Smelt Working Group
December 30, 2015

Meeting Summary

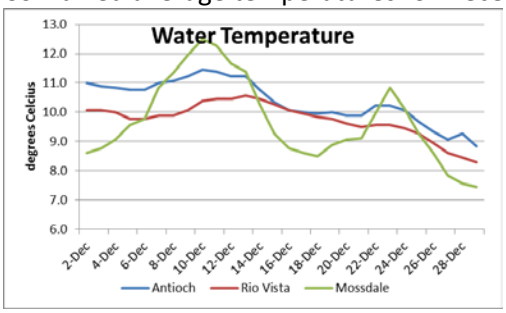
The Working Group reviewed current Delta Smelt distribution and salvage data, and current Delta conditions. The Working Group currently is following the guidance in the 2008 BiOp for Action 1 Part B and Action 2. The Working Group did not recommend a change in exports for the protection of Delta Smelt, due to the scheduled decreases in exports and OMR flow over the next several days. However, the Working Group is concerned about current conditions, and is monitoring survey results and turbidity levels daily. The Working Group described the risk of entrainment under the Service-provided advice framework. Under this framework the relative risk of entrainment for OMR flow ranges is discussed and assessed. For the current week, and considering projected Delta conditions and scheduled changes in exports and OMR flow through Monday, January 4th, the risk of entrainment for each of flow ranges is characterized as follows:

- -1250 to -2000 cfs has a low risk of entrainment,
- -2000 to -3500 cfs has a low risk of entrainment,
- -3500 to -5000 cfs has a medium risk of entrainment, and
- >-5000 cfs has a high risk of entrainment.

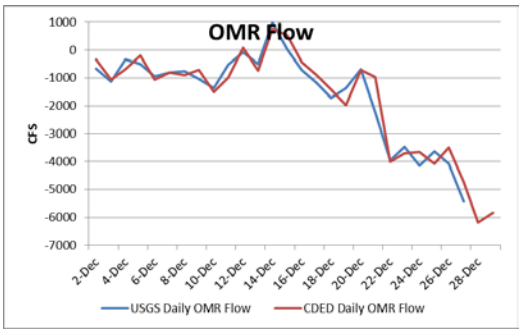
While current and projected OMR falls within the medium risk category through Saturday, January 2nd, the SWG decided to not recommend changes in exports and OMR under Action 2 because OMR is already projected to enter the low-risk categories beginning on Saturday January 2nd and continuing at least through Monday, January 4th to meet Delta outflow standards.

Reported Data

1. Current environmental data
    a. Temperature
    Combined average temperatures for December 29 are 8.2°C

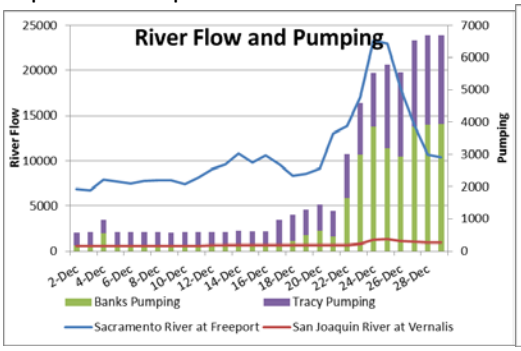


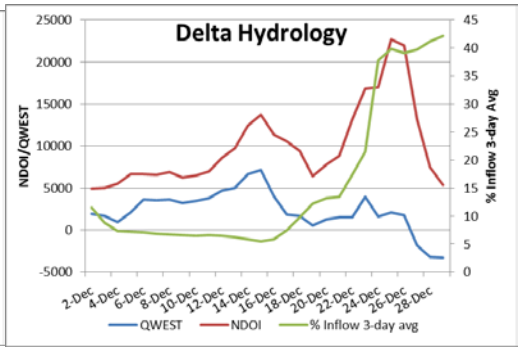
    b. OMR flow
    USGS OMR daily average flow for December 27 is -5440 cfs. CDEC OMR daily average flow for December 29 is -5843 cfs.



c. River Flows and pumping

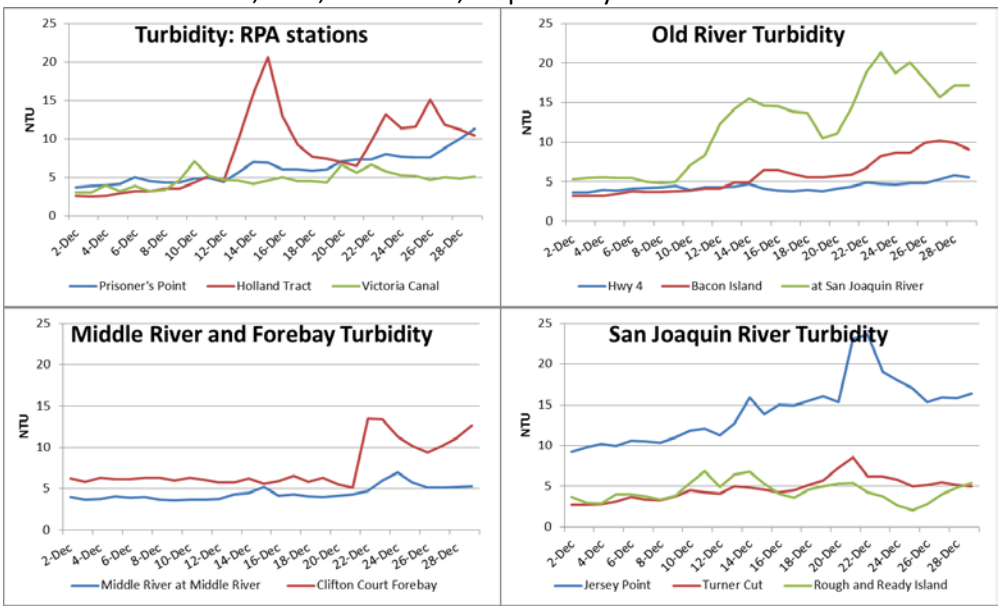
Sacramento River at Freeport flow for December 29 was 10,375 cfs. San Joaquin River at Vernalis river flow for December 29 was 953 cfs. Combined exports are 6300 cfs today and are expected to drop over the next few days until January 4, when combined exports are expected to be 2300 cfs.

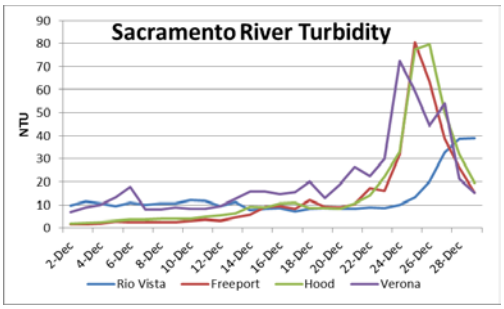




d. Turbidity

Three day average turbidity for Prisoner's Point, Holland Tract, and Victoria Canal as of December 29 was 10, 11.1, and 5 NTU, respectively.





Turbidity forecast modeling (see Attachment)

DWR's transect turbidity survey data (see Attachment).

2. Delta fish monitoring

Fall Midwater Trawl (FMWT): The December FMWT was in the field the weeks of November 30 and December 7. Two Delta Smelt were detected.

CDFW has released the 2015 FMWT indices:
The 2015 Delta Smelt annual FMWT index is 7.
The 2015 Longfin Smelt annual FMWT index is 4.
Both indices are the lowest on record (i.e. since 1967).

The December Kodiak trawl survey was conducted the week of December 14. Two Delta Smelt were caught at station 606 (both 64mm, undetermined sex), but none at any other station; all 40 stations were sampled. The 2016 SKT #1 survey will be in the field beginning January 11, 2016.

Smelt Larva Survey begins January 4, 2016.

The Early Warning Survey began November 30. Sampling has increased from last week and is alternating between Jersey and Prisoner's Point daily. Sampling on the Sacramento River began December 18 at Sherwood Harbor, Sandy Beach, and station 707.

Early Warning Survey Results, December 24 through December 30

Date	Location	Delta Smelt Catch
12/24	Sherwood Harbor	0
12/25	N/A	
12/26	N/A	
12/27	N/A	
12/28	Sherwood Harbor	0
12/28	Jersey Point	14
12/29	Prisoner's Point	1
12/30	Jersey Point	10*

*Only 3 of the 9 tows were completed in the north lane

3. Particle Tracking Modeling

Model runs given the following conditions (see Attachment):

- 30-day run
- OMRs of -1250, -3500, -5000 and current planned ops
- Insertion of particles at Jersey Point on 12/23
- Flux past Prisoner's Point, Chipps and export facilities.

4. Salvage

There has been no salvage of Delta Smelt or Longfin Smelt at either the federal or state Delta pumping facilities during the current water year.

5. Expected Project Operations

Jones pumping plant is pumping 2800 cfs. On January 1, pumping will drop to 2500 cfs, and to 800 cfs on Sunday. Clifton Court (CC) allotment is at 3500 cfs. Tomorrow, pumping will drop to 3000 cfs, to 2000 cfs on January 1, and to 1500 cfs on January 2. Combined pumping is 6000 cfs today and will drop to 2300 cfs by January 4. Today and tomorrow, pumping is being controlled by salinity. Beginning January 1, pumping will be controlled by the SWRCB D-1641 Monthly Outflow Standard of 6000 cfs and 7 day average of 4800cfs. Operators indicated the projected OMR Index (based on a combined pumping of 4000 cfs) is expected to be approximately -5600 cfs today, -5300 cfs tomorrow, -4100 cfs on January 1, -3100 cfs on January 2, -2300 cfs on January 3, and -2100 cfs on January 4.

DWR's boat turbidity transect survey was in the field December 28 and today. The data from today's survey is not available as yet.

6. Delta Conditions Team

DCT did not meet last week and is not anticipated to meet this week.

7. Assessment of Risk:

<u>WY 2016 adult Delta Smelt incidental take</u>

The WY 2016 adult Delta Smelt incidental take (IT) is 56, as is stated in the Service's December 23, 2015 memo to the Bureau of Reclamation. The method to calculate the IT is that which is described on p 386 of the 2008 BiOp, with the corrections described in both the February 22, 2013, and December 23, 2015 memos. The alternative approach that the Service presented to the 2015 independent review panel at the Long-term Operation Biological Opinions annual science review will be piloted this year.

BiOp Background:

RPA Component 1, Action 1, Part B states, "High-entrainment risk period: Delta Smelt have historically been entrained when first flush conditions occur in late December. In order to prevent or minimize such entrainment, Action 1 shall be initiated on or after December 20 if the 3 day average turbidity at Prisoner's Point, Holland Cut, and Victoria Canal exceeds 12 NTU, or if there are three days of Delta Smelt salvage at either facility or if the cumulative daily salvage count is above the risk threshold based upon the 'daily salvage index' approach described in Attachment B. Action 1 shall require the Projects to maintain OMR flows no more negative than -2,000 cfs (14-day running average) with a simultaneous 5-day running average flow no more negative than -2,500 cfs to protect adult Delta Smelt for 14 days. However, the Working Group can recommend a delayed start or interruption based on other conditions such as delta inflow that may affect vulnerability to entrainment." (BiOp page 281).

RPA Component 1, Action 2 states, "An action implemented using an adaptive process to tailor protection to changing environmental conditions after Action 1. As in Action 1, the intent is to protect pre-spawning adults from entrainment and, to the extent possible, from adverse hydrodynamic conditions."
"The range of net daily OMR flows will be no more negative than -1,250 to -5,000 cfs. Depending on extant conditions (and the general guidelines below) specific OMR flows within this range are recommended by the Working Group from the onset of Action 2 through its termination…"

The timing of Action 2 is immediately after Action 1. Before this date (in time for operators to implement the flow requirement) the SWG will recommend specific requirement OMR flows based on salvage and on physical and biological data on an ongoing basis. If Action 1 is not implemented, the SWG may recommend a start date for the implementation of Action 2 to protect adult delta smelt. (BiOp page 352).

Discussion:
The Working Group reviewed Delta Smelt distribution data, salvage data, and current Delta conditions. The working group concluded that entrainment risk has increased. This is based on fish distribution combined with increased water exports, but the group provided no recommendation for a change in water **export reductions** for either Delta Smelt or Longfin Smelt. This decision was based on the projected decrease in OMR flows from -5600cfs today to -2100cfs on Monday, 12/4. The group will be monitoring conditions closely over the next several days.

Actions 1 through 3 of the RPA are designed to protect Delta Smelt from entrainment. RPA Action 1 and Action 2 are specifically designed for adult spawning stock in the San Joaquin River during December to March via real-time management of OMR flows. Members of the Working Group are currently evaluating conditions relative to the guidance in the BiOp for Action 1 Part B (BiOp p 329), and Action 2 (BiOp p352). The following details the discussion by the group:

<u>2015 Delta Smelt abundance indices</u>
The four primary 2015 annual abundance indices for all Delta Smelt life stages are the lowest on record.

	2014	2015
SKT	30.1	13.8
20-mm	1.1	0.3
TNS	0.5	0.0
FMWT	9	7

<u>Early Warning Survey as an indicator of upstream movements and entrainment risk</u>
Previously, members of the Working Group stated that elevated catch in the Jersey Point south lane trawl would indicate increased Delta Smelt movement and increased risk of entrainment into interior Delta channels, as this location is more hydrologically linked to tidal flow into these channels. Similarly, catch at Prisoners Point would serve as an indicator that movement upstream had commenced. The Working Group is particularly concerned about fish in the south lane at Jersey Point and at Prisoner's Point, because these two locations are more closely linked hydrologically with tidal flows into interior south Delta channels than fish located in in the

middle and north lanes at Jersey Point, or at locations further downstream. Therefore, fish in these areas are considered at greater risk of entrainment.

The catch of a single Delta Smelt at Prisoner's Point yesterday and catch in the Jersey Point south lane today indicate that fish are currently distributed in locations of increased probability of movement into interior Delta channels. The Early Warning Survey is scheduled to be at Prisoner's Point tomorrow. Should any Delta Smelt be caught tomorrow, it will further support the conclusion that an increased proportion of the population is present or is moving into areas of increased entrainment risk.

Salvage

Any level of salvage observed at either facility will be of concern to the Working Group, considering the low abundance and associated low detection probability (BiOp page 338) of Delta Smelt in salvage under RPA compliant operations. Our concern is for both direct mortality and indirect mortality of the spawning stock, which are 2 of the 3 factors affecting Delta Smelt presented on in the BiOp (page 325):

"1) direct mortality associated with entrainment of pre-spawning adult delta smelt by CVP/SWP operations; 2) direct mortality of larval and early juvenile delta smelt associated with entrainment by CVP/SWP operations; and 3)indirect mortality and reduced fitness through reductions to and degradation of Delta habitats by CVP/SWP operations." Turbidity

The four primary Delta Smelt abundance indices and the December SKT all indicate that abundance has been at a record low all year, and as a result, the Working Group expects that detection ability in salvage and trawl surveys has been reduced. As members of the Working Group have stressed in previous meetings, sporadic, low catch in surveys from record low abundance makes using those survey results for assessing the species' distribution and risk of entrainment very challenging. The Working Group has suggested monitoring turbidity as a proxy for location of Delta Smelt, based on a documented migration response to turbidity (BiOp pages 146 and 347) and last water year's salvage events which once again followed a turbidity plume that extended to the export facilities into the South Delta.

The Working Group requested and reviewed turbidity and water clarity information from the early warning survey. This data indicated that turbidity has risen significantly at Prisoner's Point from last week.The Working Group noted that elevated turbidity (12 NTU or higher) had extended throughout the lower San Joaquin to at least Prisoner's Point and into the very north end of Old River, but did not extend further upstream into Old or Middle Rivers. Members noted that the DWR Turbidity Transects were collected on the start of the descending limb of the high tide, which supports the idea that the survey collected at or nearly at, the highest turbidity levels at those locations. The Working Group did not see significant evidence that a turbidity field would extend further toward the export facilities in the near future, but given the current hydrological conditions, would continue to closely monitor turbidity stations in the Old and Middle River corridors.

Extension of turbid water from the San Joaquin River further upstream into Old and Middle rivers in conjunction with a heighted proportion of San Joaquin EWS catch at Prisoner's Point and the Jersey Point south lane would be considered a clear indicator of high risk of entrainment into Old and Middle rivers, and from there, into the SWP and CVP intake facilities.

Comparison to last winter

The first salvage of Delta Smelt last season occurred on January 2., after a period of OMR flows ranged from around -6000 to -4000 (see SWG notes, 01/05/2015). The start of the salvage season began one to two weeks after increased inflow and turbidity was observed in the Delta. Although some hydrological conditions are presently different than this time last season, recent higher flows, elevated turbidity, and presence of Delta Smelt at Prisoner's Point suggest the migration "season" has started this year. Given the exceedingly low abundance and sporadic catch in surveys, the Working Group is concerned there will be little, if any, catch in the early warning survey to indicate the fish are moving into the south Delta.

OMR Flow

The last week's changes in flow and turbidity, combined with the increasingly negative OMR flow (through today) is concerning to the Working Group. On December 28, members stressed that the previous few days' conditions appeared to be setting up a situation where elevated turbidity will occur continuously from the lower San Joaquin River through the export facilities in the south Delta. Such a "turbidity bridge" has been associated with increased Delta Smelt salvage in the past (BiOp pages 146 and 347). However, given the anticipated change in operations and increasingly more positive OMR flow projected through Monday, members indicated risk of entrainment would not increase over the weekend.

The above discussion points influenced and contributed to all three flow ranges described below:

Advice Framework OMR Level Risk Ranking and Discussion

- OMR flow of -1250 to -2000 cfs: There is a low risk of entrainment under this flow range. This is the most protective range for Delta Smelt.
    - Risk factors: lowest annual indices on record, confirmed Delta Smelt presence in central Delta based upon Jersey Point and Prisoner's Point catch data.
    - Salvage: Zero salvage this water year, geographic influence of the pumps does not extend to central Delta under this flow range
    - Unknowns: detection ability in salvage and trawl surveys has been severely reduced, given the record low abundance indexes; unknown Sacramento River catch (unable to assess percentage of population in the lower San Joaquin River)
    - Persistence of risk: unlikely to change prior to January 4

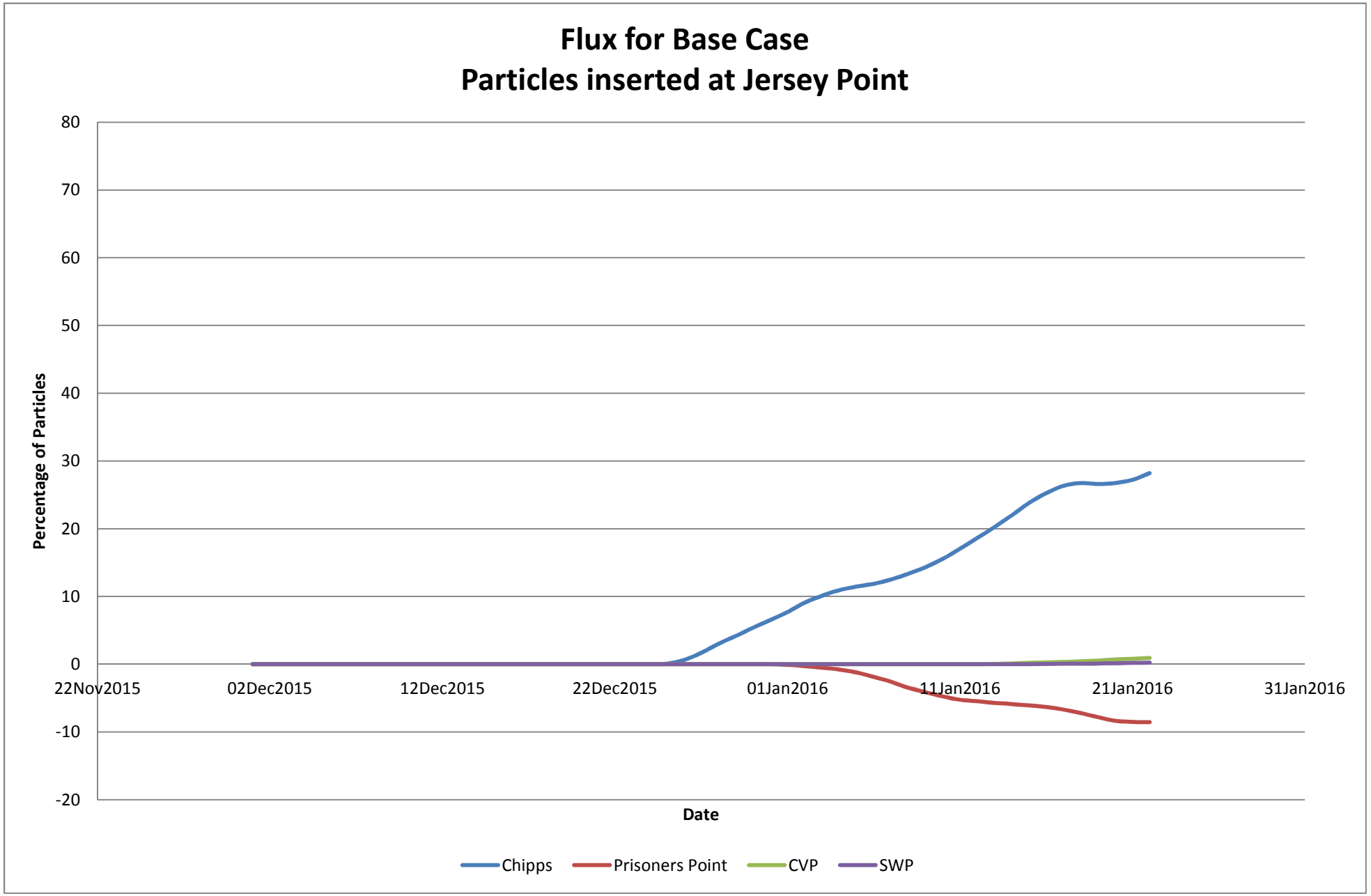
- OMR flow of -2000 to -3500 cfs: There is a low risk of entrainment under this flow range, given conditions listed below:
    - Risk factors: lowest annual index on record, confirmed Delta Smelt presence in central Delta based upon Jersey Point and Prisoner's Point catches from the Early Warning Survey.
    - Salvage: Zero salvage this water year, influence of pump not likely to extend to the lower San Joaquin River under this OMR flow range.
    - Unknowns: detection ability in salvage and trawl surveys has been severely reduced, given the record low abundance indexes, unknown Sacramento River catch (unable to assess percentage of population in the lower San Joaquin

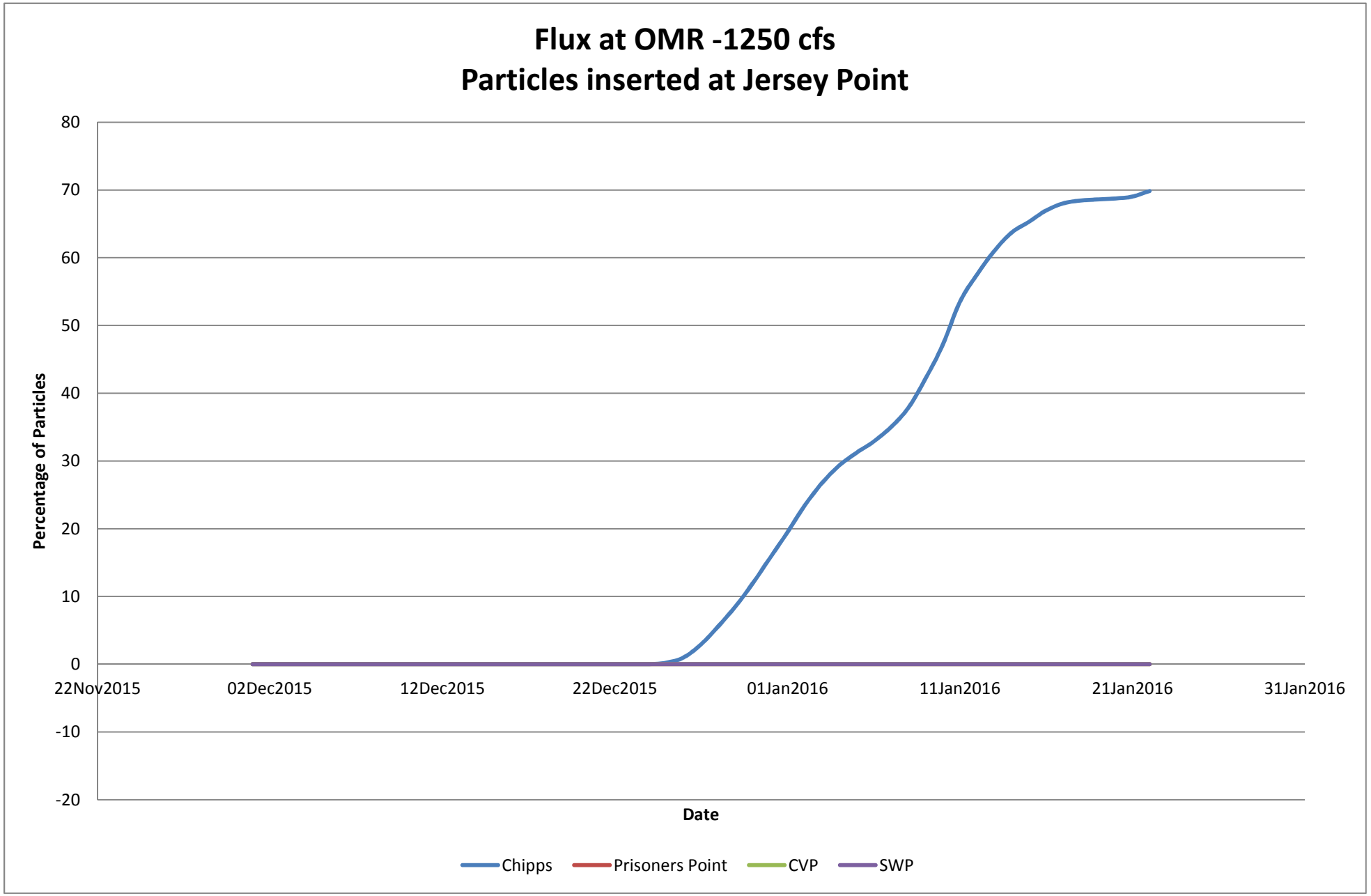
River), turbidity trend is uncertain, although likely that turbidity levels will decrease over the next several days.
    - Persistence of risk: unlikely to change prior to January 4.

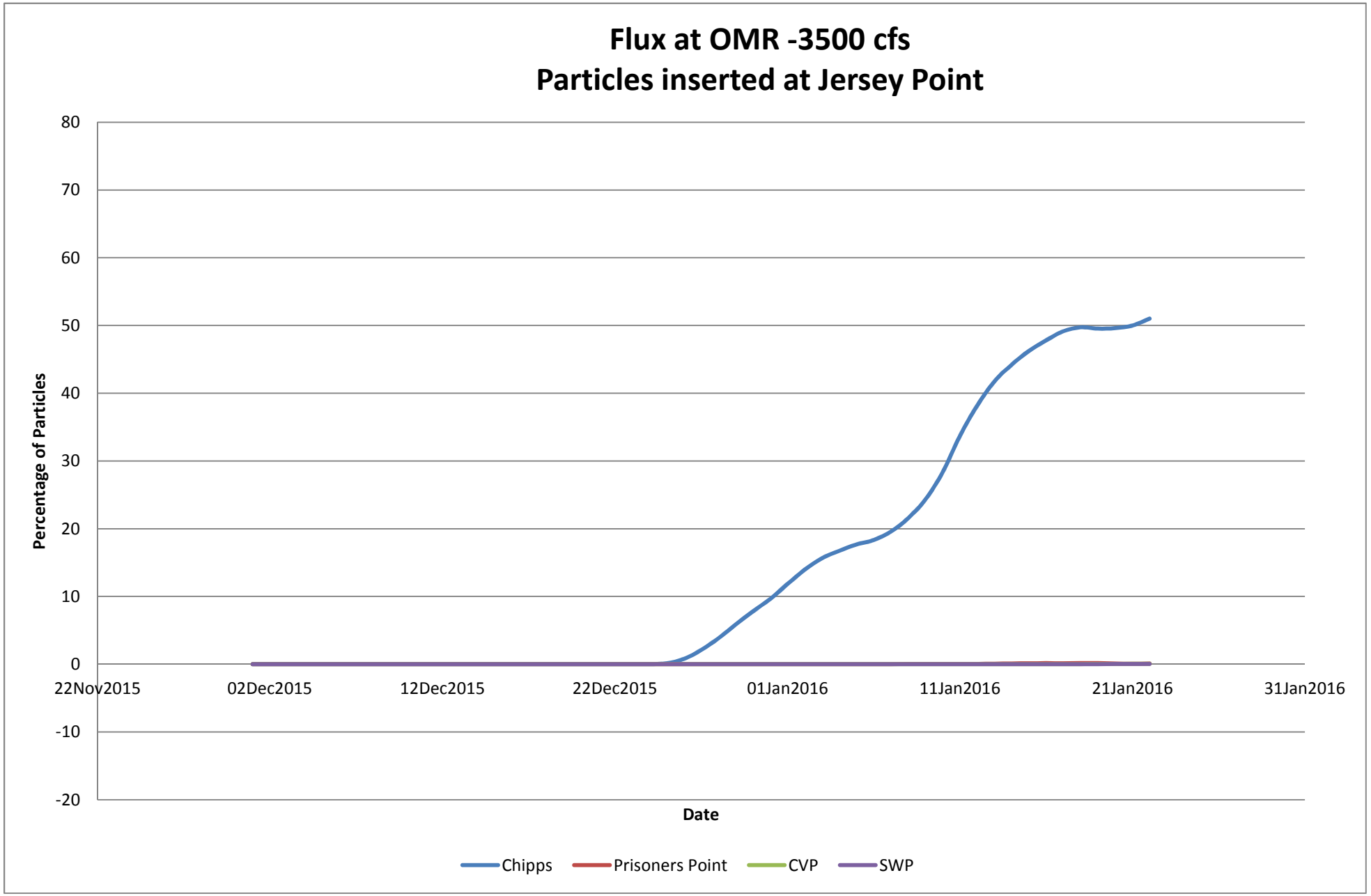
- OMR flow of -3500 to -5000 cfs: There is a medium risk of entrainment under this flow range.
    - Risk factors: lowest annual index on record, confirmed Delta Smelt presence in Jersey Point south lane and Prisoner's Point catch data, elevated turbidity in the San Joaquin River extending into the Old River.
    - Risk factors: lowest annual index on record, confirmed Delta Smelt presence in central Delta based upon Jersey Point and Prisoner's Point catch data.
    - Salvage: Zero salvage this water year, geographic influence of the pumps could extend to the lower San Joaquin River at the more negative end of this flow range, especially affecting the southern bank near Jersey Point.
    - Unknowns: detection ability in salvage and trawl surveys has been severely reduced, given the record low abundance indexes; unknown Sacramento River catch (unable to assess percentage of population in the lower San Joaquin River), turbidity trend is uncertain, although possible that turbidity levels will decrease over the next several days. At the more negative end of this flow range, it is uncertain if turbidity levels would decrease rapidly enough to keep higher turbidities from traveling further upstream in Old and Middle Rivers.
    - Persistence of risk: expected to continue through at least January 3, as long as expected operations are implemented. Risk may increase if turbidities increase in the south delta. Persistence of catch (or an increase) at Prisoner's Point would indicate an increase of relative risk for this flow range, as would detection of Delta Smelt at either salvage facility.

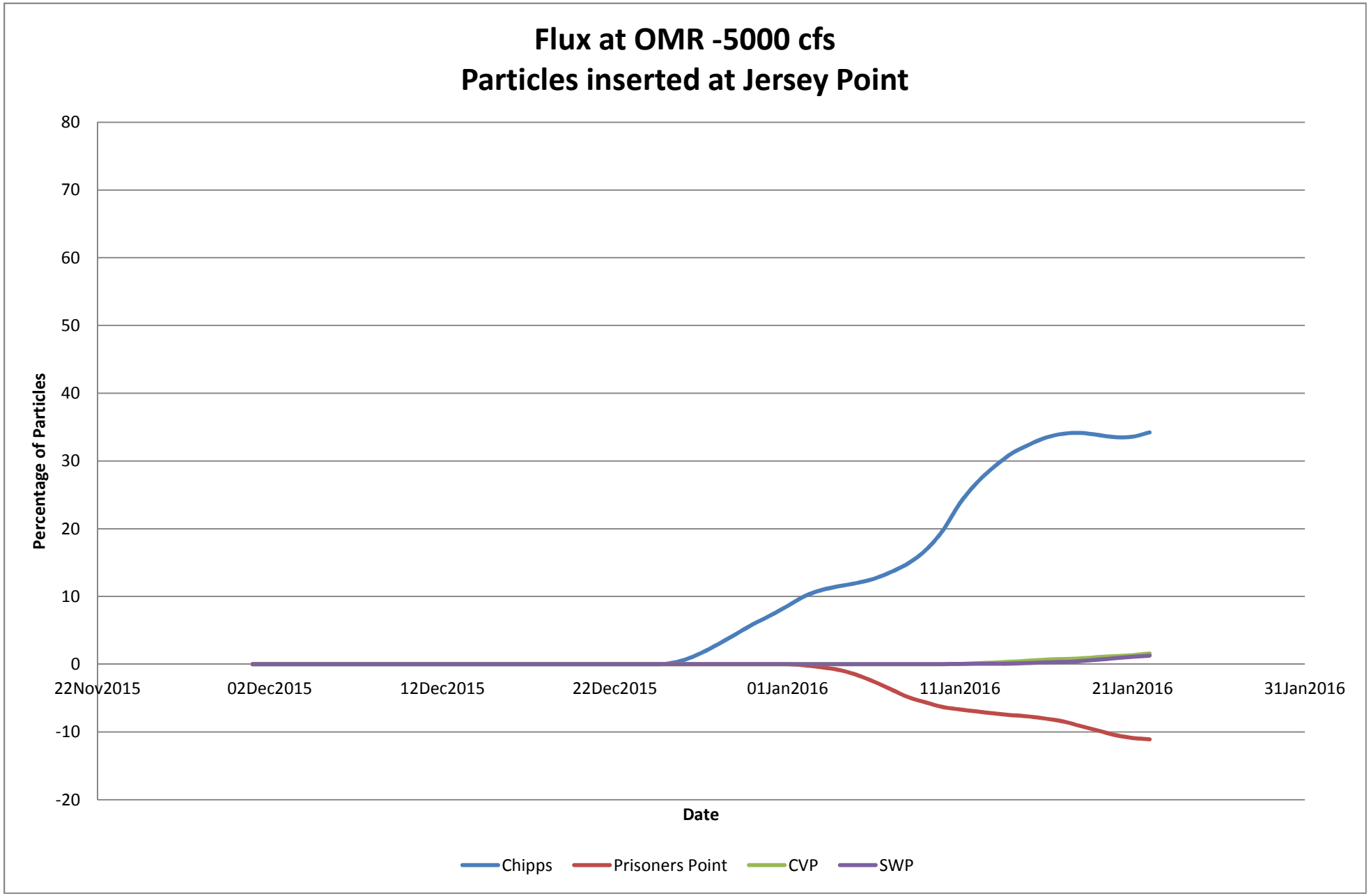
- OMR flow more negative than -5000 cfs: There is a high risk of entrainment under this flow range. Particle tracking modeling indicates OMR flows more negative than -5000 cfs entrain a greater proportion of neutral particles from the lower San Joaquin River than flows more positive than -5000 cfs. This larger pull from the lower San Joaquin River would put any Delta Smelt in the lower San Joaquin River at a high risk of entrainment.

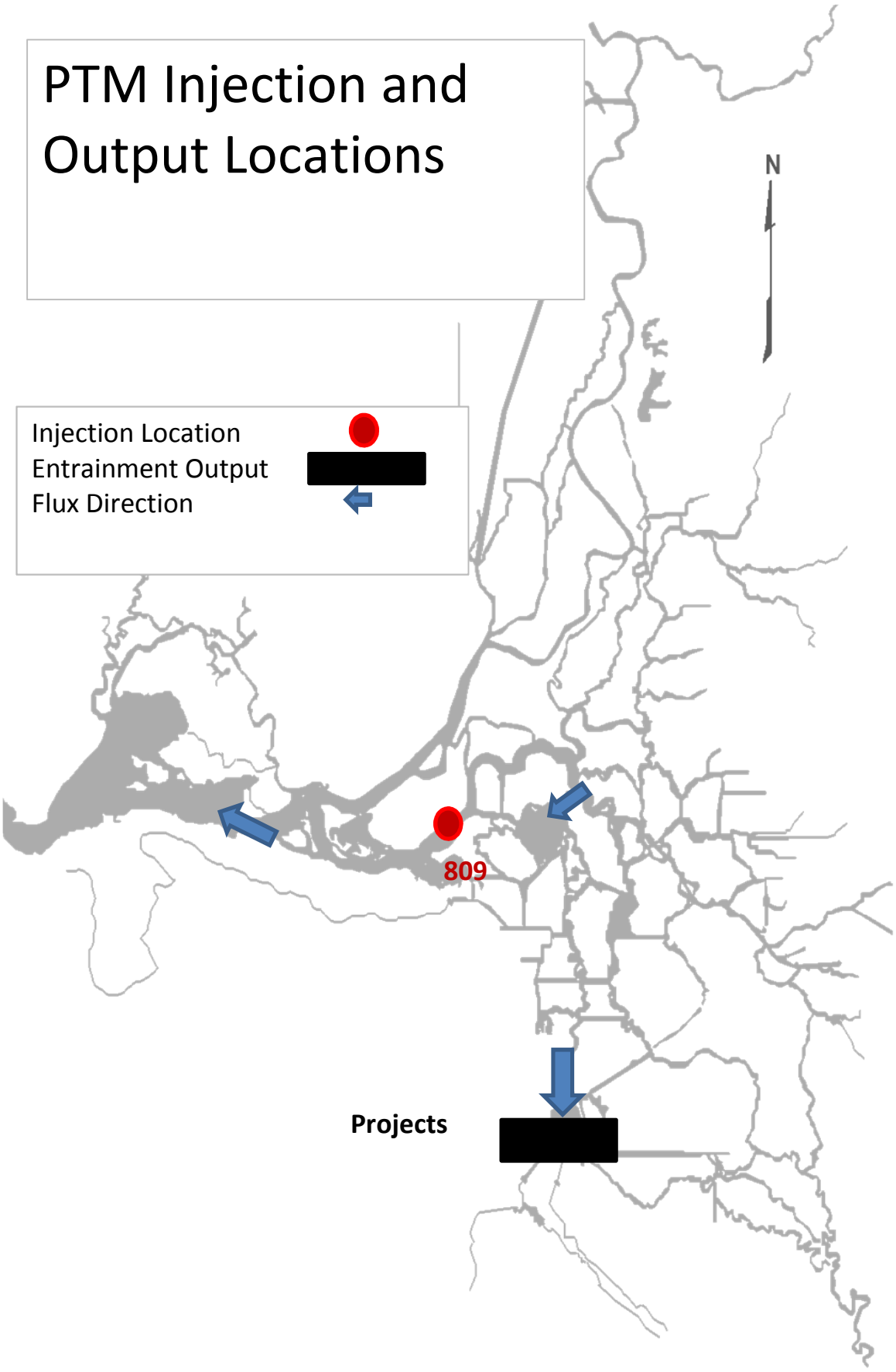
The Working Group will continue to monitor conditions and smelt distribution and will meet again on Monday, January 4, 2016.


Flux for Base Case
Particles inserted at Jersey Point
80
70
60
50
40
30
20
10
0
-10
-20
Percentage of Particles
22Nov2015
02Dec2015
12Dec2015
22Dec2015
01Jan2016
11Jan2016
21Jan2016
31Jan2016
Date
Chipps
Prisoners Point
CVP
SWP


Flux at OMR -1250 cfs
Particles inserted at Jersey Point
Percentage of Particles
80
70
60
50
40
30
20
10
0
-10
-20
22Nov2015
02Dec2015
12Dec2015
22Dec2015
01Jan2016
11Jan2016
21Jan2016
31Jan2016
Date
Chipps
Prisoners Point
CVP
SWP


Flux at OMR -3500 cfs
Particles inserted at Jersey Point
Percentage of Particles
80
70
60
50
40
30
20
10
0
-10
-20
22Nov2015
02Dec2015
12Dec2015
22Dec2015
01Jan2016
11Jan2016
21Jan2016
31Jan2016
Date
Chipps
Prisoners Point
CVP
SWP


Flux at OMR -5000 cfs
Particles inserted at Jersey Point
Percentage of Particles
80
70
60
50
40
30
20
10
0
-10
-20
22Nov2015
02Dec2015
12Dec2015
22Dec2015
01Jan2016
11Jan2016
21Jan2016
31Jan2016
Date
Chipps
Prisoners Point
CVP
SWP


PTM Injection and Output Locations
N
Injection Location
Entrainment Output
Flux Direction
809
Projects

PRELIMINARY DATA
SUBJECT TO REVISION WITHOUT NOTICE

EXECUTIVE OPERATIONS SUMMARY ON 12/29/2015

This summary can also be found at:
http://www.water.ca.gov/swp/operationscontrol/docs/delta/deltaops.pdf

SCHEDULED EXPORTS FOR TODAY

Clifton Court Inflow	=	3,900 cfs
Jones Pumping Plant	=	2,800 cfs

State Water Project Informational Data can be found at:
http://www.water.ca.gov/swp/operationscontrol/projectwide.cfm
ESTIMATED DELTA HYDROLOGY

Total Delta Inflow	~	12,419 cfs
Sacramento River	=	10,846 cfs
San Joaquin River	=	997 cfs

Data for previous 30-days is available at:
http://www.water.ca.gov/swp/operationscontrol/docs/delta/DeltaWQ.pdf

DELTA OPERATIONS

Delta Conditions	=	Balanced
Delta x-channel Gates (% of day is open)	=	0%
Outflow Index	~	5,300 cfs
% Inflow Diverted	=	43.6% (14-day avg)
X2 Position	>	81 km
Controlling Factor(s)	=	Salinity Management

~~~~~~

RESERVOIR STORAGES (AS OF MIDNIGHT)

Shasta Reservoir	=	1,427 TAF
Folsom Reservoir	=	231 TAF
Oroville Reservoir	=	1,009 TAF
San Luis Res. Total	=	402 TAF
SWP Share	=	326 TAF

Reservoir data and reports are available at:
http://cdec.water.ca.gov/reservoir.html

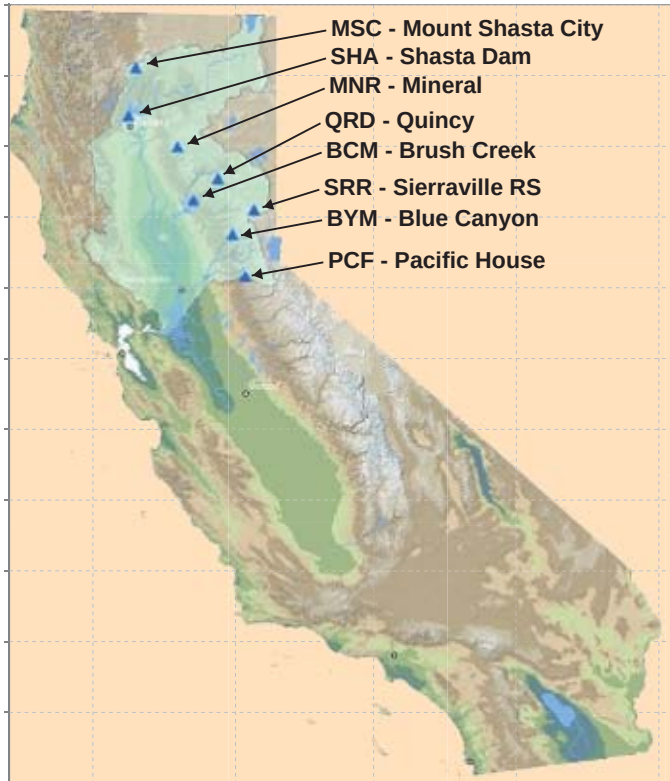
Reservoir Releases

Keswick	=	3,250 cfs
Nimbus	=	500 cfs
Oroville	=	950 cfs

~~~~~~

If you have any questions regarding the preliminary data
in this report, please contact OCO_Export_Management@water.ca.gov

North Sierra Precipitation: 8-Station Index, December 29, 2015



Percent of Average for this Date: 97%

1982-1983 (wettest) 88.5

1997-1998 82.4

Average (1922-1998) 50.0

2014-2015 Daily Precip 37.2

1976-1977(2nd driest & driest thru Aug) 19.0

Current Daily Precip:16.7

Cumulative Daily/Monthly Precipitation (inches)

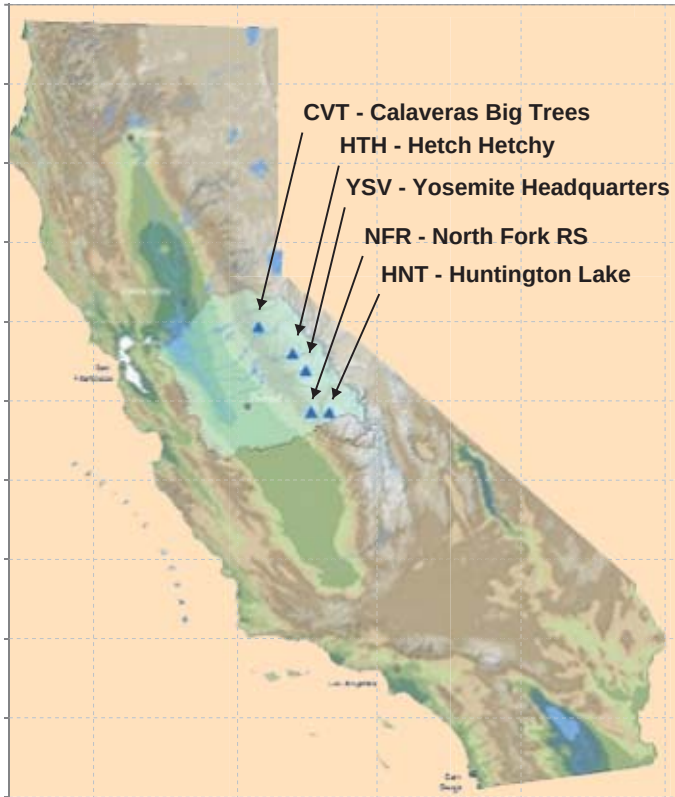
Total Water Year Precipitation

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100

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

Water Year (October 1 - September 30)

San Joaquin Precipitation: 5-Station Index, December 29, 2015



Percent of Average for this Date: 125%

1982-1983 (wettest) 77.4

1997-1998 65.3

Average (1961-2010) 40.8

2014-2015 Daily Precip 19.0

1976-1977(2nd driest & driest thru Aug) 15.4

Current Daily Precip: 15.7

Cumulative Daily/Monthly Precipitation (inches)

Total Water Year Precipitation

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90

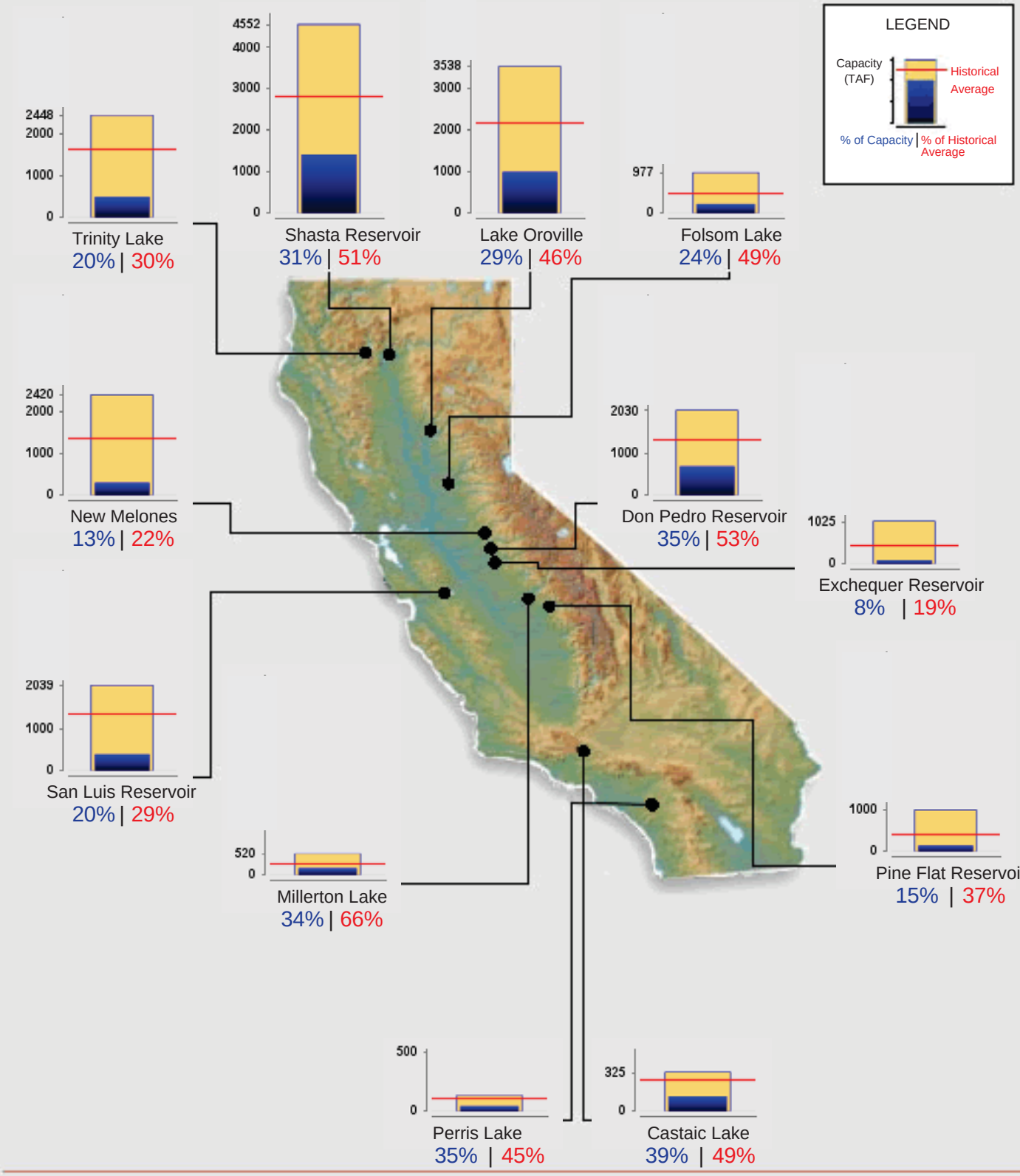
Oct 1 Nov 1 Dec 1 Jan 1 Feb 1 Mar 1 Apr 1 May 1 Jun 1 Jul 1 Aug 1 Sep 1 Oct 1

Water Year (October 1 - September 30)

Reservoir Conditions

Ending At Midnight - December 28, 2015

CURRENT RESERVOIR CONDITIONS



Graph Updated 12/29/2015 02:45 PM

Turbidity Forecast 12/29/2015

General Information

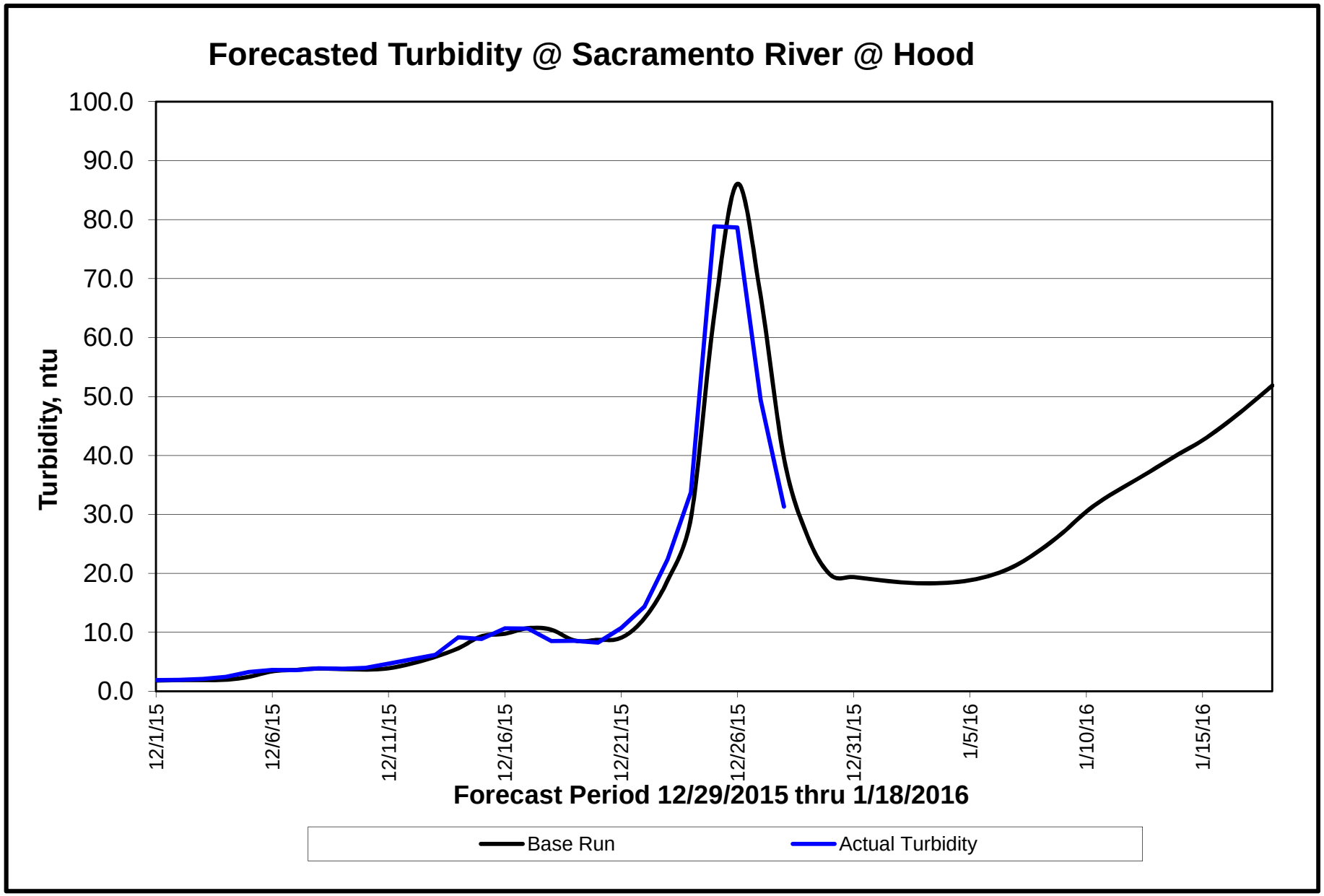
The attached model run results cover the period of December 29, 2015, through January 18, 2016 and are based on the following assumptions:

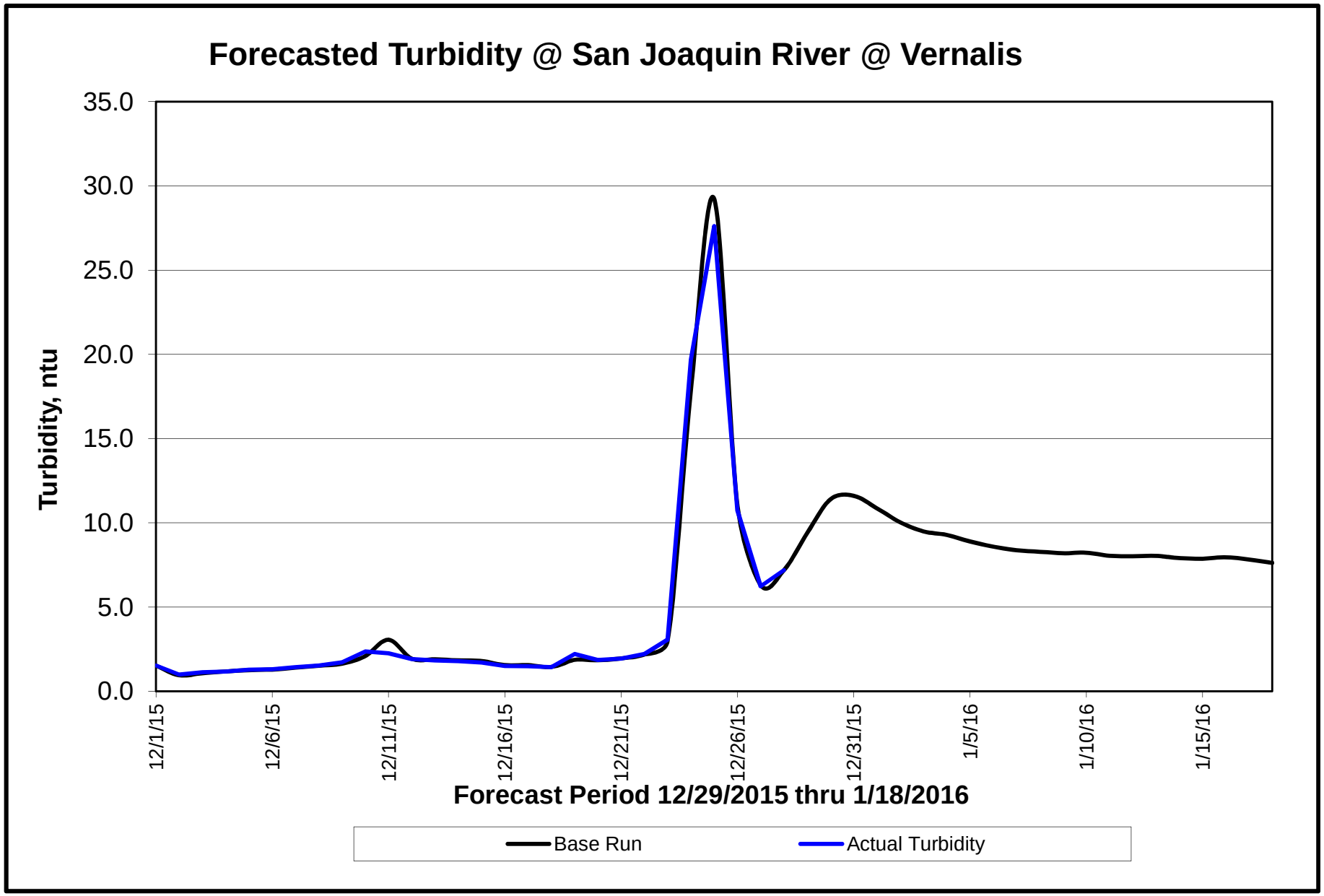
Common Assumptions

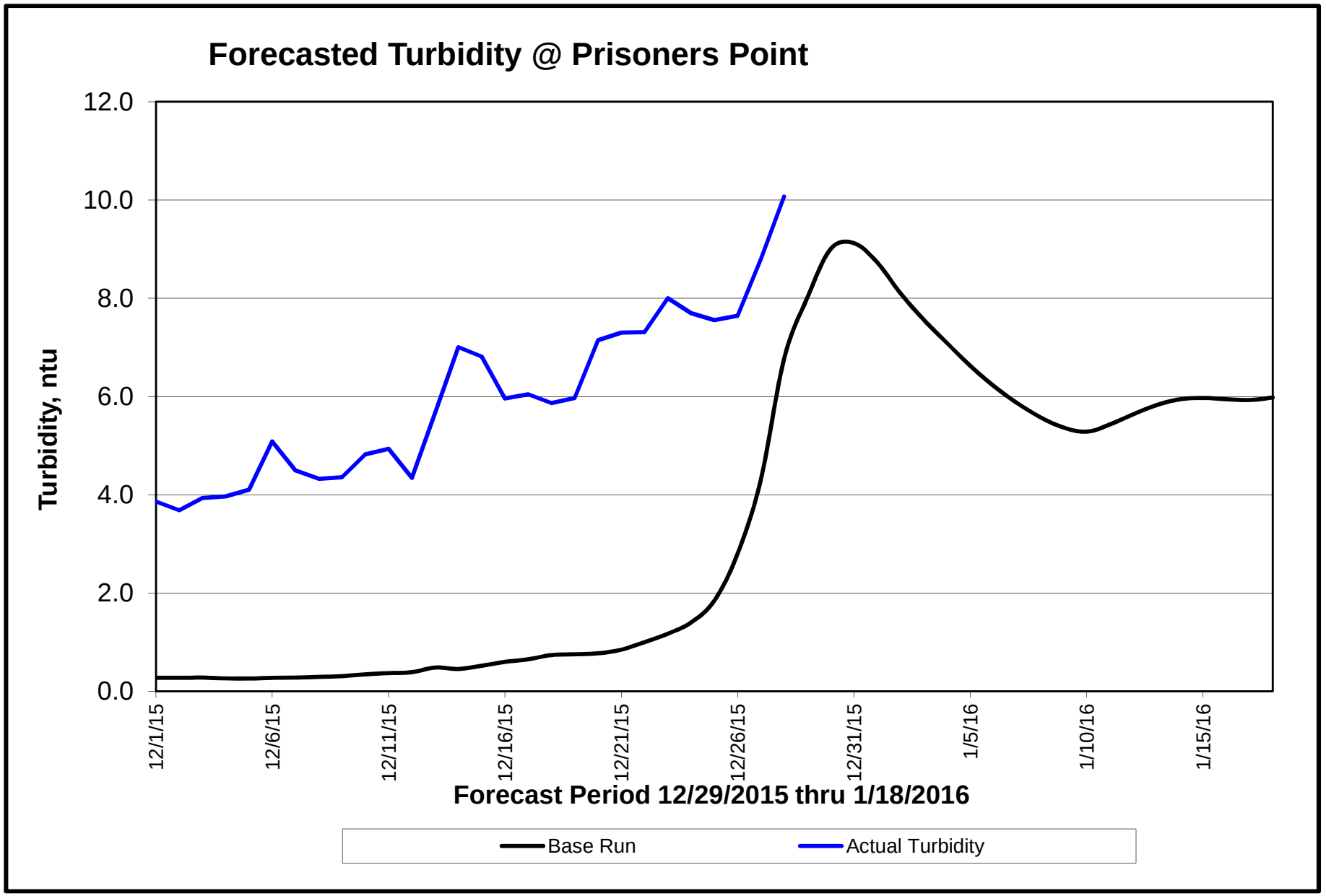
1. CCFB Gates are operating to Priority 1 throughout the forecast period.
2. The Delta Cross Channel gates will be closed throughout the forecast period.
3. Suisun Marsh salinity control flashboards are in, and the three Suisun Marsh Salinity Control Gates are in tidal operation.

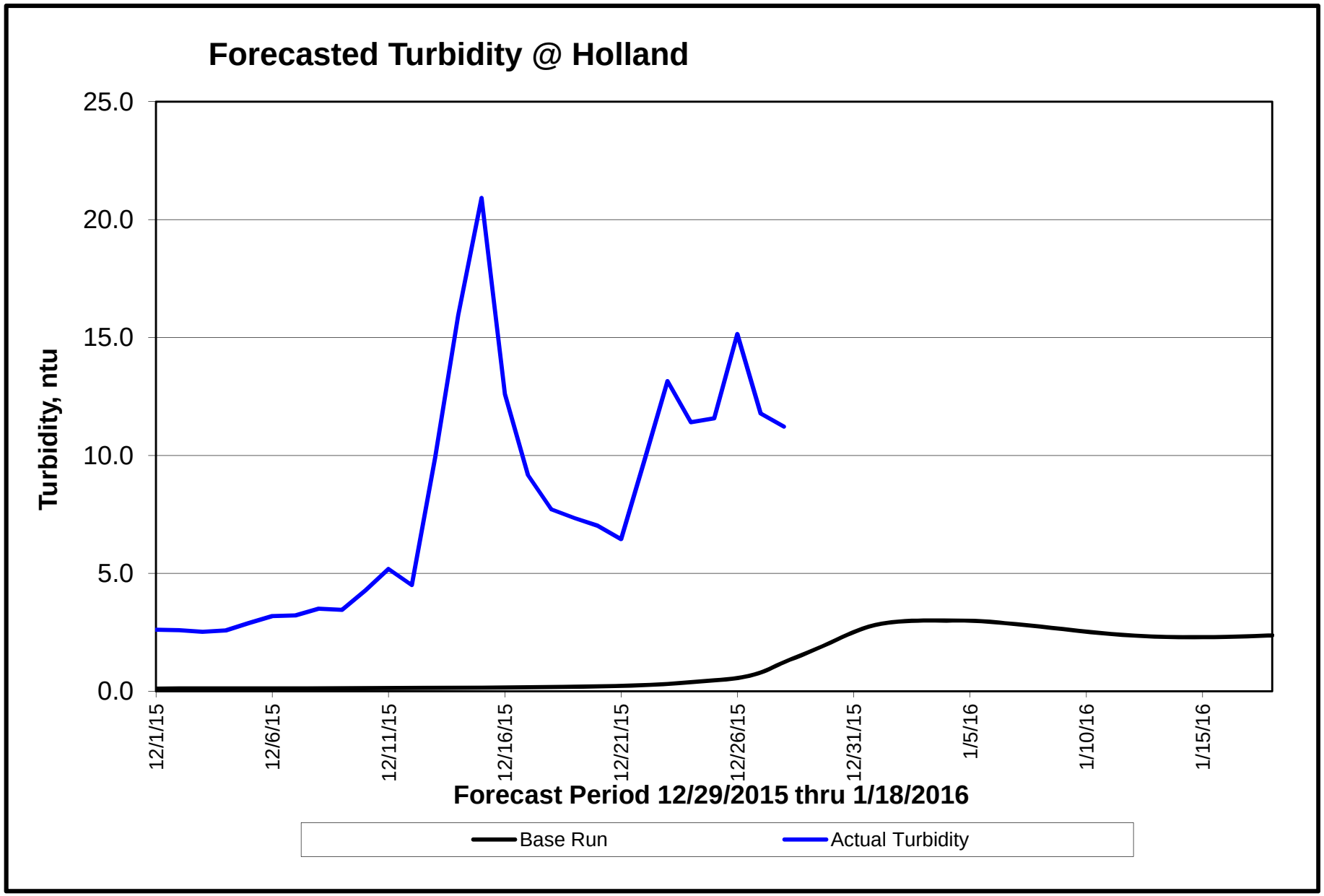
INPUT FLOW DATA (Base Case)

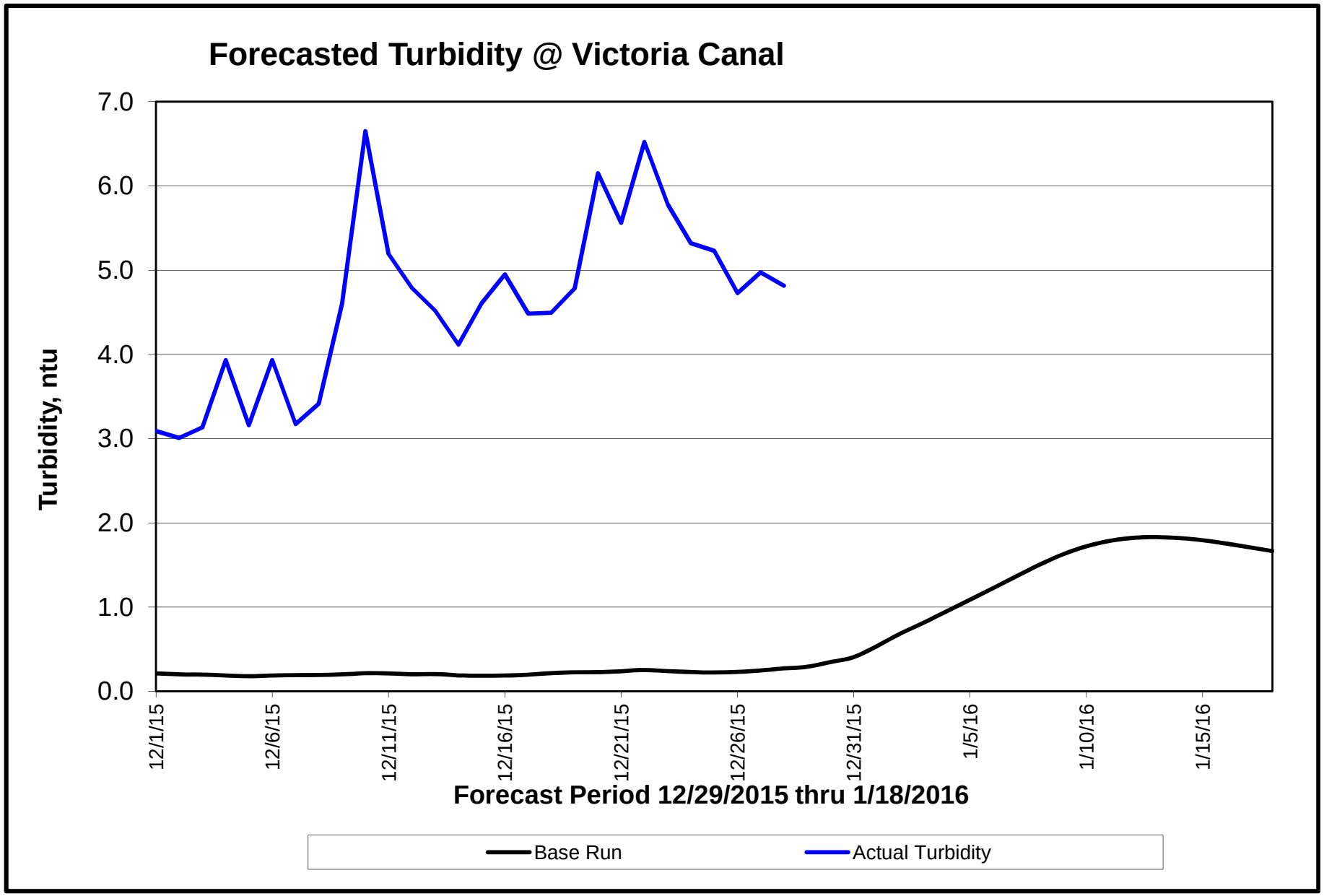
Date	Delta Inflows [cfs]								Delta Exports [cfs]	
	Sacram. River Freeport prev.day FPT	Yolo bypass Cache &weirs pr.day	Sacto Treat. rel. estim. week avg pr.day	DXC Gate ops % of day open **current day**	San Joaquin River Vernalis prior day VNS	Cosum River Michigan Bar pr. Day	Mokel. River Wood-bridge pr.day	Calaver River New Hogan pr.day	Clifton Court intake	Jones pump
29-Dec-15	11,420	20	220	0	990	210	100	20	3,900	2,800
30-Dec-15	10,225	20	220	0	900	200	100	20	3,500	2,800
31-Dec-15	9,575	20	220	0	810	190	100	20	3,000	2,800
01-Jan-16	9,282	20	220	0	730	180	100	20	2,000	2,500
02-Jan-16	8,950	20	170	0	680	170	100	20	2,000	2,500
03-Jan-16	8,950	20	170	0	600	100	100	20	2,000	2,500
04-Jan-16	8,950	20	170	0	600	100	100	20	2,000	2,500
05-Jan-16	8,950	20	170	0	600	100	100	20	2,000	2,500
06-Jan-16	8,950	20	170	0	600	100	100	20	2,000	2,500
07-Jan-16	9,450	20	170	0	600	100	100	20	2,000	2,500
08-Jan-16	10,450	20	170	0	600	100	100	20	2,000	2,500
09-Jan-16	13,450	20	170	0	600	100	100	20	2,000	2,500
10-Jan-16	15,450	20	170	0	600	100	100	20	2,000	2,500
11-Jan-16	22,450	20	170	0	600	100	100	20	2,000	2,500
12-Jan-16	16,450	20	170	0	600	100	100	20	2,000	2,500
13-Jan-16	13,450	20	170	0	600	100	100	20	2,000	2,500
14-Jan-16	11,450	20	170	0	600	100	100	20	2,000	2,500
15-Jan-16	9,450	20	170	0	600	100	100	20	2,000	2,500
16-Jan-16	8,950	20	170	0	600	100	100	20	2,000	2,500
17-Jan-16	8,950	20	170	0	600	100	100	20	2,000	2,500
18-Jan-16	8,950	20	170	0	600	100	100	20	2,000	2,500


Forecasted Turbidity @ Sacramento River @ Hood
Turbidity, ntu
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
12/1/15
12/6/15
12/11/15
12/16/15
12/21/15
12/26/15
12/31/15
1/5/16
1/10/16
1/15/16
Forecast Period 12/29/2015 thru 1/18/2016
Base Run
Actual Turbidity


Forecasted Turbidity @ San Joaquin River @ Vernalis
Turbidity, ntu
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
12/1/15
12/6/15
12/11/15
12/16/15
12/21/15
12/26/15
12/31/15
1/5/16
1/10/16
1/15/16
Forecast Period 12/29/2015 thru 1/18/2016
Base Run
Actual Turbidity


Forecasted Turbidity @ Prisoners Point
Turbidity, ntu
12.0
10.0
8.0
6.0
4.0
2.0
0.0
12/1/15
12/6/15
12/11/15
12/16/15
12/21/15
12/26/15
12/31/15
1/5/16
1/10/16
1/15/16
Forecast Period 12/29/2015 thru 1/18/2016
Base Run
Actual Turbidity


Forecasted Turbidity @ Holland
Turbidity, ntu
25.0
20.0
15.0
10.0
5.0
0.0
12/1/15
12/6/15
12/11/15
12/16/15
12/21/15
12/26/15
12/31/15
1/5/16
1/10/16
1/15/16
Forecast Period 12/29/2015 thru 1/18/2016
Base Run
Actual Turbidity


Forecasted Turbidity @ Victoria Canal
Turbidity, ntu
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
12/1/15
12/6/15
12/11/15
12/16/15
12/21/15
12/26/15
12/31/15
1/5/16
1/10/16
1/15/16
Forecast Period 12/29/2015 thru 1/18/2016
Base Run
Actual Turbidity

Old and Middle River turbidity, measured Dec. 30, 2015

NOTE: Data have not undergone initial quality assurance and quality control procedures.

min 3.9, max 27.1

data collected 9:49a - 12:53p: FLOOD/EBB TIDE

High 10:24a, Low 4:40p
(Middle R., Borden Hwy Br.)

MOK

OSJ: 16
boat: 14.52

PPT: 11
boat: 18.69

HOL: 10.3
boat: 19.08

HLT: 8.1
boat: 6.52

OBI: 7.8
boat: 9.52

MDM: 4.8
boat: 4.73

OH4

MUP

VCU

GLC

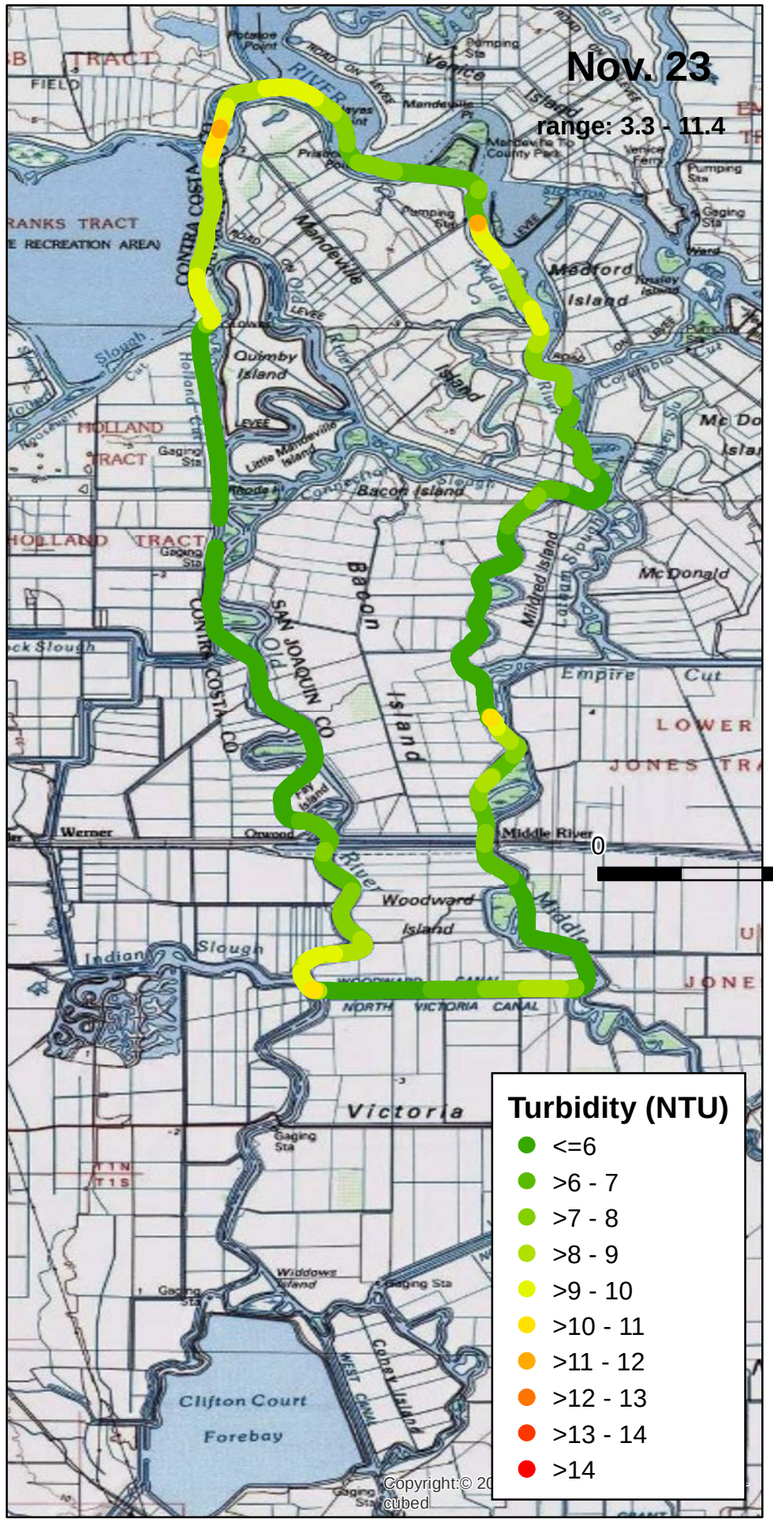
turbidity (NTU)

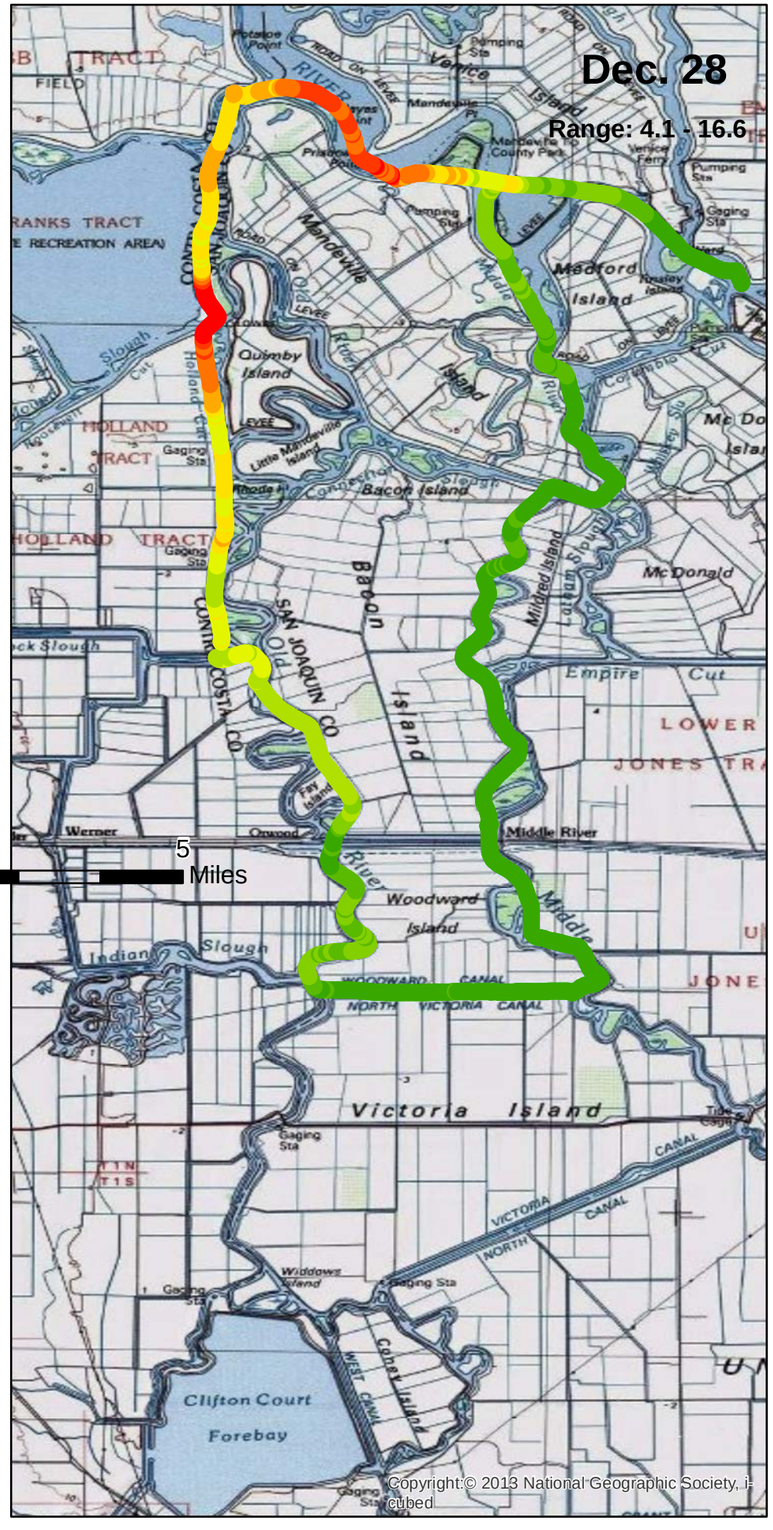
- <=6
- >6 - 7
- >7 - 8
- >8 - 9
- >9 -10
- >10 - 11
- >11 - 12
- >12 - 13
- >13 - 14
- >14

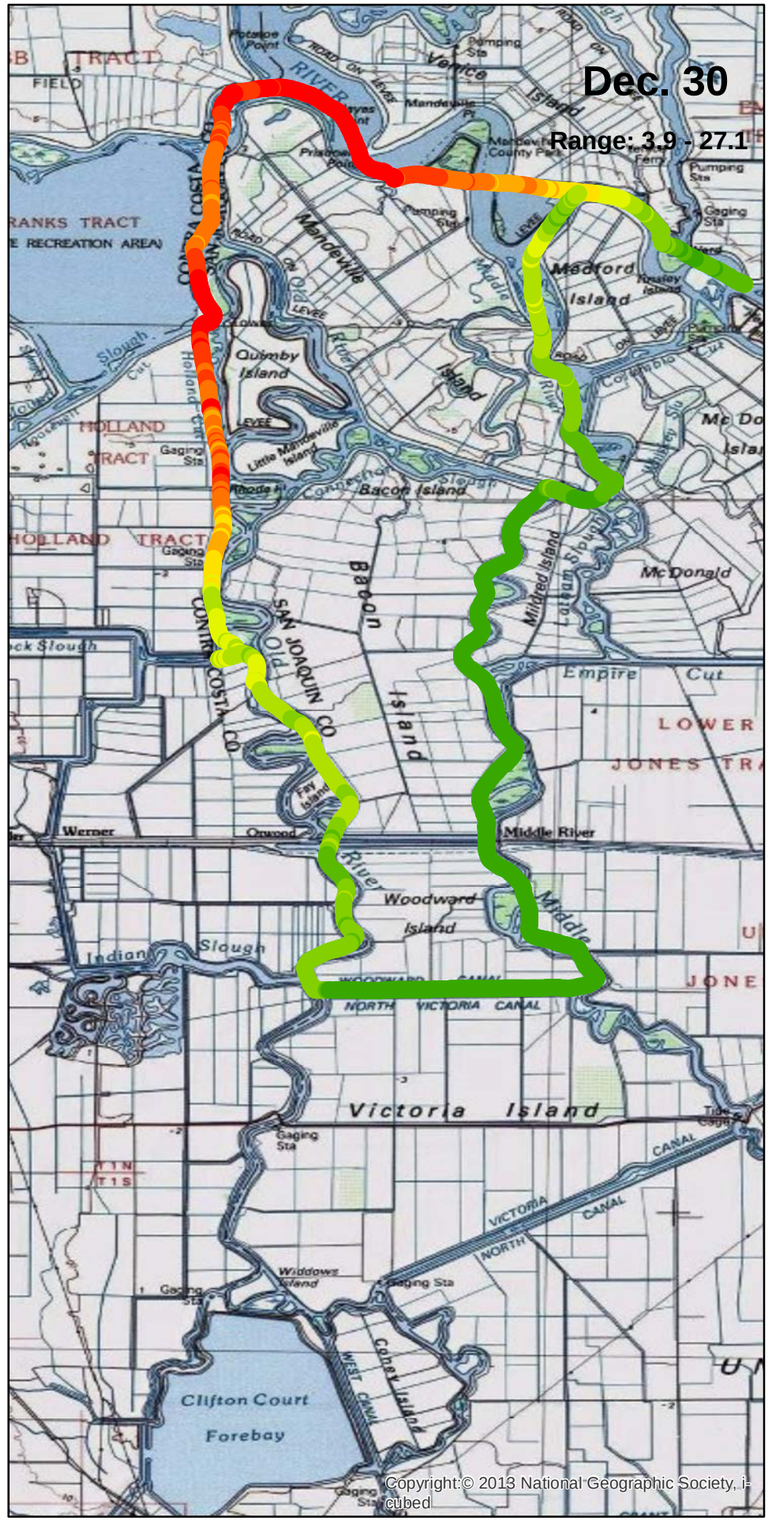
station	name
GLC	Grantline Canal (USGS)
HLT	Middle River near Holt
HOL	Holland Cut near Bethel Island
MDM	Middle River at Middle River
MOK	Mokelumne River at San Joaquin River
MUP	Middle River at Union Point
OBI	Old River at Bacon Island (USGS)
OH4	Old River at Highway 4
OSJ	Old River at Franks Tract near Terminous
PPT	Prisoners Point
VCU	Victoria Canal near Byron

N

0 1 2 3 4 5 Miles


Nov. 23
range: 3.3 - 11.4
Turbidity (NTU)
<=6
>6 - 7
>7 - 8
>8 - 9
>9 - 10
>10 - 11
>11 - 12
>12 - 13
>13 - 14
>14
0
5
Miles
N
Copyright:© 20
cubed


Dec. 28
Range: 4.1 - 16.6
Copyright:© 2013 National Geographic Society, i-
cubed


Dec. 30
Range: 3.9 - 27.1
Copyright:© 2013 National Geographic Society, i-
cubed