PECOS RIVER COMPACT

Report of the River Master
Water Year 1992
Accounting Year 1993

Final Report

June 21, 1993

Neil S. Grigg
River Master of the Pecos River
1009 S. Lemay, #103
Ft Collins, Colorado 80524

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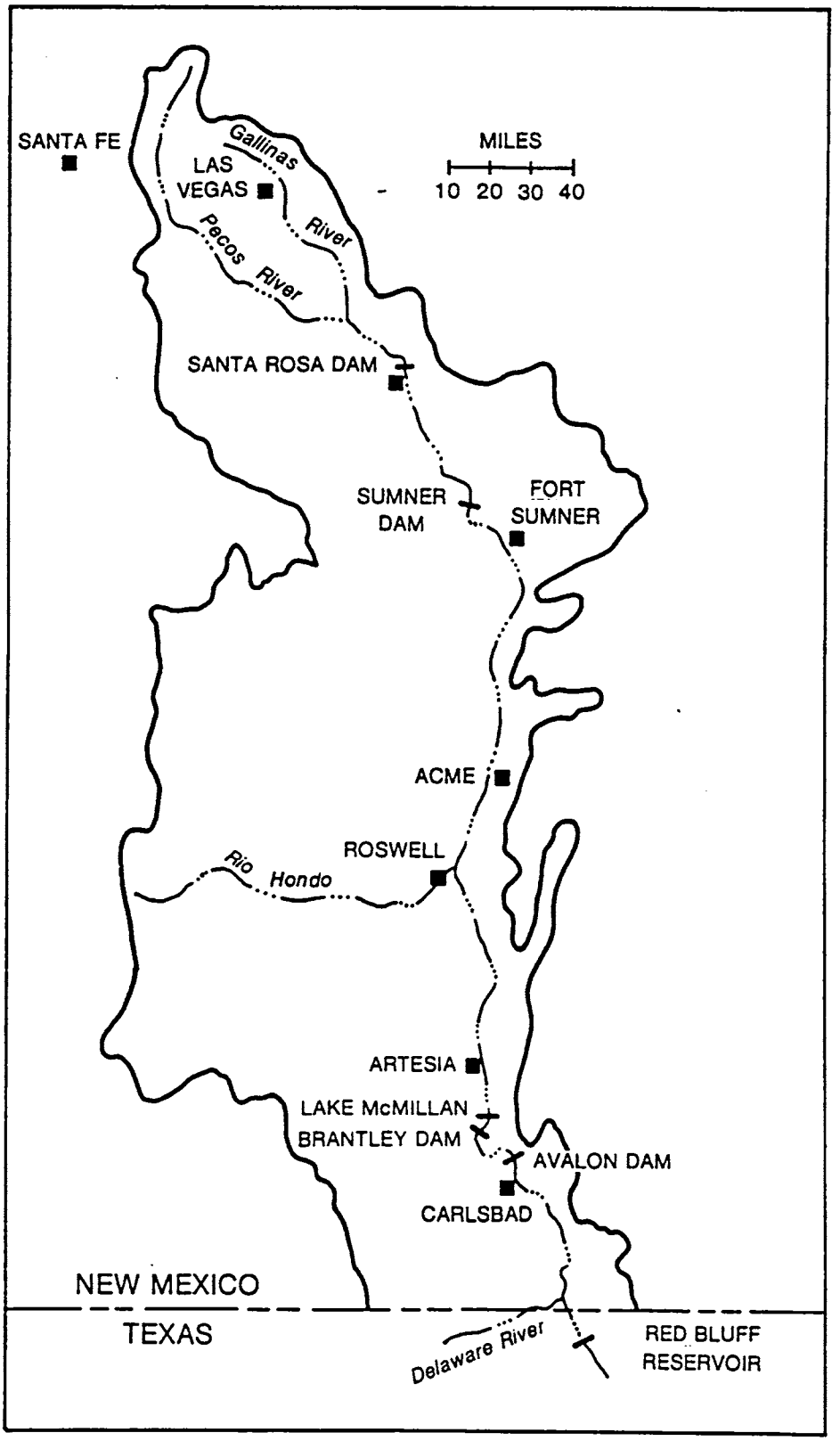
SANTA FE
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Rio Hondo
ARTESIA
LAKE McMILLAN
BRANTLEY DAM
AVALON DAM
CARLSBAD
NEW MEXICO
TEXAS
Delaware River
RED BLUFF RESERVOIR

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

Final Report of the River Master
Water Year 1992 - Accounting Year 1993
June 21, 1993

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 1992 was an overage 8,700 acre-feet. The accumulated overage since the beginning of Water Year 1987 is 19,800 acre-feet.

Water Year	Annual Overage or Shortfall	Accumulated Overage or Shortfall
1987	15,400 AF	15,400
1988	23,600	39,000
1989	2,700	41,700
1990	-14,100	27,600
1991	-16,500	11,100
1992	8,700	19,800

Special Topics. A five-year summary of compact accounting is included in this Report. Topics include: shortfalls and overages; motions to modify the River Master's Manual; Operating Policies; a list of meetings between the River Master and the States; a list of reservoir capacity manuals; and a list of legal and technical representatives involved in compact accounting.

Neil S. Grigg
River Master of the Pecos River

Table 1. General Calculation of Annual Departures, Thousand Acre-Feet
(6-21-93)

	1990	1991	1992
B.1.a. Index Inflows			
(1) Annual flood inflow			
(a) Gaged flow Pecos R bel Alamogordo Dam	102.8	122.7	143.9
(b) Flood Inflow Alamogordo - Artesia	6.6	87.3	39.1
(c) Flood Inflow Artesia - Carlsbad	10.5	13.1	8.3
(d) Flood Inflow Carlsbad - State Line	7.4	8.5	7.4
Total (annual flood inflow)	127.3	231.6	198.7
(2) Index Inflow (3-year avg)			185.9
B.1.b. 1947 Condition Delivery Obligation (Index Outflow)			83.1
B.1.c. Average Historical (Gaged) Outflow			
Gaged Flow Pecos River at Red Bluff NM	32.8	107.3	121.6
Gaged Flow Delaware River nr Red Bluff NM	4.4	3.5	3.7
(1) Total Annual Historical Outflow	37.2	110.8	125.3
(2) Average Historical Outflow (3-yr average)			91.1
B.1.d. Annual Departure			8.0
C. Adjustments to Computed Departure			
1. Adjustments for Depletions above Alam Dam			
a. Depletions Due to Irrigation	-2.8	-4.4	-2.4
b. Depl fr Operation of Santa Rosa Reservoir	2.4	23.3	-13.4
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	102.4	141.6	128.1
(b) Flood Inflow Alamogordo - Artesia	6.6	87.3	39.1
(c) Flood Inflow Artesia - Carlsbad	10.5	13.1	8.3
(d) Flood Inflow Carlsbad - State Line	7.4	8.5	7.4
Total (annual flood inflow)	126.9	250.5	182.9
Recomputed Index Inflow (3-year avg)			186.8
Recomputed 1947 Condition Del Outflow (Index Outflow)			83.7
Recomputed Annual Departures			7.4
Credits to New Mexico			
C.2 Depletions Due to McMillan Dike			1.3
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			8.7

* Note that as a result of the Third Motion Modification Determination, values for FIF, Artesia to Carlsbad, were adjusted for Water Years 1990, 1991, beginning with AY 1993.

Table 2. Determination of Flood Inflows, Alamogordo Dam to Artesia - 1992 (B.3)
(6-21-93)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	TOTAL
Flow bel Alamog Dam	.2	4.8	18.9	13.7	28.6	22.0	7.8	10.3	20.2	17.3	.0	.0	143.9
FtSumner Irrig Div	.0	.0	4.2	5.6	5.0	4.4	5.5	5.5	5.2	5.2	.0	.0	40.5
Ft Sumner ID Return	.9	.6	1.5	1.7	2.6	2.6	2.6	2.6	2.4	2.1	1.1	.9	21.5
Flow past FS IDist	1.0	5.5	16.2	9.9	26.1	20.2	4.9	7.4	17.4	14.3	1.1	.9	124.8
Channel loss	.4	2.2	3.1	2.3	4.2	4.5	.6	2.1	2.7	2.3	.3	.3	25.0
Residual Flow	.7	3.3	13.1	7.6	21.9	15.7	4.3	5.3	14.7	12.0	.8	.6	99.8
Base Inflow	5.2	5.0	4.9	4.0	3.7	3.1	2.8	2.7	2.6	2.8	2.8	3.2	42.9
River Pump Divers	.0	.0	.7	.9	.5	.6	1.0	.8	.8	.3	.0	.0	5.6
Residual, Artesia	5.9	8.3	17.3	10.7	25.1	18.2	6.1	7.2	16.6	14.4	3.5	3.7	137.1
Pecos Flow Artesia	11.4	8.8	24.9	14.2	32.3	33.5	5.1	5.2	9.2	19.6	6.1	5.8	176.2
Flood Inflow, AD-Art	5.5	.4	7.7	3.5	7.3	15.3	-1.0	-2.0	-7.4	5.1	2.5	2.1	39.1

Table 3. Determination of Flood Inflows, Artesia to Carlsbad - 1992 (B.4)
(6-21-93)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	TOTAL
Rio Penasco at Dayton	.0	.0	.0	.0	.0	.2	.0	.0	.0	.0	.0	.0	.2
Fourmile Draw nr Lakew	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
South Seven Rivers nr Lk	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1
Rocky Arroyo at Hwy Br	.0	.0	.0	.0	.0	.7	.6	.0	.0	.0	.0	.0	1.3
Flood Inflow, Art-DS3	.0	.0	.0	.0	.1	.9	.6	.0	.0	.0	.0	.0	1.5
Pecos R at Dam Site 3	1.4	4.6	6.1	13.2	27.1	38.0	23.3	15.8	13.3	19.0	1.4	1.3	164.5
Clsbd Sprgs New Water	-.2	-.2	-.2	-.2	-.2	-.2	-.2	-.2	-.2	-.2	-.2	-.2	-2.4
Total Inflow, DS3 - CB	1.2	4.4	5.9	13.0	26.9	37.8	23.1	15.6	13.1	18.8	1.2	1.1	162.1
Evap Loss, Lake Avalon	.1	.1	.4	.3	.1	.5	.4	.4	.4	.4	.2	.1	3.4
Storage Chg, Lake Aval	.8	.3	-1.7	.5	3.8	-2.6	-1.4	.2	.0	-.4	.5	.5	.5
Carls ID diversions	.0	.0	7.3	13.2	11.1	12.1	17.4	14.5	12.3	10.6	.0	.0	98.5
93% CID diver	.0	.0	6.8	12.2	10.3	11.3	16.2	13.5	11.4	9.9	.0	.0	91.6
Other depletions	.1	.1	.1	.1	.1	.1	.2	.2	.1	.1	.1	.1	1.4
Dark Canyon at Csbad	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Pecos b Dark Canyon	1.7	4.4	1.5	1.7	10.5	25.6	8.5	2.1	1.9	10.6	1.7	1.7	71.9
Pecos R at Carlsbad	1.7	4.4	1.5	1.7	10.5	25.6	8.5	2.1	1.9	10.6	1.7	1.7	71.9
Total Outflow	2.7	4.9	7.1	14.8	24.8	34.9	23.9	16.4	13.8	20.6	2.4	2.4	168.8
Flood Inflow, DS3-CB	1.5	.5	1.2	1.8	-2.0	-2.9	.8	.8	.7	1.8	1.3	1.3	6.8
Flood Inflow, Art-CB	1.5	.5	1.2	1.8	-2.0	-2.0	1.4	.8	.7	1.8	1.3	1.3	8.3

Table 4. Determination of Flood Inflows, Carlsbad to State Line (B.5)
(6-21-93)

Carlsbad to Red Bluff	5.8 TAF
Delaware River	1.6

Flood Inflows, TAF	7.4 TAF

Table 5. Depletions Due to Irrigation Above Alamogordo Dam - 1992
(4-20-93)

	APR	MAY	JUN	JUL	AUG	SEPT	OCT	TOTAL
Precip Las Vegas FAA AP	.18	1.72	2.61	2.18	3.91	.41	.11	11.12
Eff prec Las Veg FAA AP	.17	1.58	2.29	1.96	3.25	.39	.11	9.75
Precip Pecos Ranger Sta	.30	2.23	.95	2.31	3.83	1.43	.50	11.55
Eff Precip Pecos RS	.29	2.00	.91	2.07	3.19	1.33	.48	10.27
Precip Santa Rosa	.45	2.37	3.00	2.69	1.94	.94	.07	11.46
Eff Precip Santa Ro	.43	2.11	2.59	2.35	1.77	.90	.07	10.22
Average eff precip, ft	.02	.16	.16	.18	.23	.07	.02	.84
consumptive use, ft	.19	.36	.36	.30	.27	.18	.11	1.77
CU less eff precip, ft	.17	.20	.20	.12	.04	.11	.09	.93
Acres (most recent inventory)		9057.						
Streamflow depletion, AF		8423.						
1947 depletion, AF		10804.						
Difference, TAF		2.4						

Table 6. Depletions Due to Santa Rosa Reservoir Operations - 1992
(June 15, 1993)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	TOTAL
Alamogor ga ht, avg	65.98	67.04	61.83	60.91	60.93	60.99	60.52	59.24	57.09	48.53	48.01	51.14	
Alacontent, avg	59419	63116	46168	43519	43569	43740	42430	38983	33589	17142	16359	21368	
AlaArea	3435	3540	2933	2817	2819	2827	2767	2621	2396	1509	1463	1727	
Alaevap	2.12	4.22	8.49	8.95	9.76	11.88	13.91	11.85	10.76	8.52	4.62	2.52	97.60
.77Evap	1.63	3.25	6.54	6.89	7.52	9.15	10.71	9.12	8.29	6.56	3.56	1.94	75.15
AlaPrecip	.31	.27	.29	.75	2.98	2.68	.35	3.32	.50	.08	.07	.79	12.39
NetEvap	1.32	2.98	6.25	6.14	4.54	6.47	10.36	5.80	7.79	6.48	3.49	1.15	62.76
AlaEvaploss	.38	.88	1.53	1.44	1.07	1.52	2.39	1.27	1.55	.81	.43	.17	13.43
L S Rosa ga ht, avg	43.90	44.33	44.71	45.06	45.13	45.10	45.04	45.18	44.98	44.26	43.03	43.26	
SRcontent, avg	93119	94653	96016	97277	97535	97425	97203	97719	96984	94402	90079	90883	
SRarea	3534	3572	3604	3636	3644	3641	3634	3650	3627	3566	3449	3471	
SRevap	3.72	5.22	8.43	7.47	8.27	9.83	11.69	9.64	8.64	6.28	4.79	3.72	87.70
.77Evap	2.86	4.02	6.49	5.75	6.37	7.57	9.00	7.42	6.65	4.84	3.69	2.86	67.53
Lake SR precip	.50	.16	.84	.36	2.38	1.92	1.43	2.51	.36	.19	.26	.76	11.67
NetEvap	2.36	3.86	5.65	5.39	3.99	5.65	7.57	4.91	6.29	4.65	3.43	2.10	55.86
SREvaploss	.70	1.15	1.70	1.63	1.21	1.71	2.29	1.49	1.90	1.38	.99	.61	16.76
totalevaploss	1.07	2.03	3.22	3.08	2.28	3.24	4.68	2.76	3.46	2.20	1.41	.77	30.20
sumcontents	152538	157769	142184	140796	141104	141165	139633	136702	130573	111544	106438	112251	
1947area	4600	4600	4600	4600	4600	4600	4600	4600	4600	4091	3965	4109	
1947loss	.51	1.14	2.39	2.35	1.74	2.48	3.97	2.23	2.98	2.21	1.15	.39	23.55
current-1947	.57	.89	.83	.72	.54	.76	.71	.54	.47	-.01	.26	.38	6.64
											Annual adjustment for excess evaporation	=	6.6

ADJUSTMENT FOR EXCESS STORAGE IN SANTA ROSA RESERVOIR

	1991	1992
EndYear Sumner Sto	56770	23727
EndYear S R Sto	92590	91291
Sum	149360	115018
Sto Adjustment, AF		-20060
Adjustm Ex Evap, TAF		6.6
Total Adjustment,TAF		-13.4

Table 7. Carlsbad Springs New Water 1992 (6-13-93)

	TAF	cfs	Totals
Pecos R bel DC, cfs	71.9	99.3	99.3
Dark Canyon, cfs	0	0	0
Pecos R bel Lake Av, cfs	51.4	71.0	71.0
Depletion, cfs			2.0
CID lag seep, cfs			9.4
Return flow, cfs			1.0
Lake Av lagged seep, cfs			20.8
PR seepage, cfs			3.0
Carls new water, cfs			-3.9
Carls new wat, TAF			-2.8
Carls new wat monthly, TAF		723.8	-.2

Table 8. Carlsbad Main Canal Seepage lagged [B.4.c.(1)(e)] - 1992
(6-13-93)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	TOTAL AVG
CB Main Canl, TAF	.0	.0	7.3	13.2	11.1	12.1	17.4	14.5	12.3	10.6	.0	.0	98.5
days in month	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0	365.0
cfs	.0	.0	118.6	221.2	180.4	203.6	283.1	236.0	206.9	173.1	.0	.0	135.2
cfs, qtr avg	40.8			201.5			242.4			58.3			135.8

1991	1Q	2Q	3Q	4Q			
FLOWS, cfs			156.9	70.9			
SEVEN %			11.0	5.0			
1992	1Q	2Q	3Q	4Q			
FLOWS, cfs	40.8	201.5	242.4	58.3			
SEVEN %	2.9	14.1	17.0	4.1			
LAG	4.9	8.8	13.7	10.0	Avg =	9.4	cfs

Table 9. Lake Avalon leakage lagged [B.4.c.(1)(g)] - 1992
(revised 6-13-93)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	AVG
Av end mo ga ht													
Av ga ht, avg	17.2	17.8	18.1	16.0	17.6	20.4	16.9	16.2	16.2	16.5	16.0	17.0	17.2
cfs	20.2	23.1	24.5	14.5	22.1	35.5	18.8	15.4	15.4	16.9	14.5	19.3	
days	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0	
cfs avg	22.6			24.0			16.6			16.9			20.0
ga ht avg, qtr	17.7			18.0			16.4			16.5			
cfs/gage avg	22.6			24.0			16.6			16.9			20.0

1991	1Q	2Q	3Q	4Q			
gage			16.7	16.8			
flows, cfs			18.0	18.4			
1992	1Q	2Q	3Q	4Q			
gage	17.7	18	16.4	16.5			
flows, cfs	22.6	24.0	18.0	18.4			
lag	20.5	22.6	20.8	19.2	Avg =	20.8	cfs

Table 10. Evaporation Loss at Lake Avalon - 1992
(6-21-93)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	TOT
Avalon gage ht, avg	17.22	17.83	18.10	16.04	17.64	20.44	16.86	16.20	16.16	16.46	15.96	17.01	
Avg area Avalon	699	743	761	573	730	923	671	598	592	637	561	682	
Panevap Brantley	2.27	4.39	8.51	9.47	9.52	12.12	14.64	12.16	11.17	8.93	4.91	2.82	100.91
Lakeevap Brantley	1.75	3.38	6.55	7.29	7.33	9.33	11.27	9.36	8.60	6.88	3.78	2.17	77.70
precipBrantley	.61	1.35	.23	.73	5.38	2.32	3.31	.86	.72	.28	.38	.20	16.37
Netevap	1.14	2.03	6.32	6.56	1.95	7.01	7.96	8.50	7.88	6.60	3.40	1.97	61.33
Evaploss Av, TAF	.1	.1	.4	.3	.1	.5	.4	.4	.4	.4	.2	.1	3.44

Table 11. Change in storage, Lake Avalon 1992
(Gage heights from last day of each month)
(4-20-93)

	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	TOT
L Av ga end mo, ft	16.6	17.8	18.2	15.6	16.4	21.1	18.1	16.1	16.4	16.4	15.7	16.5	17.3	
Avalon storage, AF	1342	2178	2480	760	1214	4998	2403	1032	1214	1214	811	1277	1816	
Av chg stor, TAF		.8	.3	-1.7	.5	3.8	-2.6	-1.4	.2	0	-.4	.5	.5	.5

Table 12. Data Required for River Master Manual Calculations, Water Year 1992
(6-21-93)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	TOTAL/ AVG
Streamflow gage records, TAF													
Pecos R b Sumner Dam	.2	4.8	18.9	13.7	28.6	22.0	7.8	10.3	20.2	17.3	.0	.0	143.9
Fort Sumner Main C	.0	.0	4.2	5.6	5.0	4.4	5.5	5.5	5.2	5.2	.0	.0	40.5
Pecos R nr Artesia	11.4	8.8	24.9	14.2	32.3	33.5	5.1	5.2	9.2	19.6	6.1	5.8	176.2
Rio Penasco at Dayton	.0	.0	.0	.0	.0	.2	.0	.0	.0	.0	.0	.0	.2
Fourmile Draw nr Lakewood	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
South Seven Rivers nr Lkwd	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1
Rocky Arroyo at Hwy Br nr C	.0	.0	.0	.0	.0	.7	.6	.0	.0	.0	.0	.0	1.3
Pecos R b Brantley Reserv	1.5	4.6	6.8	14.1	26.9	38.1	24.8	16.4	13.6	19.9	1.3	1.3	169.2
Pecos R at Dam Site 3	1.4	4.6	6.1	13.2	27.1	38.0	23.3	15.8	13.3	19.0	1.4	1.3	164.5
Pecos bel Avalon Dam	.0	3.3	.0	.0	9.8	23.2	6.5	.0	.0	8.7	.0	.0	51.4
Carlsbad Main Canal	.0	.0	7.3	13.2	11.1	12.1	17.4	14.5	12.3	10.6	.0	.0	98.5
Dark Canyon at Carlsbad	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Pecos below Dark Canyon	1.7	4.4	1.5	1.7	10.5	25.6	8.5	2.1	1.9	10.6	1.7	1.7	71.9
Pecos R at Red Bluff	5.3	7.7	5.7	4.7	15.0	37.2	11.1	5.5	5.2	13.0	6.0	5.3	121.6
Delaware River n Red Bluff	.2	.2	.3	.2	.7	.8	.1	.4	.1	.1	.2	.2	3.7
Gage heights													end mo Dec 91
Avalon gage ht, end mo	17.80	18.20	15.60	16.40	21.10	18.10	16.10	16.40	16.40	15.70	16.50	17.30	16.60
Avalon gage ht, avg	17.22	17.83	18.10	16.04	17.64	20.44	16.86	16.20	16.16	16.46	15.96	17.01	
Alamogordo ga ht, end mo	66.60	66.36	60.58	60.99	61.05	60.99	59.87	58.91	51.58	46.53	49.50	52.47	65.20
Alamogordo gage ht, avg	65.98	67.04	61.83	60.91	60.93	60.99	60.52	59.24	57.09	48.53	48.01	51.14	
Lake S Rosa ga ht, end mo	44.12	44.49	45.09	45.12	45.10	45.08	45.11	45.10	45.00	43.04	43.11	43.38	43.75
Lake S Rosa ga ht, avg	43.90	44.33	44.71	45.06	45.13	45.10	45.04	45.18	44.98	44.26	43.03	43.26	
Precipitation, inches													
Brantley Lake	.61	1.35	.23	.73	5.38	2.32	3.31	.86	.72	.28	.38	.20	16.37
Las Vegas FAA AP				.18	1.72	2.61	2.18	3.91	.41	.11			11.12
Pecos Ranger Station				.30	2.23	.95	2.31	3.83	1.43	.50			11.55
Santa Rosa				.45	2.37	3.00	2.69	1.94	.94	.07			11.46
Sumner lake	.31	.27	.29	.75	2.98	2.68	.35	3.32	.50	.08	.07	.79	12.39
Lake Santa Rosa	.50	.16	.84	.36	2.38	1.92	1.43	2.51	.36	.19	.26	.76	11.67
Pan Evaporation, inches													
Lake Sumner	2.12	4.22	8.49	8.95	9.76	11.88	13.91	11.85	10.76	8.52	4.62	2.52	97.60
Lake Santa Rosa	3.72	5.22	8.43	7.47	8.27	9.83	11.69	9.64	8.64	6.28	4.79	3.72	87.70
Brantley Lake	2.27	4.39	8.51	9.47	9.52	12.12	14.64	12.16	11.17	8.93	4.91	2.82	100.91
Other reports													
Base Acme-Artesia, TAF	5.2	5.0	4.9	4.0	3.7	3.1	2.8	2.7	2.6	2.8	2.8	3.2	42.9
Pump depl Ac-Artesia, TAF	.0	.0	.7	.9	.5	.6	1.0	.8	.8	.3	.0	.0	5.6
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

APPENDIX A

Response to States' Objections

APPENDIX A: RESPONSE TO STATES' OBJECTIONS

New Mexico's Objections

ERRORS IDENTIFIED (pp 1 - 2)

1. Accepted. Mean monthly gage heights and surface area for evaporation computations, Santa Rosa Lake and Alamogordo Lake. Texas furnished computations for these mean values and adjustments have been made, see Texas' objections V and VIII below.

2. Accepted. Table 8, spreadsheet error for Carlsbad Main Canal seepage, see Texas' objection IV below.

3a. Accepted. River pumper data. See Texas' objection II below.

3b. Base inflow, Acme to Artesia

See separate discussion below.

4. Accepted. Gage height correction, no change needed in reservoir capacity.

HYDROGRAPH SCALPING, CARLSBAD TO STATE LINE REACH

See separate discussion below.

Texas' Objections

I. Base Inflow, Acme to Artesia

See separate discussion below.

II. River Pumpage, Acme-Artesia Reach

There were two errors in the river pumpage. First, I had used the USGS figure for cfs, and it needed to be converted to acre-feet. Second, there were errors in the reported pumpage, and I was furnished with final figures which were agreed to by both states. The pumpage used is a total of 5.6 TAF.

III. Flood Inflow, Alamogordo Dam to Artesia

This objection is the result from I and II above, and has been responded to by changing the values for base inflow and river pumpage.

IV. Carlsbad Springs New Water

Texas reported three errors. The first, average flow below Avalon of 71.1 cfs versus 71.0, is apparently not an error, as it appears that Texas did not consider the 366 day leap year which I used to compute the 71.0 cfs figure. It would not affect the final result anyway.

I accept the second objection, to change seepage from Carlsbad Main Canal to 9.4 cfs from 8.2 cfs. Both states found a spreadsheet error.

On the third objection, leakage from Lake Avalon, Texas reported a small difference in the computations. I corrected the average gage heights to use those furnished by Texas. However, my resulting computation did not agree with Texas and I could not check Texas' computation, as it was not supplied. I did not pursue the reason for the difference, because the monthly distribution of Carlsbad Springs New Water was not sensitive to a change in the leakage figure between Texas' estimate of 20.3 cfs and my final one of 20.8 cfs. I used the same monthly TAF figure arrived at by Texas, -0.2 TAF.

V. Avalon Reservoir Evaporation

There were two problems with this preliminary estimate. First, subsequent to the Preliminary Report, the states furnished a revised set of evaporation and precipitation values. These have been incorporated. Second, the values used for average gage height had been computed as the mean of the beginning and end of the month. Texas furnished a more accurate computation which used all monthly values, and I have incorporated it. In past years, USGS has furnished this average value, but for some reason they did not this year. I will ask them to include the average value in future years to avoid this problem which requires more data entry and calculations, if the average is not supplied by USGS. The revised evaporation for Lake Avalon is 3.4 TAF versus 3.9 TAF as shown in the Preliminary Report.

VI. Flood Inflow, Artesia to Carlsbad

This objection is a result of IV and V above, and has been responded to by entering the revised values for Carlsbad Springs New Water and Avalon Reservoir Evaporation. Note there is a 0.2 TAF difference between my computation and Texas' because the monthly Carlsbad Springs quantity was rounded to the nearest 0.1 TAF.

VII. Flood Inflow, Carlsbad to Stateline

See separate discussion below.

VIII. Depletions from Operation of Santa Rosa and Alamogordo Reservoirs

Texas' objection was about the method of computing mean gage heights. I used Texas' computations, and accepted the resulting value for adjustment, -13.4 TAF versus -13.5 TAF, see Table 6.

IX. Final Calculated Departure

Texas objected to the final calculated departure. After all of the above responses are incorporated into the calculation, the value is as shown on Table 1 of the Final Report.

River Pumping and Base Inflow Estimates, Acme to Artesia

Both New Mexico and Texas objected to the data and estimates of river pumping and base inflow estimates, Acme To Artesia.

RIVER PUMPING

The states furnished a joint letter dated June 7, 1993 with agreement on values to use for river pumping. These are listed on Table 12 which has been revised.

BASE INFLOW ESTIMATES, ACME TO ARTESIA

Each state and USGS provided different estimates of Base Inflow, Acme to Artesia. The estimates in TAF were: USGS 42.4; New Mexico 45.5; Texas 37.6 (USGS reported 42.7 but an arithmetic error in USGS' estimate was found and corrected for the month of April).

The Final determination for base inflow, Acme to Artesia, is 42.9 TAF.

My analysis of the three different estimates showed that although New Mexico's and USGS' final results were fairly close, they differed widely on the details of the computation. Texas and New Mexico's estimates were, however, close for the Acme gage during the entire year, and close for six months of the year on the Artesia plus pumping estimate, see Table A-1. Due to the near-agreement of these estimates, I decided to accept the areas of agreement and to concentrate on the region where the states differed markedly, January-June on the Artesia gage.

Three exhibits are included with this appendix to illustrate the estimates of base flow, one from New Mexico, one from Texas, and one from USGS (Figures A-1, A-2 and A-3). Figure A-1, New Mexico's graph, shows that Texas estimated the base flow for Artesia plus pumping much lower than did either New Mexico or USGS for the period January to the end of April. This can also be seen on Texas' display (Figure A-2) and on USGS' (Figure A-3) at an expanded scale.

How to scalp these hydrographs was the subject of an extensive exchange of comments and analysis during the process of the Amended First Motion which became effective for the 1990 Water Year. The language of the amended motion is:

"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. "

The first time this procedure was implemented was for Water Year 1990. In that year the main issue was selection of base flows at one gage. I had difficulty in comparing the graphical displays, and requested additional displays from USGS, which they are now furnishing. Also in Water Year 1991 an adjustment of USGS' estimates was made, but not as a result of differences about base flow estimates.

This year, the main difference between the states is the level of base flows for the Artesia gage during January-June. My reasoning for the selection of the final determination can be seen from the plots on the expanded scale of USGS' graph (Figure A-3). Both New Mexico and USGS judged that the Artesia flow was about at a base level on about February 20, but Texas judged the base flow much lower for that date. This difference in base flows, carried from January 1 through about April 30, accounts for most of the difference between the states.

What is the correct base flow for February 20 at Artesia? Prior to that date, flood inflow is apparently occurring between Acme and Artesia because the Artesia hydrograph is well above base estimates of both states and USGS. Both states judged that flood flow had stopped upstream at Acme by February 20 as they show a return to base flow. USGS reported that flows were released from Lake Sumner on February 20, and that accounts for the rise in both hydrographs after that date. Does the flood event at Artesia stop by February 20? I cannot answer the question with certainty because I lack details of tributary inflows, snowmelt, and other information that might affect this determination. USGS provided only a little information about the period, and did not report any "unusual hydrologic events" that might affect the determination directly. As a result of this lack of information, I must make a judgement about the base flow.

My judgment is that the flooding at Artesia was almost, but not completely finished by February 20. This is in closer agreement with the position of New Mexico and USGS than with Texas. However, it appears likely that some flooding was still occurring on February 20. My opinion on this is that the Artesia hydrograph is declining rapidly on February 20, and the only reason for the trough is that the upstream releases arrived. Base flows back in December were about at 100 cfs, and they return to that level by about the end of March. Thus, I have selected a base flow line as it is shown on Figure A-3, a compromise between the different estimates, but one which is based on physical assumptions and judgements about the base flows. The points are between the lines of New Mexico and Texas, but 2/3 toward New Mexico's estimate. This is the basis for the compromise figures on Table A-2 which are arrived at by taking the differences between the states' estimates for January-June, and adding 2/3 of them to Texas' figures. For the period after June, a figure half way between the states is used. This produces a final base inflow estimate of 42.9 TAF, a value that is close to USGS' figure, and between the states' estimates, but 2/3 toward New Mexico's estimate.

Flood Inflow, Carlsbad to State Line

Both states commented on and objected to estimates of flood inflow, Carlsbad to State Line.

Texas furnished details of their computations to compare with those in the Preliminary Report. Generally, Texas' results for Below Dark Canyon to Red Bluff were similar to mine, but different from USGS', as shown by the following table:

	River Master	Texas	USGS
FIF, RB - BDC, TAF	9592	9726	2700
FIF, Delaware R, TAF	1596	1717	1656
Total, TAF	11188	11443	4356

Texas referred to mathematical discrepancies that would change my figure from 10.9 to 11.2 TAF. I could not verify this problem since the Preliminary Report's figure was, in fact, 11.2 TAF. Since this was quite close to Texas' figure of 11.5 TAF, I concluded that Texas' objections were responded to adequately, and saw no reason to pursue this point further, especially because there were overriding issues to consider from New Mexico's objections.

New Mexico did not provide a yearly summary but did provide an analysis of the scalping of the May - June event, which was the major flooding event of the year. The following is a response to the technical points made by New Mexico about this event.

New Mexico provided data about extraordinary operational releases from the CID project that bypassed the upstream gage. CID released 3792 acre-feet to the river in the period May 24 - June 15, and 3744 acre-feet appeared between the Below Dark Canyon and Red Bluff gages. Because this was a period of rainfall in the reach, and because the 3744 acre-feet appeared between the gages, it would appear as flood inflow unless identified separately as was done by New Mexico.

New Mexico analyzed the event in two different ways, the first way was similar to my analysis in the Preliminary Report, and the second focused on the difference hydrograph. Using the first approach, New Mexico computed 2526 cfs-days (5010 acre-feet). If the Preliminary Report value of 8749 acre-feet is used, and the 3744 acre-feet of CID water deducted to indicate 5005 AF, then the results are about the same.

New Mexico also provided a one-day lag difference hydrograph (their Figure 2 attached as Figure A-4)). On it, New Mexico hypothesized base inflow additions that might occur between Below Dark Canyon and Red Bluff. This results in a rising base inflow curve as shown on Figure A-4. The Preliminary Report was based on a constant base inflow of 62.5 cfs. The assumption that this base flow was more or less constant was based on an inspection of base flows at the two gages during the remainder of the year. The base flow curves remained more or less parallel, except for periods of fluctuating flows at Red Bluff that resulted from operational releases. As a result, I don't see the physical basis for New Mexico's rising and then falling base inflow curve for the difference hydrograph on Figure A-4.

To take this discussion a little further, consider that the ordinates of the difference hydrograph would be zero if there was no base inflow addition between the two gages or flood inflow. At the beginning point of Figure A-4, about May 20, the base inflow is about 62.5 cfs, indicating that net seepage, spring flow or steady tributary flows of this magnitude are added by the Red Bluff gage. During May 20 - June 15 there are CID releases and flood inflows entering the channel in addition to these base inflows. The flood inflows will be mostly coming in the form of added tributary flows and local runoff flows. I don't believe there is a basis for assuming that the base inflows rise then fall quickly. This is the reason for my assumption that the base inflow remains constant.

Another issue is whether all of the CID release should be deducted. According to the letter from CID, the releases to the river were separately metered at the release points to the river. However, I have no mechanism to deduct carriage losses to the Red Bluff gage. Because the river is in flood during this period I am assuming that the carriage losses will be minimal and within the margin of error caused by assumptions about base flow.

Using New Mexico's difference hydrograph, if a constant base inflow of 62.5 cfs is used, then the indicated adjustment to New Mexico's final result is the difference between New Mexico's base inflow and mine:

$$3310*1.9835 - 3100 = 3465 \text{ AF};$$

or, under this assumption the equivalent to New Mexico's estimate of FIF would be 1050*1.9835 + 3465 = 5548 AF. Again, this is at least in the neighborhood of my estimate less the CID release, or 8749 - 3744 = 5005 AF.

The above analysis shows that the difference between New Mexico's analysis and the Preliminary Report's figure is composed of two quantities: the CID release of 3744 AF and the difference in our base inflow figures of 3465 AF. When these two are added to New Mexico's estimate for the May - June event of 2083 AF (1050 cfs-days) the result is 9292 AF, as compared to the Preliminary Report's figure of 8749 AF (4411 cfs-days). The difference of 543 AF is 6% of my estimate, within reason for these estimates.

Thus, I accept New Mexico's report of the CID release and have adjusted the May - June figure to deduct the full amount. However, I do not believe that New Mexico's estimate for the base inflow for the May - June period can be justified as base additions that are something other than flood inflow.

The issue of a negative difference hydrograph can be seen for May 25 on Figure A-4. The fact that the negative difference occurs even on a lag-one hydrograph shows the losses and non-linear behavior of the flood hydrograph. Presumably, the diminution of the flow rate by the Red Bluff gage results from transit losses and flood wave dynamics. If this is the case, the part due to wave dynamics will show up later downstream, but the other part may never show up. This raises the question as to whether negative differences should be used in the computations. I am not seeking to answer this question now, just to raise it for future discussion.

Thus the final determination for flood inflow, Carlsbad to Artesia is 7.4 TAF, given as follows:

Flood Inflow, Carlsbad to Red Bluff

	Carlsbad-Red Bluff		Delaware River		Totals
	cfs-days	acre-ft	cfs-day	acre-ft	acre-ft
January	22	44			44
February	90	178			178
March	9	18			18
April	72	143			143
May	625	1239	282	559	1799
June	3836	7607	355	704	8311
July	0	0			0
August	13	26	168	333	359
September	170	337			337
October	0	0			0
November	0	0			0
December	0	0			0
Total	4837	9592	805	1596	11188
deduction *		3744			
Final values		5848		1596	7444

* deduction for CID releases

Table A-1. Comparison of Base Inflow Estimates, USGS, NM, Texas

	Artesia + Pumping			Acme			Difference			
	USGS	NM	TX	USGS	NM	TX	USGS	NM	TX	NM - TX
Jan	7994	7730	5747	1845	1940	1658	6149	5790	4089	1701
Feb	7420	7172	5018	1438	1442	1397	5982	5730	3621	2109
Mar	7932	6823	4982	3074	1343	1335	4858	5480	3647	1833
Apr	6070	5544	4444	2797	1144	1138	3273	4400	3306	1094
May	7563	4961	4204	2828	1020	1016	4735	3941	3188	753
Jun	6546	4078	3692	2440	831	829	4106	3247	2863	384
Jul	4181	3517	3459	1476	726	726	2705	2791	2733	58
Aug	4858	3568	3591	4366	897	896	492	2671	2695	-24
Sep	6070	3747	3759	5831	1107	1107	238	2640	2652	-12
Oct	6456	4175	4178	3935	1392	1392	2521	2783	2786	-3
Nov	4998	4332	4328	1607	1527	1534	3392	2805	2794	11
Dec	5411	4477	4462	1414	1228	1282	3997	3249	3180	69
	75498	60124	51864	33051	14597	14310	42447	45527	37554	

Table A-2. Adjusted Base Inflow Estimates
(See text for basis of adjustment)

	NM	TX	NM-TX	Adjmt	Base Inflow
Jan	5790	4089	1701	1134	5223
Feb	5730	3621	2109	1406	5027
Mar	5480	3647	1833	1222	4869
Apr	4400	3306	1094	729	4035
May	3941	3188	753	502	3690
Jun	3247	2863	384	256	3119
Jul	2791	2733	58	29	2762
Aug	2671	2695	-24	-12	2683
Sep	2640	2652	-12	-6	2646
Oct	2783	2786	-3	-2	2785
Nov	2805	2794	11	6	2800
Dec	3249	3180	69	35	3215
	45527	37554	7973	5299	42853

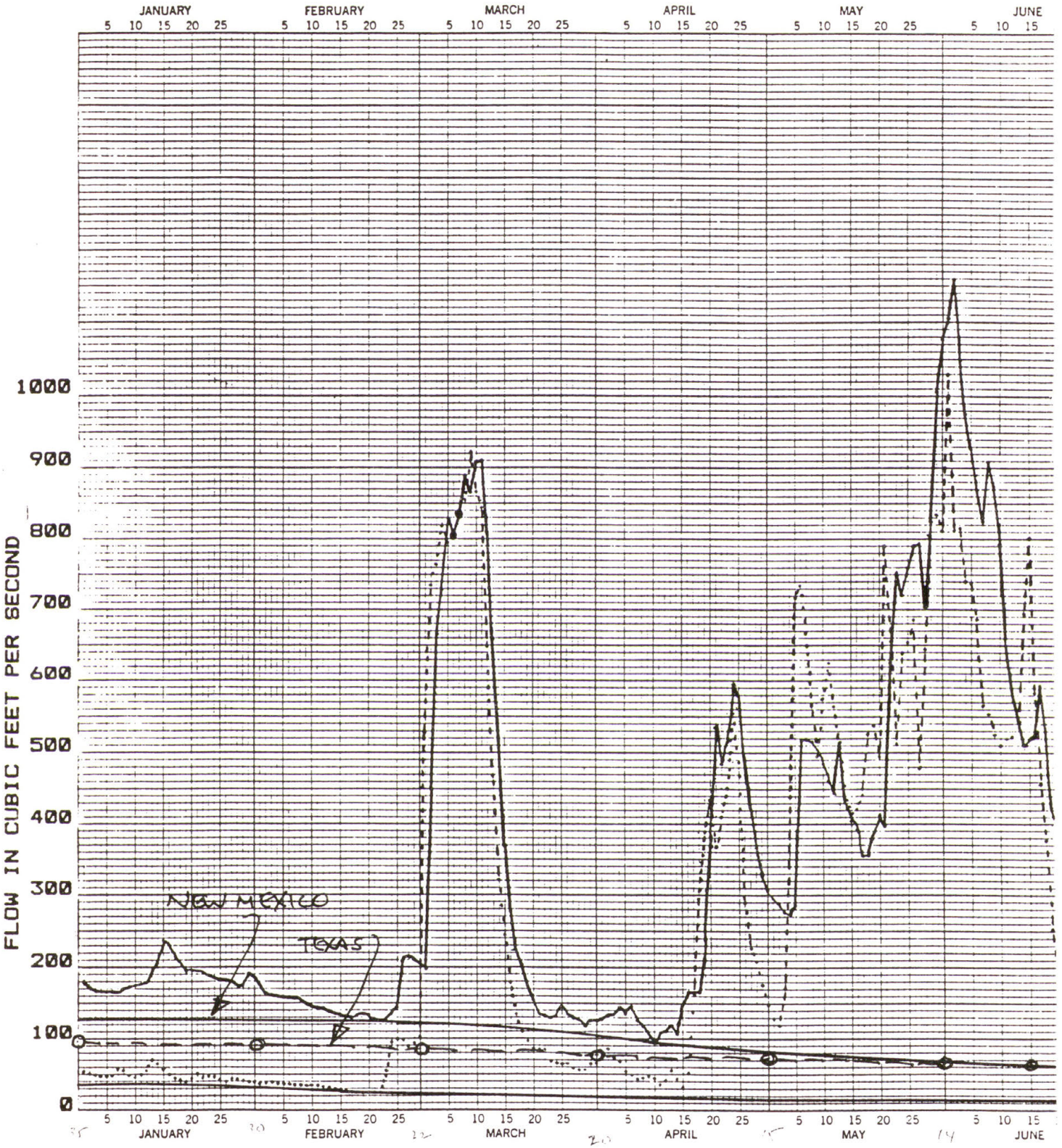
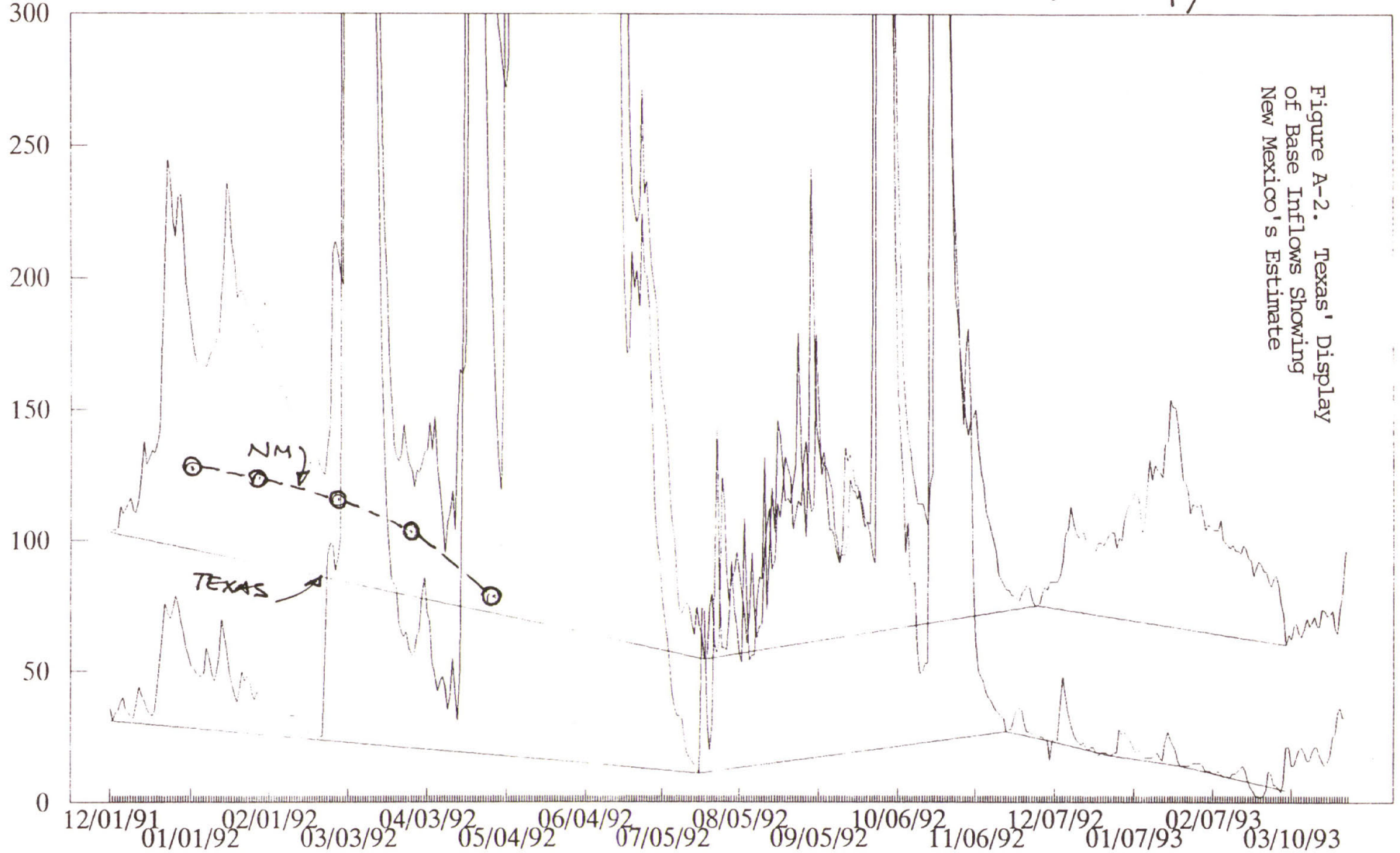


Figure A-1. New Mexico's Display of Base Inflows Showing Texas' Estimate

FIGURE 1 (TEXAS' DISPLAY)



___ acme sf ___ artesia pp sf

___ acme bf ___ artesia pp bf

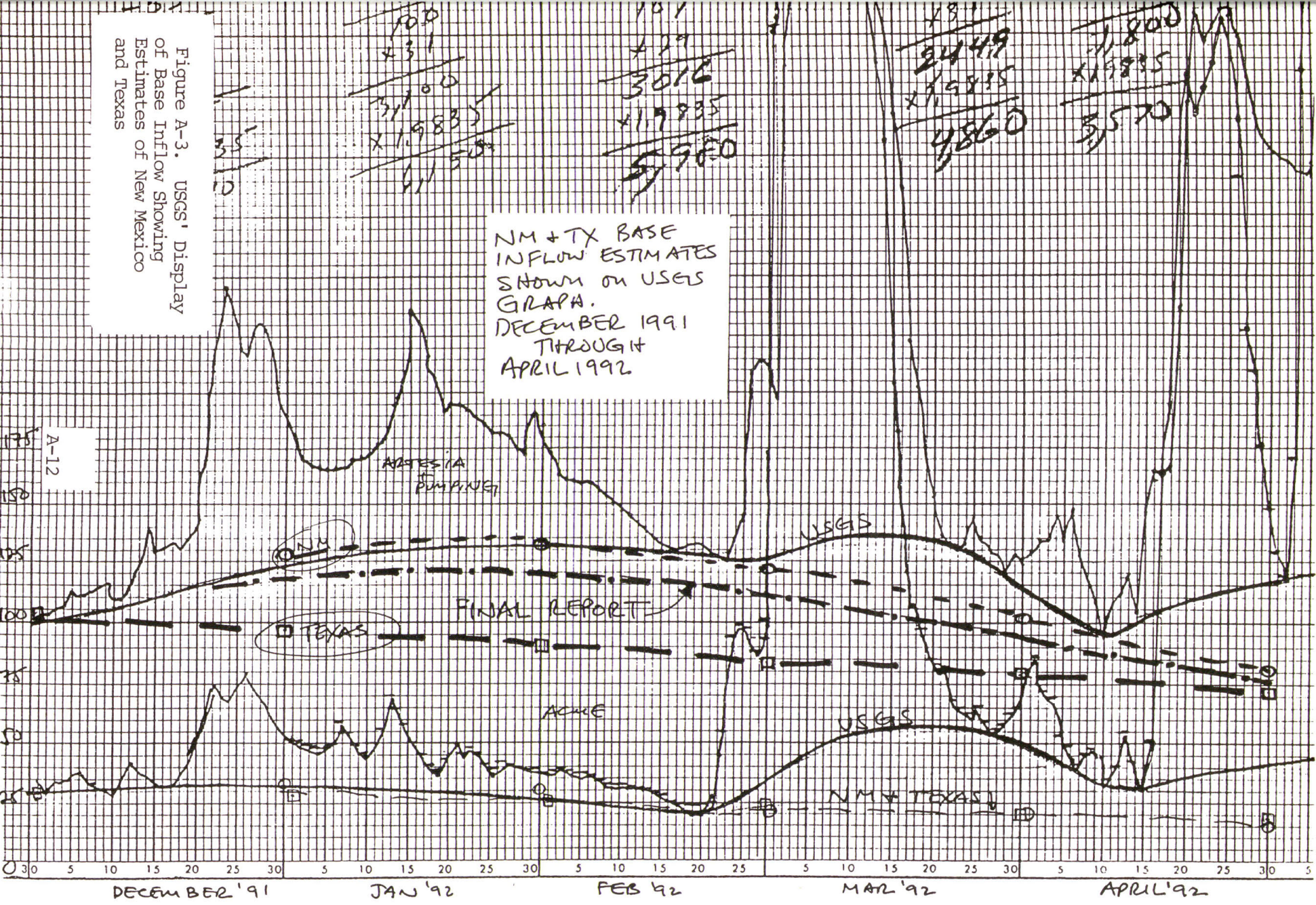


Figure A-3. USGS' Display of Base Inflow Showing Estimates of New Mexico and Texas

Figure 2. Difference Hydrograph, 1 Day Lag

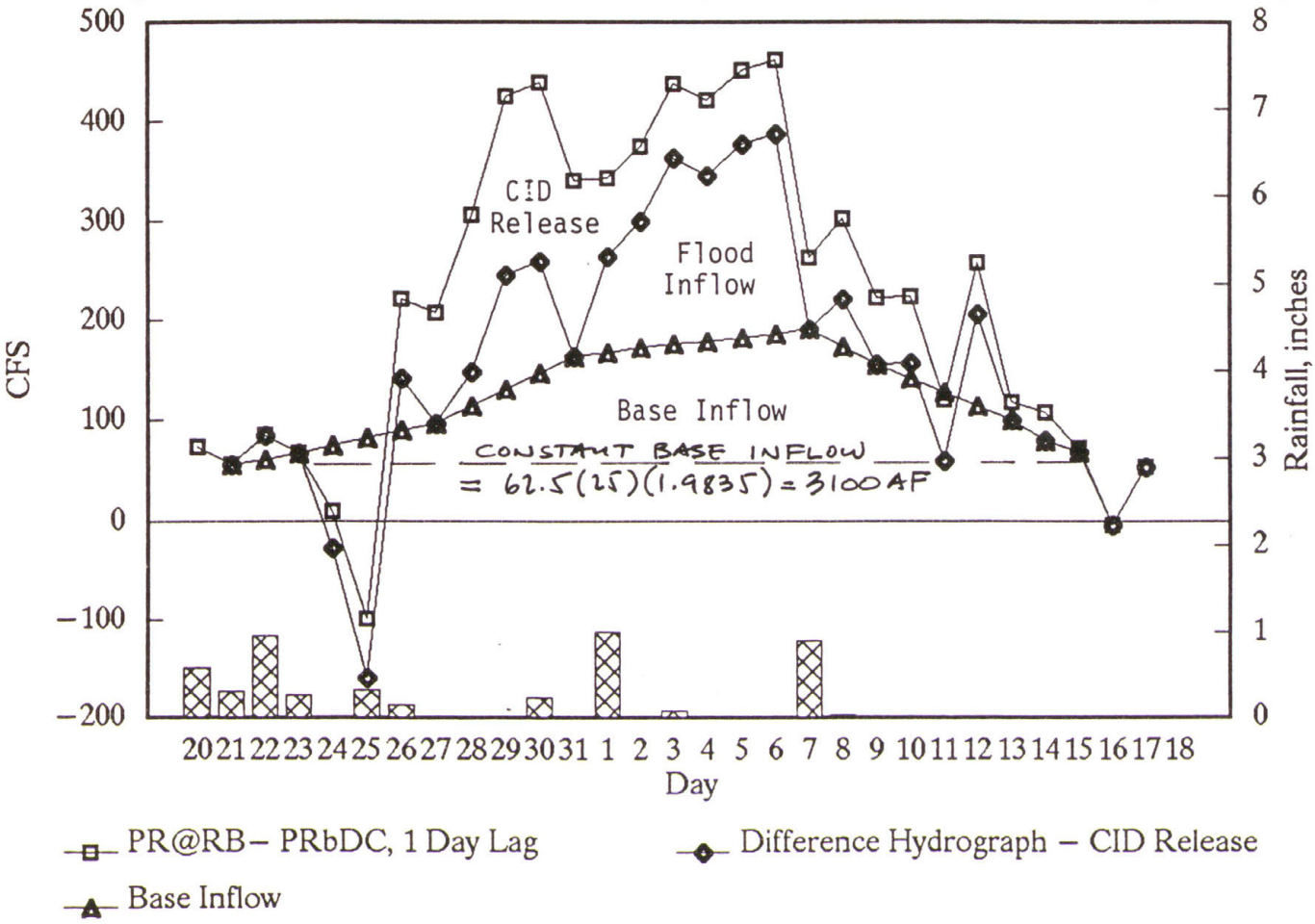


Figure A-4. New Mexico's Difference Hydrograph Showing Constant Base Inflow

APPENDIX B

Pecos River Compact

SUMMARY OF ACCOUNTING YEARS 1988-1992

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

Article III(a) Shortfalls and Overages
Accounting Years 1988-1992

Water Year	Annual Overage or Shortfall	Accumulated Overage or Shortfall
1987	15,400 AF	15,400
1988	23,600	39,000
1989	2,700	41,700
1990	-14,100	27,600
1991	-16,500	11,100

PECOS RIVER COMPACT
TEXAS V. NEW MEXICO, U.S. SUPREME COURT NO. 65, ORIGINAL
AMENDED DECREE

Motions to Modify the River Master's Manual

(Effective with the Amended Decree, the River Master's Manual was Texas Exhibit 108, dated November 30, 1987; the modifications listed below are the only changes to the Manual as of April 21, 1993.)

Motion	Date Filed	Subject	Date of Mod Det	Action
1	5-23-88	B.3.g. Base Flow, Acme to Artesia	11-18-88	Rejected
2	6-7-88	C.1.a.(2)(c) Depl Due Irrig Above Alam Dam	11-18-88	Rejected
1A	12-9-88	B.3.g. Base Flow, Acme to Artesia	12-26-90	Manual Modif
3	4-18-90	B.4. Flood Infl, Artesia to Carlsbad	12-7-92	Manual Modif
4	6-27-90	B.4.c.(1)(g) Lake Avalon Leakage	11-18-91	Rejected
5	11-13-90	B.3.e. Ch Loss, Alam Dam to Artesia	-	Pending
6	11-14-90	B.5.a. Flood Infl, Carlsbad-Red Bluff	11-25-91	Manual Modif
JM*	6-14-89	B.4.i.(2) Other Depletions	6-16-89	Manual Modif
JM	11-2-92	C.1.b.(5) Depletion Due Santa Rosa Reserv	12-7-92	Manual Modif

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* JM indicates joint motions of the states

OFFICE OF THE RIVER MASTER OF THE PECOS RIVER
OPERATING POLICIES

Texas v. New Mexico, U.S. Supreme Court No. 65, Original

November 25, 1991

1. Deadline for submission of objections to Preliminary Report or to the other State's objections.

The deadline for receipt by the River Master of objections or comments on the Preliminary Report is June 14, and this deadline will be deemed met if objections are put into overnight courier on or before June 13. If June 14 is a Saturday, Sunday or legal holiday, then the deadline is the last working day before June 14. Objections or comments on the Preliminary Report shall not be submitted after the deadline. This includes any responses by a State to the other State's objections. If, however, a State comments on the other State's objections by the deadline, then the other State may respond to such comments within five working days after receipt of the comments by the opposing State.

2. Waiting time before responding to motions.

The River Master will withhold action on requests or motions for at least five working days from the date of receipt, unless there is no objection to the request or motion or the River Master determines that immediate action is required. The motion or request shall be served by express mail or telefax. The motion or request should indicate whether it is opposed.

3. Additional submissions by the States.

The States may communicate with the River Master about any matter as long as the ex parte rule is followed. The River Master shall provide an opportunity for either State to respond to any unsolicited communication from the opposing State. The communications channels utilized by a state, such as express mail, telefax or telephone, shall be such that the opposing state receives communications simultaneously with the River Master.

4. Requests for time extensions.

A request by a State for a time extension stops the clock running on a deadline until acted on by the River Master.

Neil S. Grigg, River Master of the Pecos River

MEETINGS BETWEEN RIVER MASTER AND STATES

Date	Location	Purpose
April 28, 1988	Denver	Organization/Administration
March 20-21, 1989	Albuquerque	Amended First Motion
January 22-23, 1991	Denver	Third Motion
September 14-15, 1992	Denver	Third Motion

RESERVOIR AREA AND CAPACITY MANUALS USED FOR COMPACT ACCOUNTING

Reservoir	Source	Date	Remarks
Avalon Reservoir	USBR	2-82	
Brantley Reservoir	USBR	8-81 1-92	On line 7-88
Lake McMillan	NM	1984	Breached 8-89
Lake Santa Rosa	USCOE	8-80 10-90	
Lake Sumner	USBR	11-73 1-89	

PECOS RIVER COMPACT
TEXAS V. NEW MEXICO, U.S. SUPREME COURT NO. 65, ORIGINAL
AMENDED DECREE

Legal and Technical Representatives

	Legal Representatives		Technical Representatives	
Date	New Mexico	Texas	New Mexico	Texas
Mar 28, 1988	Peter Thomas White	Nancy N. Lynch (Renea Hicks)	S. E. Reynolds	V.R.K. Murthy
June 13, 1990			John J. Whipple	
Nov 15, 1991				Nadira Kabir
June 9, 1992		Paul Elliott		Herman R. Settemeyer
Jan 15, 1993			Peter T. Kraai	

River Master

Mar 28, 1988	Neil S. Grigg