

## **APPENDIX A – DATA LISTS**

**TABLE A-1 AERIAL PHOTO  
(SOURCE: RICHARD ET AL. 2000)**

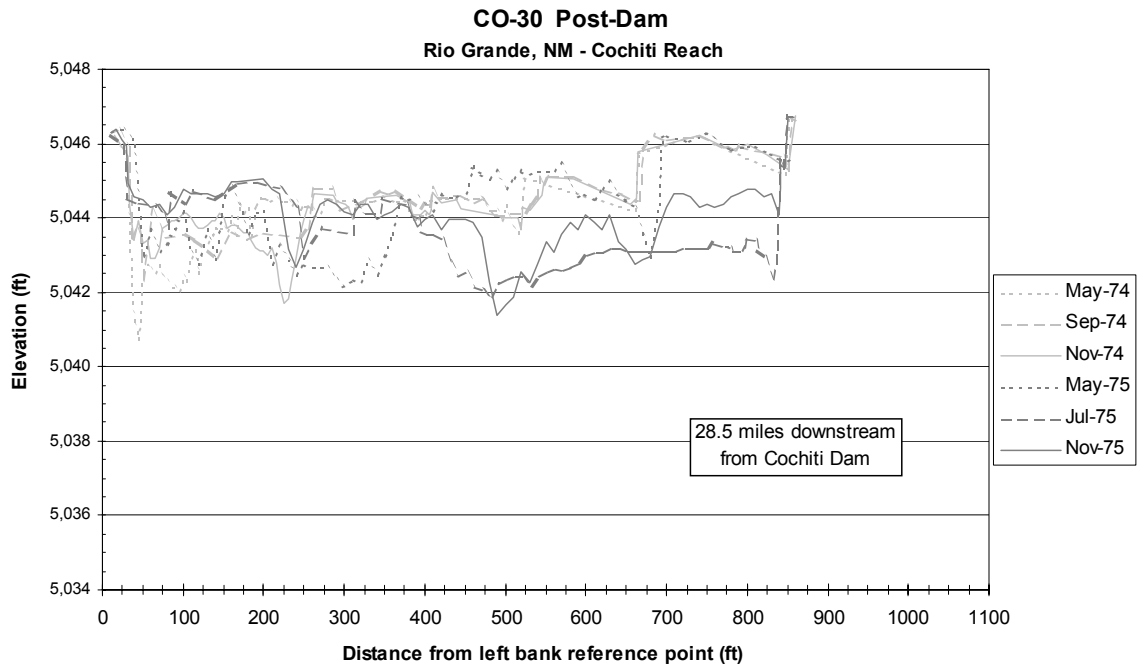
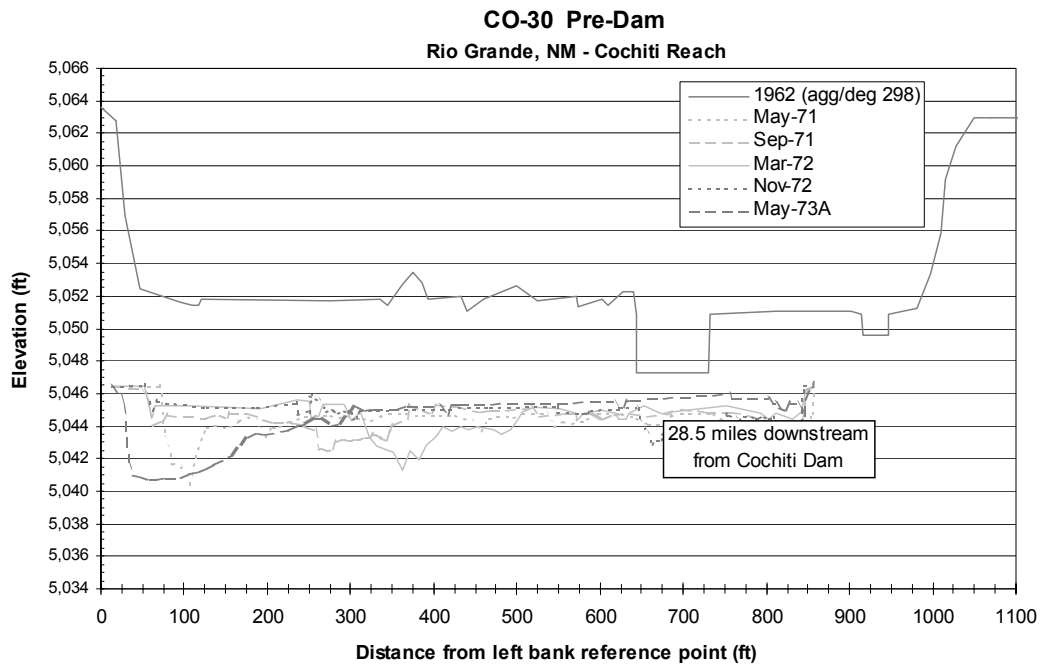
Aerial Photos digitized in the Rio Grande Geomorphology Study, v. 1 by the USBR, Remote Sensing and Geographic Information Group, Denver, CO:

- 1) 1918 – Scale: 1:12,000, Hand drafted linens (39 sheets), USBR Albuquerque Area Office. Surveyed in 1918, published in 1922.
- 2) 1935 – Scale: 1:8,000. Black and white photography, USBR Albuquerque Area Office. Flown in 1935, published 1936.
- 3) 1949 – Scale 1:5,000. Photo-mosaic. J. Ammann Photogrammetric Engineers, San Antonio, TX. USBR Albuquerque Area Office.
- 4) March 15, 1962 – Scale: 1:4,800. Photo-mosaic. Abram Aerial Survey Corp. Lansing, MI. USBR Albuquerque Area Office.
- 5) April 1972 – Scale: 1:4,800. Photo-mosaic. Limbaugh Engineers, Inc., Albuquerque, NM. USBR Albuquerque Area Office.
- 6) March 31, 1985 – Scale: 1:4,800. Orthophoto. M&I Consulting Engineers, Fort Collins, CO. Aero-Metric Engineering, Sheboygan, MN. USBR Albuquerque Area Office.
- 7) February 24, 1992 – Scale: 1:4,800. Ratio-rectified photo-mosaic. Koogle and Poules Engineering, Albuquerque, NM. USBR Albuquerque Area Office.
- 8) Winter 2001 – Scale: 1:4,800. Photo-mosaic. USBR Albuquerque Area Office.

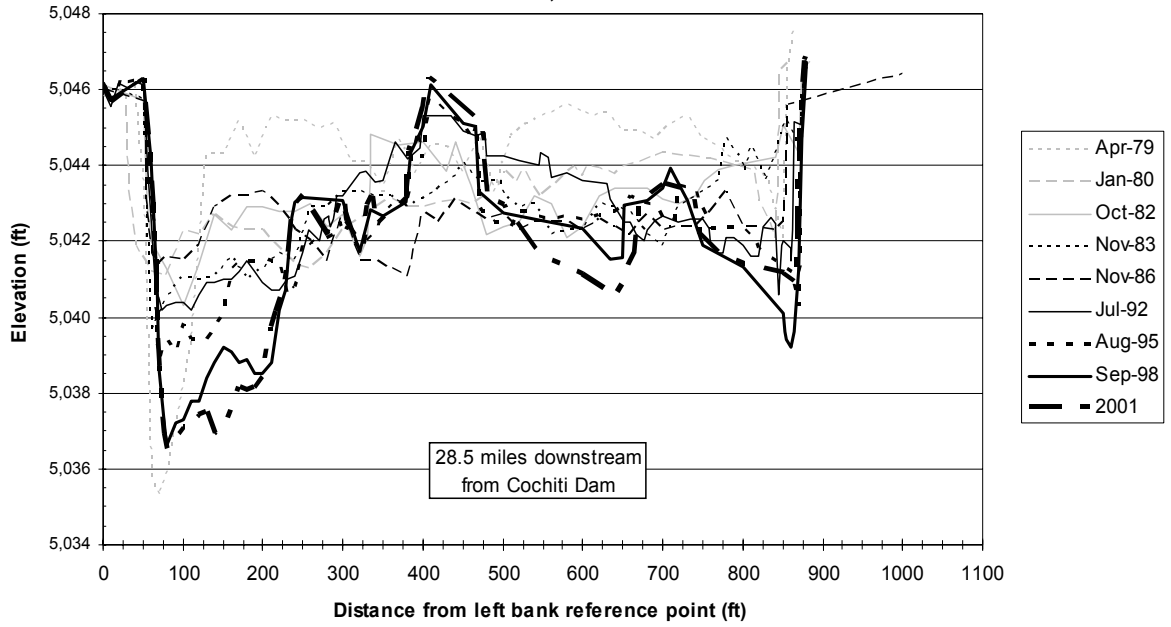
**Table A-2 Aerial photo dates and main daily discharge on those days.**

<b>Aerial Photo Dates</b>	<b>Mean Daily Discharge at Bernalillo (cfs)</b>	<b>Mean Daily Discharge at Albuquerque (cfs)</b>
February 24, 1992	No data	159
March 31, 1985	No data	109
April 1972	No data	Mean = 705 Max = 2540 Min = 116
March 15, 1962	493	No data
1949 (unknown date)	Extreme low flow (from meta-data file)	No data
1935 (unknown date)	Annual data from Otowi: Mean = 1,520 Max = 7,490 Min = 350	No data
1918 (unknown date)	No data	No data

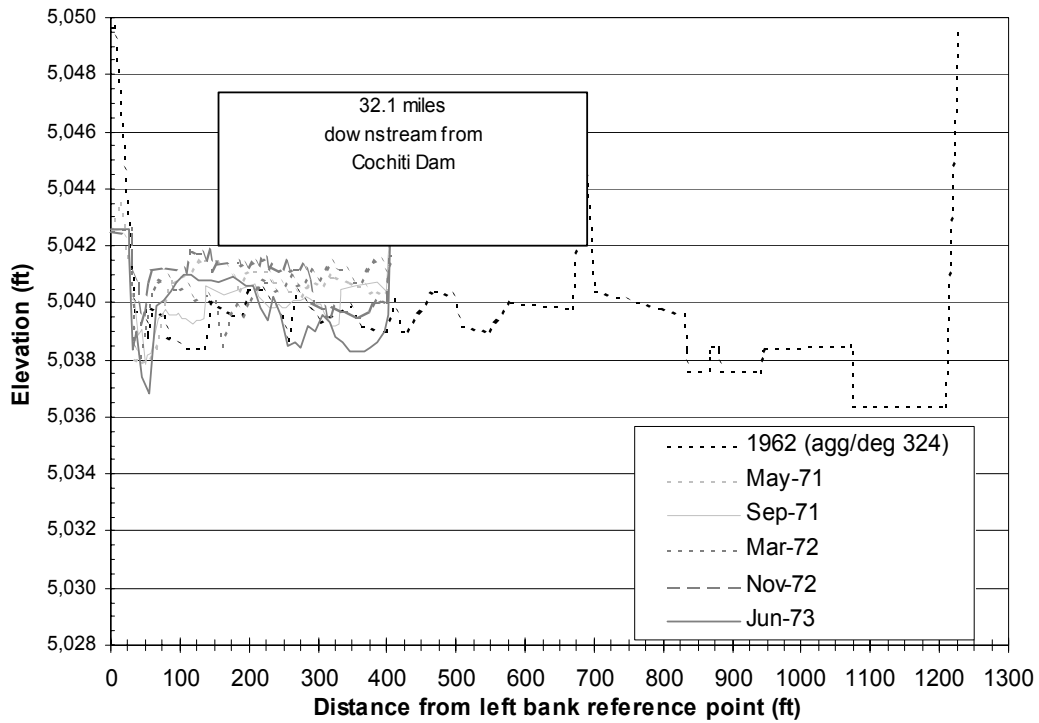
# APPENDIX B – CROSS-SECTION PLOTS



**CO-30 (1979-2001)**  
**Rio Grande, NM - Cochiti Reach**

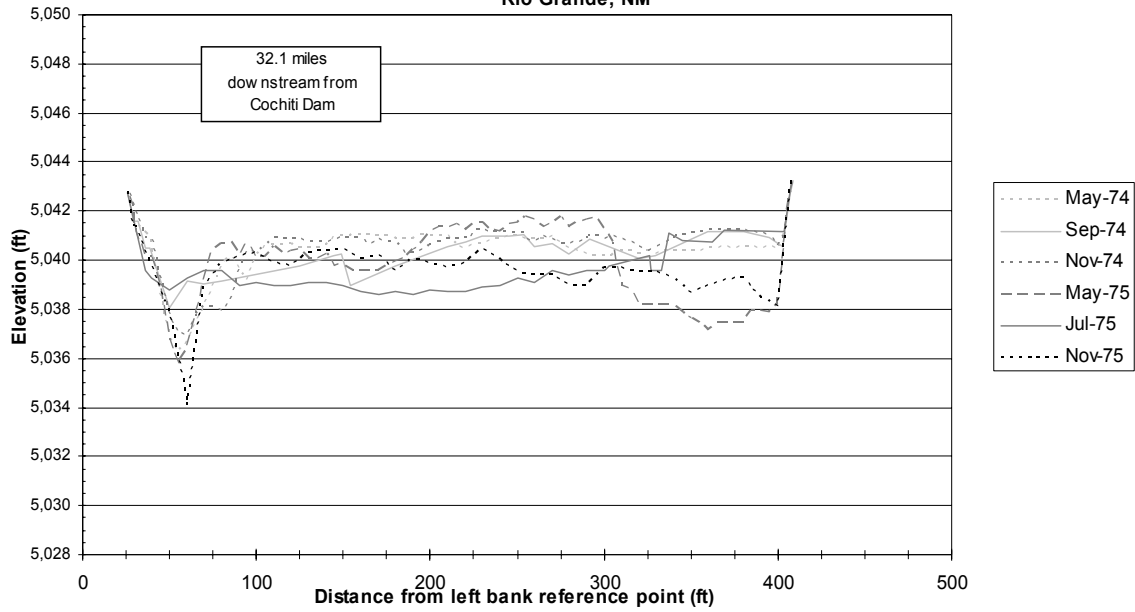


**CO-31 Pre-Dam**  
**Rio Grande, NM**



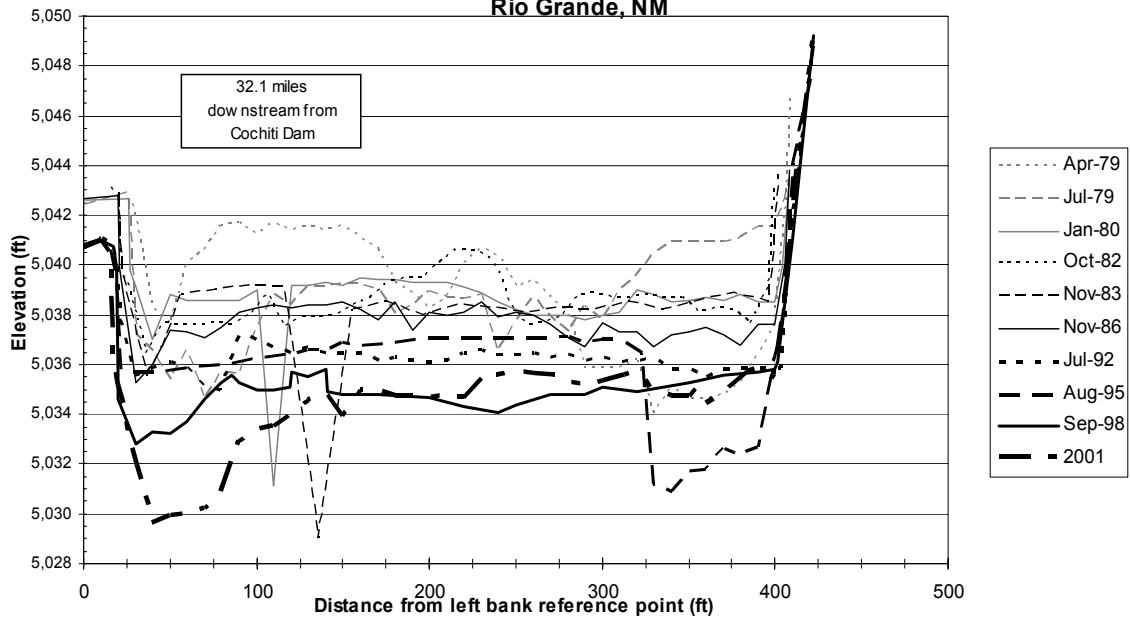
### CO-31 Post-Dam

Rio Grande, NM



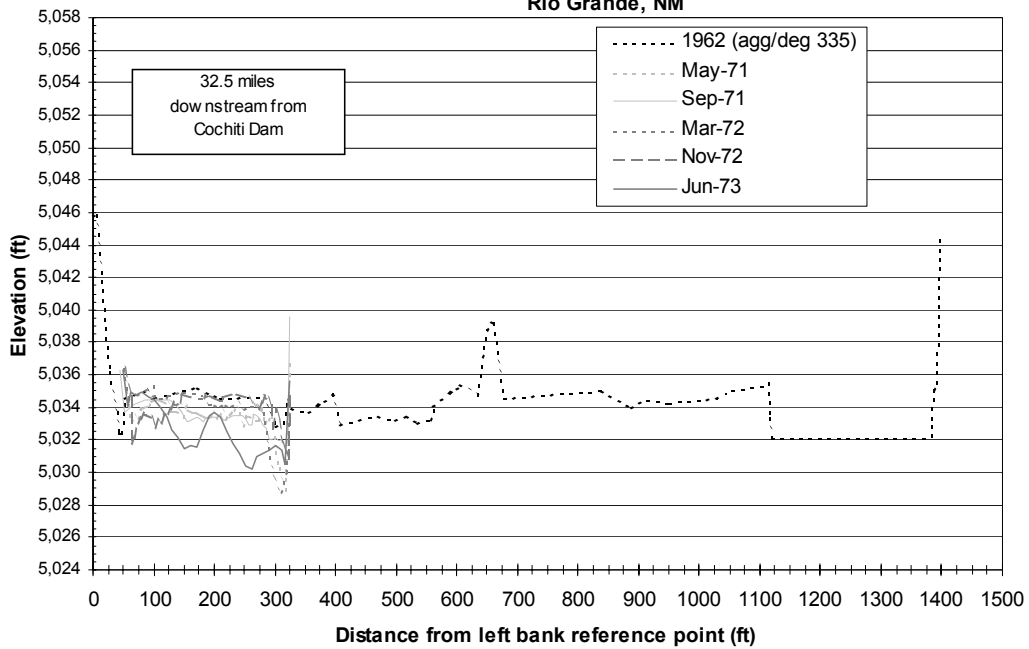
### CO-31 (1979-2001)

Rio Grande, NM



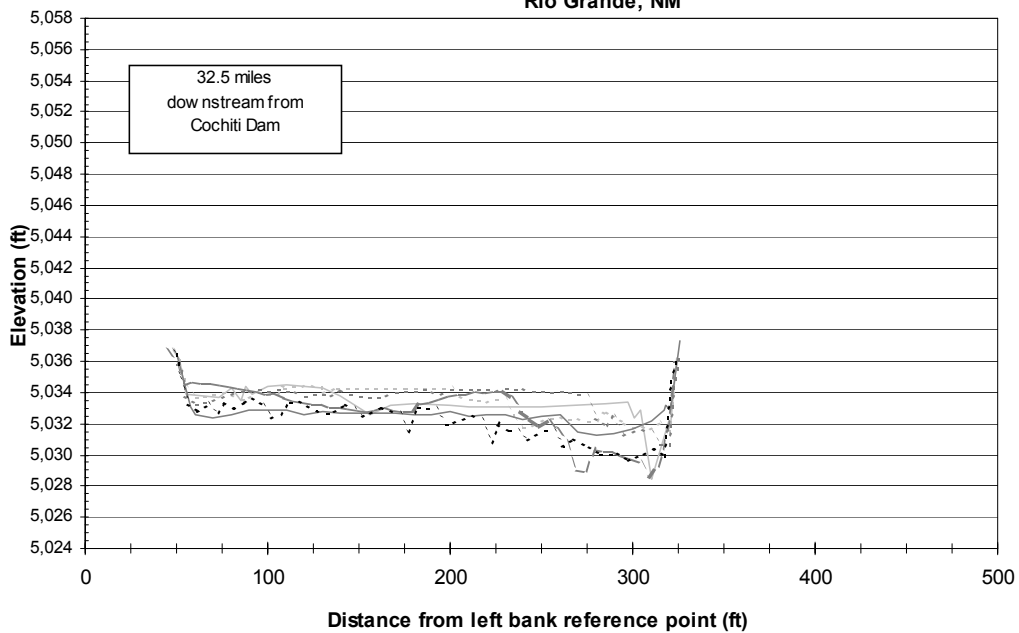
### CO-32 Pre-Dam

Rio Grande, NM

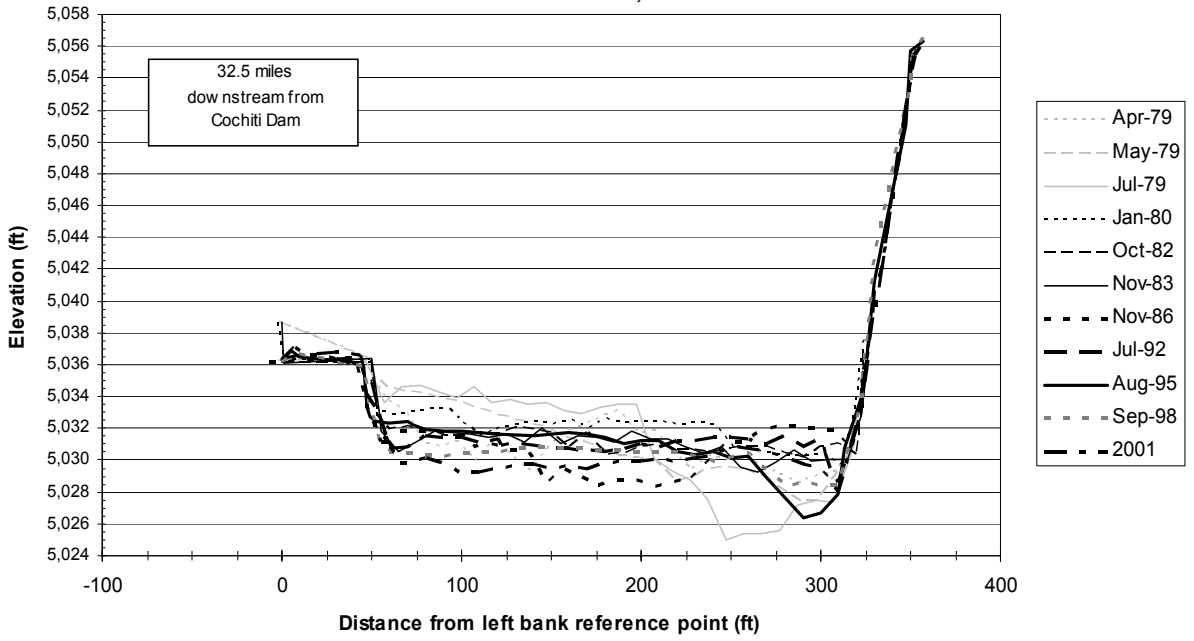


### CO-32 Post-Dam

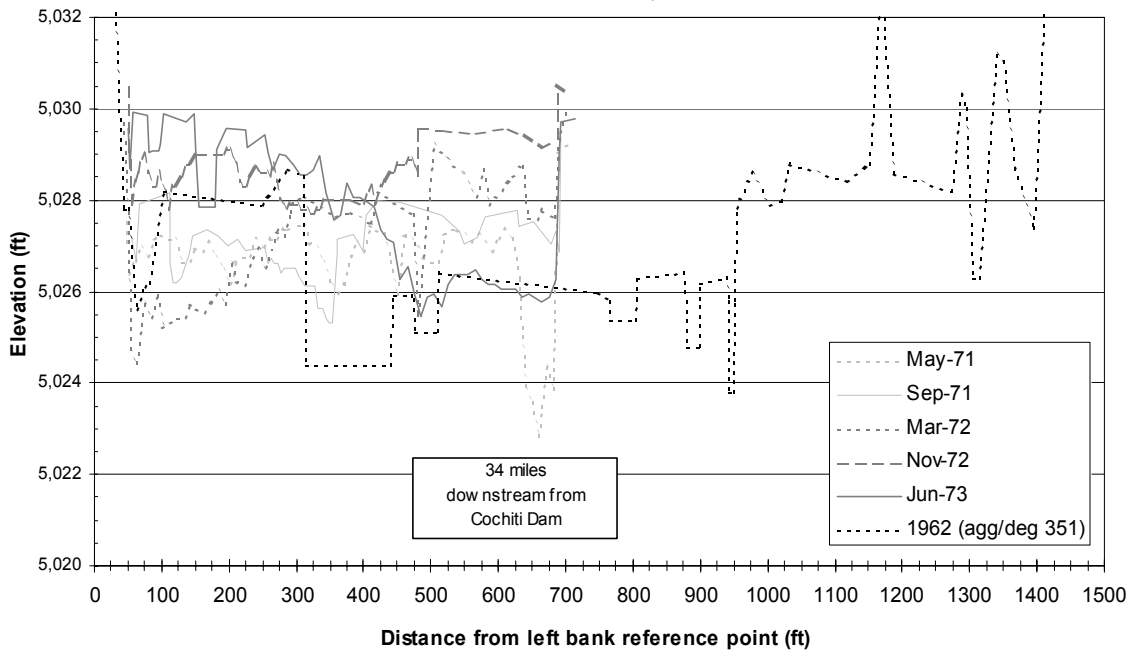
Rio Grande, NM



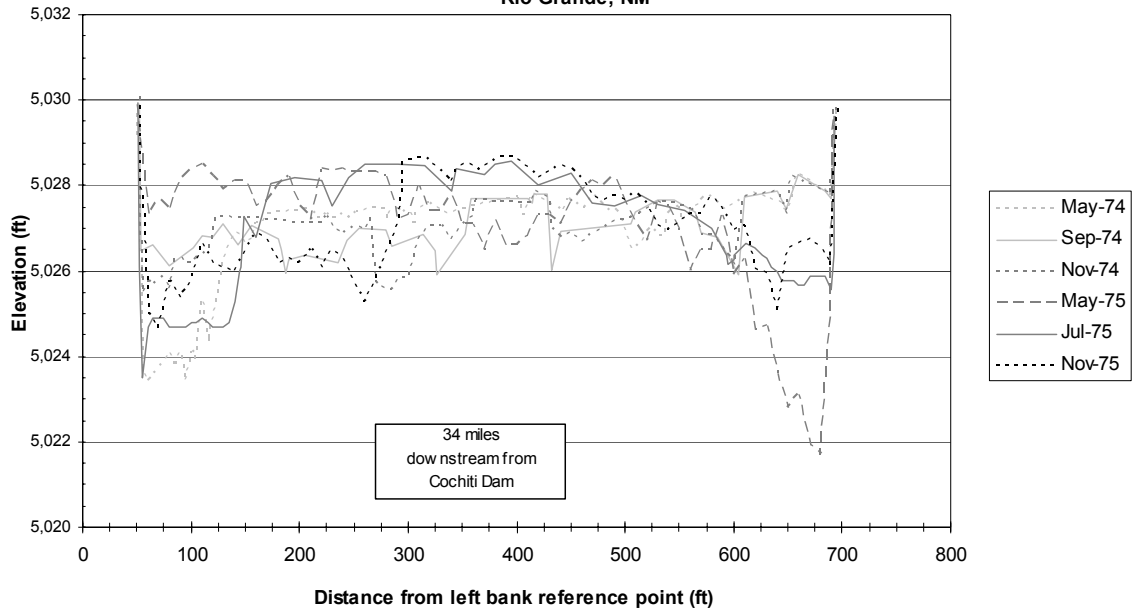
**CO-32 (1979-2001)**  
Rio Grande, NM



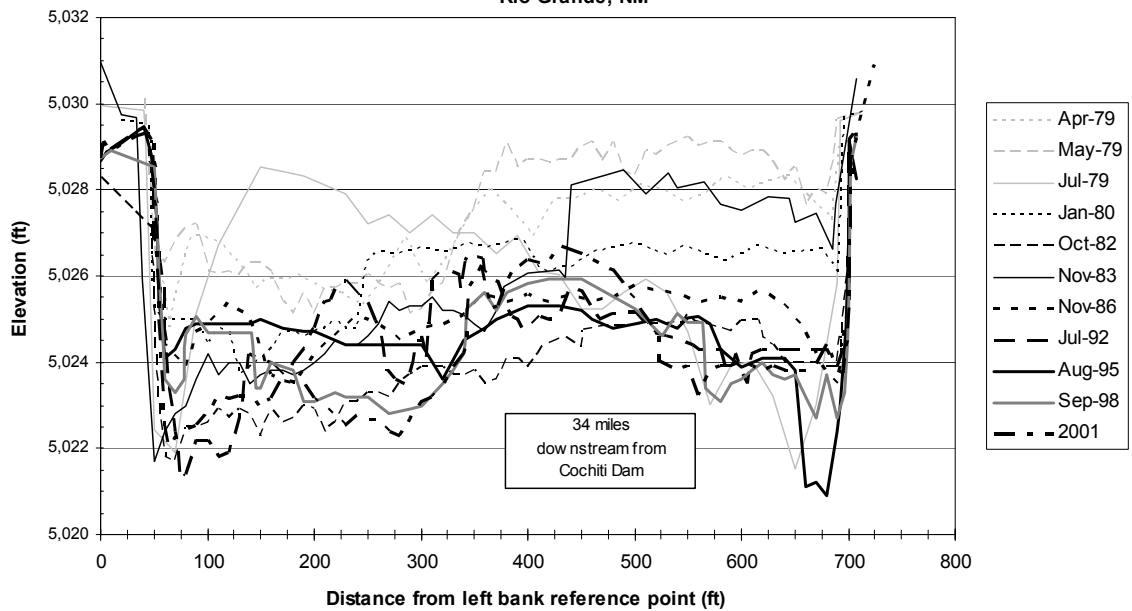
**CO-33 Pre-Dam**  
Rio Grande, NM



**CO-33 Post-Dam**  
Rio Grande, NM

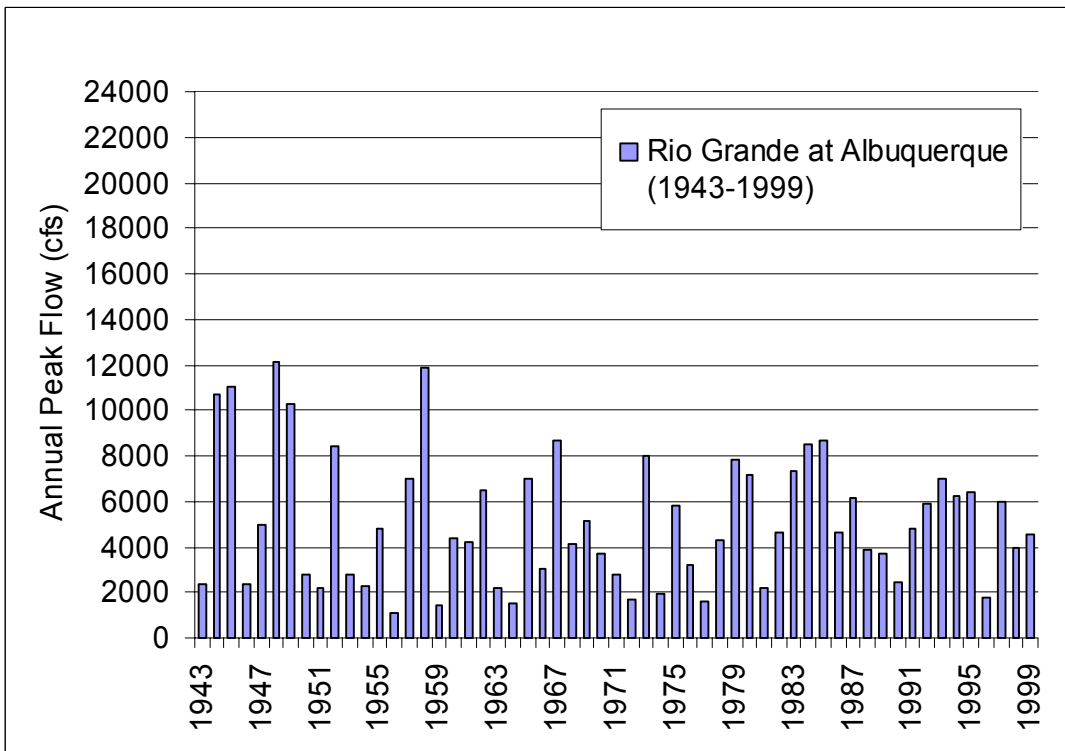
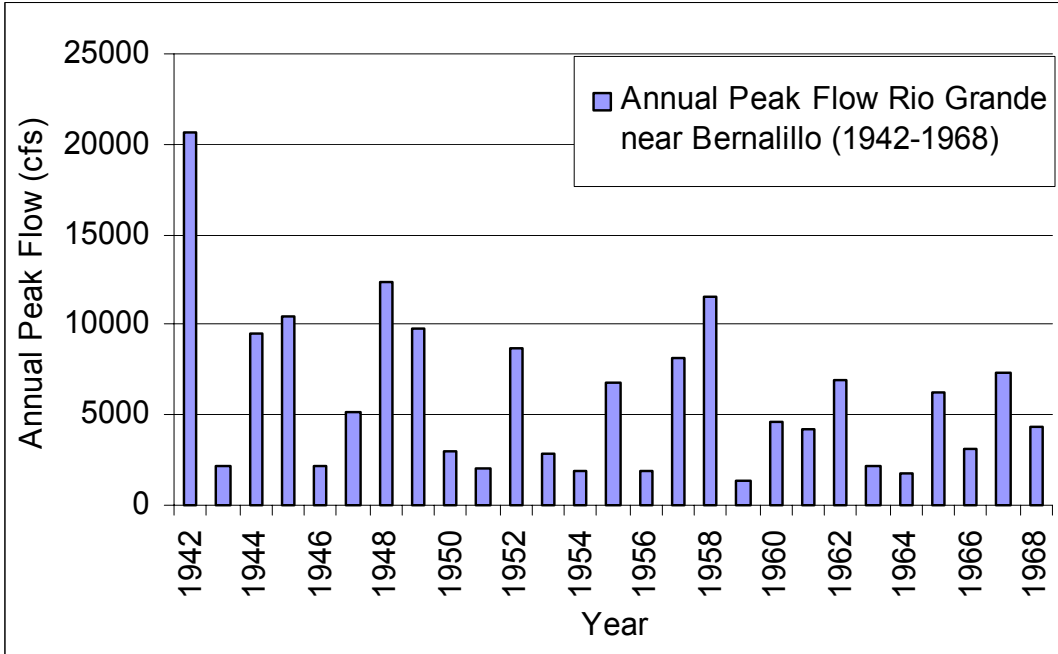


**CO-33 (1979-2001)**  
Rio Grande, NM





## APPENDIX C – ANNUAL PEAK MEAN DISCHARGE PLOTS



## APPENDIX D – REACH-AVERAGED RESULTS FROM HEC-RAS

Subreach 1									
Year	Width	EG Slope	Velocity	Area	Depth	W/D	WP	WS slope	MBE
1962	595	0.0009	3.89	1327	2.36	286	608	0.0009	5045
1972	641	0.0006	2.60	2119	3.38	270	632	0.0010	5047
1992	565	0.0009	3.86	1319	2.34	245	570	0.0009	5044
2001	560	0.0009	2.95	1715	3.12	180	565	0.0009	5044
Subreach 2									
Year	Width	EG Slope	Velocity	Area	Depth	W/D	WP	WS slope	MBE
1962	586	0.0010	3.99	1282	2.38	272	581	0.0010	5036
1972	595	0.0010	3.80	1315	2.29	277	597	0.0009	5038
1992	501	0.0010	4.17	1240	2.56	208	505	0.0010	5035
2001	421	0.0009	3.37	1522	3.79	111	424	0.0009	5034
Subreach 3									
Year	Width	EG Slope	Velocity	Area	Depth	W/D	WP	WS slope	MBE
1962	432	0.0010	4.35	1168	2.74	162	436	0.0009	5028
1972	446	0.0012	4.43	1092	2.50	185	448	0.0011	5030
1992	418	0.0012	4.58	1119	2.75	166	422	0.0011	5027
2001	546	0.0009	3.01	1676	3.17	173	551	0.0009	5026
Total									
Year	Width	EG Slope	Velocity	Area	Depth	W/D	WP	WS slope	MBE
1962	546	0.0009	4.05	1269	2.48	245	550	0.0009	
1972	574	0.0008	3.50	1551	2.74	250	572	0.0010	
1992	501	0.0010	4.20	1225	2.52	211	505	0.0010	
2001	504	0.0009	3.12	1632	3.38	149	508	0.0009	5035

**APPENDIX E – FLOW DISCHARGE DATA USED IN THE DEVELOPMENT OF THE EMPIRICAL WIDTH-DISCHARGE RELATIONSHIPS**

<i>Rio Grande at Otowi</i>				<i>Rio Grande near Bernalillo</i>			
<b>Years</b>	<b>Annual Peak Flows (cfs)</b>	<b>Years</b>	<b>Annual Peak Flows (cfs)</b>	<b>Years</b>	<b>Annual Peak Flows (cfs)</b>	<b>Years</b>	<b>Annual Peak Flows (cfs)</b>
1914	12500	1931	4600	1945	10500	1958	11600
1915	15600	1932	13500	1946	2200	1959	1400
1916	17200	1933	5570	1947	5190	1960	4670
1917	4440	1934	1880	1948	12400	1961	4270
1918	8410	1935	7490	1949	9760	1962	6900
<b>1918 Average</b>	<b>11630</b>	<b>1935 Average</b>	<b>6608</b>	<b>1949 Average</b>	<b>8010</b>	<b>1962 Average</b>	<b>5768</b>

<i>Rio Grande at Albuquerque</i>							
<b>Years</b>	<b>Annual Peak Flows (cfs)</b>	<b>Years</b>	<b>Annual Peak Flows (cfs)</b>	<b>Years</b>	<b>Annual Peak Flows (cfs)</b>	<b>Years</b>	<b>Annual Peak Flows (cfs)</b>
1968	4160	1981	2170	1988	3880	1995	6370
1969	5120	1982	4630	1989	3710	1996	1770
1970	3710	1983	7330	1990	2420	1997	5980
1971	2780	1984	8500	1991	4800	1998	3940
1972	1680	1985	8650	1992	5900	1999	4550
<b>1972 Average</b>	<b>3490</b>	<b>1985 Average</b>	<b>6256</b>	<b>1992 Average</b>	<b>4142</b>	<b>1999 Average</b>	<b>4522</b>

**APPENDIX F – EQUILIBRIUM CHANNEL WIDTH ANALYSIS. EXPONENTIAL MODEL DATA**

<b>Subreach 1</b>		<b>Wt (ft)</b>	<b>Width change rate</b>
<b>Year</b>	<b>t (year)</b>		<b>dW (ft/year)</b>
1918	0	1165	
1935	17	669	-29.2
1949	31	561	-7.8
1962	44	521	-3.1
1972	54	583	6.2
1985	67	592	0.7
1992	74	524	-9.7

<b>Subreach 2</b>			
<b>Year</b>	<b>t (year)</b>	<b>Wt (ft)</b>	<b>dW (ft/year)</b>
1918	0	1055	
1935	17	656	-23.48
1949	31	569	-6.22
1962	44	539	-2.32
1972	54	541	0.25
1985	67	500	-3.16
1992	74	488	-1.74

<b>Subreach 3</b>			
<b>Year</b>	<b>t (year)</b>	<b>Wt (ft)</b>	<b>dW (ft/year)</b>
1918	0	579	
1935	17	455	-7.30
1949	31	408	-3.30
1962	44	410	0.11
1972	54	413	0.29
1985	67	415	0.16
1992	74	406	-1.22

<b>Entire reach</b>			
<b>Year</b>	<b>t (year)</b>	<b>Wt (ft)</b>	<b>dW (ft/year)</b>
1918	0	954	
1935	17	607	-20.41
1949	31	527	-5.71
1962	44	501	-2.06
1972	54	524	2.35
1985	67	512	-0.96
1992	74	479	-4.62

**APPENDIX G – MODIFIED EINSTEIN PROCEDURE  
INPUT DATA AND RESULTS**

Table 1 – MEP input data for Albuquerque Gage .....G-2

Table 2 – MEP results for Albuquerque Gage and bed-material load estimations.....G-11

Table 2 - MEP results for Albuquerque gage and bed-material load estimations

Date	Inst. Discharge (cfs)	MEP results			d10 bed material	% washload	% bed material load	Bed material load (t/day)
		Total load	Sand load	Gravel load				
4/10/1978	326	498	177.8	0	0.16	92	8	40
4/24/1978	329	1319.9	1075.3	71.7	0.15	31	69	911
5/8/1978	1420	5186.7	2984.6	0	0.14	71	29	1504
5/22/1978	4260	69638.5	58057.7	0	0.15	36	64	44569
5/30/1978	2520	9891.2	6931.3	0	0.14	60	40	3956
6/5/1978	2810	12581.3	9882.1	0	0.17	51	49	6165
6/26/1978	1350	3967.6	3206.7	6.9	0.14	50	50	1984
7/24/1978	1040	7854.2	1099.4	0	0.14	96	4	314
4/2/1979	1840	7402.1	6199.2	0	0.14	54	46	3405
4/23/1979	4980	46703.6	32668.3	63.2	0.14	47	53	24753
5/29/1979	6610	56805.4	45329.2	589.6	0.17	50	50	28403
6/18/1979	6920	47923.7	42714.1	718	0.17	42	58	27796
7/9/1979	6040	50108.4	47521.4	465.8	0.15	31	69	34575
4/7/1980	926	632.5	535	0	0.18	60	40	253
4/28/1980	4730	44563.5	40624.3	586	0.2	41	59	26292
5/12/1980	6900	101837.1	39079.1	130.8	0.13	32	68	69249
6/9/1980	6610	94407.8	36004.9	170.2	0.14	22	78	73638
4/20/1981	641	382.7	311.3	0	0.15	62	38	145
6/22/1981	694	1223	813.7	0	0.15	58	42	514
7/27/1981	584	1527.7	506.4	0	0.15	94	6	92
4/26/1982	1740	12907.8	11471.2	0	0.16	21	79	10197
5/3/1982	3350	15377.6	10182.8	0	0.13	62	38	5843
5/24/1982	4280	15493.5	11800.8	15	0.12	47	53	8212
6/7/1982	4570	14722.7	12313.3	52	0.17	55	45	6625
6/21/1982	3480	7363.3	6331.5	6.8	0.25	81	19	1399
7/7/1982	1100	944.3	746.8	0.2	0.18	60	40	378
7/26/1982	159	42.4	18	0	0.19	90	10	4
4/3/1984	1350	1600.6	1250.6	12	0.048		100	1601
4/24/1984	4270	16901.2	13834.9	0	0.12	52	48	8113
5/8/1984	4440	20624.1	17745.6	0	0.14	43	57	11756
7/10/1984	396	232.4	93.8	0	0.19	84	16	37
5/15/1985	7170	21145.9	15792.6	0	0.039		100	21146
6/17/1985	3620	2060	1568.9	0	0.26	99	1	21
5/6/1986	2430	4713.4	4334.6	10.2	0.16	41	59	2781
5/20/1986	2300	3625.9	3274	37.7	0.2	60	40	1450
6/3/1986	3440	9018.5	8383	11.4	0.15	40	60	5411
6/30/1986	3320	5074.7	3089.8	0	0.24	95	5	254
5/11/1988	1800	6156.2	2448.1	0	0.046	94	6	369
5/8/1990	1950	2721.4	2022.2	1.7	0.065	74	26	708
7/2/1990	570	380	240.4	0	0.19	95	5	19
4/4/1991	1490	2590.6	2128.5	0	0.18	69	31	803
4/10/1991	2130	18967.7	17698	20.9	0.3	35	65	12329
4/22/1991	3060	4027	2628.7	9	0.1	86	14	564
6/3/1991	3590	15609.6	11825	2152	0.16	45	55	8585
7/2/1991	2470	4588.4	3182.9	0	0.18	85	15	688
7/10/1991	401	335.8	220.7	0	0.24	53	47	158
6/18/1992	2610	9164.3	7276.8	985.4	0.042		100	9164
6/29/1992	853	2162.6	2024.2	0	0.24	19	81	1752
7/31/1992	801	3884.5	3509.8	1.5	0.18	15	85	3302
4/1/1994	1370	1191.1	947.9	7.6	0.29	84	16	191
5/2/1994	3300	5670.8	4495.7	48.1	0.25	70	30	1701
6/13/1994	5030	4493.5	3129.8	0	0.074	67	33	1483
6/27/1994	4860	11452.3	10331.9	18	0.2	54	46	5268
5/5/1995	3980	11194	9148.1	6.1	0.26	65	35	3918
5/24/1995	6400	19248.6	16235	63.7	0.26	65	35	6737
6/6/1995	4960	16225.7	14723.8	200.5	0.29	45	55	8924
7/3/1995	5620	25603.1	21572.6	2069.4	0.26	31	69	17666

Table 2 - MEP results for Albuquerque gage and bed-material load estimations

Date	Inst. Discharge (cfs)	MEP results			d10 bed material	% washload	% bed material load	Bed material load (t/day)
		Total load	Sand load	Gravel load				
4/5/1996	437	1494.9	1454.8	0	0.21	6	94	1405
5/3/1996	471	734.3	691.2	0	0.19	12	88	646
6/20/1996	572	282.8	189.4	0	0.22	80	20	57
4/4/1997	2090	14852.7	12854.9	0	0.16	28	72	10694
6/3/1997	5040	54393.6	34813.5	247.4	0.26	30	70	38076
5/5/1998	3180	8875.1	7447.3	6.5	0.20	62	38	3373
6/3/1998	3540	27598	26510.6	47	0.25	48	52	14351
4/27/1999	969	1031.9	669.6	0.1	0.25	93	7	72
5/24/1999	4080	14002.3	11851	152.6	0.21	60	40	5601
8/7/1978	817	2504.4	902.9	0	0.13	90	10	250
8/22/1978	559	1075.7	397.8	0	0.14	94	6	65
8/13/1979	588	1160.1	549.9	0	0.16	69	31	360
9/10/1979	521	539.3	362.4	0	0.16	87	13	70
8/18/1980	377	633.5	483.1	0	0.16	30	70	443
9/15/1980	447	393.6	126.2	0				
8/24/1981	260	1484.8	421.6	0	0.14	95	5	74
8/6/1990	415	220.6	89.1	0	0.25	97	3	7
9/4/1990	267	84.8	34.4	0	0.18			
8/31/1992	1070	1153.8	333.8	0	0.21	94	6	69
8/13/1993	536	413.4	191.6	0	0.25	94	6	25
8/4/1994	588	2807.3	179.4	0	0.18	99	1	28
9/30/1994	383	155.1	55	0	0.12	87	13	20
9/2/1997	774	1355.1	335.1	0	0.27	98	2	27
9/17/1999	1080	980.3	615.3	0.7	0.27	91	9	88
Average (spring)					0.175	57		
Average (summer)					0.187	87		