Evaluation of California Water Fix Modeling

Exhibit SVWU - 110

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Overview

- Review of CWF boundary analysis modeling
- Example two-year operation of CVP/SWP with CWF and NAA
- Report on Review of Bay Delta Conservation Program Modeling
- Technical Comments on the Bay Delta Conservation Plan/California Water Fix Partially Recirculated Draft EIR/Supplemental Draft EIS
- Technical Comments on Coordinated Long-Term Operation of the Central Valley Project and State Water Project Draft Environmental Impact Statement
- California Water Fix Biological Assessment Modeling Review Report

California Water Fix

Evaluation of California Water Fix Boundary Analysis Modeling

August 31, 2016

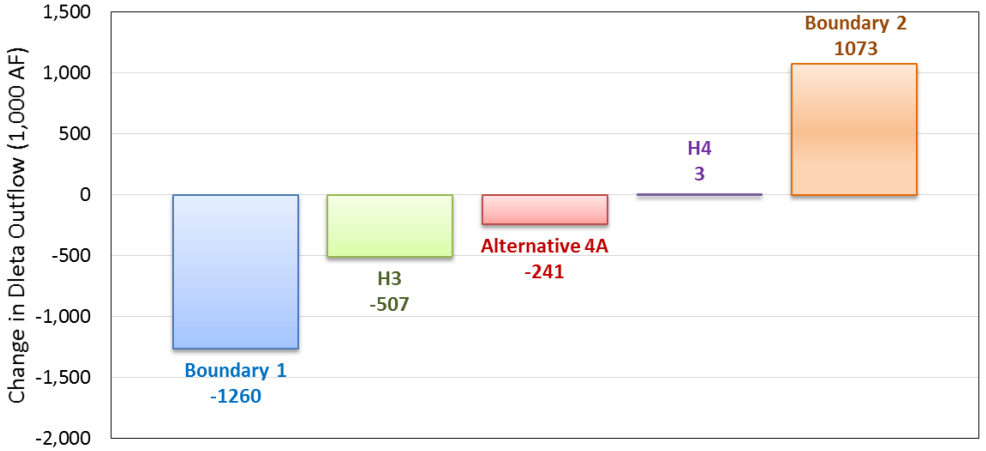
MBK ENGINEERS

CWF Boundary Analysis

USBR / DWR Modeling

- Boundary 1
- H3
- Alternative 4A (H3+)
- H4
- Boundary 2

Average Annual Change in Delta Outflow
(CWF Alternatives minus USBR/DWR BA NAA)



MBK Conclusions on CWF Boundary Analysis

Based on review of the USBR/DWR model files and results, the Boundary Analysis fails in its purported purpose of bounding the range of potential effects of the CWF.

- The Boundary Analysis alters Delta outflow requirements and Delta export restrictions that currently apply to the South Delta Diversion to create a range of changes in Delta outflow, compared to the NAA.
- The Boundary Analysis does not evaluate a range of potential operations of the CVP and SWP with the CWF, or the additional capacity to convey water across the Delta that would be provided by the NDD, even though this additional conveyance capacity is the primary purpose of the CWF.
- The Boundary Analysis fails to meet its purported purpose because it does not consider this additional capacity or the flexibility it would provide to the operations of the CVP and SWP.

MBK Conclusions on CWF Boundary Analysis

<u>Findings applicable to ALL Boundary Analysis Modeling Scenarios</u>

1. DWR/USBR Boundary Analysis Alternatives do not consider additional capacity that would be made available with the NDD when making allocations to South of Delta CVP and SWP contractors.

2. DWR/USBR Boundary Analysis Alternatives include artificial limits on the use of Joint Point of Diversion.

3. DWR/USBR Boundary Analysis Alternatives change reservoir balancing criteria so that less stored water is modeled as being conveyed from North of Delta reservoirs to San Luis Reservoir during summer months.

4. CalSim II does not address effects on many types of water users.

Export Estimates for the CWF Boundary Analysis Alternatives

- The CWF Boundary Analysis Alternatives include user input export estimates in lookup tables
    - ExportEstimate_SWP and ExportEstimate_CVP

- The export estimates are an assumption of available export capacity that is used to bound SWP Table A allocations and CVP SOD water service contractor allocations in the simulations.

CWF Export Estimates – for CVP Allocations

User Input Export Estimates for Bounding CVP SOD Service Allocations in non-Wet SJR Years
(used in same 58 years of all DWR/USBR alternatives)

Alternative	USER INPUT EXPORT ESTIMATES						SUM		Difference with NAA	
	MAR (CFS)	APR (CFS)	MAY (CFS)	JUN (CFS)	JUL (CFS)	AUG* (CFS)	APR-AUG (TAF)	MAY-AUG (TAF)	APR-AUG (TAF)	MAY-AUG (TAF)
BA NAA	2500	1000	1000	2000	4600	4600	806	746	--	--
Boundary 1	2500	1000	1000	2000	4600	4600	806	746	0	0
H3	2500	1000	1000	2000	4600	4600	806	746	0	0
H4	1250	750	750	2500	4000	4000	731	687	-74	-59
Boundary 2	800	800	800	800	800	800	243	195	-563	-551

*August export estimate set equal to July export estimate in each alternative for bounding CVP SOD service contractor allocations

Boundary 1: No Change
H3: No Change
H4: Reduced
Boundary 2: Reduced

User Input Export Estimates for Bounding CVP SOD Service Allocations in Wet SJR Years
(used in same 24 years of all DWR/USBR alternatives)

Alternative	USER INPUT EXPORT ESTIMATES						SUM		Difference with NAA	
	MAR (CFS)	APR (CFS)	MAY (CFS)	JUN (CFS)	JUL (CFS)	AUG* (CFS)	APR-AUG (TAF)	MAY-AUG (TAF)	APR-AUG (TAF)	MAY-AUG (TAF)
BA NAA	2500	2000	2000	4600	4600	4600	1081	962	--	--
Boundary 1	2500	2000	2000	4600	4600	4600	1081	962	0	0
H3	2500	2000	2000	4600	4600	4600	1081	962	0	0
H4	1250	2750	3000	3000	4000	4000	1019	855	-63	-108
Boundary 2	800	3000	3000	3000	800	800	640	461	-442	-501

*August export estimate set equal to July export estimate in each alternative for bounding CVP SOD service contractor allocations

Boundary 1: No Change
H3: No Change
H4: Reduced
Boundary 2: Reduced

CWF Export Estimates – for SWP Allocations

User Input Export Estimates for Bounding SWP Table A Allocations in non-Wet SJR Years
(used in same 58 years of all DWR/USBR alternatives)

Alternative	USER INPUT EXPORT ESTIMATES								SUM		Difference with NAA	
	JAN (CFS)	FEB (CFS)	MAR (CFS)	APR (CFS)	MAY (CFS)	JUN (CFS)	JUL (CFS)	AUG* (CFS)	APR-AUG (TAF)	MAY-AUG (TAF)	APR-AUG (TAF)	MAY-AUG (TAF)
BA NAA	3750	4250	4250	1000	1000	2500	7000	7000	1131	1071	--	--
Boundary 1	3750	4250	4250	1000	1000	2500	7000	7000	1131	1071	0	0
H3	3750	4250	4250	1000	1000	2500	7000	7000	1131	1071	0	0
H4	2250	3500	1000	750	750	750	5000	5000	750	706	-380	-365
Boundary 2	600	700	700	400	100	800	2500	2500	385	361	-746	-710

*August export estimate set equal to July export estimate in each alternative for purposes of bounding SWP Table A allocations

Boundary 1: No Change
H3: No Change
H4: Reduced
Boundary 2: Reduced

User Input Export Estimates for Bounding SWP Table A Allocations in non-Flood Wet SJR Years
(used in same 12 years of all DWR/USBR alternatives)

Alternative	USER INPUT EXPORT ESTIMATES								SUM		Difference with NAA	
	JAN (CFS)	FEB (CFS)	MAR (CFS)	APR (CFS)	MAY (CFS)	JUN (CFS)	JUL (CFS)	AUG* (CFS)	APR-AUG (TAF)	MAY-AUG (TAF)	APR-AUG (TAF)	MAY-AUG (TAF)
BA NAA	3750	4250	4250	2000	2000	6000	7000	7000	1460	1341	--	--
Boundary 1	3750	4250	4250	2000	2000	6000	7000	7000	1460	1341	0	0
H3	3750	4250	4250	2000	2000	6000	7000	7000	1460	1341	0	0
H4	2250	3500	1000	3500	2000	3000	5000	5000	1125	916	-335	-424
Boundary 2	600	700	700	700	700	3100	2500	2500	577	535	-883	-806

*August export estimate set equal to July export estimate in each alternative for purposes of bounding SWP Table A allocations

Boundary 1: No Change
H3: No Change
H4: Reduced
Boundary 2: Reduced

User Input Export Estimates for Bounding SWP Table A Allocations in Flood SJR Years
(used in same 12 years of all DWR/USBR alternatives)

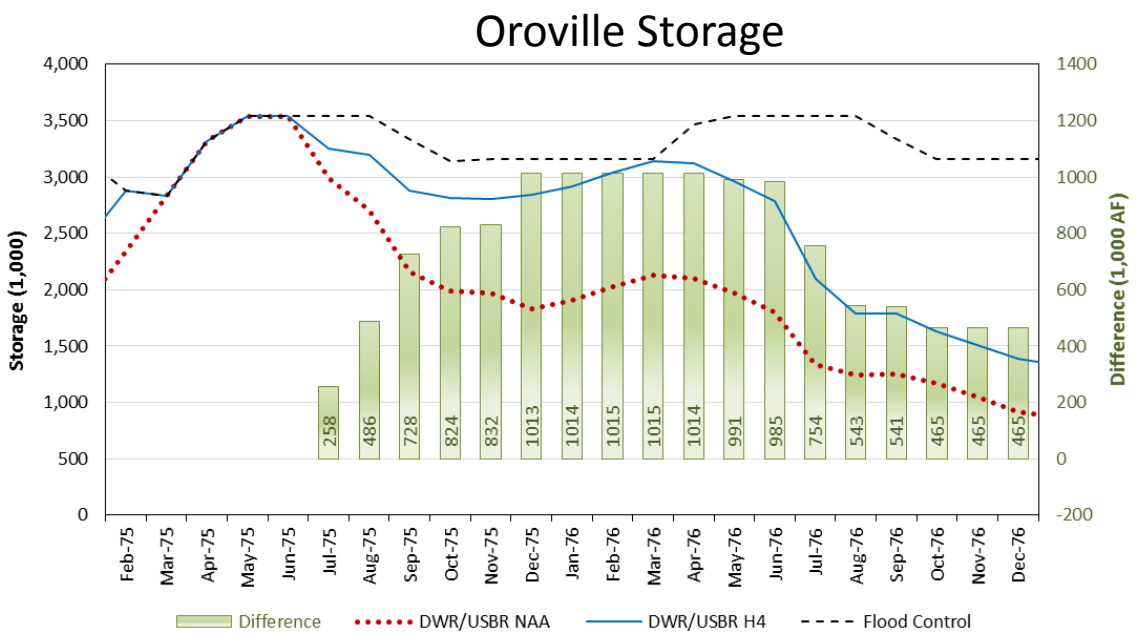
Alternative	USER INPUT EXPORT ESTIMATES								SUM		Difference with NAA	
	JAN (CFS)	FEB (CFS)	MAR (CFS)	APR (CFS)	MAY (CFS)	JUN (CFS)	JUL (CFS)	AUG* (CFS)	APR-AUG (TAF)	MAY-AUG (TAF)	APR-AUG (TAF)	MAY-AUG (TAF)
BA NAA	3750	4250	4250	6000	6000	6000	7000	7000	1944	1587	--	--
Boundary 1	3750	4250	4250	6000	6000	6000	7000	7000	1944	1587	0	0
H3	3750	4250	4250	6000	6000	6000	7000	7000	1944	1587	0	0
H4	2250	3500	1000	4500	4000	3000	5000	5000	1307	1039	-637	-547
Boundary 2	600	700	700	1100	700	3100	2500	2500	600	535	-1343	-1052

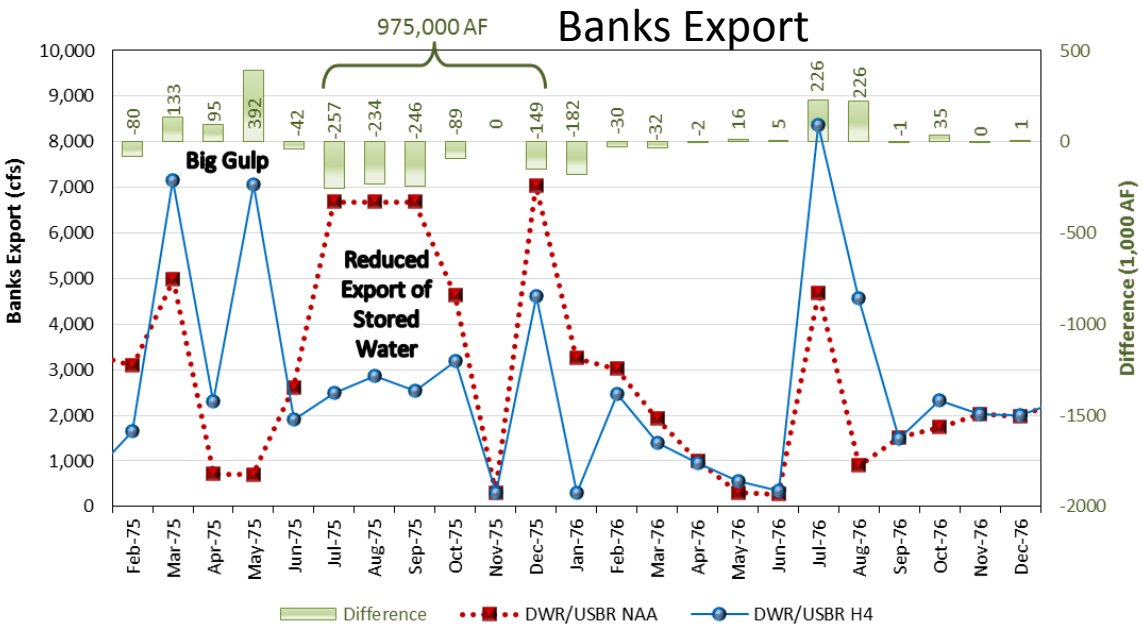
*August export estimate set equal to July export estimate in each alternative for purposes of bounding SWP Table A allocations

Boundary 1: No Change
H3: No Change
H4: Reduced
Boundary 2: Reduced

CWF H4 Scenario Detailed Look at 2 Years

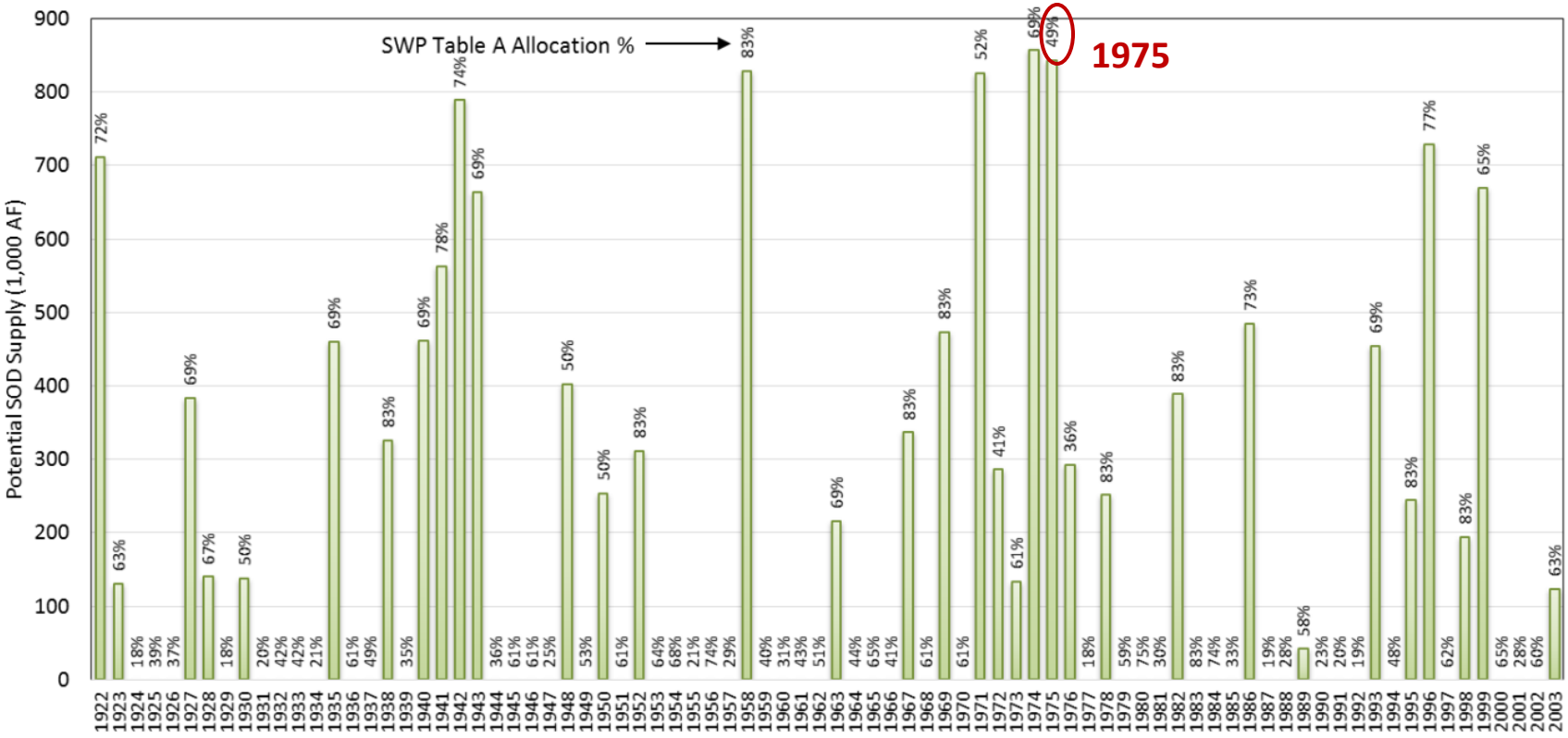
February 1975 to December 1976
DWR/USBR BA NAA and H4





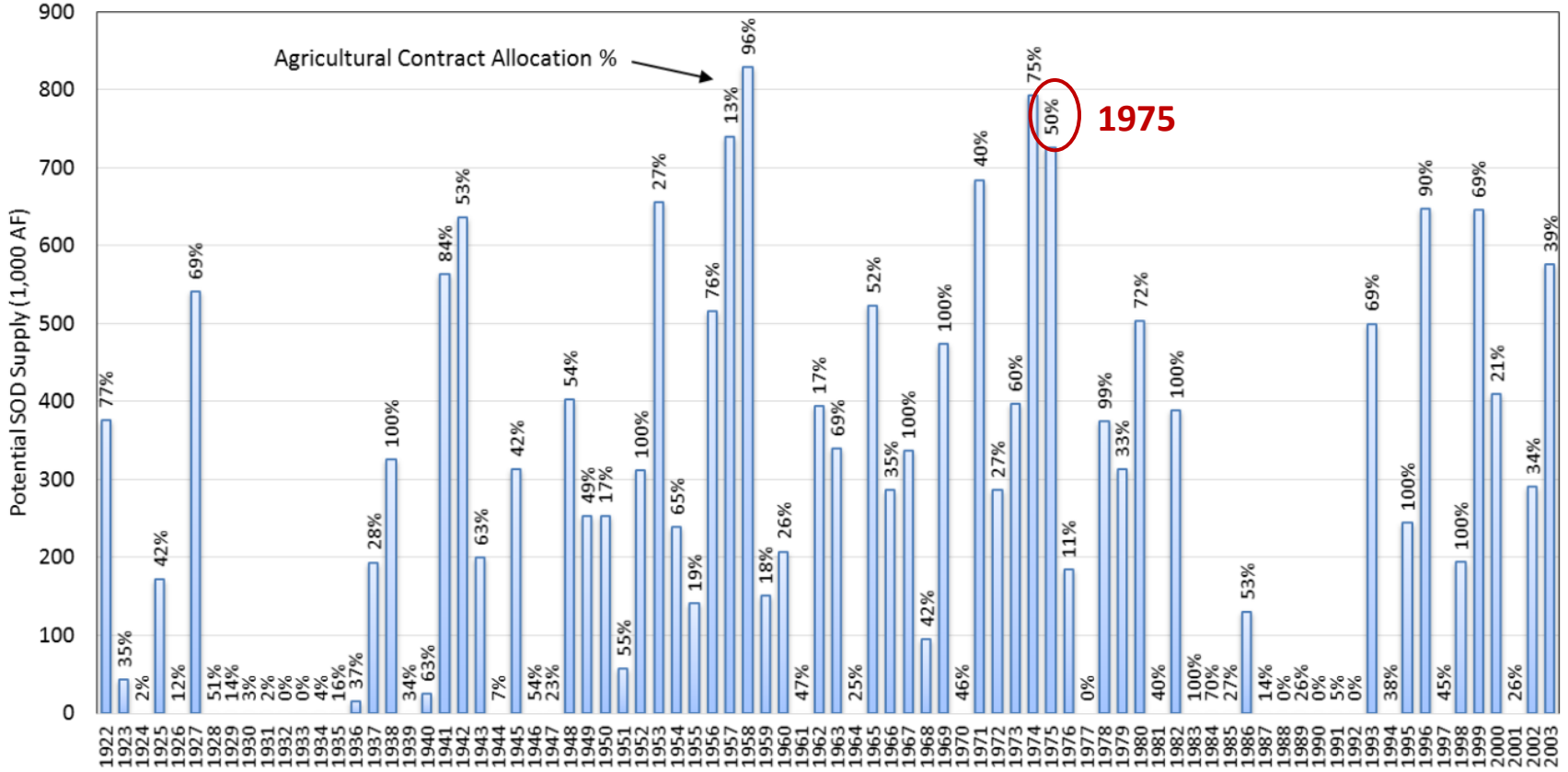
Ability to Increase SWP SOD Water Supply in CWF H4

(minimum of available export capacity and available upstream storage)



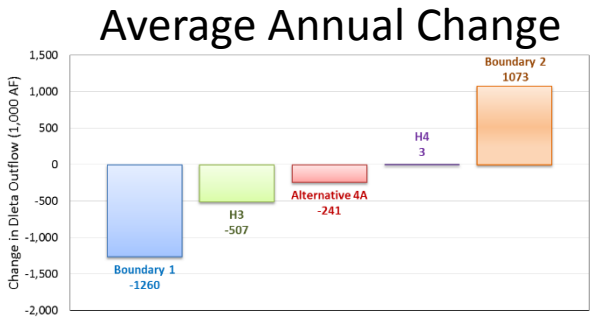
Ability to Increase CVP SOD Water Supply in CWF H4

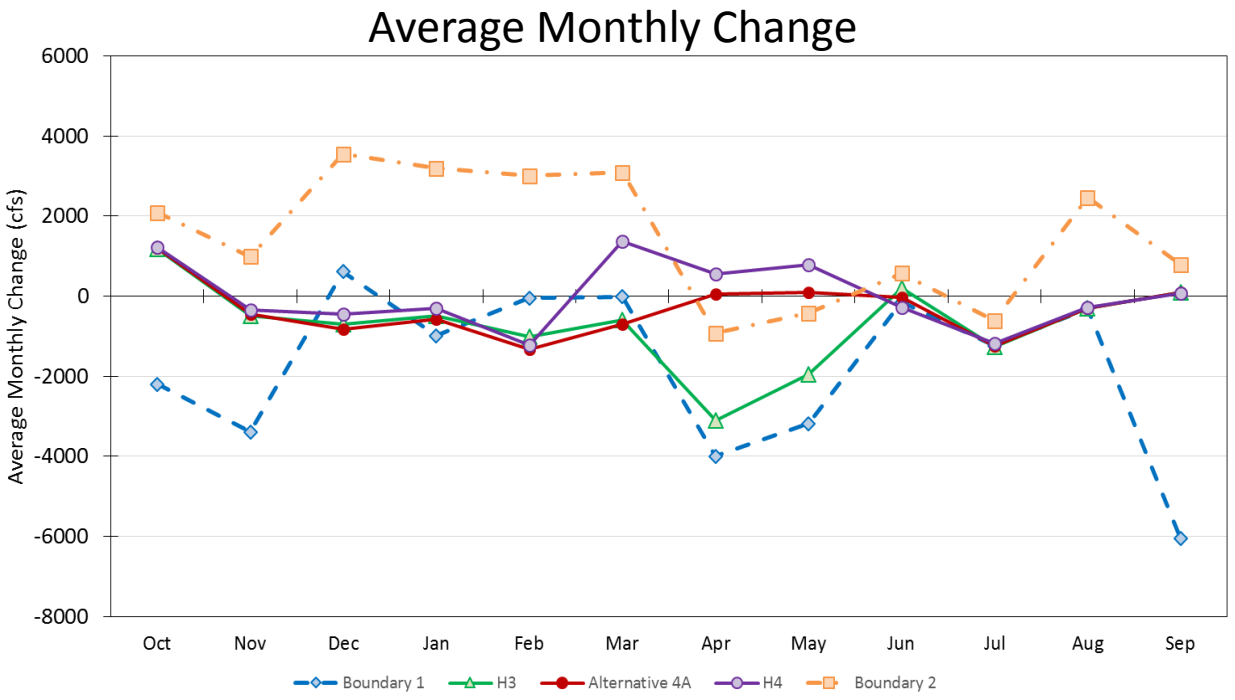
(minimum of available export capacity and available upstream storage)



CWF Boundary Analysis - Delta Outflow

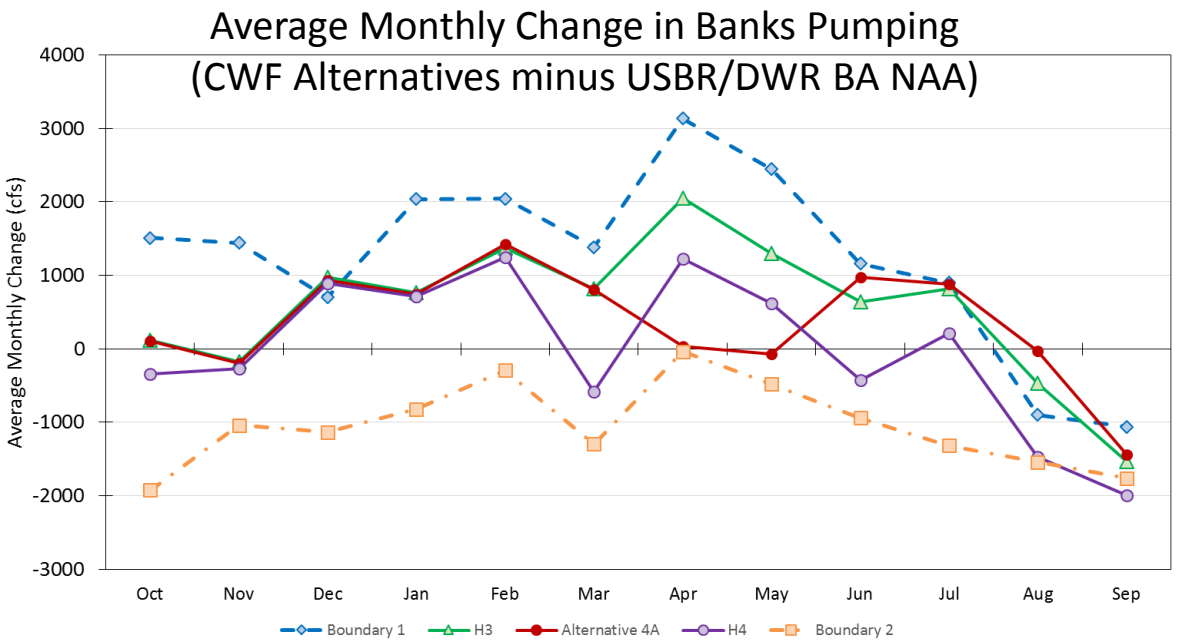
(CWF Alternatives minus USBR/DWR BA NAA)

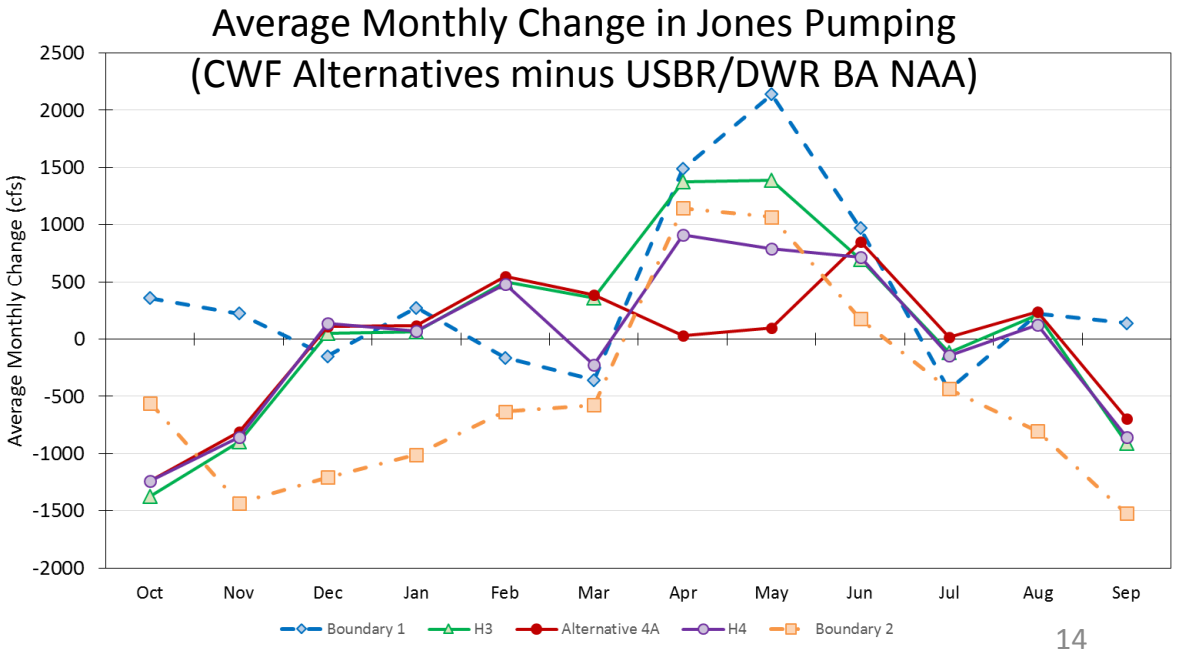




CWF Boundary Analysis

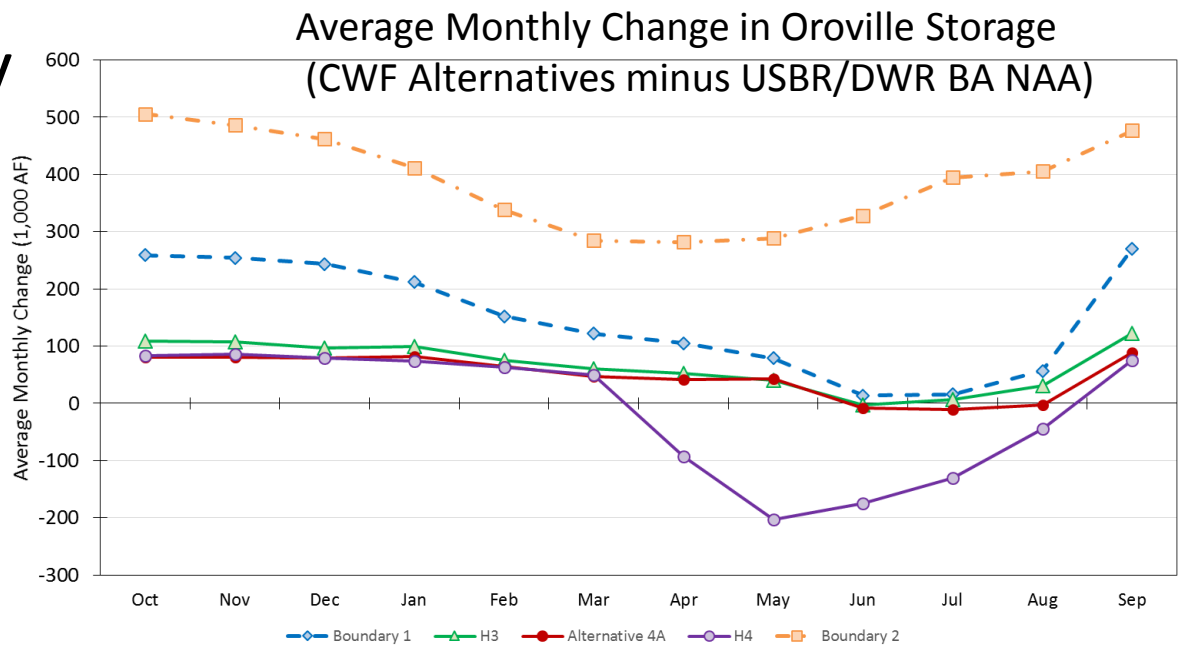
Delta Exports

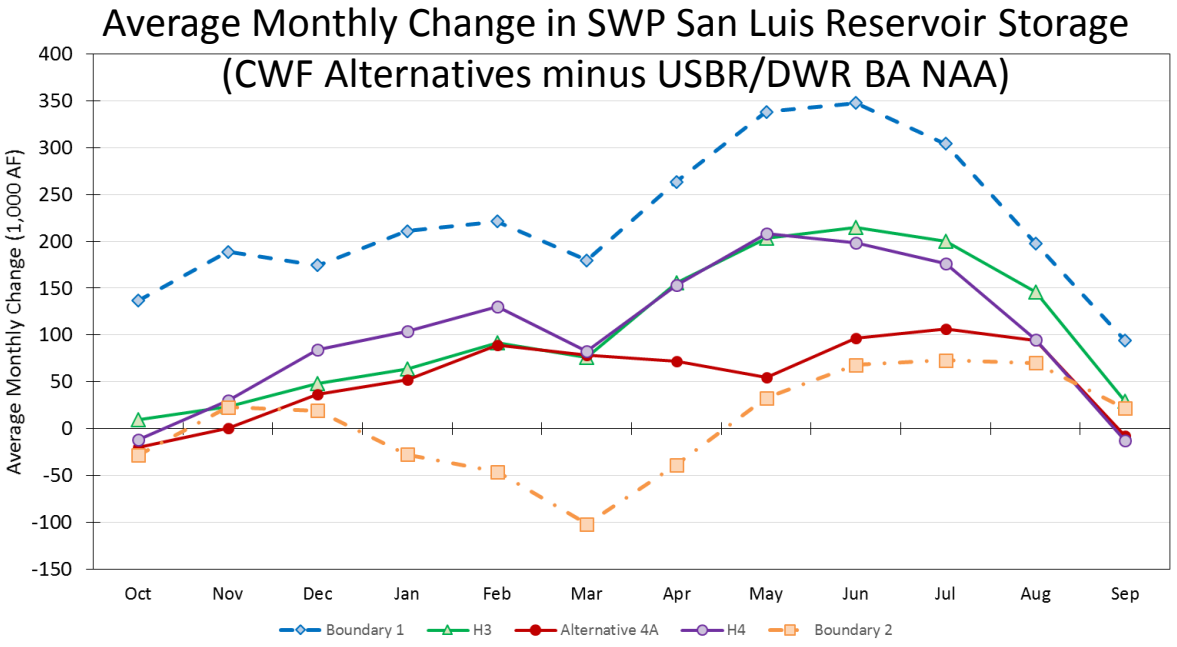




CWF Boundary Analysis

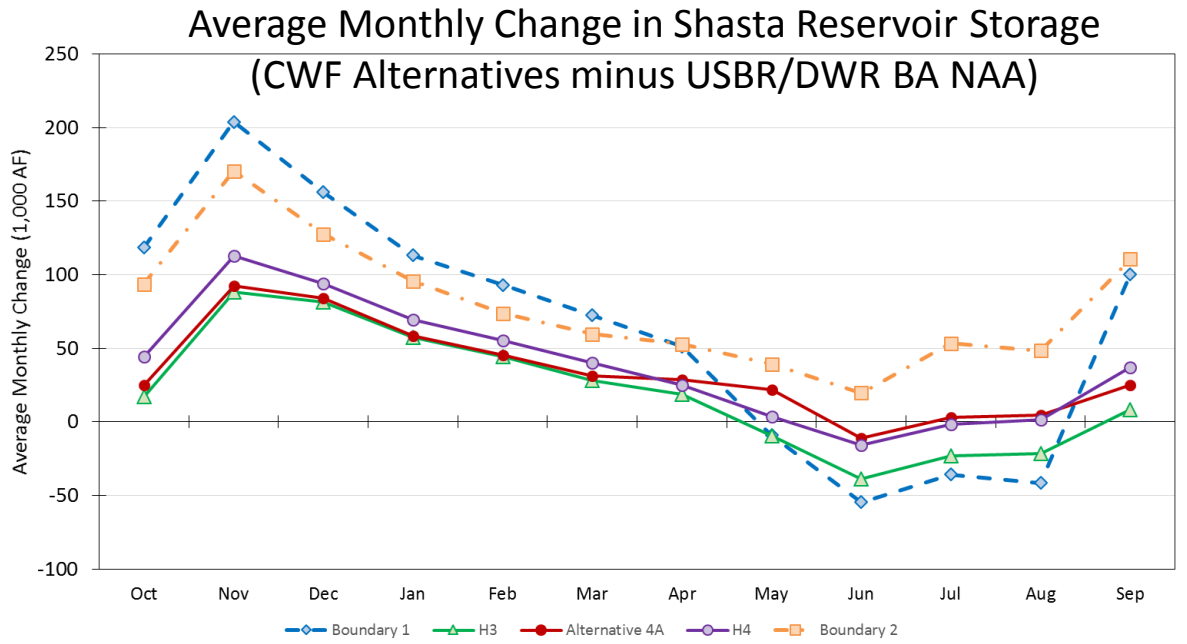
SWP Storage

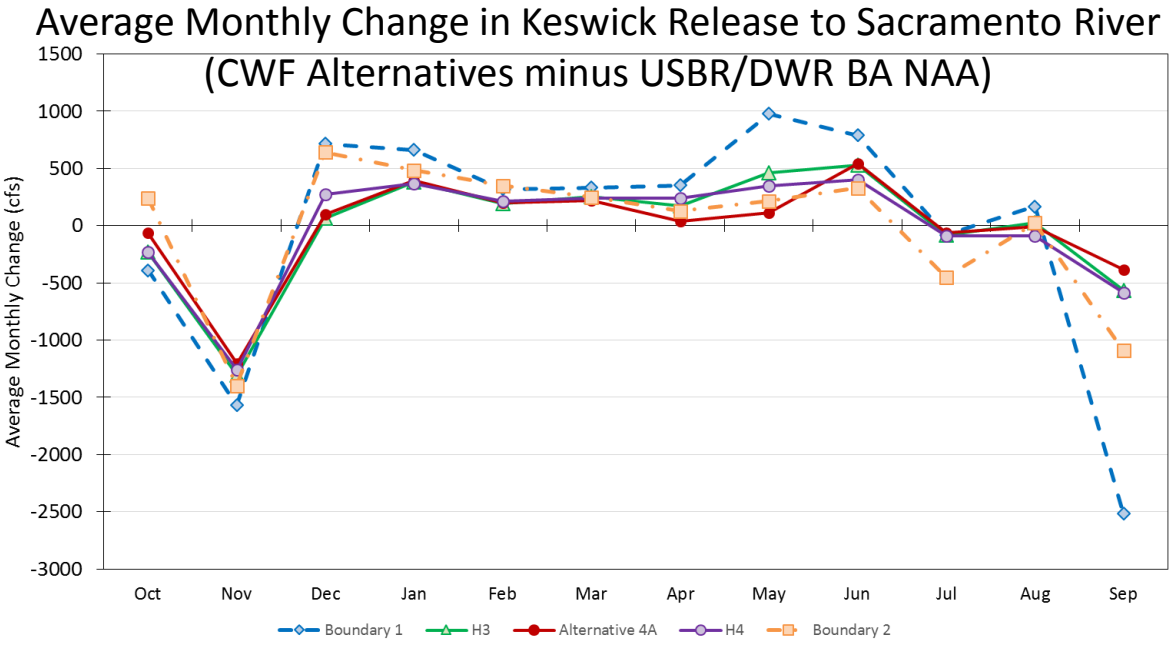




CWF Boundary Analysis

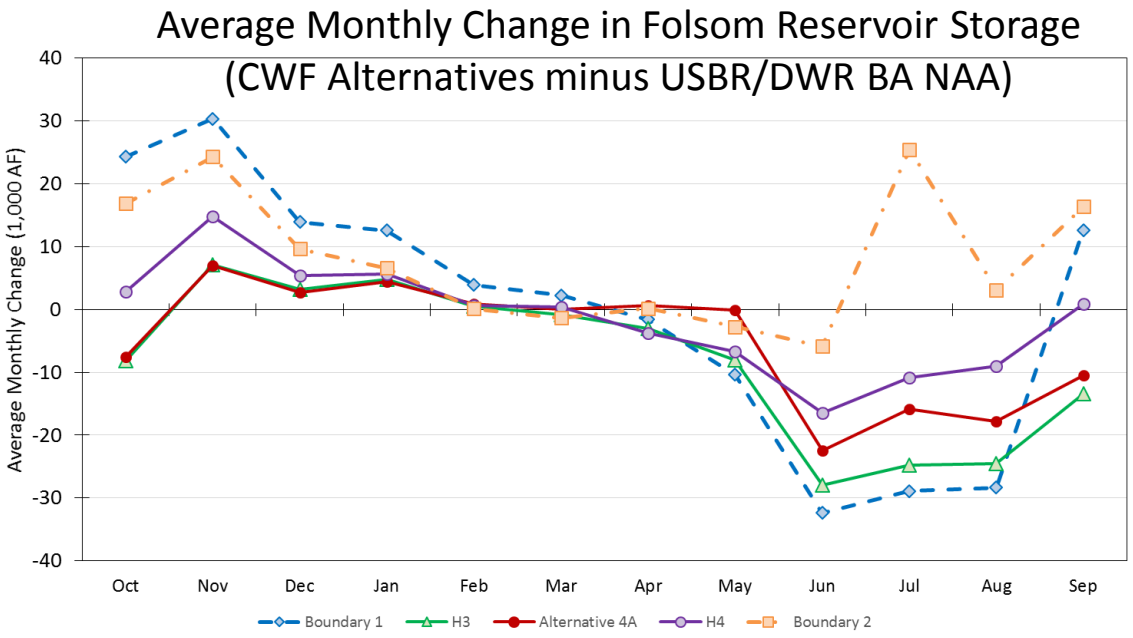
Shasta Storage and Keswick Release

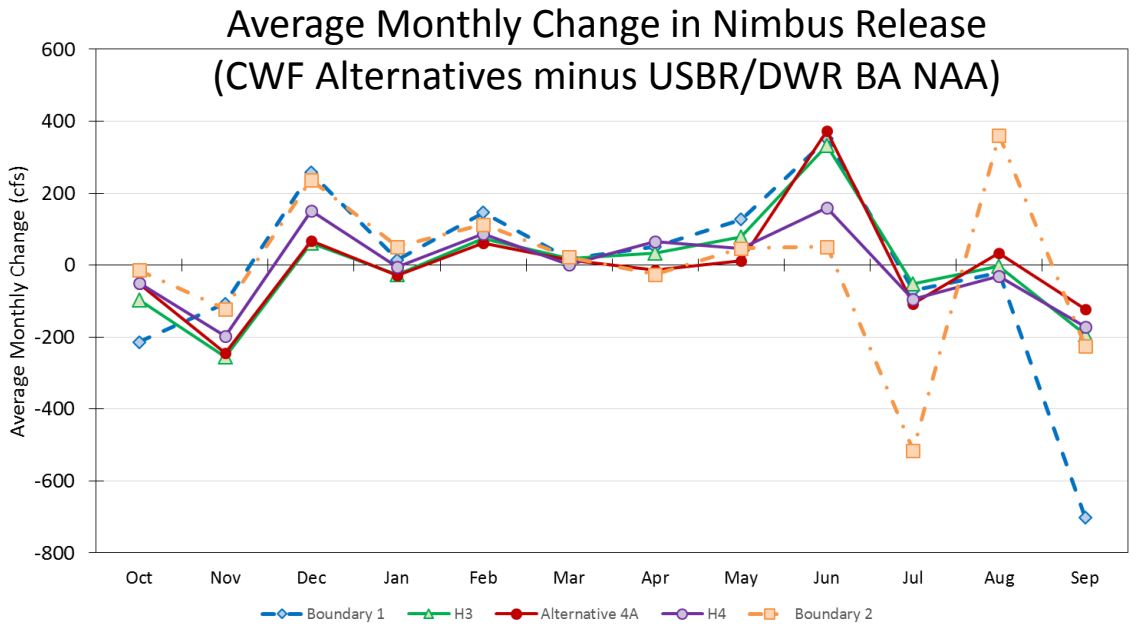




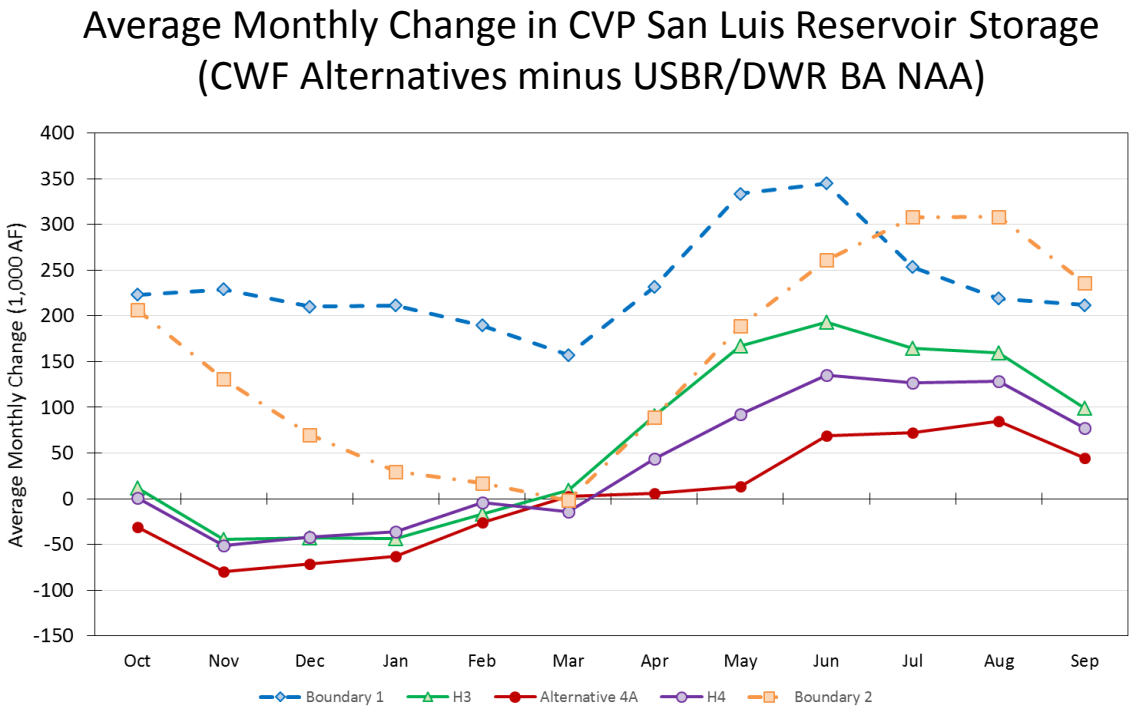
CWF Boundary Analysis

Folsom Storage and Nimbus Release





CWF Boundary Analysis
CVP San Luis Reservoir Storage



California Water Fix

Example Effect of California Water Fix on Upstream Reservoir Storage

August 31, 2016

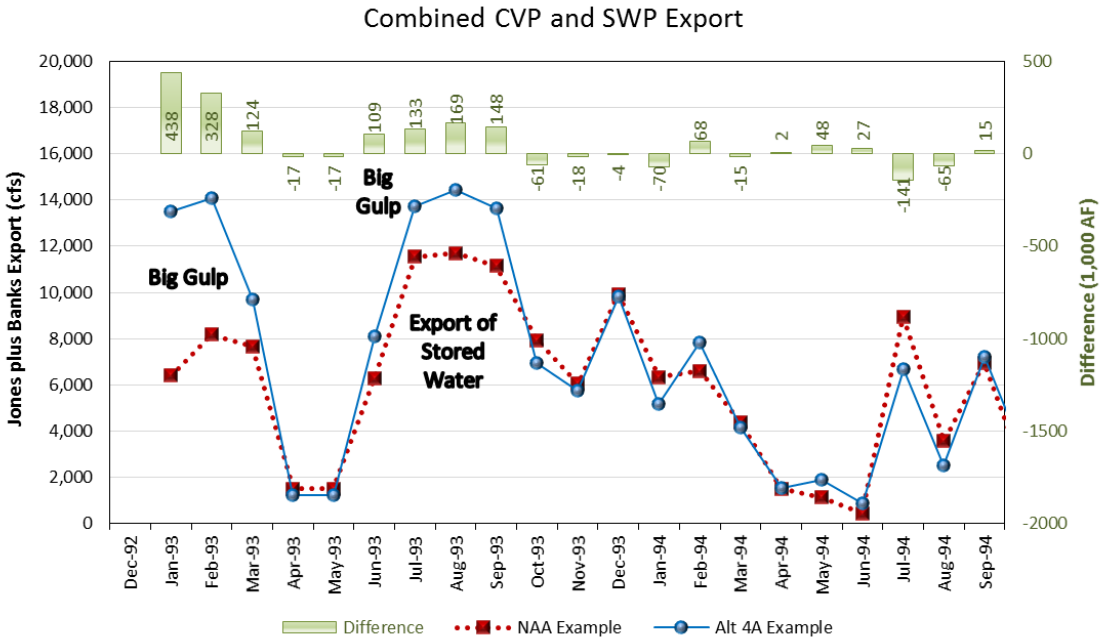
MBK ENGINEERS

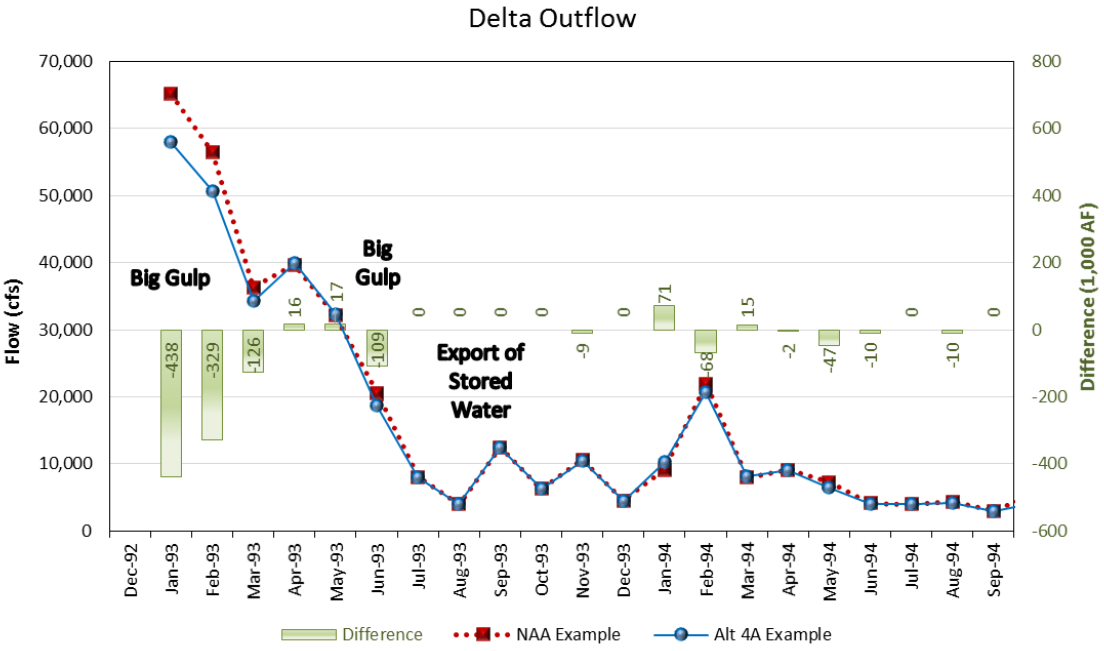
Example Operation

- The purpose of the example is to show how the CWF will enable the CVP and SWP to export additional stored water for delivery in wet years and how that may result in storage impacts in subsequent dry years.
- MBK simulated a two-year CVP/SWP operation from January 1993 to September 1994 both with and without the CWF starting from the same initial conditions.
- 1993 was a wet year and 1994 was a critically dry year.
- The with-project condition was represented by MBK Alternative 4A.
- The without-project condition was represented by MBK NAA.

Example Operation

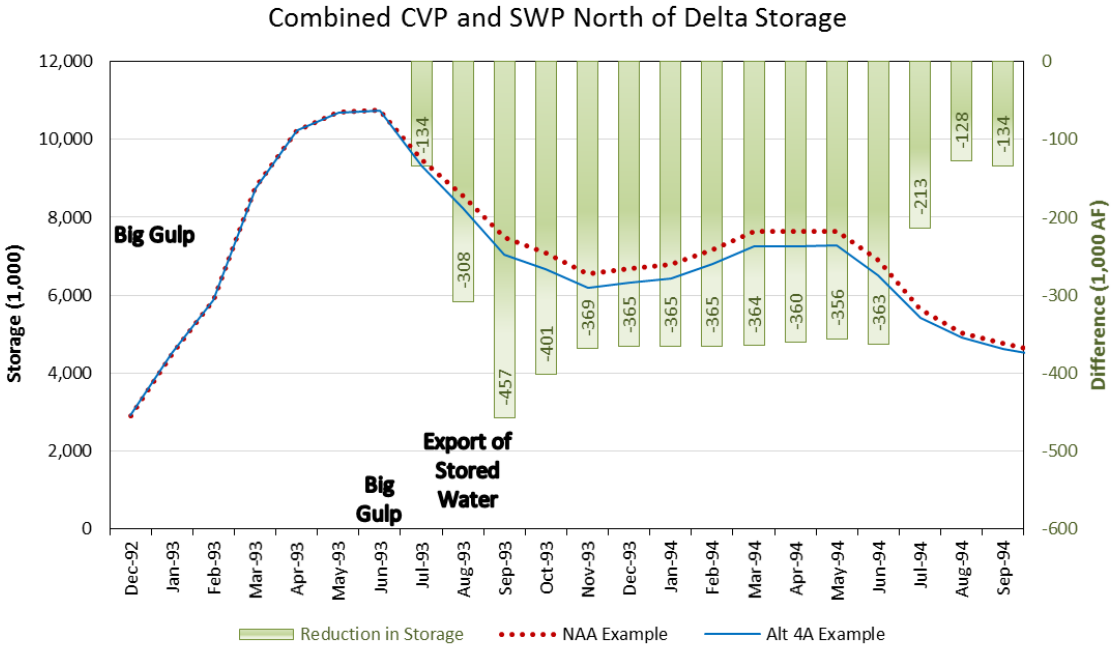
MBK Alternative 4A and MBK NAA

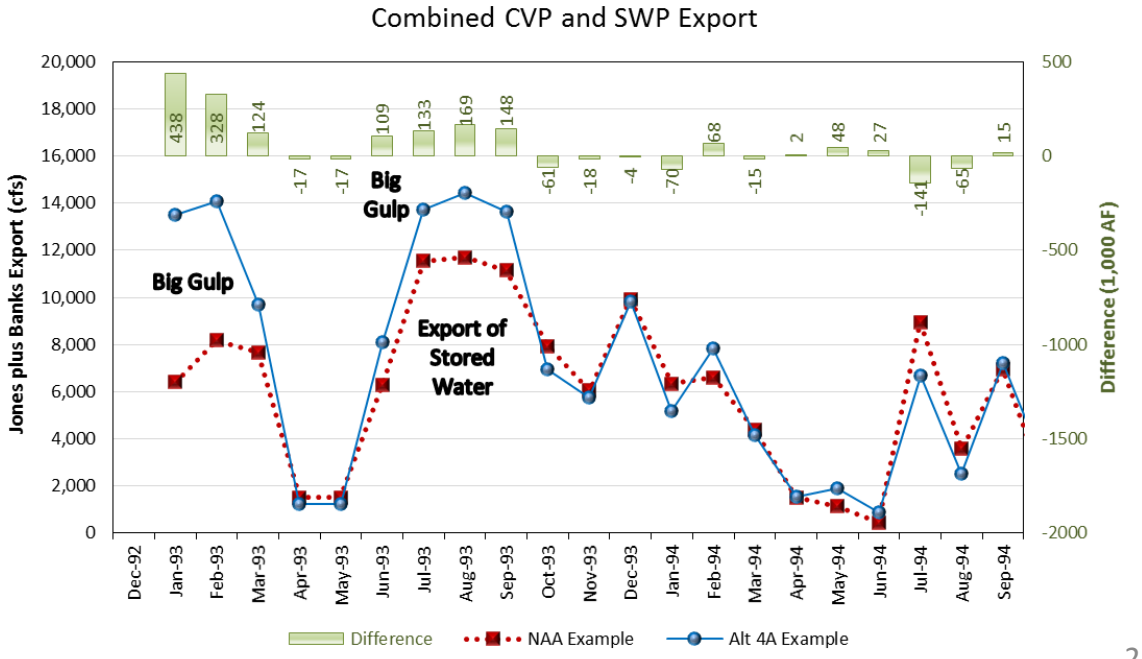




Example Operation

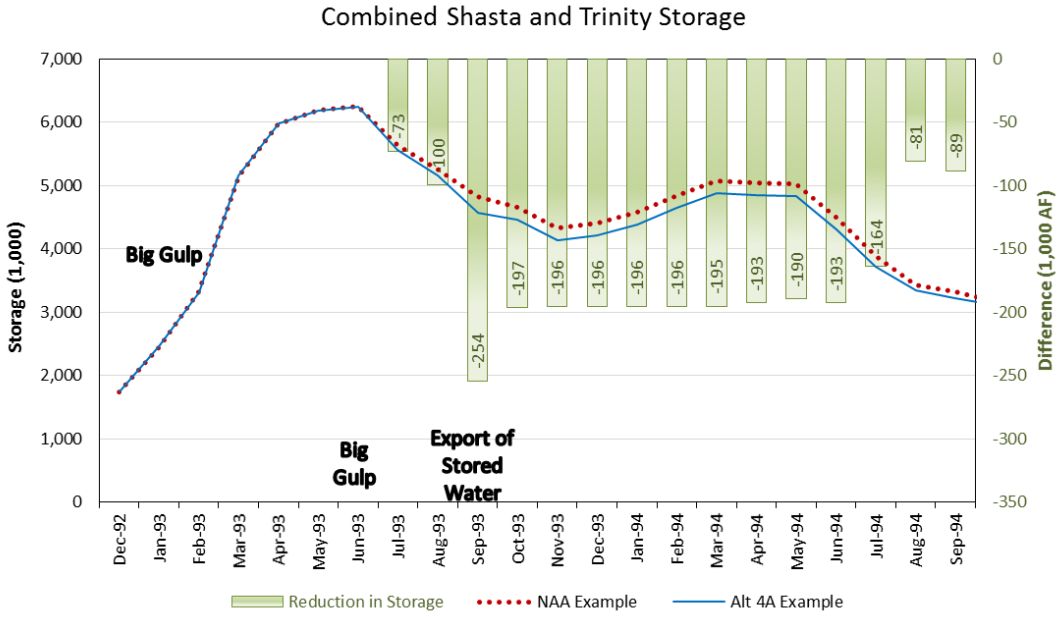
MBK Alternative 4A and MBK NAA

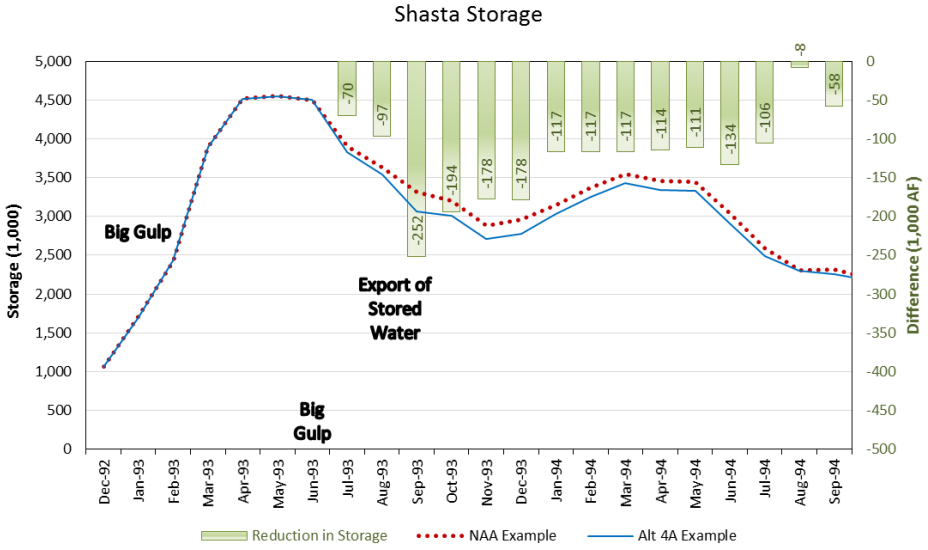


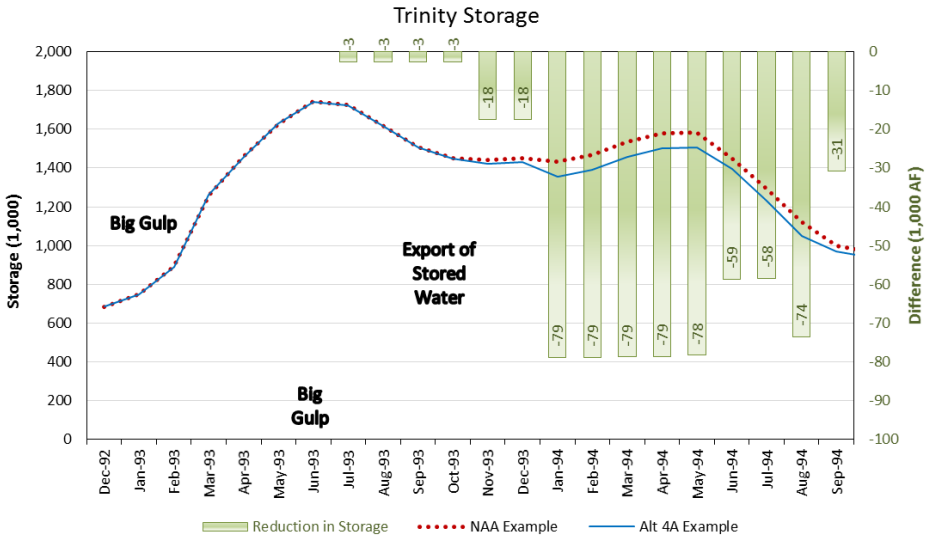


Example Operation

MBK Alternative 4A and MBK NAA

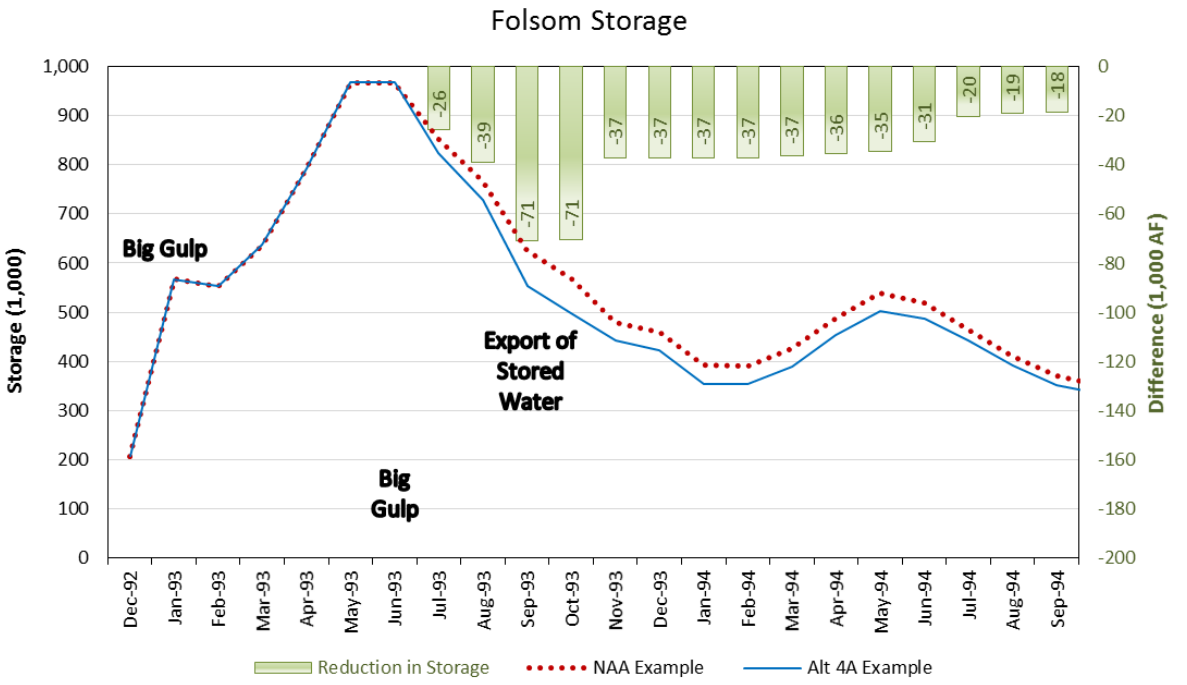


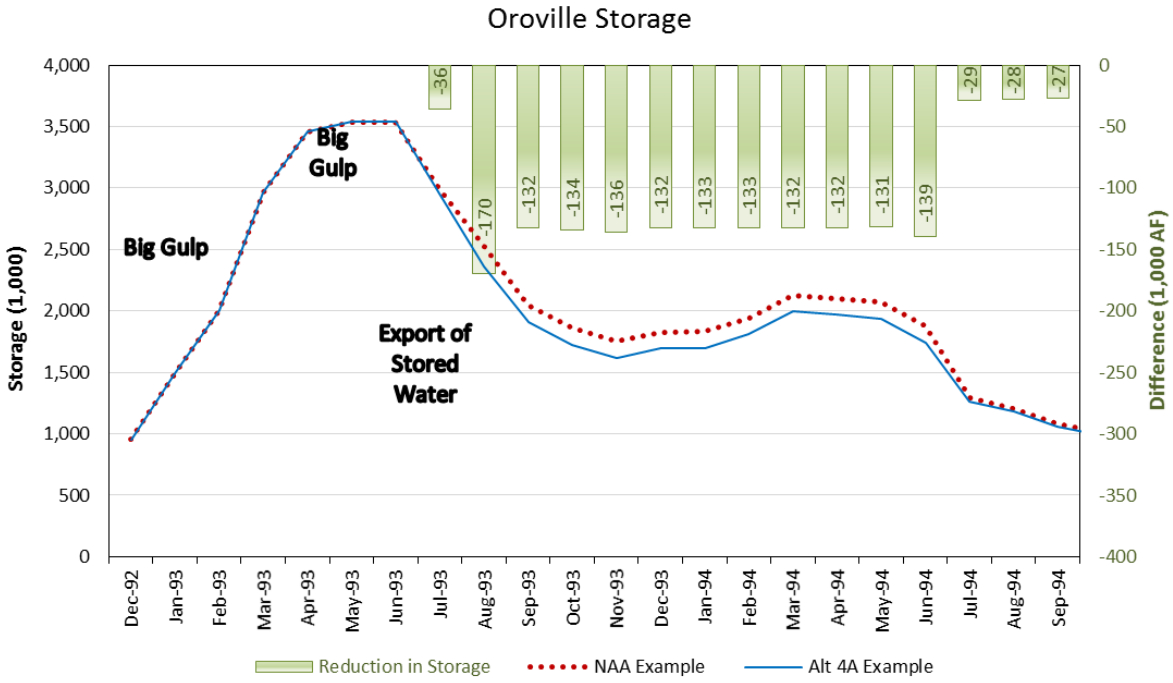




Example Operation

MBK Alternative 4A and MBK NAA





Example Operation - Delivery Summary

		1993			1994		
		NAA	CWF	Difference	NAA	CWF	Difference
CVP South of Delta	Ag	65%	90%	25%	25%	20%	-5%
	M&I	90%	100%	10%	75%	70%	-5%
CVP North of Delta	Ag	100%	100%	0%	25%	20%	-5%
	M&I	100%	100%	0%	75%	70%	-5%
SWP Table A		69%	86%	17%	41%	33%	-8%

- CalSim II does not:
  - Curtail diversions under non-CVP/SWP water rights
  - Alter water supplies for:
    - Sacramento River Settlement Contractors
    - Feather River Service Area Contractors
    - CVP San Joaquin River Exchange Contractors
    - National Wildlife Refuges
  - Impose Term 91 curtailments
- Therefore effects to these water users are based on evaluation of CalSim II output only.

California Water Fix

Previous Technical Reports

2014-2015

MBK ENGINEERS

Technical Reports

- Report on Review of Bay Delta Conservation Program Modeling – June 20, 2014
- Technical Comments on the Bay Delta Conservation Plan/California Water Fix Partially Recirculated Draft EIR/Supplemental Draft EIS – October 28, 2015
- Technical Comments on Coordinated Long-Term Operation of the Central Valley Project and State Water Project Draft Environmental Impact Statement – September 29, 2015

Report on Review of Bay Delta Conservation Program Modeling – June 20, 2014

Findings

- Climate change assumptions were incorrectly applied, yielding non-sensible results.
- Incorporation of climate change ignores reasonably foreseeable adaptation measures.
- BDCP's "High Outflow Scenario" is not sufficiently defined for analysis.
- Simulated operation of BDCP's dual conveyance, coordinating proposed North Delta diversion facilities with existing south Delta diversion facilities, is inconsistent with the project description.
- The BDCP Model contains numerous coding and data issues that significantly skew the analysis and conflict with actual real-time operational objectives and constraints.
- San Luis Reservoir operational assumptions produce results that are inconsistent with real world operations.
- Delta Cross Channel operational assumptions overestimate October outflow.

Technical Comments on the Bay Delta Conservation Plan/California Water Fix Partially Recirculated Draft EIR/Supplemental Draft EIS October 28, 2015

<u>The key findings of MBK's review of the RDEIR/SDEIS are:</u>

a) The description of the proposed project is insufficient for review of modeling analysis;

b) The project description is inconsistent with the RDEIR/SDEIS's modeling analysis; and

c) Issues regarding the modeling analysis that MBK previously identified remain unaddressed.

Assumptions, errors, and outdated tools used in the analysis for the BDCP Draft EIR/EIS remain in the RDEIR/SDEIS and result in impractical or unrealistic modeling of CVP and SWP operations. The use of the modeling analyses from the BDCP Draft EIR/EIS therefore provides limited useful information about the effects of the proposed California Water Fix project.

Technical Comments on Coordinated Long-Term Operation of the Central Valley Project and State Water Project Draft Environmental Impact Statement - September 29, 2015

A portion of the review of the LT Ops DEIS focused on climate change.

This review is applicable to this hearing because the methodology used to develop climate change hydrology in the LT Ops DEIS is the same as that used in modeling analysis for the Bay-Delta Conservation Plan DEIS/EIR and the California Water Fix Revised DEIS/EIR.

Review of the LT Ops DEIS

- Climate change assumptions result in unrealistic modeled operations of the CVP and SWP.

- Including climate change, without adaptation measures, produces model results with insufficient water to meet all regulatory objectives and contractual obligations, and results in CalSim II being operated beyond its usable range.

- Climate change hydrology is applied as changes in modeled inflows to reservoirs represented in CalSim II.
  - This ignores operations of the large CVP and SWP reservoirs upstream of the Delta that should be considered to properly incorporate climate change into CalSim II.

California Water Fix

Modeling Review

August 30, 2016

MBK ENGINEERS

California Water Fix Biological Assessment MBK Modeling Review Report- August 30, 2016

Key Findings

1. DWR/USBR BA Model does not consider the additional capacity that would be made available by the NDD when modeling allocations to South of Delta CVP and SWP contractors.

2. DWR/USBR BA Model includes artificial limits on the modeled use of Joint Point of Diversion.

3. DWR/USBR BA Model changes NOD/SOD reservoir balancing criteria so that less stored water is modeled as being conveyed from NOD reservoirs to San Luis Reservoir during summer months.

4. CalSim II does not address effects to water rights.

5. DWR/USBR BA Model constrains modeled diversions of excess Delta outflows beyond limits described in the CWF BA.

Note: Modeling is the same for the January 2016 Draft BA and July 2016 BA.

MBK Modeling

- No Action Alternative (MBK NAA)
  - With MBK improvements
- Alternative 4A (MBK Alternative 4A)
  - Modeling based on DWR/USBR BA modeling
  - Spring outflow met through export constraints
- Alternative 4A (MBK Alternative 4A-DO)
  - Modeling based on BA description
  - Spring outflow imposed as minimum required Delta outflow met through export reductions or upstream reservoir releases

California Water Fix Biological Assessment
MBK Modeling Review Report- August 30, 2016

MBK improvements to DWR/USBR CalSim II modeling

MBK NAA

- 12 key changes made to the USBR/DWR BA NAA

MBK Alternative 4A

- 8 additional key changes made to evaluate the CWF based on the USBR/DWR BA modeling

MBK Alternative 4A-DO

- 6 additional key changes made to evaluate the CWF as described in the CWF BA

Summary of Annual Average Differences in Modeling Results

	USBR/DWR BA	MBK modeling based on BA modeling		MBK modeling based on BA description	
	Alternative 4A minus NAA	Alternative 4A minus NAA	Difference from USBR/DWR	Alternative 4A DO minus NAA	Difference from USBR/DWR
Change in total Delta exports	226	491	*265*	661	*435*
North Delta Diversion	2560	2968	*408*	3156	*596*
Change in South Delta Diversion	-2334	-2477	*-143*	-2495	*-161*
Change in Delta outflow	-241	-464	*-223*	-622	*-381*
Change in Shasta carryover	25	-111	*-136*	-131	*-156*
Change in Folsom carryover	-11	-37	*-26*	-29	*-18*
Change in Oroville carryover	89	-74	*-163*	-86	*-175*
Change in CVP delivery	-11	177	*188*	208	*219*
Change in SWP delivery	216	270	*54*	392	*176*

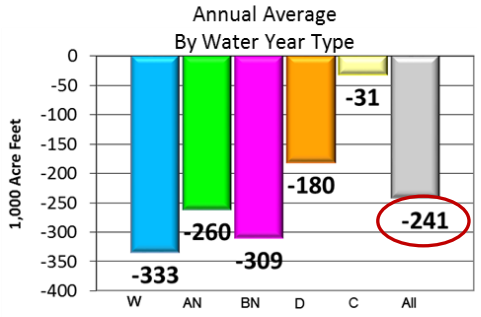
All Values are in 1,000 acre feet

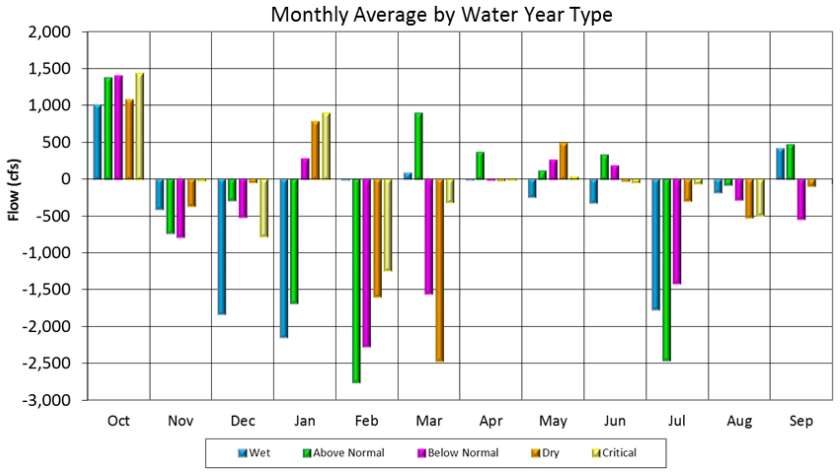
Delta Outflow – Alternative 4A

DWR/USBR Model and MBK Model

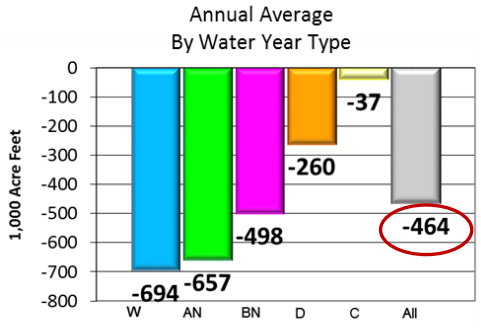
(Alternative 4A minus NAA)

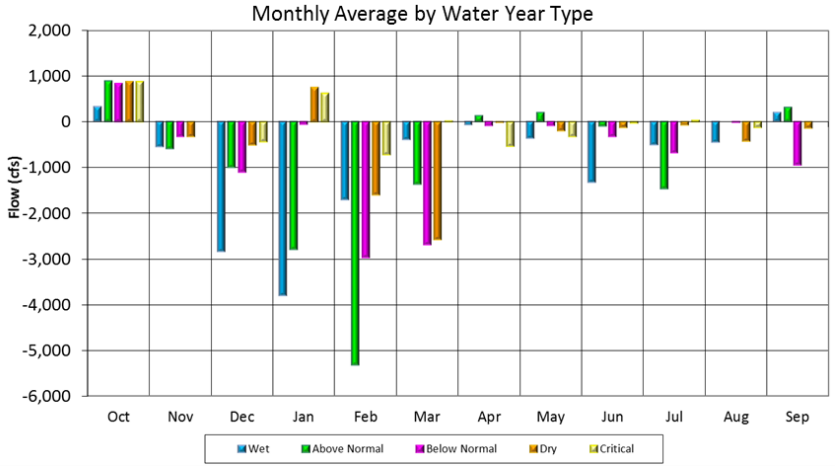
DWR/USBR Model





MBK Model Alt 4A



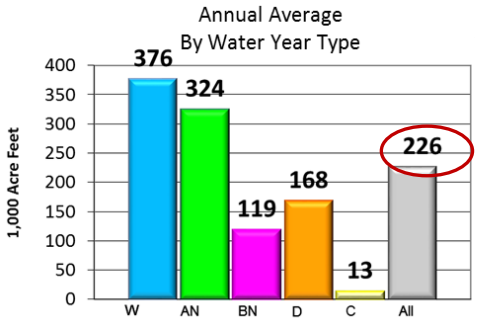


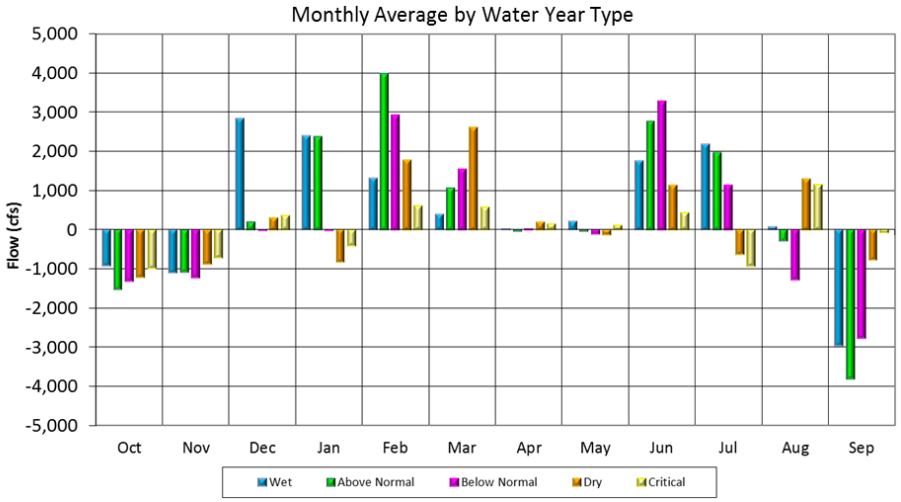
Delta Exports (Jones and Banks)– Alternative 4A

DWR/USBR Model and MBK Model

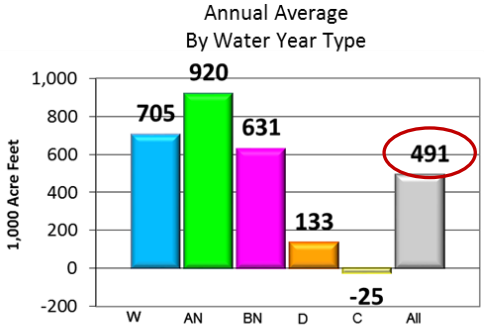
(Alternative 4A minus NAA)

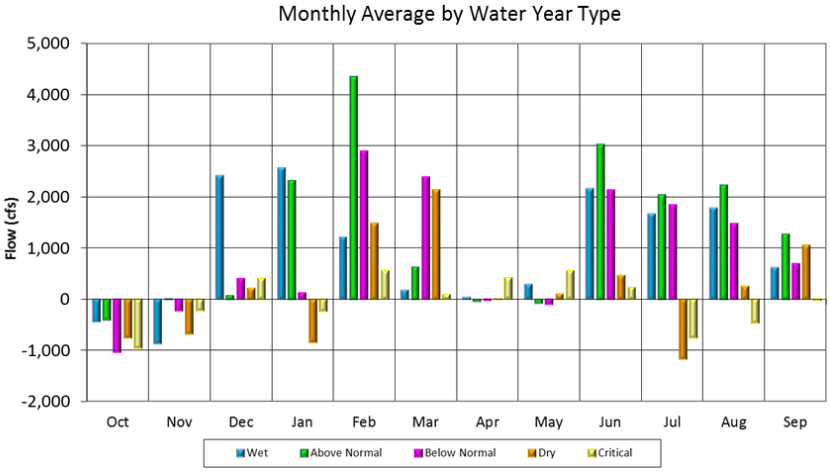
DWR/USBR Model





MBK Model Alt 4A

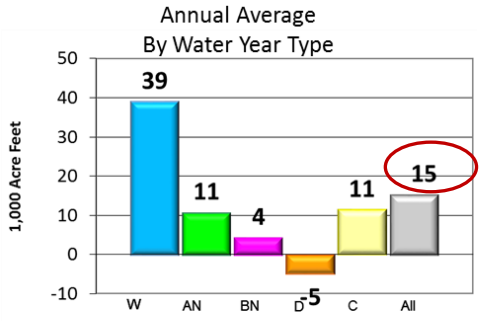


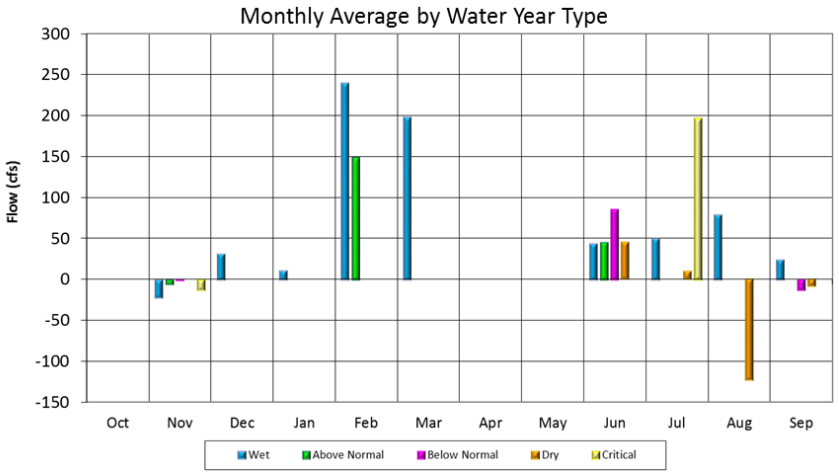


Delta Exports Using JPOD– Alternative 4A
DWR/USBR Model and MBK Model

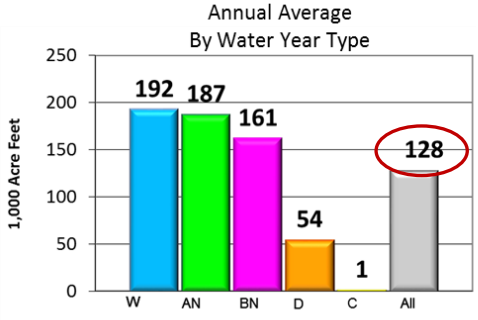
(Alternative 4A minus NAA)

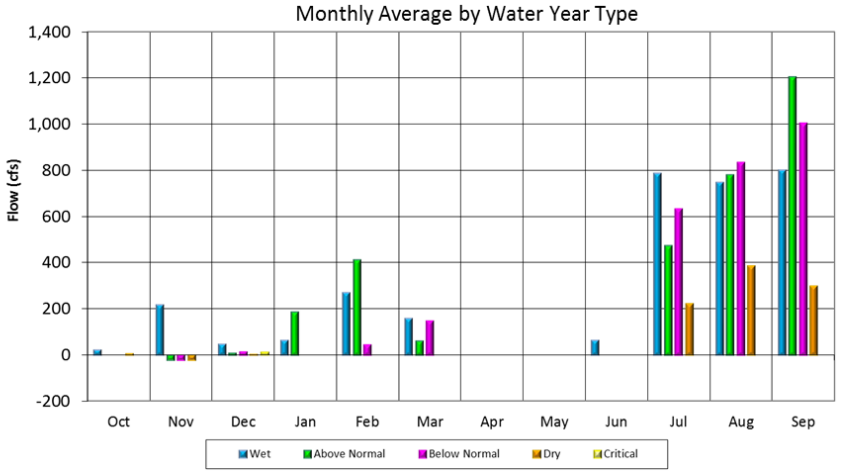
DWR/USBR Model





MBK Model Alt 4A

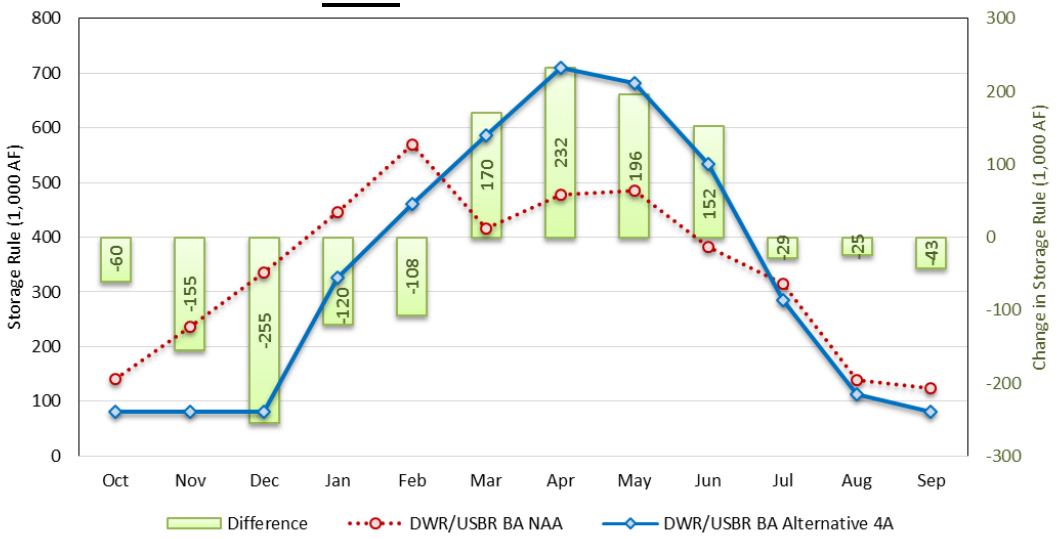




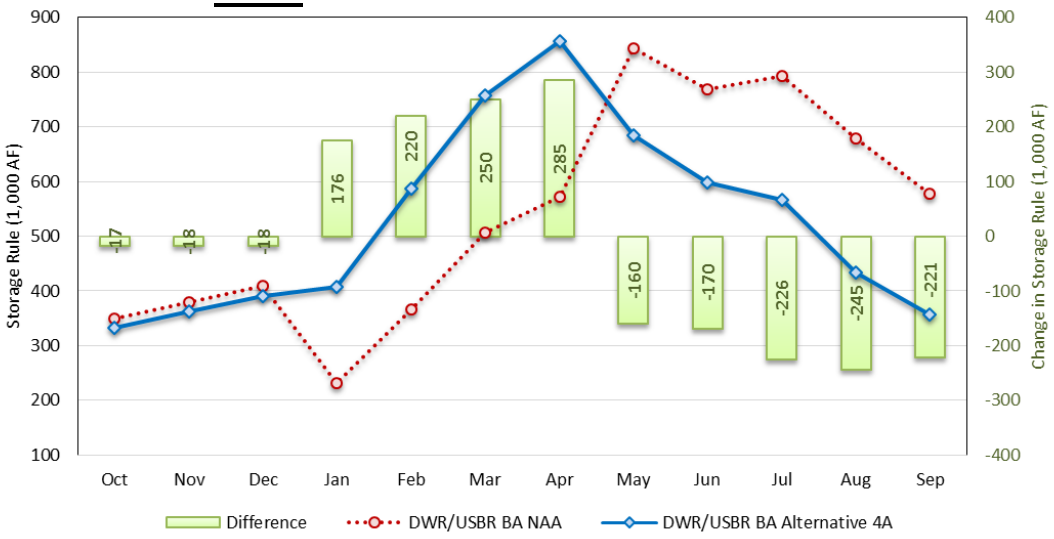
San Luis Rulecurves
DWR/USBR Alternative 4A

DWR/USBR Model

CVP San Luis Rulecurve



SWP San Luis Rulecurve

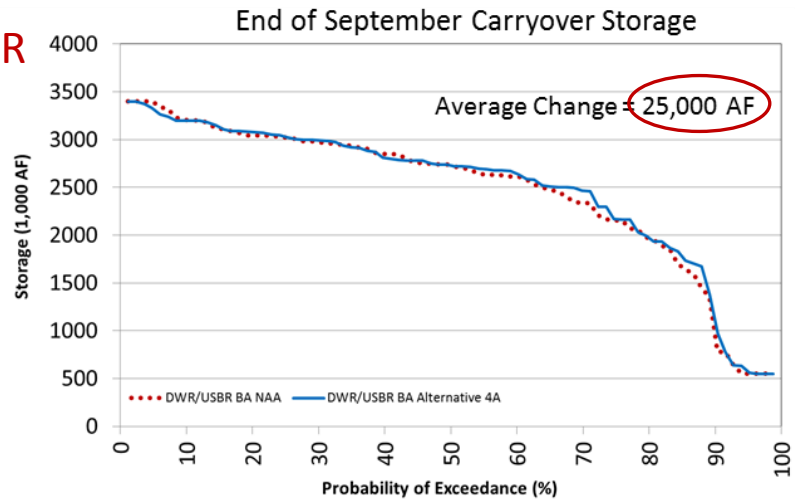


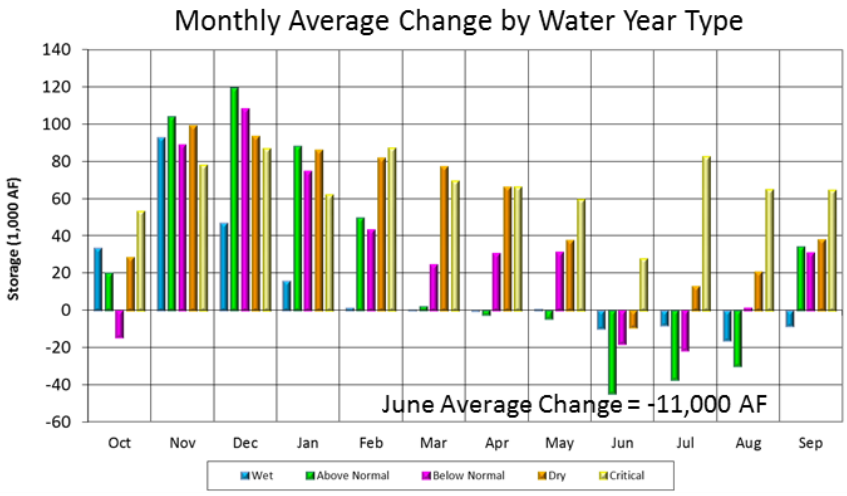
Shasta Storage – Alternative 4A

DWR/USBR Model and MBK Model

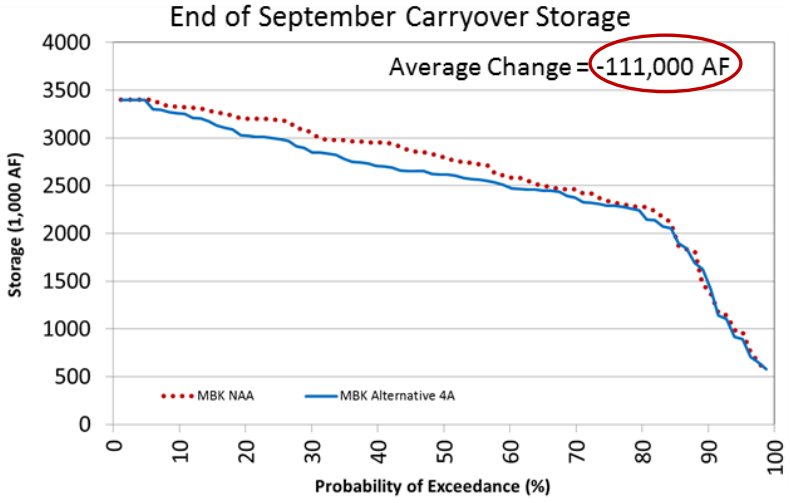
(Alternative 4A minus NAA)

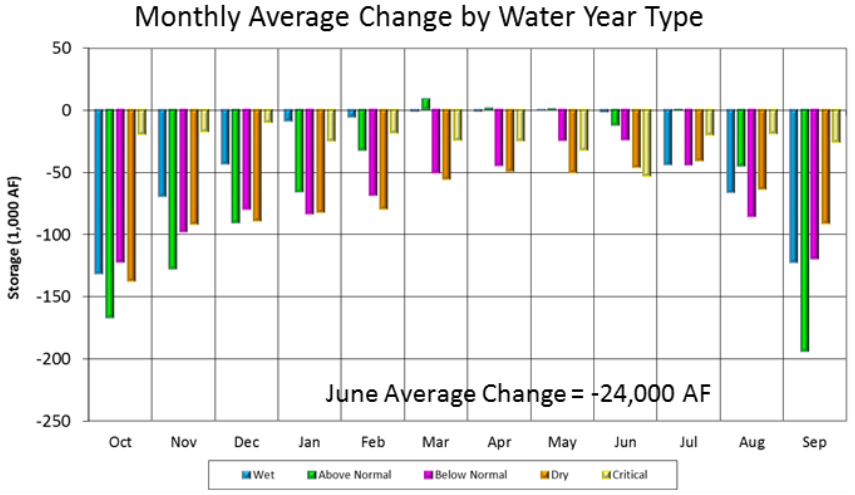
DWR/USBR Model





MBK Model Alt 4A



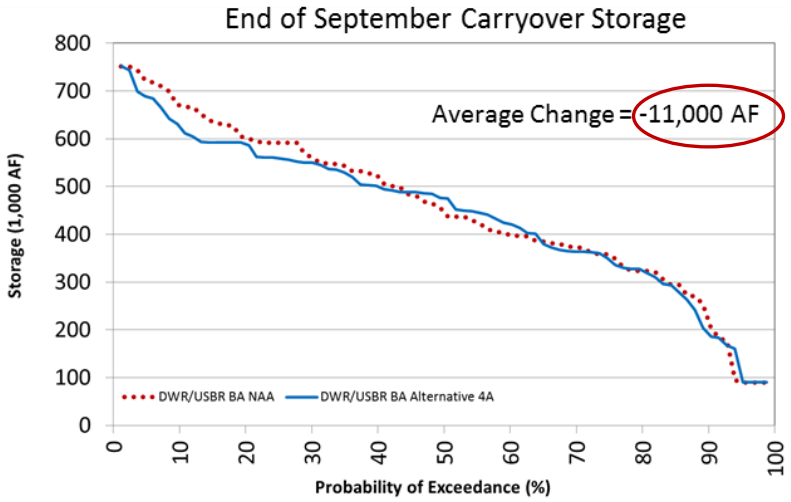


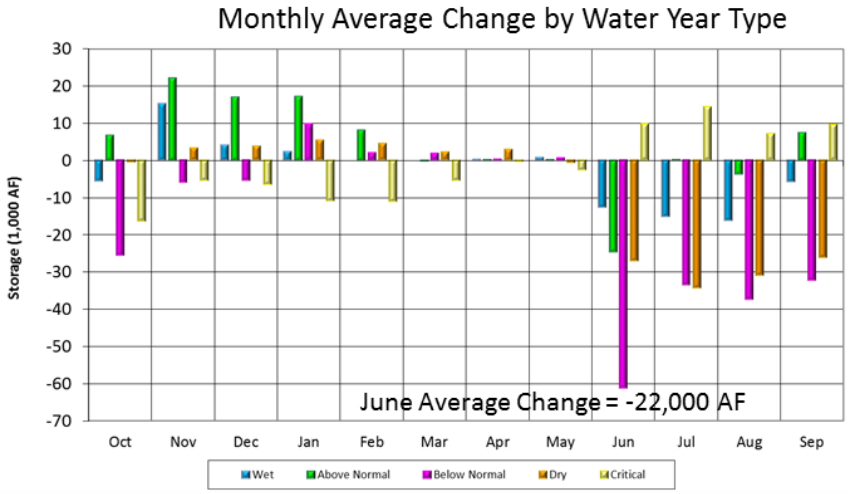
Folsom Storage – Alternative 4A

DWR/USBR Model and MBK Model

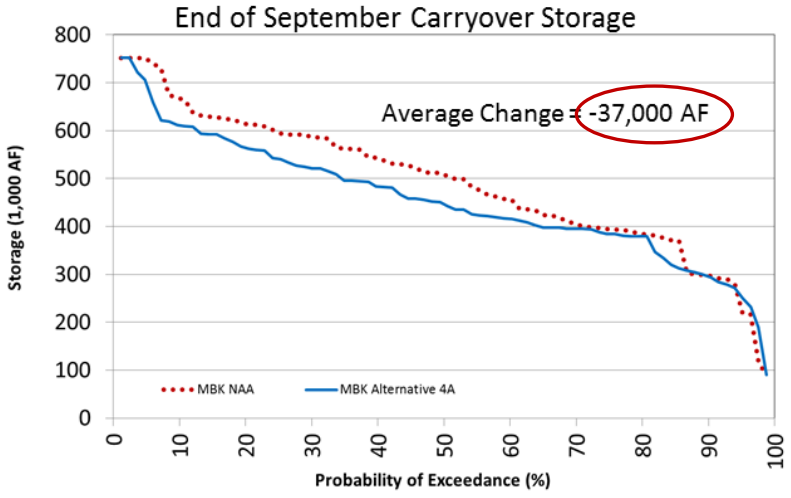
(Alternative 4A minus NAA)

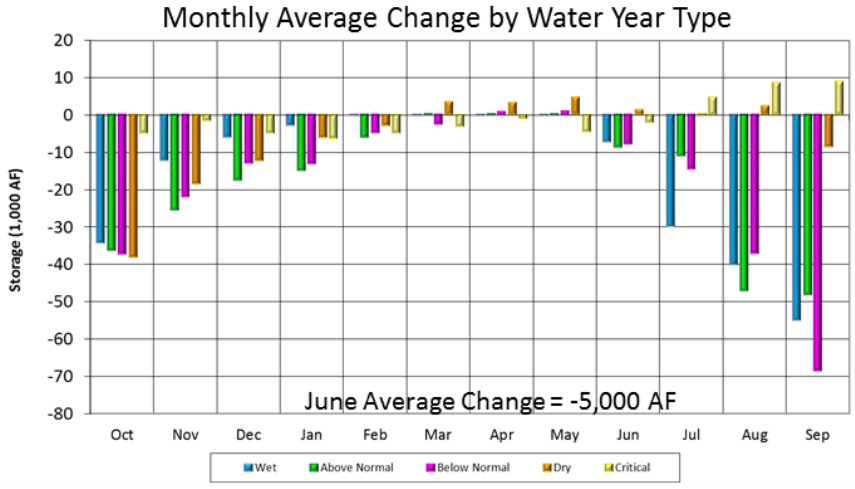
DWR/USBR Model





MBK Model Alt 4A



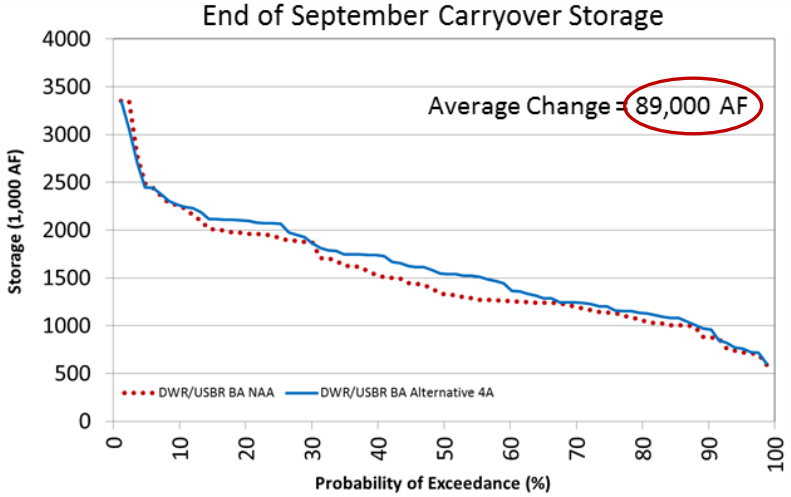


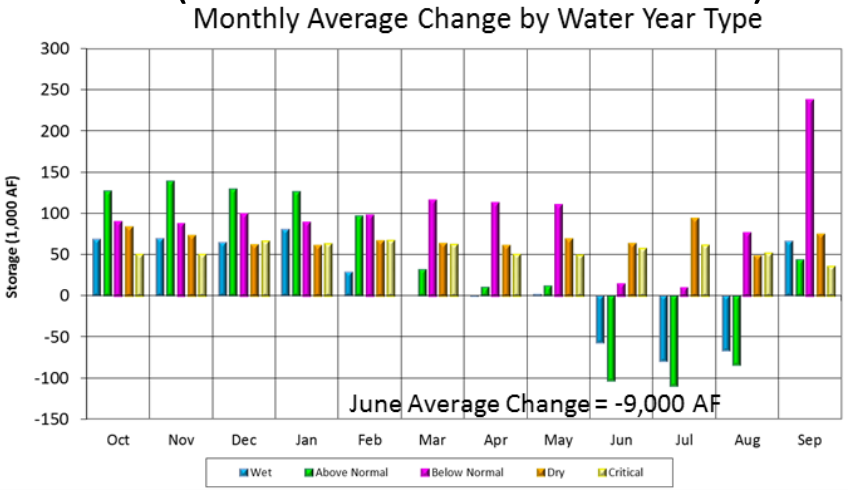
Oroville Storage – Alternative 4A

DWR/USBR Model and MBK Model

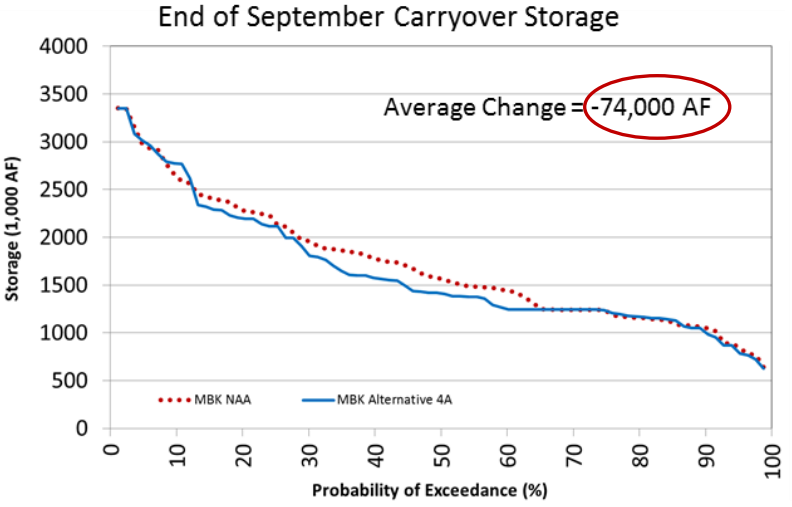
(Alternative 4A minus NAA)

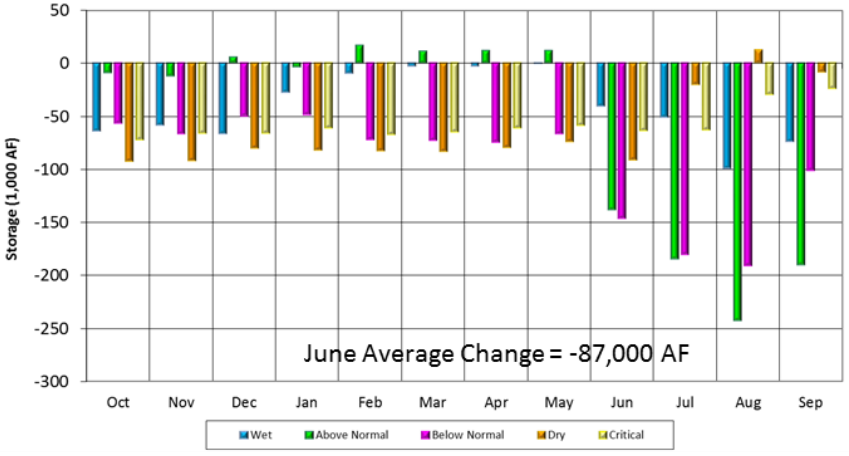
DWR/USBR Model





MBK Model Alt 4A





Change in CVP Delivery – Alternative 4A
DWR/USBR Model and MBK Model

DWR/USBR Model

Average Annual Change in CVP Delivery by Water Year Type DWR/USBR BA Alternative 4A minus DWR/USBR BA NAA

	North of Delta					South of Delta					North + South
	Ag Service	M&I Service	Settlement	Refuge	**Total**	Ag Service	M&I Service	Exchange	Refuge	**Total**	**Total**
All Years	2	1	-1	0	1	-13	1	0	0	-12	-11
Wet	-2	-1	-1	0	-4	-27	-1	0	0	-28	-31
Abv. Norm	2	4	0	0	5	-10	1	0	0	-9	-4
Blw. Norm	-4	-3	0	0	-8	-40	-1	0	0	-41	-49
Dry	11	3	0	0	14	23	4	0	-1	27	41
Critical	3	1	-7	0	-3	-9	1	0	1	-6	-9

All Values are in 1,000 acre feet

MBK Model Alt 4A

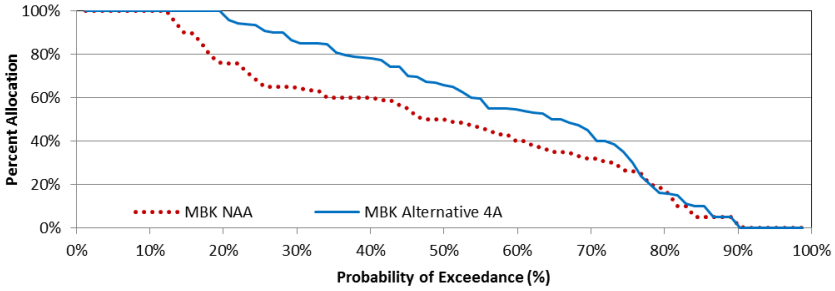
Difference in Average Annual CVP Delivery by Water Year Type - MBK Alternative 4A minus MBK NAA

	North of Delta					South of Delta					North + South
	Ag Service	M&I Service	Settlement	Refuge	**Total**	Ag Service	M&I Service	Exchange	Refuge	**Total**	**Total**
All Years	-14	-2	0	0	-16	186	7	0	0	193	177
Wet	1	0	0	0	0	212	6	0	0	218	219
Abv. Norm	-13	0	0	0	-14	248	10	0	0	258	244
Blw. Norm	-62	-10	0	0	-72	285	13	0	0	298	226
Dry	-8	-1	0	0	-9	140	5	0	0	145	136
Critical	2	1	0	0	3	5	0	0	-2	4	7

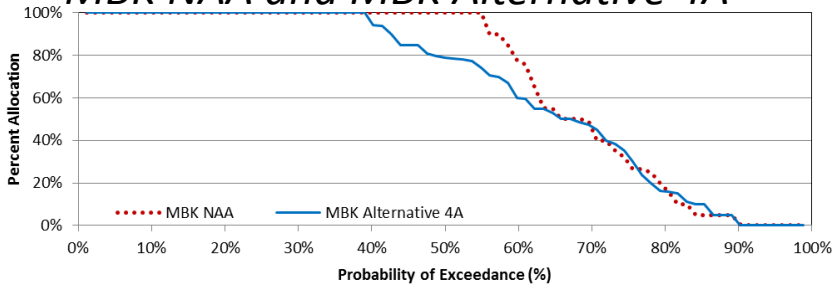
All Values are in 1,000 acre feet

CVP Agricultural Service Contractor Allocation

CVP South of Delta Agricultural Allocation
MBK NAA and MBK Alternative 4A

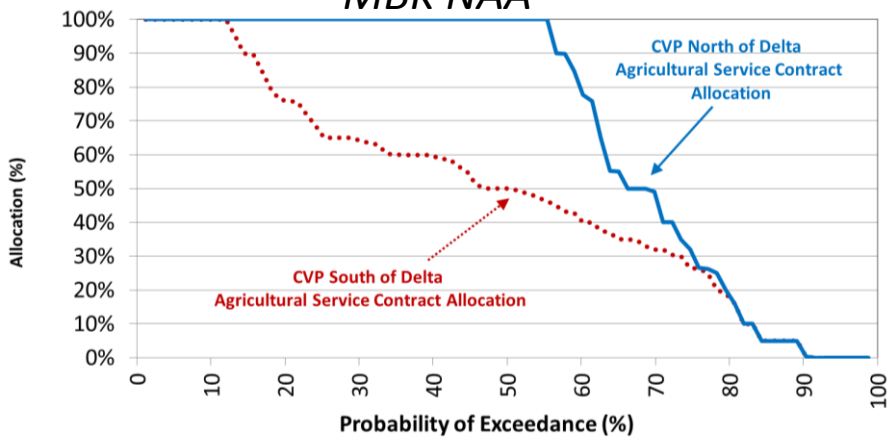


CVP North of Delta Agricultural Allocation
MBK NAA and MBK Alternative 4A

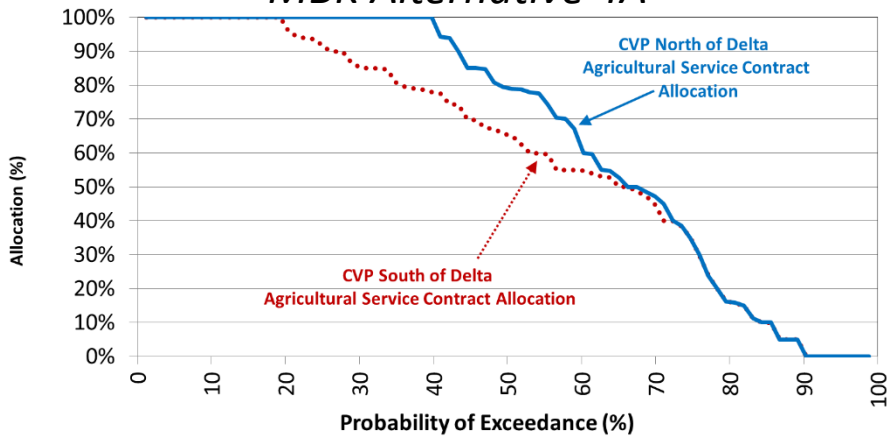


North of Delta versus South of Delta

MBK NAA



MBK Alternative 4A



Change in SWP Delivery – Alternative 4A
DWR/USBR Model and MBK Model

DWR/USBR Model

Average Annual Change in SWP Delivery by Water Year Type
DWR/USBR BA Alternative 4A minus DWR/USBR BA NAA

	Table A	Article 21	Article 56	Total
All Years	126	84	6	216
Wet	161	166	17	344
Abv. Norm	102	79	9	190
Blw. Norm	176	66	-3	240
Dry	168	37	-1	204
Critical	-57	-2	0	-59

All Values are in 1,000 acre feet

MBK Model Alt 4A

Average Annual Change in SWP Delivery by Water Year Type
MBK Alternative 4A minus MBK NAA

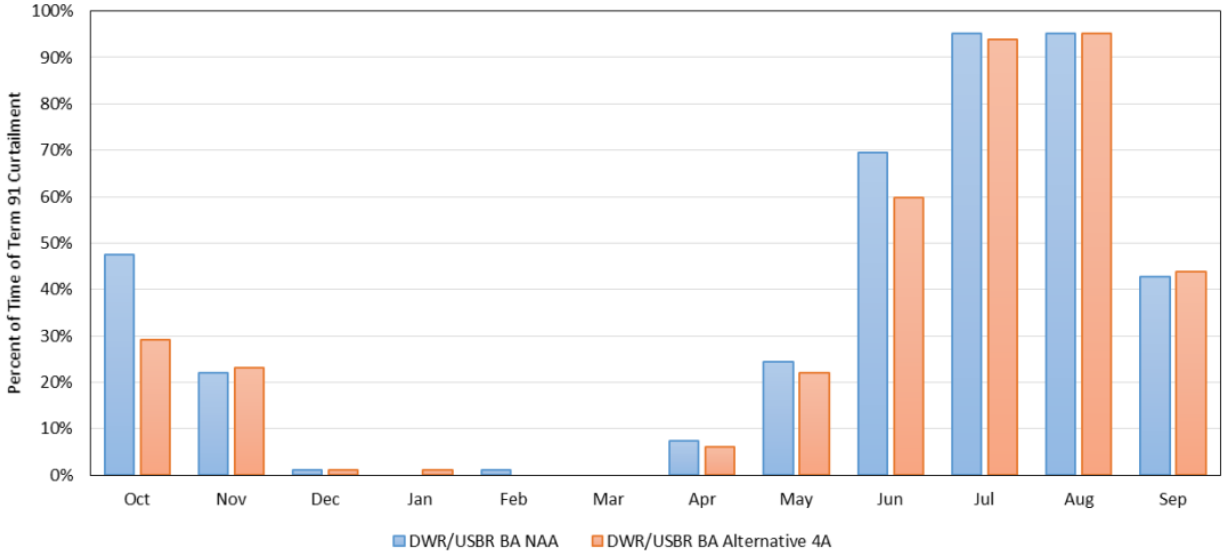
	Table A	Article 21	Article 56	Total
All Years	183	61	27	270
Wet	304	117	25	446
Abv. Norm	295	96	26	417
Blw. Norm	311	24	35	371
Dry	-5	25	37	57
Critical	-78	-2	5	-74

All Values are in 1,000 acre feet

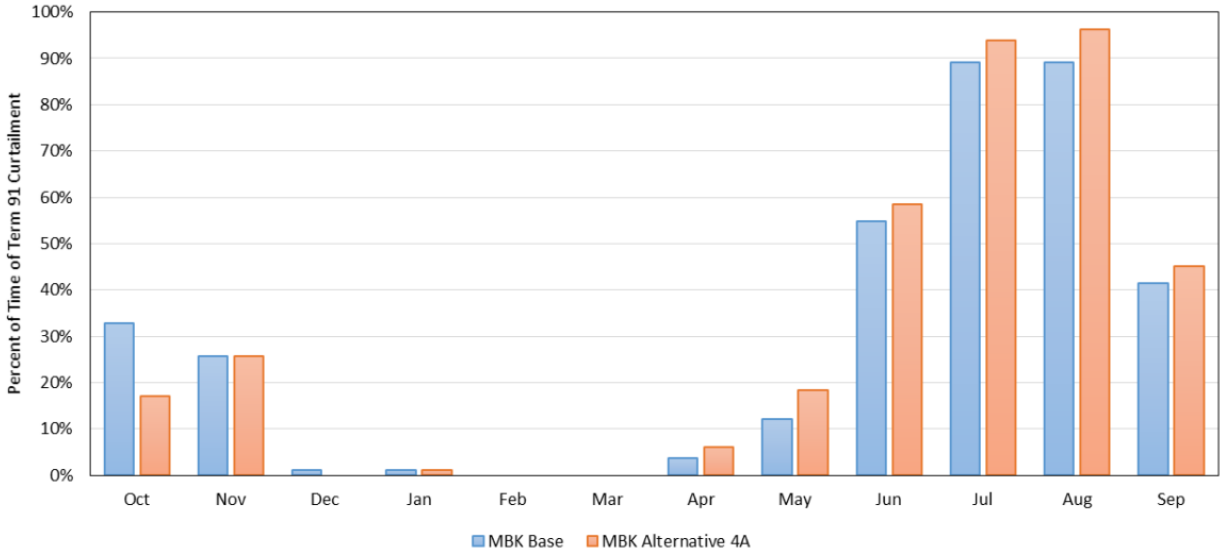
Frequency of Term 91 Curtailments – Alternative 4A

DWR/USBR Model and MBK Model

DWR/USBR Model

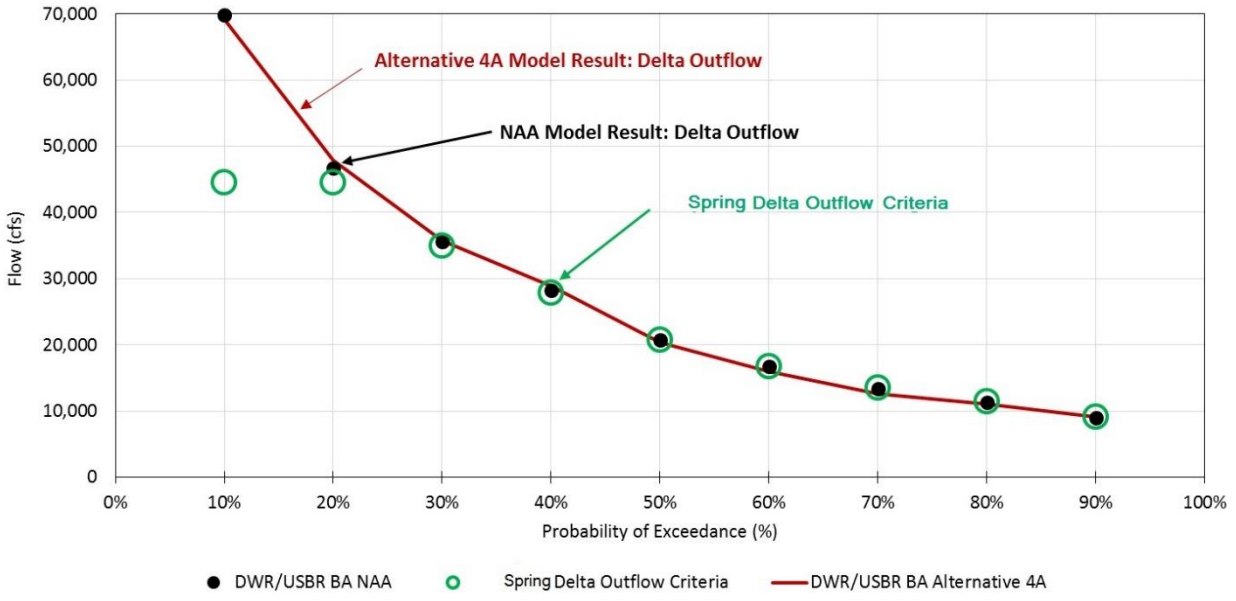


MBK Model Alt 4A

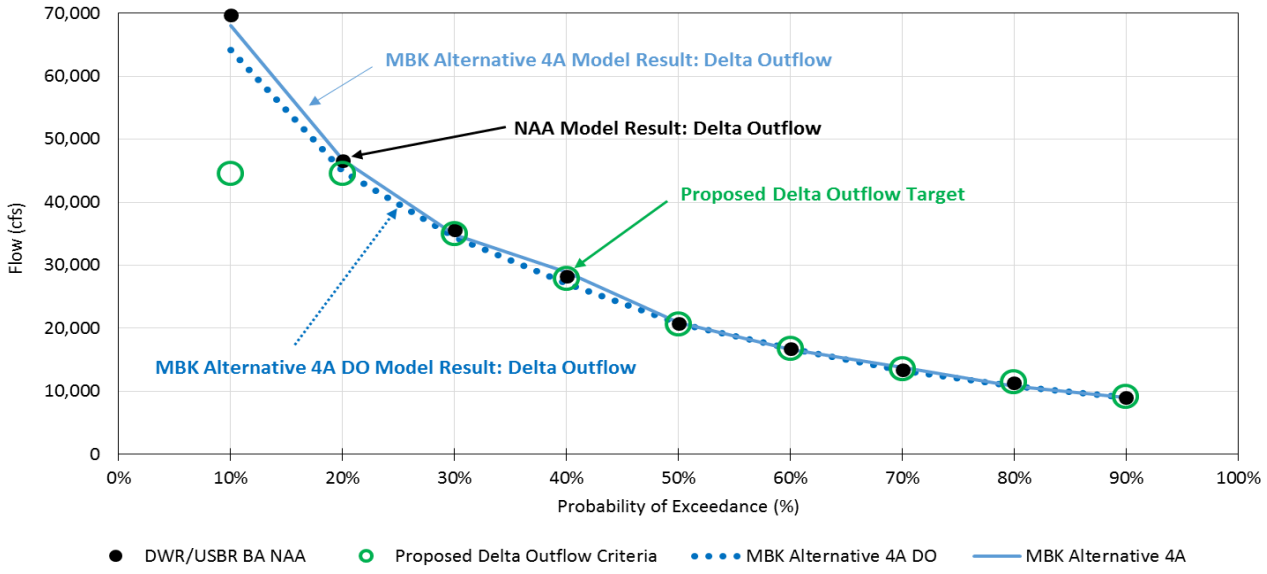


Comparison of BA Delta Outflow Criteria and Results

DWR/USBR Model



MBK Alt 4A and MBK Alt 4A DO Models

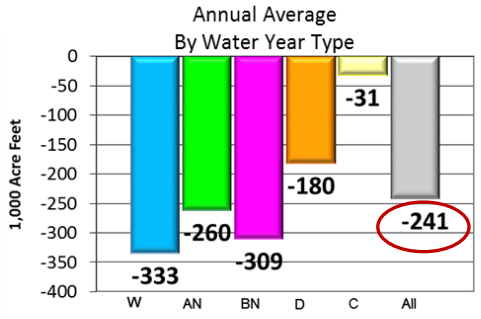


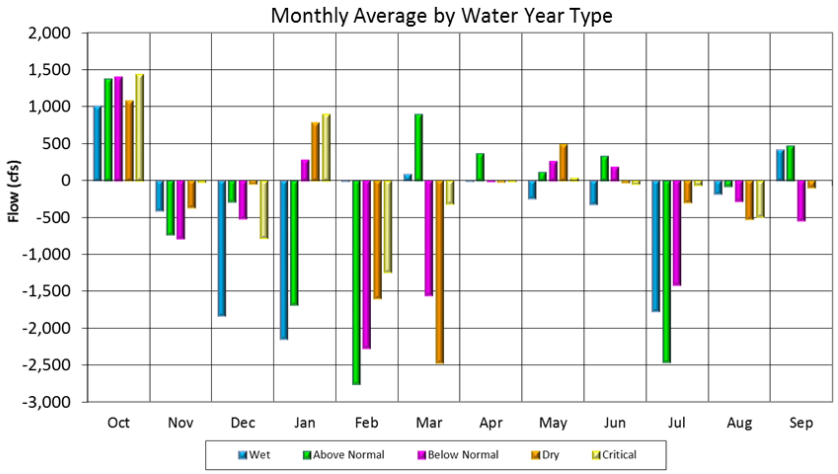
Delta Outflow – Alternative 4A

DWR/USBR Model and MBK Model Using BA Description

DWR/USBR Model

(Alternative 4A minus NAA)

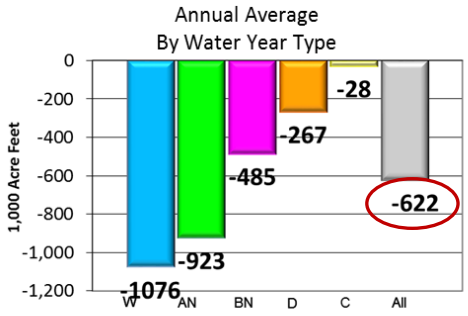


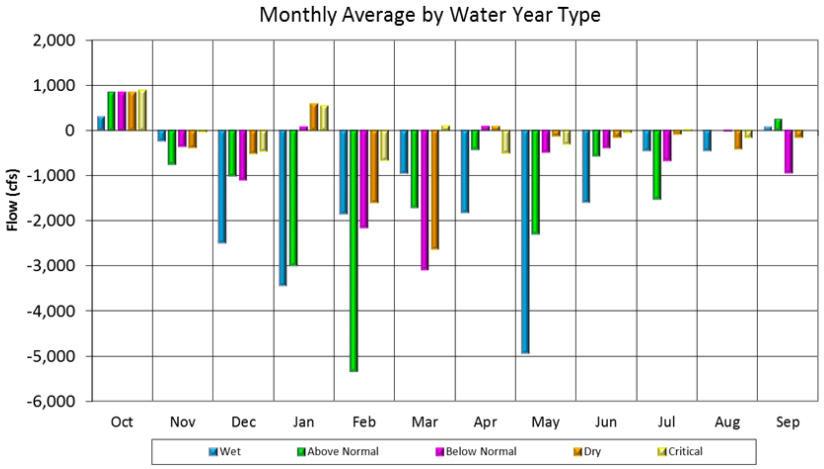


MBK Alt 4A DO Model

DO: Delta Outflow

(Alternative 4A DO minus NAA)

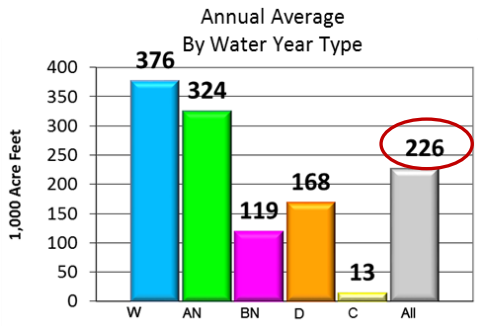


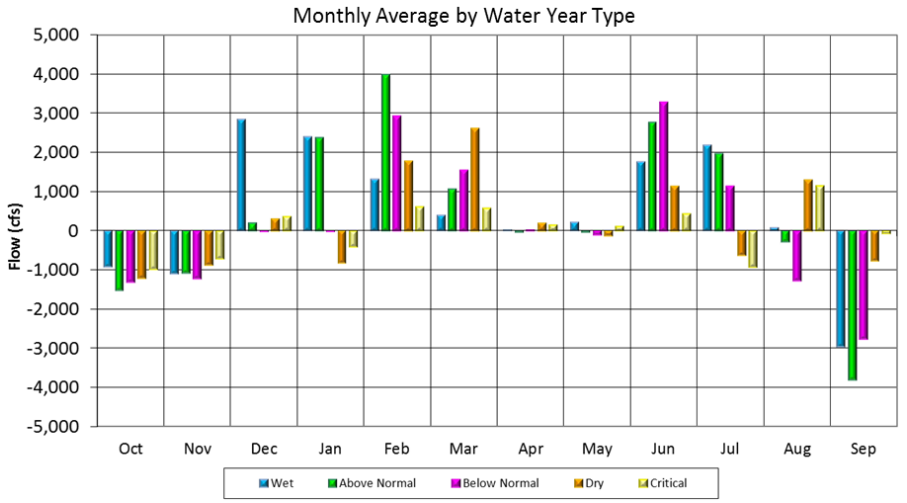


Delta Exports (Jones and Banks)– Alternative 4A
DWR/USBR Model and MBK Model with DO

DWR/USBR Model

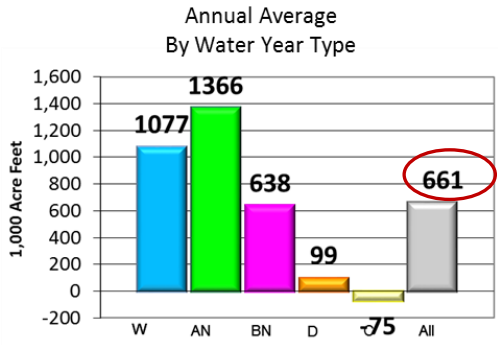
(Alternative 4A minus NAA)

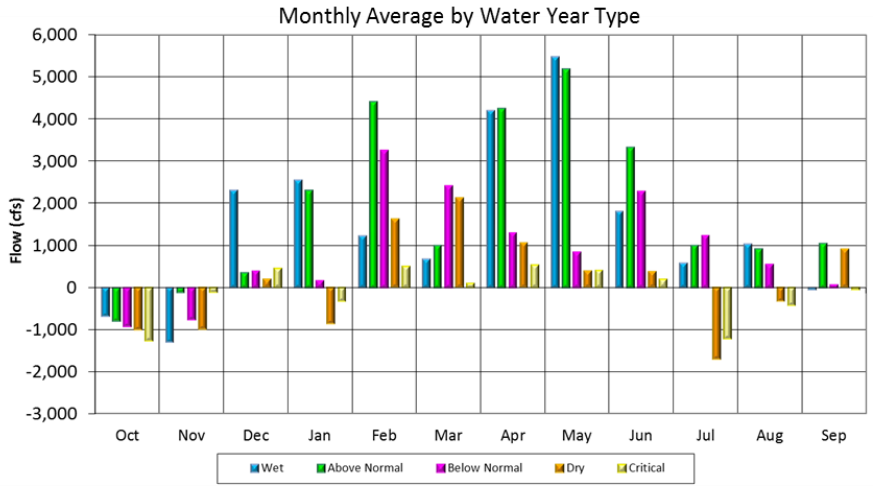




MBK Alt 4A DO Model

(Alternative 4A DO minus NAA)





Summary of Annual Average Differences in Modeling Results

	USBR/DWR BA	MBK modeling based on BA modeling		MBK modeling based on BA description	
	Alternative 4A minus NAA	Alternative 4A minus NAA	Difference from USBR/DWR	Alternative 4A DO minus NAA	Difference from USBR/DWR
Change in total Delta exports	226	491	*265*	661	*435*
North Delta Diversion	2560	2968	*408*	3156	*596*
Change in South Delta Diversion	-2334	-2477	*-143*	-2495	*-161*
Change in Delta outflow	-241	-464	*-223*	-622	*-381*
Change in Shasta carryover	25	-111	*-136*	-131	*-156*
Change in Folsom carryover	-11	-37	*-26*	-29	*-18*
Change in Oroville carryover	89	-74	*-163*	-86	*-175*
Change in CVP delivery	-11	177	*188*	208	*219*
Change in SWP delivery	216	270	*54*	392	*176*

All Values are in 1,000 acre feet