Appendix B

Flexibility in Near-Term Operations and General Hydrologic Data

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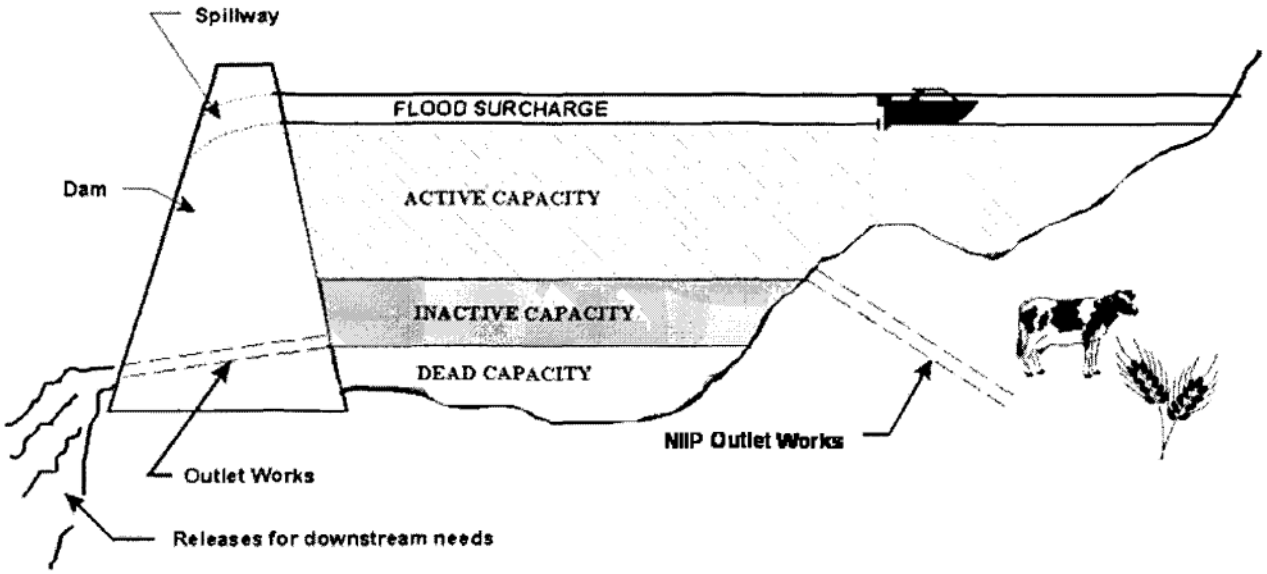
This appendix includes plots of flow at key locations as well as other supporting materials related to chapter II of the EIS.

Please note that the information contained in this appendix has not been updated to include or reflect recently approved depletions for the Long Hollow Reservoir Project or the Jicarilla Apache Nation Navajo River Water Supply Project.

Flexibility in Near-Term Operations and General Hydrologic Data Typical San Juan River Basin Hydrographs

Reservoir Storage Allocation



Definitions:

FLOOD SURCHARGE: Portion of reservoir storage assigned for the purpose of regulating flood inflows to reduce flood damage downstream.
ACTIVE CAPACITY: Portion of reservoir storage assigned to regulate inflow to provide water for purposes such as irrigation, municipal and industrial use, fish & wildlife, recreation, etc.
INACTIVE CAPACITY: Portion of reservoir storage exclusive of and above the dead capacity, from which stored water is not normally available due to operating agreements or physical restrictions.
DEAD CAPACITY: That portion of a reservoir that cannot be evacuated by gravity.

Introduction

The Bureau of Reclamation has prepared a Final Environmental Impact Statement (FEIS) for the purpose of operating Navajo Dam to implement Endangered Species Act (ESA) related flow recommendations on the San Juan River. This appendix describes hydrologic data associated with the project.

Flexibility

The Navajo Reservoir EIS evaluated three alternatives that would provide flows to conserve, in concert with other recovery actions, endangered fishes in the San Juan River and provide water for development. Only the Preferred Alternative (250/5000 release ranges) could meet all the requirements of the Flow Recommendations and future development, mainly completion of NIIP and ALP.

But these two projects are many years away from completion and using their total depletion allocations. Therefore, it has been assumed that there is "flexibility" in increasing the minimum release from Navajo Dam of 250 cfs as defined in the Preferred Alternative to some higher value. This report will summarize the analysis made to verify that flexibility may exist during non-drought years and during an interim period of time before full development occurs.

Method.—The San Juan River Basin Hydrology Model, using the RiverWare software, was the tool used to evaluate alternatives for the EIS.[1] The model configuration of the Preferred Alternative was modified to show reduced depletions for NIIP and ALP that would represent development for these two projects about 10 years in the future from current uses. Table 1, "NIIP development schedule reflecting the acreage farmed or projected to be farmed in each year through full development," from pages 8 and 9 of the Navajo Indian Irrigation Project Biological Assessment - June 11, 1999, was used to estimate project completion for NIIP. It was assumed that SJWC and the ALPWCD would be using their entire allocation, while the two Ute Tribes would not be using any water.

NIIP's average annual usage 10 years in the future was estimated to be 288,504 af of diversions to support 230,803 af of depletions on 94,570 acres. From table 1, this would occur in the year 2007. Current use is projected to be 204,000 af, which occurred in the year 1999 from table 1. Since they do not appear to be on schedule, it was assumed that only 8 years of development could be completed in the next 10 years, so 2007 from table 1 should represent water use 10 years from now.

ALP would be delivering 5,200 af to ALPWCD in Colorado, 20,800 af to SJWC in New Mexico and 4,680 af to the Navajo Nation in Shiprock, for a total diversion amount of 30,680 af per year. All other ALP uses were set to zero.

Total reduction in annual diversions are: NIIP: 337,500 - 288,504 = 48,996 af plus
ALP: 109,749 - 30,680 = 79,069 af; total = 48,996 + 79,069 = **128,065 af**.

These new adjustments to San Juan River Basin demands and depletions were read into the model and the minimum release from Navajo Reservoir was increased from 250 cfs to 350 cfs for the months of May-October. November-April remains at 250 cfs.

Results.—The model was run and the water supply was checked for shortages. None were found. Flow Recommendations were evaluated through the post-processing analysis and no violations of those recommendations occurred.

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[1] Use of the model in the work of the SJRBRIP does not necessarily constitute agreement or approval by individual program participants with the model data, methodologies, or assumptions. Use of the model does not change the responsibilities of the respective States to maintain records of water rights and water use. Official records of water rights and water use are maintained by the State agencies statutorily charged with that responsibility.

Conclusion.—Assuming these modifications depict water usage 10 years in the future, model results show that water supplies can be made and flow recommendations can be met when compared with the 1929–93 hydrology when minimum allowable releases are increased from 250 to 350 cfs during the months of May-October.

General Data

The following graphs depict typical wet, average and dry year conditions for the San Juan River at Archuleta, Farmington and Four Corners, and the Animas River at Farmington comparing the flows resulting from implementation of the Preferred Alternative (250/5000) to the No Action Alternative. The graphs were developed from model simulations of the system for the two conditions. In each case, two years were chosen to represent each of the conditions. The two dry years were selected from the lowest 10 percent of the years, the average years were selected from the middle 10 percent of the years, and the wet years from the wettest 10 percent. The model simulations represent hydrologic conditions from the 1929-1993 water year period.

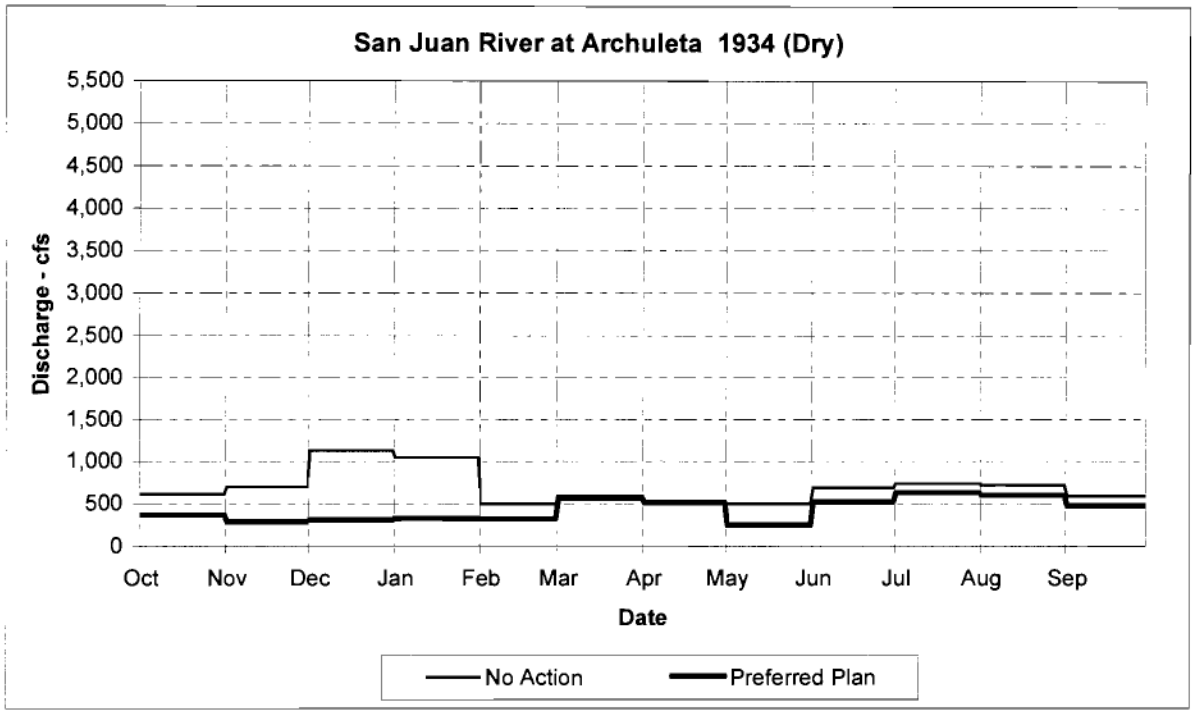
The San Juan River at Archuleta graphs demonstrate how operating Navajo Dam to implement flow recommendations will alter releases patterns. In dry conditions, spring peak releases would probably not be required, and the minimum release of 250 cfs might not be adequate to support target base flows in the recovery reach of the river. Under average conditions, lower releases can be expected during the non-spring release period. During spring release times, releases would be substantially larger than under the No Action alternative. In wet years, releases needed to evacuate flood storage space will be attempted to be made during the spring release period.

Graphs of the Animas River at Farmington show the impacts of the modified Animas-La Plata Project.

Graphs of the San Juan River at Farmington and Four Corners generally show that flows will be higher during the spring peak release and lower the remainder of the time.

Three graphs show a frequency distribution of monthly Navajo Reservoir releases for each alternative. Releases are sorted by month and ranked in ascending order.
Also shown are the end-of-month contents and water surface elevations of Navajo Reservoir for each alternative. A frequency distribution of end-of-month contents is shown in one graph and the three remaining time series graphs depict end-of-month water surface elevations with each alternative compared against the historical elevations.

Figure 1. - San Juan River at Archuleta, NM Comparing the Preferred Alternative to the No Action Alternative - Typical Dry Years



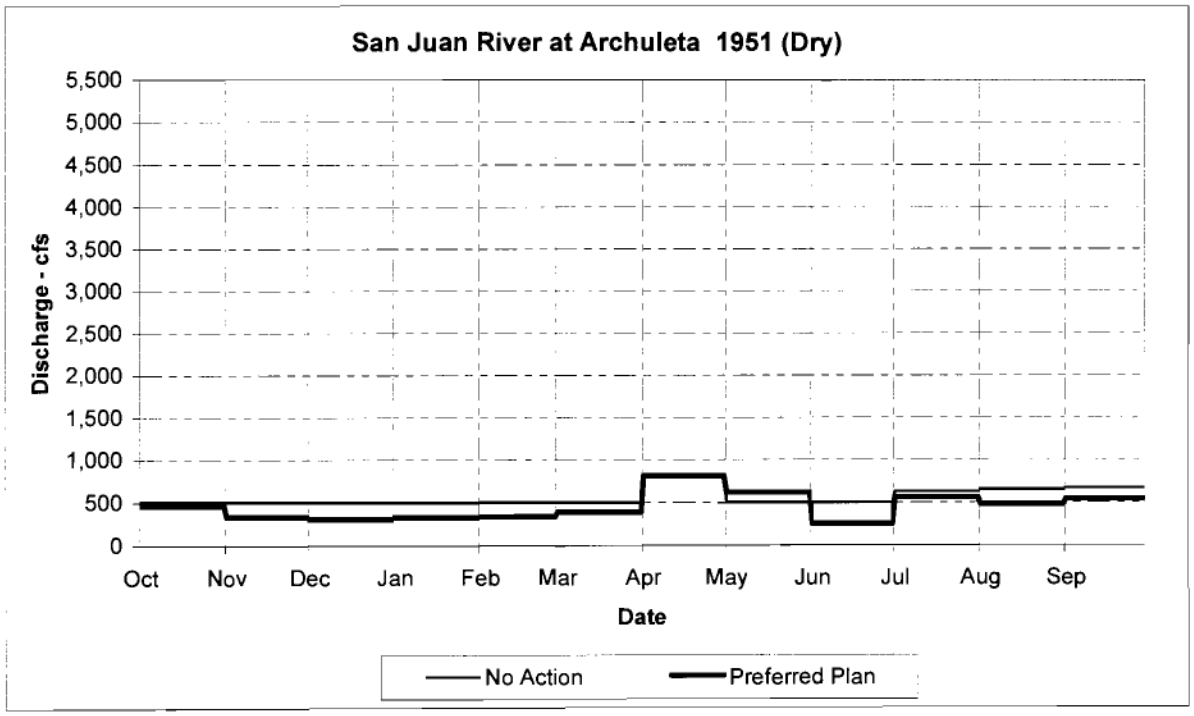
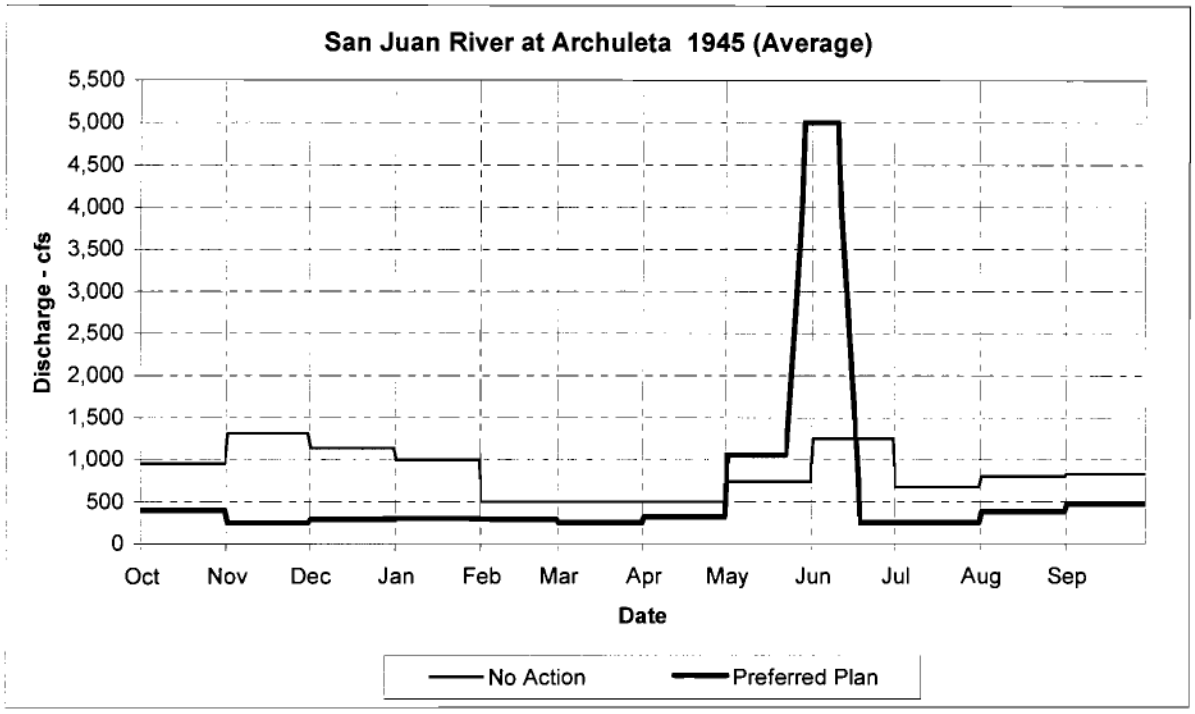


Figure 2. - San Juan River at Archuleta, NM Comparing the Preferred Alternative to the No Action Alternative - Typical Average Years



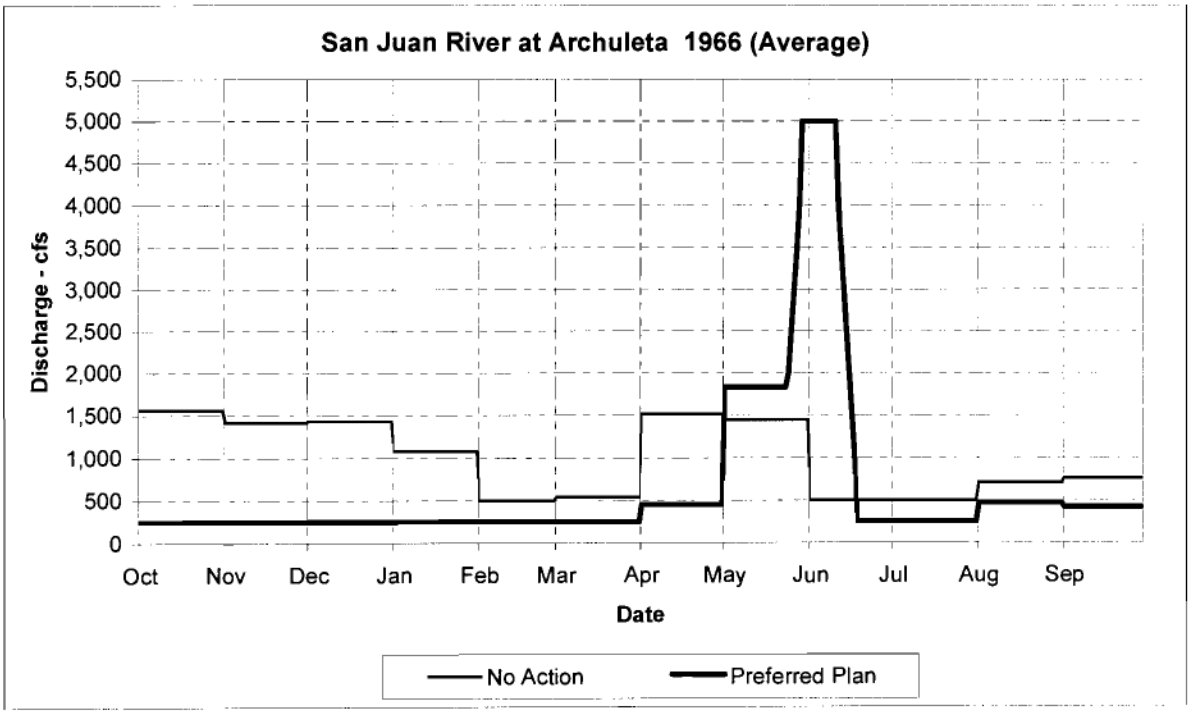
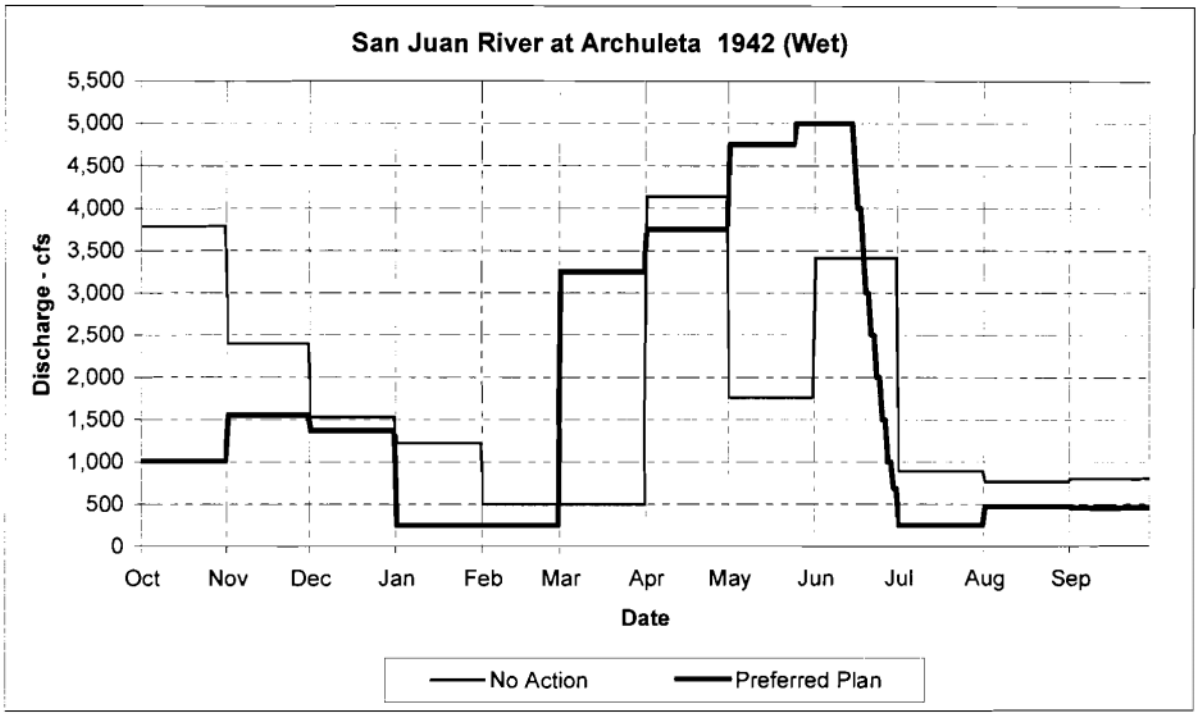


Figure 3. - San Juan River at Archuleta, NM Comparing the Preferred Alternative to the No Action Alternative - Typical Wet Years



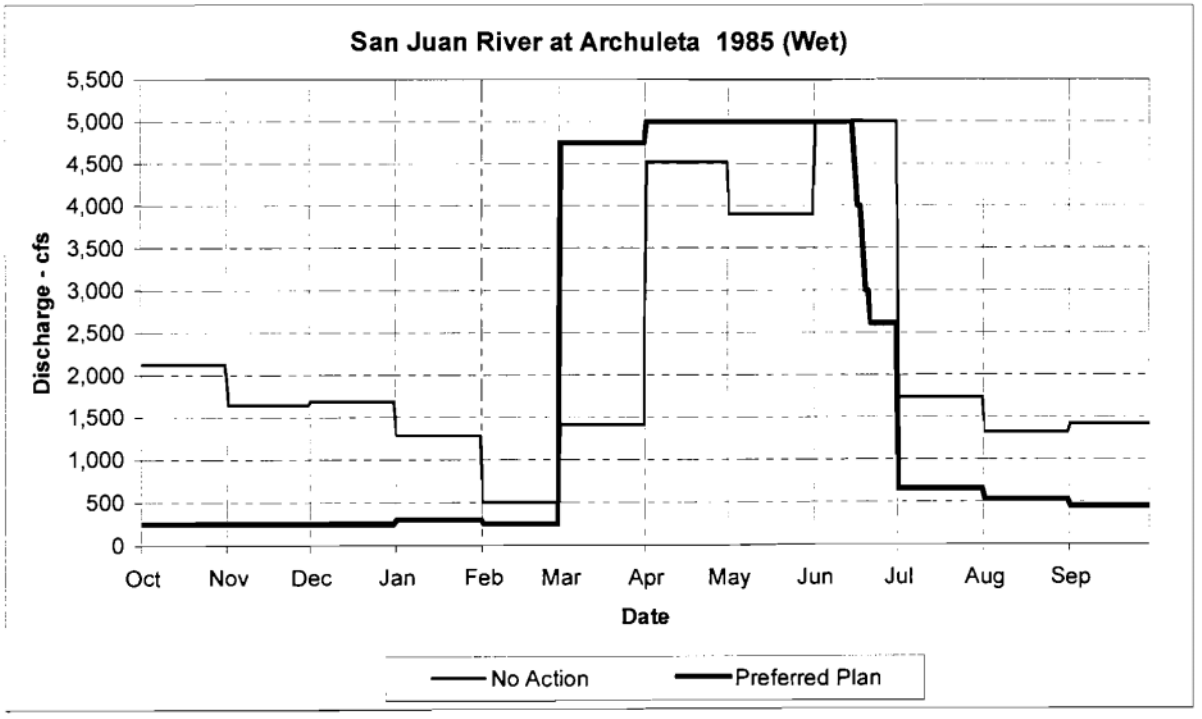
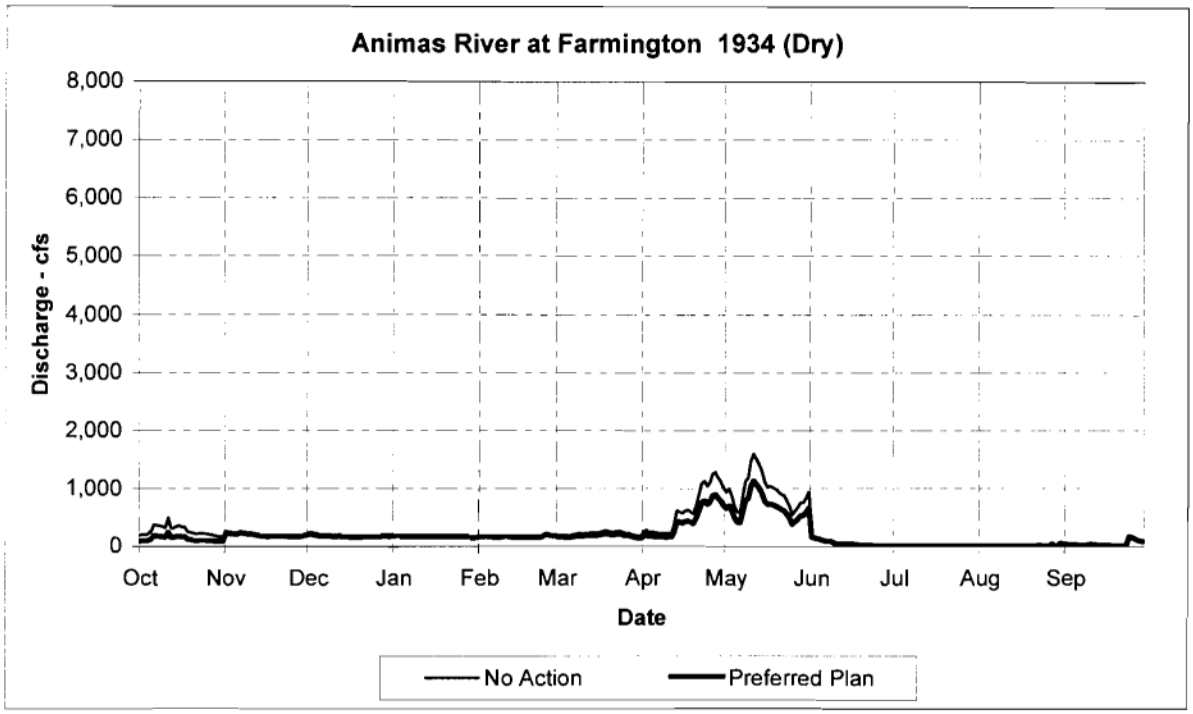


Figure 4. - Animas River at Farmington, NM Comparing the Preferred Alternative to the No Action Alternative - Typical Dry Years



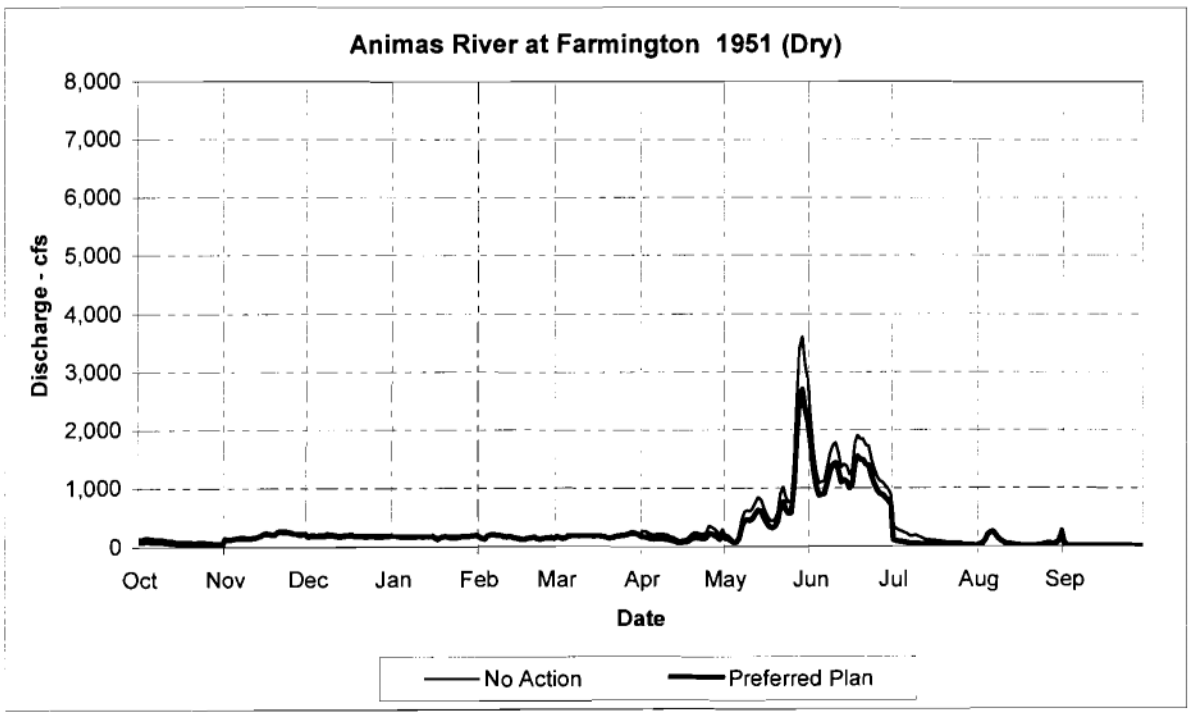
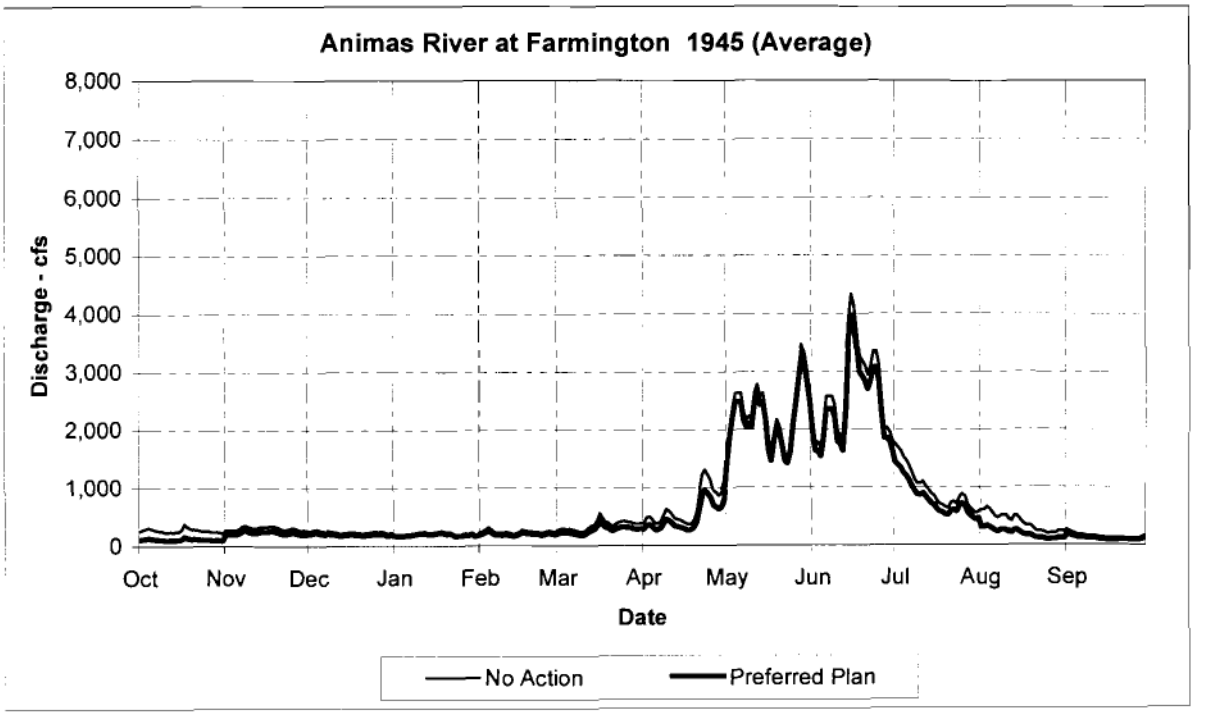


Figure 5. - Animas River at Farmington, NM Comparing the Preferred Alternative to the No Action Alternative - Typical Average Years



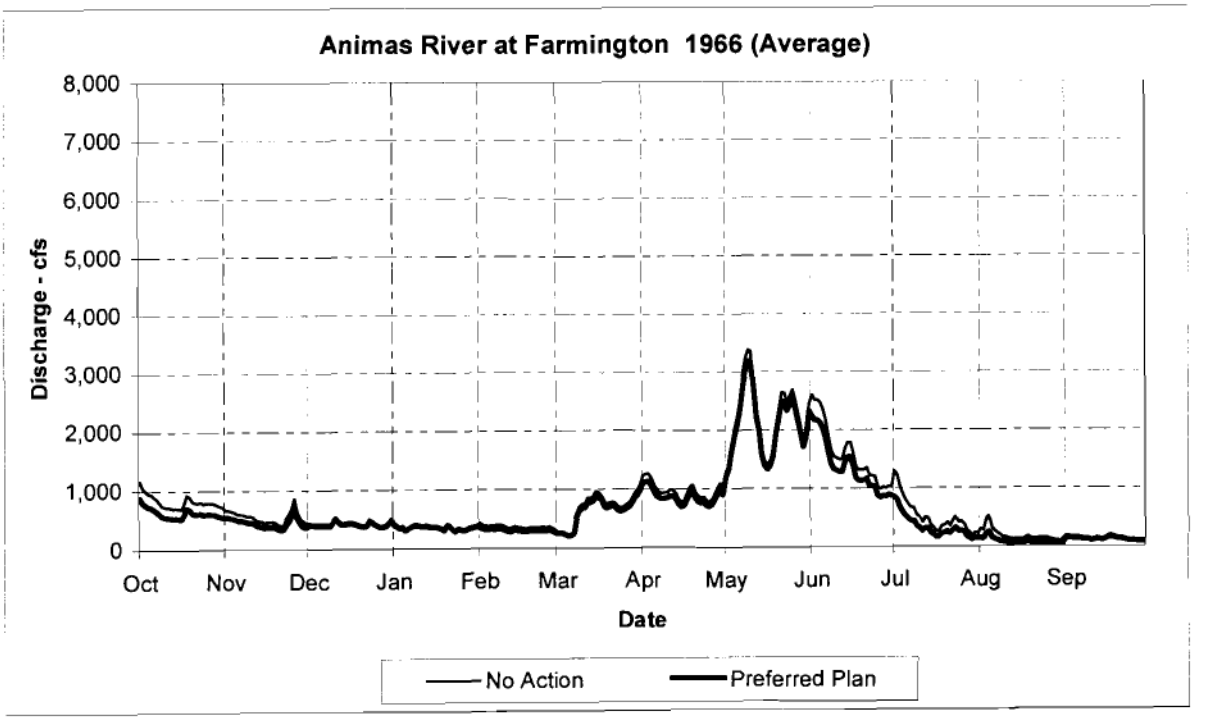
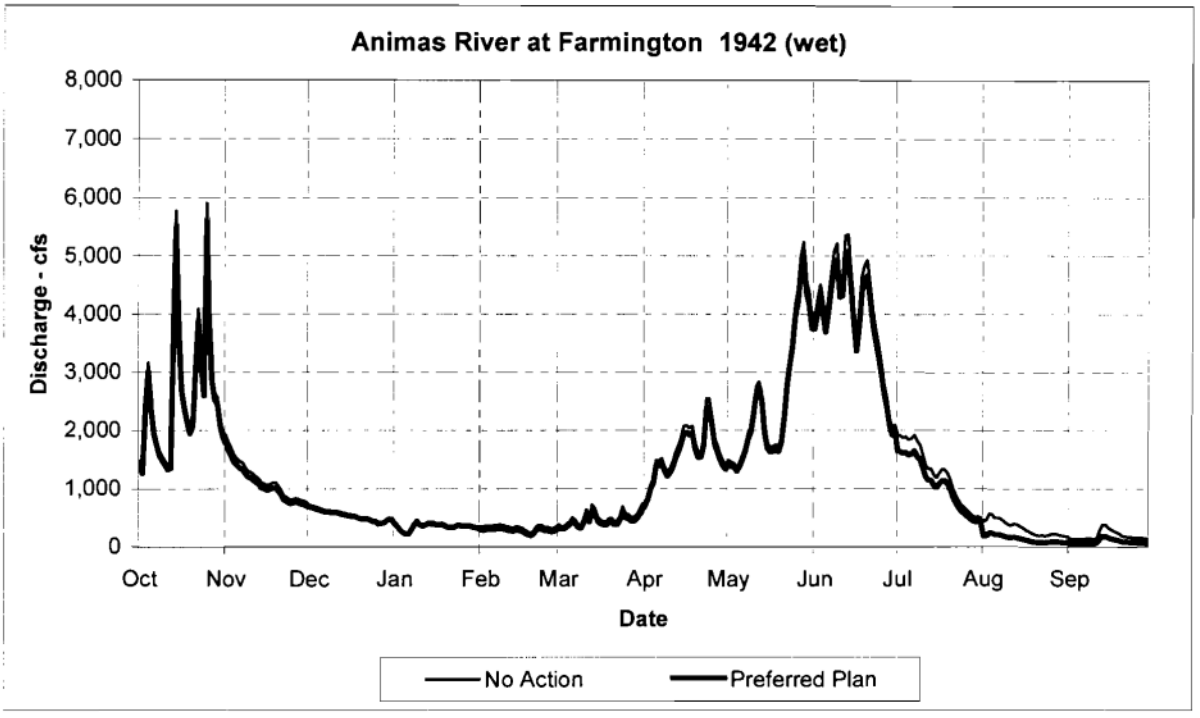


Figure 6. - Animas River at Farmington, NM Comparing the Preferred Alternative to the No Action Alternative - Typical Wet Years



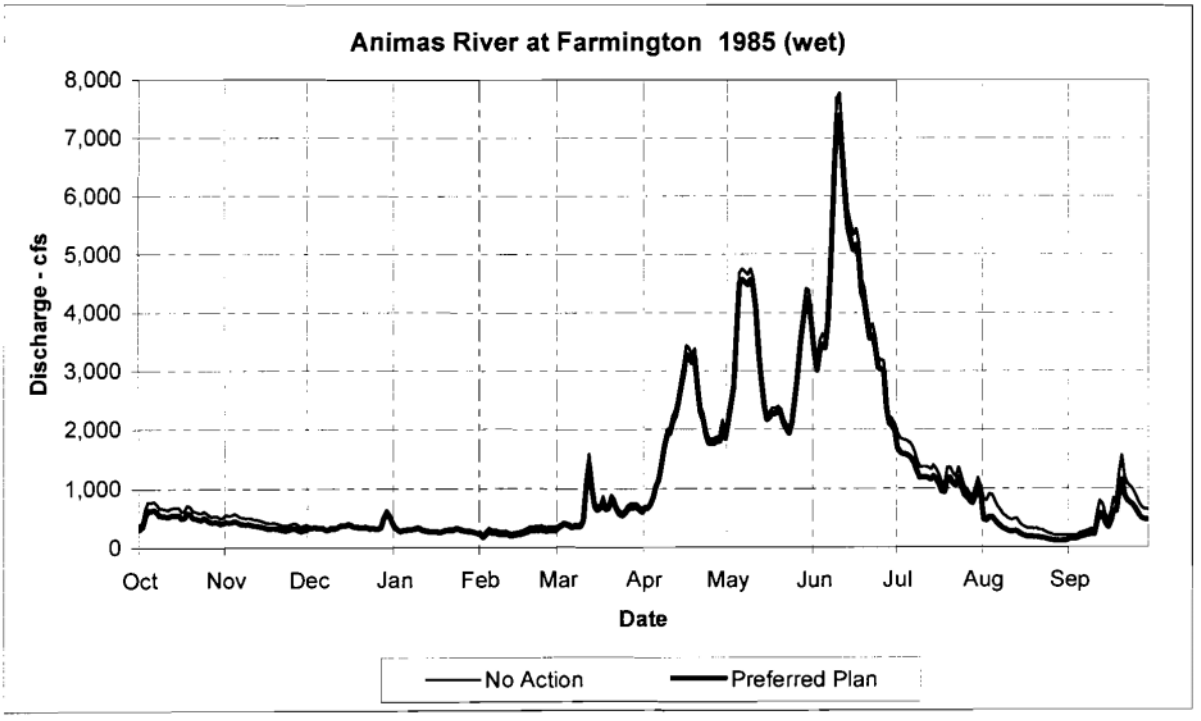
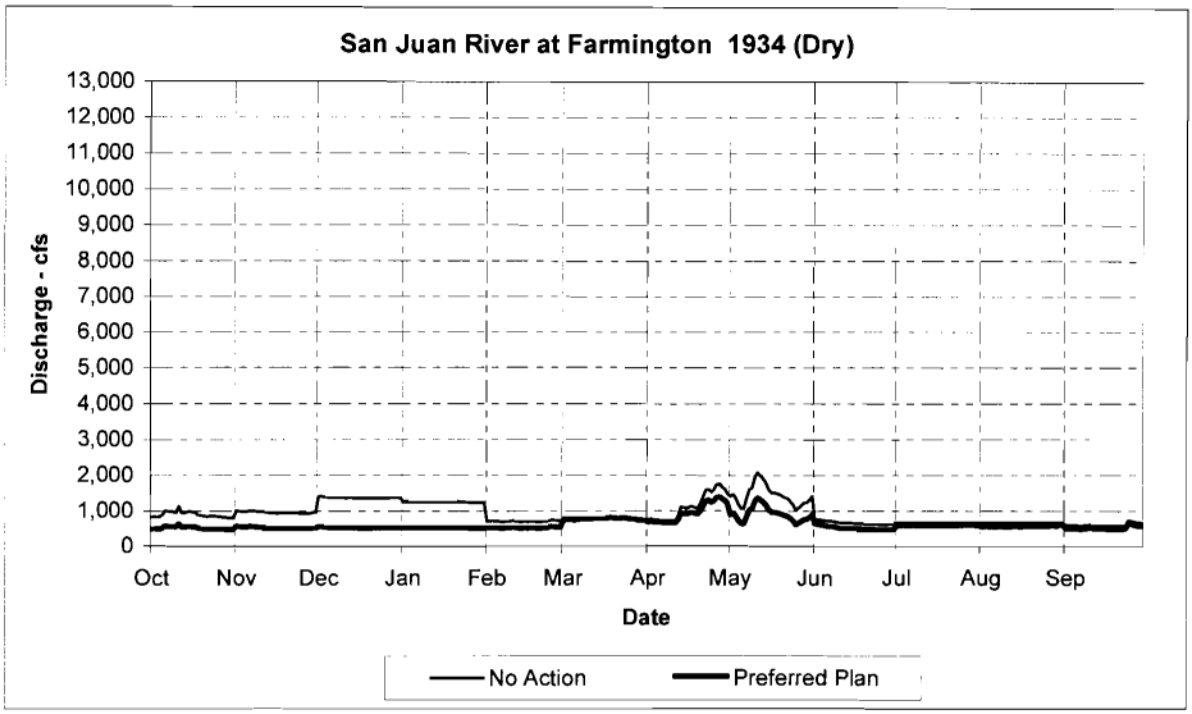


Figure 7. - San Juan River at Farmington, NM Comparing the Preferred Alternative to the No Action Alternative - Typical Dry Years



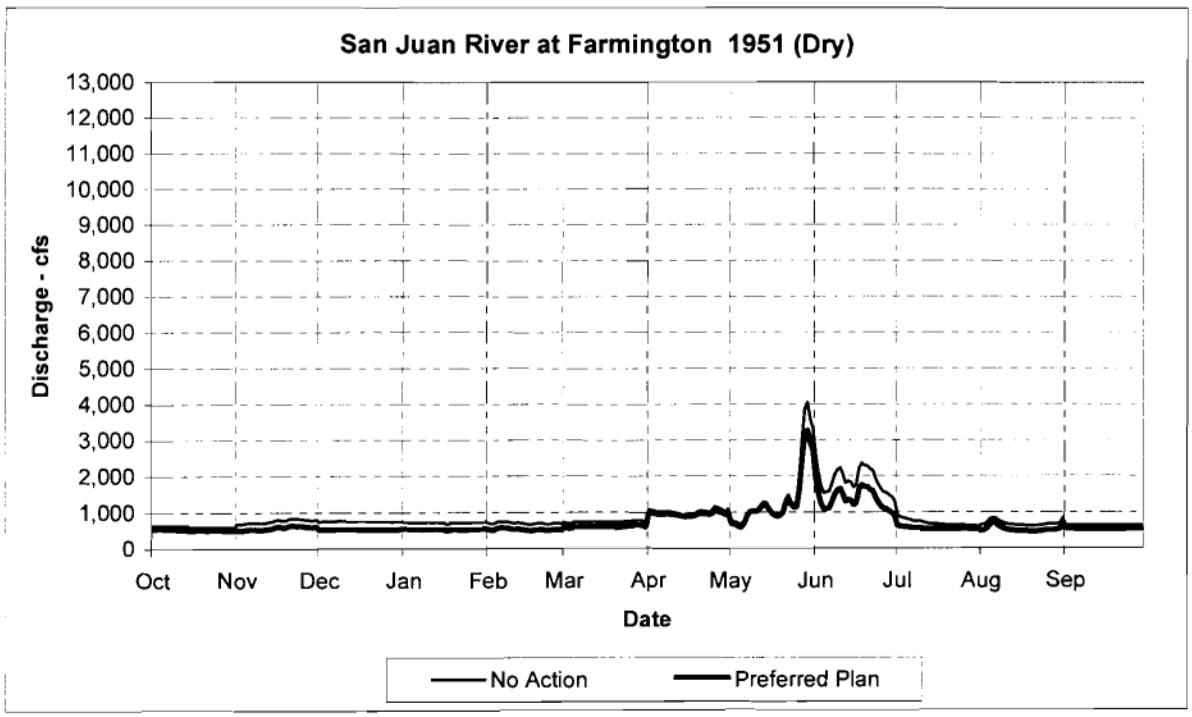
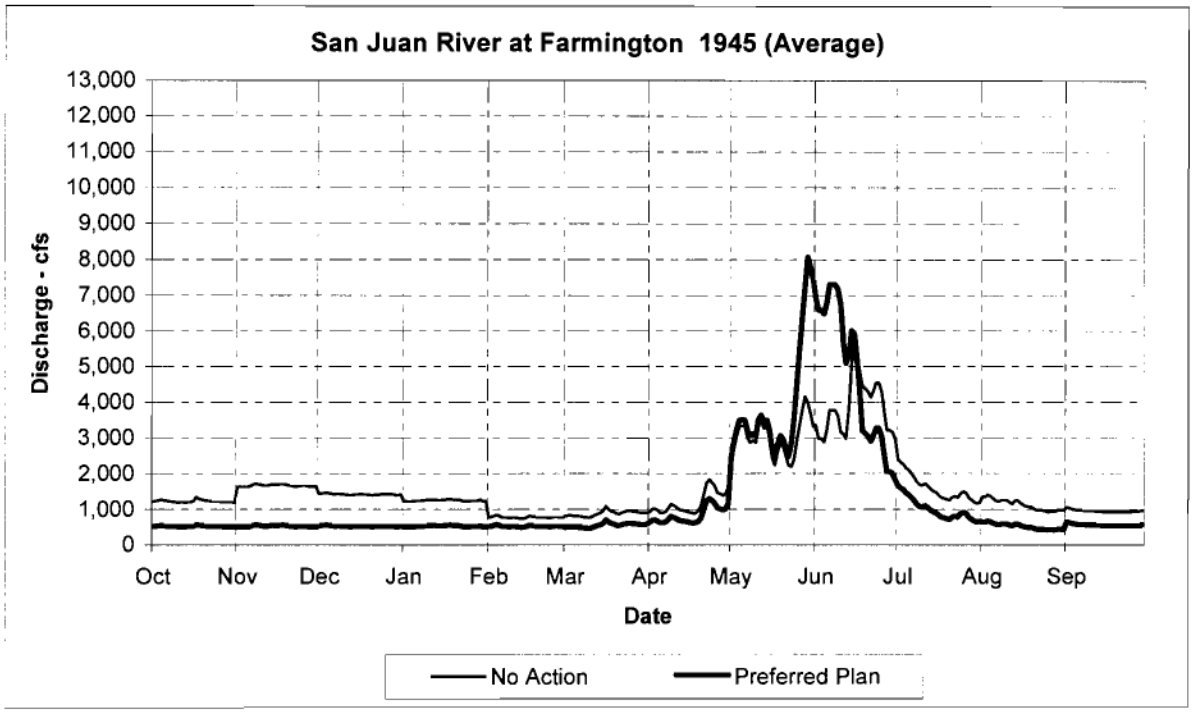


Figure 8. - San Juan River at Farmington, NM Comparing the Preferred Alternative to the No Action Alternative - Typical Average Years



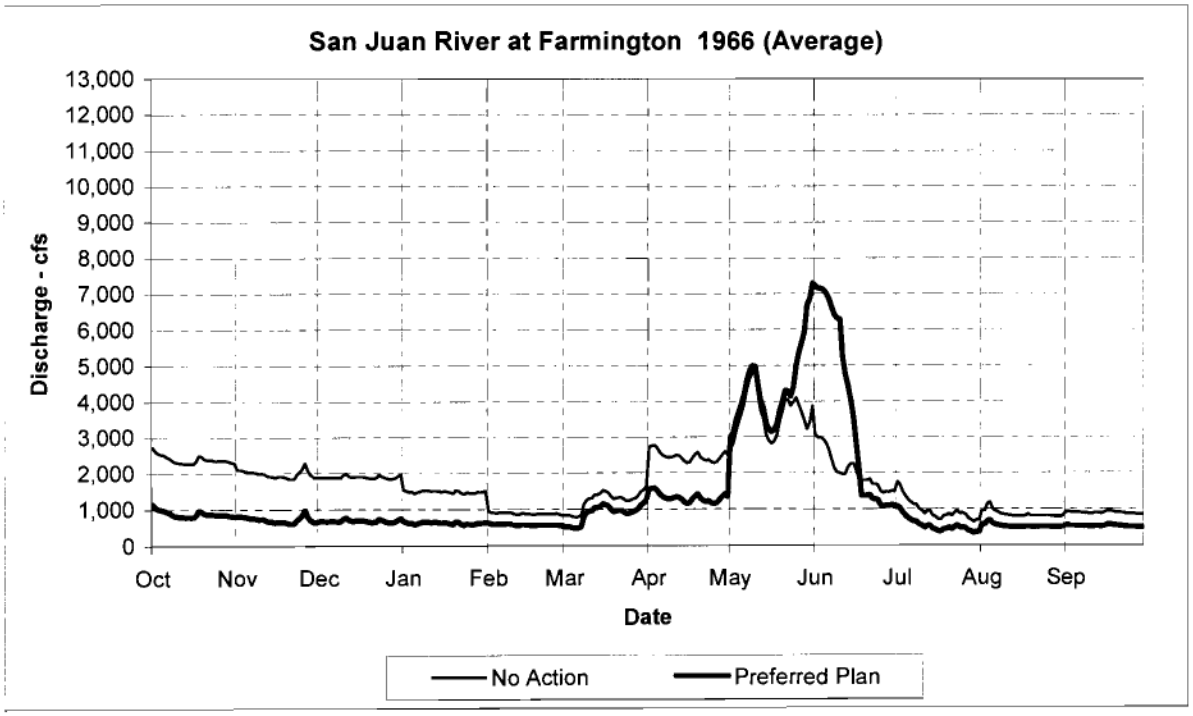
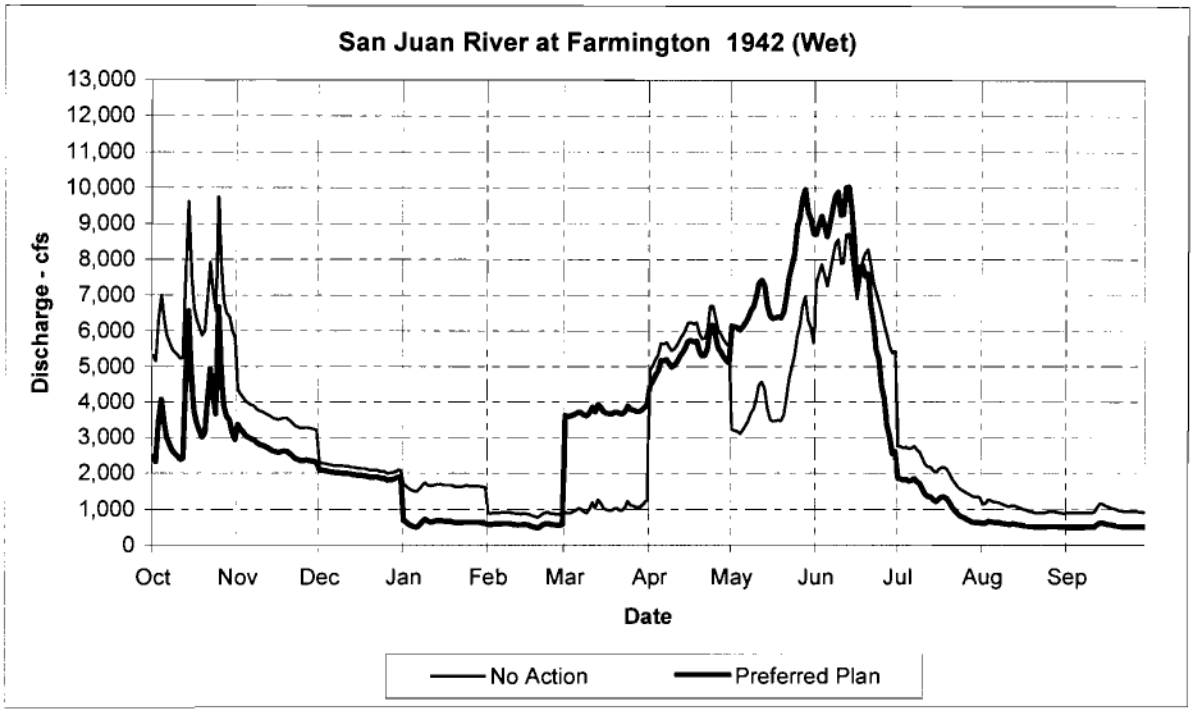


Figure 9. - San Juan River at Farmington, NM Comparing the Preferred Alternative to the No Action Alternative - Typical Wet Years



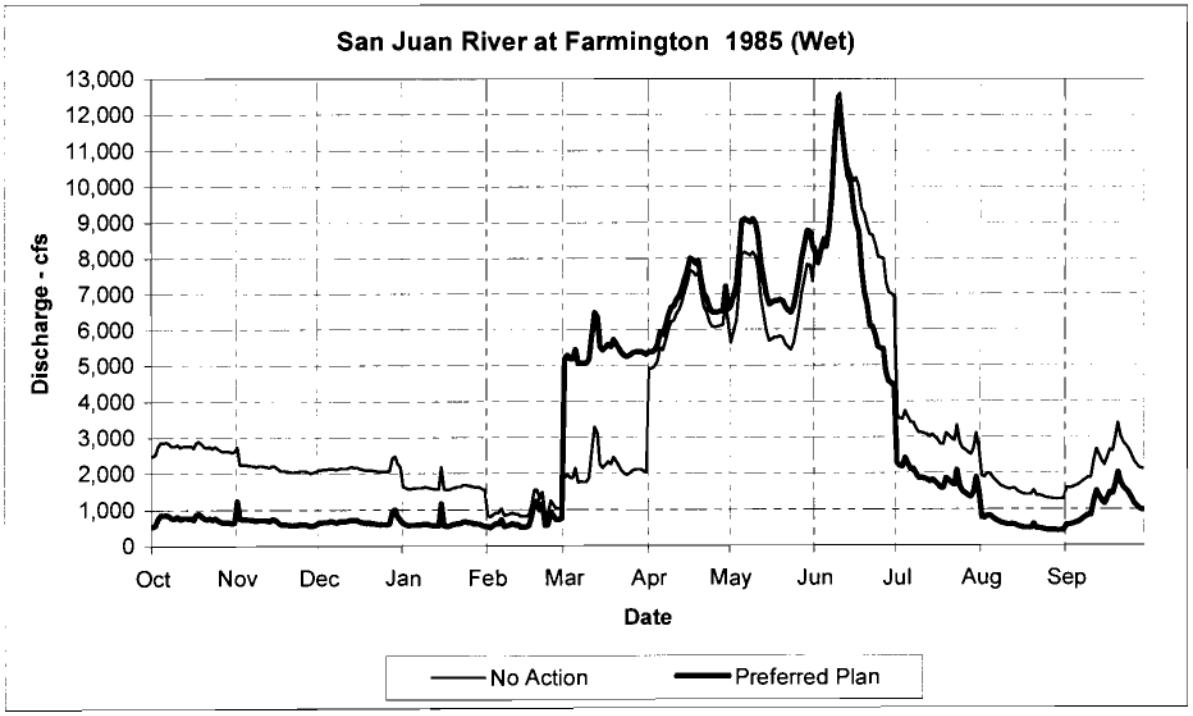
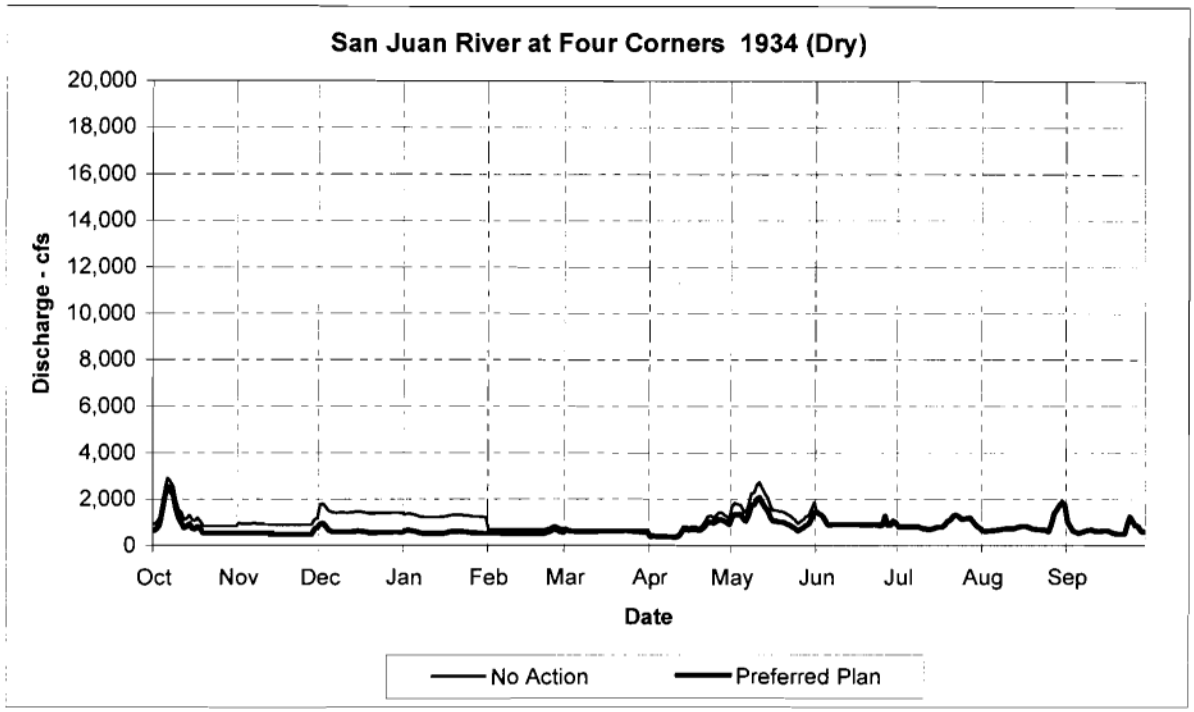


Figure 10. - San Juan River at Four Corners, CO Comparing the Preferred Alternative to the No Action Alternative - Typical Dry Years



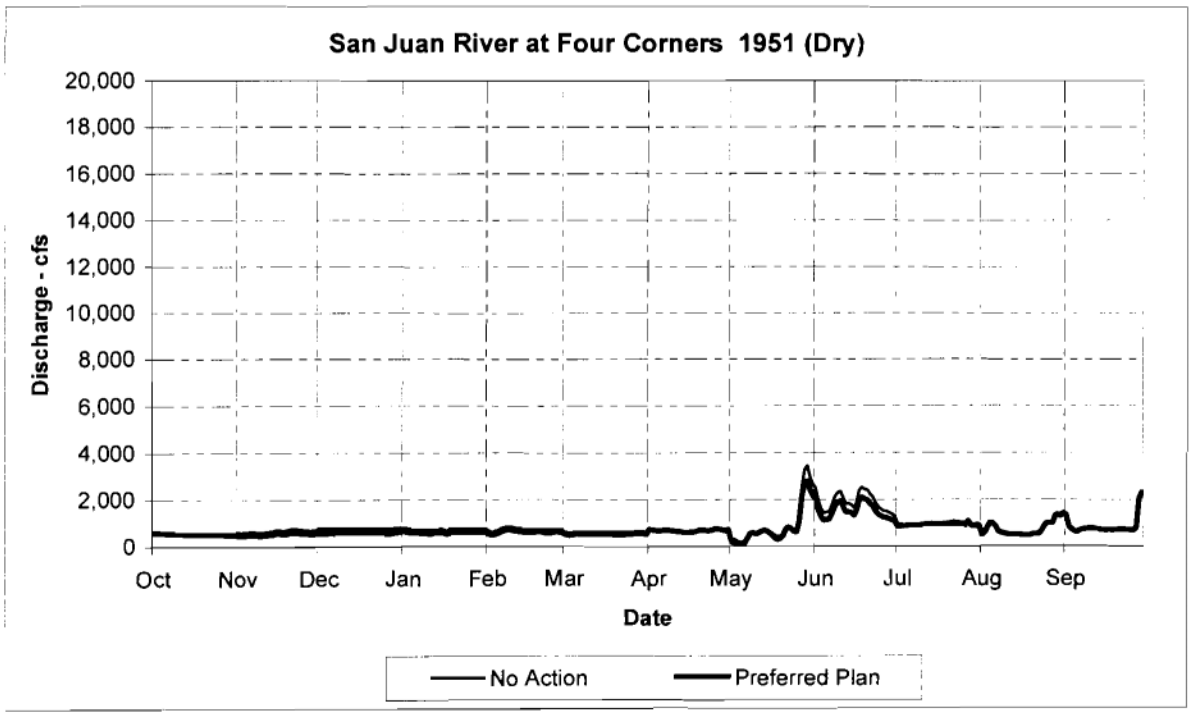
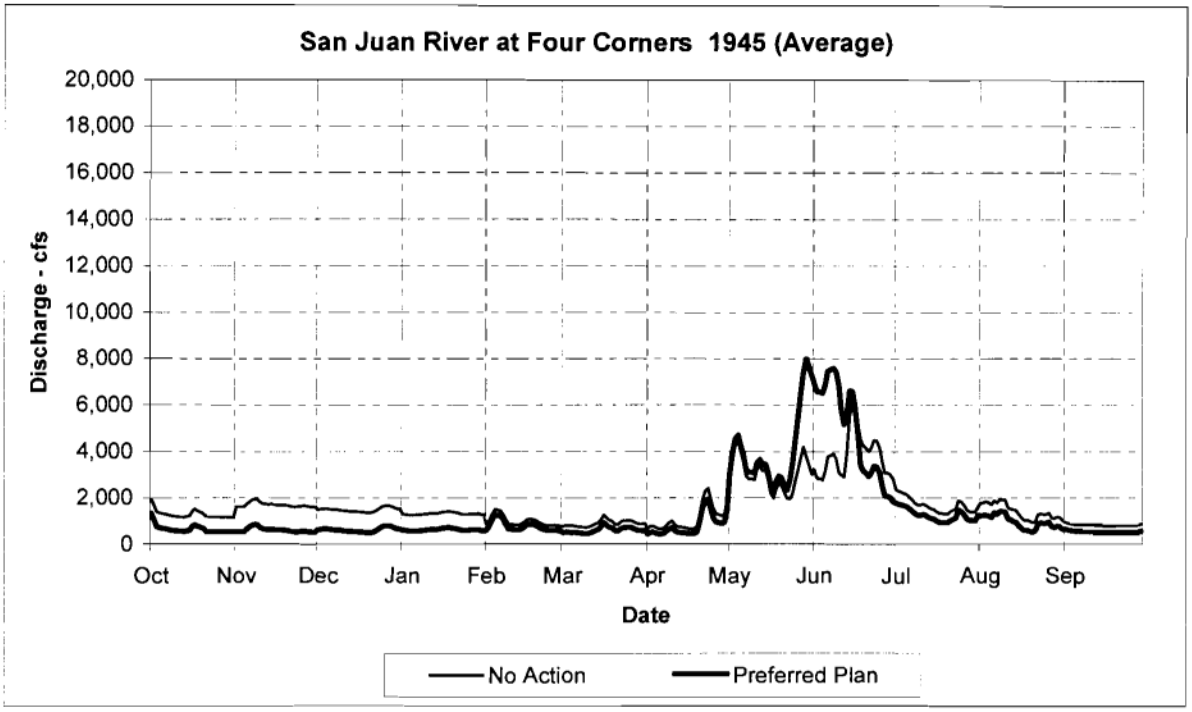


Figure 11. - San Juan River at Four Corners, CO Comparing the Preferred Alternative to the No Action Alternative - Typical Average Years



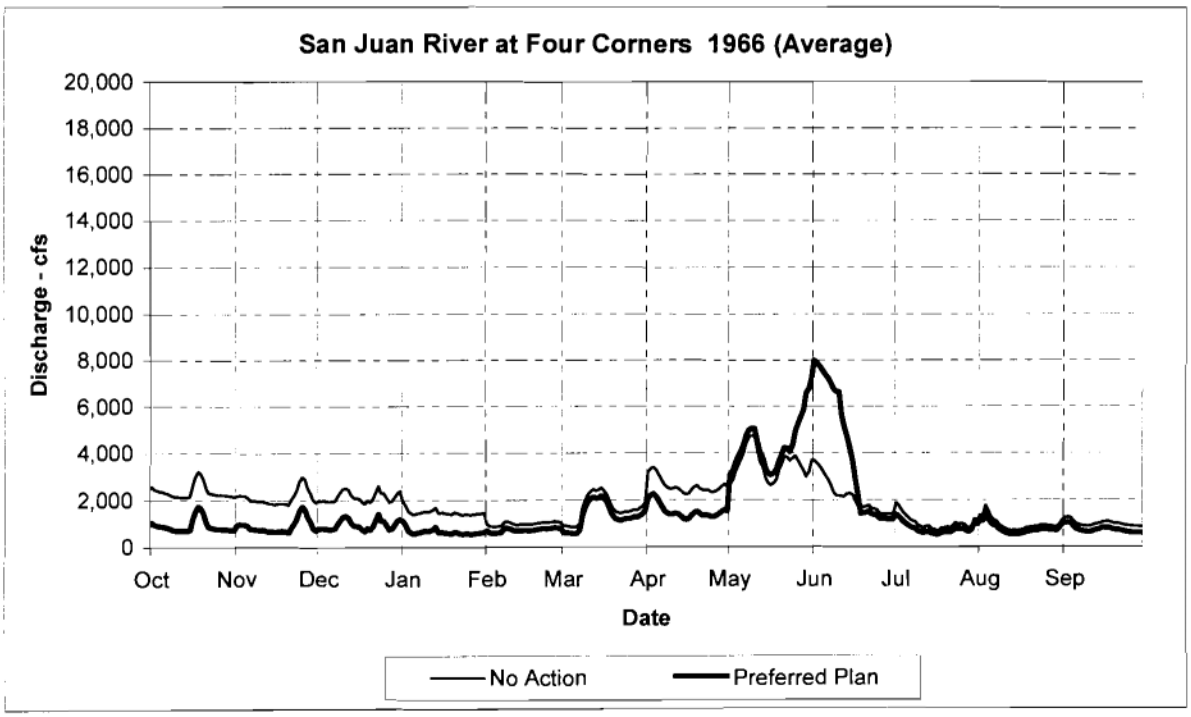
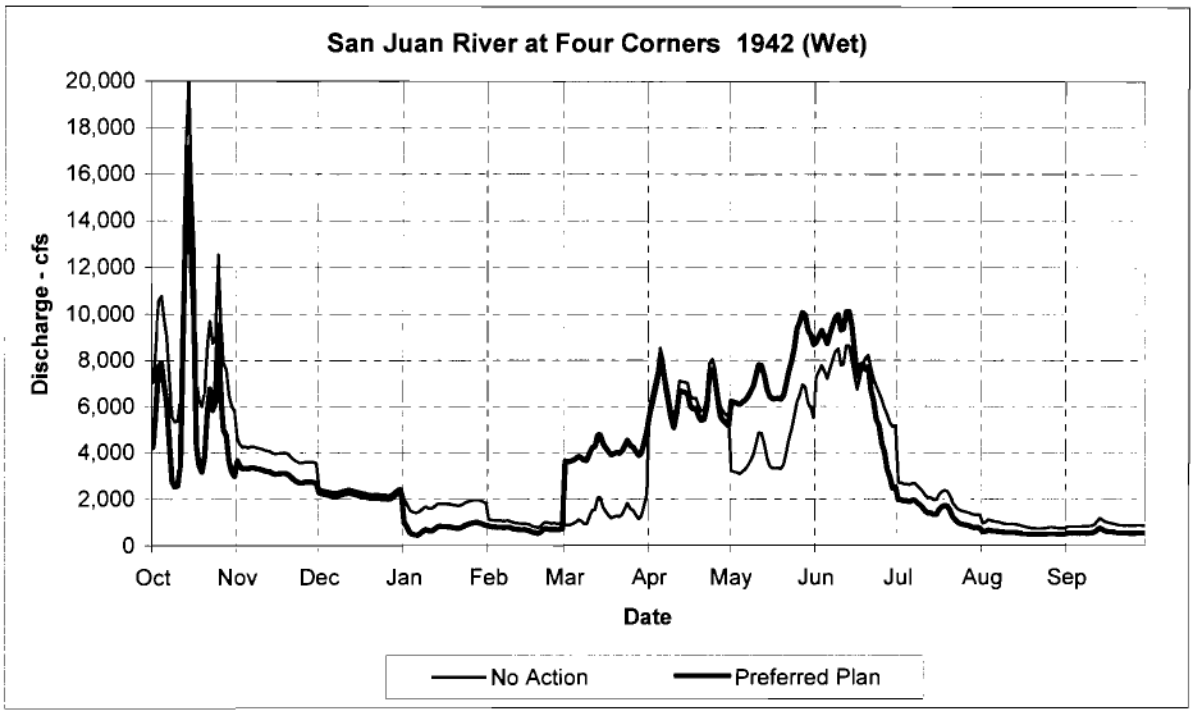
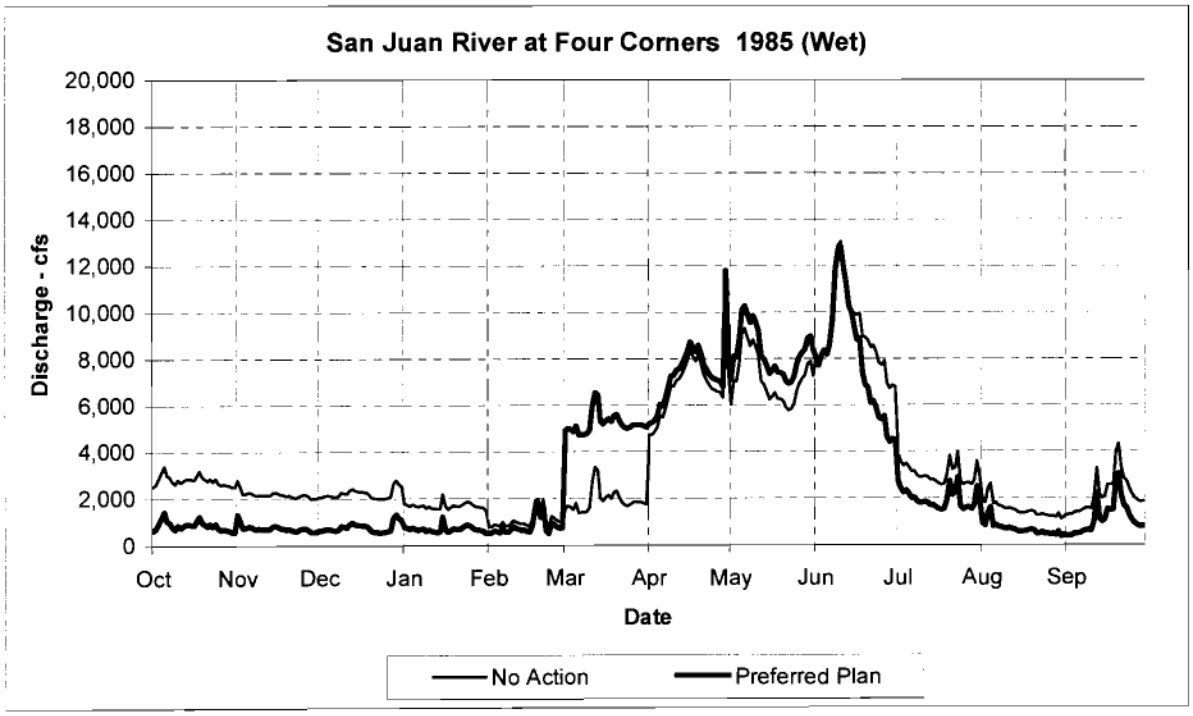


Figure 12. - San Juan River at Four Corners, CO Comparing the Preferred Alternative to the No Action Alternative - Typical Wet Years





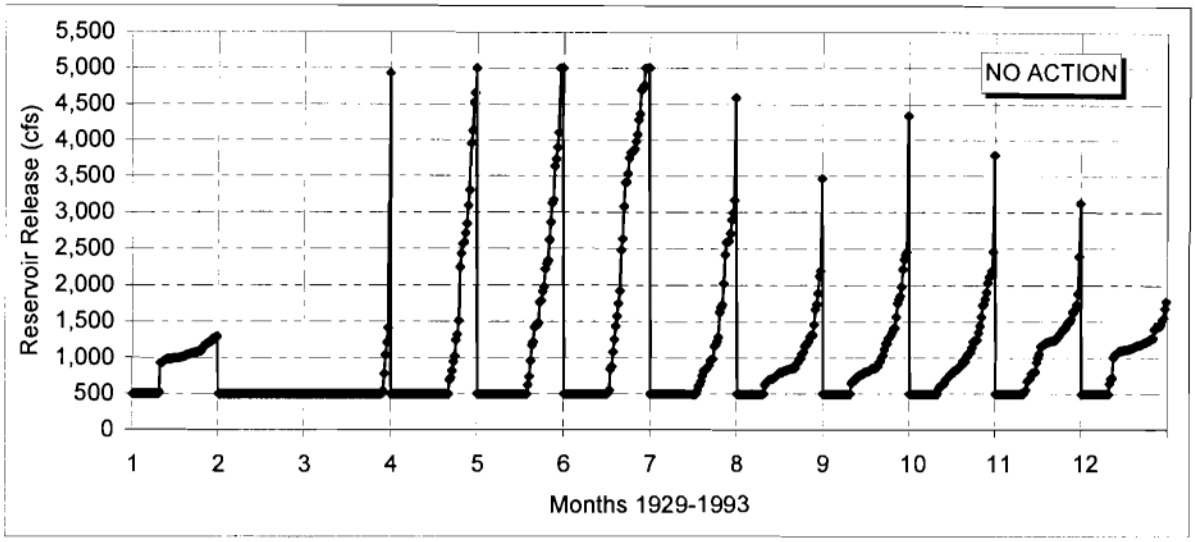


Figure 13. - Navajo Reservoir Monthly Releases Ranked by Month in Ascending Order. Under this alternative, large releases are made from August through January to meet reservoir target levels. Large releases from April through July are to prevent spills.

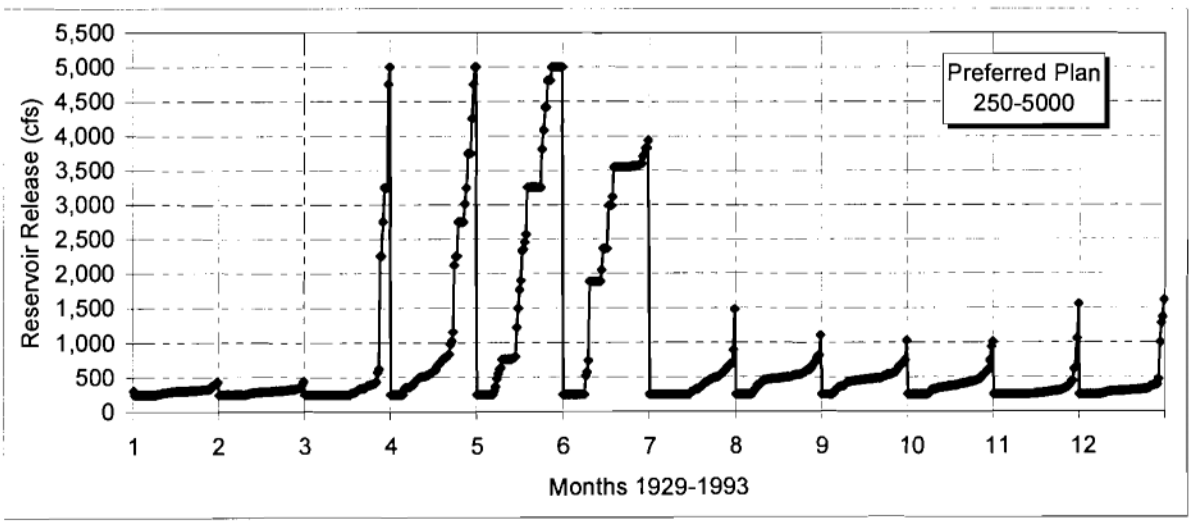


Figure 14. - Navajo Reservoir Monthly Releases Ranked by Month in Ascending Order. Under this alternative, large releases are made from April through June to meet flow recommendations and manage spills. Only a few winter months require increased releases to manage the reservoir.

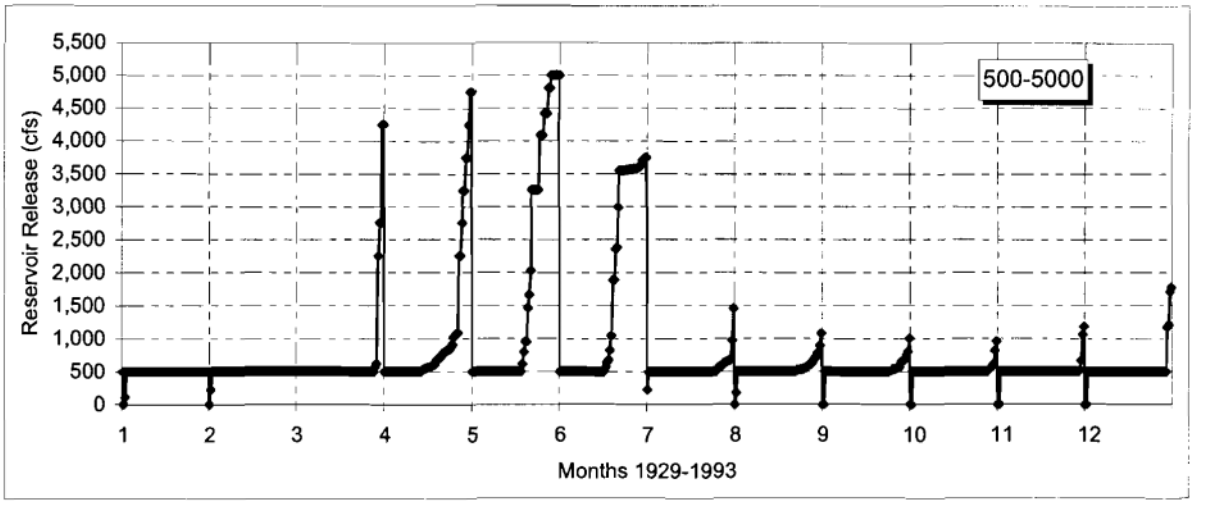


Figure 15. - Navajo Reservoir Monthly Releases Ranked by Month in Ascending Order. Under this alternative, large releases are made from April through June to meet flow recommendations and manage spills. The higher minimum releases for this alternative cause the reservoir contents to drop below the active capacity resulting in periods of no releases.

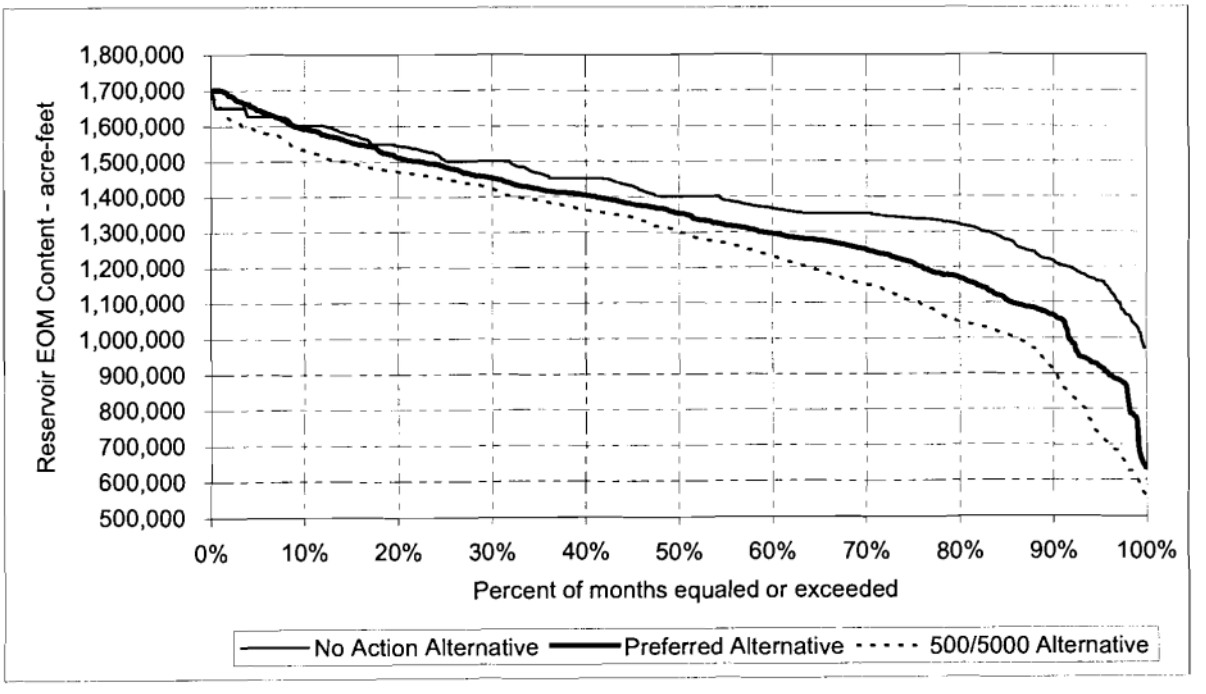
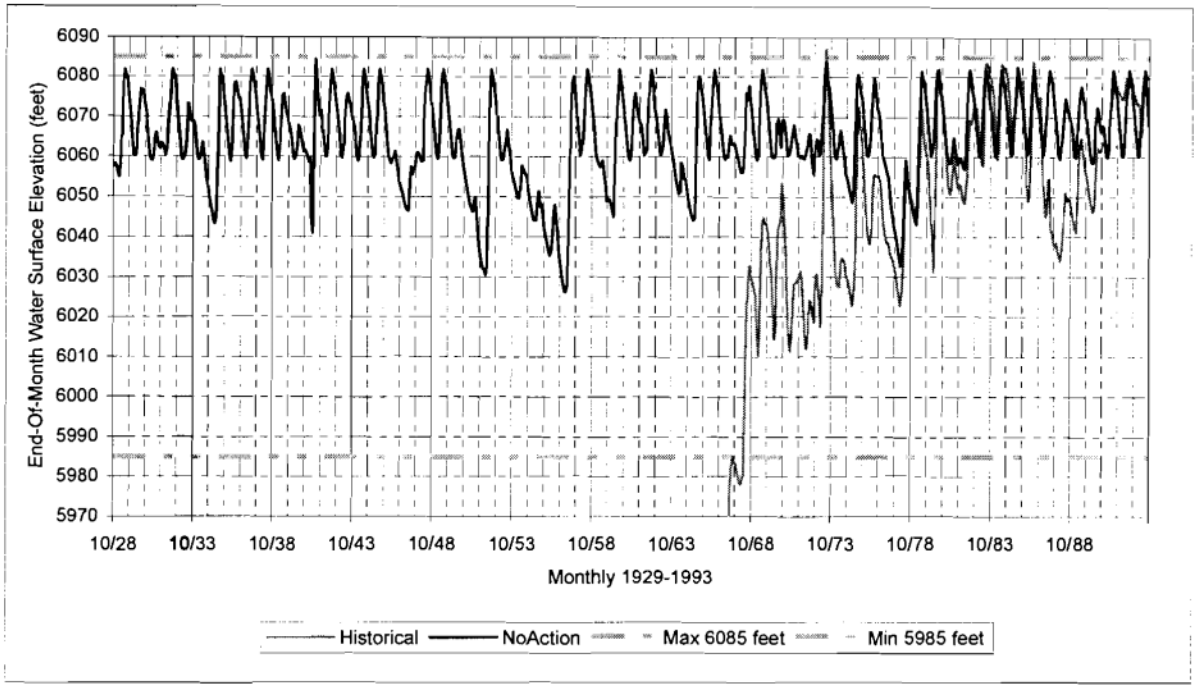


Figure 16. - Frequency Distribution of Navajo Reservoir End-Of-Month Content for the Period 1929-1993 Comparing Each Alternative.



NFigure 17. - Navajo Reservoir End-Of-Month Water Surface Elevation Comparing the No Action Alternative to the Historical.

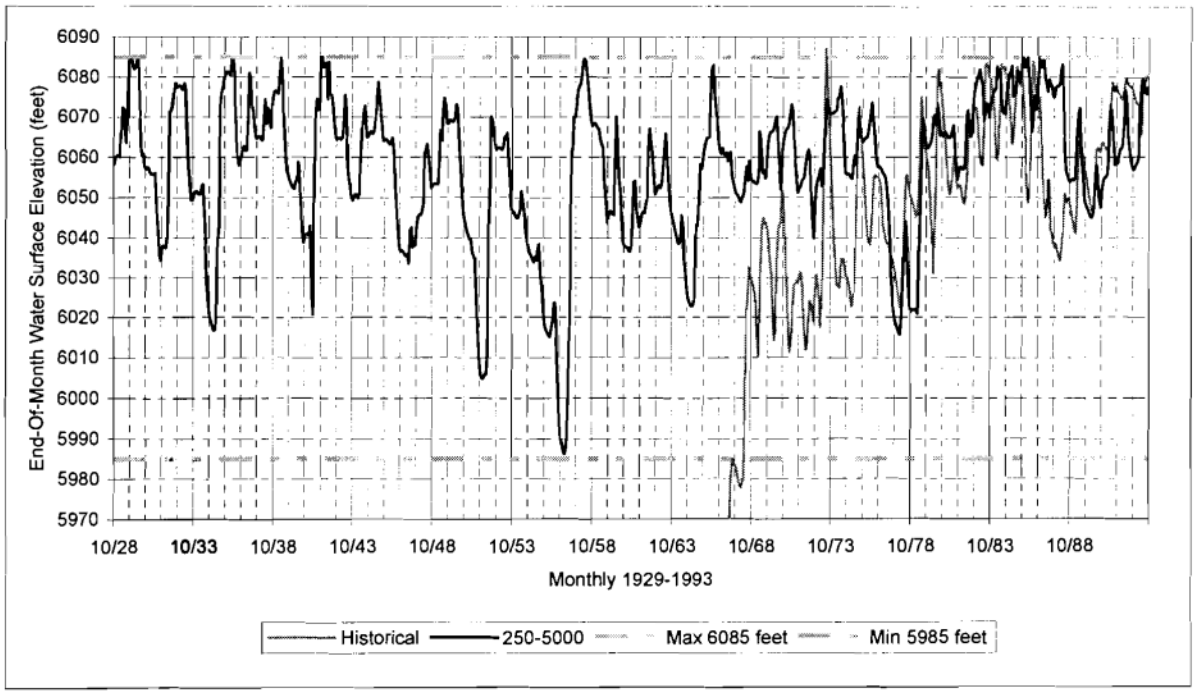


Figure 18. - Navajo Reservoir End-Of-Month Water Surface Elevation Comparing the Preferred Plan to the Historical.

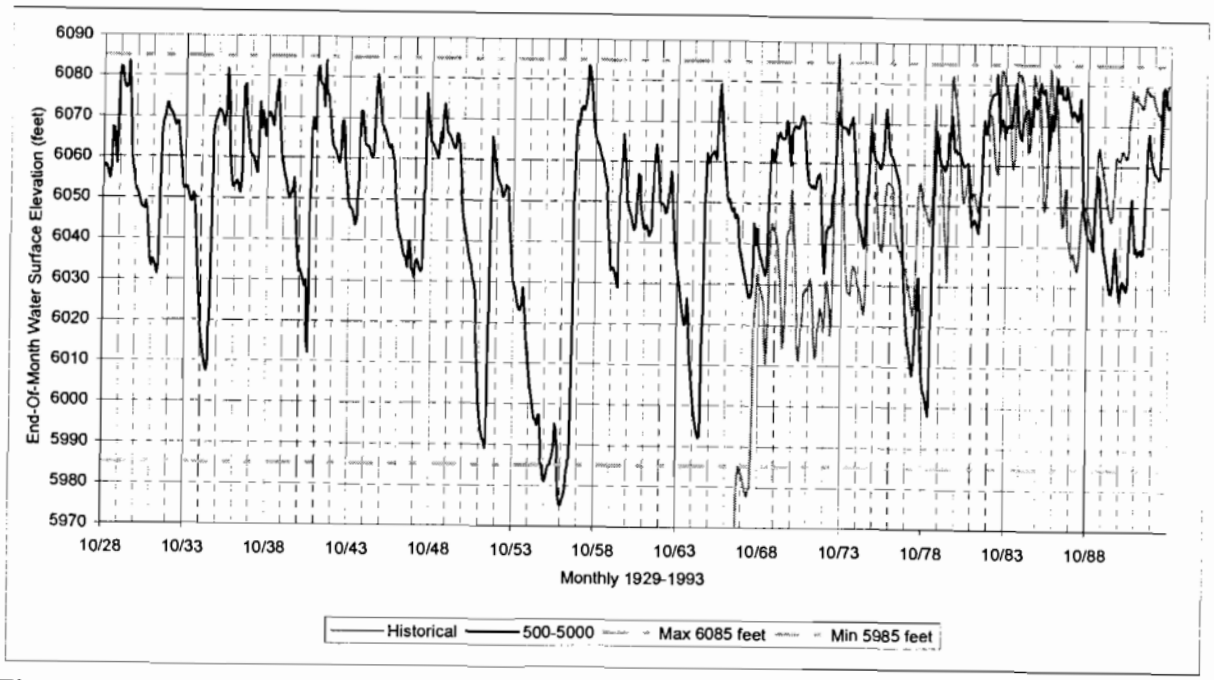


Figure 19. - Navajo Reservoir End-Of-Month Water Surface Elevation Comparing the 500-5000 Alternative to the Historical.