APPENDIX F
CONTROLLED WATER RELEASES FOR OVERBANK FLOWS

ANALYSIS METHODOLOGY

This appendix presents the technical basis and assumptions of the controlled water release evaluation. The measure, included as part of the Targeted River Restoration Alternative, is intended to induce controlled overbank flows for riparian vegetation development. Changes in flow patterns that simulate early spring runoff conditions has been proposed for establishment of cottonwood bosque along the Rio Grande (Crawford *et al*., 1996, 1999).

A simulation of controlled releases from Caballo Dam was conducted to estimate the potential extent of the overbank flows. The simulation was made using the HEC-RAS hydraulic model. While the potential extent of overbank flows was analyzed based on a maximum theoretical value –5,000 cfs discharge– it is important to emphasize that full discharge conditions would be reached only after several years of planning, gradual implementation, and regular monitoring.

Potential Extent of Overbank Flows

To simulate potential overbank conditions, 5,000 cfs was used as the maximum theoretical value for controlled discharges from Caballo Reservoir. This discharge value is dictated by the rated value of the outlet works that would be possible only when the reservoir reaches maximum water surface elevation (4,182 ft elevation, with a hydraulic head of 78 ft). This elevation is approximately 10 ft above the top of the active conservation elevation (4,172.44), and above typical reservoir operation conditions. Over the last two years, according to the operational records [*www.usbr.gov/uc/elpaso/water/reservoirs*], water surface elevations reached a maximum of 4,152.7 ft. in March 2002 and drop to a minimum of 4,128.3 ft in September 2003. Based on the 2002-2003 operational elevations, the maximum possible discharge would have ranged from approximately 3,500 cfs in March 2002 to less than 2,600 cfs in September 2003.

Table F-1 summarizes the approximate maximum discharge from Caballo Reservoir as a function of water surface elevation. Data were obtained from the outlet works' operational nomograph (both gates fully open). Steady-state flow conditions used in the overbank simulation are listed in Table F-2.

Table F-1 Theoretical Discharge Capacity of Caballo Dam Outlet Works

Water Elevation (above Rio Grande Project Datum)	4,182 ft (maximum elevation)	4,172 ft (top of active conservation)	4,162 ft	4,152 ft	4,142 ft	4,132 ft
Approximate discharge (both gates open at 7 ft.)	5,000 cfs	4,300 cfs	3,900 cfs	3,500 cfs	3,100 cfs	2,600 cfs

Table F-2 Simulated Flows for Pulse Discharges in the RGCP Northern Reach

Apparent Attenuation (100-Year Flows in a Non-Contributing Reach)
(Table 8.1 Alternatives Formulation Report, Parsons March 2001)

Mile	Length	Flow Reduction	Change (cfs)	Change (%)	Change per Mile
84.8		19,100			
81.8	3.0	18,300	800	4.2%	1.4%
80.4	1.4	17,700	600	3.3%	2.3%

Attenuation per mile selected: 1.5%

Station	Mile	Delta (miles)	Attenuation	Cumulative	Controlled Release	DESIGN FLOW	HIGHEST MONTH*	100-YR FLOOD
1055	105.4			100.0%	**5,000**	**2,350**	3,561	5,000
1031	102.9	2.5	3.8%	96.3%	4,813	2,350	3,561	9,100
1018	101.4	1.5	2.3%	94.1%	4,704	2,350	3,561	11,300
1004	99.8	1.6	2.4%	91.8%	4,591	2,350	3,561	15,600
989	98.1	1.7	2.6%	89.5%	4,474	2,350	3,561	17,600
974	96.6	1.5	2.3%	87.5%	4,374	2,350	3,561	18,700
935	92.4	4.2	6.3%	82.0%	4,098	2,350	3,561	18,900
856	84.8	7.6	11.4%	72.6%	3,631	2,350	3,561	19,100
820	81.8	3.0	4.5%	69.3%	3,467	2,350	3,470	18,300
805	80.4	1.4	2.1%	67.9%	3,395	2,350	3,470	17,700
805	80.4			67.9%	3,395	2,350	3,470	17,700
802	80.0	0.4	0.6%	67.5%	3,374	2,350	3,470	17,800
789	78.5	1.5	2.3%	66.0%	3,298	2,350	3,470	22,400
784	78.0	0.5	0.8%	65.5%	3,274	2,350	3,470	22,500
770	76.6	1.4	2.1%	64.1%	3,205	2,350	3,470	22,000
675	67.2	9.4	14.1%	55.1%	2,753	2,350	3,470	22,400
637	63.3	3.9	5.9%	51.8%	2,592	2,350	3,470	22,400
Leasburg Dam					*-450*	*-450*		
637	63.3				**2,142**	**1,900**	3,035	22,400
636	63.0	0.3	0.4%		2,136	1,900	3,045	22,200
568	55.7	7.3	11.0%		1,902	1,900	3,045	21,300
553	55.3	0.4	0.6%		1,890	1,900	3,045	21,000
497	48.7	6.6	9.9%		1,703	1,900	3,045	21,300
486	47.6	1.1	1.7%		1,675	1,900	3,270	20,500
456	44.6	3.0	4.5%		1,600	1,900	3,270	20,100
412	39.9	8.8	13.2%		1,388	1,900	3,270	20,000
Mesilla Dam					*-300*	*-300*		

* Average value of the month with highest flow on record (July 1987, reported in USACE 1996, Vol. 4 , Tables 2-2, 2-4 & 2-6).

For the flow distribution analysis along the RGCP an attenuation coefficient of 1.5 percent per mile was applied (Table F-2). Water elevations were calculated for a 5,000 cfs discharge using the existing HEC-RAS model, and plotted along the RGCP. Table F-2 also includes three reference flows: RGCP channel design flow (maximum irrigation flow capacity); highest average monthly flow (used as a reference for riparian vegetation development); and 100-year flood values (from USACE 1996 hydrology analysis). The geographic coverage of simulated bank overflows along the northern reach of the RGCP was previously provided with the Reformulation of Alternatives Report (Parsons 20031a: Appendix F). This information is available in electronic format in Appendix I of this DEIS.

Discharge Characteristics

Under current water releases, advantageous conditions for an increase in early spring flows would be in March when peak weekly irrigation discharges occur. An analysis by King and Maitland (2003) indicated that during that month irrigation releases from Caballo Reservoir peaked at approximately 2,200 cfs (29,000 ac-ft for a week) for both 1957 and 1999, two years selected as representative short- and full-water supply conditions, respectively. For an additional release of 5,000 ac-ft during this period, King and Maitland (2003) estimated that a peak flow of 3,500 cfs could be maintained for two days to simulate a spring runoff flow.

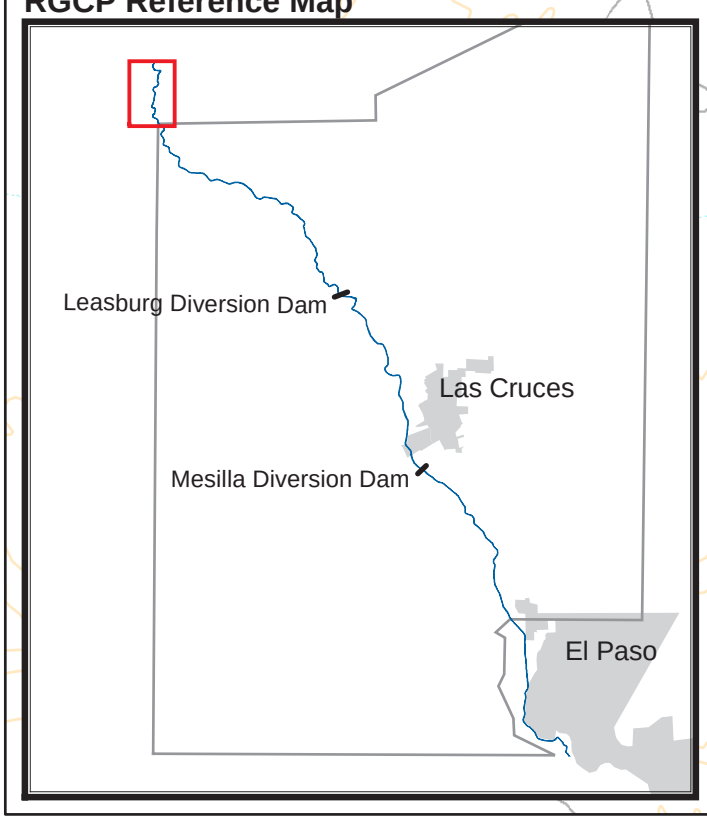
Extending the same rationale, in this DEIS it was assumed that a 3,700 cfs peak discharge above a typical 1,300 cfs irrigation flow could be sustained. The resulting water release above irrigation levels over a 1-day period would be equivalent to 7,336 ac-ft, the value used in the water consumption (Section 4.1.6) and cost calculations (Section 2.11.3). In practice the discharge duration would be limited not by theoretical considerations on the desirable peak duration, but by the water availability and cost. Releases would also be timed to coincide with peak irrigation flows, and likely to be significantly less than 5,000 cfs (given physical limitations of the outlet works). The geographic coverage of overbank flows would also be reduced relative to that calculated in the DEIS (214 acres in the Upper Rincon RMU and 302 acres in the Lower Rincon RMU).

Measures would be required to ensure that river structures are not damaged. In 1995, two months of release in excess of 3,000 cfs, peaking at 4,500 cfs caused scour damage to the siphons under the river in Rincon valley that convey EBID water from one side to the other (King and Maitland 2003).

At some locations, overbank flows would extent past the ROW, particularly in Seldon Canyon. Along this area the USIBWC jurisdiction is limited to the streambed and adjacent banks. This condition is addressed in the EIS by use of conservation easements that would be secured by other agencies or environmental organizations.

End of Canalization Project
STA. 5565+00
STA. 5560+00
STA. 5555+00
STA. 5550+00
STA. 5545+00
STA. 5540+00
mile 105
STA. 5535+00
STA. 5510+00
STA. 5500+00
STA. 5495+00
mile 104
Arrey Bridge
Tipton Arroyo
STA. 5480+00
STA. 5475+00
STA. 5465+00
STA. 5460+00
STA. 5455+00
STA. 5440+00
Trujillo Arroyo
Trujillo Groin
Trujillo Embayment
STA. 5425+00
STA. 5420+00
STA. 5400+00
STA. 5395+00
STA. 5390+00
STA. 5385+00
mile 102
Montoya Arroyo
STA. 5380+00
STA. 5375+00
STA. 5355+00
STA. 5330+14.9
mile 101
STA. 5325+00
STA. 5319+79.9
Holguin Groin
STA. 5310+00
STA. 5305+00
STA. 5300+00
Garfield Siphon
Garfield Bridge
mile 100
STA. 5275+00
Tierra Blanca Arroyo
Green Arroyo
STA. 5270+00
STA. 5260+00
STA. 5255+00
mile 99
STA. 5220+00
STA. 5215+00
STA. 5210+00
STA. 5205+00
STA. 5200+00
STA. 5195+00
Sibley Groin
STA. 5180+00
STA. 5175+00
mile 98
STA. 5170+00
STA. 5140+00
STA. 5135+00
STA. 5130+00
STA. 5125+00
STA. 5120+00
mile 97
STA. 5110+00
STA. 5100+00
Jaralosa Arroyo
Jaralosa Embayment

RGCP Reference Map



N

0 1,000 2,000 4,000 Feet

Irrigation Flow
5000 cfs Discharge
RGCP Right of Way
Cross Sections for Hydraulic Modeling

Figure F-1

Controlled Releases from Caballo Dam

PARSONS

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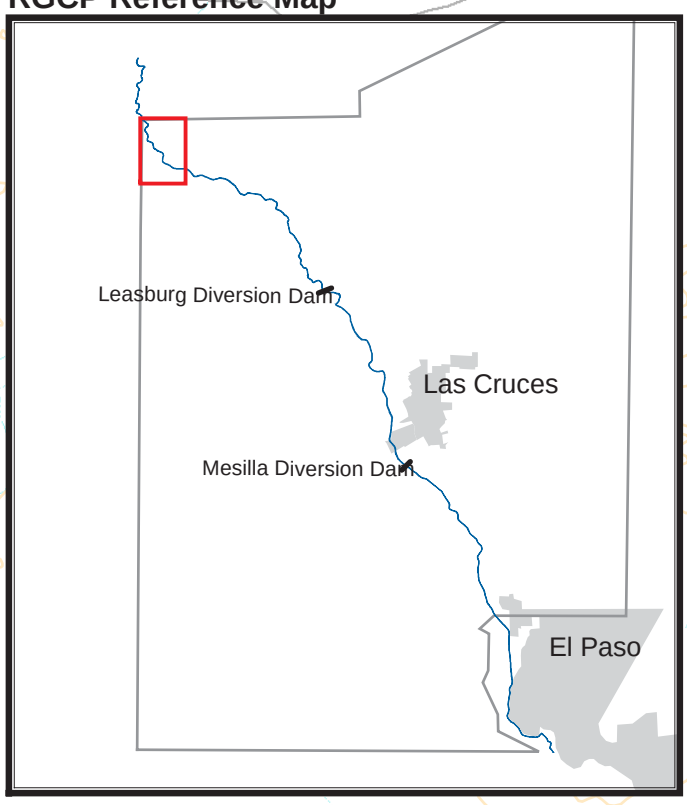
Jaralosa Arroyo
Jaralosa Embayment
Walking Bridge
mile 96
mile 95
Suspension Bridge
Yeso Groin
Yeso Arroyo
Tellas Arroyo
mile 93
mile 92
mile 91
Hatch Siphon
Hatch Canal
Hatch Siphon
mile 90
Hatch Canal
mile 89
Salem Bridg

RGCP Reference Map



N

0 1,000 2,000 4,000 Feet

Irrigation Flow
5000 cfs Discharge
RGCP Right of Way
Cross Sections for Hydraulic Modeling

Figure F-2

Controlled Releases
from Caballo Dam

PARSONS

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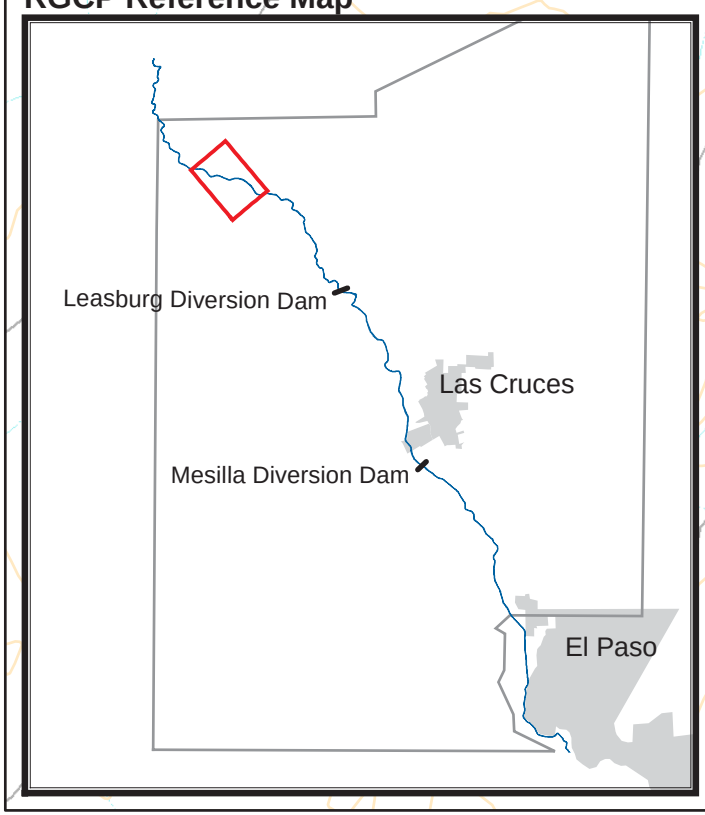
Salem Bridge
mile 88
mile 87
Highway 85
Garfield Drain
Hatch Bridge
IBWC Maint. Yard
Castle Arroyo
mile 86
mile 85
Placitas Arroyo
Placitas Groin
New Hatch Bridge
State Highway 26
mile 84
mile 83
Garcia Arroyo
Garcia Groin
Rincon Siphon
mile 82
Rincon Bridge
mile 81
mile 80

RGCP Reference Map



Irrigation Flow
5000 cfs Discharge
RGCP Right of Way
Cross Sections for Hydraulic Modeling

0 1,000 2,000 4,000 Feet

Figure F-3

Controlled Releases
from Caballo Dam

PARSONS

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Angostura Arroyo

New Rincon Bridge

Rincon Arroyo

Reed Arroyo

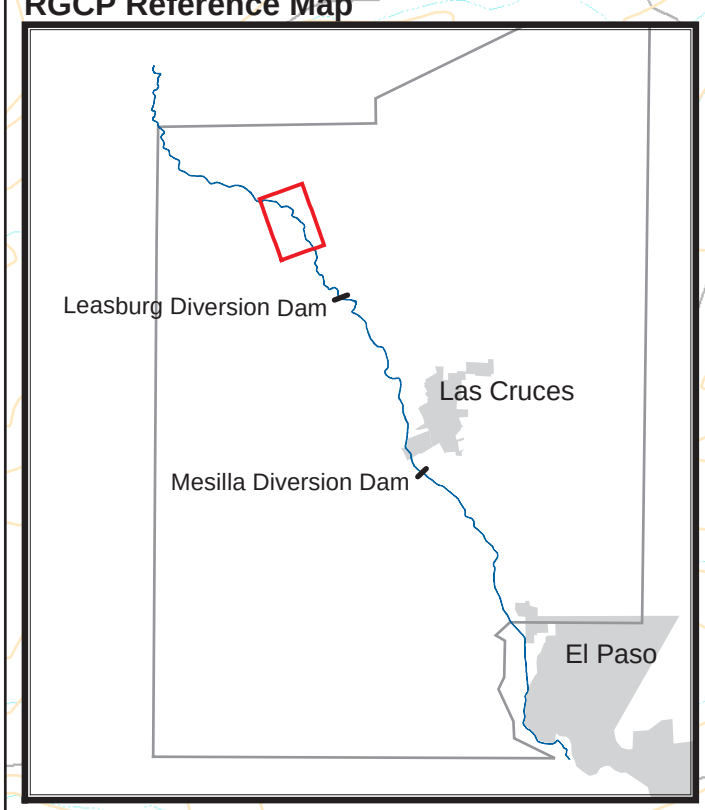
Bignell Arroyo

Hersey Arroyo

(Hayner) Tonuco Bridge

mile 80
mile 79
mile 78
mile 77
mile 76
mile 75
mile 74
mile 73
mile 72

RGCP Reference Map



N

0 1,000 2,000 4,000 Feet

Irrigation Flow

5000 cfs Discharge

RGCP Right of Way

Cross Sections for Hydraulic Modeling

Figure F-4

Controlled Releases
from Caballo Dam

PARSONS

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