

Emergency Action Plans for Dam Safety



Importance of EAPs



Tami Idol, EI
Assistant State Dam Safety Engineer



Importance of EAPs

- Dam Failures and Incidents Do Occur
 - Training Aids for Dam Safety (TADS) video
 - Teton Dam – June 1976
 - Hadlock Pond Dam – July 2006
 - Big Bay Dam – March 2004
 - Tom Sauk Upper Dam – December 2005
 - Koloko Reservoir Dam – March 2006

Reference ASDSO June 8-9, 2010 Seminar Presentation by
Mr. John France, PE of URS Corporation

Fatalities from Dam Failures

- 4 people in NC have died as a direct result of a dam failure since the NC Dam Safety Law was passed in 1967.
- 400 recorded dam failures occurred from 1985 to 1998
- 312 recorded fatalities from dam failures between 1960 and 2008

Small vs. Large Dams

The failure of large dams don't kill the most people...

The failure of smaller dams do

Dam Failures Resulting in Fatalities

- 86% of the fatalities resulted from dams between 20 and 49 feet in height (*32 ft.*)
- 47% of the fatalities resulted from dams with D.A. less than 2 sq. mi. (*1.5 sq. mi.*)
- 75% of the fatalities resulted from dams with D.A. less than 10 sq. mi. (*95% < 10 sq. mi.*)
- 87% of the fatalities resulted from dams with < 1,000 ac-ft of storage (7 dams < 300) (*548 ac.ft.*)



"RUN FOR IT!"
IS NOT AN
ADEQUATE
EMERGENCY
ACTION PLAN.

McDermid
DLR



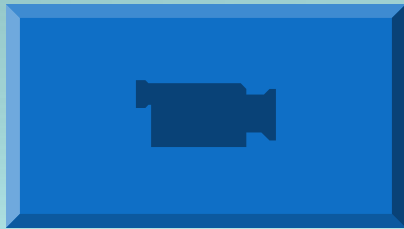
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Importance of EAPs

- TADS video clip



Importance of EAPs

- 10 Steps to Prepare and Maintain an EAP
 - Identify and meet with local responders and stakeholders
 - Complete dam break inundation studies and field reconnaissance
 - Prepare inundation maps using engineering analysis or “Simplified Inundation Mapping System” (whichever is appropriate) as will be covered in this workshop
 - Identify emergency situations and actions
 - Identify communications methods – primary and backup

Importance of EAPs

- 10 Steps to Prepare and Maintain an EAP
(continued)
 - Prepare contact charts identifying individuals, phone numbers, and order of contact
 - Prepare draft EAP
 - Distribute draft EAP to involved parties for review and comment
 - Revise EAP, obtain approval, and distribute copies
 - Regularly test, review, and revise the EAP

Importance of EAPs

- Teton Dam, Idaho
 - Failed mid-day on Saturday, June 5, 1976
 - Earthfill Dam, 305 feet high
 - Normal storage of ~300,00 acre-feet (98 billion gallons)
 - 11 to 14 fatalities, \$400M to \$1B property damage
 - High hazard potential



Muddy Water



Flow Increasing, Dozers Sent to Fill Hole
at Elevation 5200 about 10:45 am



Dozers Lost In Hole About 11:20 am

Dozers Lost



AFTER VAINLY TRYING TO FILL BRE
IN EMBANKMENT OF TETON DAM,
"CAT" OPERATORS...



About 11:25 am, June 5, 1976





B-14

Approximately 11:30 am, June 5, 1976



Second Hole in Dam about 11:32 am, June 5, 1976



Tremendous Flow of Muddy Water



B-19

Large Masses of Dam Caving into Erosion Hole about 11:50 am.



Dam Crest Breaching at 11:55 am, June 5, 1976





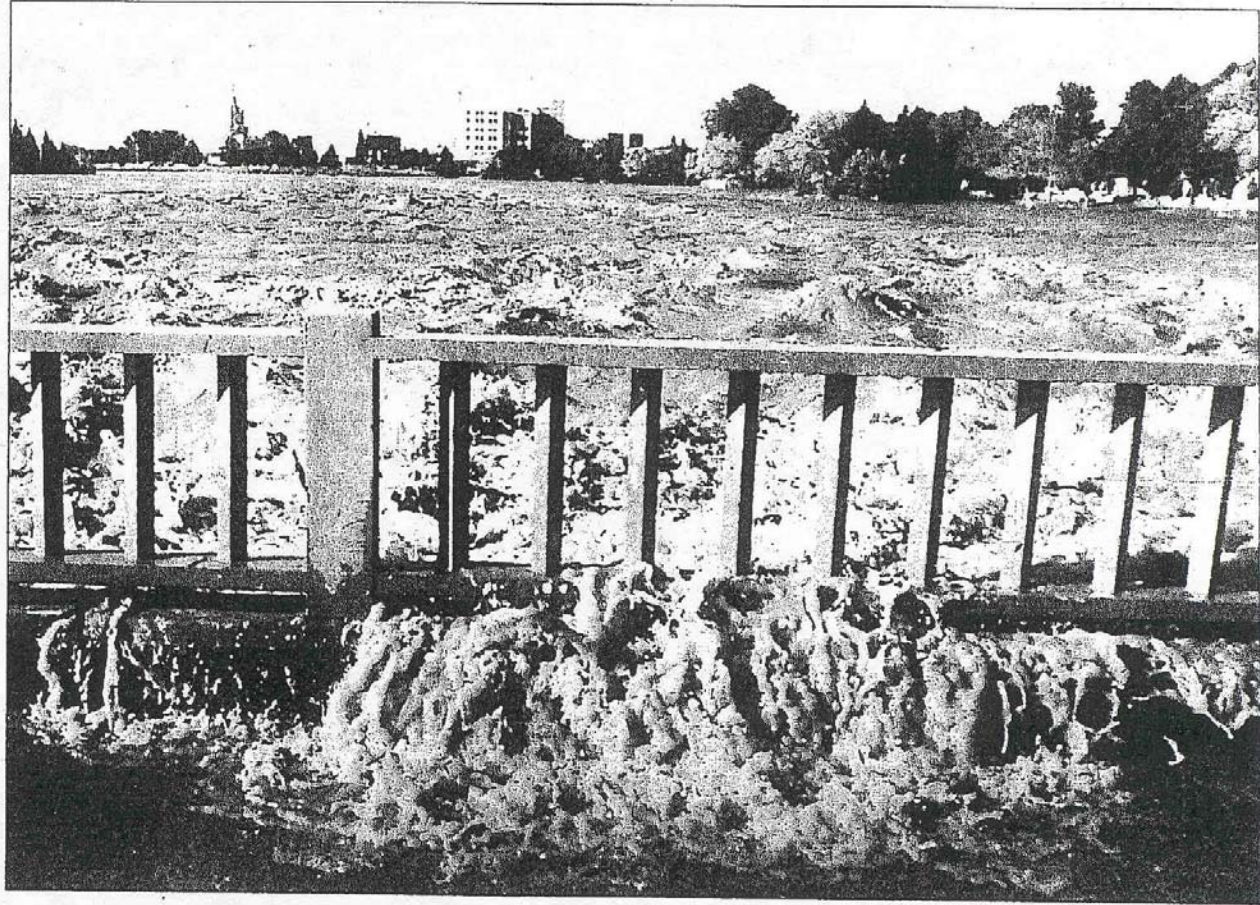




Rexburg, Idaho

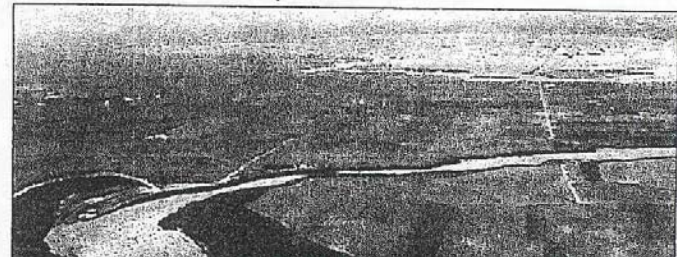
TETON FLOOD 20 YEARS AFTER

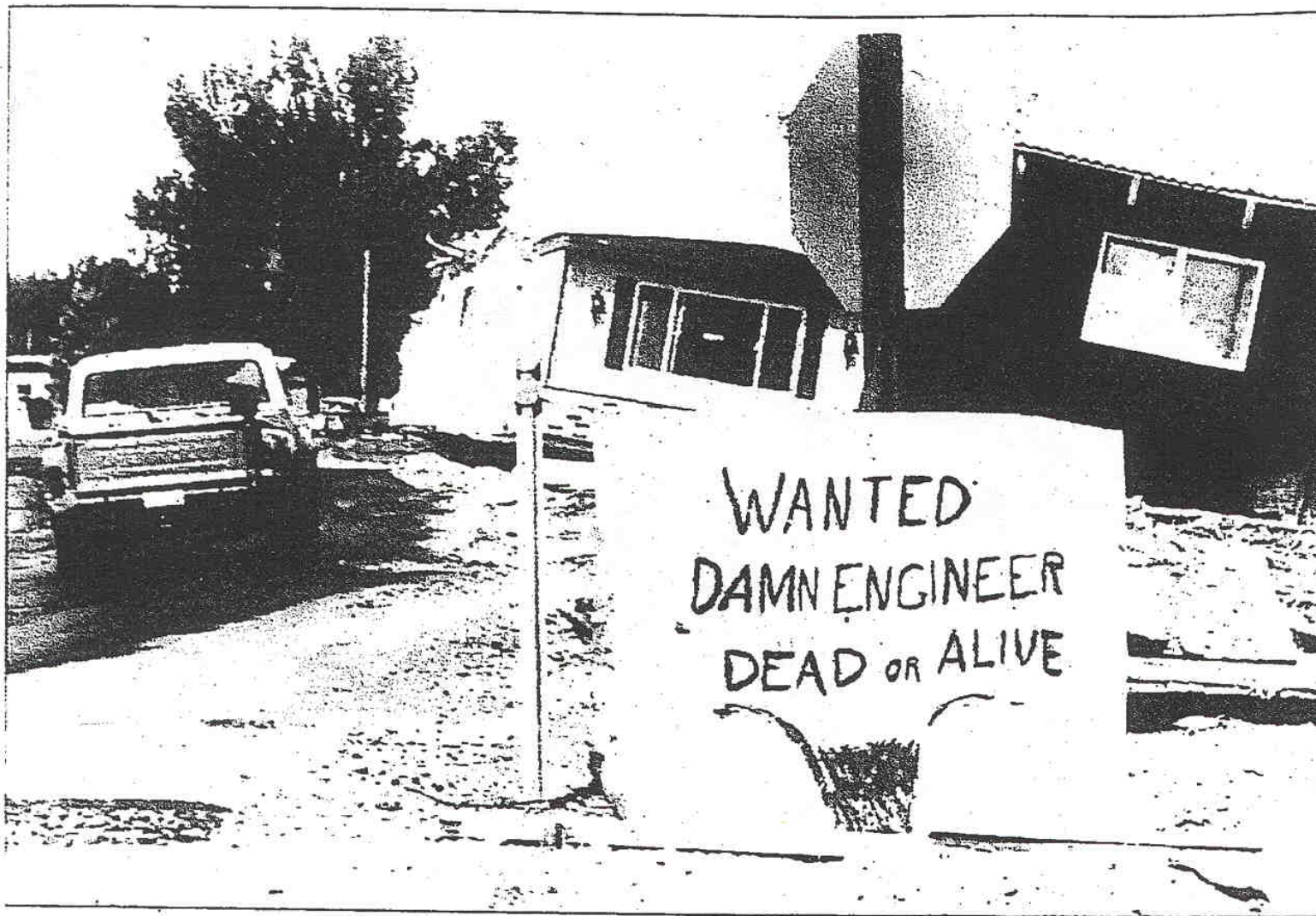
Flood waters from the failure of the Teton Dam surge through the railing and over the Broadway Bridge in Idaho Falls. By Sunday evening the full force of the flood was reaching the city and officials feared the loss of the bridge Sunday night or Monday. However the bridge held and the waters started to recede by Tuesday.



Photos by
Robert Bower
Post Register

Dam disaster buried BuRec's name in mud





A sign expressing feelings concerning the Teton Dam was posted next to wrecked homes in Rexburg during cleanup efforts.

Post Register
file photo

Importance of EAPs

- Hadlock Pond Dam, New York
 - Failed 6:15 p.m. on Saturday, July 2, 2005
 - Earth and Rockfill Dam, 29 feet high
 - Normal storage of 1,600 acre-feet (521 million gallons)
 - No fatalities, significant property damage
 - High Hazard Potential

Following photos provided by W. Graham, Bureau of Reclamation



















Importance of EAPs

- Big Bay Dam, Mississippi
 - Failed at 12:20 p.m. on Friday, March 12, 2004
 - Earth Dam, 57 feet high
 - Release of 22,100 acre-feet (7.2 billion gallons), emptied in 2.5 hours
 - No fatalities, significant property damage
 - High Hazard Potential

Following photos provided by W. Graham, Bureau of Reclamation



2004 3 16



2004 3 16



4/15/2004 1



Many vehicles were swept
one-quarter mile into the woods



2004 3 16



2004 3 16



2004 3 16

Many homes on Robbins Road were Severely Damaged or Washed Away





2004 3 16

Importance of EAPs

- Taum Sauk Upper Dam, Missouri
 - Failed at 5:20 a.m. on Wednesday, December 14, 2005
 - Earth Dam, 94 feet high
 - Release of 4,300 acre-feet (1.4 billion gallons), emptied in 12 minutes!!!
 - No fatalities
 - Injuries, significant property damage
 - High Hazard Potential











Missouri Governor Matt Blunt









← JOHNSON SHIP
STATE 'ART

Importance of EAPs

- Koloko Reservoir Dam, Hawaii
 - Failed at 5:30 a.m. on Tuesday, March 14, 2006
 - Earth Dam, 44 feet high
 - Release of 1,400 acre-feet (456 million gallons)
 - 7 fatalities, significant property damage
 - Low Hazard Potential Classification!!

Following photos provided by W. Graham, Bureau of Reclamation





PATH OF THE DEADLY FLOOD



2 Deluge flows to Morita Reservoir



Photos by **BRUCE ASATO** | The Honolulu Advertiser

A thundering mass of water swept down on Waialapa homes when a reservoir dam burst yesterday morning. Trees and debris were hurled along in the floodwater, and power transformers exploded. "It sounded like 10 jet engines coming at us," said one resident. "Trees were cracking."











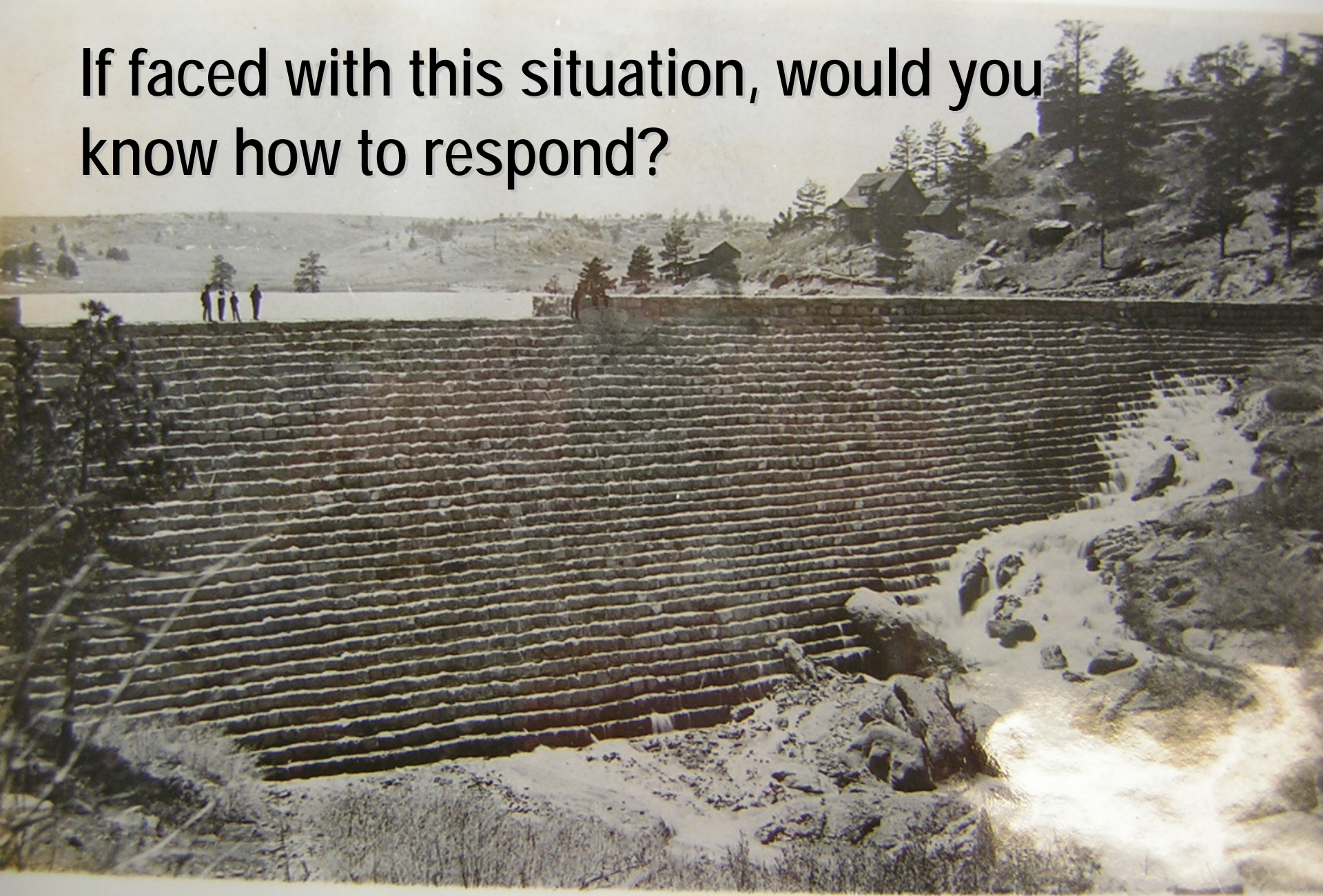
Hawaii Governor Linda Lingle



Importance of EAPs

- Emergency Action Plans
 - **Protect lives**
 - Provide an effective document that can be used by non-technical staff
 - Define conditions that require response
 - Provide clear direction for use during stressful situations
 - May minimize property damage and environmental impacts

If faced with this situation, would you know how to respond?



Castlewood Canyon Dam, CO

Would you want to
be this dam owner?





911 Operator: *“Fire, Police, Medical.”*

Caller: *“It’s a dam problem. I don’t know. What is it? Over at the Whittenton Mill complex. The dam right behind the building over on your left. I own the property, and, uh, I was down there this morning. I just called the state, because the dam is pretty old, and that thing is raging. And I am just worried about it.”*

Audio clip courtesy of M. Bellisle, Pare Engineering

911 Operator: *“Sir how bad does it look? Does it look like its going to break?”*

Caller: *“I mean you know, its got a lot of old, you know, kind of rotted wood. So does it look like it’s going to break? No. It looks like it always did. It’s just that I have never seen it have so much pressure on it before, so much water going through. In all likelihood, it’s going to be ok, but.....”*

911 Operator: *“Engine 4 You’re responding to 437 Whittenton Street, the Whittenton Mills, for a dam that’s ready to break.”*

Importance of EAPs

- Example Incidents where an EAP was activated
 - Sugar Lake L-44
 - Needwood Lake Dam

Both are “Watershed dams” designed by the USDA -
NRCS

Incident At Sugar Creek L-44



Site Data

- Located in Caddo County – SW Oklahoma
- Drainage area – 1,709 acres
- Maximum fill height – 64 feet
- Embankment length – 550 feet
- Auxiliary spillway width – 40 feet
- Constructed in 1971 as a low hazard dam
- County road 300 feet downstream

The Incident

- > 8 in. of rain in < 12 hrs. on August 18-19, 2007; greatly exceeded 100-yr. storm
- Very high auxiliary spillway flow
- Erosion of the inside training dike
- Erosion of the auxiliary spillway down to the underlying bedrock
- Erosion of the downstream toe of the dam near the auxiliary spillway outlet
- Instability of the embankment

The Incident



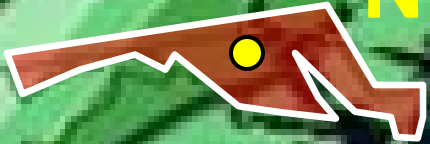
Responses

- Activation of the Emergency Action Plan
- Continuous monitoring
- Evacuation of downstream residents
- Excavation of ditch in spillway to drain lake faster
- Concrete barriers to protect a downstream resident

June 23-28, 2006

Rainfall Totals

NEEDWOOD



INCHES

10-15



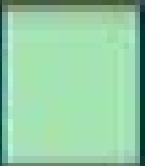
6-10



3-6



1-3



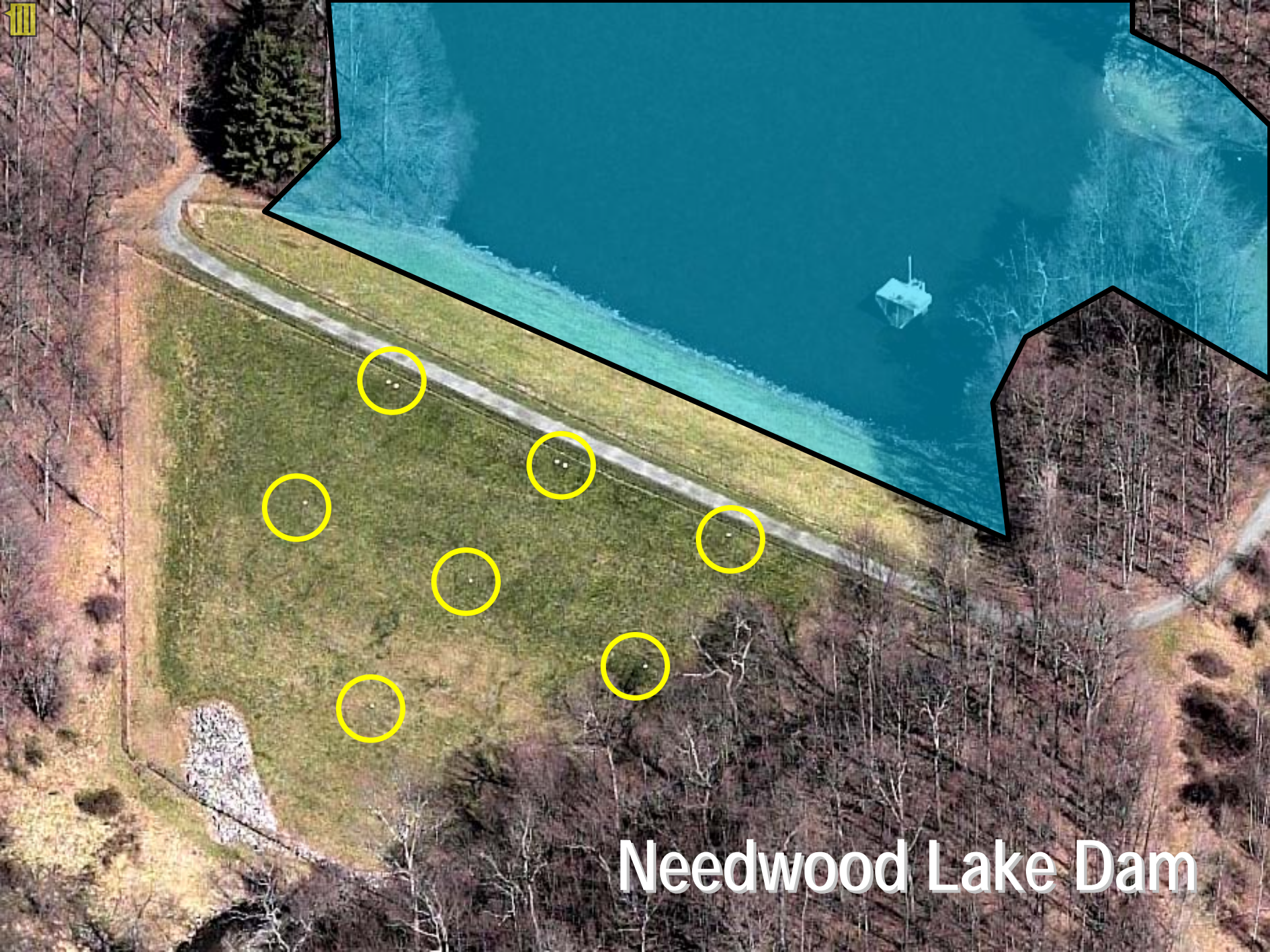
TROPICAL SURGE

Lake Needwood Dam





Water f



Needwood Lake Dam



6:32

72°







BREAKING NEWS

MANDATORY EVACUATIONS

6:31
72°







**65 ft
high**





JUN 28 2006



JUN 28 2006



JUN 28 2006



Area workers use sandbags as a temporary fix to stop the over flooding at the dam. Engineers and workers repair the damaged dam at Lake Needwood in Rock Creek Regional Park. The lake is 25 feet about normal and over 2,300 local residents were forced to evacuate.









Actions During Incident

- 2200 people evacuated for 2 days
- Monitoring of the dam 24/7
 - Lake level
 - Seepage
 - Observation wells
- Placement of weighted filter
- Continuous evaluation of safety of dam

Basis for Lifting Evacuation Order

- All observation well levels dropped for 2 consecutive readings (4 hrs)
- “Out of imminent danger” but not “all clear”
 - Dam still leaking
 - Lake still 20 feet above normal
 - Additional monitoring 24 hrs/day
- Evacuees advised to monitor local radio and TV for possible evacuation on short notice (1-2 hours)

Lessons Learned

- Existence of EAP was helpful
- Evacuation/termination decisions are difficult
- Teamwork was very effective in this instance
- Media was helpful in getting message to affected public
- Materials and equipment were mobilized quickly
- “Incident” continued until repairs were made