Folsom Dam
Water Control Manual Update

Public Workshop

November 18, 2014

9:00 am - Noon

Location: 1020 11th Street, Sacramento

CSAC Conference Center, 2nd Floor

Reclamation
Mid-Pacific Region
Sacramento, CA

SAFCA
Sacramento Area Flood Control Agency

Central Valley Flood Protection Board
State of California

U.S. ARMY

US Army Corps of Engineers
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Welcome and Introductions

Purpose of Manual Update

- Revise operation rules for Folsom Dam to reduce flood risk based on capabilities of Folsom Joint Federal Project (JFP)
- Reflect operational capabilities created by improved weather forecasts
- Potentially reduce volume of flood control reservation in Folsom Reservoir at any particular time by comparison to operations that have been in effect since 1995

Objectives of Manual Update

- Pass the Probable Maximum Flood while maintaining 3 feet of freeboard below top of dam to stay within dam safety constraints of U.S. Department of Interior, Bureau of Reclamation.
- Control a 1/100 annual chance flow ("100-year flood") to a maximum release of 115,000 cubic feet per second as criteria set by Sacramento Area Flood Control Agency to support Federal Emergency Management Agency levee accreditation along American River.
- Control a 1/200 annual chance flow ("200-year flood") as defined by criteria set by State of California (State) Department of Water Resources to a maximum release of 160,000 cubic feet per second, when taking into account all authorized modifications within American River Watershed.

Purpose of Today's Workshop

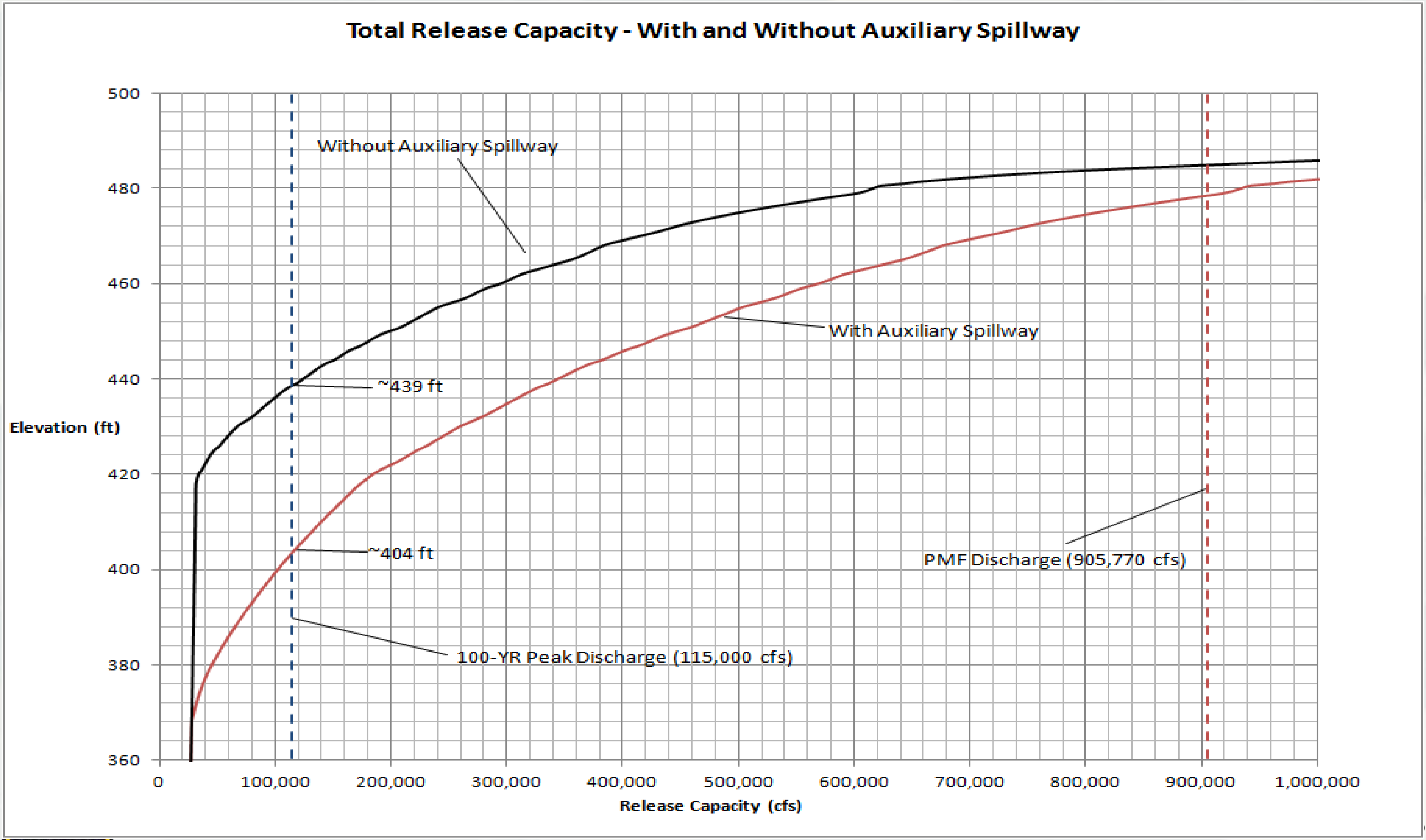
- Review and receive input on flood operation alternatives that U.S. Army Corps of Engineers (USACE) is currently evaluating; and

- Receive input on other flood operation alternatives that possibly should be evaluated

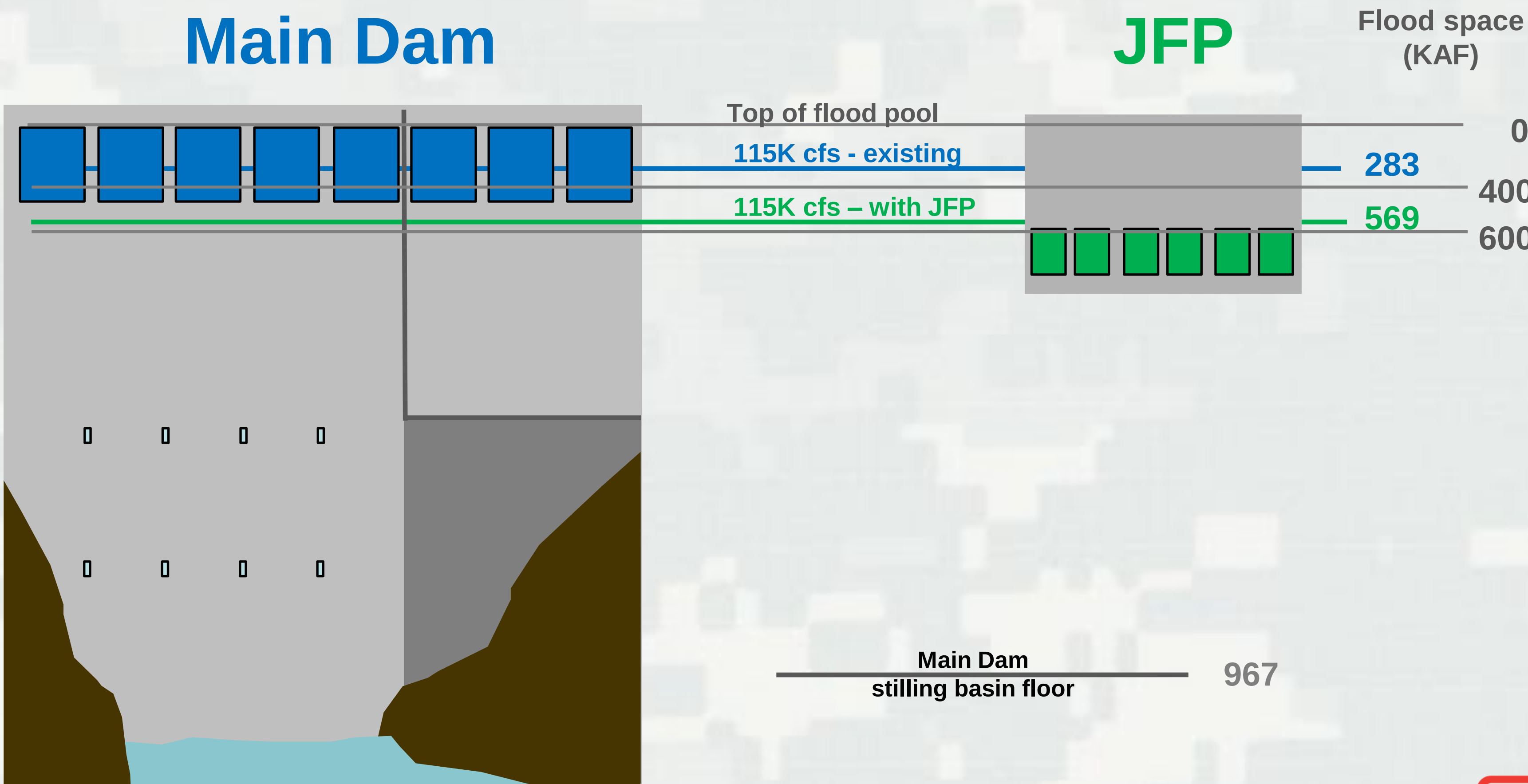
Joint Federal Project Time Lapse Video

http://youtu.be/tYXsPEwMZeQ?list=UUnFQ8FQ-6bx9yYCH8YmnB2g

JFP Increased Release Capability



Existing and JFP Outlets

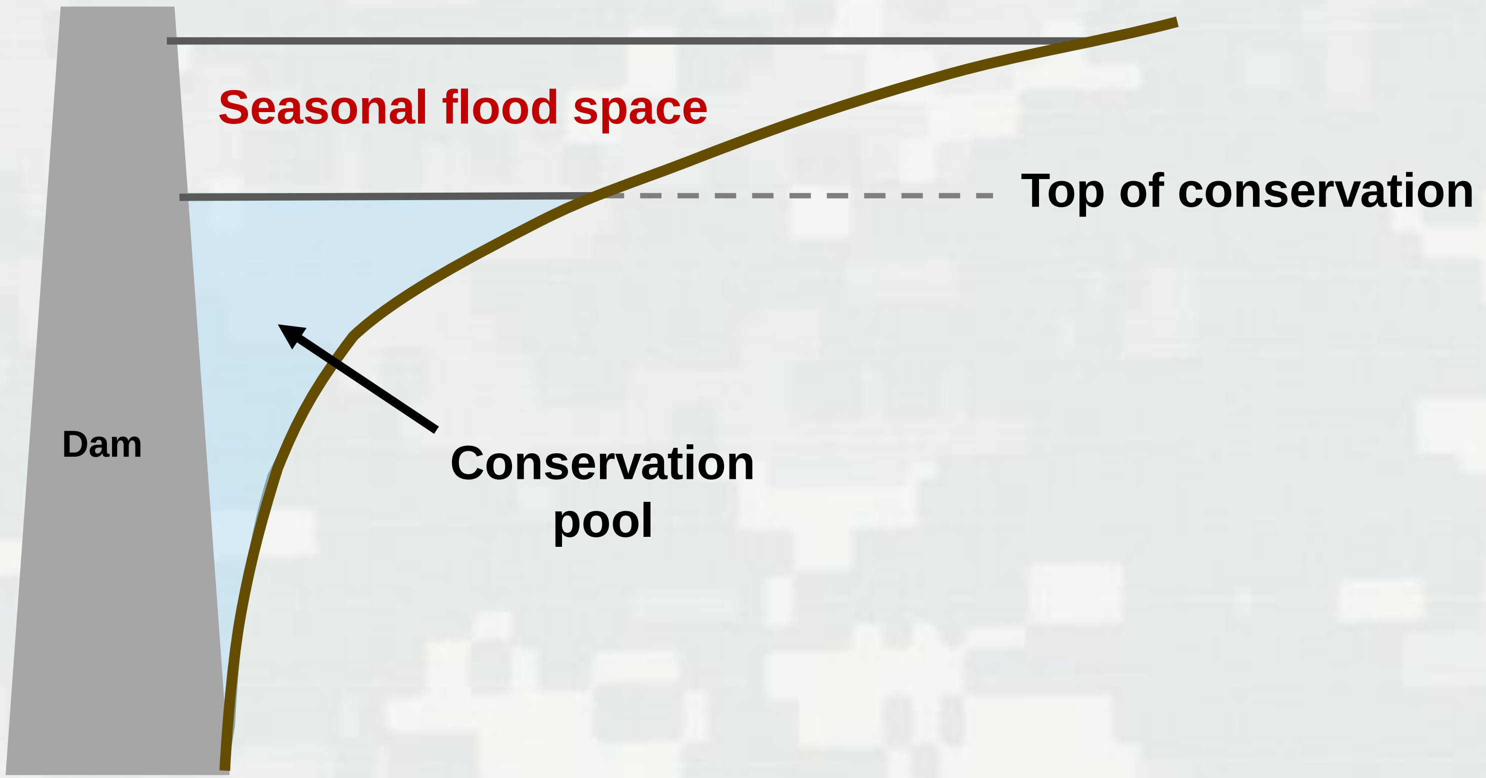


Water Control Manual

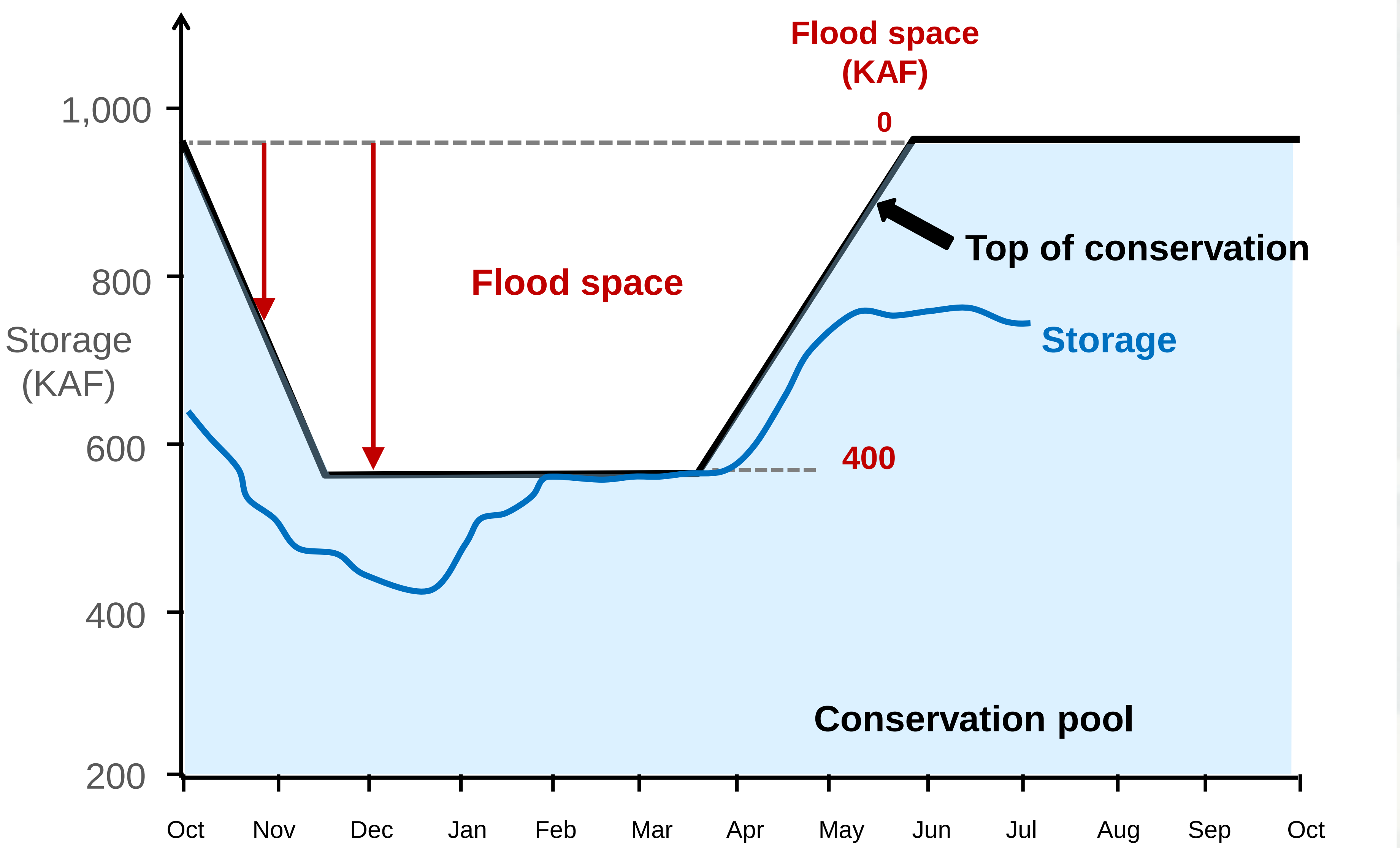
- **Water Control Plan**
  - ▸ Objectives
  - ▸ Constraints
  - ▸ Key diagrams
    - Emergency Spillway Release Diagram
    - Water Control Diagram

Primer on Water Control Diagrams

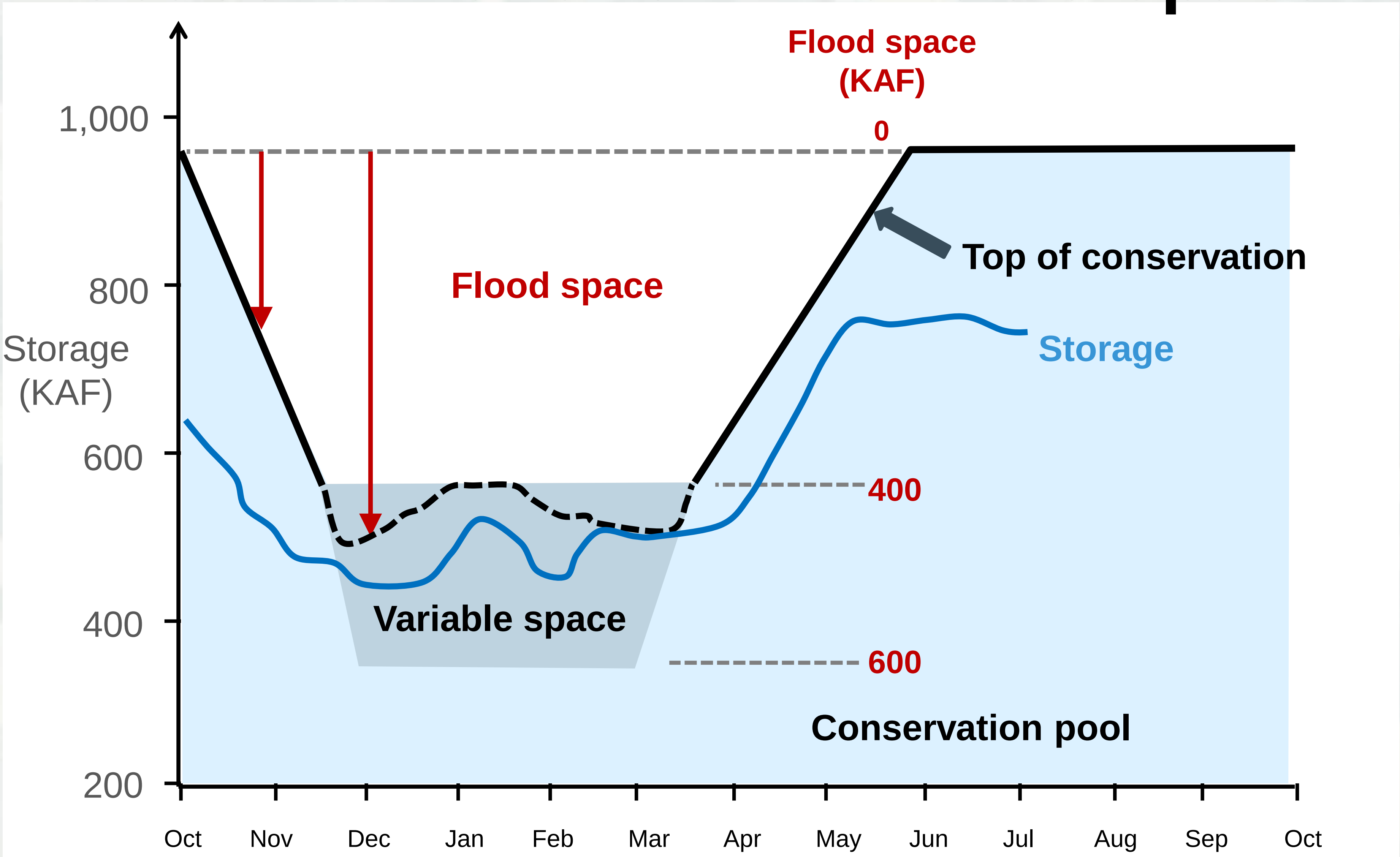
Storage Zones



Water Control Diagram Example
Seasonal Variation



Water Control Diagram Example
Seasonal Variation + Variable Space



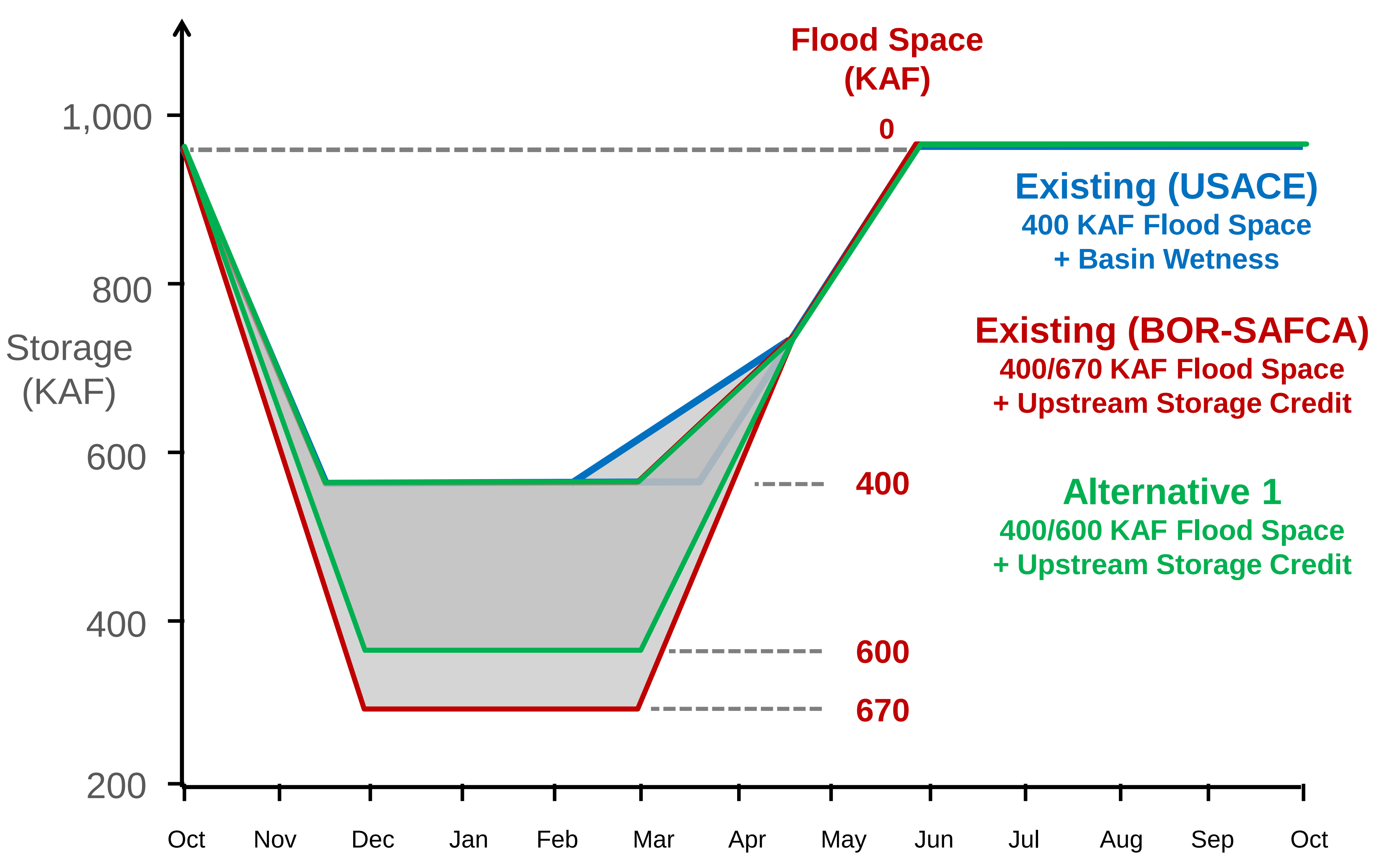
We Will Cover:

- Existing
  - ► USACE 400 + Basin Wetness
  - ► BOR-SAFCA 400/670 + Upstream Storage

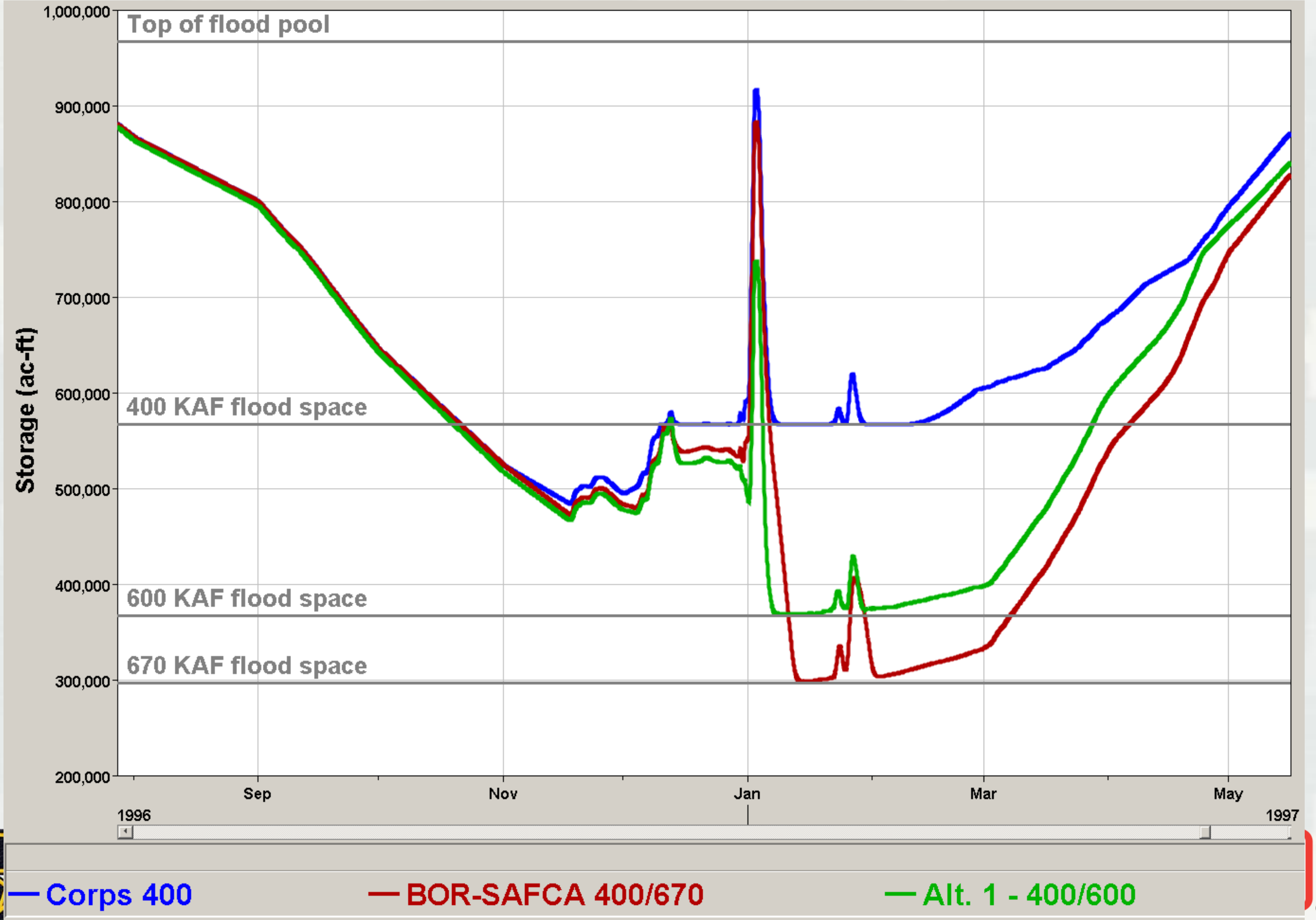
- Alternatives (400/600 with JFP)
  - ► 1 – Upstream Storage Credit
  - ► 2 – Upstream Storage Credit + Basin Wetness
  - ► 3a – Upstream Storage Credit + Runoff Forecast
  - ► 3b – Integrated Inflow Forecast

WATER CONTROL DIAGRAMS

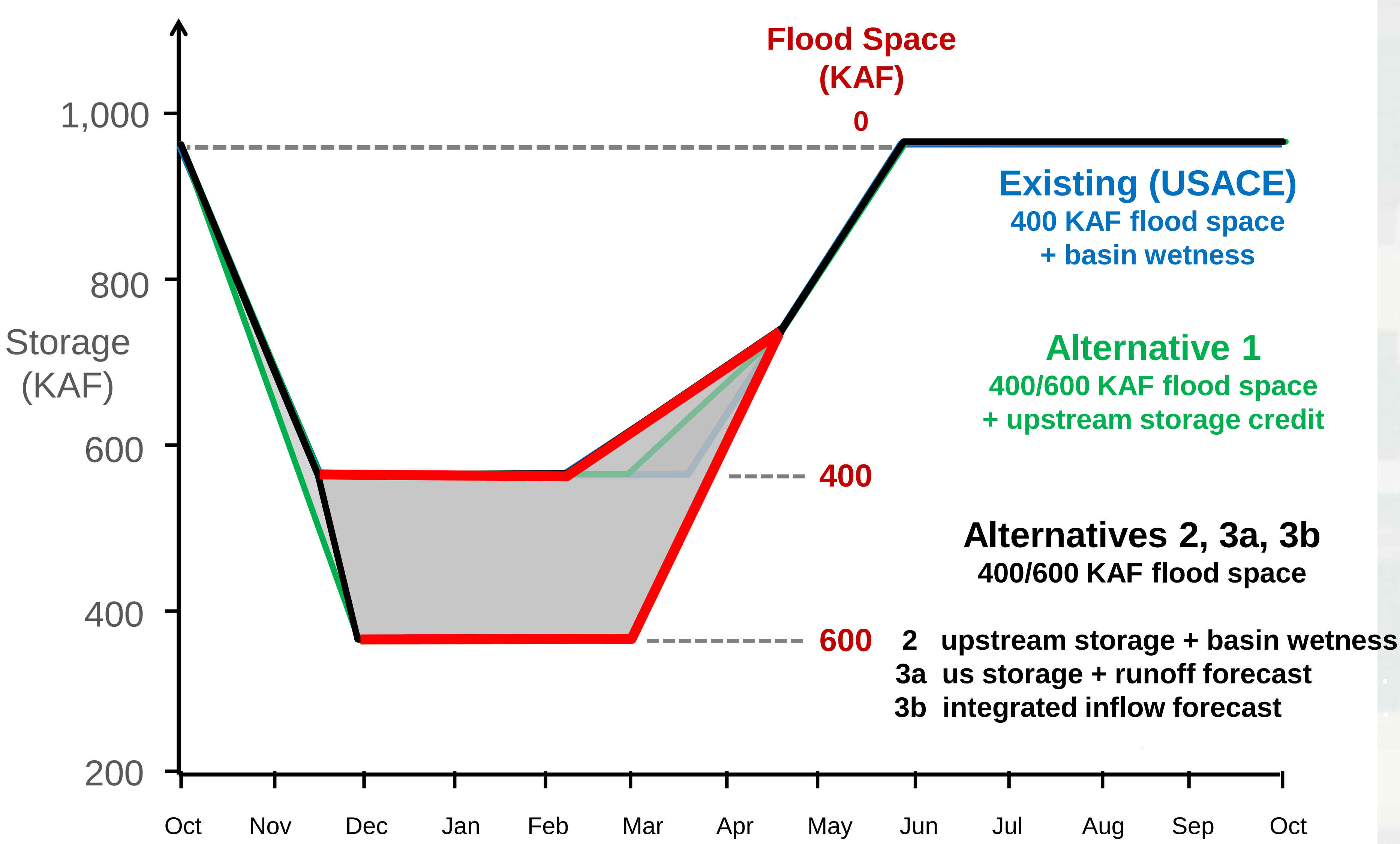
Water Control Diagram



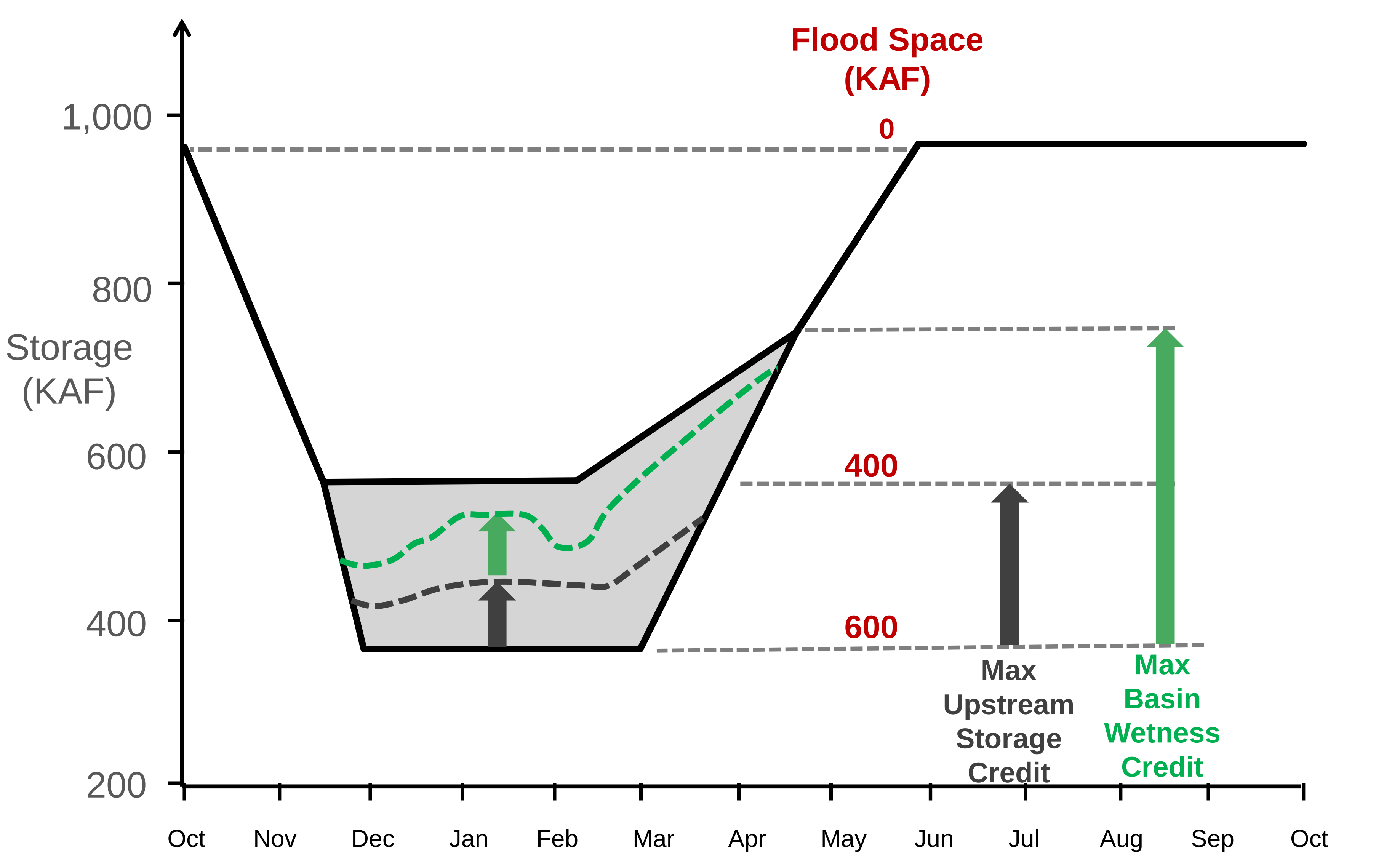
Water Year 1997 Simulation



Water Control Diagram



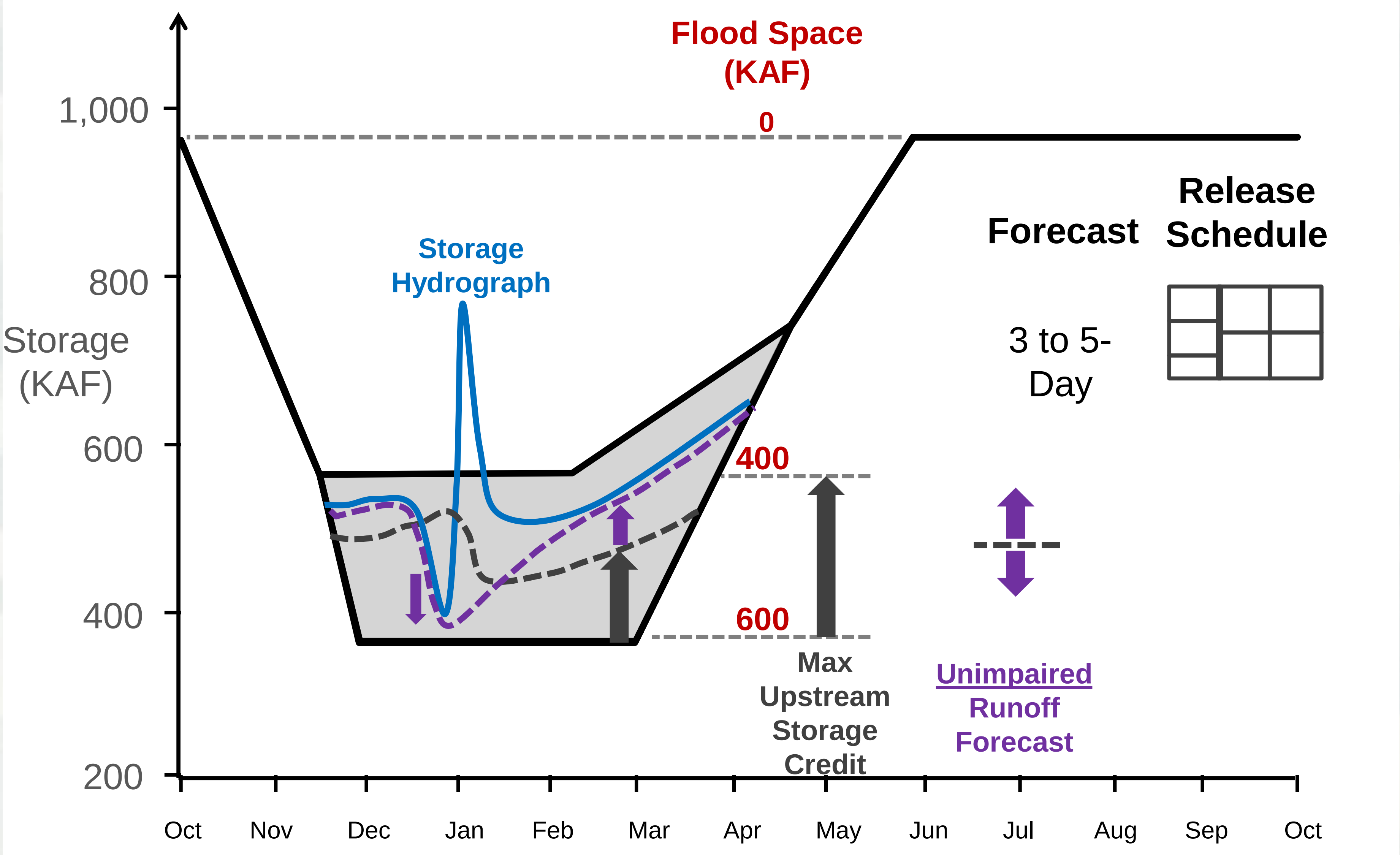
Alternative 2 - 400/600 KAF Variable Flood Space (Upstream Storage + Basin Wetness)



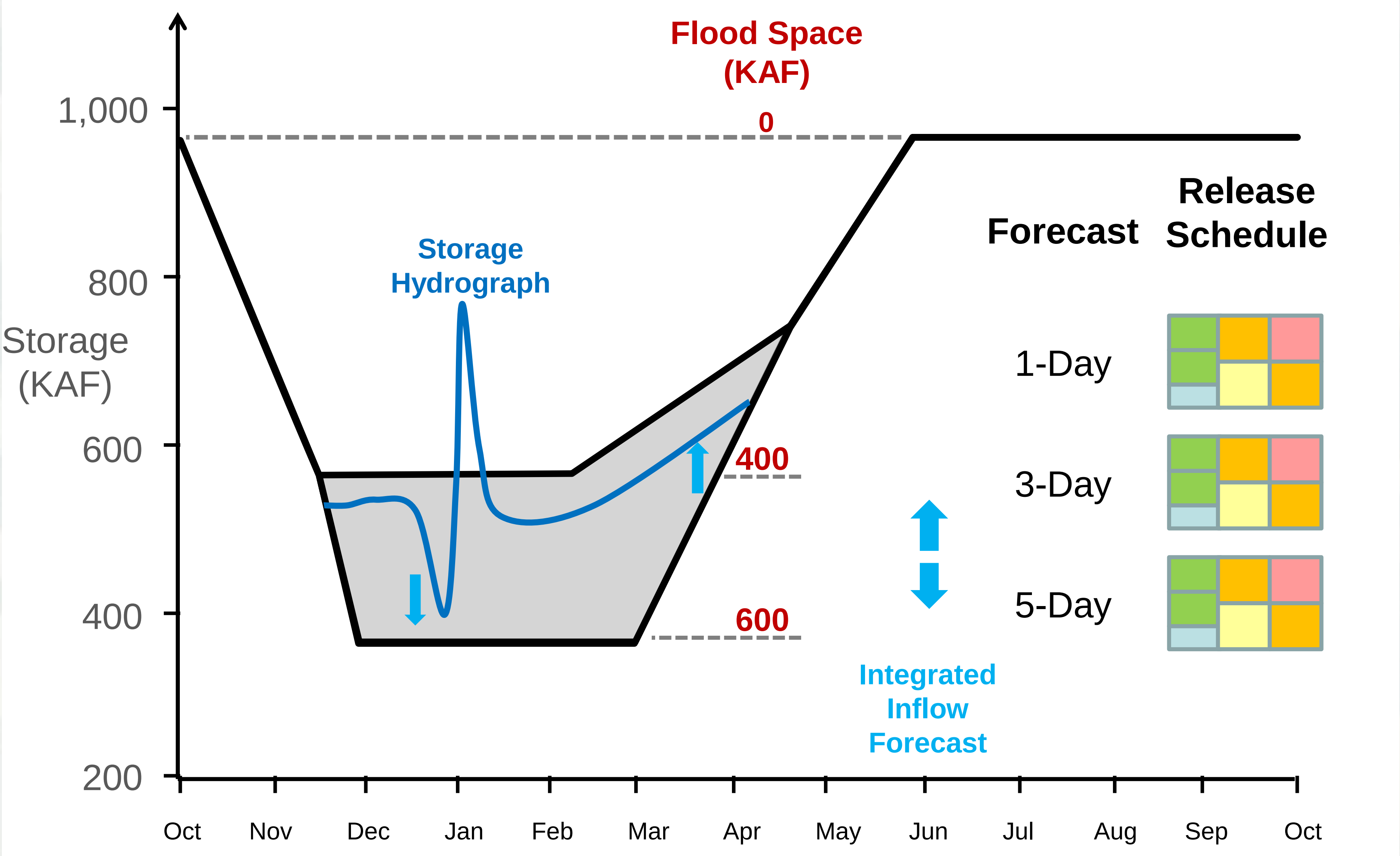
Forecast Alternatives 3a and 3b

- Incorporate inflow forecast, and uncertainty about that forecast, into release decision logic.
- Release schedule specifies minimum release required based on current storage and forecasted inflow.

Alternative 3a - 400/600 KAF Variable Flood Space (Upstream Storage + Unimpaired Runoff Forecast)



Alternative 3b - 400/600 KAF Variable Flood Space (Integrated Inflow Forecast)



Status

- Completed Models
  - ►Existing USACE
  - ►Existing BOR-SAFCA
  - ►Alternative 1

- Under Development
  - ►Alternative 2
  - ►Alternatives 3a and 3b

More Detailed Look

Integrated Inflow Forecast

Alternative 3b

400/600 KAF Variable Flood Space

Overview

1. American River Characteristics
2. Meteorology and Hydrology
3. Winter Flood Example

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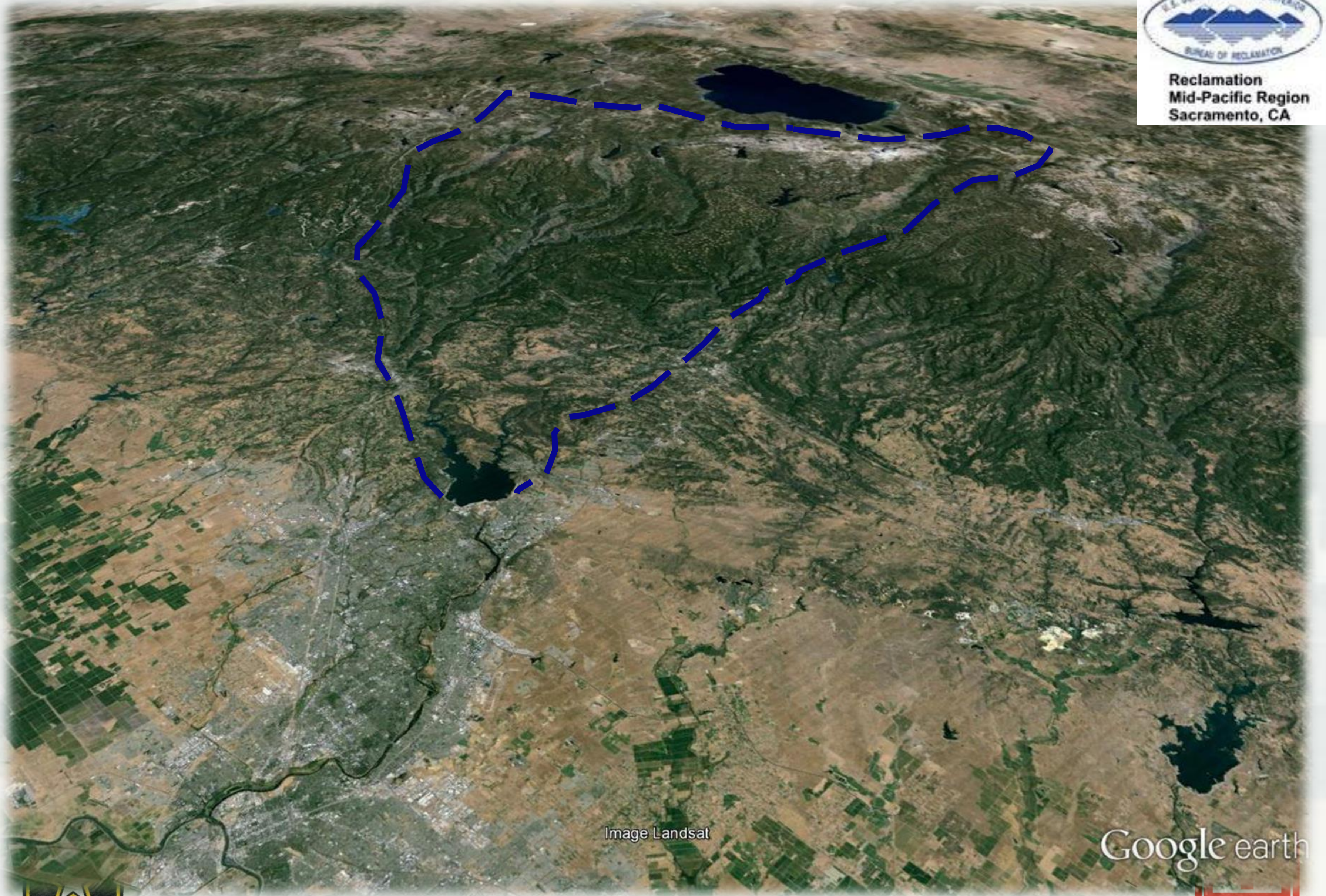

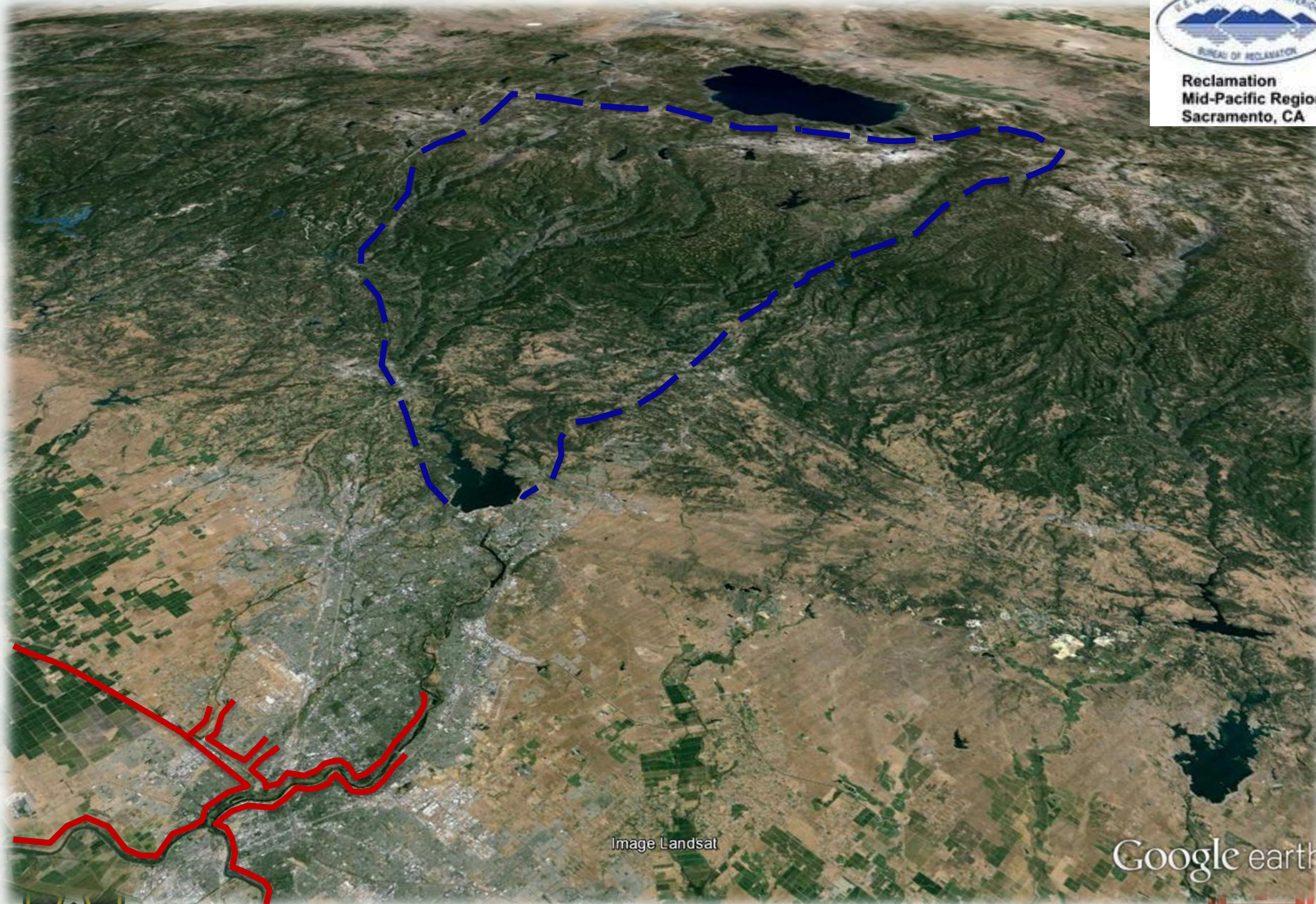

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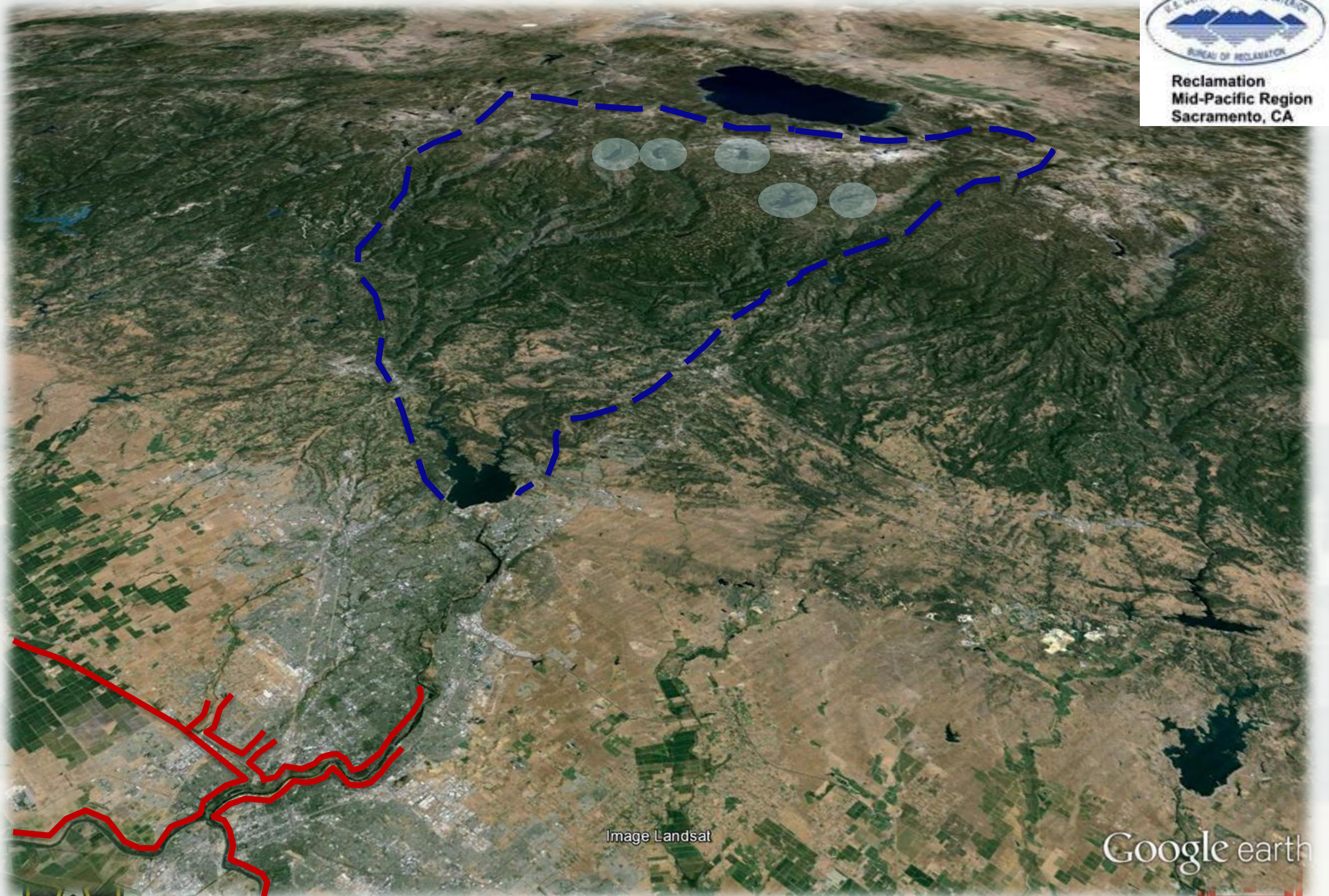

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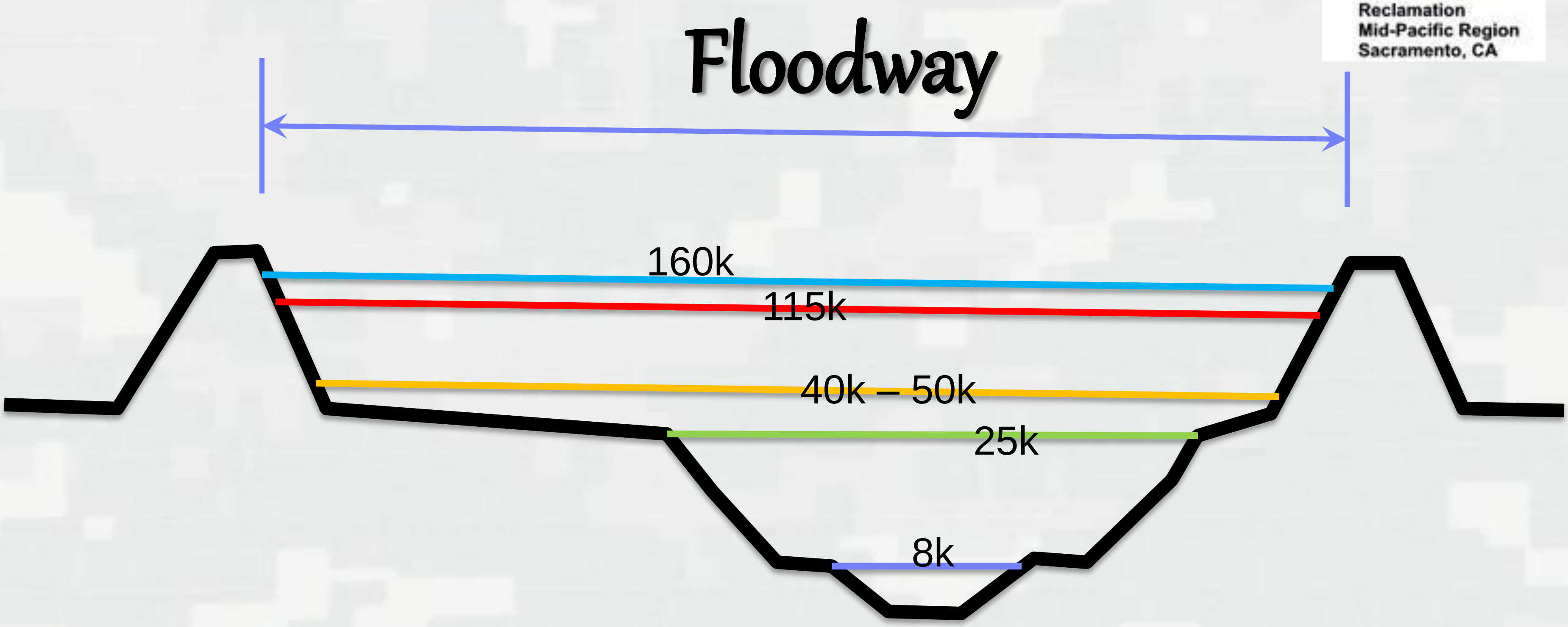
Image Landsat
Google earth



Typical American River Cross Section

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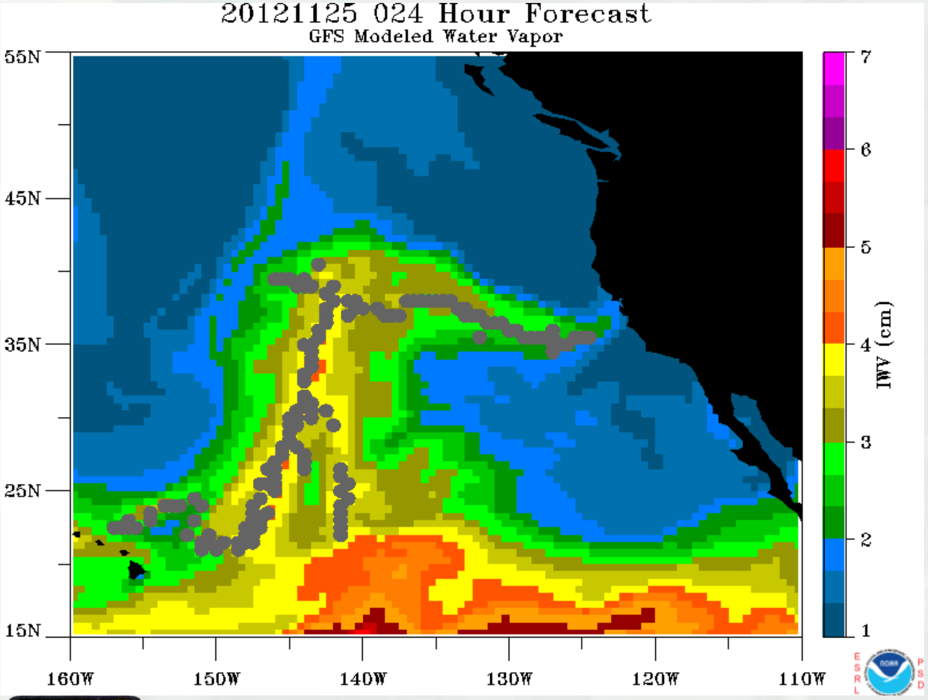
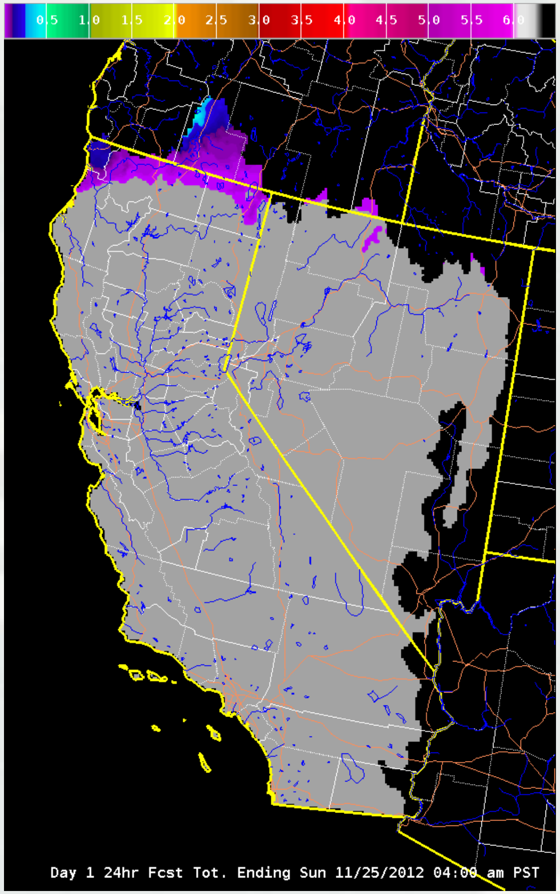
Not to scale

Meteorology and Hydrology

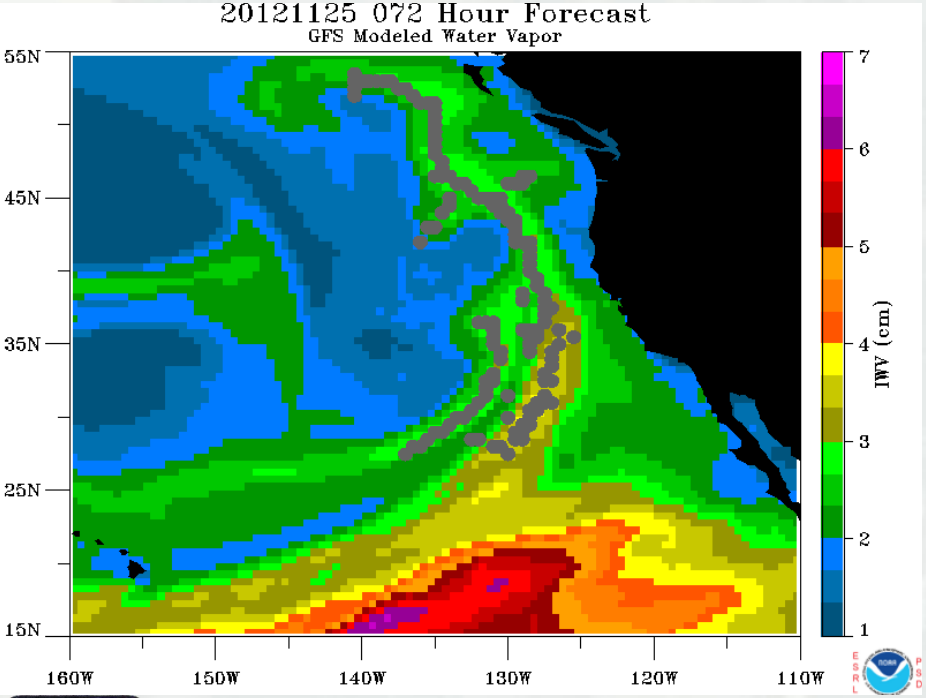
- November 25, 2012 – 1 Day AR & QPF Forecasts

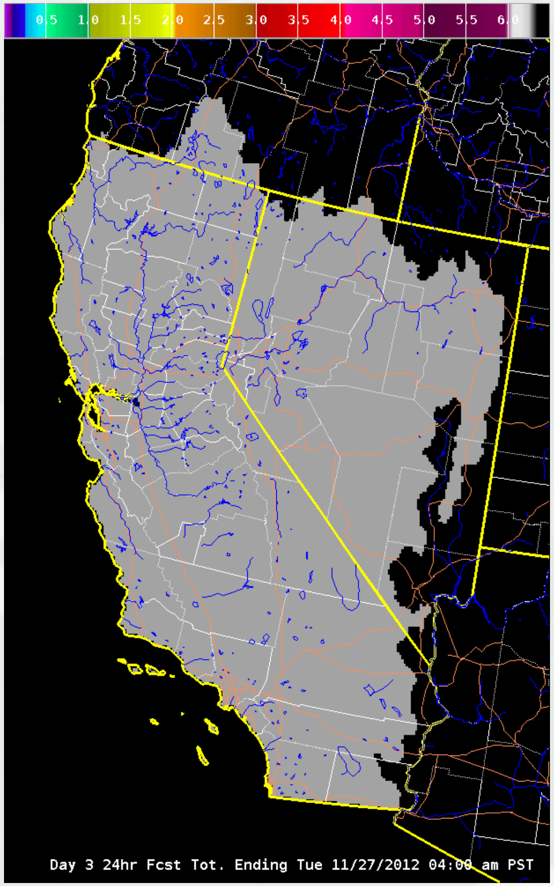




Meteorology and Hydrology

- November 25, 2012 – 3 Day AR & QPF Forecasts





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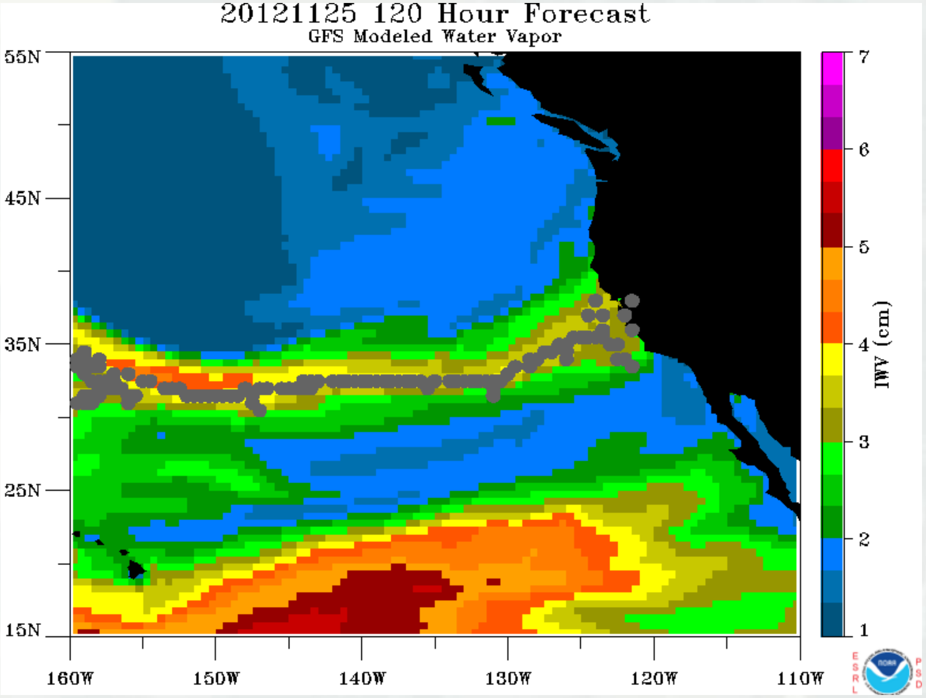
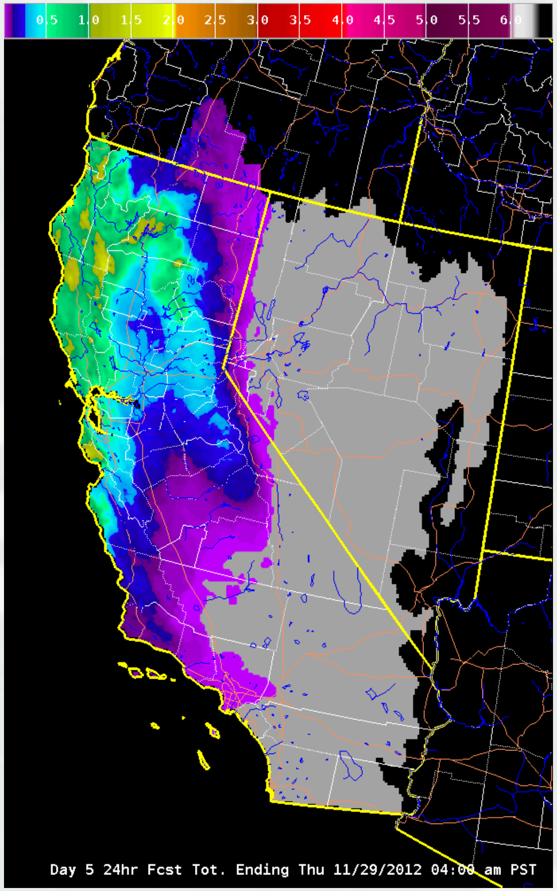
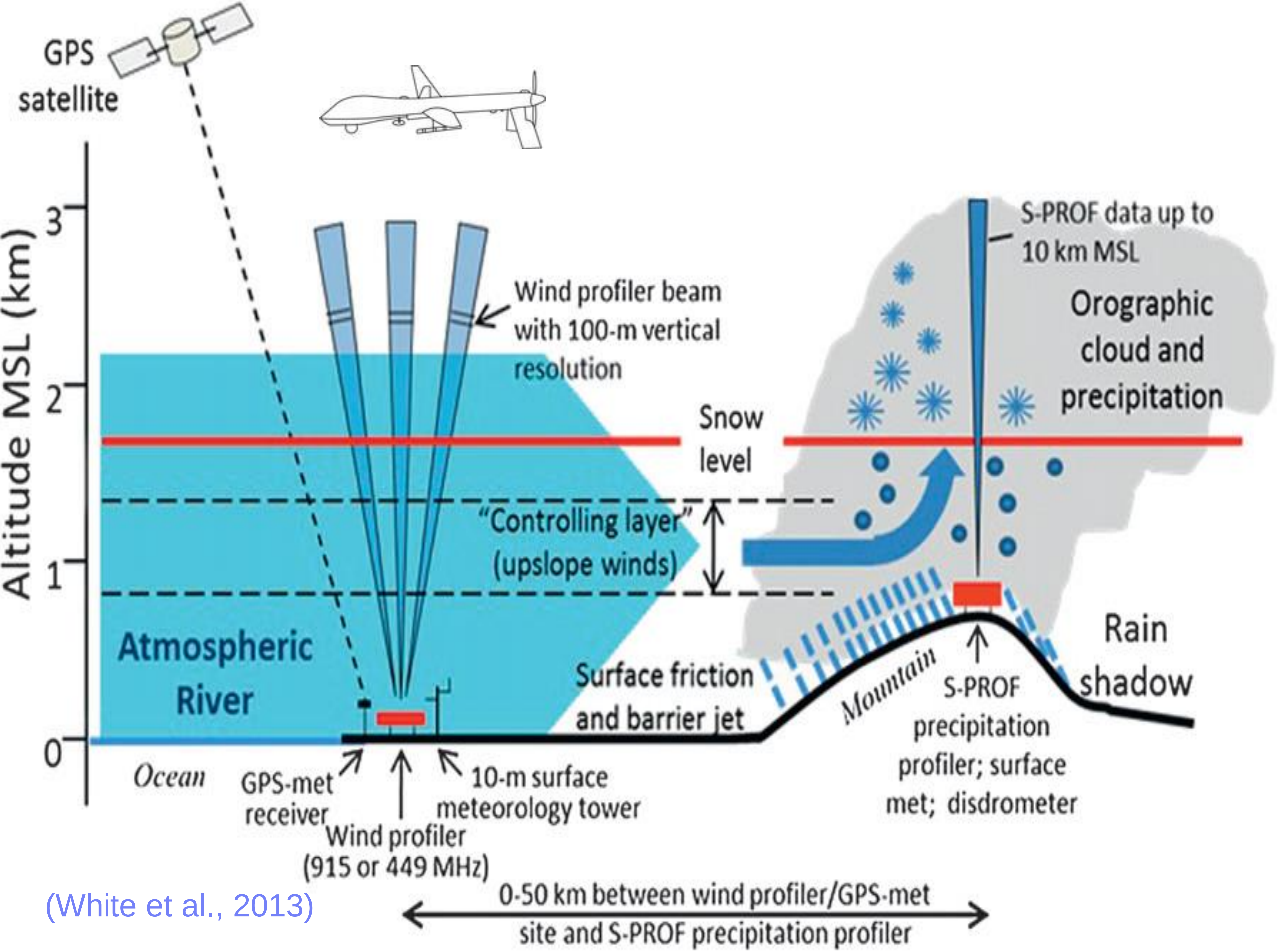
Meteorology and Hydrology

- November 25, 2012 – 5 Day AR & QPF Forecasts







(White et al., 2013)

General Objectives

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1. Readily store in Variable Space based on hydrologic conditions
2. Evacuate an increment of storage prior to main storm event by making prudent release decisions based on forecast confidence
3. Initial Release decisions based on a Forecast/Storage based framework

Conceptual Design Approach

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1. **Structured Elements**
   - Communication and Certainty
2. **Decisions Tied to Release Thresholds**
   - Notification and Operational Coordination
3. **Forecast-Informed Release**
   - Modest Releases in Advance of Major Events
4. **Anticipate Forecast Dynamics**
   - Appropriate Flood Risk and Forecast Uncertainty

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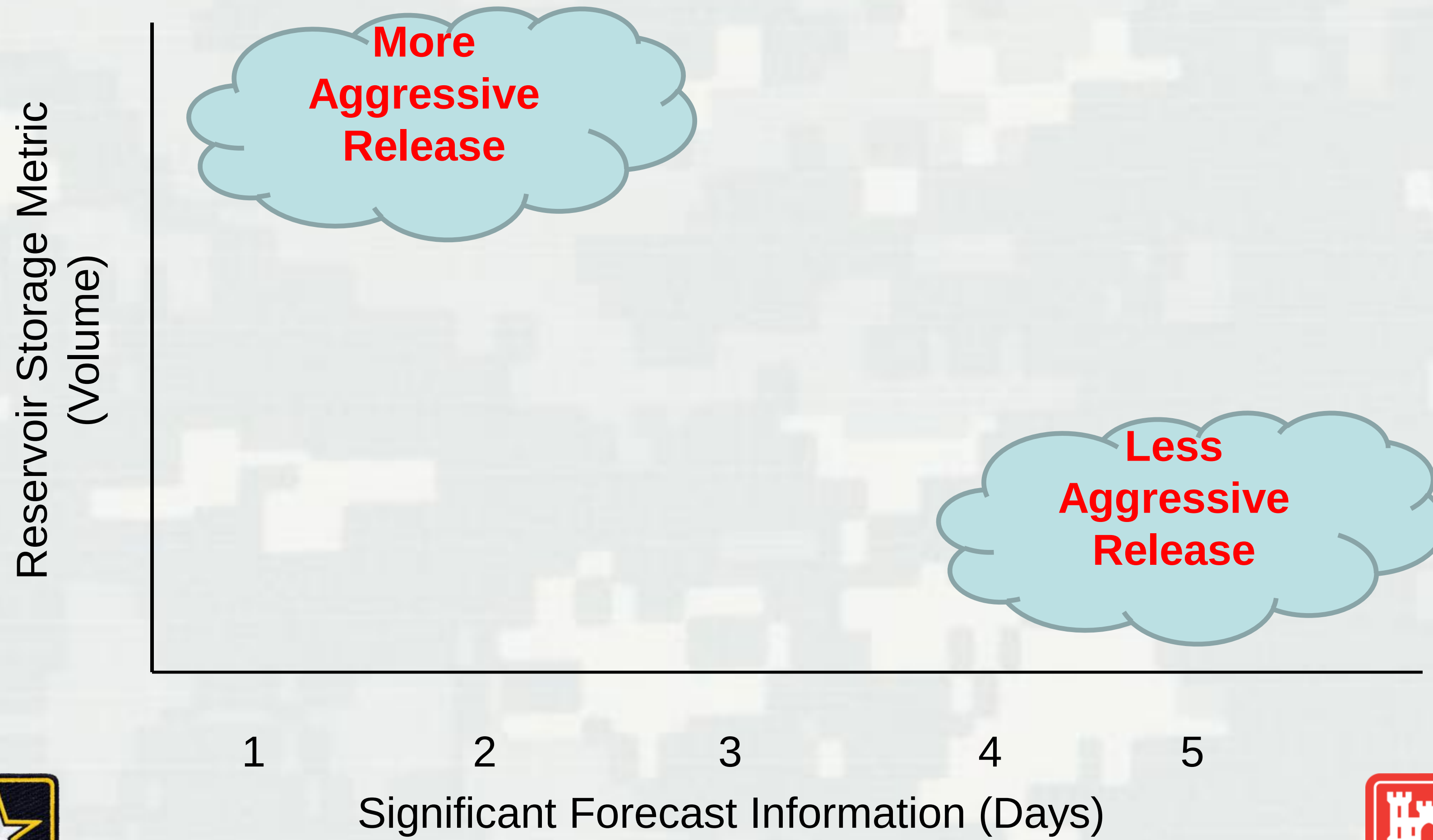
Prudent Storm Release Actions



Shasta Flood Control Diagram

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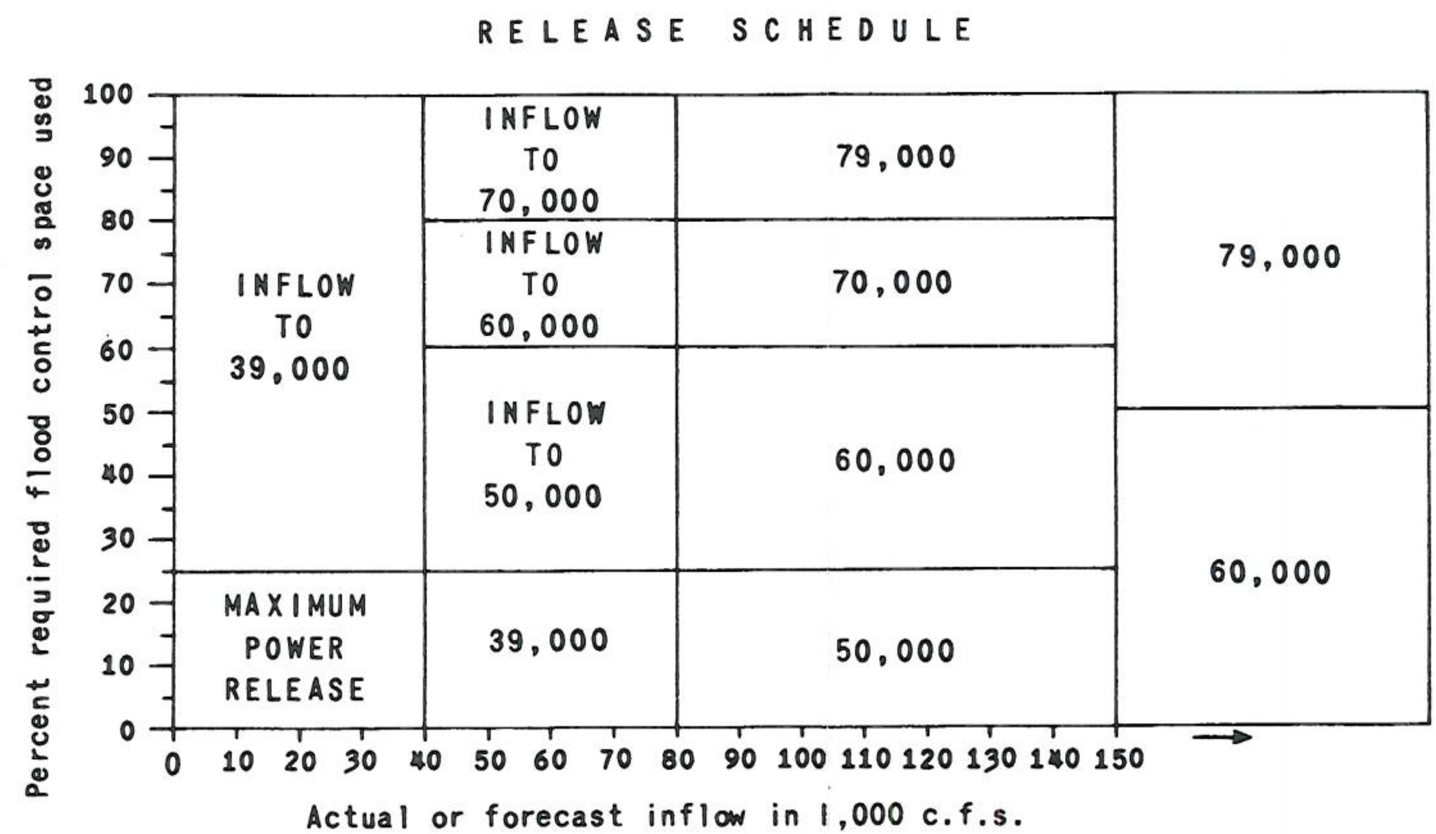

Release Schedule Applies to Rising Limb

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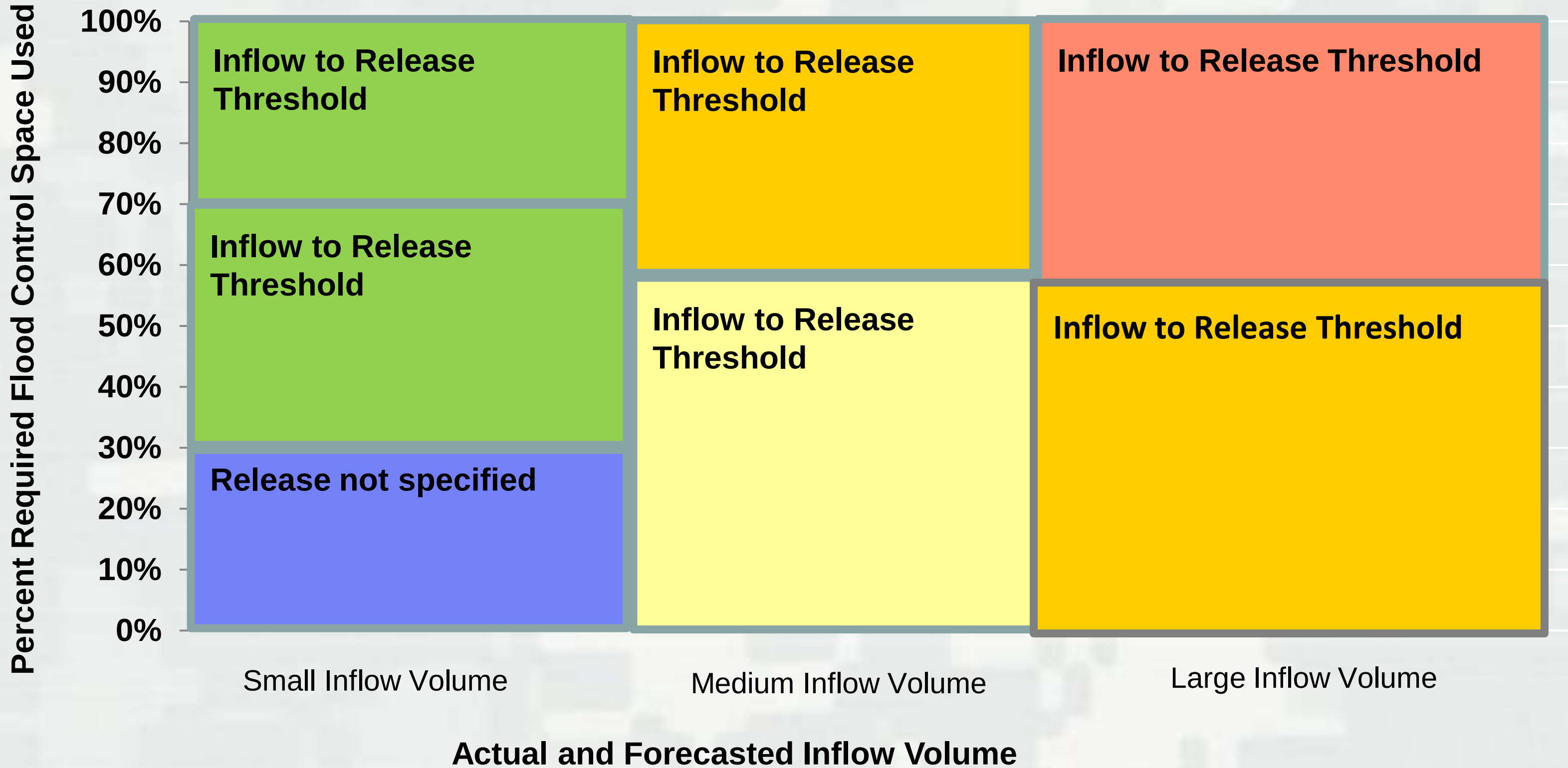

Forecast Based Release Schedule

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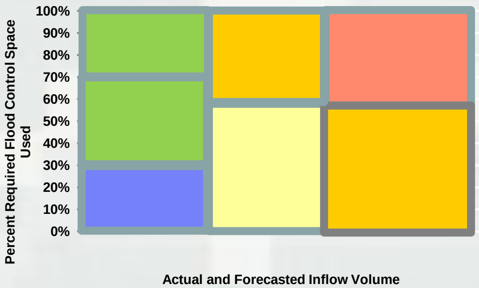
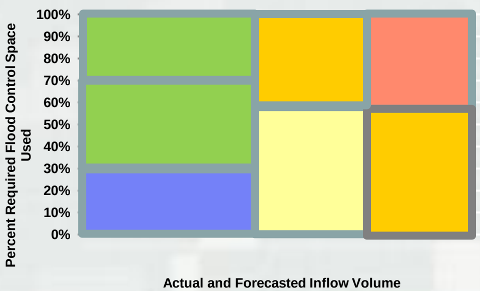
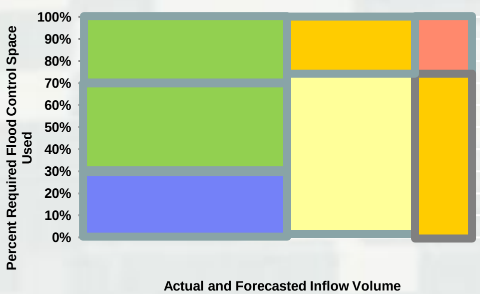
Select Maximum Release Value from Release Decisions



Actual, Forecast 24 – 48 hrs



Forecast 72 hrs



Forecast 120 hrs

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Example Advance Release: Rising Limb

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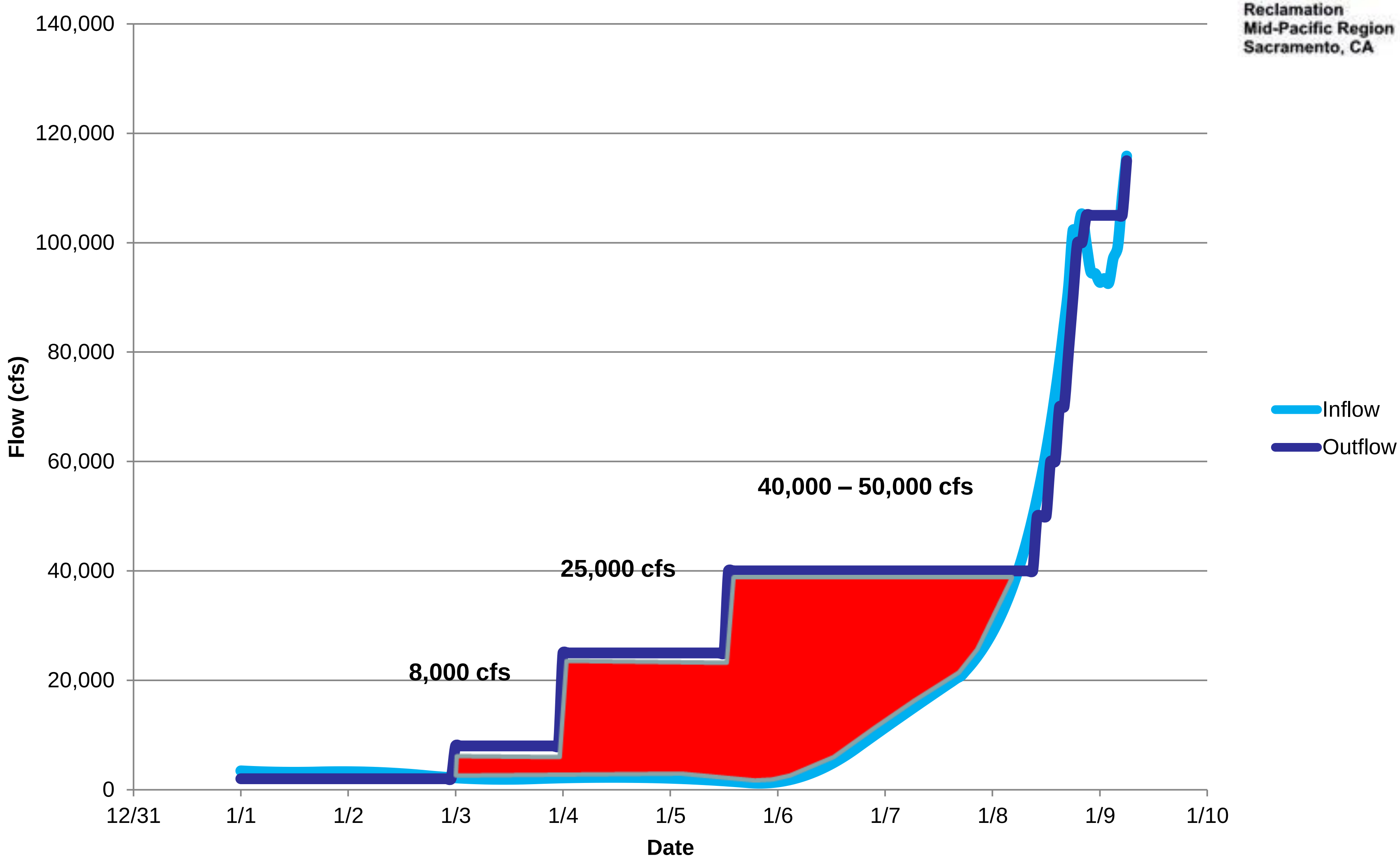

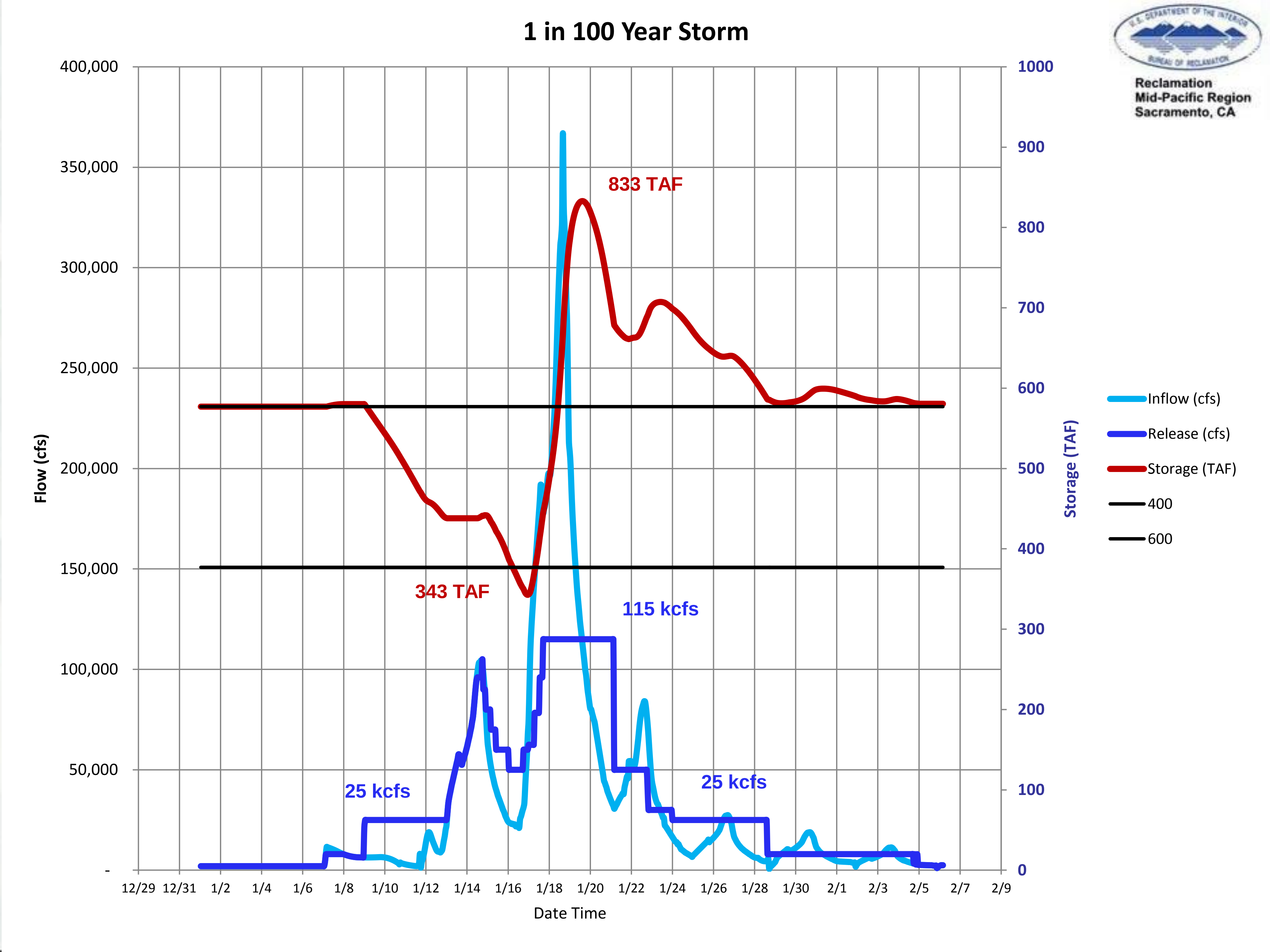

1 in 100 Year Storm
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Flow (cfs)
Storage (TAF)
Date Time
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
-
1000
900
800
700
600
500
400
300
200
100
0
12/29
12/31
1/2
1/4
1/6
1/8
1/10
1/12
1/14
1/16
1/18
1/20
1/22
1/24
1/26
1/28
1/30
2/1
2/3
2/5
2/7
2/9
833 TAF
343 TAF
115 kcfs
25 kcfs
25 kcfs
Inflow (cfs)
Release (cfs)
Storage (TAF)
400
600

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Benefits Applying Forecasts

- <u>Forecast Storm Reasonably Well</u>
  - ▸ Mobilize flood preparedness
  - ▸ Prepare flood space
  - ▸ Moderate releases downstream
  - ▸ Reduce excessive scour/gravel mobilization
  - ▸ Improve spring re-fill management

Risks Applying Forecasts

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- <u>Forecast Storm Imprecisely</u>
  - ►Volume Over Predicted
    - Prepare greater flood space than actually needed
  - ►Volume Under Predicted
    - Lost opportunity to moderate releases downstream

Further Refinement

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- Incorporate Feedback
- Pre-Storm Storage Condition
  - Assess Fill Potential vs Basin Conditions
- Further Evaluate Forecast Uncertainty
- Iterative Refinement:
  - Inflow Volume Thresholds
  - Release Decision Smoothing
  - Forecast Variability and Confidence

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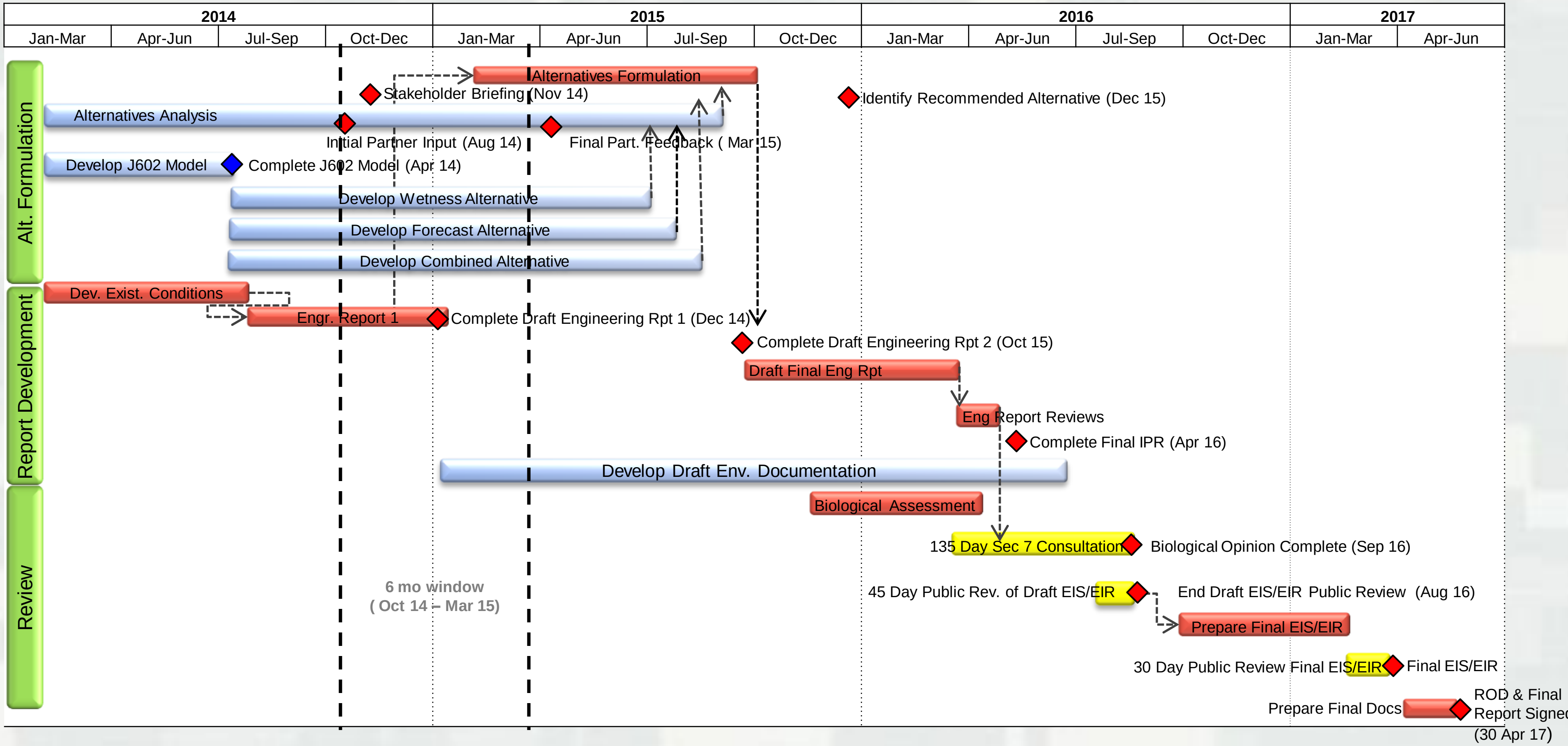
Questions/Comments

JFP – WCM Integrated Master Schedule

15 Nov 14



Milestone-Scheduled

Milestone- Actual

Critical Path

Non-Critical

Fixed Duration

Discussion / Questions

Stakeholder Input on Other Possible Alternatives

Summary Comments

Closing Remarks

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