~~SHR-353~~

Page 1 Reference links and data compiled by N. Suard, Esq for questioning or CWF modeling and/or operations witnesses

Page 2 http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/docs/petitioners_exhibit/dwr/DWR-50.pdf

SHR-354

Page 3 http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/docs/petitioners_exhibit/dwr/dwr_901.pdf

Page 4 Screen print from CDEC showing monitoring stations at Rio Vista and along Steamboat Slough

Page 5 Screen print from CDEC for monitor SXS describing computed EC

Page 6 http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/docs/SHR/SHR-350.pdf

Page 7 DWR-901 and SHR-350 comparison

Page 8 http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/docs/petitioners_exhibit/dwr/DWR-650.pdf and screen print from USGS RVB monitoring station September 2015

Page 9 www.water.ca.gov/waterdatalibrary/docs/hydstra/docs/B9145000/POR/CONDUCTIVITY_POINT_PLOT.PNG at Rio Vista and chart of EC levels for fresh water

Page 10 WWW.WATER.CA.GOV/waterdatalibrary/docs/hydstra/docs/B9145000/POR/CONDUCTIVITY_POINT_DATA.CSV at SUS

Page 11 www.water.ca.gov/waterdatalibrary/docs/hydstra/docs/B914500/2015/FLOW_15-minute_data_plotting at SXS

Page 12 cdec.water.ca.gov/jspplot/jspplotservlet.jsp?sensor_no=27856&end=10%2PO1%2F2 SXS Steamboat Slough

Page 13 CDEC monitor below Isleton on the Sacramento River at SOI

Page 14 NDWA_011 and map of water quality studies in the Delta

Page 15 EC from irrigation and from blocked flows

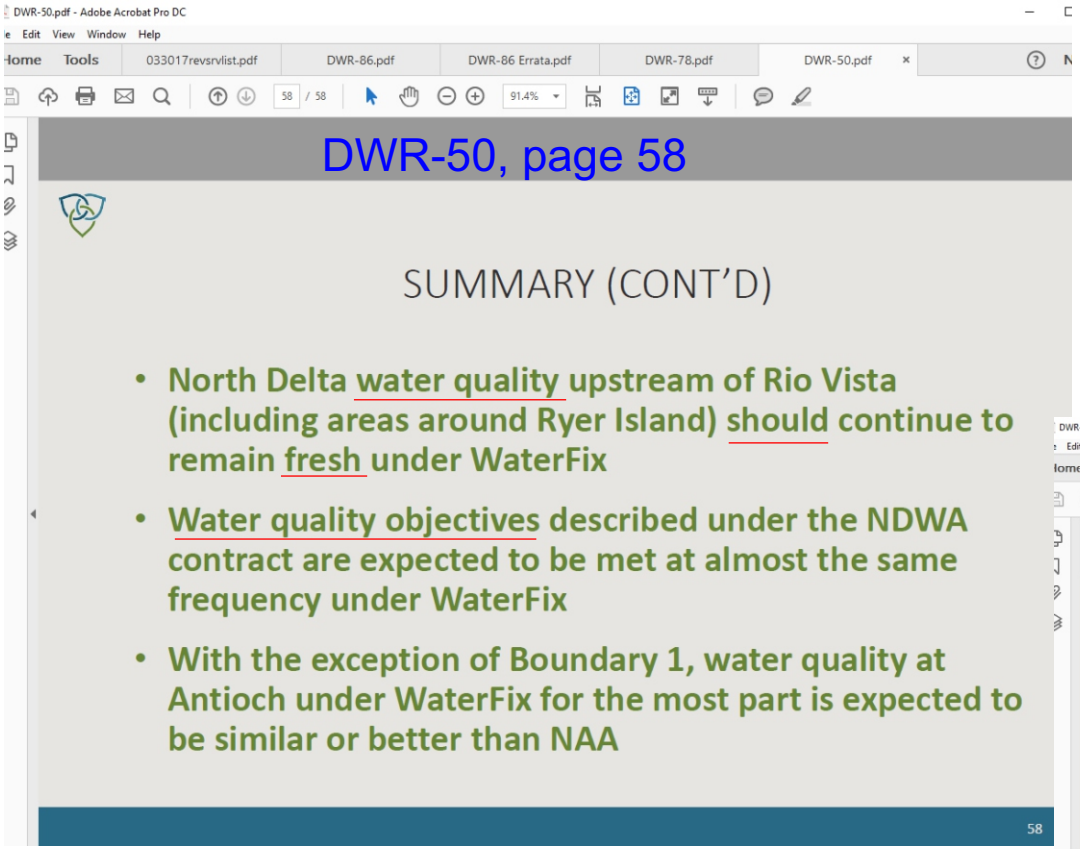
Page 16 DWR-8, pages 26, 27, 28 and 39

Page 17 DWR Youtube animation describing existing intakes and pumping compared to proposed WF

Page 21 DWR-10 page 19

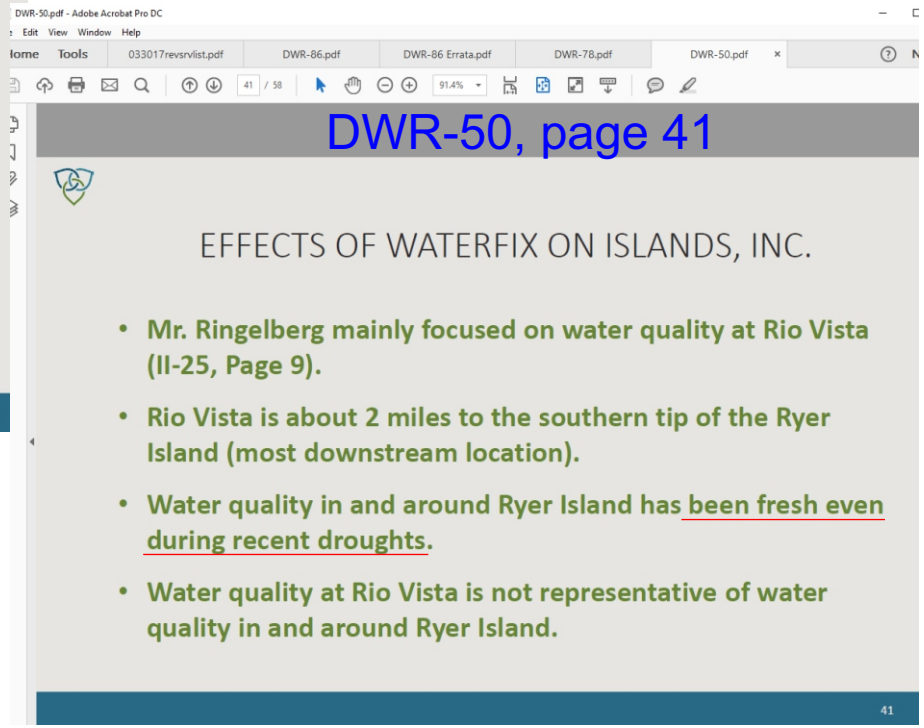
Questions based upon evidence introduced by DWR during rebuttal testimony of regarding DSM2 regarding impacts to water quality, specifically salinity/EC, temperature, and velocity on Steamboat Slough to Sacramento River at Rio Vista

http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/docs/petitioners_exhibit/dwr/DWR-50.pdf



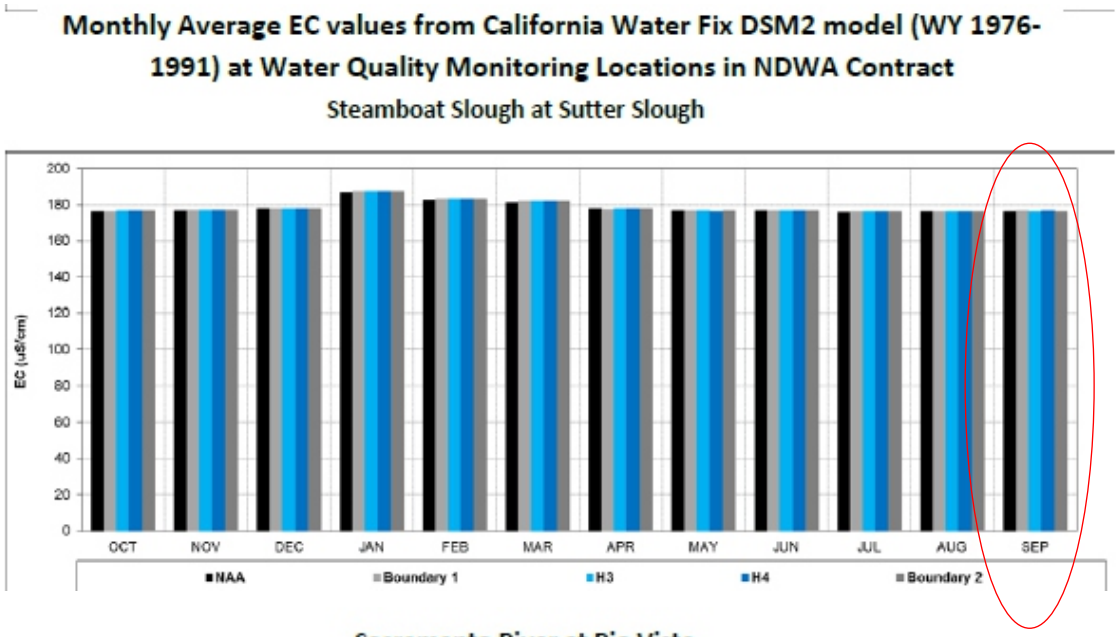
DWR-50, page 58

1. What do you mean by "Should"?
2. Was effects studied anywhere on Steamboat Slough and if so at what locations? Are the results shown in DWR-901?
3. Which model was used?
4. What is the margin of error for the model?
5. Have you ever compared the model results to actual real time receint monitoring results in this area of the Delta? (i.e. Field Test?)
5. What does "fresh" mean? ie maximum EC expected at the location modeled?



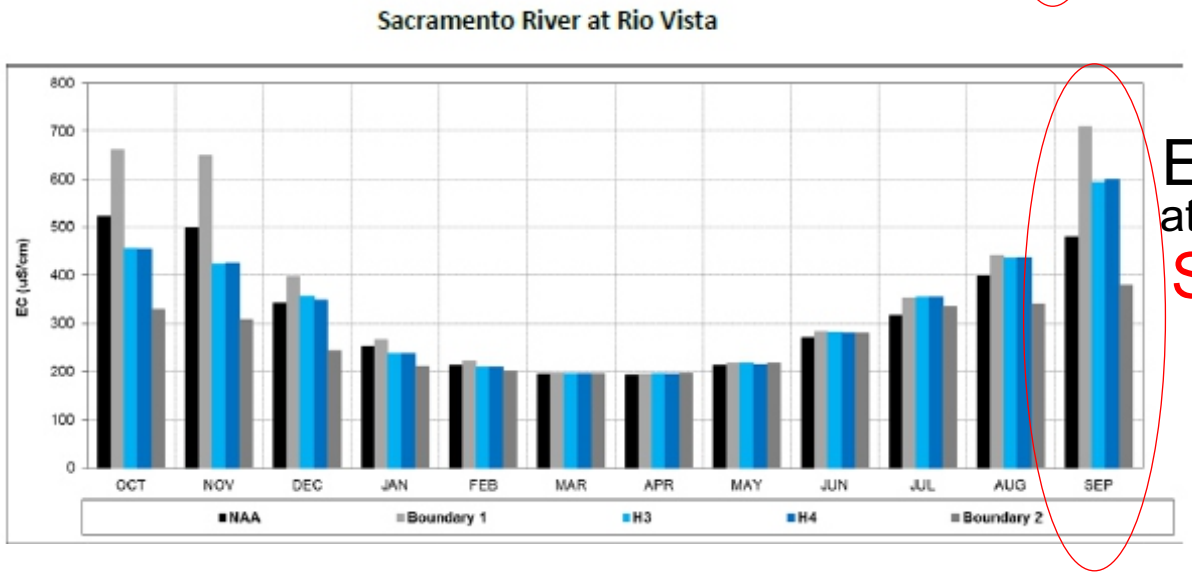
http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/docs/petitioners_exhibit/dwr/dwr_901.pdf

1. Which model was used to provide the EC information graphic?
2. Was there a similar analysis done for EC based on low flows associated with a dry year in September? Critical Dry year?
3. If so, what would be the peak or highest EC expected at SUS on Steamboat Slough and at Rio Vista?
4. What was the temperature used for computing estimated EC?
5. What is the margin of error for the data used to create graphic?



EC 180

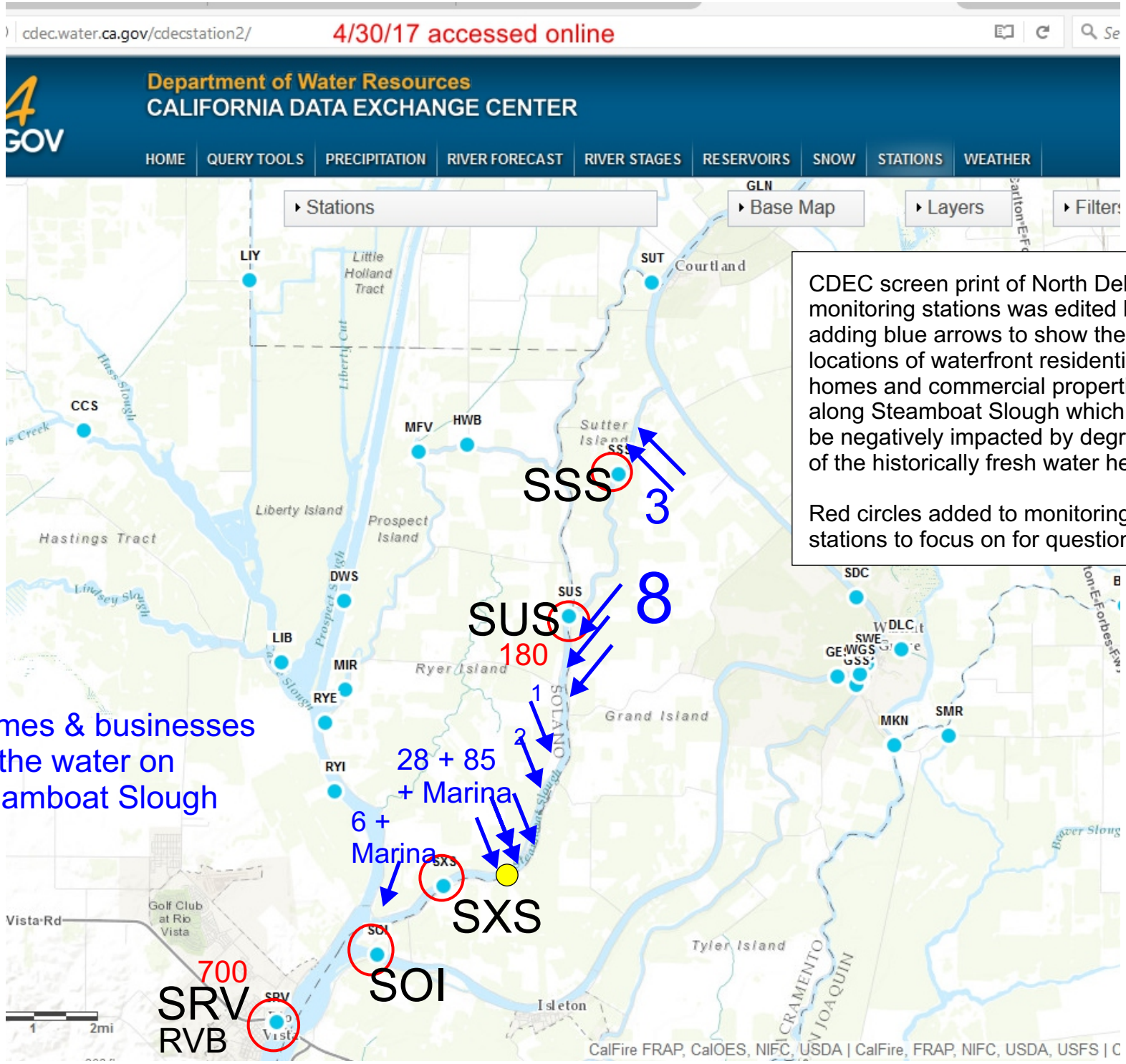
SUS



EC 700

at what celsius?

SRV



Homes & businesses on the water on Steamboat Slough

CDEC screen print of North Delta monitoring stations was edited by adding blue arrows to show the locations of waterfront residential homes and commercial properties along Steamboat Slough which could be negatively impacted by degredation of the historically fresh water here.

Red circles added to monitoring stations to focus on for questions

cdec.water.ca.gov/cgi-progs/stationInfo?station_id=SXS

DWR monitored and computed data at SXS

STEAMBOAT SLOUGH NR SACRAMENTO R

Map of surrounding area

SXS

Station ID	SXS	**Elevation**	5' ft
River Basin	SACRAMENTO R	**County**	SACRAMENTO
Hydrologic Area	SACRAMENTO RIVER	**Nearby City**	RIO VISTA
Latitude	38.191267°	**Longitude**	-121.637881°
Operator	CA Dept of Water Resources/NCRO	**Data Collection**	DATA XCHG-DWR NCRO

1. Did DWR modelers compare the data from SXS and SUS regarding EC at low flows?

2. If you did not model for a specific location how can you be so certain proposed WaterFix won't impact the surface water quality at Snug Harbor?

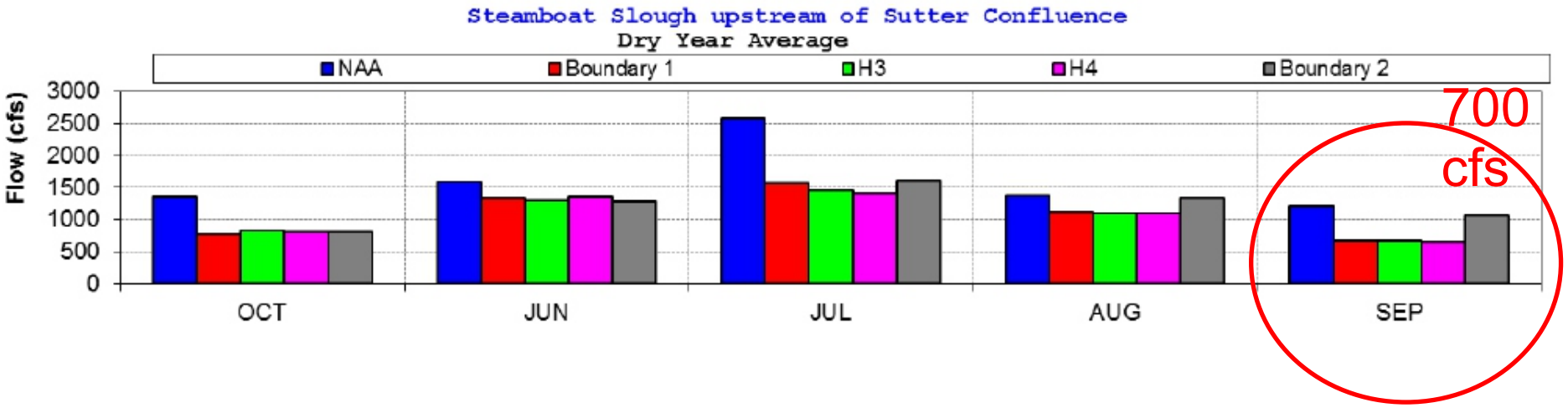
3. What are the peak EC levels you would expect based on WaterFix tunnels in operation in a Dry Year in September?

The following data types are available online. Select one of the links below to retrieve recent data.

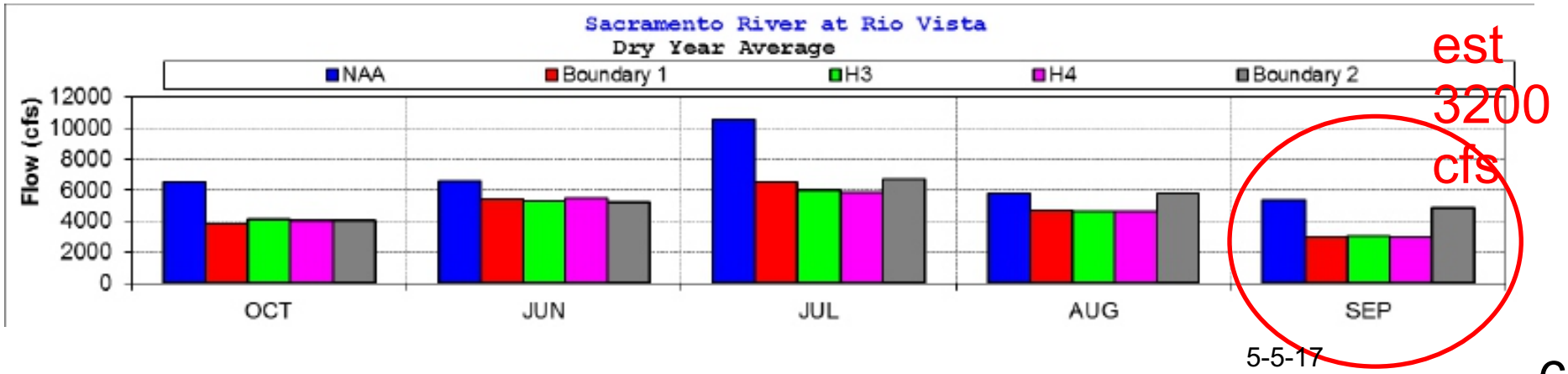
Sensor Description	Sensor Number	Duration	Plot	Data Collection	Data Available
ELECTRICAL CONDUCTIVTY MICRO S, us/cm	**100**	(daily)	(EL COND)	COMPUTED	06/16/2015 to present.
MAX ELEC CONDUCTIVTY MICRO S, us/cm	**224**	(daily)	(EC MAX)	COMPUTED	06/16/2015 to present.
MEDIAN E CONDUCTIVTY MICRO S, us/cm	**222**	(daily)	(EC MDN)	COMPUTED	06/16/2015 to present.
MIN ELEC CONDUCTIVTY MICRO S, us/cm	**223**	(daily)	(EC MIN)	COMPUTED	06/16/2015 to present.
TEMPERATURE, WATER, deg f	**25**	(daily)	(TEMP W)	COMPUTED	06/16/2015 to present.
TEMPERATURE, WATER MAXIMUM, deg f	**227**	(daily)	(TMPW MAX)	COMPUTED	06/16/2015 to present.
TEMPERATURE, WATER MEDIAN, deg f	**225**	(daily)	(TMPW MDN)	COMPUTED	06/16/2015 to present.
TEMPERATURE, WATER MINIMUM, deg f	**226**	(daily)	(TMPW MIN)	COMPUTED	06/16/2015 to present.
WATER, DISSOLVED OXYGEN, mg/l	**61**	(daily)	(DIS OXY)	COMPUTED	06/16/2015 to present.
WATER, DISSOLVED OXYGEN MAX, mg/l	**230**	(daily)	(DO MAX)	COMPUTED	06/16/2015 to present.

http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/docs/SHR/SHR-350.pdf

Portions of SHR-350



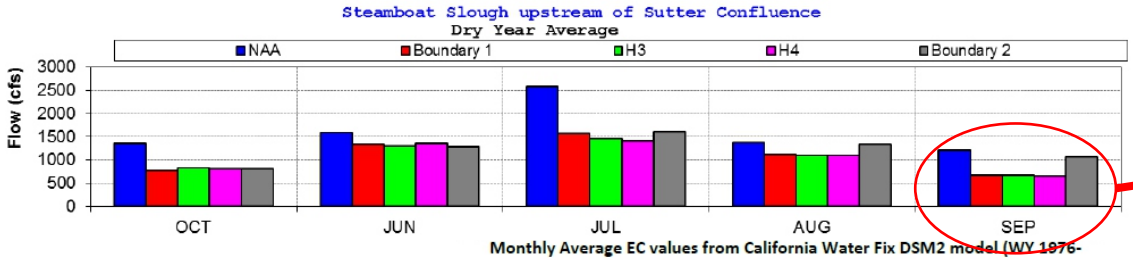
1. Do you recognize this graphic? Is it your understanding that it represents projected flows in the North Delta during a Dry Year if proposed WaterFix North Delta diversions were operational?
2. Based upon DWR modeling, for Waterfix, in a Dry Year, in September there would be no less than 700cfs of flow on Steamboat Slough past the gage labeled SSS which would result in EC no higher than 180 at the NDWA Steamboat Slough compliance station labeled SUS. Is this a correct statement based upon DWR modeling?

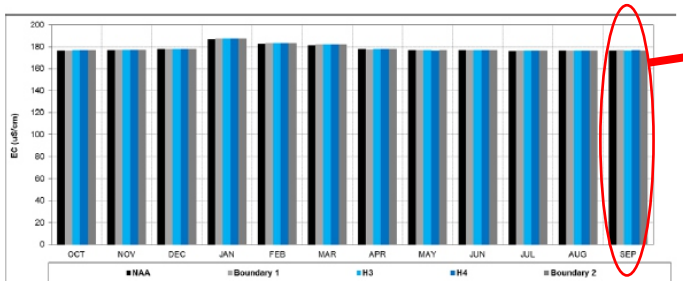


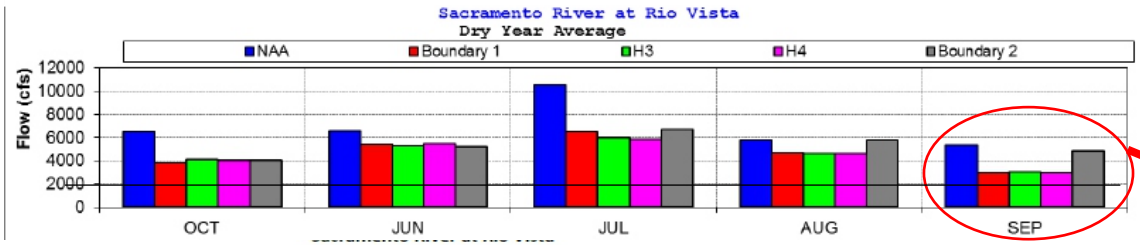
5-5-17

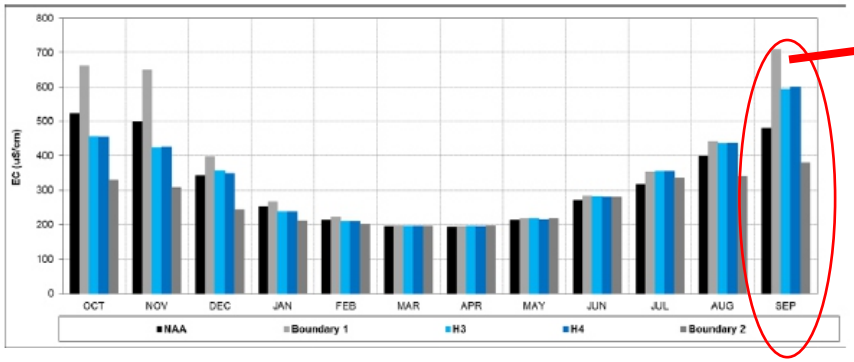
WHAT IS THE MODELED OR PROJECTED DRINKING WATER QUALITY ON STEAMBOAT SLOUGH BETWEEN THE TWO MONITORING GAGES OF SXS AND SUS?

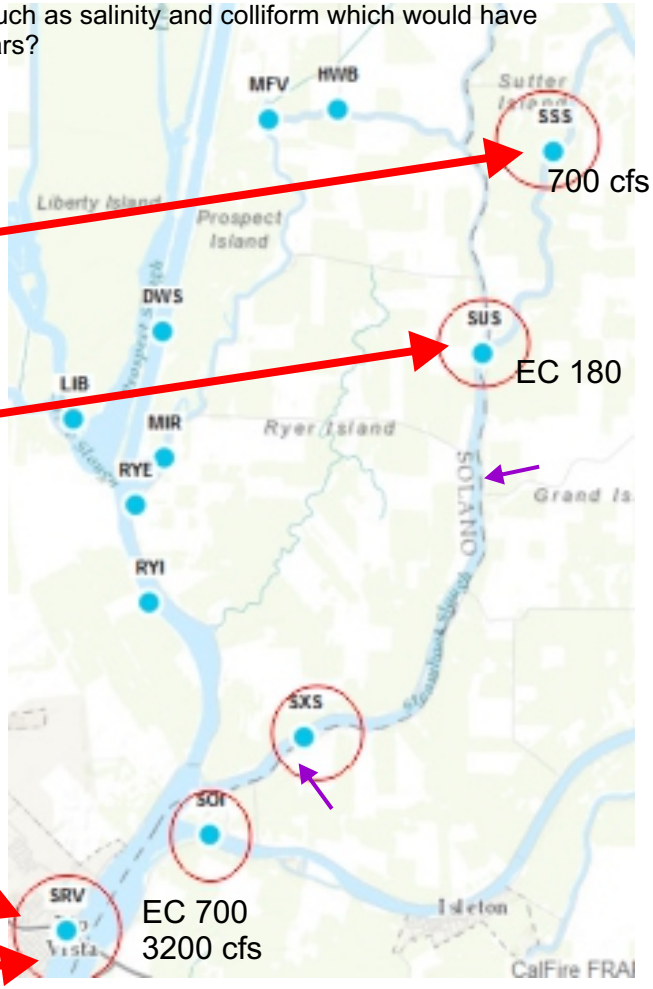
1. Based upon DWR WaterFix modeling evidence presented during WaterFix hearing, DWR claims that Steamboat Slough inflows as low as 700 cfs in September in a Dry year will be sufficient to maintain EC below 180 at the confluence of Sutter and Steamboat Sloughs. Is this a correct statement?
2. Have the farmer's diversions from Steamboat Slough been included in the modeling?
3. Have the farmers' irrigation discharge back into Steamboat Slough been modeled for impacts to water quality for constituents such as salinity and colliform which would have less flow for dillution in dry and critical years?











4 If you have not modeled for these factors, and have not compared the modeling to actual field data, how can you say that the project will not degrade the historically fresh water of Steamboat Slough and thereby cause injury to the riparian water rights holders in this area?
5. Have you modeled for the long term effects to the drinking water wells associated with the residential homes and commercial properties along Steamboat Slough?

http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/docs/petitioners_exhibit/dwr/DWR-650.pdf

is above 800 EC considered fresh drinking water?

DWR-650 page 4, with red asterics added, shows the EC at Rio Vista in a very dry year, in September. The flows appear to be as low as what is modeled to be the minimum flows per the data provided by DWR in SHR-350

DWR-650

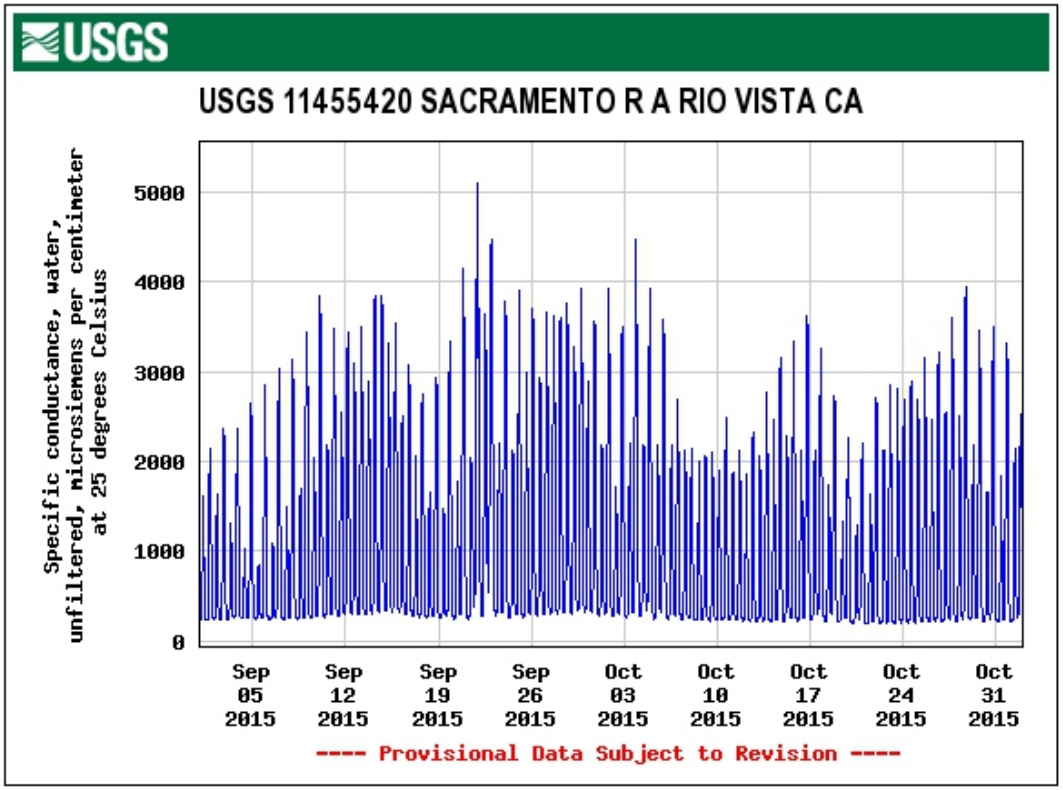
2015 CDEC Salinity Emmaton and Rio Vista Bridge
uS/cm (umhos/cm) [to convert to mmhos/cm divide by 1000]
Source: California Data Exchange Center

RVB

Date	EMM	RVB
8/14/2015	3535	392
8/15/2015	2957	354
8/16/2015	3214	368
8/17/2015	3581	453
8/18/2015	4433	618
8/19/2015	4389	573
8/20/2015	4102	517
8/21/2015	4006	482
8/22/2015	3845	474
8/23/2015	3703	434
8/24/2015	3431	403
8/25/2015	3191	403
8/26/2015	3181	425
8/27/2015	3220	429
8/28/2015	3365	438
8/29/2015	3576	482
8/30/2015	3467	448
8/31/2015	3385	419
9/1/2015	3565	503
9/2/2015	4103	544
9/3/2015	4180	502
9/4/2015	4104	502
9/5/2015	3257	461
9/6/2015	3548	449
9/7/2015	3855	518
9/8/2015	4296	612
9/9/2015	4622	741
9/10/2015	5283	891
9/11/2015	5278	774
9/12/2015	5571	852
9/13/2015	5408	855 *
9/14/2015	6192	1141 *
9/15/2015	5896	936
9/16/2015	4983	674
9/17/2015	4183	571
9/18/2015	4168	589
9/19/2015	4261	629
9/20/2015	4320	753

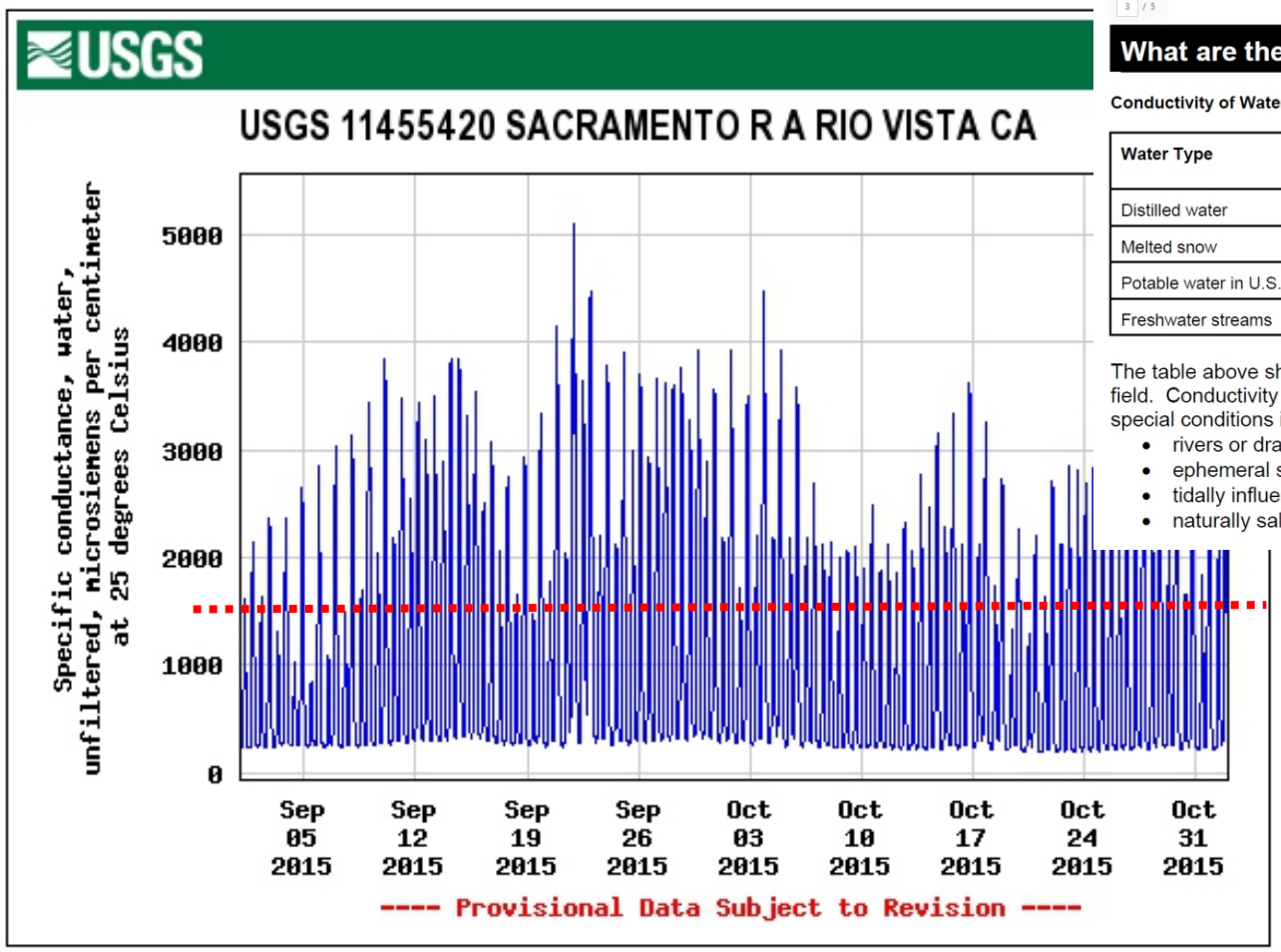
Date	EMM	RVB
9/21/2015	5070	957
9/22/2015	6170	1226
9/23/2015	5301	924
9/24/2015	4860	750
9/25/2015	5197	879
9/26/2015	5484	965
9/27/2015	5245	953
9/28/2015	5538	1054 *
9/29/2015	5662	1087 *
9/30/2015	5080	879
10/1/2015	4745	864
10/2/2015	4567	756
10/3/2015	4969	927
10/4/2015	4630	799
10/5/2015	4838	755
10/6/2015	4396	607
10/7/2015	3978	537
10/8/2015	3708	466
10/9/2015	3728	477
10/10/2015	4031	520
10/11/2015	4012	450
10/12/2015	3663	423
10/13/2015	3782	494
10/14/2015	4425	632
10/15/2015	4496	710
10/16/2015	4466	760
10/17/2015	5155	738
10/18/2015	4546	627
10/19/2015	3445	371
10/20/2015	3079	501
10/21/2015	3446	458
10/22/2015	3803	524
10/23/2015	4123	635
10/24/2015	4116	--
10/25/2015	4456	761
10/26/2015	4547	640
10/27/2015	5038	762
10/28/2015	5113	853

https://nwis.waterdata.usgs.gov/nwis/uv/?ts_id=16195&format=img_stats&site_no



What EC does DWR modelers assume is the maximum level for fresh water? The standart used to be charted as 1 PPT. How many ppt is estimated at 2000 EC? 3000 EC?

https://nwis.waterdata.usgs.gov/nwis/uv/?ts_id=16195&format=img_stats&site_no



What are the Typical Ranges?

Conductivity of Water

Water Type	Conductivity (umhos/cm)
Distilled water	0.5 - 3.0
Melted snow	2 - 42
Potable water in U.S.	30 - 1500
Freshwater streams	100-2000

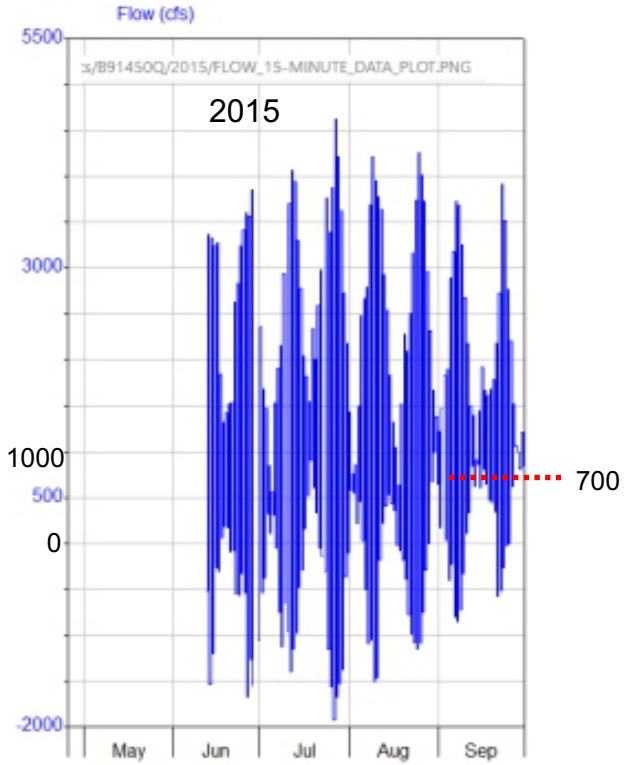
The table above shows some ranges of conductivity values you might encounter in the field. Conductivity can be much higher than the maximum values shown above under special conditions in some waters, for examples:

- rivers or drainage ditches dominated by subsurface agricultural return flows,
- ephemeral streams or pools late in the season,
- tidally influenced coastal waters, and
- naturally saline or brackish lakes or ponds

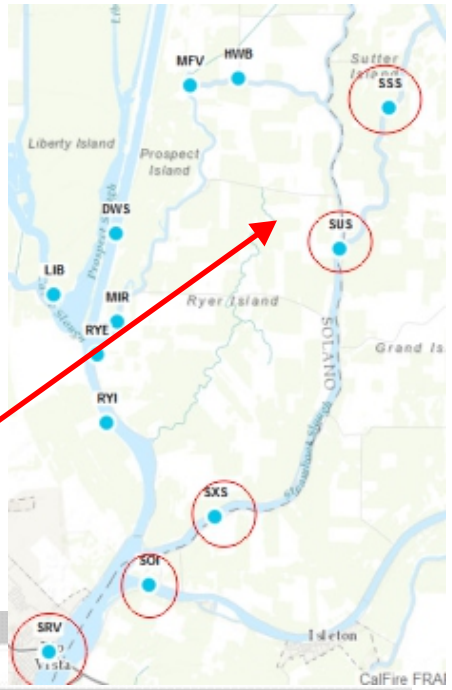
Flows were very low on Steamboat Slough in September 2015. What was EC at the same location as the flow gage?

www.water.ca.gov/waterdatalibrary/docs/Hydstra/docs/B914500/2015/FLOW_15-MINUTE_DATA_PLOT.PNG

www.water.ca.gov/waterdatalibrary/docs/hydstra/docs/B914500/2015/FLOW_15-minute_data_plotting



1. DWR modeled an "average" of 180 EC at SUS but at 700 cfs in a Dry Year the EC was as high as 220 in September 2015. Should we assume a plus minus margin of error as wide as +40 and -30 for the modeling for EC on Steamboat Slough in dry years?

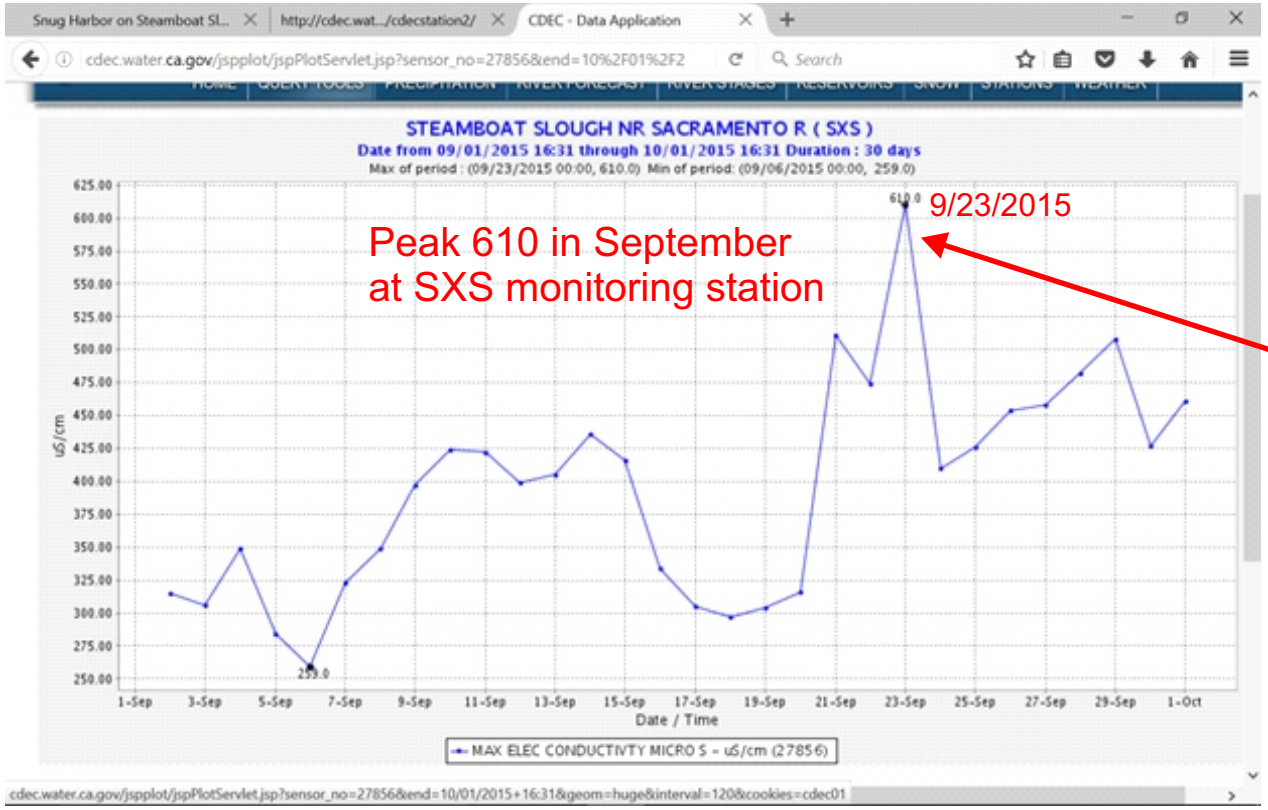


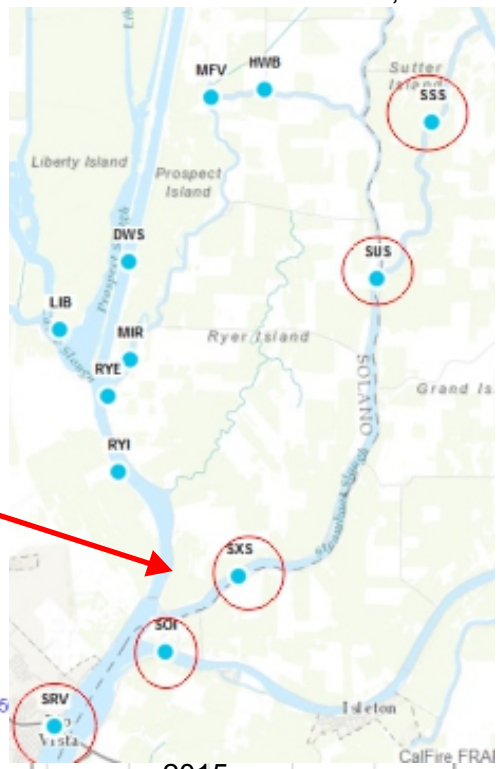
EC 220 to 150 at SUS

In 2015 in a critical dry year, with flow on lower Steamboat Slough above 700 (1000 cfs est), EC reached 610 at SXS monitoring station. If operating as proposed, where flow on Steamboat Slough would be sustained to historic low levels below 1000 cfs, what would sustained 600 EC do to the long term water quality at this location?

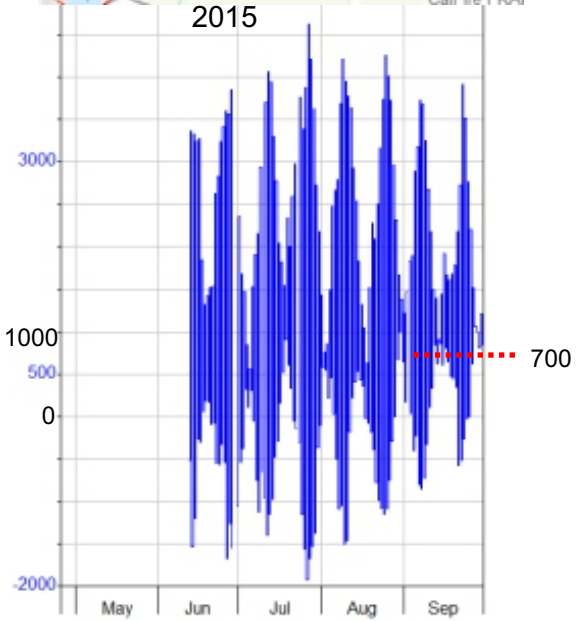
www.water.ca.gov/waterdatalibrary/docs/Hydstra/docs/B914500Q/2015/FLOW_15-MINUTE_DATA_PLOT.PNG

www.water.ca.gov/waterdatalibrary/docs/hydstra/docs/B914500/2015/FLOW_15-minute_data_plotting





cdec.water.ca.gov/jspplot/jspplotservlet.jsp?sensor_no=27856&end=10%2PO1%2F2 SXS Steamboat Slough



September 2015: Lower Steamboat Slough at monitoring station SXS with estimated flows at 1000 cfs, EC ranged from 250 to 610 !

http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/docs/petitioners_exhibit/dwr/dwr_316.pdf

200 to 400 EC September through December 2015 at monitoring station on Lower Steamboat Slough

www.water.ca.gov/waterdatalibrary/docs/Hydstra/docs/B9145000/POR/CONDUCTIVITY_POINT_DATA.CSV

08/28/2015,	206,	1,
08/29/2015,	232,	1,
08/30/2015,	227,	1,
08/31/2015,	226,	1,
09/01/2015,	235,	1,
09/02/2015,	244,	1,
09/03/2015,	237,	1,
09/04/2015,	236,	1,
09/05/2015,	224,	1,
09/06/2015,	221,	1,
09/07/2015,	226,	1,
09/08/2015,	236,	1,
09/09/2015,	250,	1,
09/10/2015,	271,	1,
09/11/2015,	279,	1,
09/12/2015,	273,	1,
09/13/2015,	268,	1,
09/14/2015,	279,	1,
09/15/2015,	260,	1,
09/16/2015,	224,	1,
09/17/2015,	215,	1,
09/18/2015,	214,	1,
09/19/2015,	210,	1,
09/20/2015,	209,	1,
09/21/2015,	235,	1,
09/22/2015,	258,	1,
09/23/2015,	233,	1,
09/24/2015,	226,	1,
09/25/2015,	245,	1,
09/26/2015,	263,	1,
09/27/2015,	277,	1,
09/28/2015,	286,	1,
09/29/2015,	274,	1,
09/30/2015,	248,	1,
10/01/2015,	247,	1,
10/02/2015,	220,	1,
10/03/2015,	271,	1,
10/04/2015,	242,	1,
10/05/2015,	217,	1,
10/06/2015,	194,	1,
10/07/2015,	189,	1,
10/08/2015,	189,	1,
10/09/2015,	192,	1,
10/10/2015,	195,	1,
10/11/2015,	189,	1,
10/12/2015,	185,	1,
10/13/2015,	186,	1,
10/14/2015,	202,	1,
10/15/2015,	211,	1,
10/16/2015,	211,	1,
10/17/2015,	201,	1,
10/18/2015,	190,	1,
10/19/2015,	177,	1,
10/20/2015,	173,	1,
10/21/2015,	173,	1,
10/22/2015,	179,	1,
10/23/2015,	190,	1,
10/24/2015,	200,	1,
10/25/2015,	217,	1,
10/26/2015,	213,	1,
10/27/2015,	226,	1,
10/28/2015,	238,	1,
10/29/2015,	219,	1,

www.water.ca.gov/waterdatalibrary/docs/Hydstra/docs/B9145000/POR/CONDUCTIVITY_POINT_DATA.CSV

11/07/2015,	188,	1,
11/08/2015,	199,	1,
11/09/2015,	215,	1,
11/10/2015,	203,	1,
11/11/2015,	195,	1,
11/12/2015,	200,	1,
11/13/2015,	197,	1,
11/14/2015,	218,	1,
11/15/2015,	285,	1,
11/16/2015,	187,	1,
11/17/2015,	186,	1,
11/18/2015,	190,	1,
11/19/2015,	188,	1,
11/20/2015,	192,	1,
11/21/2015,	211,	1,
11/22/2015,	231,	1,
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11/24/2015,	400,	1,
11/25/2015,	299,	1,
11/26/2015,	262,	1,
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11/29/2015,	278,	1,
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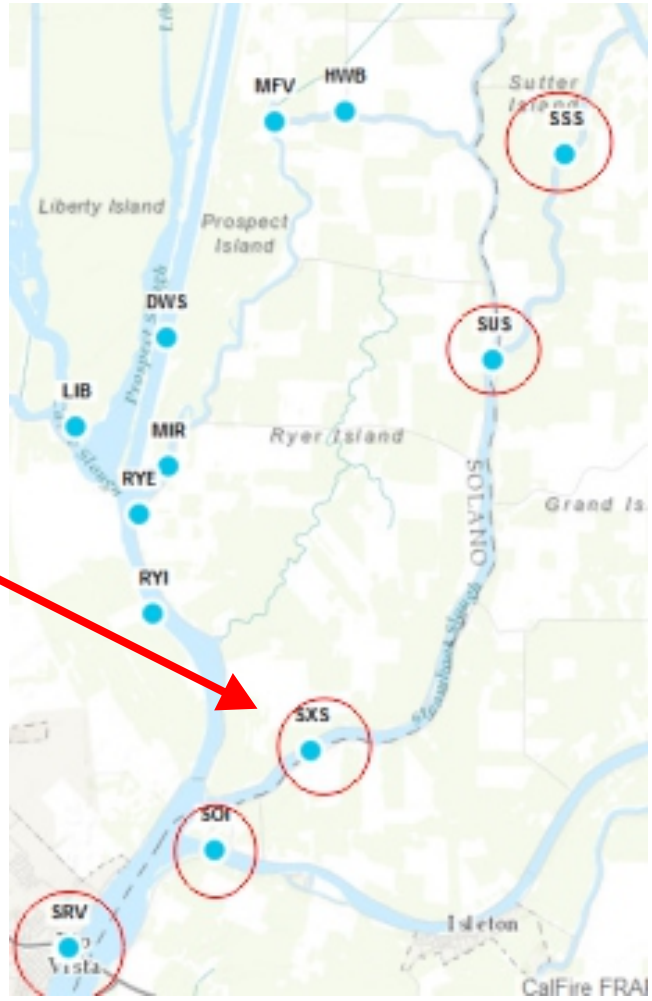
12/10/2015,	291,	1,
12/11/2015,	262,	1,
12/12/2015,	222,	1,
12/13/2015,	242,	1,
12/14/2015,	193,	1,



Note that when one drills down to find the daily EC computed totals, they do not reflect the same numbers as the charted data shown the previous page.

What is the peak EC at SCH on the Sacramento River below Isleton?

www.water.ca.gov/waterdatalibrary/docs/Hydstra/docs/B91250Q/2015/FLOW_15-MINUTE_DATA_PLOT.PNG

www.water.ca.gov/waterdatalibrary/docs/Hydstra/docs/B9125000/2015/CONDUCTIVITY_POINT_DATA.CSV

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09/20/2015 14:45:16,        277,      1,
09/20/2015 15:00:51,        265,      1,
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09/20/2015 17:00:51,        195,      1,
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09/20/2015 17:30:16,        223,      1,
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09/20/2015 21:30:16,        974,      1,
09/20/2015 21:45:16,       1020,      1,
09/20/2015 22:00:51,        987,      1,
09/20/2015 22:15:16,       1130,      1,
09/20/2015 22:30:16,       1090,      1,
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09/21/2015 02:30:16,        201,      1,
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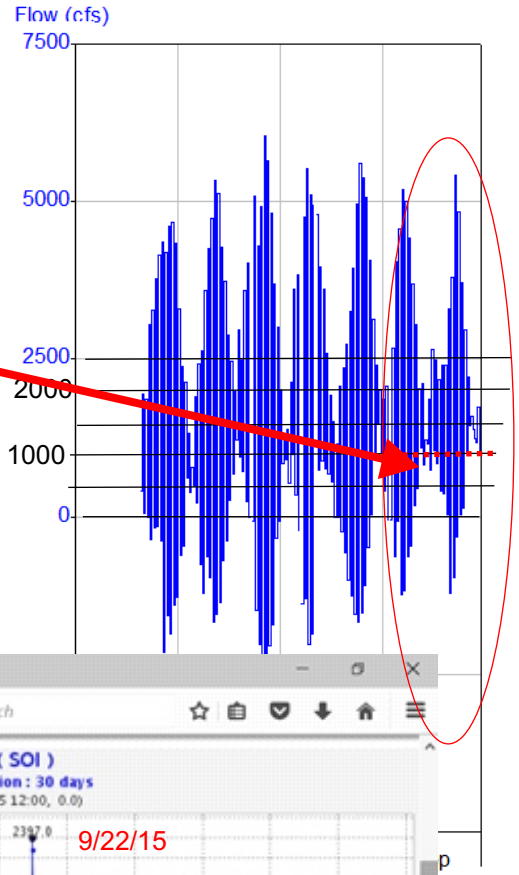
09/21/2015 04:15:16,        175,      1,
09/21/2015 04:30:16,        175,      1,
09/21/2015 04:45:16,        175,      1,
09/21/2015 05:00:51,        174,      1,
09/21/2015 05:15:16,        174,      1,
09/21/2015 05:30:16,        174,      1,
09/21/2015 05:45:16,        175,      1,
09/21/2015 06:00:51,        174,      1,
```

September 2015, down stream of Isleton, with flows above 1000 cfs, EC reached 1130, peak over 2000.

Yet Waterfix modelers say flows of less than 1000 cfs in September of a dry year will result in EC of 180.

DWR own real time monitoring station below Isleton shows EC reached 1400 in September 2015



Snug Harbor on Steamboat Sl... | http://cdec.wat.../cdecstation2/ | CDEC - Data Application

cdec.water.ca.gov/jspplot/jspPlotServlet.jsp?sensor_no=27846&end=10%2F01%2F2

SACRAMENTO R DOWNSTREAM OF ISLETON (SOI)

Date from 09/01/2015 16:40 through 10/01/2015 16:40 Duration : 30 days

Max of period : (09/21/2015 23:45, 2397.0) Min of period: (09/03/2015 12:00, 0.0)

SOI

2397 9/22/15

uS/cm

Date / Time

ELECTRICAL CONDUCTIVTY MICRO S - uS/cm (27846)

Generated on Wed May 03 16:41:06 PDT 2017

Referring to NDWA_011.pdf map, were any impacts to surface water quality analyzed for WF low flows plus irrigation discharges back into the waterways?

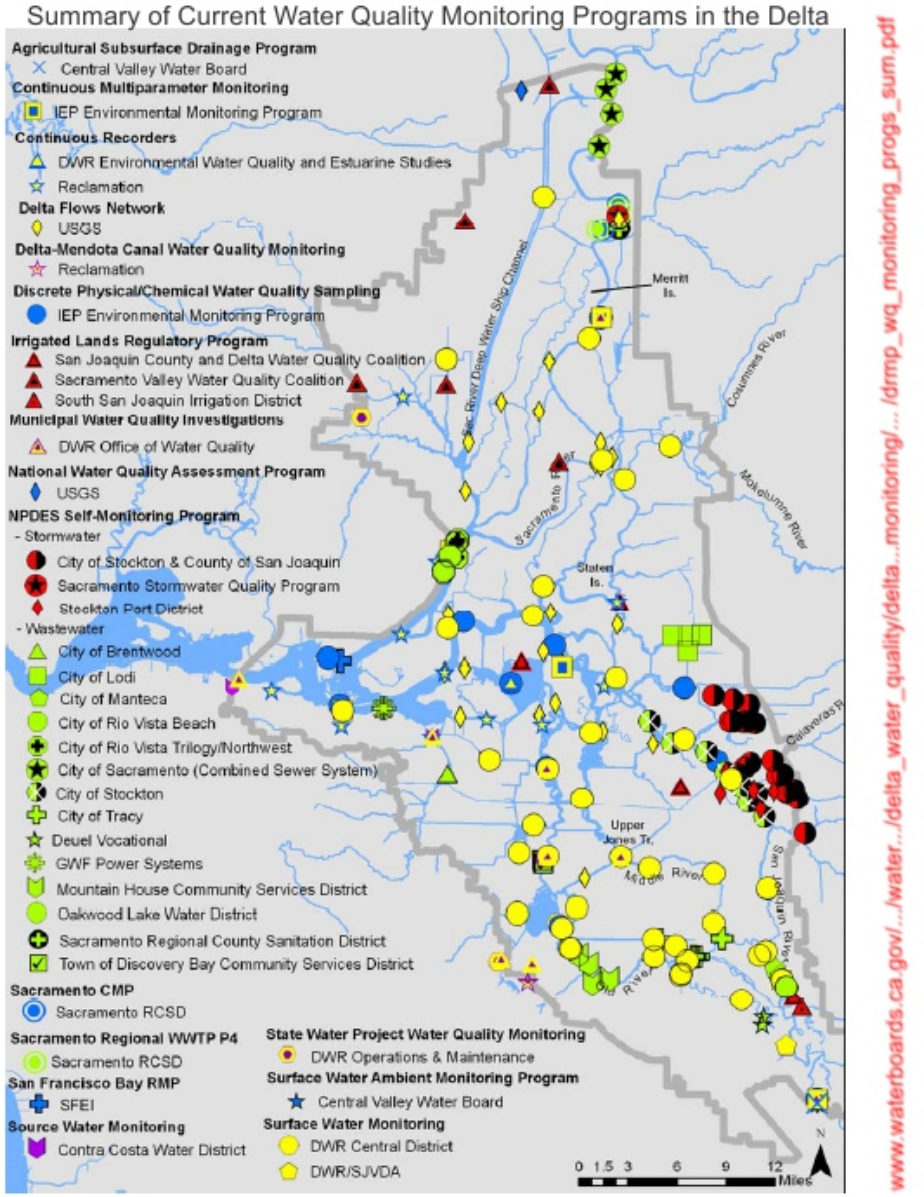
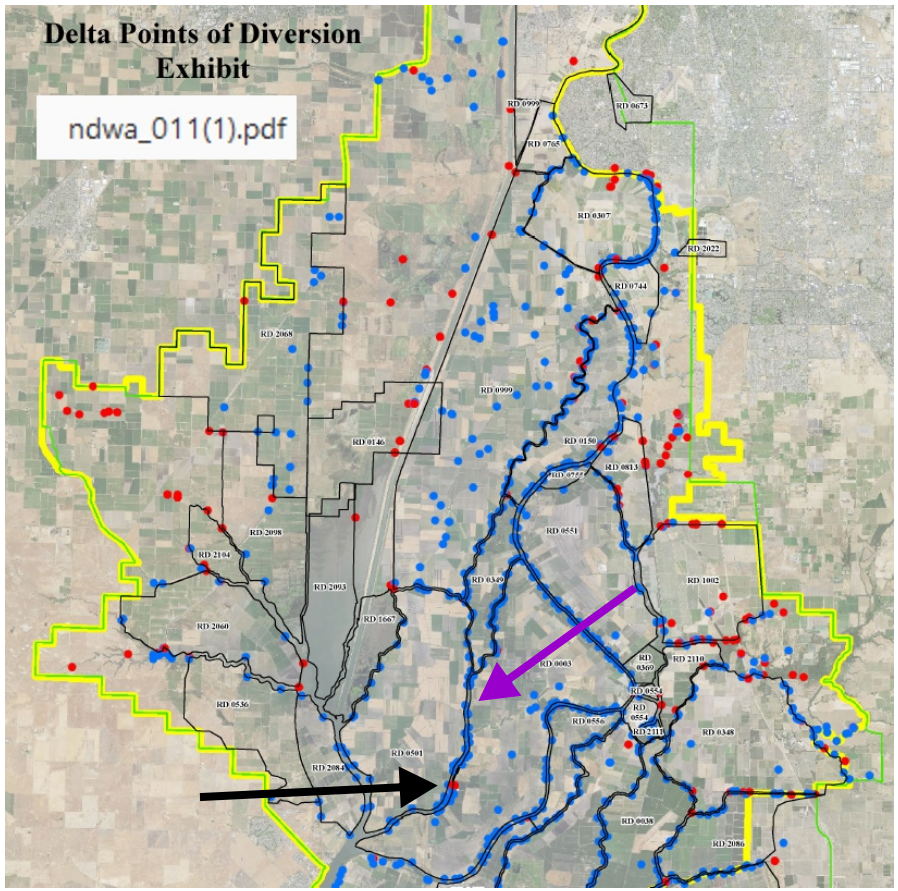


Figure 1. Overview of Delta monitoring sites by program. See Appendix A for more detailed maps of monitoring sites by program.



Operating flows as indicated by the DWR data appears to suspend the North Delta waterways into permanent drought-flow status. Negative impacts include:

*degradation of surface drinking water if low flows are not sufficient to dilute discharges back into the waterways: coliform, salinity, etc

*possible degredation of drinking water aquifer over time, which impacts the water quality of public and private drinking water wells in the impact area

*possible damage to native tree and plant roots along the waterways, causing them to die

* higher salinity in the surface water may cause native trees to die, causing risk to humans in the area of falling dead trees

*including the risk of trees falling on drinking water wells

*degradation of surface water quality could impact irrigation of landscape and fruit trees of waterside properties

Figure 6-23 March 21 Forecast - Spatial Seasonal EC Comparison

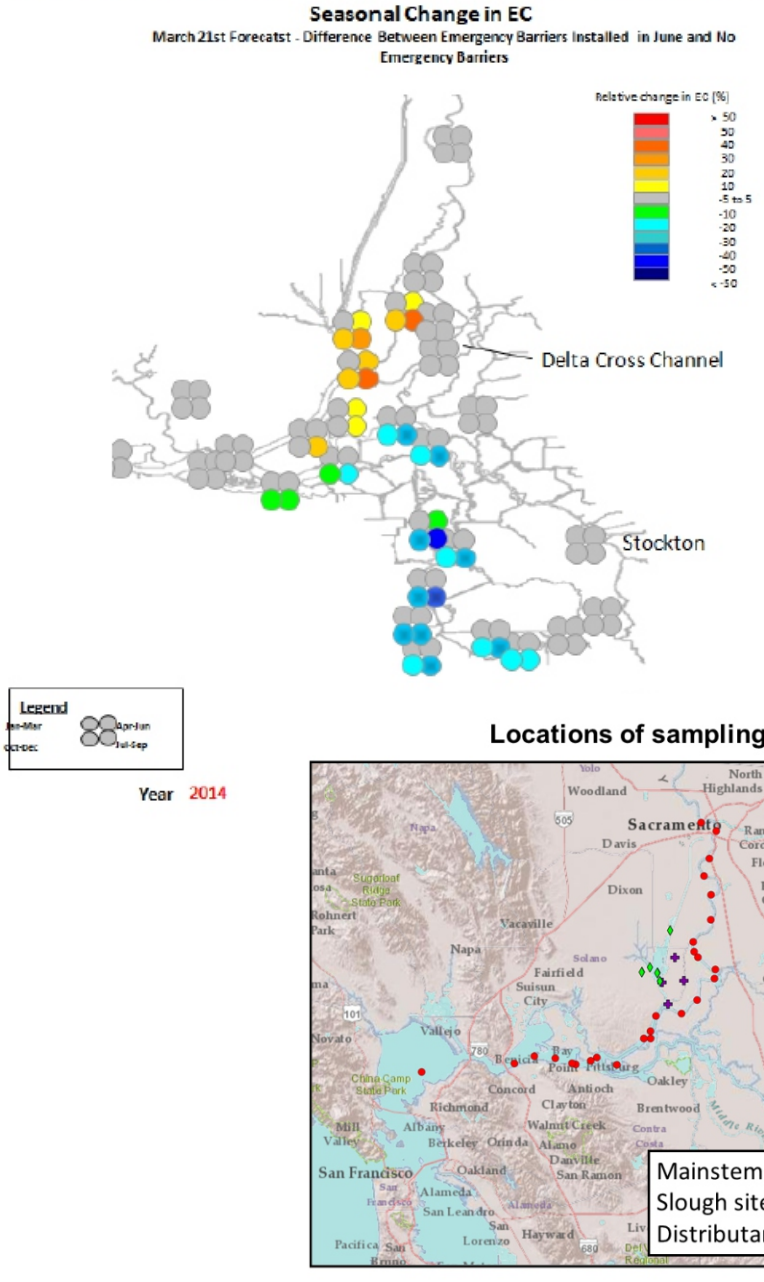
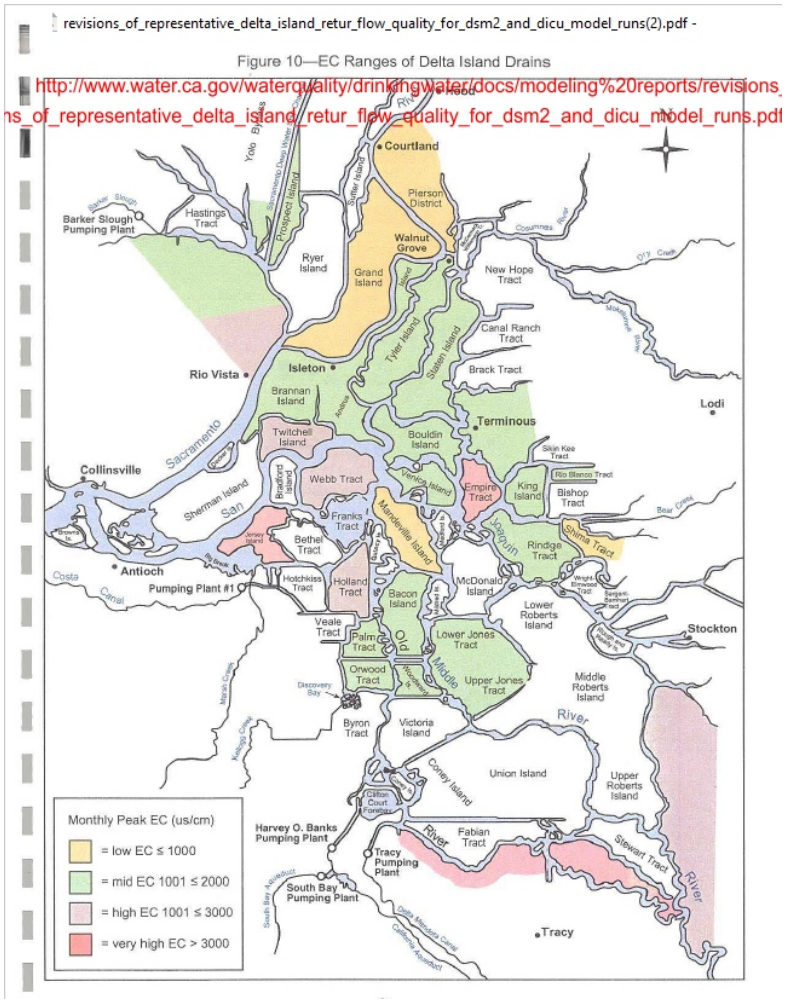


Fig. 2

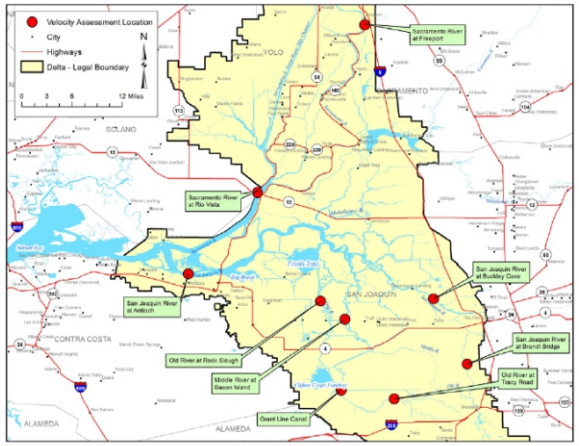
Locations of sampling sites



DWR-8, pages 26, 27, 28 and 39

28

DELTA FLOW VELOCITY EFFECTS ANALYSIS



27

DELTA FLOW VELOCITY EFFECTS ANALYSIS

- **Velocity exceedance plots**
  - Daily maximum velocities
  - Absolute 15-minute velocities (regardless of flow direction in channel)
  - 16-year period modeled (1976 to 1991)
- **Nine Delta locations, which are representative of the entire Delta.**

39

OPINION 7

Delta Temperature and HABs:

The small differences in water temperature between the CWF and NAA scenarios modeled for various locations across the Delta would not substantially increase the frequency or magnitude of cyanobacteria blooms within the Delta.

26

OPINION 5

Delta Flows and HABs:

Although *Microcystis* blooms are expected to occur at certain Delta locations in the future, as they have historically, channel velocities at various Delta locations would not be altered to a degree that would make hydrodynamic conditions substantially more conducive to *Microcystis* blooms for the CWF, relative to that which would occur for the NAA.

https://www.youtube.com/watch?v=1lblKcVclHA

YouTube

Does the CWF modeling account for the reduced flows from the circled newer intakes or pumps added after the modeling time frame?

Note that the map shows an existing intake north of the Sutter Slough bridge. When was that intake built?

Note the animation does NOT show the new pumps or intakes a Potato Slough and Empire Tract and Victoria Canal. Why ignore those new water conveyance projects?

Delta Flow Animation

California WaterFix

Subscribe 112

5,342 views

Add to Share More 12 6

Published on Jul 9, 2015

Category People & Blogs

License Standard YouTube License

Since DSM2 plays such a large part in modeling for water quality impacts from proposed WF operations, please answer the following:

1. CSDP is the cross section development program-who determined what cross sections to use for Steamboat Slough?
2. When was Steamboat Slough last surveyed for recalibration of DSM2?
3..Was the sub-surface flow barrier located 10-20 feet east of the Steamboat Slough bridge accounted for or modeled in DSM2? Was the narrow channel cut into the sub-surface flow barrier modeled in DSM2?
4. If DSM2 bathymetric input is not correct, how does that affect model outcome for flow, salinity, water temperature, velocity?

www.usbr.gov/mp/cvo/OCAP/sep08_docs/Appendix_F.pdf

http://modeling.water.ca.gov/delta/studies/validation2000.

page 12 of 76

The draft calibration and validation report is available at:

http://www.iep.ca.gov/dsm2pwt/dsm2pwt.html

A considerable effort has been made to improve the channel geometry specified for the DSM2 grid. Channel geometry is perhaps the major factor influencing the tidal hydraulics in the Delta. Modern methods of boat-mounted depth sounder connected with a GPS for location have been used to collect more accurate bathymetry data in several portions of the Delta by DWR Central District staff. All the bathymetry data are contained in the geometry database and user-interface called the "Cross Section Development Program."

More than 50 separate model runs were performed to adjust the flow friction coefficient (Manning's roughness coefficient n) values to match the stage and velocity and phase lag throughout the Delta. Salinity (EC) was calibrated by adjusting the salinity dispersion coefficient.

The results of this extensive calibration effort are demonstrated in the selected validation results shown in this section. The validation simulation used historical daily inflows and export pumping with historical tidal stage at Martinez to simulate the January 1994–September 1999 period, using the calibrated geometry and model coefficients. This period includes a wide range of flow and export pumping, with temporary barriers installed during the spring and summer months. The tidal stage comparisons for the higher flow periods are reviewed below to illustrate the accuracy of the DSM2 simulations during major flood events. Several major floods, including the January 1997 events, are simulated in these historical DSM2 results. Tidal stage comparisons in the lower flow periods illustrate the ability of DSM2 to match the normal tidal fluctuations in the Delta.

www.usbr.gov/mp/cvo/OCAP/sep08_docs/Appendix_F.pdf

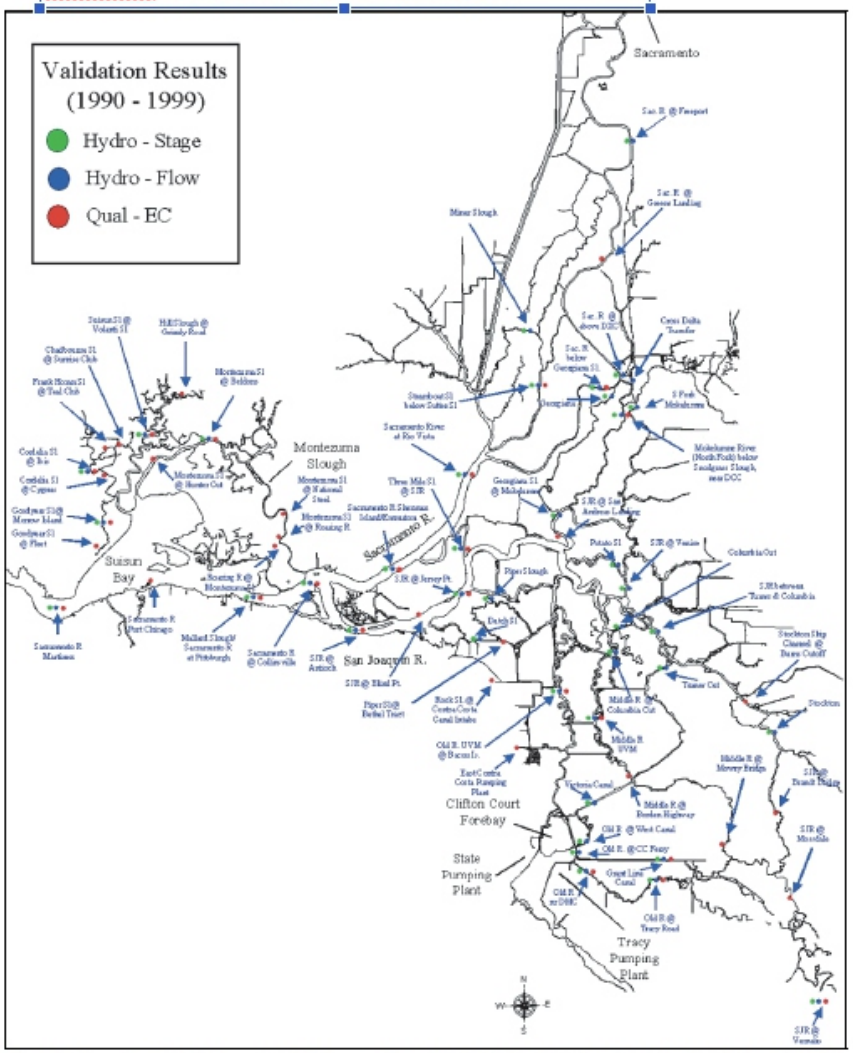
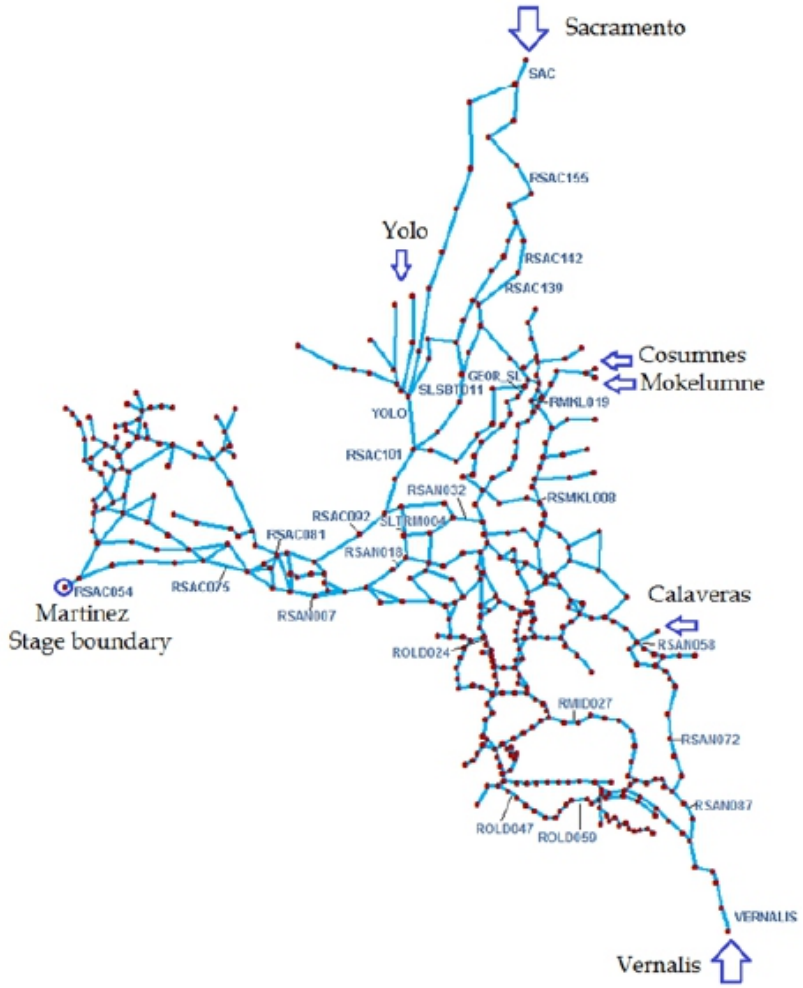


Figure 7 Location of Tidal Stage, Tidal Flow, and Electrical Conductivity Data Used for Validation of DSM2



name	Location	Name	Location
RMID027	Middle River at Tracy Rd	RSAC101	Sacramento River at Rio Vista
ROLD024	Old River at Bacon Island	RSAN007	San Joaquin River at Antioch
RSAC081	Sacramento River at Collinsville	RSAN018	San Joaquin River at Jersey Point
RSAC092	Sacramento River at Emmaton	RSAN058	Stockton Ship Canal

Figure 4-9 Delta Network for Historical EC Simulation

of interest that might influence the boundary conditions. For water quality simulations, constituent concentrations must also be provided at all boundaries. In a tidal system, such as the Delta, where most of the salinity originates in the ocean, the salt concentration at the downstream boundary is crucial because it drives the water quality conditions in the Delta.

Situated at the eastern end of the Carquinez Strait, Martinez is the location of the downstream (western) boundary condition for DSM2. While the waterways of the legal Sacramento-San Joaquin Delta are fully contained within the DSM2 boundaries (Figure 3-1), depending on the details of a particular study, the boundary condition location at Martinez can be less than ideal, as we discuss below.

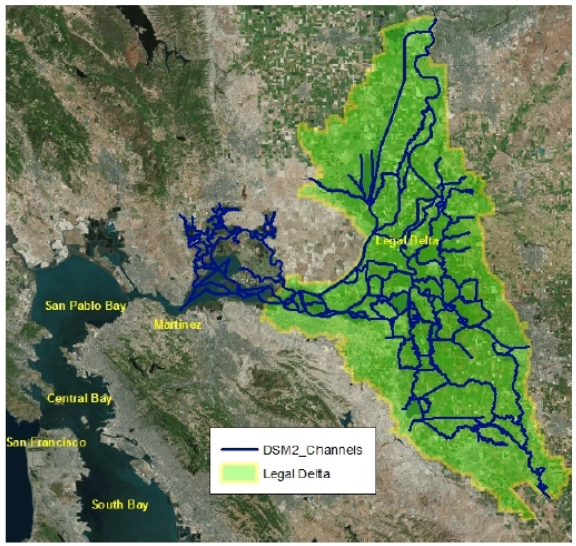
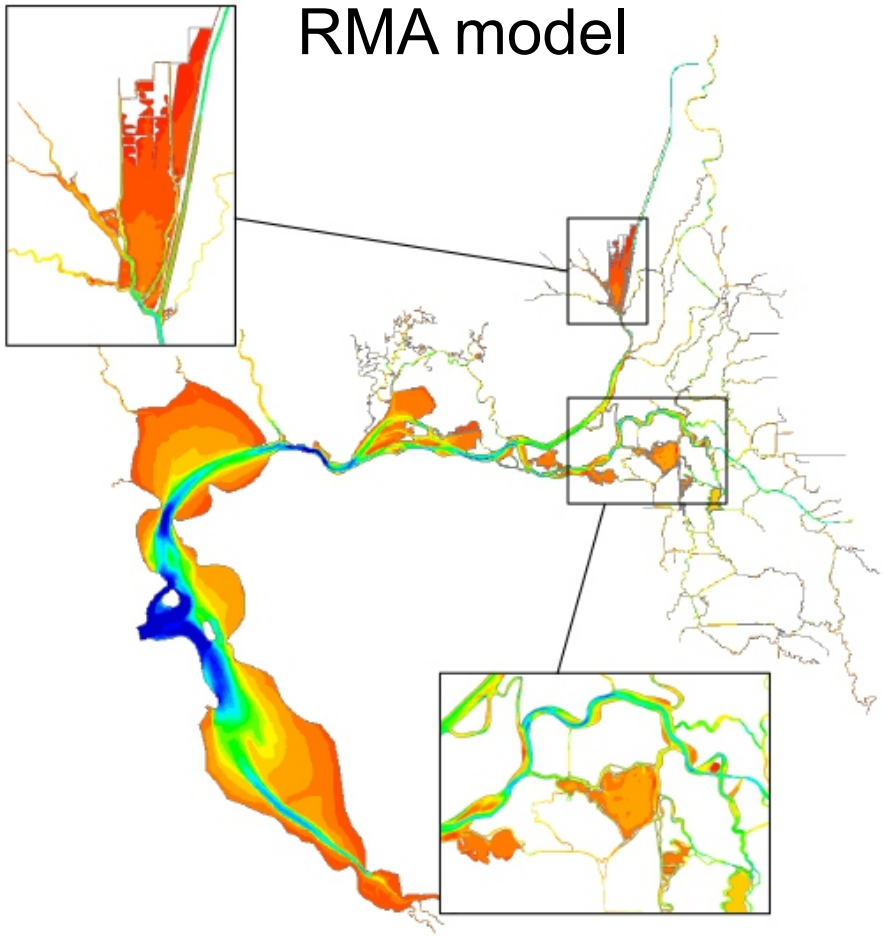


Figure 3-1 Map of Area Modeled Including Legal Boundaries of the Sacramento-San Joaquin Bay-Delta

www.rmanet.com/services/numerical-modeling/rma-bay-delta-model/

- Hydrodynamic and water quality impacts of Delta Cross Channel reoperation and installation of various gates and barriers throughout the Delta
- Fish behavior based on flow, salinity and turbidity conditions
- Flood events
- Drought conditions
- Nutrients and temperature
- Sea level rise

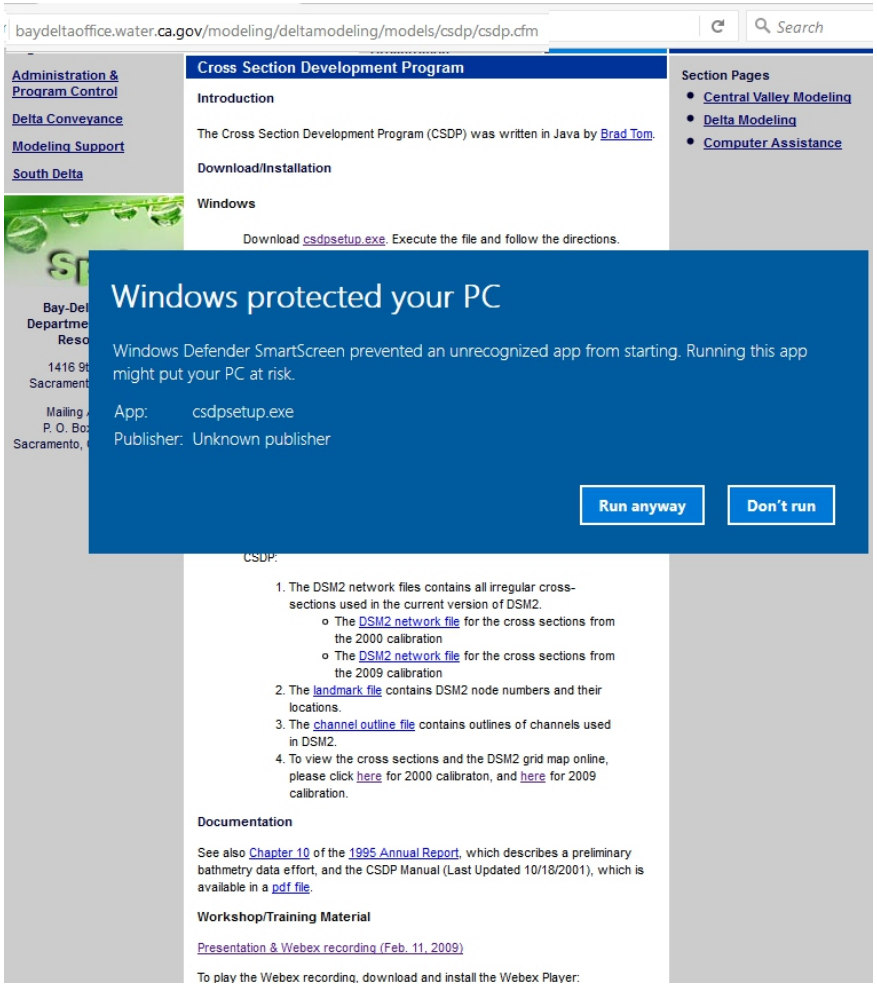
RMA model



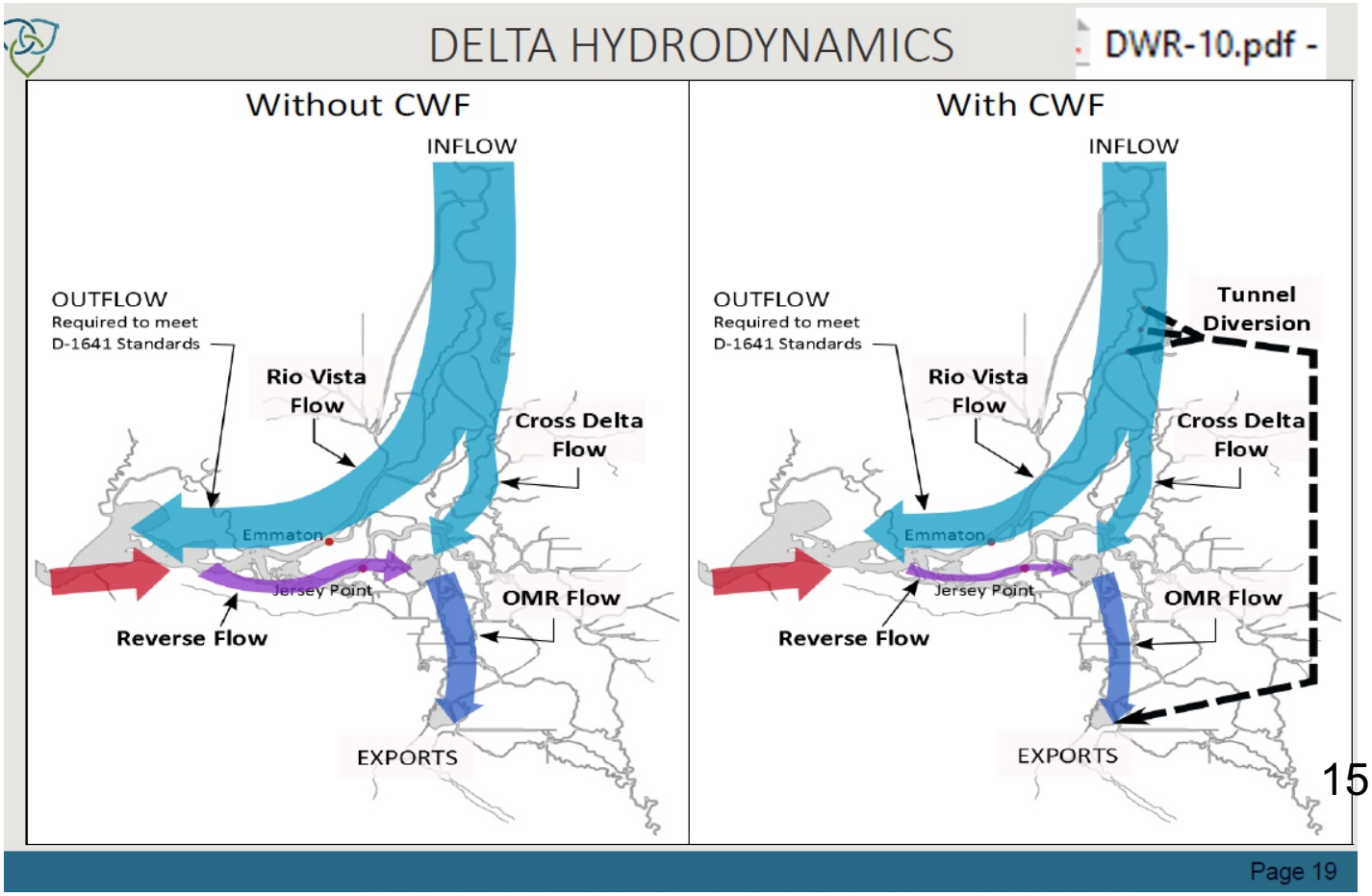
Model grid and bathymetry of the RMA Bay-Delta Model.

The RMA Bay-Delta Model accurately simulates of Delta-wide hydrodynamics and water quality transport. In addition to standard water quality simulations, the model can be used in particle tracking mode to evaluate fish behavior or simulate the generation and dispersal of phytoplankton.

NSS tried to download the updated bathmetry per DWR website but there was a warning that the data could put receiving computer at risk, so app to be able to read the data was not downloaded.



http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/docs/petitioners_exhibit/dwr/DWR-10.pdf Page 19



15

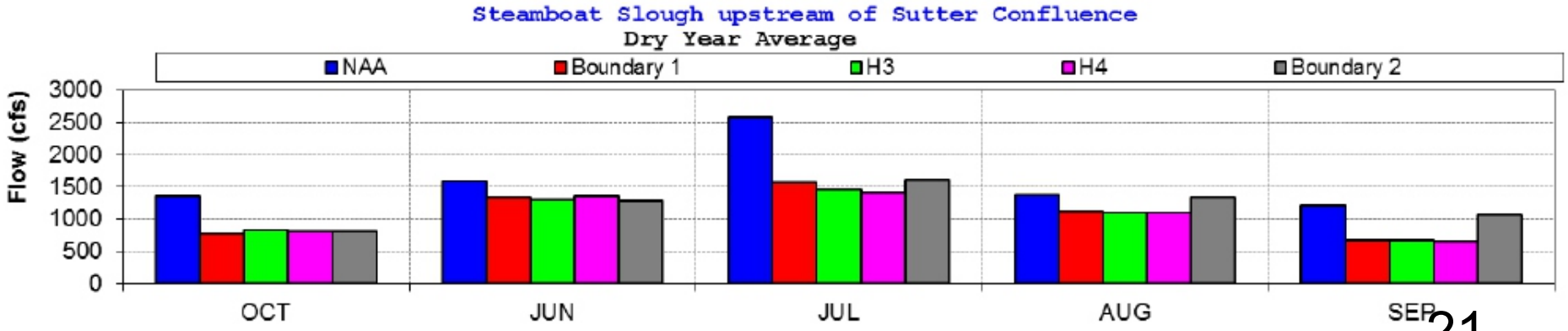
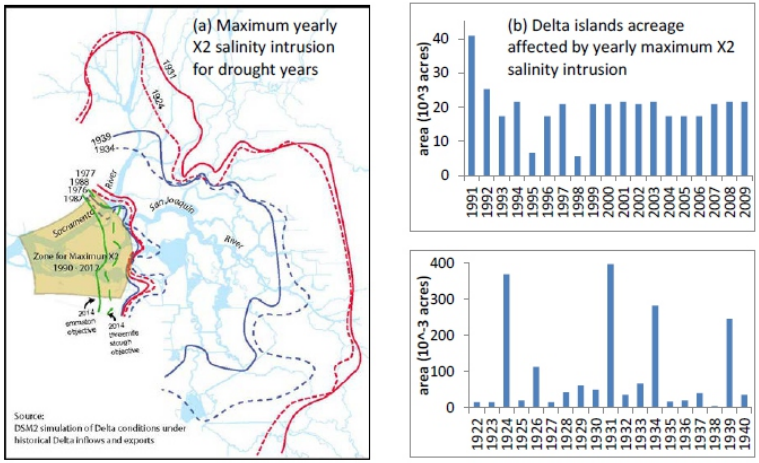


Figure 5-8 Sample Map of Maximum Salinity Intrusions of Different Drought Years Using DSM2 Simulation



5.4 Summary and Future Work

A new tool uses ArcGIS, Python scripts, and DSM2-QUAL output to generate static or dynamic Delta-wide contours of DSM2-generated water quality parameters. This tool can help users:

- directly investigate the distribution of water quality in the Delta,
- better visualize model output for specified time period,
- identify the areal extent of the Delta affected by changes in water quality due to changes in hydrology, Delta geometry, or barrier installation and operation,
- compare scenarios or different years from another perspective, and
- validate the water quality model from another perspective, particularly under low Delta outflow conditions.

Future work will use geo-referenced Delta agriculture diversion locations in order to refine estimation of impact to Delta agriculture under significant salinity intrusion.

www.rmanet.com/projects/modeling/hydrodynamic-and-salinity-transport-modeling-of-the-historical-bay-delta-system/

Modeling Projects

- Suisun Marsh Levee-Breach Modeling
- Bay-Delta Conservation Plan (BDCP)
- Modeling Nutrient Transformation and Losses in the Sacramento-San Joaquin Delta
- Turbidity and Delta Smelt Forecast Modeling
- ACF and ACT River-Reservoir Water Quality Modeling
- Prospect Island Tidal Restoration Modeling
- Three-dimensional Hydrodynamic Modeling of the Historical Delta
- Project Reports

Software Projects

Featured Projects — Modeling

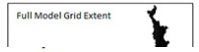
THREE-DIMENSIONAL HYDRODYNAMIC MODELING OF THE HISTORICAL DELTA

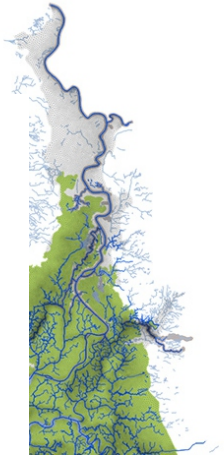
Between the mid-19th century and today, the Sacramento-San Joaquin Delta has undergone vast changes to its channel geometry (construction of cut channels, channel widening), bathymetry (shipping channel dredging, hydraulic mining sediment), marsh area (levee construction, marsh draining, flooded islands), inflow hydrology (major dam construction, urbanization), and sea level rise. From a scientific, planning, or even regulatory point of view, it is important to understand how the Delta of the past functioned in comparison to the Delta of the present. How do historical tidal ranges and in-channel velocities compare to present day values? Did the low salinity zone move and function similar to how it behaves today? How have advective and dispersive transport patterns changed?

Our historical Delta modeling work was performed in collaboration with a large team of researchers, under the direction and funding of the Metropolitan Water District of Southern California (MWD). This team included the San Francisco Estuary Institute (SFEI), whose comprehensive report on the Delta's historical ecology provided the framework for this study, the University of California Davis Center for Watershed Science (UCD-CWS), the California Department of Water Resources (DWR), and several others.

PROJECT HIGHLIGHTS:

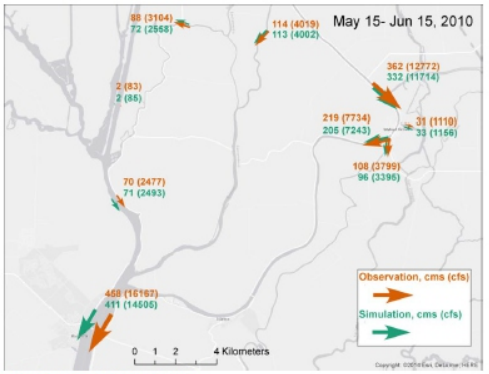
- Collaborative effort with MWD, UC Davis, SFEI, DWR
- First detailed hydrodynamic model of the Historical Delta
- Based on SFEI Delta Historical Ecology Study
- Comparison with current Delta flow and salinity regime





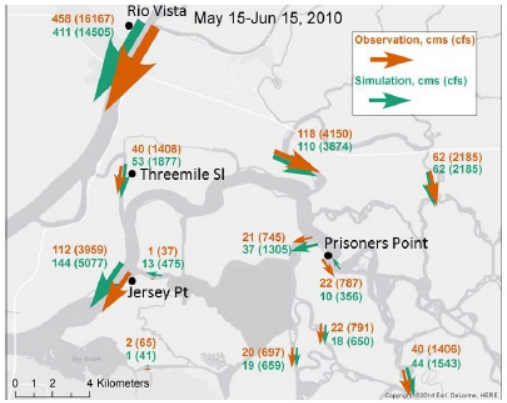
AR-2014-All.pdf

Figure 7-19 North Delta Monthly Residual Flow, May-June 2010



Note: Units are cms (cfs in parentheses)

Figure 7-20 Central Delta Monthly Residual Flow, May-June 2010



Note: Units are cms (cfs in parentheses)

last page of SHR-357

INVASIVE SPECIES (WOODY and HERBACEOUS)								
Arundo Donax	Giant reed	Shrub, graminoid	No	Dense	Moderate	Intermediate	24	
Centaurea maculosa (2)	Spotted knapweed	Biennial forb/herb	No; dies back in late fall	Moderate	Porous/absent	Low	sturdy long tap-root'	3
Centaurea solstitialis (2)	Yellow star-thistle	winter annual forb/herb	No; dies back in late fall	Moderate	Porous/absent	Low	72 (average)	5
Lepidium latifolium	Broadleaved pepperweed							
Lythrum salicaria (2)	Purple loosestrife	subshrub, perennial forb	No; dies back in late fall	Dense	Porous/absent	Intermediate	6	7
Rubus discolor	Himalayan blackberry	vine, shrub	No					
Tamarix parviflora (2)	Smallflower tamarisk	shrub/small tree	No	Low	Moderate		180 (average)	24
Tamarix ramosissima (2)	Saltcedar tamarisk	shrub/small tree	No	Low	Moderate		180 (average)	15
Conium maculatum (2)	Poison hemlock	Biennial forb/herb	No	Dense	Low	Moderate	tap root	9
Foeniculum vulgare (2)	Sweet fennel	Perennial forb	No	Dense	Low	Moderate	tap root	9
Egeria densa (3) *	Brazilian waterweed	Submerged aquatic perennial		Dense		High (grows best under low light)	Roots slender, can be buried 8" in substrate	Floating matts in water
Eichhornia crassipes (3) *	Water hyacinth	Aquatic perennial forb		Dense		High	Floating roots	Floating matts in and up to 2' above water
Ludwigia peploides (3)	Creeping water primrose	Aquatic perennial forb		Dense		High	Floating roots	Floating matts in and up to 0.5' above water
Myriophyllum spicatum (3)	Eurasian watermilfoil	Aquatic perennial forb		Dense		High	Floating roots	Floats in matts at and just below water surface
Cytisus scoparius	Scotch broom	Perennial shrub	No	Dense	Moderate	Intolerant	16	7
Ficus carica	edible fig	Perennial shrub/tree	No	Dense	Low	Moderate		30
Hydrilla verticillata	Florida elodea/ waterthyme	Submerged aquatic perennial	No	Dense	Low	High	0.2 to 0.5	Floats in matts at and just below water surface

http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/docs/SHR/SHR-350.pdf
http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/docs/SHR/SHR-351.pdf
http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/docs/SHR/SHR-352.pdf

or for WaterFix evidence submitted please go to
http://www.snugharbor.net/waterfixexhibits2016.html for pdfs of all the SHR evidence and
for a focused look at several DWR computer modeling documents regarding freshwater flows left in the Delta after proposed tunnels and "restoration" would be built, go to http://www.snugharbor.net/waterfixexhibitsDWR.html