Evolving Responses to Drought

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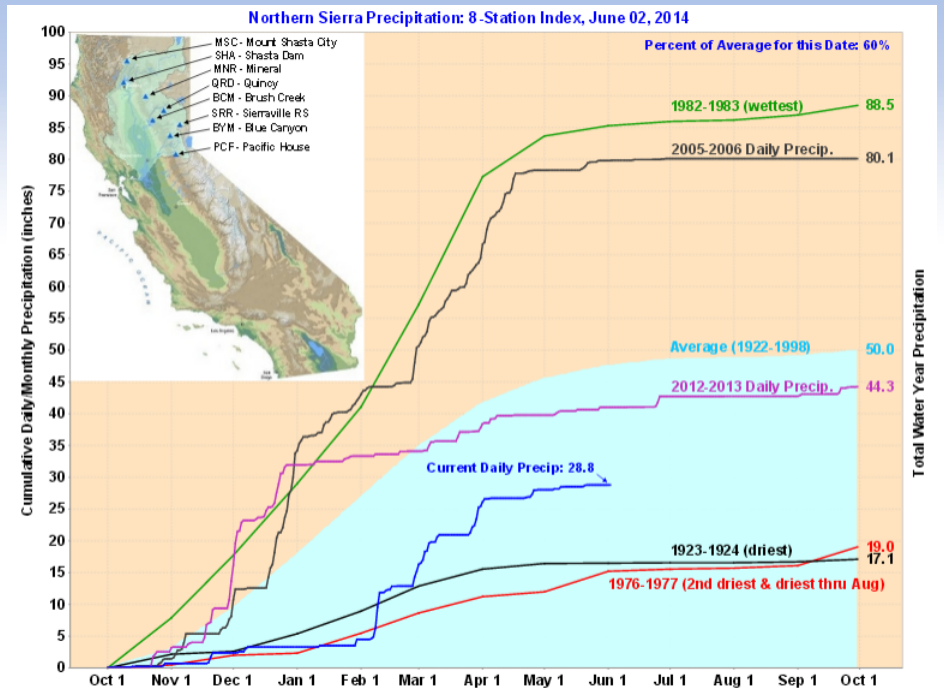
Delta and Statewide Water Management
California Department of Water Resources

June 4, 2014

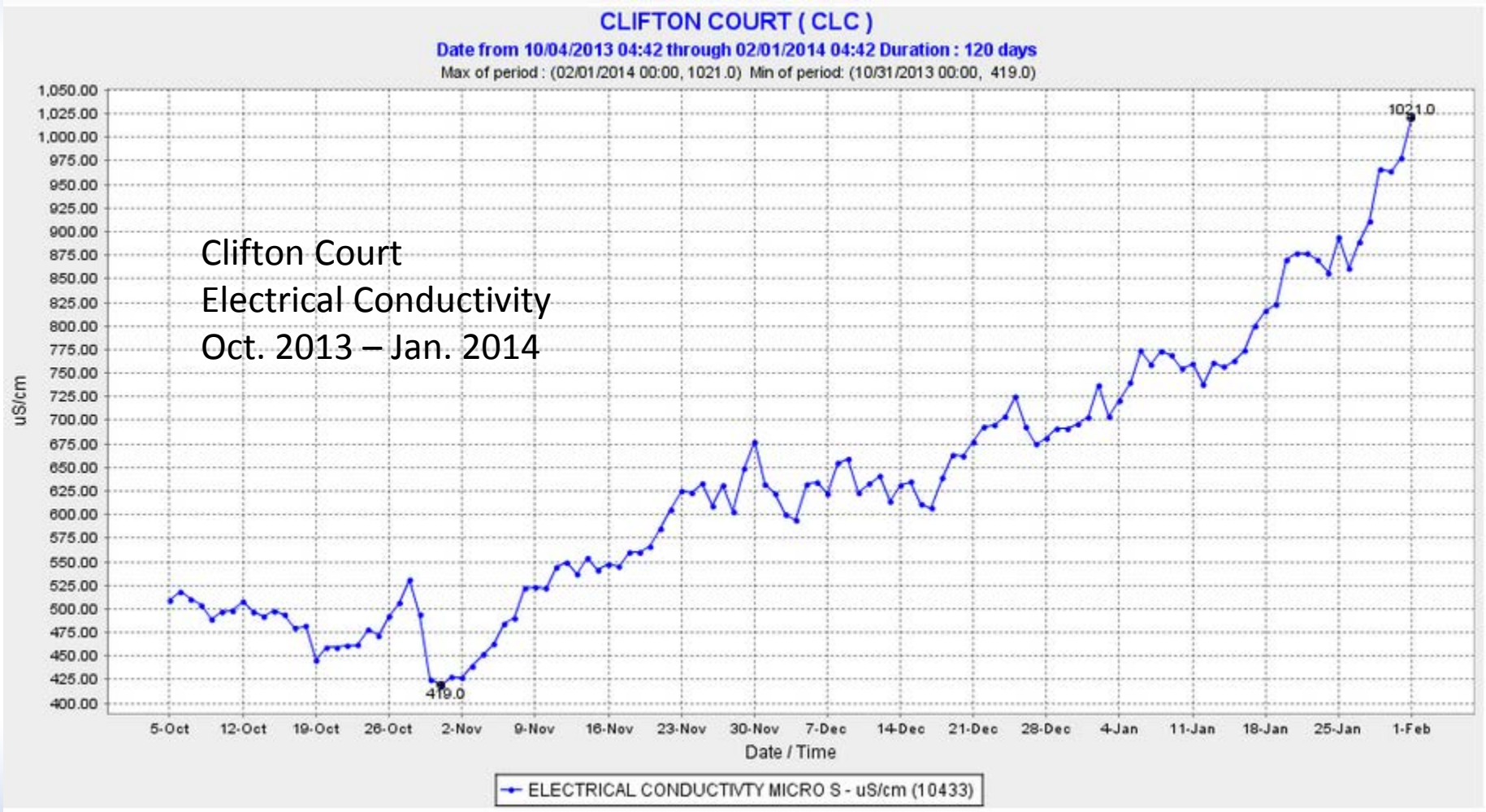
"Just water?"



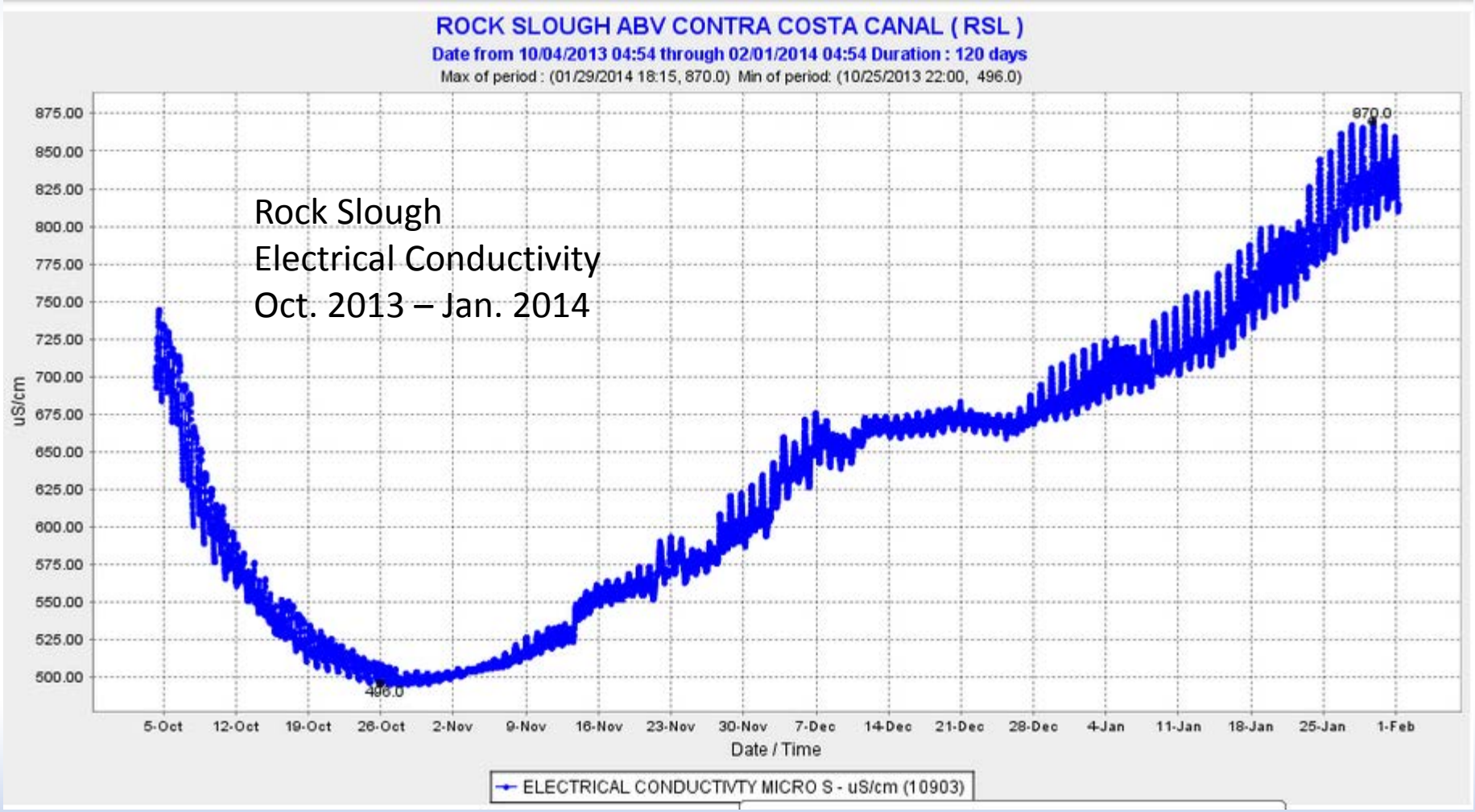
January 2014

- Unprecedented Dry Conditions
- Balance Multiple Needs
- Environmental Goals:
  - Store Cold Water for Fall Salmon Rearing
  - Provide Spring Flows for Smelt and Salmon
  - Minimize Entrainment

Increasing Salinity – Clifton Court



Increasing Salinity – Rock Slough



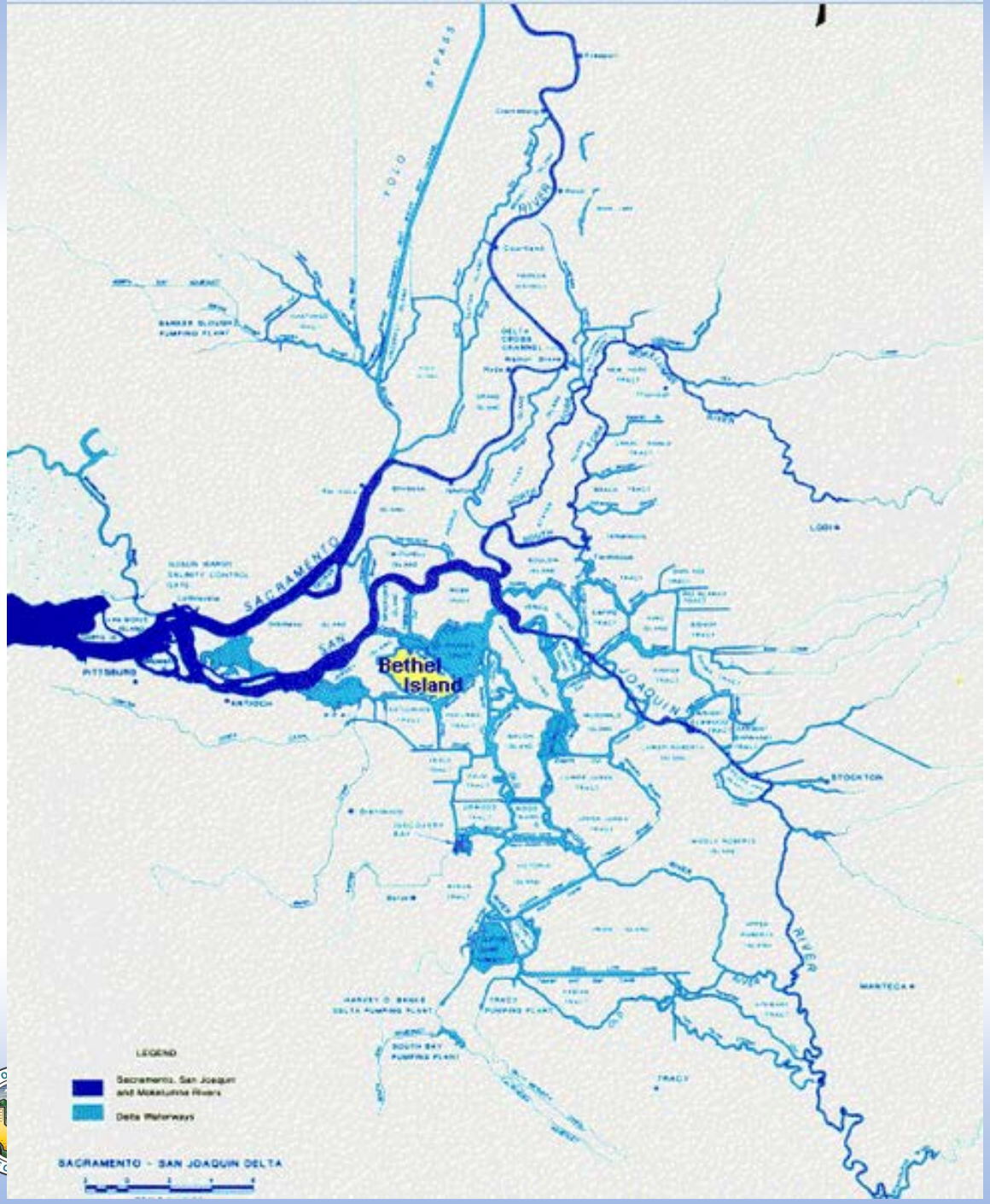
Temporary Urgency Change Order

January – March

- Reduced outflow, conserve upstream storage
- D-1641 modifications, outflow and Delta Cross Channel standards
- Continue to meet all other requirements (OMR, salvage triggers, etc.)
- Minimal pumping: 1,500 cfs for health & safety

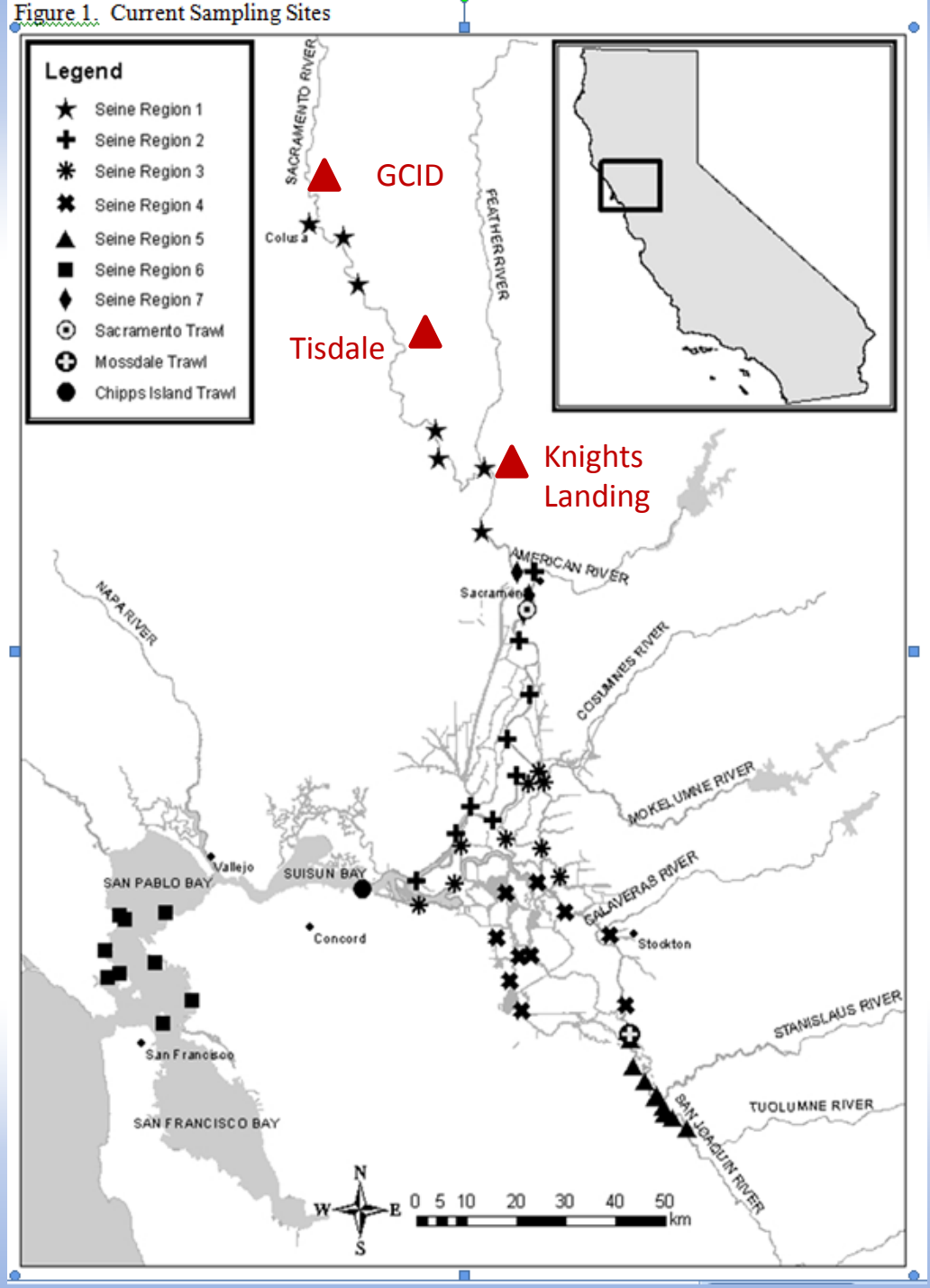
- Amendments Included:
  - Use of I:E ratio of 1:1 for pulse flows
  - Exports up to OMR limits when Delta outflow is 7,100 cfs (3 day avg) or X2 at Collinsville
  - E/I averaging periods for precipitation events

Migration Pathways



- Predation higher in Mokelumne system
- DCC gate closure requirements intended to reduce mortality
- Reduced outflows could affect migration

Juvenile Salmon Monitoring



- 58 Beach Seine locations
- Each location sampled once per week
- Three trawl locations – Mossdale (San Joaquin), Sherwood Harbor (Sacramento), Chipps Island (Western Delta)
- Trawls conducted three times per week
- Rotary traps – GCID, Knights Landing, Tisdale

Additional Monitoring - 2014

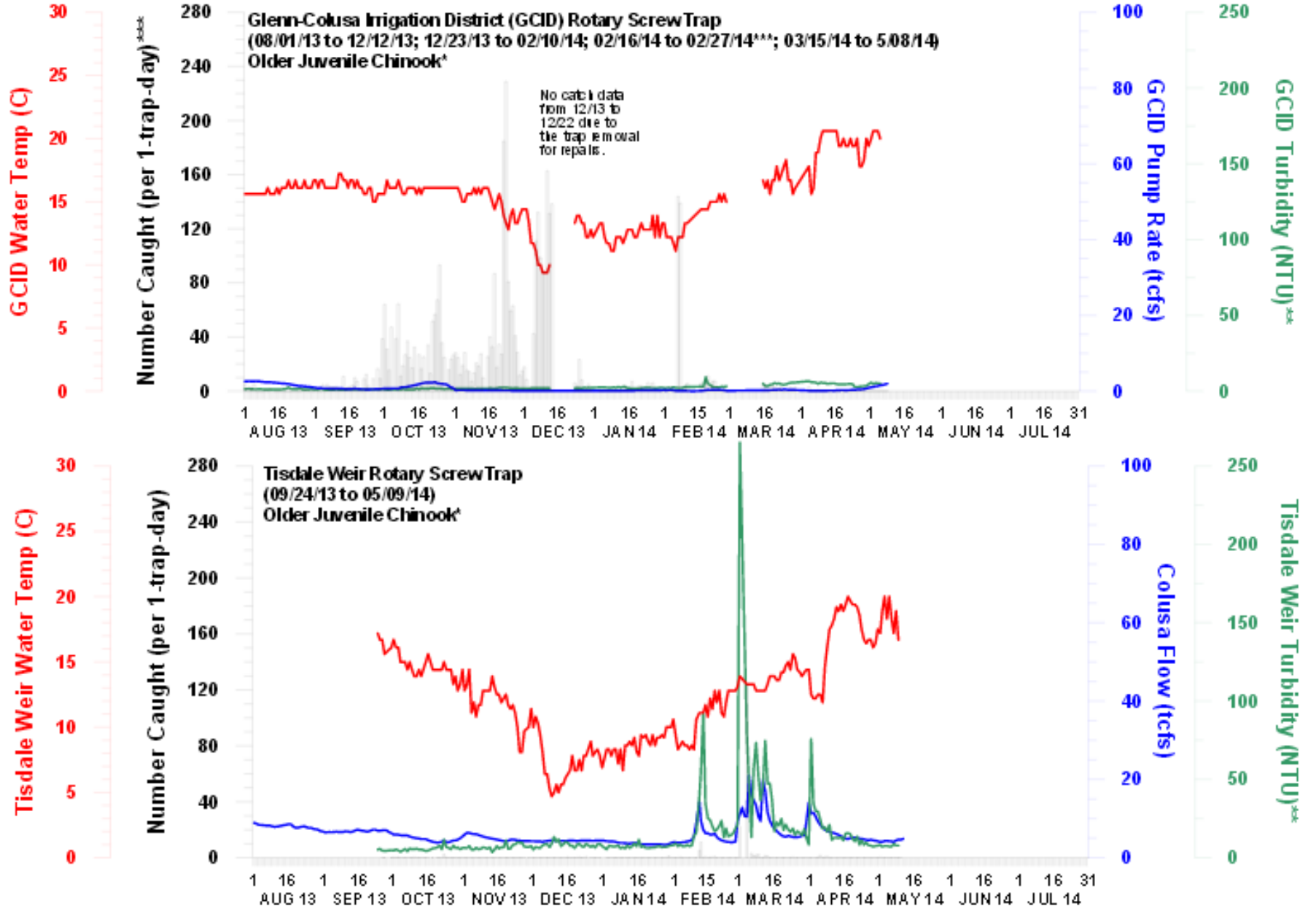
When DCC Gates Are Open

- Daily Sacramento trawl
- Daily beach seines
- Knights Landing catch triggers

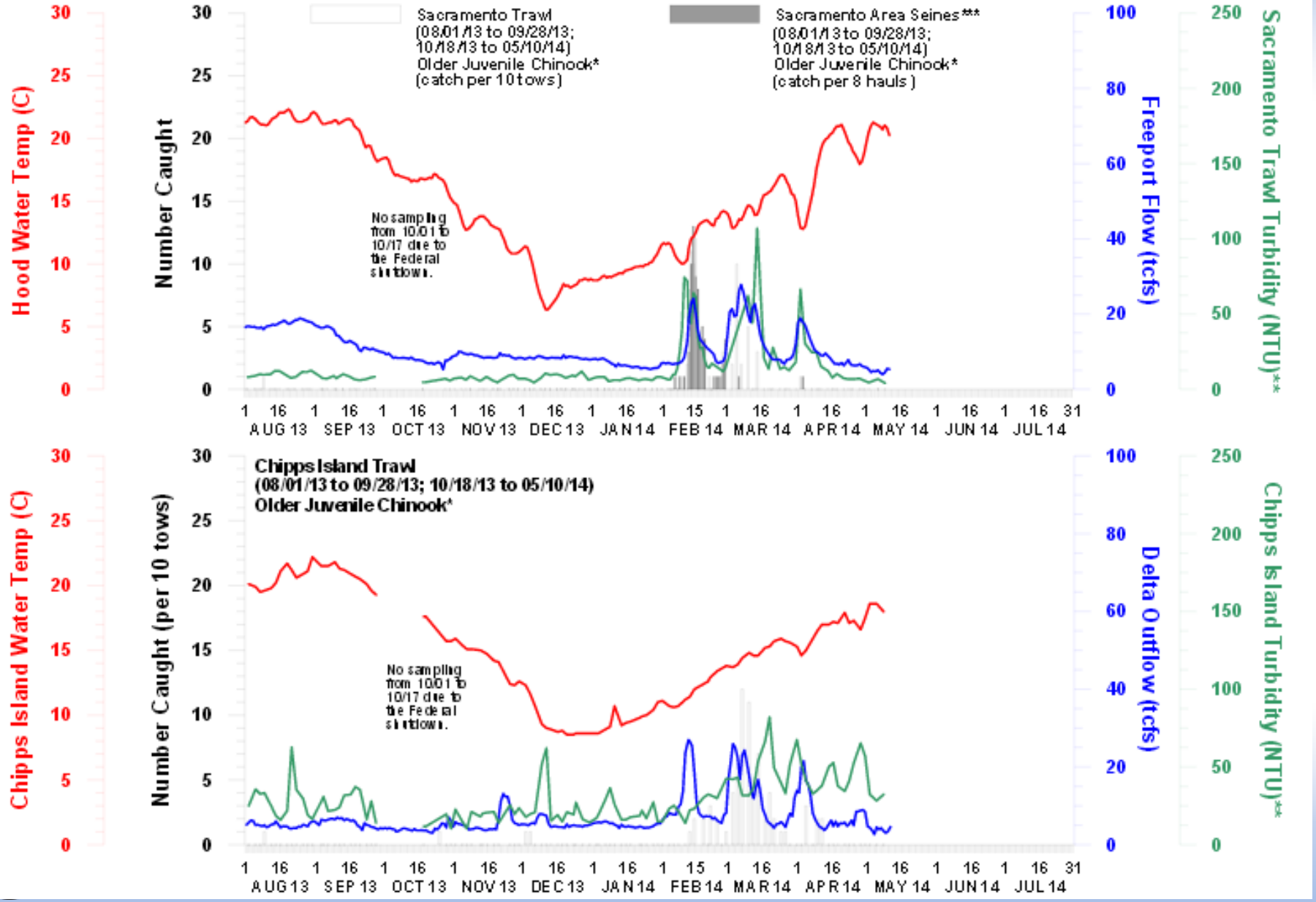
Additional 2014 Monitoring

- Upstream temperatures/redds
- Submerged aquatic vegetation/phytoplankton
- Salmon migration review

Older Juvenile Chinook



Older Juvenile Chinook



Additional Monitoring – Barriers; 2015 and Beyond

With Barriers

- Additional water quality sampling
- Fish presence and passage
- Acoustic arrays

Longer-term Enhancements

- Improve smelt distribution and abundance monitoring
- Improve understanding of salmon movement
- Upstream temperature effects
- Predation

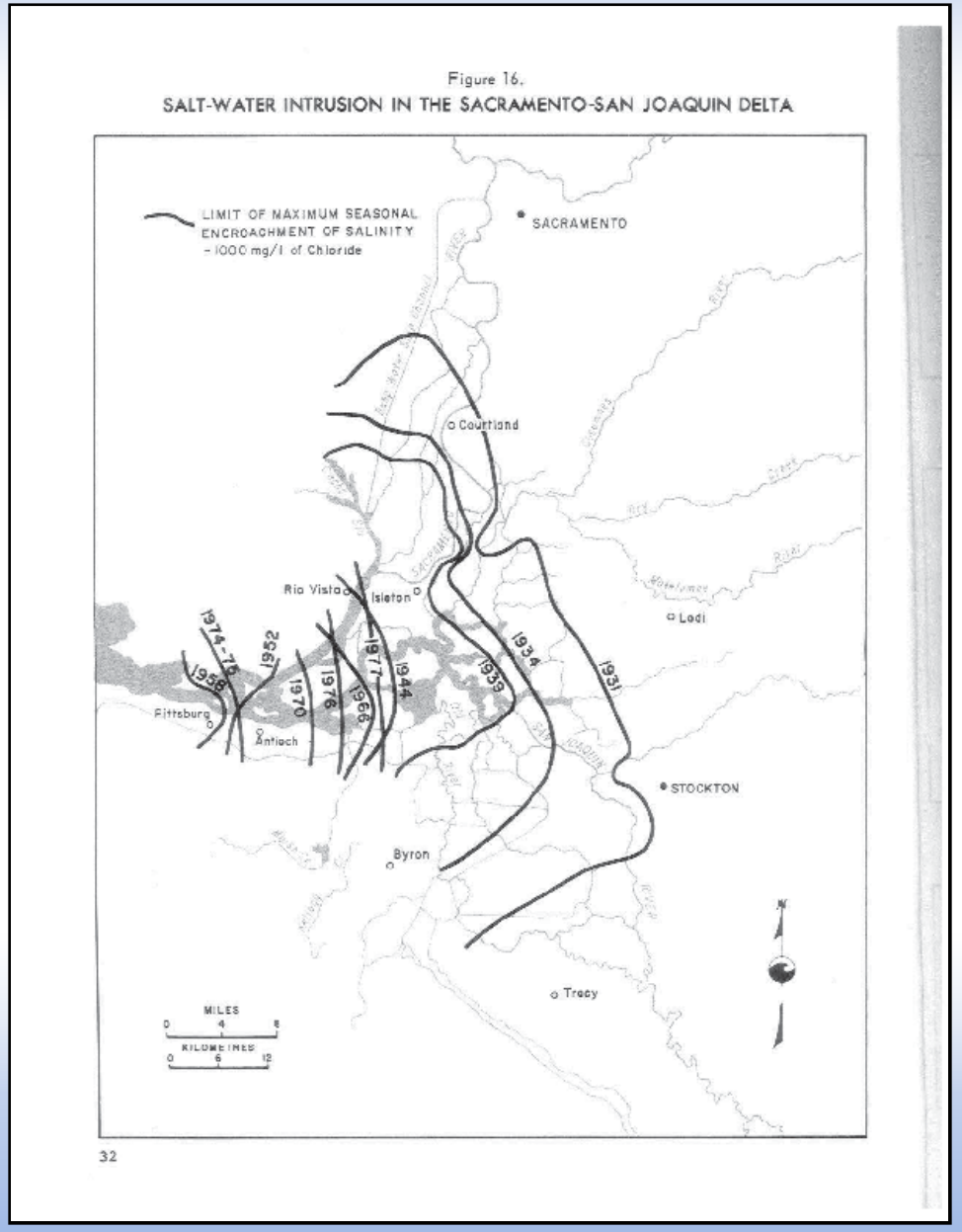
Historic Saltwater Intrusion

Taken from 1978 report

Multiple incidents

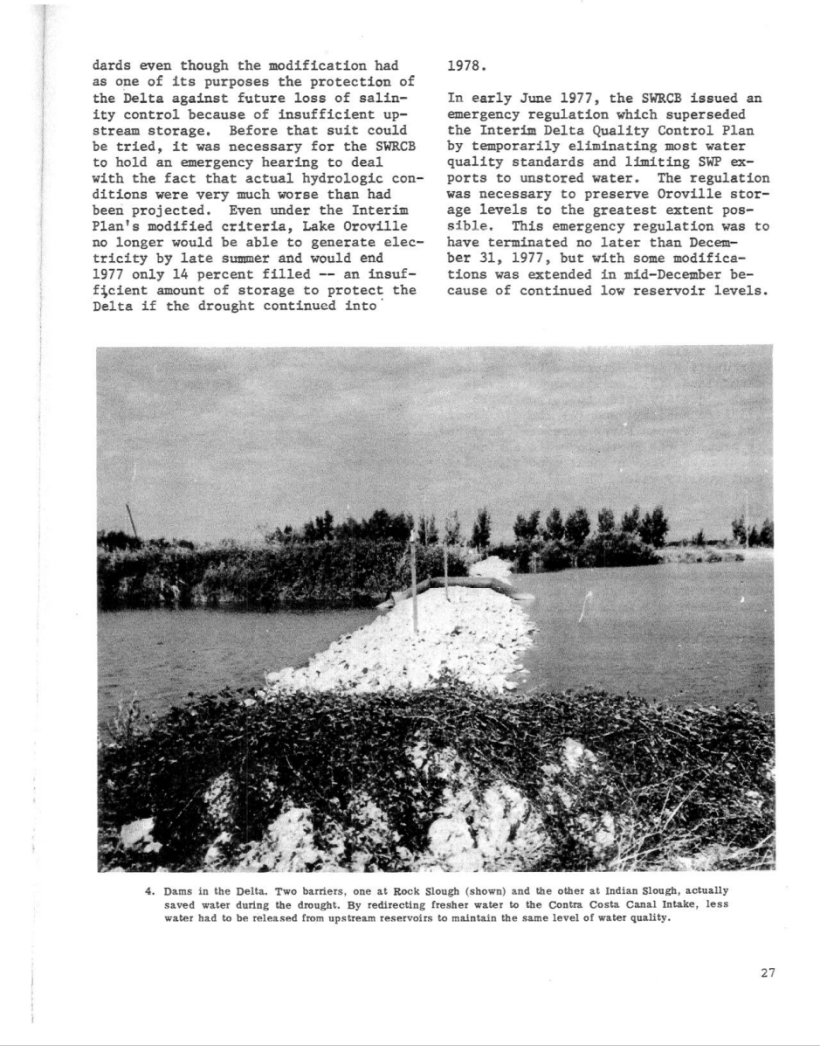
Intrusion makes water:

- unsuitable for drinking
- unsuitable for irrigation
- unsuitable for in-Delta uses
- unsuitable for other purposes



1976-77 Emergency Barriers

- 38 years ago
- California's population then was 22 million
- Today 's population - 38 million
- The '76-77 barriers helped protect many Delta water users including:
  - Delta farmers
  - City of Antioch
  - City of Tracy
  - Contra Costa Water District

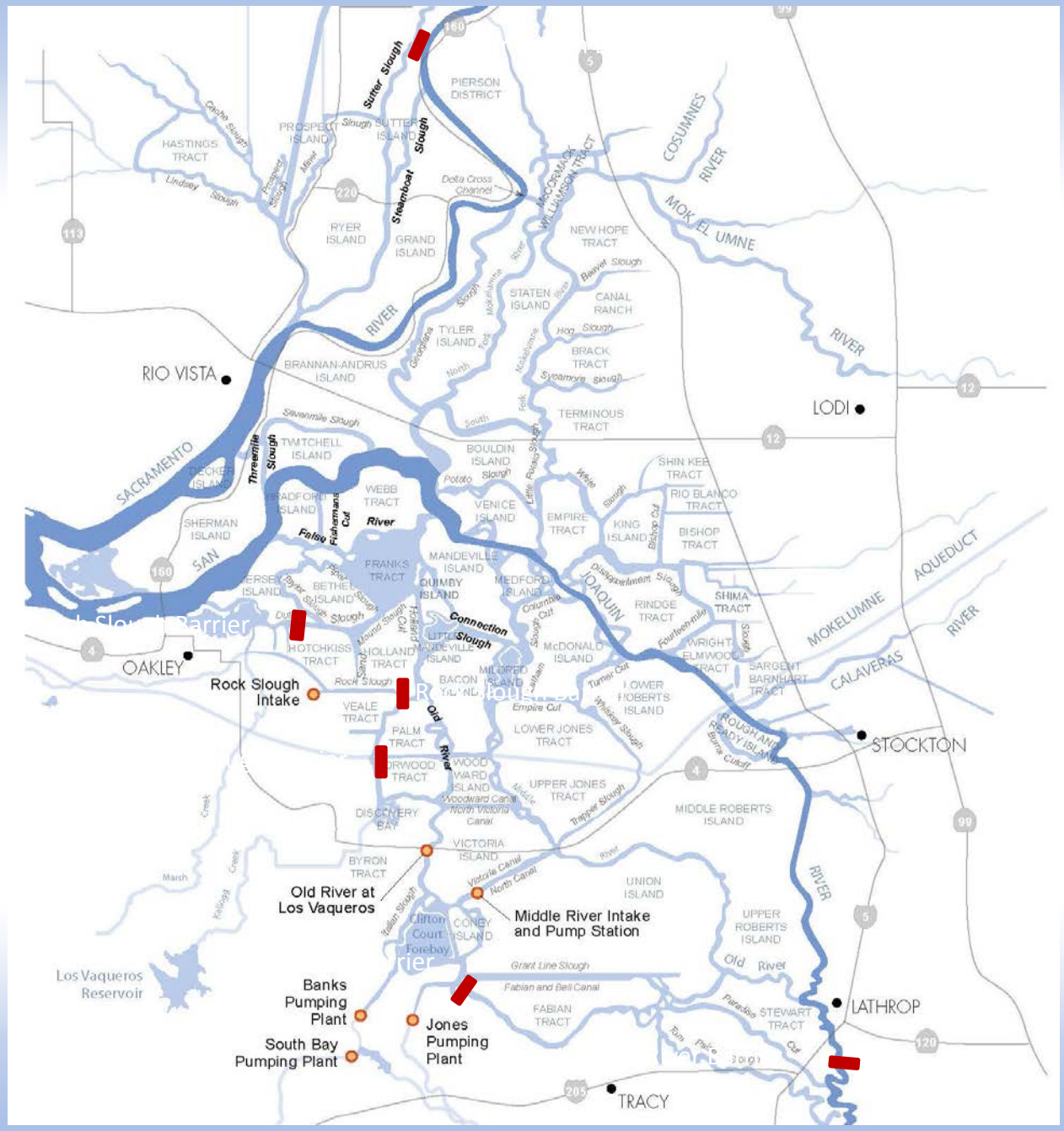


dards even though the modification had as one of its purposes the protection of the Delta against future loss of salinity control because of insufficient upstream storage. Before that suit could be tried, it was necessary for the SWRCB to hold an emergency hearing to deal with the fact that actual hydrologic conditions were very much worse than had been projected. Even under the Interim Plan's modified criteria, Lake Oroville no longer would be able to generate electricity by late summer and would end 1977 only 14 percent filled -- an insufficient amount of storage to protect the Delta if the drought continued into 1978.

In early June 1977, the SWRCB issued an emergency regulation which superseded the Interim Delta Quality Control Plan by temporarily eliminating most water quality standards and limiting SWP exports to unstored water. The regulation was necessary to preserve Oroville storage levels to the greatest extent possible. This emergency regulation was to have terminated no later than December 31, 1977, but with some modifications was extended in mid-December because of continued low reservoir levels.

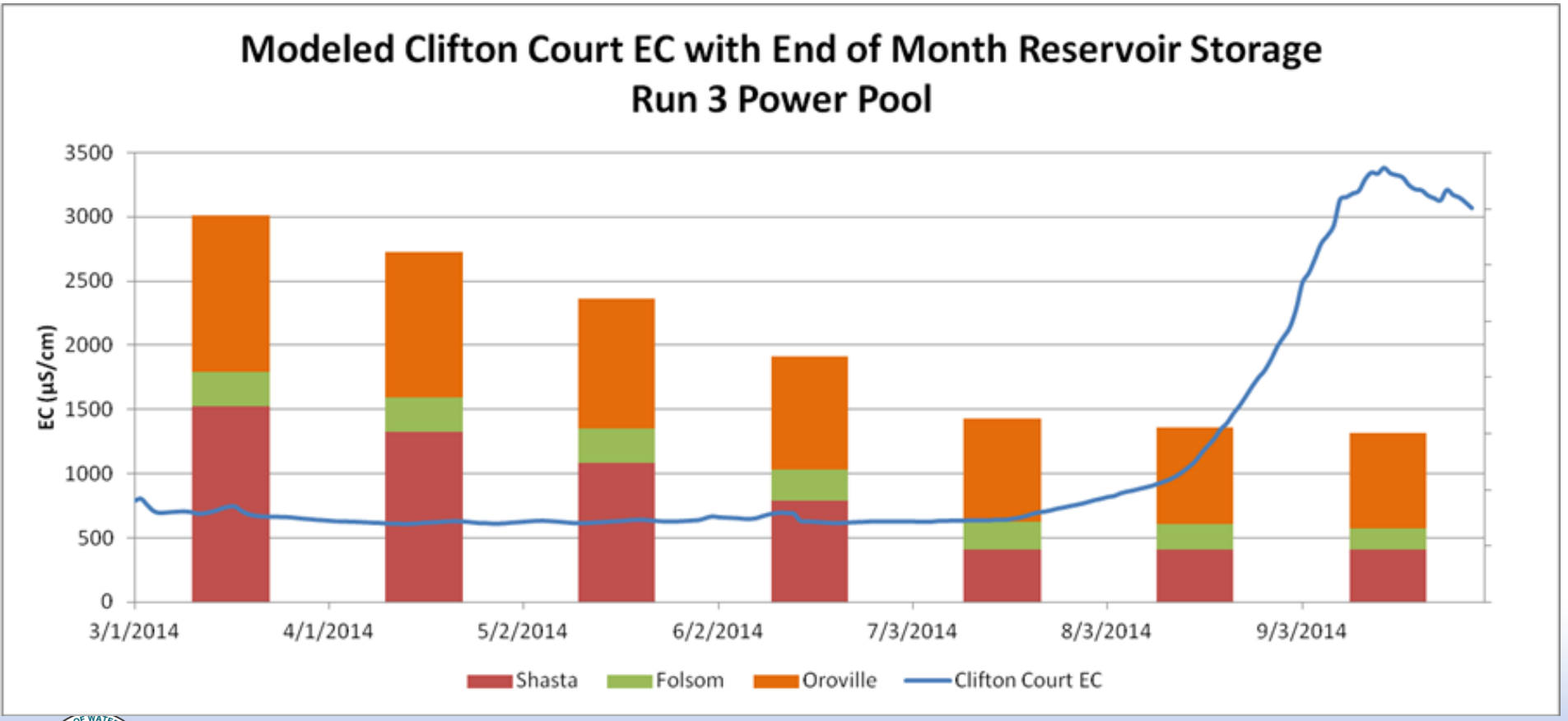
4. Dams in the Delta. Two barriers, one at Rock Slough (shown) and the other at Indian Slough, actually saved water during the drought. By redirecting fresher water to the Contra Costa Canal Intake, less water had to be released from upstream reservoirs to maintain the same level of water quality.

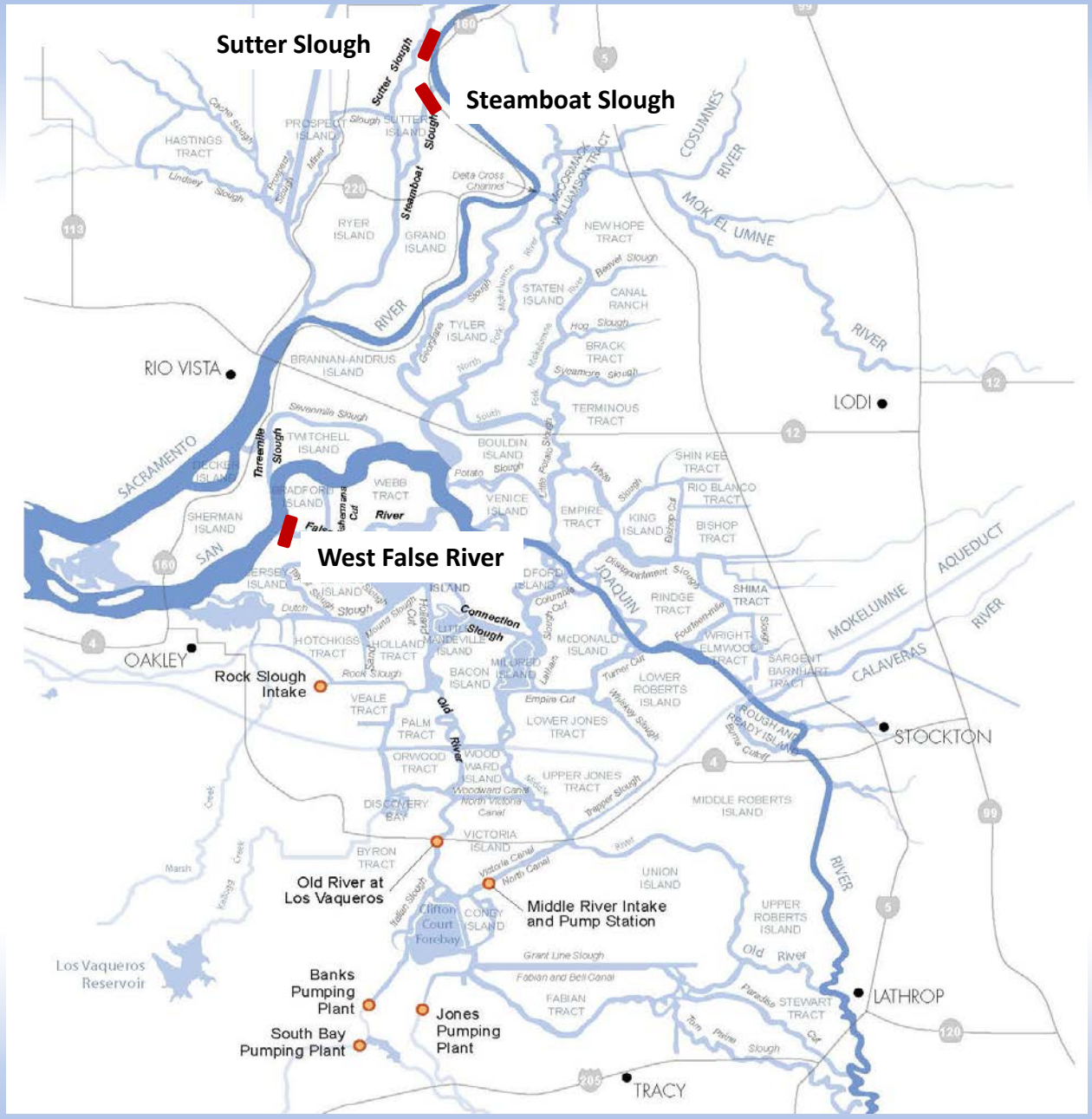
27



Barriers installed in 1977-78 Drought

Projected Salinity – 1/14

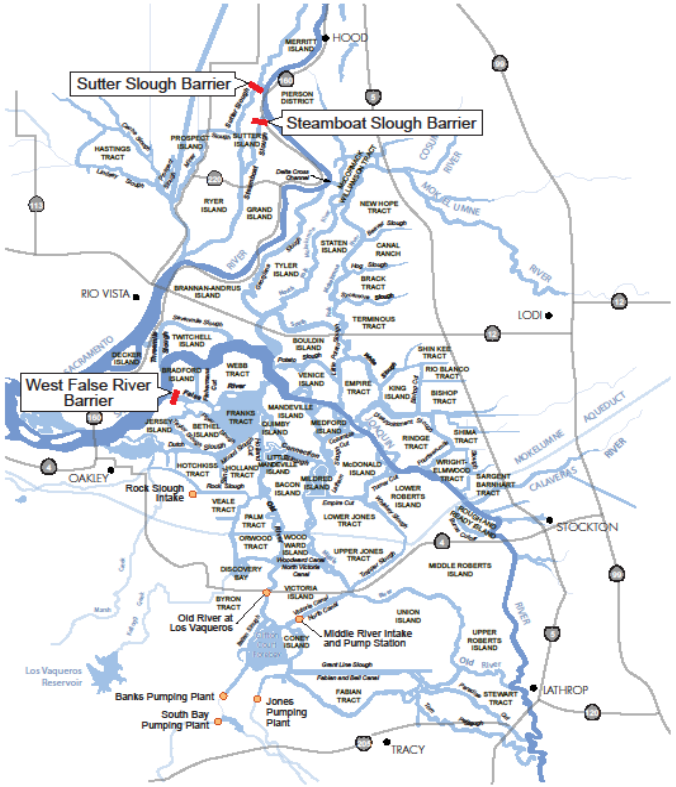




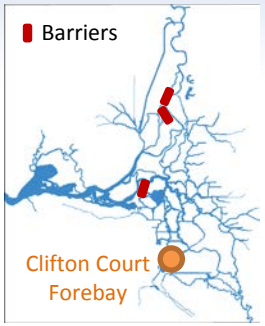
Sutter/Steamboat Sloughs and West False River Alternative

Locations of Potential Emergency Drought Barriers

- Temporary rock barriers
- Permits required
- Agency consultations
- Goals:
  - Prevent saltwater intrusion
  - Allow water managers to retain some water in upstream reservoirs for release later in the year



Comparison of Observed Data and Forecast with 1976 -1977 Observed Salinity (EC)
Barrier Installation – June 1, 2014



Obs 1976-77 Clifton Court Forebay

Observed Data Clifton Court Forebay

DSM2 Model Clifton Court Forebay

DSM2 Model - Forecasted Without Barriers

DSM2 Model - Sutter/Steamboat/False River Barriers - Installed June 1, 2014

EC

1600
1400
1200
1000
800
600
400
200
0

1976

1977

1-Jan-13
1-Feb-13
1-Mar-13
1-Apr-13
1-May-13
1-Jun-13
1-Jul-13
1-Aug-13
1-Sep-13
1-Oct-13
1-Nov-13
1-Dec-13
1-Jan-14
1-Feb-14
1-Mar-14
1-Apr-14
1-May-14
1-Jun-14
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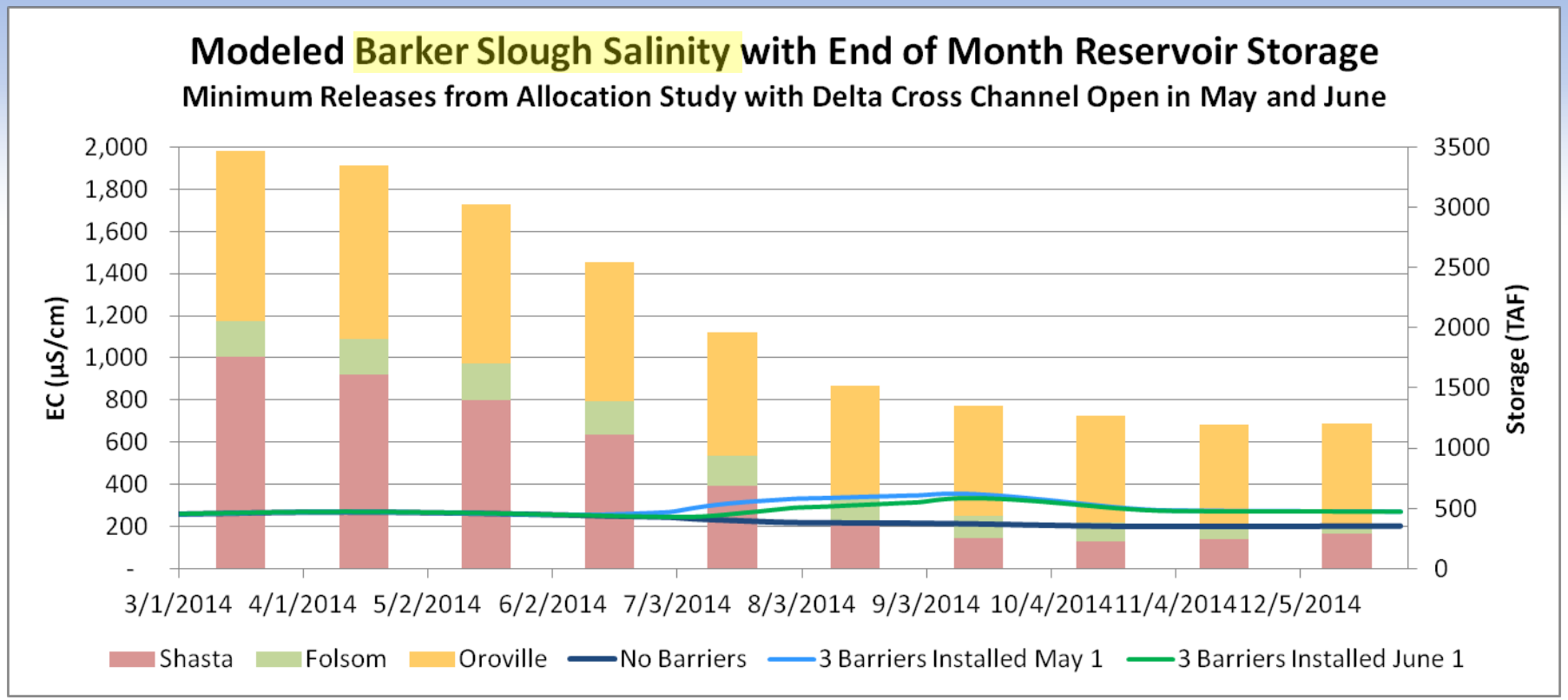
1-Aug-14
1-Sep-14
1-Oct-14
1-Nov-14
1-Dec-14

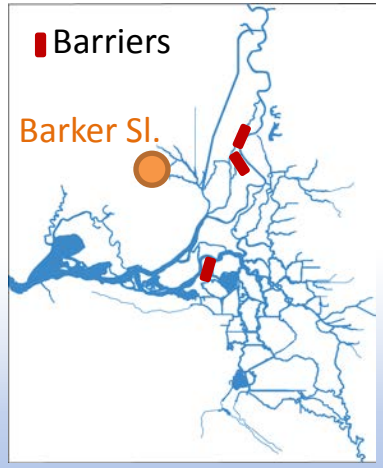


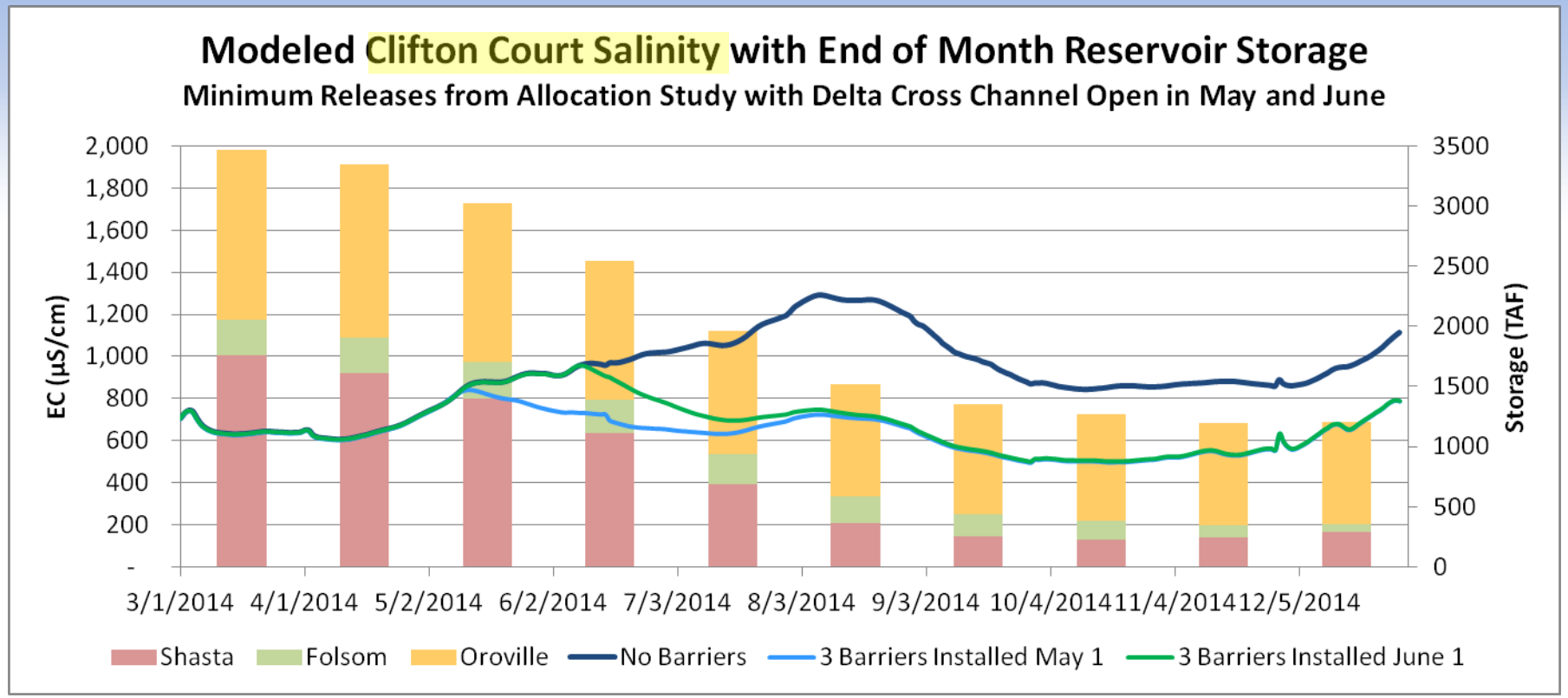
- Feb 20, 2014 forecast
- Feb 20 Reservoir Conditions
  - Shasta 1720 TAF 38% capacity
  - Folsom 290 TAF 29% capacity
  - Oroville 1385 TAF 39% capacity

Mar 16 Reservoir Conditions

- Shasta 2050 TAF 45% capacity
- Folsom 400 TAF 41% capacity
- Oroville 1600 TAF 45% capacity

- Total Reservoir Capacity ~9,000 TAF





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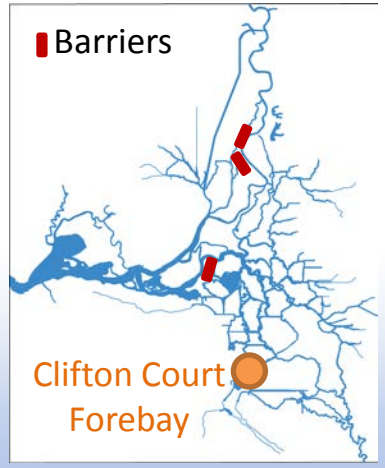
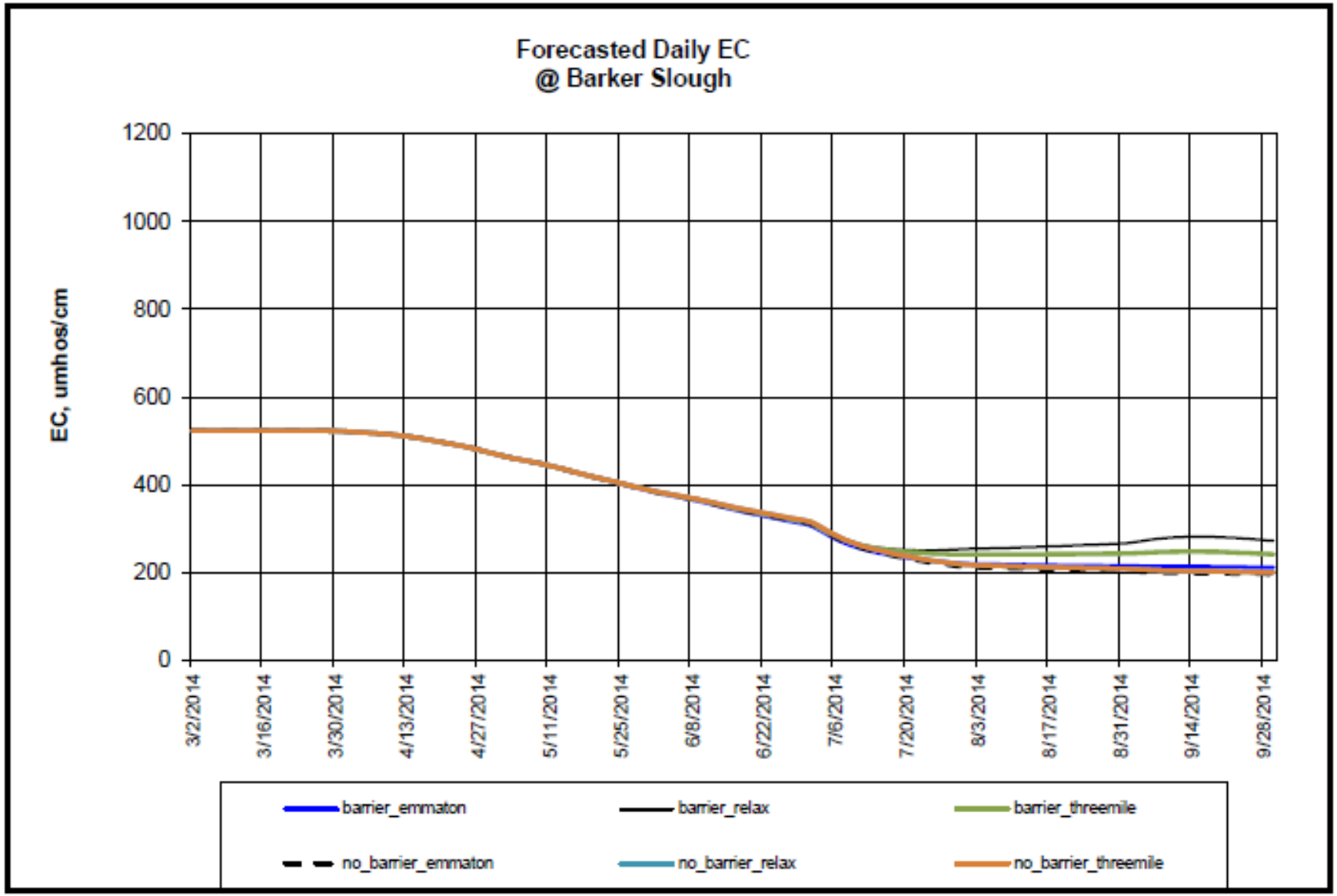
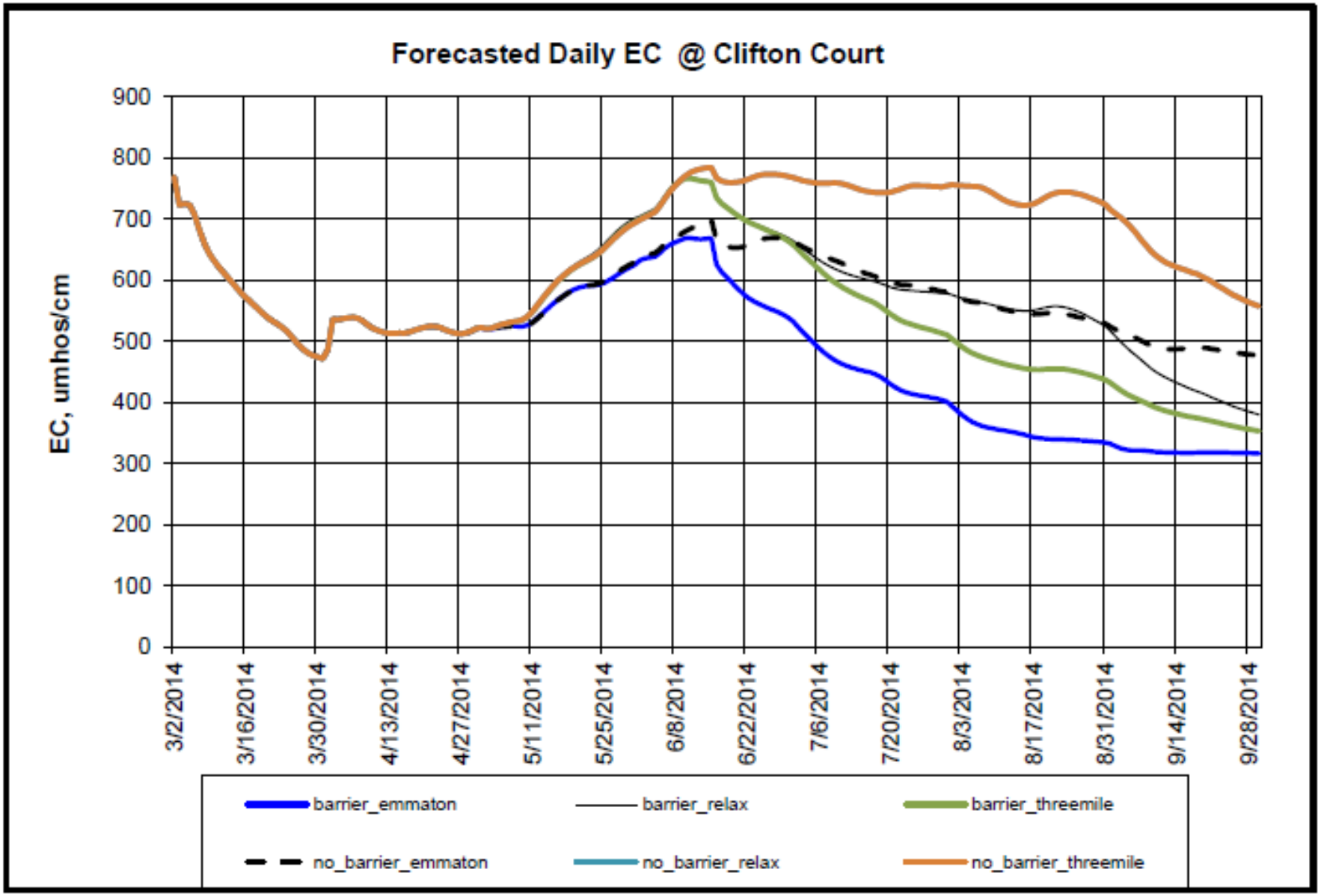


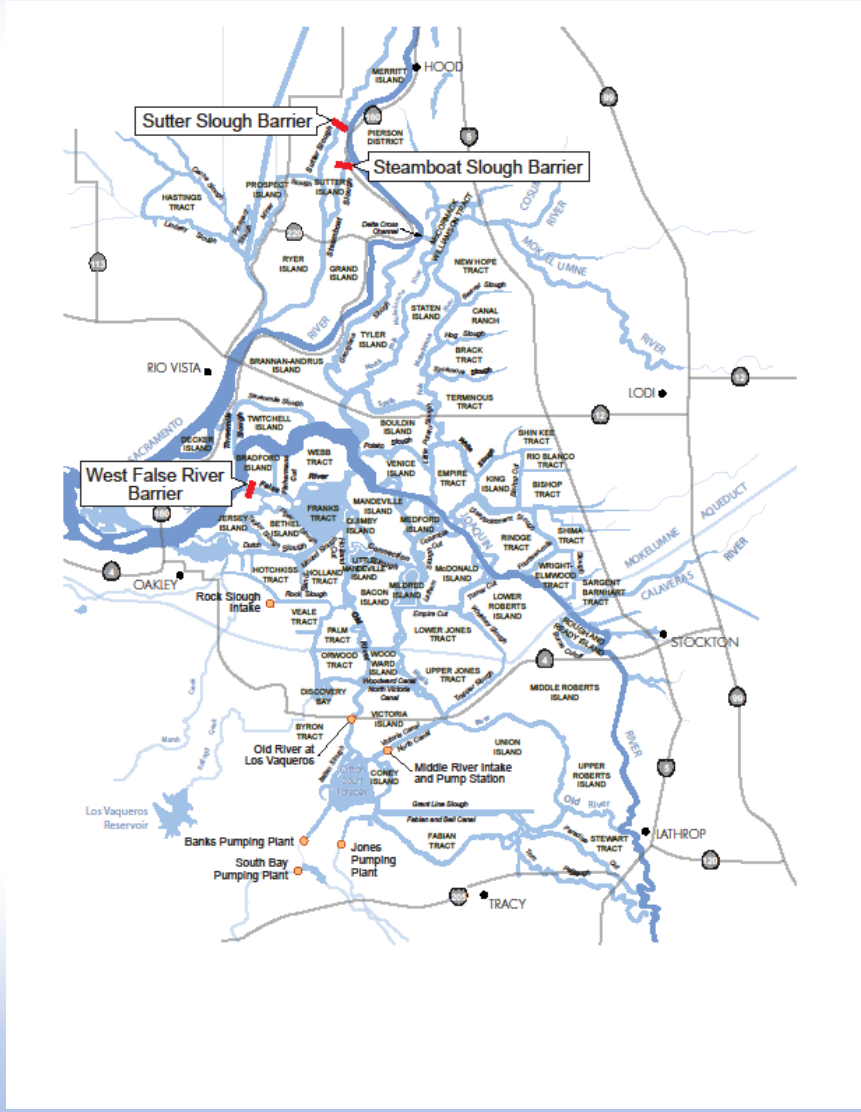

Forecasted Daily EC
@ Barker Slough
EC, umhos/cm
1200
1000
800
600
400
200
0
3/2/2014
3/16/2014
3/30/2014
4/13/2014
4/27/2014
5/11/2014
5/25/2014
6/8/2014
6/22/2014
7/6/2014
7/20/2014
8/3/2014
8/17/2014
8/31/2014
9/14/2014
9/28/2014
barrier_emmaton
barrier_relax
barrier_threemile
no_barrier_emmaton
no_barrier_relax
no_barrier_threemile


Forecasted Daily EC @ Clifton Court
EC, umhos/cm
900
800
700
600
500
400
300
200
100
0
3/2/2014
3/16/2014
3/30/2014
4/13/2014
4/27/2014
5/11/2014
5/25/2014
6/8/2014
6/22/2014
7/6/2014
7/20/2014
8/3/2014
8/17/2014
8/31/2014
9/14/2014
9/28/2014
barrier_emmaton
barrier_relax
barrier_threemile
no_barrier_emmaton
no_barrier_relax
no_barrier_threemile

Benefits of Proposed Locations

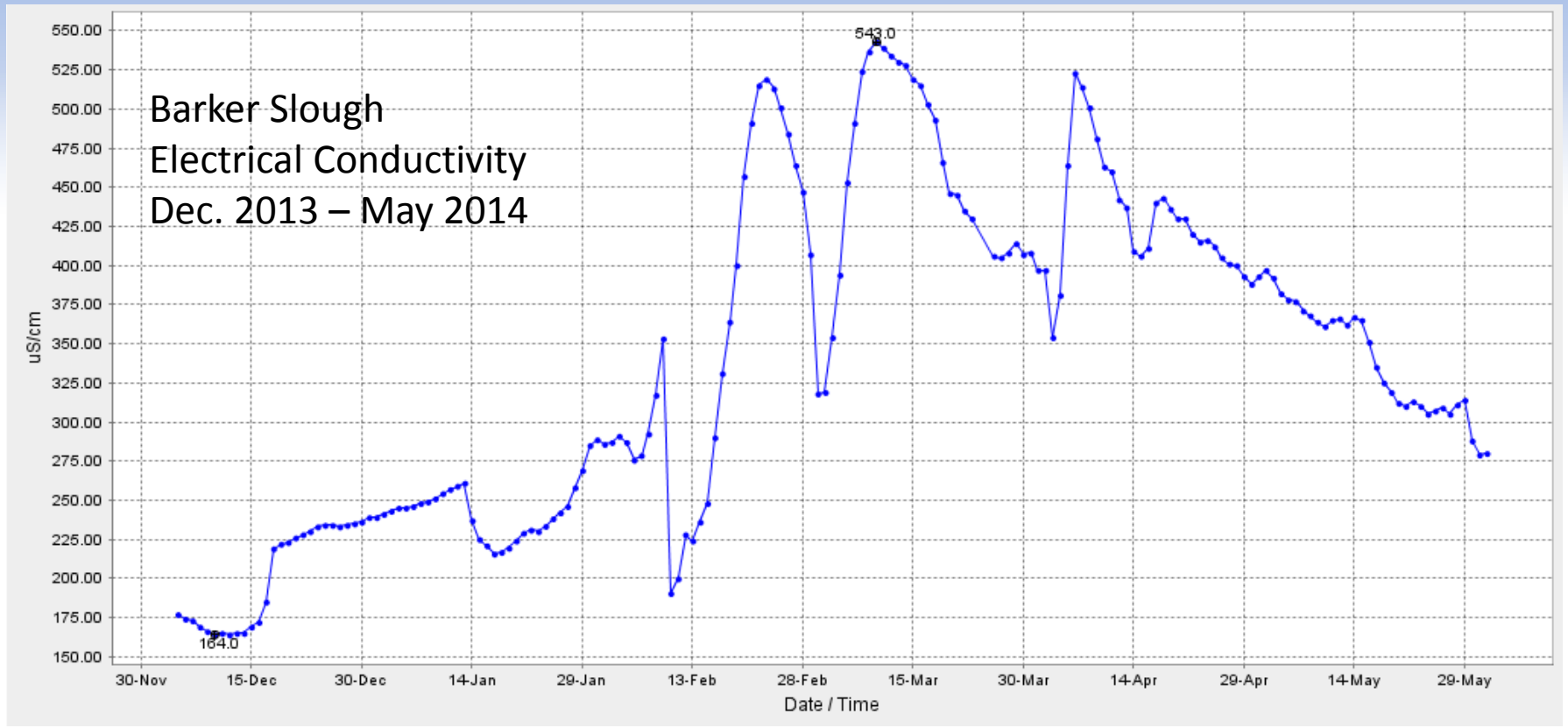
Sutter Slough and Steamboat Slough will redirect upstream flows to better repel saltwater intrusion into the Delta.

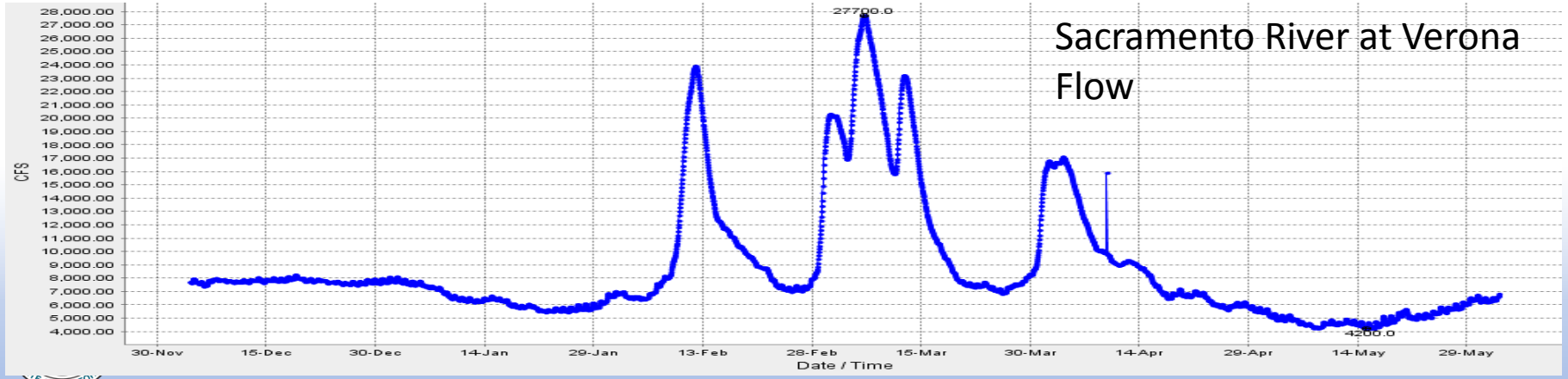
West False River will prevent saltwater intrusion into Frank's Tract and thus protect more of the Central and South Delta.



Modernized Design of Proposed Barriers Provides Additional Benefits

- Operational Flexibility. Sutter and Steamboat Slough barriers are anticipated to have four 48” culverts to allow fish passage and downstream flow for water quality when beneficial.
- Steamboat Slough is anticipated to have a boat portage facility to allow passage for boats under 22 feet to cross the barrier.


Barker Slough
Electrical Conductivity
Dec. 2013 – May 2014
uS/cm
550.00
525.00
500.00
475.00
450.00
425.00
400.00
375.00
350.00
325.00
300.00
275.00
250.00
225.00
200.00
175.00
150.00
543.0
164.0
30-Nov
15-Dec
30-Dec
14-Jan
29-Jan
13-Feb
28-Feb
15-Mar
30-Mar
14-Apr
29-Apr
14-May
29-May
Date / Time


Sacramento River at Verona
Flow
CFS
28,000.00
27,000.00
26,000.00
25,000.00
24,000.00
23,000.00
22,000.00
21,000.00
20,000.00
19,000.00
18,000.00
17,000.00
16,000.00
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14,000.00
13,000.00
12,000.00
11,000.00
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8,000.00
7,000.00
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4,000.00
27700.0
4260.0
30-Nov
15-Dec
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13-Feb
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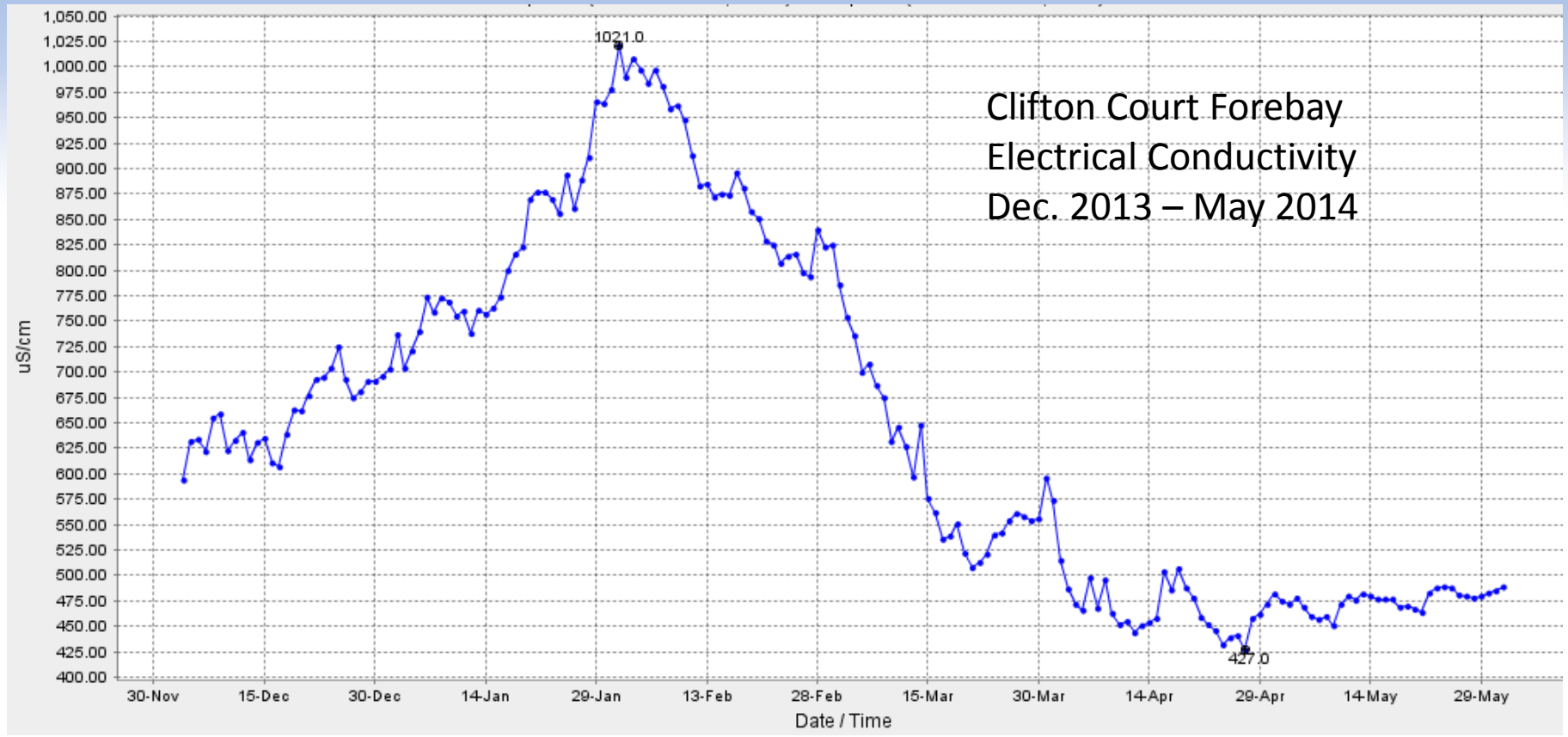
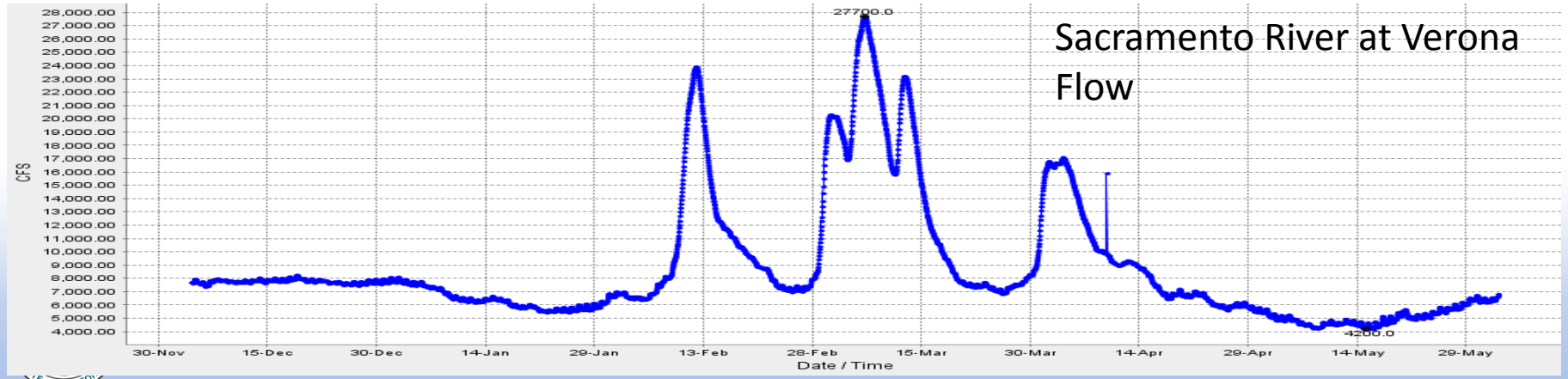
30-Mar
14-Apr
29-Apr
14-May
29-May
Date / Time


Clifton Court Forebay
Electrical Conductivity
Dec. 2013 – May 2014
uS/cm
1,050.00
1,025.00
1,000.00
975.00
950.00
925.00
900.00
875.00
850.00
825.00
800.00
775.00
750.00
725.00
700.00
675.00
650.00
625.00
600.00
575.00
550.00
525.00
500.00
475.00
450.00
425.00
400.00
1021.0
427.0
30-Nov
15-Dec
30-Dec
14-Jan
29-Jan
13-Feb
28-Feb
15-Mar
30-Mar
14-Apr
29-Apr
14-May
29-May
Date / Time


Sacramento River at Verona
Flow
CFS
28,000.00
27,000.00
26,000.00
25,000.00
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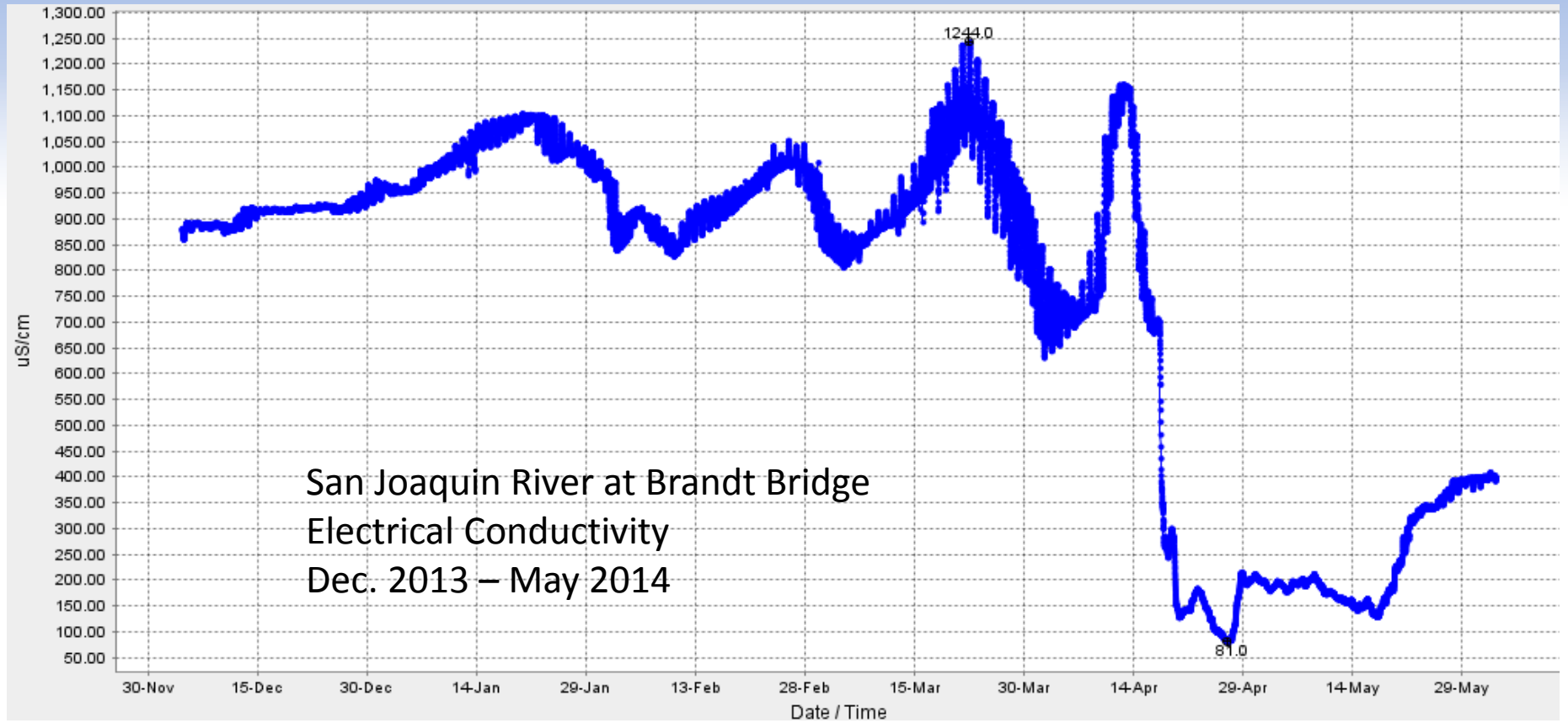
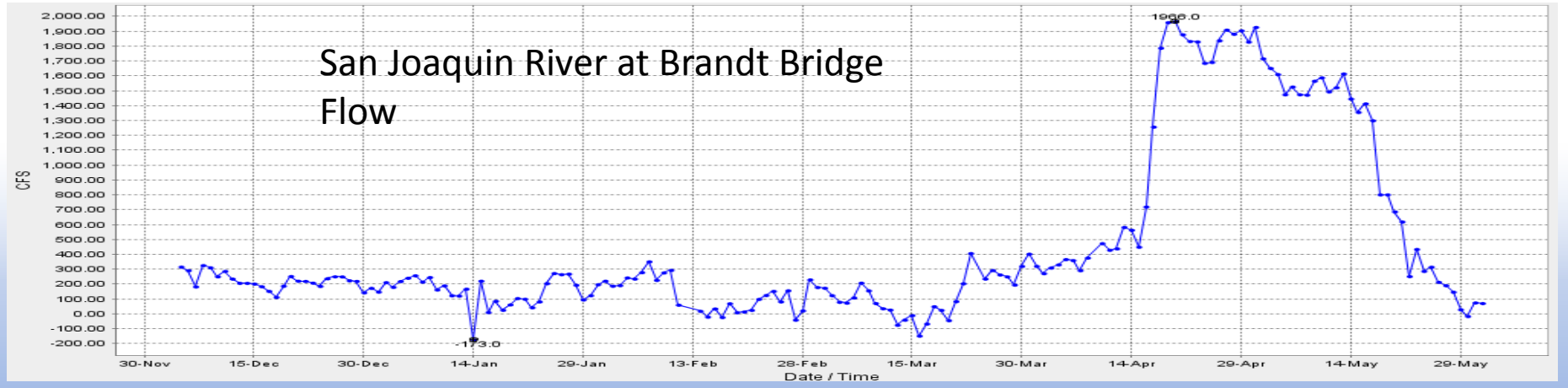
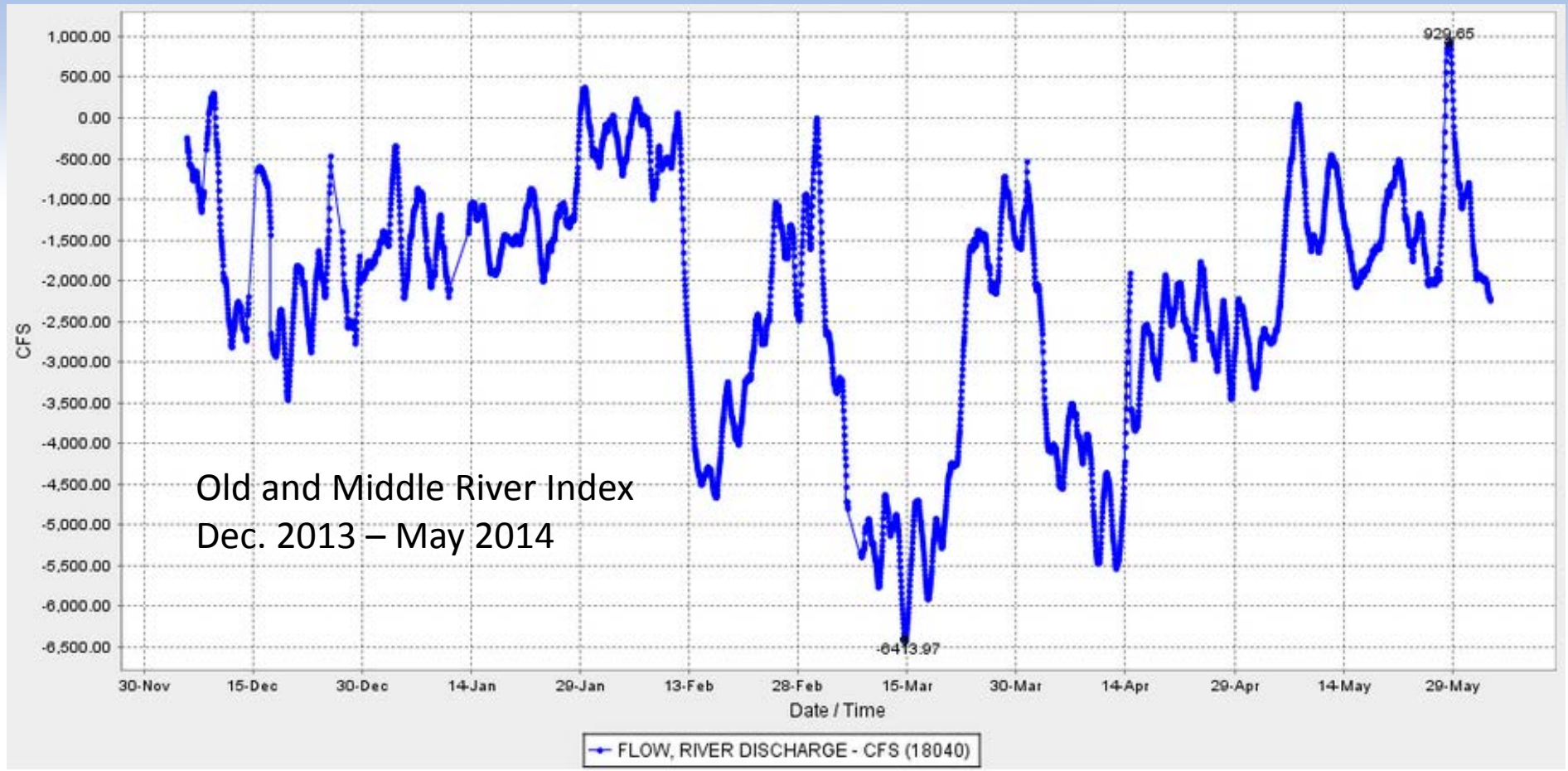
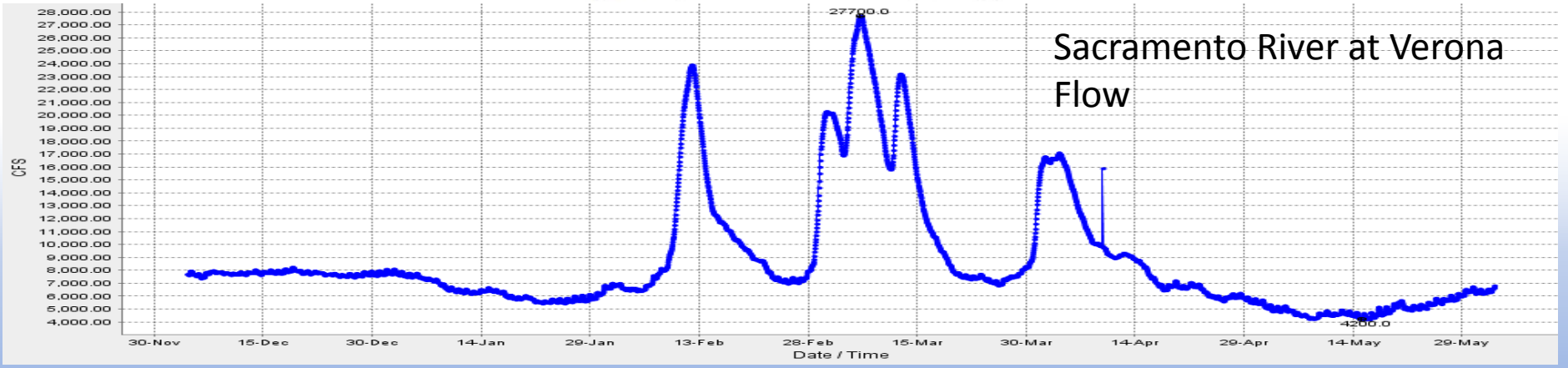
23,000.00
22,000.00
21,000.00
20,000.00
19,000.00
18,000.00
17,000.00
16,000.00
15,000.00
14,000.00
13,000.00
12,000.00
11,000.00
10,000.00
9,000.00
8,000.00
7,000.00
6,000.00
5,000.00
4,000.00
27700.0
4260.0
30-Nov
15-Dec
30-Dec
14-Jan
29-Jan
13-Feb
28-Feb
15-Mar
30-Mar
14-Apr
29-Apr
14-May
29-May
Date / Time


1,300.00
1,250.00
1,200.00
1,150.00
1,100.00
1,050.00
1,000.00
950.00
900.00
850.00
800.00
750.00
700.00
650.00
600.00
550.00
500.00
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
uS/cm
1244.0
81.0
30-Nov
15-Dec
30-Dec
14-Jan
29-Jan
13-Feb
28-Feb
15-Mar
30-Mar
14-Apr
29-Apr
14-May
29-May
Date / Time
San Joaquin River at Brandt Bridge
Electrical Conductivity
Dec. 2013 – May 2014


2,000.00
1,900.00
1,800.00
1,700.00
1,600.00
1,500.00
1,400.00
1,300.00
1,200.00
1,100.00
1,000.00
900.00
800.00
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.00
-100.00
-200.00
CFS
1900.0
-173.0
30-Nov
15-Dec
30-Dec
14-Jan
29-Jan
13-Feb
28-Feb
15-Mar
30-Mar
14-Apr
29-Apr
14-May
29-May
Date / Time
San Joaquin River at Brandt Bridge
Flow


1,000.00
500.00
0.00
-500.00
-1,000.00
-1,500.00
-2,000.00
-2,500.00
-3,000.00
-3,500.00
-4,000.00
-4,500.00
-5,000.00
-5,500.00
-6,000.00
-6,500.00
CFS
929.65
-6413.97
30-Nov
15-Dec
30-Dec
14-Jan
29-Jan
13-Feb
28-Feb
15-Mar
30-Mar
14-Apr
29-Apr
14-May
29-May
Date / Time
Old and Middle River Index
Dec. 2013 – May 2014

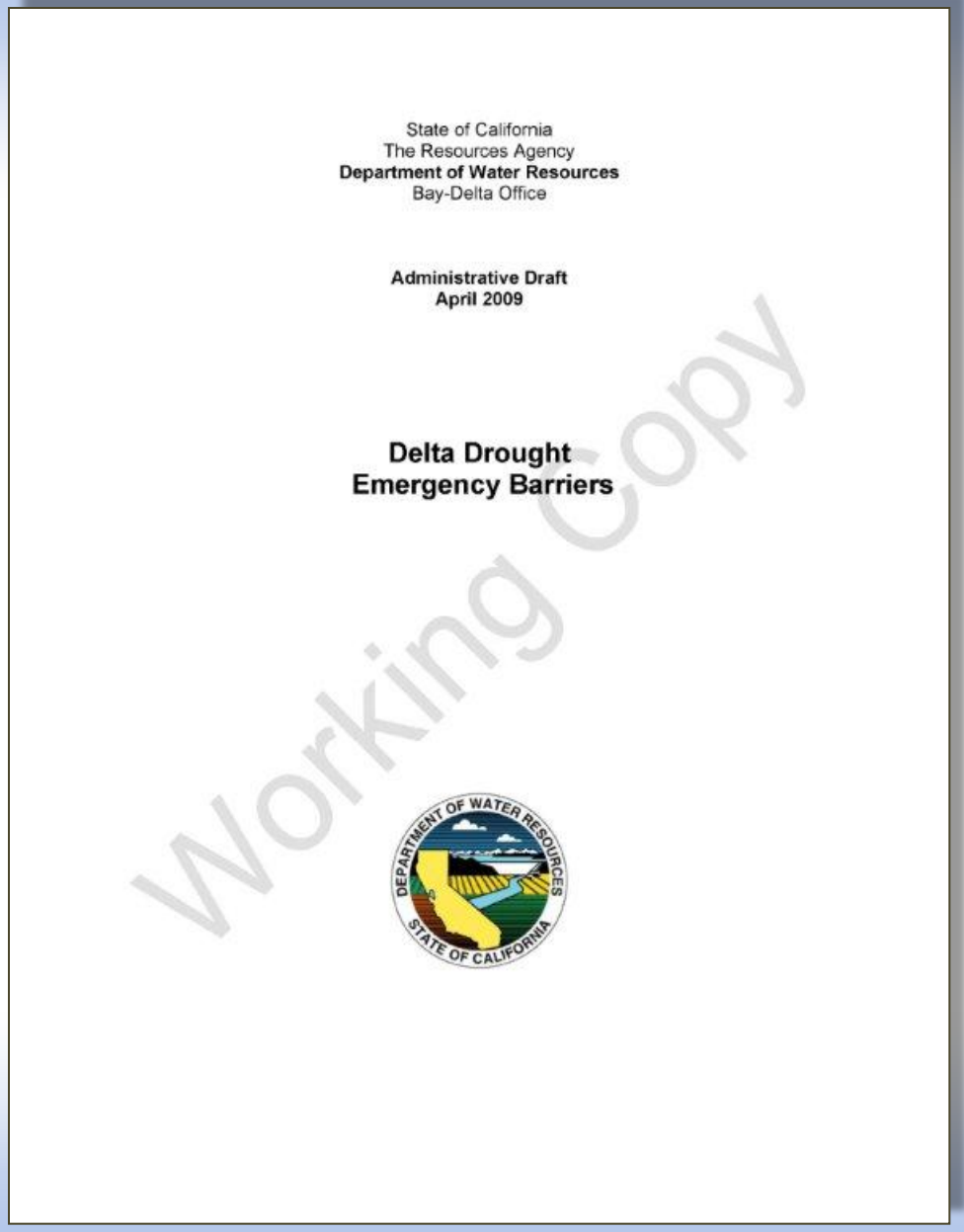

FLOW, RIVER DISCHARGE - CFS (18040)
28,000.00
27,000.00
26,000.00
25,000.00
24,000.00
23,000.00
22,000.00
21,000.00
20,000.00
19,000.00
18,000.00
17,000.00
16,000.00
15,000.00
14,000.00
13,000.00
12,000.00
11,000.00
10,000.00
9,000.00
8,000.00
7,000.00
6,000.00
5,000.00
4,000.00
CFS
27700.0
4200.0
30-Nov
15-Dec
30-Dec
14-Jan
29-Jan
13-Feb
28-Feb
15-Mar
30-Mar
14-Apr
29-Apr
14-May
29-May
Date / Time
Sacramento River at Verona
Flow

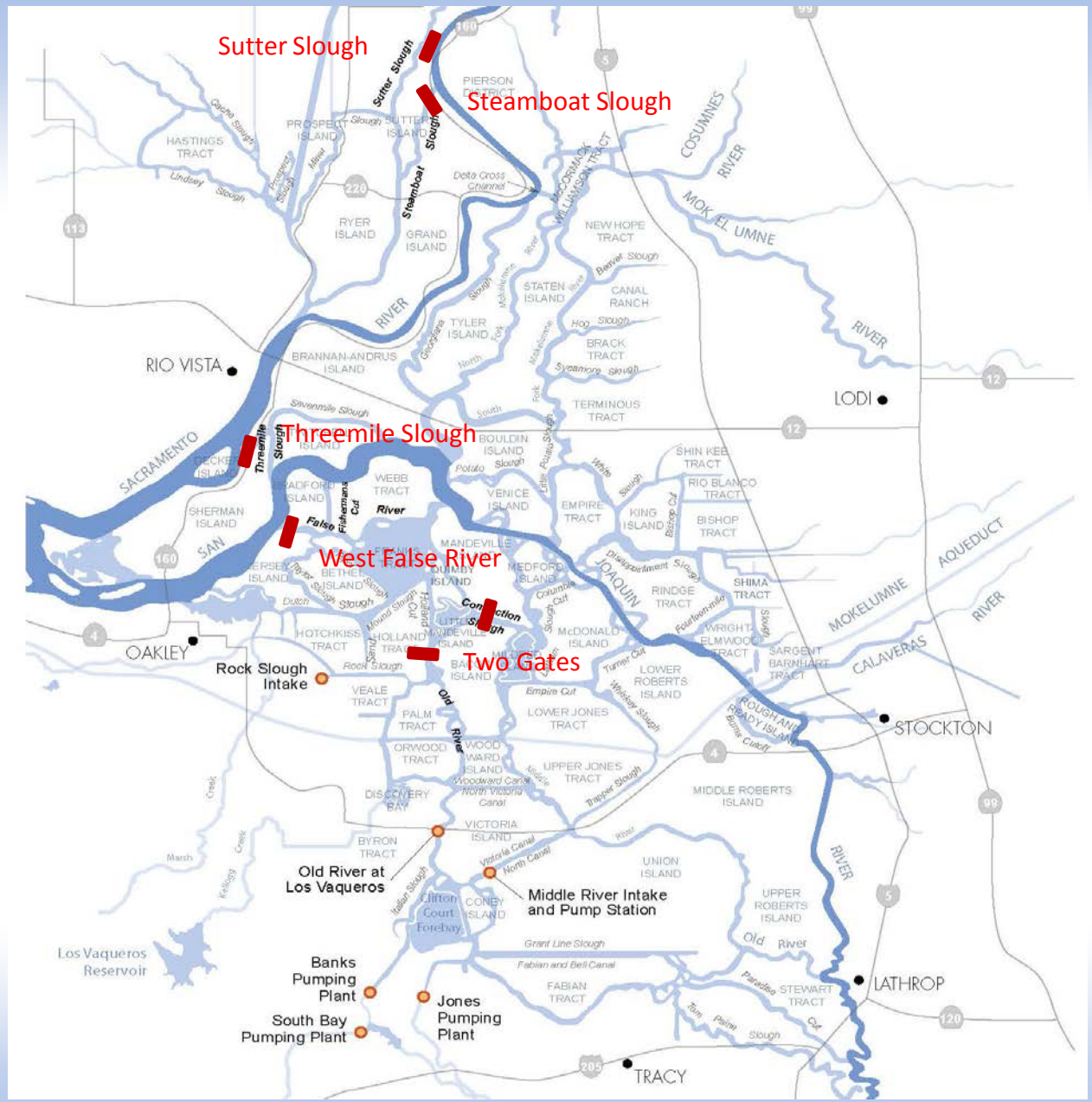
Barriers – Next Steps

- CEQA documents
- 404 permit – ESA Section 7 consultation
- Other permits (401, 1600, CVFPB, etc.)
- Encroachment agreements
- Levee stabilization

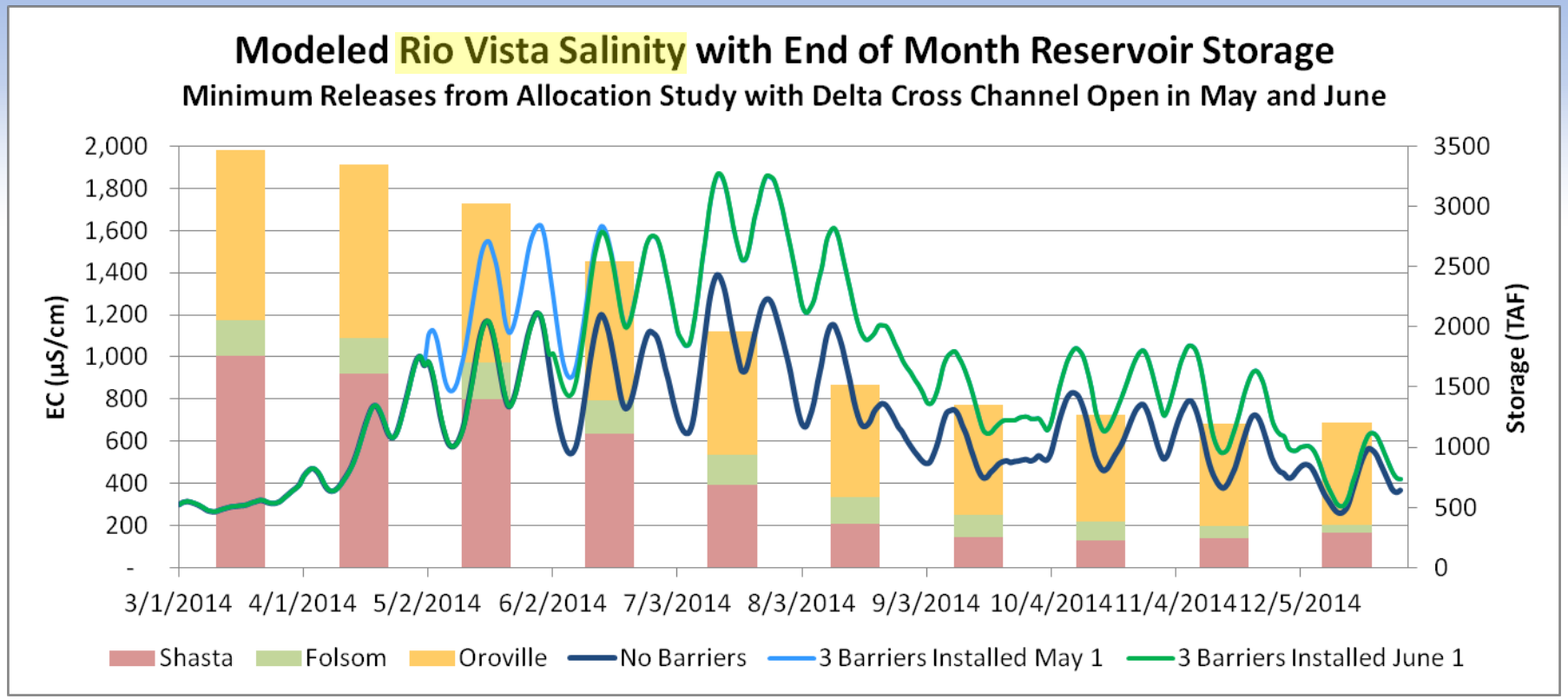
Other Slides

Drought Barriers 2009





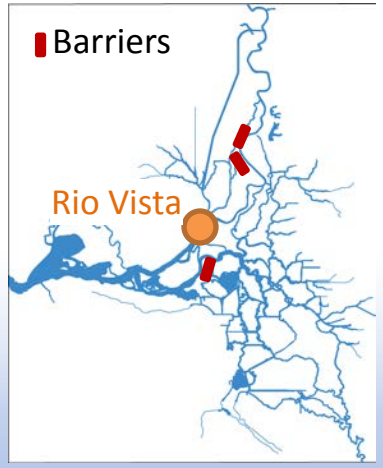
Barriers locations in 2009 DWR Drought Emergency Barriers Draft Report

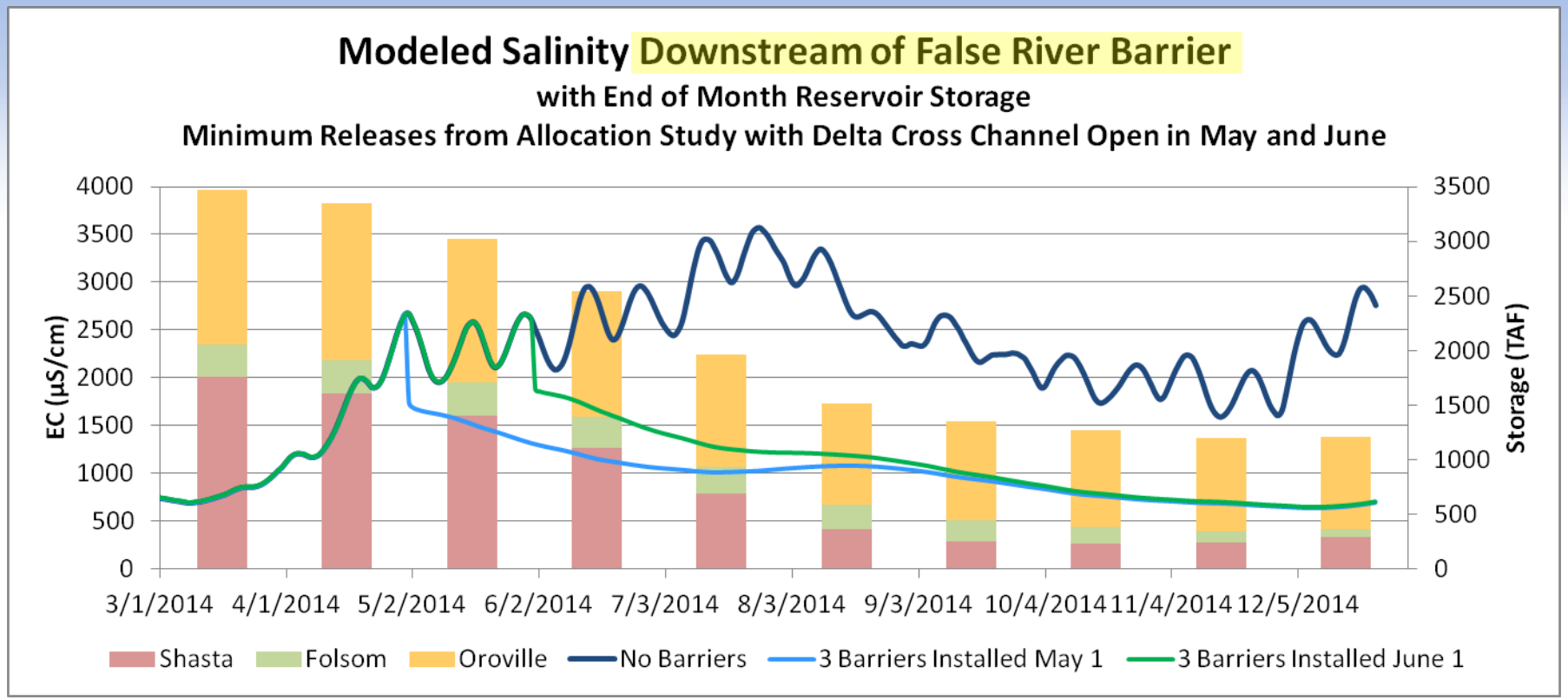


- Feb 20, 2014 forecast
- Feb 20 Reservoir Conditions
  - Shasta 1720 TAF 38% capacity
  - Folsom 290 TAF 29% capacity
  - Oroville 1385 TAF 39% capacity

Mar 16 Reservoir Conditions
- Shasta 2050 TAF 45% capacity
- Folsom 400 TAF 41% capacity
- Oroville 1600 TAF 45% capacity

- Total Reservoir Capacity ~9,000 TAF





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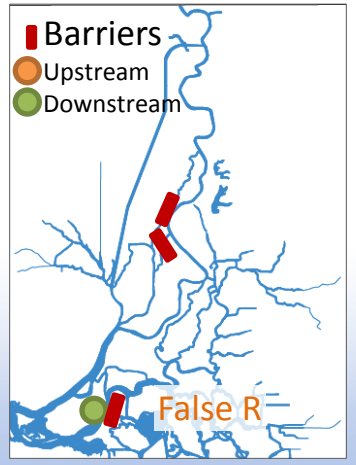

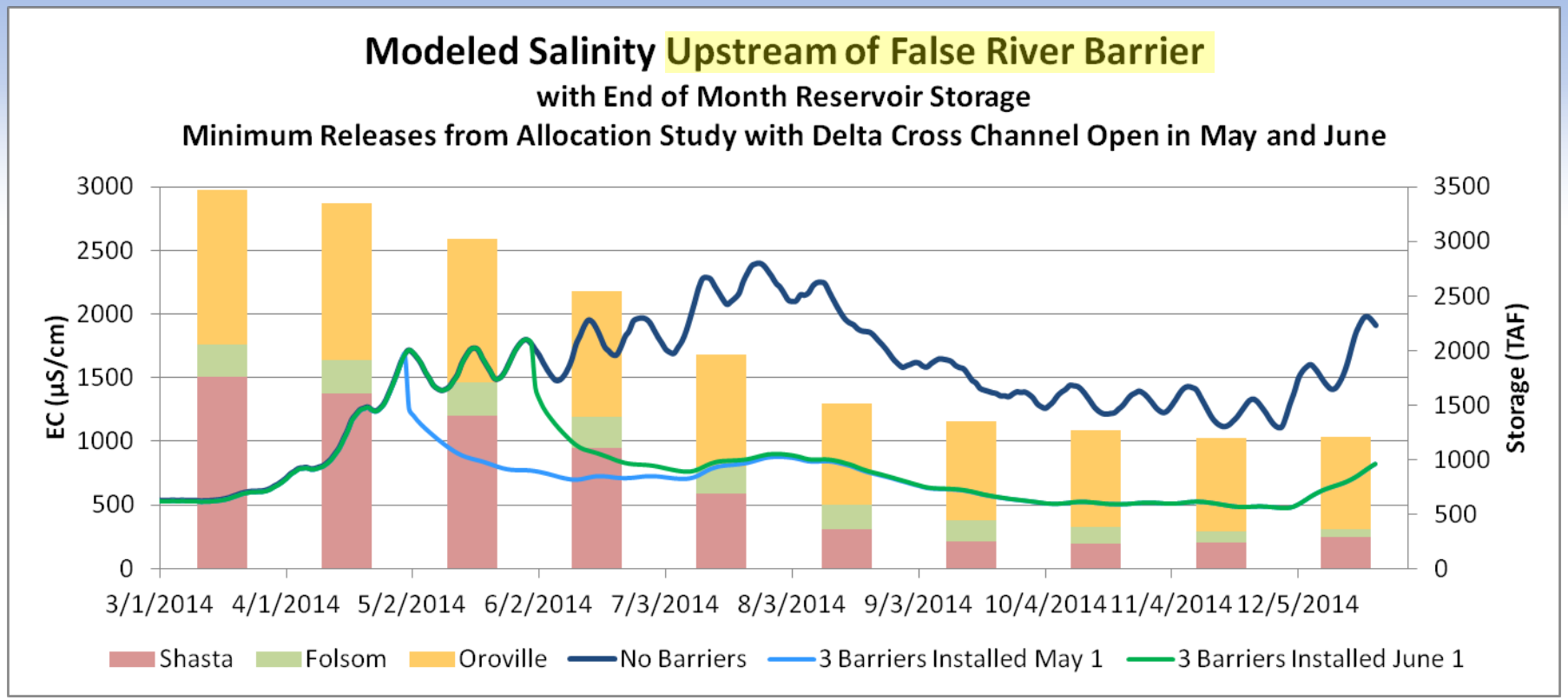

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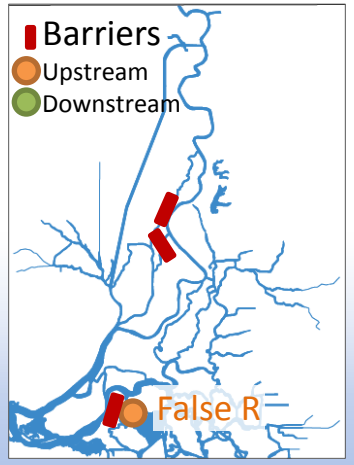
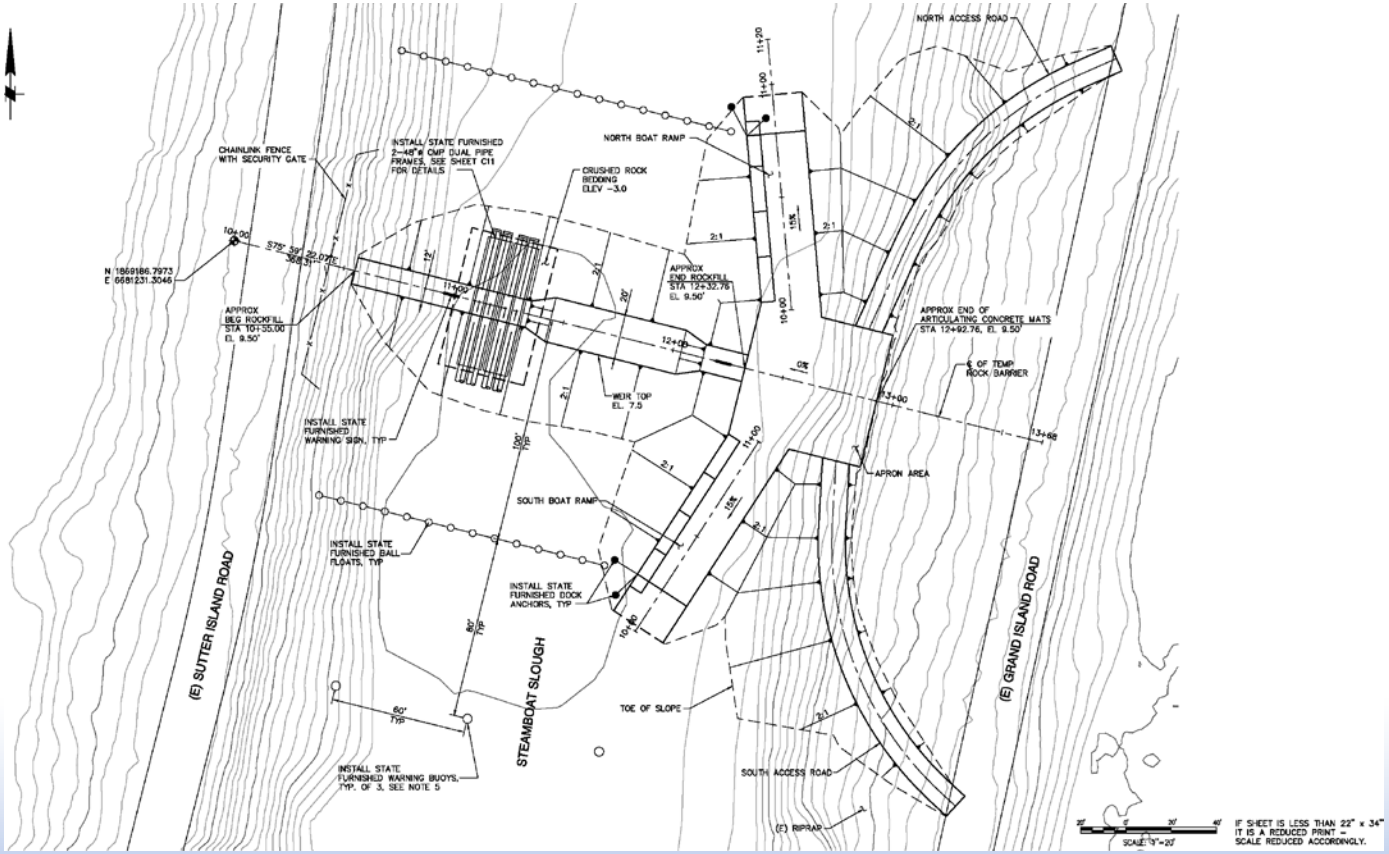
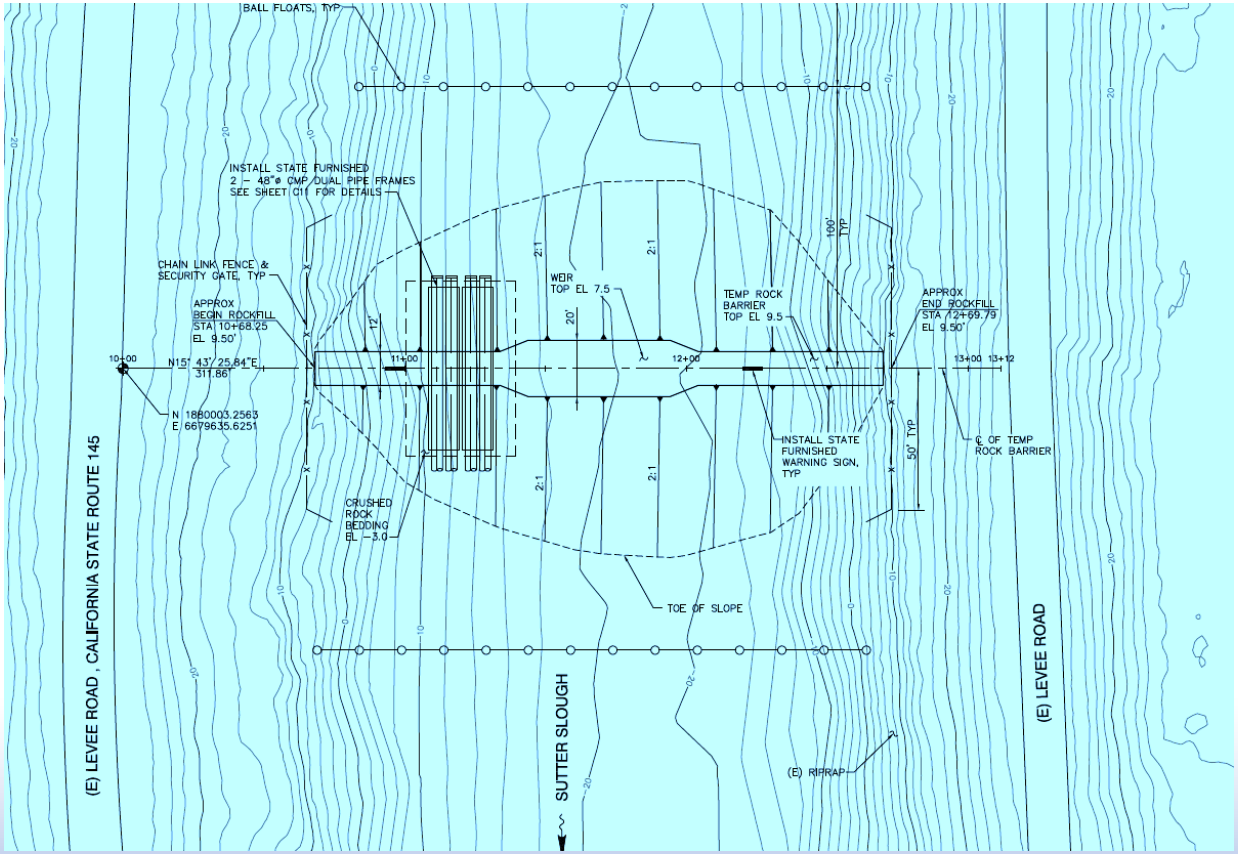


Steamboat Slough Barrier
Draft Design



Sutter Slough Barrier
Draft Design



False River Barrier
Draft Design