Appendix 5G

Comparison of FEIRS Alternative 4A Modeling Results to the California Water Fix Section BA Proposed Action Modeling Results

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5G.1 Introduction

As noted in the Appendix 5F, the BDCP/CWF Final EIR/EIS (FEIRS) included new modeling conducted for the Alternative 4A at ELT with modeling assumptions matching the description of the Proposed Action under California Water Fix Section 7 Biological Assessment (BA) (USBR and DWR, 2016). For the FEIRS, Alternative 4A was simulated based on the 2010 version of CALSIM II for consistency with remaining EIRS Alternatives and to confirm the reported RDEIR/SDEIS CEQA/NEPA determinations. The purpose of this appendix is to provide a comparison of the FIERS Alternative 4A to the CWF BA Proposed Action. The simulated changes in CVP/SWP operations under Alternative 4A with respect to the No Action Alternative under the FEIRS are compared to the simulated changes under the CWF BA Proposed Action with respect to the base model (aka, No Action Alternative) under the CWF BA. Both the FEIRS and CWF BA modeling were analyzed at Early Long-Term (ELT). ELT timeframe represents about year 2030, and the Alternatives and the No Action Alternative evaluated at ELT assumed to include projected climate change effects and a sea level rise of 15 cm. Appendix 5A includes a detailed description of the ELT assumptions, and the approach used to account for the climate change and sea level rise effects. This appendix includes a summary of the key differences in the FEIRS and CWF BA modeling, and provides a narrative summary of the key findings for Alternative 4A based on the two versions of CALSIM II and DSM2 modeling results.

5G.2 Overview of Differences in FEIRS and CWF BA Modeling

The DEIRS and REIR/SEIS Alternatives were modeled based on the April 1st, 2010 benchmark version of the CALSIM II (2010 CALSIM II), which was developed by DWR and USBR in coordination with the USFWS, NMFS and CDFW to incorporate the 2008 USFWS Smelt BiOp and 2009 NMFS Salmon BiOp.

At the beginning of 2015, DWR and Reclamation adopted the alternative implementation strategy to achieve federal and state endangered species act compliance using a shorter project implementation period through the “Section 7” process under the federal ESA, and the “Section 2081(b)” process under CESA. The Section 7 Consultation Team (SCT) comprising of representatives from Reclamation, DWR, USFWS, NMFS and CDFW formed to oversee the development of the BA, decided to use the most recent versions of the models available in early 2015 for the BA. Therefore, the BA modeling was based on the January 27th, 2015 benchmark version of the CALSIM II model (2015 CALSIM II) from Reclamation. Table 5G-1 summarizes the model versions used in the RDEIR/SDEIS, the CWF BA and the FEIRS.

Both, 2010 and 2015 versions of the CALSIM II represent the current regulatory requirements including the 2008 and 2009 BiOps. 2015 version included several updates related to any new information available for facilities, better implementation of the operational constraints, and other improvements from Reclamation, DWR and other experts. Below is a list of key changes in the 2015 version of the CALSIM II compared to the 2010 version.

- Sacramento River Updates:
  - Added Feather River rice decomposition demands and return flows
  - Added Fremont Weir Notch
  - Modified American River and Sacramento River demand assumptions
  - Added Folsom flood control improvements
  - Modified American River Flow Management Standard (FMS) implementation
- Delta:
  - Added Los Vaqueros Expansion
  - Modified export-Inflow ratio, Hood minimum instream flow, and COA sharing between CVP and SWP
  - Modified health and safety pumping limits
- San Joaquin River:
  - Stanislaus River and New Melones Operations consistent with 2008/2009 BiOps
  - Removed Vernalis Adaptive Management Program (VAMP)
- South-of-Delta (SOD) SOD SWP demand assumptions
- Updated climate change inputs
- Model refinements to better reflect new or updated information available on the ongoing operations and programs
- Other general model improvements and software updates

Table 5G-1. Summary of the Models Used for the RDEIR/SDEIS, the CWF Section 7 BA and the FEIRS

	RDEIR/SDEIS Surrogate Models	CWF Section 7 BA Models	Final EIR/EIS Models
No Action Alternative	2010 DEIRS No Action Alternative at ELT	2015 No Action Alternative at ELT	2010 DEIRS No Action Alternative at ELT with Fremont Weir updates noted in Table 5G-2
Alternative 4A	Modeled as a range between 2010 DEIRS Alternative 4 H3 and H4 at ELT	Proposed Action modeled based on the 2015 No Action Alternative at ELT	2010 DEIRS Alternative 4 H3 at ELT updated for Alternative 4A assumptions noted in Table 5G-3

For modeling of the Delta hydrodynamics and salinity changes under Alternative 4A same version of the DSM2 (version 8.0.6) was used under the FEIRS and the CWF BA. However, under the CWF BA, DSM2 was simulated for the 82-year period (water year 1922 – 2003) compared to the 16-year period (water years 1976 – 1991) simulation under the FEIRS.

5G.3 No Action Alternative

CWF BA No Action Alternative was modeled at ELT based on the 2015 CALSIM II. The BA No Action Alternative simulation did not include the San Joaquin River Restoration Program flows.

As noted above, a new No Action Alternative at ELT was simulated for the FEIRS based on the 2010 CALSIM II. CALSIM II modeling assumptions for the FEIRS No Action Alternative at ELT were consistent with the DEIRS No Action Alternative, except for the Fremont Weir modification to represent the NMFS BO (Jun, 2009) Action I.6.1: Restoration of Floodplain Rearing Habitat action. Fremont Weir was assumed to be modified as described in Table 5G.2. These assumptions are only for use in the FEIRS modeling as a placeholder, while the proposed changes associated with this RPA are still in development under a separate multi-agency process.

Simulated CVP-SWP operations resulting under the FEIRS No Action Alternative at ELT CALSIM II show minor changes compared to the CWF BA No Action Alternative at ELT as shown in Figures 5G-1 to 5G-43, with a couple of notable changes. As shown in Figures 5G-10 and 5G-11, the Oroville storage is lower under the CWF BA No Action Alternative at ELT compared to the FEIRS No Action Alternative at ELT, and the SWP deliveries (Figure 5G-35) are correspondingly lower, as a result of the assumed Feather River rice decomposition demands. As a result Feather River flow patterns are differing between the two No Action Alternatives as shown in Figure 5G-20. Figures 5G-44 to 5G-51 show similar simulated salinity conditions at key Delta locations under the FEIRS No Action Alternative at ELT and CWF BA No Action Alternative at ELT over the 16 year period (water years 1976 – 1991).

Table 5G-2. Differences in the Assumed Fremont Weir Configurations and Operations Criteria between the DEIRS No Action Alternative at ELT and the FEIRS No Action Alternative at ELT

	RDEIR/SDEIS No Action Alternative at ELT	FEIRS No Action Alternative at ELT
Weir Improvements	None. Weir configurations assumed to be consistent with current conditions.	Fremont Weir – Improve fish passage at existing weir elevation; construct opening and operable gates at elevation 17.5 ft with fish passage facilities; construct opening and operable gates at a smaller opening with fish passage enhancement at elevation 11.5 ft.
Fremont Weir operations modification	Weir operations assumed to be consistent with current conditions.	To provide seasonal floodplain inundation in the Yolo Bypass, the 17.5 ft and the 11.5 ft elevation gates are assumed to be opened between December 1st and March 31st. This may extend to May 15th, depending on the hydrologic conditions and the measures to minimize land use and ecological conflicts in the bypass. As a simplification for modeling, the gates are assumed opened until April 30th in all years. The gates are operated to limit maximum spill to 6,000 cfs until the Sacramento River stage reaches the existing Fremont Weir elevation. While desired inundation period is on the order of 30 to 45 days, gates are not managed to limit to this range, instead the duration of the event is governed by the Sacramento River flow conditions. To provide greater opportunity for the fish in the bypass to migrate upstream into the Sacramento River, the 11.5 ft elevation gate is assumed to be open for an extended period between September 15th and June 30th. As a simplification for modeling, the period of operation for this gate is assumed to be September 1st to June 30th. The spills through the 11.5 ft elevation gate are limited to 100 cfs to support fish passage. The operation of the gate is assumed to be only based on the flow at Fremont Weir.

5G.4 Alternative 4A

For the FEIRS, a new CALSIM II model was simulated to represent Alternative 4A at ELT based on the FEIRS No Action Alternative at ELT, with appropriate operational assumptions that are consistent with CWF BA Proposed Action scenario (USBR and DWR, 2016). The differences in the major CALSIM II modeling assumptions between DEIRS Alternative 4 H3, which was used as the starting point for the FEIRS Alternative 4A, and the FEIRS Alternative 4A are summarized in Table 5G.4-1. A full description of the CALSIM II modeling, and the assumptions used for Alternative 4A are included in the Appendix 5A *Modeling Technical Appendix* of the FEIRS.

Table 5G-3. Differences between Alternative 4 H3, and Alternative 4A that Potentially Affect the CVP-SWP Operations. FEIRS Alternative 4A Assumptions are Consistent with the CWF BA Proposed Action.

	DEIRS Alternative 4 H3 at ELT	FEIRS Alternative 4A at ELT	CALSIM II Assumptions
Fremont Weir modification, and operations	Included as part of CM2	Not specifically part of the Alternative; considered as part of the No Action Alternative	Included; assumptions consistent with the FEIRS No Action Alternative at ELT[1].
Tidal habitat restoration	Included as part of CM4 (25000 acres at ELT)	Only the restoration required as part of any mitigation requirements beyond the 8000 acres required under FWS (2008) BiOp	Not included; 8000 acres required under FWS BiOp not modeled explicitly in the No Action Alternative or the Alternative.
Shift of D-1641 Emmaton water quality compliance location to Threemile Slough	Included as part of Alternative 4 H3 in the DEIRS	Not included	Not included; Modeled water quality compliance with D-1641 Emmaton requirement consistent with the FEIRS No Action Alternative at ELT.
Spring Delta Outflow beyond D-1641 requirements	Not included as part of Alternative 4 decision tree scenario H3	Required to meet Mar – May average Delta outflow resulting under the No Action Alternative at ELT	Modeled by constraining the total Delta exports by the San Joaquin River i:e ratio requirement under 2009 NMFS BiOp Action IV.2.1, during April and May.

Alternative 4 H3 at ELT CALSIM II model from the DEIRS was modified to include the following specific changes to represent Alternative 4A at ELT for the FEIRS:

- ANN used in CALSIM II to simulate flow – salinity relationship in the Delta under DEIRS Alternative 4 H3 ELT was modified to be consistent with the FEIRS No Action Alternative at ELT, which does not include any effects associated with tidal habitat restoration in the Delta.
- Assumed D-1641 agricultural salinity compliance location on the Sacramento River at Threemile Slough was reverted back to Emmaton location consistent with the FEIRS No Action Alternative at ELT.
- Constrained the total Delta exports (i.e., pumping at both north and south Delta intakes) by the 2009 NMFS BiOp Action IV.2.1 San Joaquin River i:e ratio consistent with the No Action Alternative at ELT, to achieve Mar – May average spring Delta outflow under the No Action Alternative at ELT.
- Updated north Delta Diversion operation constraints to better reflect the proposed north Delta diversion bypass flow criteria.

[1] When the existing Fremont Weir is spilling, the notch is assumed to be open under the FEIRS No Action Alternative at ELT, unlike the Alternative 4A Action Alternative, which assumes it's closed. This is just a difference in modeling assumption, and there is no intent for differences in the future Fremont Weir modifications and operations between the FEIRS No Action Alternative and the Alternative 4A. The effect of this difference in assumption is minor and limited to winter months of wet and above normal years at high flow conditions. This has no effect on the impact analysis and significance conclusions in any of the resource chapters in this EIR/S.

- Added an additional constraint for the north Delta diversion to account for fish screen sweeping velocity constraints.
- Added an explicit constraint to maintain south Delta pumping of up to 3,000 cfs during Jul – Sep months.
- San Luis reservoir operations modified to minimize south-of-Delta shortages during fall months.
- Updated WSI-DI curves used to determine the water supply allocations in the CALSIM II model.

All the remaining CALSIM II assumptions for Alternative 4A remained consistent with Alternative 4 H3.

Figures 5G-1 to 5G-43 include the CALSIM II results for CWF BA No Action Alternative at ELT, CWF BA Proposed Action (PA) at ELT, FEIRS No Action Alternative at ELT and FEIRS Alternative 4A at ELT. These figures show the similarities and differences between the models used for the FEIRS and the CWF BA, and also allow assessing how the incremental changes between the Alternative 4A and the No Action Alternative would differ between the CWF BA and the FEIRS.

Several CVP-SWP results including Trinity, Shasta, Folsom, Oroville and San Luis storage conditions, flows in Trinity River, Sacramento River, Feather River, American River and Delta at key locations, and CVP-SWP exports and deliveries, are presented in Figures 5G-1 to 5G-43.

As noted earlier the No Action Alternative results are similar between the CWF BA and the FEIRS version. The changes in the CVP-SWP results under the FEIRS Alternative 4A based on the 2010 CALSIM II are similar to the results under the CWF BA Proposed Action scenario based on the 2015 CALSIM II, when compared to their respective No Action Alternative results.

Trinity, Shasta and Oroville end of May and end of September storage conditions remained similar under both the FEIRS Alternative 4A at ELT and CWF BA Proposed Action compared to their respective No Action Alternative results. Folsom storage conditions generally follow the other reservoirs, however, in below normal and dry years, the CWF BA Proposed Action is slightly lower than the CWF BA No Action Alternative, when the FEIRS Alternative 4A is similar to the FEIRS No Action Alternative. However, deliveries to the CVP American River contractors are not affected as shown in Figure 5G-34, which shows the annual CVP north of Delta M&I service contractor deliveries.

Changes in San Luis Reservoir storage under FEIRS Alternative 4A are similar to the changes under the CWF BA Proposed Action, except in dry and critical years, when FEIRS Alternative 4A shows a reduction in San Luis storage, while CWF BA Proposed Action shows increase.

Trinity River flows downstream of Lewiston are similar under the No Action Alternative and Alternative 4A at ELT under the FEIRS consistent with CWF BA. Sacramento River flows at Keswick and Wilkins Slough locations under the FEIRS No Action Alternative at ELT and Alternative 4A at ELT remain similar compared to the respective CWF BA results under all water year types. Feather River flows in the low flow channel remain unchanged. The changes in the Feather River flows below Thermalito and American River flow below Nimbus trend similarly under the FEIRS Alternative 4A at ELT and the CWF BA Proposed Action compared to their respective No Action Alternative results.

Changes in the Delta inflows remained similar between the FEIRS Alternative 4A at ELT and CWF BA Proposed Action. FEIRS Alternative 4A at ELT Delta outflows are generally similar to CWF BA Proposed Action when compared to their respective No Action Alternative results. Old and Middle River flows under FEIRS Alternative 4A during the fall, winter and spring months are similar to CWF BA Proposed Action, and show small shifts in the summer months, when compared to the respective No Action Alternatives.

Annual deliveries to the CVP north of Delta agricultural service contractor deliveries differ slightly under the FEIRS Alternative 4A and the CWF BA Proposed Action, however, the deliveries remain similar to the No Action Alternative in all water year types. Annual deliveries to the CVP north of Delta M&I service contractor deliveries under the FEIRS Alternative 4A remain similar to the No Action Alternative in all water year types, consistent with the CWF BA.

Annual Delta export changes under the FEIRS Alternative 4A at ELT are similar to the CWF BA Proposed Action under all water year types, except critical years, where the FEIRS shows slight reduction compared to the respective No Action Alternative results. The proportion of the Delta exports at the north Delta diversion intake under the FEIRS Alternative 4A at ELT are slightly lower in wet, above normal and below normal years compared to the CWF BA Proposed Action.

Changes in the total SWP deliveries and CVP south of Delta agricultural and M&I service contractor deliveries under FEIRS Alternative 4A at ELT are generally similar to CWF BA Proposed Action compared to the respective No Action Alternatives.

Overall, CVP-SWP operations results under the FEIRS Alternative 4A at ELT remained similar to the CWF BA Proposed Action results when compared to their respective No Action Alternatives.

Figures 5G-44 to 5G-51 show changes in simulated salinity conditions at key Delta locations under the FEIRS Alternative 4A at ELT and CWF BA Alternative 4A at ELT over the 16 year period (water years 1976 – 1991) compared to the respective No Action Alternatives. Even though there are small differences in magnitude of changes in salinity, typically both versions of Alternative 4A results show similar trends. In a few winter and spring months, when salinity in the Delta is lower, the two versions of the Alternative 4A show minor differences in the simulated changes. Overall, the Delta salinity results under the FEIRS Alternative 4A at ELT remained similar to the CWF BA Proposed Action results when compared to their respective No Action Alternatives.

5G.5 References

USBR and DWR. 2016. Draft Biological Assessment for California Water Fix, January.

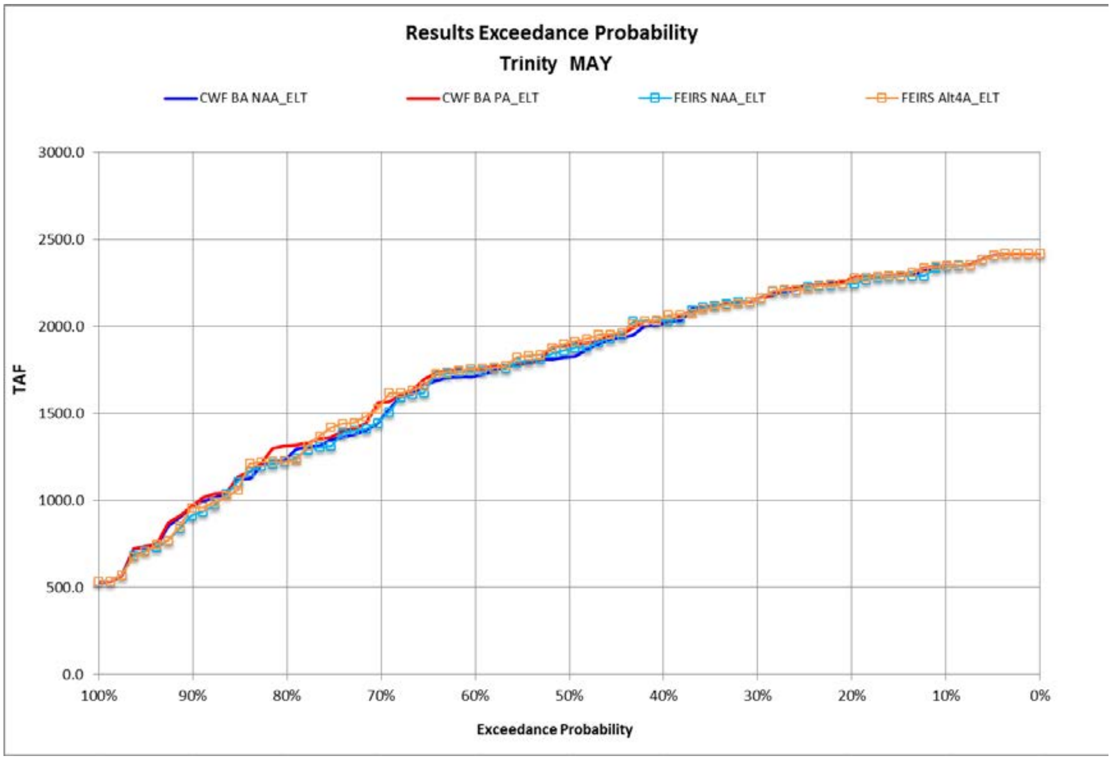


Figure 5G-1. Storage Exceedance Probability for Trinity Lake, End of May

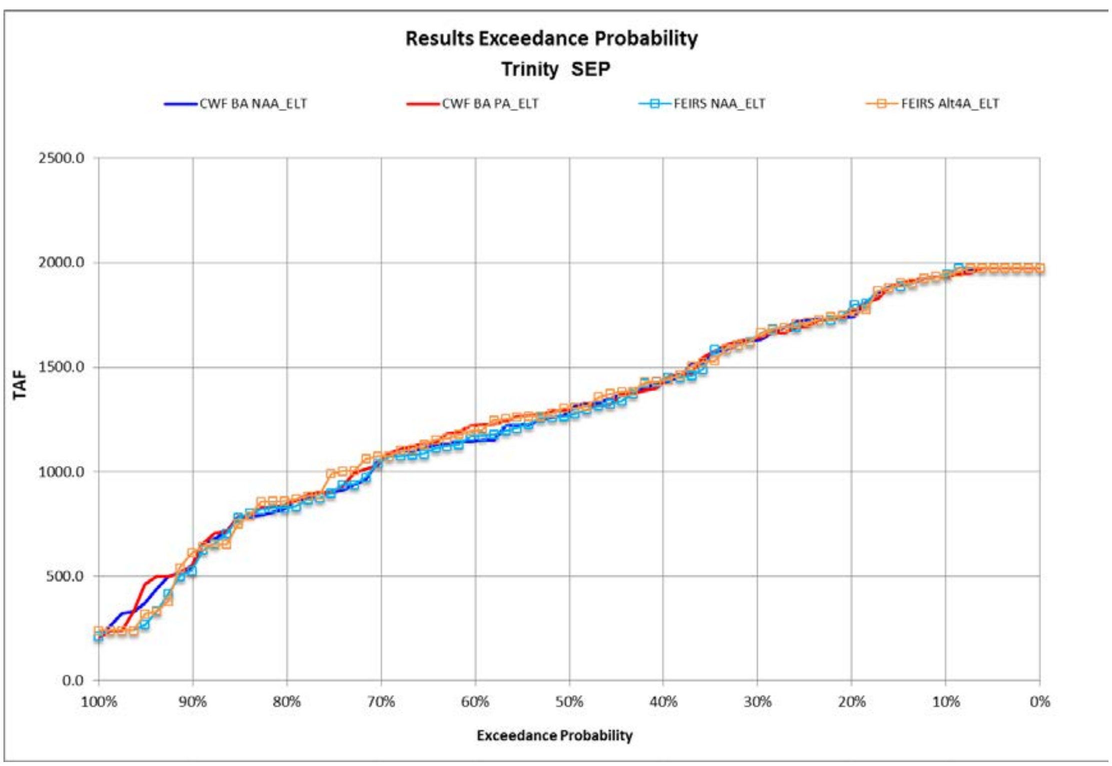


Figure 5G-2. Storage Exceedance Probability for Trinity Lake, End of September

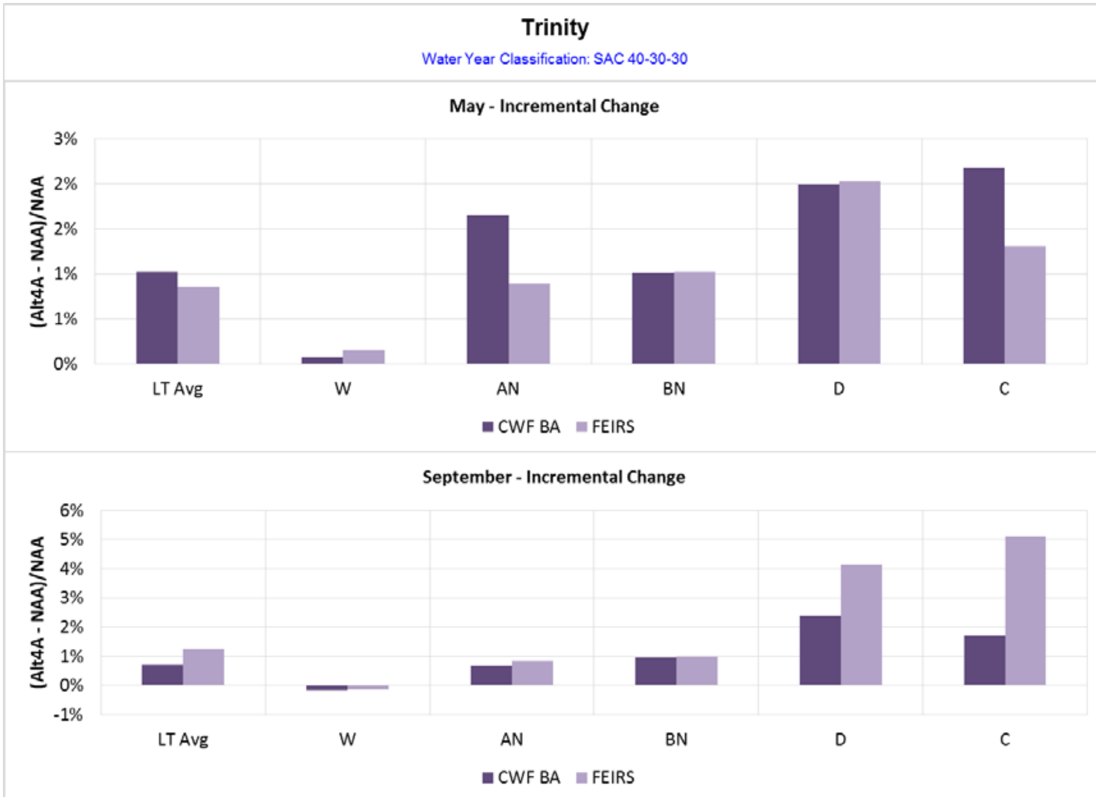


Figure 5G-3. Incremental Changes in End-of-May and End-of-September Trinity Lake Storage

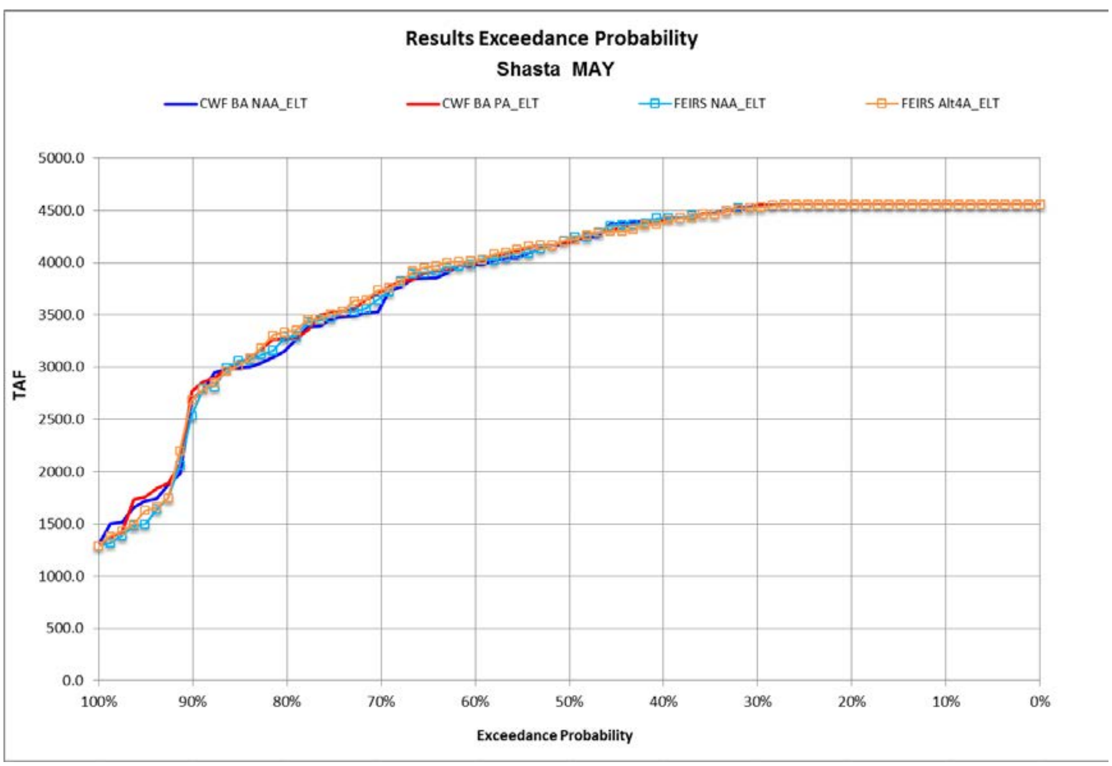


Figure 5G-4. Storage Exceedance Probability for Shasta Lake, End of May

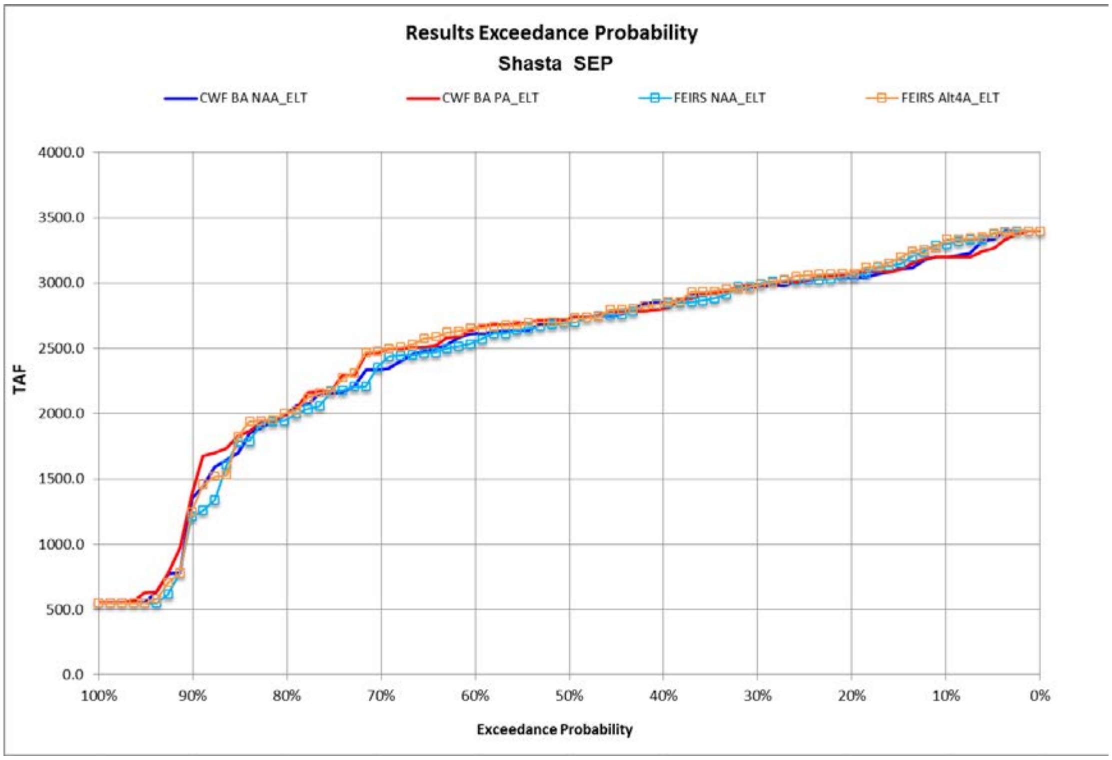


Figure 5G-5. Storage Exceedance Probability for Shasta Lake, End of September

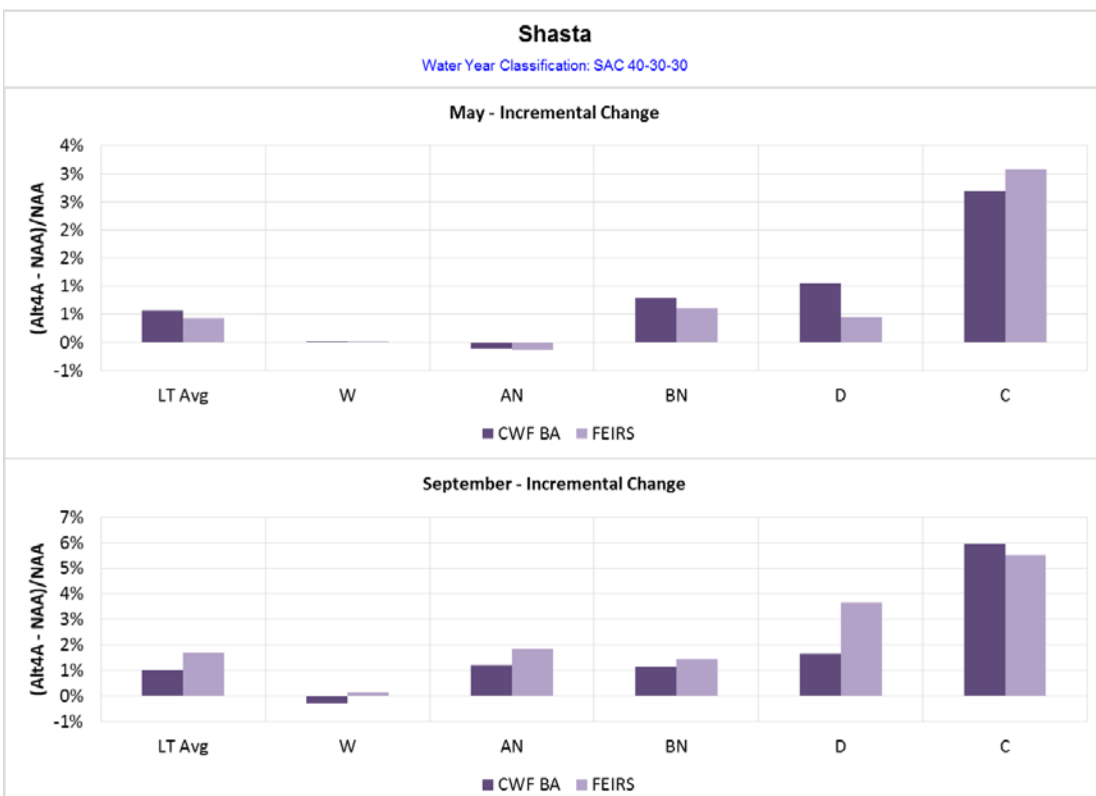


Figure 5G-6. Incremental Changes in End-of-May and End-of-September Shasta Lake Storage

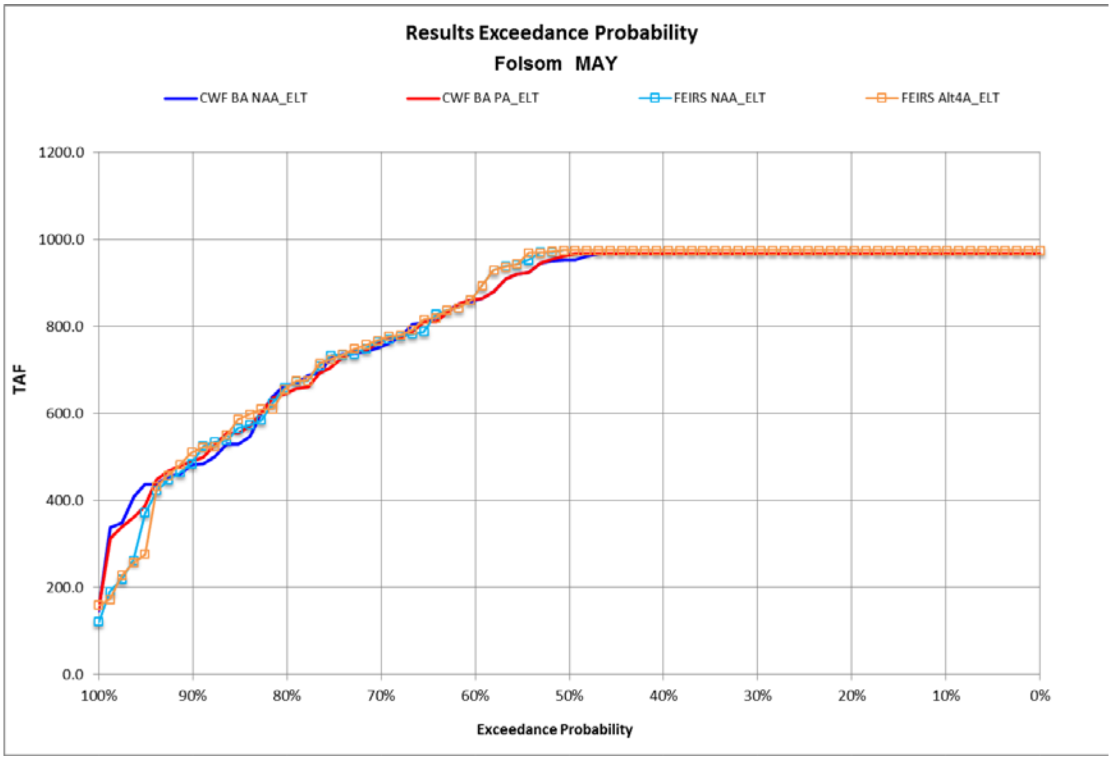


Figure 5G-7. Storage Exceedance Probability for Folsom Lake, End of May

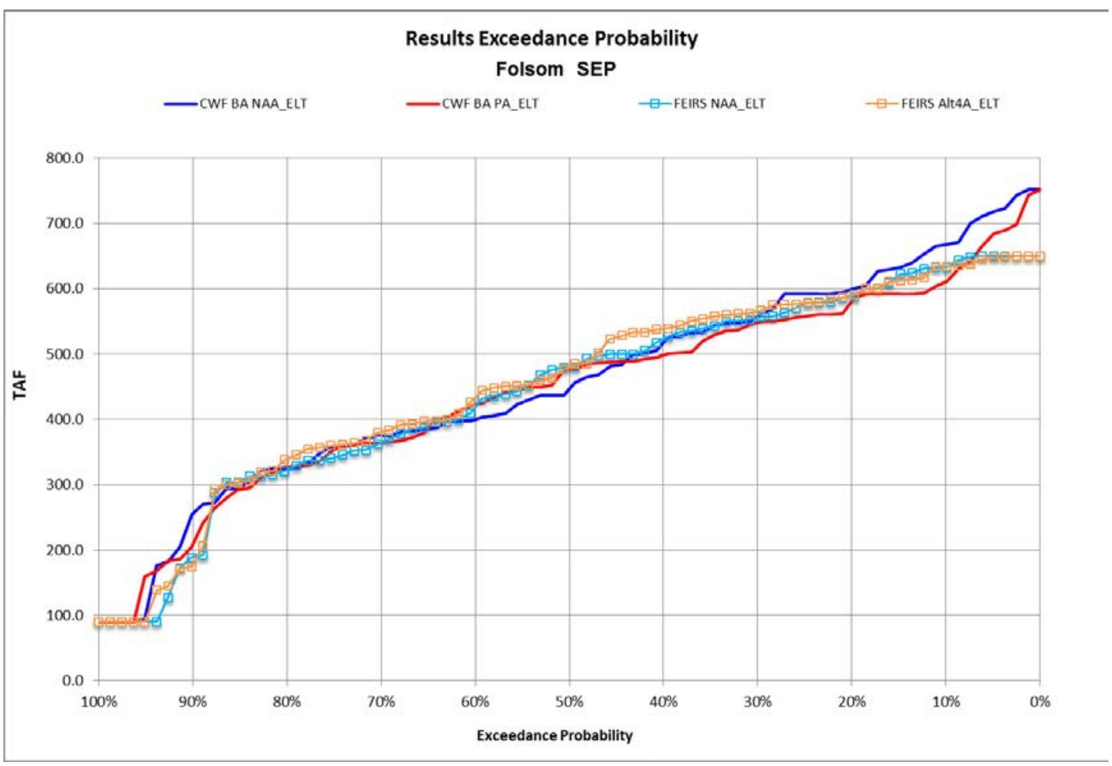


Figure 5G-8. Storage Exceedance Probability for Folsom Lake, End of September

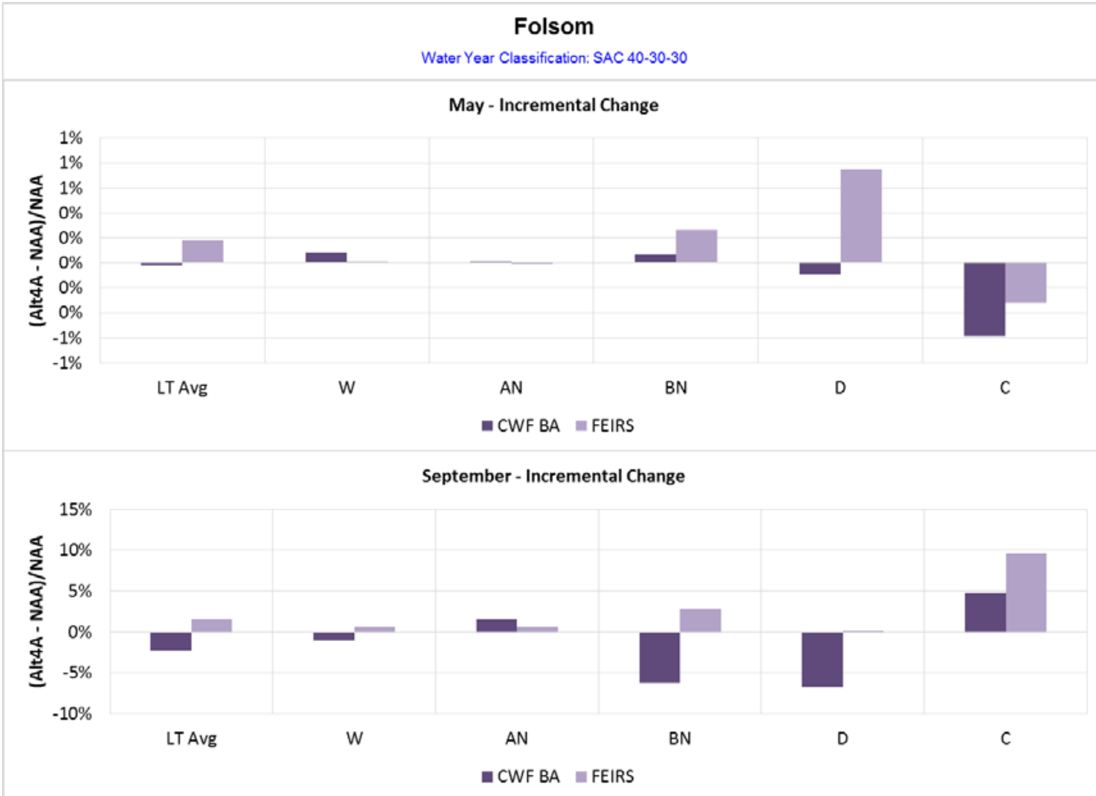


Figure 5G-9. Incremental Changes in End-of-May and End-of-September Folsom Lake Storage

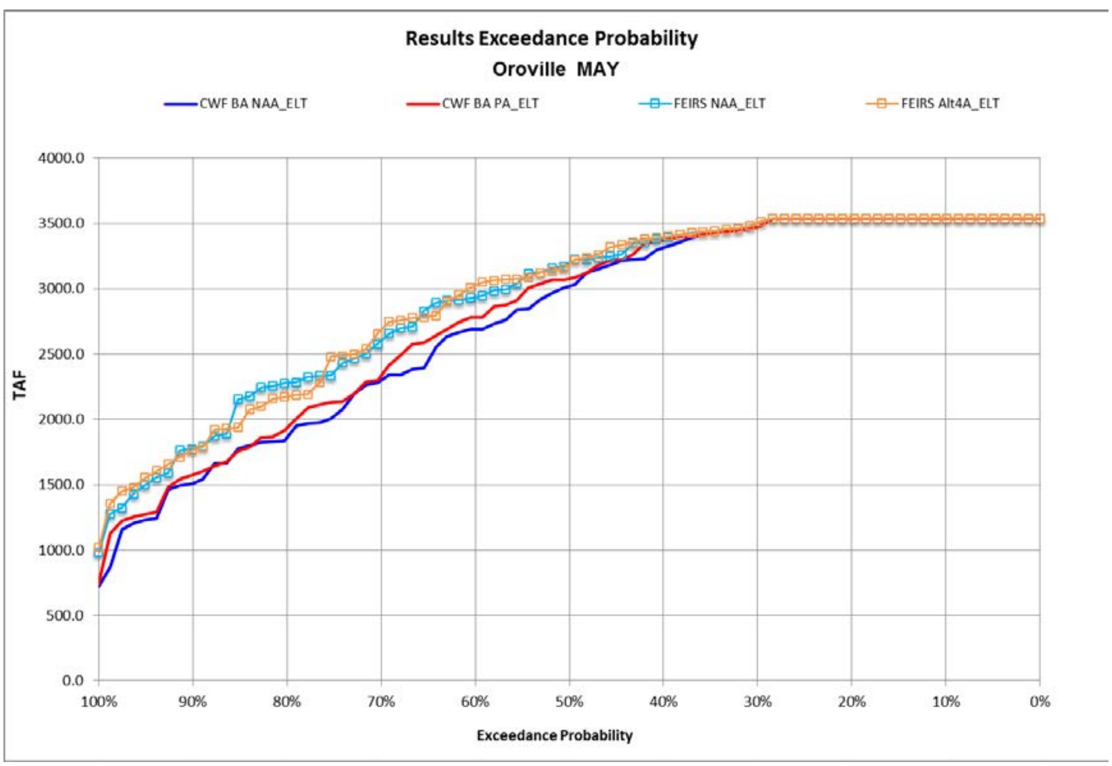


Figure 5G-10. Storage Exceedance Probability for Lake Oroville, End of May

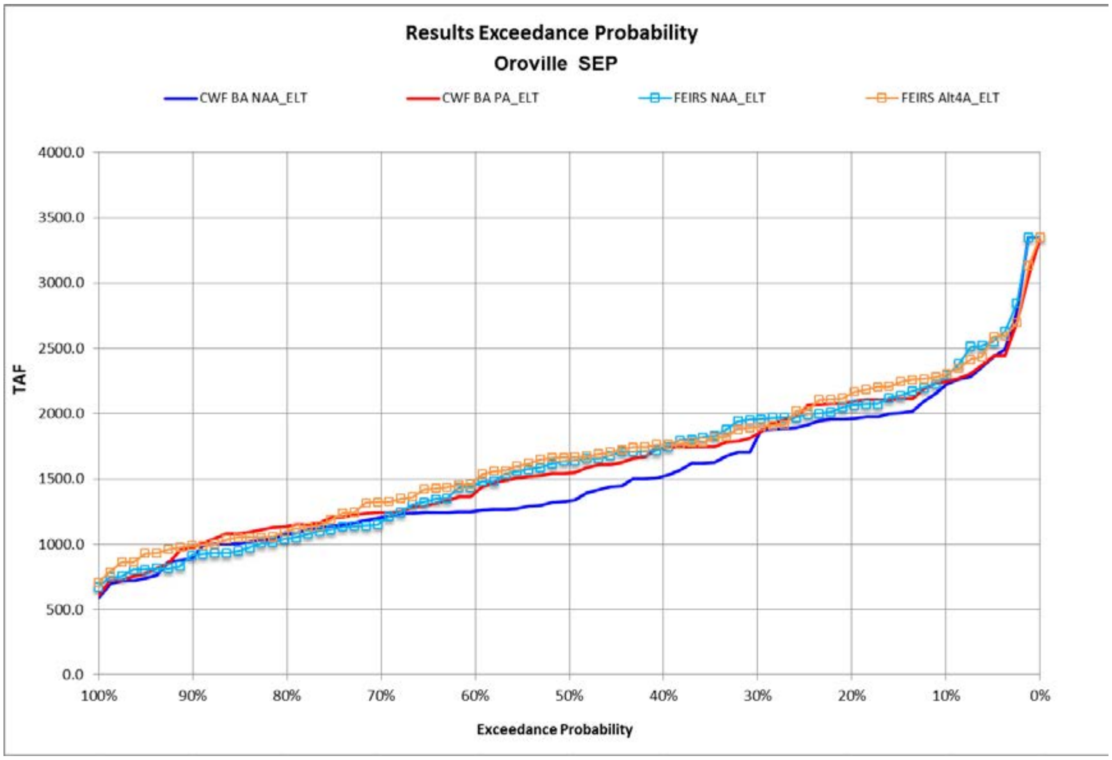


Figure 5G-11. Storage Exceedance Probability for Lake Oroville, End of September

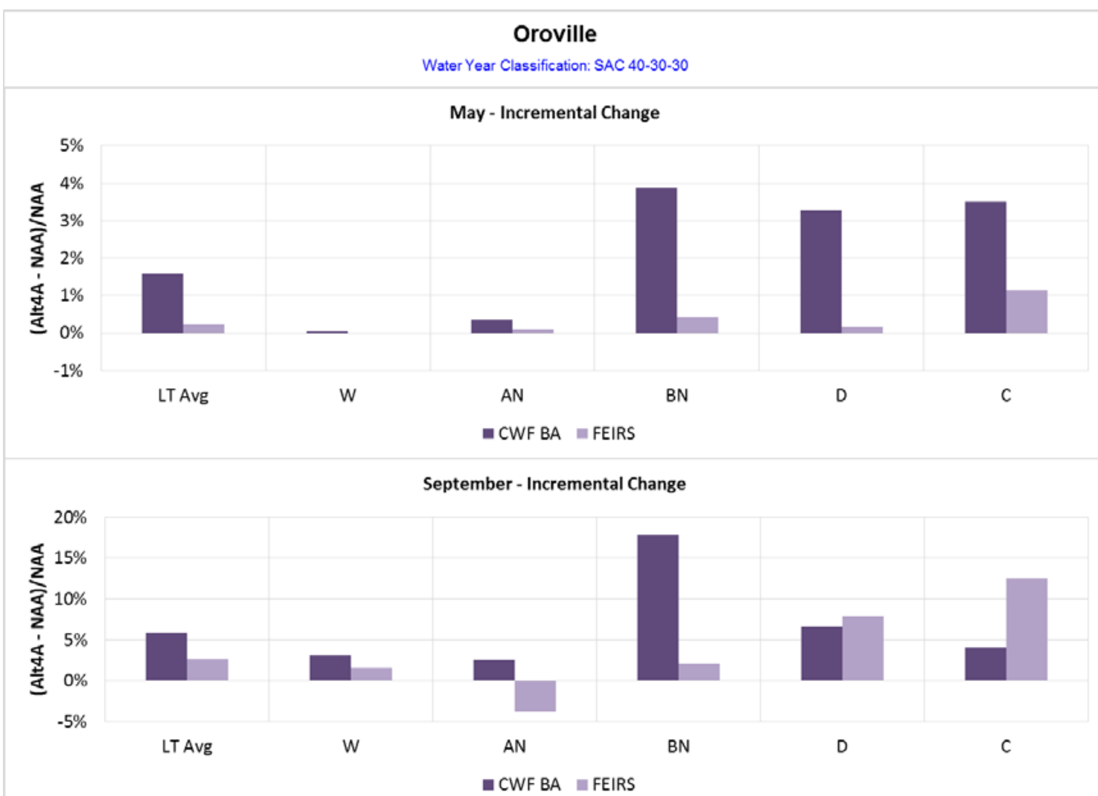


Figure 5G-12. Incremental Changes in End-of-May and End-of-September Lake Oroville Storage

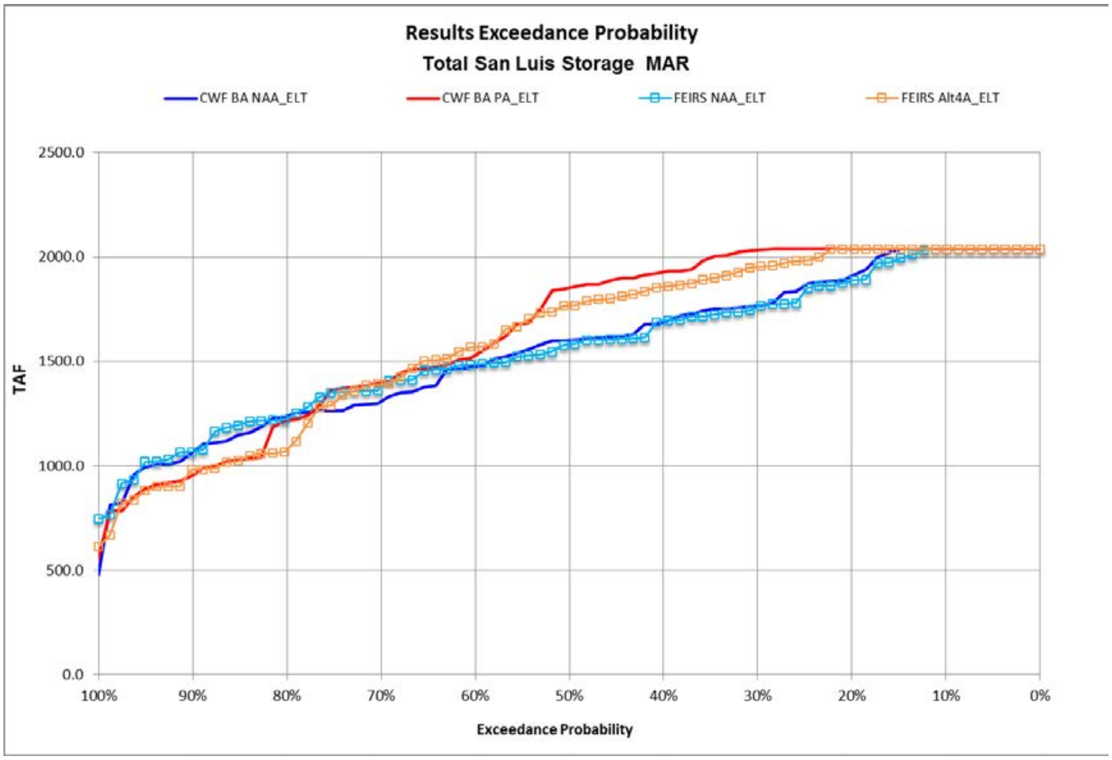


Figure 5G-13. Storage Exceedance Probability for San Luis Reservoir, End of March

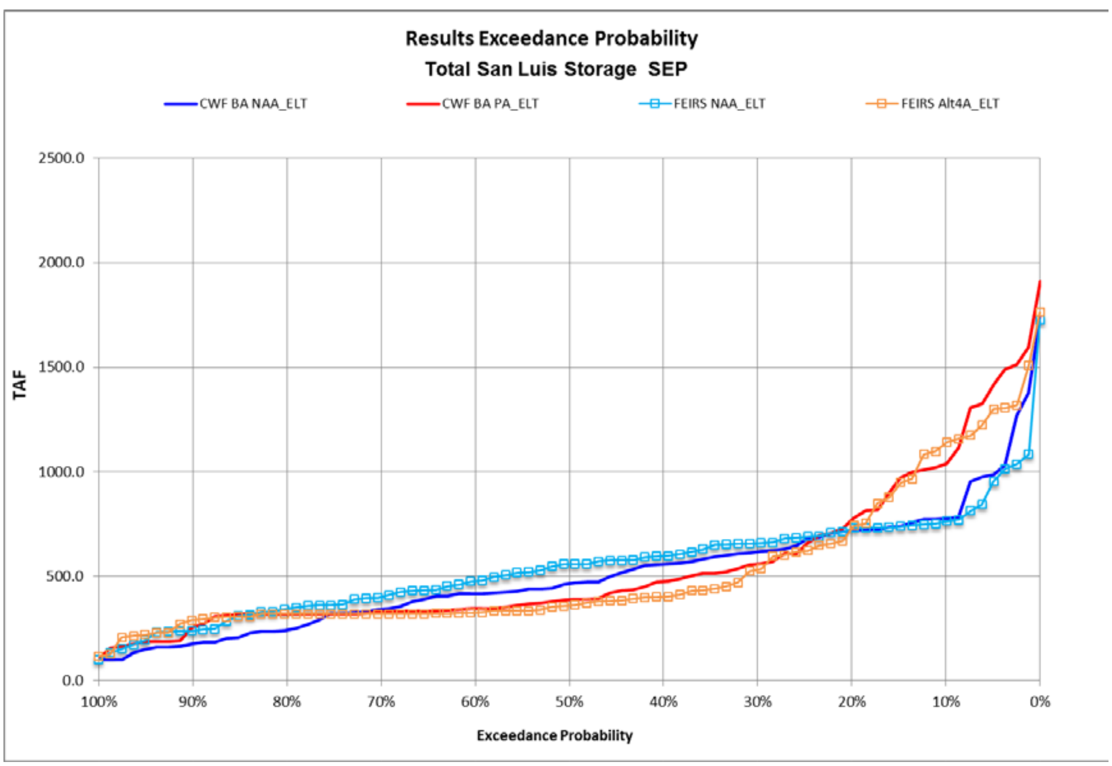


Figure 5G-14. Storage Exceedance Probability for San Luis Reservoir, End of September

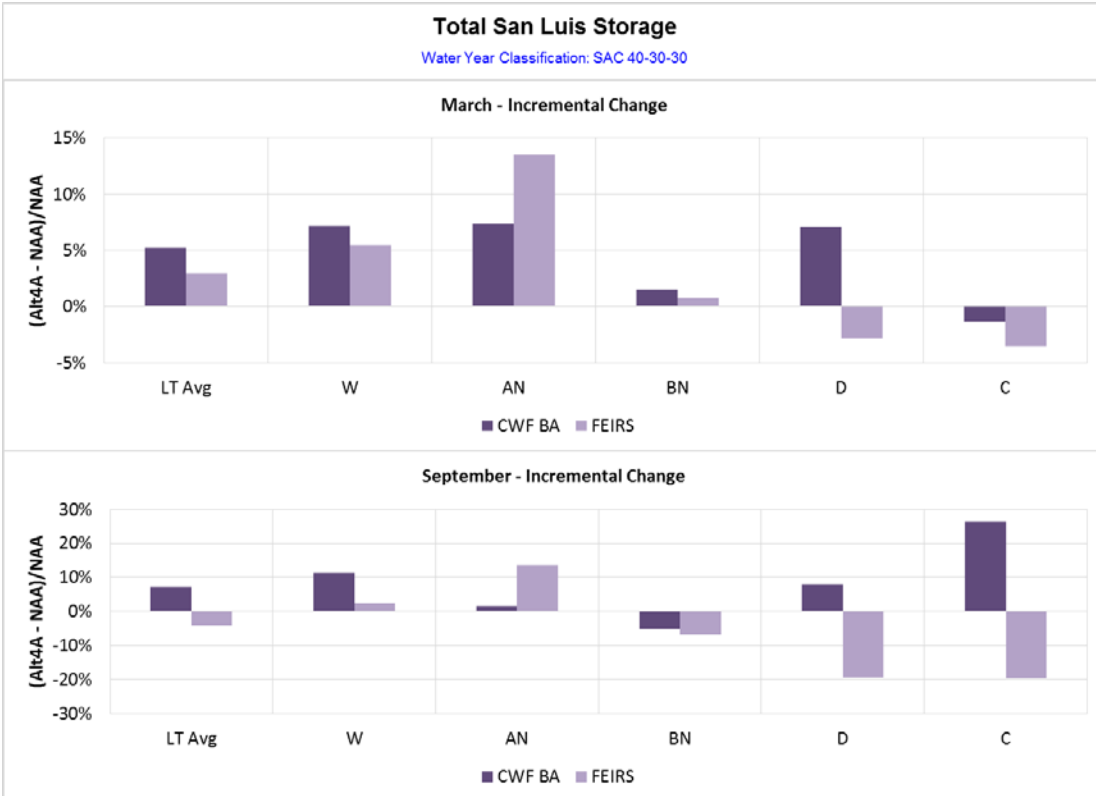


Figure 5G-15. Incremental Changes in End-of-March and End-of-September San Luis Reservoir Storage

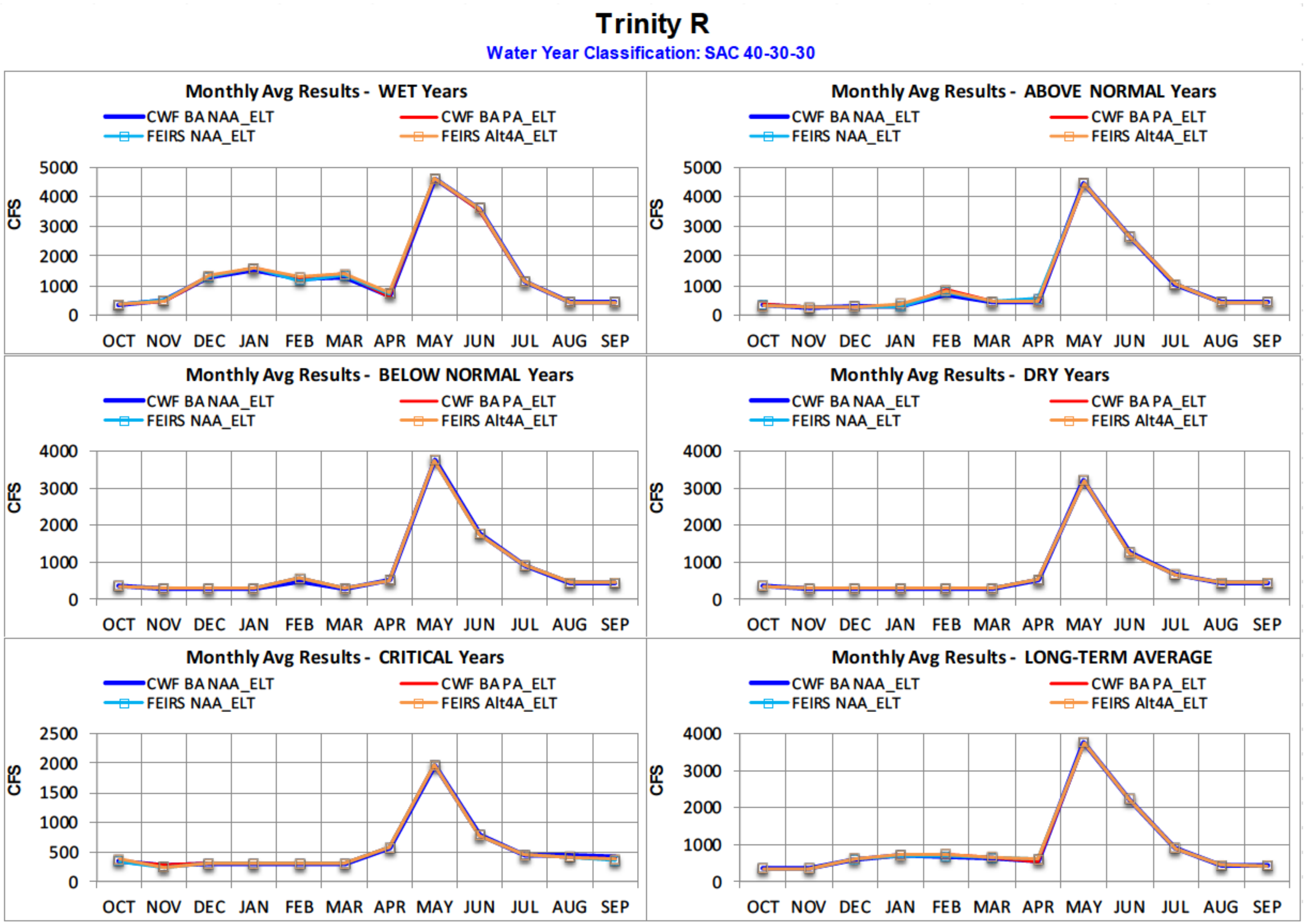


Figure 5G-16. Trinity River below Lewiston, Monthly Average Flow *[WYT based on current climate]*

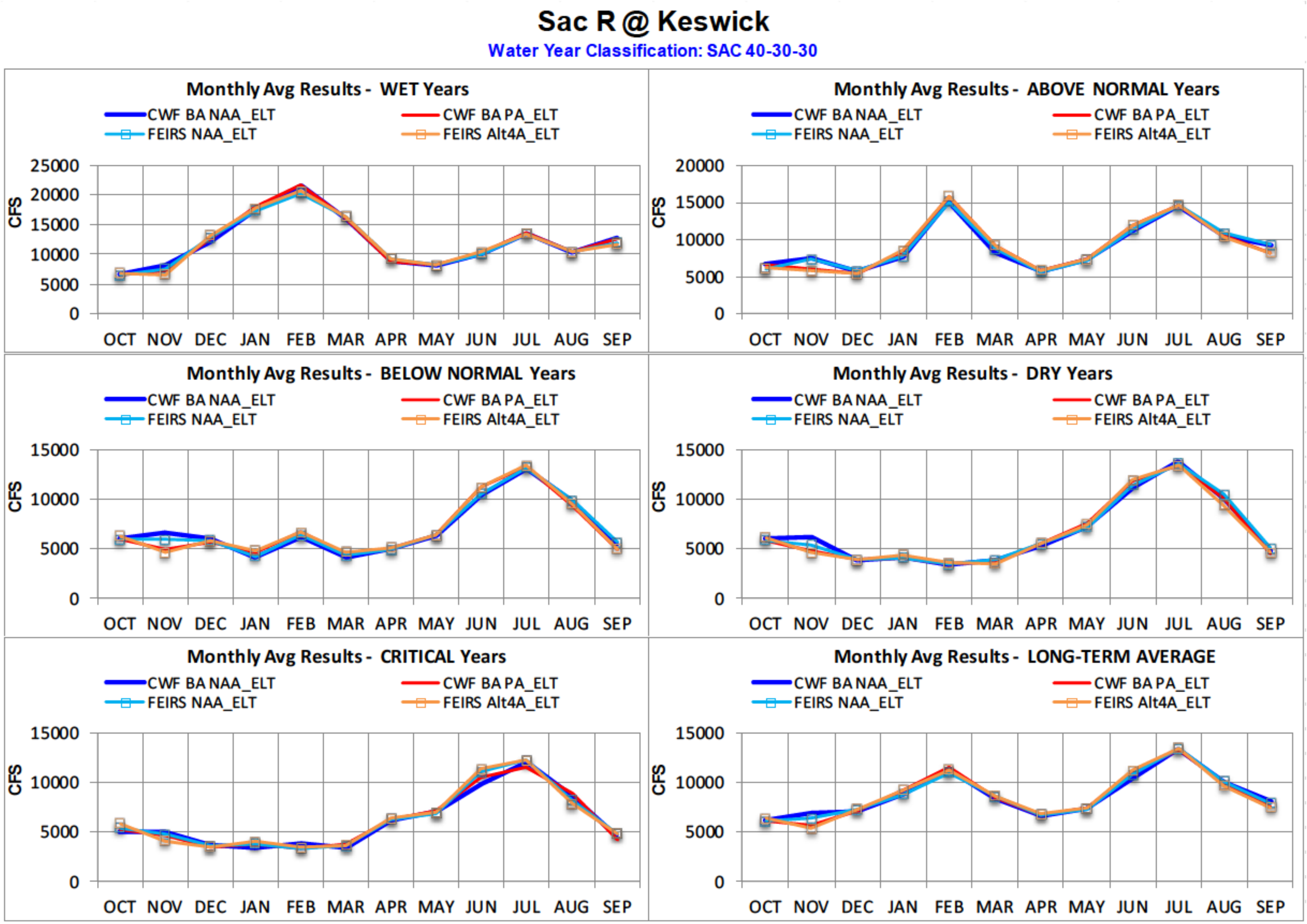


Figure 5G-17. Sacramento River below Keswick, Monthly Average Flow *[WYT based on current climate]*

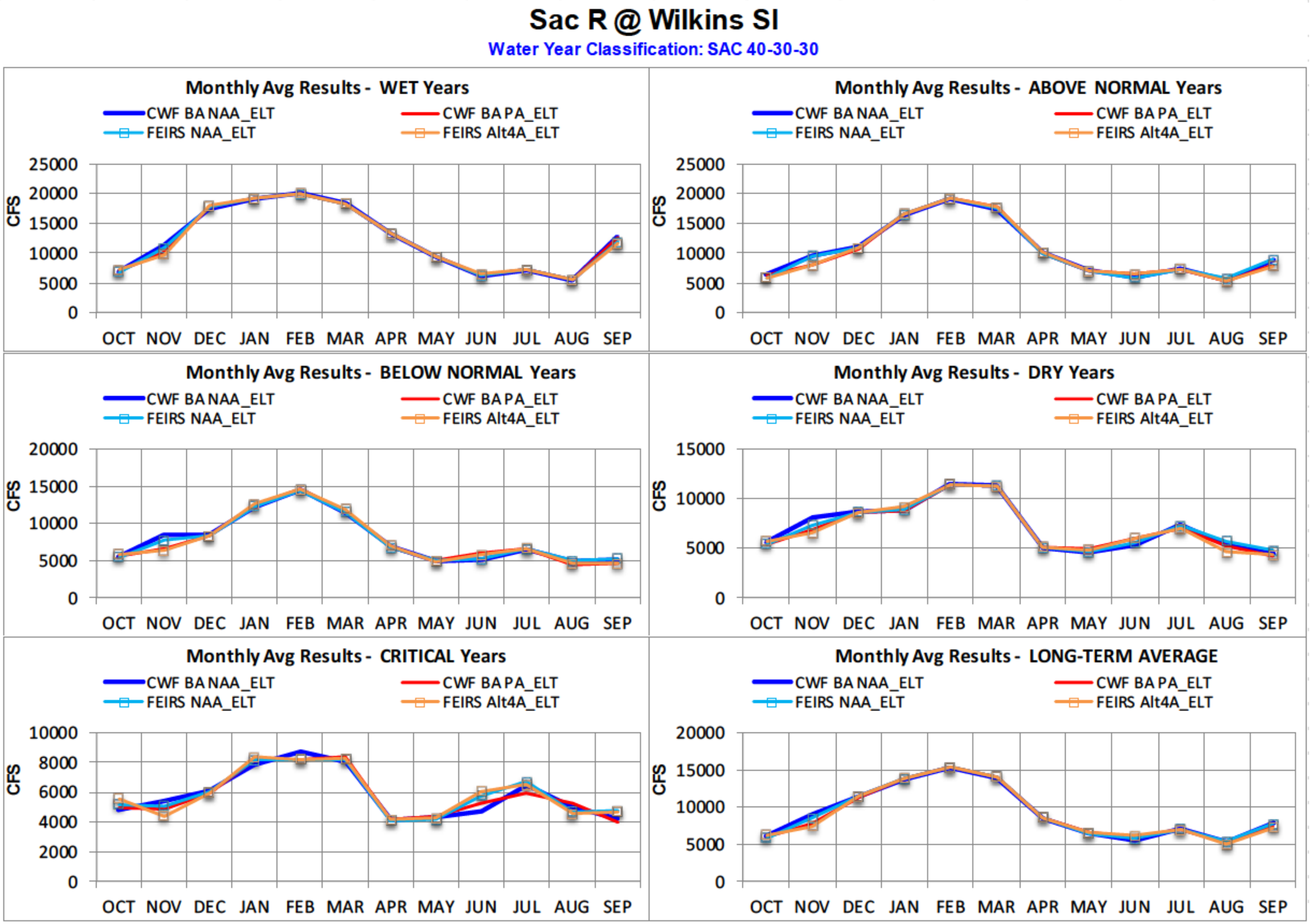


Figure 5G-18. Sacramento River at Wilkins Slough, Monthly Average Flow *[WYT based on current climate]*

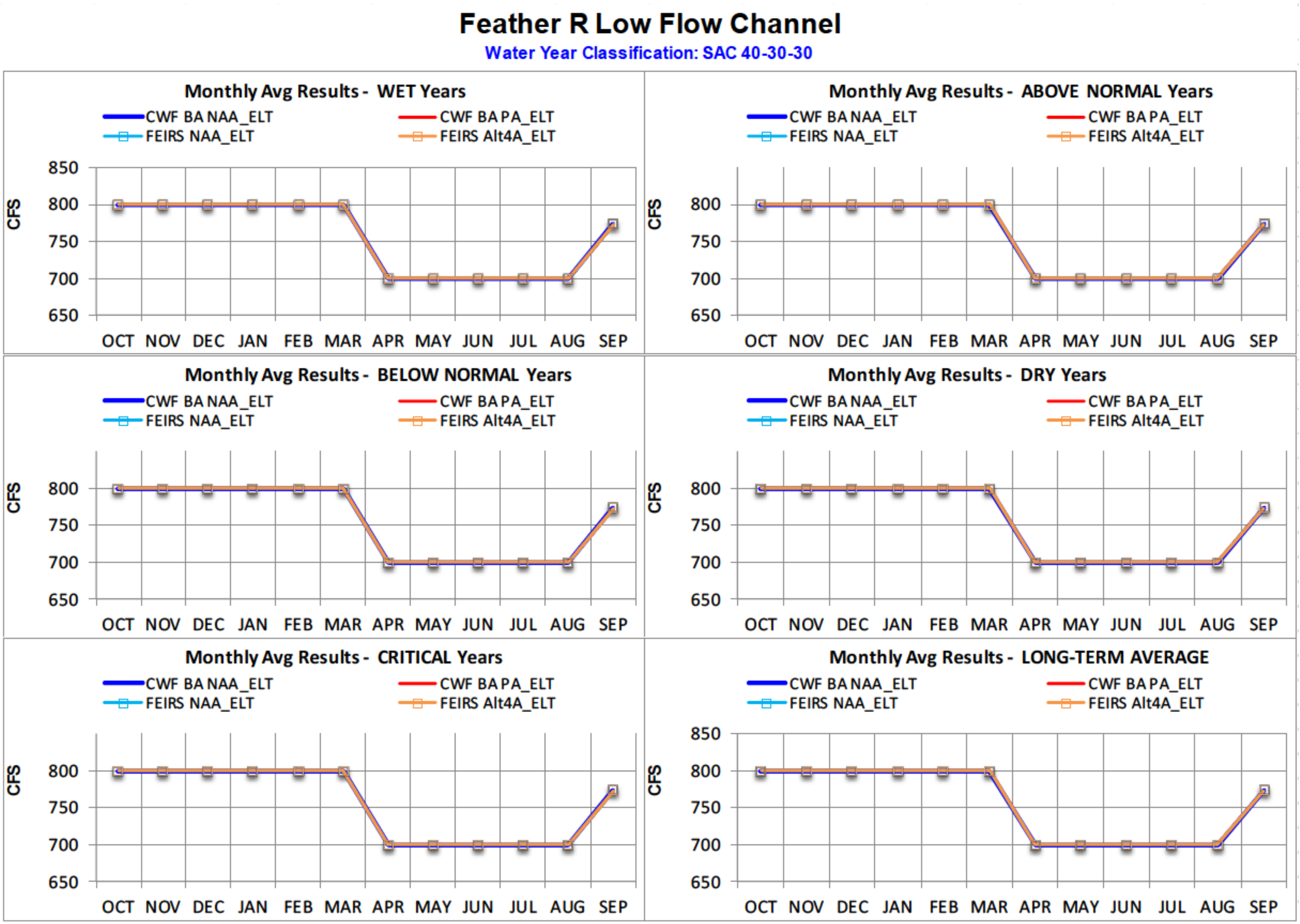


Figure 5G-19. Feather River Low Flow Channel, Monthly Average Flow *[WYT based on current climate]*

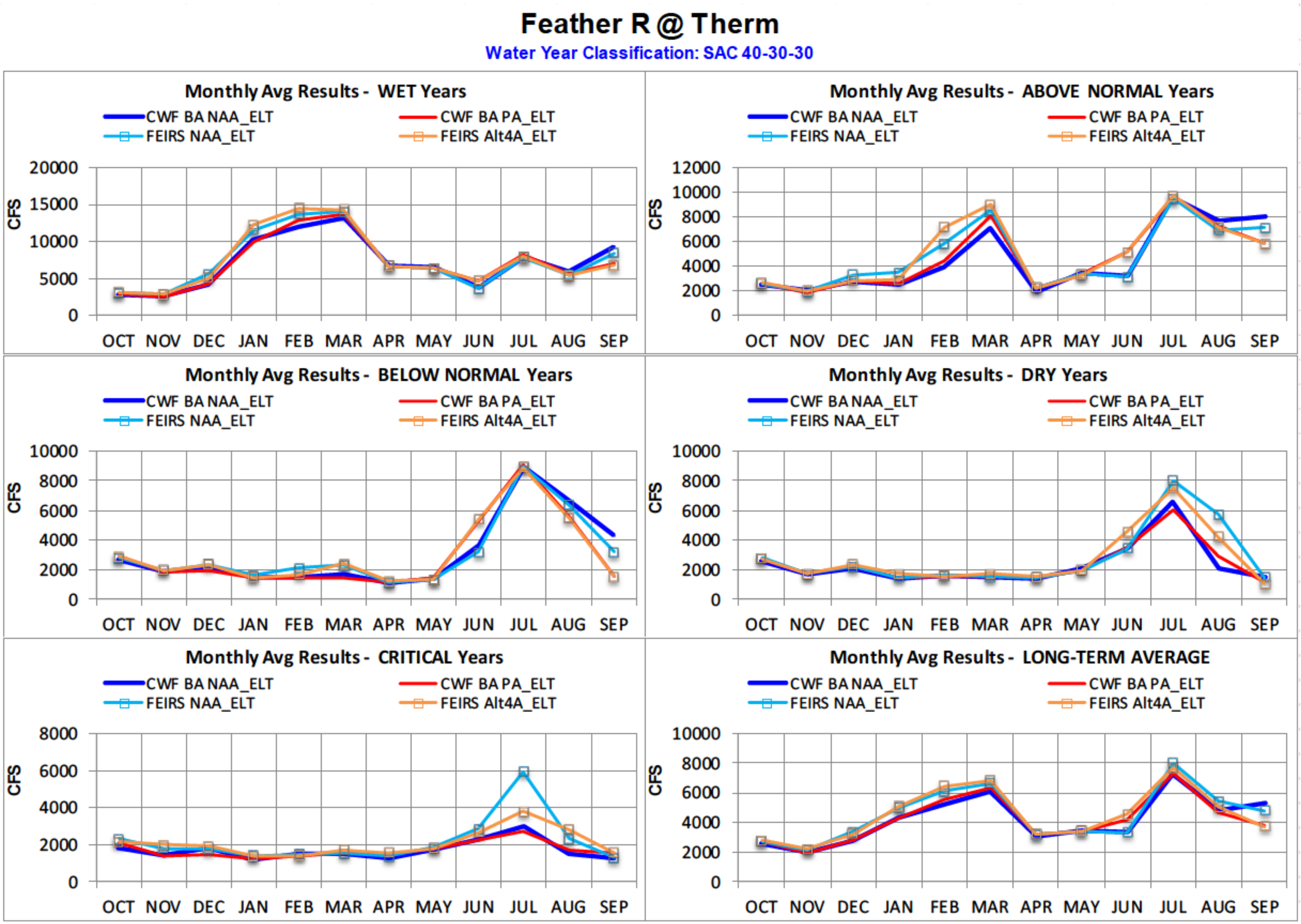


Figure 5G-20. Feather River below Thermalito, Monthly Average Flow *[WYT based on current climate]*

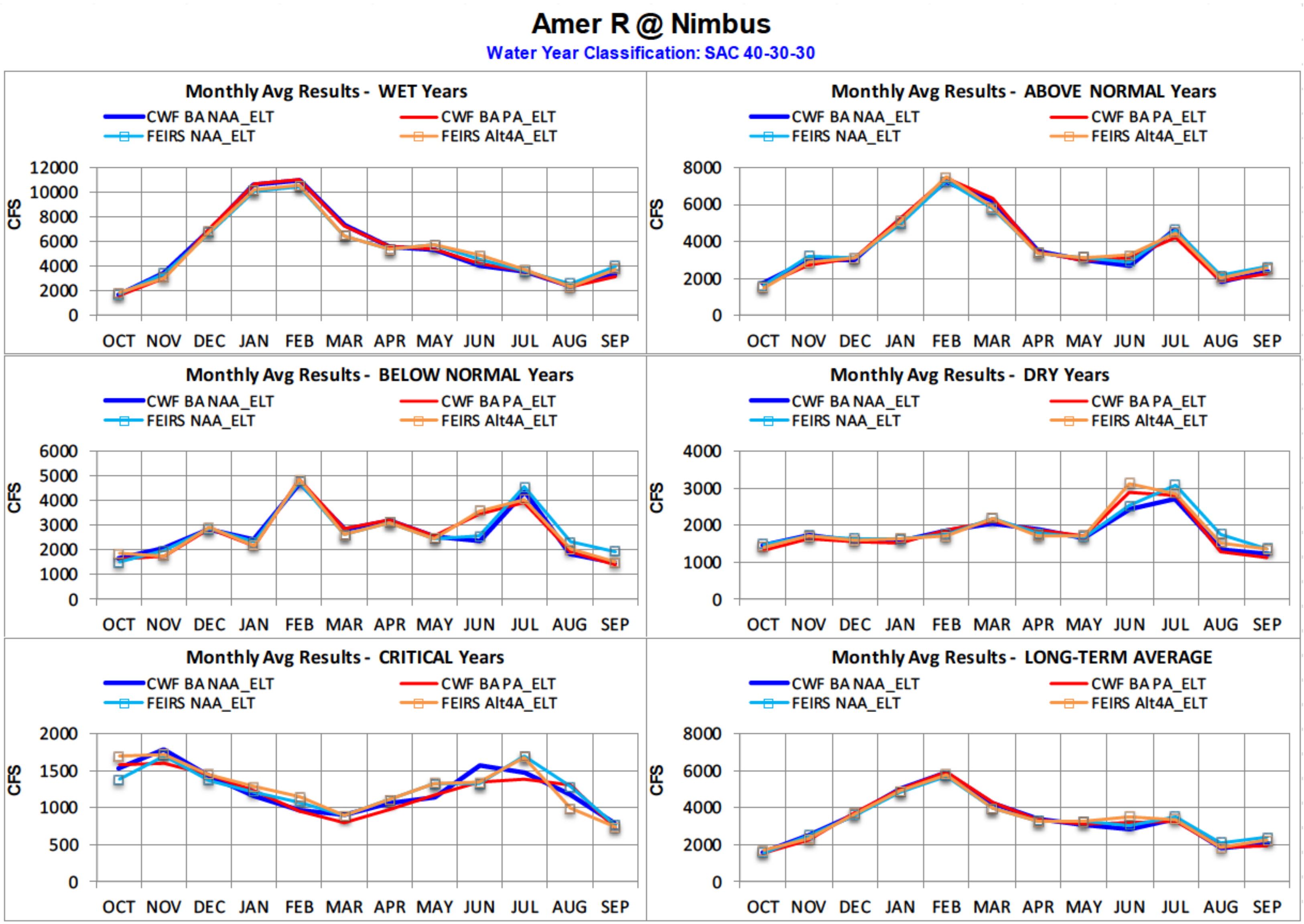


Figure 5G-21. American River below Nimbus, Monthly Average Flow *[WYT based on current climate]*

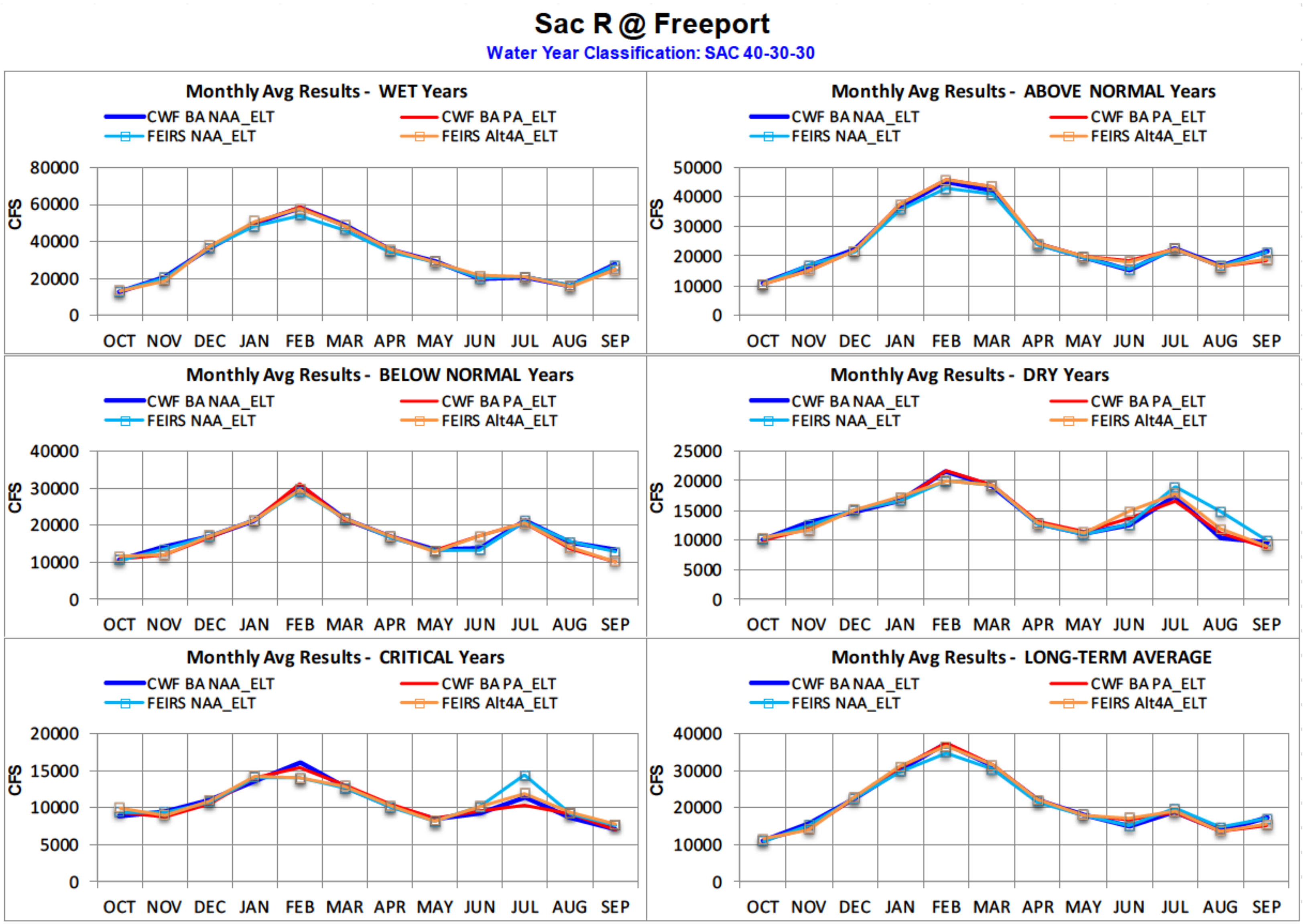
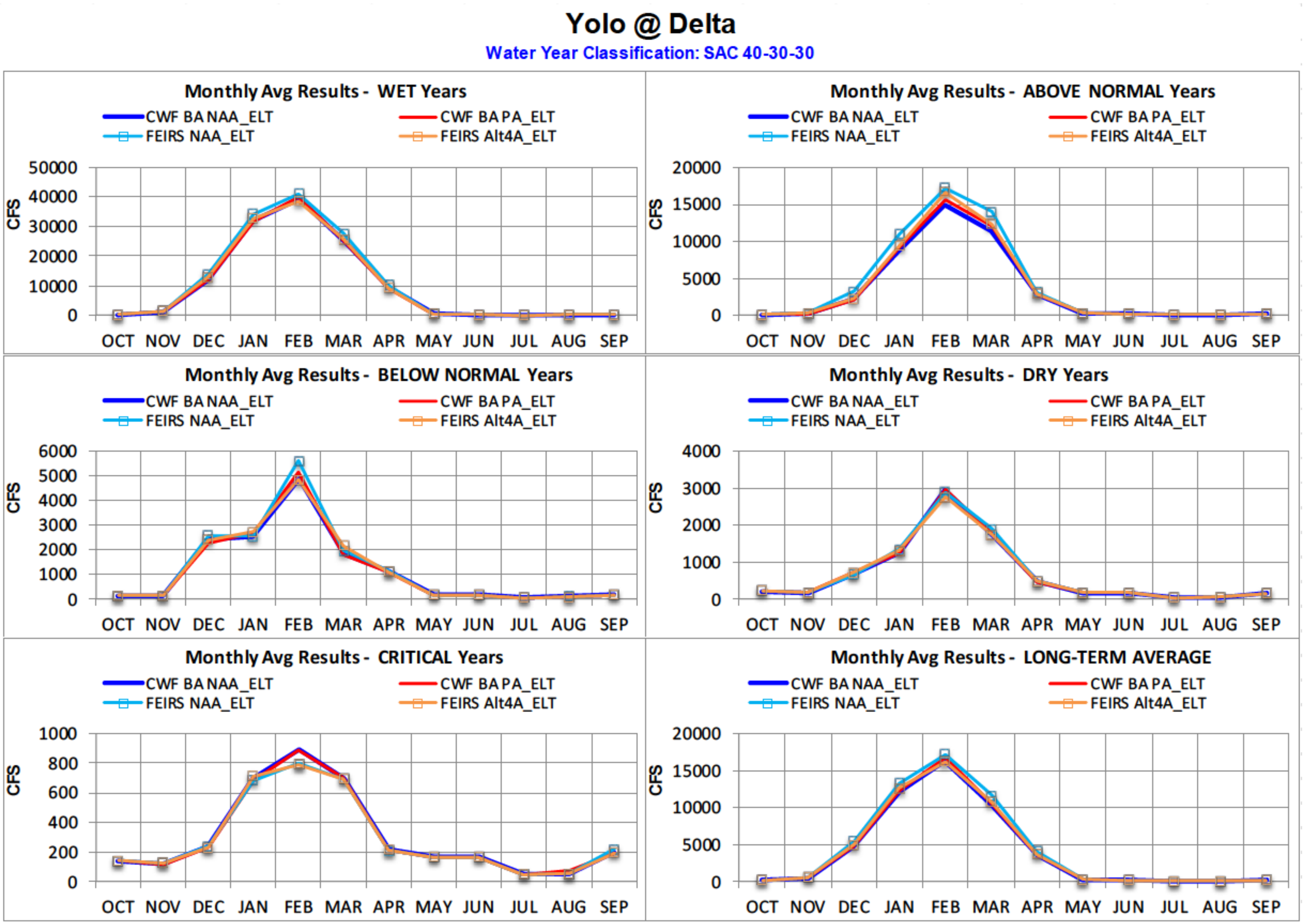


Figure 5G-22. Sacramento River at Freeport, Monthly Average Flow *[WYT based on current climate]*



1
2 Figure 5G-23. Yolo Bypass at Delta, Monthly Average Flow *[WYT based on current climate]*

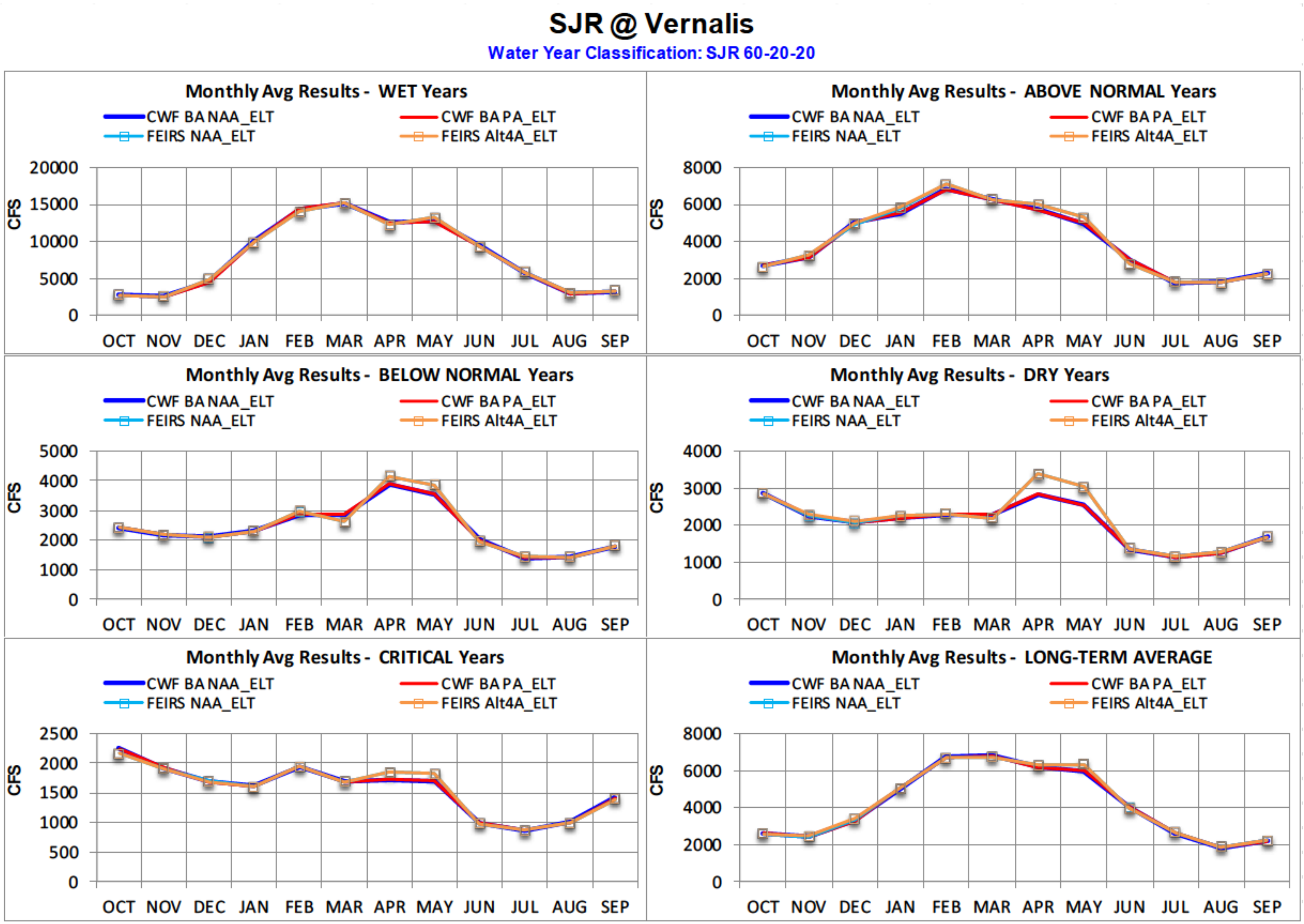


Figure 5G-24. San Joaquin River at Vernalis, Monthly Average Flow *[WYT based on current climate]*

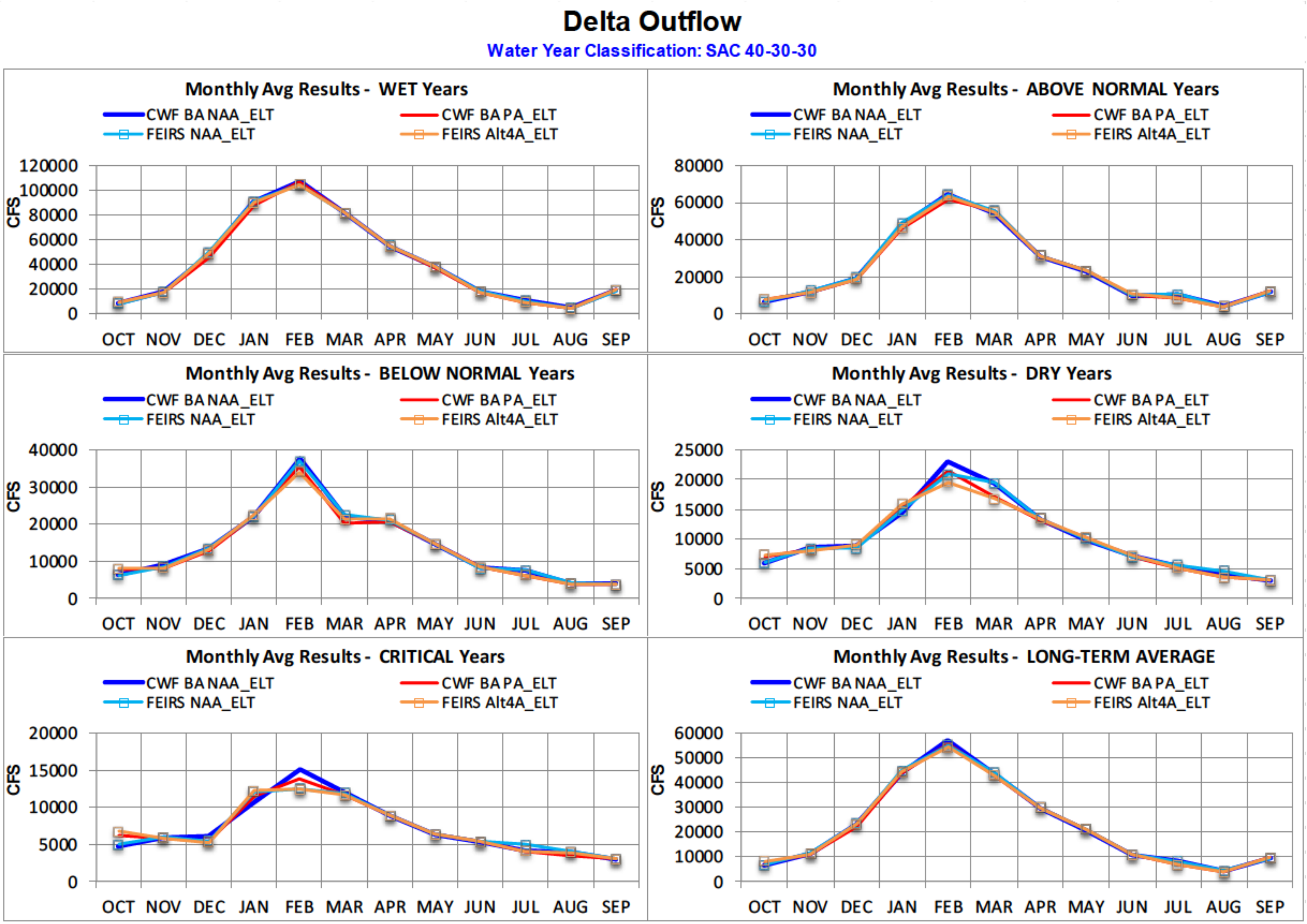


Figure 5G-25. Delta Outflow, Monthly Average Flow *[WYT based on current climate]*

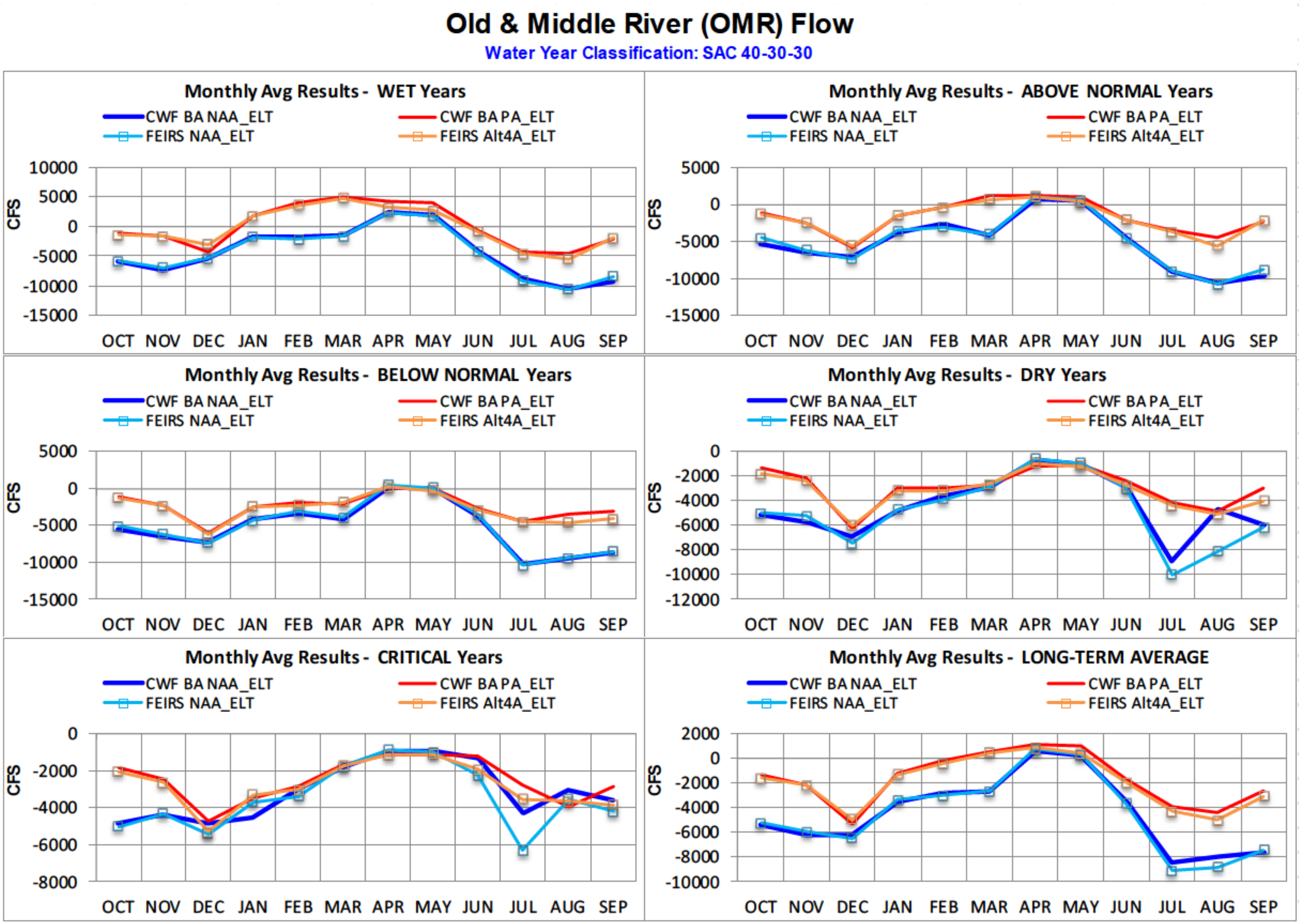


Figure 5G-26. Combined Old and Middle River Flow, Monthly Average Flow *[WYT based on current climate]*

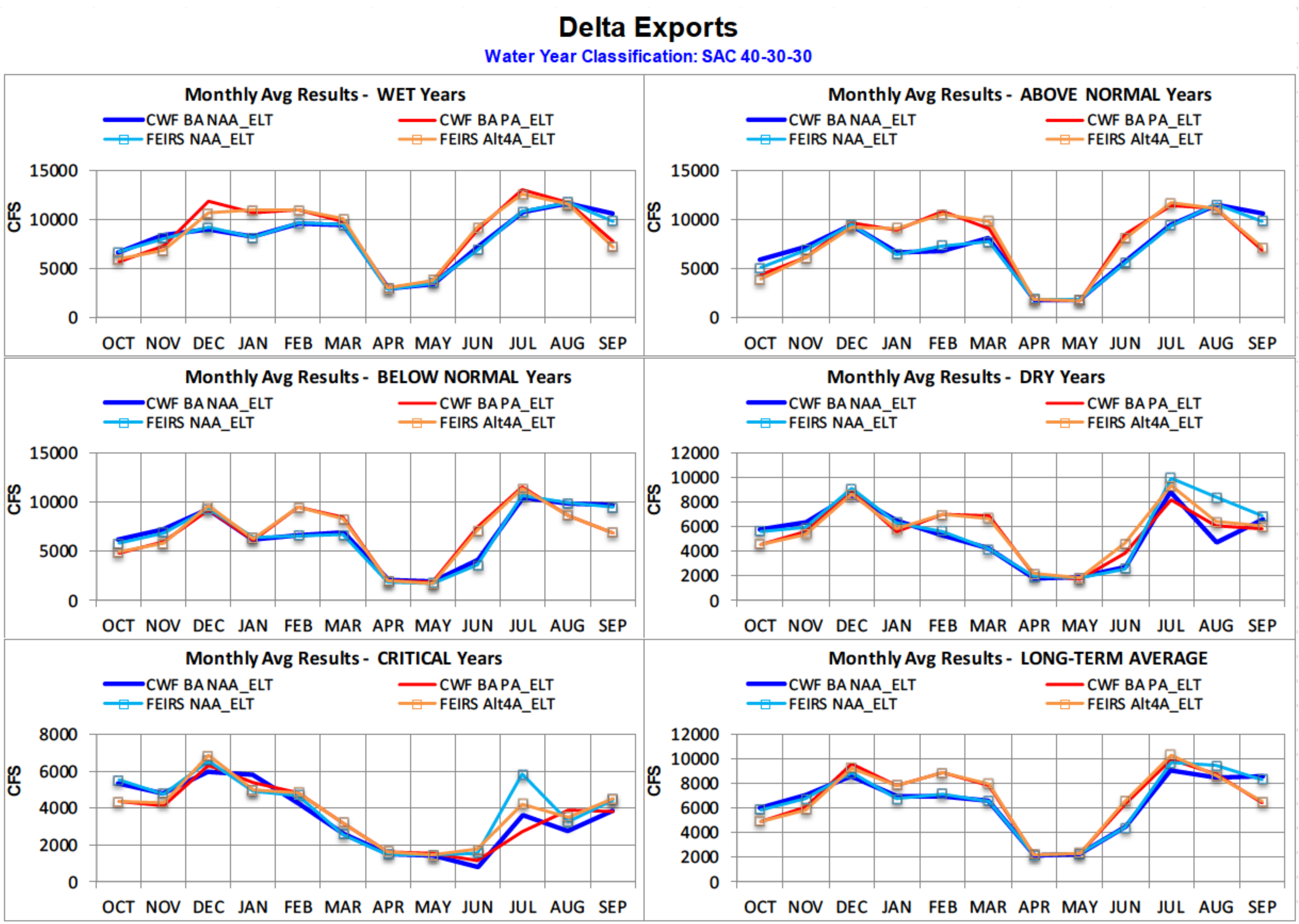


Figure 5G-27. Total Delta Exports, Monthly Average Flow *[WYT based on current climate]*

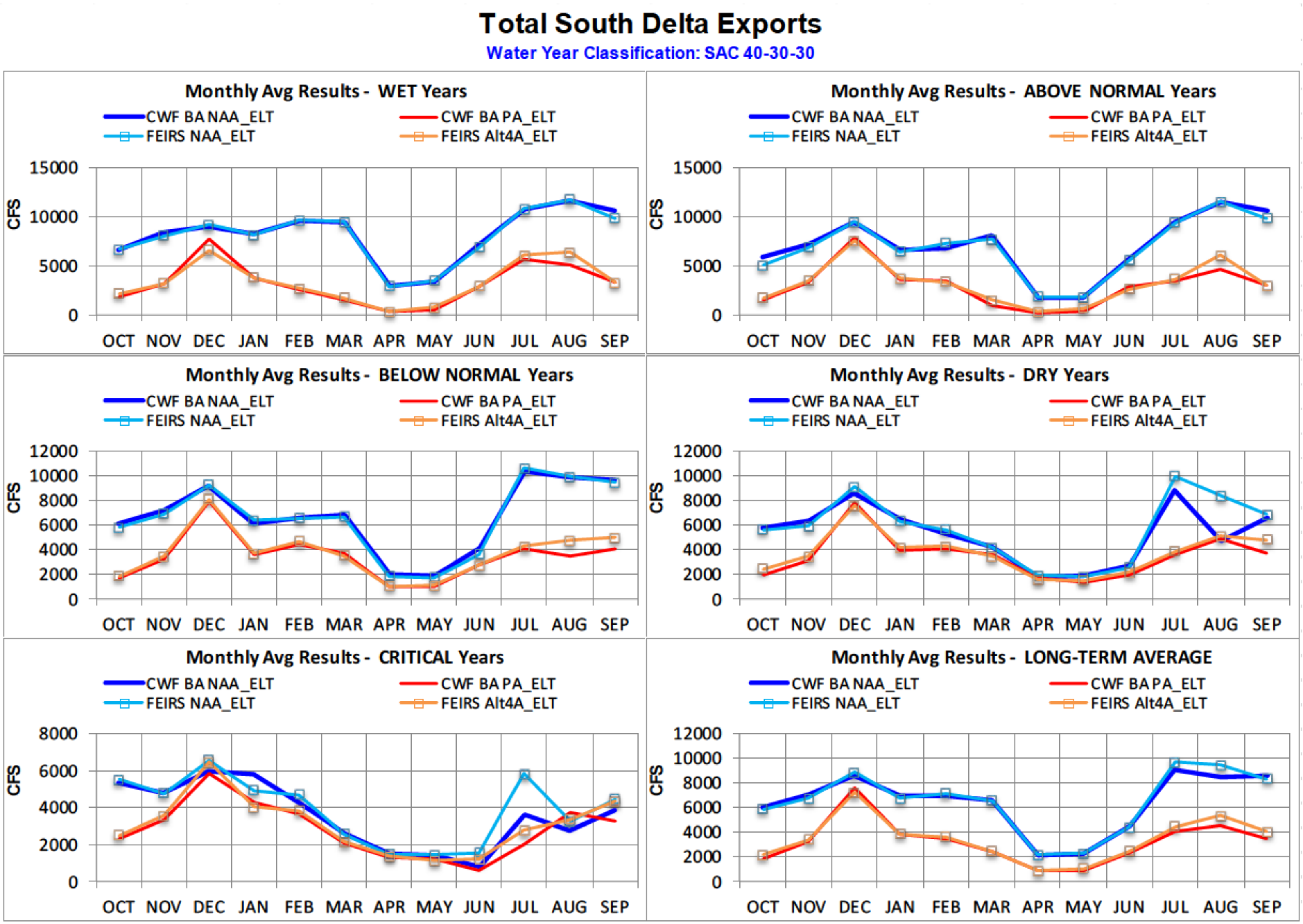


Figure 5G-28. Total South Delta Exports, Monthly Average Flow *[WYT based on current climate]*

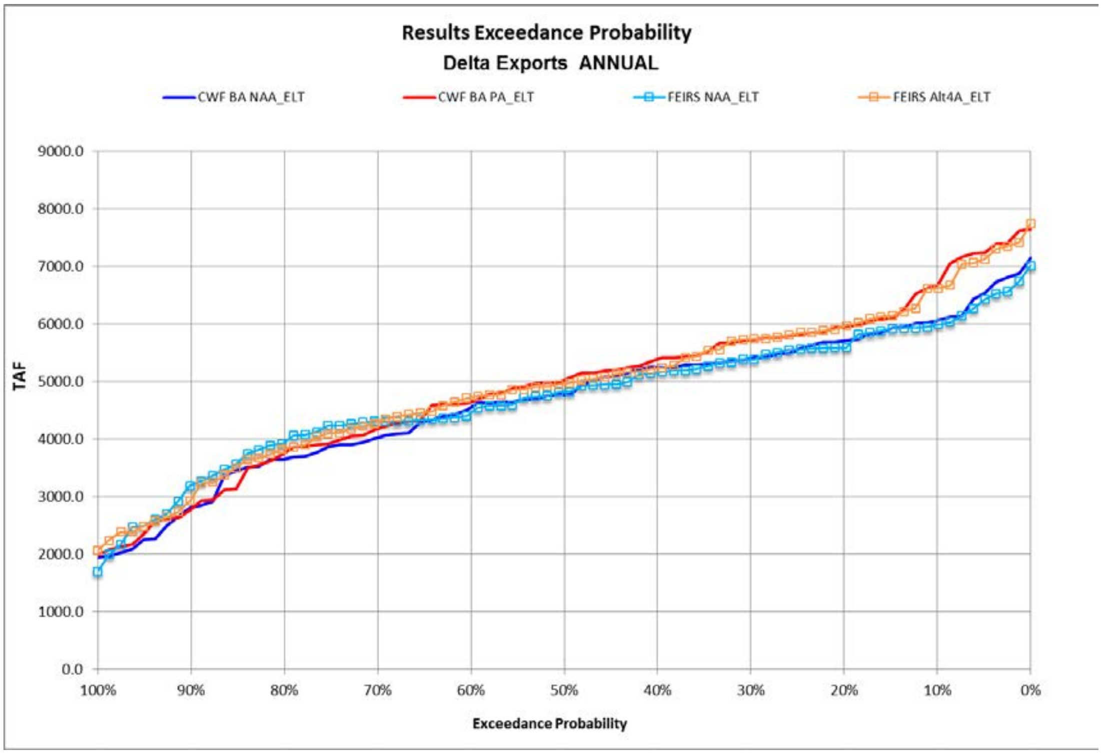


Figure 5G-29. Annual (Oct-Sep) Delta Exports Exceedance Probability

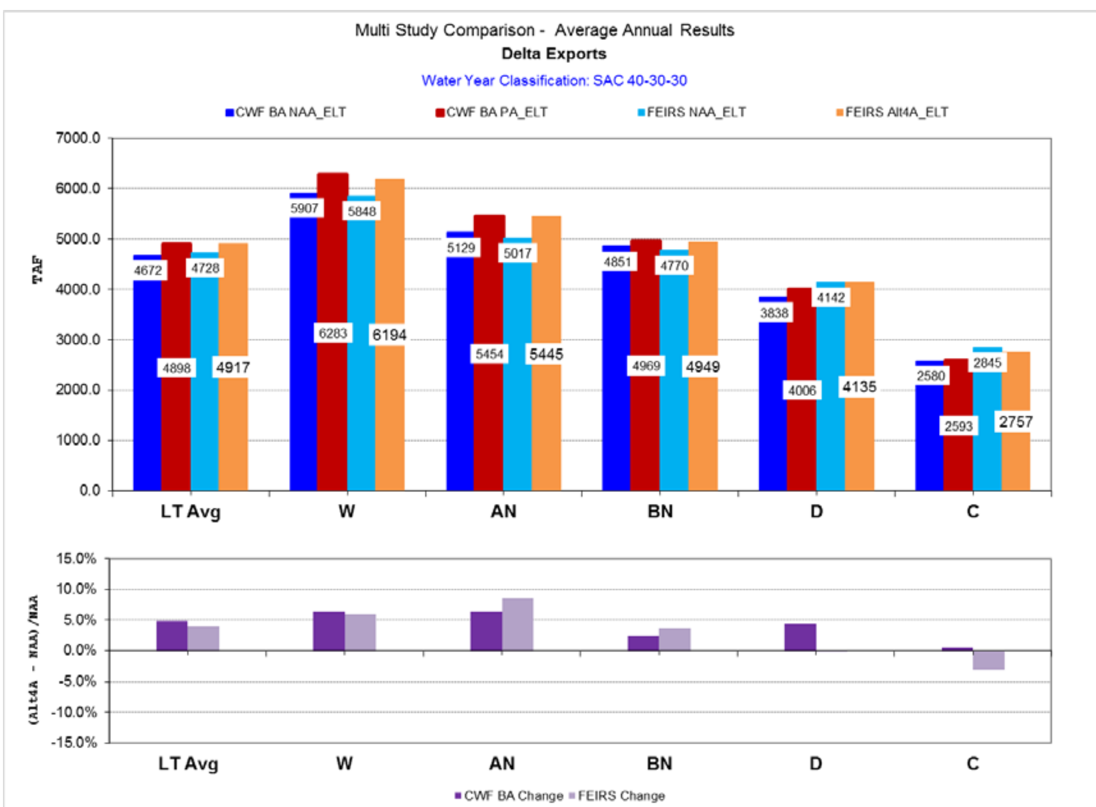


Figure 5G-30. Annual (Oct-Sep) Delta Exports by WYT *[WYT based on current climate]*

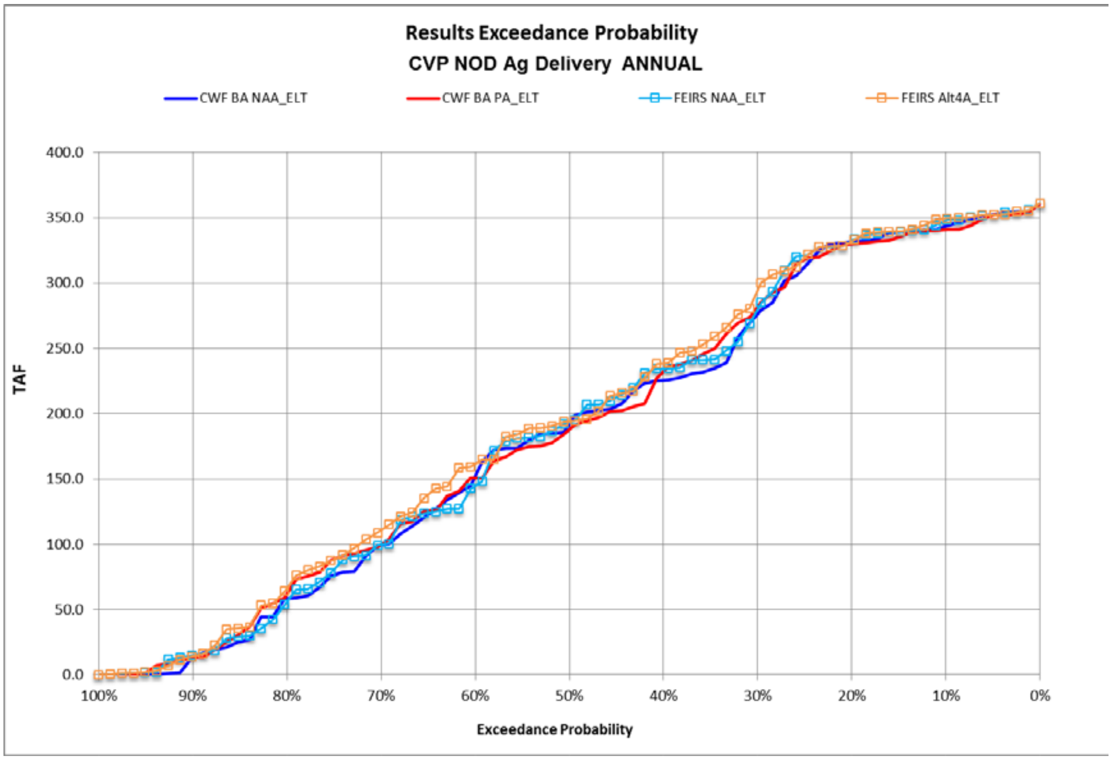


Figure 5G-31. Annual (Oct-Sep) CVP North-of-Delta Ag Deliveries Exceedance Probability

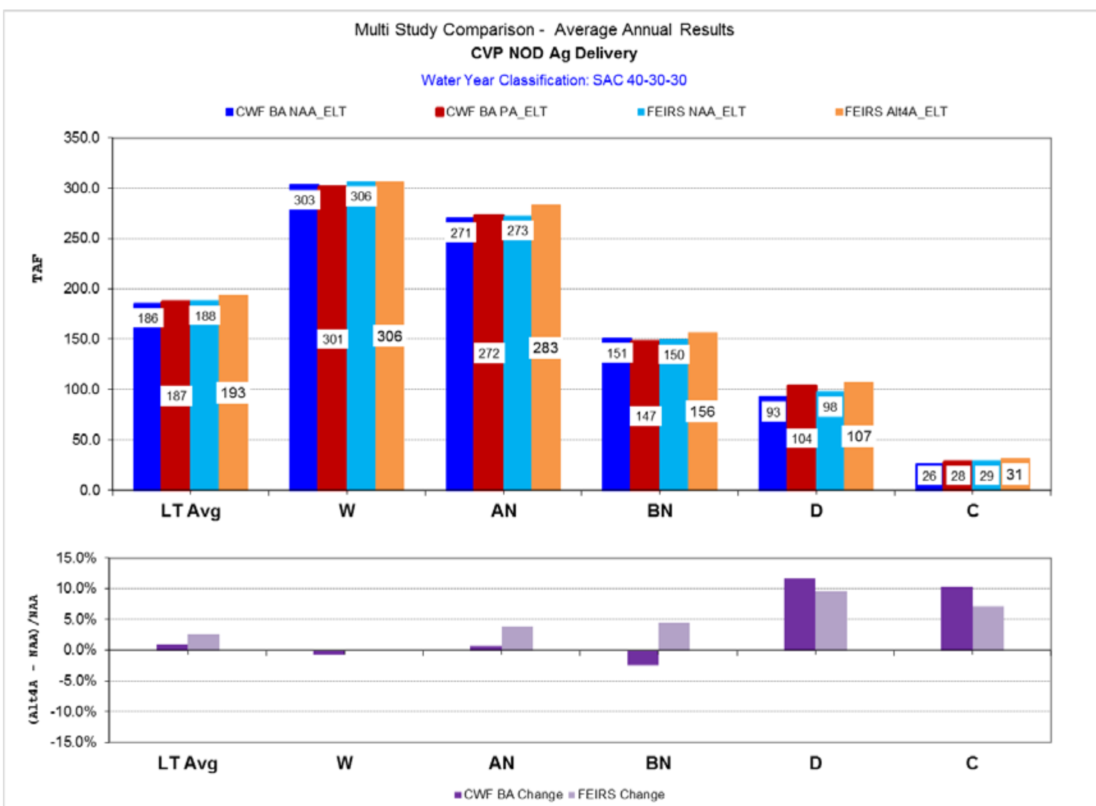


Figure 5G-32. Annual (Oct-Sep) CVP North-of-Delta Ag Deliveries by WYT *[WYT per current climate]*

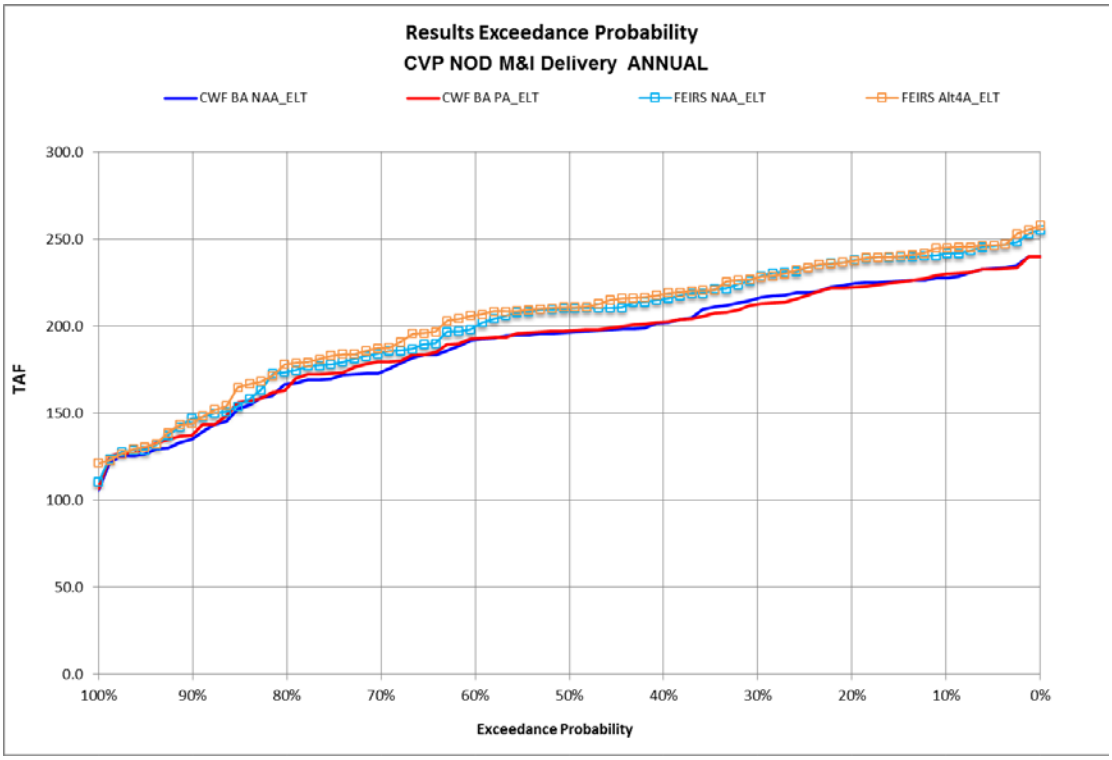


Figure 5G-33. Annual (Oct-Sep) CVP North-of-Delta M&I Deliveries Exceedance Probability

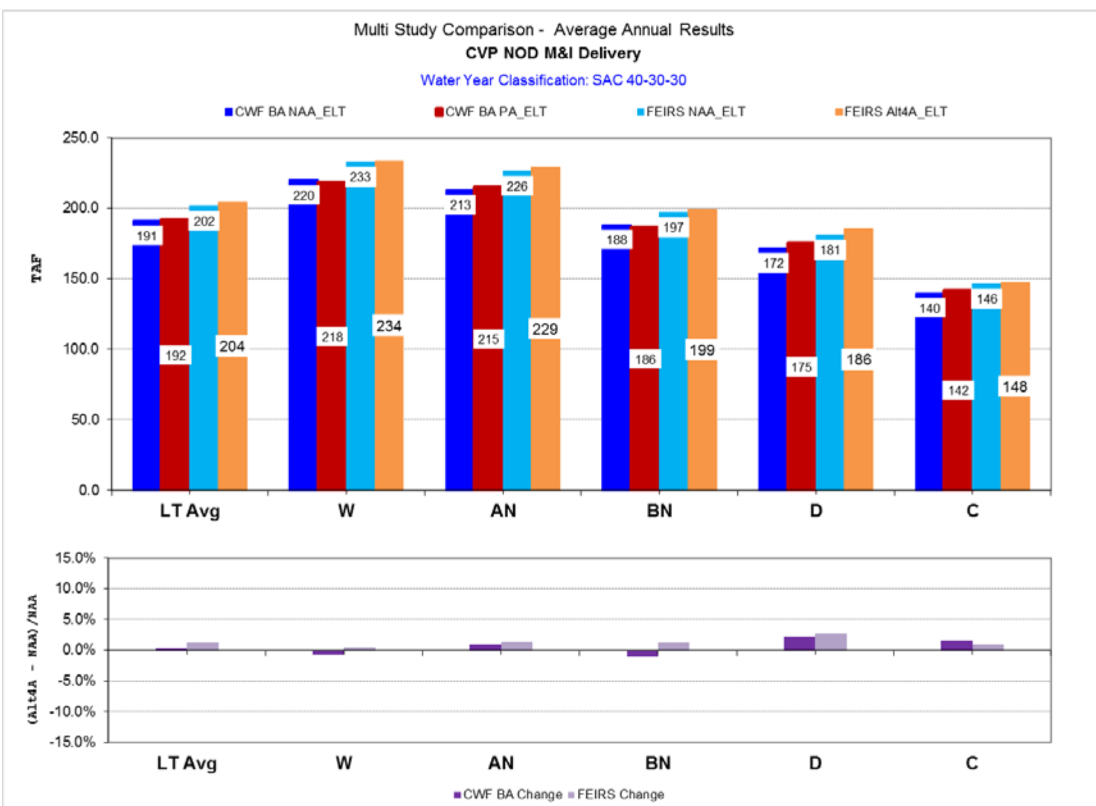


Figure 5G-34. Annual (Oct-Sep) CVP North-of-Delta M&I Deliveries *[WYT per current climate]*

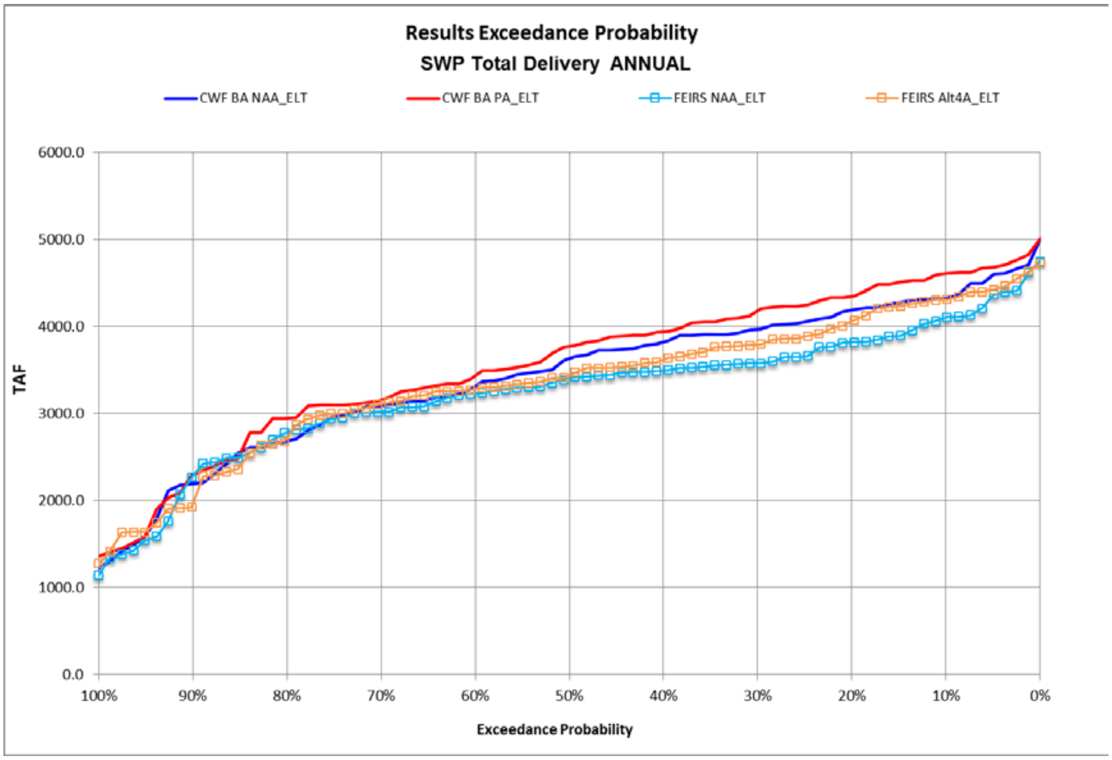


Figure 5G-35. Annual (Oct-Sep) SWP Total Deliveries Exceedance Probability

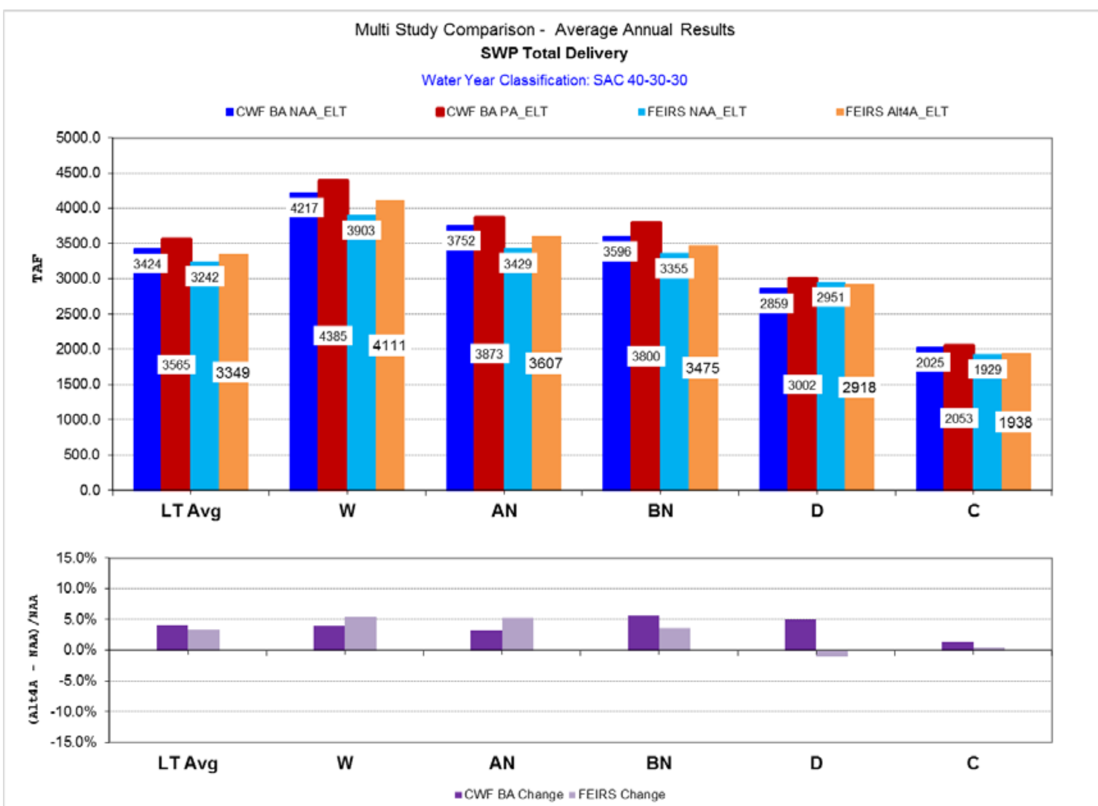


Figure 5G-36. Annual (Oct-Sep) SWP Total Deliveries by WYT *[WYT per current climate]*

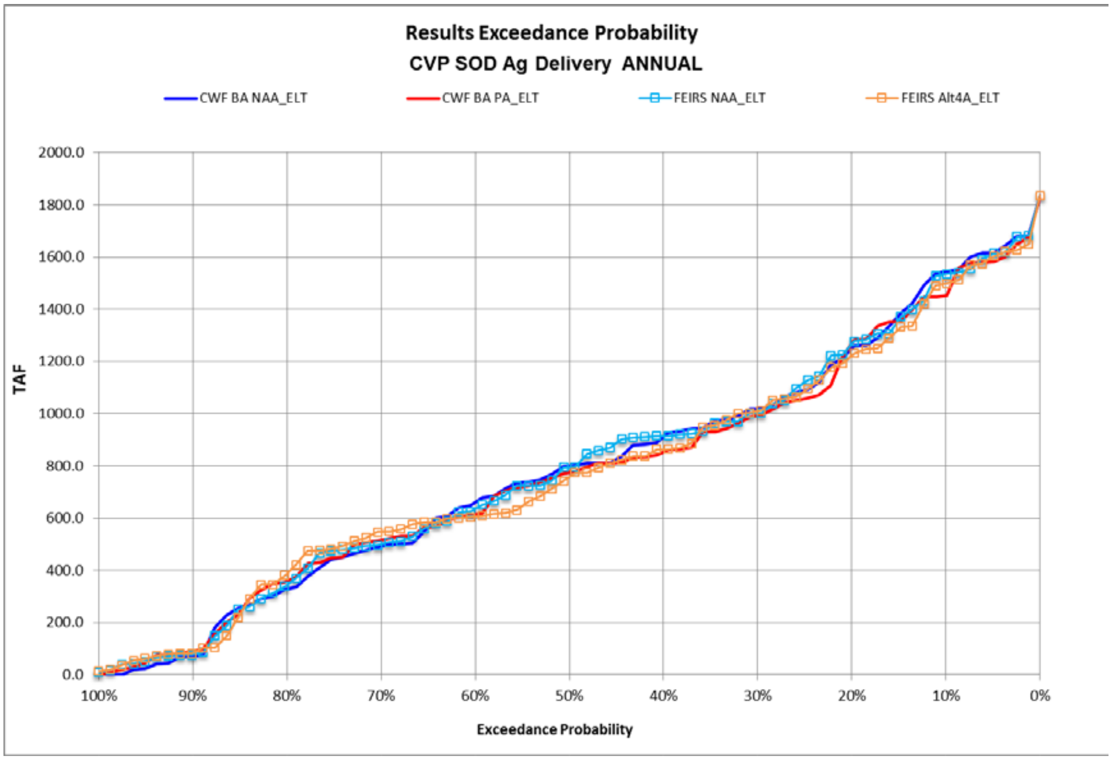


Figure 5G-37. Annual (Oct-Sep) CVP South-of-Delta Ag Deliveries Exceedance Probability

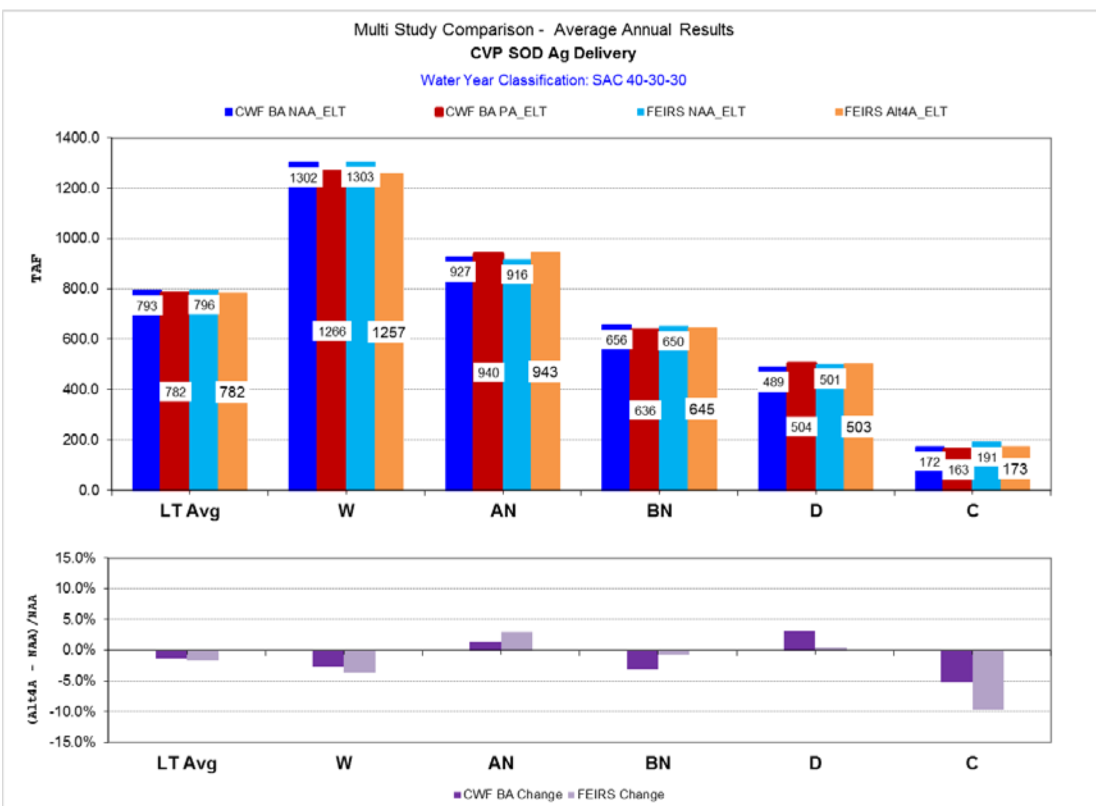


Figure 5G-38. Annual (Oct-Sep) CVP South-of-Delta Ag Deliveries by WYT *[WYT per current climate]*

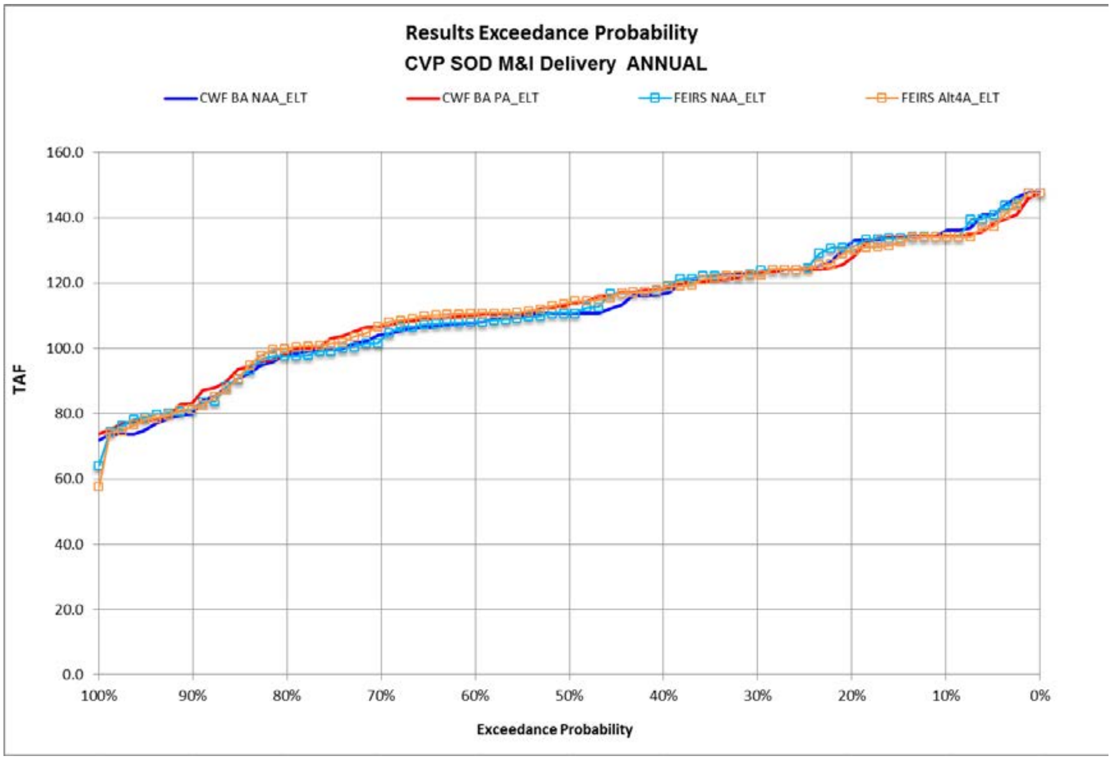


Figure 5G-39. Annual (Oct-Sep) CVP South-of-Delta M&I Deliveries Exceedance Probability

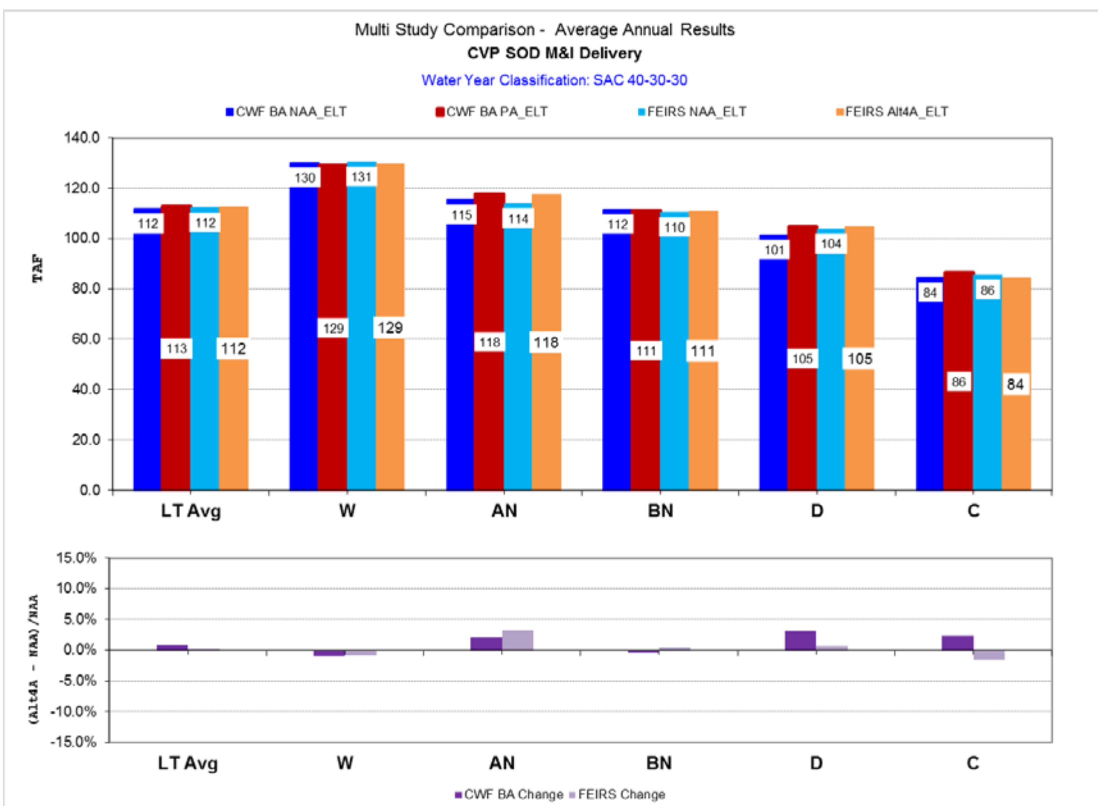


Figure 5G-40. Annual (Oct-Sep) CVP South-of-Delta M&I Deliveries *[WYT per current climate]*

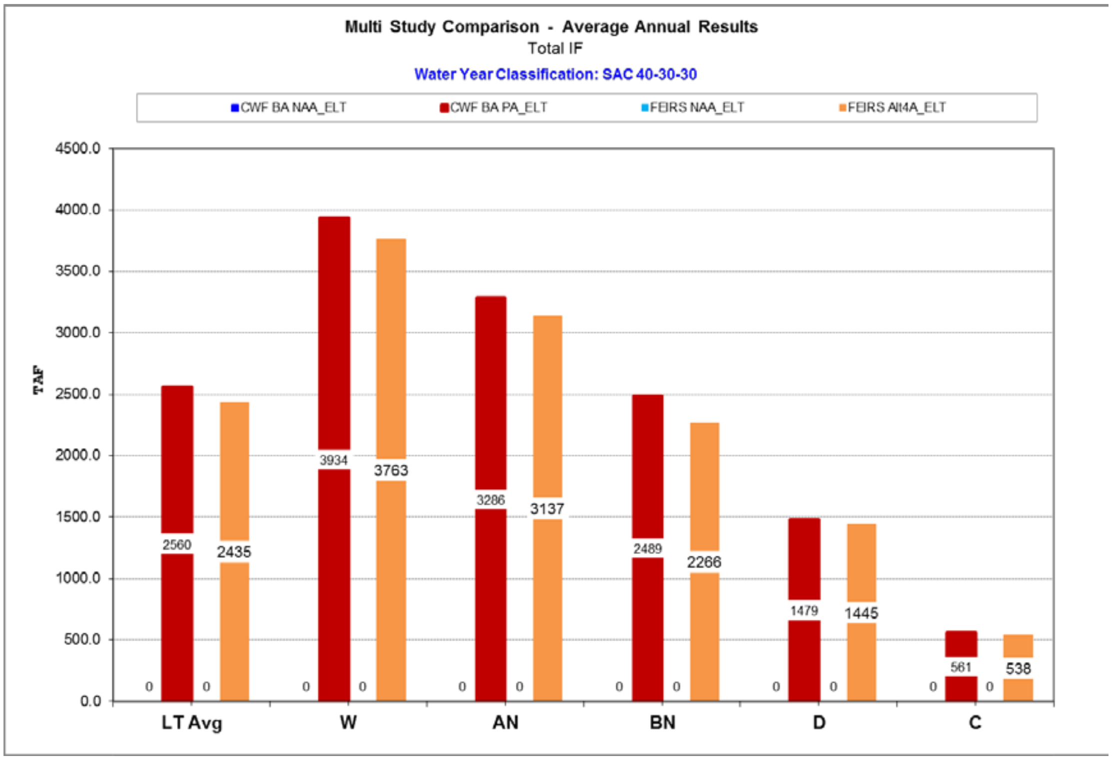


Figure 5G-41. Annual (Oct-Sep) Diversion at North Delta Intakes by WYT *[WYT per current climate]*

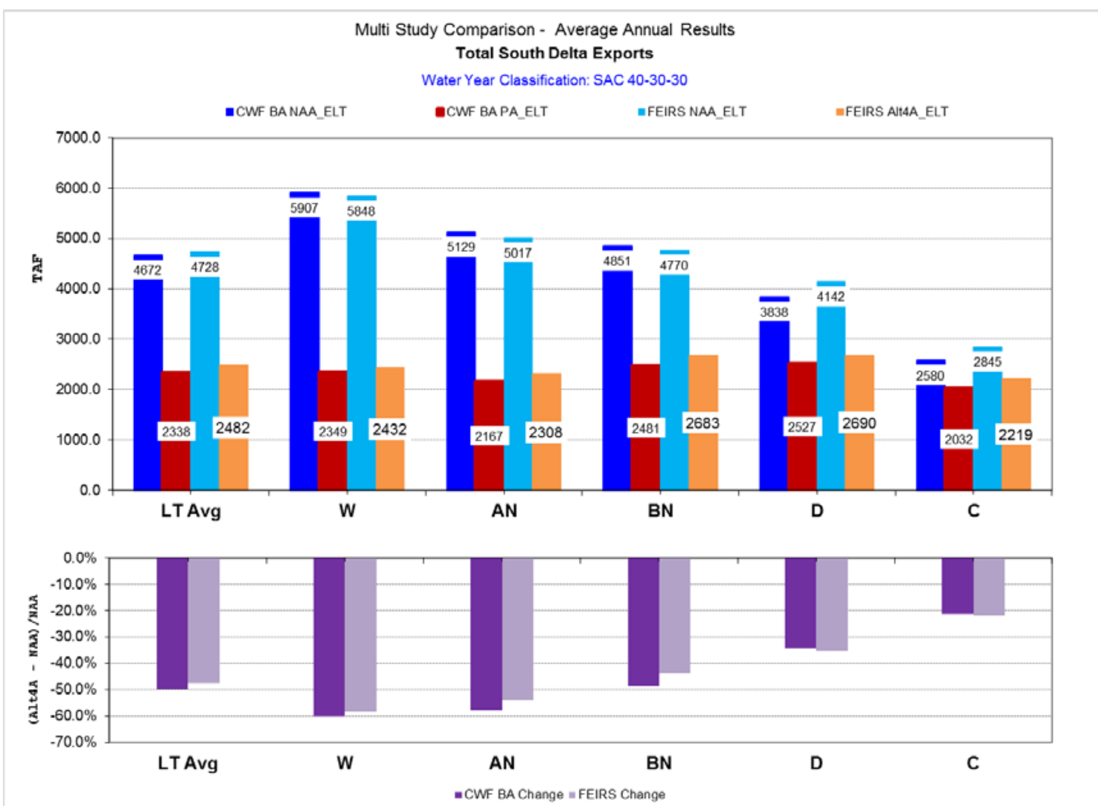


Figure 5G-42. Annual (Oct-Sep) Exports at South Delta Intakes by WYT *[WYT per current climate]*

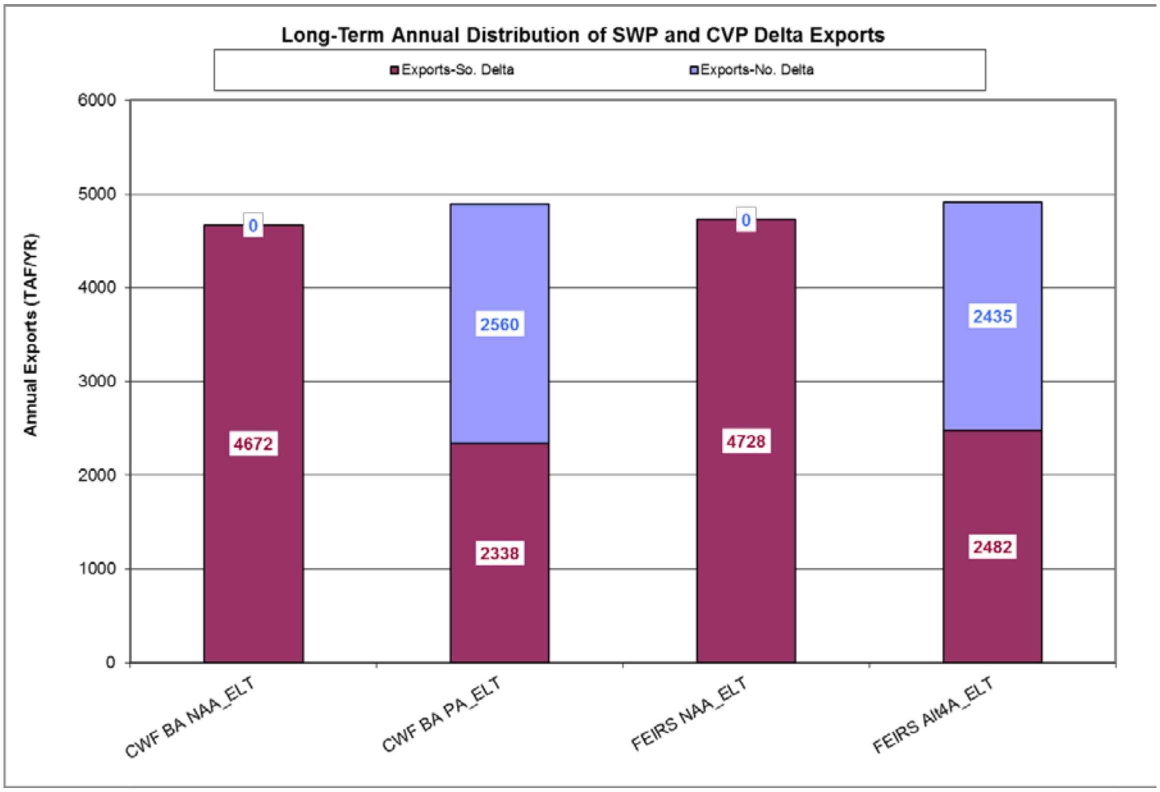


Figure 5G-43. Long-term Annual Distribution of Delta Exports at North and South Delta Intakes

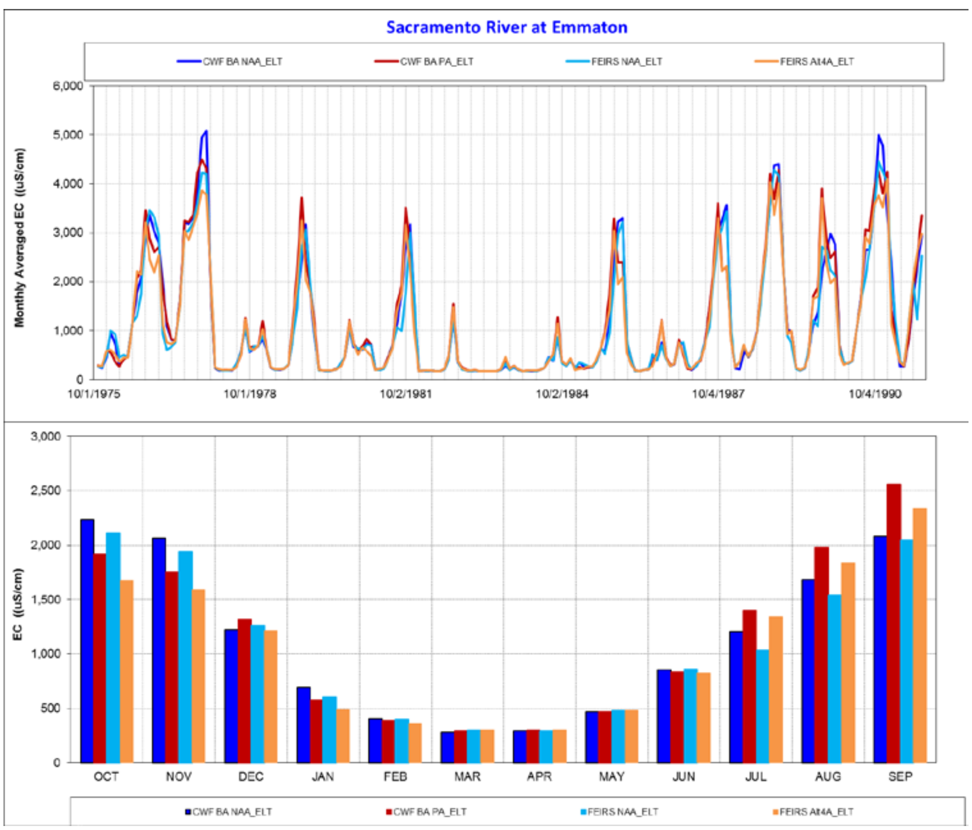


Figure 5G-44. Sacramento River at Emmaton Monthly Average Salinity

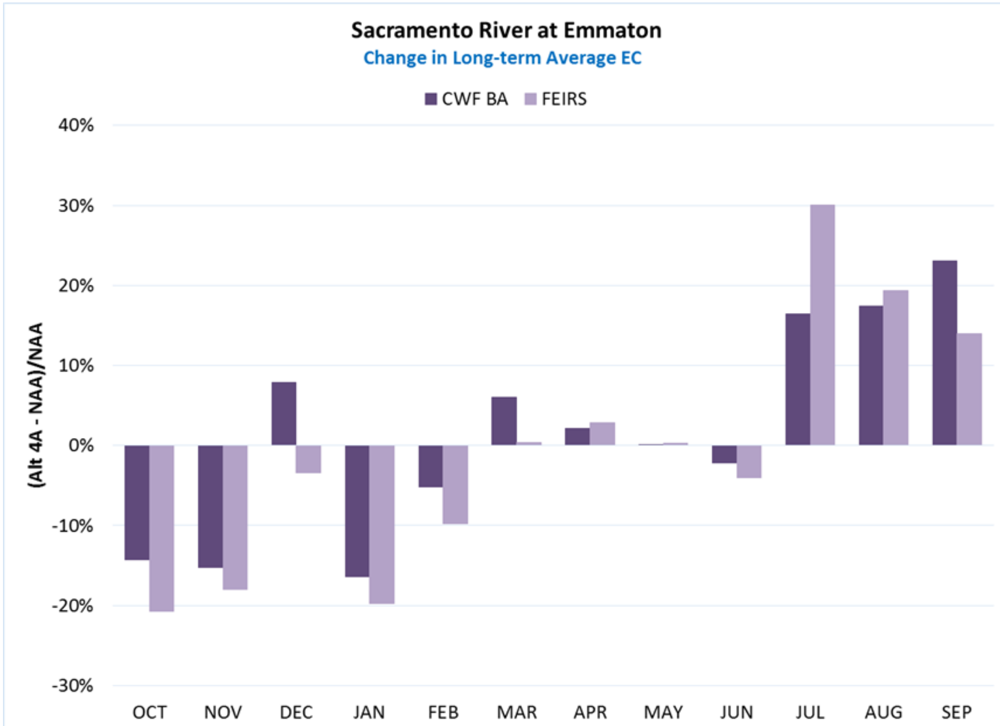


Figure 5G-45. Change in Sacramento River at Emmaton Monthly Long-term Average Salinity under Alternative 4A

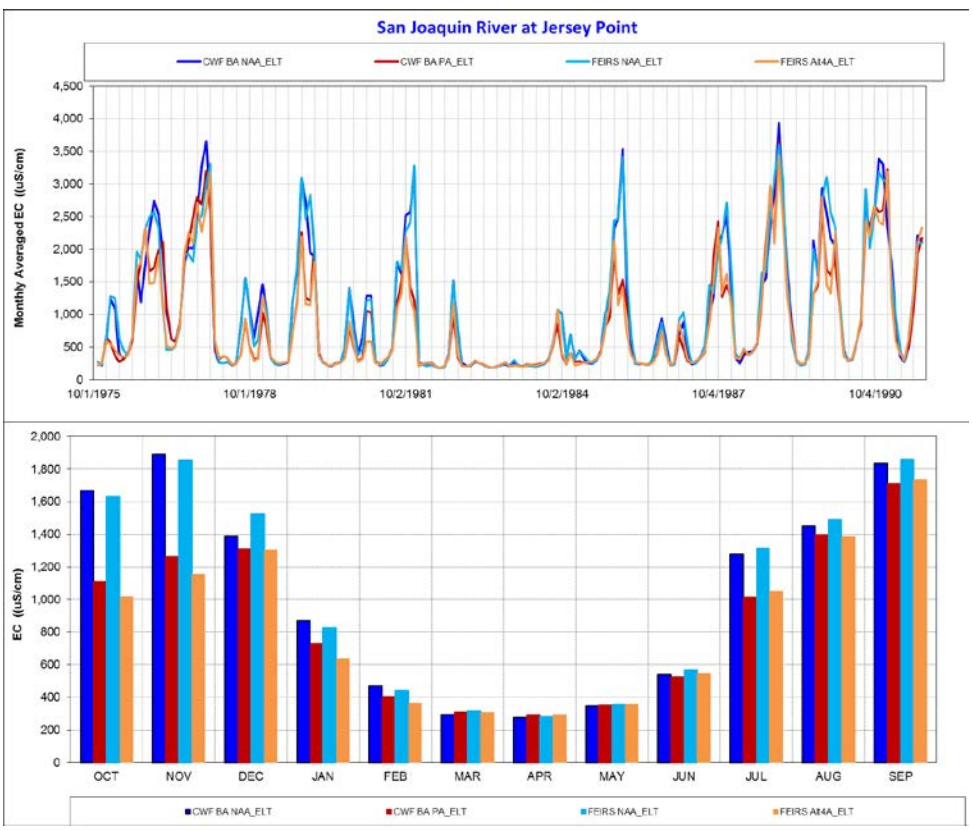


Figure 5G-46. San Joaquin River at Jersey Point Monthly Average Salinity

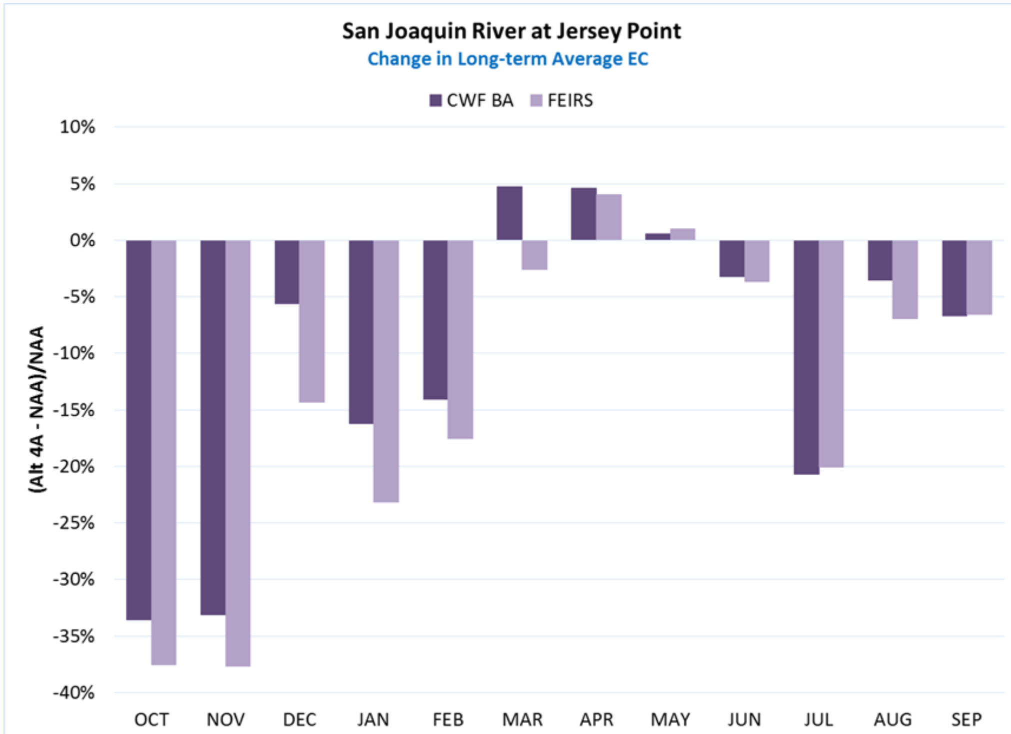


Figure 5G-47. Change in San Joaquin River at Jersey Point Monthly Long-term Average Salinity under Alternative 4A

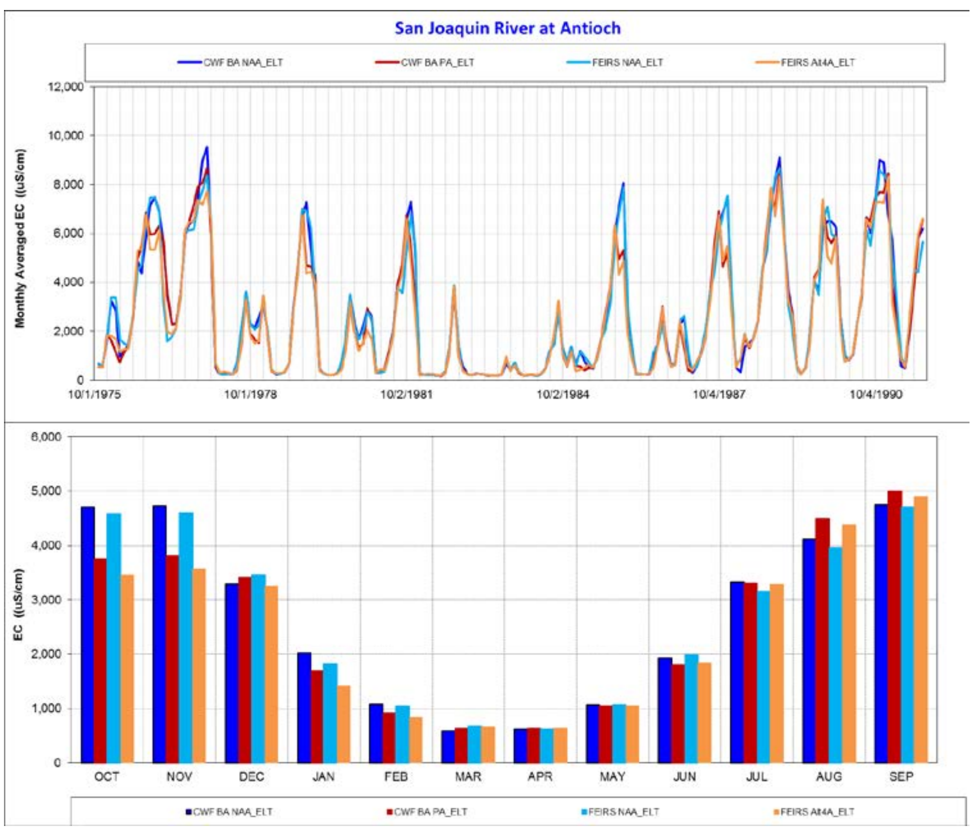


Figure 5G-48. San Joaquin River at Antioch Monthly Average Salinity

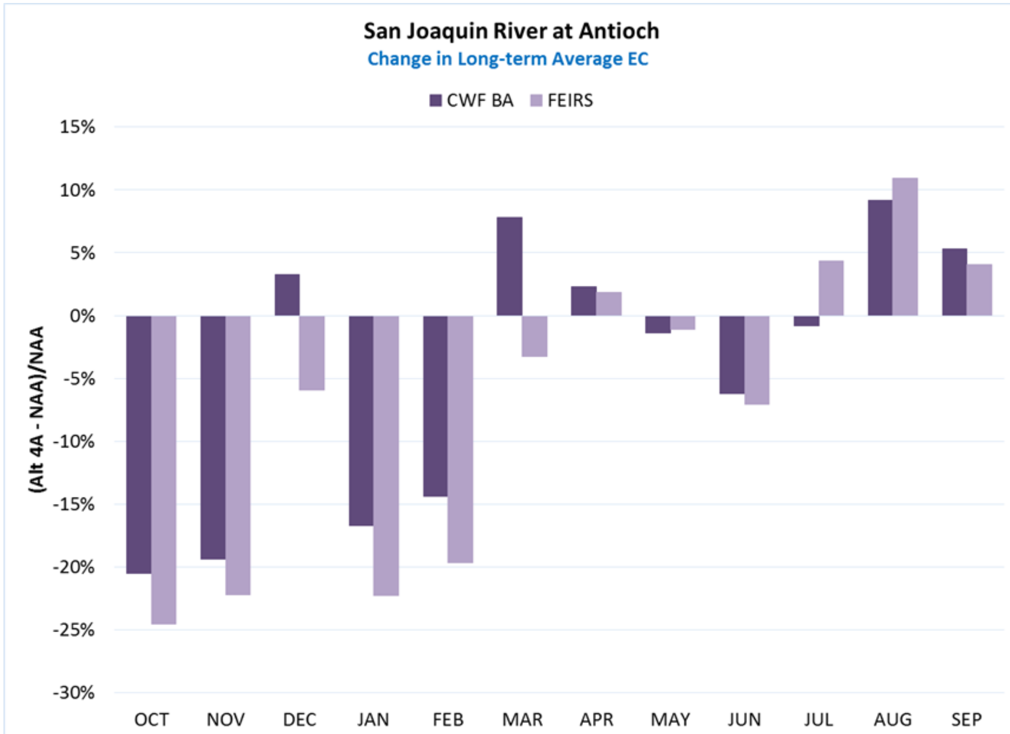


Figure 5G-49. Change in San Joaquin River at Antioch Monthly Long-term Average Salinity under Alternative 4A

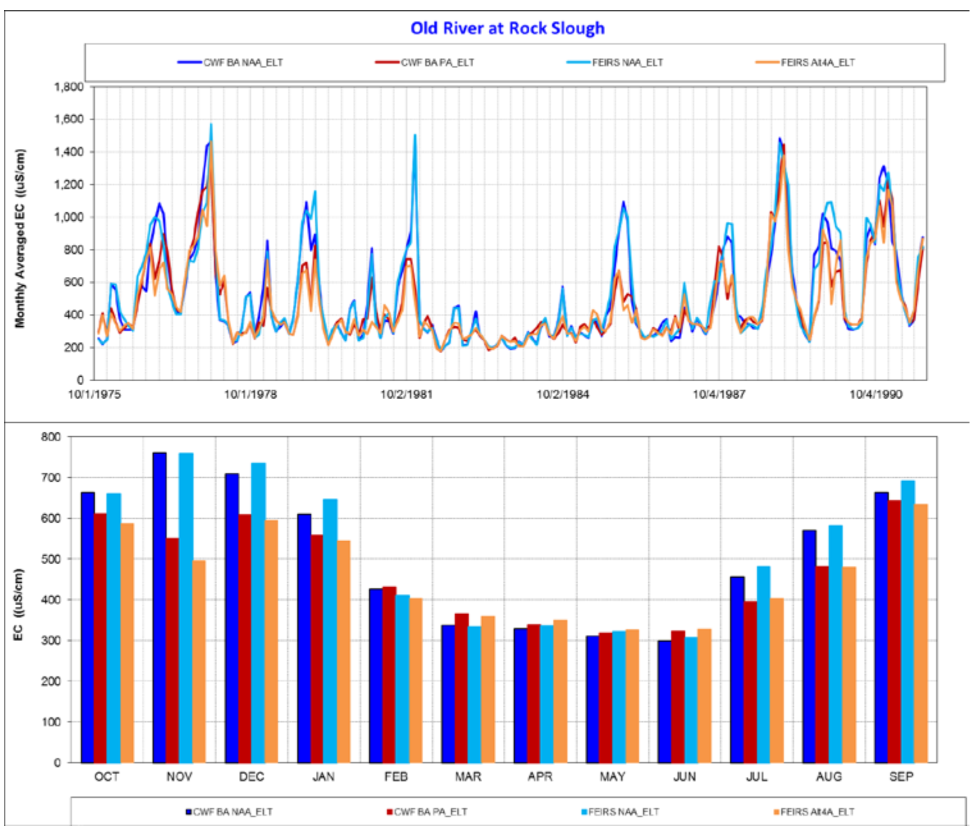


Figure 5G-50. Old River at Rock Slough Monthly Average Salinity

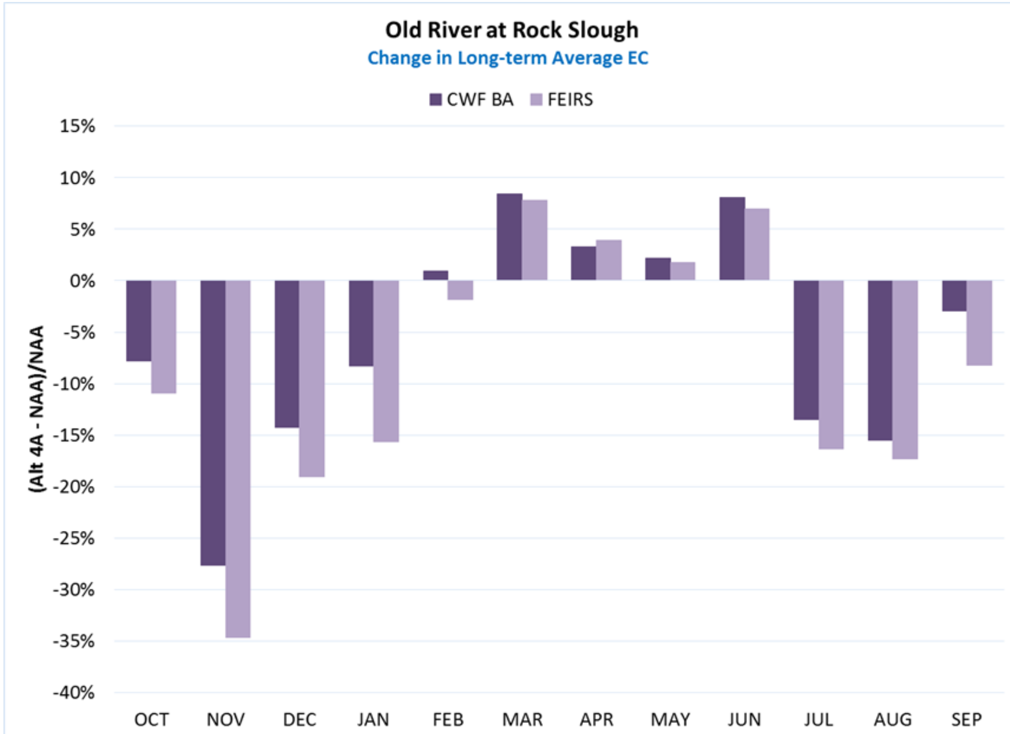


Figure 5G-51. Change in Old River at Rock Slough Monthly Long-term Average Salinity under Alternative 4A