Oroville Spillway Incident

Bill Croyle
Retired Acting Director
California Department of Water Resources
Largest state owned & operated water delivery system in the U.S.

Serves 25 million Californians

750,000 acres of farmland

32 Storage Facilities

21 Pumping Plants

4 Pumping-generating Plants

8 Hydroelectric Plants

700 miles of Canals and Pipelines
Oroville Dam, Spillways and Diversion Pool
Atmospheric Rivers

October 1, 2016 - April 12, 2017: numerous atmospheric rivers hit the West Coast.


Lake Oroville received an entire year’s average runoff of 4.4 million acre feet of water in two months.

More than 5 million acre feet of water was released from the lake from mid-January through the end of May.
Wettest Year in Northern Sierra 8 Station Index History – 97 years
February 7
Deck and Foundation Erosion

150 ft. Wide
450 ft. Long
30-45 ft. Deep
Incident Command
Forecasted Peak Inflow: 140,000 cfs
Actual Peak: 190,000 cfs

3.5 million acre-feet down broken spillway in 42 days

Total of five Folsom Lakes passed through the spillway
February 11
Approximately 8:00 AM
Flow Begins Over Emergency Spillway
Water coming over both the Emergency Spillway and the Flood Control Spillway morning of February 12
Sunday
February 12th
3:30 pm

- Rate of Erosion Began To Increase
- Moving Toward the Emergency S/W at about 30 feet/hour
This is an evacuation order.

Immediate evacuation from the low levels of Oroville and areas downstream is ordered.

A hazardous situation is developing with the Oroville Dam auxiliary spillway. Operation of the auxiliary spillway has lead to severe erosion that could lead to a failure of the structure. Failure of the auxiliary spillway structure will result in an uncontrolled release of flood waters from Lake Oroville.

In response to this developing situation, DWR is increasing water releases to 100,000 cubic feet per second.

Immediate evacuation from the low levels of Oroville and areas downstream is ordered.

This is NOT A Drill. This is NOT A Drill. This is NOT A Drill.
February 12
Approximately 4:00 PM
Flows increase to 100,000 cfs
February 14, 2017
Butte County Sheriff Kory L. Honea, Cal Fire incident commander Kevin Lawson and DWR Acting Director Bill Croyle announce that the immediate evacuation order has been reduced to an evacuation warning.
Flood Fighting at Hyatt Powerplant

Rock and concrete collected in the diversion pool, causing flood risk to Hyatt

Sandbagging, grouting, pumps, tanks, and other efforts by DWR staff and emergency response partners saved Hyatt
Aggressive head-cutting threatened Hyatt transmission tower.
Debris Dam – Diversion Pool on February 27, 2017

Over 1.9 million cubic yards removed in 9 days
36 land and barge based excavators
32 heavy haul trucks
Geologists begin their work
Operations ran 24/7 to get ready.
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<td>• Department of Fish &amp; Wildlife</td>
<td>• City of Oroville, Police Dept., Fire Dept.</td>
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<td>• CAL FIRE</td>
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<td>Organization</td>
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Lake Oroville Spillways Emergency Recovery

Objectives:

• Ensure public safety and the integrity of the Oroville Dam and associated facilities, which includes the main and emergency spillways.

• Ensure the main spillway can safely pass Feather River flood flows by November 1, 2017.

• Construct a cutoff wall to prevent uphill erosion should the emergency spillway ever need to be used again.
Key Design Milestones

- Advertised Spillways Contract – 3/31/17
  - 30% Plans and Specifications
- Awarded Spillways Contract – 4/20/17
- M.D. 6, Scour Hole Slope Stabilization – 5/9/17
- M.D. 11, 75% Plans & Specs. – 5/18/17
- M.D. 20, Final Plans & Specs. – 6/21/17
- M.D. 27, Revised Final Plans and Specs. – 7/20/17
FCO Spillway Construction Sequence

STA 13+00

730 Feet Replaced by Nov. 1, 2018

STA 20+30

790 Feet Replaced by Nov. 1, 2017

STA 28+20

1,110 Feet RCC Chute by Nov. 1, 2017
Structural Concrete by Nov. 1, 2018

STA 39+30

370 Feet Replaced by Nov. 1, 2017

STA 43+00

Complete Connection by Oct. 1, 2017

RCC Backfill
Let the "Controlled" Blasting begin!!!!
Blasting 1 to 2 times a day for weeks
Foundation
Clean up
Leveling Concrete & Drains

55,000 feet of drain pipes - stacked vertically, would stretch more than 10 miles high.
Structural Concrete
Main Spillway Upper Section

Structural rebar panels

8,519,000 pounds of reinforced steel
Main Spillway
Middle Section
Building RCC up to meet structural concrete
Main Spillway
Middle Section

349,000 Cubic Yards of Roller Compacted Concrete (RCC)

Every 5 minutes a dump truck dropped off RCC totaling more than 5,000 cubic yards a day
Main Spillway Lower Section

138,000 CY
Structural concrete

5.5 foot wide sidewalk from Sacramento to LA
Upper Chute – “The Peak”
The November 1 milestone was accomplished.

The main spillway can pass 100,000 cfs
Emergency Spillway
Buttress and Splashpad for additional integrity

Roller-Compacted Concrete Splashpad
Roller-Compacted Concrete Buttress
Emergency Spillway

Underground Cut-off Wall
(Secant pile wall)
1,450 ft long
35 - 65 ft deep
Emergency Spillway
Secant pile wall
Secant Pile Wall
Working Pad and Guide Wall
Contractor’s Leveling Pad design
This incident changed the critical infrastructure discussion?

- Public Safety
- Transparency
- Risks
- Collaboration
- Design and Service Life
- Time Schedules