USING FORECASTS IN RESERVOIR OPERATIONS

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Date: 25 June 2019

Pine Flat Dam - Lake (Corps – CA) June 2017
Black Butte Dam – Lake (Corps – CA) Jan 2017
Camanche Dam - Lake (EBMUD – CA) Feb 2017
Don Pedro Dam-Lake (TID – CA) Feb 2017
AGENDA

• USACE Authority

• Flood Control Operations

• Use of Forecast in Reservoir Operations

• Forecast Informed Reservoir Operations (FIRO)

• Considerations for FIRO at Other Projects

• Questions
Section 7 of the Flood Control Act of 1944 (58 Stat. 890, 33 U.S.C. 709)

- **Prescribe** rules and regulations in the interest of flood control

- The project owner is responsible for real-time implementation of the water control plan, but the Corps has authority to determine flood releases in the flood control space with input from the owner.
FLOOD CONTROL PROJECTS IN CALIFORNIA

CORPS (30, 17-SPK, 2-SPN, 11-SPL)*
• Corps Owned, Operated, Managed
• Flood Control

SECTION 7 (19, 16-SPK, 1-SPN, 2-SPL)*
• Operated by another agency
• Flood Control

*SPK – Sacramento District
SPN – San Francisco District
SPL – Los Angeles District

Camanche Dam-Lake (EBMUD – CA) Feb 2017
Black Butte Dam – Lake (Corps – CA) Jan 2017
Friant Dam – Millerton Lake (USBR – CA) Jul 2017
FLOOD CONTROL OPERATIONS

Water Control Manual (WCM)  
(Reservoir Regulation Manual)  
- Appendix A  
  Standing Operator Instructions  
- Water Control Diagram  
- Emergency Release Spillway Diagram*  

*Only if gated spillway
RESERVOIR OPERATING ZONES

Simplified picture of a Reservoir

Top of Dam
Surcharge Pool (Dam Safety)
Spillway Crest
Flood Control Pool
Water Conservation Pool
Outlet

Simplified Water Control Diagram

Emergency Spillway Release Diagram*

Flood Control (ac-ft)

Oct 01
Nov 15
Feb 15
Jun 01
Sep 31

Note: NOT TO SCALE

*Only if gated spillway
1. Top of Conservation (TOC) Calculation
   a. Basin wetness
   b. Upstream credit storage
   c. Snow

2. Downstream control location and release limit

3. Rate of change for flood control releases
   a. Increasing
   b. Decreasing

4. Any other rules/notes specific to that project

NOTE: Some projects do not have a conditional space component
ACTUAL STORAGE VS RULE CURVE
FRIANT DAM - MILLERTON LAKE WY2017

http://www.spk-wc.usace.army.mil/
USE OF FORECASTS IN RESERVOIR OPERATIONS
FORECAST INFORMED RESERVOIR OPERATIONS

STYLE

WCM contains rules for how/when forecasts are being used
  • Folsom Dam-Lake:
    • Forecast determines TOC
    • Forecast determines release

PROGRAM

Approach for using modeling, forecasting tools, and improved information to determine if the WCM can be updated to use forecasts
  • Coyote Dam-Lake Mendocino

http://cw3e-web.ucsd.edu/firo/#TOP
FIRO (STYLE) – FOLSOM DAM – LAKE

FIGURE A - VARIABLE TOP OF CONSERVATION

Minimum Flood Control Space: 400,000 acre-feet

RELEASE SCHEDULE
(Releases shall not exceed 115,000 cfs unless specified by the ESRD)

SEASONAL RELEASES
(EFFECTIVE MAR 1 THRU NOV 18)
Release peak inflow for current event.

FORECAST-BASED RELEASES
(EFFECTIVE NOV 19 THRU FEB 28/29)
1. If FCR = 400,000 acre-feet, release peak inflow
2. If FCR < 500,000 acre-feet, Table A Release.
3. If FCR ≥ 500,000 acre-feet, release the greater of peak inflow for the current event or Table A Release.

TABLE A
INFLOW FORECASTED VOLUME | RELEASE
120-HR > 300,000 ACRE-FEET | 25,000 CFS
72-HR > 300,000 ACRE-FEET | 50,000 CFS
48-HR > 300,000 ACRE-FEET | 80,000 CFS
24-HR > 300,000 ACRE-FEET AND INFLOW ≥ 115,000 CFS | 115,000 CFS
FIRO (PROGRAM)–COYOTE DAM–LAKE MENDOCINO

• Provides a pathway for research to operations (R2O)

• Allows for safe exploration of ideas and alternative strategies

• Has the potential for transferability and realizing major benefits for water resources, flood protection, and environmental goals
Post-2007 reductions (56%) in transfers from the Eel River have dramatically reduced the ability of the project to provide reliable water supply for municipal, agricultural, and ecosystems needs.
FIRO (PROGRAM) TRANSFERABILITY

• Prado Dam-Reservoir (SPL)
• New Bullards Bar Dam-Reservoir (SPK)

• Interest expressed by others
  ▪ USACE Districts
    • Portland (NWP)
    • Seattle (NWS)
    • Galveston (SWG)
    • Nashville (LRN)
  ▪ USBR (multiple locations, pilot projects)
  ▪ King County, WA (Snohomish River)

https://sageengineers.com/portfolio/new-bullards-bar-dam/
https://en.wikipedia.org/wiki/Prado_Dam
CONSIDERATIONS FOR FIRO (STYLE) AT OTHER PROJECTS

• Goals for use of forecasts
• Dam Safety
• Other projects reservoir operations
• Downstream channel capacity
• Percent encroached in flood space can channel capacity be released
• Upstream/downstream reservoirs
• Local flow between the project and the downstream control point
• Project specific considerations
CONCLUSION

• USACE Authority

• Flood Control Operations

• Use of Forecast in Reservoir Operations

• Forecast Informed Reservoir Operations (FIRO)
  o Style – Folsom Dam
  o Program – Coyote Dam

• Considerations for FIRO at Other Projects