BUREAU OF RECLAMATION

Development of a Folsom Flood Support Application

Drew Allan Loney, PhD PE
Derya Sumer, PhD PE
Randi Field
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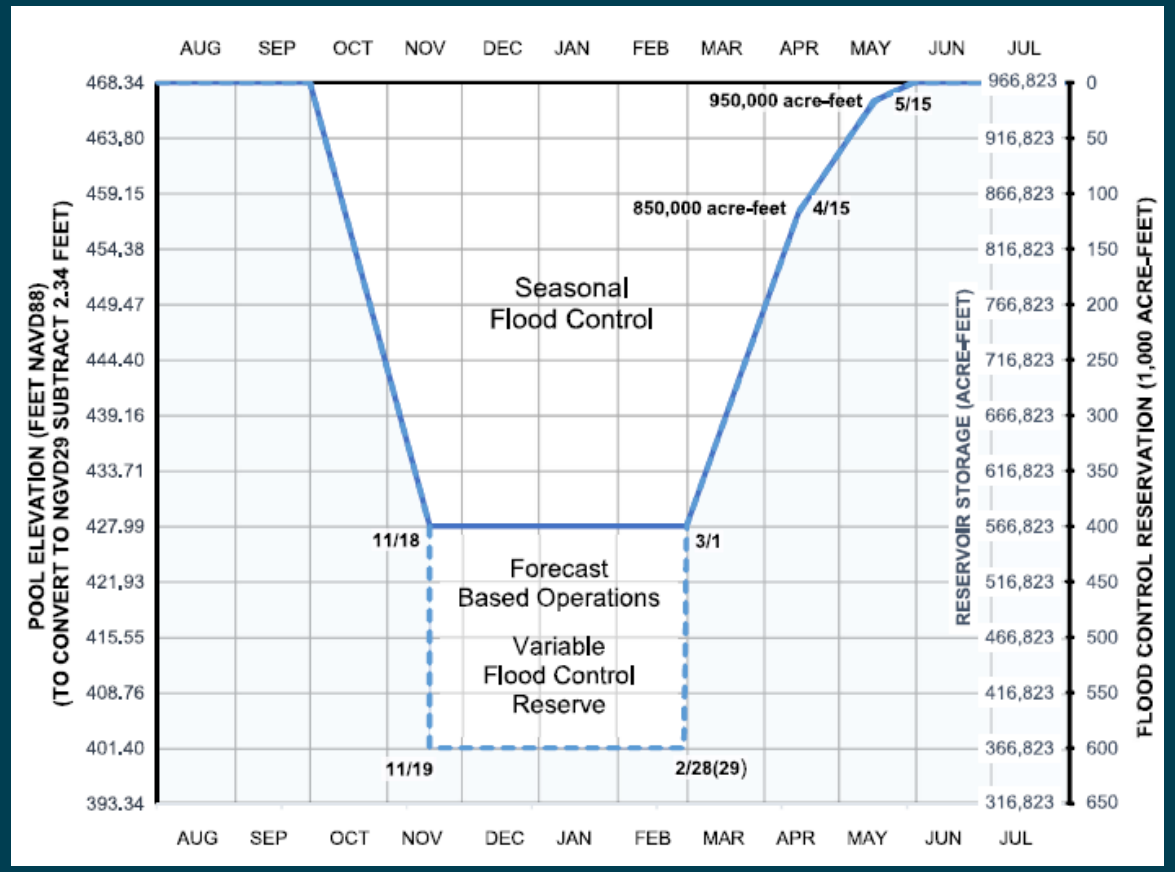
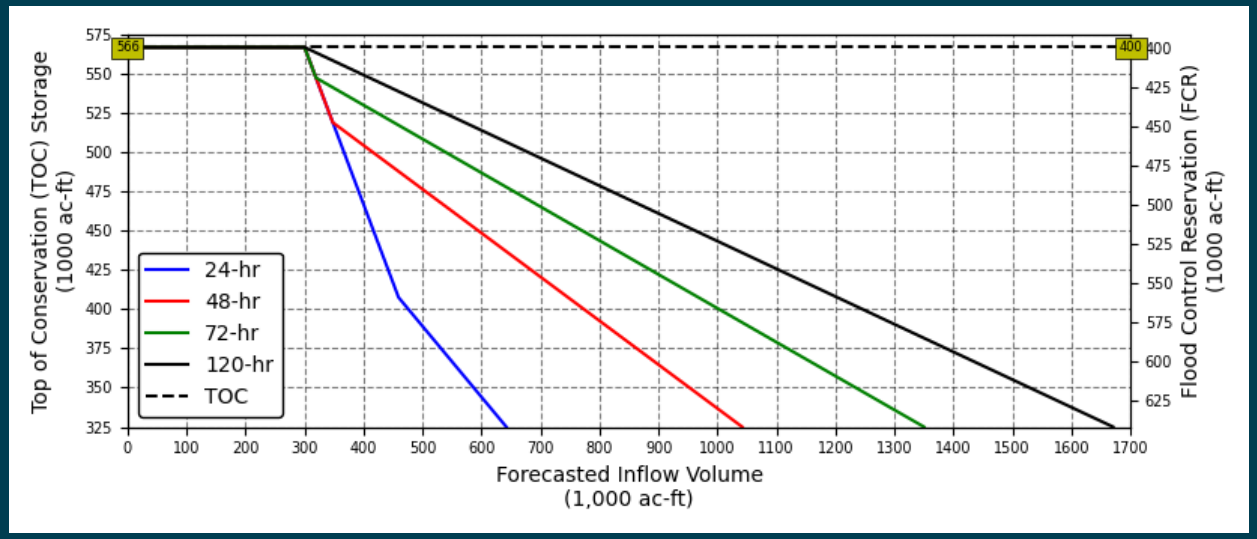
Folsom Motivation





Support application

- Automates
  - Data acquisition
  - Mass balance model
  - Rule curve tradeoffs
  - Ramping rates
- Ensemble and deterministic forecasts
- Python framework
- Continuous testing to ensure availability

Use Cases

- Forecast Mode
- Training Reanalysis Mode

Instructions

- Specify releases
- Double click

Water Control Diagram (WCD)

Data from USACE File No. NH-1-26-SEC, PLATE A-3 (Revised October 2018)

USE OF WATER CONTROL DIAGRAM

Folsom Dam and Lake shall be operated for flood control in accordance with the Water Control Diagram and the accompanying Emergency Spillway Release Diagram (ESRD). Water stored within the Flood Control Reserve (FCR) space shall be released as rapidly as possible subject to the Release Schedule, except when releases greater than 115,000 cfs are required by the ESRD. The Corps of Engineers may direct flood releases to be increased or decreased from the prescribed release when warranted by existing conditions or by high confidence forecast information provided by NWS-CNRFC.

COMPUTATION OF VARIABLE TOP OF CONSERVATION:

From mid-October thru mid-May, Folsom Lake's top of conservation storage will vary based on forecasted inflow volumes. These are developed by the NWS-CNRFC for the purpose of supporting Folsom Dam flood operations, will reflect forecasted inflows over the next 24, 48, 72, and 120 hours, and will reflect a value of non-exceedance probability (NEP) specified by the Corps. Volumes will be provided once per day during normal operations, and every six hours once the 120-hour volume exceeds 300,000 acre-feet. Figure A provides relationships relating inflow forecast volume to variable TOC storage for each duration.

RELEASE SCHEDULE

SEASONAL RELEASES

(EFFECTIVE MAR 1 THRU NOV 15) ***shall not exceed 115,000 cfs unless specified by t***

Release peak inflow for current event.

TABLE A

FORECAST-BASED RELEASES	INFLOW FORECASTED VOLUM	RELEASE
(EFFECTIVE NOV 19 THRU FEB 28/29)	120-HR > 300,000 ACRE-FEET	25,000 CFS
1. If FCR = 400,000 acre-feet, release peak inflow	72-HR > 300,000 ACRE-FEET	50,000 CFS
2. If FCR < 500,000 acre-feet, Table A Release.	48-HR > 300,000 ACRE-FEET	80,000 CFS
3. If FCR ≥ 500,000 acre-feet, release the greater of peak inflow for the current event or Table A Release.	24-HR > 300,000 ACRE-FEET AND INFLOW ≥ 115,000 CFS	115,000 CFS

RAMPING RATES

Releases between 30,000 cfs and 115,000 cfs will not be increased by more than 30,000 cfs during any 2-hour period.

Releases between 8,000 cfs and 115,000 cfs will not be decreased by more than 10,000 cfs during any 2-hour

FIGURE A INSTRUCTIONS

Locate each of the four forecast volumes on the horizontal axis. Place the four forecast volumes on the respective duration curves. For each forecast volume, identify the corresponding candidate TOC storage value on the vertical axis. Of the four candidate TOC storage values, the lowest value is the adopted variable TOC storage value. The corresponding FCR value is given by: FCR = Gross Pool (966,823 acre-feet) - variable TOC storage.

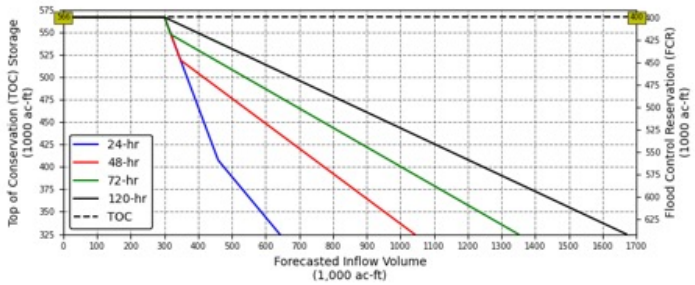
80% Percentile

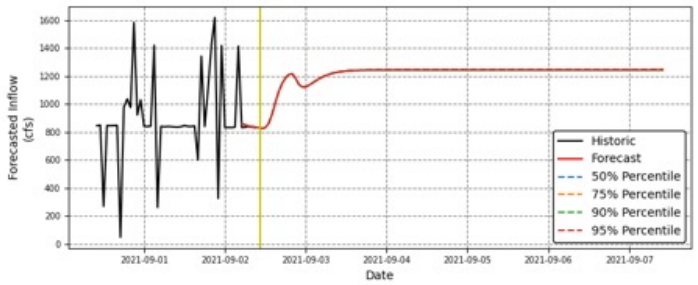
Summary				
Forecast Duration	24-hr	48-hr	72-hr	120-hr
Inflow (ac-ft)	1831.2	4080	6346.4	10879
TOC (ac-ft)	566334	566334	566334	566334
TOC (ft)(NGDV23	424.65	424.65	424.65	424.65
FCR (ac-ft)	400000	400000	400000	400000

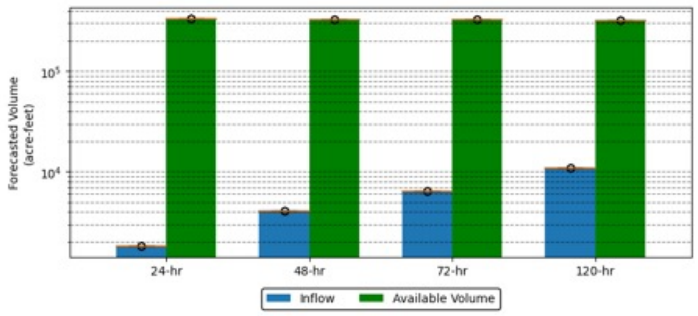
Required Release (cfs)
0

Conditions as of 03/02/2021	
Hourly Inflow (cfs)	832
Elevation (ft)(NGDV23)	374.57
Storage (ac-ft)	234003
Encroachment (ac-ft)	0

Volume to Encroachment			
24-hr	48-hr	72-hr	120-hr
331100	328851	326585	322052







Deterministic

Summary				
Forecast Duration	24-hr	48-hr	72-hr	120-hr
Inflow (ac-ft)	1831.2	4080	6345.3	10877
TOC (ac-ft)	566334	566334	566334	566334
TOC (ft)(NGDV23	424.65	424.65	424.65	424.65
FCR (ac-ft)	400000	400000	400000	400000

Required Release (cfs)
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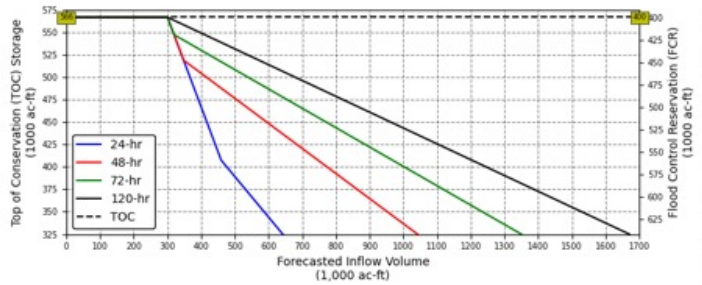
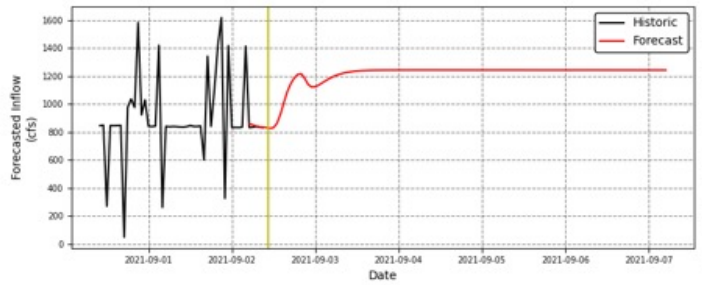
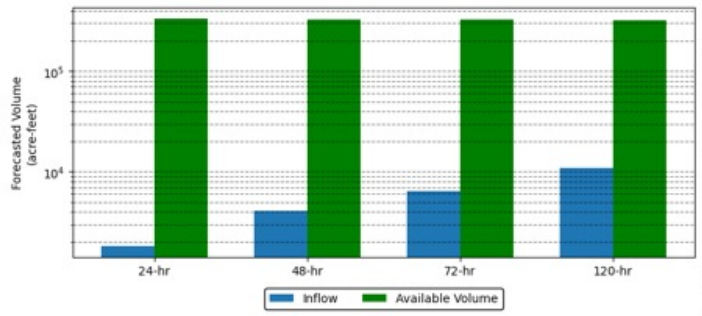






Current as of 03/30/2022. Beta product that may change..

Emergency Spillway Release Diagram

Data from USACE File No. AM-1-26-586, PLATE A-3 (Revised October 2010)

NOTE: All elevations converted from NAVD88 to NGDV29 (project datum).

OPERATING INSTRUCTIONS

required, and if so, to specify the minimum required release. The steps below should be initiated whenever water is stored above elevation 448.4 feet NGVD29.

1) Estimate current reservoir inflow in 1,000 cfs. Estimate inflow, based on change in storage and release made over previous 2 hours, or greater period if necessary to obtain reliable measurements.

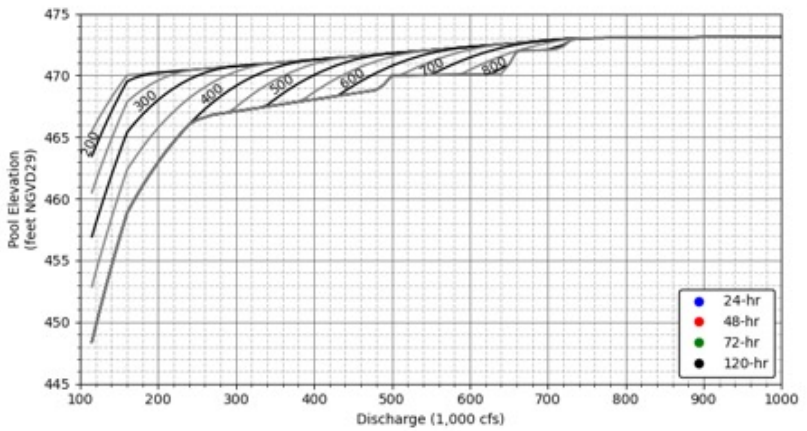
2) Enter the ESRD with current inflow (in 1,000 cfs) and current pool elevation (feet NGVD29), to compute the minimum. required release value. EXAMPLE: For a current inflow estimate of 325,000 cfs and current pool elevation of 453.7 feet NGVD29, the emergency release value is found as follows. The bounding inflow curves on the ESRD are the 300,000 cfs and 325,000 cfs. The points at which both curves intersect the horizontal line corresponding to elevation 453.7 feet are identified. On the horizontal line between these points, the location of the point corresponding to inflow 325,000 cfs is estimated. For this point, the ESRD minimum release value of 137,000 cfs is read on the X axis.

3) Once releases based on the ESRD are initiated, gate changes shall be made in accordance with the criteria found herein until the required outflow drops to 115,000 cfs. Use the Water Control Diagram to determine release of 115,000 cfs or less.

4) While communication systems are functional, Reclamation and Corps shall consult before releases greater than

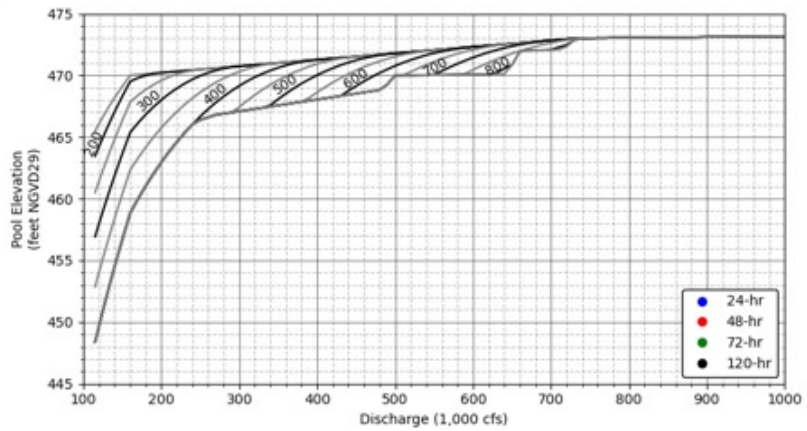
POOL RISE/FALL	POOL ELEVATIO	DS LEVE	ICATED RELEA	ACTION
n/a	< 448.4	Intact	≤ 115,000 cfs	Follow Water Control Diagram.
Rising	448.4 to 474.5	Intact	115,000 cfs to 160,000 cfs	Increase outflows to indicated release at a rate of 30,000 cfs per two hours. Notify local authorities that evacuation of areas adjacent to downstream levees should be initiated. Do not reduce outflow while pool is rising.
Rising	> 458.9	Intact	> 160,000 cfs	Increase outflow to indicated release, but not greater than 160,000 cfs until 6 hours has elapsed since flows greater than 115,000 cfs were initiated. Maximum rate of increase is 50,000 cfs per 30 minutes (100,000 cfs per hour) for releases ranging between 160,000 cfs to 360,000 cfs. Maximum rate of increase is 200,000
Falling	> 448.4	Intact	Min(125% of inflow, Max event release)	Make indicated release but do not reduce outflows below 115,000 cfs until the reservoir pool has dropped below elevation 448.4.
Falling	> 448.4	Impaired	Min(125% of inflow, Max event release)	Make indicated release but do not reduce outflows below 50,000 cfs until the reservoir pool has dropped below elevation 448.4.

80% Percentile



Required releases				
Forecast Duration	24-hr	48-hr	72-hr	120-hr
Required Release (cfs)	0	0	0	0

Deterministic



Required releases				
Forecast Duration	24-hr	48-hr	72-hr	120-hr
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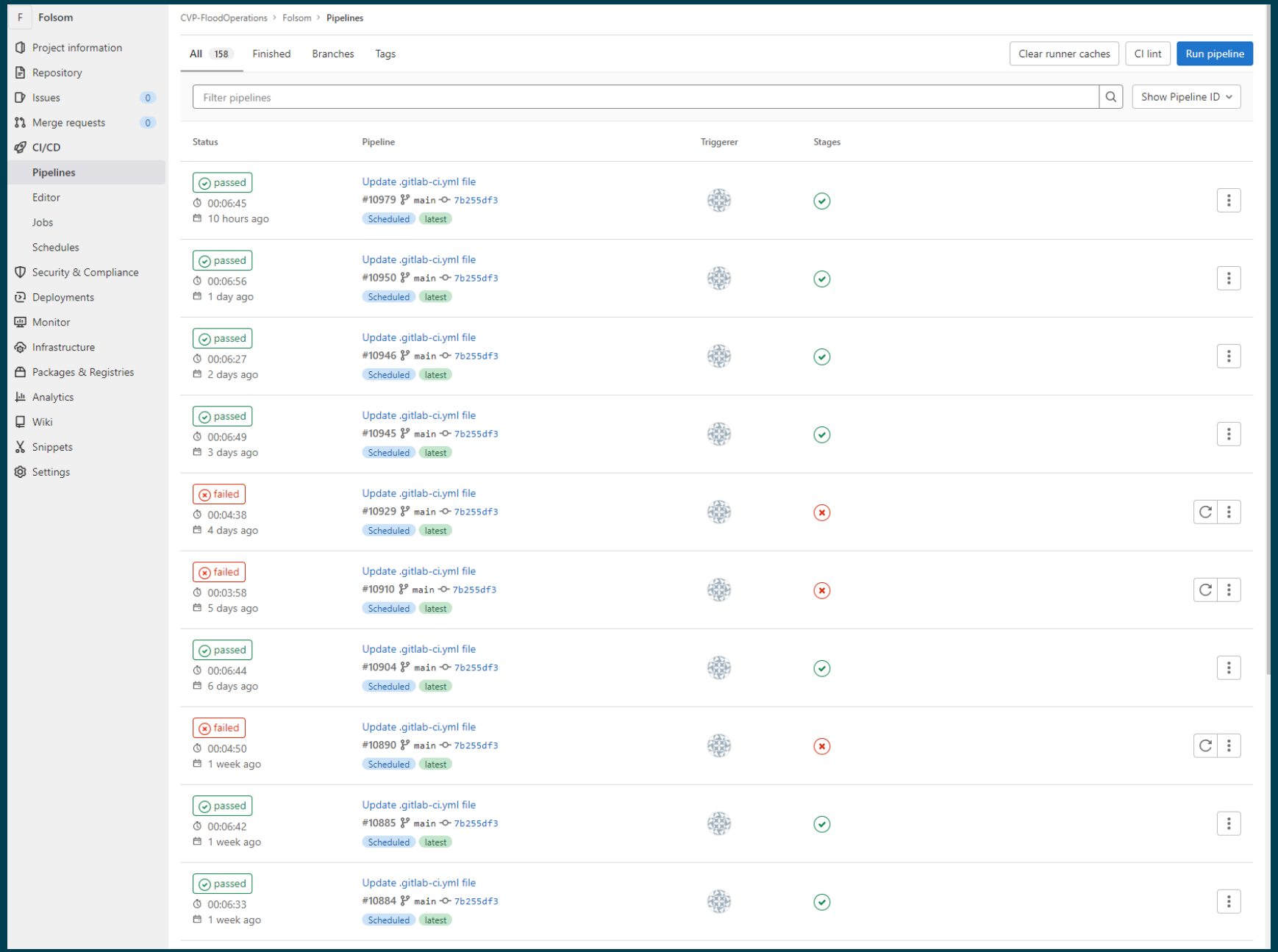

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Contact Information:

Drew Allan Loney, PhD PE

Technical Services Center

dloney@usbr.gov

Derya Sumer, PhD PE, Water Supply and Operations Analysis Branch

dsumer@usbr.gov

Randi Field, Central Valley Operations Office

rfield@usbr.gov

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