Dams, Dam Lies, and Statistics

Our Panel:

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• John Moynier, CFM, CEP (Moderator)
Dams, Dam Lies, and Statistics

Some Topics We’ll Cover:

• How Did We Get Here?
• What’s the Word?
• What’s a Dam?
• What’s Not a Dam?
• What’s a Downstream Hazard?
• What’s an Inundation Map?
• What’s an EAP?
• What’s Up? Hot Off the Press!
• Q and A with the Experts
How Did We Get Here?
California’s Oroville Dam threatens floods, forcing nearly 200,000 people to evacuate under emergency order
What’s the Word?

• **SB 92** was passed primarily in response to the Oroville crisis

• Became effective June 27, 2017

• Added Sections 6160 and 6161 to the Water Code

• Requires owners of State-regulated dams to prepare emergency action plans (EAPs) containing inundation map(s)

• **Note:** State jurisdiction (DWR/DSOD) includes roughly 1,250 dams

**Note:** There have been some recent changes
WAT § 6160
(a) An owner of a dam that is regulated by the State is responsible for emergency preparedness with regard to the potential for loss of life and property resulting from the failure of the dam

(b) DWR must classify the public safety risk of all jurisdictional dams based on downstream hazard potential
WAT § 6161 (a)

(1) An owner of a State jurisdictional dam, [except those classified as a low hazard dam], must submit an inundation map that shows the area that would be subject to flooding under various failure scenarios unique to the dam and its critical appurtenant structures.

(2) **Before approval** of an inundation map, DWR must review the map and may require the owner to make changes that the department deems necessary.

(3) **Upon approval** of the inundation map or maps by DWR, the owner of the dam must **develop and submit** to DWR and OES an emergency action plan (EAP) based upon the approved inundation map.
What’s the Word?

WAT § 6161 (d)

(1) An owner of a dam shall complete and submit an EAP as follows:

A. Extremely High Hazard:
   Due January 1, 2018

B. High Hazard:
   Due January 1, 2019

C. Significant Hazard:
   Due January 1, 2021

(2) If there was an existing EAP as of 3/1/17 with a “sufficient” inundation map, the dam owner is not subject to these deadlines.

Some dam owners have taken action to remove their facilities from DSOD jurisdiction.
Q & A: Ask the Experts

• The State legislature worked pretty fast to craft the language of SB 92 in response to the Oroville crisis. Now that we have had some time to reflect, are there any issues that you think are still in need of clarification?

• Are there any questions for our panel about how we got here and the framework that has been given us regarding helping our clients comply with the legislation and regulations?

• Is there anyone in the audience who was directly involved with the passage of SB 92 or the Oroville (or other dam-related crises) and can shared their experiences?
What’s a Dam?

**WAT § 6002**: A “Dam” is any artificial barrier which does or may impound or divert water, and which either:

(a) Is 25 feet or more in height from the natural bed of the stream at the downstream toe of the barrier (or from the lowest elevation of the outside limit of the barrier if it is not across a stream channel or watercourse), to the maximum possible water storage elevation; or

(b) Has (or will have) an impounding capacity of 50 acre-feet or more.
What’s a Dam?

This is a dam, right?
What’s a Dam?

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This is a dam, right?
What’s Not a Dam?

**WAT § 6003.** Any such barrier which is less than 6 feet in height, regardless of storage capacity, or has a storage capacity of less than 15 acre-feet, regardless of height, shall not be considered a dam.

*Is this a dam?*
What’s Not a Dam?

Is this a dam?
What’s Not a Dam?

Is this a dam?
Q & A: Ask the Experts

• There are obviously a broad range of facilities that meet the jurisdictional definition of a dam and require compliance with SB 92 and the Water Code. What has been the most interesting example in your experience?

• Are there any questions for our panel about how the legislation is applied to the jurisdiction dams and their experience working with the existing definition of a dam?

• Is there anyone in the audience who has additional thoughts on what is or what should be considered a dam (or not)?
What’s a Downstream Hazard?

- Downstream hazard is based solely on potential downstream impacts to life and property should the dam fail when operating with a full reservoir.
- This hazard is not related to the condition of the dam or its appurtenant structures.
- The definitions for downstream hazard are borrowed from FEMA P-946.

That’s clear, right?
What’s a Downstream Hazard?

- FEMA categorizes the downstream hazard potential into three categories in increasing severity: Low, Significant, and High.

- DSOD adds a fourth category of “Extremely High” to identify dams that may impact highly populated areas or critical infrastructure, or have short evacuation warning times.
What’s a Downstream Hazard?

Extremely High Hazard

- Failure would result in considerable loss of life and would result in major impacts to critical infrastructure or property

High Hazard

- Failure would result in the probable loss of one or more lives and would likely result in impacts to infrastructure or property

Significant Hazard

- Failure would not likely result in loss of life, but would likely cause some damage to infrastructure or property
### What’s a Downstream Hazard?

- **30 MG Central Reservoir** | City of Brea | High | 92
- **Eastfoot Basin** | City of Irvine (IRWD) | High | 213
- **Big Canyon** | City of Newport Beach | X-High | 600
- **Agua Chinon** | County of Orange | High | 256
- **Harbor View** | County of Orange | High | 28
- **Lowe Peters Canyon** | County of Orange | High | 206
- **Marshburn Basin** | County of Orange | High | 424
- **Peters Canyon** | County of Orange | High | 1,090
- **Rossmore Ret. Basin** | County of Orange | High | 175
- **Sulphur Creek** | County of Orange | High | 520
- **Trabuco Retarding Basin** | County of Orange | High | 390
- **Villa Park** | County of Orange | X-High | 15,600
- **Yorba** | County of Orange | High | 1,200
- **Dove Canyon** | Dove Canyon Association | High | 415
- **El Toro Reservoir** | El Toro Water District | X-High | 877
- **Rossmore No. 1** | El Toro Water District | High | 43

**Note:** This has been recently revised.
Q & A: Ask the Experts

• It seems likely that the hazard is closely related to size and location of a dam, but not always. In your opinion, what is the most important consideration when making a determination regarding the potential inundation area?

• Are there any questions for our panel about how well the palette of tools available to us are useful in adequately communicating the potential hazard to the public downstream of these facilities?

• Is there anyone in the audience who has experience with hazard/flood risk communication efforts that they’d like to share?
What’s an Inundation Map?

• An inundation map depicts the area that would result in flooding from a dam failure scenario

• A failure scenario refers to the modeled simulation of a complete failure of a dam or critical appurtenant structure which results in the uncontrolled release of water

• The map also shows critical facilities or infrastructure

Inundation maps are a key part of the Dam EAP and must be reviewed and approved by DWR before the EAP can be submitted to OES
What’s “In” an Inundation Map?

- **Data Review**
  - Previous maps, as-builts, Topo/ LiDAR, aerial photos, DSOD records
  - Regional hydrology, local hazard mitigation plans and other documents

- **Dam Breach and Downstream Inundation Analysis**
  - Failure modes analysis (e.g., rainy day/ sunny day failure)
  - Estimates of the breach hydrograph and inundation area
  - Determinations of maximum ponding and flow depths
  - Determinations of dam breach geometry and timing
  - Hydraulic model development using developed breach parameters
  - Flood wave routing extending downstream to the point where floodwaters become less than 1 foot above the elevation existing before the dam failure, and where the water velocity is less than 8.8 fps
What’s “In” an Inundation Map?

- **Inundation Mapping**
  - The inundation map depicts existing topography, physical features, and critical infrastructure in downstream areas that could be potentially affected by the hypothetical dam failure
  - Cross-sections are placed at regular intervals and depth/time calculations are shown
  - The maps are typically prepared at an appropriate scale on 11” x 17” sheets, with a minimum map scale of 1” = 2,000’

- **Technical Memorandum (TM) Preparation**
  - Documents the assumptions, methodology, and results of the analysis
  - Discusses and provides supporting justification for the dam breach parameters, assumptions, and hydraulic modeling parameters

- **Map Submittal and Approval by DWR (get in the queue)**
Q & A: Ask the Experts

• There are a broad range of models available for use in determining the potential impact of the failure of a dam. In your opinion, are there general guidelines for when to use specific tools?

• Are there any questions for our panel about how the technical aspects of addressing the hydrologic and hydraulic modeling challenges when preparing these maps?

• Is there anyone in the audience that has additional experience they can share with the modeling and mapping process? Any tips for making these efforts more efficient, accurate, or useful?
What’s an EAP?

• An EAP contains a blueprint for emergency response following an incident involving a dam failure

• It details various failure scenarios of a dam and its related critical infrastructure

• It provides special notification procedures

• OES and DWR review the EAP
What’s “In” an EAP?

- **EAP Preparation**
  - Identifies potential emergency conditions at a dam and specify preplanned actions to be followed to minimize property damage and loss of life
  - Specifies actions the dam owner, in coordination with emergency management authorities, should take to respond to incidents or emergencies related to the dam
  - Presents procedures and information to assist the dam owner in issuing early warning and notification messages to responsible emergency management authorities
  - Includes the approved inundation map

- **EAP Submittal and Approval by OES and DWR**
Q & A: Ask the Experts

• The development of an EAP requires a broader range of technical services than just engineering expertise. What additional services do you feel are critical in the preparation of a successful (and useful) EAP?

• Are there any questions for our panel about how the EAP development process, including the best ways to ensure involvement from the critical stakeholders?

• Is there anyone in the audience that has an additional experience with the development of an EAP that they’d like to share?
What’s Up? Hot Off the Press!

SB 854 amendment:

• Effective June 27, 2018

• If the EAP or inundation map was not sufficient, the owner had to submit a timeline for compliance by August 25, 2018

Notice of Proposed Rulemaking (August 17, 2018):

• Deadline for comments was September 1, 2018

• Numerous proposed revisions to the original SB 92 language
The purpose of the proposed regulations is to interpret, clarify, and make specific the provisions of the amended sections of 6160 and 6161 of the Water Code, by making specific the requirements for the preparation of inundation maps. These regulations include the following:

- Define the allowable engineering methods for simulating the extent, timing, and intensity of flooding produced by the hypothetical failure of a dam or its critical appurtenant structures using computer modeling.
- Define uniform assumptions for modeling the condition of the reservoir and dam prior to the failure.
- Address unique situations such as dams in series, in which the failure of an upstream dam may impact a downstream dam.
- Define the required components of an inundation map.
What’s Up? Hot Off the Press!

These regulations also include the following:

• Provide a **standardized and uniform set of requirements** for the presentation of the inundation extent, timing, and intensity information produced by computer modeling.

• Describe the requirements for the submission of **supporting information** needed to prepare the inundation model and map.

• Clarify the conditions that **prompt submission** of inundation map updates.

• Define the department’s **hazard potential classifications**.

• Clarify the requirements for inundation map development and submission for **dams jointly regulated with FERC**.

• Add requirements for inundation map development and submission as part of the **application approval process** for new and enlarged dams.
September 4, 2018
California Department of Water Resources Division of Safety of Dams Updates Information on California Dams
Published: Sep 04, 2018

SACRAMENTO – The California Department of Water Resources (DWR) Division of Safety of Dams (DSOD) today released updated information on the 1,246 dams under the state’s jurisdiction, listing each dam’s downstream hazard classification, condition assessment, and reservoir restriction status.

The 2018 update reflects several changes, including adjustments to some hazard classifications based on inundation maps submitted by dam owners as required by Senate Bill 52 (Committee on Budget and Fiscal Review). The downstream hazard is based solely on potential downstream impacts to life and property should the dam fail when operating with a full reservoir. This hazard is not related to the condition of the dam or its appurtenant structures.

DSOD engineers and engineering geologists assess dam conditions based on annual physical inspections and comprehensive re-evaluation studies, as well as technical analyses submitted by dam owners. This information can change from year to year as new deficiencies are identified and others are remediated. If DSOD identifies an issue that presents a significant dam safety concern, it may place restrictions on a reservoir’s operations until deficiencies are corrected.

“Public safety is the foundation of DSOD’s independent dam safety oversight,” said Sharon Tapia, Chief of DSOD. “With California’s infrastructure aging, we take our job very seriously, inspecting each jurisdictional dam annually and working closely with dam owners to correct identified issues on an ongoing basis.”

The 2018 update also includes dams taken out of, or brought into DSOD’s jurisdiction. Over the past year, five dams became non-jurisdictional by either being completely removed or reduced to less than jurisdictional size. Two existing dams were added into DSOD’s inventory.
Q & A: Ask the Experts

• Any thoughts on the recent changes to SB 92 and the Water Code, as well as the proposed rulemaking and revisions to the regulations that were recently circulated for public comment?

• Is there anyone in the audience that has experience with the development of the proposed rulemaking or other changes to the existing legislation and Water Code with respect to Dam Inundation Mapping and EAP development that they would like to share?

• Anything else you can share from this experience?
Any Additional Questions? Answers? Thoughts?
Thank you!

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