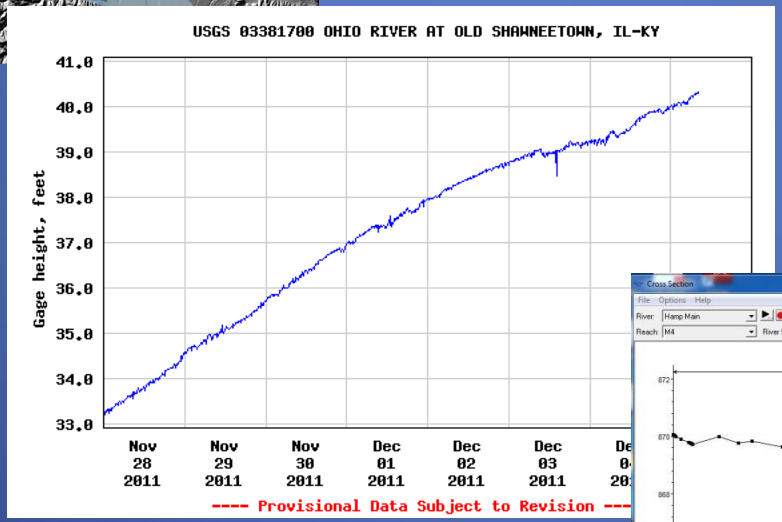
GPS-enabled camera data uploaded to Google Earth on upper right.

Page Last Modified: 05/11/10 10:53 CST

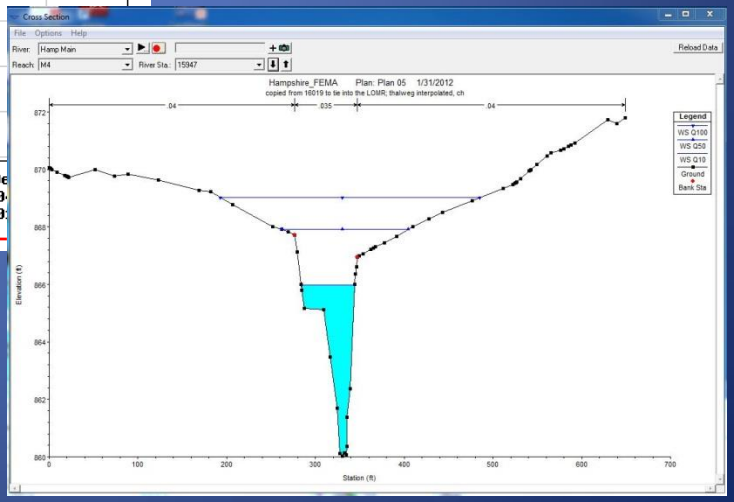
How are inundation maps produced?



USGS gage data provides water-surface elevation



Hydraulic modeling simulates water-surface elevation away from gage



Ohio River at Old Shawneetown, IL-KY--Provisional Inundation Map Subject to Revision

Elevation & Gage Height
for Ohio River at Old Shawneetown, Il-KY (03381700)

340 (31)
345 (36)
350 (41)
355 (46)
360 (51)
365 (56)
370 (61)
375 (66)

NWS Precip Estimations

- [ ] 1 Hour
- [ ] Storm Total

Disclaimer

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Office of Surface Water

Explanation

- Ohio River at Old Shawneetown, Il-KY (03381700)
- Extent of Study
- Middle Fork Saline River near Harrisburg, IL (03382200)

Gage Data

Hydrograph | Forecast

03381700

Most Recent Gage Height: feet.
Date: 2012-03-07 09:30