Memorandum Report

To : Thomas Howard
Division of Water Rights
California State Water Resources Control Board

Date : November 16, 1999

From : Sushil Arora, Acting Chief
Modeling Support Branch
Office of SWP Planning
California Department of Water Resources

Subject : Lower Yuba River Basin Operation Studies

Per your modeling request of May 25, 1999, subsequently modified on July 2, 1999, my staff has conducted a set of five simulation runs of the lower Yuba River Basin using the HEC-5 model developed by Bookman-Edmonston Engineering. This memo is to report the results, and to document the procedure and major assumptions made in conducting these simulation runs.

Basic Assumptions

All major assumptions on the hydrologic input, reservoir operation criteria, minimum release requirements, and upper basin diversions and return flows were adopted from the studies conducted by the Bookman-Edmonston Engineering, and therefore were similar to the assumptions reported in their technical memorandum, "Yuba River Basin Model, Operations and Simulation Procedures", May 1999.

The hydrologic input to the model used in the Bookman-Edmonston simulation runs was carefully examined and compared with Yuba system hydrology developed by the staff in DWR Hydrology Unit. Differences in our hydrologic input data sets are being discussed with Bookman-Edmonston Engineering staff. Minimum flow requirements below Hour House Dam, below Log Cabin Dam, below New Bullards Bar Reservoir, below Englebright Dam, and below Daguerre Point Dam in two of the studies were based on the 1965 agreement between the California Department of Fish and Game and Yuba County

Water Agency. In the remaining three studies, the minimum flow requirements at Smartville and Marysville gages proposed in the 1996 draft decision by the SWRCB were added. In four of the simulation runs the minimum power production requirements at New Bullareds Bar Reservoir were based on the informal agreement between the YCWA and PG&E (Similar to the studies with current practice conducted by Bookman-Edmonston Engineering). According to this agreement, a minimum of 18,500 MWH of electrical energy per month had to be produced by the downstream power facilities. In one of the studies, the minimum power generation requirement was removed, and releases from New Bullards Bar Reservoir were governed solely by the downstream fisheries and agricultural water demand requirements. Agricultural demands at the YCWA diversion point at Daguerre Point Dam for the studies conducted at the present level of demand were identical to the amounts presented in Table 22 of the Bookman-Edmonston Technical Memorandum. Daguerre Point demands in the studies conducted at the ultimate level of demand were identical to the amounts presented in Table 23 of the Memorandum.

List of Studies

The following five studies were conducted:

1) Study #1: This study was conducted at the ***present level*** of demands, the ***current practice*** simulation for implementing the PG&E contract, and the ***current minimum flow requirements*** in the YCWA/DFG agreement.

2) Study #5: This study was conducted at the ***present level*** of demands, the ***current practice*** simulation for implementing the PG&E contract, and the ***proposed minimum flow requirements*** in the SWRCB 1996 draft decision.

3) Study #2: This study was conducted at the ***full development level*** of demands, the ***current practice*** simulation for implementing the PG&E contract, and the ***current minimum flow requirements*** in the YCWA/DFG agreement.

4) Study #6: This study was conducted at the ***full development level*** of demands, the ***current practice*** simulation for implementing the PG&E contract, and the ***proposed minimum flow requirements*** in the SWRCB 1996 draft decision.

5) Study #9: This study was conducted at the ***full development level*** of demands, ***no provisions*** for implementing the PG&E contract (i.e., incidental power generation, only), and the ***proposed minimum flow requirements*** in the SWRCB 1996 draft decision.

Study Procedure

The modified HEC-5 model was acquired from the model developer, Eichert Engineering and was installed and tested by staff. Input files and standard output files were obtained from Bokman-Edmonston Engineering for the eight studies that they had reported in their Technical Memorandum. Studies #1, #2, #5, and #6 were rerun and checked against the runs conducted by Bookman-Edmonston. As expected, the results were found to be identical. To construct the input file for Study #9, the input file for Study #6 was modified to eliminate the minimum monthly power generation requirements at the Colgate Power Facilities, downstream of New Bullards Bar Reservoir.

Summary of Results

I. Effects of the SWRCB proposed minimum flow requirements

The effects of the higher minimum flow requirements proposed in the SWRCB 1996 draft decision were assessed at both current level of demands and the full development level of demands. Comparing the results of Study #1 against Study #5 would show the effects of the proposed flows at the present level of demands, while comparing Study #2 against Study #6 would show the effects of the proposed flows at the full development level of demands.

Effects of the higher proposed flows on meeting the current level YCWA demands, and on the full development level YCWA demands at Daguerre Point Diversion Dam are shown below in Table 1. The effects are shown as the changes in the long-term average annual supplies and on the annual supplies available during the 6.5-year dry period of April 1928 through October 1934 (AADPS).

Table 1

Effects of the SWRCB Proposed Flows on YCWA Deliveries

(1,000 AF per Year)

	Long-Term Average Deliveries	**Dry Period Average Deliveries***
Present Level Demand		
Study #1	308	327
Study #5	288	277
Difference	20	50
Full Development Level of Demand		
Study #2	378	401
Study #6	345	333
Difference	33	68

* Dry period Average deliveries are the average annual deliveries in the 6.5-year critical period of April 1928 through October 1934.

The changes in the ability of the system to meet YCWA annual demands are also shown in a set of frequency plots that compare how often the system was able to meet a certain level of demand. Figure 1 shows the comparison between studies #1 and #5 (the current level of demands), and Figure 2 shows the comparison between studies #2 and #6 (the full development level of demands).

A set of plots is also attached to show the effects of the SWRCB proposed flows on the end-of-month storage in New Bullards Bar Reservoir. Figures 3 shows the comparison of the frequency of various storage levels in New Bullards Bar Reservoir between studies 1 and 5, and Figure 4 shows the same comparison between studies 2 and 6.

II. Effects of Power Operations

The effects of power operations on the ability of the system to meet its other obligations, such as the minimum flow requirements and YCWA demands were assessed by comparing the results of Study #6 with those of Study #9. As mentioned earlier, the difference between these two studies was in their power generation requirements. Study #6 had to operate New Bullards Bar in such a way that a minimum of 18,500 MWH per month was produced. Whereas this minimum power generation requirement was eliminated in Study #9 and New Bullards Bar Reservoir was operated solely to meet its obligations with respect to the downstream minimum fisheries requirements and the requirements of the YCWA demand point.

The effect of eliminating the provision for power generation at Colgate Power Facility on the average annual energy production by the whole system was approximately 2 GWH per year. The average annual energy produced in Study #6 was 1,485 GWH per year, while the average annual power produced in Study #9 was 1,483 GWH per year. Effects of eliminating the provisions for power generation on meeting the demands at the YCWA demand point were also very small. As Table 2 shows, the long-term average annual deliveries were raised by about 2 TAF per year, from 345 TAF per year in Study #6 to 347 TAF per year in Study #9. And the 1928-34 average annual dry period supply was

raised by about the same amount, from 333 TAF per year in Study #6 to 335 TAF per year in Study #9. Changes in the annual deliveries are also shown in the frequency plot of Figure 5 that compares the annual deliveries made in Study #6 to those made in Study #9. Figure 6 shows the comparison of the end-of-month storage frequency in New Bullards Bar Reservoir due to the elimination of the power provision.

Table 2

Effects of Eliminating Power Provisions on YCWA Deliveries

(1,000 AF per Year)

	Long-Term Average Deliveries	Dry Period Average Deliveries*
Full Development Level of Demand		
Study #9	347	335
Study #6	345	333
Difference	2	2

* Dry period Average deliveries are the average annual deliveries in the 6.5-year critical period of April 1928 through October 1934.

Due to the large volume of output the complete set of tables that show inflow, outflow, and end-of-month storage for both reservoirs of the Lower Yuba Basin, total energy produced by Colgate and Narrows power facilities, information on the monthly deliveries and deficiencies at the Daguerre Point Diversion Dam (YCWA demand point), the SWRCB proposed minimum required flow in Yuba River at Marysville, the actual flow in Yuba River at Marysville gage, and the shortages in the minimum required flow in studies 5, 6, and 9 are enclosed in the appendix.

If you have any questions, or need additional information on the results of these studies contact me at 653-7921, or Sina Darabzand at 653-9648.

CC: Earnie Mona, Division of Water Rights, SWRCB
George Barnes, Supply Reliability Planning, OSWPP, DWR
Sina Darabzand, Operation Studies, OSWPP, DWR

Appendix

New Bullards Bar Operation

1. **Table A-1:** Total Inflow to New Bullards Bar Resrvoir.
2. **Table A-2:** Total Outflow from New Bullards Bar Resrvoir (Study No. 1).
3. **Table A-3:** End-of-Month Storage at New Bullards Bar Resrvoir (Study No. 1).
4. **Table A-4:** Total Outflow from New Bullards Bar Resrvoir (Study No. 2).
5. **Table A-5:** End-of-Month Storage at New Bullards Bar Resrvoir (Study No. 2).
6. **Table A-6:** Total Outflow from New Bullards Bar Resrvoir (Study No. 5).
7. **Table A-7:** End-of-Month Storage at New Bullards Bar Resrvoir (Study No. 5).
8. **Table A-8:** Total Outflow from New Bullards Bar Resrvoir (Study No. 6).
9. **Table A-9:** End-of-Month Storage at New Bullards Bar Resrvoir (Study No. 6).
10. **Table A-10:** Total Outflow from New Bullards Bar Resrvoir (Study No. 9).
11. **Table A-11:** End-of-Month Storage at New Bullards Bar Resrvoir (Study No. 9).

Total System Energy Production

12. **Table A-12:** Total Energy Production (Study No. 1).
13. **Table A-13:** Total Energy Production (Study No. 2).
14. **Table A-14:** Total Energy Production (Study No. 5).
15. **Table A-15:** Total Energy Production (Study No. 6).
16. **Table A-16:** Total Energy Production (Study No. 9).

YCWA Deliveries and Deficiencies

17. **Table A-17:** Diversion at Daguerre Point Diversion Dam (Study No. 1).
18. **Table A-18:** Deliveries and Deficiencies at Daguerre Point Diversion Dam (Study No. 1).
19. **Table A-19:** Diversion at Daguerre Point Diversion Dam (Study No. 2).
20. **Table A-20:** Deliveries and Deficiencies at Daguerre Point Diversion Dam (Study No. 2).
21. **Table A-21:** Diversion at Daguerre Point Diversion Dam (Study No. 5).

22. **Table A-22:** Deliveries and Deficiencies at Daguerre Point Diversion Dam (Study No. 5).
23. **Table A-23:** Diversion at Daguerre Point Diversion Dam (Study No. 6).
24. **Table A-24:** Deliveries and Deficiencies at Daguerre Point Diversion Dam (Study No. 6).
25. **Table A-25:** Diversion at Daguerre Point Diversion Dam (Study No. 9).
26. **Table A-26:** Deliveries and Deficiencies at Daguerre Point Diversion Dam (Study No. 9).

Minimum Required Flow Analysis

27. **Table A-27:** SWRCB Draft Decision Minimum Required Flow in Yuba River at Marysville.
28. **Table A-28:** Flow in Yuba River at Marysville (Study No. 5).
29. **Table A-29:** Shortage in Required Flow in Yuba River at Marysville (Study No. 5).
30. **Table A-30:** Flow in Yuba River at Marysville (Study No. 6).
31. **Table A-31:** Shortage in Required Flow in Yuba River at Marysville (Study No. 6).
32. **Table A-32:** Flow in Yuba River at Marysville (Study No. 9).
33. **Table A-33:** Shortage in Required Flow in Yuba River at Marysville (Study No. 9).