“THE REALITY ON THE GROUND”

OROVILLE CASE STUDY

26 AUGUST 2020

Presented by: David Serafini, P.E., G.E.
SPD-DSPC

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BACKGROUND

Oroville Dam:

- Located 65 miles north of Sacramento on the Feather River
- California's second largest reservoir (3.5 million acre-feet)
- Tallest earth-fill dam in the United States (770-feet)
- A multipurpose reservoir providing water supply, hydropower and flood control.
  - Contributes to the irrigation of 755,000 acres in the arid San Joaquin Valley
  - Generates 762 megawatts (MW).
  - Provides 750,000 acre feet or storage for flood control
  - Provides municipal supplies to some 25 million people
  - Max release at spillway design is 296,000 cfs
- Construction was completed in 1968.

Oroville Spillways:

- Flood Control Outlet crest – El. 813.6
- Conservation pool – El 850.0
- Emergency Spillway crest - El 901.0

USACE Role:

- While USACE did not construct, design, nor build Oroville Dam or it's spillways, there is a federal interest in the project, as this is a Section 7 Dam (i.e. federal dollars were invested to provide flood control space in the reservoir).

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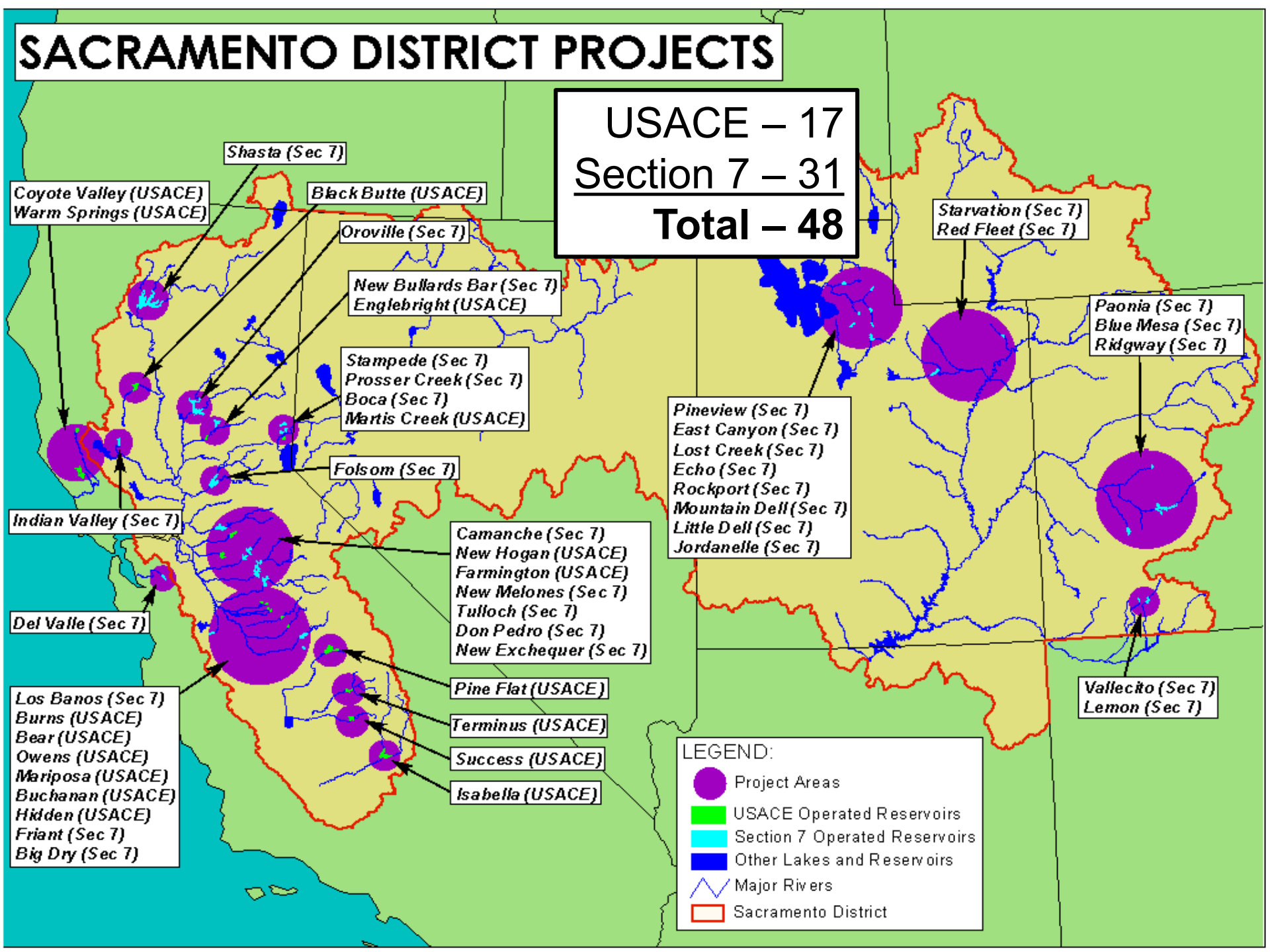
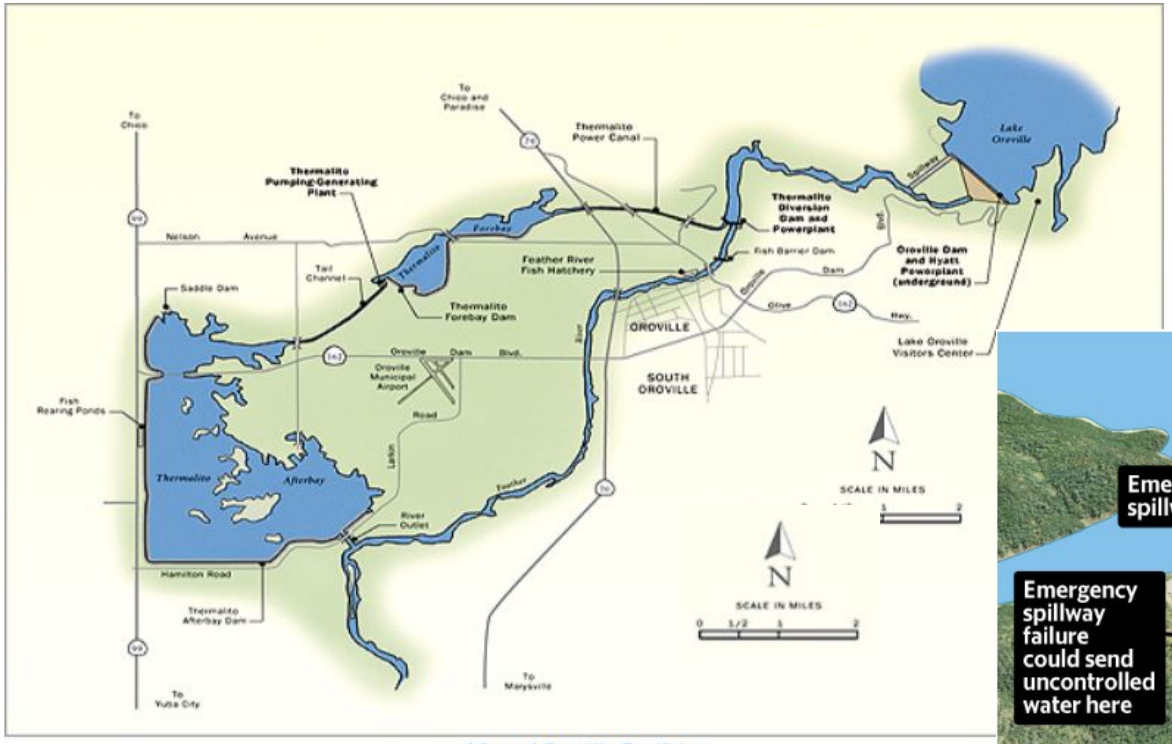
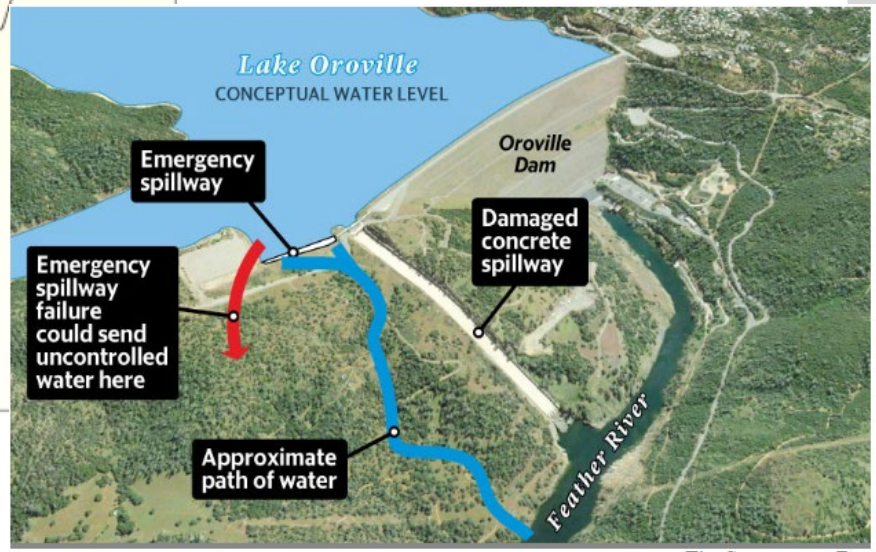

SACRAMENTO DISTRICT PROJECTS
USACE – 17
Section 7 – 31
Total – 48
Shasta (Sec 7)
Coyote Valley (USACE)
Warm Springs (USACE)
Black Butte (USACE)
Oroville (Sec 7)
New Bullards Bar (Sec 7)
Englebright (USACE)
Stampede (Sec 7)
Prosser Creek (Sec 7)
Boca (Sec 7)
Martis Creek (USACE)
Folsom (Sec 7)
Indian Valley (Sec 7)
Camanche (Sec 7)
New Hogan (USACE)
Farmington (USACE)
New Melones (Sec 7)
Tulloch (Sec 7)
Don Pedro (Sec 7)
New Exchequer (Sec 7)
Del Valle (Sec 7)
Pine Flat (USACE)
Terminus (USACE)
Success (USACE)
Isabella (USACE)
Los Banos (Sec 7)
Burns (USACE)
Bear (USACE)
Owens (USACE)
Mariposa (USACE)
Buchanan (USACE)
Hidden (USACE)
Friant (Sec 7)
Big Dry (Sec 7)
Pineview (Sec 7)
East Canyon (Sec 7)
Lost Creek (Sec 7)
Echo (Sec 7)
Rockport (Sec 7)
Mountain Dell (Sec 7)
Little Dell (Sec 7)
Jordanelle (Sec 7)
Starvation (Sec 7)
Red Fleet (Sec 7)
Paonia (Sec 7)
Blue Mesa (Sec 7)
Ridgway (Sec 7)
Vallecito (Sec 7)
Lemon (Sec 7)
LEGEND:
Project Areas
USACE Operated Reservoirs
Section 7 Operated Reservoirs
Other Lakes and Reservoirs
Major Rivers
Sacramento District

PROJECT FEATURES



Map of Oroville Facilities



The Sacramento Bee

Features: Oroville Dam and Spillway
Hyatt Powerhouse
Thermolito Diversion Dam and Powerplant
Thermolito Power Canal
Thermolito Forebay
Thermolito Pumping Generating plant
Thermolito Afterbay

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FLOOD CONTROL OUTLET (FCO)

03/24/16

The FCO has been used historically during the flood season. It is designed for routine flood releases of 150,000 cfs, and can release as much as 300,000 cfs.

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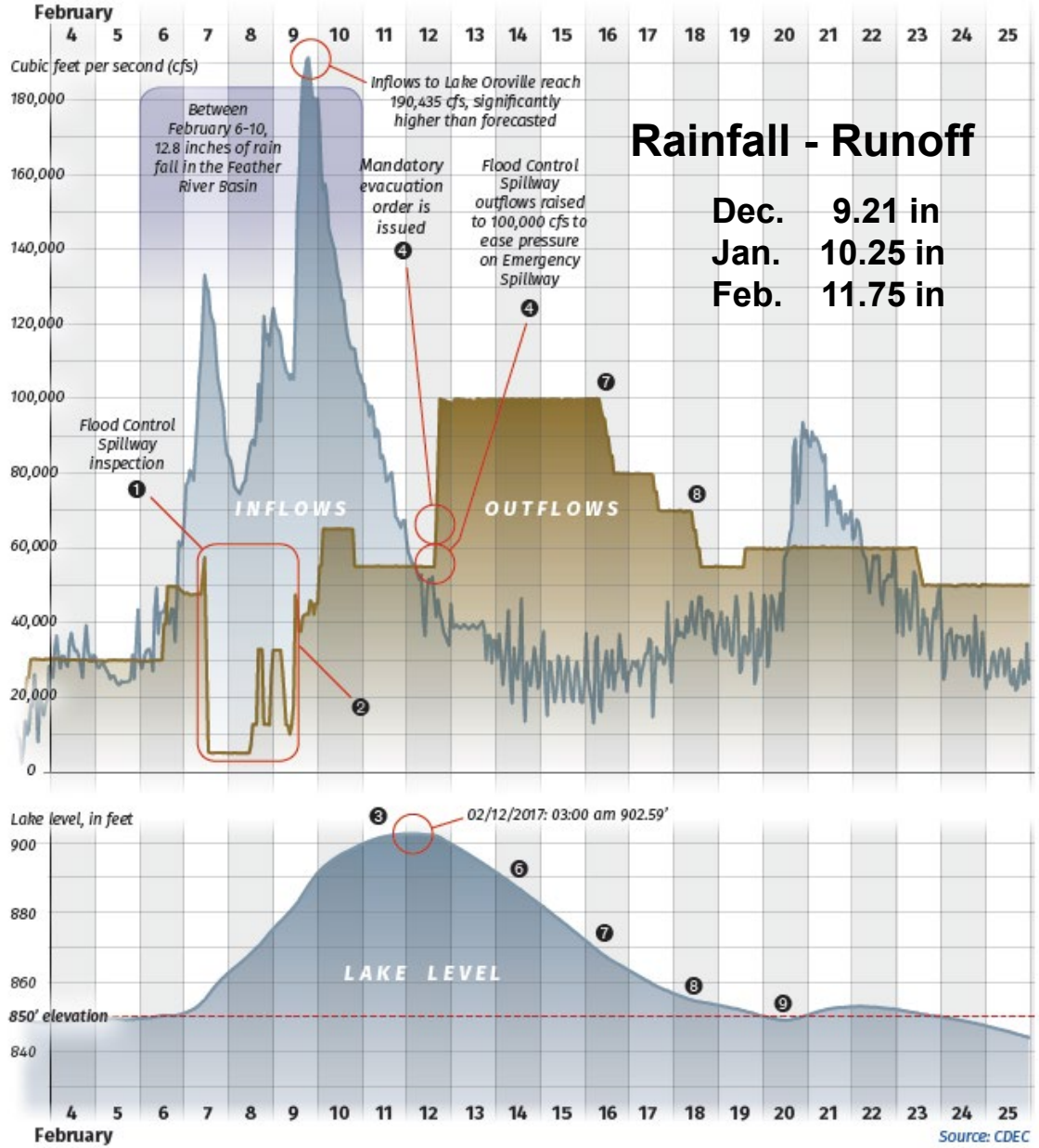
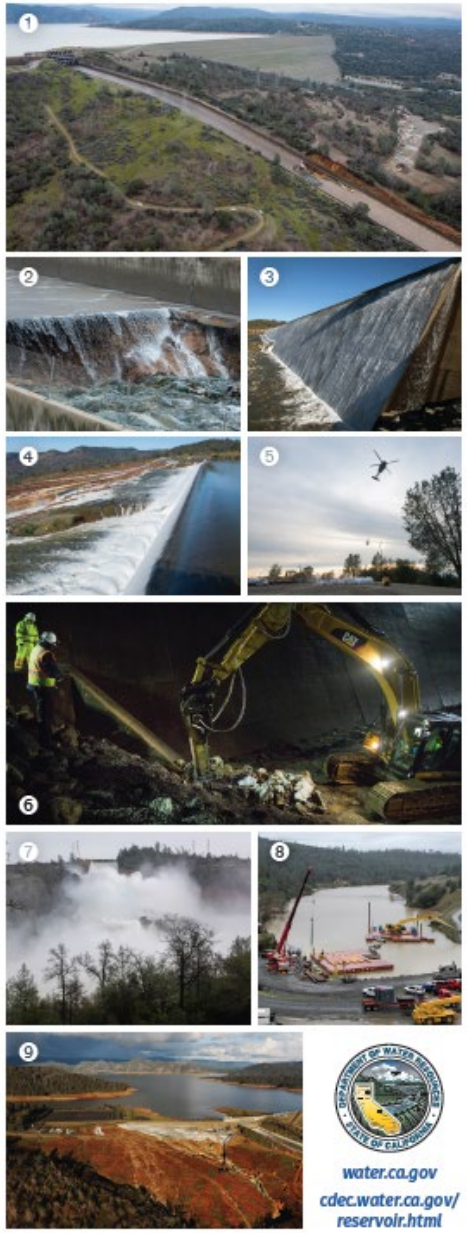
t: Timeline of Major Events February 4-25 FEBRUARY 2017

Oroville Spillway Public Info Line: (530) 538-7826



Rainfall - Runoff

Dec.	9.21 in
Jan.	10.25 in
Feb.	11.75 in



water.ca.gov
cdec.water.ca.gov/reservoir.html

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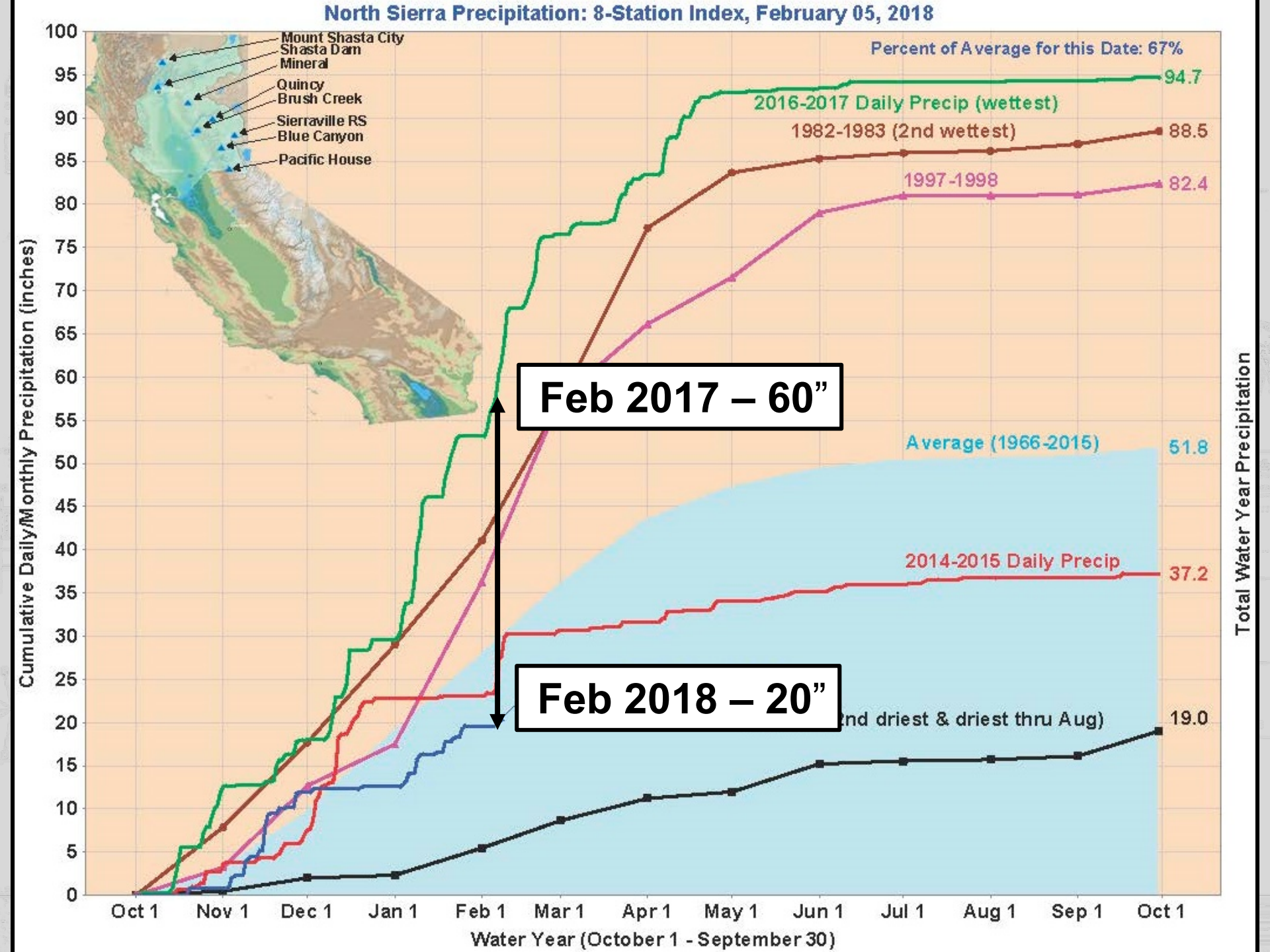
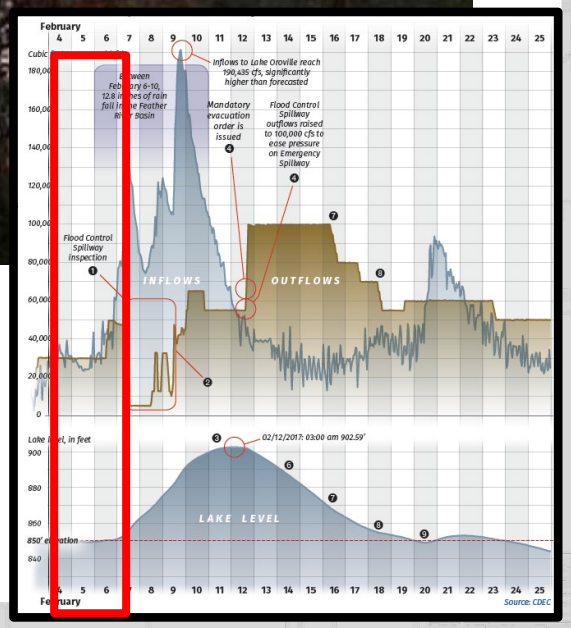
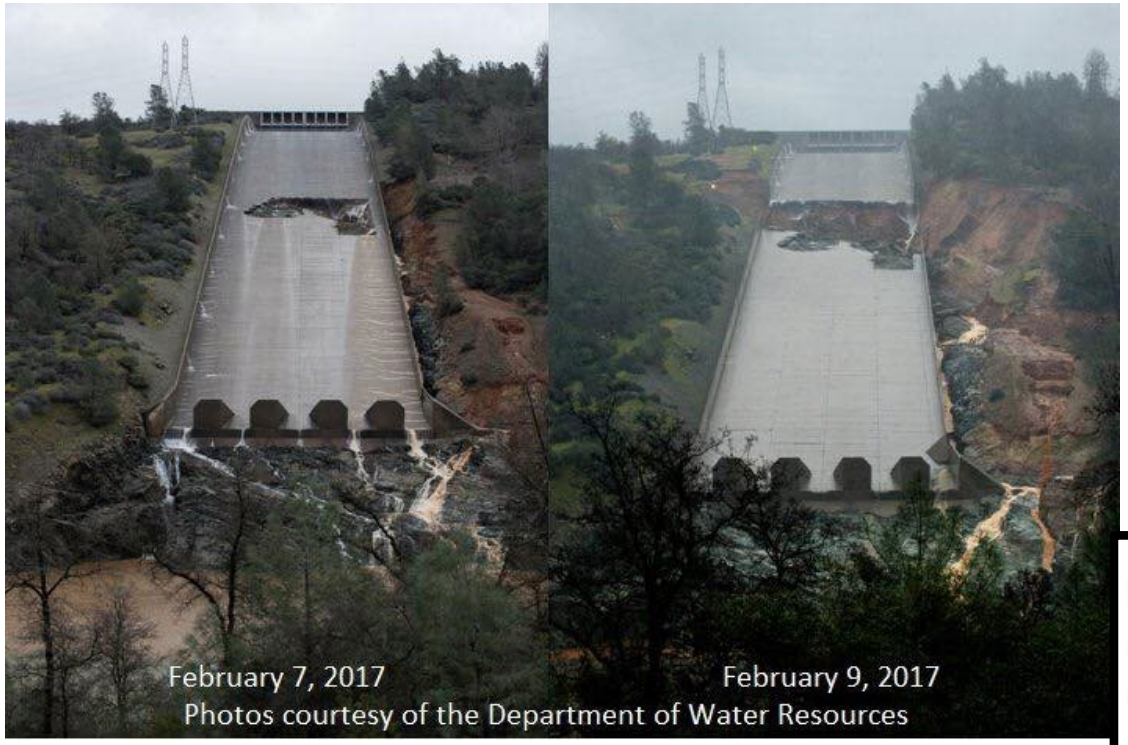

North Sierra Precipitation: 8-Station Index, February 05, 2018
Mount Shasta City
Shasta Dam
Mineral
Quincy
Brush Creek
Sierraville RS
Blue Canyon
Pacific House
Percent of Average for this Date: 67%
2016-2017 Daily Precip (wettest)
94.7
1982-1983 (2nd wettest)
88.5
1997-1998
82.4
Feb 2017 – 60”
Average (1966-2015)
51.8
2014-2015 Daily Precip
37.2
Feb 2018 – 20”
nd driest & driest thru Aug)
19.0
Cumulative Daily/Monthly Precipitation (inches)
Total Water Year Precipitation
Oct 1
Nov 1
Dec 1
Jan 1
Feb 1
Mar 1
Apr 1
May 1
Jun 1
Jul 1
Aug 1
Sep 1
Oct 1
Water Year (October 1 - September 30)

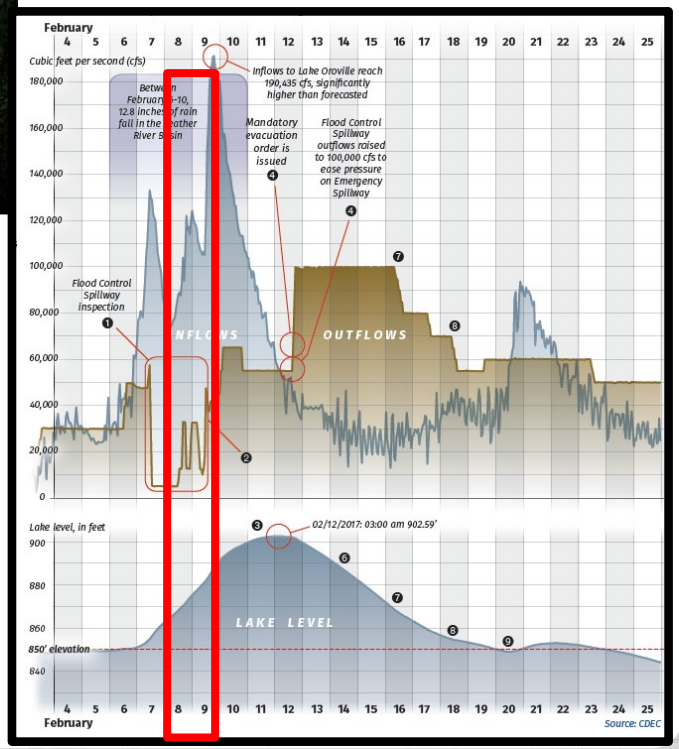
3-7 FEBRUARY 2017



3-7 Feb Release through FCO increased from 20,000 to 54,000 cfs
7 Feb Release increased to 54,500 cfs
DWR discovers plume of dirty water in spillway flow
Release cut back to 5200 cfs to inspect
Engineers discover large crater
Water surface reaches El 860 ft

8-9 FEBRUARY 2017





8 Feb

- DWR requested USACE technical assistance
- EOC activated
- FCO erosion worsened
- FCO test flows up to 30,000 cfs

9 Feb

- Larger than expected inflows peak at 190,000 cfs
- SPK Personnel deploy to DWR office to lend tech assistance as authorized under PL84-99

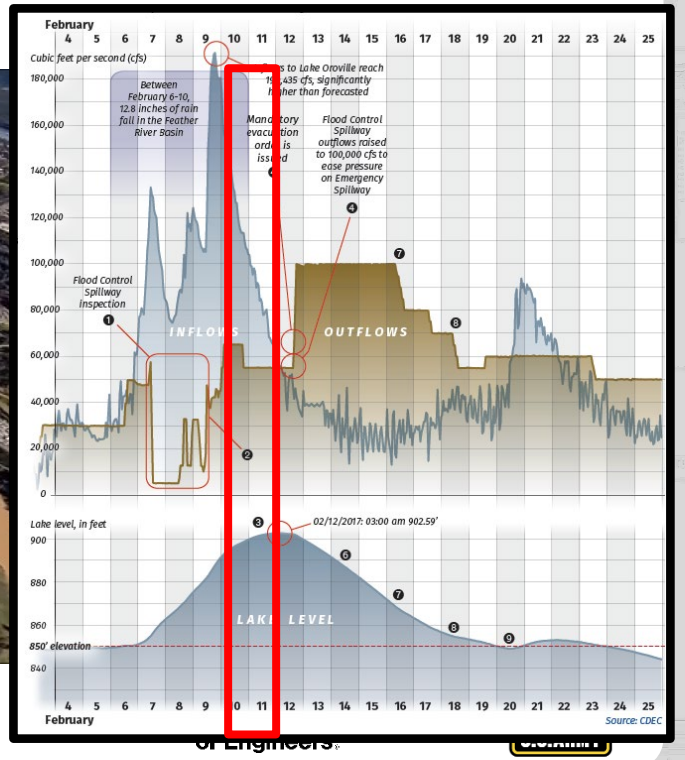
10-11 FEBRUARY 2017

10 Feb

- Spillway flow increased to 48,000 cfs
- SPK is standing by to provide the State with additional engineering and geotechnical experts as well as additional flood fight materials as needed.

11 Feb

- Emergency Spillway begins to flow at 8:00 pm for first time
- Spill across the 1,700-foot-wide crest and was expected to peak at 6,000 to 12,000 cfs



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12-16 FEBRUARY 2017

12-16 Feb - FCO flow kept at 100,000 cfs. Pool drops from El. 901 to El. 862

13 Feb

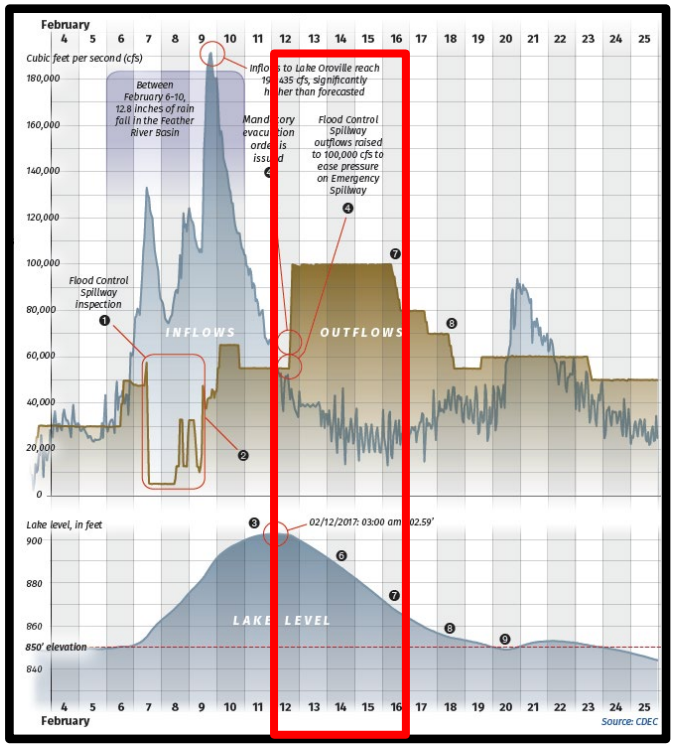
– USACE (SPK) personnel deploy to Oroville to provide technical assistance for emergency response.

15 Feb

– USACE/RMC began coordination with DWR to determine mission needs and USACE support

12 Feb

- Butte County Sheriff ordered mandatory evacuation
- FCO flow increased to 100,000 cu ft/s
- Max pool elevation of 902.5
- Flow over emergency spillway ended at 2030 hrs



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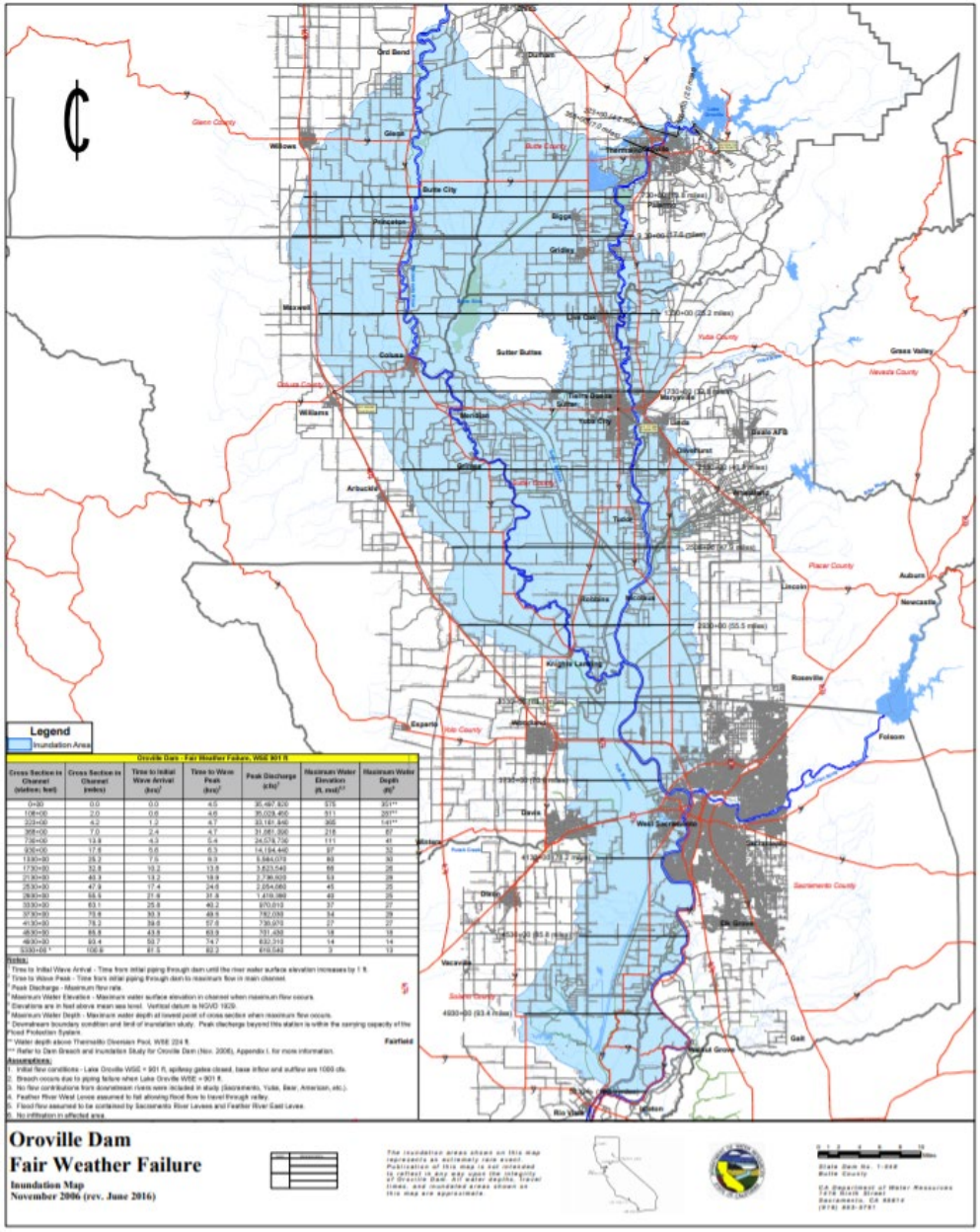
INUNDATION AREA (2006) SUNNY DAY



Understanding of Inundation Zone(s)

- Full Dam Breach
- Component Failure or Breach
- Sensitivity to Warning/Evacuation Time

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EMERGENCY SPILLWAY DAMAGE

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EMERGENCY SPILLWAY DAMAGE

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EMERGENCY SPILLWAY DAMAGE

FCO DAMAGE

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FCO

28 Feb 2017

Between 27 Feb and 17 Mar – removed 1.25 million cy of debris from the river.

1- 16 March 2017

Debris Removal

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17 Mar 2017

Operations after emergency repairs to draw reservoir down for construction

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LAKE OROVILLE SPILLWAYS CONSTRUCTION

Gated Flood Control Spillway Construction Comparisons

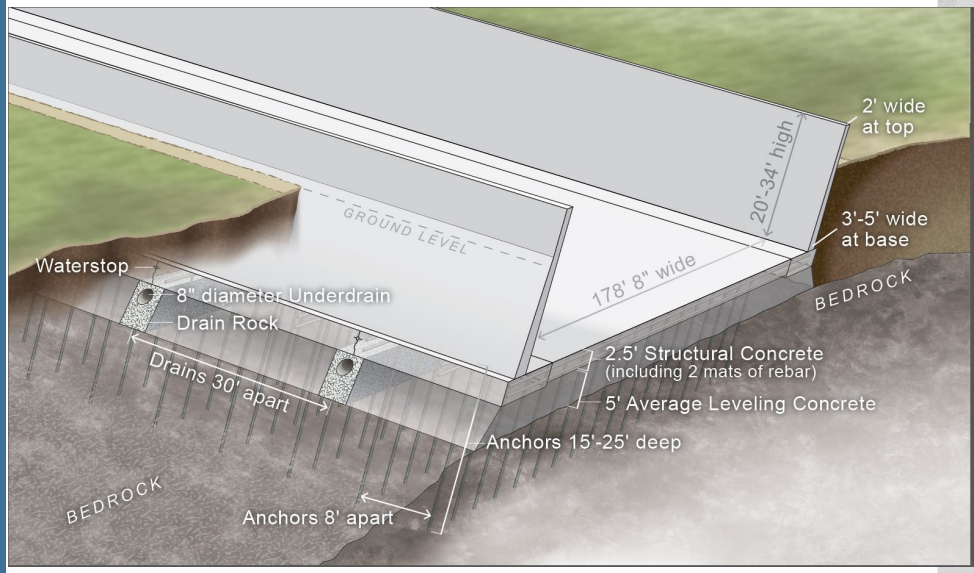
	1968	2018
Length of main spillway	3,055 feet	3,055 feet
Width of main spillway	178.75 feet As wide as a 12-lane freeway with center divider	178.75 feet As wide as a 12-lane freeway with center divider
Flow capacity	270,000 cubic feet per second	270,000 cubic feet per second (100,000 cfs from Nov 2017 through January 2019)
Spillway Chute Concrete thickness	DESIGN: 1 feet, 3 inches minimum ACTUAL: 2 feet, 8 inches average	DESIGN: 4 foot, 6 inches minimum ACTUAL: 7 feet, 6 inches average
Spillway wall height	20 feet - 27 feet 1 foot thick at the top 2 feet, 4 inches thick at the base	20 feet - 34 feet 2 feet thick at the top 5 feet thick at the base
Piezometers	0	58
Reinforcing steel	LAYERS: 1 DIAMETER: 5/8 inch	LAYERS: 2 (top is epoxy-coated) DIAMETER: 1 inch
Underdrains	TYPE: Clay DIAMTER: 6 inch	TYPE: PVC DIAMETER: 8 inch
Slab Anchors	QUANTITY: Appx. 5,700 DEPTH: 5 feet deep	QUANTITY: Appx. 7,000 (epoxy-coated) DEPTH: 15 to 25 feet deep

California Department of Water Resources | www.water.ca.gov/oroville-spillway | November 2017

The need to get a contractor(s) on site to start construction in the narrow window

Phased Approach using contract modifications

Took over an entire office floor at DWR



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Oroville Spillway Repair Progress

Days to go until November 1, 2017 milestone

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CONSTRUCTION SITE IN OCTOBER 2017

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CONSTRUCTION SITE IN 2020

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https://www.youtube.com/watch?v=xhKiq4DSLfY&list=PLeod6x87Tu6eVFnSyEtQeOVbxvSWywPlx