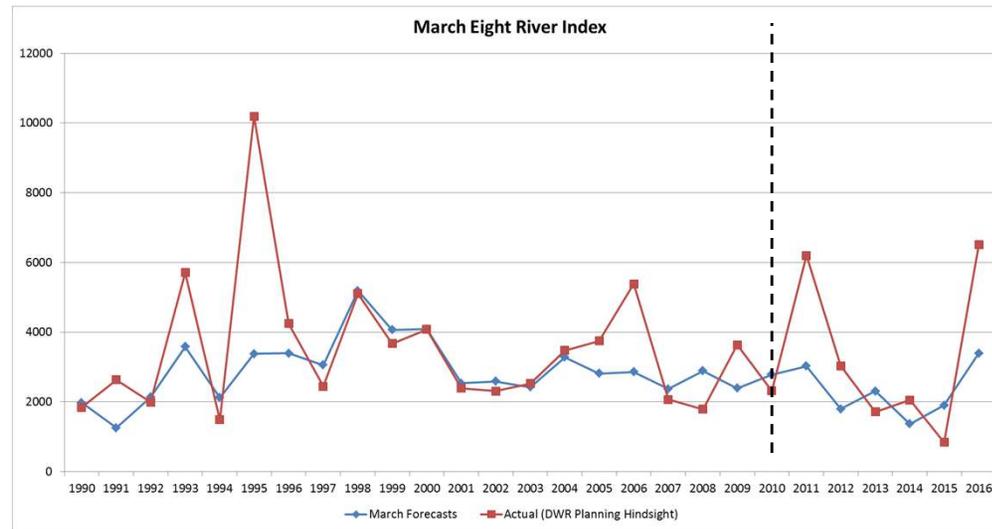


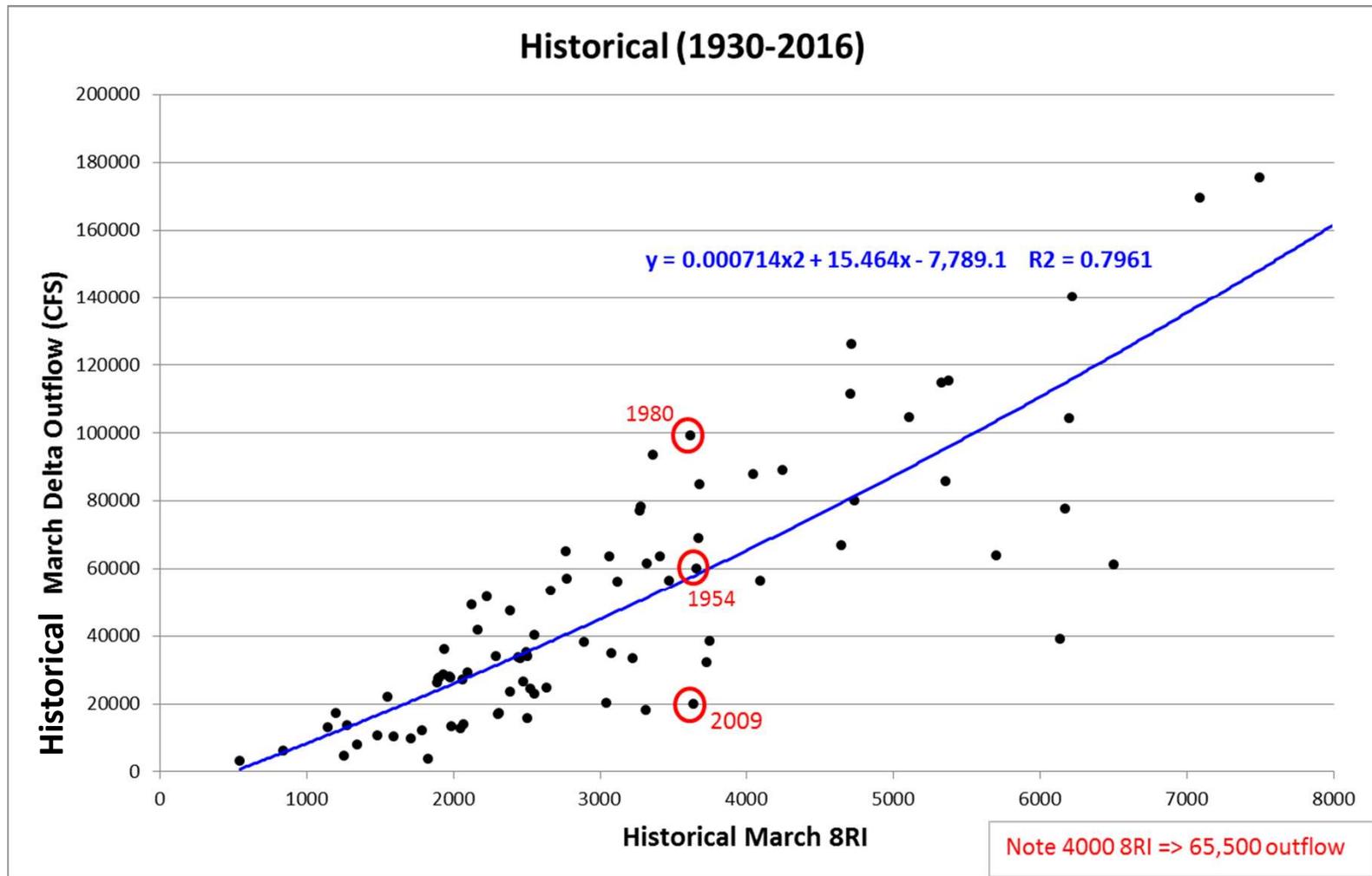
An Approach to LFS March through May Delta Outflow Requirements

Is there a good predictor of delta outflow?

- Regression analyses suggest that the current month's eight river index (8RI) is one of the better variables to predict a month's delta outflow. How well can we predict the 8RI?



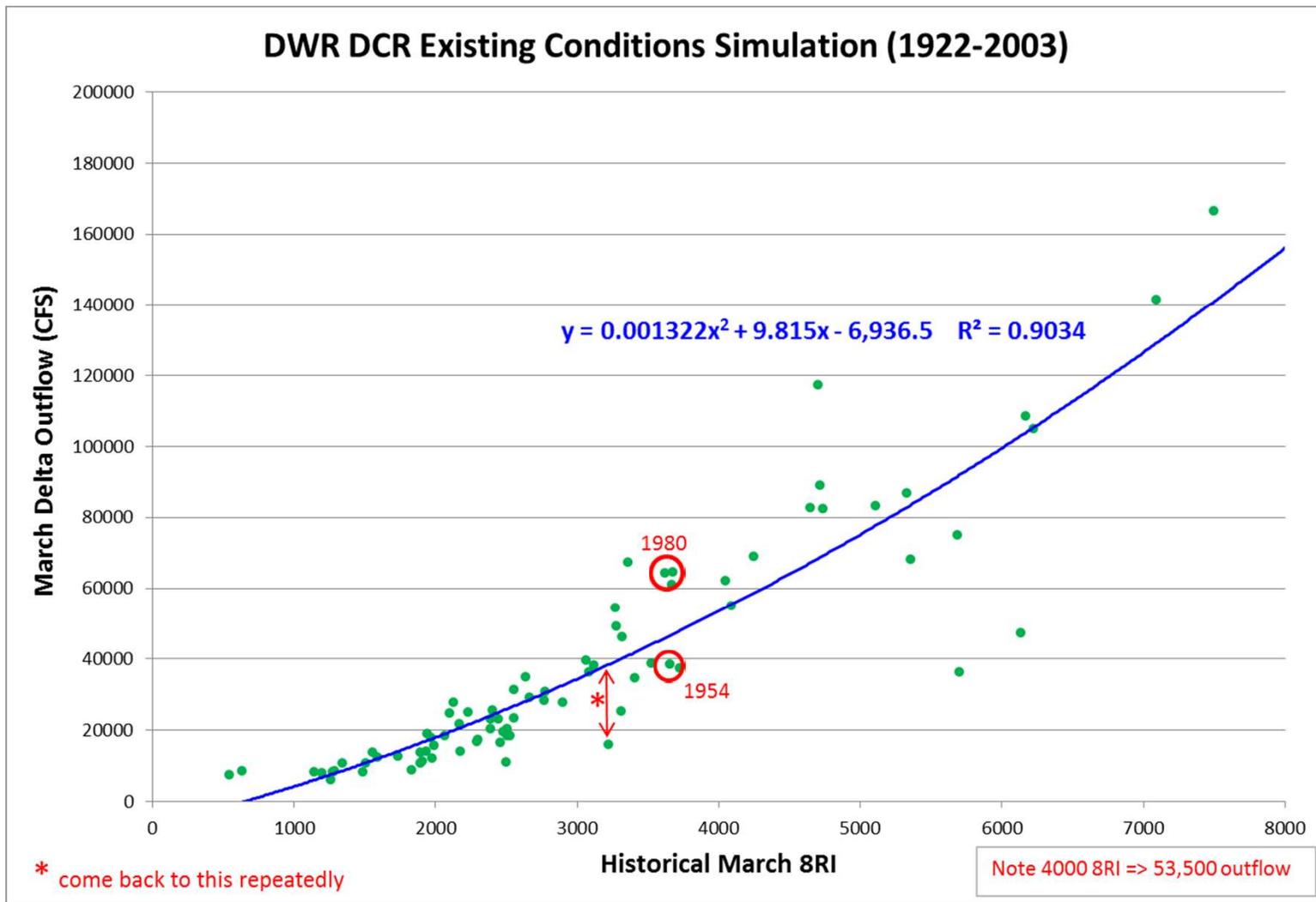
- However, even if the 8RI could be forecasted perfectly, common sense (and modeling) tells us that delta outflow in a given month is the result of many things, not just unimpaired flows, i.e., delta outflow is a function of, among other things,
 - numerous regulations affecting upstream operations (instream flow reqs, cold water pool, etc),
 - reservoir releases to meet in-delta salinity standards which depends on antecedent salinity,
 - antecedent hydrology affecting watershed accretions/depletions and flood control criteria,
 - regulations affecting delta exports, some of which are related to fish presence,
 - current month precipitation
- Below is an example for March using perfect foresight. The historical delta outflow values come from DAYFLOW. The “historical” eight river index values come from DWR reports.



For an 8RI of approximately 3600 TAF, the delta outflow has ranged from 20,000 to 100,000 cfs this month.

Regulations, water use and infrastructure have changed over time.

Let's assume a fixed level for each of these => CalSimII Existing Conditions Simulation Results (next slide).



Tighter fit - makes sense since the simulation has dams and other controls in place for all years.

Note that the same 8RI of 4000 TAF corresponds to a smaller outflow.

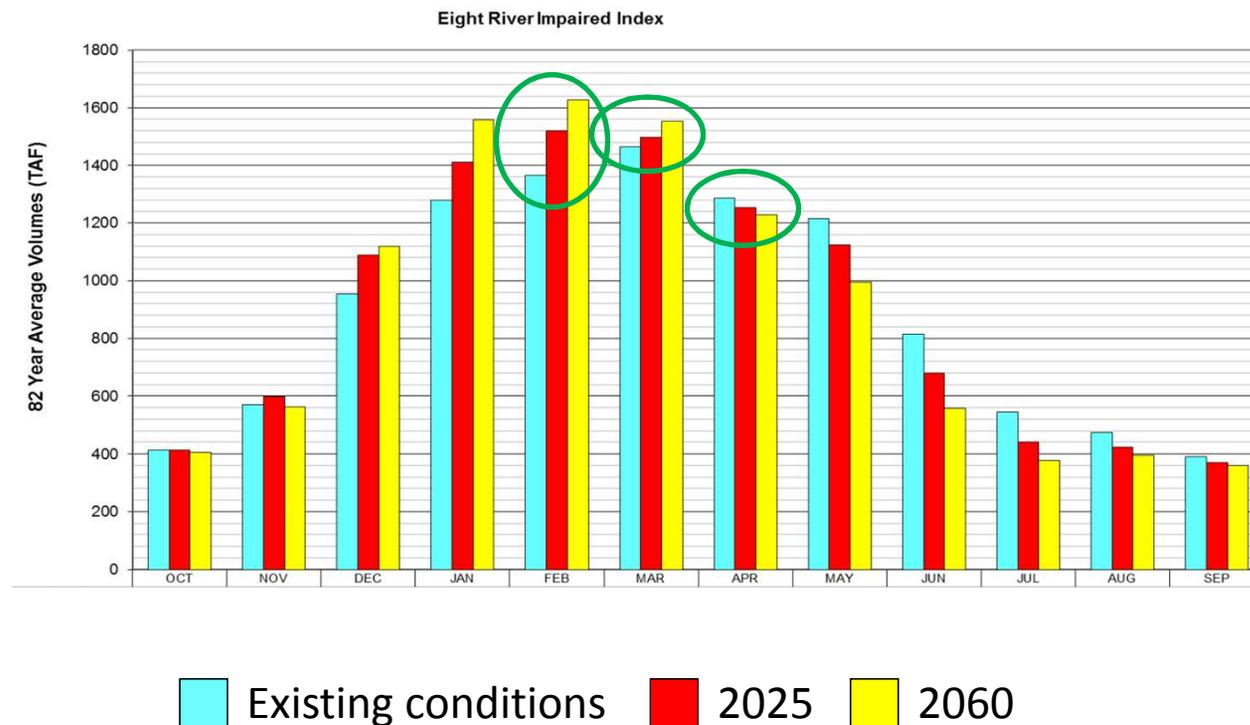
Note that outflow is much lower than predicted in some years (red arrow).

Considerations

- Perfect 8RI forecasting is not attainable.
- Imperfect 8RI forecasting pitfalls
 - Projects typically insist on using a 90% exceedance hydrology in their forecasts leading to lower than appropriate outflow targets.
 - Climate change is expected to reduce the 8RI in May over time.
 - Forecasts are not usually available until after the 10th of the month.
- Using the previous month's 8RI (PMI) may not be a much worse indicator. It could eliminate the pitfalls associated with forecasting and is already used as a regulatory standard (X2).
- Can PMI help avoid adverse effects of climate change?

Data Used to Assess Climate Change Susceptibility

- Hypothetical monthly estimated impaired runoff from the eight major streams **8RII** = CalSimII inputs for current, 2025 & 2060 climate/sea level rise scenarios.



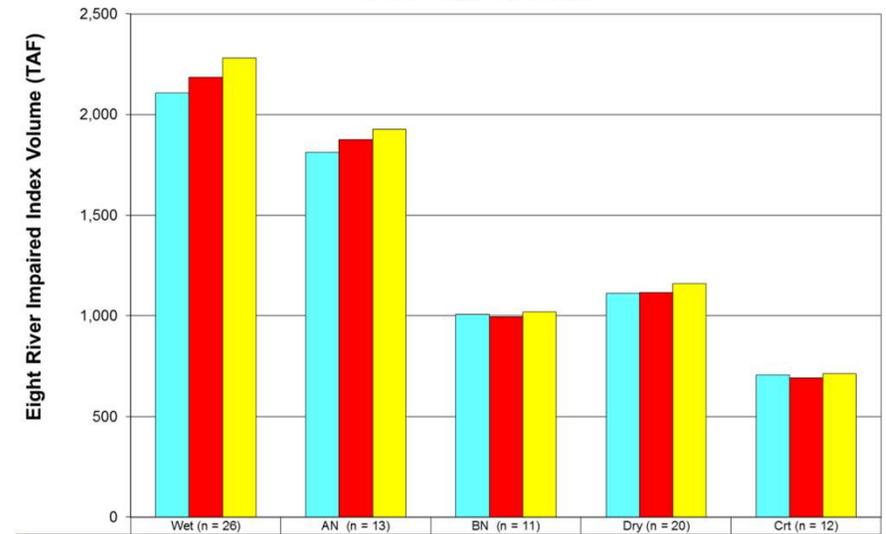
Conclusion: Using the previous month's 8RI (PMI) would minimize adverse influence of climate change for Mar, Apr & May.

Data Used (continued)

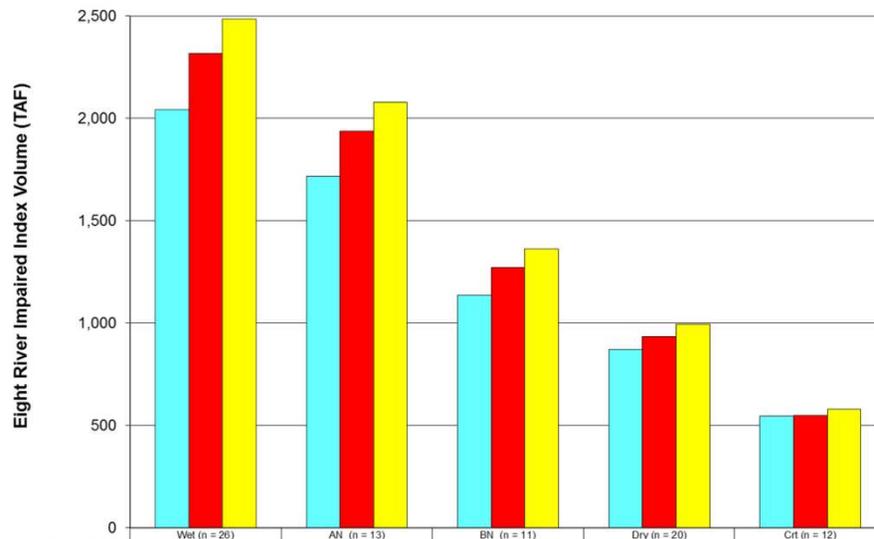
Conclusions:

1. Mar & Apr relatively unaffected by climate change, so Apr & May targets should not go down significantly.
2. Feb affected in a positive way for fish, i.e., Mar target may go up, particularly in wetter years if they aren't already at the cap of 44,500 cfs.

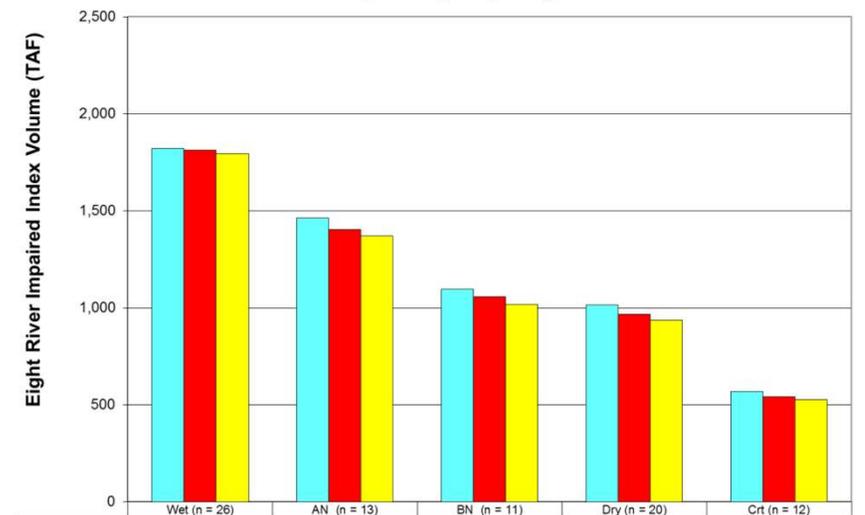
March Averages by Yeartype



February Averages by Yeartype



April Averages by Yeartype

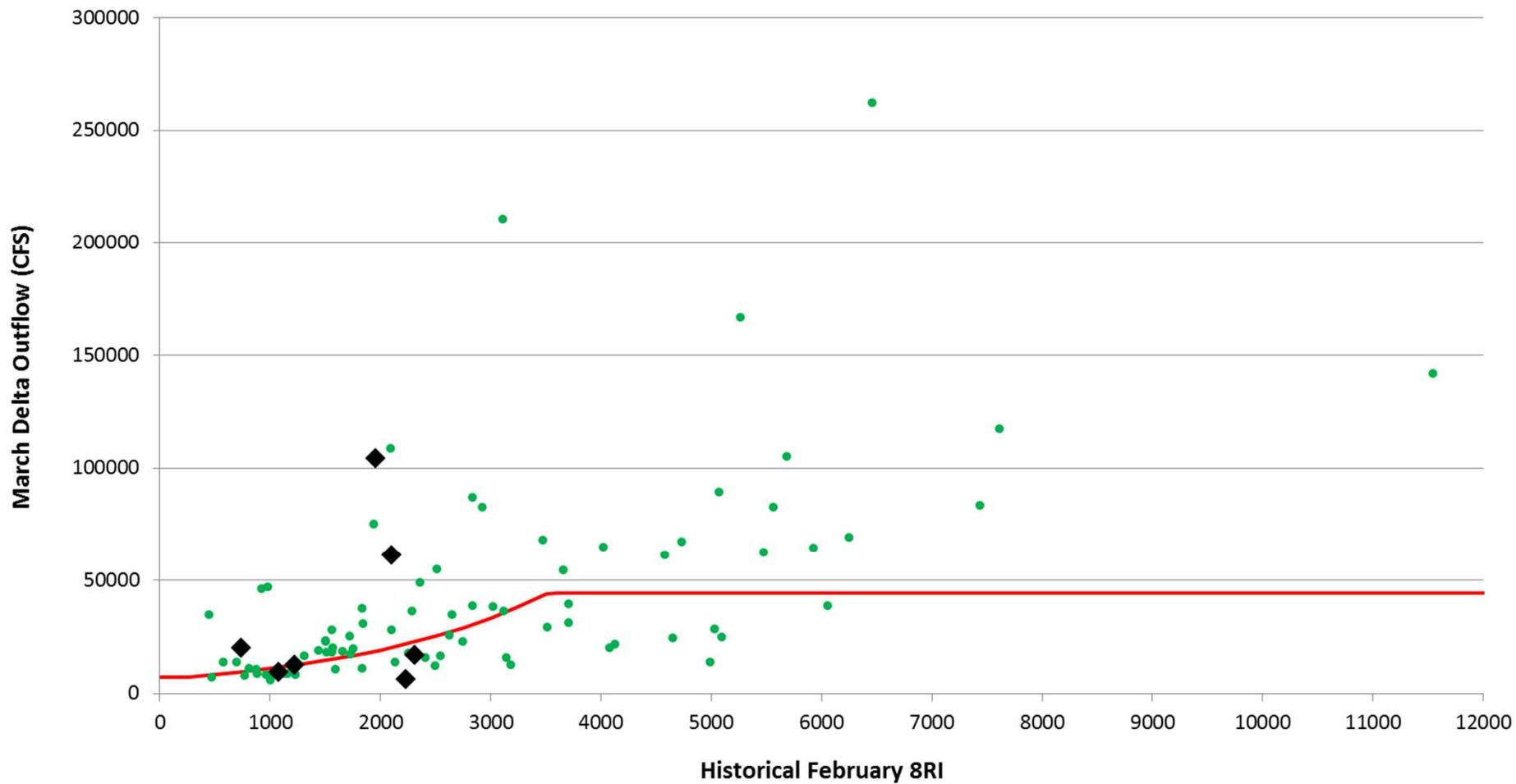


Existing conditions 2025 2060

Data Used (continued)

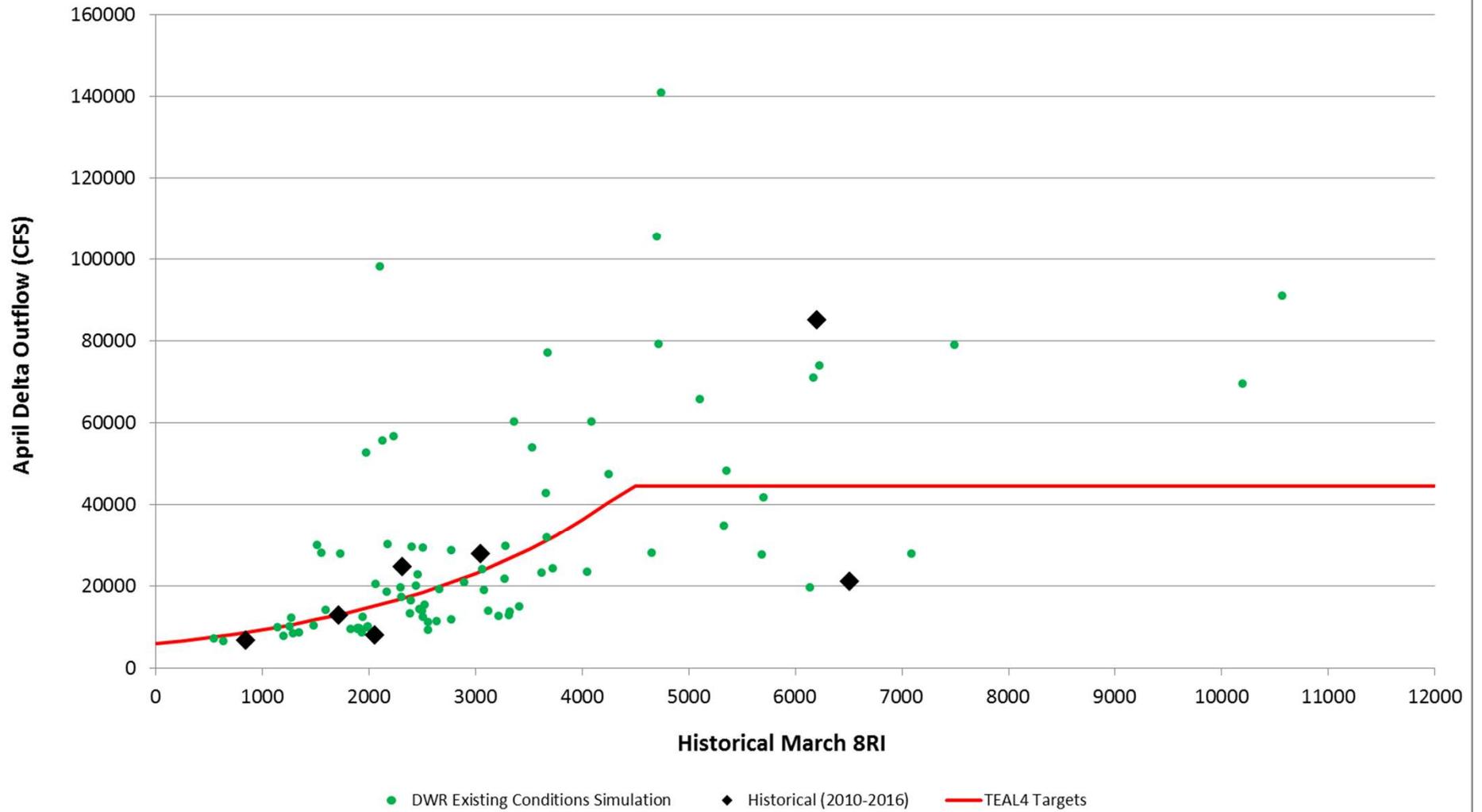
- DWR's Existing Conditions (current regulations without SLR or CC) simulation from their 2015 Delivery Capability Report was used to characterize current delta outflow conditions for comparative purposes. (Validation is currently impossible since simulated years are Water Years 1922-2003 and historical with the current regulations are Water Years 2010-2016.)
- Historical monthly estimated unimpaired (hypothetical) runoff from eight major streams feeding the Bay-Delta (**8RI**). Values are available from CDEC starting around Jan 1900 through last month of the current year (Nov 2016).
- Simulated delta outflows and Post-2009 historical delta outflows are plotted as a function of the previous month's 8RI (PMI) in the following charts. **Ignore the lines for now and note the vertical scale changes.**

March

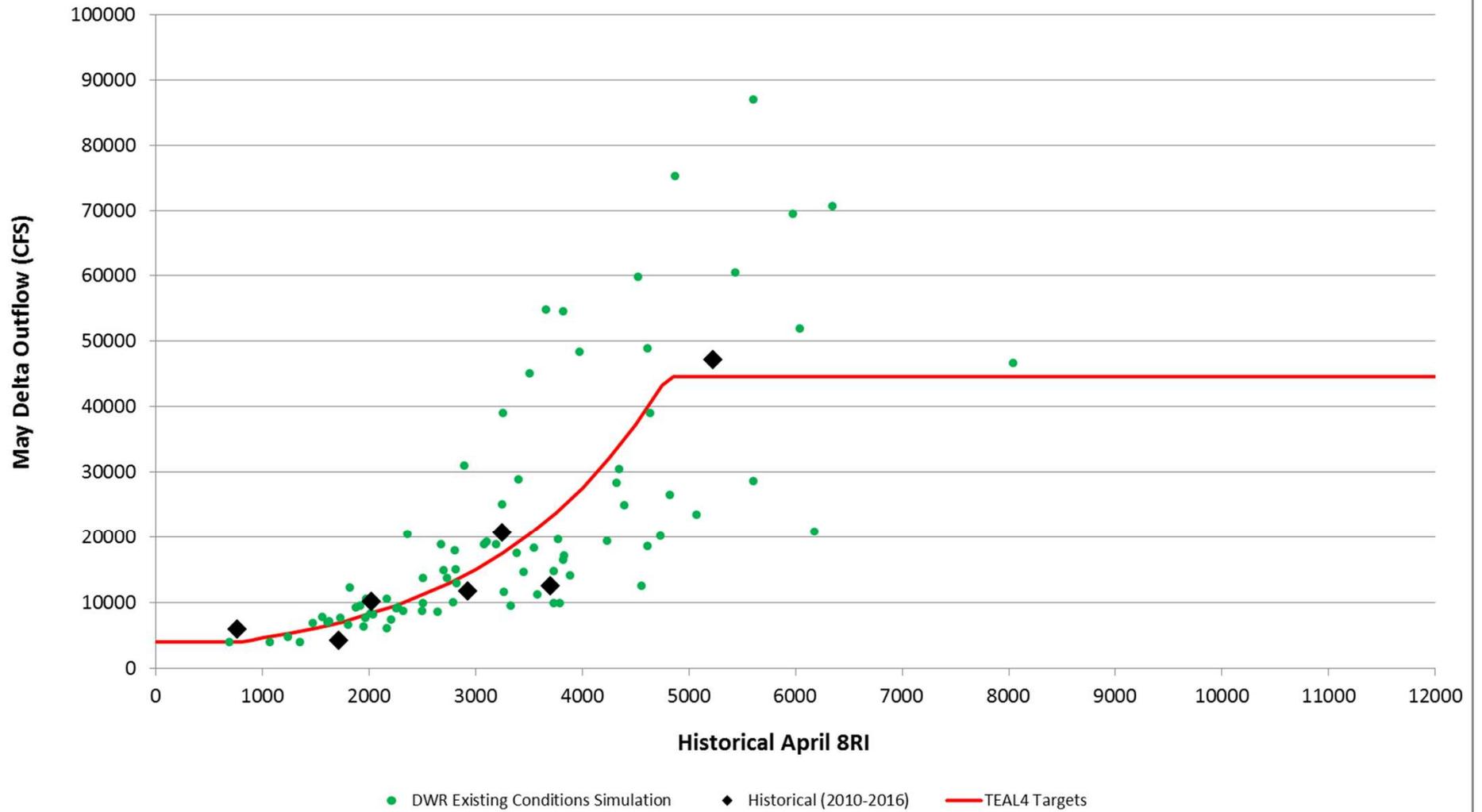


● DWR Existing Conditions Simulation ◆ Historical (2010-2016) — TEAL4 Targets

April



May



Changes from CWF 2081(b) Application

CDFW Approach: March has a PMI-based delta outflow target which can drive total exports down to health & safety level (and still not meet the target)

- instead of

2081(b) Application: March has a delta outflow target based on perfectly forecasted March 8RI which can drive total exports down to health & safety level (and still not meet the target)

CDFW Approach: April has a PMI-based delta outflow target which can drive total exports down to health & safety level (and still not meet the target) and total exports are also constrained by the SJR i:e

- instead of

2081(b) Application: April has no LFS-related delta outflow target. Total exports are constrained by the SJR i:e ratio if delta outflow is expected to be below 44,500 cfs and exports from the south delta are always constrained by the SJR i:e ratio. Said another way, there is no LFS-related constraint on the North delta diversion as long as the delta outflow is 44,500 cfs or greater.

CDFW Approach: May has a PMI-based delta outflow target which can drive exports down to health & safety level (and still not meet the target) and total exports are also constrained by the SJR i:e

- instead of

2081(b) Application: May has no LFS-related delta outflow target. Total exports are constrained by the SJR i:e ratio if delta outflow is expected to be below 44,500 cfs and exports from the south delta are always constrained by the SJR i:e ratio. Said another way, there is no LFS-related constraint on the North delta diversion as long as the delta outflow is 44,500 cfs or greater.

Proposed Criteria

- A lookup table of PMI vs targets for March capped at 44,500 cfs
- A lookup table of PMI vs targets for April capped at 44,500 cfs
- A lookup table of PMI vs targets for May capped at 44,500 cfs
- The monthly minimum delta outflow requirement is the lesser of
 - the month's target
 - and
 - the delta outflow that would occur if Jones+Banks exports were down at health and safety level (combined 1500 cfs).
- Example 1: Target = 20,000 cfs. Projected Combined Exports = 8000 cfs*. Projected delta outflow expected to be > 20,000 cfs. **NO CHANGE.**
- Example 2: Target = 20,000 cfs. Projected Combined Exports = 8000 cfs*. Projected delta outflow expected to be 15,000 cfs. **Reduce exports to 3000 cfs (5000 cfs reduction) or increase delta inflows by 5000 cfs.**
- Example 3: Target = 20,000 cfs. Projected Combined Exports = 8000 cfs*. Projected delta outflow expected to be 10,000 cfs. **Reduce exports to H&S level of 1500 cfs (6500 cfs reduction) or increase delta inflows by 6500 cfs.**

* complying with all other regulations.

Proposed Criteria

- These criteria (teal boxes) are shown with a red line in the previous charts.

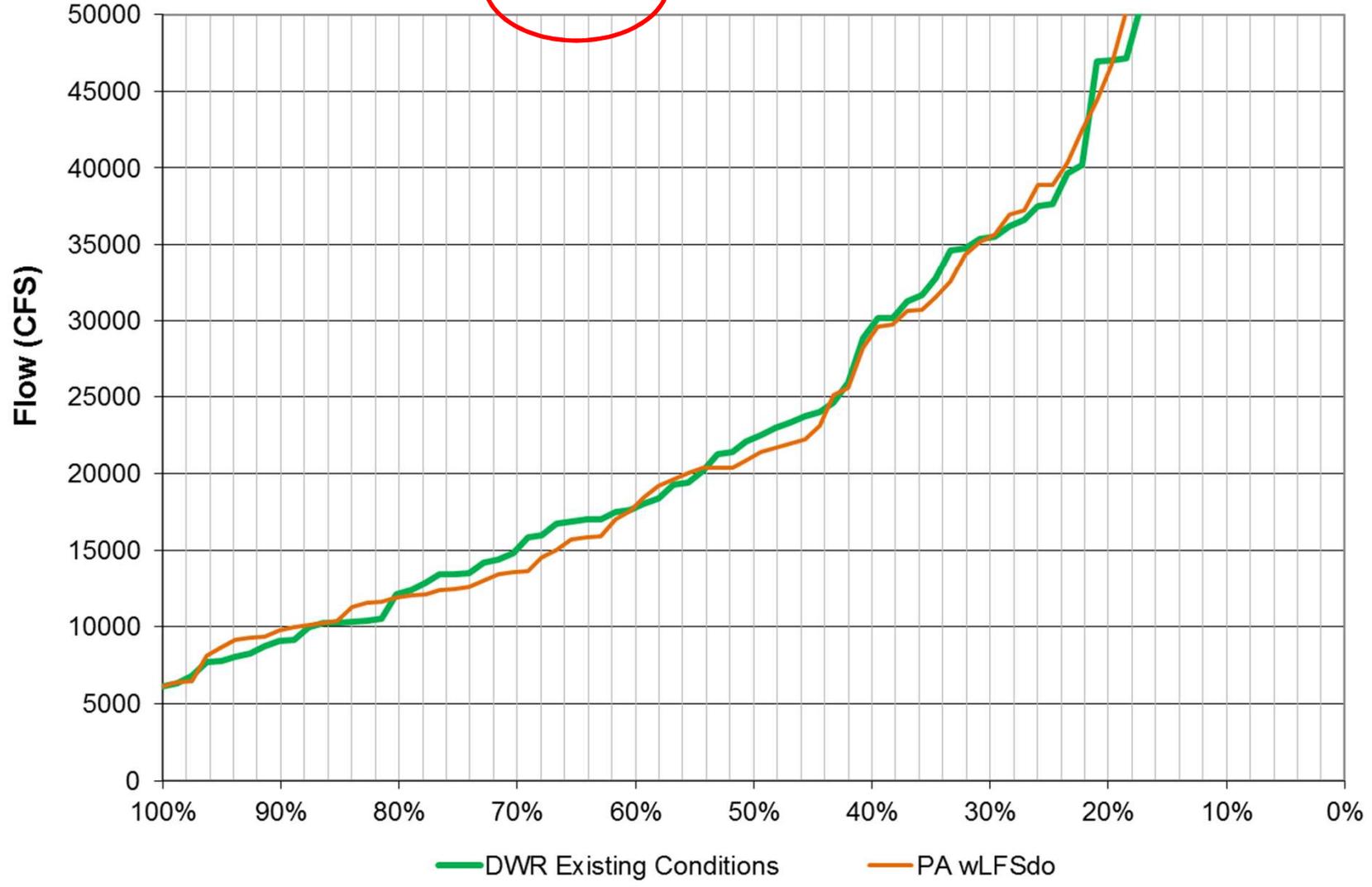
2081(b) Application	
Mar 8RI (TAF)	Mar TARGET (CFS)
0	0
545	6200
1488	8800
1911	12700
2140	17100
2421	20000
2575	25200
3104	35000
3492	43700
4217	44500
5655	44500
Based on CWF NAA w/o SLR or CC	

Feb 8RI (TAF)	Mar TARGET (CFS)
0	7100
250	7400
500	8500
750	9700
1000	11100
1250	12800
1500	14700
1750	16800
2000	19300
2250	22100
2500	25400
2750	29100
3000	33400
3250	38400
3500	44000
3600	44500
12000	44500

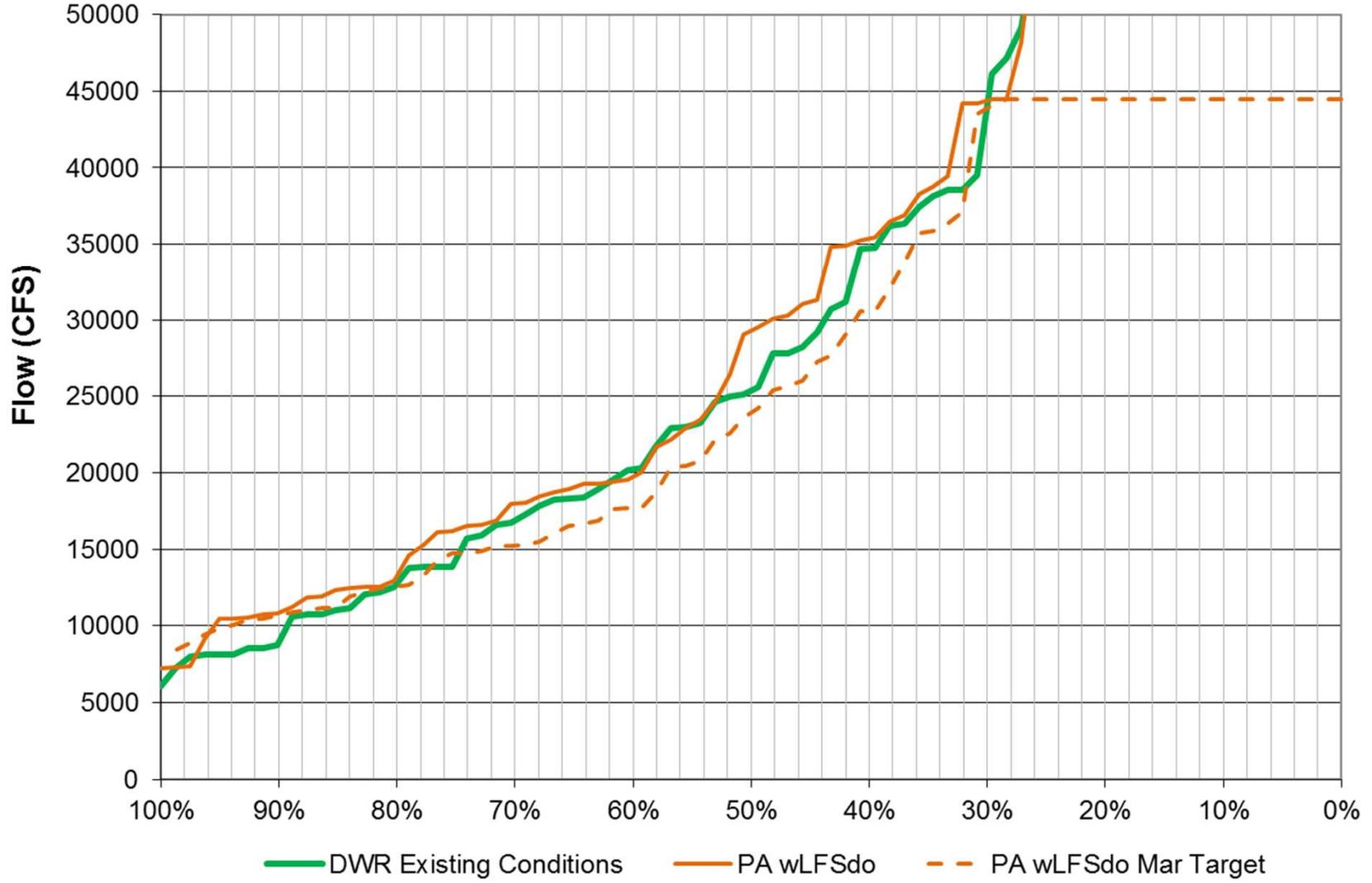
Mar 8RI (TAF)	Apr TARGET (CFS)
0	6000
250	6700
500	7500
750	8400
1000	9400
1250	10500
1500	11800
1750	13200
2000	14800
2250	16500
2500	18500
2750	20700
3000	23100
3250	25900
3500	29000
3750	32400
4000	36300
4250	40600
4500	44500
12000	44500

Apr 8RI (TAF)	May TARGET (CFS)
0	4000
800	4000
850	4200
900	4300
1000	4600
1250	5300
1500	6100
1750	7100
2000	8300
2250	9600
2500	11200
2750	13000
3000	15100
3250	17600
3500	20400
3750	23700
4000	27600
4250	32000
4500	37200
4750	43200
4850	44500
12000	44500

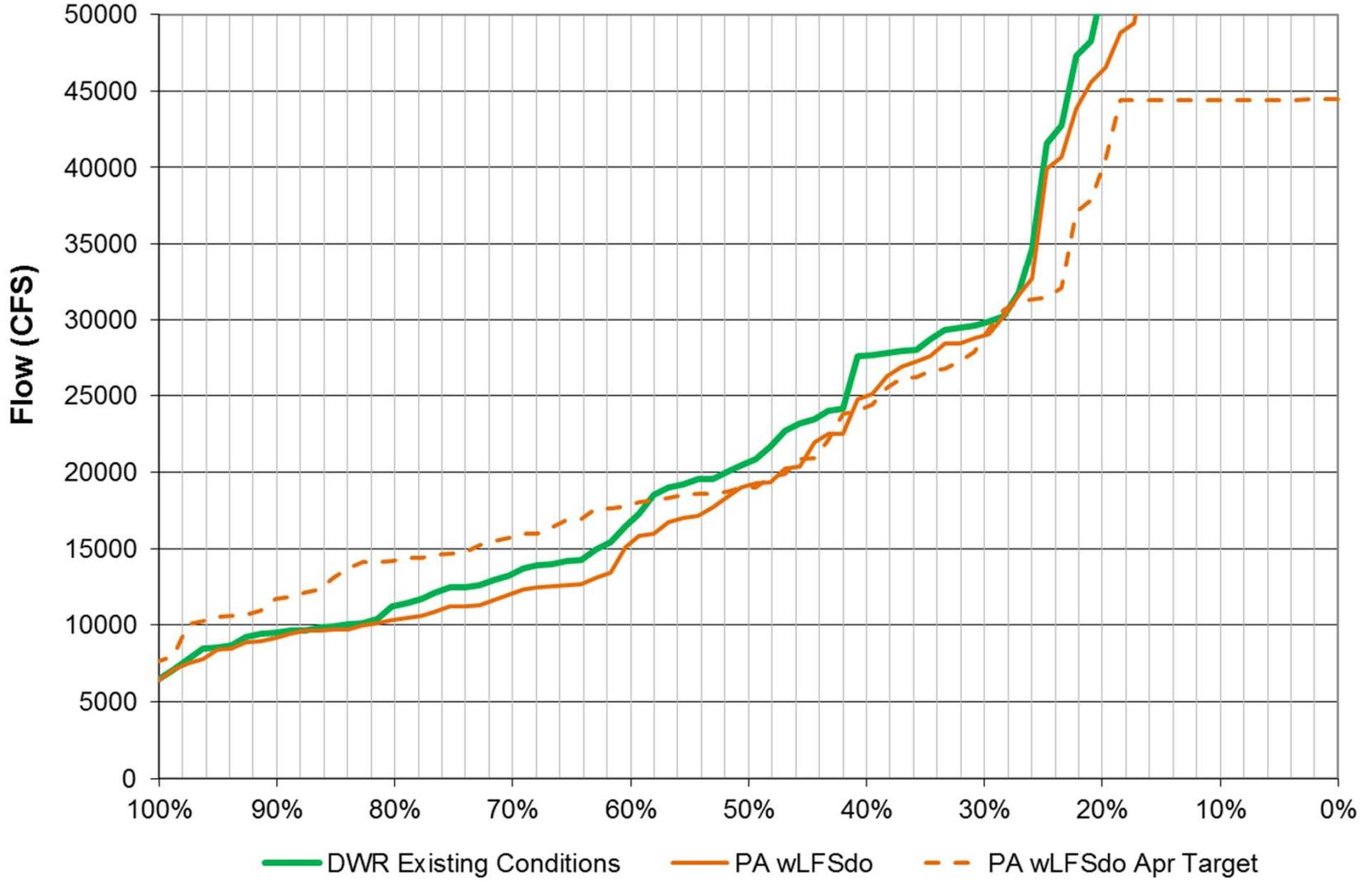
March-May Net Delta Outflow Index



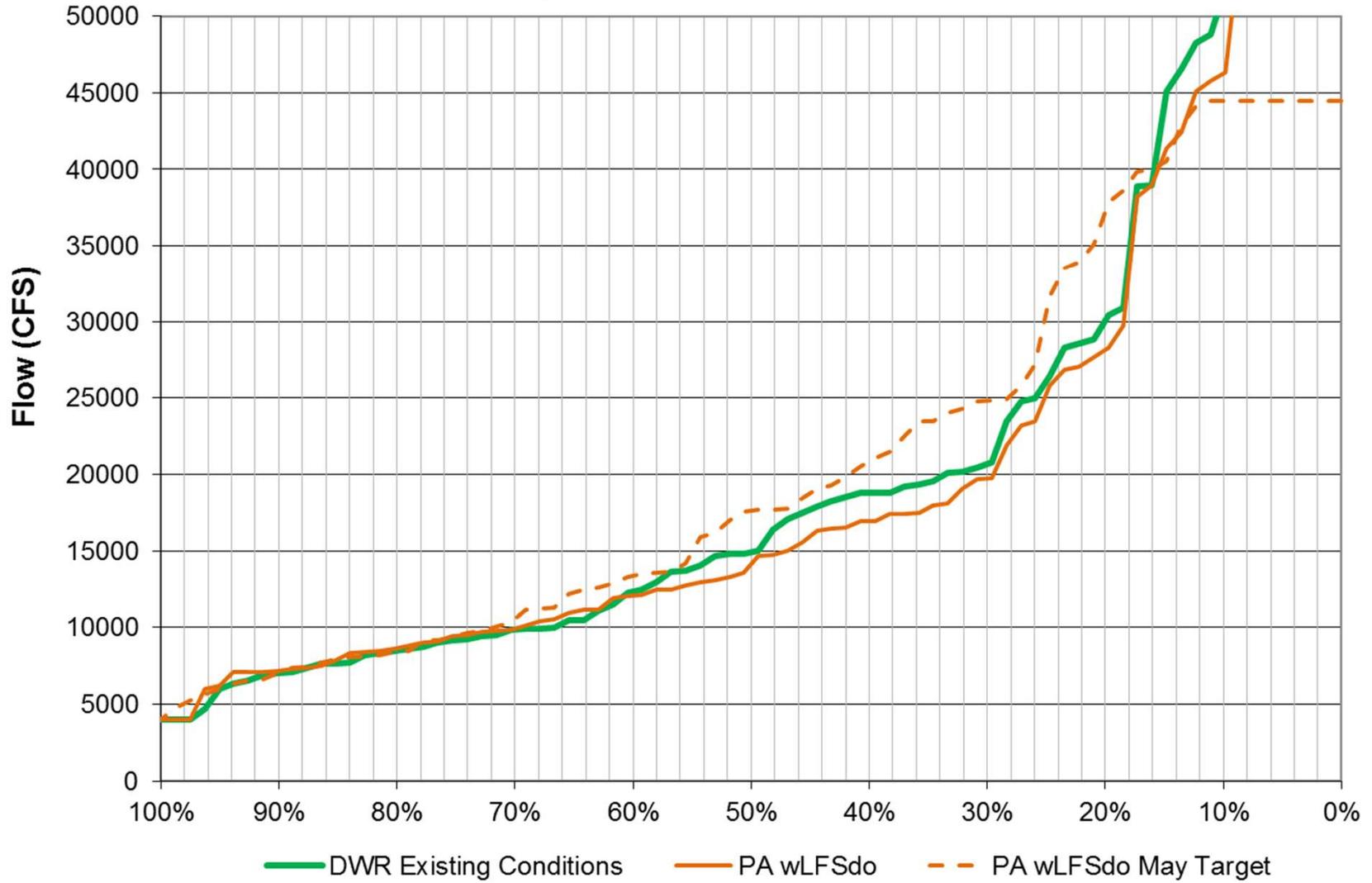
March Net Delta Outflow Index



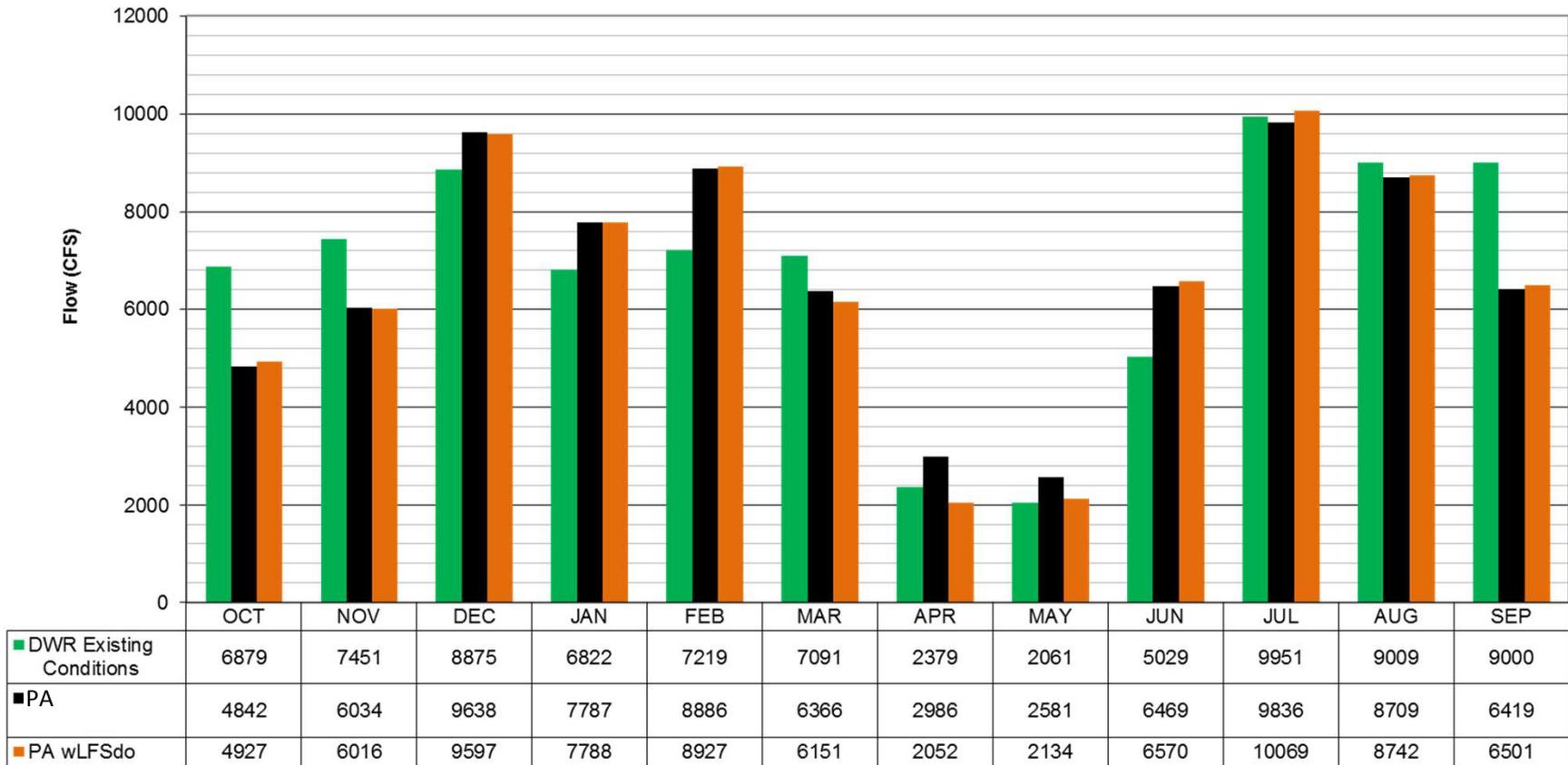
April Net Delta Outflow Index



May Net Delta Outflow Index



Calculated - Total Tracy & Banks Exports Averages



DWR Existing Conditions Average Annual (Oct-Sep) Exports = 4940 TAF/YR

PA Average Annual (Oct-Sep) Exports = 4861 TAF/YR

PA wLFSdo Average Annual (Oct-Sep) Exports = 4796 TAF/YR