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Managing Water in the West

Rio Grande River Maintenance Priority Sites on the Pueblo of Cochiti

Historical Channel Information

U.S. Department of the Interior
Bureau of Reclamation

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by

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Bureau of Reclamation
Upper Colorado Region
Albuquerque Area Office
Environment Division

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Introduction

Three Rio Grande locations within the Cochiti Pueblo have been designated as River Maintenance Priority Sites (Figure 1) by the River Analysis Team of the Bureau of Reclamation (Reclamation). Cochiti Pueblo Priority Site #1 is located on the west bank of the Rio Grande at approximately River Mile (RM) 231.3, which is less than one mile downstream from Cochiti dam. Cochiti Pueblo Priority Site #2 is located on the east bank at the Santa Fe River confluence (~RM 230.2). The third site described in this report is Cochiti Pueblo Priority Site #3, located on the east bank of the Rio Grande at RM 228.9. The purpose of this report is to describe the recent history of each of the three sites through comparisons of historic aerial photography data and cross section data.

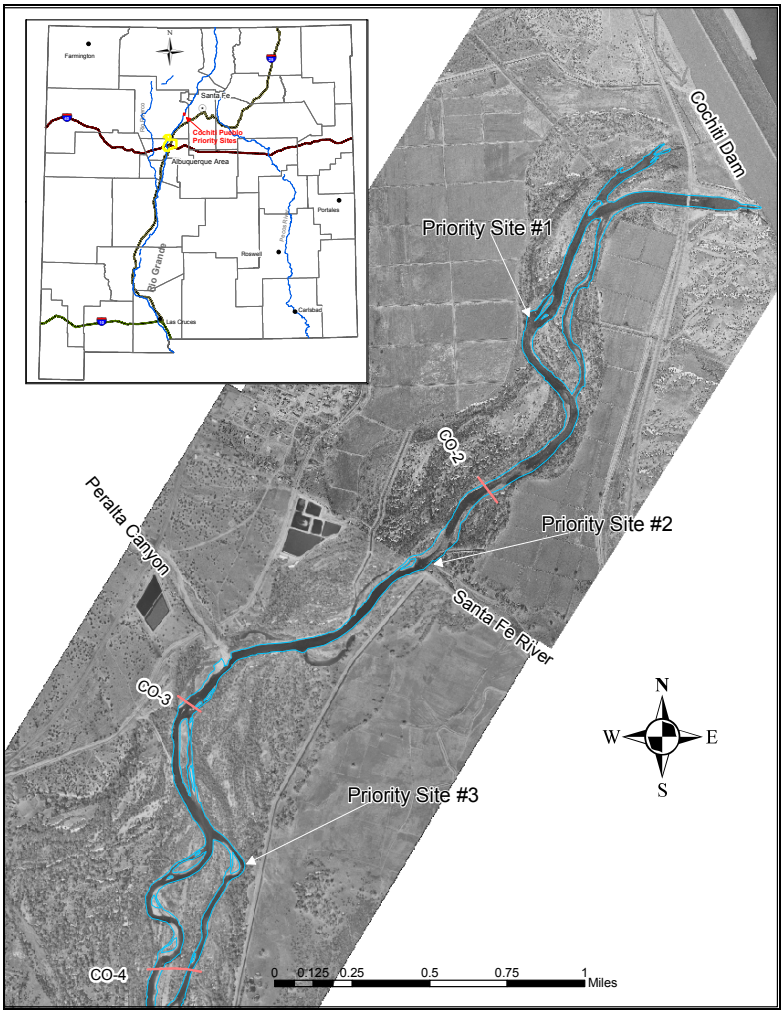


Figure 1: Site map identifying three river maintenance priority locations within the Cochiti Pueblo on the Rio Grande downstream of Cochiti dam. Reclamation 2001 aerial photography with the 2001 channel location as digitized by J. Oliver, GIS and Remote Sensing Group, Bureau of Reclamation-TSC in Denver, CO.

Channel History of Area

The Rio Grande in the Cochiti Pueblo area has steadily decreased its active channel width since 1918 (Figure 2). USGS 1918 maps, later digitized and geo-rectified by Reclamation, show a large active channel with numerous islands splitting the channel flow. Aerial photos from 1935-1972 also show numerous islands splitting the channel, but the spatial extent of the active channel is significantly decreased from the 1918 channel (Figure 2). Floodway construction occurred throughout the Middle Rio Grande, including this section of river, in the mid-1930s and again in the 1960s (Woodson 1961, Woodson and Martin 1962). The channel work predominantly included channel straightening in both episodes but also levee construction and Kellner jetty jack installation in the latter construction period. In November 1973, operations at Cochiti dam began; Cochiti dam has two main purposes: temporary retention of peak discharges and long-term retention of sediment. Both the Rio Grande and the Santa Fe Rivers contribute to their discharges to the Reservoir. Cochiti dam predominately releases flow into the Rio Grande channel, but also releases flow into the irrigation canal system managed by the Middle Rio Grande Conservancy District. The dam spillway directs its flow directly into the Santa Fe River channel. Cochiti dam is less than one river mile upstream of Cochiti Pueblo Priority Site #1.

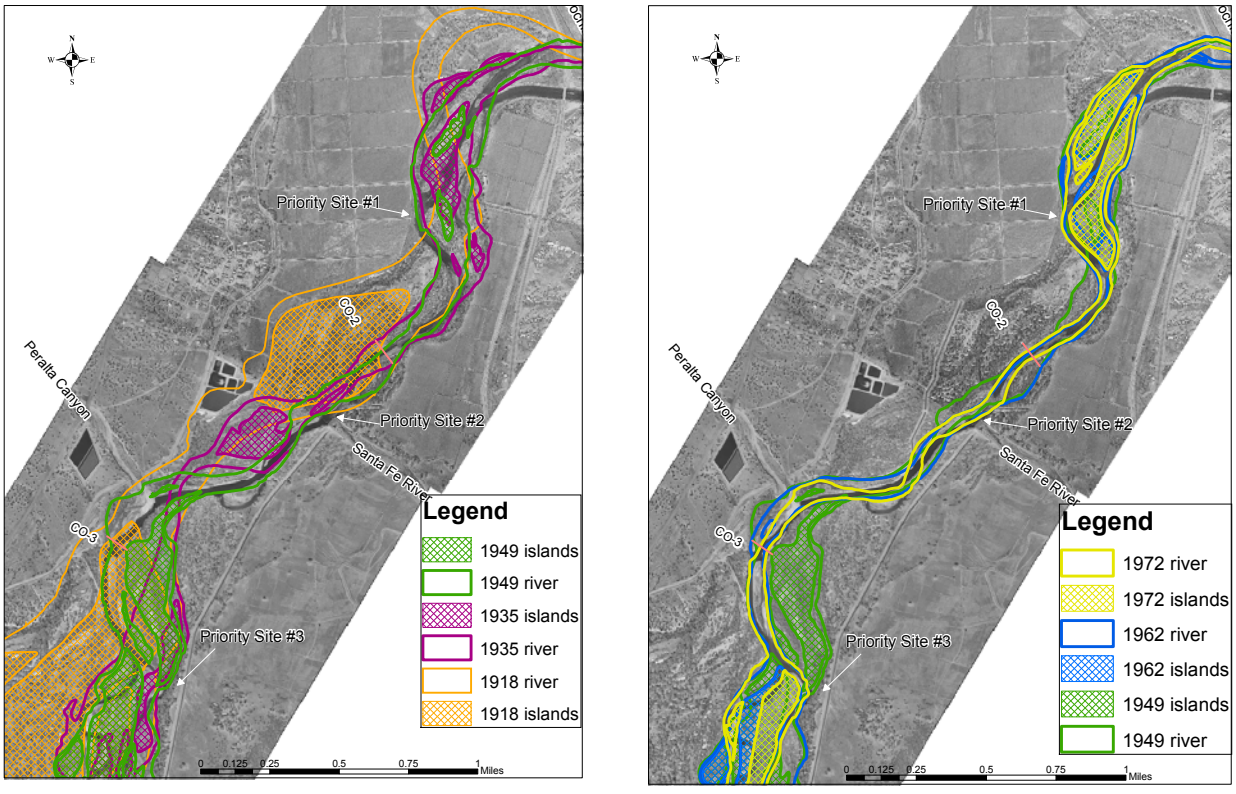


Figure 2: Historic channel locations of the Rio Grande in the Cochiti area. Bureau of Reclamation 2001 aerial photography overlain with digitized channel locations from 1918 USGS maps, 1935-1972 aerial photography. Channel boundaries digitized by J. Oliver, GIS and Remote Sensing Group, Bureau of Reclamation-TSC in Denver, CO.

Historic cross section data (Reclamation range lines CO2, CO-3, and CO-4) indicate that prior to Cochiti dam operations, the thalweg elevations were increasing (Figures 3&4). This trend suggests channel bed filling (aggradation) was occurring. Immediately after the Cochiti reservoir began filling in 1973, the thalweg elevations for most of these cross sections rapidly decreased in elevation, thus suggesting a reversal in sedimentation trends towards a degrading channel bed. The degradation is especially evident in cross section CO-2 (Figure 5). Degradation did not occur at CO-3, presumably due to the continued sediment supply from Peralta Canyon (Figures 2 and 4). Other historic cross section data is available in Appendix A.

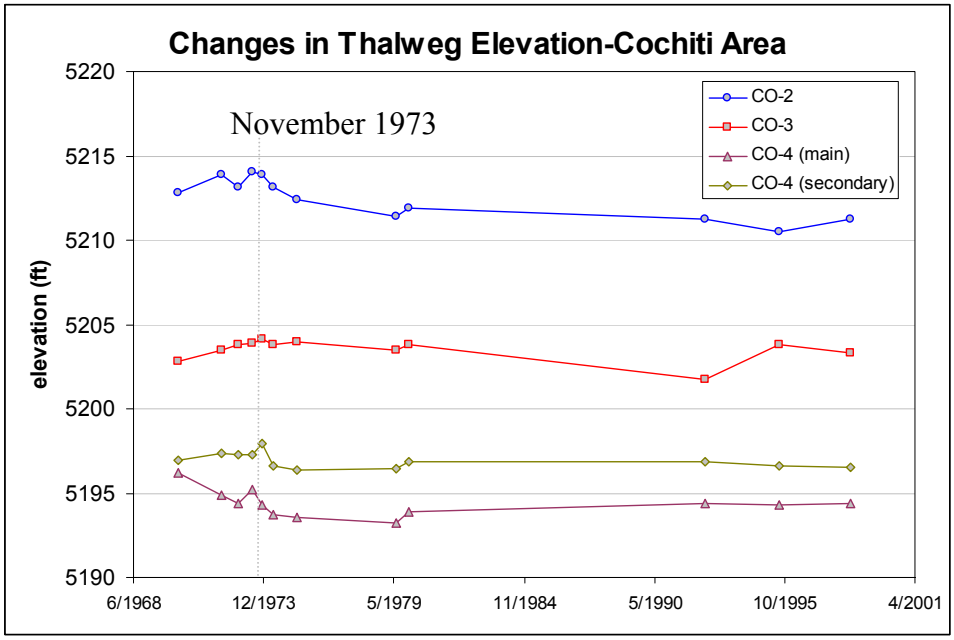


Figure 3: Changes in Rio Grande thalweg elevations at Reclamation range lines CO-2, CO-3 and CO-4 just downstream from Cochiti dam.

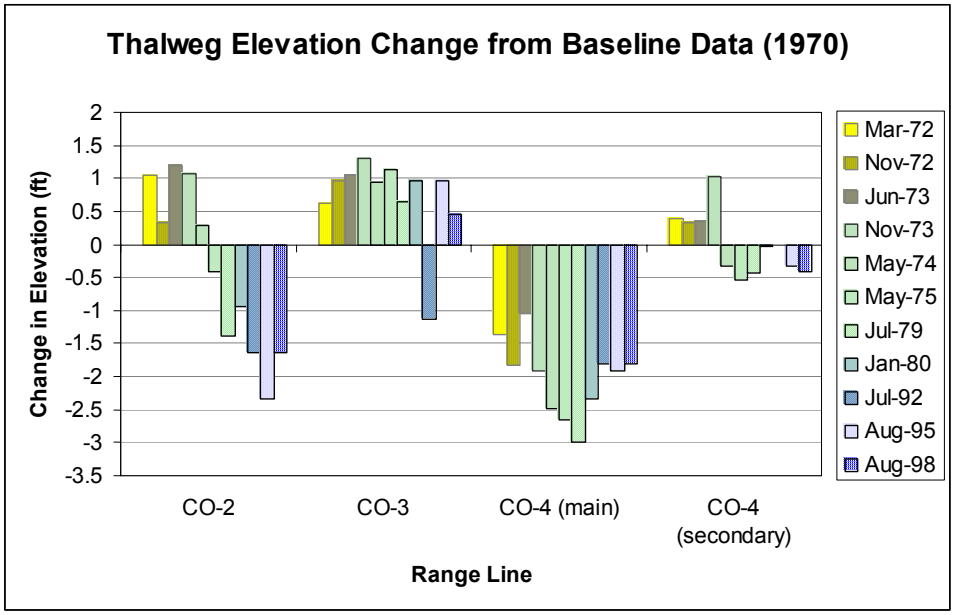


Figure 4: Change in thalweg elevation as compared to the May 1970 thalweg elevation for range lines CO-2, CO-3 and CO-4.

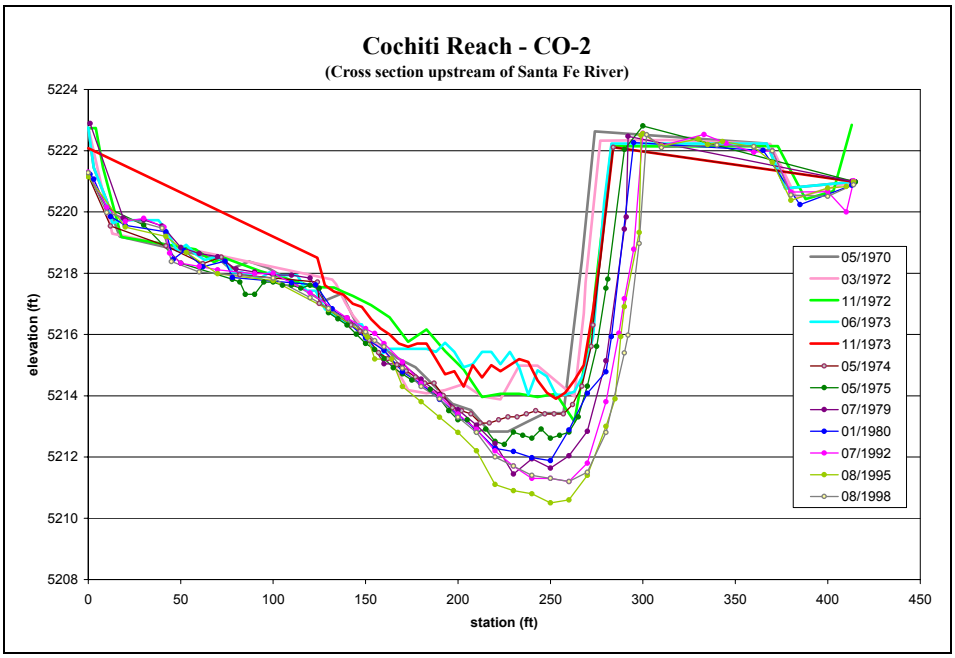


Figure 5: Historic cross section data at range line CO-2 on the Rio Grande, Bureau of Reclamation data, Albuquerque Area Office.

Historic bed material data shows that a mixture of gravel and sand were present prior to the operations of Cochiti dam in November 1973 (Table 1 and Appendix B), especially at CO-3 which is downstream of Peralta Canyon. After nearly 20 years of Cochiti dam operations, bed material data from CO-3 in 1992 clearly shows a coarsening of the channel to cobble sized sediment without the presence of sand sized material.

Table 1: Summary of bed material at CO-3, just downstream of Peralta Canyon confluence.

CO-3	d_{84}	d_{50}
MAY 12, 1970	21.33	0.34
MAY 3, 1971	0.5	0.33
SEP 13, 1971	0.68	0.38
MAR 20, 1972	6.40	0.37
NOV 10, 1972	0.79	0.23
NOV 26, 1973	1.96	1.31
DEC 18, 1973	6.91	1.38
JAN 14, 1974	2.91	1.57
JUL 06, 1975	3.00	0.81
APR 24, 1979	13.82	2.15
JUL 09, 1979	28.72	21.74
JUL 16, 1992-sample 1	77.64	58.21
JUL 16, 1992-sample 2	75.63	52.84
JUL 16, 1992-sample 3	50.85	20.59
JUL 16, 1992-sample 4	57.01	23.23
JUL 16, 1992-sample 5	29.49	6.03

Cochiti Pueblo Priority Site #1 (RM 231.3)

At present, this site is on the outside of a westward-moving meander bend (Figure 6). The bend is migrating towards a local road and groundwater drain field. At this location, the Rio Grande is split with a side channel flowing on the eastern side of the active channel, while the main channel flows on the western side of the active channel. The current bank line throughout the priority site area became established 1962-1972 (Figure 2). Although a line of Kellner jetty jacks were placed in the 1960s along the west bankline for bank protection, the channel migrated past the jetties. Prior to 1972, the jetties were left in the middle of the main Rio Grande channel (Figure 6), where they remain today. Review of channel locations, 1918-2001, indicates that the surface currently eroding at the apex of this westward moving bend pre-dates 1918. No obvious bend migration has occurred between the 1972 and 2001 photos.

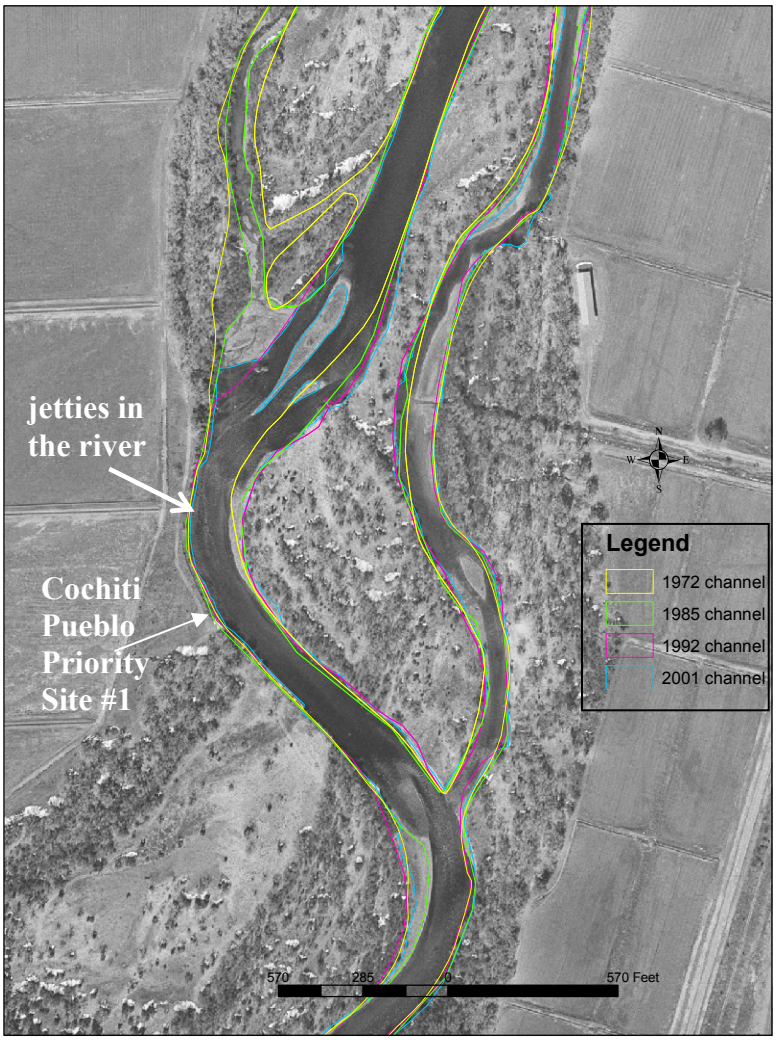


Figure 6: Cochiti Pueblo Priority Site #1 at RM 231.3. Aerial photography (2001) overlain with the 1972-2001 channel locations as digitized by J. Oliver, GIS and Remote Sensing Group, Bureau of Reclamation-TSC in Denver, CO.

Cochiti Pueblo Priority Site #2 (RM 230.2)

This priority site is located on the east bank of the river, immediately downstream from the Santa Fe River confluence. The east-side bend is moving in the southern direction towards a river side drain. The current bank line appears to have begun migrating to the south-east in 1949 (Figure 2), becoming well established by the 1985 photos (Figure 7). In fact, there appears to have been rapid migration between the 1972 and 1985 photos. The rapid south-eastward erosion at this confluence is likely due to the significant decrease in both discharge and sediment supply delivered by the Santa Fe River after Cochiti dam began operating. Review of channel locations, 1918-2001, indicates that the surface currently eroding at the apex of this south-eastward moving bend pre-dates 1918. No obvious bend migration has occurred since 1985.

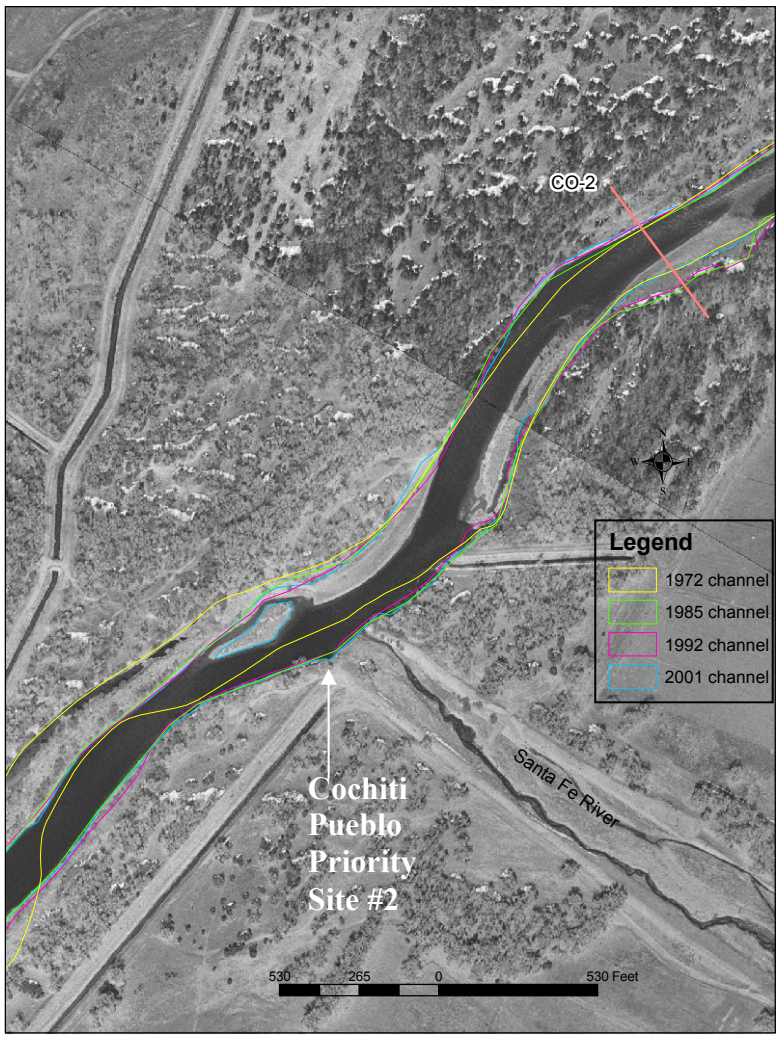


Figure 7: Cochiti Pueblo Priority Site #2 at RM 230.2, Santa Fe River Confluence. 2001 aerial photography with the 1972-2001 channel locations as digitized by J. Oliver, GIS and Remote Sensing Group, Bureau of Reclamation-TSC in Denver, CO.

Cochiti Pueblo Priority Site #3 (RM 228.9)

This priority site is located on the east bank of the river, downstream from the Peralta Canyon confluence. The Rio Grande is split into two channels; the main flow of the Rio Grande is in the larger, west channel, while the smaller, east channel is a side channel. The priority site is an eastward migrating bend located along the east side channel (Figures 2 and 8) The main channel for the Rio Grande flowed throughout the area that is now Priority Site # 3 in the 1949 photos (Figure 9), but by 1962, the main Rio Grande flow had moved west, and this area became a relatively smaller side channel. In 1962, a bend had formed in approximately the current priority site location, but with a wide curvature angle. As the angle of curvature tightened post-1972, the bend began migrating. The average rate of bank line migration is ~ 4 feet per year (Table 2); however 1992-2001 the rate of migration slowed to 2.8 feet per year. The decrease in migration rate is likely due to recently encountering a higher bank line with more competent material. The current eroding bank has not been active channel since before 1918 (Figure 2), while the eroding bank in the 1980s was active channel in the 1949 photos. After 1985, the direction of bank line migration shifted from a mostly eastern direction to a mostly southern direction.

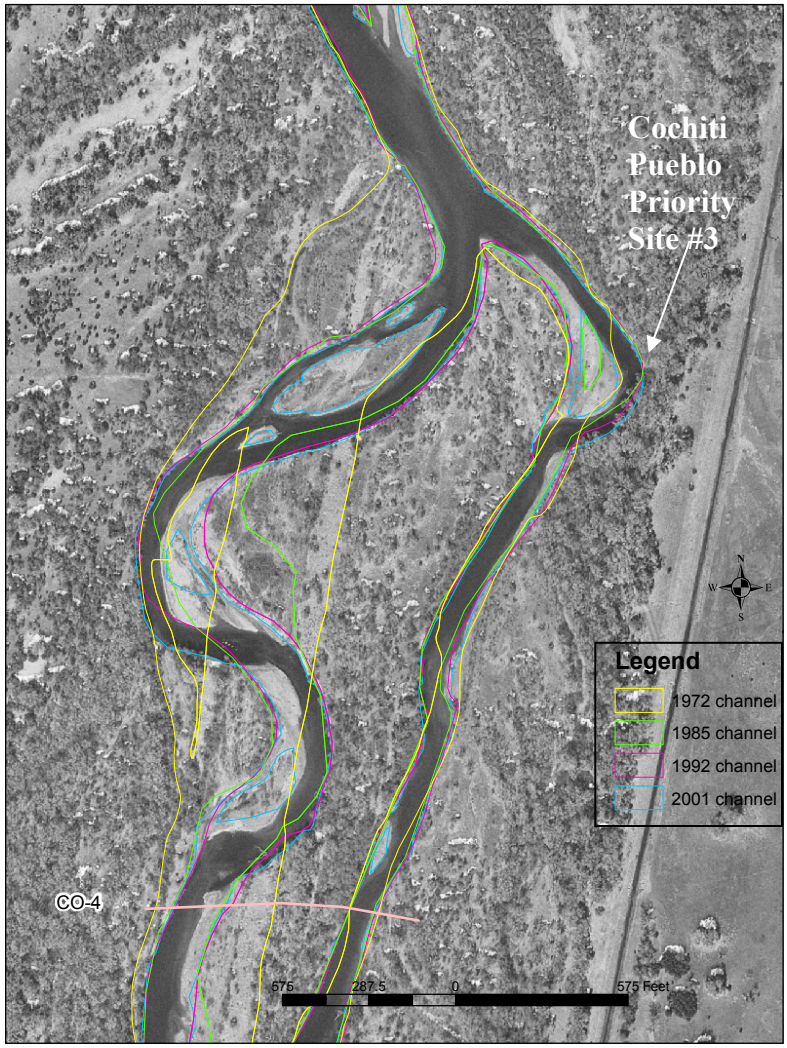


Figure 8: Cochiti Pueblo Priority Site #3 at RM 228.9. 2001 aerial photography with the 1972-2001 channel locations as digitized by J. Oliver, GIS and Remote Sensing Group, Bureau of Reclamation-TSC in Denver, CO.

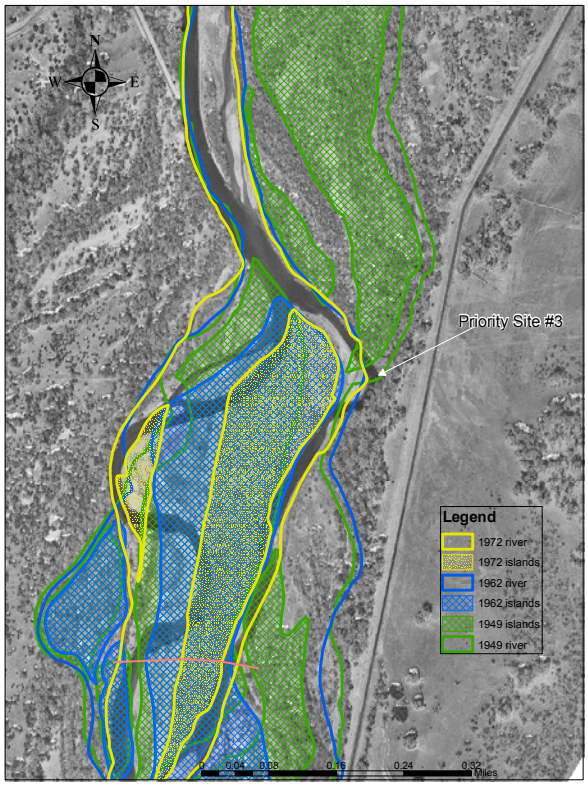


Figure 9: Close-up of the Rio Grande at Cochiti Pueblo Priority Site #3 (RM 228.9). 2001 aerial photography with the 1949-1972channel locations as digitized by J. Oliver, GIS and Remote Sensing Group, Bureau of Reclamation-TSC in Denver, CO.

Table 2: Measured bend migration of the Rio Grande at Cochiti Pueblo Priority Site #3 (RM 228.9).

Years of Photos	Feet of movement	Rate of Migration
1962-1972	0	0
1972-1985	55-90 feet	4.2 – 6.9 ft/yr
1985-1992	35 feet	5.0 ft/yr
1992-2001	25 feet	2.8 ft/yr
	Average:	4.0 ft/yr

Literature Cited

Woodson, R.C. 1961. Stabilization of the Middle Rio Grande in New Mexico. Journal of the Waterways and Harbors Division. Proceedings of the American Society of Civil Engineers. Vol.87, No. WW4. pp.1-15.

Woodson, R. C. and Martin, J. T. 1962. The Rio Grande comprehensive plan in New Mexico and its effects on the river regime through the middle valley, Control of Alluvial Rivers by Steel Jetties, American Society of Civil Engineers Proceedings, Waterways and Harbors Division Journal 88, E.J. Carlson and E.A. Dodge (eds.), NY, NY, American Society of Civil Engineers, pp. 53-81.

APPENDIX A
Profile and Cross Section Data

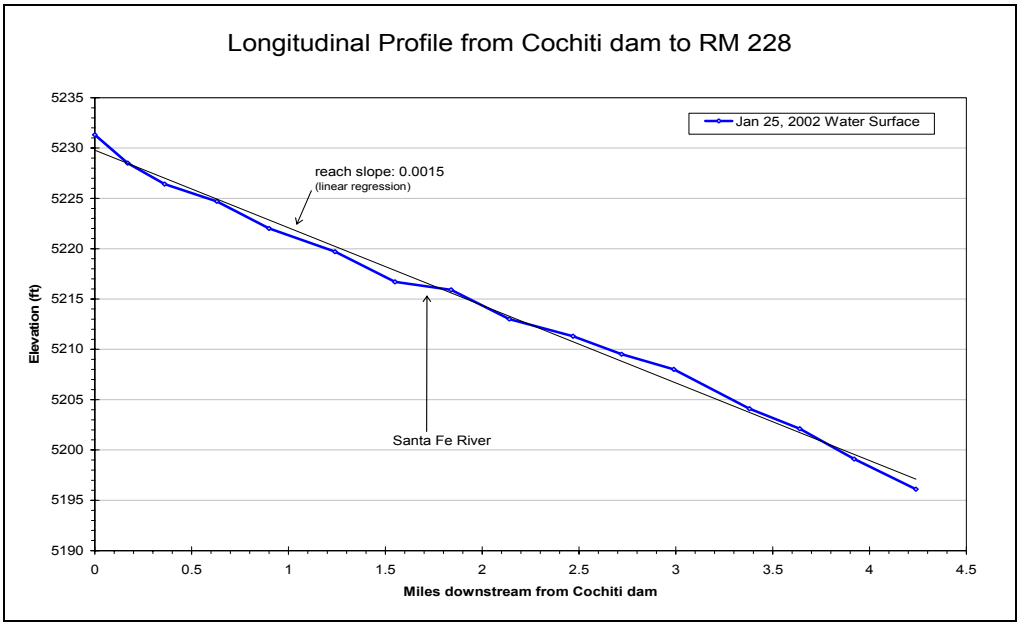


Figure A-1: 2002 Profile - The 2002 water surface profile from Cochiti dam to river mile 228, just downstream of the third priority site in this area. Cross section data prepared for Reclamation's ongoing Rio Grande Aggradational-Degradational Study.

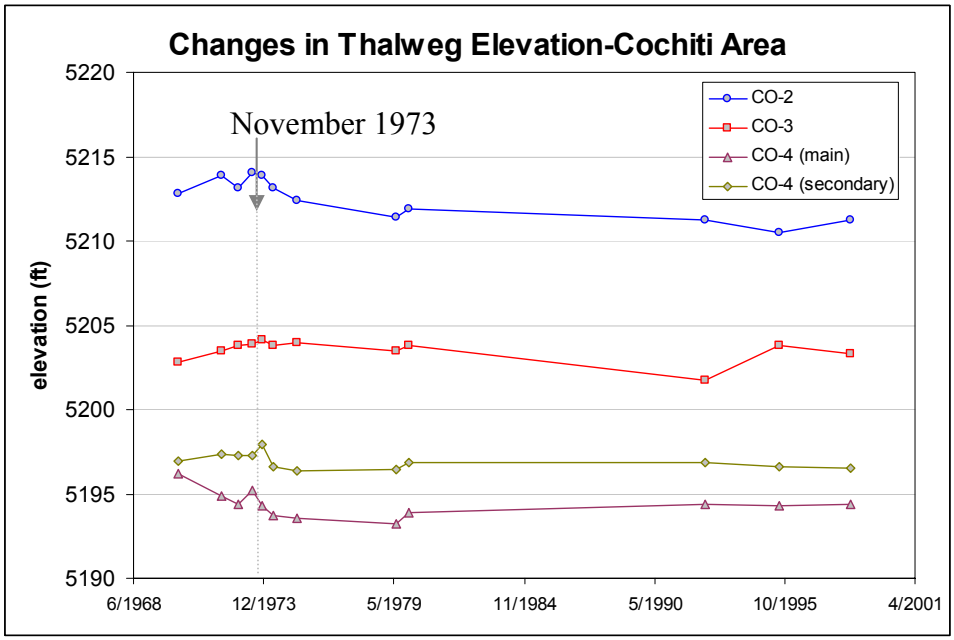
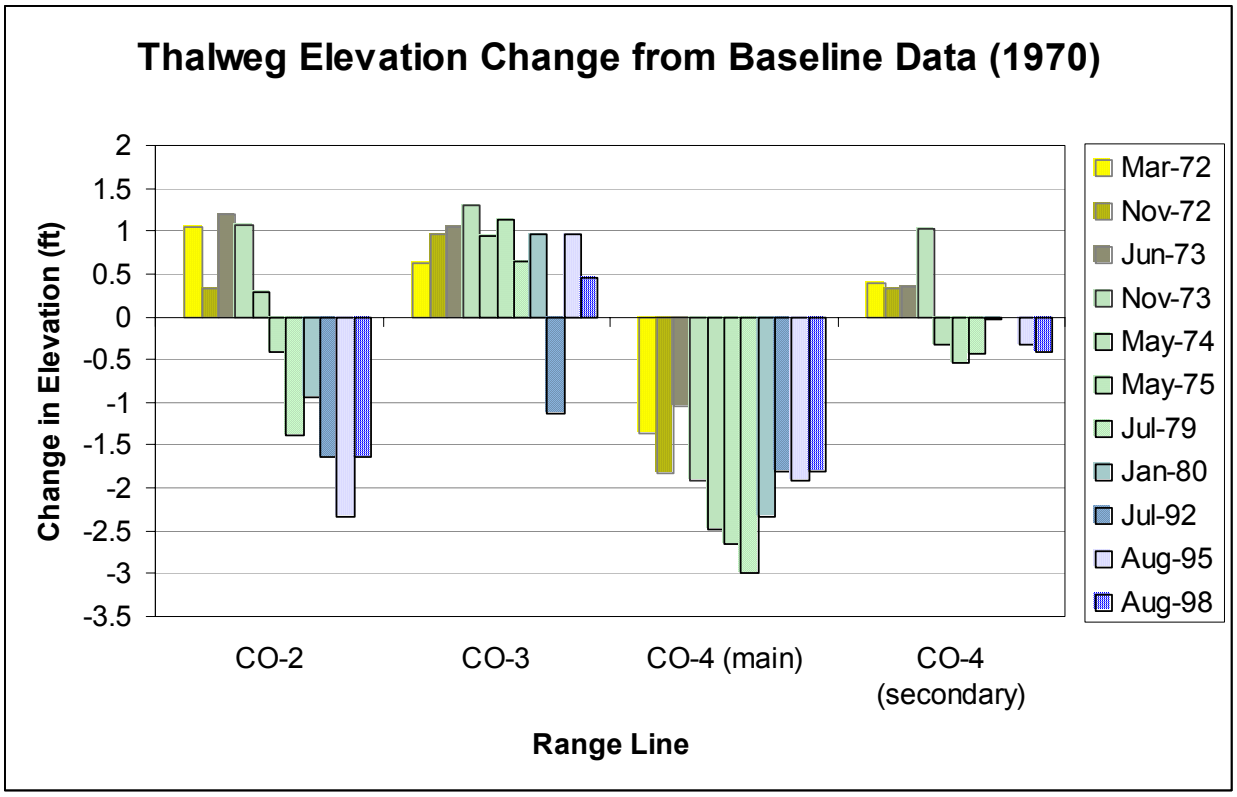
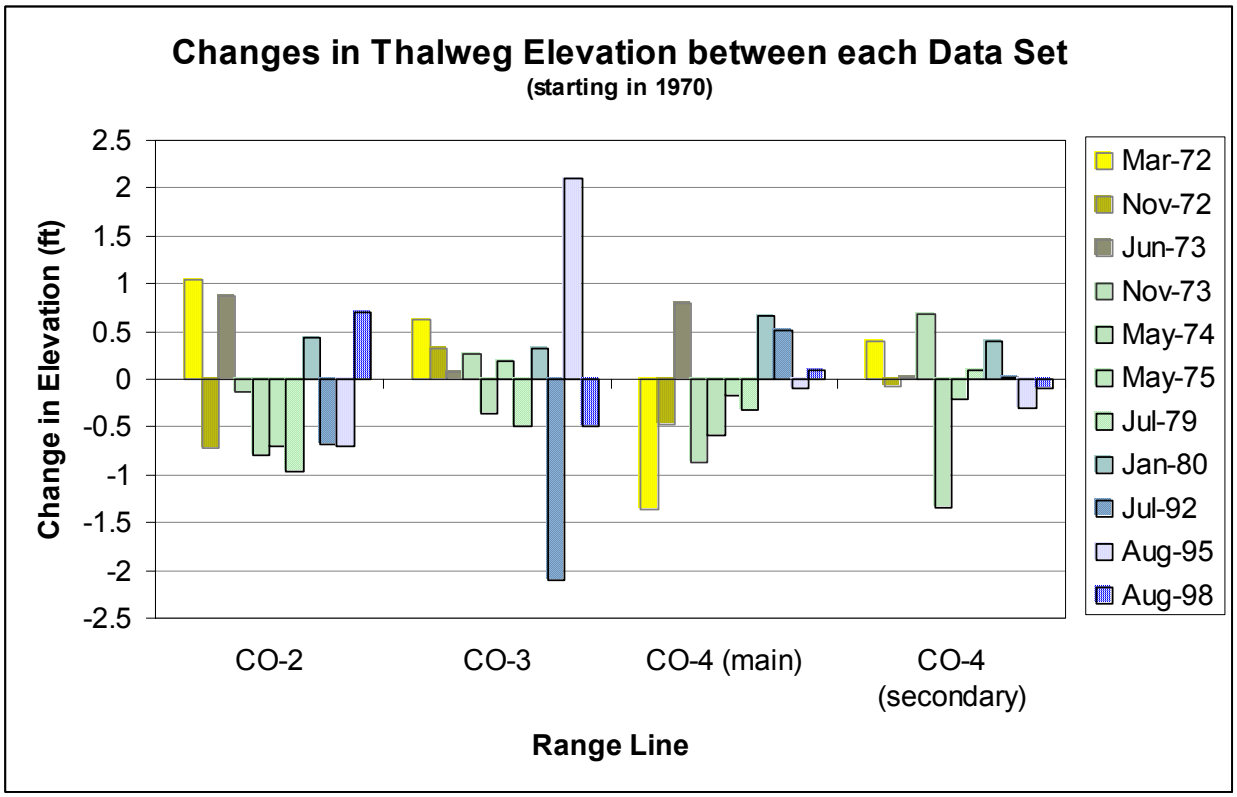
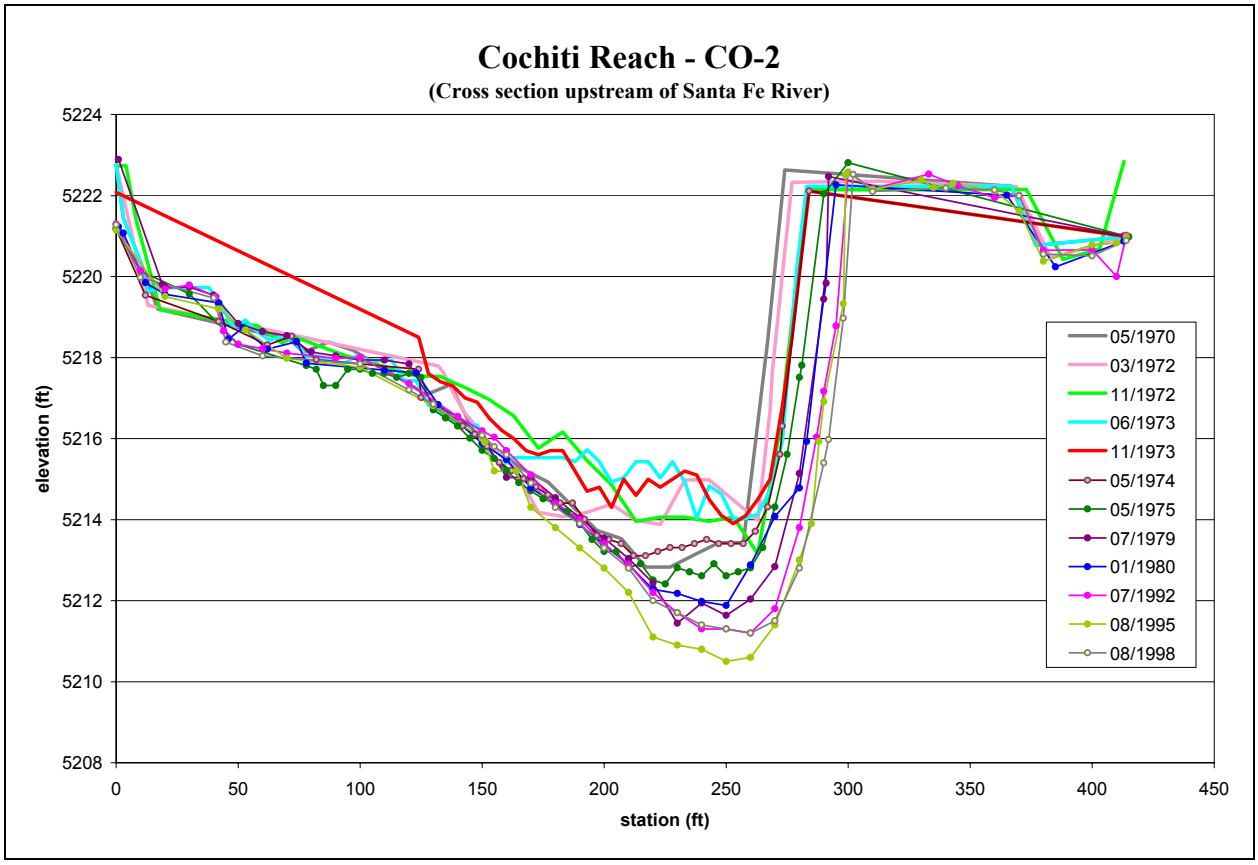


Figure A-2: Historic Thalweg Elevations - Changes in Rio Grande thalweg elevations at Reclamation range lines CO-2, CO-3 and CO-4 just downstream from Cochiti dam.

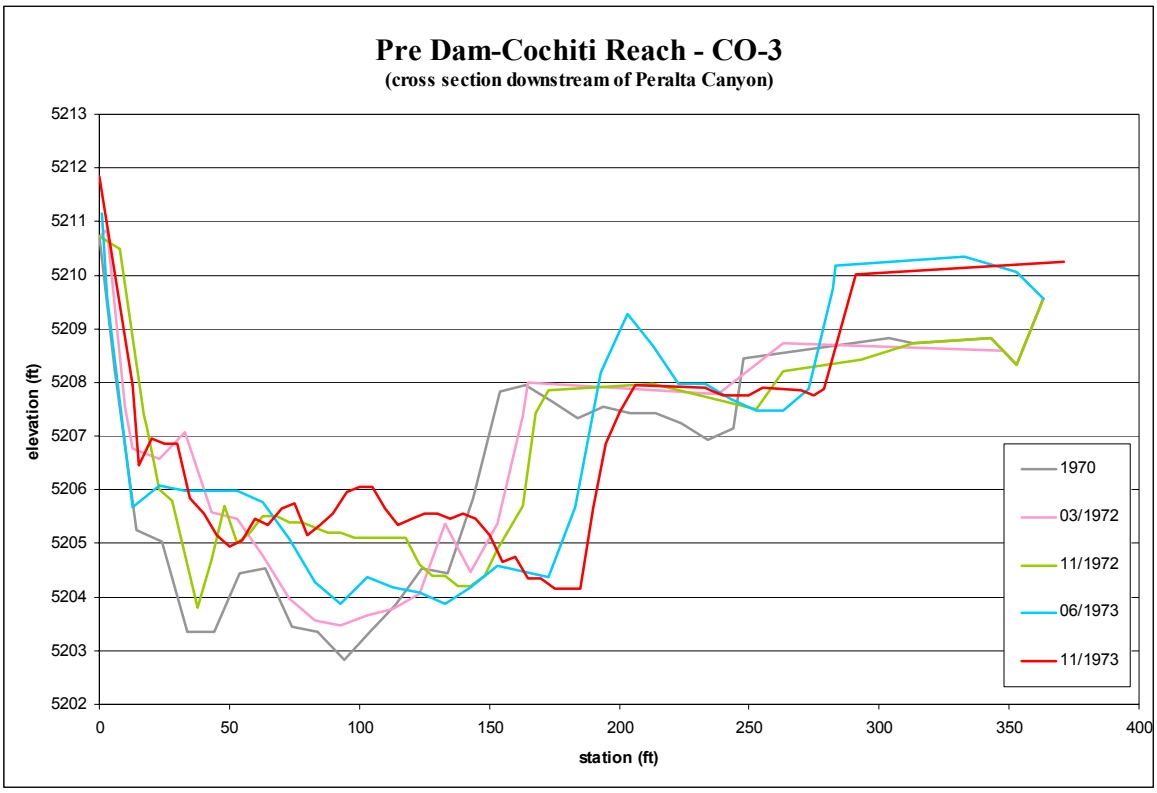

Thalweg Elevation Change from Baseline Data (1970)
Change in Elevation (ft)
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
CO-2
CO-3
CO-4 (main)
CO-4 (secondary)
Range Line
Mar-72
Nov-72
Jun-73
Nov-73
May-74
May-75
Jul-79
Jan-80
Jul-92
Aug-95
Aug-98

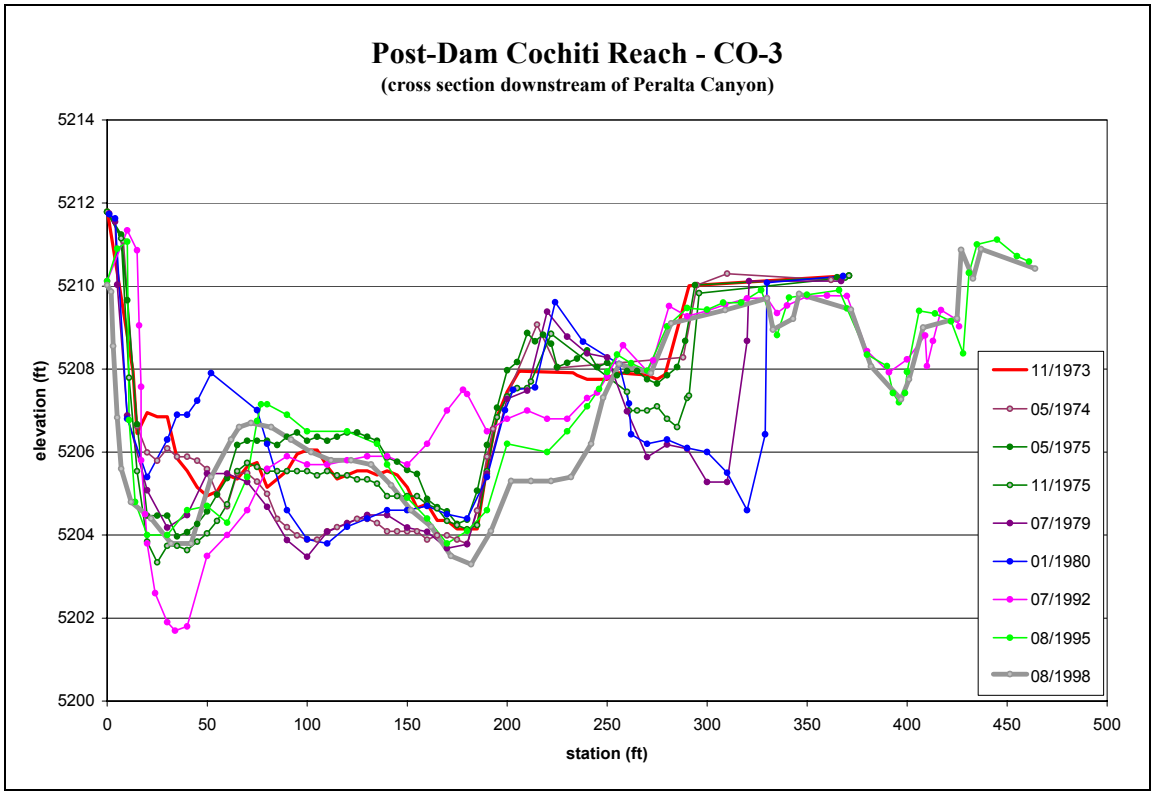

Changes in Thalweg Elevation between each Data Set
(starting in 1970)
Change in Elevation (ft)
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
CO-2
CO-3
CO-4 (main)
CO-4 (secondary)
Range Line
Mar-72
Nov-72
Jun-73
Nov-73
May-74
May-75
Jul-79
Jan-80
Jul-92
Aug-95
Aug-98

CO-2

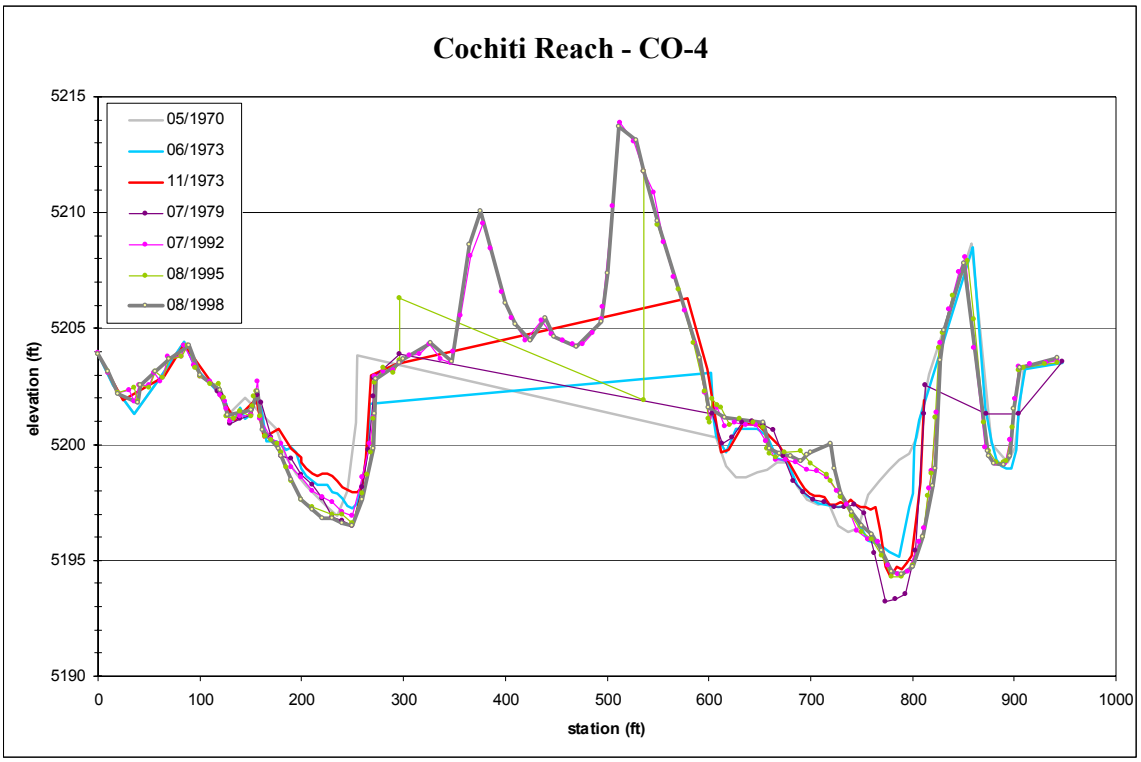

Cochiti Reach - CO-2
(Cross section upstream of Santa Fe River)
elevation (ft)
station (ft)
5224
5222
5220
5218
5216
5214
5212
5210
5208
0
50
100
150
200
250
300
350
400
450
05/1970
03/1972
11/1972
06/1973
11/1973
05/1974
05/1975
07/1979
01/1980
07/1992
08/1995
08/1998

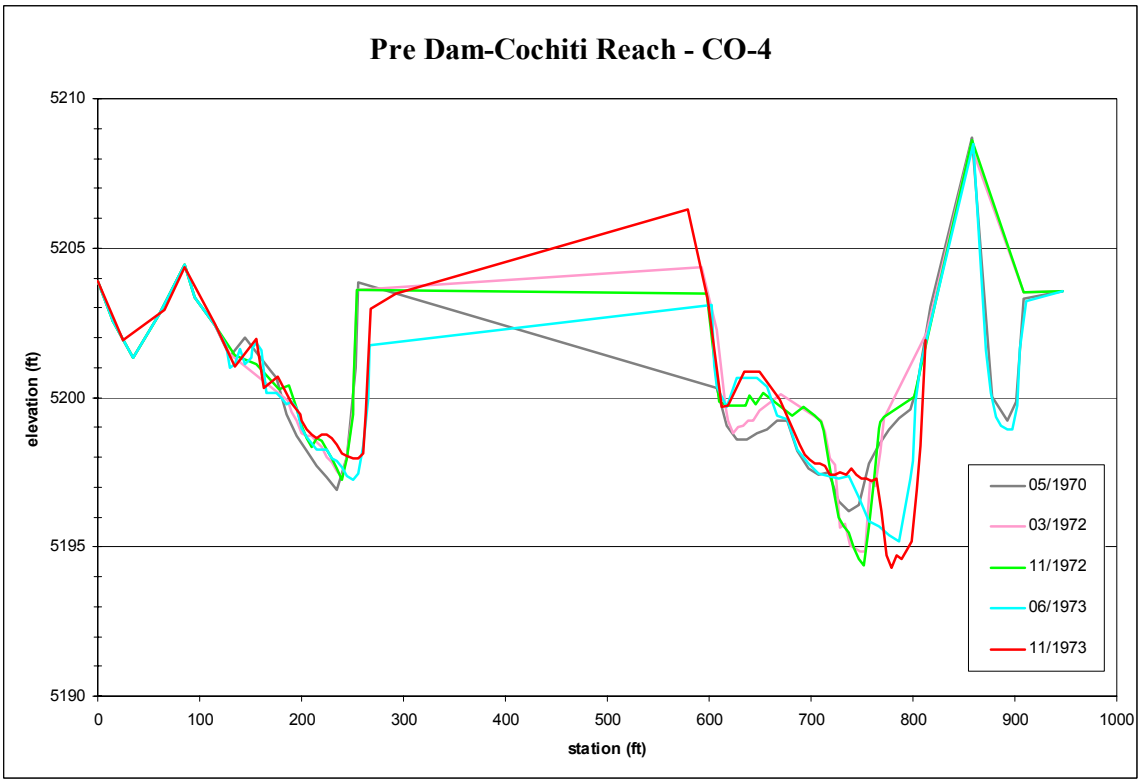
CO-3

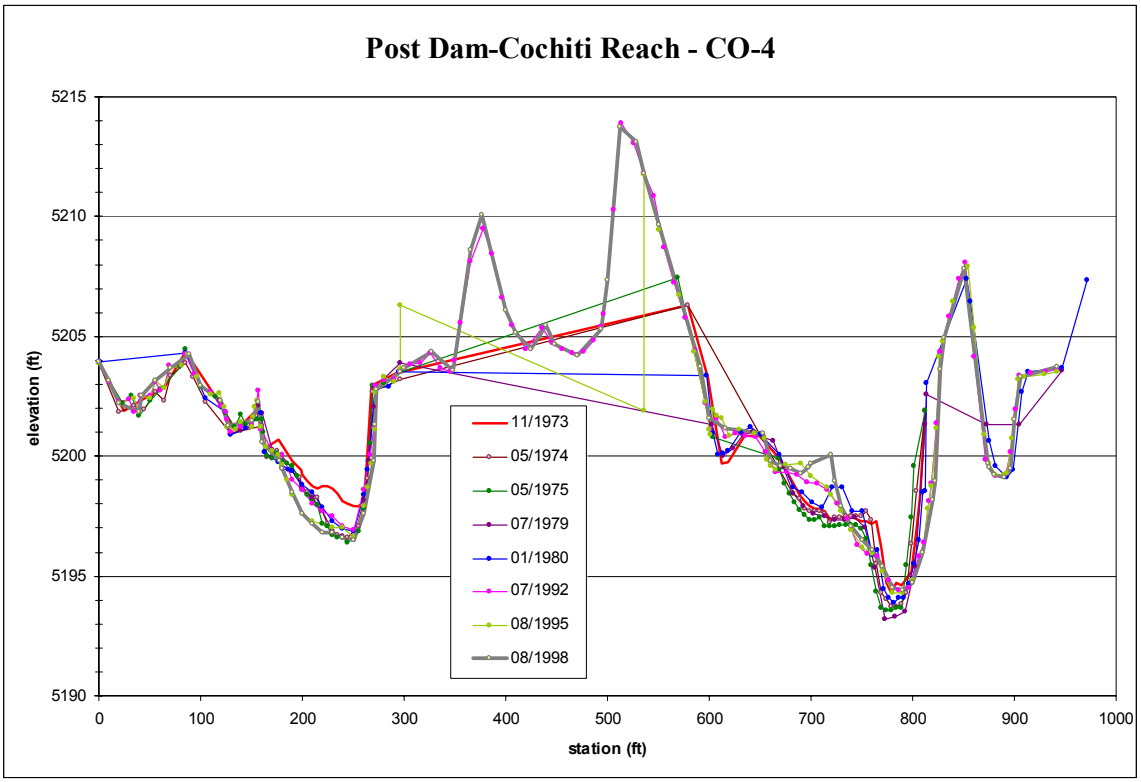

Pre Dam-Cochiti Reach - CO-3
(cross section downstream of Peralta Canyon)
elevation (ft)
station (ft)
5213
5212
5211
5210
5209
5208
5207
5206
5205
5204
5203
5202
0
50
100
150
200
250
300
350
400
1970
03/1972
11/1972
06/1973
11/1973


Post-Dam Cochiti Reach - CO-3
(cross section downstream of Peralta Canyon)
elevation (ft)
station (ft)
5214
5212
5210
5208
5206
5204
5202
5200
0
50
100
150
200
250
300
350
400
450
500
11/1973
05/1974
05/1975
11/1975
07/1979
01/1980
07/1992
08/1995
08/1998

CO-4


Cochiti Reach - CO-4
05/1970
06/1973
11/1973
07/1979
07/1992
08/1995
08/1998
elevation (ft)
station (ft)
5215
5210
5205
5200
5195
5190
0
100
200
300
400
500
600
700
800
900
1000


Pre Dam-Cochiti Reach - CO-4
05/1970
03/1972
11/1972
06/1973
11/1973
elevation (ft)
station (ft)
5210
5205
5200
5195
5190
0
100
200
300
400
500
600
700
800
900
1000


Post Dam-Cochiti Reach - CO-4
elevation (ft)
station (ft)
5215
5210
5205
5200
5195
5190
0
100
200
300
400
500
600
700
800
900
1000
11/1973
05/1974
05/1975
07/1979
01/1980
07/1992
08/1995
08/1998

APPENDIX B - Bed Material Data

CO-1	d_{84}	d_{50}
May 12, 1970	3.87	1.38
November 1, 1970	0.85	0.23
May 3, 1971	1.00	0.42
March 2, 1972	3.25	0.45
November 10, 1972	1.00	0.27

CO-2	d_{84}	d_{50}
MAY 12, 1970	16.00	0.28
NOV 01, 1970	0.59	0.26
NOV 01, 1970	0.59	0.26
MAY 3, 1971	2.00	0.47
SEP 13, 1971	0.96	0.41
MAR 20, 1972	2.83	0.45
NOV 10, 1972	0.73	0.20
JUN 11, 1973	0.75	0.37
NOV 26, 1973	1.89	0.71

CO-3	d_{84}	d_{50}
MAY 12, 1970	21.33	0.34
MAY 3, 1971	0.5	0.33
SEP 13, 1971	0.68	0.38
MAR 20, 1972	6.40	0.37
NOV 10, 1972	0.79	0.23
NOV 26, 1973	1.96	1.31
DEC 18, 1973	6.91	1.38
JAN 14, 1974	2.91	1.57
JUL 06, 1975	3.00	0.81
APR 24, 1979	13.82	2.15
JUL 09, 1979	28.72	21.74

CO-3	Sample #	d_{84}	d_{50}	d_{35}
07/16/92	1	77.64	58.21	38.79
07/16/92	2	75.63	52.84	39.49
07/16/92	3	50.85	20.59	10.59
07/16/92	4	57.01	23.23	15.21
07/16/92	5	29.49	6.03	1.18

CO-4 W	d_{84}	d_{50}
May 13, 1970	27.17	16.91
November 1, 1970	11.56	2.67
May 4, 1971	0.74	0.23
September 14, 1971	0.53	0.38
March 22, 1972	0.67	0.22
November 13, 1972	0.85	0.25
November 26, 1973	3.29	1.23

CO-4 E	d_{84}	d_{50}
May 13, 1970	27.17	16.91
November 1, 1970	0.36	0.20
September 14, 1971	0.56	0.27
March 22, 1972	0.67	0.22
November 13, 1972	0.58	0.23
November 24, 1973	0.45	0.32