PECOS RIVER COMPACT

Final Report of the River Master

Supreme Court of the United States

No. 65, Original

Amended Decree

Water Year 1990

June 28, 1991

Neil S. Grigg

River Master of the Pecos River

PECOS RIVER COMPACT

Report of the River Master
Water Year 1990
Accounting Year 1991

Final Report
June 28, 1991

Neil S. Grigg
River Master of the Pecos River
P.O. Box 8581
Ft Collins, Colorado 80524

Table of Contents

PECOS RIVER COMPACT
Supreme Court of the United States
No. 65, Original
Amended Decree

Final Report of the River Master
Water Year 1990 - Accounting Year 1991
June 28, 1991

Purpose of the Report. In its Amended Decree issued March 28, 1988 the Supreme Court of the United States appointed a River Master of the Pecos River and directed him to "...Deliver to the parties a Preliminary Report setting forth the tentative results of the calculations required by Section III.B.1 of this Decree by May 15 of the accounting year..." and to consider "...any written objections to the Preliminary Report submitted by the parties prior to June 15 of the accounting year..." and to deliver "...to the parties a Final Report setting forth the final results of the calculations required by Section III.B.1 of this Decree by July 1 of the accounting year." This is the required Final Report with the determination of:

"a. The Article III(a) obligation;

b. Any shortfall or overage, which calculation shall disregard deliveries of water pursuant to an Approved Plan;

c. The net shortfall, if any, after subtracting any overages accumulated in previous years, beginning with water year 1987."

Result of Calculations and Statement of Shortfall or Overage

The results of the calculations in this Final Report show that New Mexico's delivery in Water Year 1990 was a shortfall of 14,100 acre-feet. The accumulated overage in the period beginning with water year 1987 is 27,600 acre-feet.

Water Year	Annual Overage or Shortfall	Accumulated Overage or Shortfall
1987	15,400 AF	15,400 AF
1988	23,600	39,000
1989	2,700	41,700
1990	-14,100	27,600

Neil S. Grigg
River Master of the Pecos River

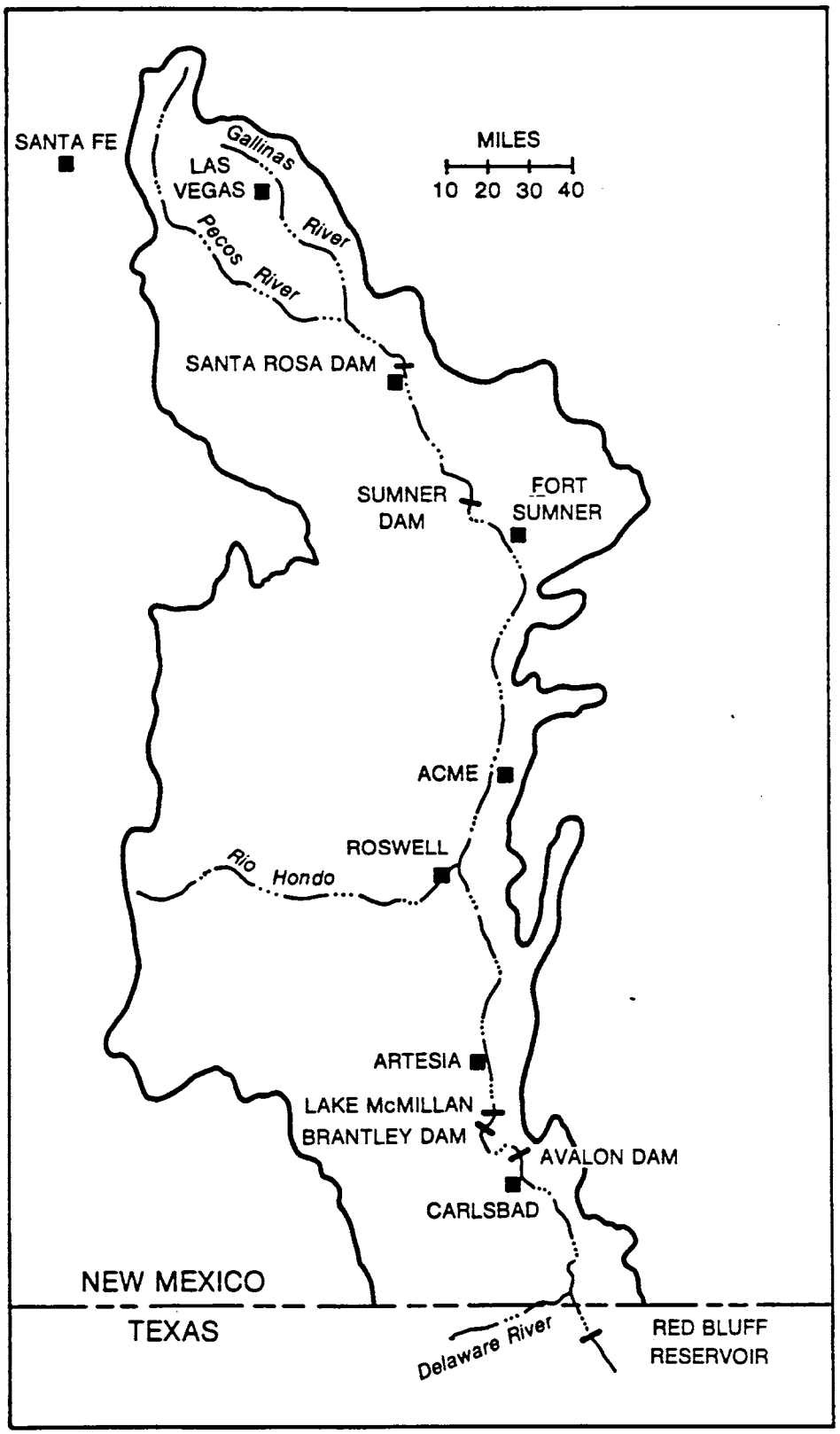


Figure 1. Map of Pecos Basin Showing Accounting Reaches (Adapted from USGS Report: Hydrologic Effects of Phreatophyte Control, 1988)

Table 1. General Calculation of Annual Departures, Thousand Acre-Feet

	1988	1989	1990
B.1.a. Index Inflows			
(1) Annual flood inflow			
(a) Gaged flow Pecos R bel Alamogordo Dam	163.2	136.9	102.8
(b) Flood Inflow Alamogordo - Artesia	16.6	2.9	6.6
(c) Flood Inflow Artesia - Carlsbad	-3.2	13.7	17.3
(d) Flood Inflow Carlsbad - State Line	6.8	1.2	7.4
Total (annual flood inflow)	183.4	154.7	134.1
(2) Index Inflow (3-year avg)			157.4
B.1.b. 1947 Condition Delivery Obligation (Index Outflow)			65.6
B.1.c. Average Historical (Gaged) Outflow			
Gaged Flow Pecos River at Red Bluff NM	59.3	35.1	32.8
Gaged Flow Delaware River nr Red Bluff NM	3.2	1.9	4.4
(1) Total Annual Historical Outflow	62.5	37.0	37.2
(2) Average Historical Outflow (3-yr average)			45.6
B.1.d. Annual Departure			-20.0
C. Adjustments to Computed Departure			
1. Adjustments for Depletions above Alam Dam			
a. Depletions Due to Irrigation	-5.1	-2.4	-2.8
b. Depl fr Operation of Santa Rosa Reservoir	-19.6	2.8	2.4
c. Transfer of Water Use to Upstream of AD	0	0	0
Recomputed Index Inflows			
(1) Annual flood inflow			
(a) Gaged flow Pecos R bel Alamogordo Dam	138.5	137.3	102.4
(b) Flood Inflow Alamogordo - Artesia	16.6	2.9	6.6
(c) Flood Inflow Artesia - Carlsbad	-3.2	13.7	17.3
(d) Flood Inflow Carlsbad - State Line	6.8	1.2	7.4
Total (annual flood inflow)	158.7	155.1	133.7
Recomputed Index Inflow (3-year avg)			149.2
Recomputed 1947 Condition Del Outflow (Index Outflow)			60.8
Recomputed Annual Departures			-15.2
Credits to New Mexico			
C.2 Depletions Due to McMillan Dike			1.1
C.3 Salvage Water Analysis			0
C.4 Unappropriated Flood Waters			0
C.5 Texas Water Stored in NM Reservoirs			0
C.6 Beneficial C.U. Delaware River Water			0
Final Calculated Departure, TAF			-14.1

Table 2. Determination of Flood Inflows, Alamogordo Dam to Artesia - 1990 (B.3)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	TOTAL
Flow bel Alamog Dam	1.2	1.6	3.9	4.7	27.4	27.2	3.5	22.4	5.3	5.7	.0	.0	102.8
FtSumner Irrig Div	.8	1.5	3.5	4.2	6.3	6.0	3.8	1.9	5.2	5.5	.1	.0	38.9
Ft Sumner ID Return	.8	.6	1.4	1.6	2.5	2.5	2.5	2.5	2.3	2.1	1.0	.8	20.6
Flow past FS IDist	1.2	.7	1.8	2.1	23.5	23.6	2.5	23.0	2.3	2.3	1.0	.8	84.6
Channel loss	.5	.2	.6	1.4	3.9	5.1	.2	3.8	.8	.8	.3	.3	17.8
Residual Flow	.7	.4	1.2	.7	19.6	18.5	2.3	19.2	1.6	1.5	.7	.5	67.0
Base Inflow	2.3	1.9	2.4	1.8	1.0	.6	.6	.7	1.2	2.2	3.0	3.3	21.1
River Pump Divers	.1	.4	.6	1.1	1.4	2.4	.7	2.3	1.3	.7	.2	.0	11.2
Residual, Artesia	3.0	2.0	2.9	1.4	19.2	16.8	2.1	17.6	1.5	3.0	3.5	3.8	76.9
Pecos Flow Artesia	3.1	3.0	2.5	2.5	7.6	22.3	.3	23.8	3.3	6.4	4.9	4.0	83.5
Flood Inflow, AD-Art	.1	1.0	-.4	1.0	-11.7	5.5	-1.9	6.2	1.9	3.4	1.4	.1	6.6

Table 3. Determination of Flood Inflows, Artesia to Carlsbad - 1990 (B.4)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	TOTAL
Pecos R at Artesia	3.1	3.0	2.5	2.5	7.6	22.3	.3	23.8	3.3	6.4	4.9	4.0	83.5
Major John Springs	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1
Carlsbad Springs	-.6	-.6	-.6	-.6	-.6	-.6	-.6	-.6	-.6	-.6	-.6	-.6	-7.1
Total Inflow	2.5	2.4	1.9	1.9	7.0	21.7	-.3	23.2	2.7	5.8	4.3	3.4	76.5
Channel Losses	.3	.3	.2	.2	1.3	4.4	.0	4.8	.3	1.0	.7	.5	13.8
Evap Loss, Av-Br	.4	.6	.8	.9	1.1	1.9	.7	.5	.4	.7	.3	.5	8.8
Sto Change, Av-Br	1.2	1.1	.5	-4.8	-1.2	3.8	-4.2	7.9	-3.6	-.6	2.2	1.3	3.6
Carls ID diversions	.0	.0	.0	10.8	8.6	11.7	6.5	8.0	7.2	6.6	.0	.0	59.4
93% CID diver	.0	.0	.0	10.0	8.0	10.9	6.0	7.5	6.7	6.2	.0	.0	55.2
Other depletions	.1	.1	.1	.1	.1	.1	.2	.2	.1	.1	.1	.1	1.4
Pecos R at Carlsbad	1.1	.9	1.0	.9	.7	.3	.4	1.0	.7	1.4	2.2	.4	10.9
Total Outflow	3.1	3.0	2.6	7.3	10.0	21.4	3.2	21.8	4.6	8.7	5.4	2.7	93.8
Flood Inflow	.6	.6	.7	5.4	3.0	-.3	3.5	-1.4	1.9	2.9	1.1	-.7	17.3

Table 4. Determination of Flood Inflows, Carlsbad to State Line (B.5)

Carlsbad to Red Bluff	4.4 TAF
Delaware River	3.0

Flood Inflows, TAF	7.4 TAF

Table 5. Depletions Due to Irrigation Above Alamogordo Dam - 1990

	APR	MAY	JUN	JUL	AUG	SEPT	OCT	TOTAL
Precip Las Vegas FAA AP	1.79	.65	.40	3.93	4.58	2.83	.15	14.33
Eff prec Las Veg FAA AP	1.65	.63	.39	3.26	3.64	2.46	.15	12.18
Precip Pecos Ranger Sta	1.25	1.25	.21	3.95	4.49	3.40	.52	15.07
Eff Precip Pecos RS	1.19	1.19	.20	3.27	3.60	2.88	.51	12.84
Precip Santa Rosa	.41	.50	.02	2.34	2.24	1.49	.81	7.81
Eff Precip Santa Ro	.39	.49	.02	2.09	2.00	1.38	.78	7.15
Average eff precip, ft	.09	.06	.02	.24	.26	.19	.04	.89
consumptive use, ft	.19	.36	.36	.30	.27	.18	.11	1.77
CU less eff precip, ft	.10	.30	.34	.06	.01	.00	.07	.88
Acres (most recent inventory)	9057.							
Streamflow depletion, AF	7998.							
1947 depletion, AF	10804.							
Difference, TAF	2.8							

Table 6. Depletions Due to Santa Rosa Reservoir Operations - 1990
(Using new area-capacity tables for Sumner and Santa Rosa Lakes)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	TOTAL
Alamogor ga ht, avg	49.95	51.28	52.77	52.69	51.12	41.76	37.20	40.50	40.79	40.88	42.60	46.30	45.65
Alacontent	19363	21606	24285	24135	21329	8988	5751	7951	8176	8248	9765	13987	
AlaArea	1635	1737	1878	1867	1725	884	593	763	791	799	965	1311	
Alaevap	4.29	5.06	6.13	9.26	15.03	18.68	13.15	10.61	8.02	8.08	5.18	3.68	107.17
.77Evap	3.30	3.90	4.72	7.13	11.57	14.38	10.13	8.17	6.18	6.22	3.99	2.83	82.52
AlaPrecip	.53	.94	1.18	1.41	1.16	.05	2.42	5.29	1.42	.64	.43	.29	15.76
NetEvap	2.77	2.96	3.54	5.72	10.41	14.33	7.71	2.88	4.76	5.58	3.56	2.54	66.76
AlaEvaploss	.38	.43	.55	.89	1.50	1.06	.38	.18	.31	.37	.29	.28	6.62
L S Rosa ga ht, avg	14.70	15.29	15.80	16.75	16.94	92.58	99.70	99.86	6.84	12.92	14.11	14.79	35.02
SRcontent	24135	24940	25658	27042	27325	5782	9494	9598	15253	21856	23356	24256	
SRarea	1340	1389	1429	1485	1494	416	650	657	948	1228	1295	1348	
SRevap	3.72	5.04	8.68	6.49	10.39	13.17	9.60	6.30	6.26	5.91	4.80	3.72	84.08
.77Evap	2.86	3.88	6.68	5.00	8.00	10.14	7.39	4.85	4.82	4.55	3.70	2.86	64.74
Lake SR precip	.87	1.07	.57	.65	.53	.09	4.95	2.86	2.15	.63	1.10	.69	16.16
NetEvap	1.99	2.81	6.11	4.35	7.47	10.05	2.44	1.99	2.67	3.92	2.60	2.17	48.58
SREvaploss	.22	.33	.73	.54	.93	.35	.13	.11	.21	.40	.28	.24	4.47
totalevaploss	.60	.75	1.28	1.43	2.43	1.40	.51	.29	.52	.77	.57	.52	11.09
sumcontents	43498	46546	49943	51177	48654	14770	15245	17549	23429	30104	33121	38243	
1947area	2020	2099	2242	2295	2187	914	937	1000	1224	1549	1643	1875	
1947loss	.47	.52	.66	1.09	1.90	1.09	.60	.24	.49	.72	.49	.40	8.66
current-1947	.13	.24	.62	.33	.53	.31	-.09	.05	.04	.05	.08	.12	2.43

Annual adjustment for excess evaporation = 2.4

ADJUSTMENT FOR EXCESS STORAGE IN SANTA ROSA RESERVOIR

	1989	1990
EndYear Sumner Sto	23572	16126
EndYear S R Sto	25964	24609
Sum	49536	49536
Sto Adjustment, AF		0
Adjustm Ex Evap, TAF		2.4
Total Adjustment,TAF		2.4

Table 7. Major Johnson Springs New Water

See Appendix of Preliminary Report for computation details

.10 AF/yr = .01 AF/mo

Table 8. Carlbad Springs New Water 1990

Pecos R bel DC, cfs	15.3
Dark Canyon, cfs	.3
Pecos R bel Lake Av, cfs	.0
Depletion, cfs	2.0
CID lag seep, cfs	6.1
Return flow, cfs	1.0
Lake Av seep lag, cfs	16.7
PR seepage, cfs	3.0
Carls new water, cfs	-9.8
Carls new wat, TAF	-7.1
Carls new wat monthly, TAF	-.6

Table 9. Carlsbad Main Canal Seepage lagged - 1990

1989	1Q	2Q	3Q	4Q
FLOWS, cfs			188.50	51.24
SEVEN %			13.20	3.59
LAG				

1990	1Q	2Q	3Q	4Q
FLOWS, cfs	0	171.64	119.64	36.39
SEVEN %	0	12.01	8.37	2.55
LAG	3.39	6.61	8.19	6.07

Average = 6.08 cfs

Table 10. Lake Avalon leakage lagged - 1990

1989	1Q	2Q	3Q	4Q
gage			16.01	16.14
flows, cfs			14.53	15.15
lag				

1990	1Q	2Q	3Q	4Q
gage	17.62	16.28	15.85	16.10
flows, cfs	22.22	15.82	13.76	14.96
lag	18.58	17.84	15.86	14.70
		Total		66.99

Average = 16.73 cfs

Table 11. Evaporation Loss at Lakes Avalon and Brantley - 1990 3-16-91

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	TOT
Avalon gage ht, avg	17.29	17.70	17.89	16.37	16.39	16.09	15.95	15.88	15.72	15.85	15.77	16.68	16.47
Avg area Avalon	704	734	747	623	627	581	560	549	525	545	532	657	
Brantley gage ht, avg	36.72	37.97	38.84	36.46	29.79	38.36	33.10	38.25	37.58	37.54	37.59	39.15	36.78
Avg Br area	887	981	1046	868	382	1010	618	1002	952	949	952	1069	
Panevap Brantley	4.65	5.60	7.86	11.06	17.30	18.63	13.42	9.01	7.78	8.08	4.82	4.34	112.55
Lakeevap Brantley	3.58	4.31	6.05	8.52	13.32	14.35	10.33	6.94	5.99	6.22	3.71	3.34	86.66
precipBrantley	.21	.00	.58	1.02	.16	.37	3.18	3.34	3.05	.86	.90	.11	13.78
Netevap	3.37	4.31	5.47	7.50	13.16	13.98	7.15	3.60	2.94	5.36	2.81	3.23	72.88
Evaploss Br, TAF	.2	.4	.5	.5	.4	1.2	.4	.3	.2	.4	.2	.3	5.1
Evaploss Av, TAF	.2	.3	.3	.4	.7	.7	.3	.2	.1	.2	.1	.2	3.7
Totalloss A+B,TAF	.4	.6	.8	.9	1.1	1.9	.7	.5	.4	.7	.3	.5	8.8

Table 12. Change in storage, Lakes Brantley and Avalon 1990 3-16-91
(Gage heights from last day of each month)

	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	TOTAL
Lake Avalon gage, ft	17.00	17.50	17.80	17.90	16.10	16.20	16.10	16.10	15.50	16.00	15.40	16.40	17.00	16.50
Avalon storage, AF	1608	1959	2178	2252	1032	1091	1032	1032	710	975	662	1214	1608	
Av change stor, AF		351	219	74	-1220	59	-59	0	-322	265	-313	552	394	0
Brantley gage, feet	36.00	37.40	38.50	39.00	33.40	31.30	36.80	30.40	40.40	36.90	36.20	38.50	39.70	36.54
Brantley storage, AF	7459	8700	9777	10296	5542	4362	8150	3957	11852	8240	7627	9777	11055	
Brant change stor, AF		1241	1077	519	-4754	-1180	3788	-4193	7895	-3612	-613	2150	1278	3596
Total change stor, TAF		1.6	1.3	.6	-6.0	-1.1	3.7	-4.2	7.6	-3.3	-.9	2.7	1.7	3.60

Table 13. Data Required for River Master Manual Calculations, Water Year 1990

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	TOTAL/ AVG
Streamflow gage records													
Pecos R b Sumner Dam, TAF	1.2	1.6	3.9	4.7	27.4	27.2	3.5	22.4	5.3	5.7	.0	.0	102.8
Fort Sumner Main C, TAF	.8	1.5	3.5	4.2	6.3	6.0	3.8	1.9	5.2	5.5	.1	.0	38.9
Pecos R nr Artesia, TAF	3.1	3.0	2.5	2.5	7.6	22.3	.3	23.8	3.3	6.4	4.9	4.0	83.5
Pecos R nr Lkwd (KC), TAF	3.1	3.1	2.3	2.2	7.5	22.1	.0	23.1	3.0	6.3	4.5	3.4	80.5
Pecos R b Brantley R, TAF	1.3	1.2	1.2	10.1	9.6	13.3	7.3	9.1	8.2	6.8	1.2	1.4	70.8
Pecos b Dark Canyon, TAF	1.1	.9	1.0	.9	.7	.3	.4	1.0	.9	1.4	2.2	.4	11.1
Dark Canyon at Csbad, TAF	.0	.0	.0	.0	.0	.0	.0	.0	.2	.0	.0	.0	.2
Pecos bel Avalon Dam, TAF	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Carlsbad Main Canl, TAF	.0	.0	.0	10.8	8.6	11.7	6.5	8.0	7.2	6.6	.0	.0	59.4
Pecos R at Red Bluff, TAF	3.4	2.9	2.4	1.6	.9	.3	1.1	2.4	3.7	4.4	5.8	3.8	32.8
Delaware R nr Red B, TAF	.2	.1	.2	.2	.1	0	.4	.7	1.2	1.1	.2	.2	4.4
Gage heights													
Avalon gage ht, end mo	17.50	17.80	17.90	16.10	16.20	16.10	16.10	15.50	16.00	15.40	16.40	17.00	16.50
Avalon gage ht, avg	17.29	17.70	17.89	16.37	16.39	16.09	15.95	15.88	15.72	15.85	15.77	16.68	16.47
Brantley gage ht, end mo	37.40	38.50	39.00	33.40	31.30	36.80	30.40	40.40	36.90	36.20	38.50	39.70	36.54
Brantley gage ht, avg	36.72	37.97	38.84	36.46	29.79	38.36	33.10	38.25	37.58	37.54	37.59	39.15	36.78
Alamogordo gage ht, avg	49.95	51.28	52.77	52.69	51.12	41.76	37.20	40.50	40.79	40.88	42.60	46.30	45.65
Lake St Rosa ga ht, avg	14.70	15.29	15.80	16.75	16.94	92.58	99.70	99.86	6.84	12.92	14.11	14.79	35.02
Precipitation													
Precip Brantley, inches	.21	.00	.58	1.02	.16	.37	3.18	3.34	3.05	.86	.90	.11	13.78
Precip LV FAAA AP, inches				1.79	.65	.40	3.93	4.58	2.83	.15			14.33
Precip Pecos Rang, inches				1.25	1.25	.21	3.95	4.49	3.40	.52			15.07
Precip Santa Rosa, inches				.41	.50	.02	2.34	2.24	1.49	.81			7.81
Precip Sumnr lake, inches	.53	.94	1.18	1.41	1.16	.05	2.42	5.29	1.42	.64	.43	.29	15.76
Precip Lake SRosa, inches	.87	1.07	.57	.65	.53	.09	4.95	2.86	2.15	.63	1.10	.69	16.16
Evaporation													
PanEvap Lake Sumn, inches	4.29	5.06	6.13	9.26	15.03	18.68	13.15	10.61	8.02	8.08	5.18	3.68	107.17
PanEvap Lk SRosa, inches	3.72	5.04	8.68	6.49	10.39	13.17	9.60	6.30	6.26	5.91	4.80	3.72	84.08
Pan Evap, Brantley, inches	4.65	5.60	7.86	11.06	17.30	18.63	13.42	9.01	7.78	8.08	4.82	4.34	112.55
Other reports													
Base Acme-Artesia, TAFc	2.3	1.9	2.4	1.8	1.0	.6	.6	1.1	1.9	2.5	3.0	3.3	22.5
Pump depl Ac-Artesia, TAFc	.1	.4	.6	1.1	1.4	2.4	.7	2.3	1.3	.7	.2	.0	11.2
NM irrigation inv, acres													9057.
NM Transfer water use, TAF													0
NM salvaged water, TAF													0
Texas, water stored NM, TAF													0
Texas, use Del water, TAF													0

RESPONSE TO STATES' OBJECTIONS TO PRELIMINARY REPORT

New Mexico's Objections

1. Major Johnson Springs New Water Computation

New Mexico's first set of objections relate to the Major Johnson Springs (MJS) New Water Computation. New Mexico states that the compact accounting is not valid and alleges that the computation is inconsistent with other procedures in the Manual and technically erroneous. While New Mexico's allegations for this statement seem to be restatements of reasons and advocacy for the Third Motion, I have examined them carefully to see if any present new and valid objections to the Preliminary Report.

The context of these objections is that until Brantley Reservoir was filled the approved Manual procedure was to compute summer MJS New Water discharge by correlating it to the depth of water in a nearby well (20.26.8.1211). The discharges for other months were to be estimated by adding quantities as prescribed by Manual Section B.4.b.(2). This method, which is clearly an approximation, was to be used until the newly constructed Brantley Reservoir was filled.

After Brantley began to impound water the Manual calls for computing the New Water by the "water balance technique" using the following factors: evaporation, content changes, diversions, gaged inflows and outflows and losses and gains to bank storage by piezometric measurements. These are the quantities I used in the MJS water balance accounting.

The Manual recognized that there would be a transitional period during and after the filling when not all measurements were available; for this period of water years 1988 and 1989 it allowed the assumption that the New Water was 8200 acre-feet, an approximate figure based on a compromise between the states. It placed a deadline on this by specifying that if the gages and piezometers were not installed by January 1, 1989 that the River Master would have them installed. This was an unlikely outcome since piezometers and stream gages are part of the ongoing programs of the Bureau of Reclamation and USGS and it would have been much more expensive for the states if the River Master had arranged to have a piezometer and gaging network designed and installed; furthermore, arrangements for regular reading of the gages would be needed, and the agencies already employ technicians for this purpose. Based on this I took the position that I would rely on the USBR and USGS gages.

In addition to the gages, procedures were needed for implementing the "water balance technique" called for in B.4.b.(3). At the River Master's conference held March 20-21, 1989 I learned that the states would be proposing procedures for the technique. If these procedures had been jointly proposed by the states they could have been implemented for water year 1989. However, New Mexico's Third Motion, filed April 18, 1990, was the first to propose procedures and it came after the Preliminary Report for water year 1989 was essentially finished. Also, rather than propose procedures to implement the Manual's water balance technique, the Motion proposed a different approach that would eliminate the separate MJS computation and make it implicit in a surface water analysis that would not require piezometric measurements. Texas

opposed this motion and proposed a cross motion that would follow the general lines of the existing procedure and require a research study by USGS to establish some of the estimation parameters.

Because the procedures were not ready for water year 1989 accounting the 8200 acre-foot MJS figure was used. In addition, it became clear that the Third Motion could not be decided by the end of calendar year 1990 and I proposed to continue the 8200 acre foot approximation for water year 1990. This would have provided a definite figure to use for the annual accounting to use in the period while the Third Motion process continued. Texas opposed this approach and New Mexico, while not rejecting it totally, sought to link it to the use of retroactive adjustments to the annual accounting, and this was unacceptable to Texas. For this reason I determined that the only avenue available was to use the approved Manual procedure, a water balance technique called for in B.4.b.(3). This procedure, while approved in the Manual, necessarily calls for the use of estimation parameters that are not in the Manual and involve judgement.

While all water budget items called for in B.4.b.(3) are generally available, not all are fully and precisely measured. Water budget items such as channel losses, local runoff, stream channel evaporation and losses to deep aquifers are among the unmeasured items, and how to obtain accurate values for them will be considered in the Third Motion process. However, in spite of its limitations, the water balance method that has been used may well be as accurate as the original MJS estimation method which relied on the well level correlation and incremental monthly additions. The limited accuracy of that method is evident by reviewing how it was developed using a correlation of spring discharge with well levels (see Review of Basic Data, Appendix 11).

New Mexico's claim that the accounting is not valid and allegation that the computation is inconsistent with other procedures in the Manual and technically erroneous are presented along three lines: consistency with other Manual procedures; validity of water balance; and reliability of aquifer characteristics. Each of these issues is currently under consideration in the Third Motion process (see the River Master's Deferral of Decision on Proposed Modification, New Mexico's Third Motion, April 1, 1991).

New Mexico's inconsistency argument (page 2, Objections) is that "Identical quantities must be used to represent the same inflow or outflow item when that item is included in two water balance equations for overlapping reaches. To do otherwise defies both logic and mathematics and results in erroneous flood inflows..." New Mexico devotes four and a half pages to a discussion of the inconsistency argument (pp 2-6, Objections), and addresses issues to be considered in the Third Motion process. While New Mexico's arguments may have validity, they address complex issues going beyond the basic inconsistency issue, and have been disputed by Texas. My conclusion is that they do not present valid objections to this year's accounting of New Water which follows as closely as possible the current Manual technique.

New Mexico's water balance argument (page 6-9, Objections) states correctly that the River Master interprets Section B.4.b.(3) to require bank storage estimates from piezometric measurements. The Manual (Section B.4.b.(3)) states: "...compute...by the water balance technique using ...Losses and gains to Brantley Reservoir bank storage by piezometric measurements (emphasis added)." There appear to be two lines to New Mexico's reasoning here: that

there are additional groundwater budget items beyond those measured by the piezometers and that there should be a use of "time-variant piezometric gradients". This first point, of concern to both states, is acknowledged; however, since we lack data on additional groundwater budget items, such as losses to deep aquifers, these cannot be quantified or accounted at this time. The second point infers that a computerized mathematical model is needed to make the accounting; this is a subject that has been mentioned in the Third Motion process, but neither state has proposed such a modeling effort. Each of these issues will be discussed in the Third Motion process, but neither is relevant to this year's accounting using current Manual procedures.

New Mexico's third reason for objecting to the MJS calculation is based on the validity of estimates of aquifer properties; specifically the value of specific yield and extent of aquifer. New Mexico observed correctly that the values were suggested by Texas. However, in the process of considering Texas' suggestion I reviewed the USGS and Bureau of Reclamation reports and maps that are available to me and concluded that the estimates were based on these research and engineering reports and were reasonable. These documents are basically the same ones that will be used in the Third Motion process. I invited New Mexico to comment on these values during her review of the Preliminary Report, but New Mexico did not propose any alternative values.

In conclusion, New Mexico's objections to the Major Johnson Springs New Water computation present issues which will be considered further in the Third Motion process. These objections present New Mexico's advocacy for the Third Motion and for allowing retroactive adjustments to Final Determinations of annual delivery obligations. In the meanwhile, as far as I can determine, the MJS Springs New Water estimate provided in the Preliminary Report and in this Final Report follows current approved Manual procedures as closely as possible. New Mexico did not support her objections with any alternative computations that follow current Manual procedures. For these reasons I conclude that there is no reason to change the estimate of 0.1 TAF for the 1990 MJS New Water.

2. Adjustments Above Alamogordo Dam

The first objection in this category relates to irrigation depletions. First, there were some numerical errors in listing of effective precipitation; Texas also noted these and they have been corrected. Second, as the official Pecos Ranger Station data for August is missing, it is necessary to estimate the data. New Mexico's approach to estimate the data point is reasonable and I accept it.

The second objection relates to adjustments for Santa Rosa Reservoir operations. There was a numerical error in the Preliminary Report that New Mexico correctly identified as leaving 1989 data in a table. Texas also found the error and it has been corrected. The final adjustment for Santa Rosa Reservoir operations as calculated by both states and the River Master is now +2.4 TAF.

3. Artesia to Damsite 3 Channel Losses

There were two numerical errors in the listing of channel losses; Texas also found these numerical errors and they have been corrected. The rest of New Mexico's discussion is additional advocacy for their Third Motion and will be considered further when the Motion process resumes.

4. Carlsbad to State Line Flood Inflows

New Mexico repeats objections that were filed in 1990 and refers to the pending Sixth Motion that relates to hydrograph scalping. These points have been noted.

New Mexico objects to procedures for estimating flood inflows contributed by the Delaware River. New Mexico's objections seem mostly to deal with semantics; for example (see page 18 of NM Objections), to me the difference between daily streamflow data and a hydrograph is deals with semantics: a hydrograph with a time increment scale of one day is a plot of daily streamflow data. In any event New Mexico's results are the same as the River Master's, 3.0 TAF; and the monthly totals are also the same.

In New Mexico's objections to the computation of Pecos River Below Dark Canyon and Near Red Bluff flood inflows, the first point is about the scale of the hydrographs. New Mexico states that the hydrograph scales as presented in the Preliminary Report are not adequate and presents a 1" = 200 cfs version of the plot. However, it is my observation that the 1" = 200 cfs plot is very difficult to read and interpret; thus I favor hydrograph plots at larger scales to enable inspection of individual flood events. The problem of breaking the time interval into small pieces is a problem needing further analysis. This same problem appears in the display of results of the Acme to Artesia base inflow computation, and more discussion is provided about it under the response to Texas' observations.

New Mexico states opinions about hydrograph scalping and the display of information on pages 20-21; these have noted by the River Master. One of these, the display of information by months as well as events, has been accommodated in the Final Report. Concerning which raingages have been used, the identifier "Red Bluff" on certain graphs on page C-8 is incorrect and should read "rain". The graphics package used to generate these plots is limited and will only accommodate one scale; this is why the rainfall data is not plotted to scale. I will consider using a different graphics package for next year's report to improve this display.

The issue of using Red Bluff Dam precipitation was covered last year and my policy remains unchanged. I will consider it if brought to my attention by the states, but I do not receive the Texas precipitation reports or present Red Bluff precipitation data in the Preliminary Report. This is the subject of New Mexico's Sixth Motion and will be decided before next year's report.

On pages 23-27 New Mexico makes useful observations of why there might be operational rises in the Red Bluff hydrograph. The Manual does not prescribe the consideration of information such as changes in diversions from the Harroun Canal or releases from Lower Tansill Lake, but this information might

improve precision in hydrograph scalping. The constraint of only considering hydrograph rises when there has been precipitation in the reach partially addresses this issue.

All in all, the River Master's Preliminary Report estimate of Carlsbad-State Line flood inflows did not differ much from New Mexico's: 6.9 TAF by New Mexico and 7.2 TAF by the River Master. As discussed later under Texas' objections the figure is adjusted to 7.4 TAF in the Final Report.

Texas' Objections

1. Base Inflows, Acme to Artesia

This year a Manual Modification related to base inflows takes effect (see Modification Determination, New Mexico's Amended First Motion to Modify the River Master's Manual, December 26, 1990). The new language states :

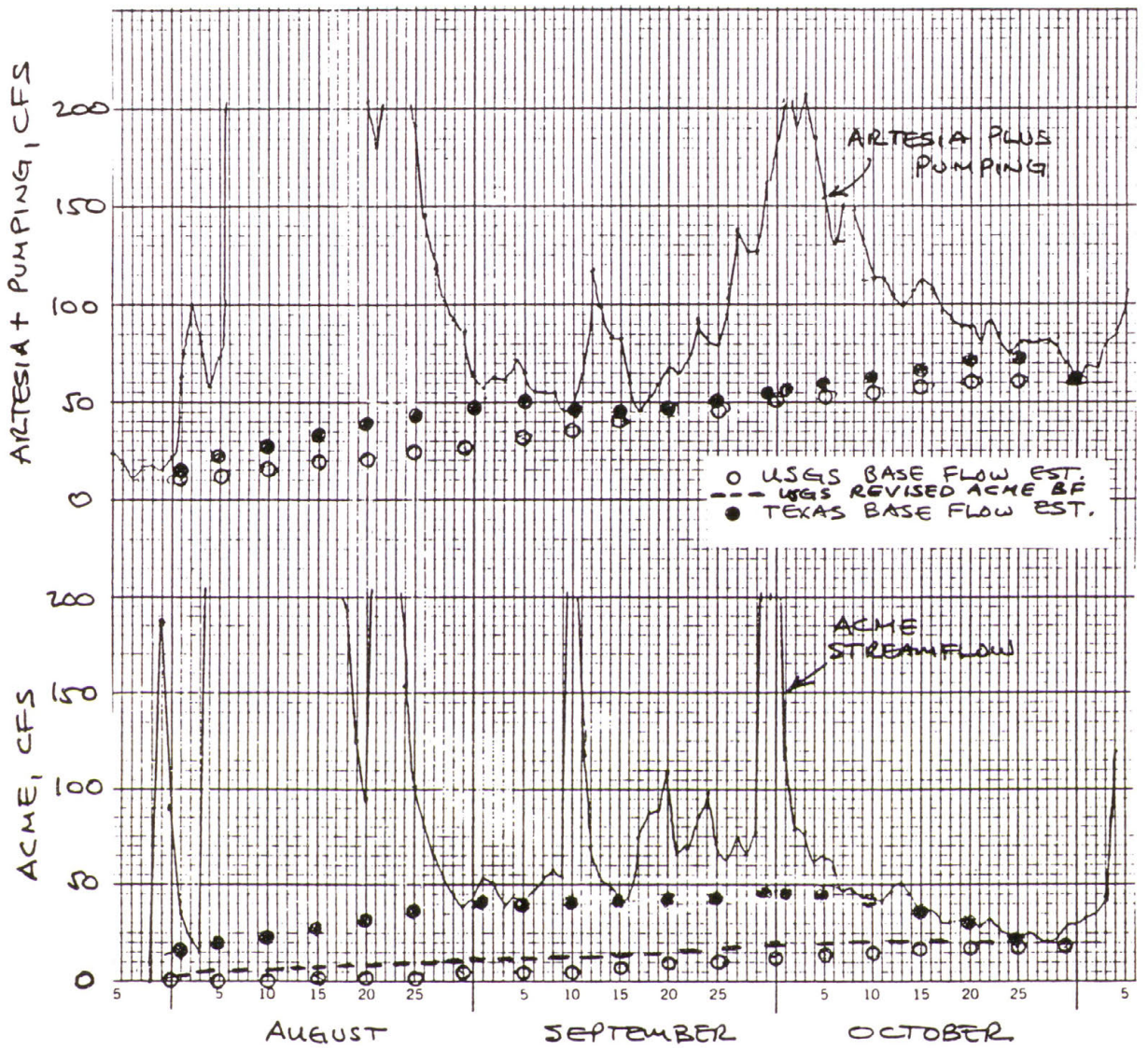
"For the River Master's Preliminary Report use the monthly base inflow quantities determined and furnished by the USGS. USGS will utilize the best available data and methods to estimate the total monthly base inflows accruing to the Acme to Artesia reach. In their report USGS will describe the data and methods used to estimate the base inflows and describe any unusual hydrologic events that occurred during the water year. After review of any objections to the USGS estimates by the states the River Master will make any adjustments deemed necessary to the base inflow estimates and determine the base inflow quantities for the Final Report. If no monthly base inflow quantities are determined and furnished by USGS the River Master will prepare the estimates for the Preliminary Report. "

This procedure was followed. Texas objected to USGS' computation of base inflow in the Acme to Artesia reach. Texas computed 18.4 TAF in comparison with USGS' result of 22.5 TAF. New Mexico did not object to USGS' estimate. The following describes how Texas' objections have been considered.

Texas observed that there were major differences between their computation and USGS' for the months of August and September and significant differences for the months of February, October, November and December. To compare the results I selected all months where the differences were greater than 200 acre-feet: February and August through December.

For the month of February the main difference between Texas and USGS is a difference in opinion about the Acme base flow. In this period USGS' estimate seems more consistent than Texas in their treatment of the Artesia and Acme base flows, especially during the period February 18-22. In any case, it is a matter of judgement and I accept USGS' estimate. During November and December I cannot discern for practical purposes much difference on the graphs between Texas' and USGS' estimates and I accept USGS' estimates. The numerical differences of about 0.2 to 0.3 TAF per month result from different judgement decisions of selecting base flows. This is also true for the other months during 1990 except for the period August - October where Texas noted major differences of 0.7 to 1.5 TAF.

My initial review of USGS' estimates during August-October USGS suggested that USGS was inconsistent in estimating the base flow and duration of flood event for the Acme gage, and their estimate of Acme base flow seems too low. USGS' presentation was very difficult to follow for this period due to the multiple intersection of lines which could not be distinguished from each other. I replotted the Acme and Artesia streamflow hydrographs on separate graphs to enable inspection of the selection by USGS and Texas of base flows. As shown by the attached figure there is considerable difference between these selections. The biggest factor in the difference is USGS' selection of the Acme base flow which is much lower than Texas'. USGS' selection of this base flow seemed to have the effect of introducing inconsistency in the estimate of base flows for the Acme and Artesia gages.



Comparison of USGS and Texas estimates of base flow for August - October, 1990
Acme and Artesia (plus pumping) hydrographs

For example, note the Acme flow on September 15 and the Artesia flow on September 17; although the streamflows are close to equal for these corresponding hydrologic observations, USGS' selection of a low base flow for Acme seems to have the effect of overestimating base inflow in the Acme to Artesia reach. It would seem that the 44 cfs at Acme on September 15 would be essentially the same 45 cfs that showed up as Artesia plus pumping on September 17. The base inflow, if this is true, would be essentially zero for this day; and by showing a low base flow for Acme and a higher one for Artesia plus pumping USGS seems to be overstating the base inflow.

To evaluate this hypothesis I contacted Mr. Herb Garn of USGS and furnished him with a plot of Texas' base flow analysis for the period. Mr. Garn reevaluated the estimate and revised the USGS estimate, but not to the same levels as Texas. In effect, USGS kept the Acme base flow line lower than Texas for the period August - October. Mr. Garn's reasoning was that there are other criteria for scalping the hydrographs, including: the actual gaged base flow of zero for Acme during July; the need to have the estimate of daily base inflows follow a smooth curve so that it is consistent with physical reality and does not artificially show abrupt changes in base inflow contributions; and the unexplained phenomena of negative difference hydrograph for the period September 17 - 21. If there is some unmeasured diversion from the stream in this period, for example, the Artesia plus pumping hydrograph should be higher, thus making the base flow for this gage higher and resulting in a higher base inflow contribution.

Thus the River Master's final determination of base inflows is 21.1 TAF as shown below using USGS' revised estimate for the year:

	USGS	TX	REVISED USGS
Jan	2340	2236	2340
Feb	1940	1632	1940
Mar	2400	2303	2400
Apr	1790	1708	1790
May	984	844	984
Jun	595	492	595
Jul	615	680	615
Aug	1110	359	738
Sep	1900	367	1190
Oct	2520	1979	2210
Nov	2980	2703	2980
Dec	3320	3089	3320
Total	22494	18392	21102

My comparison of USGS' and Texas' estimates illustrated the difficulty of comparing hydrograph scalping results. Not only are there numerous measurement and judgement issues, the format of presentation can be an impediment to evaluating the estimates. The format of presentation must be improved to enable better cross checking and comparisons. USGS furnished a graphical display of the entire year's hydrographs for both Acme and Artesia. This display is convenient in the sense that it enables inspection of

multi-month periods and of the base flows of both gages, but it is quite difficult to read. Also, USGS did not furnish a numerical computation to check the precise values of daily base flow selections. Texas furnished monthly hydrographs which are, in general, easier to read, but lack the multi-month viewpoint. These graphs could be used for comparison of the states' and USGS computations if they were at the same scale and if they had grids on them. Also Texas furnished numerical computations enabling the checking of base flow values.

I encourage USGS to re-evaluate how to present the base inflow computation in a manner to facilitate comparisons and checking. One possibility, for example, might be for USGS to furnish the states and the River Master with copies of larger, clear versions of a full year's plot; then the River Master could distribute those as part of the Preliminary Report without further copying. The states could accompany their objections with a comparative graphical display showing directly the areas of agreement and disagreement. The River Master could then compare all three estimates on one graph to see the areas of disagreement. The states are invited to make suggestions to USGS and/or the River Master about improving the presentation.

2. Channel Losses, Artesia to Carlsbad

The two numerical errors discovered by Texas have been corrected.

3. Brantley Reservoir Bank Storage

Texas' objection is noted. The River Master's position on this issue as stated in the Preliminary Report still holds: "As I have stated before I see no way to give this credit without implementation of B.4.i.(2)". As this Manual Section is under discussion in the Third Motion process the issue of bank storage credit can be raised again soon.

In reviewing this objection I found a need to clarify a statement that I made in the statement of issues accompanying the decision to defer action on the Third Motion (dated April 1, 1991). Under "Retroactive Credit" I stated "The River Master has stated his intention to incorporate Brantley bank storage into the calculations for Water Year 1990 and does not consider this to be a retroactive adjustment in the sense that a final determination of delivery obligation would be adjusted on a retroactive basis." There are two aspects to incorporating Brantley bank storage: using it to compute MJS New Water under B.4.b.(3) and providing credit for losses to deep aquifers under B.4.i.(2). In the statement accompanying the decision on the Third Motion I was referring to the MJS computation. I still see no way to implement B.4.i.(2) without USGS making a determination.

4. Flood Inflows, Carlsbad to State Line.

Texas' objection relating to the flood in April 1990 is accepted. Texas' objection relating to the August flood is rejected. Texas extends the flood longer than the River Master; note New Mexico's explanation in her objections about the operation of the Harroun Canal in this period. Texas' objections relating to the flooding in October are rejected; the River Master believes

that Texas has extended the flood period too long. Texas' objections for November are rejected; the River Master believes that this is an operational rise; note New Mexico's comments about the draining of Lower Tansill Lake.

The final determination for flood inflows, Carlsbad to State Line is:

	Carlsbad to Red Bluff (including DCD)				Delaware River				Total			
	RM	NM	TX	USGS	RM	NM	TX	USGS	RM	NM	TX	USGS
Jan	.0	0	.0	.0	.0	.0	.0	.0	.0	0	.0	.0
Feb	.1	0	.1	.0	.0	.0	.0	.0	.1	0	.1	.0
Mar	.1	0	.3	.0	.0	.0	.0	.0	.1	0	.3	.0
Apr	.3	0	.3	-.0	.0	.0	.0	.0	.3	0	.3	.0
May	-.0	0	-.0	0	.0	.0	.0	.0	.0	0	.0	0
Jun	0	0	0	0	.0	.0	.0	.0	0	0	0	0
Jul	.6	.5	1.0	.5	.3	.3	.3	.3	.9	.8	1.3	.8
Aug	.4	.4	1.3	.4	.6	.6	.6	.6	1.0	1.0	1.9	1.0
Sep	2.0	2.1	2.9	2.2	1.1	1.1	1.1	1.1	3.1	3.2	4	3.3
Oct	.8	.8	1.2	.6	1.0	1.0	1.0	1.0	1.8	1.8	2.2	1.6
Nov	.1	.1	.5	.3	.0	.0	.0	.0	.1	.1	.5	.3
Dec	0	0	0	-.0	.0	.0	.0	.0	0	0	0	.0
Sum	4.4	3.9	7.6	4.0	3.0	3.0	3.0	3.0	7.4	6.9	10.6	7.1

(Note: totals in this table may differ due to rounding)

5. Depletions above Alamogordo Dam

The numerical errors found by Texas have been corrected. In the case of the 1947 condition evaporation loss from Alamogordo Reservoir, the problem was a data error rather than the use of the wrong reservoir contents table; see New Mexico's objections on this same item.

6. Salvage water due to Brantley Reservoir

This is the first time Texas has objected to this item in the Preliminary Report process. If credit is to be considered for salvage water due to Brantley operations it will have to be proposed through the motion process. Texas wrote on February 21, 1991 that they intended to file a motion about the salvage water issue. The issue can be taken up in conjunction with further discussion of the Third Motion.

New Mexico made a communication about this item which was received on June 14. The fact that New Mexico's comments arrived by Fax on June 14 made them admissible. I determined that New Mexico's communication did fall within the guidelines of the River Master's Operating Policy which states: "Objections to or comments on the Preliminary Report received after June 14 (other than those placed in overnight courier by June 13) shall not be considered. This includes any responses by a State to the other State's objections received between June 14 and July 1."