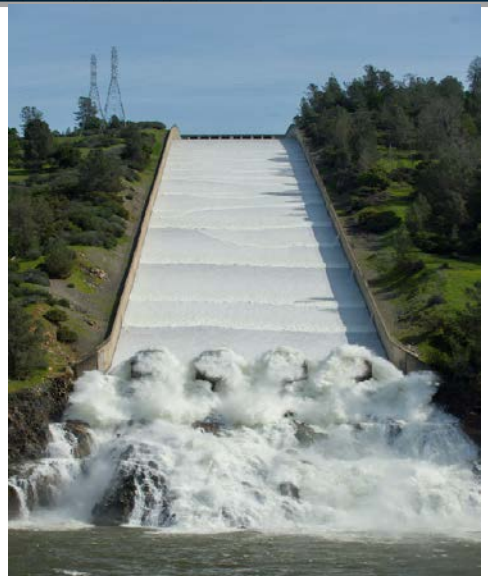
Oroville Spillway Failure

Bill Croyle
Retired Acting Director
California Department of Water Resources



State Water Project Overview

- 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

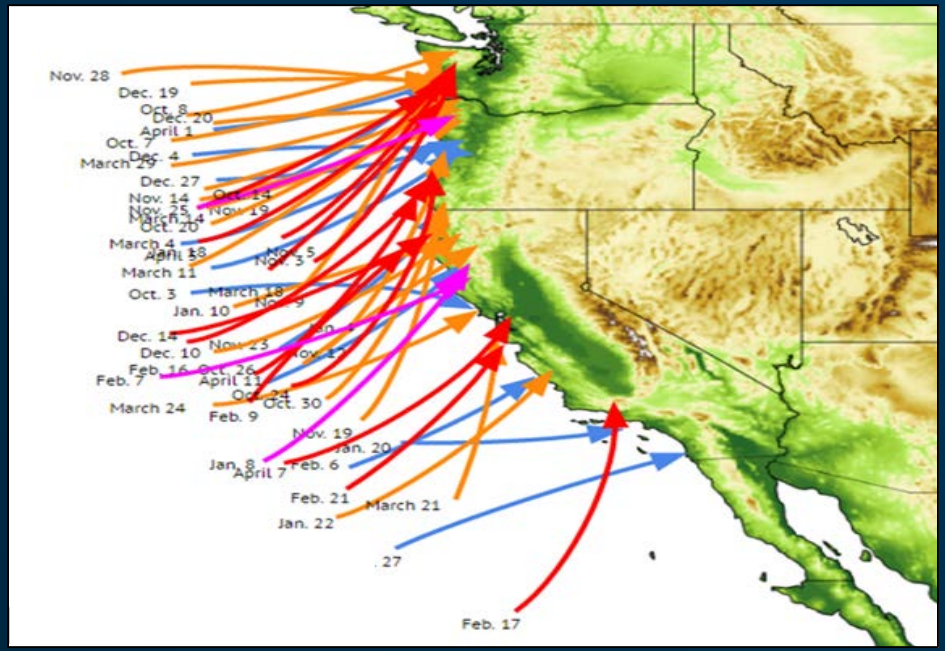
Atmospheric Rivers

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

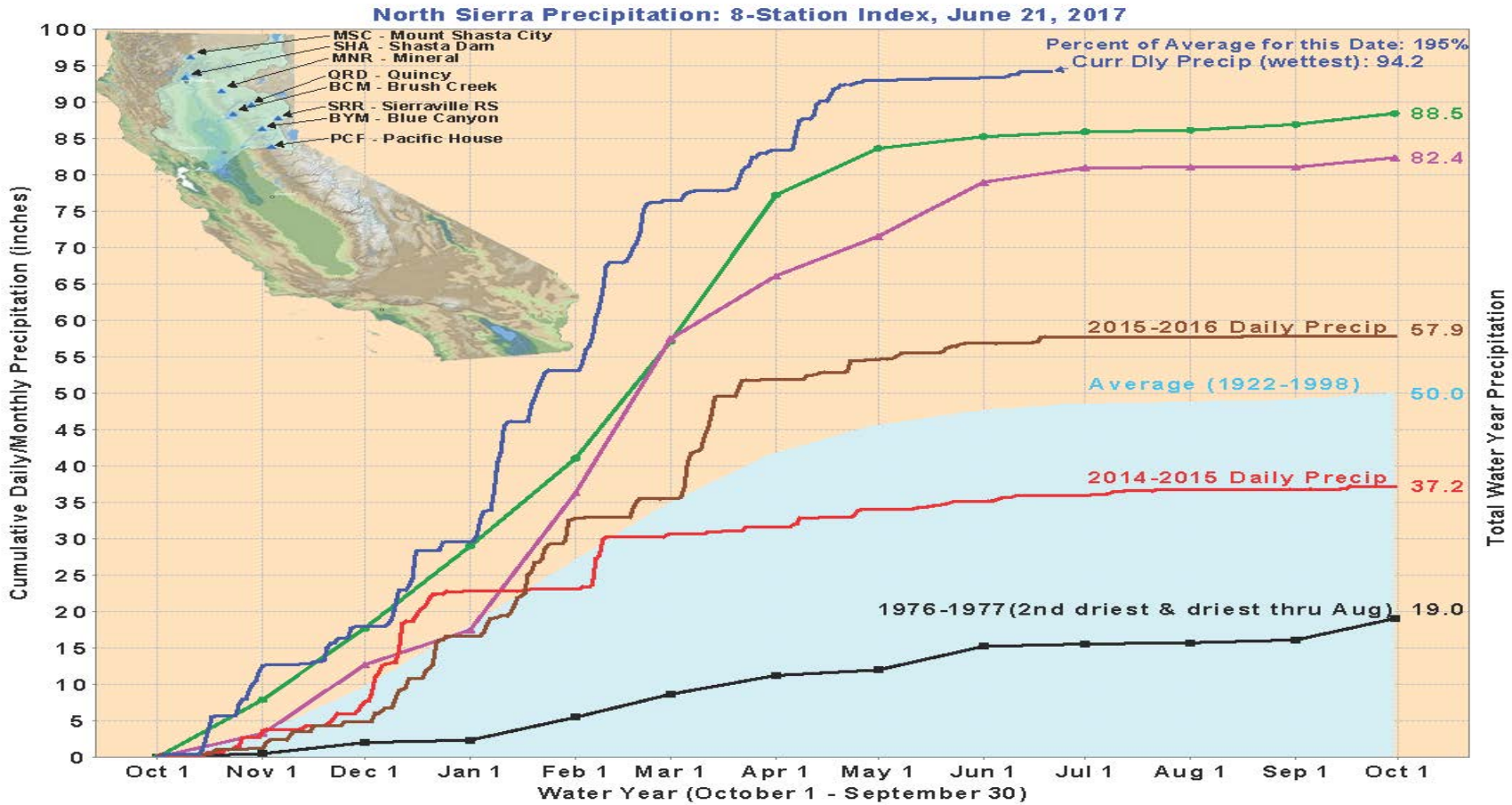
An unrelenting series of storms hit California in late 2016 and early 2017

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

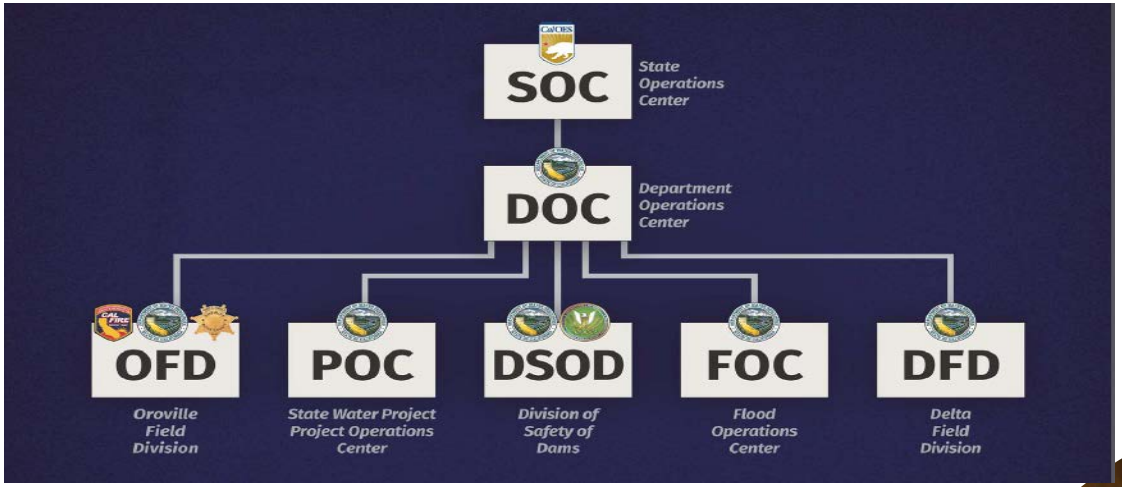


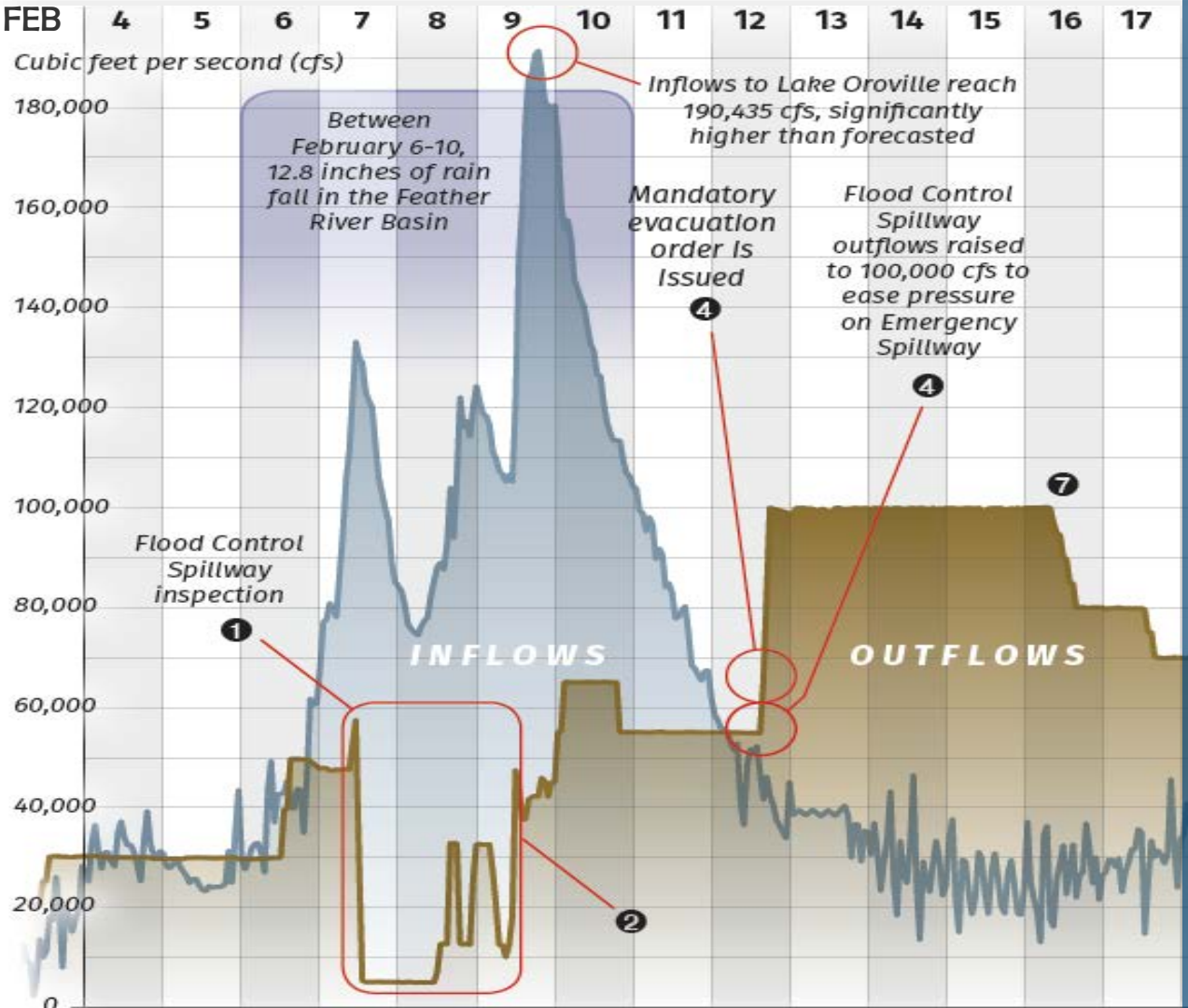

Monday
February 6th


Tuesday
February 7th

February 7
Deck and Foundation Erosion

Incident Command





Forecasted Peak Inflow: 140,000 cfs
Actual Peak: 190,000

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

Butte County Sheriff Kory Honea Ordered Evacuation

February 12

Approximately 3:30 PM

Butte County Sheriff
February 12 ·

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.

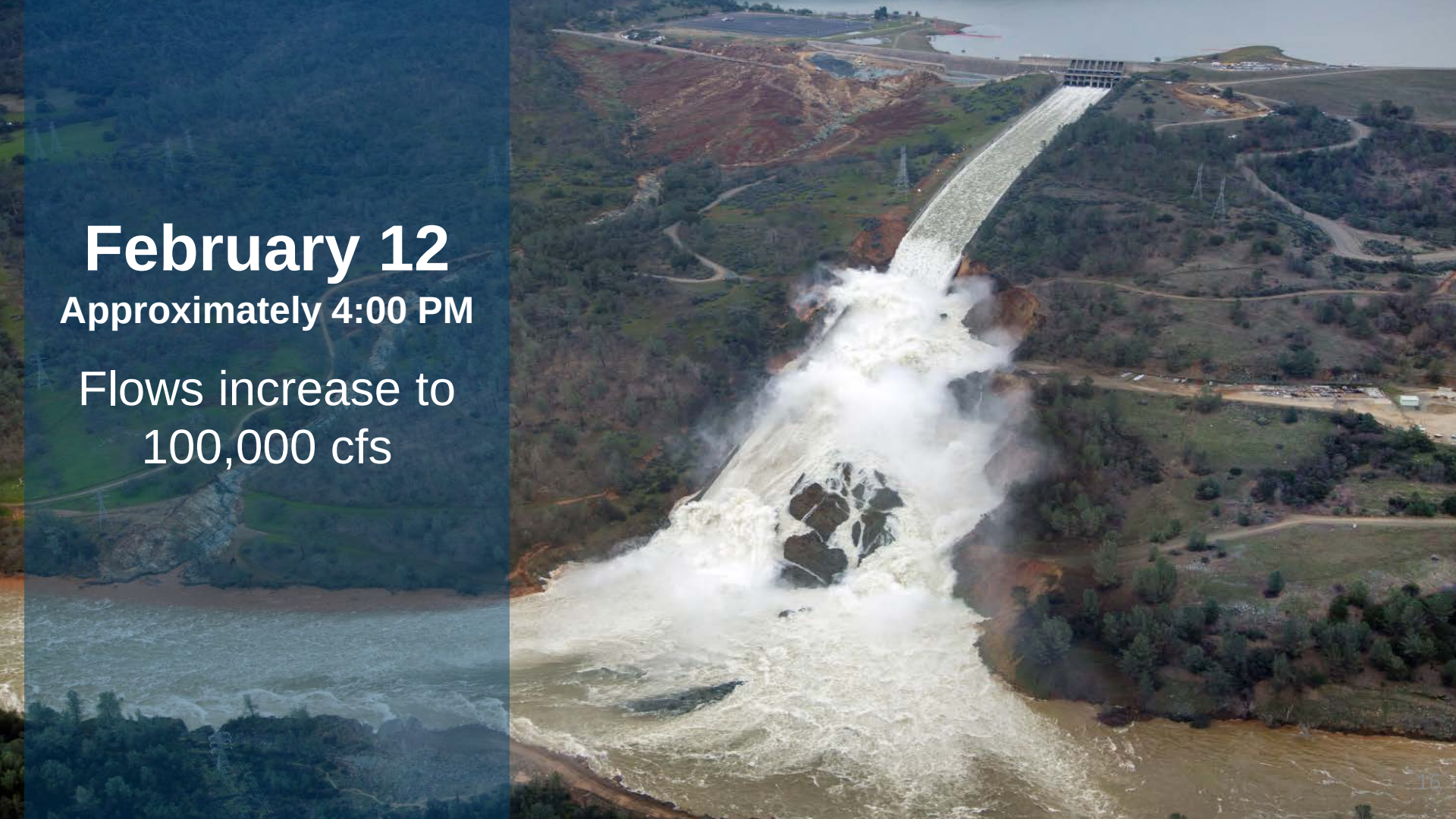
In response to this developing situation, DWR is increasing water releases to 100,000 cubic feet per second.

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

This in NOT A Drill. This in NOT A Drill. This in NOT A Drill.

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



February 12

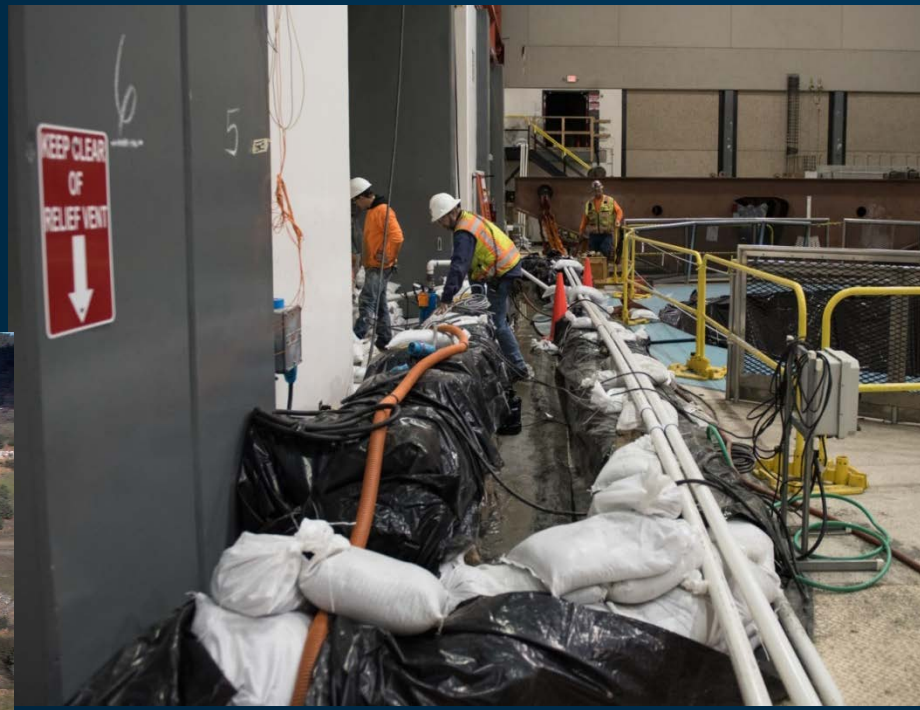
Approximately 4:00 PM

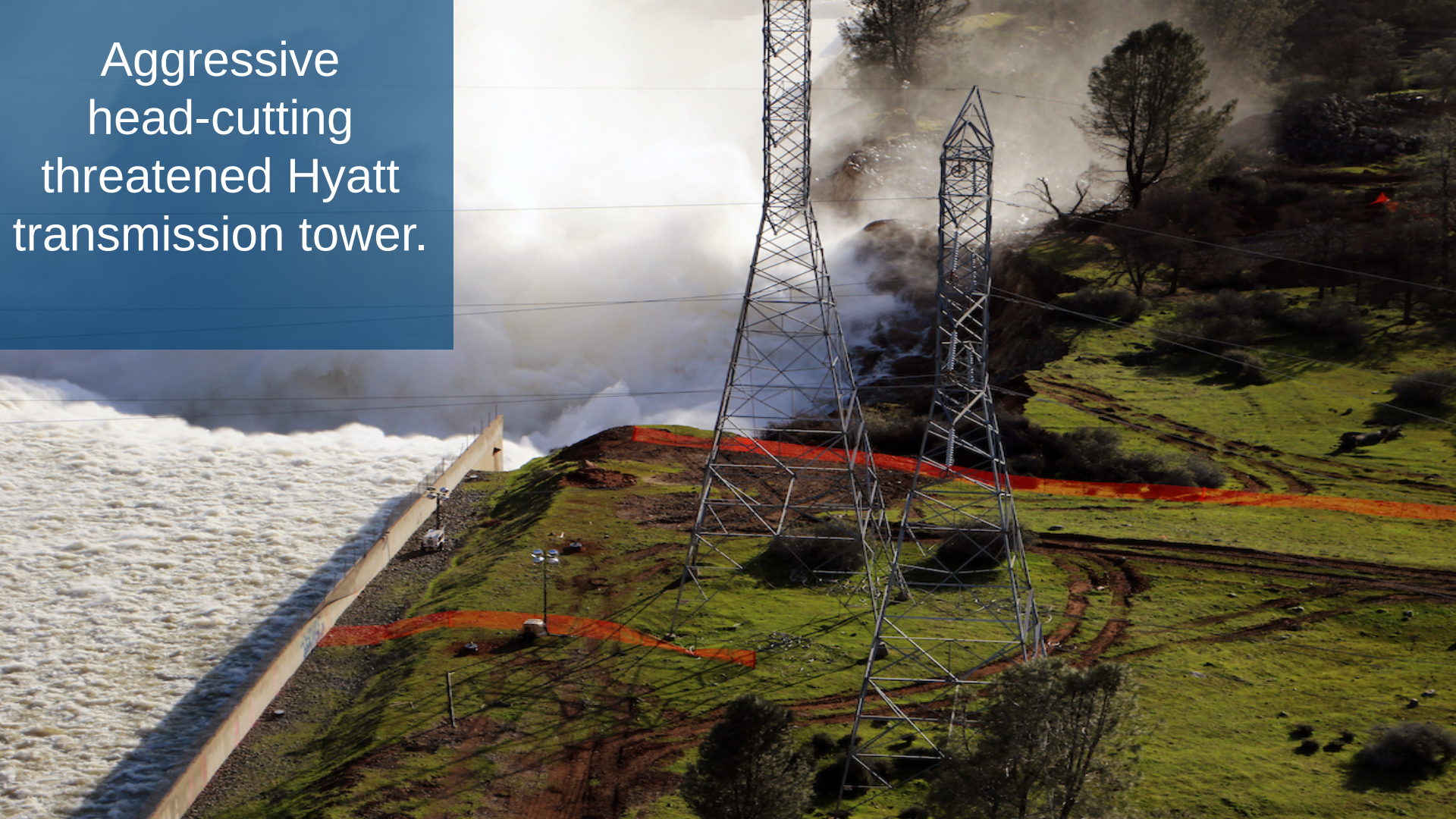
Flows increase to 100,000 cfs

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.

Monday,
February 27

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

State Partners

- Department of Parks & Recreation
- Department of Fish & Wildlife
- CAL FIRE
- California Conservation Corps.
- California Highway Patrol
- California National Guard
- Office of Emergency Services
- CalTrans

Local & Other Partners

- Butte County Sheriff, OES, PW
- City of Oroville, Police Dept., Fire Dept.
- Gridley-Biggs Police Department
- Oroville Hospital
- Bureau of Indian Affairs
- PG&E
- Red Cross
- Association of State Dam Safety Officials
- U.S. Society on Dams

Regulators & Oversight

Federal Energy Regulatory Commission

Dam operational license, Inspections, input on construction, regulator

CA Division of Safety of Dams

Operations, maintenance, regulatory compliance, inspections

Association of State Dam Safety Officials

Industry guidance, selection of Independent Forensic Team

US Society on Dams

Industry guidance, selection of Independent Forensic Team

US Army Corps of Engineers

Response Assistance & Dam Flood Control Operations

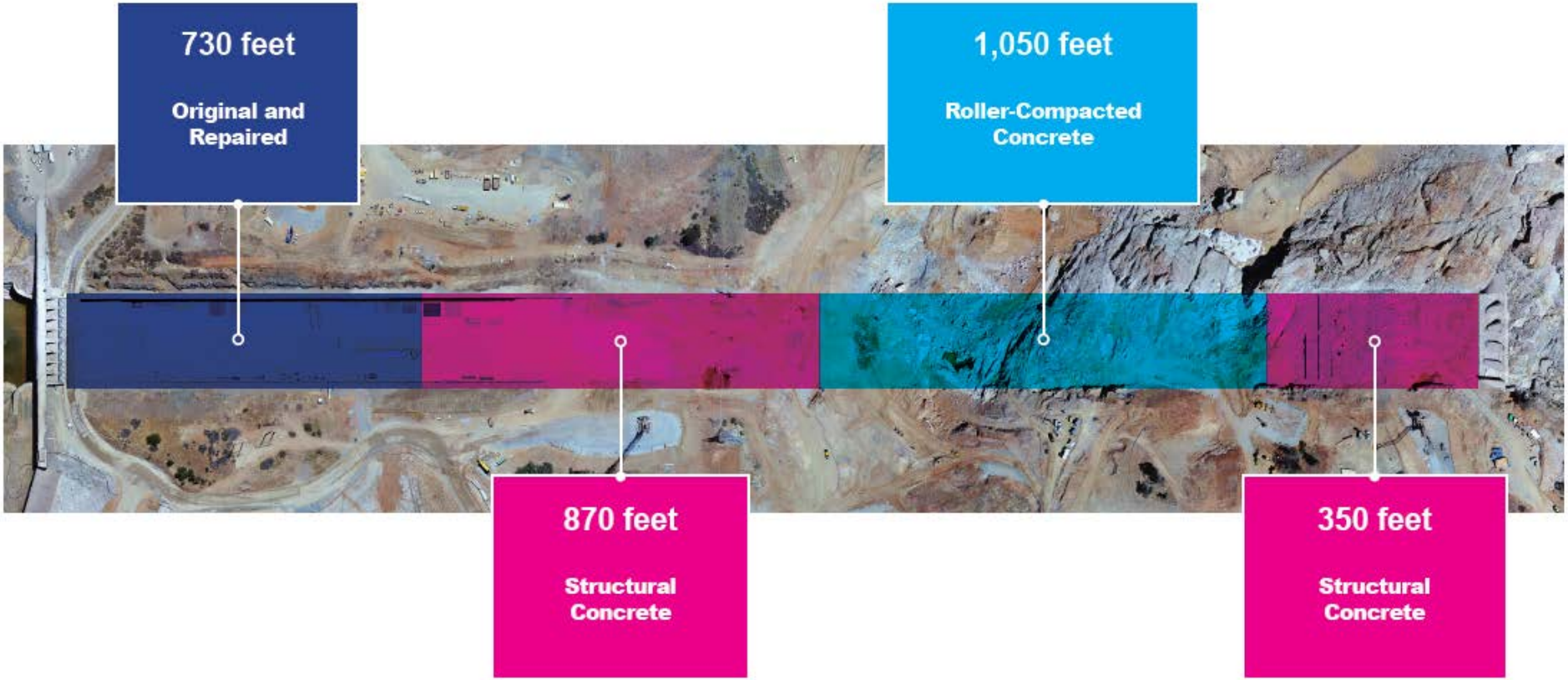
Kiewit was awarded contract in April demolition began in May

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.

Main Spillway
Phase 1 Construction – Completed November 1, 2017



Demolition

Blasting

1 to 2 times a day for weeks

Lower Chute

Foundation Clean up

Foundation Cleanup

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

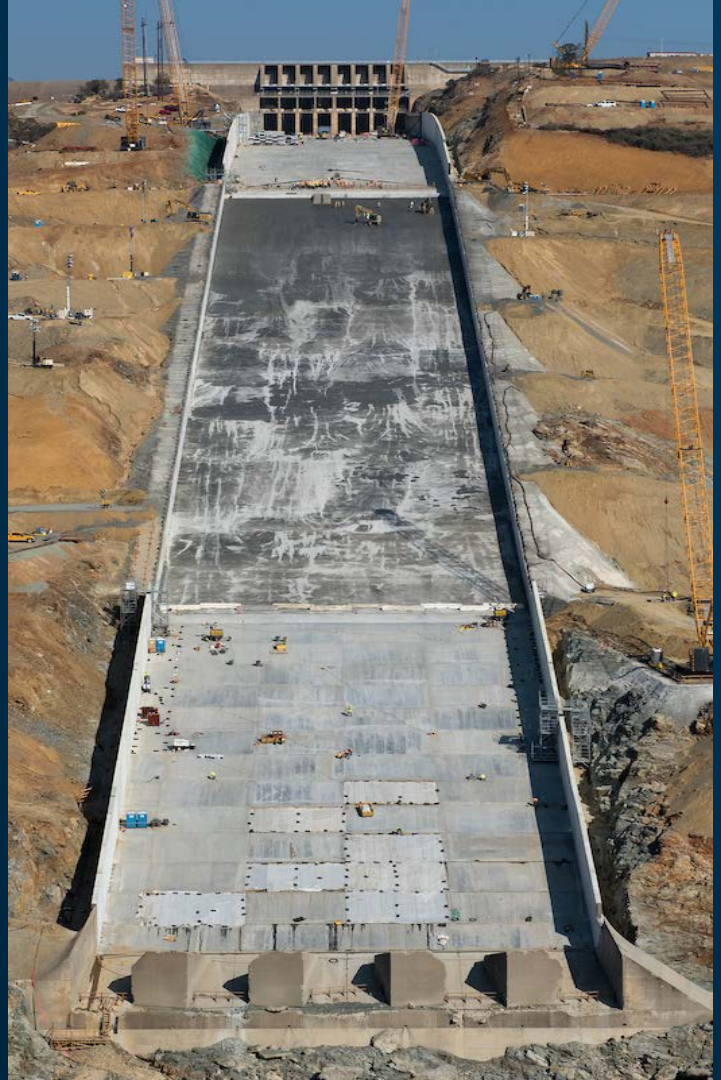
138,000 CY
Structural concrete

5.5 foot wide sidewalk from Sacramento to LA

Spillway Repair Progress

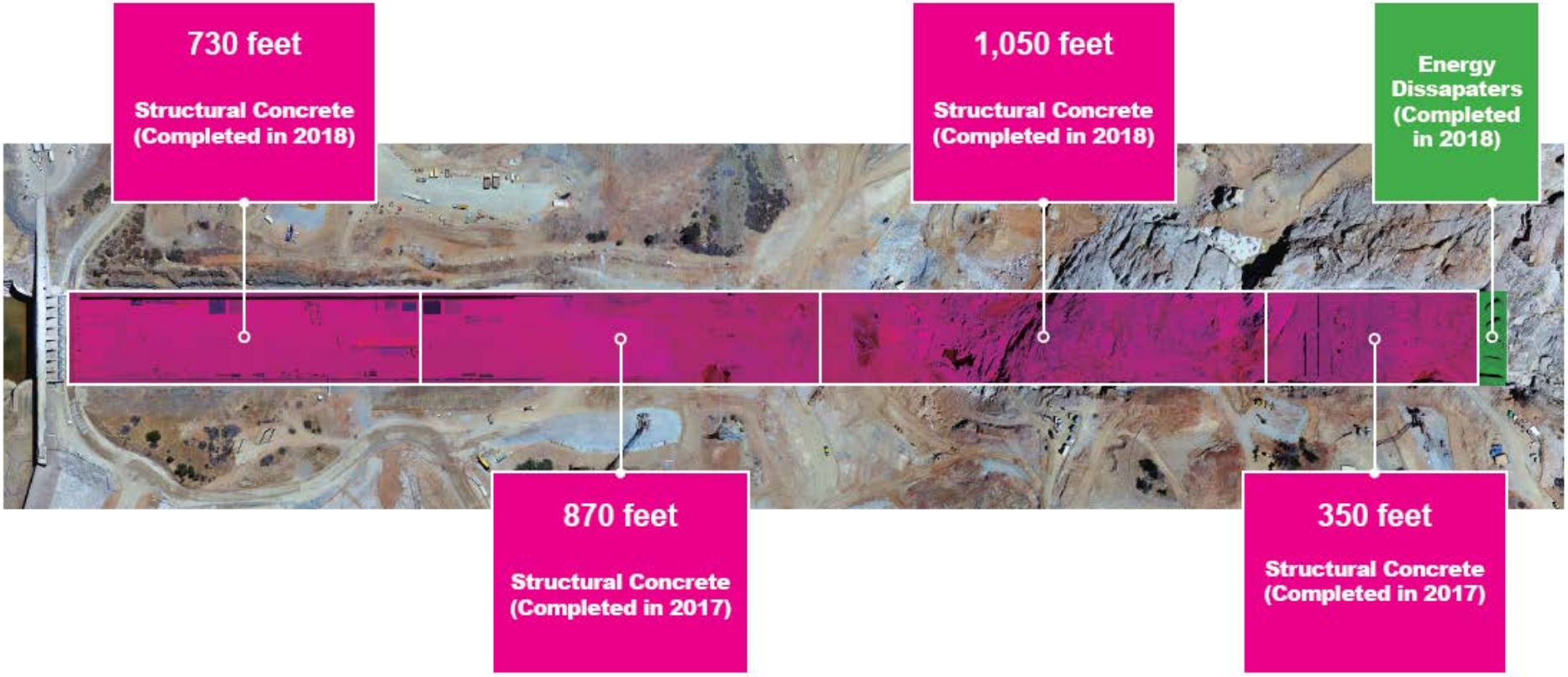
The November 1 milestone was accomplished.

The main spillway can pass 100,000 cfs



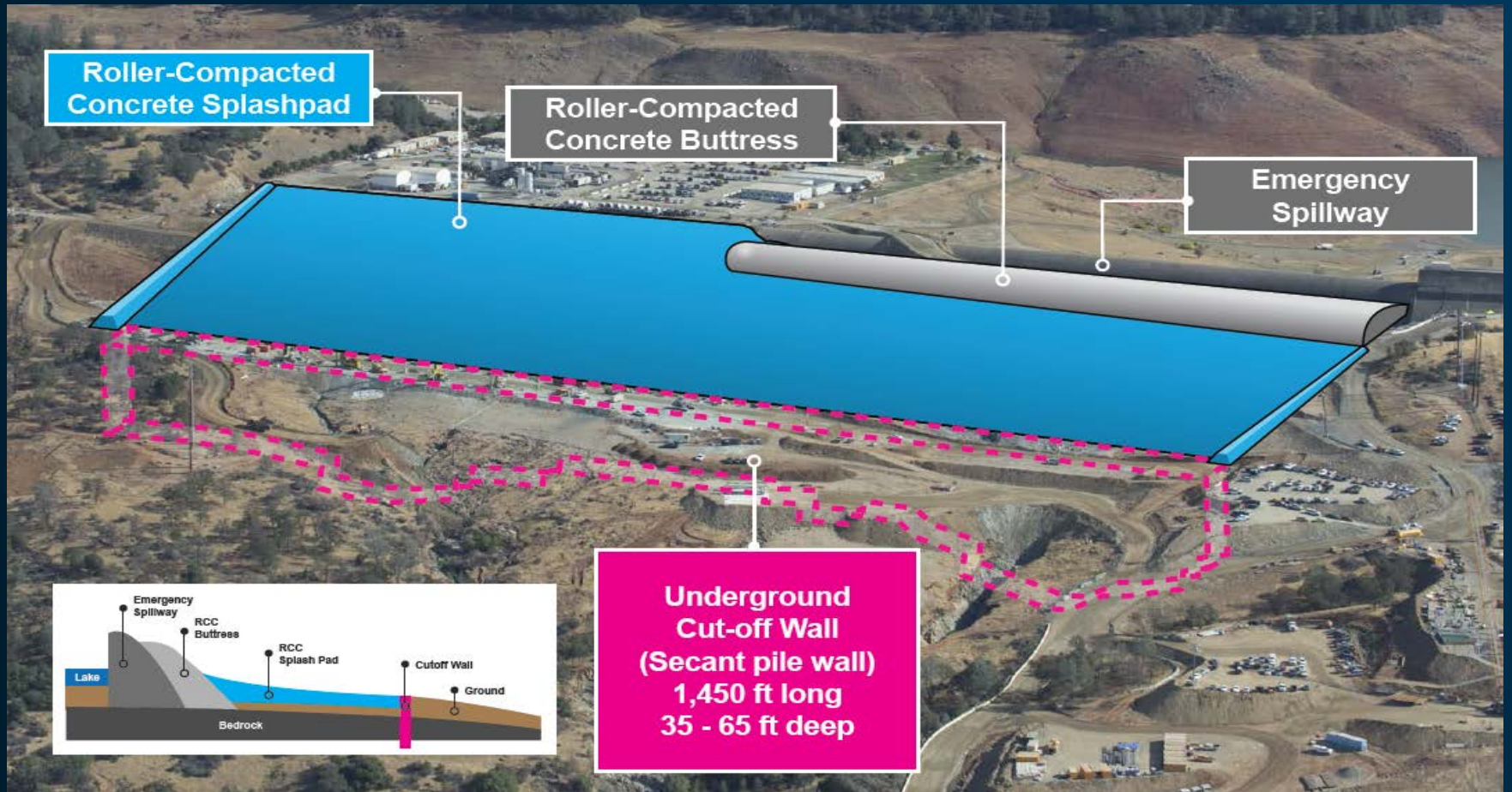
Main Spillway

Phase 2 Construction – Kiewit contract ends January 2019



Emergency Spillway

Buttress and Splashpad for additional integrity

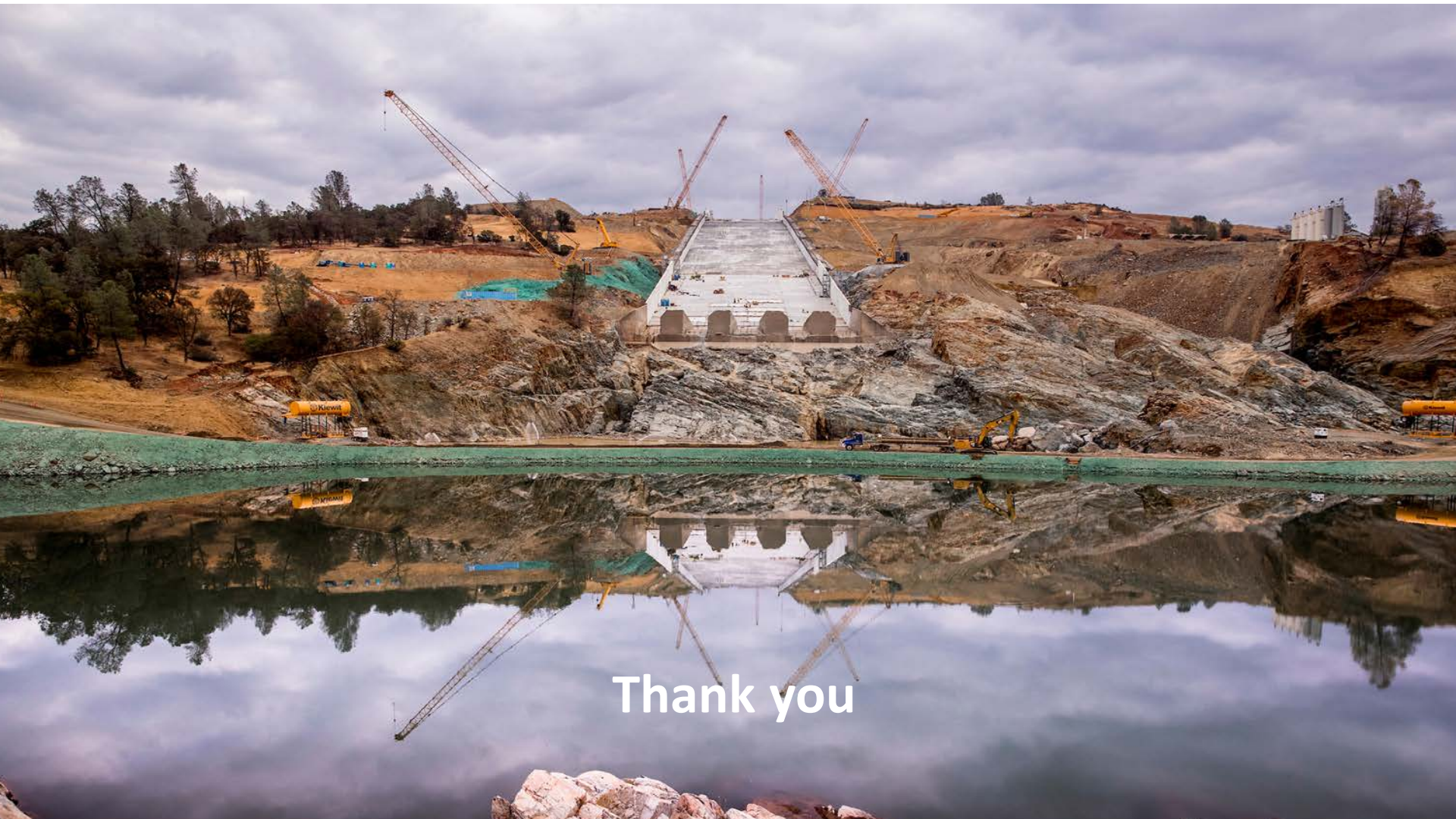


Emergency Spillway

Secant pile wall

How has this incident changed the critical infrastructure discussion?

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


Thank you