Proposed Basin Plan Amendment to Establish Salinity Objectives in the Lower San Joaquin River

Jim Brownell
Engineering Geologist

Anne Littlejohn
Senior Environmental Scientist

Presentation Overview

I. Background and Setting

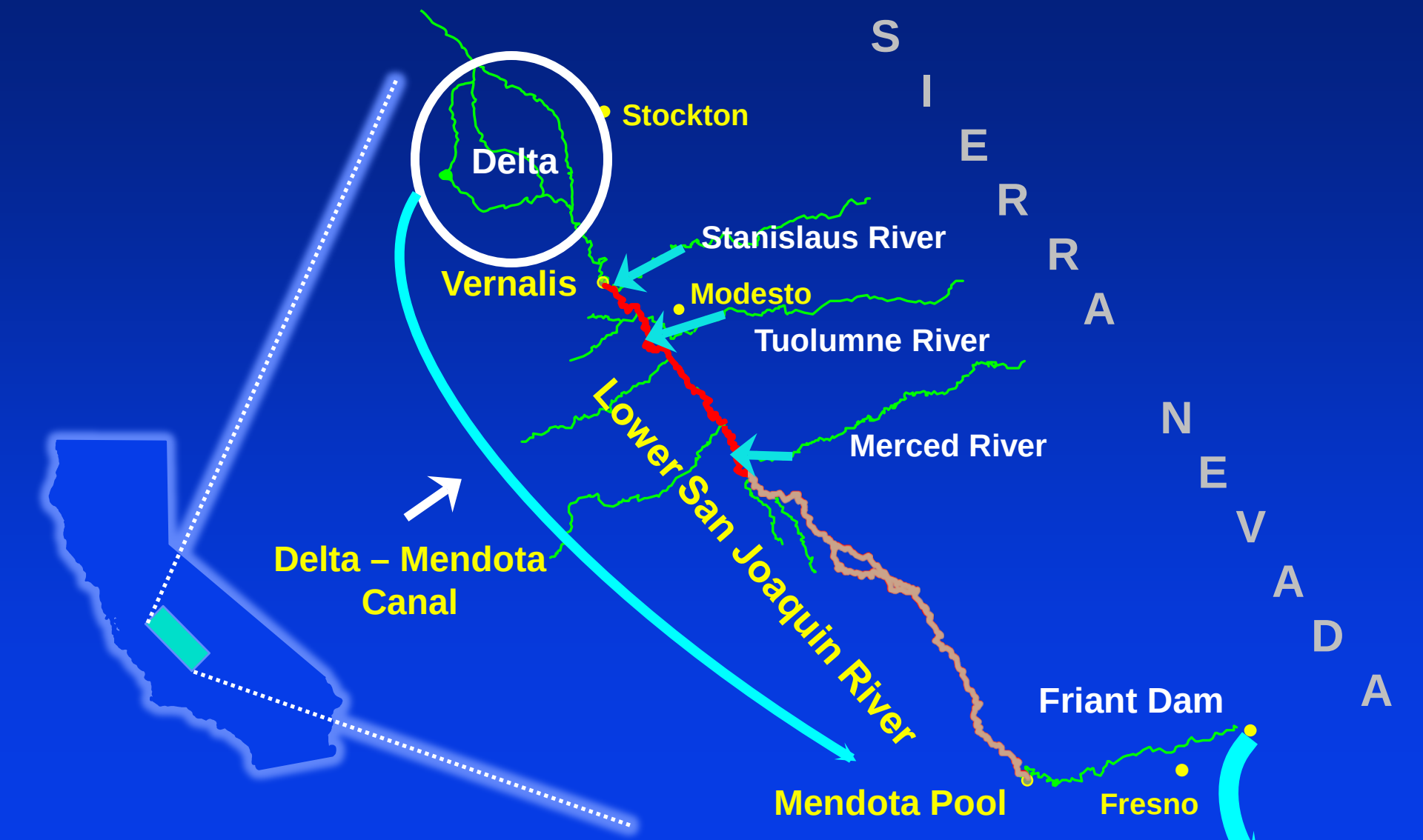
II. Proposed BPA for Upstream WQOs

III. Special Considerations

IV. Peer Review

V. Next Steps and Timeline

Modified Hydrology



LSJR Salt/Boron Control Program

One River Segment – Two Phases

Phase 1 (2004/2006)

- Vernalis Salinity
- Salt Export

Phase 2 (Today)

- **Upstream** Salinity
- Limit New Melones Reservoir Releases

LSJR Salt/Boron Control Program

Phase 1

Vernalis Objectives

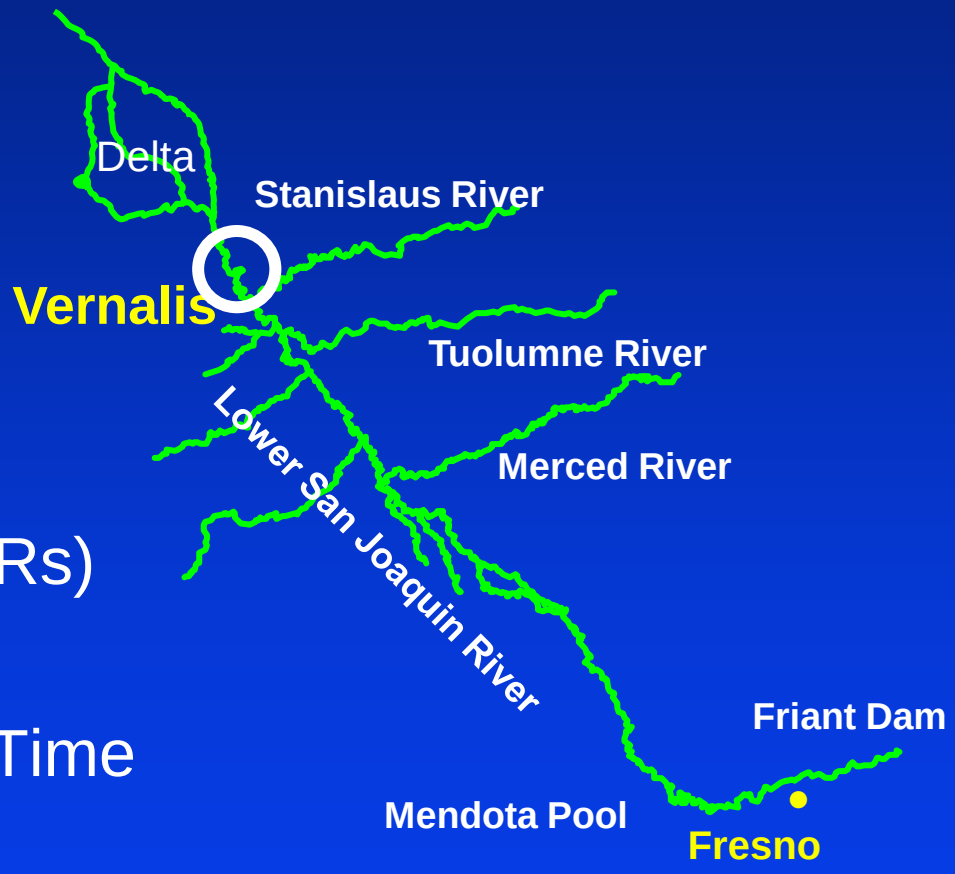
- 700 uS/cm Apr-Aug
- 1,000 uS/cm Sep-Mar

Compliance Methods

- Strict Load Limits (WDRs)

or

- Board Approved Real-Time Management Program



LSJR Salt/Boron Control Program

Phase 1

Status:

- ✓ Vernalis Objectives Met Since 1995
- ✓ Grassland Bypass Project salt loads decreasing
- ✓ Provisions of the Control Program incorporated by reference into ILRP General Orders
- ✓ Real-time Salinity Management Program approved by the CV Water Board in December 2014
- ✓ Coalitions and Cooperating Agencies participating

*** NOT CHANGING WITH NEW EFFORTS ***

LSJR Salt/Boron Control Program

Phase 2

Proposed Upstream WQOs
2005 – June 2010

Project led by CV Water Board staff

- CEQA Scoping Sessions (in 2005 and 2009) and Public Workshops in (2006)

- Soil Salinity Modeling for the LSJR
  - Draft Water Board Staff Technical Report: Salt Tolerance of Crops in LSJR Basin March 2010
  - Response to Minor Public Comments June 2010

Proposed Upstream WQOs
June 2010 – Current

Incorporated into CV-SALTS Initiative

- Formation of the LSJR Committee of Stakeholders
  - Agriculture
  - Water Supply & Resource Conservation Districts
  - City, County, State and Federal Agencies
  - Water Quality and Watershed Coalitions
  - Clean Water and Wastewater Associations
  - Other interested parties
- Monthly Meetings—Technical/Policy

Proposed Upstream WQOs
LSJR Committee Actions

- Beneficial Uses and Salt Sensitivity
- Baseline Water Quality/Climate/Cropping
- Salinity Water Quality Criteria
- Alternatives for WQOs
- Preferred Alternative
- Implementation Program
  - Monitoring and Surveillance

Beneficial Uses & Salt Sensitivity

Lower San Joaquin River Reach	MUN	AGR		PROC	REC-1		REC-2	WARM	COLD	MIGR		SPWN		WILD
	Municipal and Domestic Supply	Irrigation	Stock Watering	Industrial Process Supply	Contact	Canoeing and Rafting	Other Noncontact	Freshwater Habitat-Warm	Freshwater Habitat-Cold	Warm	Cold	Warm	Cold	Wildlife Habitat
Merced River to Vernalis	P	E	E	E	E	E	E	E		E	E	E		E

P = potential E = existing

Proposed Upstream WQOs
Beneficial Uses

- No changes to Beneficial Uses needed
- Completed water quality criteria review for:
  - Potential Municipal and Domestic Supply
  - Agricultural Irrigation Supply
  - Agricultural Stock Watering
  - Aquatic Life

Proposed Upstream WQOs
Water Quality Criteria

- Potential MUN protection
  - SMCL range (900 – 1,600 µS/cm EC)
  - Short term SMCL (2,200 µS/cm EC)

- AGR Irrigation protection
  - Narrative Interpretation – 700 µS/cm EC (Ayers and Westcot,1985)

Appropriate for the LSJR?

Proposed Upstream WQOs
Water Quality Objectives
Developing WQOs Protective of AGR

- Crop Salt Sensitivity Modeling Reviewed
  - Hoffman Model
- Modeling Parameters Revised
- Crop Surveys Updated

Proposed Upstream WQOs
Water Quality Objectives

- Revised Parameters for Updated Modeling
  - Commercial Crops that Cover ≥5% of the Acreage
  - Crop Yield ≥95%
  - 95th percentile driest water year
  - Leaching Fraction = 15%
  - Exponential plant water uptake pattern
- Almonds Identified as Most Salt-Sensitive Crop
- Updated Model Result for Almonds
  - 1,550 µS/cm EC irrigation water is protective
  - 1,010 uS/cm for 10% Leaching Fraction

Proposed Upstream WQOs
Alternatives Evaluation

Identified Range of Criteria:

- 700 µS/cm (Vernalis/Ayers and Westcot)
- 1,000/1,010 µS/cm (Vernalis/10% Leaching)
- 1,550 µS/cm (Hoffman Modeling)
  - Almonds; 95% yield; 95th percentile driest year; 15% leaching fraction

Proposed Upstream WQOs
Alternatives Evaluation

California Water Code Section 13241

a) Beneficial uses
b) Environmental characteristics of hydrographic unit
c) Water quality that can be achieved
d) Economics
e) Housing need
f) Recycled water

Proposed Upstream WQOs
Alternatives Evaluation

Watershed Modeling

- Selected WARMF Model
- Identified Implementation Actions that Manage Salinity
- Grouped Implementation Actions into three “Bundles”

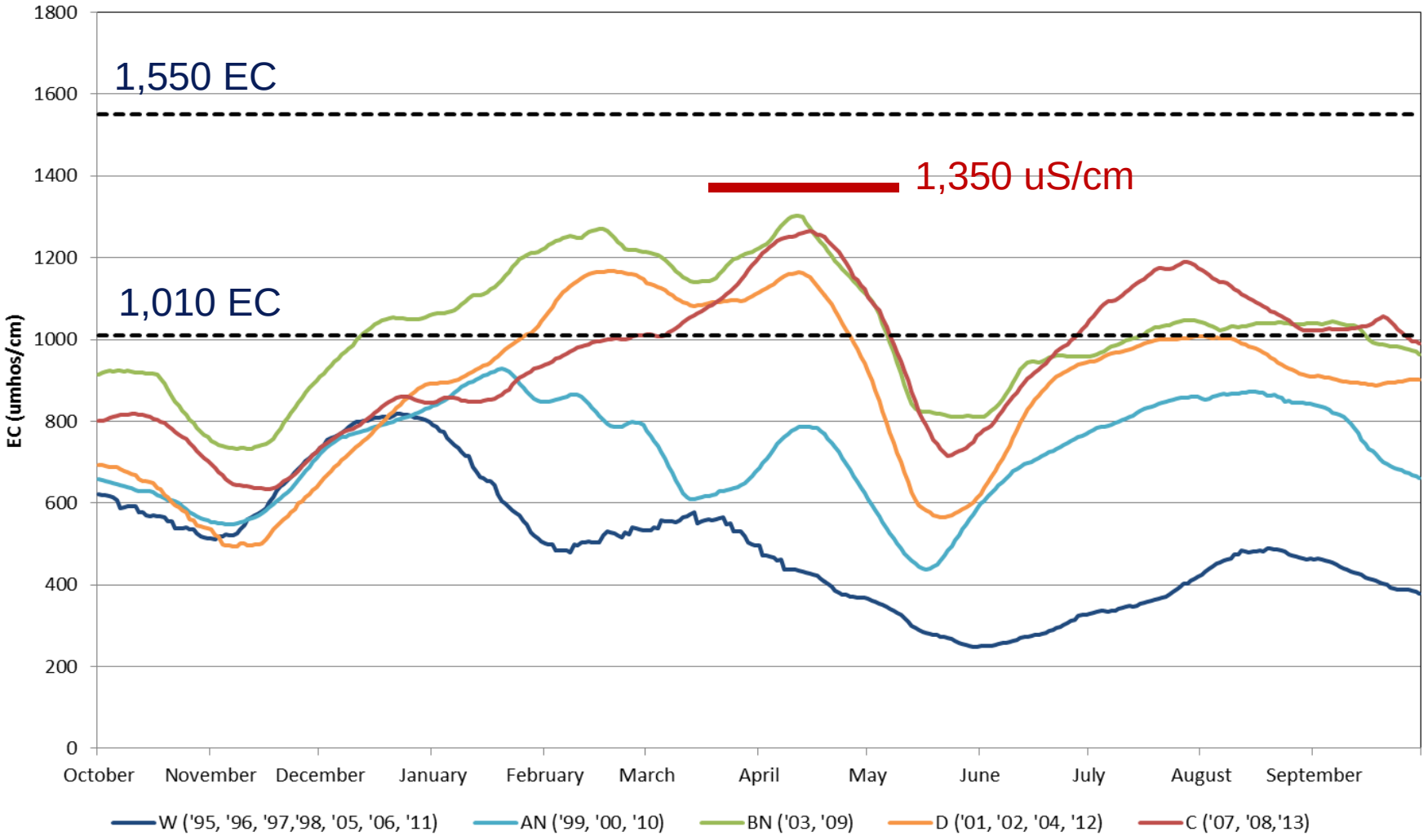
Proposed Upstream WQOs

Alternatives Evaluation: Implementation "Bundles"

Implementation Action	Planned	Planned + Max Management	Planned + Max Treatment
Controlled Timing of Salinity Discharges	X	X	X
Reduce Point Source	X	X	X
Reduce Non-Point	X	X	X
Water Conservation	X	X	X
High Eff Irrigation	X	X	X
Reuse/Vol Reduction	X	Expanded	X
Tailwater Recovery	X	X	X
Tilewater Recovery	X	X	X
Regional Treatment	---	---	X

PLANNED Actions at Crow's Landing

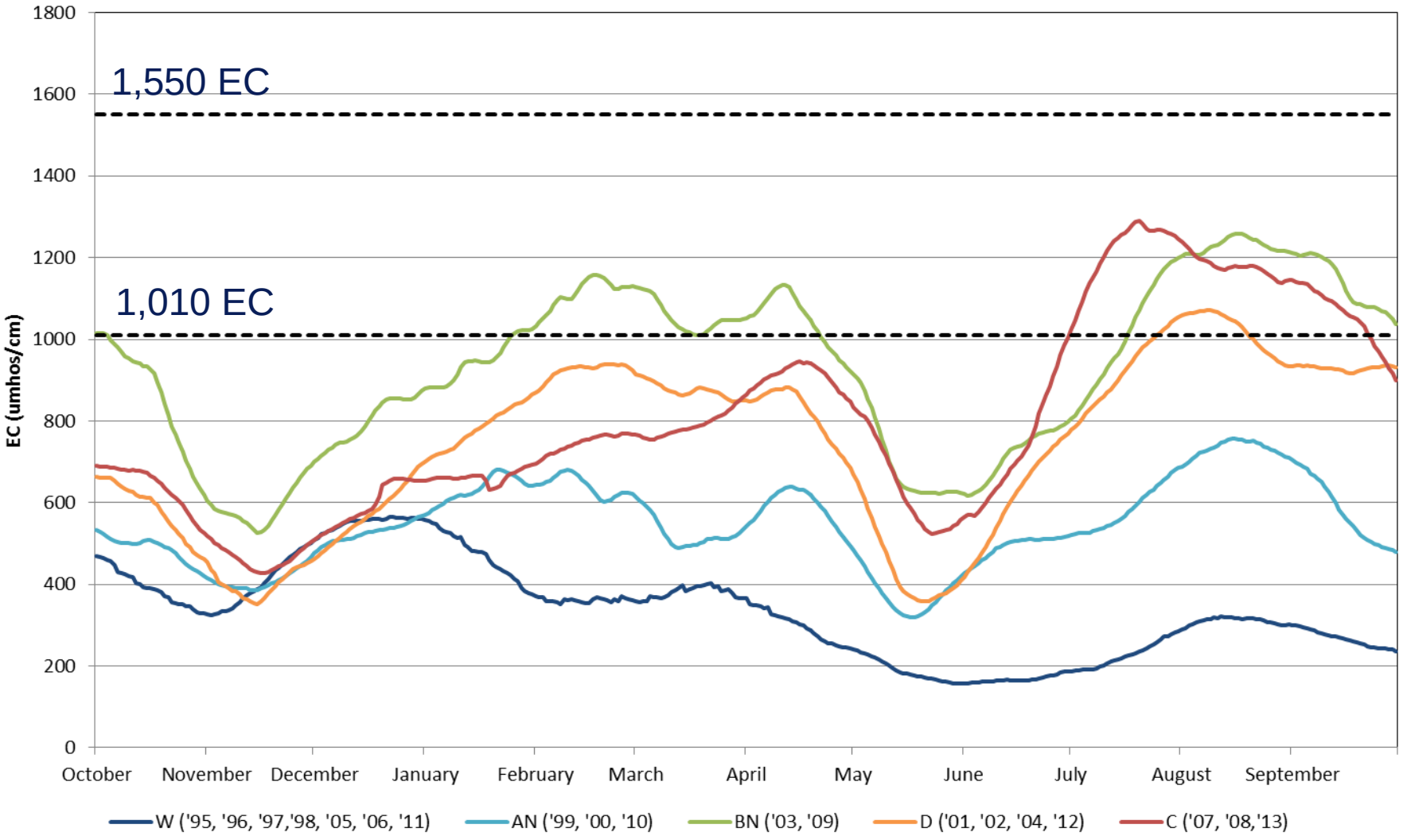
Adjusted to Historical EC by Water Year Type
(Oct. 1, 1995 - Sept. 30, 2013)



MAXIMUM MANAGEMENT at Crow's Landing

Adjusted to Historical EC by Water Year Type

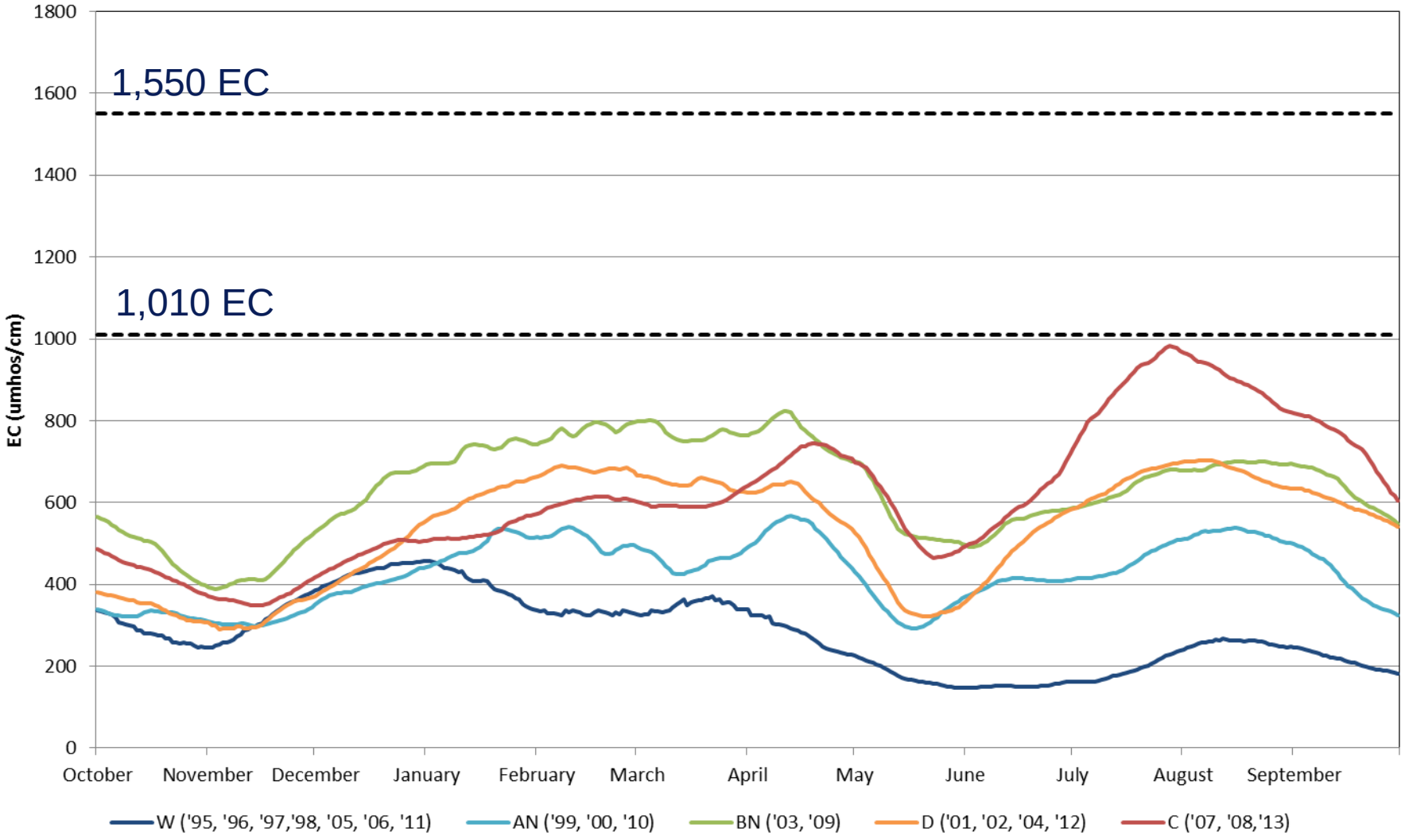
(Oct. 1, 1995 - Sept. 30, 2013)



MAXIMUM TREATMENT at Crow's Landing

Adjusted to Historical EC by Water Year Type

(Oct. 1, 1995 - Sept. 30, 2013)



Proposed Upstream WQOs
Alternatives Evaluation

Initial Range of Criteria Identified:

- 700 µS/cm (Ayers and Westcott)
- 700 and 1,000 µS/cm (Vernalis Objectives)
- 1,010 µS/cm (Hoffman Modeling at 10% LF)
- 1,550 µS/cm (Hoffman Modeling at 15% LF)

Additional Criteria Identified:

- 1,350 µS/cm (predicted by WARMF Modeling)

Proposed Upstream WQOs
Alternatives Evaluation

EC Water Quality Objective Alternatives
1. No Objective (No Action)
2. 1,550 µS/cm
3. Tiered Objective for Water Year Considerations: 1,350 µS/cm & 1,550 µS/cm during critical years
4. 1,550 µS/cm Objective and 1,350 µS/cm Perf Goal for Seasonal & Water Year Considerations
5. 1,350 µS/cm
6. 1,010 µS/cm
7. 700 µS/cm

Proposed Upstream WQOs
Alternatives Evaluation

Selection Criteria

- Consistent with federal/state laws, plans and policies
- Consistent with other relevant WQOs
- Reduce dependency on New Melones Reservoir water quality releases
- Support salt transport out of basin
- Scientifically Defensible
- Meets CV-SALTS Goals
- Achievable and Economically Feasible to Implement

Proposed Upstream WQOs
Alternatives Evaluation

EC Water Quality Objective Alternatives
1. No Objective (No Action)
2. 1,550 µS/cm
~~3.~~ Tiered Objective for Water Year Considerations: 1,350 µS/cm & 1,550 µS/cm during critical years
4. 1,550 µS/cm Objective and 1,350 µS/cm Perf Goal for Seasonal & Water Year Considerations
~~5.~~ 1,350 µS/cm
6. 1,010 µS/cm
~~7.~~ 700 µS/cm

Proposed Upstream WQOs
Alternatives Evaluation

Reduce Dependency on New Melones Reservoir Water Quality Releases

- "New Melones Operational Model"
- Forecasts Potential Changes in Water Quality Releases
- Results Range—Maximum reduction 56,000 ac-ft

Reduction or No Change in Releases

Proposed Upstream WQOs
Alternatives Evaluation

Economic Analysis

- Costs of project alternatives & WQOs
  - No Action – dismissed from further consideration
  - 1,550 – Minimal – Lower costs ($)
  - 1,550 + 1,350 Perf Goal – Minimal – lower costs ($)
  - 1,010 – High costs ($$$$) [30 year $1.15 billion]

Proposed Upstream WQOs
Selection Process

Management Alternatives Model Results ✚ WQO Alternatives Evaluation ✚ Economic Analysis

⇩

Preferred Alternative (#4)

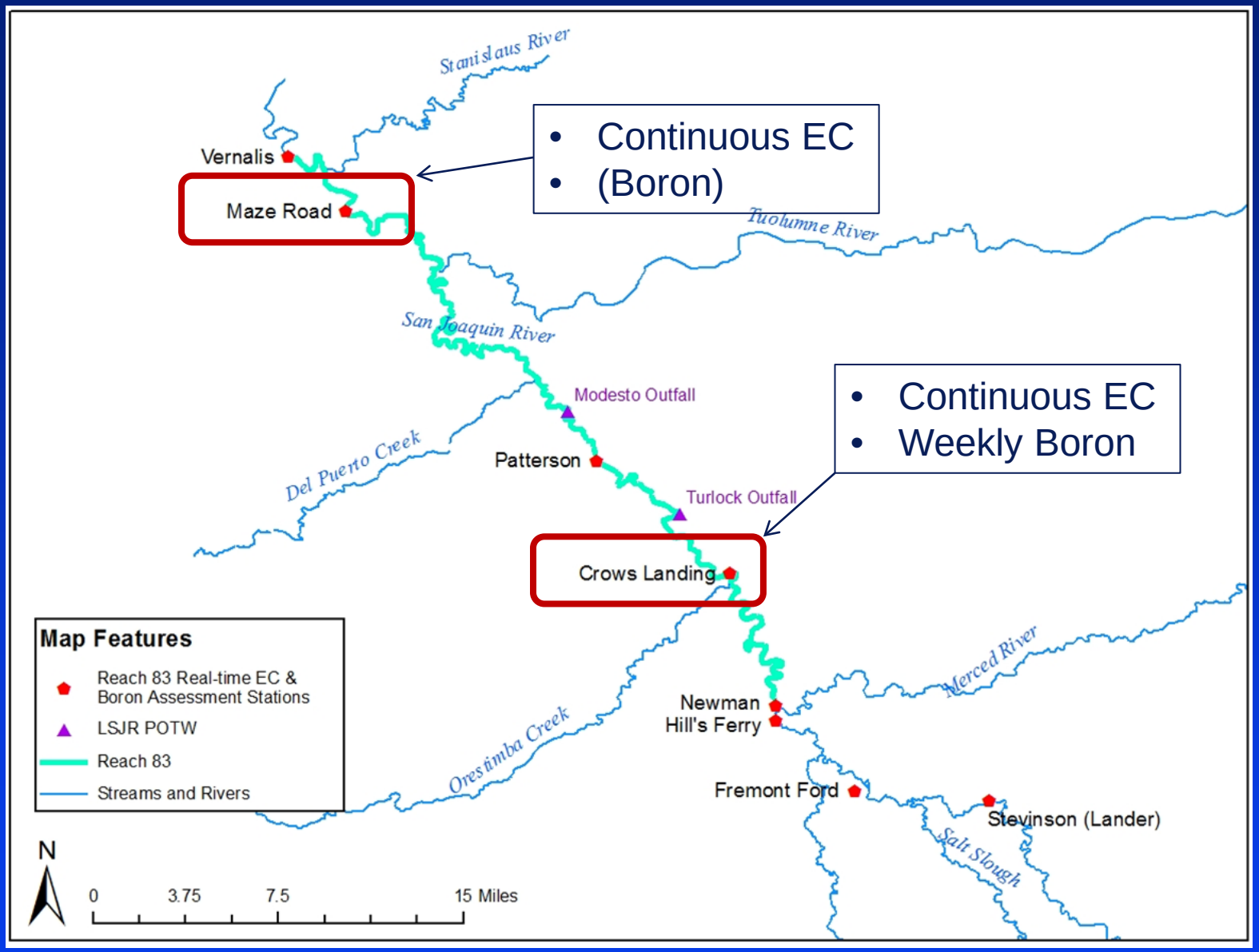
1,550 µS/cm EC WQO &
1,350 µS/cm EC Performance Goal
Seasonal and Water Year Considerations

30-Day Running Average

Proposed Upstream WQOs
Implementation

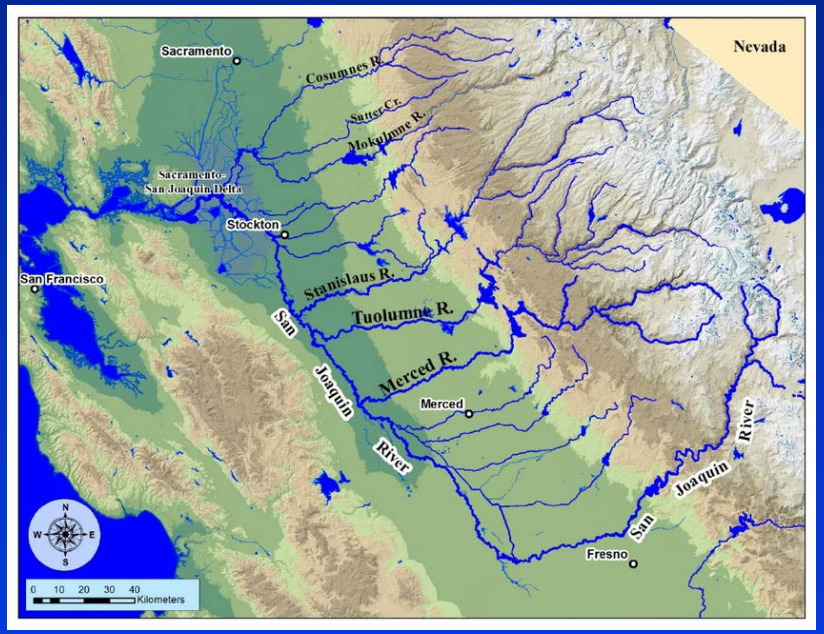
- Salinity Management – Planned Bundle
  - Full Implementation of Grassland Bypass Project
- Monitoring and Surveillance
  - Crows Landing
  - Maze Road

Monitoring Program



Special Considerations

1. Extended Dry Periods
2. Performance Goal
3. NPDES Compliance
4. Boron Compliance
5. Basin Plan Reopener



Special Considerations
Extended Dry Periods

Considerations:

1. Level of Beneficial Use Protection Needed

2. Defining an Extended Dry Period

Special Considerations
Extended Dry Periods

1. Level of Beneficial Use Protection

- Quantity overrides quality
- Any water is better than none
- Crop Survival begins to outweigh crop yield
- Any changes to salinity levels need to be temporary

Special Considerations
Extended Dry Periods

Short-Term Salinity Protection Levels

- 2,470 µS/cm for Ag irrigation
  - Crop to Protect: Almonds
  - **75% Yield**
  - 95th percentile driest water year
  - 15% Leaching Fraction

- 2,200 µS/cm for Short-Term MUN
  (an average of the previous 4 quarterly samples)

Special Considerations
Extended Dry Periods

2. Defining an Extended Dry Period

- Hydrologic Years divided into 5 types based on flow (D-1641 Analysis)
  - Wet
  - Above Normal
  - Below Normal
  - Dry
  - Critical

Special Considerations
Extended Dry Periods

Assigned Value

- Each Water Year type is assigned a numerical value

Wet -	5
Above Normal -	4
Below Normal -	3
Dry -	2
Critical -	1

Special Considerations
Extended Dry Periods

Definition

- Extended Dry Period occurs when the sum of the current water year and the previous two water years is 6 or less

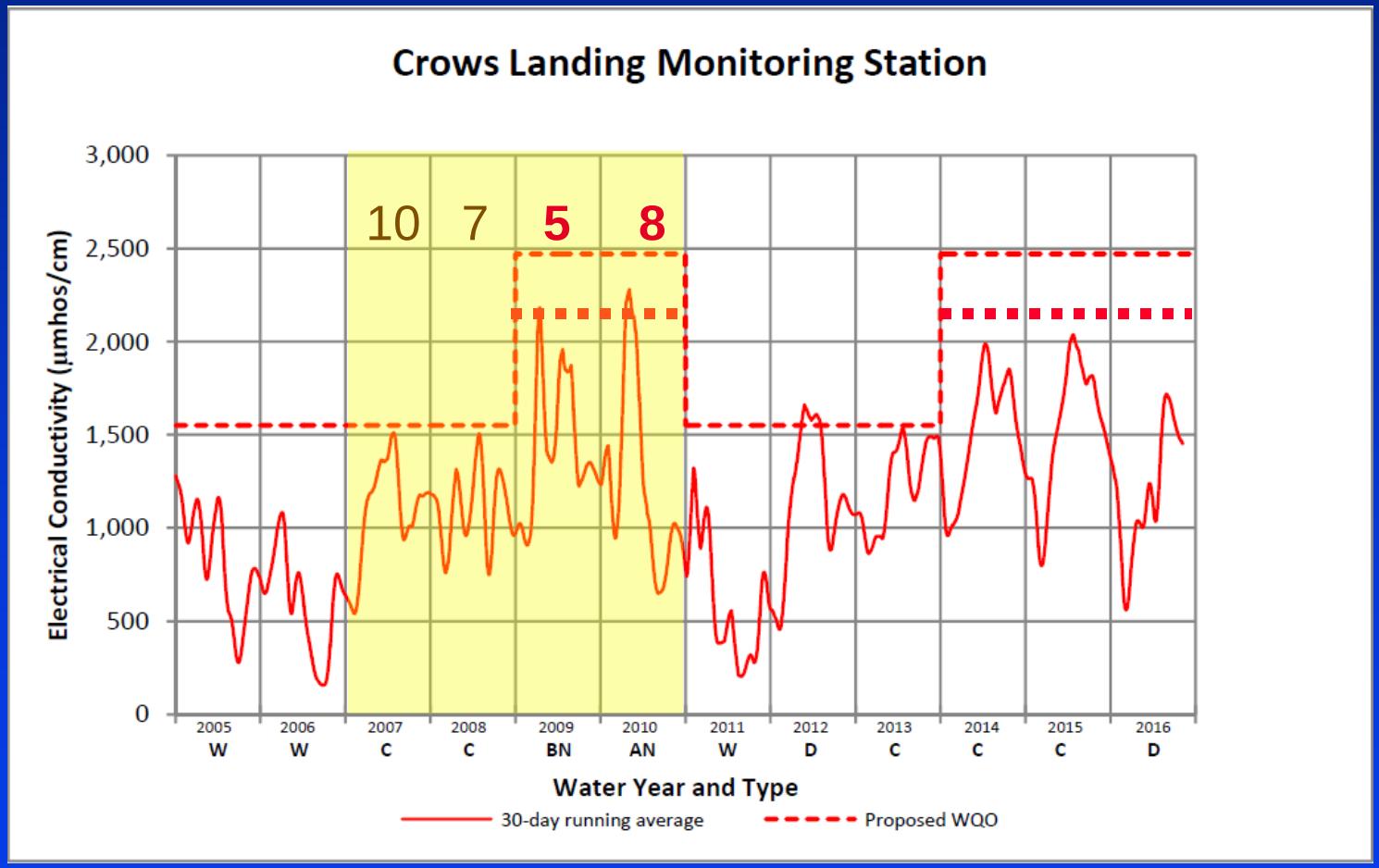
Example # 1	
Dry	2
BN	3
Dry	2
Total	7

Example # 2	
BN	3
Crit	1
Dry	2
Total	6

- An Extended Dry Period shall be deemed to exist for one water year (12 months) following a period with an indicator value total of six (6) or less

Special Considerations
Extended Dry Periods

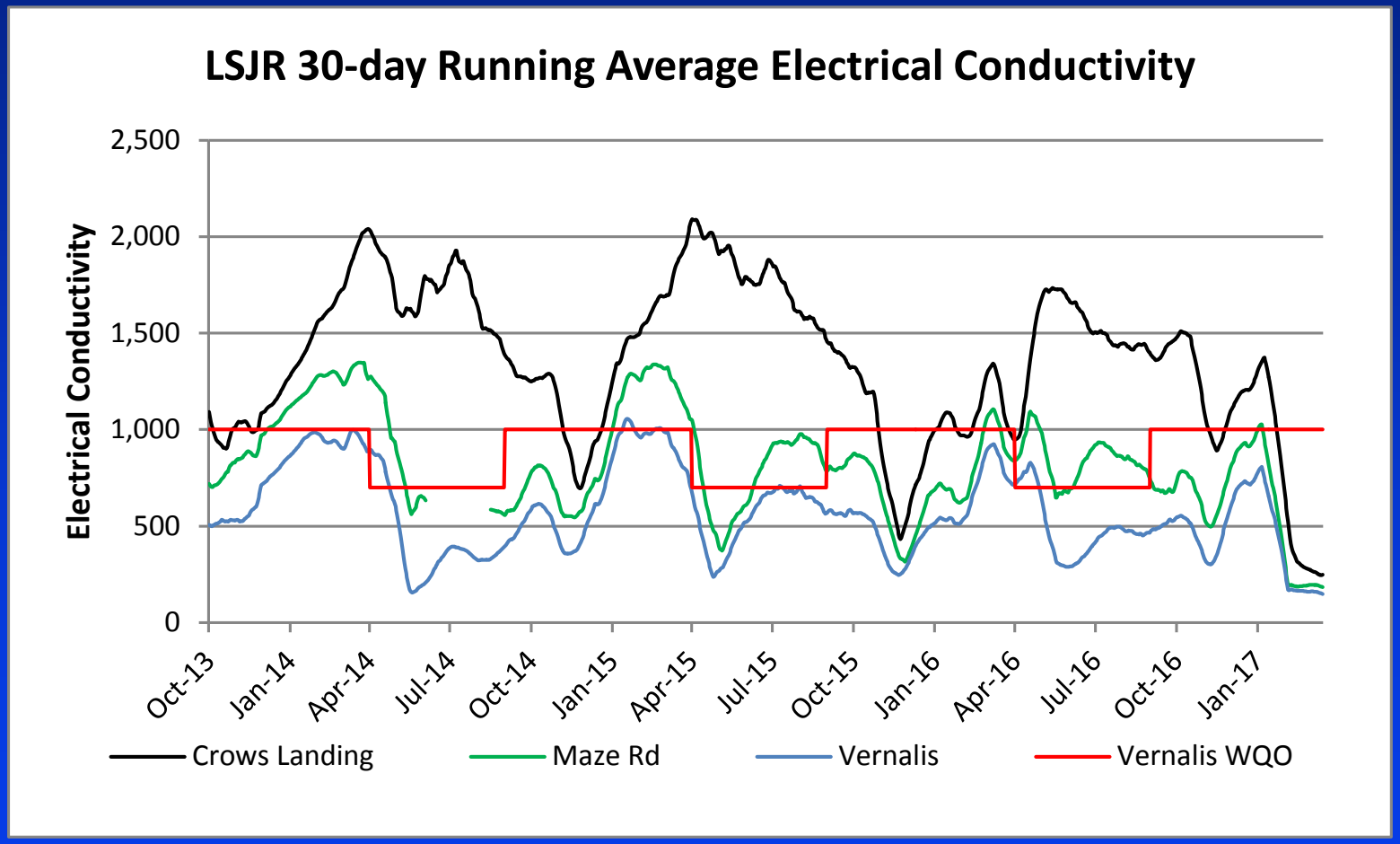
Influence of Water Year Types on Salinity Levels



Special Considerations

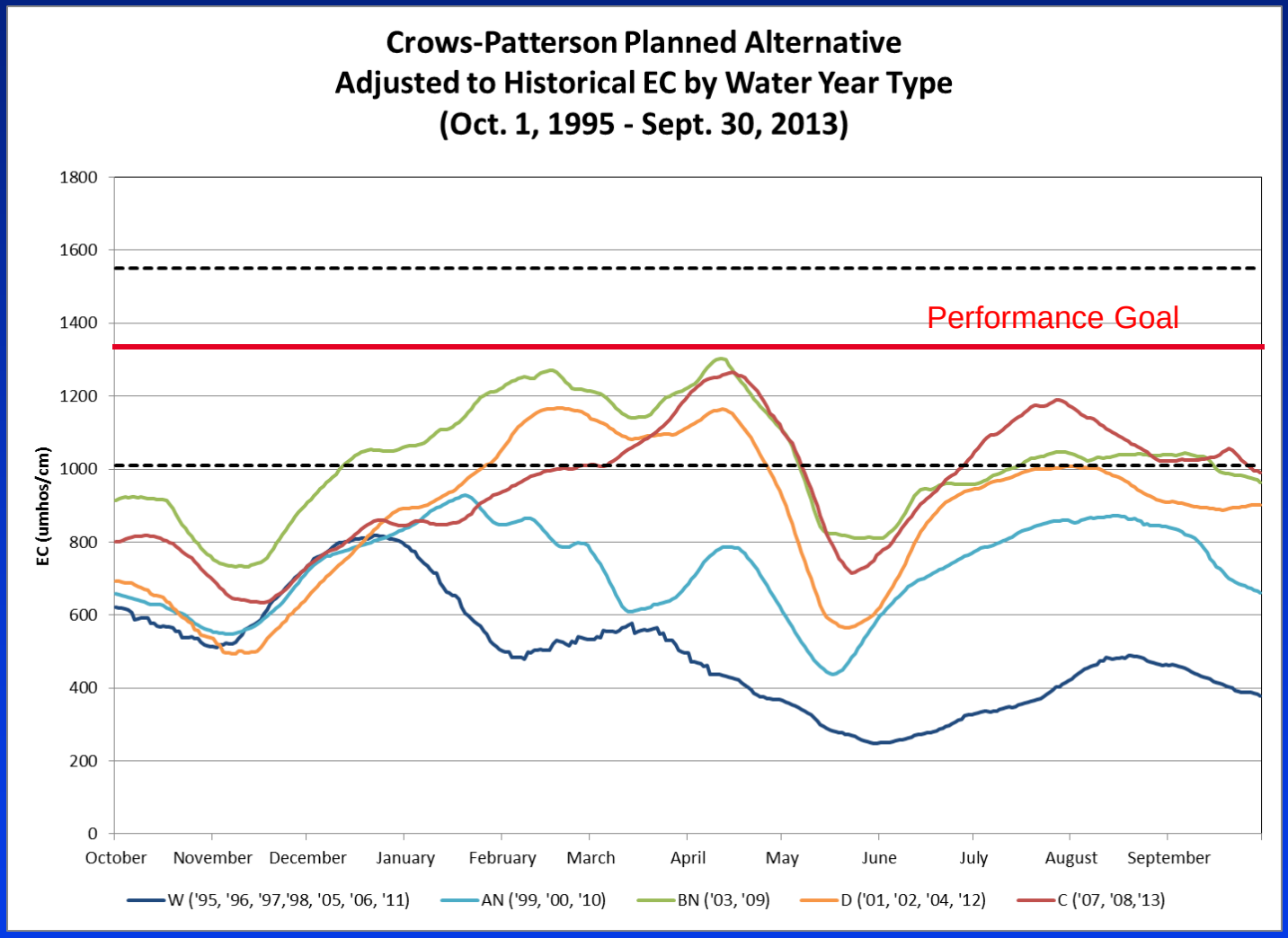
Extended Dry Periods

Most Recent Drought



Special Considerations
Performance Goal

Special Considerations
Performance Goal



Special Considerations
Performance Goal

Proposed Performance Goal Periods

WY Type	Irrigation Season		Non-irrigation Season
	Mar-Jun	Jul-Oct	Nov-Feb
Wet	1350 µS/cm		
Above Normal	1350 µS/cm		
Below Normal	1350 µS/cm		
Dry	1350 µS/cm		
Critical			

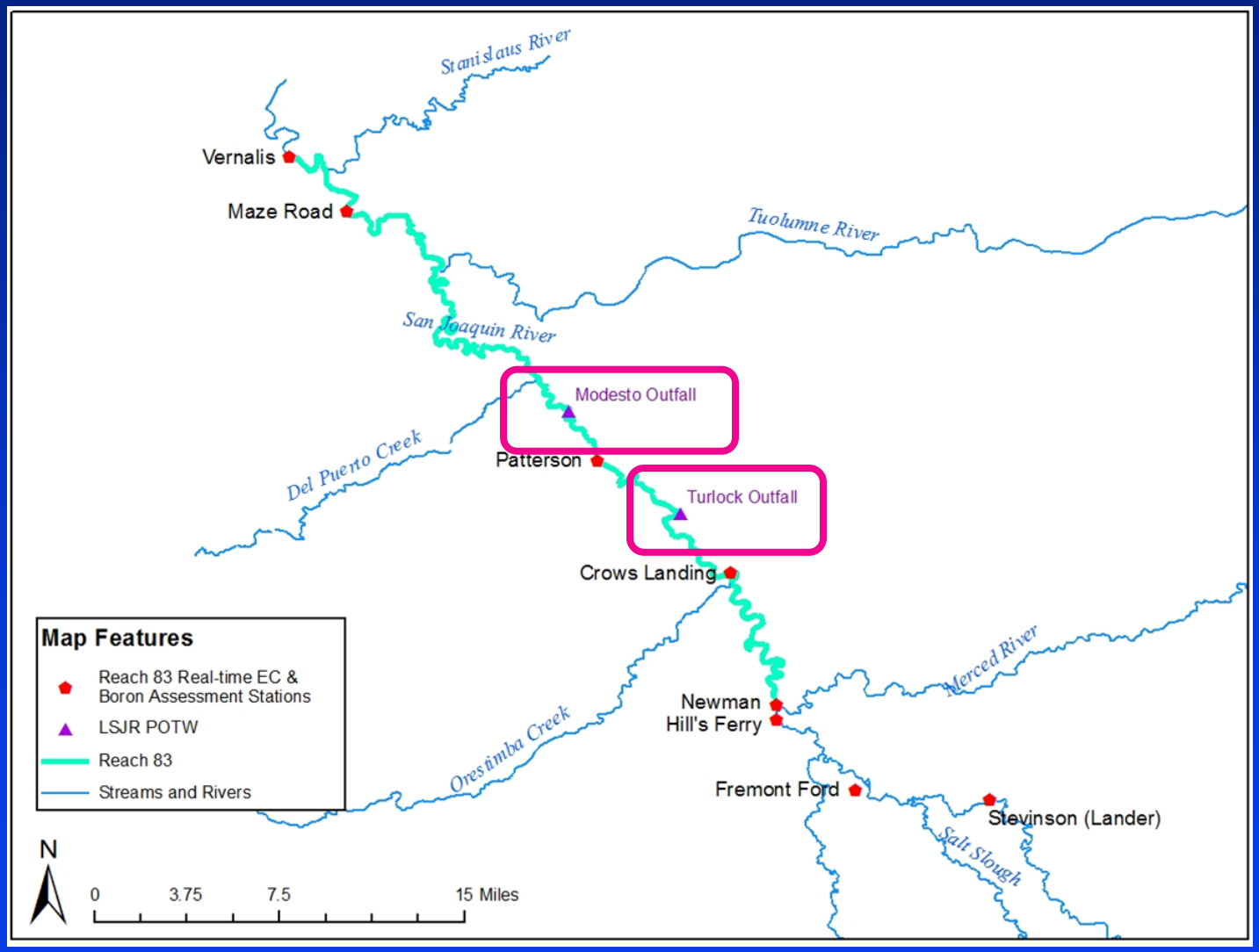
Special Considerations
Performance Goal

Performance Goal not Met?

- Staff evaluation
- Solicit information from:
  - Dischargers
  - RTMP
  - Other interested parties

Special Considerations

NPDES Compliance



Special Considerations
NPDES Compliance

1. Control Program (Vernalis)
   - End-of-pipe discharge limits: 700 and 1,000 µS/cm by 2022

   --OR--

   - Participation in a Board-approved Real Time Management Program
2. Control Program (Upstream)
   - Basin Plan Guidance

Special Considerations
NPDES Compliance

Proposed Guidance

- RPA - Dilution in receiving water to first downstream AGR or MUN diversion
- TDS Load or EC Concentration
  - Site-Specific Dry Weather/Wet Weather Conditions
- Monthly average concentration (AGR)

Special Considerations
Boron Compliance

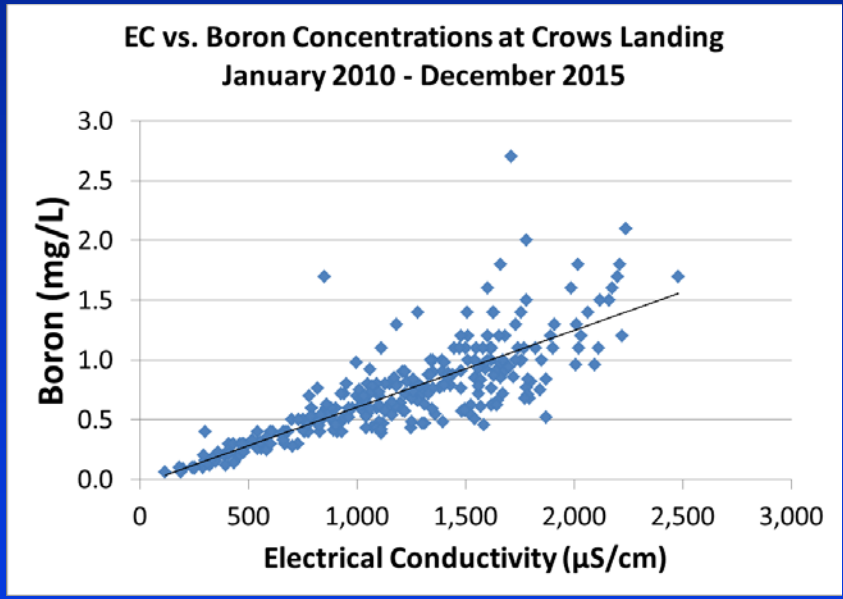
Existing WQOs in Lower San Joaquin River

Boron (mg/L)	Statistical Parameter	Enforcement Period	Water-Year Type
0.8	monthly mean	15 March through 15 Sept.	All, except Critically Dry
1.0	monthly mean	16 Sept. through 14 March	All, except Critically Dry
1.3	monthly mean	1 October through 30 Sept.	Critically Dry
2.0	maximum	15 March through 15 Sept.	All
2.6	maximum	16 Sept. through 14 March	All

Special Considerations
Boron Compliance

Boron Evaluation

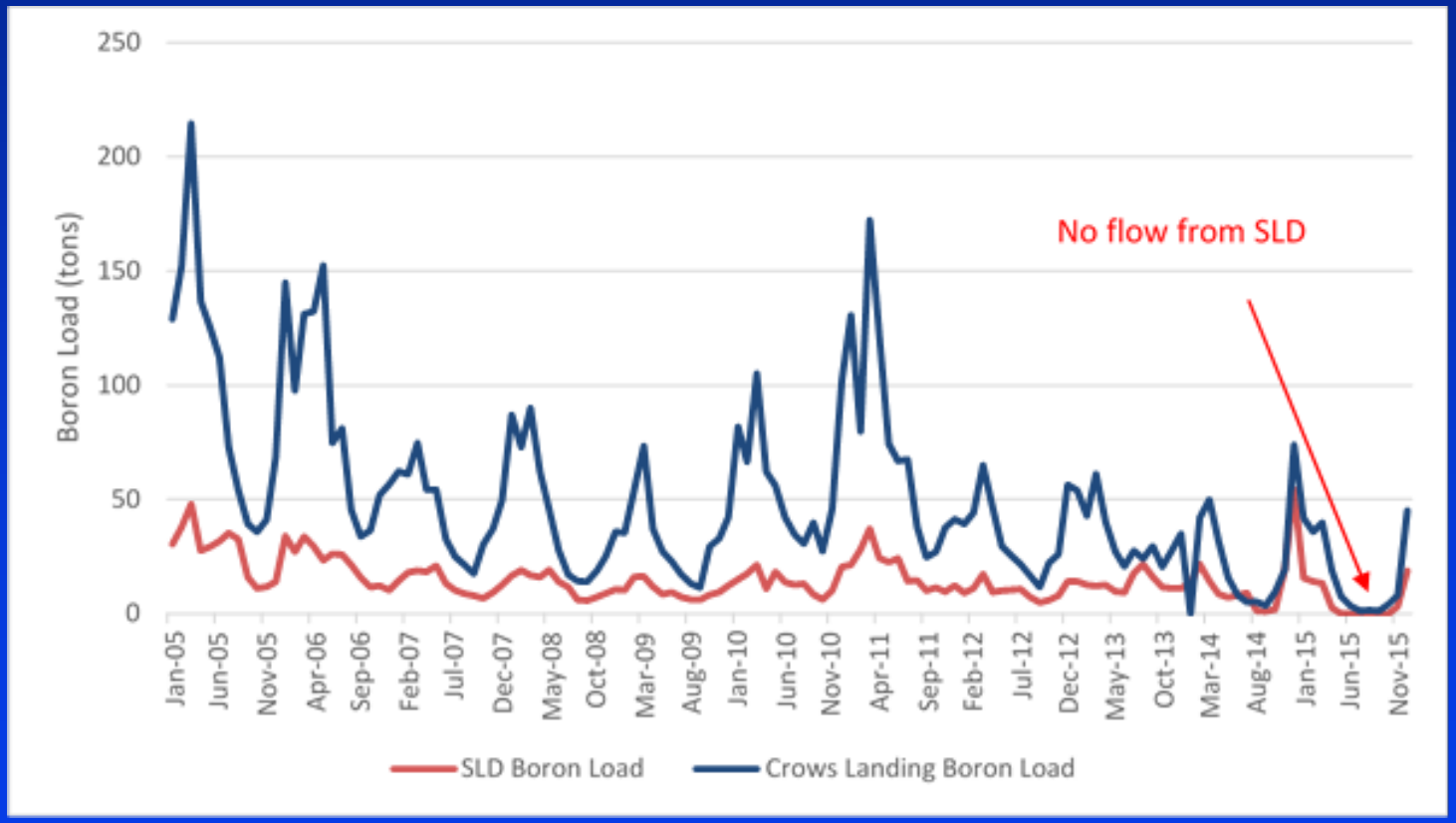
- Initial Review: EC/Boron ratio
  - Ratios in flux
- Additional analyses:
  - Boron Loads in the SJR
  - Boron Concentrations vs. WQOs
  - Impact of Grasslands Bypass Project



Special Considerations

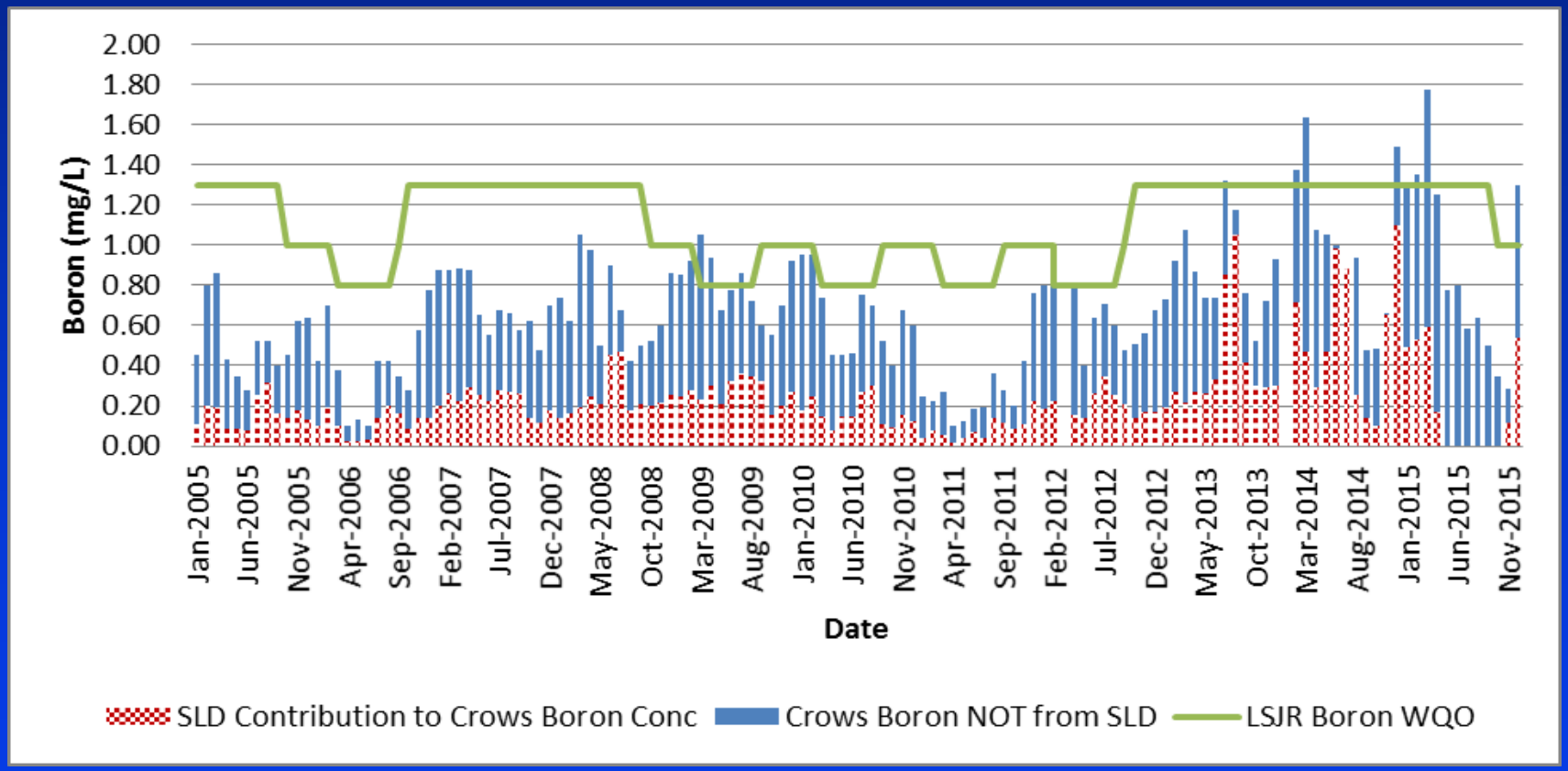
Boron Compliance

Monthly Boron loads from San Luis Drain (Grasslands Bypass Project) and LSJR Crows Landing (in tons)



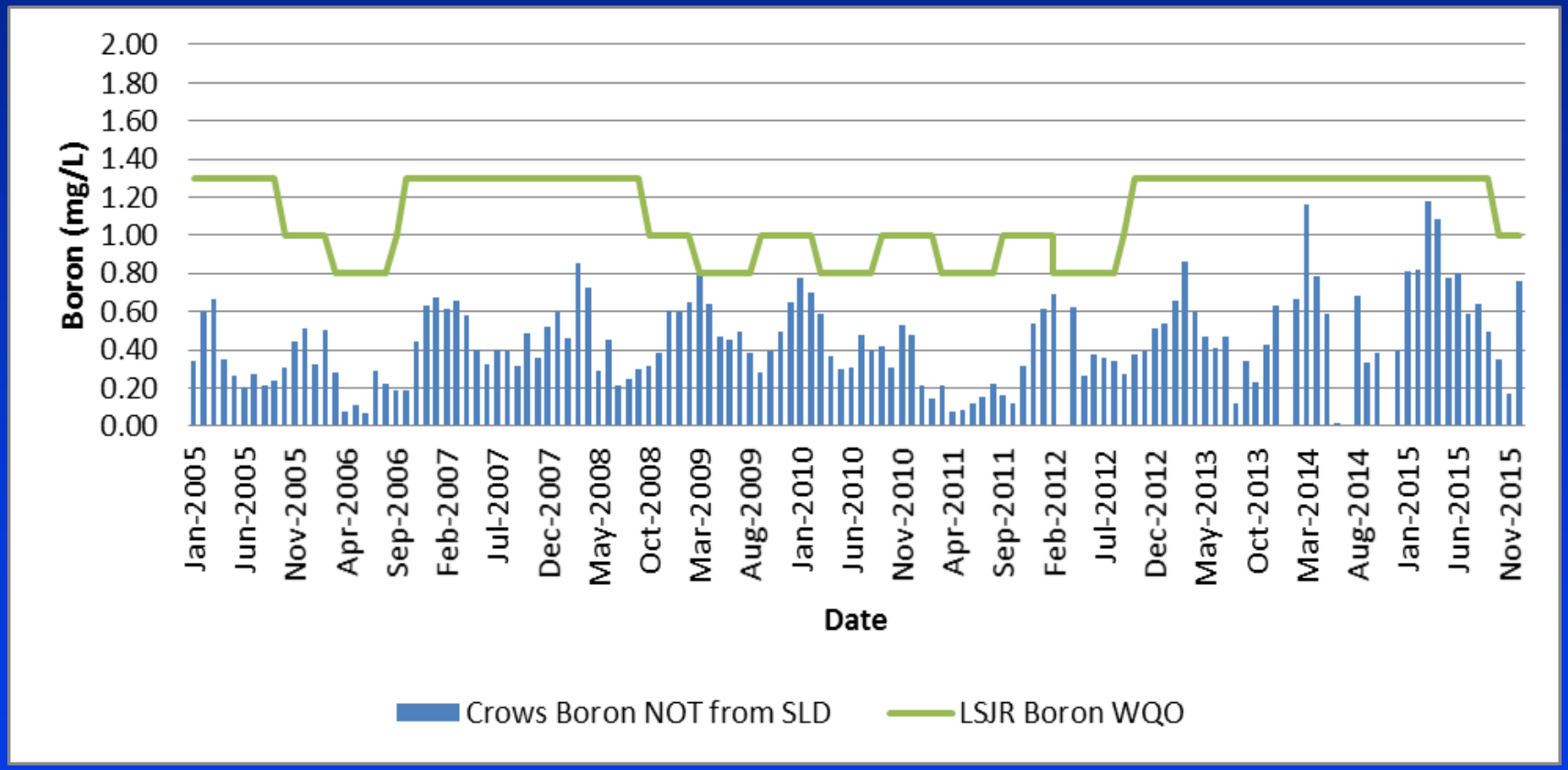
Special Considerations
Boron Compliance

Monthly Boron Concentration at Crows Landings



Special Considerations
Boron Compliance

Monthly Boron Concentration at Crows Landings



Special Considerations
Basin Plan Reopener

After 10 Years

- Changing Hydrology
  - SJR Restoration Program
  - Bay-Delta Flow Objectives
  - Grasslands Bypass Project- (no discharge >2019)
- Evaluate implementation projects
- Evaluate Monitoring Data
  - Look at compliance with the WQOs and achievability of the Performance Goal
  - Consider a variety of water year types

Independent Scientific Peer Review

Peer Review of these Conclusions:

1. The WARMF model is a reasonable tool to evaluate water quality changes under the various alternatives evaluated.
2. The Hoffman model is an appropriate tool to calculate ranges of protective salinity criteria for irrigated agriculture.
3. Based on recent trend data it is reasonable to expect that proposed EC WQOs will be protective of boron WQOs.

In addition reviewers were invited to provide general comments on the staff report.

Peer Reviewers

- Dr. Randy A. Dahlgren, UCD Land, Air, & Water Resources
- Dr. Todd H. Skaggs, U.S.D.A. Salinity Laboratory, Riverside
- Dr. Steven R. Grattan, UCD Cooperative Extension

Conclusion 1

Is the WARMF model a reasonable tool to evaluate water quality changes under different implementation alternatives?

→Yes

→However, must be qualified as having great uncertainty as a forecast tool

Conclusion 1

Amendments Account for Uncertainty

- Water Quality Objectives higher than predicted by model
- Performance Goal at the model-predicted water quality

Conclusion 2

Is the Hoffman model an appropriate tool to calculate ranges of protective salinity criteria for irrigated agriculture?

<u>All Three Reviewers:</u>

→Science and concepts sound

<u>Recommendations</u>

→Evaluate developing models/crop data for future10 year review

- Leaching Fractions Variable
  - Drip irrigation becoming more popular

Conclusion 3

Is it reasonable to expect that proposed EC WQOs will be protective of boron WQOs, based on recent trend data?

→Yes

→Recommendation

- Increase monitoring to confirm boron/EC ratio

Big Picture Comments

Grattan

→WQOs for specific ions need to be considered

- Na/Cl

  —Impacts to different almond root stock - "Nemaguard" root stock sensitivity

→Model selections

- Reduction of Conservative factors

Big Picture Comments

Dahlgren

→Recognizes RTMP acts as an insurance policy that provides necessary monitoring

→Report should clarify that these amendments do not aggravate other listed impairments

Next Steps & Timeline

Public Review	**Ends April 14 2017**
Response to Comments	May 2017
Regional Board Hearing to consider Adoption	June 2017
State Board Hearing to consider Adoption	TBD (December 2017)
OAL & US EPA Approval	TBD (June 2018)

Questions?