

# A TECHNICAL BRIEF FOR THE FEDERAL EXECUTIVE BOARD (FEB) AWARD NOMINATION

## FLOOD WARNED ACTIONS

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Senior Risk Management

Specialist

USACE Institute for Water

Resources

**August 8, 2017**

Kris Lander and Scott Watson,  
NOAA NWS

Brian Kelly and Paul Rydlund,  
USGS

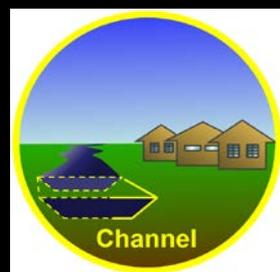
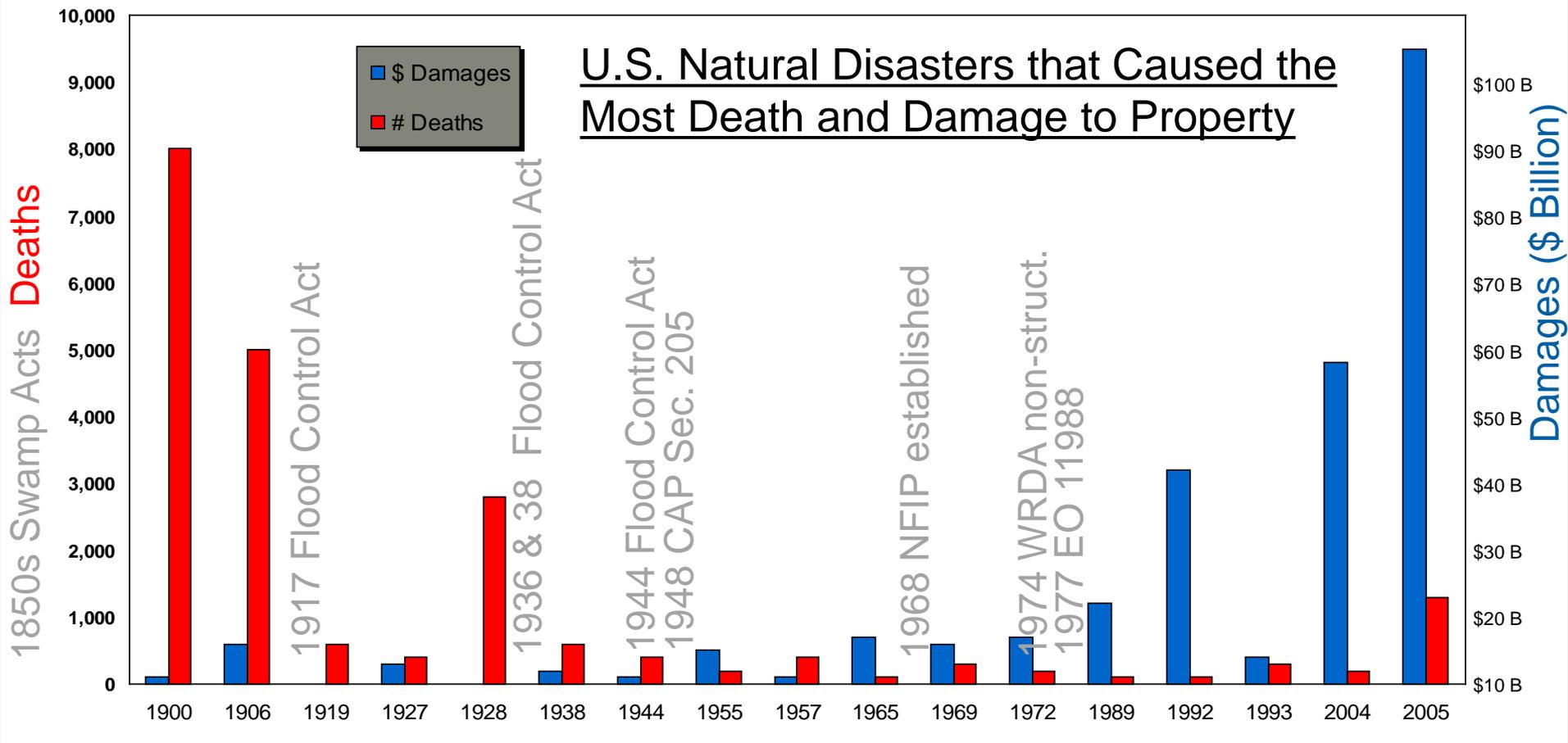
Inundation Levels	
NAVD88	Stage
779.5	36.9
778.5	35.9
<b>Record Crest: 35.34 ft</b>	
777.5	34.9
776.5	33.9
775.5	32.9
774.5	31.9
773.5	30.9
<b>Major Flooding</b>	



**US Army Corps  
of Engineers**



# U.S. Natural Disasters that Caused the Most Death and Damage to Property



0917 PM CDT MON MAY 27, 2016

THE FLOOD WARNING CONTINUES FOR

THE MISSOURI RIVER NEAR LEAVENWORTH.

\* UNTIL FURTHER NOTICE.

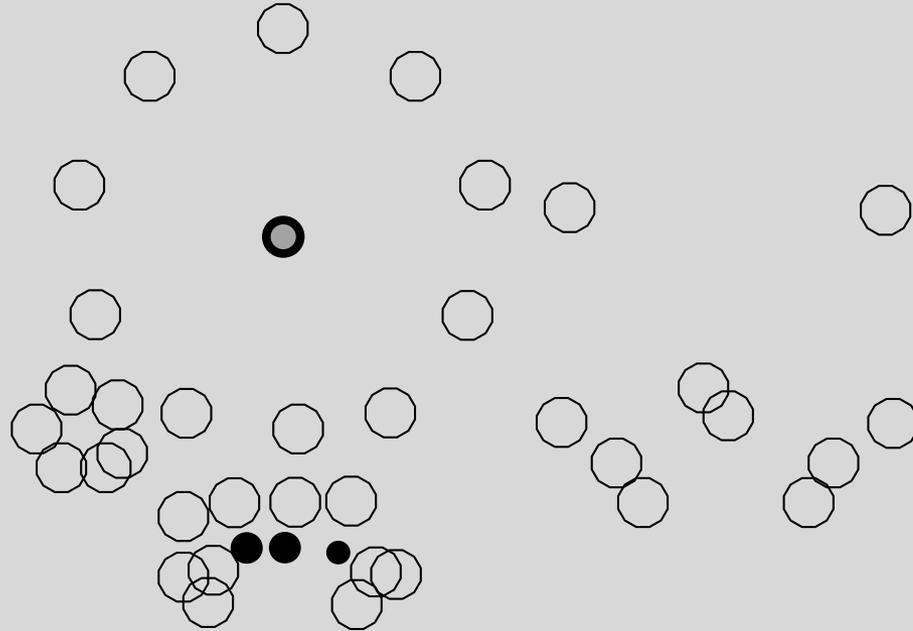
\* AT 09AM MONDAY THE STAGE WAS 17.0 FEET.

\* FLOOD STAGE IS 20.0 FEET.

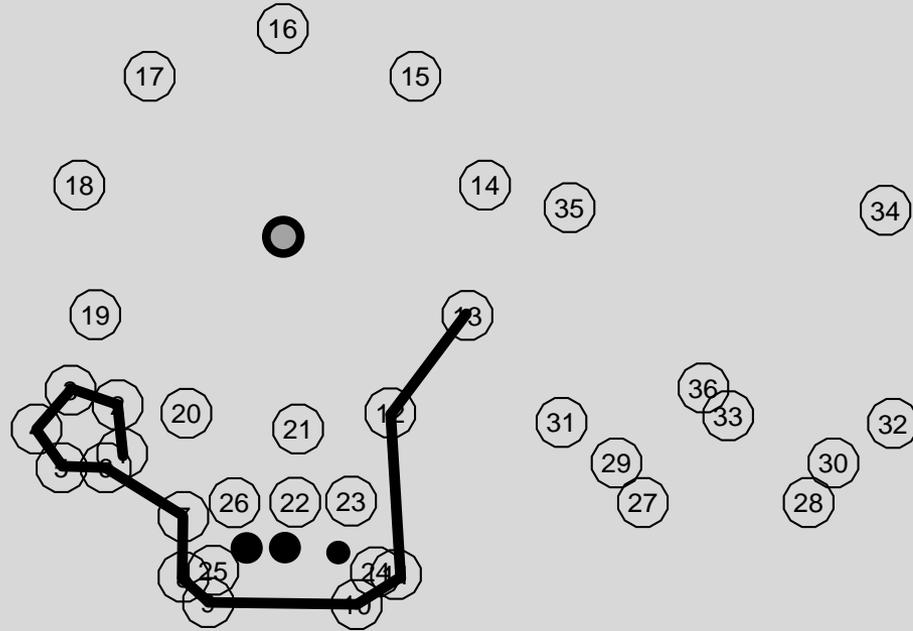
\* FORECAST...THE RIVER IS FORECASTED TO REACH 21.5 FEET IN  
NEXT 24 HOURS.

\* AT STAGES NEAR 22.3 FEET...WATER ENTERS RIVERFRONT PARK IN  
LEAVENWORTH. IN ADDITION, 2ND STREET AT THE WASTE WATER  
TREATMENT PLANT IS CLOSED DUE TO HIGH WATER. PERSONS  
SHOULD VACATE THE PARK TO AVOID THE LOSS OF LIFE AND  
PROPERTY.

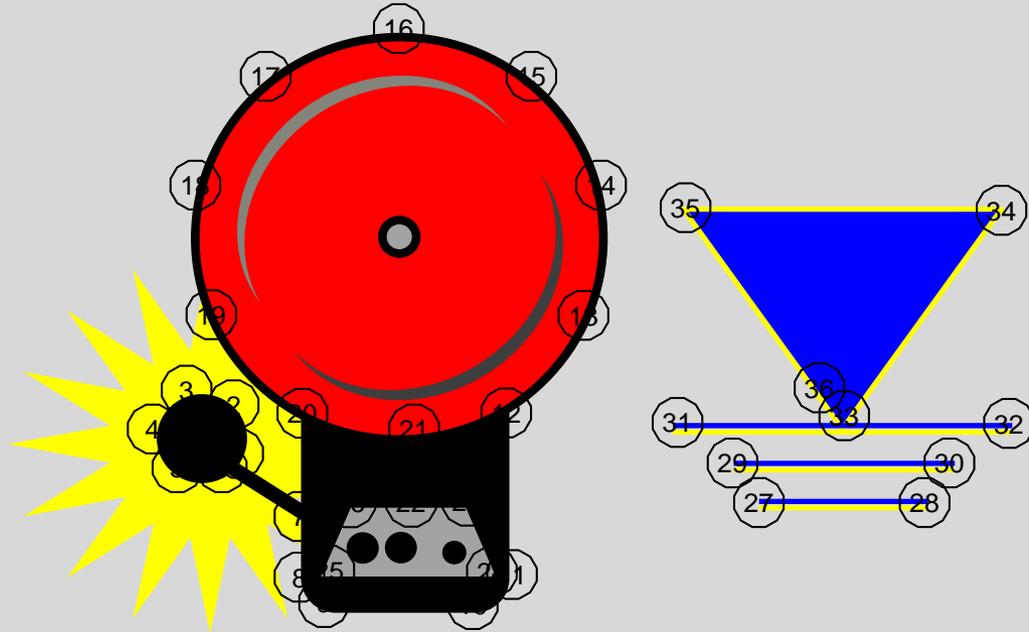
# CONNECTING THE DOTS



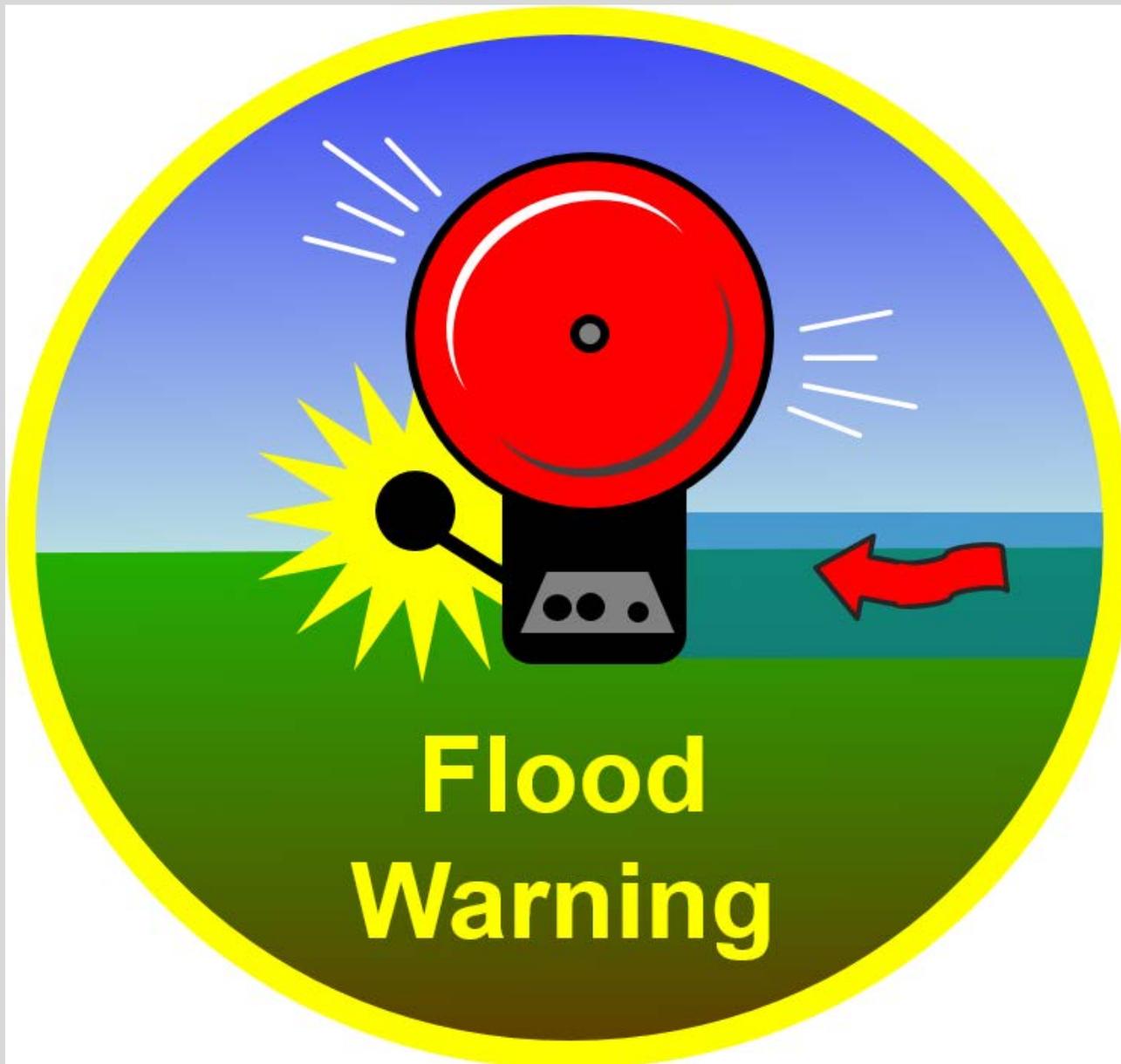
# CONNECTING THE DOTS



# CONNECTING THE DOTS



# CONNECT THE DOTS TO FLOOD WARNED ACTIONS



# VISUAL REPRESENTATION OF FORECASTED RISK

Inundation Levels	
NAVD88	Stage
779.5	36.9
778.5	35.9
<b>Record Crest: 35.34 ft</b>	
777.5	34.9
776.5	33.9
775.5	32.9
774.5	31.9
773.5	30.9
<b>Major Flooding Begins</b>	
772.5	29.9
771.5	28.9
770.5	27.9
769.5	26.9
768.5	25.9
767.5	24.9
<b>Moderate Flooding Begins</b>	
766.5	23.9
765.5	22.9
764.5	21.9
763.5	20.9
<b>Minor Flooding Begins</b>	
762.5	19.9
761.5	18.9
760.5	17.9
<b>Near Flooding Begins</b>	
759.5	16.9
* = Extended rating	
<b>Inundation Feedback</b>	



37.1  
33.3  
29.6  
25.9  
22.2  
18.5  
14.8  
11.1  
7.4  
3.7  
0.0

Depth in feet

- Gauge Location
- About Inundation
- Download Dataset (s)
- FAQ
- User Guide
- Inundation Sites
- Inundation Legend

User guide video on

What is UTC time?

Map Help

Disclaimer

Click on mapped inundation to see water depth values for that location, or hold shift and drag to zoom to area.

<b>Current Stage:</b> 10.2 ft at 06/08/2017 13:00:00 UTC	<b>Selected Inundation</b> NAVD88: 764.5 ft stage: 21.9 ft	<b>Mouse Location</b> Depth: 3.97 - 5.97 ft	Lat: 39.395 Lon: -94.938
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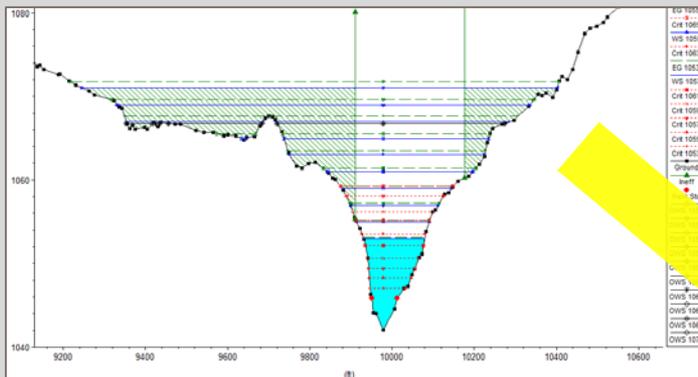


# INTERAGENCY PARTNERSHIP CONTRIBUTIONS



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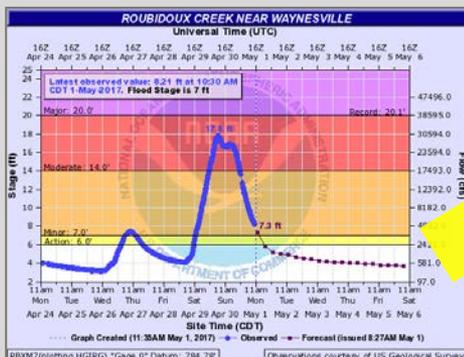
Interagency nonstructural projects under Silver Jackets



Active stream gages



One time \$4,000 fee



Community, pays one time \$4,000 fee



# PUBLIC UNDERSTANDING

NWS flood category color scheming is a consistent tool extended to describe the level of flooding.

Major Flood Stage: 23

Moderate Flood Stage: 17

Flood Stage: 14

Action Stage: 9

Extensive inundation of structures and roads. Significant evacuations of people and property.

Some inundation of structures and roads near stream –some evacuations of people and property.

Minimal or no property damage, but possibly some public threat.

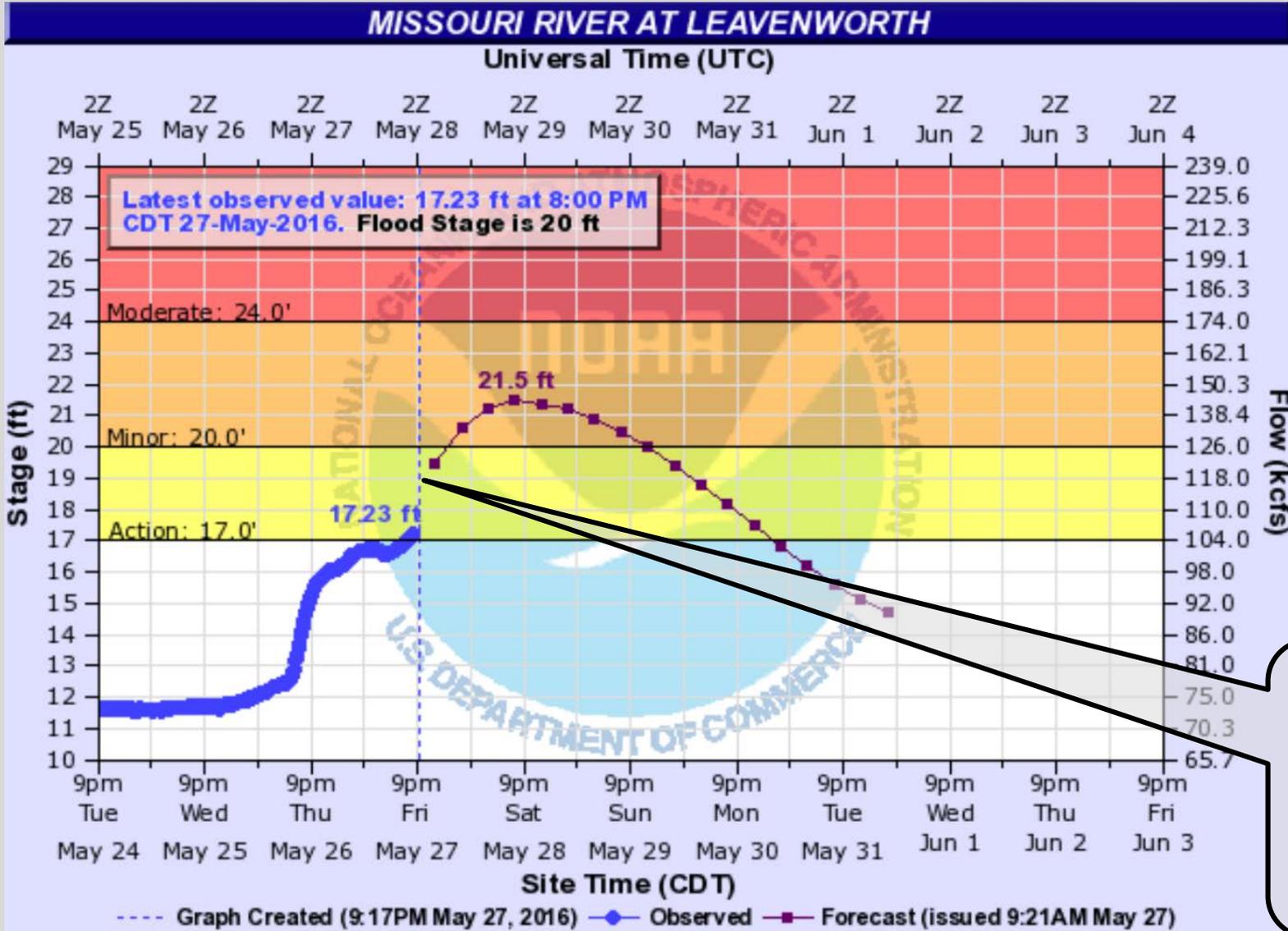
River or stream level approaching flood stage.

River or stream level below flood stage.

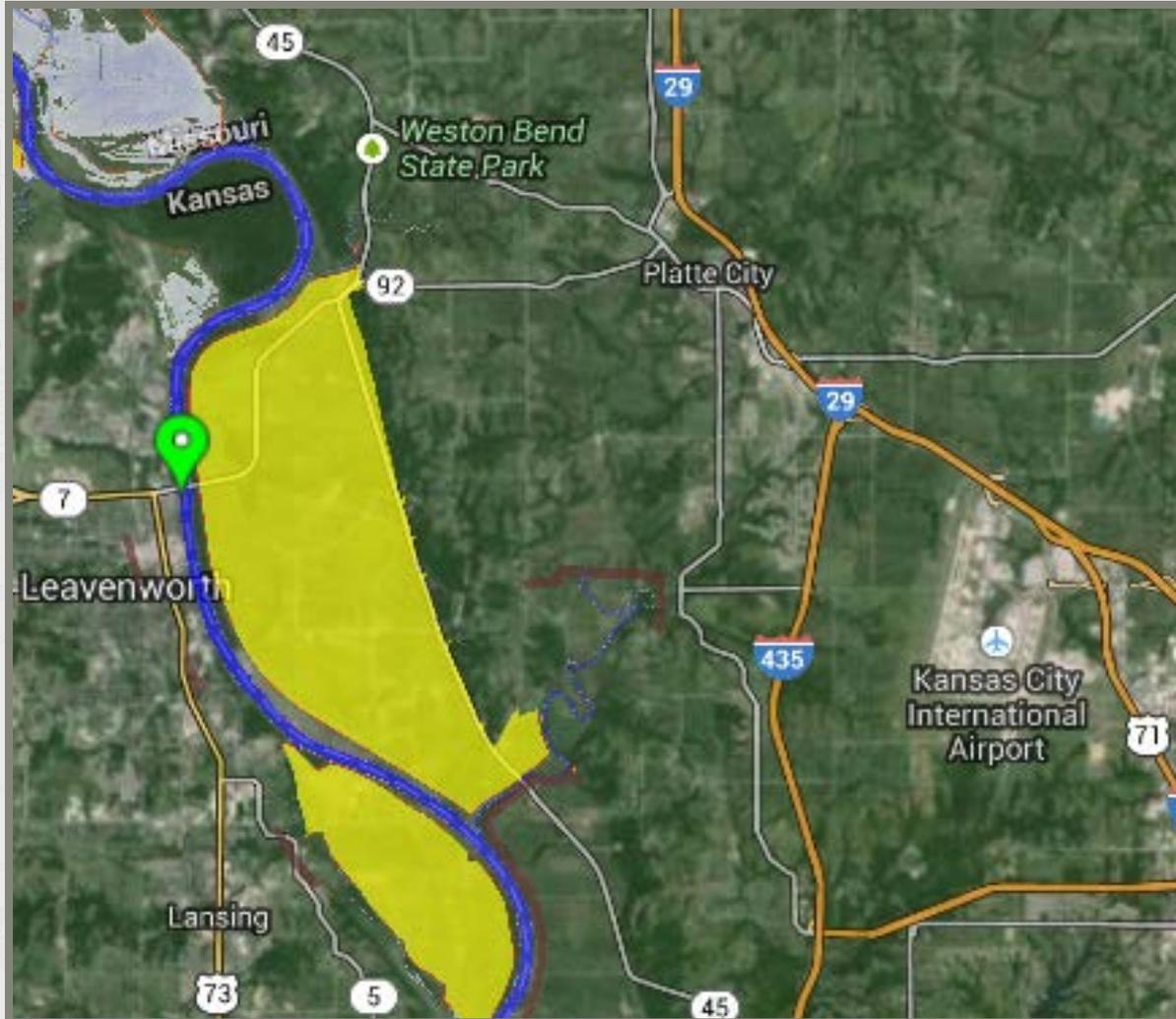
*These numbers are stages for a nonspecific example.*



# FORECAST HYDROGRAPH, MISSOURI RIVER



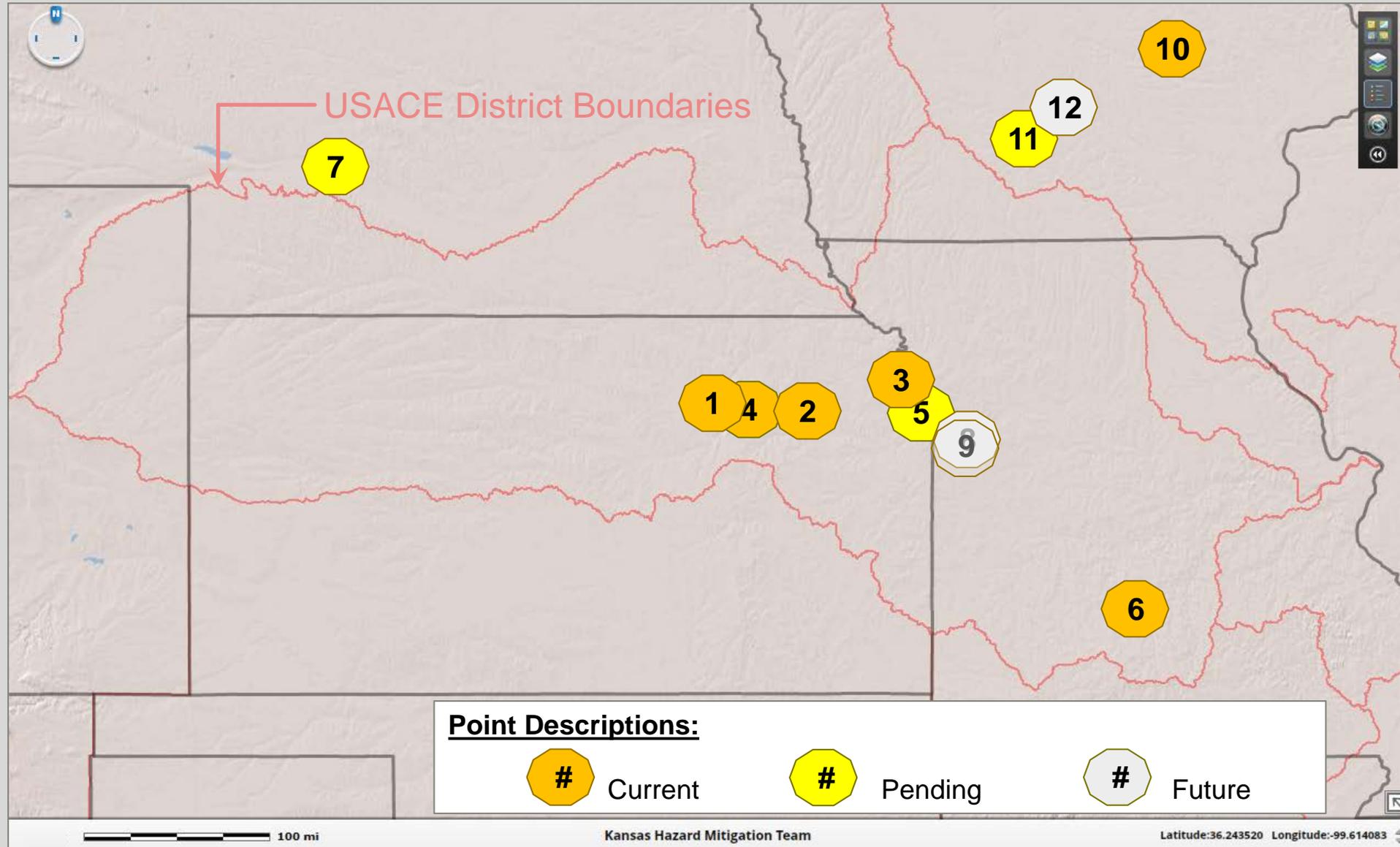
# YELLOW LEVEED AREA UNTIL OVERTOPPING CAPACITY EXCEEDANCE



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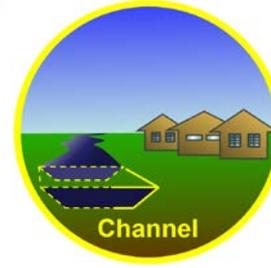
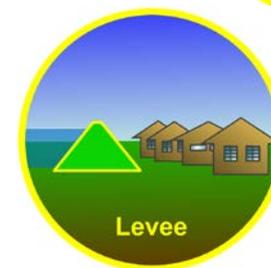
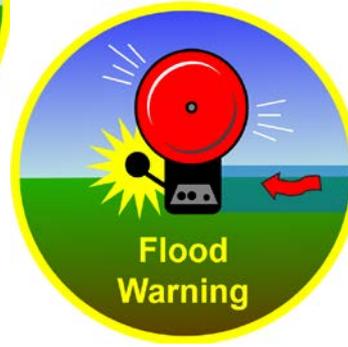
# IMPLEMENTED LOCATIONS OF THIS INTERAGENCY PROJECT APPROACH CALLED FFIMS



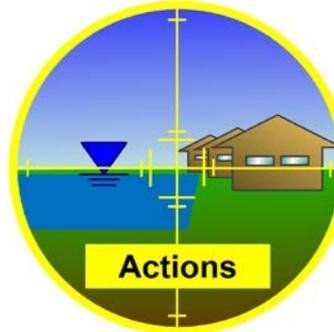
# INNOVATIVE ELEMENTS

- Link for public between **forecasts and flood warnings**
- **Cost effective** (\$4,000 one time fee) and **quick** means of informing the public
- **Visual** for where flooding will happen at publically familiar gage location
- Sustained, **continuous** and **dependable availability** and risk communication (available 24 hours a day and 7 days a week)
- Flood map that **does not limit** risk informed decision making to the **regulatory flood extents** or flood elevation
- **Consistent** and **same standards** are part of how every single flood forecast inundation map is made, which keeps up public **trust**
- Knowledge of future flood levels and **when** to flood fight, preventing costly, unnecessary efforts for preparedness
- Tool for **risk informed decision making**
- Nonstructural measure for improving public risk knowledge
- Interagency effort that **leverages** abilities of **multiple agencies**

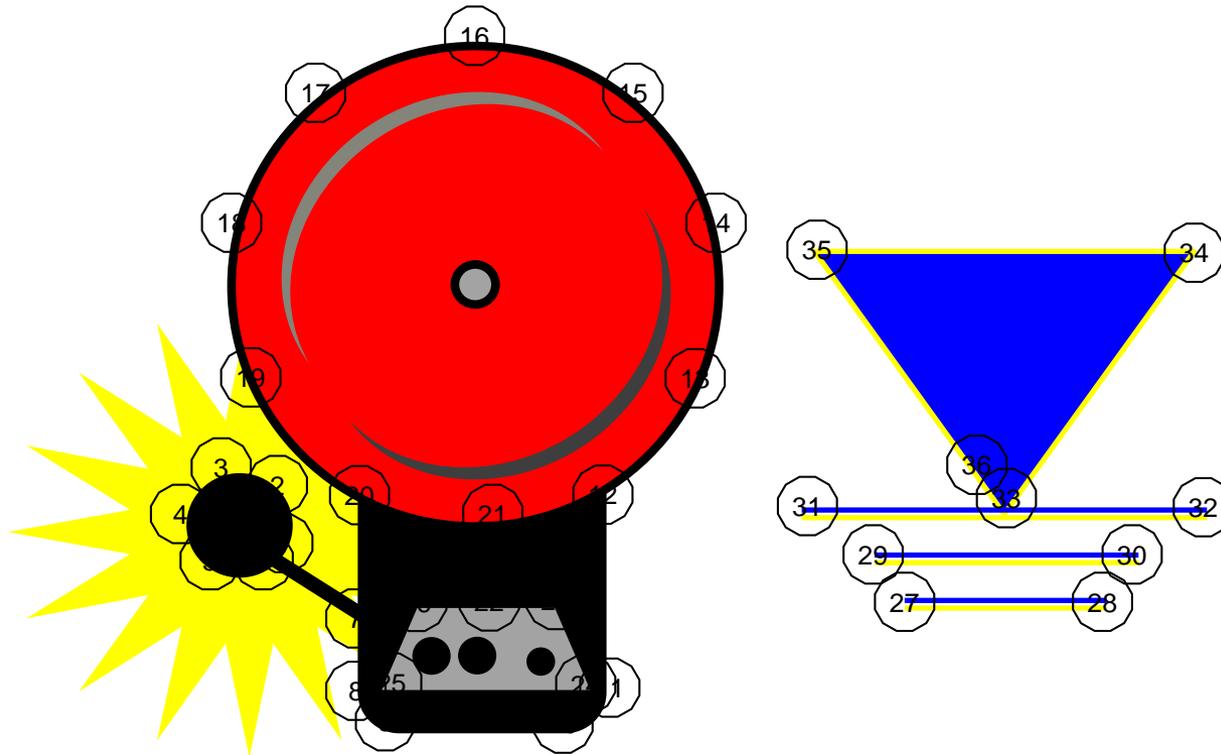




# SUCCESS IS WHEN AWARENESS LEADS TO ACTION



# REDUCING FLOOD RISKS THROUGH AWARENESS THE FLOOD FORECAST INUNDATION MAP



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# QUESTIONS



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## FIND OUT MORE

USACE Missouri River Flood Inundation Map project poster

- [http://silverjackets.nfrmp.us/Portals/0/doc/Missouri/MO\\_MORiverFIM\\_08-14-14.pdf](http://silverjackets.nfrmp.us/Portals/0/doc/Missouri/MO_MORiverFIM_08-14-14.pdf)

NOAA National Weather Service AHPS project site

- [http://water.weather.gov/ahps2/inundation/inundation\\_google.php?gag\\_e=levk1](http://water.weather.gov/ahps2/inundation/inundation_google.php?gag_e=levk1)

USACE National Nonstructural/Flood Proofing Committee

- <http://www.usace.army.mil/Missions/CivilWorks/ProjectPlanning/nfpc.aspx>

USACE NFPC National Flood Barrier Testing and Certification Program

- <http://nationalfloodbarrier.org/>

USACE MVP Emergency Action Plans Template

- <http://www.mvp.usace.army.mil/Missions/Civil-Works/Flood-Risk-Management/Emergency-Action-Plan-Guidebook/>

USACE Guide to public alerts communication resource

- [https://silverjackets.nfrmp.us/Portals/0/doc/WarningGuidebook\\_USACE.pdf?ver=2015-08-10-213008-520](https://silverjackets.nfrmp.us/Portals/0/doc/WarningGuidebook_USACE.pdf?ver=2015-08-10-213008-520)

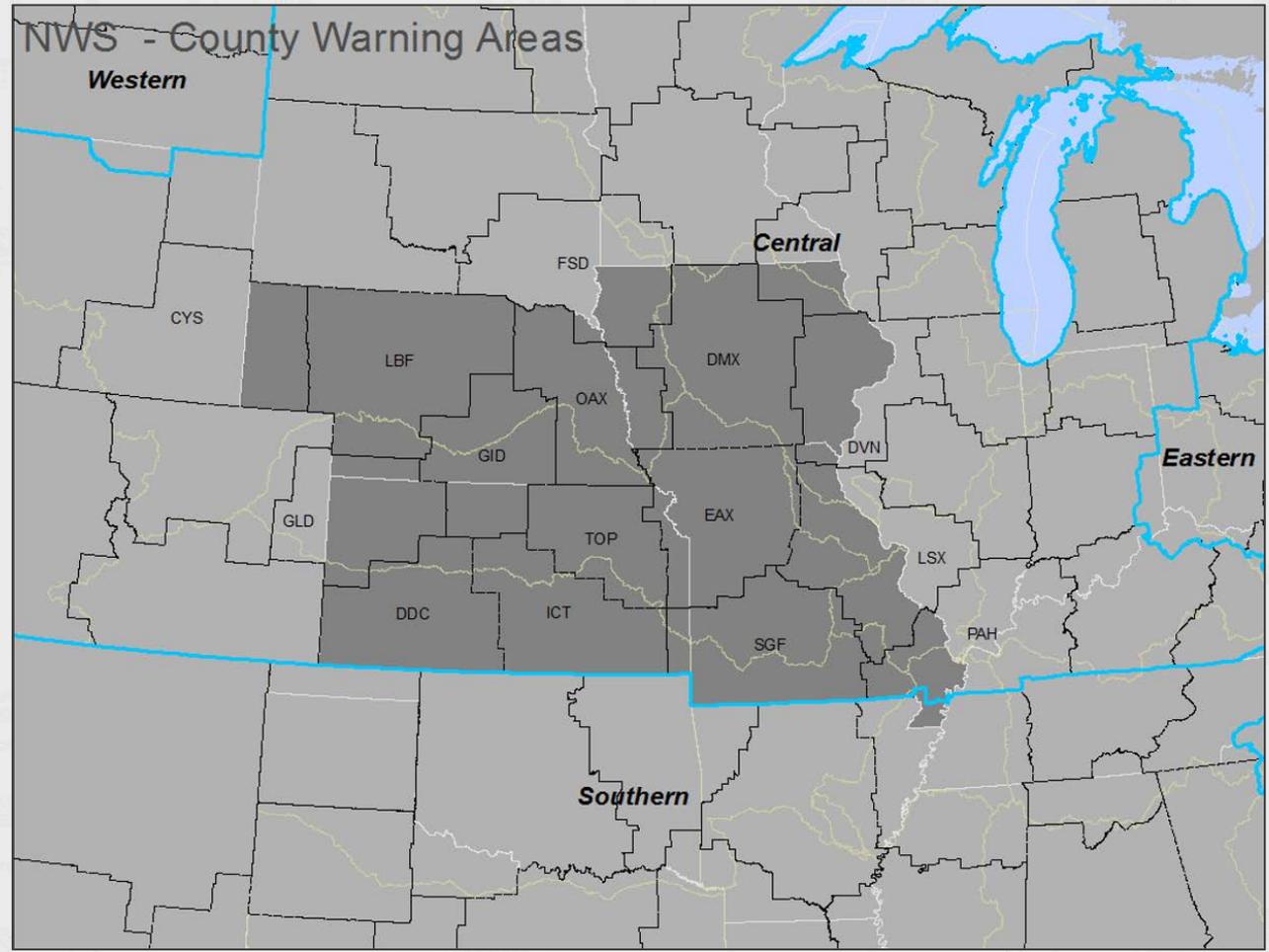
# ADDITIONAL SLIDES

For use to answer some questions



# AGENCY AUTHORIZED FOR OPERATIONS

All-the-time, **continuous and dependable availability** and risk communication (available 24 hours a day and 7 days a week)



# FFIMS LIVE PAST FIRMS

Flood Insurance Rate Maps are snapshots in time. Each map depends on a previous and short period of record. Since we have evidence that rain bombs are happening more often, they can give a false sense of security. They can take 10 to 20 years to revise, as well.

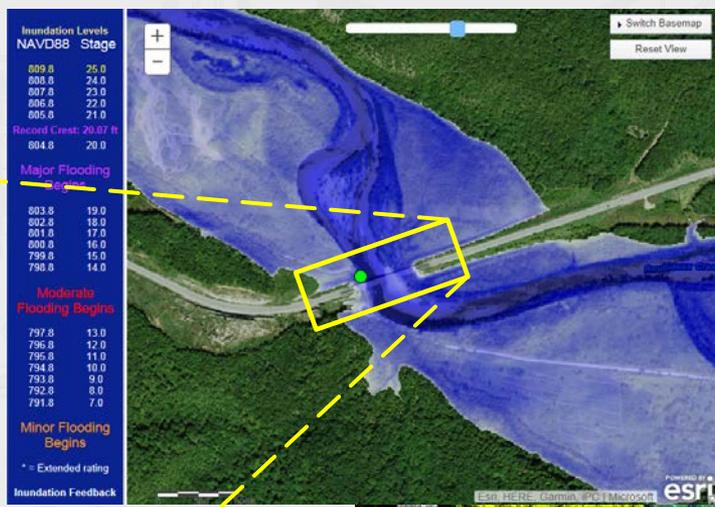


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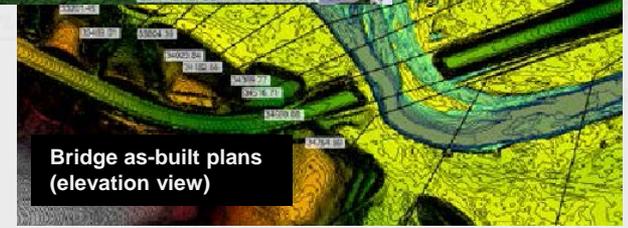
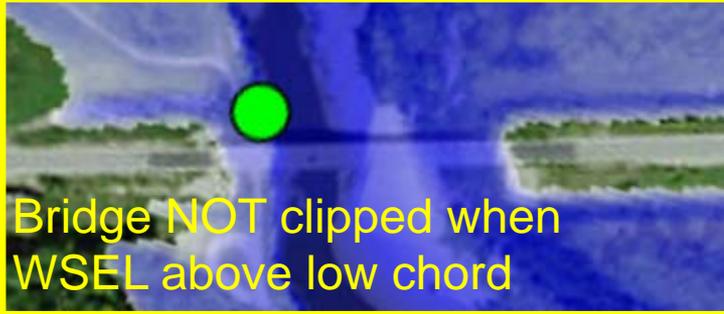
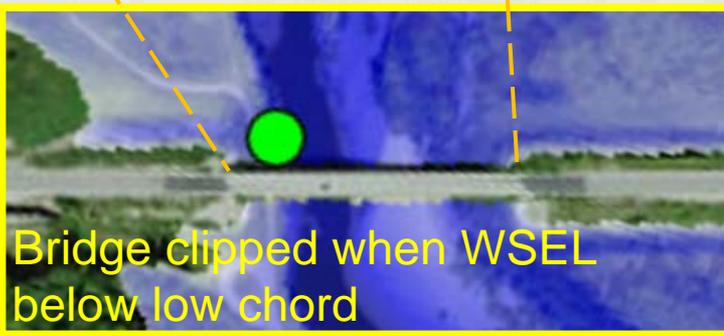


# CONSISTENT STANDARDS

Example: Mapping a road overtopping, highly dependent on hydraulics of the bridge configuration.



Digital Terrain model and 1-ft contours





### Map Overlays

Inundation Study Boundaries

1% Annual Exceedance Flood Probability

0.2% Annual Exceedance Flood Probability

Floodway

1053.0 Water Level

[Reset Overlays](#)

### Flood Categories (in feet)

Major Flood Stage: 23

Moderate Flood Stage: 17

Flood Stage: 14

Action Stage: 9

Graphical representation of flood inundation for NWS flood categories are based on steady state hydraulic model surface elevations for incremented discharges. Map shows approximate inundation areas for given water surface elevation. Map should not be used for navigation or permitting or other legal purposes, but strictly as a planning reference tool.

### Historic Crests

(1) 17.53 ft on 06/10/2014

(2) 10.18 ft on 08/02/2013

**Extended rating:**  
Rating Curve Extension - The Rating Curve Extension is calculated by using either a linear, logarithmic, or hydrologic to extend the rating curve above the currently established relationship between stage and flow.

(P): Preliminary values subject to further review.

### Recent Crests

(1) 17.53 ft on 06/10/2014

(2) 10.18 ft on 08/02/2013

(P): Preliminary values subject to further review.

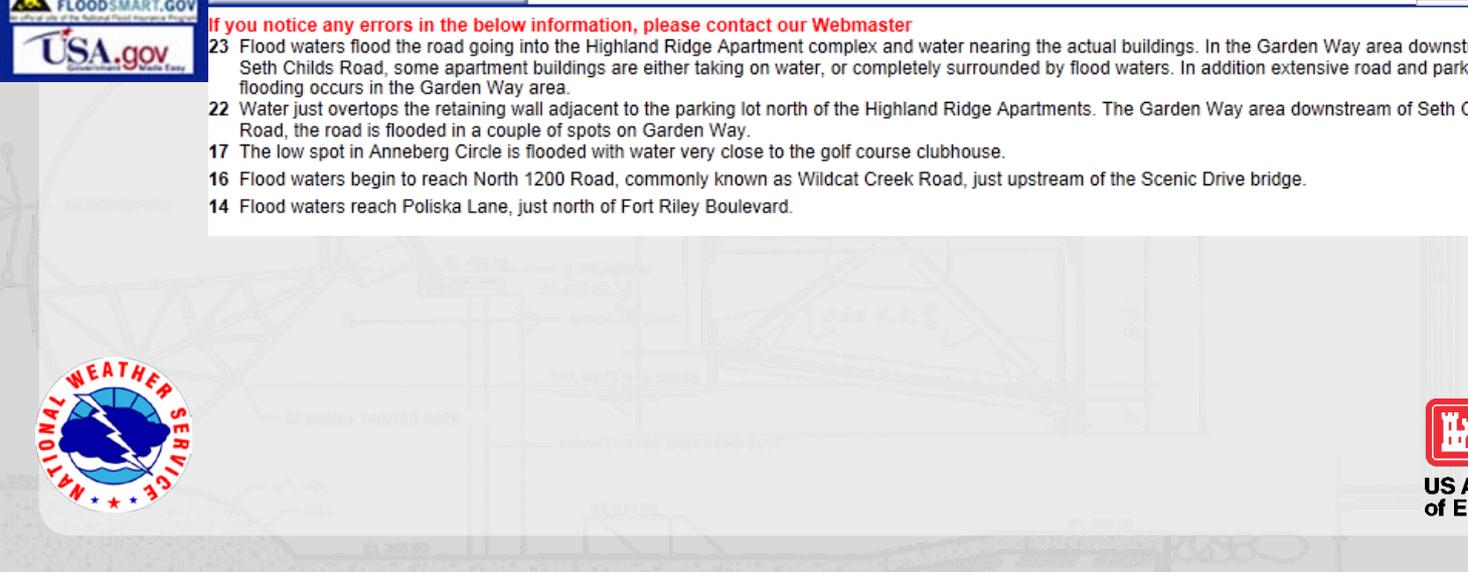
**Low Water Records**  
Currently none available.

[Flood Impacts](#)

- If you notice any errors in the below information, please contact our Webmaster**
- 23 Flood waters flood the road going into the Highland Ridge Apartment complex and water nearing the actual buildings. In the Garden Way area downstream of Seth Childs Road, some apartment buildings are either taking on water, or completely surrounded by flood waters. In addition extensive road and parking flooding occurs in the Garden Way area.
  - 22 Water just overtops the retaining wall adjacent to the parking lot north of the Highland Ridge Apartments. The Garden Way area downstream of Seth Childs Road, the road is flooded in a couple of spots on Garden Way.
  - 17 The low spot in Anneberg Circle is flooded with water very close to the golf course clubhouse.
  - 16 Flood waters begin to reach North 1200 Road, commonly known as Wildcat Creek Road, just upstream of the Scenic Drive bridge.
  - 14 Flood waters reach Poliska Lane, just north of Fort Riley Boulevard.

National Weather Service - Since 1870

- The variety of tools on the webpage can help any stakeholder understand their flood risks better
- Inset, including **Historical Crests**, will be visible for users to relate past flooding to current forecast
- **Depth grids** are also available, showing water depth associated with any inundation map



# ACTIONS

Flood Impacts stages (below) are significant. The community determines and supplies them to the NWS.

These stages could become critical input to the EAP:

Situations come up...

...if bad things happen at a stage of 12 feet, and it takes 24 hours to install a closure, you may need to begin setup at a stage of 9 or 10 feet depending rate of rise, etc.

- required actions at each stage,
- how long the action takes,
- who does it,
- what is the process to initiate the actions

From NOAA NWS Advance Hydrologic Prediction Service

## Flood Impacts & Photos

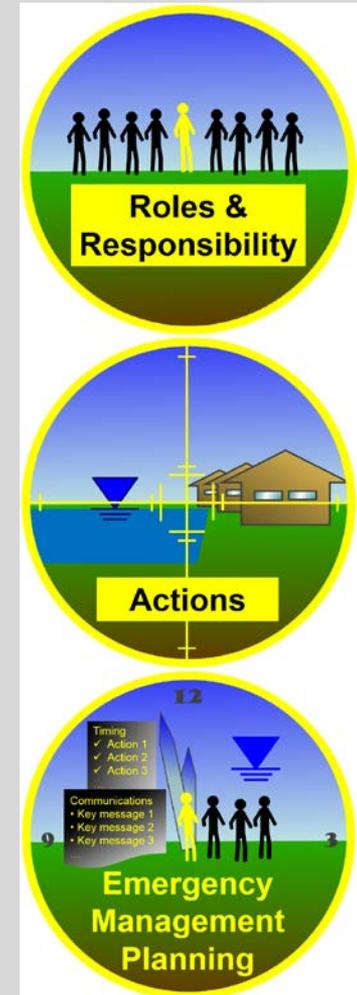
**If you notice any errors in the below information, please contact our Webmaster**

25.15 Water overtops the levee north of Fort Leavenworth.

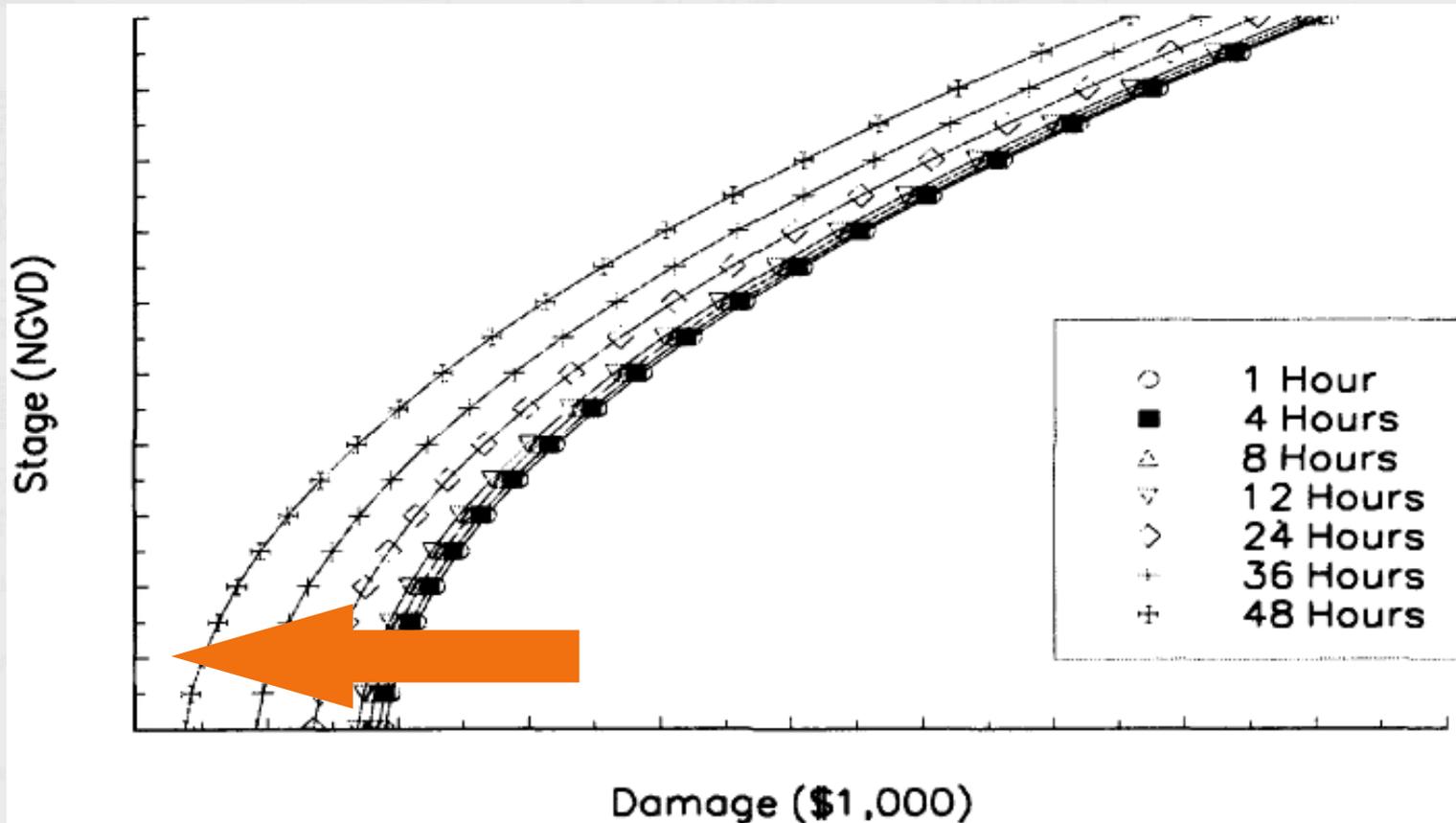
23.4 The Hildebrandt Island north of Fort Leavenworth begins to flood and families in this area need to evacuate.

22.3 Water enters Riverfront Park in Leavenworth. In addition, 2nd Street at the waste water treatment plant is closed due to high water. Persons should vacate the park to avoid the loss of life and property.

20 Lowland flooding occurs along the east and west banks of the river.



# THE BENEFIT\$, DAY CURVE



Risk informed individuals can drive the stage damage curve to the left to reduce damages and flood fight costs.



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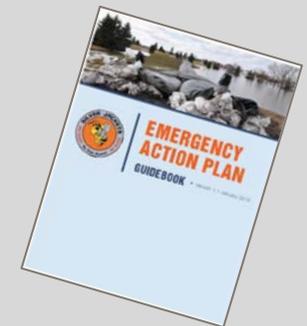


# NEXT STEPS AFTER FLOOD WARNINGS

- Flood barrier
  - Acquire thru an unbiased selection prior to the pressure from a flood event
  - Understand the minimum standards
- Emergency action plan, new or update
  - Tie stage levels to action thresholds
  - Correlate resources to durations of actions
    - Relate to setup time required
    - Consider effort by available city maintenance staff members
    - Be mindful of how variables affect timing
    - Clarify roles including substitutes



Staff (# of People)	4-ft Segment Length	Setup Duration (hour)	>4-ft Segment Length	Setup Duration (hour)	>8-ft Segment Length	Setup Duration (hour)	Total Setup Time (hours)
8	66	0.4	1,476	9.8	378	2.5	12.8
4	66	1.0	1,476	21.6	378	5.5	28.2



# DETAILS ON FLOOD BARRIER

## Cost

- \$300 per panel at 4-ft height
- \$400 per panel at 6-ft height

## Set up time

- 5 minutes per panel
- 6 feet horizontal
- 150 feet per hour assuming
  - ✓ 8 people
  - ✓ Panel is stored on site
  - ✓ 8 panel per crate (89x50x50 inches)



*Brian Rast and Randy Behm demonstrate a certified flood barrier, AquaFence, along Missouri River in Parkville, MO at ASFPM conference (per ERDC / NFPC / FM Approvals)*



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of Engineers.



# FLOOD BARRIER – DURATION FOR SETUP

## Flood Risk

- What rate of rise is the focus?
- What threshold should be selected based on the gage's flood stage?
- What other interference might floods cause?

## Flood Barriers

- Has it been certified?
- Where can it be stored?

## Emergency Action Plan

- Are people available to set up the flood barrier?
- Tie barrier set up to number of people and timing thresholds
- What flood stage requires each action?



*Tiger Dam, certified and tested temporary barrier.*



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