IN THE SUPREME COURT OF THE UNITED STATES
BEFORE THE OFFICE OF THE SPECIAL MASTER
HON. MICHAEL J. MELLOY

STATE OF TEXAS	)	
	)	
Plaintiff,	)	
	)	Original Action Case
VS.	)	No. 220141
	)	(Original 141)
STATE OF NEW MEXICO,	)	
and STATE OF COLORADO,	)	
	)	
Defendants.	)	

****
REMOTE ORAL AND VIDEOTAPED DEPOSITION OF
GREGORY K. SULLIVAN
OCTOBER 22, 2020
****

REMOTE ORAL AND VIDEOTAPED DEPOSITION of GREGORY K. SULLIVAN, produced as a witness at the instance of the Plaintiff State of Texas, and duly sworn, was taken in the above-styled and numbered cause on October 22, 2020, from 9:00 a.m. to 9:33 a.m., before Heather L. Garza, CSR, RPR, in and for the State of Texas, recorded by machine shorthand, at the offices of HEATHER L. GARZA, CSR, RPR, The Woodlands, Texas, pursuant to the Federal Rules of Civil Procedure and the provisions stated on the record or attached hereto; that the deposition shall be read and signed.

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VIDEOGRAPHER:

Ms. Kayla Brown

ALSO PRESENT:
Peggy Barroll
Gil Barth
Steve Setzer
Estevan Lopez
Dana Hoag
Chuck Spalding
Nathan Horesh
Ian Ferguson
Jean Moran

EXAMINATION INDEX

WITNESS: GREGORY K. SULLIVAN

EXHIBIT INDEX

THE VIDEOGRAPHER: The time is 9:00 a.m. We're on the record.

GREGORY K. SULLIVAN,

having been first duly sworn, testified as follows:

E X A M I N A T I O N

BY MS. KLAHN:

Q. Good morning, Mr. Sullivan. My name is Sarah Klahn. I represent the State of Texas. We're here today to take your deposition. Before we do that, I'm going to take appearances.

MS. KLAHN: I'm here on behalf of the State of Texas, as is looks like Stuart Somach.

And so State of New Mexico?

MS. THOMPSON: Lisa Thompson for the State of New Mexico. We also have John Draper and Michael Kopp. And then we have a number of the experts observing until their deposition begins. Looks like we have Steve Setzer, Gil Barth, Margaret Barroll, and we will later be joined by Estevan Lopez, Dana Hoag, and then, also, Chuck Spalding.

MS. KLAHN: Great. Okay. So, Kayla, let's go ahead and put up the deposition exhibits for -- for Greg, and I believe we should start with the second edition of the report.

MS. O'BRIEN: Sarah, did you want to

this report.

Q. And the July 15th report involved a version of the model, and when I say "the model," I mean the Integrated Lower Rio Grande Model, the ILRG. If I use that initials, you'll know what I mean?

A. Yes.

Q. So involved in the version of the ILRG, Version 111; is that correct?

A. Yes.

Q. And then the September 15th version of the model, which was the subject of this -- which was -- which was used, I believe, in the context of this report was Version 116, correct?

A. Correct.

Q. So after July 15th, what was the compelling event that caused you to begin to work on revising Version 111 of the ILRG or events if it was more than one event?

A. In -- in reviewing the results, some of the model results that were described in July 15th report and in preparation for my August deposition, I -- I noticed some of the results that were -- didn't comport with what I thought they should look like and so we looked into it further and in doing some more forensics, decided that there -- the way that the

Steve Setzer is probably a better person to ask about those individual versions, but I think as he was testing various forms of -- of the equation, then he would -- he would number the model differently. So there was -- there was not a -- a version in between 111 and 116 that has any real significance.

Q. Was the idea to change the model -- the demand equation that we just talked about in Exhibit 3, did that idea come from you?

A. Yes.

Q. So after the change in the demand equation in Exhibit 3, after that was applied to the model, and then Version 116 was run, did you evaluate the results of the model runs from Version 116?

A. Yes.

Q. Did your opinions change after you saw the results of Version 116?

A. No. Some of the numbers changed, but the overall conclusions did not change.

Q. So does the September 15th report replace the July 15th report entirely?

A. Yes.

Q. So you testified in August during your deposition that the July 15th report replaced the October, 2019, report, but this July 15th report -- or

September 15th report, that's it, right?

MS. THOMPSON: Objection to form.

Q. (BY MS. KLAHN) You can answer.

A. I -- I think the -- the October, 2019, report, as it's been updated, is still a viable piece of -- or summary of opinions that I'll give in this case related to things like historical data and project operations and farm budget model, things like that.

Q. But for --

A. This --

Q. Sorry. I didn't mean to interrupt you. Go ahead.

A. This rebuttal report had -- is -- has replaced the -- the prior reports in the piece related to model runs.

Q. Okay. So in terms of the model, if our experts are looking at the model itself, they should be looking at Version 116 and throw out Version 111; is that right?

A. Yes. That's -- that would be correct.

Q. Do you know who Nathan Horesh is?

A. He's a person on my staff that's helping me on -- on this case.

Q. If the Special Master were asked to exclude

WITNESS CORRECTIONS AND SIGNATURE

Please indicate changes on this sheet of paper, giving the change, page number, line number and reason for the change. Please sign each page of changes.

PAGE/LINE CORRECTION REASON FOR CHANGE

14/4-5 so that led us to look correction

GREGORY K. SULLIVAN

S I G N A T U R E   O F   W I T N E S S

I, GREGORY K. SULLIVAN, solemnly swear or affirm under the pains and penalties of perjury that the foregoing pages contain a true and correct transcript of the testimony given by me at the time and place stated with the corrections, if any, and the reasons therefor noted on the foregoing correction page(s).

GREGORY K. SULLIVAN

Job No. 65732

IN THE SUPREME COURT OF THE UNITED STATES
BEFORE THE OFFICE OF THE SPECIAL MASTER
HON. MICHAEL J. MELLOY

STATE OF TEXAS	)	
	)	
Plaintiff,	)	
	)	Original Action Case
VS.	)	No. 220141
	)	(Original 141)
STATE OF NEW MEXICO,	)	
and STATE OF COLORADO,	)	
	)	
Defendants.	)	

THE STATE OF TEXAS :
COUNTY OF HARRIS :

I, HEATHER L. GARZA, a Certified Shorthand Reporter in and for the State of Texas, do hereby certify that the facts as stated by me in the caption hereto are true; that the above and foregoing answers of the witness, GREGORY K. SULLIVAN, to the interrogatories as indicated were made before me by the said witness after being first remotely duly sworn to testify the truth, and same were reduced to typewriting under my direction; that the above and foregoing deposition as set forth in typewriting is a full, true, and correct transcript of the proceedings had at the time of taking of said deposition.

I further certify that I am not, in any capacity, a regular employee of the party in whose

behalf this deposition is taken, nor in the regular employ of this attorney; and I certify that I am not interested in the cause, nor of kin or counsel to either of the parties.

That the amount of time used by each party at the deposition is as follows:

MS. KLAHN - 00:32:52
MS. THOMPSON - 00:00:00
MR. DUBOIS - 00:00:00
MR. HARTMAN - 00:00:00
MS. O'BRIEN - 00:00:00
MS. BARNCASTLE - 00:00:00

GIVEN UNDER MY HAND AND SEAL OF OFFICE, on this, the 11th day of November, 2020.

____
HEATHER L. GARZA, CSR, RPR, CRR
Certification No.: 8262
Expiration Date: 04-30-22

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No. 141, Original

In the

SUPREME COURT OF THE UNITED STATES

STATE OF TEXAS,

Plaintiff,

v.

STATE OF NEW MEXICO and
STATE OF COLORADO,

Defendants.

OFFICE OF THE SPECIAL MASTER

DECLARATION OF WILLIAM R. HUTCHISON IN SUPPORT OF THE STATE OF TEXAS'S MOTION FOR PARTIAL SUMMARY JUDGMENT; MEMORANDUM OF POINTS AND AUTHORITIES IN SUPPORT THEREOF FEDERAL RULE OF CIVIL PROCEDURE 56

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**Counsel of Record*

October 29, 2020

I, William R. Hutchison, declare as follows:

BACKGROUND AND EXPERIENCE

1. My name is William R. Hutchison, Ph.D., P.E., P.G. I was born on November 4, 1958 in Nueces County, Texas, and I am competent to make this declaration.

2. I am an independent consultant with over 35 years of professional experience as a groundwater hydrologist. I have been retained by the State of Texas to provide consulting services on hydrologic issues presented in the Lawsuit. My professional resume is included as Attachment 1.

3. My street address is 16717 Captain Hook Road, Jamaica Beach, TX 77554. The United States Postal Service does not provide home mail service to my address. My mailing address is 9305 Jamaica Beach, Jamaica Beach, TX 77554.

4. My education includes a Bachelor of Science degree in Soil and Water Science from the University of California, Davis, a Master of Science degree in Hydrology from the University of Arizona, and a Ph.D. in Environmental Science and Engineering from the University of Texas at El Paso.

5. I am licensed in Texas as follows: Professional Engineer (Geological and Civil) No. 96287, Engineering Firm No. 14526, and Professional Geoscientist (Geology) No. 286.

6. From August 1983 to October 2001, I was employed by various consulting firms or worked as an independent consultant in California and Arizona.

7. From October 2001 to June 2009, I was employed by El Paso Water Utilities in El Paso, Texas.

8. From June 2009 to August 2011, I was the Director of the Groundwater Resources Division of the Texas Water Development Board in Austin, Texas.

9. From August 2011 to July 2012, I was employed by LBG-Guyton Associates in Austin, Texas.

10. Since July 2012, I have been an independent consultant based in Austin,

Texas (July 2012 to July 2015), Aberdeen, North Carolina (July 2015 to January 2016), and Jamaica Beach, Texas (January 2016 to present).

11. I have completed (or I am actively working on) over 60 consulting assignments for over 30 different clients in Texas.

12. In the last four years, I have testified as an expert witness in two cases.

13. In August 2016, I was retained by the Middle Pecos Groundwater Conservation District to testify at a mandamus action filed against the District by Republic Water Company of Texas, LLC (Republic). Republic sued the District to have its permit application declared administratively complete despite not including results from a model run, which was required by the rules of the District. My testimony involved details of the required model run. The Court agreed with the District's interpretation of the District's administrative completeness requirements.

14. In March 2019, I was retained as an expert witness for the General Manager of the Lost Pines Groundwater Conservation District in a contested case hearing. The Lower Colorado River Authority submitted eight applications to withdraw 25,000 acre-feet of water per year from eight wells in Bastrop County, Texas. I prepared an expert report and pre-filed written testimony regarding the use of models to evaluate potential impacts of the proposed pumping. As part of the assignment, I reviewed model runs of the applicant's and protesting parties' experts. Specifically, I processed model output to assess surface water-groundwater interaction impacts, provided predicted impacts to over 2,600 registered wells in the District, and processed model output to provide predicted impacts to 39 monitoring wells for use in future monitoring. I was deposed on my expert report and pre-filed written testimony, and I testified at the contested case hearing.

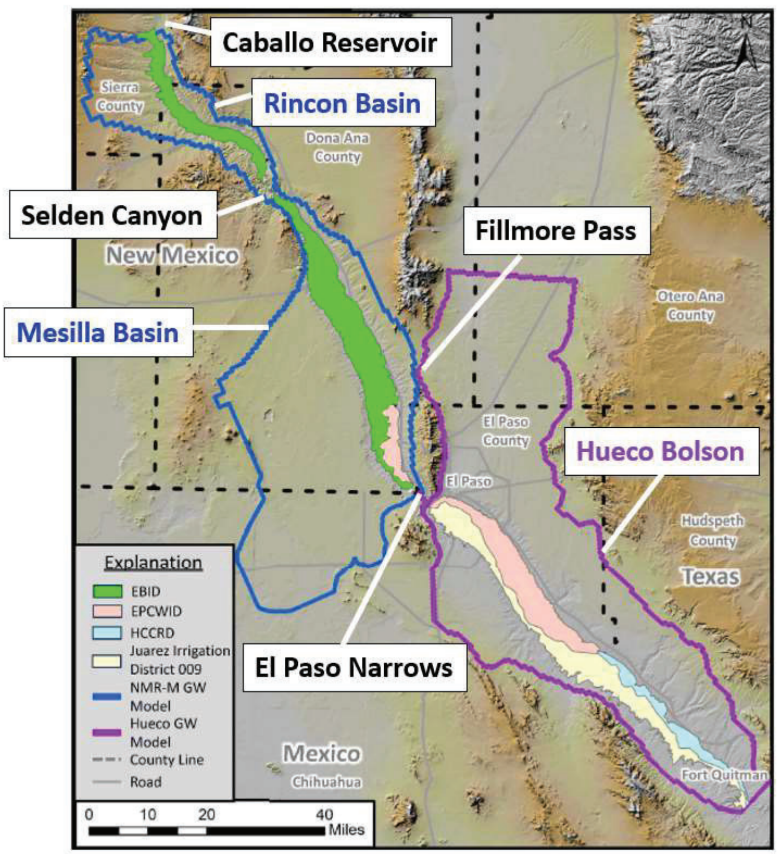
15. A summary of my experience with developing, reviewing, updating, and running simulations with 37 groundwater models in Texas since 2001 is presented in Attachment 2, and 24 models outside of Texas prior to 2001 is presented in Attachment 3.

16. My direct experience in the El Paso, Texas area began in 2001 as an employee of El Paso Water Utilities.

17. In 2006, I completed my doctoral dissertation, titled Groundwater Management in El Paso, Texas, which included details of modeling and management of the Mesilla Basin in New Mexico and Texas.

HYDROGEOLOGIC BACKGROUND

18. The map shown is a modified version of a map in the expert report of Daniel J. Morrissey, one of the New Mexico experts, and is intended to provide some geographic background of the surface water and groundwater resources of the El Paso area. The only modifications to Mr. Morrissey's version of the map is that the labeling in white boxes was added.



19. Water is released from Caballo Reservoir and flows in the Rio Grande through the Rincon Basin.

20. The Rio Grande flows through Selden Canyon from the Rincon Basin to the Mesilla Basin.

21. The Rio Grande flows through the El Paso Narrows from the Mesilla Basin to the El Paso Valley, where the groundwater basin is known as the Hueco Bolson.

22. The Rio Grande at El Paso stream gage is in the El Paso Narrows.

23. The two major diversion points on the Rio Grande just below the El Paso Narrows are the Acequia Madre (for Mexico) and the American Canal (for Texas).

24. The Rincon Basin is entirely in New Mexico (the green area of the map).

25. Most of the Mesilla Basin is in New Mexico (the green area of the map). A small area at the southern end of Mesilla Basin (upstream of the El Paso Narrows) is in Texas (the peach area of the map).

26. Throughout the Rincon and Mesilla Basins in both New Mexico and Texas, there has been varying amounts of groundwater pumping for irrigated agriculture, municipal use, industrial, commercial, domestic, and livestock use.

27. Groundwater flow from the Rincon and Mesilla Basins to the Hueco Bolson is limited to minor flow through Fillmore Pass and the El Paso Narrows due to the geologic structure of the area. This hydrogeologic isolation between the basins means that the Rio Grande at El Paso stream gage is an ideal location to measure and assess impacts of groundwater pumping in the Rincon and Mesilla Basins to Rio Grande flow.

28. Because of the relative geologic isolation and the minimal flow between the Rincon-Mesilla Basin and the Hueco Bolson, groundwater models of the Rincon-Mesilla Basin and the Hueco Bolson can be developed independently.

29. Surface water and groundwater are connected in the Rincon and Mesilla Basins. As water flows in a surface water feature (i.e. a stream, canal, or river), the surface water flow can either increase from the inflow of groundwater or decrease due to seepage losses to the underlying aquifer.

30. When groundwater elevations are higher than surface water elevations, groundwater flows into the surface water body and surface flow increases (a gaining stream condition). Figure 1 conceptually illustrates a gaining stream condition.

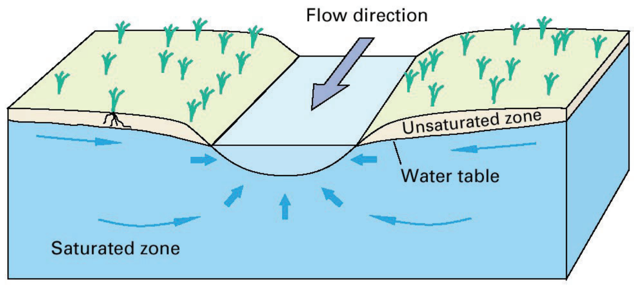


Figure 1. Illustration of a Gaining Stream (from Winter and others, 1988)

31. When groundwater elevations are lower than surface water elevations, surface water flows into the surrounding aquifer and surface flow decreases (a losing stream condition). Figures 2 and 3 conceptually illustrate two types of losing stream conditions.

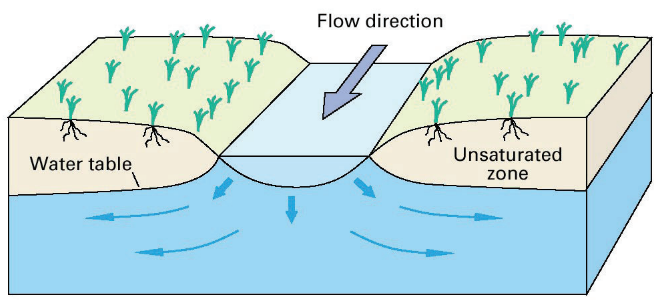


Figure 2. Illustration of a Losing Stream (from Winter and others, 1988)

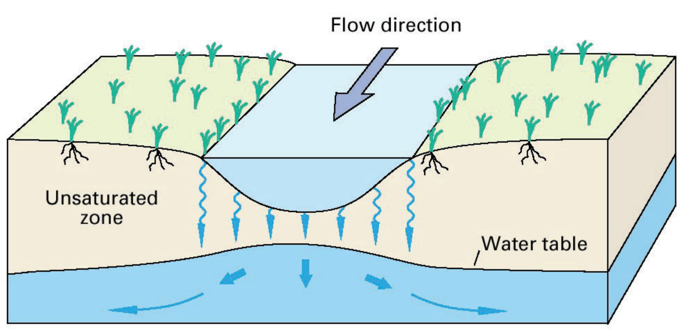


Figure 3. Illustration of a Disconnected Stream (from Winter and others, 1988)

32. Figure 2 illustrates a condition where groundwater elevations are lower than the stream elevation, but still connected to the stream bottom. This is a losing stream condition, and the seepage rate out of the stream is dependent on the difference between the elevation of the water in the stream and the elevation off the groundwater.

33. Figure 3 illustrates a condition where groundwater elevations have dropped lower than the stream bottom elevation. In this case (a disconnected stream), the seepage rate out of the stream has reached its maximum and is based on the depth of the stream only.

34. One of the impacts of groundwater pumping is the reduction of groundwater elevations (also known as drawdown). Long-term groundwater pumping can result in drawdown to the point where a stream that has been historically gaining (i.e. groundwater flows into the stream providing base flow) can be changed to a losing or disconnected stream (i.e. water percolates out of the stream and recharges the underlying aquifer).

SUMMARY OF NEW MEXICO MODEL (INTEGRATED LOWER RIO GRANDE MODEL)

35. New Mexico has disclosed the "Integrated Lower Rio Grande Model" (ILRGM) for use in this case. The ILRGM combines a River Ware model of the surface water network (and includes a simplified representation of the shallow groundwater system) and two detailed groundwater flow models using the MODFLOW-OWHM code: one of the Rincon Basin and the-Mesilla Basin and one of the Hueco Bolson.

36. One of the important outputs from the ILRGM is the flow of the Rio Grande in the El Paso Narrows (Rio Grande at El Paso). As described above, the El Paso Narrows represents the geographic and hydrogeologic boundary between the Mesilla Basin (upstream) and the El Paso Valley (downstream). If groundwater pumping in the Rincon and Mesilla Basins results in stream depletions, it can be measured at the gaging station in the El Paso Narrows. Any model that simulates surface water-groundwater interactions of the Rincon and Mesilla Basins should reproduce historic flows at this measuring point and should be capable of quantitatively assessing depletions at this measuring point.

37. As described in the expert reports of Greg Sullivan and Heidi Welsh, New Mexico completed a calibration run of the model (Run 0) simulating historic conditions from 1940 to 2017, a run simulating historic conditions using Rio Grande Project operations rules developed by New Mexico experts (Run 1), and 26 predictive simulations using the ILRGM.

38. The relevant ILRGM runs for this declaration are:

- Run 3 – NM Pumping Off (all New Mexico pumping off);
- Run 6 – RM Pumping Off (all Rincon-Mesilla pumping off); and
- Run 7 – TX Mesilla Pumping Off (all Texas pumping in the Mesilla Basin off).

39. These "pumping off" runs hypothetically assumed no groundwater pumping from 1940 to 2017 and resulted in higher simulated Rio Grande at El Paso flows as compared to the historic operation simulation (Run 1). Under the pumping off runs, groundwater elevations in the Rincon and Mesilla Basins are generally higher than the groundwater elevations in the Rincon and Mesilla Basins in the Run 1 simulation. The higher groundwater elevations result in more groundwater discharge to the surface water system (canals, drains and the Rio Grande itself), and, thus, results in higher surface water flows.

40. The New Mexico experts interchangeably use the terms "depletion" and "pumping impact" in the text of their reports, the figures associated with the reports, and the Excel spreadsheets that contain the results of the ILRGM simulations. New Mexico experts generally calculated depletion as the difference between the stream flow associated with a "no pumping" run of the ILRGM and the stream flow associated with the historic operation run of the ILRGM (Run 1).

ILRGM RIO GRANDE DEPLETION RESULTS

41. New Mexico experts provided ILRGM results for the relevant runs of the model in the following Excel spreadsheets:

- *Run 1 Summary – Operational – All Pumping On v116.xlsx*;
- *Run 3 Summary – Operational – NM Pumping Off v116.xlsx*;

- *Run 6 Summary – Operational – RM Pumping Off v116.xlsx*; and
- *Run 7 Summary – Operational – TX Mesilla Pumping Off v116.xlsx*.

42. New Mexico completed a specific analysis of Rio Grande at El Paso depletions using data and results from the ILRGM results described above. Attachment 4 is the *DataAnn* sheet of the Excel file named *Ferguson Rebuttal revised 9-15-20 v116.xlsx* that was disclosed by New Mexico.

43. The first line of Attachment 4 distinguishes results from the ILRGM, and calculations completed in the spreadsheet for the depletion analysis. The first eight columns are labeled "ILRG", which means that the data in the columns are directly from ILRGM. The final 11 columns are labeled "Calc", which means that the data in the columns are calculations completed in this spreadsheet based on ILRGM results. Please note that the blue color of the "Calc" columns was from the original Excel file disclosed by New Mexico.

44. The results in the *DataAnn* sheet of the Excel file can be grouped as follows:

- Rio Grande at El Paso Flow;
- Northwest Wastewater Treatment Plant (WWTP) Discharge;
- Sum of Rio Grande at El Paso Flow and Northwest WWTP Discharge;
- Pumping Impact in acre-feet per year; and
- Specific State Pumping Impact as a Percentage of Total Impact.

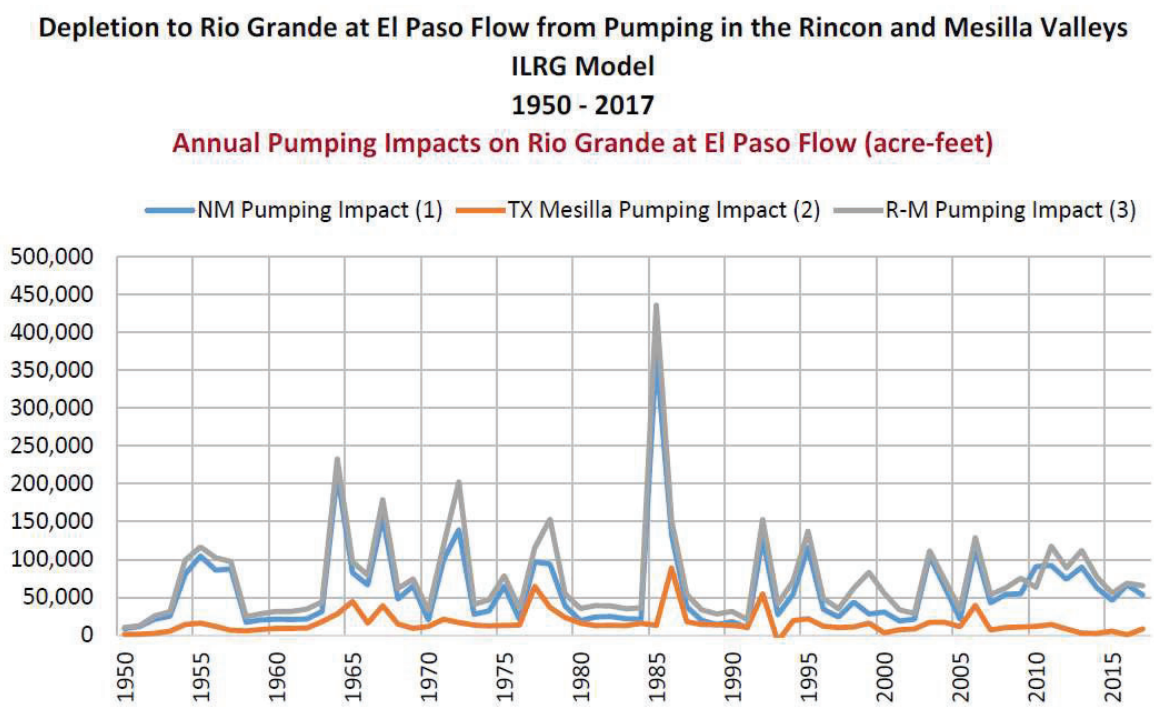
45. WWTP flow is from Texas Mesilla pumping Rio Grande at El Paso flow, Northwest WWTP discharge, and the sum of Rio Grande at El Paso flow and Northwest WWTP discharge are provided for each model run (Run 1, Run 3, Run 6, and Run 7) in the spreadsheet.

46. The Northwest WWTP is a El Paso Water facility that treats municipal wastewater from the west side of El Paso. The source of the water supply on the west side of El Paso (and, thus, the origin of the wastewater) is almost exclusively from groundwater pumping in the Texas portion of the Mesilla Basin (i.e. the Canutillo well field).

47. The Northwest WWTP discharge enters the Rio Grande downstream of the Rio Grande at El Paso stream gage. Thus, the sum of Rio Grande at El Paso and the Northwest WWTP discharge represents the available flow for diversions to the Acequia Madre (Mexico) and the American Canal (Texas) below the El Paso Narrows.

48. The difference in the sum of Rio Grande at El Paso flow and Northwest WWTP between a relevant "no pumping" run and the historic operation simulation (Run 1) is defined as the "pumping impact" in the spreadsheet (in acre-feet per year), and is either termed "depletion" or "pumping impact" in the text and figures of the New Mexico expert reports.

49. The annual depletions were presented in Figure 19-2 (page 147) of the September 15, 2020 version of the report by Greg Sullivan and Heidi Welsh and is reproduced below.



50. The columns on the right side of the *DataAnn* sheet (Attachment 4) are calculations of the pumping impact caused by each state's pumping expressed as a percentage of the total impact. New Mexico experts alternatively defined the total impact as

the impact simulated in Run 6 or as the sum of the impact simulated in the two state runs (Run 3 and Run 7), so there are two calculations of each state's impact.

51. The final line of New Mexico's spreadsheet with ILRGM results related to streamflow depletions (Attachment 4) are the average flows and depletions (calculated for each column in the spreadsheet) for the period 1940 to 2017.

52. Average stream depletions (or groundwater pumping impacts) as calculated at the Rio Grande at El Paso gage for the period 1940 to 2017 based on ILRGM results (as shown in Attachment 4) were reported by experts retained by New Mexico as follows:

- Total Rincon-Mesilla Groundwater Pumping Impact: 66,351 AF/yr
- New Mexico Groundwater Pumping Impact: 52,610 AF/yr
- New Mexico Groundwater Pumping Impact: 79 percent of total impact
- Texas Mesilla Groundwater Pumping Impact: 13,700 AF/yr
- Texas Mesilla Groundwater Pumping Impact: 21 percent of total impact

DISCUSSION OF ILRGM RESULTS AND ILRGM LIMITATIONS

53. The analysis presented in the spreadsheet (Attachment 4) completed by New Mexico experts establishes that groundwater pumping in New Mexico has depleted surface water flow in the Rio Grande.

54. In addition, Daniel J. Morrissey, one of New Mexico's experts acknowledged that the ILRGM shows depletions due to pumping in the Rincon and Mesilla Basins to streamflow measured at El Paso (Morrissey deposition, December 9, 2019, page 75, lines 12 to 18).

55. The ILRGM can be used for analyses that focus on large geographic areas and over a period of few to several years.

56. Limitations of the ILRGM affect the reliability of results focused on a single year or time periods less than one year, and results that focus on a small geographic area. The geographic and temporal scale limitation of ILRGM results is primarily because the

RiverWare model "governs" the results (Daniel J. Morrissey deposition of December 10, 2019, page 65, lines 13 to 23).

57. All models are simplifications of real-world systems. The New Mexico RiverWare model calculates surface water-groundwater interaction within "groundwater objects" that are several square miles in area. In contrast, the New Mexico groundwater models of the Rincon-Mesilla Basins and the Hueco Bolson calculates surface water-groundwater interactions in cells that are 10 acres in area. The groundwater objects in the RiverWare model are analogous to the groundwater model cells when comparing the surface water-groundwater interaction calculations. Daniel J. Morrissey acknowledged that the calculations in the RiverWare model are more "generalized" than in the groundwater models (Daniel J. Morrissey deposition of December 10, 2019, page 65, lines 6 to 12).

58. In summary, the ILRGM calculations rely on surface water-groundwater interaction calculations that are averaged over an area of several square miles and ignore groundwater model calculations that are averaged over an area of 10 acres in the groundwater models.

59. The surface water-groundwater interaction issue is one of the most important aspects of this litigation. Stream depletion is a reduction in streamflow that is caused by groundwater pumping. Calculations of stream depletion with the groundwater models are averaged over areas of about 10 acres, but calculations with the RiverWare model represent averages over areas that are several square miles. The choice by New Mexico experts to rely on the RiverWare model results instead of the groundwater model results is inconsistent with their claims of the sophistication and necessary complexity of the ILRGM (e.g. Daniel J. Morrissey deposition of December 9, 2019, page 44, line 22 to page 45, line 4).

60. Reliance on the ILRGM and its simplified representation of the surface water-groundwater interactions in the RiverWare model is appropriate for evaluating impacts of pumping over a large scale (i.e. impacts of pumping in New Mexico and impacts of pumping in Texas) and over a few to many years.

61. However, the limitations prevent reliable use of ILRGM results for analyses over smaller scales (several square miles) and for short time scales (months to a single year).

CONJUNCTIVE MANAGEMENT

62. Estevan Lopez, one of New Mexico's expert witnesses, defined conjunctive use during his July 6, 2020 deposition on page 68, lines 3 to 6 as: "using the available surface water as the primary irrigation supply and making up the difference up to the crop irrigation requirements with supplemental groundwater."

63. A proper conjunctive management approach increases total supply because the surface water component and the groundwater component are different sources.

64. If the groundwater supply is connected to the surface water supply (i.e. they are interconnected), the groundwater pumping depletes the surface water supply to some extent. The surface water depletion component of the groundwater pumping is not a "new supply" or "separate supply."

65. New Mexico's practice of conjunctive use is to use surface water ***and*** to pump interconnected groundwater limited only by crop needs or permit limits (Estevan Lopez 30(b)(6) deposition, September 18, 2020 page 36, lines 17 to 22).

66. New Mexico's "conjunctive use" as defined by Mr. Lopez ensures that New Mexico water users receive all the water they need while decreasing some water that would have otherwise flowed into Texas.

I declare under penalty of perjury that the foregoing is true and correct. Executed this 29th day of October 2020 at Aberdeen, North Carolina

William R Hutchison

William R. Hutchison, Ph.D., P.E., P.G

ATTACHMENT 4

Attachment 4

DataAnn sheet of Excel file named ***Ferguson Rebuttal_revised 9-15-20v116.xlsx***

Source	ILRG	ILRG	ILRG	ILRG	ILRG	ILRG	ILRG	ILRG	Calc.	Calc.	Calc.	Calc.	Calc.	Calc.	Calc.	Calc.	Calc.	Calc.	Calc.
				ILRG MODEL RESULTS										**ILRG MODEL RESULTS**					
Note	Run 1	Run 3	Run 7	Run 6	Run 1	Run 3	Run 7	Run 6	Run 1	Run 3	Run 7	Run 6	Run 3	Run 7	Run 6				
Year	El Paso Flow (Base Run 1)	El Paso Flow (NM Pump Off Run 3)	El Paso Flow (TX Mesilla Pump Off Run 7)	El Paso Flow (R-M Pump Off Run 6)	Northwest WWTP Discharge (Base Run 1)	Northwest WWTP Discharge (NM Pump Off Run 3)	Northwest WWTP Discharge (TX Mesilla Pump Off Run 7)	Northwest WWTP Discharge (R-M Pump Off Run 6)	El Paso Flow + NW (Base Run 1)	El Paso Flow + NW (NM Pump Off Run 3)	El Paso Flow + NW (TX Mesilla Pump Off Run 7)	El Paso Flow + NW (R-M Pump Off Run 6)	NM Pumping Impact (1)	TX Mesilla Pumping Impact (2)	R-M Pumping Impact (3)	NM Pumping Impact (1) / R-M Pumping Impact (3)	TX Mesilla Pumping Impact (2) / R-M Pumping Impact (3)	NM Pumping Impact (1) / Total NM (1) plus TX (2) Pumping Impact	TX Mesilla Pumping Impact (2) / Total NM (1) plus TX (2) Pumping Impact
1938																			
1939																			
1940	552,764	552,736	552,741	552,736	0	0	0	0	552,764	552,736	552,741	552,736	-29	-23	-28	101%	83%	55%	45%
1941	458,189	458,465	458,274	458,480	0	0	0	0	458,189	458,465	458,274	458,480	276	86	291	95%	29%	76%	24%
1942	1,504,863	1,505,016	1,504,880	1,505,027	0	0	0	0	1,504,863	1,505,016	1,504,880	1,505,027	153	18	164	93%	11%	90%	10%
1943	576,168	576,288	576,158	576,287	0	0	0	0	576,168	576,288	576,158	576,287	120	-10	119	101%	-8%	109%	-9%
1944	483,966	483,892	483,811	483,894	0	0	0	0	483,966	483,892	483,811	483,894	-73	-154	-71	103%	217%	32%	68%
1945	545,391	545,480	545,390	545,501	0	0	0	0	545,391	545,480	545,390	545,501	89	-1	110	81%	-1%	101%	-1%
1946	525,340	525,509	525,407	525,552	0	0	0	0	525,340	525,509	525,407	525,552	169	67	212	80%	32%	72%	28%
1947	496,315	496,458	496,350	496,495	0	0	0	0	496,315	496,458	496,350	496,495	143	36	180	79%	20%	80%	20%
1948	497,678	497,695	497,723	497,745	0	0	0	0	497,678	497,695	497,723	497,745	17	45	68	25%	67%	27%	73%
1949	489,207	489,100	489,233	489,141	0	0	0	0	489,207	489,100	489,233	489,141	-107	26	-66	162%	-40%	132%	-32%
1950	388,095	396,991	389,565	398,474	0	0	0	0	388,095	396,991	389,565	398,474	8,896	1,471	10,379	86%	14%	86%	14%
1951	346,936	358,701	348,284	359,954	0	0	0	0	346,936	358,701	348,284	359,954	11,765	1,348	13,018	90%	10%	90%	10%
1952	314,660	335,827	317,304	340,210	0	0	0	0	314,660	335,827	317,304	340,210	21,167	2,644	25,550	83%	10%	89%	11%
1953	361,452	386,715	366,987	392,726	0	0	0	0	361,452	386,715	366,987	392,726	25,263	5,535	31,274	81%	18%	82%	18%
1954	143,986	224,944	158,128	243,156	0	0	0	0	143,986	224,944	158,128	243,156	80,958	14,142	99,170	82%	14%	85%	15%
1955	83,646	188,363	99,836	200,418	0	0	0	0	83,646	188,363	99,836	200,418	104,717	16,190	116,772	90%	14%	87%	13%
1956	91,244	177,134	103,026	193,876	0	0	0	0	91,244	177,134	103,026	193,876	85,890	11,783	102,633	84%	11%	88%	12%
1957	136,149	224,042	142,952	233,534	0	0	0	0	136,149	224,042	142,952	233,534	87,893	6,803	97,385	90%	7%	93%	7%
1958	335,540	352,935	341,522	359,978	0	0	0	0	335,540	352,935	341,522	359,978	17,395	5,983	24,438	71%	24%	74%	26%
1959	350,524	371,102	358,377	379,188	0	0	0	0	350,524	371,102	358,377	379,188	20,578	7,853	28,664	72%	27%	72%	28%
1960	337,479	358,694	346,849	368,883	0	0	0	0	337,479	358,694	346,849	368,883	21,215	9,370	31,404	68%	30%	69%	31%
1961	314,751	335,711	323,880	346,333	0	0	0	0	314,751	335,711	323,880	346,333	20,960	9,129	31,581	66%	29%	70%	30%
1962	320,866	342,663	330,534	355,578	0	0	0	0	320,866	342,663	330,534	355,578	21,798	9,668	34,712	63%	28%	69%	31%
1963	298,952	330,476	316,856	342,948	0	0	0	0	298,952	330,476	316,856	342,948	31,524	17,904	43,996	72%	41%	64%	36%
1964	110,864	324,072	139,102	343,729	0	0	0	0	110,864	324,072	139,102	343,729	213,207	28,238	232,865	92%	12%	88%	12%
1965	227,718	310,568	272,367	324,660	0	0	0	0	227,718	310,568	272,367	324,660	82,850	44,649	96,942	85%	46%	65%	35%
1966	268,926	335,576	285,188	348,512	0	0	0	0	268,926	335,576	285,188	348,512	66,650	16,262	79,587	84%	20%	80%	20%
1967	181,407	337,919	220,530	360,166	0	0	0	0	181,407	337,919	220,530	360,166	156,512	39,123	178,759	88%	22%	80%	20%
1968	256,788	304,573	271,996	318,787	0	0	0	0	256,788	304,573	271,996	318,787	47,784	15,208	61,998	77%	25%	76%	24%
1969	305,283	370,573	314,412	379,714	0	0	0	0	305,283	370,573	314,412	379,714	65,290	9,129	74,431	88%	12%	88%	12%
1970	334,900	354,894	346,776	367,688	0	0	0	0	334,900	354,894	346,776	367,688	19,994	11,876	32,788	61%	36%	63%	37%
1971	247,193	346,919	268,319	366,280	0	0	0	0	247,193	346,919	268,319	366,280	99,727	21,127	119,087	84%	18%	83%	17%
1972	131,542	270,976	148,230	333,742	0	0	0	0	131,542	270,976	148,230	333,742	139,434	16,688	202,200	69%	8%	89%	11%
1973	278,794	306,691	292,285	319,987	0	0	0	0	278,794	306,691	292,285	319,987	27,897	13,492	41,194	68%	33%	67%	33%
1974	321,260	353,391	333,882	368,076	0	0	0	0	321,260	353,391	333,882	368,076	32,131	12,622	46,816	69%	27%	72%	28%
1975	278,465	343,232	291,794	357,246	0	0	0	0	278,465	343,232	291,794	357,246	64,767	13,328	78,780	82%	17%	83%	17%
1976	287,245	308,193	300,648	322,730	0	0	0	0	287,245	308,193	300,648	322,730	20,948	13,404	35,485	59%	38%	61%	39%
1977	210,882	307,934	275,836	326,288	0	0	0	0	210,882	307,934	275,836	326,288	97,052	64,954	115,406	84%	56%	60%	40%
1978	167,704	261,679	204,697	320,876	0	0	0	0	167,704	261,679	204,697	320,876	93,976	36,993	153,173	61%	24%	72%	28%

Attachment 4

DataAnn sheet of Excel file named ***Ferguson Rebuttal_revised 9-15-20v116.xlsx***

Source	ILRG	ILRG	ILRG	ILRG	ILRG	ILRG	ILRG	ILRG	Calc.	Calc.	Calc.	Calc.	Calc.	Calc.	Calc.	Calc.	Calc.	Calc.	Calc.
				ILRG MODEL RESULTS										**ILRG MODEL RESULTS**					
Note	Run 1	Run 3	Run 7	Run 6	Run 1	Run 3	Run 7	Run 6	Run 1	Run 3	Run 7	Run 6	Run 3	Run 7	Run 6				
Year	El Paso Flow (Base Run 1)	El Paso Flow (NM Pump Off Run 3)	El Paso Flow (TX Mesilla Pump Off Run 7)	El Paso Flow (R-M Pump Off Run 6)	Northwest WWTP Discharge (Base Run 1)	Northwest WWTP Discharge (NM Pump Off Run 3)	Northwest WWTP Discharge (TX Mesilla Pump Off Run 7)	Northwest WWTP Discharge (R-M Pump Off Run 6)	El Paso Flow + NW (Base Run 1)	El Paso Flow + NW (NM Pump Off Run 3)	El Paso Flow + NW (TX Mesilla Pump Off Run 7)	El Paso Flow + NW (R-M Pump Off Run 6)	NM Pumping Impact (1)	TX Mesilla Pumping Impact (2)	R-M Pumping Impact (3)	NM Pumping Impact (1) / R-M Pumping Impact (3)	TX Mesilla Pumping Impact (2) / R-M Pumping Impact (3)	NM Pumping Impact (1) / Total NM (1) plus TX (2) Pumping Impact	TX Mesilla Pumping Impact (2) / Total NM (1) plus TX (2) Pumping Impact
1979	279,978	318,719	303,521	334,625	0	0	0	0	279,978	318,719	303,521	334,625	38,741	23,544	54,647	71%	43%	62%	38%
1980	332,070	351,451	348,156	367,674	0	0	0	0	332,070	351,451	348,156	367,674	19,381	16,087	35,604	54%	45%	55%	45%
1981	324,245	348,302	337,129	363,596	0	0	0	0	324,245	348,302	337,129	363,596	24,057	12,883	39,350	61%	33%	65%	35%
1982	329,923	354,723	342,975	368,912	0	0	0	0	329,923	354,723	342,975	368,912	24,800	13,052	38,989	64%	33%	66%	34%
1983	306,563	328,447	319,242	341,751	0	0	0	0	306,563	328,447	319,242	341,751	21,884	12,679	35,188	62%	36%	63%	37%
1984	321,246	342,567	337,040	357,589	0	0	0	0	321,246	342,567	337,040	357,589	21,321	15,793	36,343	59%	43%	57%	43%
1985	345,847	717,772	359,179	781,597	0	0	0	0	345,847	717,772	359,179	781,597	371,925	13,332	435,750	85%	3%	97%	3%
1986	1,153,486	1,286,599	1,242,712	1,305,478	0	0	0	0	1,153,486	1,286,599	1,242,712	1,305,478	133,112	89,226	151,992	88%	59%	60%	40%
1987	1,067,954	1,105,757	1,087,980	1,123,877	2,089	2,089	0	0	1,070,042	1,107,845	1,087,980	1,123,877	37,803	17,938	53,835	70%	33%	68%	32%
1988	611,555	631,389	627,790	647,168	2,095	2,095	0	0	613,649	633,483	627,790	647,168	19,834	14,141	33,519	59%	42%	58%	42%
1989	416,354	430,542	432,313	446,723	2,089	2,089	0	0	418,442	432,631	432,313	446,723	14,188	13,870	28,281	50%	49%	51%	49%
1990	295,480	313,611	310,748	328,935	2,089	2,089	0	0	297,568	315,699	310,748	328,935	18,131	13,179	31,367	58%	42%	58%	42%
1991	335,563	345,465	348,312	358,632	2,089	2,089	0	0	337,651	347,553	348,312	358,632	9,902	10,661	20,981	47%	51%	48%	52%
1992	431,819	560,100	488,743	586,431	2,095	2,095	0	0	433,913	562,195	488,743	586,431	128,281	54,829	152,518	84%	36%	70%	30%
1993	613,864	640,841	607,988	657,541	2,089	2,089	0	0	615,953	642,930	607,988	657,541	26,977	-7,965	41,588	65%	-19%	142%	-42%
1994	638,104	692,589	659,473	711,907	2,089	2,089	0	0	640,192	694,678	659,473	711,907	54,486	19,281	71,715	76%	27%	74%	26%
1995	727,783	843,906	757,229	872,395	7,310	7,310	0	0	735,093	851,216	757,229	872,395	116,123	22,136	137,302	85%	16%	84%	16%
1996	525,962	560,367	545,239	581,878	7,331	7,331	0	0	533,293	567,699	545,239	581,878	34,405	11,946	48,584	71%	25%	74%	26%
1997	328,104	352,350	345,813	370,706	7,310	7,310	0	0	335,414	359,660	345,813	370,706	24,246	10,399	35,292	69%	29%	70%	30%
1998	468,057	512,105	486,208	537,413	7,310	7,310	0	0	475,367	519,415	486,208	537,413	44,048	10,841	62,046	71%	17%	80%	20%
1999	461,965	490,047	485,489	552,243	7,310	7,310	0	0	469,275	497,357	485,489	552,243	28,082	16,214	82,967	34%	20%	63%	37%
2000	440,141	471,087	453,149	505,300	9,661	9,662	0	0	449,803	480,748	453,149	505,300	30,945	3,347	55,497	56%	6%	90%	10%
2001	395,519	414,530	411,564	437,673	8,592	8,592	0	0	404,111	423,122	411,564	437,673	19,011	7,453	33,562	57%	22%	72%	28%
2002	414,288	435,598	430,372	450,933	7,652	7,652	0	0	421,940	443,250	430,372	450,933	21,310	8,432	28,993	74%	29%	72%	28%
2003	280,965	385,759	305,077	399,276	6,795	6,795	0	0	287,760	392,554	305,077	399,276	104,794	17,317	111,516	94%	16%	86%	14%
2004	231,937	295,368	255,088	310,395	5,785	5,785	0	0	237,722	301,153	255,088	310,395	63,431	17,366	72,673	87%	24%	79%	21%
2005	347,785	368,891	364,675	387,692	5,686	5,686	0	0	353,471	374,577	364,675	387,692	21,106	11,205	34,222	62%	33%	65%	35%
2006	259,801	374,734	305,316	394,482	6,047	6,047	0	0	265,847	380,780	305,316	394,482	114,933	39,469	128,635	89%	31%	74%	26%
2007	315,441	358,167	328,547	375,606	6,197	6,197	0	0	321,638	364,364	328,547	375,606	42,726	6,909	53,968	79%	13%	86%	14%
2008	327,937	381,999	343,897	396,282	5,821	5,821	0	0	333,758	387,820	343,897	396,282	54,062	10,139	62,524	86%	16%	84%	16%
2009	388,423	443,302	405,049	469,472	5,538	5,538	0	0	393,961	448,840	405,049	469,472	54,879	11,088	75,511	73%	15%	83%	17%
2010	322,459	413,240	340,368	391,975	6,312	6,312	0	0	328,771	419,552	340,368	391,975	90,781	11,597	63,204	144%	18%	89%	11%
2011	232,153	324,284	255,478	358,955	9,061	9,061	0	0	241,214	333,345	255,478	358,955	92,132	14,265	117,741	78%	12%	87%	13%
2012	157,505	231,504	172,608	253,189	6,712	6,712	0	0	164,217	238,216	172,608	253,189	73,998	8,391	88,972	83%	9%	90%	10%
2013	70,457	160,508	80,895	189,940	7,351	7,351	0	0	77,808	167,859	80,895	189,940	90,050	3,087	112,131	80%	3%	97%	3%
2014	130,887	193,412	141,681	215,851	8,053	8,053	0	0	138,940	201,465	141,681	215,851	62,525	2,741	76,911	81%	4%	96%	4%
2015	226,971	272,930	238,705	289,000	6,320	6,320	0	0	233,291	279,250	238,705	289,000	45,959	5,413	55,708	82%	10%	89%	11%
2016	282,459	349,150	289,591	357,400	6,310	6,310	0	0	288,769	355,460	289,591	357,400	66,691	822	68,631	97%	1%	99%	1%
2017	322,514	376,045	338,504	395,616	7,475	7,475	0	0	329,989	383,520	338,504	395,616	53,531	8,515	65,627	82%	13%	86%	14%
1940-2017 Avg	372,137	424,747	388,128	440,778	2,291	2,291	0	0	374,428	427,038	388,128	440,778	52,610	13,700	66,351	79%	21%	79%	21%

IN THE SUPREME COURT OF THE UNITED STATES
BEFORE THE OFFICE OF THE SPECIAL MASTER
HON. MICHAEL J. MELLOY

STATE OF TEXAS Plaintiff, VS. STATE OF NEW MEXICO, and STATE OF COLORADO, Defendants.	Original Action Case No. 220141 (Original 141)

****

REMOTE ORAL AND VIDEOTAPED DEPOSITION OF
WILLIAM R. HUTCHISON
MAY 28, 2020

****

REMOTE ORAL AND VIDEOTAPED DEPOSITION of WILLIAM R. HUTCHISON, produced as a witness at the instance of the Defendant State of New Mexico, and duly sworn, was taken in the above-styled and numbered cause on May 28, 2020, from 9:05 a.m. to 4:35 p.m., before Heather L. Garza, CSR, RPR, in and for the State of Texas, recorded by machine shorthand, at the offices of HEATHER L. GARZA, CSR, RPR, The Woodlands, Texas, pursuant to the Federal Rules of Civil Procedure and the provisions stated on the record or attached hereto; that the deposition shall be read and signed.

DEITCHMAN DECL. EXH 3

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Mr. Ian Ferguson
Mr. Ken Knox
Ms. Melissa Quintero
Ms. Susan Barela

EXAMINATION INDEX

WITNESS: WILLIAM R. HUTCHISON

EXHIBIT INDEX

THE VIDEOGRAPHER: Today is May 28th, 2020. The time is approximately 9:05 a.m. We are now on the record.

WILLIAM R. HUTCHISON,

having been first duly sworn, testified as follows:

E X A M I N A T I O N

BY MS. THOMPSON:

Q. Good morning, Dr. Hutchison. As a reminder, my name is Lisa Thompson. I'm with the law firm Trout Raley. I'm an attorney representing the State of New Mexico in this case, Texas v. New Mexico, and we are, of course, here taking your deposition remotely today.

MS. THOMPSON: I'm going to ask that each of the parties' attorneys go ahead and state their appearances and state who is observing the deposition today for them. I'll start for the State of New Mexico. Of course, Lisa Thompson, and then I believe observing today is Chuck Spalding and Greg Sullivan and then I believe we also have Jeff Wechsler and John Draper. And then if there's anyone else with the State of New Mexico, if you could go ahead and state your appearance.

All right then. For Texas?

MR. GOLDSBERRY: Francis Goldsberry for the State of Texas. We have one of our law clerks

Q. And in the question presented to you from the Texas counsel, you state that the Heywood and Yager model -- excuse me -- whether or not -- whether or not the Heywood and Yager model would be a better model to address the issues associated with this lawsuit, correct?

A. That was the question that was posed, yes.

Q. Okay. And so describe for me what your understanding is of the issues associated with the lawsuit.

A. Well, the issues raised in the lawsuit have to do with groundwater pumping having an effect on surface flows and so the issue has been evaluated in terms of the Rincon and Mesilla basin by my model, by the New Mexico model, models before that, that demonstrate a quantified relationship. To the extent that issues have been raised about groundwater/surface water interactions being -- affecting surface flows of the Hueco Bolson, the Heywood and Yager model demonstrates that.

Q. Is it your understanding that that's the extent of the issues raised by New Mexico in this case is just the extent of the groundwater/surface water interactions that affect the surface flows in the Texas portion of the Compact?

A. No. I think it goes beyond that, but in terms of the Hueco Bolson groundwater model, some of the other issues that New Mexico has raised cannot be addressed by either the Heywood and Yager model by itself or the Spalding and Morrissey model by itself.

Q. And when you say, "I think it goes beyond this," can you clarify what you mean by "goes beyond that"? What other issues are there?

A. Well, New Mexico has raised an issue that activities, groundwater pumping and -- yeah, groundwater pumping in the Hueco Bolson has resulted in some sort of essentially the effects of that propagate upward all the way to Caballo outflow and so as a result of that -- that position, the integrated model has been developed, and the New Mexico expert reports all have a common theme that this integrated model that's very important because you have to look at the -- the system all the way down to Fort Quitman in order to evaluate Compact issues. So, again, a MODFLOW model, either Heywood and Yager or Spalding and Morrissey, in and of themselves cannot answer that question. That was the whole point of New Mexico developing the integrated model.

Q. So if those are some of the issues raised by New Mexico, is it your opinion then that the Heywood

and Yager model could be linked as in its current condition to the RiverWare surface water model?

A. Yes. Could be is defined as could technically be, yes.

Q. Could it be to answer those questions that you just described?

A. I don't think it's necessary. I think the questions in terms of groundwater/surface water interactions are well defined with the MODFLOW model itself. The operations issues, I don't think are necessary because New Mexico's own modeling shows that that's not necessary.

Q. But my understanding of the question asked of you is whether or not, you know, the Heywood and Yager model could be used to address the issues raised by New Mexico in this case and so the -- the question is whether or not the Heywood and Yager model, in its current condition, could just be linked to a RiverWare model and be a tool to answer those questions?

A. Well, it depends on the question. The issues that I specifically place in my rebuttal report, those can be answered by the Heywood and Yager model. I was not asked in this rebuttal report any questions related to the operations issues and the need to link and integrate. That -- your question had to do with

Q. And that -- that process, though, to come up with a estimate of groundwater pumping, do you know whether or not McDonald Morrissey did a, you know, similar approach as what Texas did to come up with those estimates?

A. That's one of the key questions. Did McDonald Morrissey do I had or did Spronk do it and how did the Spronk information -- how was it used by McDonald Morrissey in putting this model together? That's what's unclear. And the underlying basis for it was the same approach that Spronk used in the Rincon and Mesilla also applied to the EP1 area down in the -- in the lower valley, and is that same approach appropriate given the differences in groundwater quality. These are -- in my mind, these are unanswered questions. And, again, like I said, overall on that is, is the impacts of the agricultural area versus the urban area, the work that had been done previously suggested that they're kind of separate systems in -- in the Hueco Bolson.

Q. When you say "separate systems," I'm not clear on what that means. Are you saying the ag pumping is a different aquifer than the municipal pumping or are you referring to something different?

A. Yeah. And this is something we discussed at my previous deposition. Typically the ag pumping, to the extent it exists in the Hueco Bolson, is shallow. The urban pumping is deep. They're separated by a pretty good distance, several miles, and if you recall, you -- one of my exhibits from my previous deposition was that journal paper that I wrote for Barry Hibbs, and that was one -- one of the sections of that dealt with urban versus -- excuse me -- urban versus rural areas in terms of historic impacts. We found that what was going on in the rural area wasn't having near the magnitude of effect on the surface water/groundwater interactions than the urban area.

Q. Would you agree, though, that the Heywood and Yager model doesn't take into account impacts of agricultural groundwater pumping?

A. Well, I'm not sure, because I don't know how much agricultural groundwater pumping there has been, and that's one of the things that we need to get a better understanding from the work that Spronk and McDonald Morrissey did was, was the numbers that they are producing reasonable or was it based on the same approach that was done in the Rincon and Mesilla and given the differences in water quality, is that an appropriate assumption? These are the questions that we -- we need to discuss with them.

because that also plays into how useful it might be in meeting various objectives.

Q. So part of the McDonald Morrissey model objective was to look at, you know, impacts to project operations and included that level of detail within the project area. Do you agree that the Heywood and Yager model, of course, couldn't answer those same questions related to project operations?

A. Well, I think I would disagree with the first part of your question. I don't think the McDonald Morrissey model can look at impacts to project operations in and of itself. That requires the linkage with -- with RiverWare model. If I under -- if I understand what they did correctly, that's something that we're still trying to fully understand.

Q. Other details like wastewater treatment flow returns are not included in the Heywood and Yager model, but are included in McDonald Morrissey model. Do you agree?

A. I'm not sure. It's been a while since I looked at the -- that level of detail of -- of the Heywood/Yager model.

Q. What about, you know, waste channels within the project area, do you recall whether or not the Heywood and Yager model included that level of detail?

Morrissey report how many of the surface water allocations they calibrated to?

A. I remember these figures, but I don't remember linking back to what -- what they actually quote unquote calibrated to.

Q. Okay.

A. I remember they reported these.

Q. If, in fact, they calibrated to all of these points on Figures 8.2 and 8.3, versus the Heywood and Yager, which if you look at 8.3, there's a label kind of on the right side in green called, "Island drain." Do you see that?

A. In 8.2?

Q. 8.3.

A. 8.3. I see, "Island drain."

Q. Okay. So if, in fact, the McDonald Morrissey model calibrated to all of these points shown on 8.2 and 8.3 versus the Heywood and Yager, which only calibrated to the island drain surface water feature, would you agree that the calibration for the McDonald Morrissey would be more accurate as far as surface water impacts?

MR. GOLDSBERRY: Objection; incomplete hypothetical.

A. Well, I'm not sure, because is it truly --

what I don't understand in the big picture of this is how much of this is MODFLOW and how much of it is RiverWare. In other words, there's this back and forth between the two models, and one of the -- one of the issues or one of the unanswered questions from the documentation is if the RiverWare is doing all the work and just providing the information to MODFLOW, is MODFLOW really calibrated or is it just getting that information from somewhere else? I don't know the answer to that yet.

Q. (BY MS. THOMPSON) Okay. Say just hypothetically then if, in fact, MODFLOW -- just the MODFLOW model itself, putting aside RiverWare completely, calibrated to all of these points versus the Heywood and Yager that calibrated to just one of them, would the McDonald Morrissey MODFLOW model be, you know, a superior model to look at impacts of surface water features?

MR. GOLDSBERRY: Objection; incomplete hypothetical.

A. Again, all by itself, calibration is not the issue. The other issue is underlying data that you're calibrating to. The other issue is convergence. I mean, you've provided a hypothetical. I can provide a hypothetical that you've got a model that does not converge and has very poor quality data to which to calibrate, then what you've got is an over fit -- a model that's over fit to data that are not really accurate or appropriate. So in -- it depends on how you phrase your hypothetical. If the underlying data are gold standard perfect data, then yeah; but I don't think you can necessarily assume that given what we know about data in that area. There's -- there's questions, which then would lead to if a -- if the underlying data have problems/issues/uncertainties, then calibrating to those data actually makes -- can make things worse. And these are -- these are questions that we don't -- we don't know yet, don't understand in full yet.

Q. (BY MS. THOMPSON) You mentioned poor quality data, and it -- it seems like there's something in particular that you're concerned about. Can you describe for me what you mean by poor quality data?

A. Well, in general, drains are notoriously difficult to measure, and I know that -- I don't know about some of the specific stations, but they're also kind of spotty. So first -- the first issue revolves around interpolating/extrapolating data. The second issue is just the ability to measure or -- or measure the -- the drain flow given the flat gradients and the

Juarez corridor, the amount of leakage from the Rio Grande, Rio Grande alluvium to the Hueco Bolson will continue to account for much of the current recharge in the Bolson." Did I read that correctly?

A. Yes.

Q. Do you know if the -- there are sections in the Rio Grande channel and the agricultural channels that remain unlined today?

A. Yeah. We got into this in the last deposition. Yeah, there -- there's -- there are places that are lined. There are places that are unlined, and I don't remember in detail where those are or how that's changed in the last 10 or 15 years since I wrote -- or 10 years since I wrote this.

Q. Would that be a relevant analysis to understanding the overall impacts of groundwater pumping in the Hueco?

A. Well, the significance of it is on Page 10 of the PDF, Figure -- what is that -- 11.

Q. Sorry. The same exhibit?

A. Yeah.

Q. Yeah.

A. So here we have the urban and rural alluvium analysis, and it shows that over time the rural interaction hasn't changed much, at least in comparison to the urban area. So, you know, on a -- on a very fine scale, sure, the -- you could -- you could drill down and understand how the lining has changed, you know, resulting in a lot of these little wiggles, but I think the big picture takeaway on a regional basis is evident in what -- what the Heywood/Yager model shows. I mean, a lot of it depends on are you interested in a general big-scale understanding of how surface water and groundwater interact. This provides that. If you're interested on a -- on quantifying it down to the acre-foot, I don't think any regional model is going to really be able to tell you that, because they're really not designed for that purpose. You'd have to get into a more data-intensive and more finely developed model for -- to get it down to that level because of all the other interactions that are going on. Makes it very difficult.

Q. And doesn't the McDonald Morrissey model, though, do that? I mean, doesn't it get it down to a finer detail?

A. Well, that's one of the things that I don't know, because of the interaction between it and the RiverWare model. I mean, we touched on this a little bit earlier about the cell size of the USGS model versus the cell size of the McDonald Morrissey model, but absent from that discussion is the, if you will, the cell size of the RiverWare model. The RiverWare model operates essentially like it is a groundwater model in the sense that it has these big groundwater objects that are exchanging surface water and groundwater. One of the things that we don't have a complete understanding of is how much of the calculation is driven by the RiverWare model. In other words, are you just running the groundwater model, but not really using the results at that level of detail because the RiverWare model is controlling the -- the iterative process, and if that's true, then what you've done is take -- is develop a groundwater model with cell sizes of several square miles, which then can result in the potential for overfitting and overinterpretation and underlying data problems that are exacerbated because you're not really tracking the gradient in a small area; you're averaging it out over a several square-mile area. These are things that we don't fully understand and need -- and need to have some discussion over.

Q. And I meant to ask you this earlier. You've used the term over fit a couple times. Can you just define that for me and tell me what exactly over fit

spreading around just on a 57/43 basis; is that your understanding, as well?

A. Well, that's what I read, but I never -- I didn't go into the files to understand what that meant because the 57/43 is not a delivery goal, and it's complicated in this case, even if it was, it'd be complicated because there's a part of Texas that's in the Mesilla and part of it that's in the -- you know, below the narrows. So this is where -- how do you allocate that? I -- I mean, there's ways to do it that don't get involved in the 57/43, and unless someone can define for me how that -- how you allocate the Texas portion inside the model and outside the model, it -- it's arguably something that there's other ways to do it that might be equally good.

Q. You had mentioned earlier the 1947 report. Are you talking about was it a Kirby report or is it some other report?

A. Well, the USGS report.

Q. Oh, the USGS. And would you agree you were talking about conjunctive use scenarios, would you agree that even in that early time frame, the -- the project operations, you know, intended for some level of conjunctive use?

A. Well, reading the 1947 report certainly identified or acknowledged that continuous pumping would cause a reduction in stream flow, not only due to reduced drain flows, but also used to leakage out of the river, and they acknowledged and recognized the fact that they would have to be some point when -- when pumping would have to stop in order to allow the groundwater levels to recover, and that was essentially what I did in my conjunctive use scenarios where the idea of pumping in -- would essentially shut off pumping at, quote unquote, wet years, and then I evaluated different definitions of what a wet year is in order to assess what the stream flows would be at the gage at El Paso versus an overall pumping reduction. So, again, I was interested in large-scale conjunctive use kind of operations as a concept versus permanent reductions in pumping and how those would compare on a physical basis. Adding in 57/43 and extra diversions and reservoir operations, that just -- that -- all of that would actually have it, but at this point, we're -- you know, it's baby steps. It's let's understand how physical system works and responds as a foundation before you get into all the other stuff.

Q. And you did look at a number of different alternatives, taking -- setting aside the Stetson sort

of new version, but, you know, you looked at both a conjunctive use option and then alternatively, a consumptive use option. Am I characterizing that right?

A.   Yeah. I looked at -- I looked at a bunch of things. I looked at overall pumping reductions that was largely like a sensitivity analysis, despite what others have characterized it as. I've looked at holding, you know, the 1938 level of irrigation and taking a literal view of that as the limit, which didn't -- which recognized that pumping would occur in dry years and then looked at the conjunctive use approach with different levels of how do you define a wet year. So, yeah, I looked at all of those as a way to kind of inform counsel as to what the physical response of the system would look like under some broad large scale big picture kind of alternatives, not getting down into details of project deliveries and allocations and all that, just look at the big picture, because the Compact -- the complaint of the Compact kind of deal with big picture questions in my mind.

Q.   You know, Shane Coors mentioned that, you know, the modeling was done to fit, you know, the complaint, Paragraph 18. Then does that mean, though,

SIGNATURE OF WITNESS

I, WILLIAM R. HUTCHISON, solemnly swear or affirm under the pains and penalties of perjury that the foregoing pages contain a true and correct transcript of the testimony given by me at the time and place stated with the corrections, if any, and the reasons therefor noted on the foregoing correction page(s).

____
WILLIAM R. HUTCHISON

Job No. 63386

GAIL REEVES
NOTARY PUBLIC
STATE OF TEXAS
NOTARY ID 13167190-2
MY COMM. EXP. 08-06-2022

State of Texas County of Pecos

This Signature of a Remote Oral and Videotaped Deposition of William R.

Hutchison on May 28, 2020 was acknowledged before me on July 13, 2020.

William R. Hutchison
Signature of Affiant

This Signature of Witness was acknowledged by

Gail Reeves
Notary Public Signature

(Seal)

Witness Corrections and Signature

Page	Line	Correction	Reason for Change
17	8	Change "back" to "Mac"	Clarification
32	5	Change "was ongoing" to was not ongoing"	Clarification
35	7	Change "do I had" to "do it"	Clarification
36	6	Change "I wrote for" to I wrote with"	Clarification
39	24	Change "post analysis" to "post audit"	Clarification
43	3	Change "site transport" to "solute transport"	Clarification
56	3	Change "vetted" to "netted"	Clarification
66	2	Change MODFLOW water" to "MODFLOW One Water"	Clarification
76	18	Change "two heads" with "to heads"	Clarification
82	20	Change "could consider couldn't" with "could or couldn't"	Clarification
84	17	Change "predicted" to "predictive"	Clarification
90	10	Change "scale" to "scaled"	Clarification
90	19	Change "scale" to "scaled"	Clarification
92	14	Change "lot" to "plot"	Clarification
101	6	Change "time from" to "time of"	Clarification
102	18	Change "whether you" to "when you"	Clarification
117	19	Change "G AM" to "GAM"	Clarification
118	8	Change "--" with "Ogallala"	Clarification
122	24	Change "Board" to "border"	Clarification
135	2	Change "trading" to "treading"	Clarification
140	10	Change "remember they" to "remember if they"	Clarification
140	10	Change "and" to "or"	Clarification
142	10	Change "optimized" to "to optimize"	Clarification
151	3	Change "Balleau" to Balliew"	Name spelling correction
152	22	Change "for a head" to "for head"	Clarification
153	3	Change "period for the initial" to "period or the initial"	Clarification
154	11	Change "usually" to "user"	Clarification
158	12	Change "a mass balance" to "a good mass balance"	Clarification
158	21	Change "estimates" to "statements"	Clarification
162	1	Change "lay typeset" to "LAYTYPs set"	Clarification
184	24	Change "at a groundwater model" to "in a groundwater model"	Clarification

William R Hutchison

William R. Hutchison

GAIL REEVES
NOTARY PUBLIC
STATE OF TEXAS
NOTARY ID 13187190-2
MY COMM. EXP. 08-06-2022

IN THE SUPREME COURT OF THE UNITED STATES
BEFORE THE OFFICE OF THE SPECIAL MASTER
HON. MICHAEL J. MELLOY

STATE OF TEXAS	)	
	)	
Plaintiff,	)	
	)	Original Action Case
VS.	)	No. 220141
	)	(Original 141)
STATE OF NEW MEXICO,	)	
and STATE OF COLORADO,	)	
	)	
Defendants.	)	

THE STATE OF TEXAS :
COUNTY OF HARRIS :

I, HEATHER L. GARZA, a Certified Shorthand Reporter in and for the State of Texas, do hereby certify that the facts as stated by me in the caption hereto are true; that the above and foregoing answers of the witness, WILLIAM R. HUTCHISON, to the interrogatories as indicated were made before me by the said witness after being first remotely duly sworn to testify the truth, and same were reduced to typewriting under my direction; that the above and foregoing deposition as set forth in typewriting is a full, true, and correct transcript of the proceedings had at the time of taking of said deposition.

I further certify that I am not, in any capacity, a regular employee of the party in whose

behalf this deposition is taken, nor in the regular employ of this attorney; and I certify that I am not interested in the cause, nor of kin or counsel to either of the parties.

That the amount of time used by each party at the deposition is as follows:

MS. THOMPSON - 05:31:20
MR. GOLDSBERRY - 00:00:00
MR. DUBOIS - 00:00:00
MR. WALLACE - 00:00:45
MS. O'BRIEN - 00:00:00
MS. BARNCASTLE - 00:00:00

GIVEN UNDER MY HAND AND SEAL OF OFFICE, on this, the 21st day of June, 2020.

HEATHER L. GARZA, CSR, RPR, CRR
Certification No.: 8262
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Screenshot - *DataAnn* Tab - Ferguson Rebuttal_revised 9-15-20 v116.xlsx

	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1	Source	ILRG	ILRG	ILRG	ILRG	ILRG	ILRG	ILRG	ILRG	Calc.	Calc.	Calc.	Calc.	Calc.	Calc.	Calc.	Calc.	Calc.	Calc.	Calc.
2		ILRG MODEL RESULTS								ILRG MODEL RESULTS										
3	Note	Run 1	Run 3	Run 7	Run 6	Run 1	Run 3	Run 7	Run 6	Run 1	Run 3	Run 7	Run 6	Run 3	Run 7	Run 6				
4	Year	El Paso Flow (Base Run 1)	El Paso Flow (NM Pump Off Run 3)	El Paso Flow (TX Mesilla Pump Off Run 7)	El Paso Flow (R-M Pump Off Run 6)	Northwest WWTP Discharge (Base Run 1)	Northwest WWTP Discharge (NM Pump Off Run 3)	Northwest WWTP Discharge (TX Mesilla Pump Off Run 7)	Northwest WWTP Discharge (R-M Pump Off Run 6)	El Paso Flow + NW (Base Run 1)	El Paso Flow + NW (NM Pump Off Run 3)	El Paso Flow + NW (TX Mesilla Pump Off Run 7)	El Paso Flow + NW (R-M Pump Off Run 6)	NM Pumping Impact (1)	TX Mesilla Pumping Impact (2)	R-M Pumping Impact (3)	NM Pumping Impact (1) / R-M Pumping Impact (3)	TX Mesilla Pumping Impact (2) / R-M Pumping Impact (3)	NM Pumping Impact (1) / Total NM (1) plus TX (2) Pumping Impact	TX Mesilla Pumping Impact (2) / Total NM (1) plus TX (2) Pumping Impact
5	1938																			
6	1939																			
7	1940	552,764	552,736	552,741	552,736	0	0	0	0	552,764	552,736	552,741	552,736	-29	-23	-28	101%	83%	55%	45%
8	1941	458,189	458,465	458,274	458,480	0	0	0	0	458,189	458,465	458,274	458,480	276	86	291	95%	29%	76%	24%
9	1942	1,504,863	1,505,016	1,504,880	1,505,027	0	0	0	0	1,504,863	1,505,016	1,504,880	1,505,027	153	18	164	93%	11%	90%	10%
10	1943	576,168	576,288	576,158	576,287	0	0	0	0	576,168	576,288	576,158	576,287	120	-10	119	101%	-8%	109%	-9%
11	1944	483,966	483,892	483,811	483,894	0	0	0	0	483,966	483,892	483,811	483,894	-73	-154	-71	103%	217%	32%	68%
12	1945	545,391	545,480	545,390	545,501	0	0	0	0	545,391	545,480	545,390	545,501	89	-1	110	81%	-1%	101%	-1%
13	1946	525,340	525,509	525,407	525,552	0	0	0	0	525,340	525,509	525,407	525,552	169	67	212	80%	32%	72%	28%
14	1947	496,315	496,458	496,350	496,495	0	0	0	0	496,315	496,458	496,350	496,495	143	36	180	79%	20%	80%	20%
15	1948	497,678	497,695	497,723	497,745	0	0	0	0	497,678	497,695	497,723	497,745	17	45	68	25%	67%	27%	73%
16	1949	489,207	489,100	489,233	489,141	0	0	0	0	489,207	489,100	489,233	489,141	-107	26	-66	162%	-40%	132%	-32%
17	1950	388,095	396,991	389,565	398,474	0	0	0	0	388,095	396,991	389,565	398,474	8,896	1,471	10,379	86%	14%	86%	14%
18	1951	346,936	358,701	348,284	359,954	0	0	0	0	346,936	358,701	348,284	359,954	11,765	1,348	13,018	90%	10%	90%	10%
19	1952	314,660	335,827	317,304	340,210	0	0	0	0	314,660	335,827	317,304	340,210	21,167	2,644	25,550	83%	10%	89%	11%
20	1953	361,452	386,715	366,987	392,726	0	0	0	0	361,452	386,715	366,987	392,726	25,263	5,535	31,274	81%	18%	82%	18%
21	1954	143,986	224,944	158,128	243,156	0	0	0	0	143,986	224,944	158,128	243,156	80,958	14,142	99,170	82%	14%	85%	15%
22	1955	83,646	188,363	99,836	200,418	0	0	0	0	83,646	188,363	99,836	200,418	104,717	16,190	116,772	90%	14%	87%	13%
23	1956	91,244	177,134	103,026	193,876	0	0	0	0	91,244	177,134	103,026	193,876	85,890	11,783	102,633	84%	11%	88%	12%
24	1957	136,149	224,042	142,952	233,534	0	0	0	0	136,149	224,042	142,952	233,534	87,893	6,803	97,385	90%	7%	93%	7%
25	1958	335,540	352,935	341,522	359,978	0	0	0	0	335,540	352,935	341,522	359,978	17,395	5,983	24,438	71%	24%	74%	26%
26	1959	350,524	371,102	358,377	379,188	0	0	0	0	350,524	371,102	358,377	379,188	20,578	7,853	28,664	72%	27%	72%	28%
27	1960	337,479	358,694	346,849	368,883	0	0	0	0	337,479	358,694	346,849	368,883	21,215	9,370	31,404	68%	30%	69%	31%
28	1961	314,751	335,711	323,880	346,333	0	0	0	0	314,751	335,711	323,880	346,333	20,960	9,129	31,581	66%	29%	70%	30%
29	1962	320,866	342,663	330,534	355,578	0	0	0	0	320,866	342,663	330,534	355,578	21,798	9,668	34,712	63%	28%	69%	31%
30	1963	298,952	330,476	316,856	342,948	0	0	0	0	298,952	330,476	316,856	342,948	31,524	17,904	43,996	72%	41%	64%	36%
31	1964	110,864	324,072	139,102	343,729	0	0	0	0	110,864	324,072	139,102	343,729	213,207	28,238	232,865	92%	12%	88%	12%
32	1965	227,718	310,568	272,367	324,660	0	0	0	0	227,718	310,568	272,367	324,660	82,850	44,649	96,942	85%	46%	65%	35%
33	1966	268,926	335,576	285,188	348,512	0	0	0	0	268,926	335,576	285,188	348,512	66,650	16,262	79,587	84%	20%	80%	20%
34	1967	181,407	337,919	220,530	360,166	0	0	0	0	181,407	337,919	220,530	360,166	156,512	39,123	178,759	88%	22%	80%	20%
35	1968	256,788	304,573	271,996	318,787	0	0	0	0	256,788	304,573	271,996	318,787	47,784	15,208	61,998	77%	25%	76%	24%
36	1969	305,283	370,573	314,412	379,714	0	0	0	0	305,283	370,573	314,412	379,714	65,290	9,129	74,431	88%	12%	88%	12%
37	1970	334,900	354,894	346,776	367,688	0	0	0	0	334,900	354,894	346,776	367,688	19,994	11,876	32,788	61%	36%	63%	37%
38	1971	247,193	346,919	268,319	366,280	0	0	0	0	247,193	346,919	268,319	366,280	99,727	21,127	119,087	84%	18%	83%	17%
39	1972	131,542	270,976	148,230	333,742	0	0	0	0	131,542	270,976	148,230	333,742	139,434	16,688	202,200	69%	8%	89%	11%
40	1973	278,794	306,691	292,285	319,987	0	0	0	0	278,794	306,691	292,285	319,987	27,897	13,492	41,194	68%	33%	67%	33%
41	1974	321,260	353,391	333,882	368,076	0	0	0	0	321,260	353,391	333,882	368,076	32,131	12,622	46,816	69%	27%	72%	28%
42	1975	278,465	343,232	291,794	357,246	0	0	0	0	278,465	343,232	291,794	357,246	64,767	13,328	78,780	82%	17%	83%	17%
43	1976	287,245	308,193	300,648	322,730	0	0	0	0	287,245	308,193	300,648	322,730	20,948	13,404	35,485	59%	38%	61%	39%
44	1977	210,882	307,934	275,836	326,288	0	0	0	0	210,882	307,934	275,836	326,288	97,052	64,954	115,406	84%	56%	60%	40%
45	1978	167,704	261,679	204,697	320,876	0	0	0	0	167,704	261,679	204,697	320,876	93,976	36,993	153,173	61%	24%	72%	28%
46	1979	279,978	318,719	303,521	334,625	0	0	0	0	279,978	318,719	303,521	334,625	38,741	23,544	54,647	71%	43%	62%	38%
47	1980	332,070	351,451	348,156	367,674	0	0	0	0	332,070	351,451	348,156	367,674	19,381	16,087	35,604	54%	45%	55%	45%
48	1981	324,245	348,302	337,129	363,596	0	0	0	0	324,245	348,302	337,129	363,596	24,057	12,883	39,350	61%	33%	65%	35%
49	1982	329,923	354,723	342,975	368,912	0	0	0	0	329,923	354,723	342,975	368,912	24,800	13,052	38,989	64%	33%	66%	34%
50	1983	306,563	328,447	319,242	341,751	0	0	0	0	306,563	328,447	319,242	341,751	21,884	12,679	35,188	62%	36%	63%	37%
51	1984	321,246	342,567	337,040	357,589	0	0	0	0	321,246	342,567	337,040	357,589	21,321	15,793	36,343	59%	43%	57%	43%
52	1985	345,847	717,772	359,179	781,597	0	0	0	0	345,847	717,772	359,179	781,597	371,925	13,332	435,750	85%	3%	97%	3%
53	1986	1,153,486	1,286,599	1,242,712	1,305,478	0	0	0	0	1,153,486	1,286,599	1,242,712	1,305,478	133,112	89,226	151,992	88%	59%	60%	40%
54	1987	1,067,954	1,105,757	1,087,980	1,123,877	2,089	2,089	0	0	1,070,042	1,107,845	1,087,980	1,123,877	37,803	17,938	53,835	70%	33%	68%	32%
55	1988	611,555	631,389	627,790	647,168	2,095	2,095	0	0	613,649	633,483	627,790	647,168	19,834	14,141	33,519	59%	42%	58%	42%
56	1989	416,354	430,542	432,313	446,723	2,089	2,089	0	0	418,442	432,631	432,313	446,723	14,188	13,870	28,281	50%	49%	51%	49%
57	1990	295,480	313,611	310,748	328,935	2,089	2,089	0	0	297,568	315,699	310,748	328,935	18,131	13,179	31,367	58%	42%	58%	42%
58	1991	335,563	345,465	348,312	358,632	2,089	2,089	0	0	337,651	347,553	348,312	358,632	9,902	10,661	20,981	47%	51%	48%	52%
59	1992	431,819	560,100	488,743	586,431	2,095	2,095	0	0	433,913	562,195	488,743	586,431	128,281	54,829	152,518	84%	36%	70%	30%
60	1993	613,864	640,841	607,988	657,541	2,089	2,089	0	0	615,953	642,930	607,988	657,541	26,977	-7,965	41,588	65%	-19%	142%	-42%
61	1994	638,104	692,589	659,473	711,907	2,089	2,089	0	0	640,192	694,678	659,473	711,907	54,486	19,281	71,715	76%	27%	74%	26%
62	1995	727,783	843,906	757,229	872,395	7,310	7,310	0	0	735,093	851,216	757,229	872,395	116,123	22,136	137,302	85%	16%	84%	16%
63	1996	525,962	560,367	545,239	581,878	7,331	7,331	0	0	533,293	567,699	545,239	581,878	34,405	11,946	48,584	71%	25%	74%	26%
64	1997	328,104	352,350	345,813	370,706	7,310	7,310	0	0	335,414	359,660	345,813	370,706	24,246	10,399	35,292	69%	29%	70%	30%
65	1998	468,057	512,105	486,208	537,413	7,310	7,310	0	0	475,367	519,415	486,208	537,413	44,048	10,841	62,046	71%	17%	80%	20%
66	1999	461,965	490,047	485,489	552,243	7,310	7,310	0	0	469,275	497,357	485,489	552,243	28,082	16,214	82,967	34%	20%	63%	37%
67	2000	440,141	471,087	453,149	505,300	9,661	9,662	0	0	449,803	480,748	453,149	505,300	30,945	3,347	55,497	56%	6%	90%	10%
68	2001	395,519	414,530	411,564	437,673	8,592	8,592	0	0	404,111	423,122	411,564	437,673	19,011	7,453	33,562	57%	22%	72%	28%
69	2002	414,288	435,598	430,372	450,933	7,652	7,652	0	0	421,940	443,250	430,372	450,933	21,310	8,432	28,993	74%	29%	72%	28%
70	2003	280,965	385,759	305,077	399,276	6,795	6,795	0	0	287,760	392,554	305,077	399,276	104,794	17,317	111,516	94%	16%	86%	14%
71	2004	231,937	295,368	255,088	310,395	5,785	5,785	0	0	237,722	301,153	255,088	310,395	63,431	17,366	72,673	87%	24%	79%	21%
72	2005	347,785	368,891	364,675	387,692	5,686	5,686	0	0	353,471	374,577	364,675	387,692	21,106	11,205	34,222	62%	33%	65%	35%
73	2006	259,801	374,734	305,316	394,482	6,047	6,047	0	0	265,847	380,780	305,316	394,482	114,933	39,469	128,635	89%	31%	74%	26%
74	2007	315,441	358,167	328,547	375,606	6,197	6,197	0	0	321,638	364,364	328,547	375,606	42,726	6,909	53,968	79%	13%	86%	14%
75	2008	327,937	381,999	343,897	396,282	5,821	5,821	0	0	333,758	387,820	343,897	396,282	54,062	10,139	62,524	86%	16%	84%	16%
76	2009	388,423	443,302	405,049	469,472	5,538	5,538	0	0	393,961	448,840	405,049	469,472	54,879	11,088	75,511	73%	15%	83%	17%
77	2010	322,459	413,240	340,368	391,975	6,312	6,312	0	0	328,771	419,552	340,368	391,975	90,781	11,597	63,204	144%	18%	89%	11%
78	2011	232,153	324,284	255,478	358,955	9,061	9,061	0	0	241,214	333,345	255,478	358,955	92,132	14,265	117,741	78%	12%	87%	13%
79	2012	157,505	231,504	172,608	253,189	6,712	6,712	0	0	164,217	238,216	172,608	253,189	73,998	8,391	88,972	83%	9%	90%	10%
80	2013	70,457	160,508	80,895	189,940	7,351	7,351	0	0	77,808	167,859	80,895	189,940	90,050	3,087	112,131	80%	3%	97%	3%
81	2014	130,887	193,412	141,681	215,851	8,053	8,053	0	0	138,940	201,465	141,681	215,851	62,525	2,741	76,911	81%	4%	96%	4%
82	2015	226,971	272,930	238,705	289,000	6,320	6,320	0	0	233,291	279,250	238,705	289,000	45,959	5,413	55,708	82%	10%	89%	11%
83	2016	282,459	349,150	289,591	357,400	6,310	6,310	0	0	288,769	355,460	289,591	357,400	66,691	822	68,631	97%	1%	99%	1%
84	2017	322,514	376,045	338,504	395,616	7,475	7,475	0	0	329,989	383,520	338,504	395,616	53,531	8,515	65,627	82%	13%	86%	14%
85																				
86	1940-2017 Avg	372,137	424,747	388,128	440,778	2,291	2,291	0	0	374,428	427,038	388,128	440,778	52,610	13,700	66,351	79%	21%	79%	21%
87	1951-1978 Avg																			
88	1979-2005 Avg																			
89																				
90																				

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No. 141, Original

IN THE
SUPREME COURT OF THE UNITED STATES

♦

STATE OF TEXAS,

Plaintiff

v.

STATE OF NEW MEXICO and
STATE OF COLORADO,

Defendants

♦

DECLARATION OF GREGORY SULLIVAN, P.E.
IN SUPPORT OF STATE OF NEW MEXICO'S
PARTIAL SUMMARY JUDGMENT MOTIONS

♦

I, Gregory K. Sullivan, P.E., hereby declare as follows:

1. I am over 18 years of age and have personal knowledge of the information stated herein.

2. I have authored two expert reports in this case including an Expert Report dated October 31, 2019 (revised July 15, 2020) (NM-EX 122)[1] and a Rebuttal Expert Report dated July 15, 2020 (revised September 15, 2020) (NM-EX 123).

3. I was also deposed three (3) times in this case in conjunction with the opinions I expressed in those expert reports.

4. I have a Bachelor's Degree in Civil Engineering from Colorado State University (1985), and a Master's Degree in Civil Engineering from the University of Colorado, Denver (1990).

5. From 1985 until 1990, I was employed as a water resources engineer by J.W. Patterson and Associates in Denver, Colorado.

6. From December 1990 to the present, I have been employed by Spronk Water Engineers, Inc. ("SWE") in Denver, Colorado. My current position at SWE is President and Senior Water Resources Engineer. Throughout my career with SWE, I have served as a primary consultant to numerous water providers in areas of water supply planning and water rights engineering. In that role, I have been responsible for technical analyses supporting changes of water rights, exchanges, augmentation plans, and other water right matters. I have led the development of

[1] All Exhibits ("NM-EX") identified in this Declaration are part of the State of New Mexico's Exhibit Compendium dated November 5, 2020 filed with New Mexico's Partial Summary Judgment Motions dated November 5, 2020.

complex surface water operations models that simulate municipal water demands and how those demands may be met by available water supplies and water rights. On behalf of the State of Kansas, I operated and maintained the Hydrologic-Institutional Model of the Arkansas River Basin that supported Kansas' successful original action lawsuit in Kansas v. Colorado in the U.S. Supreme Court (No. 105 Original), and I provided expert testimony in that role before the Special Master in that case. Since 1996, I have served on the Eastern Snake Hydrologic Modeling Committee that guides the development and use of a regional ground water model of the Eastern Snake River Plain Aquifer in Idaho.

7. I have been accepted by various courts as an expert in water resources engineering, water rights engineering, hydrologic modeling, groundwater modeling, hydrology, water measurement, evaluation of beneficial use, and/or data analysis. In my role as an expert, I have authored numerous expert reports and provided expert deposition and trial testimony in cases before the U.S. Supreme Court, the Colorado Water Courts, the Snake River Basin Adjudication Court (Idaho), and in administrative hearings before the Idaho Department of Water Resources.

8. My professional involvement with Lower Rio Grande issues in New Mexico and Texas began in 1999 and my work has involved, among other things:

   - Compilation and review of hydrologic and water use data in the Lower Rio Grande area.
   - Development of a surface water database that supports New Mexico's technical analyses and hydrologic modeling.
   - Development of canal and farm budget models of the irrigation systems of the Rio Grande Project ("Project"), the Hudspeth County Conservation and Reclamation District No. 1 ("HCCRD"), and the Juarez Irrigation District ("JID) in Mexico.
   - Review and analysis of the 2008 Operating Agreement ("2008 OA") for the Project.
   - Review and analysis of historical Project operations.
   - Development of the Integrated Lower Rio Grande Model ("ILRG Model").
   - Use of the ILRG Model to analyze the claims and counterclaims of the parties to this case.
   - Review of technical analyses and modeling submitted by experts for the State of Texas and the United States.
   - Litigation support for New Mexico Counsel.

9. My curriculum vitae, list of expert reports during the past four years and list of expert reports during the past five years can be found in my October 31, 2019 Expert Report at 326-334, NM-EX 122.

Background

10. In this Declaration, I refer to the New Mexico water district, Elephant Butte Irrigation District as "EBID," and the Texas water district, El Paso County Water Improvement District No. 1,

as "EPCWID." I refer to EBID and EPCWID collectively, as the "Districts." I refer to the United States Bureau of Reclamation as "Reclamation."

11. I have been asked by Counsel for New Mexico to review the statements of facts in the motions for partial summary judgment filed by the United States and Texas, and to assess whether they are accurate from my perspective as an expert in this case, and to provide information in response.

12. I have determined that a number of the alleged facts listed by the United States and Texas in their motions for summary judgment are inaccurate, disputed, incomplete, and/or are opinions rather than facts.

United States of America's Memorandum in Support of Motion for Partial Summary Judgment

13. In the United States' Statement of Material Facts, Fact No. 6 states, "Groundwater pumping in New Mexico below Elephant Butte interferes with Project deliveries because it depletes the surface water flows in the river, canals, and drains, and the Project must release additional water from the reservoir to compensate for the depletions instead of storing that water for use in future years."

    The extent of interference with Project deliveries caused by groundwater pumping in New Mexico is a matter of expert opinion rather than fact. The United States exaggerates the effects of New Mexico pumping, implying that it has caused continuous and unrelenting impacts. This is incorrect for several reasons: First, as shown in **Figure 1**, pumping in New Mexico has varied substantially since it developed in the early 1950s, with higher amounts of pumping in low Project supply years and lower amounts of pumping in full supply years. NM-EX 122 Expert Report of Gregory K. Sullivan and Heidi M. Welsh (Second Edition) (July 15, 2020) ("Spronk Report") at 194 and 318. Second, in full supply years, the Districts received all water they ordered, up to their total allocations. Id. Even if Reclamation had to release additional water in these years to make Project deliveries, this did not impact deliveries in those years. NM-EX 123 Gregory K. Sullivan and Heidi M. Welsh, Expert Rebuttal Report (Second Edition) (Sept. 15, 2020) ("Spronk Rebuttal") at 58-59. Third, this statement ignores the seasonality of Project deliveries, and that some of the river depletions from pumping occur during the winter when the Project is not making deliveries. Id. at 351-352. Fourth, this statement ignores that the amount and timing of Rio Grande depletions from pumping depends on many factors, including the locations and depth of the wells, the timing and amount of pumping, aquifer characteristics, the interaction of ground water and surface water, Project and reservoir operations, including spills, and many other factors. Further, this statement ignores the impacts that pumping in Texas has on Project deliveries. Id. at 373-374.

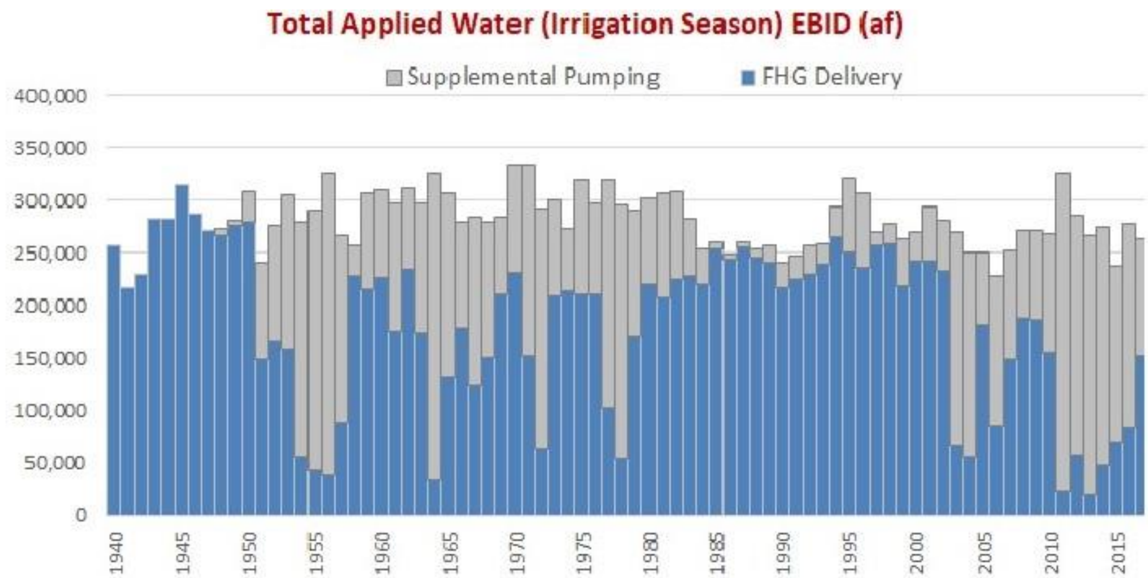


Figure 1. Total Applied Water (Irrigation season) EBID (af), adapted from Spronk Report Figure 5-15.

14. Fact No. 7 states, "In years when surface water supply is low, pumping in New Mexico below Elephant Butte reduces the amount of water the Project can deliver to Texas."

 The extent of any reduction in Project deliveries in years of low surface supply is a matter for expert analysis and expert opinion. The impacts of pumping on Project deliveries depends on many factors and can only be evaluated using a robust simulation model like the ILRG Model. Spronk Rebuttal at 86. In addition, the statement ignores the impacts that pumping in Texas, including in the Texas portion of the Mesilla Valley and in the El Paso Valley, has on Project deliveries. Id. at 373-374. Texas pumping in these areas averaged 127,500 AF/y during 1951-2017 with irrigation pumping averaging 41,600 AF/y (155,000 AF/y maximum) and non-irrigation pumping averaging 85,900 AF/y (124,000 AF/y maximum). SWE Report at 153.

15. Fact No. 10 states, "In the seven years since Texas filed its complaint in this action (and six years since the United States filed its complaint), New Mexico has not curtailed any groundwater pumping to address those complaints."

 The extent that New Mexico pumping is affecting Project operations is a complex matter requiring expert analysis and expert opinion. In addition, this statement ignores the negative effects that Texas pumping, the 2008 OA, increases in Project operational waste, and changes in EPCWID operations are having on New Mexico. Analyses using the ILRG Model indicate that Project water diversions by New Mexico during 2006 - 2017 were reduced by an average of 15,500 AF/y by Texas pumping, an average of 94,200 AF/y by imposition of the 2008 OA, an average of 86,300 AF/y by increases in Project operational waste (mostly in Texas), and by an average of 72,400 AF/y by changes in EPCWID operations. Spronk Rebuttal at 379, 533, 577, 709. Due to nonlinearities in the ILRG Model, the foregoing impacts are not fully independent and additive.

16. Fact No. 58 states, "Since 1980, groundwater pumping for non-irrigation uses (including municipal use) below Elephant Butte has nearly doubled, from about 20,000 acre-feet per year ("AF/y") to about 37,000 AF/y, driven by an increase in pumping by entities other than the City of Las Cruces whose groundwater use began after the Compact."

This statement is generally correct regarding the volume of non-irrigation groundwater pumping in New Mexico, but it fails to mention that much larger volumes of non-irrigation groundwater pumping occur in Texas and Mexico averaging 86,700 AF/y and 150,900 AF/y, respectively during 2013 - 2017. Spronk Report at 51 and 205-207. The statement also neglects to mention that non-irrigation groundwater pumping in New Mexico currently produces approximately 17,000 AF/y in return flows to the river that offset some of the impacts of pumping. Id. at 51. Historical annual non-irrigation pumping in New Mexico, Texas, and Mexico is shown in **Figure 2**, **Figure 3**, and **Figure 4**, respectively.

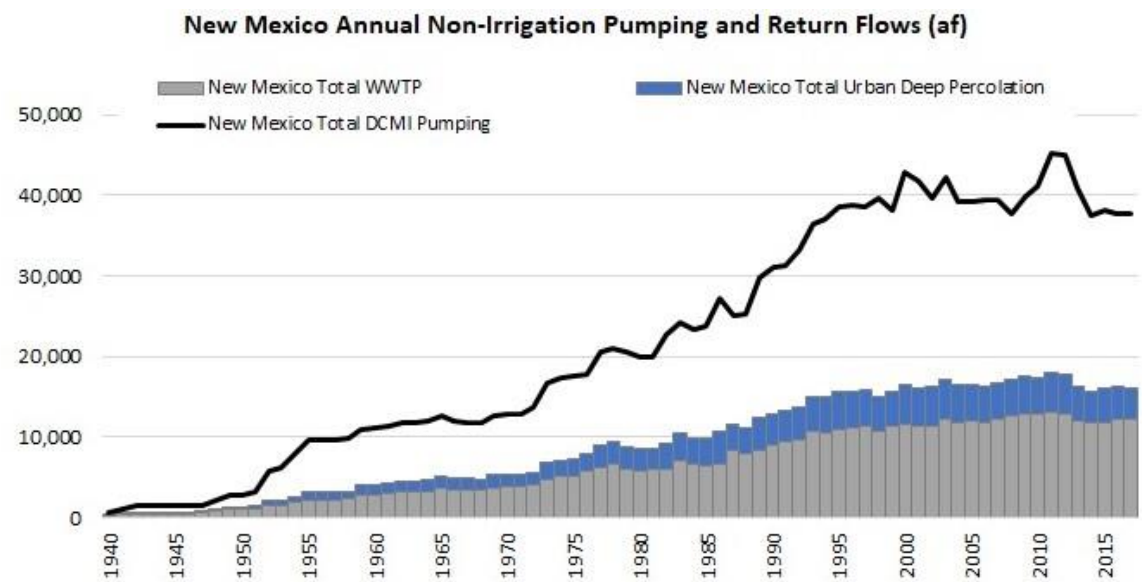


Figure 2. New Mexico Annual Non-Irrigation Pumping and Return Flows (af), adapted from Spronk Report Figure 5-26.

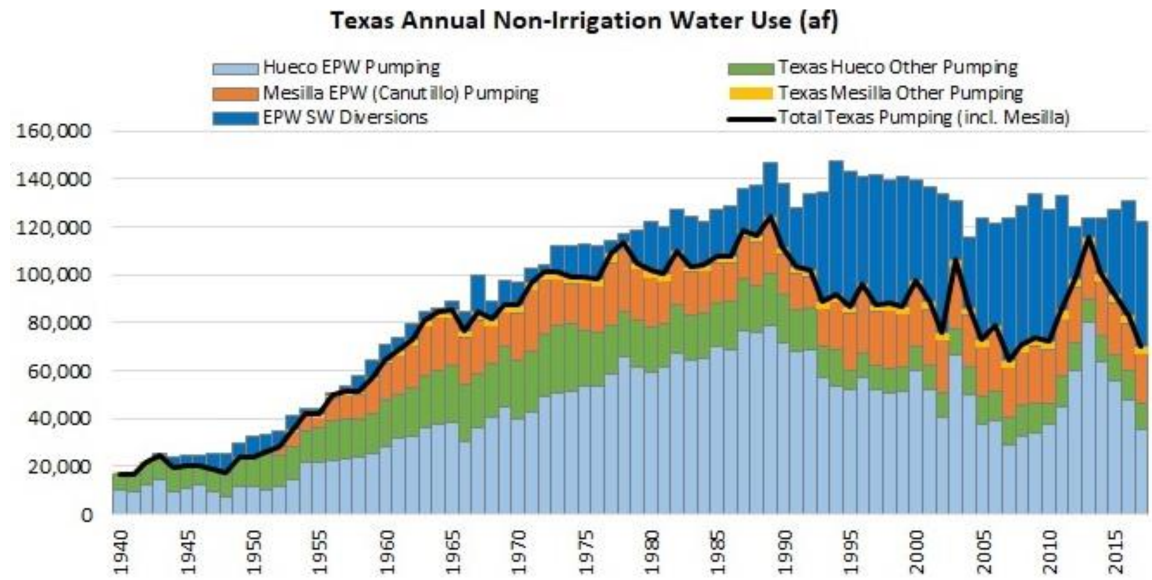


Figure 3. Texas Annual Non-Irrigation Water Use (af), adapted from Spronk Report Figure 5-27.

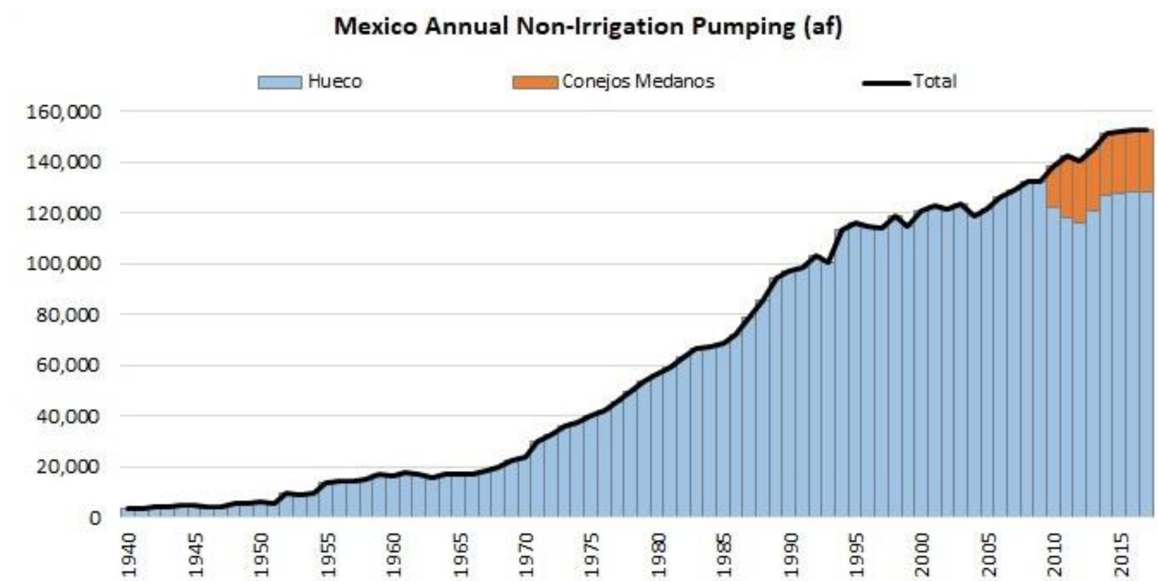


Figure 4. Mexico Annual Non-Irrigation Pumping (af), adapted from Spronk Report Figure 5-28.

17. Fact No. 61 states, "Groundwater pumping in New Mexico impacts the surface water supply for the Project because it depletes the flow of the Rio Grande and reduces the amount of water flowing in Project drains and canals."

The extent that New Mexico pumping impacts the surface water supply of the Project is a complex matter requiring expert analysis and expert opinion. Depletions of surface water flows do not affect Project deliveries in full supply years and depletions during the non-irrigation season do not affect Project deliveries because the Project is not operating then. Spronk Report at 72, 112, 122. This statement also ignores that when Reclamation developed the D1/D2 allocation procedures using Project delivery data from 1951 – 1978 it effectively grandfathered in any effects that groundwater pumping during that period had on Project operations. Id. at 118. Finally, the United States' statement ignores that an appreciable portion of any impacts that pumping has had on Texas have come from Texas pumping. Spronk Rebuttal at 373-374.

18. Fact No. 62 states, "Groundwater pumping in New Mexico in years of lower surface water supply can reduce the volume of water available for Project allocation and delivery to the Districts, and thus reduce the apportionment to Texas."

The extent of impacts from New Mexico pumping on Project water allocations and deliveries in low supply years is a complex matter requiring expert analysis and expert opinion. To the extent that New Mexico pumping does impact Project water allocations and deliveries in low supply years, so does Texas pumping. Spronk Rebuttal at 120. Simulations with the ILRG Model show that Texas pumping reduced New Mexico's diversions of Project water by an average of 15,500 AF/y during 2006 - 2017 when the 2008 OA was in effect. Id.

19. Fact No. 63 states, "On average, groundwater pumping in New Mexico reduced Project diversions by over 60,000 acre-feet annually between 1951 and 2017."

This statement reflects the estimated effect of New Mexico pumping on combined Project water diversions by New Mexico and Texas. Spronk Rebuttal at 119. The extent of any injury resulting from a reduction in diversions caused by New Mexico pumping is a complex matter requiring expert analysis and expert opinion. To the extent that New Mexico pumping has reduced Project diversions, so has Texas pumping. In addition, the imposition of the 2008 OA, increases in Project operational waste, and change in EPCWID operations have caused significant negative impacts to New Mexico that far exceed any impacts of New Mexico pumping on Texas. See Paragraph No. 15.

20. Fact No. 71 states, "The effect of the 2008 Operating Agreement is that EBID voluntarily cedes some of its surface water allocation to EPCWID to compensate for surface water depletion caused by groundwater pumping in New Mexico, including pumping by water users outside of EBID."

The U.S. experts have stated that the purpose of the 2008 OA was to offset the impact of increased pumping by New Mexico. Expert Rebuttal Report of Dr. Ian M. Ferguson (12/30/2019) ("Ferguson Rebuttal") at 5. However, the level of New Mexico pumping during 1951-1978 was effectively grandfathered into the D1/D2 allocation procedure. Expert Report of Robert J. Brandes (5/31/2019) ("Brandes Report") at 16-17 and Spronk Report at 118. After that time and until commencement of the D3 allocation procedure under the 2008 OA (1979-2005), New Mexico's pumping was much less than during the D1/D2 data period. Spronk Rebuttal at 27.

State of Texas's Motion for Partial Summary Judgment

21. On page 19 of its Motion for Partial Summary Judgment: Memorandum of Points and Authorities in Support Thereof, Texas states, "the number of groundwater wells has increased from 60 in 1938 to over 8,000 in 2020. [Schorr Decl. at TX_MSJ_000697-000699.] Figures 3 and 4 are depictions showing the proliferation of wells in New Mexico from 1938 to 2020. Id."

This statement leaves out the Texas analysis which concluded that by 2016, the number of New Mexico wells had increased to more than 7,700, with about 465 wells for municipal and industrial purposes, 1,300 for irrigation purposes, and majority still for domestic purposes. Expert Report of Staffan W. Schorr and Colin P. Kikuchi at (5/31/2019) ("M&A Report") at 3. Annual pumping from the domestic wells in the LRG in New Mexico has been estimated at approximately 730 AF/y. Expert Report of Gilbert R. Barth, Ph.D. Third Edition (9/15/2020) "SSPA Report" at Appendix H 4-1. Further, as shown in **Figure 5**, there has been widespread development of groundwater wells throughout the LRG in Texas and Mexico as well as in New Mexico, and the impacts of pumping on ground water levels has been substantially greater in the Hueco Bolson in the El Paso/Juarez area than it has in the Rincon and Mesilla basins in New Mexico.

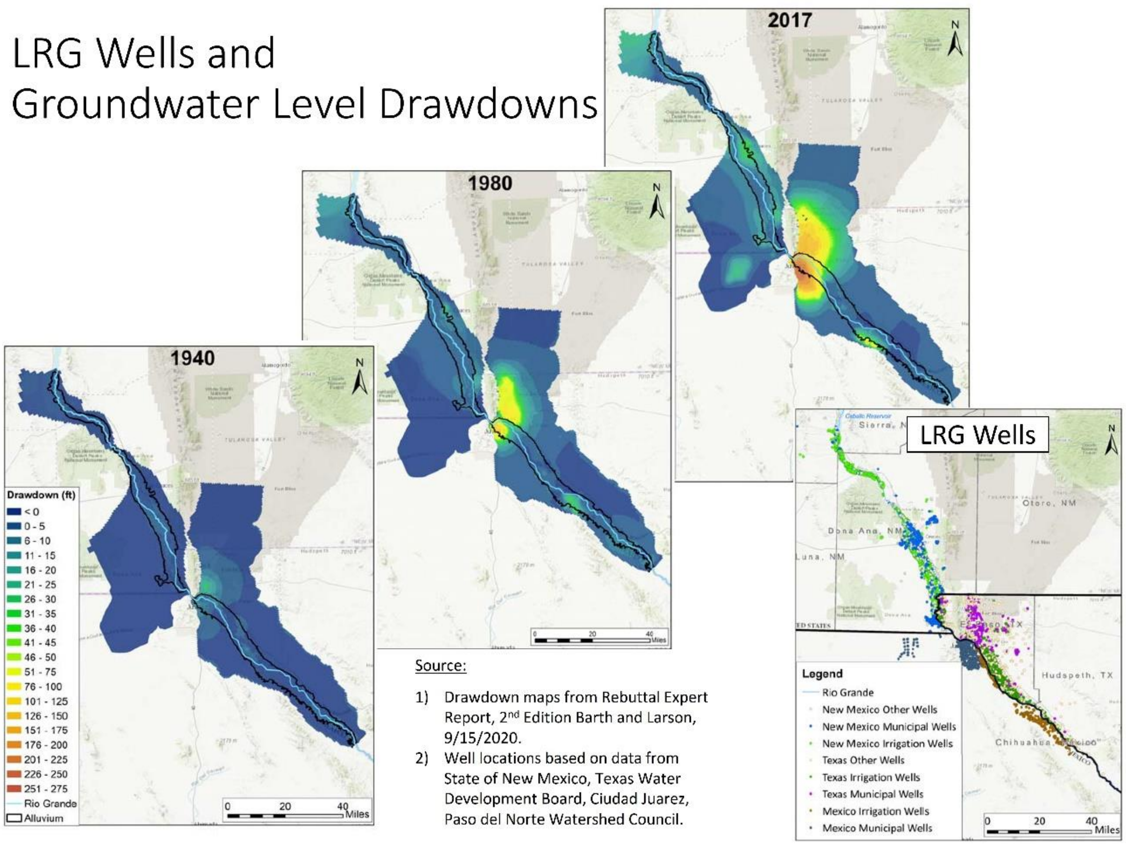


Figure 5. LRG Wells and Groundwater Level Drawdowns, NM-EX 117.

22. On page 20, Texas states, "Mining of a groundwater basin means that more water is being pumped from the groundwater basin than can be replaced, causing groundwater levels to decline and causing the further depletion of the volume of water available to Texas. Brandes Decl. at TX_MSJ_000007."

This statement is incomplete. As shown in **Figure 5**, the depletion of ground water storage is much greater in the Hueco Bolson in Texas and Mexico than in the Rincon and Mesilla basins in New Mexico. Further, the proportion of water available to Texas under the allocation procedure of the 2008 OA is now far greater than the 43% share that Texas was allocated and received until 2005. Spronk Report at 318.

23. On page 23, Texas states, "The Project, in turn, is the means by which the water apportioned to Texas by the Compact is stored in Elephant Butte Reservoir and subsequently delivered to Texas, subject to deliveries to EBID pursuant to its contract with the United States, and to Mexico pursuant to the 1906 Treaty. [Brandes Decl. at TX_MSJ_000007.]"

    This statement implicates legal issues in this case. It is New Mexico's position that it received an apportionment of water downstream of Elephant Butte Reservoir under the Compact. In addition, this statement is incomplete and misleading. Substantial ground water development also occurred in the Mesilla Basin in Texas and the El Paso Valley in Texas, and this development impacts Project operations and has reduced deliveries of Project water to New Mexico. Finally, portions of the water delivered into Elephant Butte Reservoir cannot be delivered to Texas or New Mexico because (a) it is delivered to Mexico under the 1906 Treaty obligation, (b) is lost to evaporation and seepage, (c) it is consumed by evapotranspiration of native vegetation, and (d) it spilled with the reservoir is full at rates that exceed the ability to beneficially use it upstream of Fort Quitman. Spronk Report at 10, 40.

24. On page 22, Texas states, "Current water users in the Lower Rio Grande basin are primarily divided between irrigators and municipal users. Irrigation is the primary use of water in the Lower Rio Grande in New Mexico. Id."

    This statement is generally true in New Mexico where from 1951-2017 approximately 84% of all pumping is for irrigation. However, this is not the case in Texas where from 1951-2017 only 33% of pumping is for irrigation and the remainder is for other uses. Spronk Rebuttal at 152-153.

25. On page 25, Texas states, "Return flows are a key part of Project operations, and interference with return flows removes a critical component of deliveries to Project users. [Brandes Decl. at TX_MSJ_000008-000009.]"

    The effects on Project operation resulting from interference with Project return flows (e.g., impact of ground water pumping on return flows) is a complex matter requiring expert analysis and expert opinion. It is true that return flows are a key component of Project operation and return flows from upstream uses of Project water become a portion of the Project supply that is delivered for downstream use. However, interference with return flows does not always impact Project operations. For example, depletions during the winter when the Project is not delivering water does not impact Project operations. See Paragraph 17. In addition, depletions of return flows in full allocation years do not impact Project deliveries because additional water can be released from storage to deliver Project water orders. Spronk Report at 72, 112, 122. Increased Project releases in full supply years have the potential to diminish the amount of water available for allocation in future years of less than full supply, but this depends on many factors, including increased reservoir evaporation and spills that may occur in the interim. Id. at 72, 142. Furthermore, the effects of pumping in Texas and the cessation of use of return flows in Texas has resulted in increases in reservoir releases to meet EPCWID demands and this has reduced the supply of Project water available for allocation and delivery to EBID. Spronk Rebuttal at 120, 130.

26. On page 25, Texas states, "Project return flows consist of excess irrigation tailwater and groundwater seepage from irrigated fields that are collected in drains that convey these return flows to the Rio Grande. [Brandes Decl. at TX_MSJ_000008-000009.]"

    To the extent this statement implies that return flows consist of "excess" water applied to irrigation, this is incorrect. The accumulation of tailwater and seepage from irrigated fields is a normal part of the irrigation process, even in well-managed fields. Spronk Report at 52. In addition, this statement incorrectly implies that Project return flows must return to the bed of the Rio Grande to be usable. Because of the configuration of Project infrastructure in EPCWID, return flows in EPCWID generally do not reach the bed of the river, but this did not prevent EPCWID members from diverting these flows for irrigation use until the early 1980s. Spronk Report at 19-20. If EPCWID resumed use of the irrigation return flows that arise within its boundaries, this would reduce the reservoir releases needed to meet EPCWID demands and would make additional water available for allocation and delivery to EBID. Spronk Rebuttal at 130.

27. On page 25, Texas states, "The proportion of return flows in the river increases in the downstream direction relative to stored water from the reservoirs, and the water diverted by Project users in the lower Mesilla basin and in the El Paso Valley of Texas includes diversion of significant quantities of return flows. Brandes Decl. at TX_MSJ_000008-000009."

    This statement is overly simplified and ignores that the proportion of return flows in the river varies depending on the time of year and hydrologic conditions. Early in the irrigation season, the proportion of Project return flows in the river is lower than it is later in the irrigation season. During dry periods, the proportion of return flows in the river also tends to be lower than during wet years. Spronk Rebuttal at 168 and 170-171.

28. On page 29, Texas states, "Significant groundwater development began in the early 1950s in the Project area within the Rincon and Mesilla basins of New Mexico. Brandes Decl. at TX_MSJ_00010-00012."

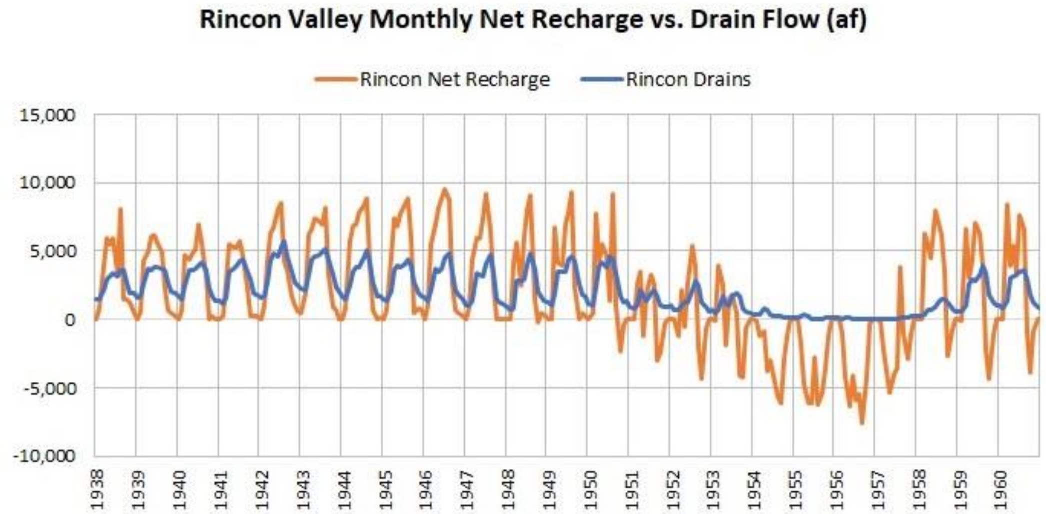
    This statement fails to note that significant groundwater development in the Mesilla and Hueco basins in Texas also began in the early 1950s. Spronk Report at 194-195. Groundwater development for irrigation in both states occurred in response to drought. Id. In addition, Texas fails to note that significant groundwater development for El Paso municipal use began in Texas prior to the early 1950s. Spronk Report at 206.

29. On page 30, Texas states, "The solution was to construct a complex system of drains that would capture excess groundwater created by irrigation and return it to the river. [Brandes Decl. at TX_MSJ_00010-00012.]"

    This statement is generally correct regarding the reason for construction of the drain system in both New Mexico and Texas but neglects to mention that the drains also allowed return flows to more easily be collected and diverted for reuse as part of Project supply, particularly within EPCWID. See Paragraph 25.

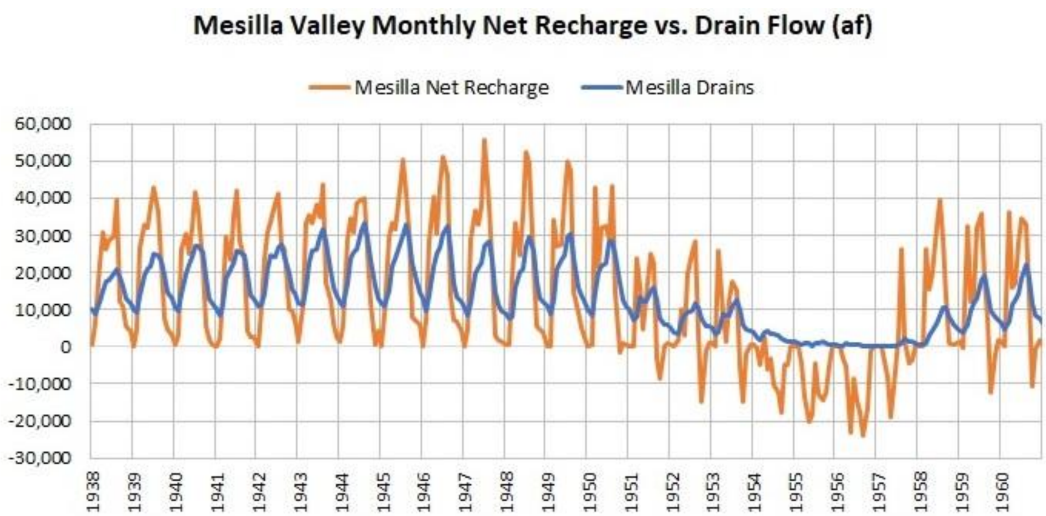
30. On page 30, Texas states, "With the construction of the drains, irrigation water not consumed by crops and other vegetation or by evaporation, percolated down through the soil into the groundwater system, which typically flowed toward and into drains specifically designed for collecting groundwater and for conveying groundwater and excess irrigation tailwater away from fields and to the Rio Grande. [Brandes Decl. at TX_MSJ_00010-00012.]"

This statement misleadingly implies that the only water collected in the drains is "irrigation water not consumed by crops and other vegetation or by evaporation," when, in fact, other sources of water, including wastewater, tailwater, and on-farm runoff, also contribute to drain flows in the Project area. The statement also neglects to mention that drain flows vary throughout the year depending on many factors, including the timing and volume of surface water deliveries and irrigation applications, weather conditions, and other factors. Spronk Rebuttal at 170-171. The historical relationship between recharge and drain flows is shown for the Rincon Valley in **Figure 6** and for the Mesilla Valley in **Figure 7**.



Note: Net recharge computed as canal seepage + on farm deep percolation minus pumping from the SWE Canal and Farm Budget Model.

Figure 6. Rincon Valley Monthly Net Recharge vs. Drain Flow (af), adapted from Spronk Rebuttal Figure 23-1.



Note: Net recharge computed as canal seepage + on farm deep percolation minus pumping from the SWE Canal and Farm Budget Model.

Figure 7. Mesilla Valley Monthly Net Recharge vs. Drain Flow (af), adapted from Spronk Rebuttal Figure 23-2.

31. On pages 30 to 31, Texas states, "This condition is illustrated in a general fashion by the diagram in Figure 10. As shown, Project water is diverted from the Rio Grande into an irrigation system canal and then distributed to individual irrigated fields, where it is either consumptively used by the growing crops or evaporated into the atmosphere. Any excess irrigation water is either discharged directly to the drain as tailwater or percolated through the subsurface into the groundwater system. Brandes Decl. at TX_MSJ_000011-000012."

    Figure 10 in the Texas Motion is highly idealized and is not representative of the myriad of conditions that exist throughout the Project. The graphic in Figure 10 implies a closed loop system for use and reuse of return flows on the same field that does not reflect that reuse of return flows within the Project typically occurs downstream. Spronk Report at 19. In addition, Figure 10 does not depict the releases from storage that are an important source of Project supply, not does it reflect the depletions of surface water caused by evaporation from water surfaces, and evapotranspiration of native vegetation and bare ground, and other processes. Spronk Report at 225.

32. On page 31, Texas states, "The bottom of the drain is below the upper level of the groundwater; thus, groundwater is induced to flow toward and into the drain."

    This statement implies that in all areas of the Project the bottoms of Project drains were below the upper level of groundwater. This statement is overly simplified and does not reflect that ground water levels relative to drain elevations vary spatially throughout the Project and temporally throughout the year and from one year to the next depending on hydrologic and water supply conditions.

33. On page 31, Texas states, "Similarly, the bottom of the river channel is below the level of the groundwater, with water shown flowing in both directions depending on the relative heights of the water in the river and the groundwater from location to location. [Brandes Decl. at TX_MSJ_000011-000012.]"

    This statement is incorrect. The flow of water between the river and the ground water depends on the relative elevations of the groundwater surface and the river <u>surface</u>. Further, this statement is overly simplified and does not reflect that groundwater levels relative to the river surface vary spatially throughout the Project and temporally throughout the year and from one year to the next depending on hydrologic and water supply conditions.

34. On page 31, Texas states, "The irrigation tailwater and groundwater collected in the drain flows to the river and is referred to as return flow."

    This statement is incomplete. In addition to tailwater and groundwater collected in drains, return flows in the Project area also include operational waste and on-farm surface runoff. Spronk Report at 78.

35. On page 31, Texas states, "The return flow from the drain that is discharged into the Rio Grande provides an important supply of Project water for users located downstream, namely users in the lower Mesilla basin and in the El Paso Valley of Texas. [Brandes Decl. at TX_MSJ_000011-000012.]"

    This statement ignores the fact that return flows vary spatially and temporally depending on many factors, including hydrologic conditions and Project operations. See Paragraph 25 . While reuse of return flows had long been an essential part of Project operations, Reclamation interfered with this reuse in the El Paso Valley by changes to water delivery infrastructure that eliminated river diversions that previously supplied the Riverside and Tornillo Canals and other changes. Spronk Rebuttal at 32. In addition, EPCWID ceased diversions of return flows from drains in the early 1980s eliminating an important source of its irrigation supply. These changes have increased the reservoir releases that are needed to deliver Project water to EPCWID, and therefore have reduced the supply of water available for allocation to the District's in subsequent years. Id. at 32-33.

36. On page 32, Texas states, "With the extensive development and use of groundwater in the Rincon and Mesilla basins of New Mexico that began during the early 1950s – particularly in the relatively shallow aquifers with generally high groundwater levels such as those along the Rio Grande – groundwater levels began to fluctuate and decline in some areas. Brandes Decl. at TX_MSJ_000012-000013."

While ground water levels in the Rincon and Mesilla basins declined when ground water pumping increased during drought periods with low Project allocations, the ground water levels recovered during wet periods when pumping decreased in periods of full or near full Project supply. NM-EX 006, Barroll 2nd Decl. Paragraph 44. This statement also neglects to mention that the Texas part of the Mesilla basin also underwent "extensive development and use of groundwater" for irrigation in the 1950s. Spronk Report at 65. In addition, municipal well development in the Texas part of the Mesilla basin and in the El Paso Valley have also caused ground water level declines. The groundwater level declines in Texas have increased depletions to surface water flows and increased conveyance losses in delivering Project water. Spronk Report at 65; see Paragraph 28. The extensive development and use of groundwater for municipal and irrigation use in the Hueco Bolson by Texas and Mexico have created the large and lasting cone of depression in the groundwater levels shown in **Figure 5** that is over 100 feet deep in some areas. Expert Report of Charles P. Spalding and Daniel J. Morrissey (Third Edition) (Sep. 14, 2020) ("MMA Report") at Figs. 5.4, 5.6, 6.1, 8.21, 8.22 & App. Q.

37. On page 32, Texas states, "This in turn caused reduction of discharges of groundwater into the drains, and directly into the river. [Brandes Decl. at TX_MSJ_000012-000013.]"

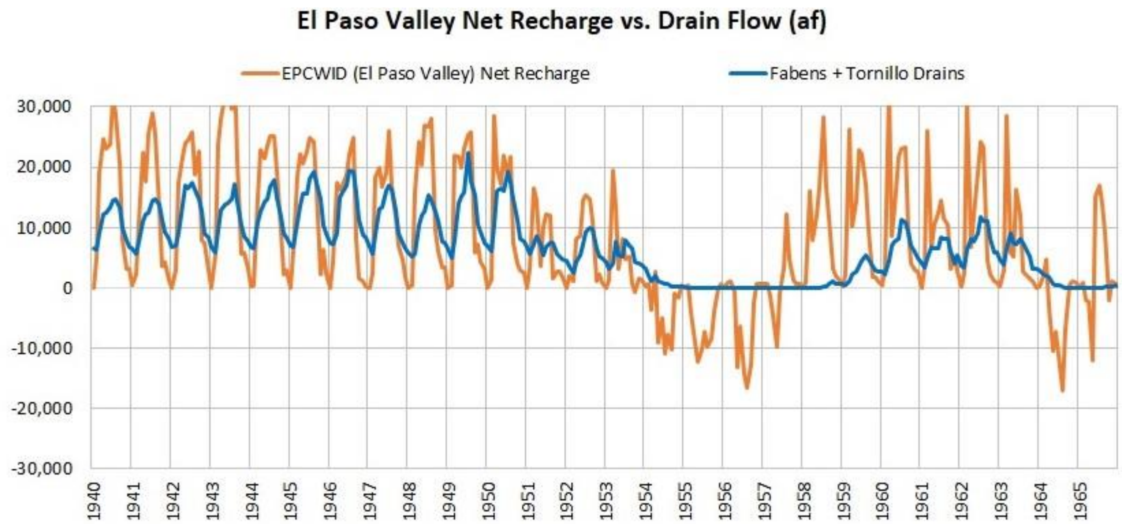
This statement fails to mention that factors other than groundwater pumping also affect the timing and amount of water that returns to Project drains. See Paragraph 30. While drain flows generally declined during drought periods when pumping was high, they recovered during wet periods when pumping was low. Spronk Rebuttal at 170-171. Finally, Texas fails to note that groundwater pumping in Texas has also caused a reduction in discharges of groundwater to drains and the river. Spronk Report at 97.

38. On page 32, Texas states, "Eventually, with enough groundwater pumping, the groundwater gradient in many areas reversed, with significant reductions in the groundwater inflows to the drains and into the river. [Brandes Decl. at TX_MSJ_000012-000013.]"

This statement is incomplete. Groundwater levels and drain flows historically recovered in both the Rincon and Mesilla valleys during periods of full or near full Project water allocations when pumping was low. See Paragraph 37. Pumping in Texas has also impacted groundwater discharges to drains and to the river and increased conveyance losses of Project water, but, unlike in New Mexico, groundwater level declines in the Hueco Bolson in Texas have not recovered in full supply years. See Paragraphs 36 and 37.

39. On pages 32 to 33, Texas states, "This condition is illustrated by the diagram in Figure 11. As shown, the level of the groundwater is below the bottom of the river channel and the drain, and water flowing in the river and into the drain moves toward and into the groundwater system, rather than the other way around, as it did prior to the initiation of groundwater pumping. Brandes Decl. at TX_MSJ_000012-000013."

Figure 11 in the Texas Motion is highly idealized and not representative of conditions everywhere in the Rincon and Mesilla basins. The condition shown in Figure 11 generally is limited to periods with low Project supply and high pumping. In addition, the conditions illustrated in Figure 11 also occur in Texas. MMA Report Figure 6.4. The historical relationship between recharge and drain flows in the El Paso Valley is shown in **Figure 8**.



Note: Net recharge computed as canal seepage + on farm deep percolation minus pumping from the SWE Canal and Farm Budget Model.

Figure 8. El Paso Valley Net Recharge vs. Drain Flow (af), adapted from Spronk Rebuttal Figure 19-3.

Spronk Rebuttal at 148.

40. On page 33, Texas states, "The discharge of return flow from the drain into the river is substantially curtailed, if not reduced to zero, thereby also reducing the flow in the river. [Brandes Decl. at TX_MSJ_000012-000013.]"

This statement fails to mention that when drain flows decline in full supply years, the reduction typically is offset by increased releases from Project storage such that there is no change in Rio Grande flow and Project deliveries. See Paragraph 25.

41. On page 33, Texas states, "The phenomenon of reduced river flows caused by groundwater withdrawals is an underlying component of what is referred to as streamflow depletions, and these streamflow depletions have increased along the Rio Grande within the Rincon and Mesilla basins since significant groundwater development began in the early 1950s. Brandes Decl. at TX_MSJ_000012-000013."

This statement misleadingly implies that streamflow depletions have steadily increased in the Rincon and Mesilla valleys in New Mexico from the 1950s through the present. Streamflow depletions attributable to groundwater pumping vary from year to year depending on hydrologic conditions and Project operations. Simulations with the ILRG Model show that streamflow depletions, as reflected in the changes in river flows between scenarios with and without pumping, vary considerably, typically little change in full supply years and greater changes in partial supply years. Spronk Rebuttal at 331-332. Texas also neglects to mention that streamflow depletions attributable to pumping in the Mesilla and El Paso valleys in Texas also impact Project supplies. See Paragraph 18.

42. On page 33, Texas states, "One of the obvious impacts of these increased streamflow depletions has been to alter the Project water budget by reducing flows in the Rio Grande that otherwise would ultimately reach water users in the lower Mesilla basin and in the El Paso Valley in Texas. Brandes Decl. at TX_MSJ_000012-000013."

    This statement ignores that because the Project is operated as a single unit, changes in conditions anywhere within the Project area can affect water deliveries throughout the Project. Spronk Rebuttal at 6. This applies to depletions caused by pumping in Texas in addition to pumping in New Mexico. Id.

43. On pages 33 to 34, Texas states, "In essence, the release of a specific quantity of water from Caballo Reservoir now contributes less to the surface water supply for these users because of the losses of flow due to the increased seepage from the Rio Grande and interior drainage ways, thus altering the previously existing Project water budget. [Brandes Decl. at TX_MSJ_000012-000013.]"

    While it is true that conveyance losses in delivering Project water increase because of pumping impacts on drain flows and seepage, these change have occurred throughout the Project as a result of pumping in New Mexico and Texas. See Paragraph 38.

44. On page 87, Texas states, "The volume of Project water that was split 57/43 in 1938 for the Project to make the allocation to EBID and EP#1 pursuant to the contracts with the United States reflected the acreages of irrigated land in the two Districts at that time and the generally gaining condition of the river below Caballo Reservoir as influenced by relatively high groundwater levels in the absence of significant pumping. [Brandes Decl. at TX_MSJ_000001-000016.]"

    This statement is incorrect. The 57%/43% split of Project supply between EBID and EPCWID reflected the relative authorized Project acreages within each District, as reflected in the Contract between EBID and EPCWID (Feb. 19, 1938), NM_EX 324 ("1938 Downstream Contract"), and not the number of acres that were actually irrigated at that time. The actual irrigated acreage within the Project in 1938 was approximately 140,000 acres, about 20,000 acres less than the full irrigated acreage authorized in the 1938 Downstream Contract. Spronk Report at 43 & Fig. 5-4. The irrigated area within the Project increased gradually through the 1940s, reaching its maximum extent of about 160,000 acres in the early 1950s as shown in **Figure 9**. Id. It has gradually declined in both New Mexico and Texas ever since. Id. However, the actual irrigated acreage within the Project fluctuates from year to year based on a number of factors, including water supply, planting and fallowing decisions by individual farmers, and urbanization. Id. at 43. In addition, the generally gaining condition of the river in 1938 had no bearing on the adoption of the 57%/43% split of Project water between EBID and EPCWID.

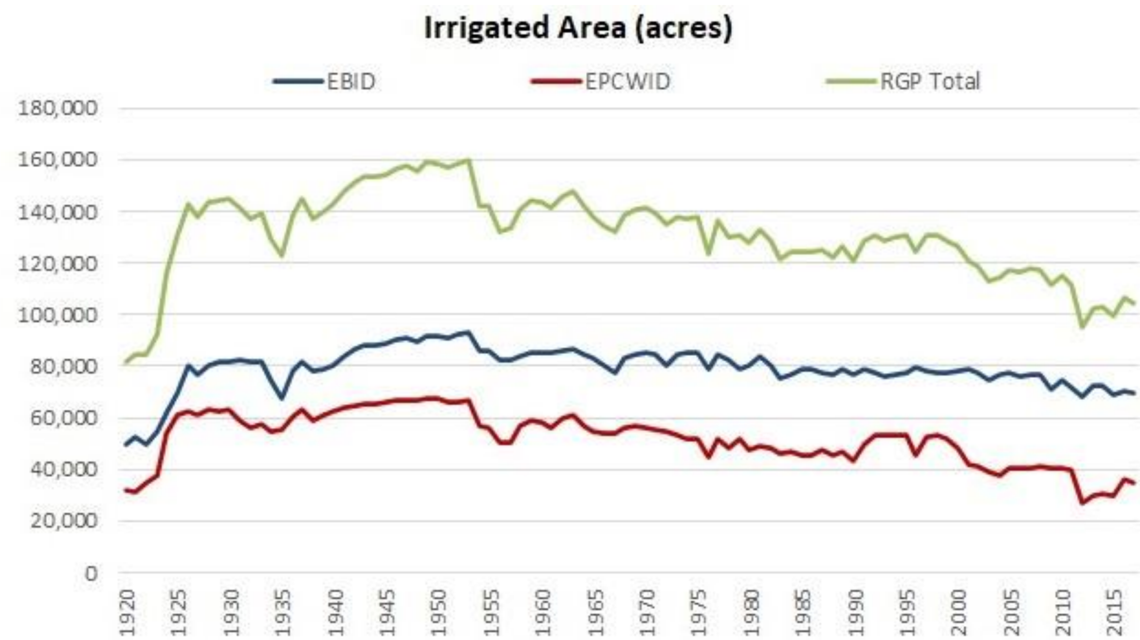


Figure 9. Irrigated Area (acres), adapted from Spronk Report Figure 5-4.

45. On page 87, Texas states, "This changed beginning in the 1950s with the extensive development of groundwater in New Mexico and the subsequent lowering of groundwater levels along the Rio Grande that altered the condition of the river from a generally gaining stream to a generally losing stream. [Brandes Decl. at TX_MSJ_000001-000016.]"

    This statement is incorrect. While some reaches of the Rio Grande were losing during periods of low Project supply and increased groundwater pumping, these reaches recovered and became gaining again during full allocation periods. Spronk Report at 90; Spronk Rebuttal at 57-58. This statement also ignores that groundwater pumping for irrigation in Texas beginning in the 1950s, and before then for municipal use in Texas, also impacted Project deliveries by depleting the Rio Grande, depleting drain flows, and increasing conveyance losses. Spronk Report at 97-98 and Paragraph 28.

46. On page 87, Texas states, "The implications of this change are obvious – river flow losses mean greater depletions and less Project water for downstream users. [Brandes Decl. at TX_MSJ_000001-000016.]"

    This statement is incorrect and misleading. River losses are impacted by factors other than pumping in New Mexico, including but not limited to crop selection, Project operating efficiency, changes in reservoir releases, changes in irrigation efficiency, and the changes in Project allocation procedure that occurred with imposition of the 2008 OA. Spronk Report at 111. In addition, there is no decrease in Project water deliveries in full supply years even with increased conveyance losses caused by pumping if additional water can be released from Project storage to compensate for the increased conveyance losses. See Paragraph 25.

47. On page 27, Texas states, "Surface water and groundwater are interconnected in the Rincon and Mesilla basins. Miltenberger Decl. at TX_MSJ_001612; Declaration of William R.

Hutchison (Hutchison Decl.), attached as TX_MSJ_000657-000661 in Texas's Appendix of Evidence."

This statement is incomplete because it does not also state that groundwater and surface water are also interconnected in portions of the El Paso Valley. The groundwater and surface water have become disconnected in the northern portions of the El Paso Valley due to municipal pumping by El Paso and Juarez. This means that Project water conveyance losses in the disconnected area are at a maximum and are not affected by variations in pumping. NM-EX 006, Barroll 2nd Decl. Paragraph 18.

48. On page 28, Texas states, "This is a losing stream condition, and the seepage rate out of the stream is dependent on the difference between the elevation of the water in the stream and the elevation of the groundwater. [Hutchison Decl. at TX_MSJ_000657-000662.]"

    This statement is incomplete. The seepage rate out of the river is not only dependent on the difference between water surface elevation of the stream and the groundwater level elevation, but also the hydraulic conductivity of the riverbed and aquifer materials. Spronk Report at 73.

49. On pages 28 to 29, Texas states, "In this case, involving a disconnected stream, the seepage rate out of the stream has reached its maximum and is based on the depth of the stream only. [Hutchison Decl. at TX_MSJ_000657-000662.]"

    The seepage rate out of the stream is also affected by the hydraulic conductivity of the riverbed and aquifer materials. Spronk Report at 73.

50. On page 29, Texas states, "Long-term groundwater pumping can result in drawdown to the point where a stream that has been historically gaining (i.e., groundwater flows into the stream providing base flow) can be changed to a losing or disconnected stream (i.e., water percolates out of the stream and recharges the underlying aquifer). [Hutchison Decl. at TX_MSJ_000657-000663.]"

    The statement is incomplete. There are factors other than pumping that can affect river gains and losses. See Paragraph 46.

51. On page 29, Texas states, "A water budget is an accounting for a defined time period of the inflows into, and the outflows from, a defined control area. Brandes Decl. at TX_MSJ_000010-000012."

    This statement is incomplete because it fails to mention that the change in storage within the defined controlled area is also important to water budget analysis. Spronk Report at 124.

52. On page 29, Texas states, "Often, performing a water budget with known volumes of inflows and outflows for a specific time period can lead to the quantification of one or more unknown variables for that same time period. [Brandes Decl. at TX_MSJ_000010-000012.]"

    This statement is correct that, to the extent that certain inflows or outflows are known, the combined amount of the unknowns, including the unknown inflows, unknown outflows, and unknown storage can be arithmetically computed. However, the individual amounts of the unknown inflows, outflows, and changes in storage cannot be disaggregated without further information.

53. On page 29, Texas states, “Performing multiple water budgets for a specific control area for different time periods can provide information regarding how certain phenomena may have changed. [Brandes Decl. at TX_MSJ_000010-000012.]”

This statement is vague, and it is unclear what Texas means by it.

54. On page 29, Texas states, “Even a visual depiction of the water budget for a control area showing the generalized movement of water into, within, and out of the Project area under different conditions and circumstances can be informative and help to understand how the Project water supply system was originally conceived to work and how it has changed with the development of groundwater in New Mexico. [Brandes Decl. at TX_MSJ_000010-000012.]”

Visual depictions can be informative, but they can also be misleading since they tend to be idealized and may not represent the varied conditions that exist in a large area like the Rio Grande Project. In addition, a diagram created today provides little insight into the intentions of the Project planners.

55. On page 86, Texas states, “Since 1938, the volume of groundwater pumped in the Rincon and Mesilla Valleys in New Mexico has increased. Schorr Decl. at TX_MSJ_000697-000699; Brandes Decl. at TX_MSJ_000001-000016, Figure 11.”

This statement misleadingly implies that the volume of groundwater pumping in New Mexico has increased continuously since 1938. Significant pumping for irrigation in New Mexico did not commence until the late 1940’s. Spronk Report at 102. The volume of irrigation pumping in New Mexico has varied with the available Project supply with greater pumping in partial supply years and less pumping in full supply years. Spronk Rebuttal at 152. This statement omits that the amount of groundwater pumping in Texas is far greater now than it was in 1938. Spronk Rebuttal at 153.

56. On page 90, Texas states, “New Mexico has constructed an expensive, time consuming, and complex set of models for use in this litigation.”

The models developed by the New Mexico experts were thoughtfully developed over a number of years and are sufficiently complex to reasonably and rationally simulate the complex Project operations, surface water flows, ground water flows and SW-GW interactions that exist in the Lower Rio Grande between Elephant Butte Reservoir and Ft. Quitman. Spronk Rebuttal at 55.

57. On pages 90 to 91, Texas states, “Its experts have created two detailed groundwater flow models using a version of a modeling system known as MODFLOW. Hutchison Decl. at TX_MSJ_000657-000660, 000664-000669. One of these groundwater models addresses the Rincon and Mesilla aquifers which underlie southern New Mexico and a small portion of Texas, and the other covers the Hueco Bolson aquifer which underlies the El Paso Valley. Id.”

This statement is incomplete. New Mexico’s Rincon-Mesilla groundwater model also simulates ground water flow in the aquifers of the Santa Fe Group that lie below and laterally outward from the Rincon and Mesilla alluvial aquifers. Similarly, the New Mexico’s Hueco groundwater model also simulates the Santa Fe Group aquifers that extends below and laterally outward from the El Paso Valley alluvial aquifer. The simulation domains for the groundwater model components of New Mexico's ILRG Model are shown in **Figure 10**.

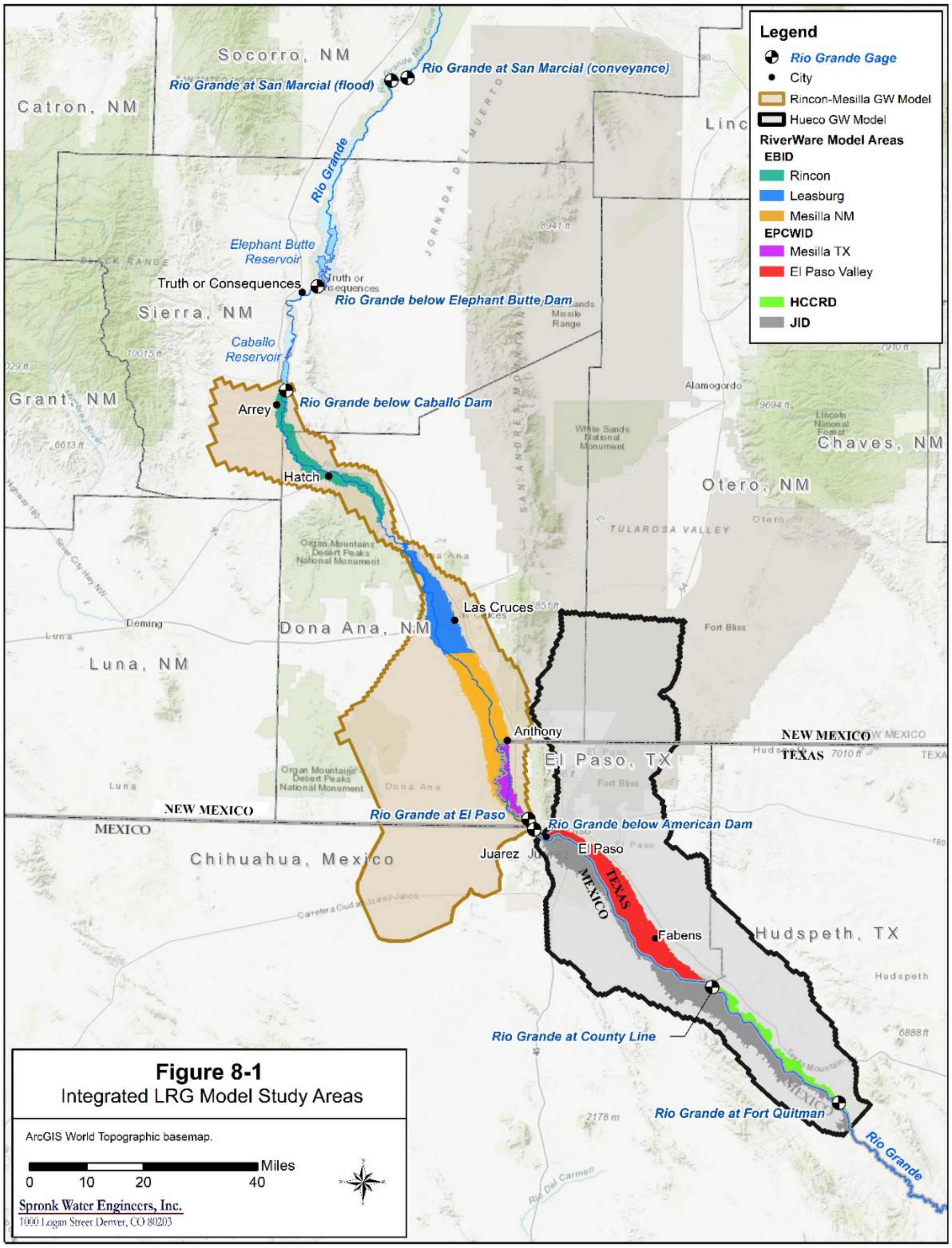


Figure 10. Integrated LRG Model Study Areas, adapted from Spronk Report Figure 8-1.

58. On page 91, Texas states, "These groundwater models have been combined with a RiverWare model of the surface waters network in the Rincon, Mesilla, and El Paso Valleys. [Hutchison Decl. at TX_MSJ_000657-000660, 000664-000669.]"

This statement is incomplete. The RiverWare Model also simulates Project water allocation and accounting, the operation of Elephant Butte and Caballo Reservoirs, canal and on-farm operations throughout the study area, ground water flow in the alluvial aquifers underlying the Rincon, Mesilla, and El Paso Valleys, and the interaction between surface flow and alluvial groundwater flow. Spronk Report at 76. The simulation area for the RiverWare Model component of New Mexico's ILRG Model is shown in **Figure 10**.

59. On page 91, Texas states, "The ILRGM has been used by the New Mexico experts to evaluate various historic conditions and hypothetical situations involving the Compact's appropriation to Texas that New Mexico believes to be involved in this dispute. [Hutchison Decl. at TX_MSJ_000657-000660, 000664-000669.]"

This statement is incorrect. The ILRG Model simulates only one historical condition and that is in the Historical Base Run that is used for comparison to numerous simulations of alternative scenarios involving reduced ground water pumping, alternative Project operations, modified EPCWID operations, and conjunctive use of ground water and surface water. Spronk Rebuttal at 13-15.

60. On page 91, Texas states, "Although Texas disputes the need for, and reliability of, the ILRGM to evaluate certain situations, results from this model are instructive regarding the question of whether groundwater pumping in the Rincon and Mesilla Valleys depletes the surface water flows of the Rio Grande below Elephant Butte and Caballo Reservoirs. Hutchison Decl. at TX_MSJ_000657-000660, 000664-000669."

I agree with Texas that the ILRG Model's results are instructive. New Mexico's ILRG Model is the best available tool for evaluating the claims and counterclaims in this case because it is the only model that (a) simulates the entire area from Elephant Butte Reservoir to Fort Quitman, (b) simulates operation of the Project and LRG irrigation systems using rules that are capable of dynamic response when simulating alternative scenarios, and (c) utilizes monthly stress periods that can distinguish impacts during the irrigation season when the Project is operating from impacts during the non-irrigation season when the Project is not operating. Spronk Report at 9. The excellent calibration of the ILRG Model and its rational simulation of Project operations, surface water flows, ground water flows and SW-GW interaction are convincing evidence of the reliability of the model. Spronk Report at 112.

61. On page 91, Texas states, "New Mexico has run its ILRGM and made calculations from the ILRGM output to address the surface water depletions. [Hutchison Decl. at TX_MSJ_000657-000660, 000664-000669.]"

This statement is incomplete. The ILRG Model was not run only to simulate surface water depletions from pumping. Rather the model simulates the impact of pumping on surface water flows and the effects on Project operations and all simulated processes that result as the changed conditions ripple spatially and temporally through the model just as they would in the real world. This is referred to as "re-operation" and is an essential element of the ILRG Model that is not present in the ground water model of the Rincon and Mesilla basins developed by the Texas experts ("Texas Model"). Spronk Report at 142-143. The ILRG

Model has been used to determine the impact on Project deliveries from pumping, changes in Project operations, changes in EPCWID operations, and in evaluating several conjunctive management scenarios. Spronk Report at 9-11.

62. On page 91, Texas states, "Again, without conceding the need for or reliability of the ILRGM, its results are the only evidence that New Mexico has disclosed on these issues and serve as admissions."

This is incorrect, as New Mexico has disclosed much evidence other than modeling regarding historical changes in streamflow and project supplies. For example, New Mexico disclosed an analysis of the difference in the annual flow of the Rio Grande at the gages below Caballo Reservoir and at El Paso as another measure of depletions. As shown in **Figure 11**, the average annual Caballo-El Paso depletions now are little different than they were circa 1938. Spronk Report at 42 and 181.

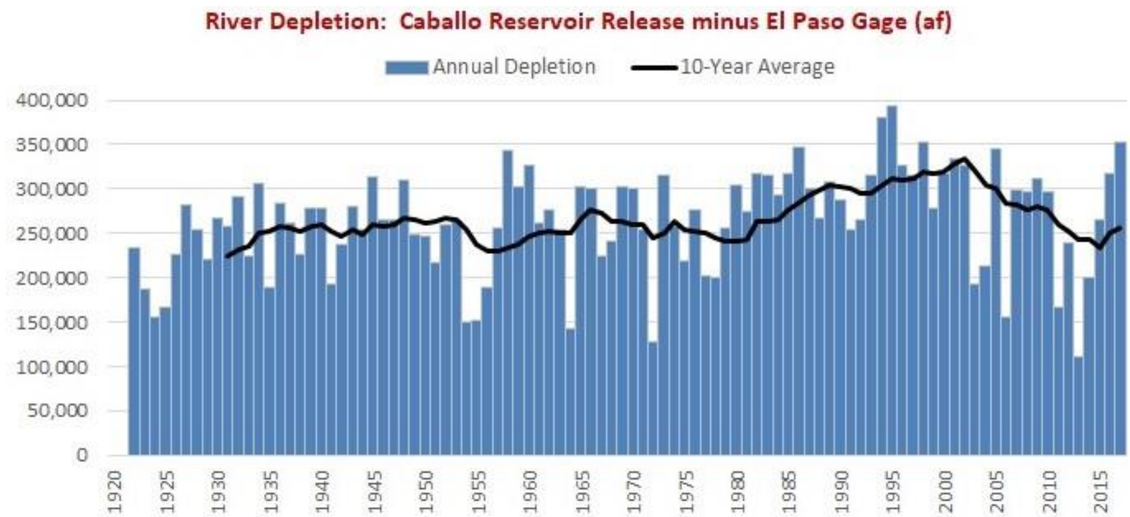


Figure 11. River Depletion: Caballo Release minus El Paso Gage, adapted from Spronk Report Figure 5-2.

63. On page 91, Texas states, "New Mexico's analysis indicates that groundwater pumping during the period of 1940 to 2017 has depleted the streamflow of the Rio Grande, on average, in the amount of 66,351 acre feet per year (AF/yr). Hutchison Decl. at TX_MSJ_000657-000660, 000664-000669."

This statement is misleading for several reasons. First, the figure Texas cited is the average annual change in simulated flow at the El Paso gage (plus changes in Northwest WWTP discharges) based on comparison of the historical base run with historical pumping (Run 1), and an alternative scenario run in which all pumping in the Rincon and Mesilla basins was turned off (Run 6). This included turning off irrigation pumping and M&I pumping in the Texas portion of the Mesilla basin. Texas pumping in the Mesilla basin accounts for a significant portion of the modeled depletions in the simulated flow at the El Paso gage. See Paragraph 18. Second, significant portions of the differences in annual El Paso flows between the historical base run and the no R-M pumping run occur during the winter or as a result of spills from Project storage and, therefore, do not represent impacts to Project deliveries. This is shown in **Table 1** which disaggregates the simulated change in El Paso flow when all pumping in the Rincon and Mesilla basins is turned off in Run 6 between the increased flows during the irrigation season, during the winter, and during reservoir spills.

Table 1. Change in Rio Grande at El Paso Flow, adapted from Spronk Rebuttal Appendix 30F.

Rio Grande at El Paso	Historical Base Run (Run 1) (1,000 af)	Rincon-Mesilla Pumping Off (Run 6) (1,000 af)	Run 6 minus Run 1 (1,000 af)
Reservoir Spills	49.4	67.8	18.4
Nov-Feb Flows	22.8	51.3	28.5
Mar-Oct Flows	263.8	296.6	32.8
Total	336.0	415.7	79.7

Spronk Rebuttal at 418.

Third, the Rio Grande at El Paso gage is not a point of delivery for Texas, and changes in the flows at this gage location have no bearing on the claims or counterclaims in this case. Spronk Report at 108.

64. On Page 91, Texas states, "New Mexico's calculations from this analysis further indicate that 52,610 AF/yr of the total depletion is attributable to New Mexico's pumping and 13,700 AF/yr is due to Texas's pumping."

This statement is misleading and is disputed. See Paragraph 63.

65. On pages 98 to 99, Texas states, "It is undisputed that New Mexico pumping intercepts and depletes the Rio Grande [Hutchison Decl. at TX_MSJ_000657-000669; see section V.F.3, supra (New Mexico admitted that its pumping depletes surface water flows)], and as such, operation of these water rights under New Mexico law conflicts with the Compact – federal law – and the *California* rule has no application."

This statement is disputed. The effect of pumping in New Mexico on the Rio Grande is a complex issue involving interactions of Project operations, surface flows, and ground water flows. Determination of the effects of New Mexico pumping on Rio Grande flows and deliveries of Project water are matters of expert analysis and expert opinion. There are times (e.g., full supply years) when New Mexico pumping has no impact on Project deliveries. See Paragraph 17. This statement is incomplete because it omits that Texas pumping also depletes the Rio Grande and deliveries of Project water. Spronk Rebuttal at 375-376.

66. On page 89, Texas states, "Mr. Lopez concedes that groundwater pumping in New Mexico below Elephant Butte Reservoir has depleted the surface water of the Rio Grande."

This statement is incomplete because it omits that Texas pumping also depletes the Rio Grande and affects deliveries of Project water. Spronk Rebuttal at 375-376; see Paragraph 65.

67. On page 85, Texas states, "In this matter, it is undisputed that groundwater pumping in New Mexico below Elephant Butte Reservoir depletes surface water flow of the Rio Grande, and that groundwater pumping has increased substantially since 1938. Brandes Decl. at TX_MSJ_000001-000016, Figure 10; Schorr Decl. at TX_MSJ_000697-000699."

This statement omits that Texas pumping also depletes the Rio Grande and deliveries of Project water, and that Texas pumping has also increased since 1938. Spronk Rebuttal at 375-376.

68. On page 16, Texas states, "Now, New Mexico's post-Compact development has depleted that water supply by capturing returns flows that otherwise would have been available. Brandes Decl. at TX_MSJ_000006."

This statement omits that Texas pumping, both for irrigation and municipal purposes, also depletes the Rio Grande and deliveries of Project water. Spronk Rebuttal at 375-376.

Declaration of William R. Hutchison

69. I was also asked by counsel for New Mexico to review the Declaration of Dr. William R. Hutchison, which Texas submitted to support its Motion for Partial Summary Judgment, to determine whether any of Dr. Hutchison's statements are inaccurate, disputed, incomplete, and/or are opinions rather than facts.

70. In paragraph 23 of his Declaration, Dr. Hutchison states, "The two major diversion points on the Rio Grande just below the El Paso Narrows are the Acequia Madre (for Mexico) and the American Canal (for Texas)."

This statement is incorrect. Previously, there were two other major river headings in the Project area downstream of the American Canal heading, including the Riverside Canal heading and the Tornillo Canal heading. In addition, there were two other minor river diversions in the Project area further downstream at the Guadalupe heading and the Hudspeth heading. JIR at 101 and Plate 21.

71. In paragraph 26 of his Declaration, Dr. Hutchison states, "Throughout the Rincon and Mesilla Basins in both New Mexico and Texas, there has been varying amounts of groundwater pumping for irrigated agriculture, municipal use, industrial, commercial, domestic, and livestock use."

This statement neglects to mention that there has been pumping in the Hueco Bolson in both Texas and Mexico for irrigated agriculture, municipal use, industrial, commercial, domestic, and livestock use. Spronk Report at 50.

72. In Paragraph 27 of his Declaration, Dr. Hutchison states, "Groundwater flow from the Rincon and Mesilla Basins to the Hueco Bolson is limited to minor flow through Fillmore Pass and the El Paso Narrows due to the geologic structure of the area. This hydrogeologic isolation between the basins means that the Rio Grande at El Paso stream gage is an ideal location to

measure and assess impacts of groundwater pumping in the Rincon and Mesilla Basins to Rio Grande flow."

This statement is incomplete and, therefore, inaccurate because the Rincon-Mesilla Basin and El Paso Valley are hydraulically connected by the surface flow of the Rio Grande. Because the Project is operated as a single unit, the effects of pumping on surface flows in Texas can propagate throughout the Project area and impact deliveries of Project water to New Mexico. Spronk Rebuttal at 46.

73. In Paragraph 36 of his Declaration, Dr. Hutchison states, "One of the important outputs from the ILRGM is the flow of the Rio Grande in the El Paso Narrows (Rio Grande at El Paso). As described above, the El Paso Narrows represents the geographic and hydrogeologic boundary between the Mesilla Basin (upstream) and the El Paso Valley (downstream). If groundwater pumping in the Rincon and Mesilla Basins results in stream depletions, it can be measured at the gaging station in the El Paso Narrows."

Dr. Hutchison implies that the El Paso Gage is a Compact delivery point, but it is not. Spronk Report at 82. Further, due to how the Project is operated, depletions to surface flows caused by ground water pumping in the Rincon and Mesilla Basins will not all manifest as depletions to Rio Grande flows at El Paso. Depletions to surface flows can also affect the following operations and processes upstream of El Paso:

- Project storage and evaporation.
- Diversions of Project water at the Arrey Canal, Leasburg Canal, Mesilla Eastside Canal, Mesilla Westside Canal.
- Deliveries of Project water for irrigation use in EBID and the Mesilla portion of EPCWID.
- Evapotranspiration of native vegetation upstream of the El Paso gage.
- Evaporation from the Rio Grande water surface upstream of the El Paso gage.

Spronk Report at 93 and Spronk Rebuttal at 439-440.

74. In Paragraph 36 of his Declaration, Dr. Hutchison also states, "Any model that simulates surface water-groundwater interactions of the Rincon and Mesilla Basins should reproduce historic flows at this measuring point and should be capable of quantitatively assessing depletions at this measuring point."

The El Paso gage is not a Compact delivery point. Spronk Report at 82. While simulation of the flows at El Paso gage and other points is relevant for assessing model calibration, assessment of depletions to surface flows at the El Paso gage is irrelevant to addressing the claims and counterclaims in this case. More important is use of the model to assess impacts to deliveries of Project water to EBID and EPCWID. Spronk Rebuttal at 45.

75. In Paragraph 38, of his Declaration Dr. Hutchison states, "The relevant ILRGM runs for this declaration are:

- Run 3 – NM Pumping Off (all New Mexico pumping off);
- Run 6 – RM Pumping Off (all Rincon-Mesilla pumping off); and
- Run 7 – TX Mesilla Pumping Off (all Texas pumping in the Mesilla."

Dr. Hutchison states that the relevant ILRGM runs for his declaration are Run 3, 6 and 7, however these are not the only runs relevant in this case. While Dr. Hutchison discusses Runs 3, 6, and 7 in his declaration, the New Mexico experts disclosed many other ILRG Model runs, all of which are relevant to this case. These include other runs in which certain types of pumping and/or pumping in certain geographic areas were turned off, runs with alternative Project allocations, a run with reduced Project operational waste, runs with alternative EPCWID Operations, and various conjunctive administration runs.

76. In Paragraph 39 of his Declaration, Dr. Hutchison states, "These 'pumping off' runs hypothetically assumed no groundwater pumping from 1940 to 2017 and resulted in higher simulated Rio Grande at El Paso flows as compared to the historic operation simulation (Run 1). Under the pumping off runs, groundwater elevations in the Rincon and Mesilla Basins are generally higher than the groundwater elevations in the Rincon and Mesilla Basins in the Run 1 simulation. The higher groundwater elevations result in more groundwater discharge to the surface water system (canals, drains and the Rio Grande itself), and, thus, results in higher surface water flows."

This statement is incomplete because it does not list changes in other simulated model outputs from the model including the following:

- Increased Project storage, reservoir evaporation, releases of Project water, and spills. Spronk Report at 10-11.
- Increased deliveries of Project water to EBID farmers, EPCWID farmers, and EPW. Spronk Rebuttal at 119.
- Increased evapotranspiration by native vegetation and increased evaporation from water surface areas. Spronk Report at 10-11.

Spronk Rebuttal at 12 and 417-418.

77. In Paragraph 40 of his Declaration, Dr. Hutchison states, "The New Mexico experts interchangeably use the terms 'depletion' and 'pumping impact' in the text of their reports, the figures associated with the reports, and the Excel spreadsheets that contain the results of the ILRGM simulations. New Mexico experts generally calculated depletion as the difference between the stream flow associated with a "no pumping" run of the ILRGM and the stream flow associated with the historic operation run of the ILRGM (Run 1)."

This statement is incomplete. The New Mexico experts used the ILRG Model to compute pumping impacts on many model outputs in addition to streamflows. See Paragraph 73.

78. In Paragraph 42 of his Declaration, Dr. Hutchison states, "New Mexico completed a specific analysis of Rio Grande at El Paso depletions using data and results from the ILRGM results

described above. Attachment 4 is the DataAnn sheet of the Excel file named Ferguson Rebuttal revised 9-15-20 v116.xlsx that was disclosed by New Mexico."

Analysis of differences in Rio Grande at El Paso flows between the historical base run and selected alternative scenario runs were computed primarily to compare these results to the changes in El Paso flow determined by Dr. Hutchison using the Texas Model. These results demonstrate the inferiority of the Texas Model due to its limited geographic scope, lack of Project reoperation in alternative runs, and coarse annual stress periods. Spronk Report at 143. The purpose of the analysis of model results shown in Attachment 4 was to rebut the opinion of Dr. Ian Ferguson (U.S. Expert) that the impact of Texas Mesilla pumping on El Paso flows was 20% of the total impact of all pumping in the Rincon-Mesilla basin. As illustrated in the far righthand columns, the Texas Mesilla pumping in some years causes impacts that are far greater than 20% of the total impact of Rincon-Mesilla basin pumping. Spronk Rebuttal at 22-23 and 147, Fig. 19-2.

79. In Paragraph 43 of his Declaration, Dr. Hutchison states, "The first line of Attachment 4 distinguishes results from the ILRGM, and calculations completed in the spreadsheet for the depletion analysis. The first eight columns are labeled 'ILRG,' which means that the data in the columns are directly from ILRGM. The final 11 columns are labeled 'Calc,' which means that the data in the columns are calculations completed in this spreadsheet based on ILRGM results. Please note that the blue color of the 'Calc' columns was from the original Excel file disclosed by New Mexico."

This statement is incomplete because Attachment 4 does not show all of the simulated impacts from pumping.

80. In Paragraph 47 of his Declaration, Dr. Hutchison states, "The Northwest WWTP discharge enters the Rio Grande downstream of the Rio Grande at El Paso stream gage. Thus, the sum of Rio Grande at El Paso and the Northwest WWTP discharge represents the available flow for diversions to the Acequia Madre (Mexico) and the American Canal (Texas) below the El Paso Narrows."

This statement is not accurate. During the irrigation season when Project water is being delivered, the flow at El Paso represents the flow that is being simulated for delivery to the American Canal (Texas) and the Acequia Madre (Mexico). In some years, the irrigation season flows also include additional water spilled from Project storage. During the non-irrigation season when water is not being released from Project storage, the simulated difference in the Rio Grande at El Paso plus NW WWTP flow represents the additional drain flows and river gains that would occur without pumping. Streamflow during this time is not considered Project water. In summary, a substantial portion of the simulated annual changes in Rio Grande at El Paso flows in the ILRG Model do not reflect changes in Project water deliveries. Spronk Rebuttal at 23 and 119.

81. In Paragraph 49 of his Declaration, Dr. Hutchison states, "The annual depletions were presented in Figure 19-2 (page 147) of the September 5, 2020 version of the report by Greg Sullivan and Heidi Welsh and is reproduced below."

The results shown in Figure 19-2 from the Spronk Rebuttal Report represent the annual total impact of Rincon-Mesilla pumping computed as the sum of the impacts during the irrigation season and non-irrigation season. A substantial portion of the annual impacts shown in

Figure 19-2 do not reflect impacts to deliveries of Project water for beneficial use. See Paragraph 63.

82. In Paragraph 52 of his Declaration, Dr. Hutchison states, "Average stream depletions (or groundwater pumping impacts) as calculated at the Rio Grande at El Paso gage for the period 1940 to 2017 based on ILRGM results (as shown in Attachment 4) were reported by experts retained by New Mexico as follows:

- Total Rincon-Mesilla Groundwater Pumping Impact: 66,351 AF/yr
- New Mexico Groundwater Pumping Impact: 52,610 AF/yr
- New Mexico Groundwater Pumping Impact: 79 percent of total impact
- Texas Mesilla Groundwater Pumping Impact: 13,700 AF/yr
- Texas Mesilla Groundwater Pumping Impact: 21 percent of total impact"

The summary of the impact to Rio Grande at El Paso flows from the ILRG Model Runs disclosed by New Mexico represents average annual changes in (a) flows being delivered past the El Paso gage for delivery to EPCWID and Mexico during the irrigation season, (b) spills from Project storage in wet years, and (c) return flows during the non-irrigation that are not considered to be Project water (e.g., Spronk Rebuttal at 418).

83. In Paragraph 53 of his Declaration, Dr. Hutchison states, "The analysis presented in the spreadsheet (Attachment 4) completed by New Mexico experts establishes that groundwater pumping in New Mexico has depleted surface water flow in the Rio Grande."

This statement is incomplete misleading. The impacts shown in Attachment 4 represent total year-around changes in El Paso flows including changes in project spills and changes in non-irrigation season flows that are not considered Project water available for beneficial use.

84. In Paragraph 55 of his Declaration, Dr. Hutchison states, "The ILRGM can be used for analyses that focus on large geographic areas and over a period of few to several years."

This statement is vague. The ILRG Model was used by the New Mexico experts to analyze numerous alternative scenarios and the results from these scenarios are appropriate for accessing the claims and counterclaims in this case. The ILRG Model is the best available tool to analyze the claims and counterclaims in this case. Spronk Report at 9. Spronk Rebuttal at 51 and 112.

85. In Paragraph 56 of his Declaration, Dr. Hutchison states, "Limitations of the ILRGM affect the reliability of results focused on a single year or time periods less than one year, and results that focus on a small geographic area. The geographic and temporal scale limitation of ILRGM results is primarily because the RiverWare model 'governs' the results (Daniel J. Morrissey deposition of December 10, 2019, page 65, lines 13 to 23)."

This statement is misleading. In his deposition testimony, Mr. Morrisey was simply comparing differences between how RiverWare and MODFLOW models simulate the exchange of ground water and surface water. These differences are irrelevant because the performance of the ILRG Model is reflected in its remarkable calibration. Spronk Rebuttal at 112. Further, the calibrated and tuned ILRG Model is the best available tool for evaluating claims, counterclaims, and answering questions about the effects of certain actions on Project operations and deliveries of water to LRG water users. The ILRG Model is superior to the Texas Model for use in the litigation because (a) it simulates the entire LRG Area between the El Paso Gage and Fort Quitman, (b) it employs monthly stress periods that allow it to simulate the important seasonal variations in ground water and surface water flows, and (c) it is capable of simulating the dynamic response of Project operations to changes in flow through rule-based simulation processes. Spronk Rebuttal at 9.

86. In Paragraph 57 of his Declaration, Dr. Hutchison states, "All models are simplifications of real-world systems. The New Mexico RiverWare model calculates surface water-groundwater interaction within 'groundwater objects' that are several square miles in area. In contrast, the New Mexico groundwater models of the Rincon-Mesilla Basins and the Hueco Bolson calculates surface water-groundwater interactions in cells that are 10 acres in area. The groundwater objects in the RiverWare model are analogous to the groundwater model cells when comparing the surface water-groundwater interaction calculations. Daniel J. Morrissey acknowledged that the calculations in the RiverWare model are more 'generalized' than in the groundwater models (Daniel J. Morrissey deposition of December 10, 2019, page 65, lines 6 to 12)."

See Paragraph 85.

87. In Paragraph 58 of his Declaration, Dr. Hutchison states, "In summary, the ILRGM calculations rely on surface water-groundwater interaction calculations that are averaged over an area of several square miles and ignore groundwater model calculations that are averaged over an area of 10 acres in the groundwater models."

See Paragraph 85. In addition, the differences between MODFLOW and RiverWare in the spatial scale of the computed groundwater-surface water interactions need to be considered in the context that much of the Project operation and water use data that are used in the models are available at only irrigation unit or irrigation district scales. These data are necessarily averaged across the smaller computational areas in the RiverWare and MODFLOW components of the ILRG Model. Expert Report of John C. Carron and Steven T. Setzer (Third Edition) (September 15, 2020) ("Hydros Report") at Appendix A page 6-7.

88. In Paragraph 59 of his Declaration, Dr. Hutchison states, "The surface water-groundwater interaction issue is one of the most important aspects of this litigation. Stream depletion is a reduction in streamflow that is caused by groundwater pumping. Calculations of stream depletion with the groundwater models are averaged over areas of about 10 acres, but calculations with the RiverWare model represent averages over areas that are several square miles. The choice by New Mexico experts to rely on the RiverWare model results instead of the groundwater model results is inconsistent with their claims of the sophistication and necessary complexity of the ILRGM (e.g. Daniel J. Morrissey deposition of December 9, 2019, page 44, line 22 to page 45, line 4)."

See Paragraph 85.

89. In Paragraph 60 of his Declaration, Dr. Hutchison states, "Reliance on the ILRGM and its simplified representation of the surface water-groundwater interactions in the RiverWare model is appropriate for evaluating impacts of pumping over a large scale (i.e., impacts of pumping in New Mexico and impacts of pumping in Texas) and over a few to many years."

See Paragraphs 84 and 85.

90. In Paragraph 61 of his Declaration, Dr. Hutchison states, "However, the limitations prevent reliable use of ILRGM results for analyses over smaller scales (several square miles) and for short time scales (months to a single year)."

See Paragraphs 84 and 85. This statement is vague, as it is unclear what specific small scaled geographic areas or short times scales that Dr. Hutchison is referring to. The ILRG Model is reliable and suitable for analyzing the claims and counterclaims in this case. It has been shown to be far superior to the Texas Model and therefore is the best available modeling tool for use in this case. Spronk Rebuttal at 13.

Declaration of Robert J. Brandes

91. I was also asked by counsel for New Mexico to review the Declaration of Dr. Robert Brandes, submitted by Texas in support of its Motion for Partial Summary Judgment, to determine whether any of Dr. Brandes's assertions are inaccurate, disputed, incomplete, and/or are opinions rather than facts.

92. In Paragraph 11 of his Declaration, Dr. Brandes states, "The primary purpose of the joint investigation was to compile factual data essential to support an apportionment of the waters of the Rio Grande above Ft. Quitman. JIR at vi-vii. A true and correct copy of the JIR is attached hereto as Attachment 2."

This statement is incomplete. The JIR also reflects the understanding and expectations of Reclamation and the States of Colorado, New Mexico, and Texas about the continued development of the Project and how the Project would be operated. Spronk Report at 115.

93. In Paragraph 12 of his Declaration, Dr. Brandes states, "The Rio Grande winds southward approximately 400 miles across New Mexico, and crosses into Texas near the city of El Paso, where it defines the 1,250-mile international boundary between the United States and Mexico as it traverses to the Gulf of Mexico. The entire Rio Grande basin is depicted on the map below entitled Figure 1."

This statement is generally correct, however the map in Figure 1 is misleading because it is not to scale and incomplete because it doesn't show the entire basin to the Gulf of Mexico and doesn't show important gages and other features.

94. In Paragraph 13 of his Declaration, Dr. Brandes states, "Along its entire course, the Rio Grande provides a source of surface water that is used extensively to meet the needs of municipalities, industries, and agricultural irrigators, as well as to support various environmental uses. Numerous dams and reservoirs exist along the river primarily for water supply and flood control purposes; consequently, flows in much of the river are substantially controlled and regulated."

This statement is generally correct but lacks specificity.

95. In Paragraph 14 of his Declaration, Dr. Brandes states, "With respect to the usage of water, the river is divided into two distinct sections at Fort Quitman. The Upper Rio Grande basin (the area above Fort Quitman, Texas) is comprised of parts of Colorado and New Mexico, and a very small part of Texas. The Upper Rio Grande basin itself is divided into three sections: (1) the San Luis section in Colorado, (2) the Middle section in New Mexico, and (3) the Elephant Butte-Fort Quitman section in New Mexico, Texas, and Mexico. JIR at 7.

This case is centered primarily upon issues involving the Elephant Butte-Fort Quitman section of the Upper Rio Grande basin. Figure 2 depicts the Upper Rio Grande basin."

Figure 2 in Dr. Brandes's Declaration is illegible.

96. In Paragraph 17 of his Declaration, Dr. Brandes states, "The states of Colorado, New Mexico, and Texas agreed to the Rio Grande Compact in 1938 (1938 Compact or Compact). As a result of the negotiations to formalize the 1938 Compact, depletions were frozen at pre-1938 conditions. Two delivery schedules, or indices, were adopted: one for Colorado to New Mexico, and one for New Mexico to Elephant Butte Reservoir. These schedules were derived from streamflow data and analyses developed primarily by the JIR – an effort to provide the needed data to resolve the impasse over the apportionment of the Rio Grande waters above Fort Quitman."

The Project has never been operated based on depletions at pre-1938. However, to the extent that conditions existing at the time of the Compact are relevant to this case, Dr. Hutchison's characterization of those conditions based on stream depletions in the single year of 1938 are inappropriate. As shown in **Figure 11**, depletions in the Lower Rio Grande varied widely from year to year around the time of the Compact. Spronk Report at 181. This is due to a variety of factors, including temperature and precipitation, variations in crop choice and irrigation practices, fallowing decisions, and so on. Because stream depletions vary so much from year to year, analysis of depletions in a single year is inappropriate to characterize a Compact condition or 1938 conditions. To the extent that a "1938 Condition" is relevant to this case, it should consider (a) that new Project lands continued to be developed and put into irrigation until the mid-1950s, (b) the parties would have expected changes in crops and improvements in irrigation practices, and (c) the conjunctive use of ground water and surface water through development of irrigation wells occurred in both states with the encouragement of Reclamation to maintain the viability of the Project through the unprecedented droughts that occurred after the Compact.

97. In Paragraph 18 of his Declaration, Dr. Brandes states, "The total water supply available for diversion by Elephant Butte Irrigation District (EBID), El Paso County Water Improvement District No. 1 (EP#1), and Mexico included storage in and releases from Elephant Butte Reservoir and return flows generated within EBID and EP#1. New Mexico's post-Compact development has depleted that water supply by capturing returns flows that otherwise would have been available."

This statement is incomplete and disputed. First, Dr. Brandes fails to mention other supplies allocated as Project water, including tributary inflows and municipal return flows that are also used in EBID and EPCWID. Dr. Brandes also fails to mention that EPCWID is not charged for its use of municipal return flows in the El Paso Valley. Finally, Dr. Brandes implies that it was only the post-Compact development in New Mexico that depleted Project supplies. Because the Project is operated as a single unit, development anywhere within the Project can affect Project deliveries and therefore impact the supply to all Project water users. Paragraph 42. Spronk Rebuttal at 46.

98. In Paragraph 20 of his Declaration, Dr. Brandes states, "Mining of a groundwater basin means that more water is being pumped from the groundwater basin than can be replaced, causing groundwater levels to decline and, in the context of this case, has caused further depletion of

the volume of water available to Texas. Groundwater pumping in New Mexico continues unabated today."

See Paragraph 22. In addition, Dr. Brandes misrepresents the extent of pumping in New Mexico. New Mexico's pumping capacity was largely developed by the mid-1950s. Spronk Report at 101. Since that time, most of New Mexico's irrigation pumping has been to supplement the available Project water supply, with more pumping in dry years with lower Project water allocations and less pumping in years with greater allocations. The average irrigation pumping in New Mexico during recent years is not much greater than it was during the 1950s. Spronk Report at 89. While pumping in dry years caused ground water levels to decline in dry years, increased deliveries of Project water in average and wet years combined with reduced pumping resulted in recovery of ground water levels. The unprecedented ground water level declines during the recent drought were caused by the 2008 OA, which substantially reduced Project water deliveries to New Mexico, resulting in increased pumping. Municipal and other non-irrigation pumping by New Mexico has increased modestly during recent decades but, at approximately 37,000 AF/y, remains much less than the historical irrigation pumping. Spronk Rebuttal at 5.

99. In Paragraph 21 of his Declaration, Dr. Brandes states, "Colorado, New Mexico and Texas adopted the Compact in 1938 to ensure, among other things, a prescribed delivery of water from the Rio Grande in Elephant Butte Reservoir. The Project is dependent on the Compact for its water supply. The Project, in turn, is the means by which the water apportioned to Texas by the Compact is stored in Elephant Butte Reservoir, and subsequently delivered to Texas (subject to deliveries to EBID, pursuant to its contract with the United States, and to Mexico, pursuant to the 1906 Treaty). The relationship between the Compact and the Project is critical to the ability to effectively supply water from the Rio Grande to users in Texas, EBID, and Mexico. Both the Project and the Compact were conceived and implemented prior to the significant development of groundwater in the Rincon and Mesilla basins of New Mexico, which began in the early 1950s."

See Paragraph 23.

100. In Paragraph 22 of his Declaration, Dr. Brandes states, "Today, the Project includes Elephant Butte Dam and Reservoir, Caballo Dam and Reservoir located immediately below Elephant Butte Dam, a hydropower plant at Elephant Butte Dam, three diversion dams on the Rio Grande in New Mexico (Percha, Leasburg, and Mesilla), two diversion dams on the Rio Grande in Texas (American and International, both owned and operated by the International Boundary and Water Commission), and an extensive system of canals, laterals, waste ways, and drainage ways that support irrigation operations in EBID and EP#1. The major dams and reservoirs and the diversion dams included in the Project are identified on the map of the region in Figure 5."

Dr. Brandes does not mention that the Project previously included four additional river diversions within the Project area in Texas downstream of American Dam, including at the Riverside Dam, the Tornillo heading, the Guadalupe heading, and the Hansen heading. See Paragraph 70. These additional dams facilitated reuse of return flows and other sources of water that arose within the EPCWID area. Although the Tornillo, Hansen, and Guadalupe headings were removed as part of the Rio Grande Rectification, EPCWID continued to use return flows for irrigation by diverting water from drains until the early 1980s. Spronk Rebuttal at 33.

101. In Paragraph 23 of his Declaration, Dr. Brandes states, "There are 159,650 acres authorized within the Project, with 90,640 acres within EBID in New Mexico and 69,010 acres within EP#1 in Texas. These acreages translate to approximately a 57/43 split for the distribution of irrigable acres between EBID and EP#1 (collectively 'Districts')."

This statement lacks context. The original authorized acres consisted of 88,000 acres in EBID and 67,000 acres in EPCWID. The 1938 Downstream Contract provided for a 3% increase in the original authorized acres. However, the actual irrigated area in the Project in 1938 was less than the authorized acres. Project lands continued to be developed after 1938 and peaked at approximately 160,000 acres in the early 1950s. Spronk Report at 43. The irrigated Project lands have declined since that time to approximately 70,000 acres in EBID and 35,000 acres in EPCWID. Id. at 183.

102. In Paragraph 24 in his Declaration, Dr. Brandes states, "Releases of Project water stored in Elephant Butte and Caballo Reservoirs are made at the start of the irrigation season (typically February) to Project users in New Mexico and Texas, and to Mexico. The Districts request releases of stored water during the irrigation season in response to irrigation demands. As a practical matter, however, diversions by the Districts and Mexico consist of varying amounts of reservoir storage, return flows from upstream irrigation operations, and occasional arroyo inflows. Return flows are a key part of Project operations, and interference with return flows removes a critical component of deliveries to Project users. Project return flows consist of excess irrigation tailwater and groundwater seepage from irrigated fields that are collected in drains that convey these return flows to the Rio Grande. The proportion of return flows in the river increases in the downstream direction relative to stored water from the reservoirs, and the water diverted by Project users in the lower Mesilla basin and in the El Paso Valley of Texas includes diversion of significant quantities of return flows."

The statement is incomplete. See Paragraphs 25-27. Interference with return flows through depletions from pumping do not necessarily affect Project deliveries. In full-supply years, Reclamation can release additional water from storage if return flows are reduced. Spronk Report at 12. Dr. Brandes also fails to consider that Texas has ceased using return flows that arise in the Hueco area. Spronk Rebuttal at 24. This has increased the amount of water that must be released from Project storage to meet Texas demands. Spronk Rebuttal at 130. Dr. Brandes further fails to mention that Project return flows also include reasonable operational waste and not just excess water supply. Dr. Brandes also implies that Project return flows must return to the bed of the Rio Grande channel to be usable, but this is not correct. This is particularly the case in EPCWID in the El Paso Valley where municipal return flows are discharged to canals and irrigation return flows accrue in drains, and these return flows are available for use in EPCWID even though they don't accrue to the Rio Grande channel. Records show that EPCWID diverted water from drains for irrigation use until the early 1980s and EPW WWTP returns continue to be a significant source of irrigation supply for EPCWID farmers. Spronk Report at 58 and 59. In addition, the proportion of return flows in the river varies depending on the time of year with relatively less returns early in the irrigation season and relatively more returns late in the season. The proportion of return flows in the river also varies with the hydrologic condition, with generally relatively less returns in dry periods and relatively more returns in wet periods. Spronk Rebuttal at 168, 170-171.

103. In Paragraph 25 of his Declaration, Dr. Brandes states, "Figure 6 is Table 90 of the JIR. It shows the percentage of net diversions for each valley for reservoir releases, arroyo flow, and drain flow for the period prior to the Compact. The net diversions in the Rincon portion of EBID contained 0.3 percent drain flow and seepage (return flows) and net diversions in the Mesilla portion of EBID contained 7.4 percent, while the net diversions into the Franklin canal in EP#1 contained 35.1 percent return flows and the net diversions into the Tornillo canal in EP#1 contained 57.7 percent return flows and only 38.2 percent of reservoir releases."

The percentages of net diversions in various divisions of the Elephant Butte to Ft. Quitman area in Figure 6, from Table 90 of the JIR, are averages derived from analysis of 1930-1936 data and estimates. JIR at 100. The percentages represent Project facilities that included river diversions in the El Paso area at Riverside, Hansen, Guadalupe, and Tornillo dams that no longer serve the EPCWID. The removal of these dams and cessation of use of drain flows by EPCWID in the early 1980s has resulted in an increase in releases from Project storage that are needed to deliver Project water to EPCWID. These increased releases have reduced the supply of Project water available for allocation and delivery to New Mexico. Spronk Rebuttal at 130-132 and 703-704.

104. In Paragraph 27 of his Declaration, Dr. Brandes states, "Within the Project area from Elephant Butte Reservoir downstream to Fort Quitman, Texas, the Rio Grande covers approximately 210 river miles. Project water was to be allocated between irrigators in southern New Mexico and in the El Paso Valley of Texas in proportion to the irrigated acreage of Project lands within each state."

See Paragraph 44.

105. In Paragraph 28 of his Declaration, Dr. Brandes states, "A water budget is an accounting for a defined time period of the inflows into, and the outflows from, a defined control area. Often, performing a water budget with known volumes of inflows and outflows for a specific time period can lead to the quantification of one or more unknown variables for that same time period. Performing multiple water budgets for a specific control area for different time periods can provide information regarding how certain phenomena may have changed. Even a visual depiction of the water budget for a control area showing the generalized movement of water into, within, and out of the area under different conditions and circumstances can be informative and help to understand how the Project water supply system was originally conceived to work and how it has changed with the development of groundwater in New Mexico."

See Paragraphs 51 - 54.

106. In Paragraph 29, Dr. Brandes states, "I have utilized conceptual water budgets to illustrate the effect of groundwater depletions in the Project area within the Rincon and Mesilla basins of New Mexico where significant groundwater development began in the early 1950s. Prior to the development of extensive groundwater pumping in the Rincon and Mesilla basins, groundwater levels generally were relatively high and fluctuated in response to the seasonal application of irrigation water from the Rio Grande on Project lands. In the early days of the Project, this phenomenon created a serious problem. Soon after the Project began delivering water to the irrigators, groundwater levels rose in New Mexico to and above ground level, thereby waterlogging and making useless land previously capable of growing crops. The

solution was to construct a complex system of drains that would capture excess groundwater created by irrigation and return it to the river. This "return flow" became a significant source of irrigation water for downstream irrigators, particularly in Texas, a fact recognized and catalogued in the JIR. With the construction of the drains, irrigation water not consumed by crops and other vegetation or by evaporation, percolated down through the soil into the groundwater system, which typically flowed toward and into drains specifically designed for collecting groundwater and for conveying groundwater and excess irrigation tailwater away from fields and to the Rio Grande. This condition is illustrated in a general fashion by the diagram in Figure 10."

This statement is incomplete. See Paragraphs 29-31. In addition, significant ground water development for irrigation commenced in the Rincon, Mesilla, and El Paso Valleys in the late 1940s in response to developing drought conditions. Spronk Report at 78. There also was development of ground water for municipal use in El Paso and Juarez prior to the 1950s. Spronk Report at 206-207. Before extensive irrigation and municipal groundwater development in the Hueco bolson by Texas and Mexico, groundwater levels in the El Paso valley were relatively high and fluctuated in response to the seasonal application of irrigation water. NM-EX 121, MMA Report, App. Q. Ground water levels rose throughout the Project in response to irrigation, including in Texas. Return flows logically would have been a significant source of irrigation water to the Project prior to the drain construction.

107. In Paragraph 30 of his Declaration, Dr. Brandes states, "As shown in Figure 10, Project water is diverted from the Rio Grande into an irrigation system canal and then distributed to individual irrigated fields, where it is either consumptively used by the growing crops or evaporated into the atmosphere. Any excess irrigation water is either discharged directly to the drain as tailwater or percolated through the subsurface into the groundwater system. The bottom of the drain is below the upper level of the groundwater; thus, groundwater is induced to flow toward and into the drain. Similarly, the bottom of the river channel is below the level of the groundwater, with water shown flowing in both directions depending on the relative heights of the water in the river and the groundwater from location to location. The irrigation tailwater and groundwater that is collected in the drain flows to the river and is referred to as return flow. The return flow from the drain that is discharged into the Rio Grande provides an important supply of Project water for users located downstream, namely users in the lower Mesilla basin and in the El Paso Valley of Texas. This important source of water for Project users was contemplated in the early development of Project operations and in the negotiations among the states leading up to the adoption of the 1938 Compact."

See Paragraphs 31 - 35.

108. In Paragraph 31 of his Declaration, Dr. Brandes states, "For example, the JIR investigation determined that approximately 35 percent of the total supply of Project water delivered to Texas in the El Paso Valley was from upstream return flows, with the majority of the balance originating as releases from Caballo Reservoir. Conversely, since water for Project users in New Mexico was diverted from the Rio Grande farther upstream, i.e., above the river outfalls of most drains, less than seven percent of New Mexico's total deliveries originated from return flows."

This statement is incomplete. The percentages referenced by Dr. Brandes are taken from Table 90 of the JIR. The relative portions of the Project supply for the El Paso Valley were determined based on assumed reuse of return flows downstream to the Tornillo Canal. EPCWID's cessation of irrigation use of return flows that arise in the El Paso Valley have adversely impacted EBID. See Paragraph 26.

109. In Paragraph 32 of his Declaration, Dr. Brandes states, "With the extensive development of groundwater in the Rincon and Mesilla basins of New Mexico that began during the early 1950s – particularly in the relatively shallow aquifers with generally high groundwater levels such as those along the Rio Grande – groundwater levels began to fluctuate and decline in some areas. This in turn caused discharges of groundwater into the drains, and directly into the river, to be reduced. Eventually, with enough groundwater pumping, the groundwater gradient in many areas reversed, with significant reductions in the groundwater inflows to the drains and into the river. This condition is illustrated by the diagram in Figure 11."

See Paragraph 36-39.

110. In Paragraph 33 of his Declaration, Dr. Brandes states, "As shown in Figure 11, the level of the groundwater is below the bottom of the river channel and the drain, and water flowing in the river and in the drain moves toward and into the groundwater system, rather than the other way around, as it was prior to the initiation of groundwater pumping. The discharge of return flow from the drain into the river is substantially curtailed, if not reduced to zero, thereby also reducing the flow in the river."

See Paragraphs 39 and 40.

111. In Paragraph 34 of his Declaration, Dr. Brandes states, "The phenomenon of reduced river flows caused by groundwater withdrawals is an underlying component of what is referred to as streamflow depletions, and these streamflow depletions have increased along the Rio Grande within the Rincon and Mesilla basins since significant groundwater development began in the early 1950s. One of the obvious impacts of these increased streamflow depletions has been to alter the Project water budget by reducing flows in the Rio Grande that otherwise would ultimately reach water users in the lower Mesilla basin and in the El Paso Valley in Texas. In essence, the release of a specific quantity of water from Caballo Reservoir now contributes less to the surface water supply for these users because of the losses of flow due to the increased seepage from the Rio Grande and interior drainage ways, thus altering the previously existing Project water budget."

See Paragraphs 41 - 43.

112. In Paragraph 37 of his Declaration, Dr. Brandes states, "Regarding the 57/43 split, referable to Project allocations, the Project delivers the water available to it at the points of diversion on the river. The volume of Project water that was split 57/43 in 1938 for the Project to make the allocation to EBID and EP#l pursuant to the contracts with the United States reflected the acreages of irrigated land in the two Districts at that time and the generally gaining condition of the river below Caballo Reservoir as influenced by relatively high groundwater levels in the absence of significant pumping. This changed beginning in the 1950s with the extensive development of groundwater in New Mexico and the subsequent lowering of groundwater levels along the Rio Grande that altered the condition of the river from a generally gaining stream to a generally losing stream. The implications of this change are obvious - river flow losses mean greater depletions and less Project water for downstream users. The Project has no control over New Mexico's depletions and can only allocate the amount of water

remaining after the New Mexico groundwater pumping depletes Project water in the river, including Reservoir releases."

This statement is incorrect. The 57/43 split refers to a division of the allocation of Project water deliveries to the end users. Until 1978, the Project was operated to allocate equal water to each Project acre and deliver it directly to Project water users, resulting in approximately 57% of Project water being allocated to lands in New Mexico and 43% to lands in Texas. The D1/D2 Curves were developed to maintain the same relative allocation of deliveries to Project lands in both States following the transfer of ownership and operational responsibility for the Project's delivery infrastructure to the Districts. Using the D1/D2 Curve allocation procedures, Project deliveries were accounted for at the river headings rather than at the farm headgates. During the D1/D2 allocation period, Project water allocations were computed based on the water in Project storage. Spronk Report at 22-23. The pumping that existing during the D1/D2 data period was effectively grandfathered into the D1/D2 curves and associated allocation procedure. During the time after the D1/D2 data period and prior to implementation of the allocation under 2008 OA (1979-2005) pumping in New Mexico did not rise above the level that existed during the D1/D2 data period. Spronk Rebuttal at 27. See Paragraphs 44 - 46.

Declaration of Staffan Schorr

113. I was also asked by counsel for New Mexico to review the Declaration of Staffan Schorr, submitted by Texas in support of its Motion for Partial Summary Judgment, to determine whether any of Mr. Schorr's assertions are inaccurate, disputed, incomplete, and/or are opinions rather than facts.

114. In Paragraph 11 of his Declaration, Mr. Schorr states, "From my work in this case, I have concluded that the volume of groundwater pumped in the Rincon and Mesilla Valleys of New Mexico has increased since 1938."

See Paragraph 55. Ground water development for irrigation occurred in New Mexico and Texas after 1938 in response to unprecedented drought and with the encouragement of Reclamation. Spronk Report at 102 and 194.

115. In Paragraph 13 of his Declaration, Mr. Schorr states, "Also based on my work on this matter, I conclude that the number of groundwater wells in the Rincon and Mesilla Valleys (below the Elephant Butte and Caballo Reservoirs and above the New Mexico-Texas state line at El Paso, Texas) has increased since 1938 from less than 60 to about 8000 in 2020. I made this conclusion based on well data and information my office obtained, and that I personally reviewed and analyzed, from the New Mexico OSE."

See Paragraph 21.

116. In Paragraph 14 of his Declaration, Mr. Schorr states, "I was asked by counsel to prepare a map of the groundwater wells in the Rincon and Mesilla Valleys of New Mexico (below the Elephant Butte and Caballo Reservoirs and above the New Mexico-Texas state line at El Paso, Texas) existing in 1938, and the groundwater wells in the same geographic area that currently exist as of October 2020. To do that, I obtained well data from the New Mexico OSE and displayed wells based on location coordinates, well type, and installation date specified in the datasets."

See Paragraph 21.

117. In Paragraph 15 of his Declaration, Mr. Schorr states, “Figures 3 and 4, depicted above, accurately reflect the change in number and distribution of groundwater wells in New Mexico in the Rincon and Mesilla Valleys in New Mexico (below Elephant Butte and Caballo Reservoirs and above the New Mexico-Texas state line at El Paso, Texas).”

See Paragraph 21.

New Mexico’s Integrated Lower Rio Grande Model

118. New Mexico’s ILRG Model is the best available tool for evaluating the claims and counterclaims in this case because it is the only hydrologic model available to evaluate the effects of groundwater pumping and changes in historical Project operations on Project deliveries to Texas and New Mexico. Spronk Expert Report at 9. The ILRG Model is superior to the Texas Model because (a) it simulates the entire Lower Rio Grande area from Elephant Butte Reservoir to Fort Quitman, (b) it employs monthly stress periods that allow it to simulate the important seasonal variations in groundwater and surface water flows, and (c) it is capable of simulating the dynamic response of Project operations to changes in flow throughout the entire Project area. Spronk Report at 9. Conversely, the Texas Model fails to accurately evaluate pumping effects to Project deliveries because it does not simulate the dynamic response of Project reservoir releases to changes in flows that occur without pumping, provides no simulations for the area downstream of the El Paso gage and thus cannot simulate the feedback response from a large part of the Project area, and uses annual stress periods that prevent distinguishing impacts that occur during the Project release period (irrigation season) from impacts that occur during the non-irrigation season. In short, the absence of dynamic simulation of Project operations renders the Texas Model of no utility in analyzing the key issue presented in this case: impacts to Project deliveries from groundwater pumping and changes in historical Project operations. Spronk Report at 113.

119. The ILRG Model has been used to run several model scenarios that evaluate New Mexico’s pumping, Texas’s pumping, the impacts of implementing the 2008 OA, the impacts of changes to historical Project operations and accounting in EPCWID on overall Project allocations, and various potential conjunctive use scenarios. The ILRG Model is the only model in this case that is capable of analyzing and quantifying the effects of these scenarios. Spronk Report at 47. The Texas Model is incapable of such analyses.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on December 21, 2020

Gregory K. Sullivan, P.E.

May 31, 2019

EXPERT REPORT OF:
William R. Hutchison

In the matter of:

No. 141, Original
In the Supreme Court of the United States
State of Texas v. State of New Mexico and State of Colorado

Prepared for:

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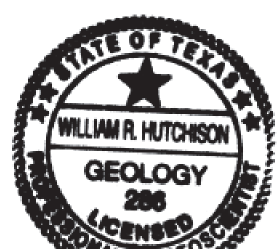
5/31/2019



William R Hutchison
5/31/2019

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1.0 Introduction

1. My name is William R. Hutchison, Ph.D., P.E., P.G. I was born on November 4, 1958 in Nueces County, Texas.

2. My street address is 16717 Captain Hook Road, Jamaica Beach, TX 77554. The US Postal Service does not provide home mail service to my address. My mailing address is 9305 Jamaica Beach, Jamaica Beach, TX 77554.

3. I have been retained by the State of Texas to provide consulting services on hydrologic issues presented in the Lawsuit.

4. I am being compensated for work on this assignment at the rate of $150 per hour plus expenses.

2.0 Professional Background and Specific Qualifications

5. My professional resume is included as Attachment 1.

6. I am an independent consultant with over 35 years of professional experience as a groundwater hydrologist.

7. I am licensed in Texas as follows: Professional Engineer (Geological and Civil) No. 96287, Engineering Firm No. 14526, and Professional Geoscientist (Geology) No. 286.

8. My education includes a Bachelor of Science degree in Soil and Water Science from the University of California, Davis, a Master of Science degree in Hydrology from the University of Arizona, and a Ph.D. in Environmental Science and Engineering from the University of Texas at El Paso.

9. From August 1983 to October 2001, I was employed by various consulting firms or worked as an independent consultant in California and Arizona.

10. From October 2001 to June 2009, I was employed by El Paso Water Utilities in El

Paso, Texas.

11. From June 2009 to August 2011, I was the Director of the Groundwater Resources Division of the Texas Water Development Board in Austin, Texas.

12. From August 2011 to July 2012, I was employed by LBG-Guyton Associates in Austin, Texas.

13. Since July 2012, I have been an independent consultant based in Austin, Texas (July 2012 to July 2015), Aberdeen, North Carolina (July 2015 to January 2016), and Jamaica Beach, Texas (January 2016 to present).

14. As an independent consultant since July 2012, I have completed (or I am actively working on) over 60 consulting assignments for over 30 different clients in Texas.

15. In the last four years, I have testified as an expert witness in one case. In August 2016, I was retained by the Middle Pecos Groundwater Conservation District (District) to testify in Fort Stockton, Texas at a mandamus action filed against the District by Republic Water Company of Texas, LLC (Republic). Republic sued the District to have its permit application declared administratively complete despite not including results from a model run, which is a requirement under the District's administrative rules. My testimony involved details of the required model run. The Court agreed with the District's interpretation of the administrative completeness requirements.

16. A summary of my experience with developing, reviewing, updating, and running simulations with 30 groundwater models in Texas since 2001, and 24 models outside of Texas prior to 2001 is presented in Attachment 2.

17. The model code used in this consulting assignment is MODFLOW-USG (Unstructured Grids), which was publicly released by the US Geological Survey in 2013.

18. As shown in Attachment 2, I was a secondary developer of Llano Uplift Region model and the Lower Rio Grande Flow and Transport Model which used the MODFLOW-USG code.

19. Also shown in Attachment 2, I am the primary developer of three models listed as "in progress" (Bluebonnet GCD Model, Kinney County – Version 2, Pecos County – MPGCD). These models will use either the MODFLOW-USG code or the MODFLOW-6 code, and these models utilize unstructured grids.

20. My direct experience in the El Paso, Texas area began in 2001. One of my first assignments when employed by El Paso Water Utilities was to review the Canutillo Area model. The model and report had just been delivered to El Paso Water Utilities in draft form by CH2M-Hill. My review comments on the draft report included improving the section on the history of previous models of the Mesilla Bolson.

21. Also, in late 2001, I began to review the draft model that had been developed by the US Geological Survey of the Hueco Bolson. El Paso Water Utilities was one of the cooperators on the development of the model. My work from 2001 to 2004 culminated in the preparation of a report that detailed an update of the Hueco Bolson model and the results of several simulations with the Canutillo Area model and the updated Hueco Bolson model. The simulation results were the foundation of El Paso's comprehensive conjunctive use strategy for the Mesilla Bolson, the Hueco Bolson, and surface water diversions from the Rio Grande that was included in the 2005 Regional Water Plan, which, in turn, were incorporated into the 2006 State Water Plan adopted by the Texas Water Development Board.

22. In 2006, I completed my doctoral dissertation, Chapter 5 of which covered groundwater conditions in the Mesilla Bolson (Hutchison, 2006). Of note was the recommendation that the Mesilla Bolson model (the basis of the Canutillo Area model) needed to

be updated.

23. On June 11, 2008, the US Geological Survey, Texas AgriLife Research Center, and the New Mexico Water Resources Research Institute convened a meeting in El Paso to receive stakeholder input on the initial year's work plan for the Transboundary Aquifer Assessment Program that was focused on the Mesilla Bolson. At this meeting, it was announced that a model of the Mesilla Bolson had been released to the public that had been developed by S.S. Papadopulos and Associates for the state of New Mexico Office of State Engineer in late 2007. After the June 11, 2008 meeting, I downloaded a copy of the model files and documentation. In this expert report, this model is called the OSE Model (for New Mexico Office of State Engineer).

24. I sent a letter on July 11, 2008 (Attachment 3) to the Transboundary Aquifer Assessment Program Coordinators that included a brief review of the OSE model and recommended that the proposed work plan needed to include a process to more thoroughly review the 2007 OSE Model prior to developing a new model.

3.0 OSE Model Review

25. At the beginning of this consulting assignment in late 2012 and early 2013, I completed a more detailed review of the 2007 model, also known as the OSE (Office of State Engineer) model (S.S. Papadopulos & Associates, 2007).

26. The documentation of the OSE model contained minimal details about the calibration of the model. My July 11, 2008 letter referenced above summarized a comparison of data downloaded from the USGS Mesilla Basin groundwater network and EPWU data and model results to assess calibration of the model. The limited review that I completed in 2008 found that the OSE model was an improvement over previous models of the area.

27. Among the features of the OSE model was a more transparent approach to estimate

agricultural consumptive use, surface water deliveries, agricultural groundwater pumping, and deep infiltration of excess irrigation water as compared with earlier models. This effort was documented in Appendix J of the OSE documentation.

28. The OSE model used an Excel spreadsheet (*Canal.V10.3-2010update.xlsx*, dated 11/30/2012, obtained from Al Blair) that included estimates of agricultural consumptive use and surface water deliveries. The version of the Excel spreadsheet that I reviewed was an updated version of the one that was described in Appendix J of the OSE model documentation. The spreadsheet was used to calculate the agricultural pumping and deep infiltration of excess irrigation water. The documentation for the spreadsheet was not available and was not reviewed.

29. Appendix J of the OSE model documentation also identified several files that were used in the development of the model that were not available and not reviewed. These include a file that assigns model cells to defined canal service areas (*cellinfo.xls*), a file or pre-processor program that was used for the "identification of a depth distribution from which groundwater pumping is to occur", a Visual Basic program (*rechdist2_withfilepicker.exe*), and a FORTRAN subroutine (*Well.dll*) and its source code (*Well.f90*) that generated cell-by-cell fluxes for the WEL and RCH packages.

30. One of the conclusions of my review of the OSE model was that it appeared that some parameters in the WEL and RCH packages had been adjusted during calibration. Details of these changes were not documented.

31. My simulations with the OSE model completed in late 2012 and early 2013 demonstrated and quantified the correlation between groundwater pumping and streamflow (i.e. when pumping increased, streamflow decreased). However, there were some water budget

discrepancies between the model results and the input spreadsheet (*Canal.V10.3-2010update.xlsx*) estimates that could not be resolved without a more complete understanding of how some of the input files were developed. These details may have been clearer if the unavailable files had been available and had been reviewed (i.e. *cellinfo.xls, rechdist2_withfilepicker.exe, Well.dll,* and *Well.f90*).

32. Based on the review completed in late 2012 and early 2013, and the unanswered questions regarding the OSE model, I began developing a new model that used the OSE model as a foundation. The updated model added additional (and updated) data that were developed specifically for this effort by consultants for the State of Texas as described below.

4.0 New Groundwater Model (Texas Model)

33. The new groundwater model that was developed as part of this effort is called the Texas Model.

34. The foundation of the Texas Model is the OSE 2007 model, which represented the latest evolutionary step of a series of models that had been developed since the 1980s. Updated data on the geologic framework, agricultural consumptive use, agricultural pumping, and deep infiltration of irrigation water were developed and used in this effort.

4.1 Questions Addressed by Texas Model

35. The model was developed to answer the following specific questions that were posed by Counsel for the State of Texas:

a) What is the nature and extent of hydrologically connected groundwater and its relationship to the Rio Grande and the Rio Grande Project and the relevant issues raised in the Texas Complaint?

b) What was the 1938 condition that should be used as the basis upon which to judge New Mexico's actions and the effect of those actions?

c) Have New Mexico's actions depleted the quantity of water available below Elephant Butte Reservoir, and if so, (a) what was the cause of these depletions and (b) what was the extent (quantification) of these depletions?

d) If groundwater pumping in New Mexico were regulated to control the amount of water pumped, would it decrease or eliminate the effects on surface flows in the Rio Grande? Would the system recover to levels that existed in 1938 (i.e. the baseline condition)? If so, how long would it take to recover?

4.2 Summary Answers to Questions

36. Summary answers to the questions outlined above are provided below. More complete answers are developed later in this expert report and the associated technical memoranda.

a) Surface water and groundwater are connected in the Rincon and Mesilla Valleys. As water flows in a stream, canal, or river, the flow in the stream, canal, or river, the flow can either increase from the inflow of groundwater or decrease due to losses to the underlying aquifer. When groundwater elevations are higher than surface water elevations, groundwater flows into the surface water body and surface flow increases (Figure 1). When groundwater elevations are lower than surface water elevations, surface water flows into the surrounding aquifer and surface flow decreases (Figures 2 and 3). Figures 2 and 3 illustrate two types of losing stream conditions. Figure 2 illustrates a condition where groundwater elevations are lower than the stream edges, but still connected to the stream bottom. Figure 3 illustrates a condition where groundwater elevations have dropped lower than the stream bottom elevation. In the case of a disconnected stream, the seepage rate out of the stream has reached its maximum. One of the impacts of groundwater pumping is the reduction of groundwater elevations (also known as drawdown). This drawdown has resulted in a condition where the Rio Grande was generally gaining flow from the inflow of groundwater prior to 1950 to a condition where the Rio Grande generally is a losing stream that recharges the aquifer. The Texas Model was designed to simulate the details of the nature of the surface water/groundwater interaction and quantify how it has changed through time.

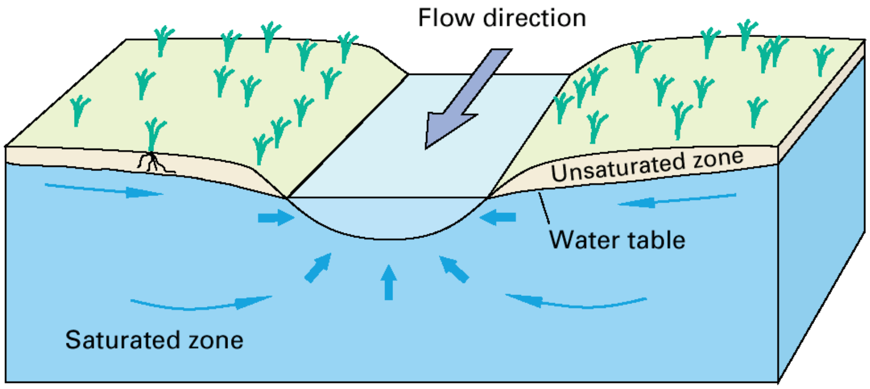


Figure 1. Illustration of a Gaining Stream (from Winter and others, 1988)

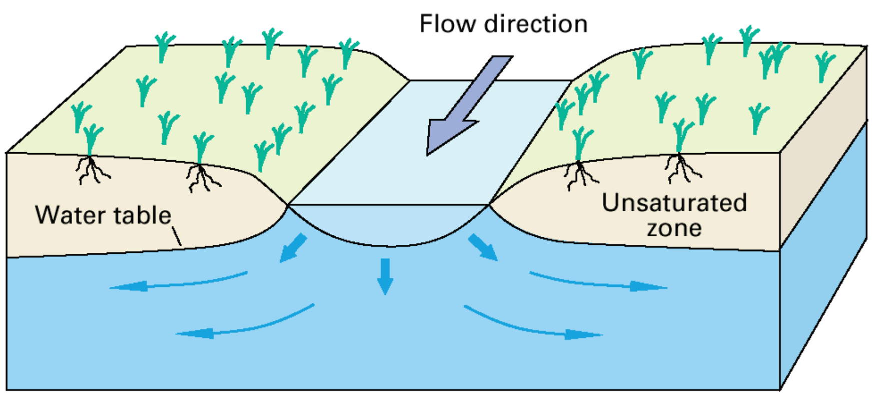


Figure 2. Illustration of a Losing Stream (from Winter and others, 1988)

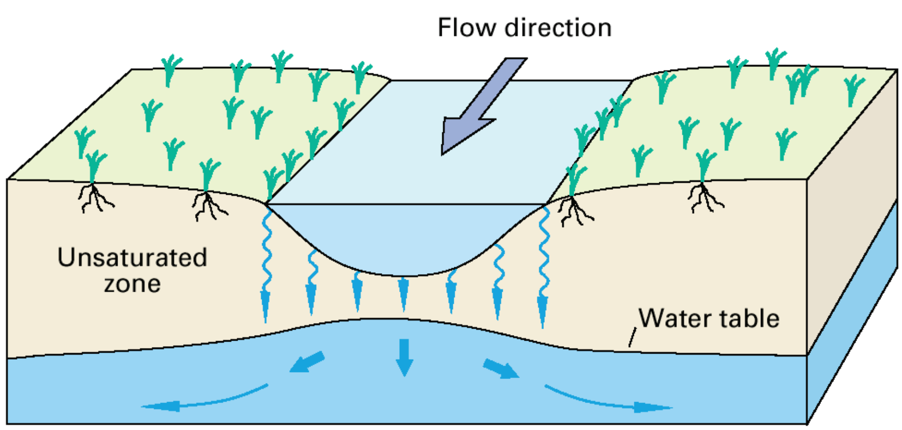


Figure 3. Illustration of a Disconnected Stream (from Winter and others, 1988)

b) The 1938 condition can be viewed as a combination of three elements: 1) minimal groundwater pumping, 2) a specific number of irrigated acres and a specific distribution of irrigated crops, and 3) a specific amount of irrigation water that was applied (expressed in terms of acre-feet of water per irrigated acre). Simulations with the Texas Model demonstrate that increases in groundwater pumping have had a larger impact to Rio Grande at El Paso flows than increases in agricultural consumptive use.

c) Simulations with the 2007 OSE Model and the Texas Model demonstrate that groundwater pumping resulted in decreased flows in the Rio Grande. Brandes (2019) developed an estimate of hypothetical Rio Grande at El Paso flows that would have occurred under a "without the effects of groundwater pumping" condition. Brandes (2019) concluded that the average increase in flow as compared with historic flows from 1951 to 2017 is about 79,000 AF/yr. Simulations with the Texas Model demonstrate that an overall 60 percent reduction in all pumping would result in a hypothetical increase in Rio Grande at El Paso flow of about 73,000 AF/yr from 1951 to 2016. About 81 percent of the increase (59,000 AF/yr) is attributable to New Mexico pumping, and about 19 percent of the increase is attributable to Texas pumping (13,000 AF/yr).

d) Simulations with the Texas Model demonstrate that an overall pumping decrease of 70 percent from historic levels would return the surface water system to a near neutral condition. This means that in wet years, groundwater would provide baseflow to the surface water system (gaining stream condition), and in dry years, surface water would lose flow to the groundwater system (losing stream condition). Overall, the hypothetical simulation demonstrates that the overall average of these gains and losses would balance. Simulations with the Texas Model also demonstrate that conjunctive use of the surface water and groundwater would result in increased Rio Grande at El Paso flow as compared with historic flow. Specifically, if groundwater pumping was limited only to years with Caballo Reservoir releases less than 600,000 AF/yr (i.e. pumping only in drought years), Rio Grande at El Paso flow would increase in years with no pumping to a degree that mimics flows under the 60 or 70 percent pumping reduction scenarios. Rio Grande flows would be low in drought years (i.e. years with pumping), but the return to high flows and cessation of pumping would provide the opportunity for recovery of groundwater levels. This, in turn, would lead to a return to gaining stream conditions that has not been historically observed due to uninterrupted groundwater pumping. As shown in the simulations with the Texas Model, any remedy needs to acknowledge that, based on the years of historic pumping, full recovery of groundwater elevations and Rio Grande flows to a new dynamic equilibrium condition would take about 40 to 50 years.

5.0 Model Overview

37. Data were gathered and developed from 2013 to 2018 by consultants for the State of Texas that were incorporated into the Texas model. These data include an updated geologic framework, estimates of irrigation area and agricultural consumptive use, and updated and improved water budgets.

38. Updated geologic framework data were developed based on John Hawley's most recent work (Hawley and others, 2017). Implementation of Hawley's updated geologic framework is documented by Schorr (2019a).

39. Irrigation area and agricultural consumptive use data were developed as described in Land IQ (2019).

40. Basin-wide water budget analyses for land-surface water, surface water and groundwater were developed as described in Schorr and Kikuchi (2019).

41. The conversion of the water budget information of Schorr and Kikuchi (2019) and other information to model input datasets were documented in Schorr (2019b).

42. Details of how the information from Land IQ (2019), Schorr (2019a), Schorr (2019b), and Schorr and Kikuchi (2019) were used in the specific development of individual model packages are presented in 16 Technical Memoranda.

43. The 16 Technical Memoranda that document model development are summarized in Table 1. The five Technical Memoranda that document the calibration of the model and the results of the predictive simulation results are summarized in Table 2.

Table 1. Technical Memoranda – Model Development

TM Number	Subject	Number of Pre-Processor Programs	Pages
1	Model Grid, Service Areas, Zones	2	26
2	Gridded Acres CU	1	22
3	Adjusted CU - Double Cropping and Match GoldSim Output	1	21
4	Monthly Zonal Estimates of Agricultural Supply and Deep Infiltration	2	22
5	Agricultural Groundwater Pumping and Deep Infiltration of Irrigation Water (WEL)	6	53
6	Urban and Domestic Groundwater Pumping (WEL)	4	44
7	Mountain Front Recharge (WEL)	3	15
8	Urban Infiltration (WEL)	1	11
9	Combine WEL components (Complete WEL Package)	1	13
10	BAS and DISU files	9	38
11	Basin Underflow (CHD)	3	14
12	Aquifer Parameters (LPF)	11	69
13	SFR Package	8	92
14	Groundwater Evapotranspiration (EVT)	3	23
15	Model Calibration Datasets (Groundwater Elevations, Stream Flows, Drain Flows)	6	78
16	NAM, GAGE, OC, Solver	0	6

Table 2. Technical Memoranda – Model Calibration and Predictive Simulations

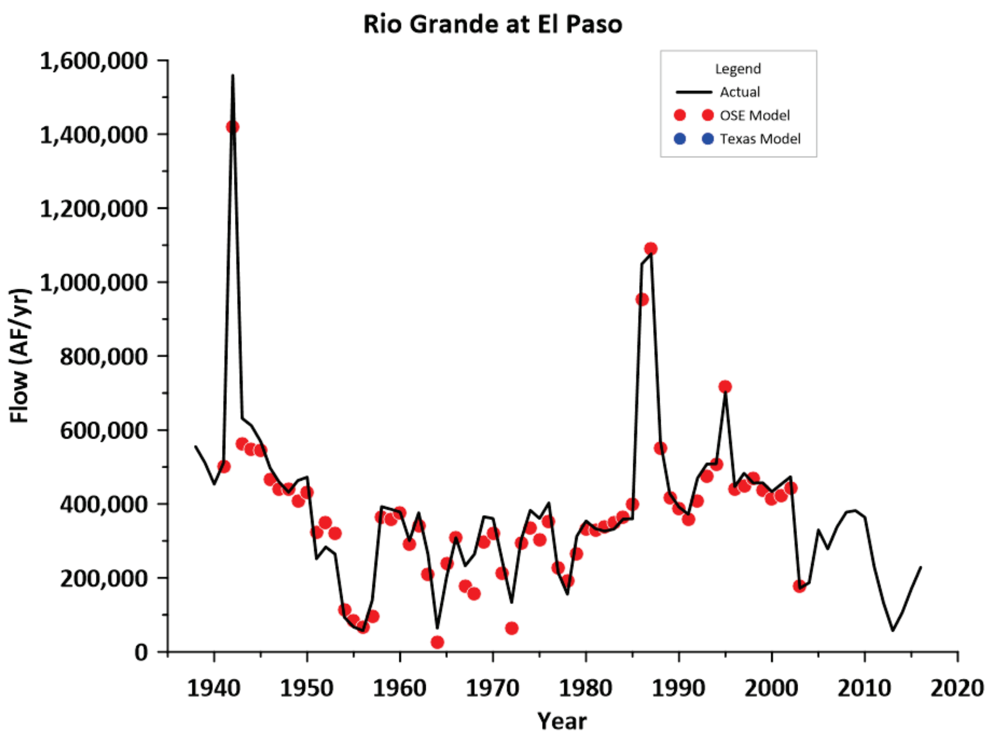
TM Number	Subject	Number of Pre- and Post-Processor Programs	Pages
17	Model Calibration	5	162
18	Reduced Pumping Scenarios (1938 to 2016)	6	88
19	Reduced Pumping Scenarios (1985 to 2016)	1	16
20	Alternative Consumptive Use Scenarios	2	30
21	Alternative Conjunctive Use Scenarios	1	23

44. The model was developed with data from 1938 to 2016. Because much of the data used to develop the model contain some uncertainty and because of the uncertainty in the overall conceptualization of the groundwater flow system and its interaction with the surface water system, adjustments to the input data were made during a process called model calibration.

45. Calibration was accomplished by adjusting model parameters to minimize differences between actual measured data of groundwater elevations and stream flow and model estimates of groundwater elevations and stream flow. Groundwater elevations are important because they are used by the model to calculate the direction and rate of groundwater flow in the groundwater flow system. Also, groundwater elevations are an important factor is defining the groundwater-surface water interaction.

46. Given the questions posed by Counsel for Texas related to impacts of New Mexico's actions on flow of the Rio Grande at El Paso, the greatest attention in calibration was the comparison of actual and simulated Rio Grande flows at El Paso.

47. The upper part of Figure 4 presents a comparison of actual Rio Grande flow at El Paso and simulated flow of Rio Grande at El Paso from the 2007 OSE model. One major goal of calibration was to develop a model that met or improved the match that was achieved with the OSE model. This goal was accomplished as shown in the lower part of Figure 1 which presents the comparison of the Texas Model estimates of Rio Grande at El Paso with the actual flow data.



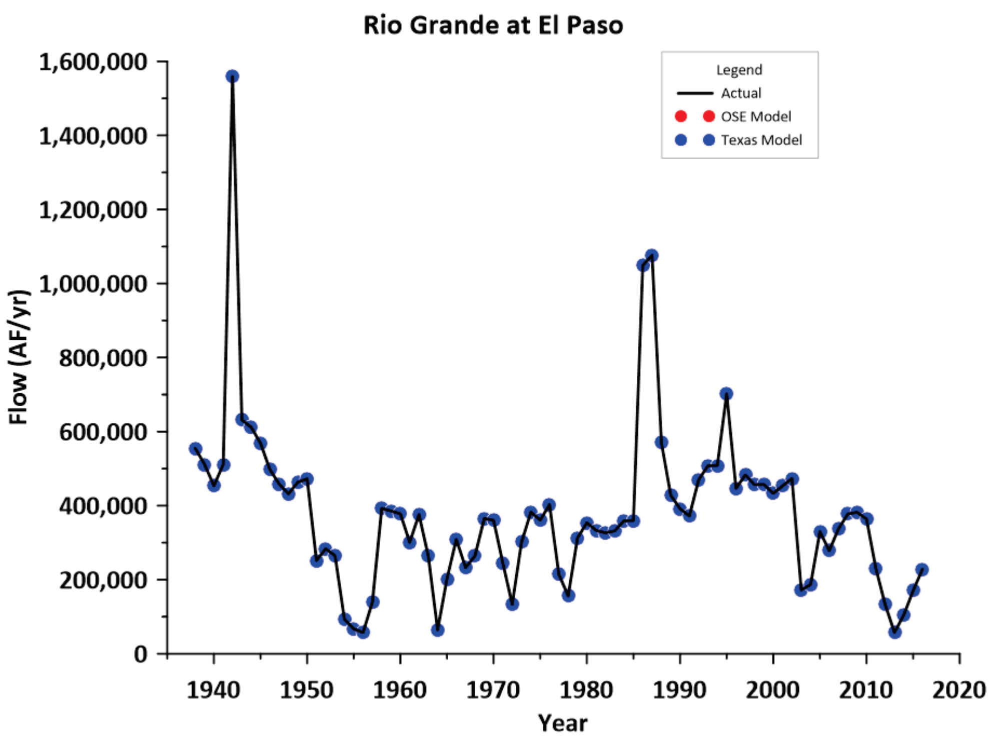


Figure 4. Rio Grande at El Paso (Actual Flow and Simulated Flow from OSE Model and Texas Model)

5.1 Model Code Selection (MODFLOW-USG)

48. The model code MODFLOW-USG was selected for this effort. MODFLOW refers to Modular Flow. USG refers to unstructured grids. The model code is public domain and is documented in Panday and others (2013).

49. Version 1.5 of the code was used for the Texas Model which was released by the USGS on February 27, 2019. The model software and documentation were downloaded from: https://water.usgs.gov/ogw/mfusg/. The model executable was used as downloaded from the USGS website (i.e. no changes to the source code and the source code was not recompiled).

50. The input and output documentation for Version 1.5 of the code is provided in Panday and others (2019).

51. MODFLOW-USG uses a control volume finite-difference approach to solve the governing equation of groundwater flow. The USG code provides for the use of cells of different shapes and varying sizes and orientations. Thus, cell geometry can follow geographic and geologic features. Model resolution can be focused in areas of interest and reduced in boundary areas of the model domain.

52. This code provided the ability to focus discretization of the model domain in areas of interest, in this case the Rio Grande and the canals and drains associated with the Rio Grande Project.

5.2 Model Domain and Grid

53. The domain of the model is shown in Figure 5 and compared with the model domain of the OSE model (S.S. Papadopulos & Associates, Inc., 2007). The most significant difference is the southwestern expansion of the model domain to incorporate the Conejos Medanos well field in Mexico.

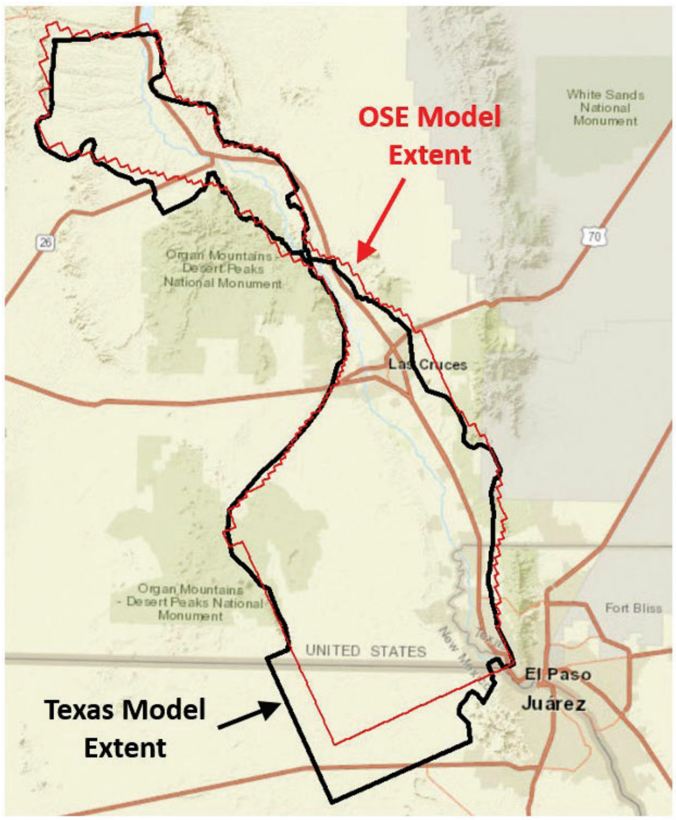


Figure 5. Model Domain (Texas Model and OSE 2007 Model)

54. Details of the model grid are discussed in Technical Memorandum 1. In general, finer grid spacing reduces model error, but models with small grid sizes can result in difficulties because the models can be too large to run and calibrate effectively. Balancing the need for accuracy and the ability to effectively calibrate a model with acceptable run times and file sizes is generally guided by considering the model objectives.

55. As documented in Technical Memorandum 1, the Texas Model balanced the need for model accuracy and limitations of model run times and file sizes by specifying a variable model grid focused in the area around the irrigated lands and the Rio Grande. Of the 176,794 cells in the model, about 57 percent of the cells are less than 5 acres, about 36 percent of the cells are between 5 acres and 40 acres, and about 7 percent of the cells are greater than 40 acres. For comparison, the OSE model had a uniform grid cell size of 40 acres.

5.3 Geologic Framework

56. The model consists of four layers: layer 1 represents alluvium, layer 2 represents the Upper Santa Fe Formation, layer 3 represents the Middle Santa Fe Formation, and layer 4 represents the Lower Santa Fe Formation. Details of the geologic framework are covered in Hawley and others (2017) and Schorr (2019a).

5.4 Model Service Areas and Zones

57. The model domain was subdivided into 17 zones based on Rio Grande Project service areas. The details of the specification of zones and service areas are detailed in Technical Memorandum 1. These zones were used during model development to summarize various inflows and outflows. The zones were also used during model calibration to guide some of the aquifer parameter adjustments.

5.5 Name File (NAM)

58. The NAM (Name) file specifies the names of the files that comprise the Texas Model. The details of the files are described in Technical Memorandum 16.

5.6 Solver File (SMS)

59. Implementation of the sparse matrix solver (SMS) file is documented in Technical Memorandum 16 and was tested further once the model was calibrated. The details of tests of the

solver file that were made as part of model calibration related to mass balance errors are described in Technical Memorandum 17.

6.0 Model Packages Defining Model Grid and Aquifer Parameters

6.1 Basic Package (BAS)

60. The BAS (basic) package contains input data related to active cells and initial heads. Documentation of the BAS package is covered in Technical Memorandum 10.

6.2 Discretization Package (DISU)

61. The DISU (discretization) package contains input data related to the spatial and temporal discretization of the model. The details of the DISU package are documented in Technical Memorandum 10.

62. Of note in the DISU package is the specifications for 80 stress periods. The first stress period is defined as steady state and is used to refine the specified starting heads prior to simulating 79 annual stress periods, each with the length of a year. Thus, the transient simulation period of the model is 1938 to 2016 (79 years).

6.3 Aquifer Parameters (LPF Package)

63. The LPF (Layer Property Flow) Package contains aquifer parameter data. As developed in more detail in Technical Memorandum 12, aquifer parameter values were initially taken from the new USGS model (Hanson and others, 2018) that was originally released in June 2018.

64. The USGS released a second version of their model in October 2018, which contained differences in the aquifer parameters as compared to the June 2018 version. To date, this version of the USGS model has not been documented.

65. Of note in both versions of the USGS model was the generally low hydraulic conductivity values as compared with the OSE model developed in 2007. Early runs of the Texas model that relied on these low values were characterized by convergence problems that were corrected once lower limits were placed on the minimum hydraulic conductivity values.

66. The use of higher hydraulic conductivity values improved model convergence, performance, and calibration. The values of aquifer hydraulic conductivity were further tested by using values from the OSE model as initial values for the Texas Model. However, calibration runs with initial aquifer parameters from the OSE model resulted in less favorable calibration statistics and unreasonably high mountain front recharge values.

67. Of note in the LPF package is the specification of the LAYTYP value for each layer as 4 (convertible, with transmissivity computed using upstream water-table depth). The OSE model and the USGS model use a LAYTYP values for all layers as 0 (confined). The use of a convertible layer specification is a conceptual improvement to the previous models.

68. Final calibrated values of aquifer parameters were developed as detailed in Technical Memorandum 17, which documents model calibration.

7.0 Head Dependent Flux Packages

69. Head dependent boundary flows into and out of the model domain were simulated in three packages: the CHD Package for subsurface basin flow, the SFR Package for surface water-groundwater interactions, and the EVT package for groundwater evapotranspiration in the areas of riparian vegetation.

7.1 Basin Underflow (CHD)

70. The CHD (Time-Variant Specified-Head) Package was used to simulate head-dependent flows in and out of the model domain. Specifically, subsurface flow to and from Caballo Dam, Rincon Arroyo, Jornada Basin, Fillmore Pass, El Paso Narrows, and Conejos Medanos (Figure 6) are simulated with the CHD package as documented in Technical Memorandum 11.

Figure 6. Location of CHD Cells

71. As detailed in Technical Memorandum 17, model calibration included comparing basin underflow estimated from the Texas Model with estimates developed by Montgomery & Associates and previous models.

7.2 Stream Flow Routing (SFR)

72. The SFR (Stream-Flow Routing) Package was used to route surface flows through the Rio Grande and the canals and drains associated with the Rio Grande Project, and to simulate the interaction of the surface flow with the underlying aquifer.

73. As documented in Technical Memorandum 13, the surface water features simulated in the Texas Model are the same as those simulated in the OSE Model. The basic framework of segments and reaches were modified only to the extent necessary for the updated and refined grid of the Texas Model.

74. Technical Memorandum 13 documents changes made to improve convergence of the model, including the modification of several of the flow/depth/width tables that were used in the OSE model. In addition, features were added that were not included in the OSE model (tributary flow, urban runoff, and net channel evaporation).

75. Calibration of the Texas Model included modifying the original OSE-based parameters of the SFR package including final or terminal diversions from 30 points in the SFR system that represent diversions for irrigation, and the streambed hydraulic conductivity. The preprocessors used to make these changes are documented in Technical Memorandum 13 and the results of these changes are covered in Technical Memorandum 17.

7.3 Evapotranspiration (EVT)

76. The OSE Model used the RIP-ET (Riparian Evapotranspiration) Package to simulate groundwater evapotranspiration from areas with riparian vegetation. The code of the Texas Model (MODFLOW-USG) does not support the RIP-ET package, so the EVT (Evapotranspiration) Package was used. Technical Memorandum 14 documents the implementation of the EVT package.

77. As explained in detail in Technical Memorandum 14, the use of the EVT package was consistent with the findings reported in the documentation of the OSE model that the level of detail implemented in the RIP-ET package is not consistent with the spatial and temporal model resolution of the OSE model. Thus, it was concluded that the use of the EVT package in the Texas Model is an acceptable alternative (i.e. the simplification of the approach does not introduce additional errors).

78. Consistent with the finding of the OSE model, attempts to vary parameters of the EVT package during calibration of the Texas Model yielded minimal improvement and suggested that the parameters associated with the EVT package (i.e. maximum evapotranspiration rate and extinction depth) were largely insensitive parameters as discussed in Technical Memorandum 17.

8.0 Specified Flux Packages

79. Specified flux boundary flows in and out of the model domain were simulated with the WEL (Well) Package. The components of the WEL package included farm processes (agricultural groundwater pumping and deep infiltration of irrigation water), urban and domestic groundwater pumping, mountain front recharge, and urban infiltration.

80. Pre-processors were developed to estimate each component of specified flux. Documentation of these pre-processors are described below. The individual components were combined to create a single WEL file as documented in Technical Memorandum 9.

8.1 Farm Processes

8.1.1 Agricultural Consumptive Use

81. Data and information from Land IQ (2019), Schorr (2019b), and Schorr and Kikuchi (2019) were processed for developing estimates of agricultural groundwater pumping and deep

infiltration of irrigation water.

82. Technical Memorandum 2 documents the calculation of monthly consumptive use for each model cell based on gridded crop data for specific years. Technical Memorandum 2 also documents how the estimates for specific years were interpolated and extrapolated to specify consumptive use for each model cell for all years.

83. Technical Memorandum 3 documents further processing of the agricultural consumptive use from Technical Memorandum 2. Specifically, the consumptive use estimates on a zone level are adjusted for double cropped acres and further adjusts the estimates to match with zonal monthly estimates of the Montgomery & Associates farm budget.

84. Figure 7 presents a double mass plot of cumulative Rio Grande releases at Caballo versus the cumulative New Mexico agricultural consumptive use in the Rio Grande Project Area (Zones 1 through 4). The objective of this graph is to assess how consumptive use has changed with time, which has relevance in the context of defining the "1938 condition" and evaluate if changes in agricultural practices in New Mexico and groundwater pumping are consistent with the 1938 condition.

85. As detailed in Technical Memorandum 3, Figure 7 shows that consumptive use data from 1951 to 2016 lie above the regression line that established a baseline from 1942 to 1950. This deviation from the regression line represents an increase in consumptive use that was supplied with groundwater pumping in New Mexico.

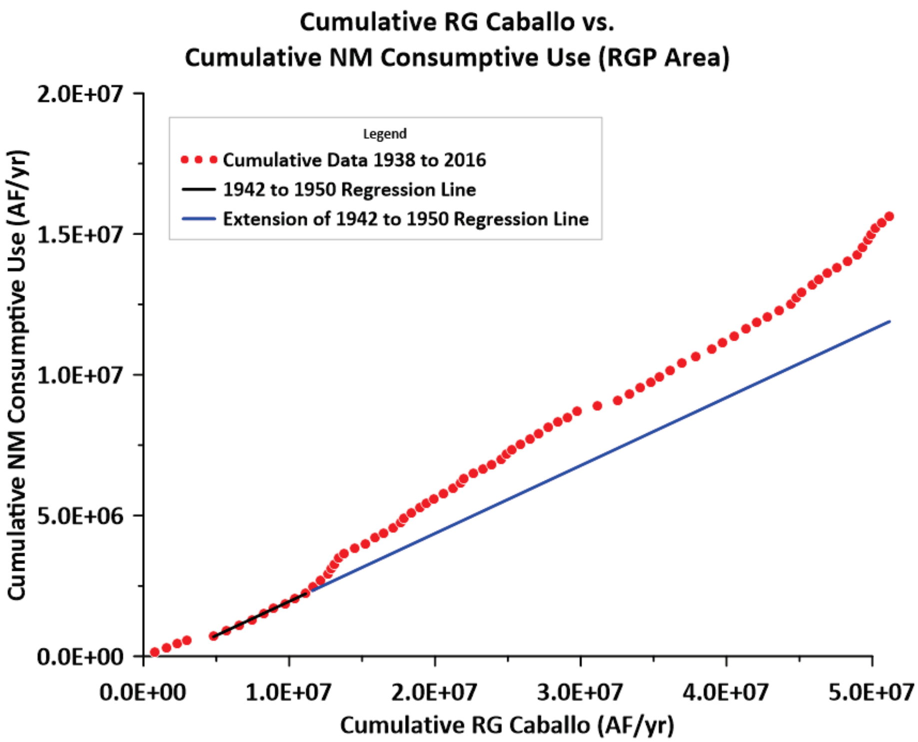


Figure 7. Double Mass Plot of New Mexico Agricultural Consumptive Use

8.1.2 Agricultural Water Supplies

86. Technical Memorandum 4 documents the calculation of monthly surface water deliveries, agricultural groundwater pumping and deep infiltration of irrigation water by zone.

87. Figure 8 presents a double mass plot of cumulative Rio Grande at Caballo releases versus cumulative New Mexico agricultural surface water deliveries. After 1951, the data points lie below the regression line that establishes the baseline from 1942 to 1950. As detailed in Technical Memorandum 4, this deviation from the regression line suggests that for a given release of water from Caballo, the supply of surface water for New Mexico agriculture has decreased with time.

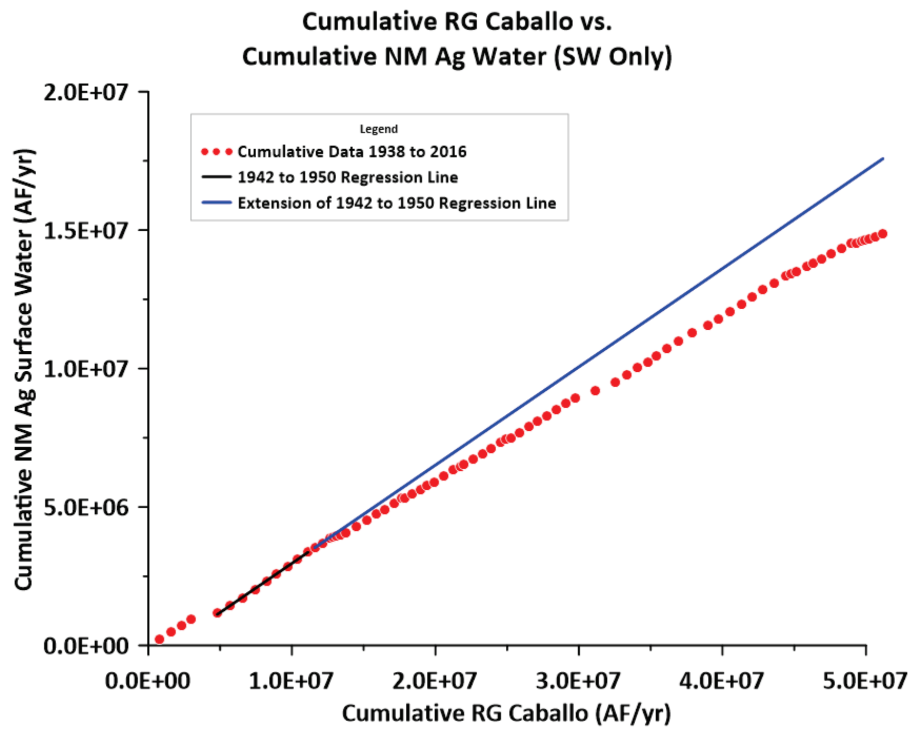


Figure 8. Double Mass Plot - Rio Grande at Caballo versus New Mexico Agricultural Surface Water Supply

88. Figure 9 presents a double mass plot of cumulative Rio Grande at Caballo releases versus cumulative New Mexico agricultural deliveries (combined surface water and groundwater). After 1951, the data points lie above the extended regression line, which is consistent with the double mass plot for consumptive use presented earlier.

89. Figures 8 and 9 along with the similar consumptive use plot presented earlier (Figure 7) show that groundwater pumping has become an important irrigation supply source and demonstrates that groundwater pumping has reduced the amount of surface water that has been available in New Mexico.

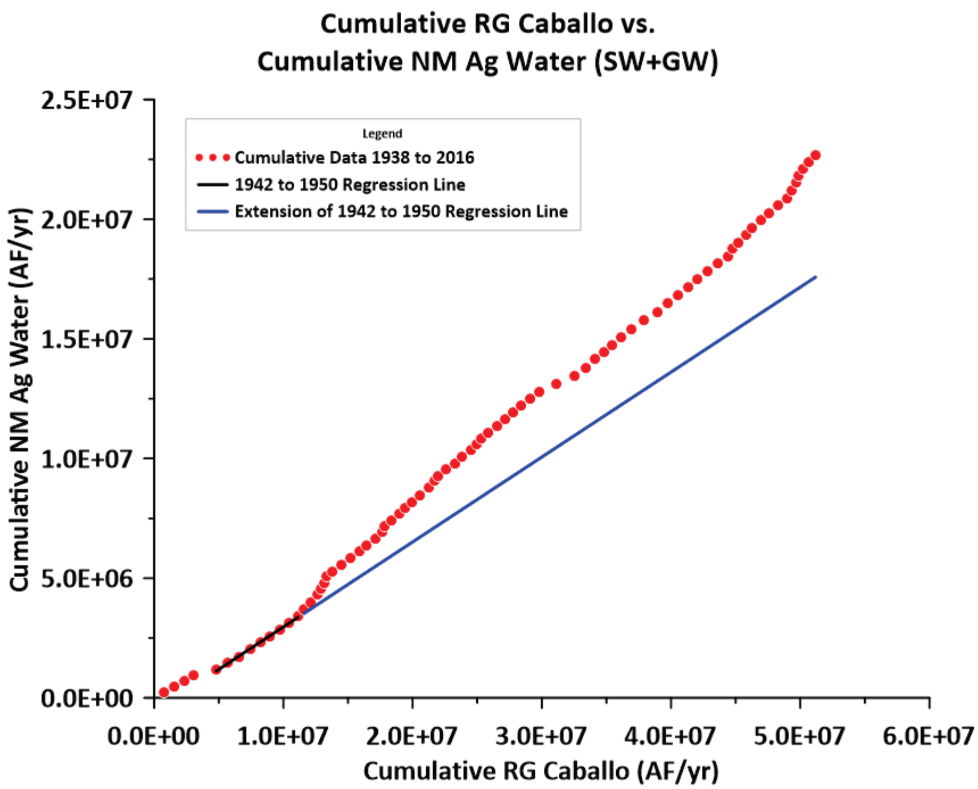


Figure 9. Double Mass Plot - Rio Grande at Caballo versus Total New Mexico Agricultural Water Supply

8.2 Specific Components of the WEL Package

90. As described above, the pre-processors that simulate the farm processes (documented in Technical Memoranda 2, 3 and 4) yield estimates of agricultural groundwater pumping and deep infiltration of irrigation water, which are two of the five components of the WEL package. The development of these and the other three components of the WEL package is described below.

8.2.1 Agricultural Groundwater Pumping and Deep Infiltration of Irrigation Water

91. Technical Memorandum 5 documents how the monthly zonal estimates of agricultural pumping and deep infiltration of irrigation water are used to calculate annual estimates for inclusion in the WEL package.

92. Agricultural groundwater pumping is distributed monthly to 3,950 irrigation wells on a rotational basis based on the well construction date as described in Technical Memorandum 5.

93. As documented in Technical Memorandum 5, monthly deep infiltration of irrigation water is applied to cells where irrigation occurred.

8.2.2 Urban and Domestic Groundwater Pumping

94. Monthly urban and domestic groundwater pumping estimates for 7,181 wells are developed as described in Technical Memorandum 6.

8.2.3 Mountain Front Recharge

95. Mountain front recharge for 17 areas (Figure 10) is documented in Technical Memorandum 7.

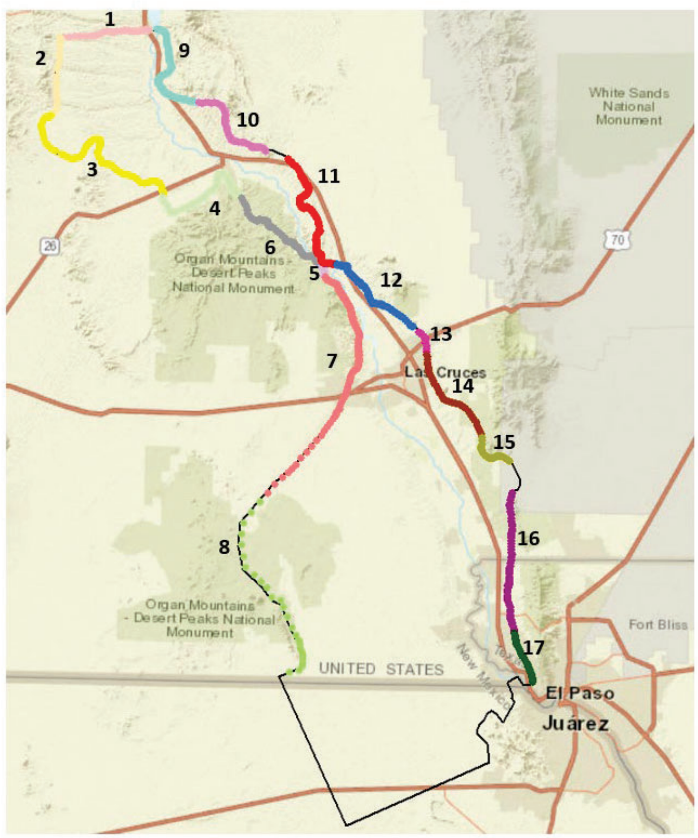


Figure 10. Location of Mountain Front Recharge Locations

8.2.4 Urban Infiltration

96. Technical Memorandum 8 documents monthly urban infiltration at 5,996 cells.

8.3 Combined WEL Package

97. The five components of the WEL package described above were combined for use in the model as described in Technical Memorandum 9.

9.0 Calibration Data

98. The data used to calibrate the model consisted of groundwater elevations and surface water flows as described in Technical Memorandum 15.

9.1 Groundwater Elevations

99. As documented in Technical Memorandum 15, Montgomery & Associates compiled a database of 799 wells with 46,126 groundwater elevations for use in model calibration.

100. The database was used to compile end-of-the-year data for use in the annual model. The monthly priority was applied as follows: 1) December of the current year, 2) January of the subsequent year, 3) November of the current year, and 4) February of the subsequent year. This processing resulted in 385 wells with 8,549 groundwater elevations.

101. During calibration, 142 groundwater elevations were removed for a variety of reasons. The most common reasons were that the well was completed in bedrock near the edge of the model domain, the groundwater elevations were pumping water levels, or the data were considered outliers compared to other data points in that well.

9.2 Surface Water Flows

102. As documented in Technical Memorandum 15, Montgomery & Associates compiled a database of 48 surface water flow stations with 18,444 flow measurements through 2014. The database was subsequently updated with 108 measurements for 2015 and 2016.

103. The monthly data were summed for the annual model. Thus, 1,874 flow measurements from 48 stations were used in calibration of the annual model.

104. Data from these 48 stations are included in the MODFLOW-USG GAGE package that also includes "terminal diversions" from the SFR package, which are the 30 points where flow is diverted out of the surface water network for farm deliveries.

10.0 Model Calibration

105. Details of the calibration of the Texas Model are documented in Technical Memorandum 17. In general, parameters adjusted during calibration included constant heads (boundary inflows), aquifer parameters, mountain front recharge, and various parts of the SFR (Stream Flow Routing) package.

106. Figure 11 presents the comparison of actual groundwater elevations and simulated groundwater elevations from the Texas Model.

107. Figure 12 presents the comparison of actual surface water flows and simulated surface water flows from the Texas Model.

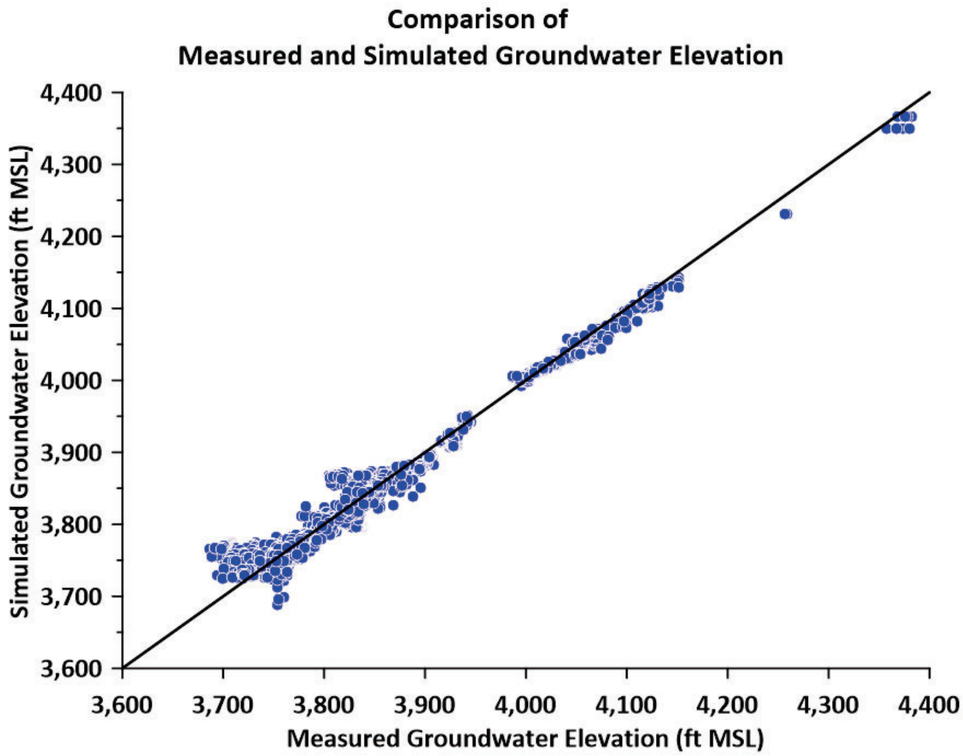


Figure 11. Measured and Simulated Groundwater Elevations

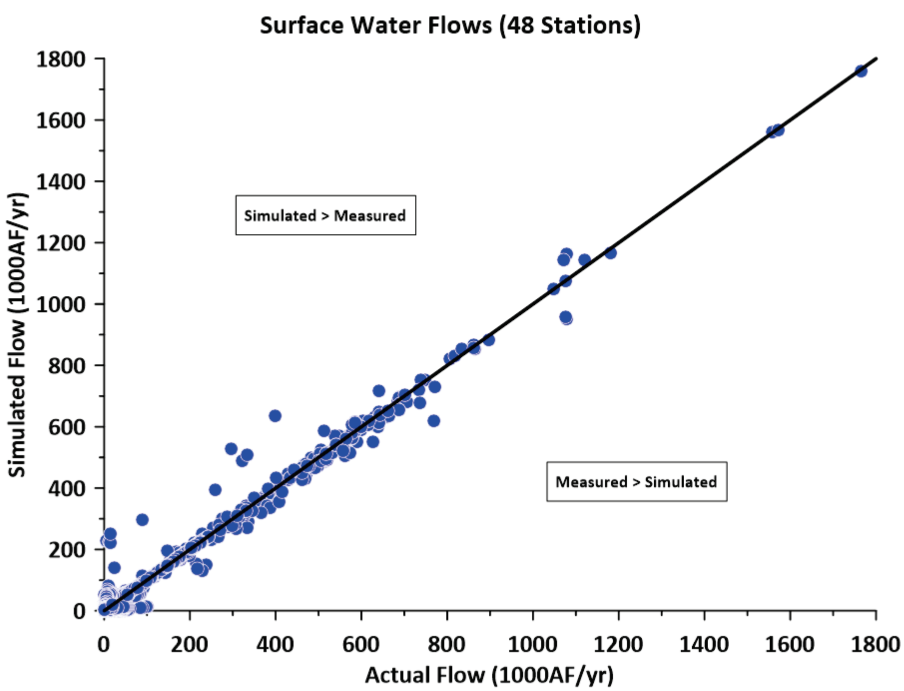


Figure 12. Measured and Simulated Surface Water Flows

108. As discussed above, the questions posed by Counsel for Texas were focused on the availability of Rio Grande flow to Texas and the potential effects of New Mexico's actions on that availability. Thus, one of the most important comparisons of actual data and simulated data is Rio Grande at El Paso. A comparison hydrograph is presented in Figure 13 (previously presented as the lower part of Figure 4.)

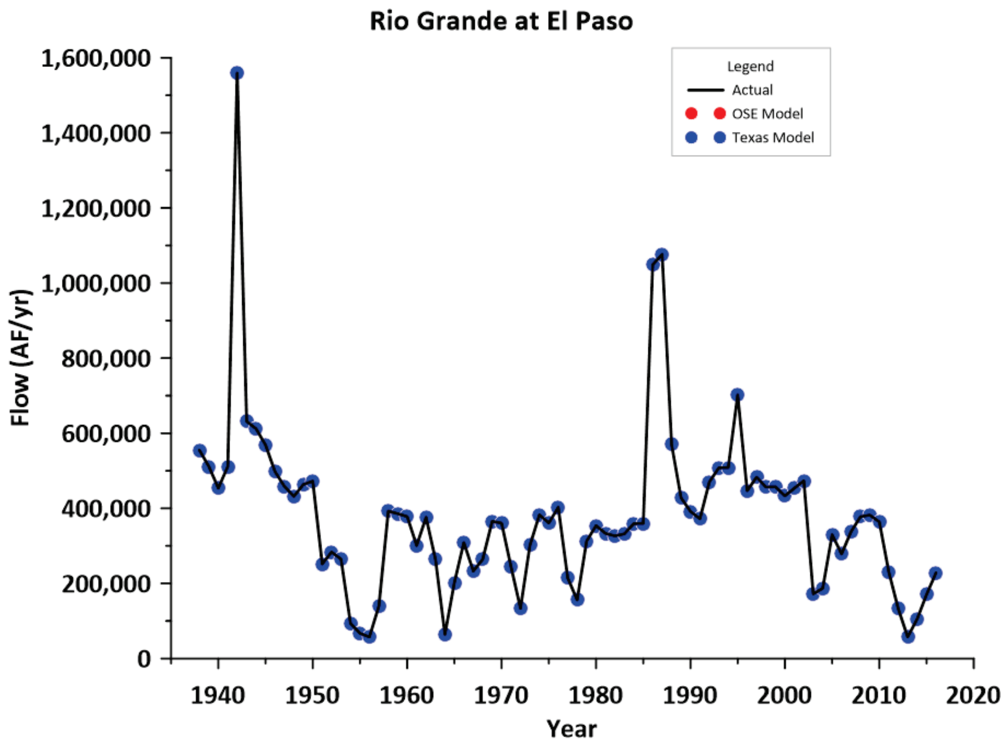


Figure 13. Measured and Simulated Rio Grande at El Paso

109. Figure 14 presents the annual and cumulative groundwater storage changes based on the calibrated model. The annual storage changes (in blue) are depicted on the y-axis on the left side of the graph, and the cumulative storage changes (in red) are depicted on the y-axis on the right side of the graph. The y-axes are in units of thousand acre-feet (cumulative or red axis) and thousand acre-feet per year (annual or blue axis).

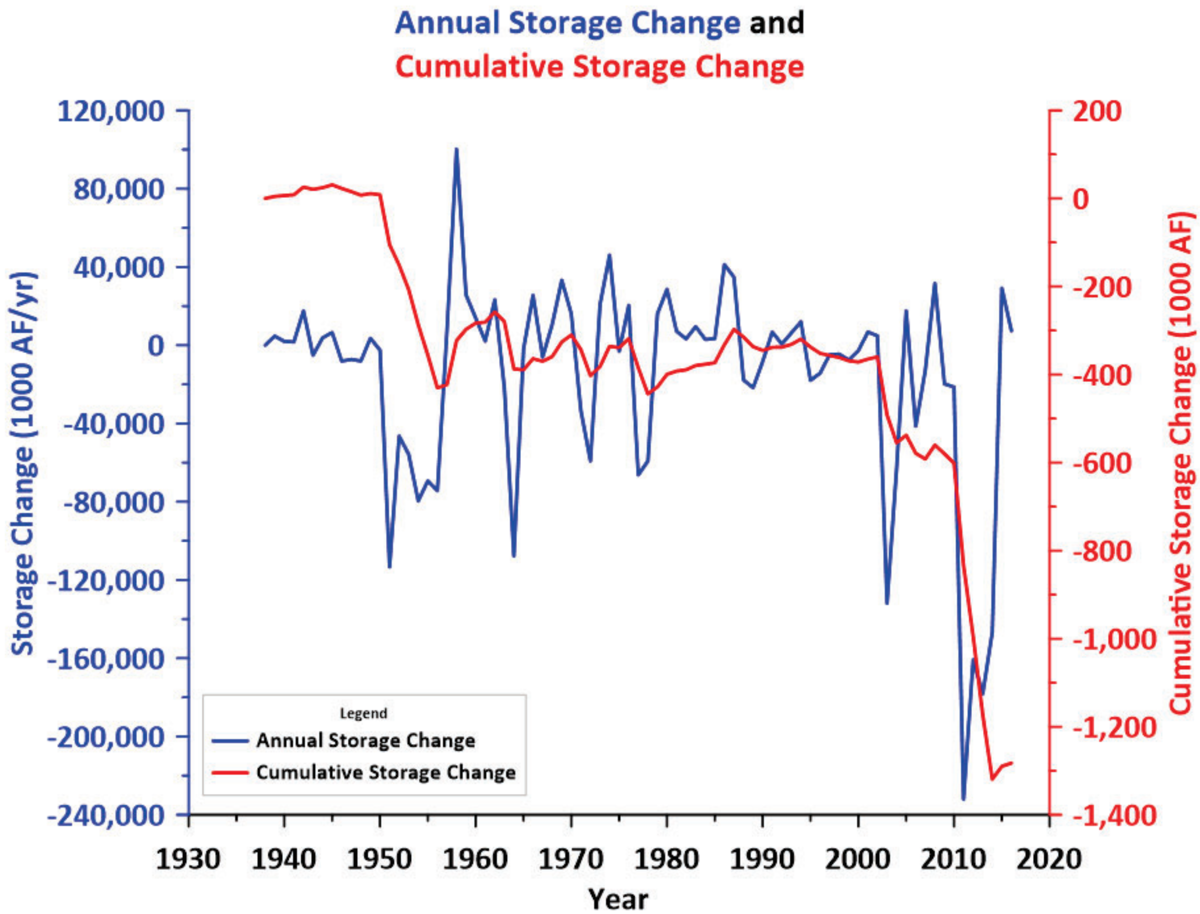


Figure 14. Annual and Cumulative Groundwater Storage Changes

110. As described in more detail in Technical Memorandum 17, the groundwater budget from the calibrated model demonstrates that the impacts of the increased groundwater pumping include decreased groundwater levels (manifested as decreased groundwater storage). The reduced groundwater levels resulted in increased losses from the surface water system which changed the condition of the surface water system from a net gaining system to a net losing system.

111. The losses from the surface water system represents increased recharge to the groundwater system. The increased recharge can be viewed as induced groundwater inflow that is one of the sources of supply to the groundwater wells.

11.0 Simulation Results of Hypotheticals

112. Once calibrated, the Texas Model was used to simulate hypothetical scenarios. The results were used to evaluate changes in Rio Grande flow at El Paso and groundwater budget changes as compared to the baseline condition (i.e. the calibrated model results).

113. Hypotheticals included:

- Pumping Reduction Scenarios (1938 to 2016)
- Pumping Reduction Scenarios (1985 to 2016)
- Alternative Consumptive Use Scenarios
- Alternative Conjunctive Use Scenarios

11.1 Pumping Reduction Scenarios: 1938 to 2016

114. Technical Memorandum 18 documents the results of pumping reduction scenarios. There were three groups of scenarios that were used to gain a quantitative understanding of surface water/groundwater interaction. The three sets of scenarios are:

- Overall pumping reduction scenarios
- Geographically isolated pumping reduction scenarios
- Long term average future pumping scenarios

115. The details of these three sets of scenarios are documented in Technical Memorandum 18, and the results are summarized below. These scenarios were developed to assess and quantify the impact of reduced pumping on Rio Grande flow at the El Paso gage and should not be construed as management alternatives.

116. In the first set of simulations, all pumping is reduced without regard to geographic location (i.e. New Mexico, Texas, or Mexico) and without regard to the use of the pumped groundwater (i.e. agricultural, urban and domestic, etc.). The set of 10 scenarios simulated incremental reductions in all pumping from 1938 to 2016. Each scenario represents a 10 percent

increment in decreased groundwater pumping. Thus, Scenario 1 simulates a 10 percent reduction in all groundwater pumping. Scenario 2 simulated a 20 percent reduction in all groundwater pumping. Finally, Scenario 10 simulates a 100 percent reduction in all groundwater pumping. Summary results on resulting hypothetical increased flows at the Rio Grande at El Paso gage are summarized below in Section 11.1.1. Detailed results are presented in Technical Memorandum 18.

117. In order to attribute the impacts of pumping in New Mexico, Texas, and Mexico, the second set of simulations consisted of three scenarios that simulated 60 percent pumping reductions in each of the individual geographic areas covered by the model (New Mexico, Texas, and Mexico). Summary results on resulting hypothetical increased flows are summarized below in Section 11.1.2. Detailed results are presented in Technical Memorandum 18.

118. The third set of simulations included running the hypothetical case of river flow and pumping at a constant amount to assess the time to return to a near equilibrium condition. Summary results of these simulations are summarized below in Section 11.1.3. Detailed results are presented in Technical Memorandum 18.

11.1.1 Pumping Reduction Scenarios

119. Each of the pumping reduction scenarios resulted in Rio Grande at El Paso flows that were higher than the historic flows. The average Rio Grande Flow at El Paso in Scenario 6 (60 percent groundwater pumping reduction) from 1951 to 2016 was about 73,000 AF/yr higher than historic average Rio Grande at El Paso flow, which is consistent with results from Brandes (2019) of a hypothetical Rio Grande at El Paso flow under a “without the effects of groundwater pumping” scenario (79,000 AF/yr).

120. As described in Technical Memorandum 18, an analysis of the 10 pumping reduction scenarios included evaluating the irrigation supply associated with each scenario. Because a reduction in pumping in each scenario is associated with a decreased in irrigation supply, the remaining pumping was added to the surface water supply to estimate the total irrigation supply. The analysis documented in Technical Memorandum 18 demonstrated that the average annual agricultural water use for Scenario 6 is consistent with the 1938 agricultural water use. Figure 15 summarizes the relationship of average annual agricultural water use for each of the pumping reduction scenarios and the 1938 agricultural water use.

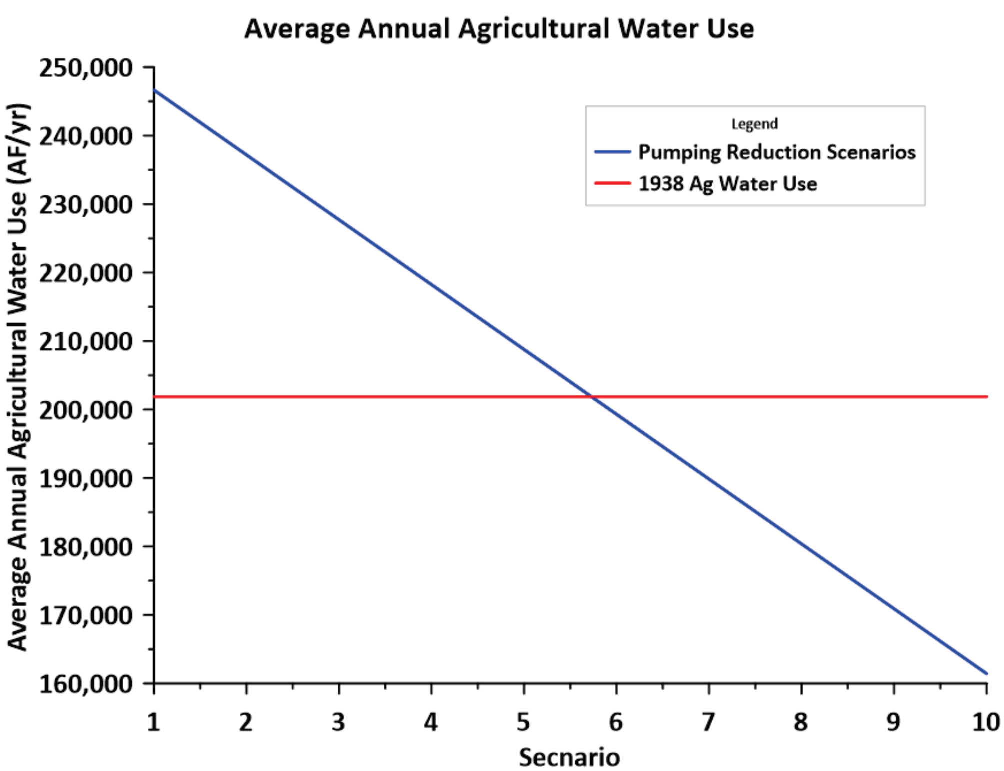


Figure 15. Average Annual Agricultural Water Use - Pumping Reduction Scenarios

121. Based on the 60 percent pumping reduction scenario, which is consistent with the "without the effects of groundwater pumping" scenario of Brandes (2019), Rio Grande at El Paso

would have been, on average, about 73,000 AF/yr higher than historic flows from 1951 to 2016. A double mass curve of cumulative Rio Grande at Caballo versus cumulative Rio Grande at El Paso for the historic data, the Brandes (2019) regression curve, and the results of the 60 percent pumping reduction are presented in Figure 16.

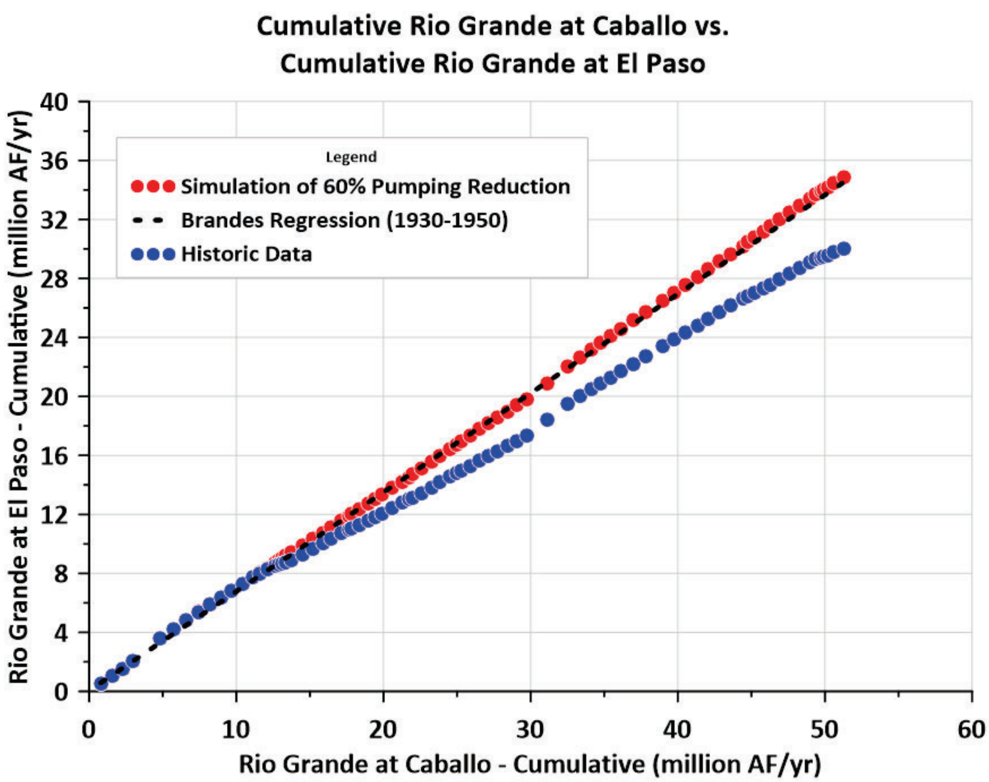


Figure 16. Double Mass Plot of Rio Grande at Caballo vs. Rio Grande at El Paso - Historic Data, Brandes Regression, and 60% Pumping Reduction Simulation

11.1.2 Geographic Pumping Reduction Scenarios

122. These simulations sequentially isolated the pumping reductions to specific geographic areas to quantitatively assess impact of the pumping to the Rio Grande flow at El Paso under the 60 percent groundwater pumping reduction scenario. The contribution of this hypothetical river flow increase from a 60 percent reduction in New Mexico groundwater pumping

is about 59,000 AF/yr. The contribution of this hypothetical river flow increase from a 60 percent reduction in Texas pumping is about 13,000 AF/yr. Simulations with full reduction in pumping result in similar proportions of attribution of increased river flow.

11.1.3 Hypothetical Future Scenarios Under Average Conditions

123. The objective of these simulations was to assess the extent and nature of recovery of the groundwater system if pumping were reduced, and how long it would take for the surface water system to return to a neutral or gaining stream condition. In order to accomplish this objective, pumping and releases from Caballo Reservoir were set equal to 2009 amounts (approximate average levels) starting in 2017 and held constant for 80 years.

124. Technical Memorandum 18 documents these simulations. Key assumptions are:

- Starting heads are set equal to 2016 levels (last stress period of the calibrated model)
- Rio Grande at Caballo is set to 2009 condition and held constant for all 80 stress periods
- All SFR diversions are set equal to 2009 levels and held constant for all 80 stress periods
- Riparian evapotranspiration rates are set equal to 2009 levels and held constant for all 80 stress periods
- Groundwater pumping and agricultural and urban deep infiltration is set equal to 2009 conditions for each companion pumping reduction scenario (Scenarios 1 to 10) and remained constant for 80 years into the future.

125. All simulations show that average Rio Grande at El Paso flows would equilibrate to a new higher baseline, and that degree of increase would be dependent on how much pumping is reduced.

126. The return to true equilibrium conditions would extend beyond the 80 years of the simulation, although from a practical perspective, a near-equilibrium condition would be restored in about 40 to 50 years.

127. Scenarios with reductions in pumping between 10 and 50 percent show that the surface water system would continue to lose surface flow to the groundwater system (i.e. a losing stream condition would persist).

128. Scenarios with reductions in pumping between 80 and 100 percent show that the surface water system would return to a condition where groundwater would provide base flow to the surface water system (i.e. a gaining stream condition would return).

129. Scenarios with reductions in pumping between 60 and 70 percent show that the surface water system and groundwater system would be approximately in balance, with relatively minor amounts of gain or loss.

11.2 Pumping Reduction Scenarios: 1985 to 2016

130. Technical Memorandum 19 documents the results of 10 scenarios where all groundwater pumping is incrementally reduced in all years after 1984 (i.e. pumping reductions applied from 1985 to 2016).

131. These simulations are conceptually the same as the 1938 to 2016 pumping reduction scenarios described above, but the pumping reductions were simply applied to a different time period. The time period of these simulations was specifically requested by Counsel for the State of Texas.

132. Each scenario represents a 10 percent increment in decreased groundwater pumping. Thus, Scenario 1 simulates a 10 percent reduction in all groundwater pumping. Scenario 2 simulated a 20 percent in all groundwater pumping. Finally, Scenario 10 simulates a 100 percent reduction in all groundwater from 1985 to 2016.

11.3 Alternative Consumptive Use Scenarios

133. As stated earlier, one of the components of the "1938 condition" is the irrigated acreage and consumptive use expressed as acre-foot per acre in 1938. Agricultural consumptive use has increased since 1938 as documented in Technical Memorandum 3 and previously shown in Figure 7.

134. The hypothetical simulations documented in Technical Memorandum 20 cover five scenarios where agricultural consumptive use is limited to that of 1938. The simulations were run from 1938 to 2016, but the modifications were applied only after 1950 to provide a means of comparison with other scenarios.

135. The agricultural pumping, agricultural deep infiltration, and surface water diversion components of the alternative consumptive use scenarios were developed by summing the consumptive use of 1938 (149,005 AF/yr) and the necessary component for canal losses and deep infiltration associated with irrigation. For each year, this sum was viewed as a demand and compared with the annual historic surface water diversions for agricultural use. If the historic surface water deliveries were higher than the new demand, the excess remained in the surface water system (i.e. surface flow was not diverted). If the historic surface water deliveries were less than the new demand, groundwater pumping for irrigation was set equal to the deficit.

136. Five alternative urban and domestic groundwater pumping scenarios were simulated. Scenario 1 assumed a limit of 10,000 AF/yr, Scenario 2 assumed a limit of 20,000 AF/yr, Scenario 3 assumed a limit of 30,000 AF/yr, Scenario 4 assumed a limit of 40,000 AF/yr, and Scenario 5 assumed a limit of 50,000 AF/yr.

137. Results of the simulations show that Rio Grande at El Paso flows are higher under

each of these scenarios as compared with historic flows. The pattern of increase in these scenarios, however, is different than the pumping reduction scenarios discussed earlier. For purposes of this discussion, comparisons are made with the Pumping Reduction Scenario 6 (60 percent reduction). As described above, this Pumping Reduction Scenario 6 is consistent with the "without the effects of groundwater pumping" analysis of Brandes (2019).

138. Because agricultural pumping is based on the revised "demand", pumping is higher in the consumptive use scenario than in Pumping Reduction Scenario 6 in low river flow years (i.e. dry years). Conversely, pumping in the consumptive use scenario is lower than in Pumping Reduction Scenario 6 in high river flow years (i.e. wet years).

139. Conclusions from these scenarios show that, with an urban and domestic pumping limit of 10,000 AF/yr, average increase in Rio Grande at El Paso flow is about 56,000 AF/yr. This average amount is less than the simulated increase from Reduced Pumping Scenario 6 (about 73,000 AF/yr). A double mass plot of cumulative Rio Grande at Caballo versus cumulative Rio Grande at El Paso is presented in Figure 17. The historic data, the Brandes regression line and the results of Consumptive Use Scenario 1 (urban and domestic pumping capped at 10,000 AF/yr) are included for comparison. Consumptive Use Scenarios 2 through 5 results show progressively lower Rio Grande at El Paso flows due to impacts of the higher pumping.

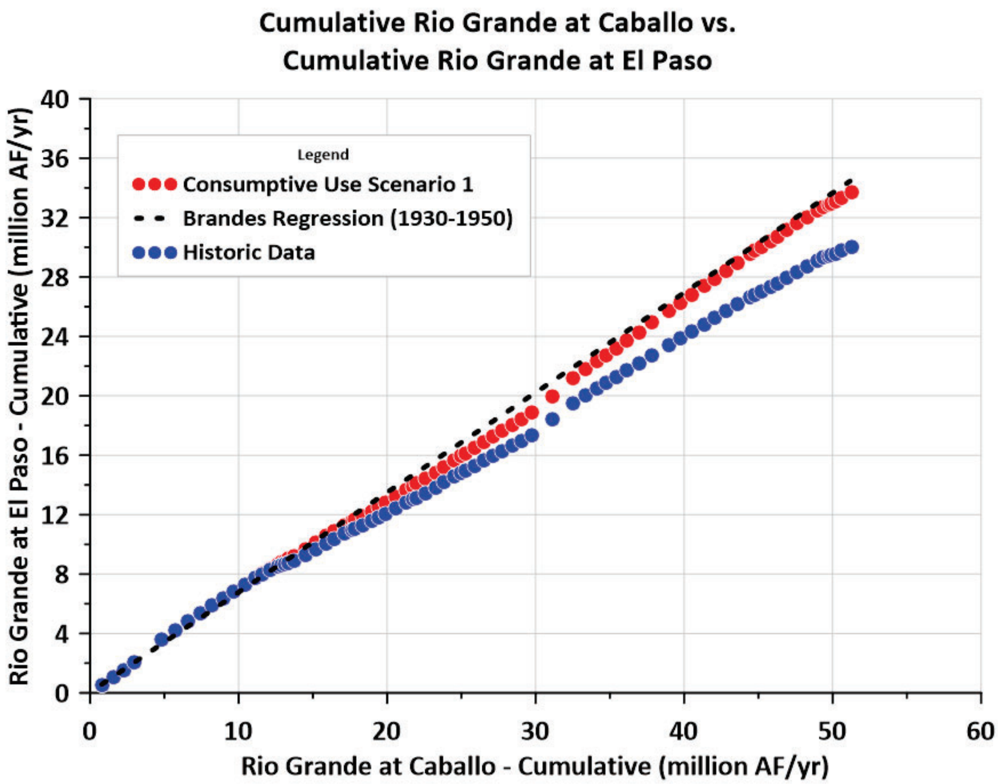


Figure 17. Double Mass Plot of Rio Grande Flows - Consumptive Use Scenario 1

140. These scenarios were instructive to understand the relative importance of groundwater pumping and agricultural consumptive use to Rio Grande at El Paso flows. This scenario demonstrated that limiting consumptive use to 1938 conditions still results in years where groundwater pumping is needed to meet full irrigation demands.

141. The results of these simulations coupled with results of other simulations show that the flow of the Rio Grande at El Paso is more sensitive to changes in groundwater pumping than to changes in agricultural consumptive use if groundwater pumping is required to make up deficits in irrigation demands (i.e. surface water is insufficient to meet full irrigation requirements).

142. The results of these consumptive use scenarios were used to develop more generalized

conjunctive use scenarios as discussed below.

11.4 Conjunctive Use Scenarios

143. For purposes of this analysis, the use of groundwater to make up deficits in surface water flows to meet agricultural demands is generally referred to as conjunctive use of surface water and groundwater. This definition of conjunctive use is generally consistent with how conjunctive use is defined and applied in the City of El Paso (preferential use of surface water to meet municipal demands and increase groundwater pumping to meet deficits in surface water supply).

144. The consumptive use scenarios discussed above were based on a set consumptive use limit. The results, however, demonstrated the importance of groundwater pumping in estimating Rio Grande Flow at El Paso. From a practical management perspective and from the perspective to evaluate remedies, this group of simulations evaluated alternative hypothetical scenarios where historic groundwater pumping only occurred in years with less than specific amounts of surface water availability. These simulations are documented in Technical Memorandum 21.

145. Prior to the drought of the 1950s, agricultural pumping was minimal. Partly in response to drought conditions and partly as a result of the initial availability of deep turbine pumps, groundwater pumping began in the 1950s. Annual groundwater pumping, which consists of agricultural pumping and urban and domestic pumping, from 1938 to 2016 is presented in Figure 18.

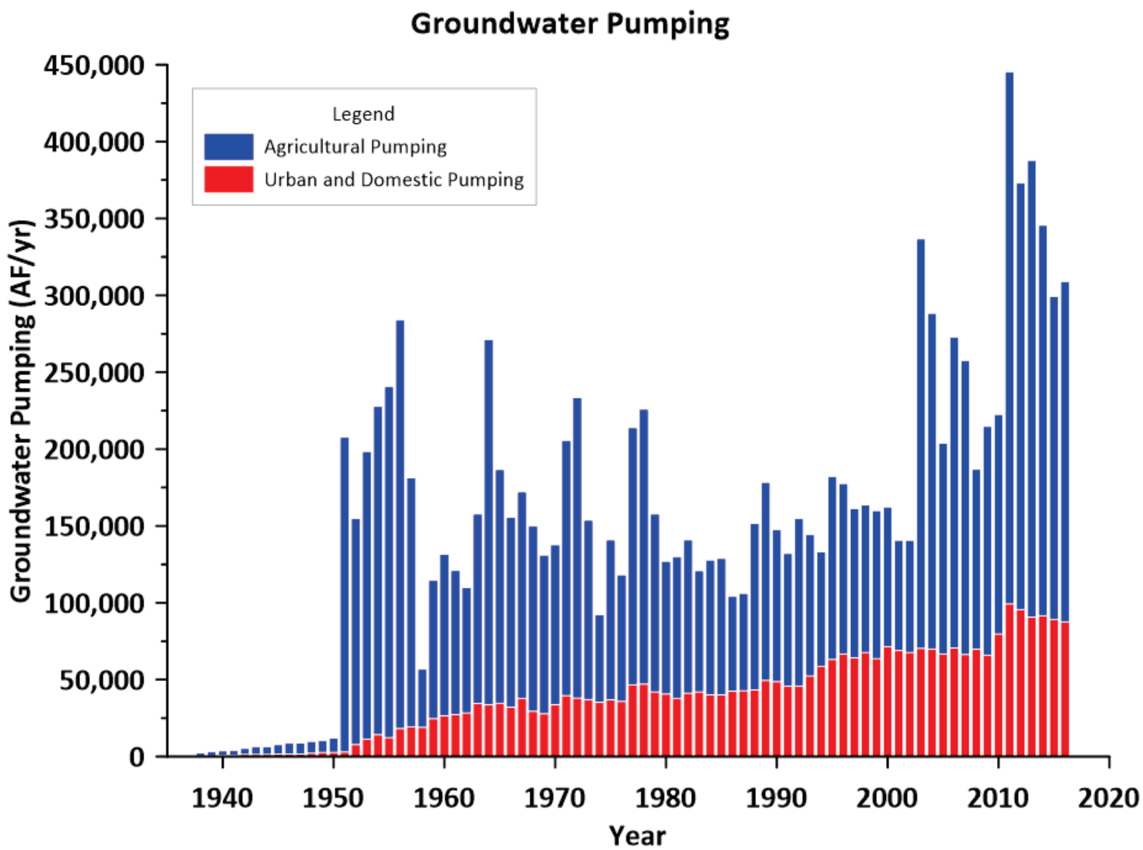


Figure 18. Historic Groundwater Pumping

146. Surface water availability was defined by releases to the Rio Grande from Caballo Reservoir. From 1938 to 2016, annual releases ranged from about 170,000 AF/yr (2013) to about 1.8 million AF/yr (1942).

147. For purposes of these simulations:

- Scenario 1 assumed that groundwater pumping is zero when annual releases from Caballo are above 790,000 AF/yr (i.e. no pumping in 13 years, historic pumping in 66 years)
- Scenario 2 assumed that groundwater pumping is zero when annual releases from Caballo are above 700,000 AF/yr (i.e. no pumping in 30 years, historic pumping in 49 years)
- Scenario 3 assumed that groundwater pumping is zero when annual releases from Caballo are above 600,000 AF/yr (i.e. no pumping in 52 years, historic pumping in 27 years)

- Scenario 4 assumed that groundwater pumping is zero when annual releases from Caballo are above 500,000 AF/yr (i.e. no pumping in 60 years, historic pumping in 19 years)
- Scenario 5 assumed that groundwater pumping is zero when annual releases from Caballo are above 400,000 AF/yr (i.e. no pumping in 66 years, historic pumping in 13 years)

148. Results include the estimated flow of the Rio Grande at El Paso. Comparison of the results of the alternative scenarios yielded quantified estimates of various levels of pumping reductions and an evaluation of their significance.

149. As the threshold value of Rio Grande at Caballo decreases (from 790,000 to 400,000 AF/yr), average Rio Grande at El Paso flows (1951-2016) increase.

150. The results demonstrate that limiting groundwater pumping during years with low river flow has a similar effect as long term reductions in pumping. For example, Figure 19 presents a hydrograph of Rio Grande at El Paso flow that compares actual historic flow, the results of reduced pumping scenario 6 (60 percent reduction of pumping in all years), and the results of conjunctive use Scenario 3 (pumping at historic levels when Rio Grande Flow at Caballo is less than 600,000 AF/yr, zero when Rio Grande Flow at Caballo is greater than 600,000 AF/yr).

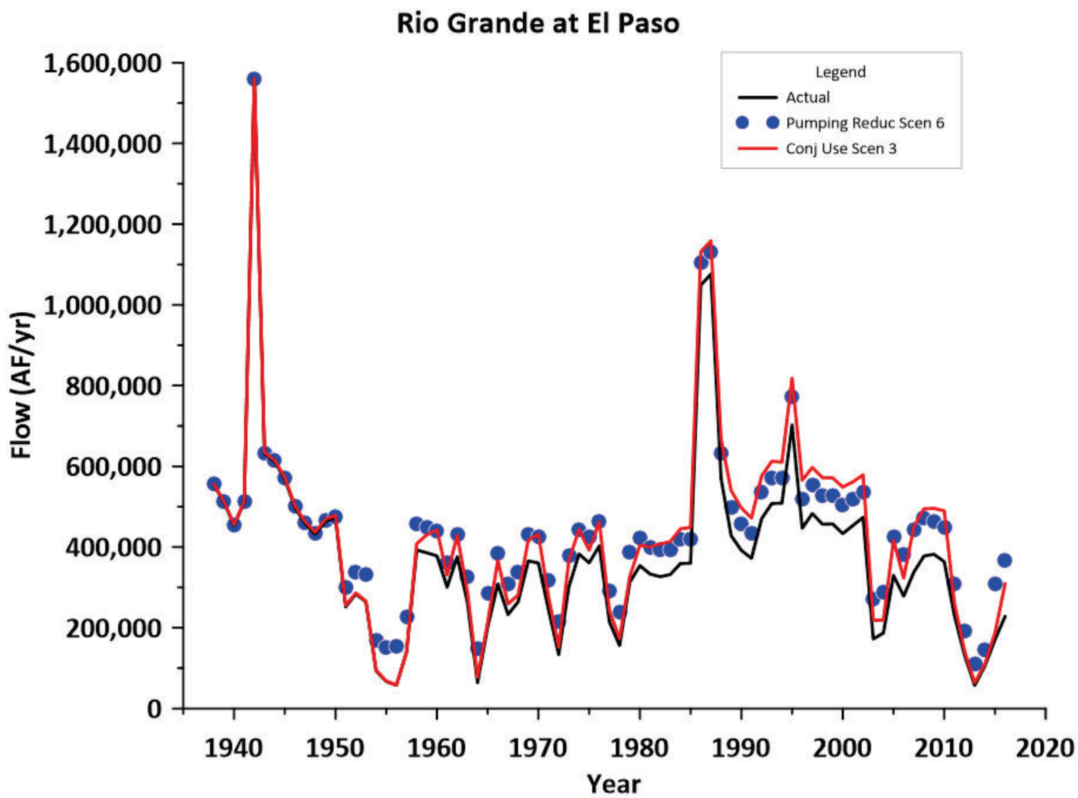


Figure 19. Rio Grande at El Paso - Pumping Reduction Scenario 6 and Conjunctive Use Scenario 3

151. During drought periods, the conjunctive use scenario estimates Rio Grande at El Paso flows that are near historic as a result of groundwater pumping. However, during periods of no pumping (in the case presented in Figure 19, when Rio Grande at Caballo flow is greater 600,000 AF/yr), Rio Grande flows at El Paso are about the same as the scenario where pumping in all years is reduced 60 percent.

152. Under this scenario, Rio Grande at El Paso flows would be low in drought years (i.e. years with pumping), but in years with high reservoir releases, pumping would cease, and groundwater levels would recover. This, in turn, would lead to a return to many years with gaining stream conditions that has not been observed since 1951 due to uninterrupted groundwater pumping.

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Attachment 1

Professional Resume of

William R. Hutchison, Ph.D., P.E., P.G.

April 2019

WILLIAM R. HUTCHISON, Ph.D., P.E., P.G.

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EDUCATION

University of Texas at El Paso: Ph.D., Environmental Science and Engineering, 2004-2006
University of Arizona: M.S., Hydrology, 1980-1981, 1982-1983
University of California, Davis: B.S., Soil and Water Science, 1976-1980

PROFESSIONAL LICENSES

Professional Engineer (Geological and Civil) No. 96287 (Texas)
Engineering Firm Registration No. 14526 (Texas)
Professional Geoscientist (Geology) No. 286 (Texas)
Registered Professional Geologist No. 0779 (Mississippi)

PROFESSIONAL HISTORY

Organization and Location(s)	Position	Dates
Independent Groundwater Consultant Jamaica Beach, TX		2012 – pres.
LBG-Guyton Associates Austin, TX	Associate	2011 – 2012
Texas Water Development Board Austin, TX	Director, Groundwater Resources Division	2009 – 2011
El Paso Water Utilities El Paso, TX	Water Resources Manager	2006 – 2009
	Hydrogeology Manager	2003 – 2006
	Hydrogeologist	2001 – 2003
TEAM Engineering and Management, Inc. Bishop, CA and Phoenix, AZ	Senior Hydrologist	1998 – 2001
Woodward-Clyde Consultants Santa Ana, CA and Phoenix, AZ	Associate	1996 – 1998
	Sr. Project Hydrologist	1993 – 1996
Luhdorff & Scalmanini Consulting Engineers Woodland, CA	Principal Hydrologist	1991 – 1993
	Senior Hydrologist	1988 – 1991
Inyo County Water Department Bishop, CA (now in Independence, CA)	County Hydrologist	1985 – 1988
Geothermal Surveys, Inc. South Pasadena, CA	Hydrologist	1983 – 1985
University of Arizona Tucson, AZ	Research Assistant	1982 – 1983
Mobil Oil Corporation Denver, CO and Glendive, MT	Hydrologist	1981
Metropolitan Water District of Southern California Yorba Linda, California	Intern	1979

REPRESENTATIVE CONSULTING EXPERIENCE SINCE 2011

Update to Groundwater Availability Model for the Southern Carrizo-Wilcox Aquifer

Principal Hydrogeologist for a team of consultants developing an updated flow model for the Southern Carrizo-Wilcox Aquifer (GMA 13 area of Texas) under a contract with the Texas Water Development Board. The updated model will address documented issues with the current model related to outcrop area calibration, surface water-groundwater interactions, and application to long-term predictive simulations. (2019 to present)

Update to Groundwater Availability Model for the Northern Carrizo-Wilcox Aquifer

Principal Hydrogeologist for a team of consultants developing an updated flow model for the Northern Carrizo-Wilcox Aquifer (GMA 11 area of Texas) under a contract with the Texas Water Development board. The updated model will address documented issues with the current model related to outcrop area calibration, surface water-groundwater interactions, and application to long-term predictive simulations. (2017 to present)

Groundwater Management Activities in Kinney County, Texas

Completed a management plan update, reviewed permit applications, and initiated a data collection effort in Kinney County for the Kinney County Groundwater Conservation District. Currently developing an updated groundwater flow model of Kinney County that will be used for general management initiatives and rules revisions. (2013 to present)

Joint Planning in Groundwater Management Areas 2, 3, 4, 7, 11 and 13

Consultant for GMAs 2, 3, 4, 7, 11 and 13 to develop updated desired future conditions. Included in this effort were the review of aquifer conditions and uses, review of water management strategies, review of hydrologic information and data, developing future pumping estimates, running alternative simulations with the Groundwater Availability Models, and preparing an explanatory report. (2012 to 2018)

Groundwater Flow and Transport Model of Lower Rio Grande Valley

Principal Hydrogeologist for a team of consultants developing a flow and transport model for the Lower Rio Grande Valley using MODFLOW-USG under a contract for the Texas Water Development Board. The model objectives included the simulation of 23 water management strategies related to proposed fresh groundwater development and brackish groundwater desalination plants. Simulation results included quantitative estimates of groundwater elevation changes, changes in salinity, and impacts to surface water flows. (2015 to 2017).

Joint Planning Support for Bluebonnet Groundwater Conservation District
Completed analyses and simulations to support Bluebonnet Groundwater Conservation District's consideration of revising the desired future conditions in GMA 14. Lone Star Groundwater Conservation District requested that the desired future conditions be revised as part of the settlement of litigation over the reasonableness of the desired future conditions adopted in 2016. The requested revision was reviewed and documented, and various alternative revisions were simulated using inverse runs of the Groundwater Availability Model to provide perspective on the requested revision. (2018 to present)

Groundwater Model Reviews in Pecos County, Texas
Reviewed two existing groundwater models for Middle Pecos Groundwater Conservation District: one developed by the USGS in 2014 and one developed by a team of consultants in 2011. The models were evaluated in terms of how they could be used for predictive simulations in support of developing desired future conditions and in support of permit applications. (2016 to 2017)

Groundwater Monitoring Thresholds in Pecos County, Texas
Reviewed historic groundwater data and model results to develop a groundwater monitoring plan, including regulatory thresholds. The results of the review and associated analyses were used in the settlement of several years of litigation between the Middle Pecos Groundwater Conservation District and a permit applicant. (2017)

Subsidence Analysis for Bluebonnet Groundwater Conservation District
As part of a rules revision that simplified the permitting process for small diameter wells and included more detailed requirements to consider subsidence analysis in the permit review process, simulations have been completed to estimate maximum pumping that would avoid subsidence using the Houston Area Groundwater Model, which has recently been adopted by TWDB as the Groundwater Availability Model for the northern portion of the Gulf Coast Aquifer. (2014 to 2015)

Groundwater Availability Model Development using MODFLOW-USG
As a consultant to the Hickory Underground Water Conservation District No. 1, Dr. Hutchison worked with staff of the Texas Water Development Board in the development of the Groundwater Availability Model for the Llano Uplift Aquifers. This model was developed with MODFLOW-USG. (2013 to 2016)

Hydrogeologic Study of Val Verde County, Texas
Completed a hydrogeologic study of the Edwards-Trinity (Plateau) Aquifer in Val Verde County for the County of Val Verde and City of Del Rio. The study included developing, calibrating, and applying a groundwater flow model of the area to assess impacts of proposed pumping on local spring flow and Rio Grande flows. (2013 to 2014)

Comparison of Groundwater Monitoring Data with Groundwater Model Results

As part of the current round of joint groundwater planning, completed assignments for groundwater conservation districts in Groundwater Management Area 9 and Groundwater Management Area 13 to compare groundwater monitoring data with groundwater model results from the desired future conditions process. These efforts examined, in detail, the various assumptions used in developing the initial round of desired future conditions adopted in 2010. (2012 to 2013)

Groundwater Model Review Panel

Participated as a member of the Groundwater Review Panel for the Edwards Aquifer Authority related to the new finite element model being developed for the Edwards Aquifer by Southwest Research Institute. (2012 to 2015)

Groundwater Transport Permit Review

A private landowner submitted a permit application to transport 22,500 acre-feet per year of groundwater from Austin and Waller Counties to the cities of Richmond and Rosenberg in Fort Bend County. Dr. Hutchison completed the technical review of the application for the Bluebonnet Groundwater Conservation District as part of a contested case hearing. The applicant subsequently withdrew the application. (2012 to 2014)

Well Classification Study and Hydrogeologic Report Guidelines Update

Over 2,500 wells in the Bluebonnet Groundwater Conservation District (Austin, Grimes, Waller and Walker Counties) were evaluated to determine the aquifer completion interval by comparing the screened interval with various groundwater models of the region (Carrizo-Wilcox, Queen City, Sparta, Yegua-Jackson, and Gulf Coast). The results of this evaluation were used to update and enhance the review process of permit applications submitted to the district. (2012 to 2014)

Rules Update for Bluebonnet Groundwater Conservation District

Based on the well classification study and the review of the groundwater transport permit (please see above), the Board of Directors completed a revision to the district rules that simplified the permitting process for small diameter wells and included more detailed requirements to consider subsidence analysis in the permit review process. (2014)

Mine Dewatering Groundwater Pumping Permit

Hickory Underground Water Conservation District No. 1 received a permit application from Premier Silica LLC to pump groundwater for dewatering associated with an expansion of an existing aggregate mine in the Brady area. Dr. Hutchison was retained to review the groundwater model that has been developed in support of the permit application, and to review the impact of the proposed pumping on the adopted desired future condition for the Hickory Aquifer. (2012 to 2013).

Evaluation of a Proposed Groundwater Development Project in East Texas

Completed an evaluation of potential effects of a proposed groundwater development project located in Anderson, Cherokee, and Houston counties in east Texas for the Neches & Trinity Valleys Groundwater Conservation District. Consultants for the project proponents and the Texas Water Development Board (TWDB) had previously completed simulations of the proposed pumping using the Groundwater Availability Model (GAM) of the Northern Carrizo-Wilcox Aquifer. Neches & Trinity Valleys Groundwater Conservation District asked for the completion of three tasks: 1) review TWDB GAM run reports, including the GAM run model run that was used to establish Desired Future Conditions, and the GAM run that was used to evaluate the regional effects of the proposed project, 2) extend the previous analyses of the project proponent's consultant and the TWDB by evaluating the effects of the proposed pumping on specific wells, and 3) recommend and monitoring network. The analysis was presented to the Neches & Trinity Valleys Groundwater Conservation District and was presented at the GMA 11 petition hearing in February 2012. (2011 to 2012)

Groundwater Management Plan for Red River Groundwater Conservation District

Consultant to the Red River Groundwater Conservation District in Fannin and Grayson Counties in the preparation of their initial management plan. This assignment required compiling and organizing the goals, objectives and performance measures from management plans of neighboring districts, preparing a handout for Board members and reviewing the various approaches with the Board in an open workshop session. Based on the discussion, a draft plan was prepared and approved by the Board. The review draft was subsequently approved by the Texas Water Development Board with no changes. The public hearing and final approval were completed by District personnel as a means of reducing costs. (2012)

Evaluation of Groundwater Availability using Groundwater Budget Analysis

Completed a groundwater budget analysis to provide data and information pertaining to groundwater availability for a private property owner in California. The analysis involved identifying and quantifying individual components of the inflows to and outflows from the defined area. Based on an analysis of precipitation and groundwater elevation changes, a series of historic groundwater budgets were developed for 20-year periods ranging from 1949-1968 to 1991-2010. The analysis was extended to estimate changes to the groundwater budget, generally, and groundwater elevations, specifically under alternative groundwater pumping scenarios from the subject property. (2011 to 2012)

REPRESENTATIVE AGENCY EXPERIENCE (TWDB and EPWU)

Joint Groundwater Planning in Texas

In 2005, the Texas Legislature adopted HB 1763, which required that groundwater conservation districts within each groundwater management area adopt desired future conditions by September 1, 2010. The Texas Water Development Board provided technical assistance to this process. As Director of the Groundwater Resources Division, Dr. Hutchison was responsible for coordinating the effort of division staff and took the lead in 9 of the 15 Groundwater Management Areas. Technical support included developing and running groundwater models to estimate impacts of alternative pumping scenarios and attending meeting to discuss and interpret the results of these analyses. Partly because of the technical support provided by the Groundwater Resources Division staff, all desired future conditions were adopted prior to the statutory deadline. (2009 to 2010)

Challenges to the Reasonableness of Desired Future Conditions in Texas

Prepared technical reports related to petitions challenging the reasonableness of desired future conditions for Groundwater Management Area 1 (Ogallala Aquifer) and Groundwater Management Area 9 (Edwards Group of the Edwards-Trinity (Plateau) Aquifer). These petitions were filed with the Texas Water Development Board in accordance with statute and agency rules. The technical analysis was submitted to the Board for consideration in their deliberations as to the reasonableness of the adopted desired future condition. (2009 to 2010)

Modeled Available Groundwater Development in Texas

Managed development of modeled available groundwater estimates that were based on the desired future conditions adopted by the groundwater conservation districts. These estimates, required by statute, include estimating the total pumping that will achieve the desired future condition and estimating the exempt use of the area. Prior to the 2011 legislative session, these estimates were termed Managed Available Groundwater, and represented the amount of groundwater available for permitting, and were calculated as the total pumping minus the exempt use. (2010 to 2011)

Update of the Hueco Bolson Model in Chihuahua, New Mexico and Texas

Completed an update of the USGS model of the Hueco Bolson (Texas, New Mexico and Chihuahua) by extending the model period to 2002. The model was used to complete simulations of alternative groundwater management strategies. Based on the results of this work, recommendations were developed regarding long-term groundwater management strategies for the Hueco Bolson. (2001 to 2003)

Groundwater Availability Model Updates in Texas

Completed updates to groundwater availability models in support of the Joint Groundwater Planning Process in Texas. Updated models included: Dockum Aquifer, Edwards-Trinity (Plateau) Aquifer and Pecos Valley Aquifer, Barton Springs Segment of the Edwards (Balcones Fault Zone) Aquifer, Kinney County portions of the Edwards (Balcones Fault Zone) Aquifer and Edwards-Trinity (Plateau) Aquifer, and Southern Gulf Coast Aquifer (GMA 16 portion). These models were updated because the existing models proved to be inadequate for assisting the groundwater conservation districts in developing desired future conditions. (2009 to 2010)

Groundwater Model of the Dell City, Texas Area

Developed a regional groundwater flow model covering a large area in Hudspeth and Culberson Counties, Texas and Otero County, New Mexico. This objective of this groundwater model was to develop a more complete understanding of the hydrogeology of the karstic aquifer in the region, and develop data and information related to acquiring property and water rights for a potential groundwater importation project for the City of El Paso. In 2016, the model was adopted by the Texas Water Development Board as the official Groundwater Availability Model for the Bone Spring-Victorio Peak Aquifer. (2001 to 2008)

Hueco Bolson Evaluation, Texas

Completed analyses of groundwater flow and groundwater quality of the Hueco Bolson covering west Texas, southern New Mexico and northern Chihuahua. These analyses included evaluating historic groundwater flow patterns, mapping current groundwater quality in three dimensions, evaluating historic groundwater quality changes caused by pumping, and changes in the groundwater budget including induced inflow from the Rio Grande. Prepared comprehensive report of findings that was peer reviewed by a 5-member panel. Results included the finding that the reduction in groundwater pumping from 1989 to 2002 had fundamentally changed conditions in the Hueco Bolson. Moreover, the assumptions that were the foundation of a conclusion made in a 1979 analysis (depletion of fresh groundwater by 2030) were no longer applicable. (2001 to 2004)

Mesilla Bolson Groundwater Management, El Paso, Texas

Completed analyses of groundwater flow and groundwater quality of the Mesilla Bolson in west Texas and southern New Mexico. These analyses included evaluating previous groundwater models developed for a variety of objectives and analyzing the role of the Rio Grande in the recharge of the Mesilla. As a result of the analyses a series of piezometers were constructed to improve data coverage and long-term monitoring of the area. In addition, limitations to previous models were identified, and work is currently underway to better incorporate the known hydrostratigraphy in an updated and improved model of the area. (2001 to 2009)

Model Documentation of Groundwater Availability Models in Texas

Completed documentation of the Hueco Bolson and Mesilla Bolson groundwater flow models (Texas, New Mexico and Chihuahua). These models had been previously developed and were designated as official Groundwater Availability Models (GAM) for the Hueco-Mesilla Aquifer by the Texas Water Development Board. Documentation was needed to fully satisfy the requirements of the Texas Water Development Board. (2001 to 2004)

Brackish Groundwater Well Location, El Paso, Texas

Completed analyses of the Hueco Bolson related to locations of new wells for use in the Kay Bailey Hutchison Desalination Plant, a joint project between El Paso Water Utilities and Fort Bliss. After initial concerns were raised by Fort Bliss, an investigation was completed in cooperation with the US Army Corps of Engineers to evaluate five alternative well field locations that would produce brackish groundwater to be treated in the planned reverse osmosis plant. Based on this analysis, an alternative was selected and agreed upon. (2003)

Desalination Concentrate Injection Wells in El Paso, Texas

Completed preliminary analyses of impacts from injection wells that were proposed for use as part of the Kay Bailey Hutchison Desalination Plant in El Paso, Texas. The analyses included the development of a simple numerical flow model based on a subsurface geologic model developed by researchers at UTEP from gravity data and on the results from slug tests completed during a test hole drilling project funded and managed by the US Army Corps of Engineers. These analyses were incorporated into the Environmental Impact Statement (EIS) for the overall project. Based on the results of the analysis, a full-size injection well was constructed and tested to obtain better data to support authorization from the Texas Commission on Environmental Quality (TCEQ) under the Underground Injection Control (UIC) program. Once authorization was obtained, two additional wells were constructed, and all three wells were equipped and tested. Issues related to the potential for mineral precipitation in the well bores and reservoir were evaluated with a combination of geochemical modeling, experiments with formation samples, formation water and concentrate, and monitoring of initial operation. (2004 to 2009)

Simulations of Potential Desalination Plant in Mission Valley, El Paso, Texas

Completed a preliminary analysis of a proposed desalination plant in the Mission Valley area of El Paso. This analysis consisted of simulating three potential configurations of well fields to assess impacts to groundwater elevations and gradients, and to estimate potential impacts to the groundwater budget of the area. Based on this analysis, and a companion engineering analysis completed by a consultant, future pre-design work was recommended. (2003)

Region E Water Planning, Far West Texas

Developed the conceptual approach of an Integrated Water Management Strategy for El Paso County that was used in the 2005 Regional Water Plan for Far West Texas. Working with Far West Texas Regional Planning Group and their consultants, the conceptual plan was used to develop six specific alternatives designed to meet expected increased water demands in El Paso County through 2060. Alternatives ranged from reliance on single existing sources to a balanced approach that relied on numerous sources, including importation from Hudspeth, Culberson, Jeff Davis, and Presidio Counties. (2004 to 2005)

Impacts of Climate Variability and Climate Change in El Paso, Texas

Analyzed the reliability of El Paso's municipal water supplies under a wide range of climate scenarios, including integration of the Intergovernmental Panel on Climate Change (IPCC) projections for the region. Because El Paso practices conjunctive use management, the analysis included evaluation of impacts to both surface water (Rio Grande) and groundwater impacts. The analysis included developing simulated Rio Grande flows entering Elephant Butte reservoir based on a published 1000-yr tree ring record, developing a simple reservoir operations model to estimate Elephant Butte outflows and El Paso municipal diversions, estimating groundwater pumping, and simulating groundwater storage changes using a groundwater model. A total of 60 climatic scenarios were developed. Each scenario was simulated under 958 50-year simulations for a total of 57,480 simulations. The results demonstrated the effectiveness of the investments in water infrastructure and the efficacy of the management approach that has been developed over the last several decades in meeting municipal water demands over a wide range of climatic conditions. (2007 to 2008)

Well Construction

Managed a well construction and equipping program while employed by El Paso Water Utilities that resulted in:

- Drilling of 50 test holes
- Construction of 14 monitoring wells
- Construction of 3 multi-zone piezometers
- Construction and equipping of 16 fresh groundwater production wells
- Construction and equipping of 32 brackish groundwater production wells

Well designs and construction management are completed in-house. Equipping design and construction management are supervised through a consulting engineer. (2001 to 2009)

REPRESENTATIVE CONSULTING EXPERIENCE (1983 to 2001)

Owens Valley, California

Hydrology consultant to the Inyo County (California) Board of Supervisors, Water Department, Water Commission and Environmental Health Department from 1985 to 1999 on issues related to water resources management and protection in the Owens Valley and Death Valley regions, including a key role in the development and negotiation of an historic water management agreement between Inyo County and the City of Los Angeles for the Owens Valley and the preparation of the associated environmental documentation. Assignments also included review and analysis of the Anheuser-Busch groundwater export project in the Cartago area, review and analysis of the groundwater pumping proposed by OLSAC in the Cottonwood Creek area, review and analysis of the groundwater export project proposed by Western Water in the Olancha area, and many others. Many of these assignments included the development and application of groundwater models and the development of monitoring networks and environmental triggers and thresholds to manage the pumping operations. (1985 to 1999)

Owens Valley Indian Reservation Groundwater Modeling

Completed local scale groundwater models of three Indian Reservations in the Owens Valley, California. The regional model developed by the USGS was used as a starting point for these models. The initial phase consisted of using Telescopic Mesh Refinement to define the boundary conditions of the three local scale models. Subsequent phases included enhancing and updating the local scale models. The preliminary model of the Big Pine area was used to evaluate potential increases in pumping that are associated with the Big Pine Ditch System project. (2000 to 2006)

Los Angeles Aqueduct Simulation Model

Consultant to the California State Water Resources Control Board related to the Mono Basin Water rights decision, a court ordered review of water rights licenses held by the City of Los Angeles. Working in partnership with State Board staff and Board members, hydrologic analyses were completed, and a simulation model (LAAMP) of the Mono Basin and Los Angeles Aqueduct system was developed and applied to evaluate the impacts of alternative water rights decisions. The simulation model was accepted by all parties involved in the process and was ultimately used in the final water rights decision that resulted in decreased diversions in order to maintain fish flows and restore lake elevation. (1992 to 1994)

Tri-Valley Groundwater Evaluation, Mono County, California

Completed a preliminary groundwater model for the Tri-Valley Groundwater Management District in Mono County, California. This model was based on existing data and was used to preliminarily evaluate the potential impacts of a proposed groundwater export project. Based on the model results, additional data requirements were identified and recommended for Phase 2 of the project. (2000 to 2001)

Evaluation of Impacts of Increased Capacity of Salinas Dam, California

Completed analyses related to the evaluation of potential downstream impacts of increased storage capacity of the Salinas Dam in central California. These analyses included estimates of reduced spills associated with the increased storage, evaluating the relationship of river flows and groundwater levels in the Atascadero area, and estimating potential groundwater level impacts that may result from the reduced spills. The analyses were summarized in an Environmental Impact Report, and in several technical appendices to the EIR. Because the work involved modification of a water right held by the City of San Luis Obispo, expert witness testimony was given at the California State Water Resources Control Board. (1997 to 1999)

Aggregate Mine Expansion, Ventura County, California

Consultant to Ventura County (California) Resource Management Agency on the analysis of potential hydrologic impacts of the expansion of an aggregate mine. Concerns had been raised about the potential impact of the mine expansion on seawater intrusion and nitrate contamination. The assignment began with the review of a groundwater model prepared by the project proponent's consultant. As a result of the review, the existing analyses was expanded with the development of a site-specific groundwater model to enhance the simulation of the potential impacts on nearby spreading facilities, the development of a solute transport model, the completion of a risk assessment of potential groundwater pollution, and the preparation of the water resources and water quality sections of an Environmental Impact Report. (1995 to 1996)

Simulation of Impacts of Tunnel Construction, California

Developed a finite element model for the Metropolitan Water District of Southern California using FRAC3DVS to simulate groundwater inflow during the construction of the Inland Feeder East Tunnel near San Bernardino, California. The model was calibrated under steady-state conditions using groundwater level data from geotechnical boreholes constructed during the design-phase geotechnical investigation. The model was calibrated under transient conditions using tunnel inflow data and groundwater level changes caused by groundwater inflow into the tunnel. Based on the model results, recommendations were made regarding grouting operations for later phases of construction. (1996 to 2002)

Los Osos Groundwater Model

Updated and enhanced a groundwater model and developed a groundwater management plan for the three water purveyors in Los Osos, California (Southern California Water Co, S&T Mutual Water Company, and Los Osos Community Services District). The original model had been developed in 1987 by the USGS, and the updated version was used to address specific management questions related to construction and operation of a sewer project, seawater intrusion, conjunctive use strategies, and the need to import surface water. (1997 to 2000)

San Benito County Groundwater Evaluation, California

Conducted a countywide evaluation of the groundwater resources of San Benito County, California. This effort included the evaluation of surface water and groundwater quantity and quality, development and calibration of a basin wide numerical model of the groundwater system, and the evaluation of recharge patterns altered by the delivery of supplemental surface water, some of which is used for direct groundwater recharge. At the completion of the model and report, expert witness testimony was given in a groundwater rights lawsuit between a developer and the local water district. Four years after the model was completed, the County requested that the model be updated and enhanced. (1991 to 1992, 1996)

San Luis Obispo Groundwater Evaluation

Completed analyses related to a proposed increase in groundwater pumping in the San Luis Obispo area of central California. The initial analysis consisted of integrating potential local groundwater pumping increases into the reservoir operations planning model used by the City of San Luis Obispo to identify conjunctive use opportunities and limitations. The second phase of the analysis consisted of developing and calibrating a groundwater model of the entire groundwater basin. This model was then used to identify potential impacts of increased pumping on groundwater levels in nearby wells, potential reductions in streamflow, and potential subsidence effects. (2000 to 2001)

Cadiz Valley Groundwater Exploration and Development

Completed a comprehensive groundwater exploration and development project in the Cadiz Valley near the Fenner Gap in the Mojave Desert region of southeastern California. Exploration work included review of available information and data on groundwater conditions and geology. An extensive geophysical study using shallow ground temperatures was completed and results were used to select drilling sites. Three test holes were drilled, and two production wells were constructed and tested. Based on the results of the investigations, a report was prepared, and a groundwater budget of the area was estimated. Sixteen years later, assisted the Metropolitan Water District of Southern California in the review of a proposed groundwater storage and recovery project in the Cadiz Valley. As part of this assignment, the groundwater model that had been developed to evaluate the feasibility and potential impacts of the project was modified and enhanced. (1983 to 1984, 2000 to 2001)

Groundwater Management Spreadsheet Models

Developed management tools in the form of empirical models that can be run in a spreadsheet format for the Soquel Creek Water District in central California, and the Vista Irrigation District in southern California. The models were designed to provide a tool for Soquel Creek Water District to manage their groundwater pumping with the objective of preventing seawater intrusion, and by Vista Irrigation District to conjunctively use local surface water, local groundwater, and imported water (1988 to 1991).

Groundwater Storage Project Evaluation in Southeastern California

Developed groundwater models for four basins in southeastern California to evaluate the feasibility of storing Colorado River water for the Metropolitan Water District of Southern California. These models were used to simulate the storage of water in wet years, "holding" the water for 5 to 10 years, then extracting after the "hold" period. Models were developed for the Hayfield, Palen, Chuckwalla, and Rice Valleys. Based on the initial modeling work, a focused field investigation was completed in the Hayfield Valley are, the site chosen as the most desirable. (1996 to 2001)

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Attachment 2

Groundwater Modeling Experience

Attachment 2
William R. Hutchison, Ph.D., P.E., P.G.
Groundwater Modeling Experience in Texas and Outside of Texas

Texas

Model	Area	Developed Model		Updated Model	Reviewed Model	Simulations with Model
		Primary Role	Secondary Role			
Bluebonnet GCD Model	Southeast Texas	in progress				
Bone Spring-Victorio Peak Aquifer	Dell City area, Texas	x				x
Canutillo Area	West Texas and Southern New Mexico (El Paso area)				x	x
Capitan Reef Complex Aquifer	West Texas				x	x
Dockum Aquifer	Panhandle and West Texas		x			x
Edwards BFZ (Barton Springs Segment) Aquifer	Travis County	x				x
Edwards BFZ (San Antonio Segment) Aquifer	Southwest Texas				x	x
Edwards-Trinity (Plateau) and Pecos Valley Aquifers	West Texas	x				x
GMA 16 Model	Rio Grande Valley (South Texas)	x				x
Hill Country	Central Texas		x			x
Hueco Bolson (USGS)	West Texas, Southern New Mexico, and Mexico			x	x	x
Hueco Bolson Flow and Transport (EPWU)	West Texas, Southern New Mexico, and Mexico		x			x
Kinney County (Version 1)	Southwest Texas	x				x
Kinney County (Version 2)	Southwest Texas	in progress				
Llano Uplift Region	Central Texas		x			x
Lower Rio Grande Flow and Transport Model	Rio Grande Valley (South Texas)		x			x
Northern Carrizo-Wilcox Aquifer (Version 2)	Northeast Texas			x	x	x
Northern Carrizo-Wilcox Aquifer (Version 3)	Northeast Texas		in progress			
Northern Gulf Coast Aquifer	Southeast Texas				x	x
Ogallala Aquifer	Panhandle and West Texas				x	x
Pecos County (USGS)	West Texas				x	x
Pecos County (MPGCD)	West Texas	in progress				
Presidio and Redford Bolsons	West Texas		x			
Rustler Aquifer	West Texas				x	x
Seymour Aquifer	North Texas		x			
Southern Carrizo-Wilcox Aquifer	Southwest Texas				x	x
Southern Carrizo-Wilcox Aquifer (Version 2)	Southwest Texas		in progress			
Val Verde County	Southwest Texas	x				x
Western Pecos County (Harden and others)	West Texas				x	x
Yegua-Jackson Aquifer	Southwest Texas				x	x

Attachment 2
William R. Hutchison, Ph.D., P.E., P.G.
Groundwater Modeling Experience in Texas and Outside of Texas

Outside of Texas

Model	Area	Developed Model		Updated Model	Reviewed Model	Simulations with Model
		Primary Role	Secondary Role			
Big Pine Area Model	Owens Valley, CA	x				x
Bishop Area Model	Owens Valley, CA	x				x
Cadiz Area Model	San Bernadino County, CA				x	x
Casa Grande Area Model	Pinal County, AZ	x				x
Chuckwalla Valley Model	San Bernadino County, CA	x				x
Hayfield Valley Model	San Bernadino County, CA	x				x
Hollywood Reservoir Groundwater Model	Los Angeles County, CA	x				x
Independence Area Model	Owens Valley, CA	x				x
Inland Feeder Model - Badlands	Riverside County, CA	x				x
Inland Feeder Model - Mountain	San Bernadino County, CA	x				x
Kaweah Area Model	Tulare County, CA				x	
Lone Pine Area Model	Owens Valley, CA	x				x
Los Osos Model	San Luis Obispo County, CA	x				x
Modesto-Turlock Model	Stanislaus County, CA	x				x
Mojave Area Model	Kern County, CA	x				x
Owens Valley Model	Owens Valley, CA				x	x
Palen Valley Model	San Bernadino County, CA	x				x
Piceance Basin Model	Western Colorado		x			
Rice Valley Model	San Bernadino County, CA	x				x
San Benito County Model (2)	San Benito County, CA	x		x		x
San Luis Obispo Model	San Luis Obispo, CA	x				x
Swall Meadows Area Model	Mono County, CA	x				x
Tri-Valley Model	Mono County, CA	x				x
Ventura Slice Model	Ventura County, CA	x				x

Attachment 3

El Paso Water Utilities Letter to Transboundary Aquifer Assessment Coordinators (July 11, 2008)

EL PASO WATER UTILITIES
PUBLIC SERVICE BOARD

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July 11, 2008

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Dear Transboundary Aquifer Assessment Program Coordinators:

El Paso Water Utilities (EPWU) is pleased to submit this comment letter regarding the proposed work plan (dated June 6, 2008) for the initial year of the Transboundary Aquifer Assessment Program, which is focused on the Mesilla Bolson. This work plan was distributed to interested stakeholders at our meeting of June 11, 2008.

The proposed work plan outlined seven elements: a coordination/collaboration element, four "review" elements, an element focused on identifying gaps in the context of model development, and an element devoted to preparing progress reports. The overall focus of the work plan appears to be headed towards the development of another groundwater model (flow and possibly transport) that may not be necessary because the most recent model of the area (Papadopulos model) appears to be a good representation of the area.

Papadopulos Model

At the June 11, 2008 meeting, it was announced that the latest model of the Mesilla Bolson had been released to the public. This model was developed by S.S. Papadopulos and Associates for the state of New Mexico in late 2007. As mentioned at the meeting, this is the most recent of at least 9 or 10 models that have been developed over the years for the Mesilla Bolson.

After the meeting, EPWU downloaded a copy of the model files and documentation. Based on our review, the Papadopulos model appears to be a significant improvement over previous models in its scope, detail, and calibration. Although any model can be improved, it is our opinion that, as a regional tool, the Papadopulos model is a reasonable representation of the groundwater system.

The Papadopulos model report did not contain details of the overall calibration of the model. As part of our review of the model, we downloaded data from the USGS Mesilla groundwater monitoring network and combined these data with EPWU data from the Canutillo wells. Although not clearly stated in the Papadopulos report, we assumed that this combined dataset was part of the model calibration dataset.

This combined dataset contained over 15,000 groundwater measurements in over 270 wells. Since the model stress periods ended in February and October of each year, only data from those months were used for comparison. This resulted in nearly 3,000 groundwater elevation measurements to assess model fit. Comparison of measured groundwater elevations with model-estimated groundwater elevations was completed on a layer-by-layer basis using well depth. For purposes of this comparison, we assumed that the well was open at the bottom and was only open in a single layer. This assumption introduced some error into the analysis where a well is screened in more than one layer. However, because vertical gradients in the area are small, errors were considered minor for purposes of model review. Also, no filtering of data was attempted to remove outliers or groundwater levels that would be considered pumping water levels. A summary of the calibration statistics is presented in Table 1.

Table 1
Summary of Papadopulos Model Calibration

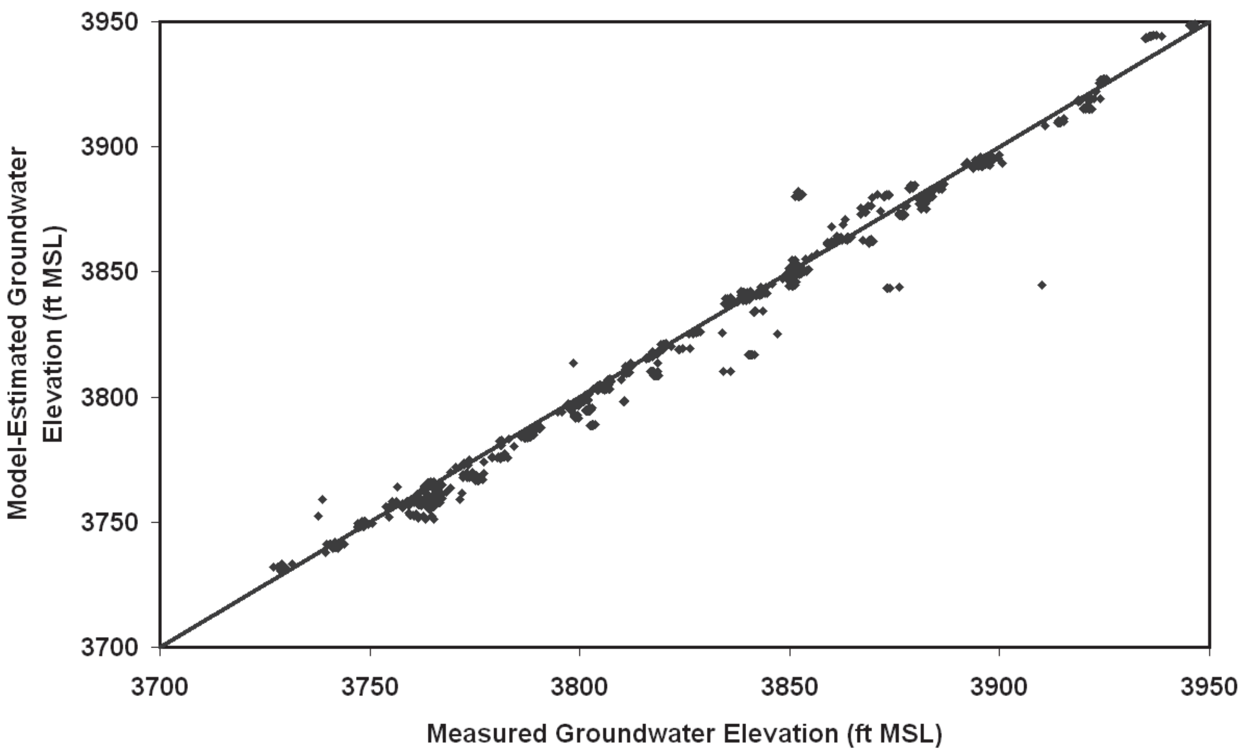
Calibration Statistic	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Entire Model
Number of Readings	1160	673	401	249	501	2984
Minimum Residual (ft)	-29.95	-29.99	-66.96	-131.63	-83.09	-131.63
Maximum Residual (ft)	65.43	21.95	31.21	15.37	28.27	65.43
Average Residual (ft)	2.66	1.64	-9.07	-14.37	-16.28	-3.75
Standard Deviation of Residuals (ft)	6.34	6.73	18.84	22.95	18.88	15.46
Range of Measured Groundwater Elevations (ft)	219.69	155.25	200.70	142.53	217.17	272.60
Standard Deviation/Range	0.029	0.043	0.094	0.161	0.087	0.057
Sum of Squared Residuals	54,801	32,227	175,034	182,103	311,017	755,182

Percentage of Residuals Within:	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Entire Model
± 5 ft	69	67	39	33	18	53
± 10 ft	94	87	57	50	40	75
± 20 ft	97	97	75	74	61	86
± 40 ft	100	100	90	95	87	96

The residuals noted in Table 1 were calculated as measured groundwater elevation minus model-estimated groundwater elevation. A negative residual indicates that the model-estimated groundwater elevation is higher than the measured groundwater elevation, and a positive residual indicates that the model-estimated groundwater elevation is lower than the measured groundwater elevation. The standard deviation of the residuals divided by the range of measured groundwater elevations is less than 0.10 for the overall model and in all layers except layer 4, which suggests that the model calibration is acceptable. Filtering pumping groundwater levels out of the dataset would likely address some of the layer 4 issues.

Please note that the standard deviation divided by the range is lowest in layer 1 (0.029), and the number of measurements in layer 1 (1,160) is nearly twice that of any other layer. Also, the assumption regarding single layer completion is strictly met in layer 1 (i.e. no additional error is introduced). The model calibration for layer 1 is summarized graphically in Figure 1, which depicts measured groundwater elevations vs. model-estimated groundwater elevations.

Figure 1
Layer 1 Calibration



Note that nearly all points fall on or very close to the 1:1 line which represents a good calibration. The good fit depicted in Figure 1 highlights the success of the detailed work associated with the development of surface water flow data (Appendix E of the Papadopulos report) and the detailed work associated with the development of the canal and farm budget (Appendix F of the Papadopulos report). These two appendices represent a significant advancement in knowledge as compared to previous models.

In our opinion, the Papadopulos model simulates the interaction between surface water and groundwater better than previous modeling efforts. Knowledge of the interaction of surface water and groundwater in the Mesilla Bolson is of considerable importance in the management of water in the Mesilla Bolson. One of the conclusions of our review is that the Papadopulos model is a useful tool in understanding the regional aspects of surface water and groundwater interactions.

Papadopulos Recommendations for Future Work

The Papadopulos model report contained nine recommendations for future work. Five of the recommendations identified activities that would "broaden the potential application of the model to more detailed assessment of more localized questions". We believe that the Transboundary Aquifer Assessment work plan should remain focused on regional issues, and thus not include any work that "chooses" a local question to address.

The other four recommendations were aimed at "maintaining this model as a contemporary and defensible tool for water resource management". These recommendations were:

- Continued metadata for all data sources
- Continued update of data from observation well targets
- Refinement of Texas M&I pumping rates
- Updating the model every three to five years

Continued update of metadata is associated with the work already outlined in the proposed Transboundary Aquifer Assessment work plan (Review existing data and geographic information system data for Mesilla Basin). We would suggest adding a subtask that specifically incorporates the Papadopulos recommendation.

Groundwater elevation measurements are currently being taken by the USGS, EPWU and other agencies and needs no additional attention in the Transboundary Aquifer Assessment work plan.

We have reviewed Texas M&I pumping rate input to the model and compared the estimates to actual data maintained in EPWU files. While there are differences, we concluded that the differences would not significantly alter model calibration or usefulness. We will be corresponding directly with others regarding this finding, and there is no need to incorporate this recommendation in the Transboundary Aquifer Assessment Work Plan.

We agree that the model should be updated on a three to five year schedule as recommended by Papadopulos. However, we do not recommend that this "update" be accomplished as part of the Transboundary Aquifer Assessment work plan as the funds could be used for broader purposes as outlined below in our recommended work plan elements.

Recommended Work Plan Elements

This comment letter on the proposed Transboundary Aquifer Assessment work plan has discussed the Papadopulos model at some length to highlight our opinion that the model is a suitable regional tool. The current proposed work plan appears to be focused on ultimately developing another model of the area. Prior to making a decision to develop another model, an overall assessment of the state-of-knowledge is needed. We recommend that the work plan for the initial year of the Transboundary Aquifer Assessment Program include the following:

- Initiate and develop collaboration and partnerships for participation in this assessment program, including organizing project meetings, and preparation of progress reports per federal requirements (this combines the first and last element of the 6/6/2008 proposed work plan)
- Identify, review and evaluate previous studies on the Mesilla Bolson, including models of the hydrogeologic framework and groundwater models of the area (this combines three elements of the 6/6/2008 work plan)
- Review existing data and geographic information system (GIS) data for Mesilla Bolson (no change from 6/6/2008 proposed work plan, except adding a subtask to specifically address the Papadopulos recommendation regarding metadata for the model input and calibration datasets)
- Prepare a study plan for subsequent years of the Transboundary Aquifer Assessment Program

The final element and final work product would be a study plan that would include the findings of the reviews associated with the recommended second and third elements. Including reviews of these previous studies in the context of a future study plan would be regionally significant effort. The reviews associated with the second and third elements would be broader than those suggested in the June 6, 2008 proposed work plan. By separating the “review” elements in the proposed work plan, and based on certain bulleted statements in the proposed work plan, it appears that it is predetermined that a new model is needed. We believe that it would be more prudent to complete the review without an *a priori* conclusion.

The recommended study plan/review report should also include a discussion of data gaps identified by previous studies that would result in recommendations for future work under the Transboundary Aquifer Assessment Program. Examples (and suggestions) of potential data gaps that need to be considered include hydrogeology and groundwater flow of Fillmore Pass, and isotopic characterization of the Mesilla. The Papadopulos report identified the need to develop a more complete understanding of groundwater flow in the Fillmore Pass area. This has implications for both the Mesilla Bolson and the Hueco Bolson. This issue can be addressed in a more comprehensive manner in a summary report that includes a review of past studies on groundwater flow conditions in that area. A discussion of the merits of isotopic characterization in the Mesilla needs to be developed in the context of previous studies, including the Papadopulos model. Isotopic characterization has proven to be quite valuable in the Hueco

Bolson, and it seems likely that substantial benefits would be realized if a similar program were started in the Mesilla.

One opportunity of the recommended “study plan” approach is the ability to be flexible in implementation if funding is interrupted or if there are gaps in funding during the 10-year period of the Program. During this first year of the Program, we have already seen a significant reduction in the appropriation. We need to develop a study plan that is flexible to funding variations, yet can still accomplish the objective of improving our understanding of the Mesilla. We would suggest that as the study plan is developed, that some attention is paid to developing alternatives in the event that funding is limited or temporally uneven.

We appreciate the opportunity to review the work plan. If you have any questions, please advise.

Sincerely:

EL PASO WATER UTILITIES

William R. Hutchison, Ph.D., P.E., P.G.
Water Resources Manager

No. 141, Original

In the

SUPREME COURT OF THE UNITED STATES

STATE OF TEXAS,

Plaintiff,

v.

STATE OF NEW MEXICO and
STATE OF COLORADO,

Defendants.

OFFICE OF THE SPECIAL MASTER

DECLARATION OF ROBERT J. BRANDES, P.E., Ph.D IN SUPPORT OF THE STATE OF TEXAS'S MOTION FOR PARTIAL SUMMARY JUDGMENT; MEMORANDUM OF POINTS AND AUTHORITIES IN SUPPORT THEREOF FEDERAL RULE OF CIVIL PROCEDURE 56

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November 5, 2020

TX_MSJ_000001

DEITCHMAN DECL. EXH 7

I, Robert J. Brandes, declare as follows:

BACKGROUND AND EXPERIENCE

1. My name is Robert J. Brandes, P.E., Ph.D. I am over the age of 18, have personal knowledge of the facts set forth in this Declaration, and if called as a witness could and would testify competently under oath to such facts.

2. I have been engaged in consulting engineering practice since the late 1960s specializing in water resources and related engineering and environmental disciplines. Today, I own and operate my consulting business Robert J. Brandes Consulting in Austin, Texas. My street address is 6000 Maurys Trail, Austin, Texas 78730.

3. I have been retained by the State of Texas to provide consulting services on hydrologic and water resources issues presented in this case.

4. A true and correct copy of my professional curriculum vitae is attached hereto as Attachment 1 and is incorporated as though fully set forth herein.

5. My education includes a Bachelor of Science degree in Civil Engineering from the University of Texas at Austin (1967), a Master of Science degree in Civil Engineering from the University of Texas at Austin (1968), and a Ph.D. in Water Resources from the from the University of Texas at Austin (1972).

6. I am licensed in Texas as a Professional Engineer, No. 39120.

7. I specialize in water resources and related engineering and environmental disciplines. I have represented numerous private, commercial, and governmental entities, providing various planning, analysis, permitting, design, and operational services for a wide range of water projects. I have directed and conducted numerous studies and investigations dealing with surface and groundwater hydrology and hydraulics; water resources planning and development; water availability modeling (WAMs), water rights permitting and related issues;

municipal, industrial and agricultural water supply; reservoir system operations; rural and urban flooding and stormwater management; water quality; irrigation system analyses; project site development engineering; and environmental impact assessments. My experience encompasses a wide variety of problems involving rivers and streams, lakes and reservoirs, groundwater aquifers, wetlands, and bays and estuaries, and I am especially familiar with the development and application of computerized simulation techniques for analyzing water-related phenomena in these systems.

8. I have prepared and presented testimony and served as an expert witness in various judicial proceedings in state and federal courts and in administrative and regulatory hearings conducted by the State Office of Administrative Hearings and natural resources agencies in Texas, as well as the Texas Legislature.

9. I have authored or co-authored numerous technical documents and project reports, and have presented many technical papers and lectures pertaining to water resources and water rights at professional society meetings, water conferences and short courses.

10. In the last four years, I have testified as an expert witness in two cases.

11. The Rio Grande is an interstate and international river, approximately 1,800 miles long, originating in southern Colorado. *See* National Resources Committee, Regional Planning: Part VI-The Rio Grande Joint Investigation in the Upper Rio Grande Basin in Colorado, New Mexico and Texas 1936-1937, published in February 1938 (JIR) at 7 (Volume I). The JIR reflects an investigation by federal agencies at the request of the Rio Grande Compact Commissioners with input from Colorado, New Mexico, and Texas representatives. The primary purpose of the joint investigation was to compile factual data essential to support an apportionment of the waters of the Rio Grande above Ft. Quitman. JIR at vi-vii. A true and correct copy of the JIR is attached hereto as Attachment 2.

12. The Rio Grande winds southward approximately 400 miles across New Mexico, and crosses into Texas near the city of El Paso, where it defines the 1,250-mile international boundary between the United States and Mexico as it traverses to the Gulf of Mexico. The entire Rio Grande basin is depicted on the map below entitled **Figure 1**.

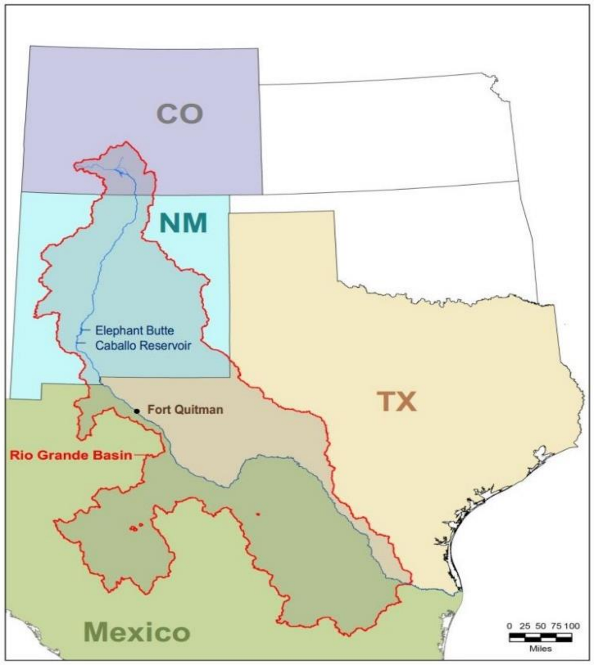
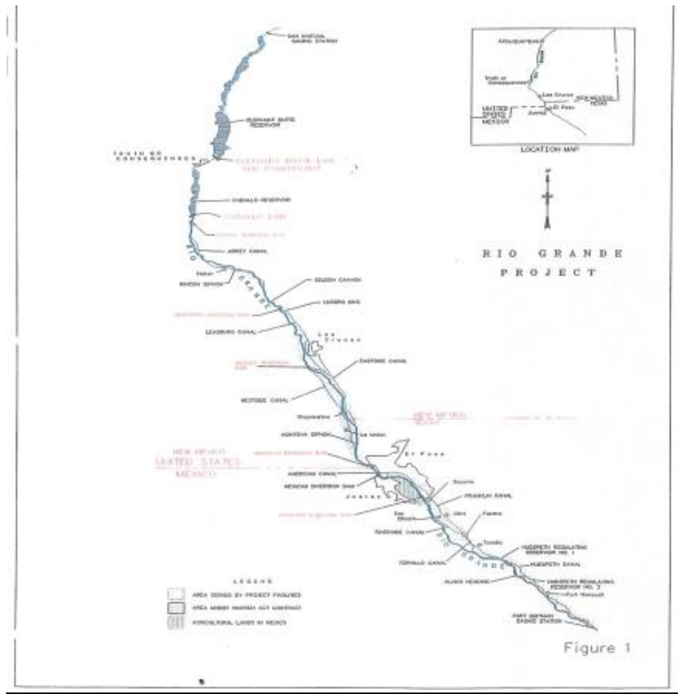


FIGURE 1: The Rio Grande basin

13. Along its entire course, the Rio Grande provides a source of surface water that is used extensively to meet the needs of municipalities, industries, and agricultural irrigators, as well as to support various environmental uses. Numerous dams and reservoirs exist along the river primarily for water supply and flood control purposes; consequently, flows in much of the river are substantially controlled and regulated.

14. With respect to the usage of water, the river is divided into two distinct sections at Fort Quitman. The Upper Rio Grande basin (the area above Fort Quitman, Texas) is comprised of parts of Colorado and New Mexico, and a very small part of Texas. The Upper Rio Grande basin itself is divided into three sections: (1) the San Luis section in

Colorado, (2) the Middle section in New Mexico, and (3) the Elephant Butte-Fort Quitman section in New Mexico, Texas, and Mexico. JIR at 7. This case is centered primarily upon issues involving the Elephant Butte-Fort Quitman section of the Upper Rio Grande basin. Figure 2 depicts the Upper Rio Grande basin.



<u>FIGURE 2: The Upper Rio Grande basin</u>

15. A different naming system for the full Upper Rio Grande basin geographic area (upstream of Ft. Quitman, Texas) is used locally. The San Luis section in Colorado is referred to as the "Upper Rio Grande," the middle section in New Mexico is referred to as the "Middle Rio Grande," and the Elephant Butte-Fort Quitman section in New Mexico, Texas, and Mexico is referred to as the "Lower Rio Grande." This local naming system is used in my Declaration and in Texas's Memorandum of Points and Authorities in support of its Motion for Partial Summary Adjudication. Correspondingly, this case is primarily centered upon issues involving the Lower Rio Grande, as the term is used in this local naming system.

16. The Project was authorized pursuant to the Rio Grande Reclamation Project Act of 1905 as a federal project that provides water from the Rio Grande primarily for agricultural irrigation along the Rio Grande in southern New Mexico and in the El Paso Valley of Texas. Elements of the Project also provide hydropower, flood control, and water for municipal users. It included construction of Elephant Butte Dam and Reservoir ("Elephant Butte Reservoir" or "Reservoir") on the Rio Grande near Truth or Consequences, New Mexico, to provide stored water for Project users.

17. The states of Colorado, New Mexico, and Texas agreed to the Rio Grande Compact in 1938 (1938 Compact or Compact). As a result of the negotiations to formalize the 1938 Compact, depletions were frozen at pre-1938 conditions. Two delivery schedules, or indices, were adopted: one for Colorado to New Mexico, and one for New Mexico to Elephant Butte Reservoir. These schedules were derived from streamflow data and analyses developed primarily by the JIR – an effort to provide the needed data to resolve the impasse over the apportionment of the Rio Grande waters above Fort Quitman.

18. The total water supply available for diversion by Elephant Butte Irrigation District (EBID), El Paso County Water Improvement District No. 1 (EP#1), and Mexico included storage in and releases from Elephant Butte Reservoir and return flows generated within EBID and EP#1. New Mexico's post-Compact development has depleted that water supply by capturing returns flows that otherwise would have been available.

19. By 1938, and later, releases from Elephant Butte Reservoir comprised effectively all of the Rio Grande surface water supply in the Lower Rio Grande. In addition to releases from the Reservoir, small amounts of seasonal arroyo discharges contribute to available water in the Rio Grande. These arroyo flows were included in the total volume of water that was to be made available downstream of the Reservoir.

20. Mining of a groundwater basin means that more water is being pumped from the groundwater basin than can be replaced, causing groundwater levels to decline and, in the context of this case, has caused further depletion of the volume of water available to Texas. Groundwater pumping in New Mexico continues unabated today.

21. Colorado, New Mexico and Texas adopted the Compact in 1938 to ensure, among other things, a prescribed delivery of water from the Rio Grande in Elephant Butte Reservoir. The Project is dependent on the Compact for its water supply. The Project, in turn, is the means by which the water apportioned to Texas by the Compact is stored in Elephant Butte Reservoir, and subsequently delivered to Texas (subject to deliveries to EBID, pursuant to its contract with the United States, and to Mexico, pursuant to the 1906 Treaty). The relationship between the Compact and the Project is critical to the ability to effectively supply water from the Rio Grande to users in Texas, EBID, and Mexico. Both the Project and the Compact were conceived and implemented prior to the significant development of groundwater in the Rincon and Mesilla basins of New Mexico, which began in the early 1950s.

22. Today, the Project includes Elephant Butte Dam and Reservoir, Caballo Dam and Reservoir located immediately below Elephant Butte Dam, a hydropower plant at Elephant Butte Dam, three diversion dams on the Rio Grande in New Mexico (Percha, Leasburg, and Mesilla), two diversion dams on the Rio Grande in Texas (American and International, both owned and operated by the International Boundary and Water Commission), and an extensive system of canals, laterals, waste ways, and drainage ways that support irrigation operations in EBID and EP#1. The major dams and reservoirs and the diversion dams included in the Project are identified on the map of the region in **Figure 5**.

FIGURE 5: Map of Rio Grande Project Area

23. There are 159,650 acres authorized within the Project, with 90,640 acres within EBID in New Mexico and 69,010 acres within EP#1 in Texas. These acreages translate to approximately a 57/43 split for the distribution of irrigable acres between EBID and EP#1 (collectively "Districts").

24. Releases of Project water stored in Elephant Butte and Caballo Reservoirs are made at the start of the irrigation season (typically February) to Project users in New Mexico and Texas, and to Mexico. The Districts request releases of stored water during the irrigation season in response to irrigation demands. As a practical matter, however, diversions by the Districts and Mexico consist of varying amounts of reservoir storage, return flows from upstream irrigation operations, and occasional arroyo inflows. Return flows are a key part of Project operations, and interference with return flows removes a critical component of deliveries to Project users. Project return flows consist of excess irrigation tailwater and

groundwater seepage from irrigated fields that are collected in drains that convey these return flows to the Rio Grande. The proportion of return flows in the river increases in the downstream direction relative to stored water from the reservoirs, and the water diverted by Project users in the lower Mesilla basin and in the El Paso Valley of Texas includes diversion of significant quantities of return flows.

25. **Figure 6** is Table 90 of the JIR. It shows the percentage of net diversions for each valley for reservoir releases, arroyo flow, and drain flow for the period prior to the Compact. The net diversions in the Rincon portion of EBID contained 0.3 percent drain flow and seepage (return flows) and net diversions in the Mesilla portion of EBID contained 7.4 percent, while the net diversions into the Franklin canal in EP#1 contained 35.1 percent return flows and the net diversions into the Tornillo canal in EP#1 contained 57.7 percent return flows and only 38.2 percent of reservoir releases.

TABLE 90.—*Estimated percentages of reservoir water, arroyo inflow, and drainage in net diversions and disposal of reservoir releases, Elephant Butte-Fort Quitman section, 1930–36*

Division or item	Mean disposal of reservoir water 1930–36 (percentage distribution)	Mean percentage content, 1930–36, in net diversions, of—			
		Unused reservoir releases [1]	Arroyo inflow	Drain flow and seepage	Total
Rincon	8.5	97.5	2.2	[2] 0.3	100.0
Mesilla	46.4	89.8	2.8	7.4	100.0
El Paso	18.4	58.4			
Upper El Paso (Franklin canal)		61.5	3.4	35.1	100.0
Lower El Paso (Tornillo canal)		38.2	4.1	57.7	100.0
Rio Grande Project	73.3	79.8	3.0	17.2	100.0
Hudspeth	2.2	33.9	6.1	60.0	100.0
Juarez (Mexico)	11.4	49.5	5.4	45.1	100.0
Upper Juarez		58.3	3.1	38.6	100.0
Lower Juarez		24.4	11.8	63.8	100.0
Riverbed losses	9.2				
Passing Fort Quitman	3.9	17.2	14.8	68.0	100.0
Total	100.0				

[1] Distinguished from returned drainage originally from the reservoir.
[2] Invisible accretion to river.

Estimates based on detail study of all available data, 1930–36, on river flow, reservoir releases, diversions, wastes, drain flow, and arroyo inflow.

FIGURE 6: Table 90 of the JIR

26. After diversion by EP#1, Project water is delivered to the city of El Paso for municipal use under agreements with EP#1 and its constituents that assign their Project water

allotments for specific land parcels to the city. Excess canal flows and return flows from Project lands within EP#1 also provide a supplemental water supply for approximately 18,000 acres of land within the Hudspeth County Conservation and Reclamation District No. 1 (HCCRD) below EP#1 down to Fort Quitman, Texas.

27. Within the Project area from Elephant Butte Reservoir downstream to Fort Quitman, Texas, the Rio Grande covers approximately 210 river miles. Project water was to be allocated between irrigators in southern New Mexico and in the El Paso Valley of Texas in proportion to the irrigated acreage of Project lands within each state.

28. A water budget is an accounting for a defined time period of the inflows into, and the outflows from, a defined control area. Often, performing a water budget with known volumes of inflows and outflows for a specific time period can lead to the quantification of one or more unknown variables for that same time period. Performing multiple water budgets for a specific control area for different time periods can provide information regarding how certain phenomena may have changed. Even a visual depiction of the water budget for a control area showing the generalized movement of water into, within, and out of the area under different conditions and circumstances can be informative and help to understand how the Project water supply system was originally conceived to work and how it has changed with the development of groundwater in New Mexico.

29. I have utilized conceptual water budgets to illustrate the effect of groundwater depletions in the Project area within the Rincon and Mesilla basins of New Mexico where significant groundwater development began in the early 1950s. Prior to the development of extensive groundwater pumping in the Rincon and Mesilla basins, groundwater levels generally were relatively high and fluctuated in response to the seasonal application of irrigation water from the Rio Grande on Project lands. In the early days of the Project, this

phenomenon created a serious problem. Soon after the Project began delivering water to the irrigators, groundwater levels rose in New Mexico to and above ground level, thereby waterlogging and making useless land previously capable of growing crops. The solution was to construct a complex system of drains that would capture excess groundwater created by irrigation and return it to the river. This "return flow" became a significant source of irrigation water for downstream irrigators, particularly in Texas, a fact recognized and catalogued in the JIR. With the construction of the drains, irrigation water not consumed by crops and other vegetation or by evaporation, percolated down through the soil into the groundwater system, which typically flowed toward and into drains specifically designed for collecting groundwater and for conveying groundwater and excess irrigation tailwater away from fields and to the Rio Grande. This condition is illustrated in a general fashion by the diagram in Figure 10.

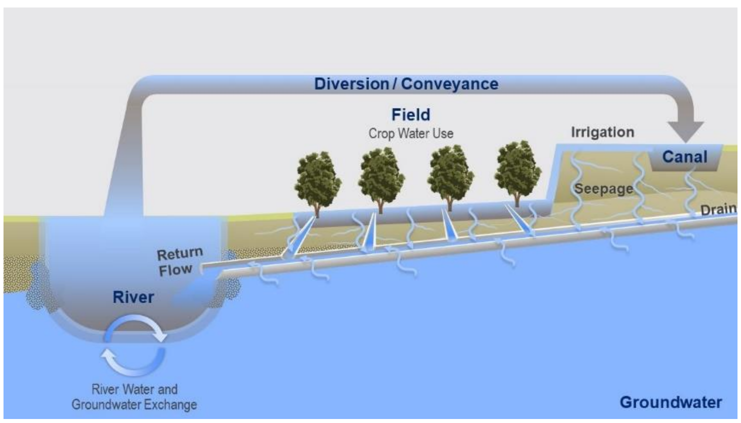


FIGURE 10: Schematic of Rio Grande and Groundwater System Interaction Prior to Development of Groundwater Pumping in Rincon and Mesilla basins

30. As shown in Figure 10, Project water is diverted from the Rio Grande into an irrigation system canal and then distributed to individual irrigated fields, where it is either consumptively used by the growing crops or evaporated into the atmosphere. Any excess irrigation water is either discharged directly to the drain as tailwater or percolated through the subsurface into the groundwater system. The bottom of the drain is below the upper level of

the groundwater; thus, groundwater is induced to flow toward and into the drain. Similarly, the bottom of the river channel is below the level of the groundwater, with water shown flowing in both directions depending on the relative heights of the water in the river and the groundwater from location to location. The irrigation tailwater and groundwater that is collected in the drain flows to the river and is referred to as return flow. The return flow from the drain that is discharged into the Rio Grande provides an important supply of Project water for users located downstream, namely users in the lower Mesilla basin and in the El Paso Valley of Texas. This important source of water for Project users was contemplated in the early development of Project operations and in the negotiations among the states leading up to the adoption of the 1938 Compact.

31. For example, the JIR investigation determined that approximately 35 percent of the total supply of Project water delivered to Texas in the El Paso Valley was from upstream return flows, with the majority of the balance originating as releases from Caballo Reservoir. Conversely, since water for Project users in New Mexico was diverted from the Rio Grande farther upstream, i.e., above the river outfalls of most drains, less than seven percent of New Mexico's total deliveries originated from return flows.

32. With the extensive development of groundwater in the Rincon and Mesilla basins of New Mexico that began during the early 1950s – particularly in the relatively shallow aquifers with generally high groundwater levels such as those along the Rio Grande – groundwater levels began to fluctuate and decline in some areas. This in turn caused discharges of groundwater into the drains, and directly into the river, to be reduced. Eventually, with enough groundwater pumping, the groundwater gradient in many areas reversed, with significant reductions in the groundwater inflows to the drains and into the river. This condition is illustrated by the diagram in Figure 11.

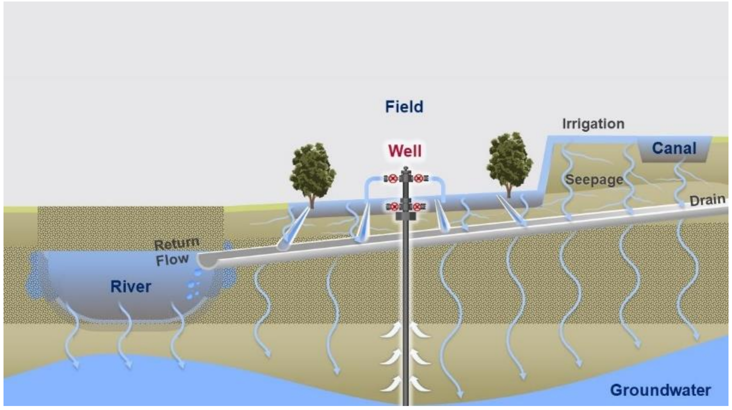


FIGURE 11: Schematic of Rio Grande and Groundwater System Interaction After Development of Groundwater Pumping in Rincon and Mesilla basins

33. As shown in Figure 11, the level of the groundwater is below the bottom of the river channel and the drain, and water flowing in the river and in the drain moves toward and into the groundwater system, rather than the other way around, as it was prior to the initiation of groundwater pumping. The discharge of return flow from the drain into the river is substantially curtailed, if not reduced to zero, thereby also reducing the flow in the river.

34. The phenomenon of reduced river flows caused by groundwater withdrawals is an underlying component of what is referred to as streamflow depletions, and these streamflow depletions have increased along the Rio Grande within the Rincon and Mesilla basins since significant groundwater development began in the early 1950s. One of the obvious impacts of these increased streamflow depletions has been to alter the Project water budget by reducing flows in the Rio Grande that otherwise would ultimately reach water users in the lower Mesilla basin and in the El Paso Valley in Texas. In essence, the release of a specific quantity of water from Caballo Reservoir now contributes less to the surface water supply for these users because of the losses of flow due to the increased seepage from the Rio Grande and interior drainage ways, thus altering the previously existing Project water budget.

35. In the early 1980s, the BOR developed the D1 and D2 allocation curves for the Project based on 1951-1978 operating data, and under normal supply conditions for the Project, these curves provided for 122 percent of the annual Caballo Reservoir release to be diverted from the Rio Grande for Project users. This additional 22 percent was almost entirely from return flows discharged into the Rio Grande from drains. This is shown on Figure 10 (Schematic of Rio Grande and Groundwater System Interaction Prior to Development of Groundwater Pumping in Rincon and Mesilla basins), discussed above. These D1 and D2 allocation curves reflect conditions that are different from the flow regime that existed at the time of the Compact. The D1 and D2 allocation curves were based upon the depleted flow conditions influenced by the extensive groundwater pumping in New Mexico during the 1951-1978 period.

36. I have reviewed, and am familiar with the contents of, the 2001 Report of the Rio Grande Compact Commission. A true and correct copy of the 2001 Report of the Rio Grande Compact Commission is attached hereto as Attachment 3. Within that report, beginning at page 3, is the Report of the Engineer Advisors to the Rio Grande Compact Commissioners, dated February 22, 2002 (2/22/02 EA Report). The 2/22/02 EA Report demonstrates that there is nothing in all the figures that the Compact Commission collects that addresses the 57/43 split. This is because that is an allocation issue and not a Compact issue. If it were a Compact issue, it would have been accounted for as such. Section 2.1 of the Memorandum of Understanding between the Rio Grande Compact Commission and the BOR, included in the 2001 Report of the Rio Grande Compact Commission, confirms that the Compact accounting data includes “deliveries by New Mexico to Texas at Elephant Butte.” 2001 Report of the Rio Grande Compact Commission, at 19.

37. Regarding the 57/43 split, referable to Project allocations, the Project delivers the *water available to it* at the points of diversion on the river. The volume of Project water that was split 57/43 in 1938 for the Project to make the allocation to EBID and EP#1 pursuant to the contracts with the United States reflected the acreages of irrigated land in the two Districts at that time and the generally gaining condition of the river below Caballo Reservoir as influenced by relatively high groundwater levels in the absence of significant pumping. This changed beginning in the 1950s with the extensive development of groundwater in New Mexico and the subsequent lowering of groundwater levels along the Rio Grande that altered the condition of the river from a generally gaining stream to a generally losing stream. The implications of this change are obvious - river flow losses mean greater depletions and less Project water for downstream users. The Project has no control over New Mexico's depletions and can only allocate the amount of water remaining after the New Mexico groundwater pumping depletes Project water in the river, including Reservoir releases.

38. I declare under penalty of perjury that the foregoing is true and correct. Executed this 4th day of November 2020 at Austin, Texas.

Robert J. Brandes

Robert J. Brandes, P.E., Ph.D.

INTENTIONALLY

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No. 141, Original

In the

SUPREME COURT OF THE UNITED STATES

STATE OF TEXAS,

Plaintiff,

v.

STATE OF NEW MEXICO and
STATE OF COLORADO,

Defendants.

OFFICE OF THE SPECIAL MASTER

DECLARATION OF ROBERT J. BRANDES, P.E., PH.D. IN SUPPORT OF THE STATE OF TEXAS'S OPPOSITIONS TO THE STATE OF NEW MEXICO'S MOTIONS FOR PARTIAL SUMMARY JUDGMENT AND BRIEFS IN SUPPORT

Stuart L. Somach, Esq.*
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**Counsel of Record*

December 22, 2020

I, Robert J. Brandes, declare as follows:

BACKGROUND AND EXPERIENCE

1. My name is Robert J. Brandes, P.E., Ph.D. I am over the age of 18, have personal knowledge of the facts set forth in this declaration, and if called as a witness could and would testify competently under oath to such facts.

2. I have been engaged in consulting engineering practice since the late 1960s specializing in water resources and related engineering and environmental disciplines. Today, I own and operate my consulting business Robert J. Brandes Consulting in Austin, Texas. My street address is 6000 Maurys Trail, Austin, Texas 78730.

3. I have been retained by the State of Texas (Texas) to provide consulting services on hydrologic and water resources issues presented in this case.

4. Details of my education and professional background can be found in paragraphs 1 - 10 of the November 5, 2020, Declaration of Robert J. Brandes, P.E., Ph.D. in Support of the State of Texas's Motion for Partial Summary Judgment; Memorandum of Points and Authorities in Support Thereof Federal Rule of Procedure 56 (Brandes First Declaration). TX_MSJ_000001 - 000016.

5. My resume was also appended to the Brandes First Declaration. TX_MSJ_000017 - 000021.

6. I have reviewed the State of New Mexico's (New Mexico) Motion for Partial Summary Judgment to Exclude Texas's Claim for Damages in Certain Years. New Mexico claims that because the years 1985-2002, 2005 and 2007-2010 were years in which the Rio Grande Project (Project) made available a full supply to the Districts, Texas's damages claims for those years should be excluded.

7. I have also reviewed the report of Margaret (Peggy) Barroll Ph.D. (October 31, 2019) ("Barroll Report") and the Spronk Water Engineers, Inc. Report dated October 31, 2019 ("Spronk Report"). I have also reviewed the subsequent reports filed by Barroll and Spronk in July and September of 2020; however, the results and underlying data reported in the later reports do not change the conclusions I've drawn from review of the October 31, 2019 reports of Barroll and Spronk.

8. I have reviewed Project allocations for the years 1985-2002, 2005 and 2007-2010 (Subject Years) identified by New Mexico as "full supply" years for the Rio Grande Project. I generally agree; however, based on annual allocations presented in the Barroll Report, the allocation for the year 2007 was less (by about 23,000 acre-feet) than the full supply allocation for the El Paso County Water Improvement District No. 1 (EP#1) as determined from the Bureau of Reclamation's D2 Curve. *See* Figure 1.

9. Although the Subject Years may represent "full supply" for the Project, I disagree with New Mexico's assertion that Texas did not suffer damages from failure to receive its entire Compact apportionment during those years.

A. New Mexico's modeling demonstrates that Texas would have been allocated more water during "full Project supply" years without New Mexico's groundwater pumping.

10. Figure 2 presents a bar graph showing annual allocations to EP#1 from 1980 through 2017 as simulated with New Mexico's ILRG model under historical conditions with groundwater pumping (Run 1, green bars). The orange bars above the green bars represent the additional allocation EP#1 would have received as simulated with the New Mexico model for a hypothetical condition without groundwater pumping by New Mexico (referred to as Run 3). The blue dots at the top of the graph signify full supply years as identified by New Mexico. As

shown, additional allocations were simulated for 2007, 2009, and 2010 without New Mexico groundwater pumping, all designated as full supply years by New Mexico. The same is also true with respect to 2017, also a full supply year according to the Barroll Report. With more water allocated during these full supply years, EP#1 very likely would have benefitted, suggesting that EP#1 very likely suffered damages historically due to New Mexico's groundwater pumping.

11. The diversions of Project water simulated with the New Mexico model for these same Run 1 and Run 3 conditions further demonstrate that EP#1 could have experienced increased Project water supplies during the full supply years but for New Mexico's groundwater pumping. Figure 3 presents a graph using the same format as that in Figure 2, but here annual diversions are plotted instead of allocations, with these results extending from 1980 to 2017. Again, the extended orange bars for some of the years, as simulated with New Mexico's Run 3 model, indicate additional diversions by EP#1 without New Mexico groundwater pumping, and many of these years are full supply years as they coincide with the blue dots at the top of the graph. This is further evidence based on New Mexico's own modeling that damages to EP#1 could have occurred due to limited Project water supplies during full supply years.

B. The "full supply" condition New Mexico relies on is the D2 Curve, which Incorporates Ground Water Pumping Depletions from 1951-1978

12. In the Subject Years, the "full Project supply" that the Bureau of Reclamation made available was based on the D2 Curve.

13. The D2 Curve was developed by Reclamation in the early 1980s to reflect the relationship between releases from Caballo Reservoir and deliveries to the Elephant Butte Irrigation District (EBID) and EP#1 (collectively "Districts") between 1951-1978 assuming that EBID received 57 percent of available Project water and EP#1 received 43 percent of available Project water.

14. I have plotted the D2 Curve in attached Figure 4 as the red line and data points.

15. The D2 curve incorporates the effects of groundwater pumping during the years 1951 - 1978.

16. During the years 1951 - 1978, New Mexico groundwater pumping was continuous from year to year, ranging from about 50,000 acre-feet/year up to 250,000 acre-feet per year and averaging about 140,000 acre-feet per year, as shown in Figure 5. Significant pumping occurred even in the full-supply years identified by New Mexico.

17. By contrast, the blue line and "x" data points plotted on attached Figure 4 reflect the same delivery relationship as the D2 Curve but are based on depletion conditions in 1938 when there was very little groundwater pumping in the Rincon and Mesilla Valleys of New Mexico. The data corresponding to the blue "x" data points shown on Figure 4 are from Run 2 of New Mexico's model with all groundwater pumping in New Mexico and Texas turned off, which is essentially the 1938 condition. And as illustrated, the 1938 Condition representation of the D2 Curve lies considerably above the 1951 - 1978 D2 Curve, obviously indicating that groundwater pumping that began in the early 1950s reduced annual diversions (deliveries) of Project water relative to Caballo releases.

18. Figures 6 and 7 show overall change in the number of wells in the Lower Rio Grande below Caballo between 1938 and 2020. Based on Figure 6 there were very few wells and very little groundwater pumping in 1938, in contrast to the numerous wells in place along the Rio Grande in 2020 shown in Figure 7.

C. Effect of New Mexico Groundwater Pumping has been to disconnect drain flows to the Rio Grande, reducing Project supplies and Texas's apportionment

19. Based on work by William Hutchison using his Texas model and Shane Coors' assessment of New Mexico's model, groundwater pumping withdrawals beginning in the early

1950s in the Rincon and Mesilla basins caused groundwater levels to fall from conditions in 1938 at the time of the Compact. Expert Report of William Hutchison, Ph.D., P.E., P.G. (May 31, 2019) (Hutchison 2019 Report) and Expert Report (Supplemental Rebuttal Report) of Adolph (Shane) Coors V, M.E., P.E. (May 6, 2020) (Coors 2020 Report).

20. When Texas entered into the Compact it anticipated adequate drain flows to satisfy part of its apportionment. As shown in the 1938 report of the National Resources Committee, Regional Planning: Part VI-The Rio Grande Joint Investigation in the Upper Rio Grande Basin in Colorado, New Mexico and Texas 1936-7, the reliance on drain flows by Project water users increased relative to the distance downstream from Elephant Butte Reservoir. *See* Figure 8.

21. Based on the long-term volumes of groundwater pumping in the Rincon and Mesilla Valleys and the resulting lowered groundwater levels, the Lower Rio Grande basin experiences significantly reduced drain inflows to the Rio Grande due to:

a. infiltration of excess irrigation water from the fields directly to the subsurface rather to the drains;

b. increased seepage losses from the drains to the subsurface due to the lowered groundwater levels; and

c. increased seepage losses from the Rio Grande to the subsurface due to the lowered groundwater levels.

An illustration of how drain flows have been reduced since significant groundwater pumping began in the early 1950s is shown on the graph in Figure 9.

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D. Long Term Effects of New Mexico Groundwater Pumping

22. Texas' claims for damages arises primarily from the long-term effects of groundwater pumping by New Mexico, not effects that can be broken into an annual timestep.

23. These changes in the hydrologic system are not readily apparent when viewed from year to year, but when examined over long periods of time, they become quite evident. The effects of sustained groundwater pumping translate to long-term changes in hydrologic conditions that can extend the adverse effects of groundwater pumping over many years. Coors 2020 Report.

24. The prolonged effects of groundwater pumping in terms of reduced drain flows, increased seepage losses from the Rio Grande, and lower Rio Grande flows at El Paso continued from year to year with or without full Project water supplies. These prolonged effects have been demonstrated by plotting historical cumulative flows in the Rio Grande at El Paso versus historical cumulative releases from Caballo Reservoir. Expert Report of Robert J. Brandes, May 31, 2019; *see* Figure 10. On this plot, the distinct break in slope of the historical data around the early 1950s supports the conclusion that groundwater pumping in the Rincon and Mesilla basins, which significantly increased about that time in response to drought conditions, was the cause of the reduced river flows. These conclusions are confirmed by the simulated model results with (historical) and without (hypothetical) groundwater pumping as produced by Hutchison 2019 Report based on his Texas model and by Coors 2020 Report based on his analysis of results from New Mexico's model.

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E. New Mexico's Undisputed Facts Asserted in the NM MSJ on Apportionment Are in Dispute

25. I have reviewed the State of New Mexico's (New Mexico) Motion for Partial Summary Judgment on Compact Apportionment and Brief in Support (NM MSJ on Apportionment).

26. Based on review and evaluation of the Barroll and Spronk Reports and underlying data, I dispute certain of the assertions in the "Statement of Undisputed Material Facts" section.

27. New Mexico's reference in paragraphs 60, 63 and 64 of NM MSJ on Apportionment regarding how Project supply was historically allocated based on an equal acre-foot per acre basis is not relevant to apportionment of Rio Grande water under the Compact. This allocation applies solely to Project water already stored in Elephant Butte Reservoir and inflows to the Rio Grande downstream of the reservoir, whereas the Compact applies to Rio Grande deliveries to Elephant Butte Reservoir. Project allocations made to respond to orders by the District water users do not form the basis of Texas's Compact apportionment. The Compact requires New Mexico to deliver prescribed and indexed quantities of Rio Grande water to Texas in Elephant Butte Reservoir. The 1906 treaty with Mexico and the contracts between the federal government and the Districts then allocate the stored water in Elephant Butte Reservoir, along with downstream inflows to the Rio Grande, to Mexico, EBID, and EP#1.

28. New Mexico's own data as reported in the underlying files of the Spronk Report are inconsistent with the diversion percentages reported in paragraph 65 of NM MSJ on Apportionment and attributed in paragraph 65 to the work of New Mexico's other expert, Peggy Barroll. In paragraph 65, New Mexico states that from 1931 to 1979, diversions by EP#1 totaled 45.5 percent of total diversions, but the Spronk data show only 41.7 percent, slightly less than the 43 percent allocation. Similarly, for 1951 to 1979, in paragraph 65 New Mexico reports that

EP#1 diverted 43.8 percent of the total diversions, whereas the Spronk data show that EP#1 diverted only 38.5 percent. Methods used by Peggy Barroll and those described in the underlying data of the Spronk Report also differ in how the distributions of diversions by EP#1 in Mesilla Valley were made, with Barroll assuming 20 percent and Spronk an average of 14 percent.

29. The D1/D2 method referenced in paragraphs 68 through 70 and paragraphs 72 through 76 of NM MSJ Motion on Apportionment has nothing to do with Compact apportionment; rather, it relates to how the Project was operated during 1951 through 1978. The Compact requires Rio Grande water deliveries from New Mexico to Elephant Butte Reservoir for Texas, and the 1906 treaty with Mexico and the contracts between the federal government and the Districts allocate the stored water in Elephant Butte Reservoir, along with downstream inflows to the Rio Grande, to Mexico, EBID, and EP#1. Furthermore, the D1/D2 method does not reflect Project water supply conditions as they existed at the time of Compact adoption in 1938. The D1/D2 method understates the supply of Project water available under the Compact because it is based on Project delivery conditions that occurred during 1951 and 1978 when substantial groundwater pumping had already developed in the Rincon and Mesilla basins of New Mexico (*See* Figure 5) causing flows in the drains and in the Rio Grande at El Paso relative to releases from Caballo Reservoir and the deliveries to EP#1 to be reduced. (*See* Figures 9 and 10).

30. In paragraph 79 of NM MSJ on Apportionment, New Mexico asserts that the 2008 Operating Agreement "changed the way that water was allocated between the two Districts, and therefore the amount of water that was available for lands in New Mexico and Texas." In paragraph 80, New Mexico asserts its "primary concern" with the 2008 Operating Agreement is

that it is not consistent with the Compact and does not allocate 57 percent of Project supply to New Mexico lands.

31. In fact, under the Operating Agreement New Mexico has received more water than it otherwise should have based solely on the D2 Curve prior to implementation of the Operating Agreement. This is demonstrated by the graph in Figure 11. The blue x's show total Project surface water diversions between 2008 and 2016; the black x's show the total amount of diversions, including groundwater pumping by New Mexico, for the same period.

32. As stated in paragraph 83, the use of the D1/D2 method produces 376,000 acre-feet for EP1. However, as I have said elsewhere in my declaration, the D1/D2 method does not reflect 1938 conditions and does not represent Texas's Compact apportionment.

I declare under penalty of perjury that the foregoing is true and correct. Executed this 21st day of December 2020 at Austin, Texas.

Robert J. Brandes

Robert J. Brandes, Ph.D.

Figures follow on the next page.

Figure 1 - Analysis of New Mexico Full Supply Years

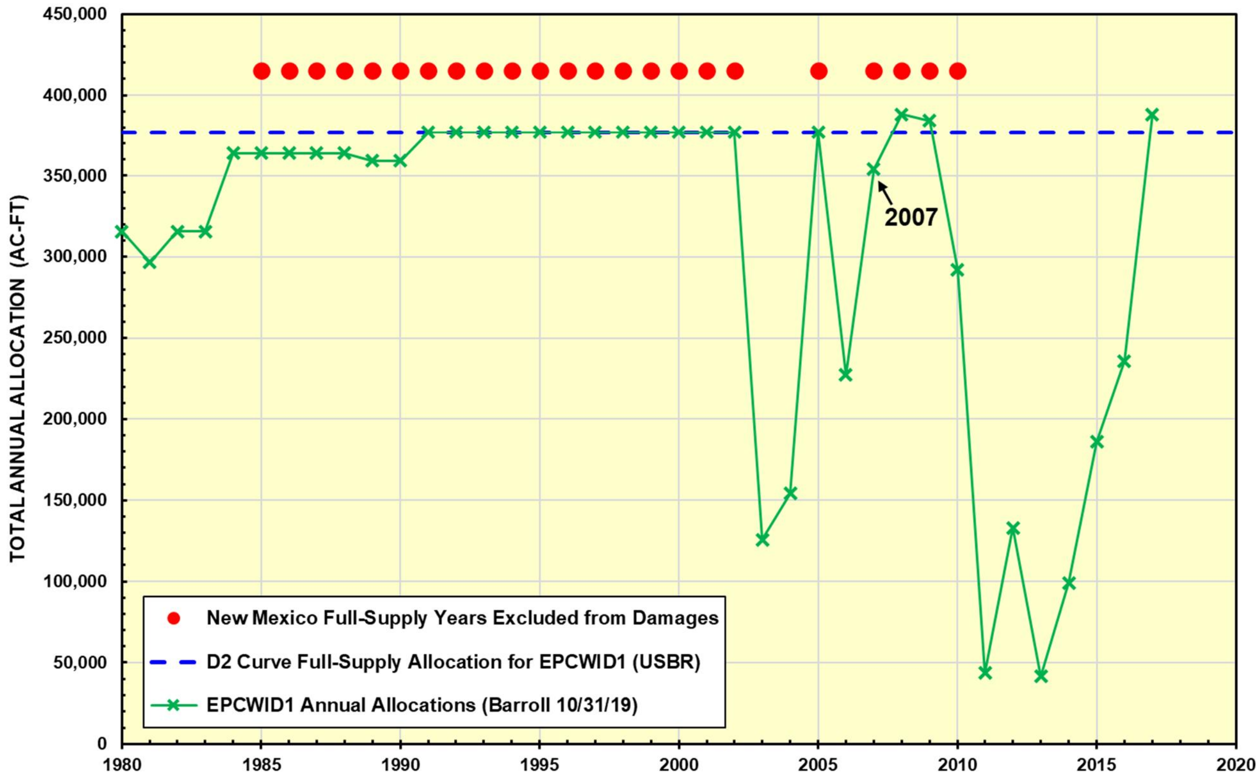


Figure 2 - Allocations to EP1 Based on New Mexico Model Run 1 (Historical) and Model Run 3 Without New Mexico Groundwater Pumping

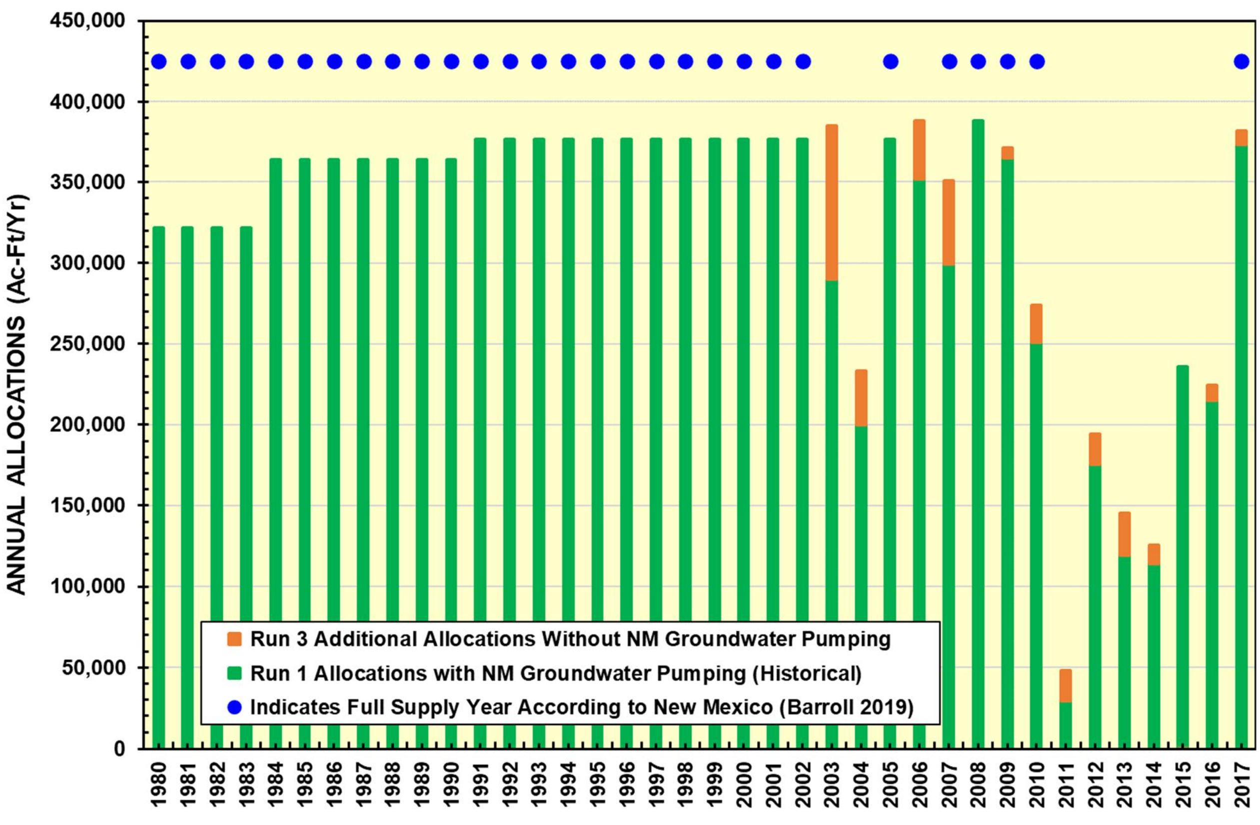


Figure 3 - EP1 Diversions Based on New Mexico Model Run 1 (Historical) and Model Run 3 Without New Mexico Groundwater Pumping

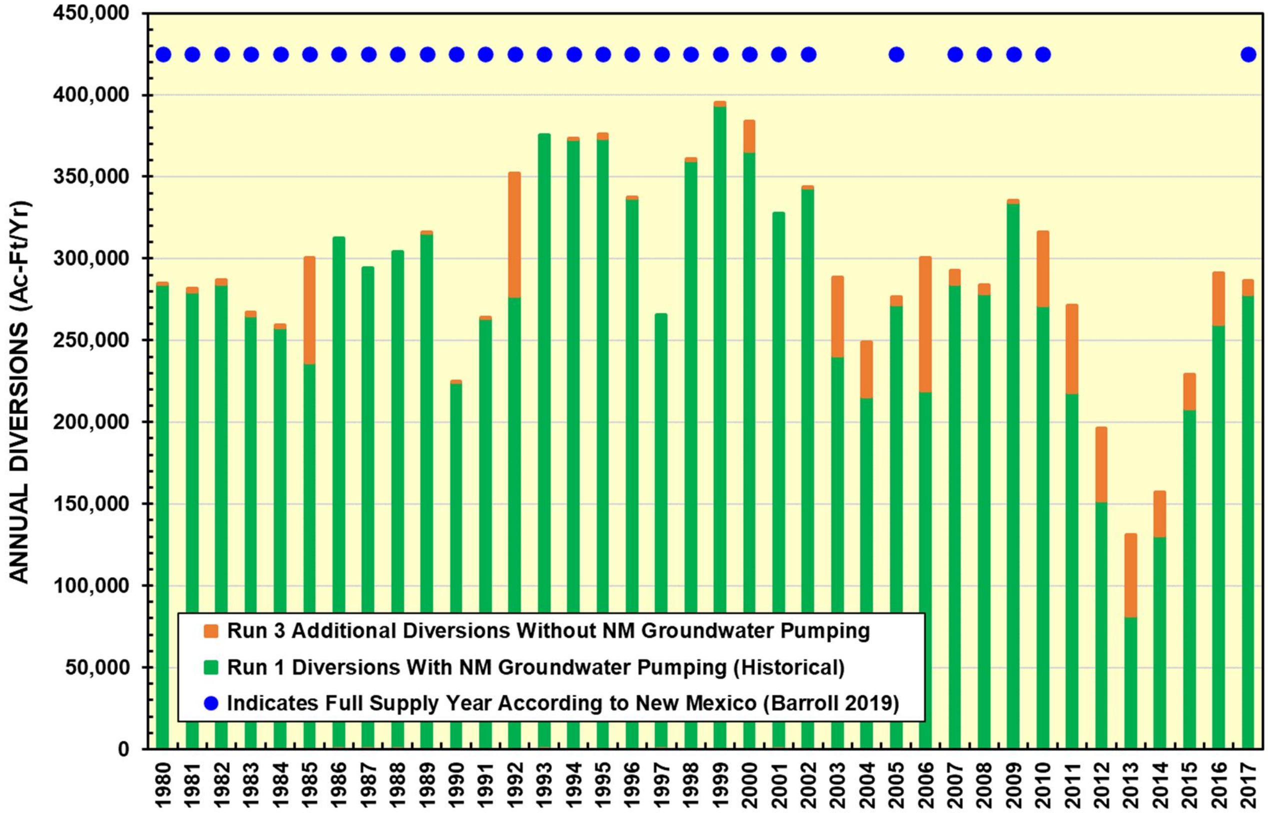


Figure 4 - D2 Curve and Similar 1938 Condition Curve Based on Results from New Mexico's Model Without Groundwater Pumping

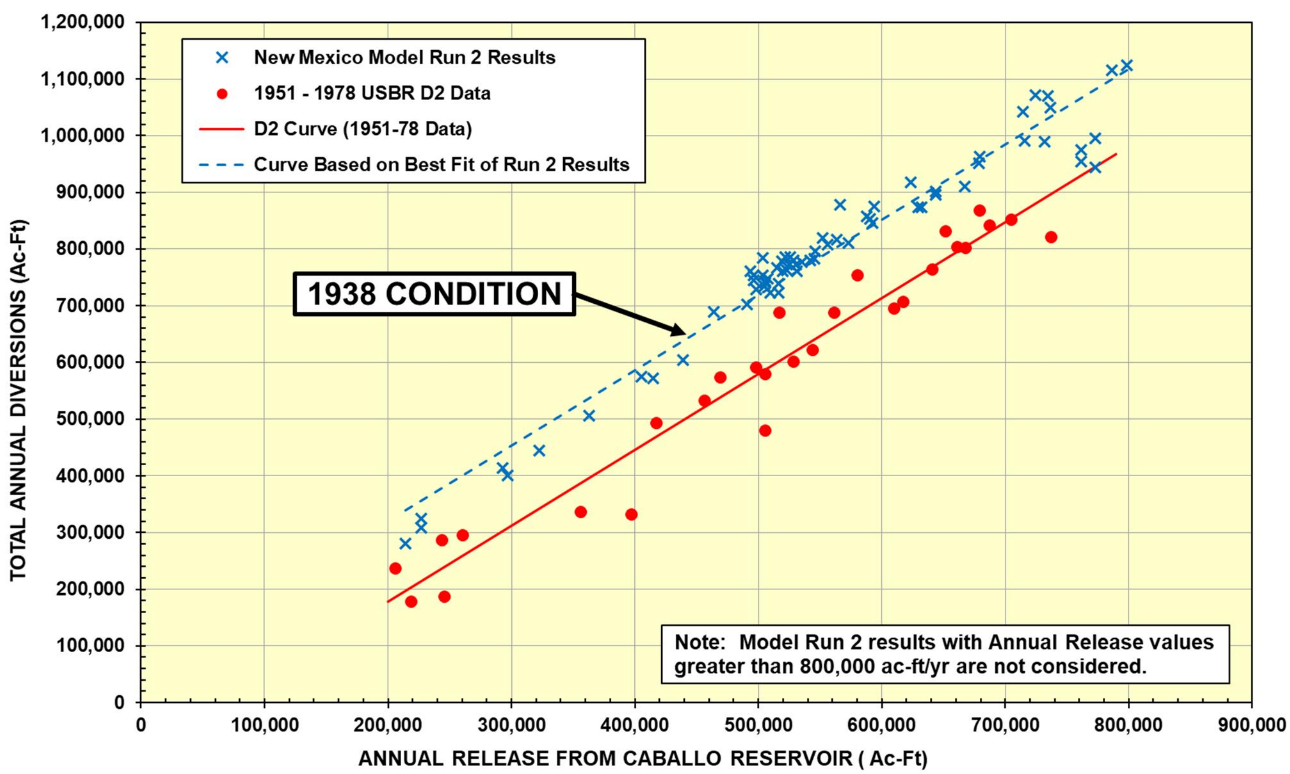
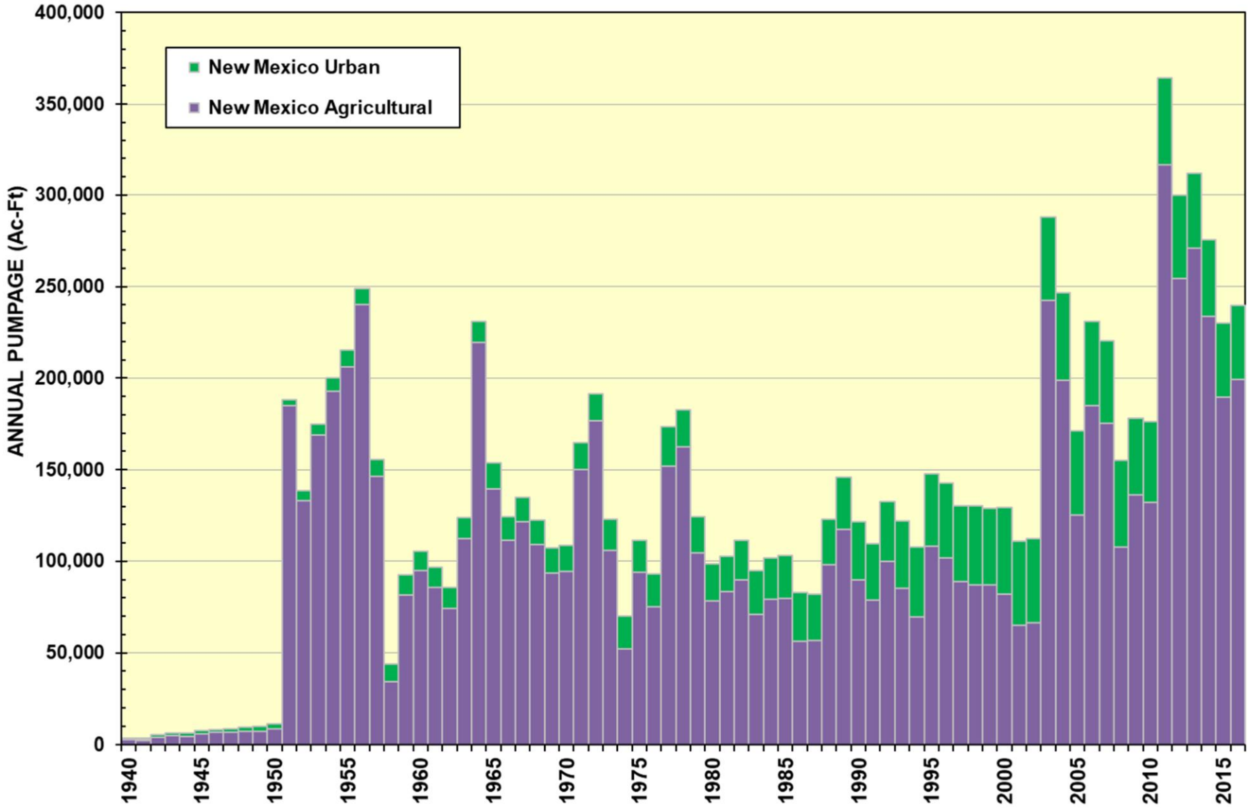


Figure 5 - Annual Groundwater Pumpage in Rincon and Mesilla Basins



Data from files of Expert Report by Staffan W. Schorr and Collin P. Kikuchi, "Water Budget Estimates in Support of Groundwater Model Development: Rincon and Mesilla Basins, New Mexico, Texas, and Northern Mexico, 1938 through 2016", prepared for State of Texas, in the matter of No. 141, Original, State of Texas v. State of New Mexico and State of Colorado, May 31, 2019.

Figure 6 - Groundwater Wells Along Lower Rio Grande in 1938

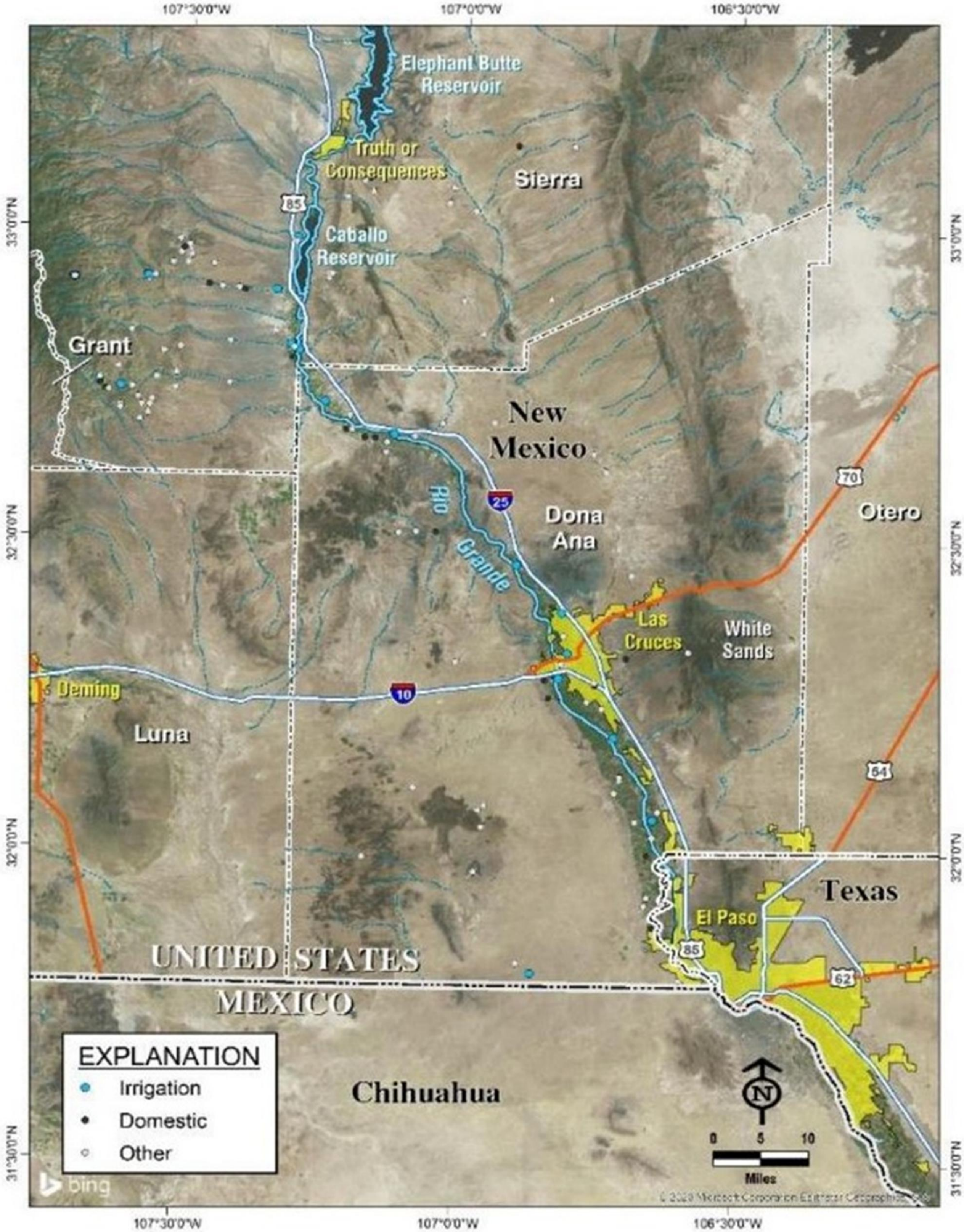


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Figure 7 - Groundwater Wells Along Lower Rio Grande in 2020

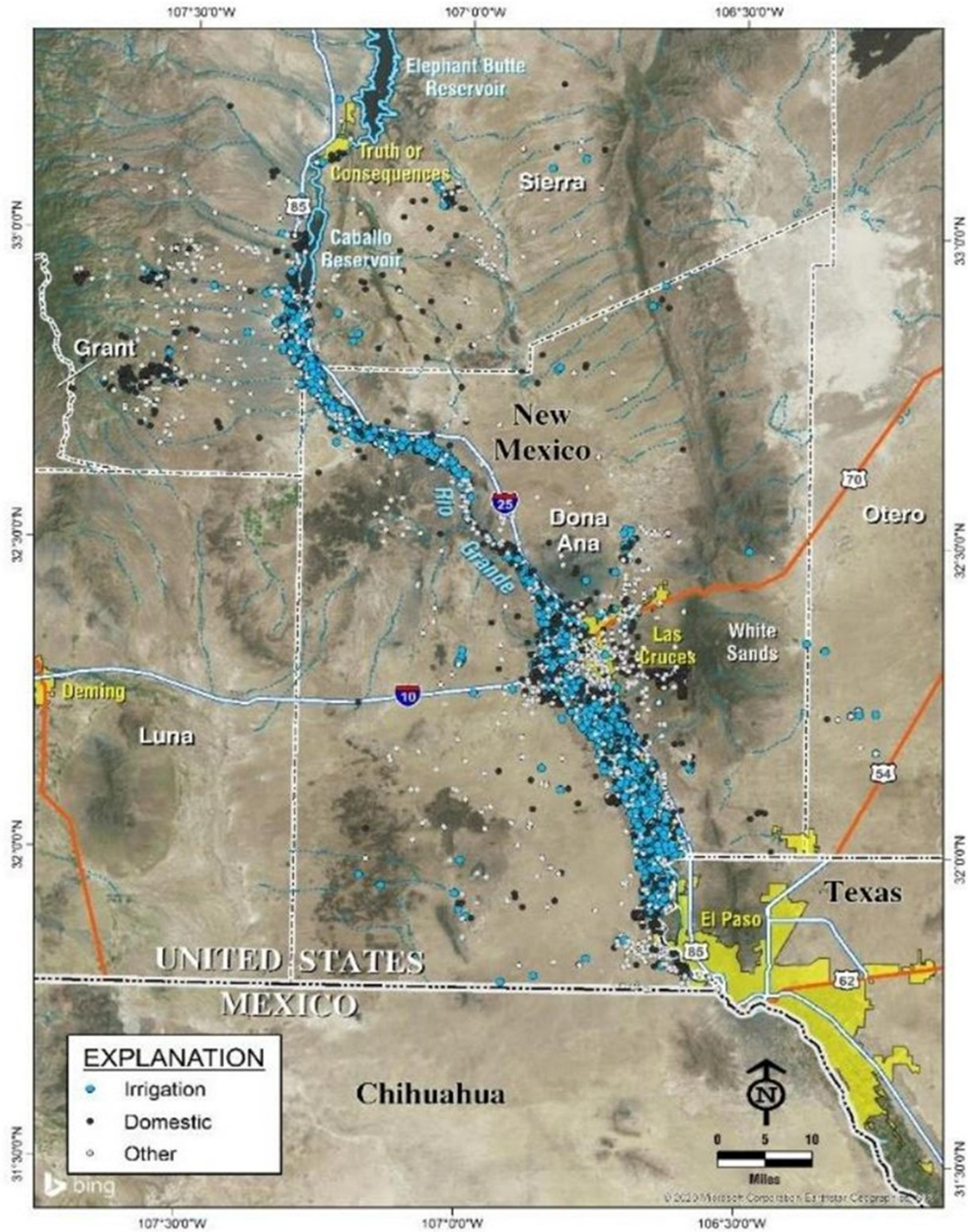

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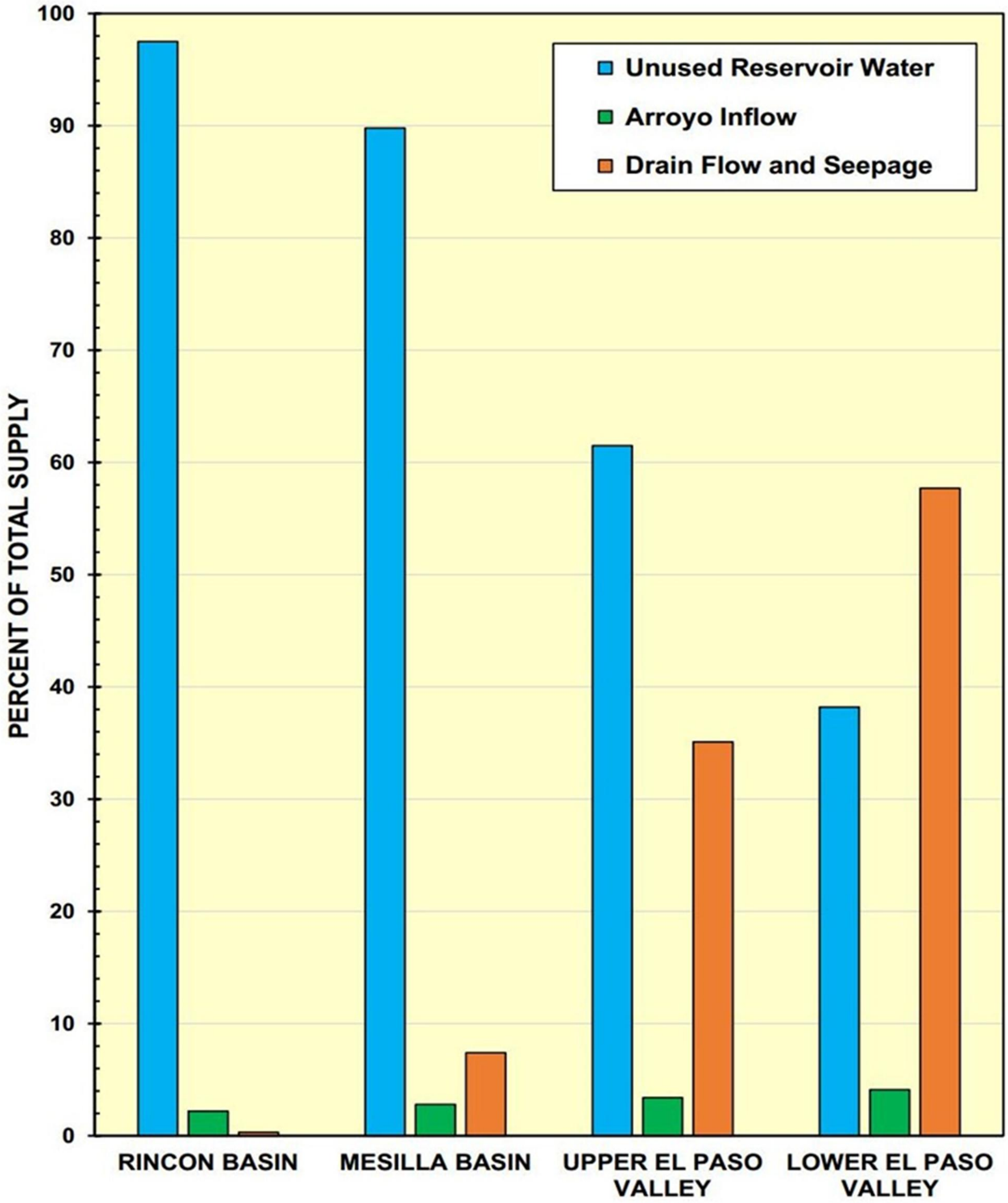
Figure 8 - Significance of Drain Flows to Downstream Project Water Users



Data from Table 90, National Resources Committee; *Regional Planning, Part VI – The Rio Grande Joint Investigation in the Upper Rio Grande Basin in Colorado, New Mexico, and Texas*, *Volume I*; Washington D. C.; February 1938.

Figure 9 - 1938-1995 Cumulative Discharges from the Montoya Drain to the Rio Grande

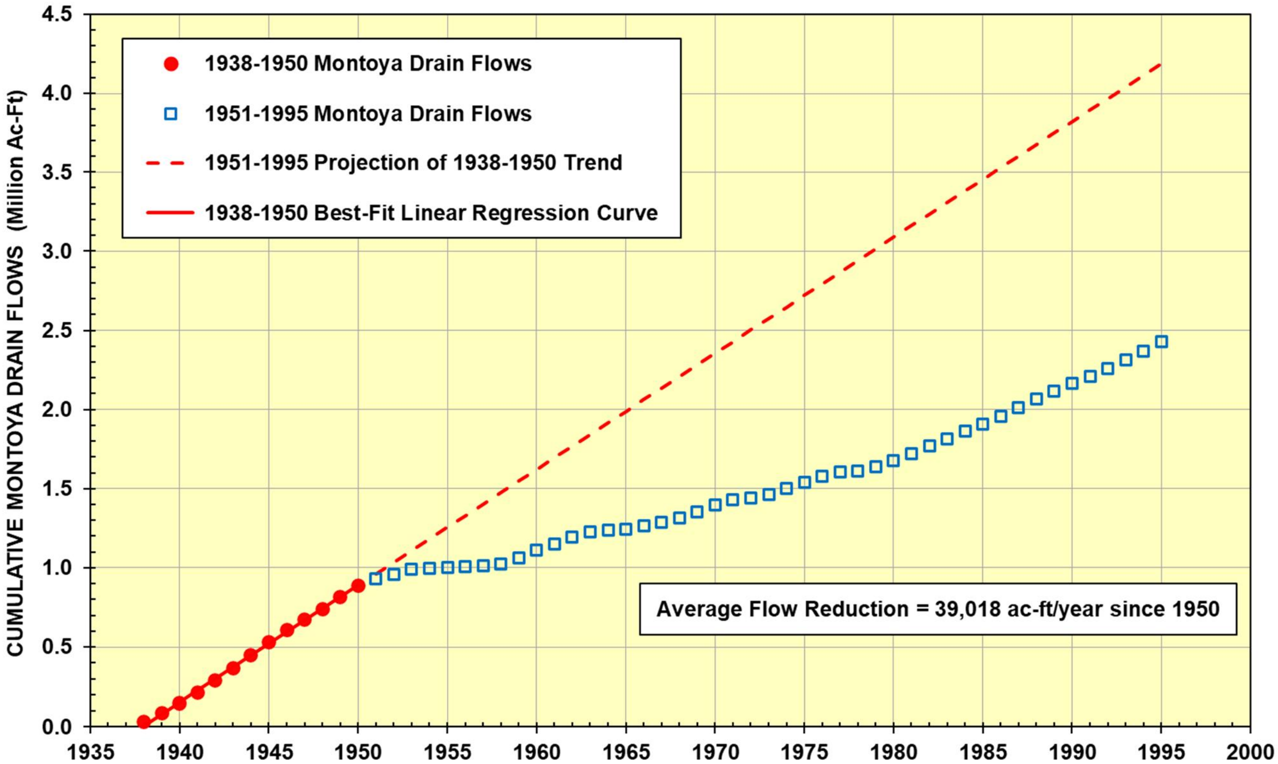


Figure 10 - Long-Term Relationship of Historical Rio Grande Flows at El Paso and Reservoir Releases

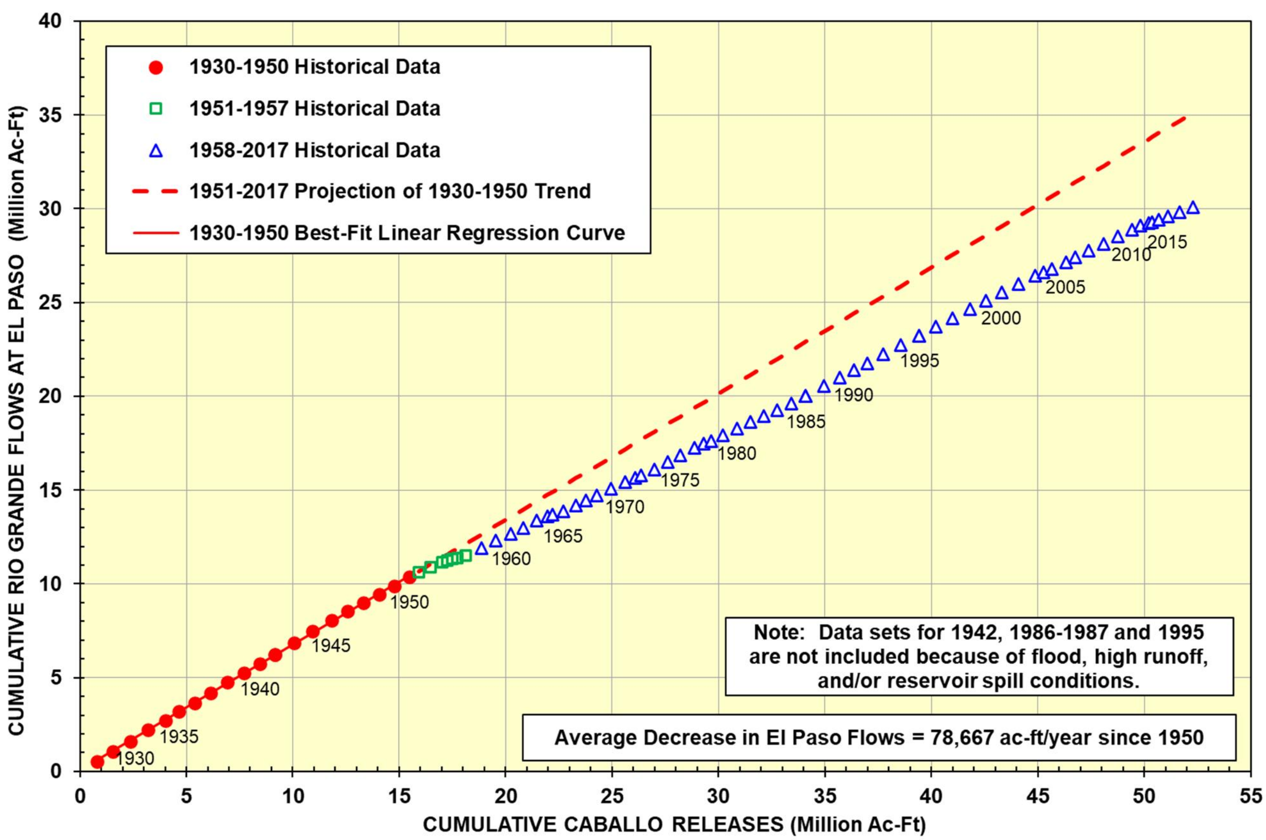


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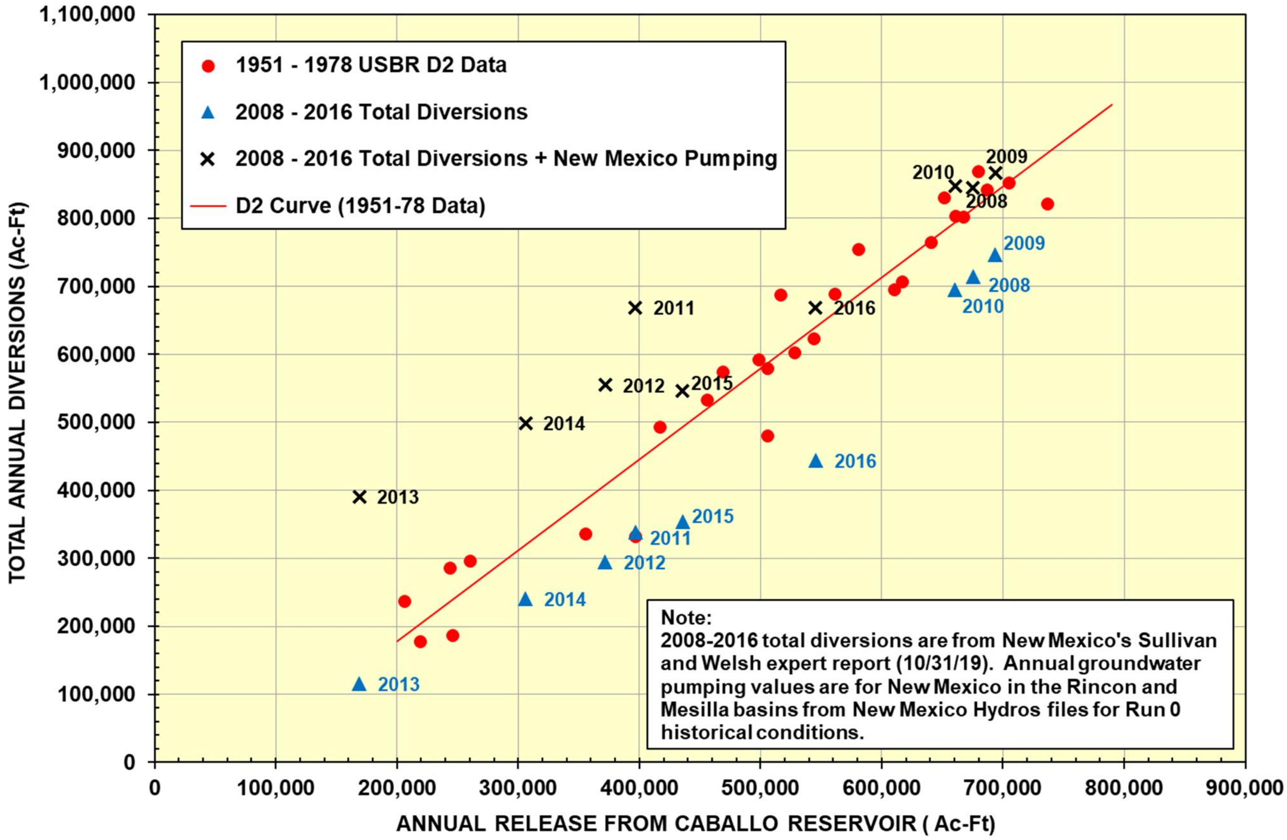
Figure 11 - Total Project Diversions for 2008-2016 Increased by New Mexico 2008-2016 Groundwater Pumping Compared to Total Diversions Allocated by D2 Curve



May 31, 2019

EXPERT REPORT OF ROBERT J. BRANDES

In the matter of:

No. 141, Original
In the Supreme Court of the United States
State of Texas v. State of New Mexico and State of Colorado

Prepared for:

Somach Simmons & Dunn
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Prepared by:

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STATE OF TEXAS
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39120
REGISTERED
PROFESSIONAL ENGINEER
MAY 31, 2019

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1.0 INTRODUCTION

My name is Robert John Brandes. I have been engaged in consulting engineering practice in Texas since the late 1960s specializing in water resources and related engineering and environmental disciplines. Today, I own and operate my consulting business Robert J. Brandes Consulting in Austin, Texas. For this current assignment, I have been retained by Somach Simmons & Dunn ("SSD") to assist and advise SSD in its representation of the State of Texas regarding legal matters related to the Rio Grande Compact.

The Appendix to this report contains my professional resume and a list of cases in which I have testified as an expert either by trial or deposition during the last four years. For the consulting services I provide to SSD, I am compensated at the rate of $250 per hour. My compensation is not dependent on the outcome of this litigation or the substance of my opinions.

2.0 ASSIGNMENT AND SUMMARY OF OBSERVATIONS AND OPINIONS

My assignments in this matter have been undertaken in response to specific requests from SSD. In this regard, I have provided information pertaining to elements of the Rio Grande Project prior to and after the early 1950s when development of significant groundwater pumping began in the Rincon and Mesilla basins of New Mexico, including evidence of the impacts of this groundwater pumping on hydrologic conditions and water use. I have summarized specific aspects of how the Rio Grande Project has been operated historically and what changes have occurred over time. Also, I have considered historical deliveries of Project water to users in New Mexico and Texas and how these deliveries have changed with the development of groundwater pumping.

Based on my investigations and analyses, I have made the following observations and arrived at the following opinions[1]:

1) One of the stated purposes of the Rio Grande Compact, as adopted by the States of Colorado, New Mexico and Texas in 1938, is to ensure a prescribed delivery of water from the Rio Grande to Elephant Butte Reservoir; hence, the Rio Grande Project, with its primary source of water supply being Elephant Butte Reservoir, is intricately tied to the Compact and dependent on the Compact for its water supply. The Rio Grande Project is the means by which Compact water from Elephant Butte Reservoir is apportioned among and delivered to users in New Mexico, Texas and Mexico. Hence, the relationship between the Compact and the Project is critical to being able to effectively supply water from the Rio Grande to users in southern New Mexico and western Texas, as well as Mexico.

2) In order to develop an understanding of Rio Grande Project operations, the U. S. National Resources Committee, through its Water Resources Committee, went to great detail in its 1938 Joint Investigation Report to identify the sources of and relationships among diversions of Rio Grande Project water and related activities based on 1930-1936 data. A primary goal of the Committee's analyses was to quantify the annual amount of reservoir water needed to support a normal irrigation supply within the Project area. The data and information

[1] The observations and opinions noted in the text of this report directly relate to the requests from SSD.

compiled and presented do provide a useful baseline for understanding the operation of the Rio Grande Project prior to adoption of the 1938 Rio Grande Compact.

3) Based on 1930-1936 data, the 1938 Joint Investigation determined that an amount of 773,000 acre-feet per year was the required release of water from Elephant Butte and Caballo Reservoirs to provide a normal supply for Rio Grande Project water users. In 1980, an amount equal to 763,800 acre-feet per year was established by the U. S. Bureau of Reclamation ("USBR") as the normal supply of reservoir water for the Project based on Project irrigation deliveries during 1946-1950 when supplies were considered to be normal. However, the Rio Grande Compact stipulates that 790,000 acre-feet per year of reservoir water represents an average normal supply for the Project. This quantity was a negotiated amount that evolved through discussions in 1938 among the Rio Grande Compact Engineering Advisors representing Colorado, New Mexico and Texas.

4) Rio Grande Project water delivered to users in New Mexico, Texas and Mexico historically has consisted of releases of stored water from Elephant Butte and Caballo Reservoirs, supplemented with return flows discharged back into the Rio Grande by upstream Project water users and limited arroyo inflows to the Rio Grande. Since the early 1900s, this concept of water use and reuse for the Rio Grande Project has allowed annual deliveries of Project water to exceed annual releases of stored water, with upstream users in New Mexico receiving relatively higher proportions of reservoir water and lower proportions of return flows than users in the El Paso Valley of Texas and Mexico. In this regard:

   - The 1938 Joint Investigation determined that 91.3% percent of the diversions in New Mexico originated as reservoir releases, whereas only 62.2% and 61.7% comprised the diversions by Texas and Mexico, respectively. Conversely, only 6.2% of New Mexico's diversions were comprised of drain return flows, whereas those for Texas and Mexico contained 34.9% and 35.0%, respectively.
   - In the 1980 USBR studies referred to above, the USBR determined, based on 1951-1978 Project operations data, that with the release of 763,800 acre-feet of stored water from Caballo Reservoir as a normal annual supply, the amount of water that could be apportioned for diversion from the Rio Grande by Project users was 931,840 acre-feet, or about 122 percent of the volume of reservoir water released. The additional 22% is almost entirely comprised of return flows from upstream drains.

5) Irrigated land within the Rio Grande Project area historically has been distributed approximately 57 percent in New Mexico and 43 percent in Texas, and allocations of Project water between the States generally have been in accordance with these proportions. However, this does not mean that the deliveries of stored water from Elephant Butte and Caballo Reservoirs to users in the two states have conformed precisely to these percentages because of the reliance on return flows to meet part of the water demands of downstream users in the lower Mesilla Valley and in the El Paso Valley in Texas.

6) Extensive groundwater withdrawals, particularly from relatively shallow aquifers with high groundwater levels such as those that existed along the Rio Grande below Elephant Butte Reservoir, can cause groundwater levels to decline, which in turn can cause normal

discharges of groundwater into rivers and streams, and into drains within irrigated areas, to be reduced. Eventually, with enough groundwater pumping, groundwater levels can fall below the elevation of surface water flowing in rivers and streams, and in the drains, thus causing the surface water to be depleted by seepage from the channels of rivers and streams, and from the drains, into the subsurface and the groundwater system. This streamflow depletion phenomenon has occurred in areas along the Rio Grande within New Mexico below Caballo Reservoir, causing Rio Grande flows to be less relative to the quantities of stored water released from Caballo Reservoir. One of the obvious effects of such increased surface water depletions in the Rio Grande basin below Caballo Reservoir has been to reduce flows in the river that otherwise would ultimately have reached Texas. Based on an analysis of historical data, since the development of significant groundwater pumping in New Mexico that began in the early 1950s, annual flows in the Rio Grande at El Paso have decreased an average of about 78,000 acre-feet per year.

7) Significant development of groundwater for providing supplemental supplies of irrigation water in the Rincon and Mesilla basins of New Mexico began with the onset of the severe drought of the 1950s when surface water supplies from the Rio Grande Project were limited. Since 1950, total annual groundwater withdrawals in these basins for irrigation and urban uses consistently have been above 100,000 acre-feet per year, with peak pumpage in recent dry years ranging generally from 300,000 to over 400,000 acre-feet per year. Of these amounts, annual groundwater withdrawals by the City of El Paso from its Canutillo well field in the lower Mesilla basin have ranged from a few thousand acre-feet up to around 25,000 acre-feet, with an average of about 19,000 acre-feet.

8) Numerous previous studies dating back 30 to 40 years, some of which were conducted by experts in New Mexico, have identified increased groundwater pumping for irrigation in the Rincon and Mesilla basins of New Mexico as a concern with regard to causing depletions of Project water flowing in the Rio Grande that otherwise would serve users in southern New Mexico and in the El Paso Valley of Texas. These studies noted that decreases in the Rio Grande flows at El Paso relative to releases from Caballo Reservoir began to occur in the early 1950s, around the same time that significant development of groundwater began in the Rincon and Mesilla basins of New Mexico.

9) Based on the significant changes evident in historical Rio Grande flows, streamflow depletions, drain discharges, and deliveries of Project water to users in southern New Mexico and in the El Paso Valley of Texas, there are strong empirical indications that the significant groundwater pumping that began in the 1950s in the Rincon and Mesilla basins caused these changes and effectively reduced the available supply of surface water from the Rio Grande below Caballo Reservoir.

10) The D1 and D2 Curves were developed by the USBR around 1980 to provide an organized structure for allocating Project water among the Elephant Butte Irrigation District ("EBID") in New Mexico, the El Paso County Water Improvement District No. 1 ("EPCWID") in Texas (together the "Districts"), and Mexico at the heading of its Acequia Madre. Having been developed based on actual historical Project data for the 1951-1978 period when groundwater development in the Rincon and Mesilla basins had already advanced to significant levels and was impacting Rio Grande flows, these relationships inherently

incorporate and reflect the effects of historical groundwater pumping in Rincon and Mesilla basins of New Mexico prior to 1978.

11) Historically, the volume of water in storage in Elephant Butte and Caballo Reservoirs immediately prior to and during each irrigation season has been the basis for determining annual allotments of Project water and annual releases of Project water from Caballo Reservoir. There are no apparent indications in the historical data that suggest this mechanism for determining annual releases from Caballo Reservoir has changed as a result of the development of significant groundwater pumping in the Rincon and Mesilla basins. There have been no apparent reductions in the releases of Project water from Caballo Reservoir that could have caused the observed reductions in the flows in the Rio Grande at El Paso since the onset of significant groundwater pumping in the early 1950s.

12) The 2008 Operating Agreement adopted by EBID, EPCWID and the USBR established official operating and allocation procedures for the Rio Grande Project and attempted to provide an equitable means for annually apportioning Project water among EBID, EPCWID and Mexico while recognizing the need to limit adverse impacts of New Mexico's groundwater pumping on deliveries of Project water to EPCWID and Mexico. Based on recent data, it is clear that the 2008 operating agreement has not fully offset the apparent effects of groundwater pumping on Project water diversions.

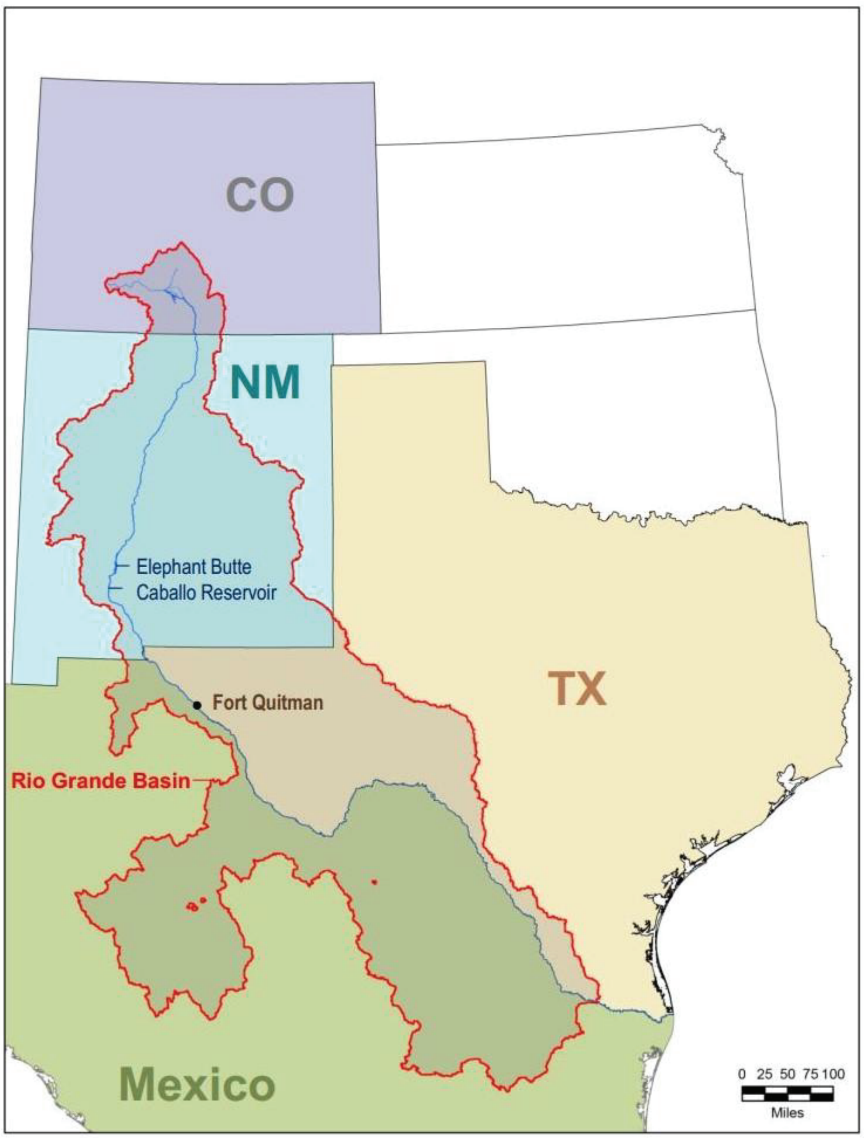
13) Accounting and reporting procedures for deliveries of Project water to and for diversions of Project water by EBID and EPCWID have changed since the Rio Grande Compact was adopted, and this fact, coupled with incomplete and/or unavailable data from the USBR and the Districts, limits the ability to effectively and consistently quantify actual historical deliveries of Project water to New Mexico, Texas and Mexico. Consequently, some delivery data have been estimated for purposes of this report.

3.0 RIO GRANDE BACKGROUND

The Rio Grande is an interstate and international river that originates in southern Colorado, runs generally north to south across New Mexico, enters Texas near the city of El Paso, Texas, and then defines the boundary between the United States and Mexico as it traverses to the Gulf of Mexico. The entire Rio Grande basin is depicted on the map in Figure 3.1. In total, the Rio Grande extends over a total distance of approximately 1,900 river miles, with about 1,255 river miles in Texas along the U.S.-Mexico border. Within the Rio Grande Project area from Elephant Butte Dam downstream to Fort Quitman, Texas, the Rio Grande covers approximately 210 river miles. Along its entire course, the Rio Grande provides a source of surface water that is used extensively to meet the needs of municipalities, industries, and agricultural irrigators, as well as to support various environmental uses. Numerous dams and reservoirs exist along the river primarily for water supply and flood control purposes; consequently, flows in much of the river are substantially controlled and regulated.

The Rio Grande Compact was agreed to in 1938 by the States of Colorado, New Mexico and Texas and the United States after many years of contentious relations involving the distribution and use of waters flowing in the Rio Grande between and within the states [1][2]. The Compact was subsequently ratified by the three State Legislatures and approved by the Congress of the United States. Based on real-time flows at key index locations as measured in the Rio Grande and its tributaries in New Mexico, the Compact defines procedures for quantifying the requirements for deliveries of Rio Grande water from Colorado to New Mexico at the state line and from New Mexico to the Rio Grande Project at Elephant Butte Reservoir. Under normal water supply conditions with ample water in storage in Elephant Butte and Caballo Reservoirs, the Compact establishes 790,000 acre-feet as the annual release of stored water for Rio Grande Project users in southern New Mexico, the El Paso Valley of Texas, and Mexico. Of this amount, the United States is obligated to provide 60,000 acre-feet of water per year to Mexico under provisions of the Convention of 1906 [2]; however, when Project water supplies are limited, Mexico's share is a prorated amount consistent with the reduced deliveries to New Mexico and Texas users.

Figure 3.1 Rio Grande Basin from Colorado to Gulf of Mexico



[2] Numbers in brackets refer to numbered items in the List of References in Section 8.0 of this report.

The Rio Grande Project ("Project") was created as a federally-supported irrigation project for the purpose of providing a dependable and equitable supply of water from the Rio Grande for agricultural interests along the Rio Grande in southern New Mexico and in the El Paso Valley of Texas. It was authorized pursuant to the Rio Grande Reclamation Project Act of 1905, and it included construction of Elephant Butte Dam and Reservoir on the Rio Grande near Truth or Consequences, New Mexico, to provide stored water for Project users. Project water was to be apportioned between irrigators in southern New Mexico and in the El Paso Valley of Texas in proportion to the irrigated acreage of Project lands within each State. Currently, there is a total of 159,650 acres authorized within the Project, with 90,640 acres within the EBID in New Mexico and 69,010 acres within the EPCWID in Texas [3]. These acreages translate to approximately a 57/43 split for the distribution of Project water between New Mexico and Texas users.

Today, the Project includes Elephant Butte Dam and Reservoir, Caballo Dam and Reservoir located immediately below Elephant Butte Dam, a hydropower plant at Elephant Butte Dam, three diversion dams on the Rio Grande in New Mexico (Percha, Leasburg, and Mesilla), two diversion dams on the Rio Grande in Texas (American and International, both owned and operated by the International Boundary and Water Commission), and an extensive system of canals, laterals, waste ways, and drainage ways that support irrigation operations in both Districts. The major dams and reservoirs and the diversion dams included in the Project are identified on the map of the region in Figure 3.2. Irrigated areas for EBID and EPCWID also are identified.

Depending on the quantity of water stored in Elephant Butte and Caballo Reservoirs before the beginning of each irrigation season, which typically begins during February, and the inflows to the reservoirs anticipated during the irrigation season, Project water is apportioned to users in New Mexico and Texas and to Mexico. Releases of stored water are made during the irrigation season in response to irrigation demands, and Project water consisting in varying amounts of released stored water, return flows from upstream irrigation operations, and occasional arroyo flows is diverted by EBID and EPCWID into their respective canal systems and by Mexico into its Acequia Madre. The return flows consist of excess irrigation tailwater and groundwater seepage from irrigated fields that are collected in drains that convey these return flows to the Rio Grande; hence, the proportion of return flows in the river increases in the downstream direction relative to stored water from the reservoirs, with Project water users in the lower Mesilla basin and in the El Paso Valley of Texas having to divert significant quantities of return flows. A portion of the Project water delivered to the El Paso Valley also is diverted by the City of El Paso for municipal use under agreements with EPCWID and private land owners within EPCWID that assign their Project water allotments for specific land parcels to the City. Excess canal flows and drainage water (return flows) from Project lands within the EPCWID also provide a supplemental water supply for approximately 18,000 acres of land within the Hudspeth County Conservation and Reclamation District No. 1 below the EPCWID down to Fort Quitman, Texas.

With the Rio Grande Compact having been adopted by the States in 1938 to ensure a prescribed delivery of water from the Rio Grande to Elephant Butte Reservoir, it is apparent that the Rio Grande Project is intricately tied to the Compact and dependent on the Compact for its water supply. The Rio Grande Project, in turn, is the means by which Compact water from Elephant Butte Reservoir is apportioned between and delivered to New Mexico, Texas, and Mexico. Hence, the relationship between the Compact and the Project is critical to being able to effectively supply water from the Rio Grande to users in southern New Mexico and the El Paso Valley of Texas, as well as Mexico. It is significant to note that both the Rio Grande Project and the Rio Grande Compact were conceived and implemented prior to the significant development of groundwater in the Rincon and Mesilla basins of New Mexico, which began in the early 1950s.

Figure 3.2 Map of Rio Grande Project Area

4.0 THE GROUNDWATER PROBLEM

4.1 Rio Grande Project Water Budgets

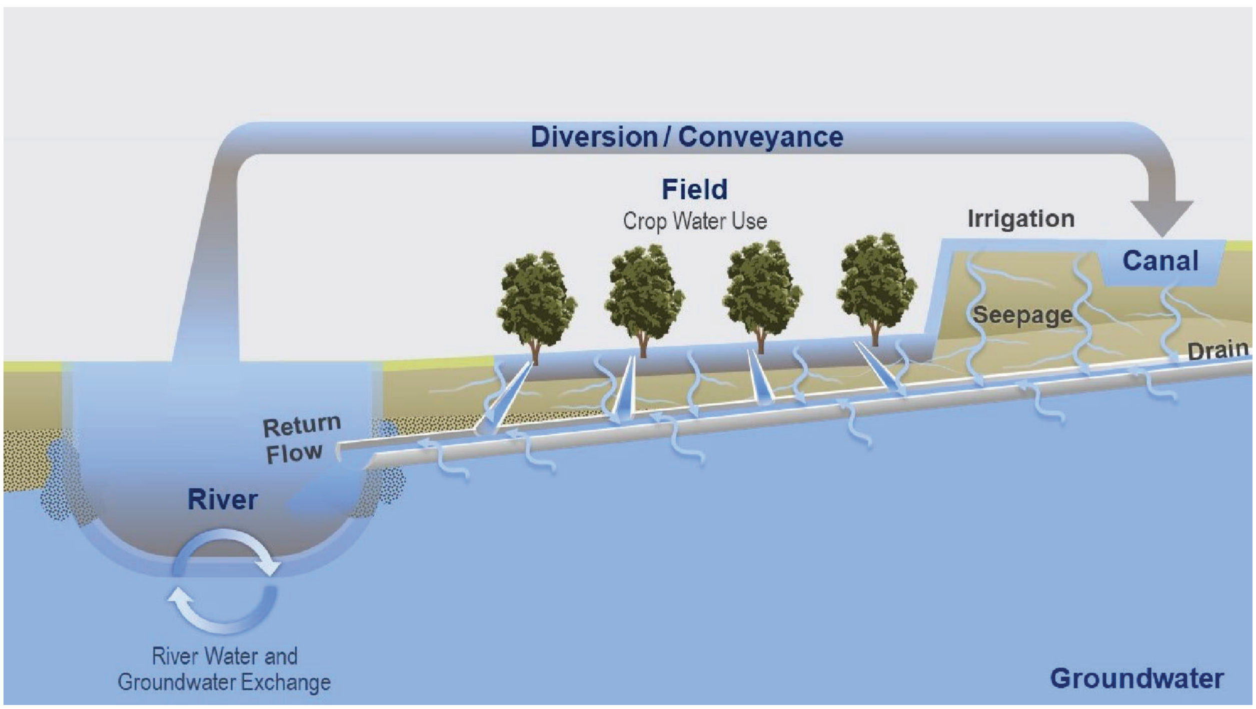
A water budget is an accounting for a defined time period of the inflows into and the outflows from a defined control area. Often, performing a water budget with known volumes of inflows and outflows for a specific time period can lead to the quantification of one or more unknown variables for that same time period. Or, performing multiple water budgets for a specific control area for different time periods can provide information regarding how certain phenomenon may have changed. Even a visual depiction of the water budget for a control area showing the generalized movement of water into, within and out of the area under different conditions and circumstances can be informative and help understand how the Project water supply system was originally conceived to work and how it has changed with the development of groundwater in New Mexico.

Hutchison [23] provides a general discussion of the changes that take place when groundwater pumping is initiated in an area where surface water historically has been used for irrigation of crops. This discussion has application to the Rio Grande Project area within the Rincon and Mesilla basins of New Mexico where significant groundwater development began in the early 1950s. Prior to the development of extensive groundwater pumping in the Rincon and Mesilla basins, groundwater levels generally were relatively high and fluctuated in response to the seasonal application of irrigation water from the Rio Grande on Project lands [24]. Irrigation water that was not consumed by crops and other vegetation or by evaporation, percolated down through the soil into the groundwater system, which typically flowed toward and into drains specifically designed for collecting groundwater and for conveying groundwater and excess irrigation tailwater away from fields and to the Rio Grande. In close proximity to the Rio Grande, the shallow groundwater generally flowed toward the river and discharged directly into the river; although, locally, there were segments of river flow gains and other segments that experienced flow losses. This condition is illustrated in a general fashion by the diagram in Figure 4.1.

As shown, Project water is diverted from the Rio Grande into an irrigation system canal and then distributed to individual irrigated fields, where it is either consumptively used by the growing crops or evaporated into the atmosphere, with any excess irrigation water either discharged directly to the drain as tailwater or percolated through the subsurface into the groundwater system. The bottom of the drain is below the upper level of the groundwater; thus, groundwater is induced to flow toward and into the drain. Similarly, the bottom of the river channel also is below the level of the groundwater, with water shown flowing in both directions depending on the relative heights of the water in the river and the groundwater from location to location. The irrigation tailwater and groundwater that is collected in the drain flows to the river and is referred to as return flow.

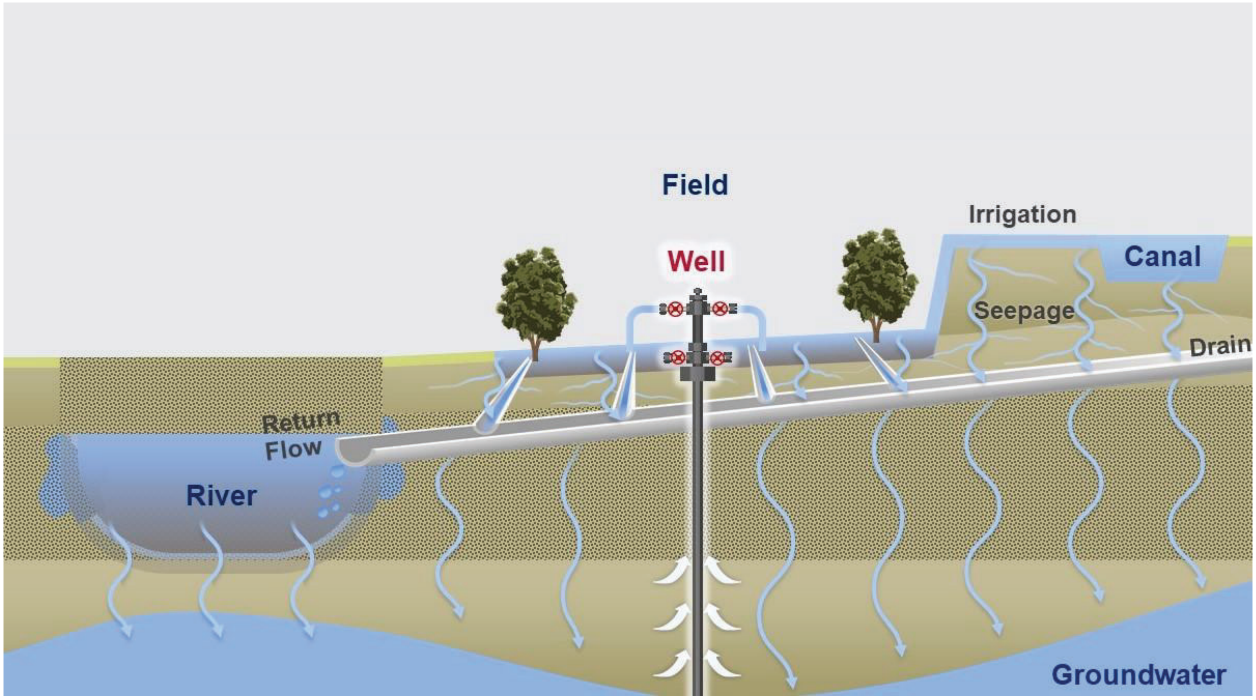
The return flow from the drain that is discharged into the Rio Grande provides an important supply of Project water for users located downstream, namely users in the lower Mesilla basin and in the El Paso Valley of Texas. This important source of water for Project users was contemplated in the early development of Rio Grande Project operations and in the negotiations among the States leading up to the adoption of the Rio Grande Compact. For example, the 1938 "Joint Investigation" [19], which was conducted by federal agencies at the request of the Rio Grande Compact Commissioners with input from Colorado, New Mexico and Texas representatives, determined that approximately 35 percent of the total supply of Project water delivered to Texas in the El Paso Valley was from upstream return flows, with the majority of the balance originating as releases from Caballo Reservoir. Conversely, since water for Project users in New Mexico was diverted from the Rio Grande farther upstream, i.e. above the river outfalls of most drains, only about six percent of New Mexico's total deliveries originated from return flows. Subsequently, in the early 1980s, the USBR developed the D1 and D2 allocation curves for the Rio Grande Project based on 1951-1978 operating data, and under normal supply conditions for the Project, these curves provided for 122 percent of the annual Caballo Reservoir release to be diverted from the Rio Grande for Project users [12]. This additional 22 percent was almost entirely from return flows discharged into the Rio Grande from drains.

Figure 4.1 Schematic of Rio Grande and Groundwater System Interaction Prior to Development of Groundwater Pumping in Rincon and Mesilla Basins



With the extensive development of groundwater in the Rincon and Mesilla basins of New Mexico that began during the early 1950s, particularly in the relatively shallow aquifers with generally high groundwater levels such as those along the Rio Grande, groundwater levels began to fluctuate and decline in some areas, which in turn caused discharges of groundwater into the drains, and directly into the river, to be reduced [24,25]. Eventually, with enough groundwater pumping, the groundwater gradient in many areas reversed, with reductions in the groundwater inflows to the drains and into the river. Hutchison demonstrates this phenomenon with his groundwater model for the historical conditions base case [25,29,30]. This condition is illustrated by the diagram in Figure 4.2. As shown, the level of the groundwater is below the bottom of the river channel and the drain, and water flowing in the river and in the drain moves toward and into the groundwater system, rather than the other way around as it was prior to the initiation of groundwater pumping. The discharge of return flow from the drain into the river is substantially curtailed, if not reduced to zero, thereby also reducing the flow in the river.

Figure 4.2 Schematic of Rio Grande and Groundwater System Interaction After Development of Groundwater Pumping in Rincon and Mesilla Basins



The phenomenon of reduced river flows caused by groundwater withdrawals is an underlying component of what is referred to as streamflow depletions, and these streamflow depletions have increased along the Rio Grande within the Rincon and Mesilla basins since significant groundwater development began in the early 1950s [4,6,7,8,30]. One of the obvious impacts of these increased streamflow depletions has been to alter the Project water budget by reducing flows in the Rio Grande that otherwise would ultimately reach water users in the lower Mesilla basin and in the El Paso Valley in Texas [29,30]. In essence, the release of a specific quantity of water from Caballo Reservoir now contributes less to the surface water supply for these users because of the losses of flow due to the increased seepage from the Rio Grande and interior drainage ways, thus altering the previously existing Project water budget.

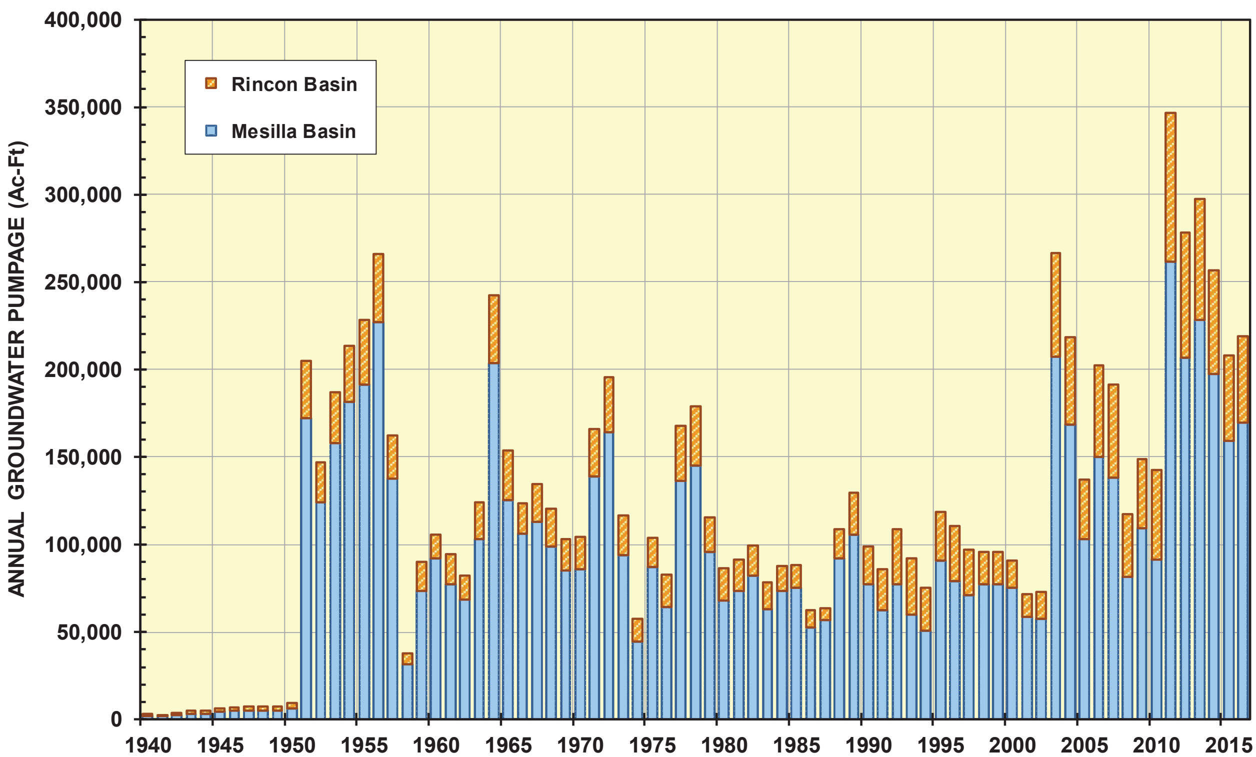
4.2 Historical Groundwater Development

Groundwater development for irrigation along the Rio Grande within New Mexico below Elephant Butte Reservoir began, to a very limited extent, around the early 1900s as farmers attempted to offset the uncertainties of the highly variable surface water supplies from the Rio Grande [4]. Only minimal groundwater development for irrigation continued until the early 1950s when well installations began to increase in response to limited surface water supplies from the Rio Grande Project due to drought conditions [5]. With the onset of this severe multi-year drought that gripped most of the southwestern part of the United States, groundwater development in New Mexico began to accelerate rapidly in an effort to provide supplemental water supplies for irrigation. Groundwater pumping for domestic, municipal and industrial uses also began in the early 1900s [4] and has continued to increase through the present along with increased urban development [5].

Montgomery and Associates [5] has compiled data on the development of groundwater wells in the Rincon and Mesilla basins through an analysis of well records from the New Mexico Office of State Engineer and the Texas Water Development Board. This information shows that irrigation well development began to increase significantly during the early 1950s, followed by installations of municipal and industrial wells. With steady increases since that time, as of 2015, Montgomery reports that there were approximately 4,100 irrigation wells in the Rincon and Mesilla basins and about 7,400 urban wells. Approximately 550 of the urban wells are for municipal and industrial use, with about 460 of these in New Mexico and about 90 in Texas [26].

The estimated annual groundwater withdrawals for irrigation in the Rincon and Mesilla basins since 1940 are presented on the bar chart in Figure 4.3 [5]. As reported by Montgomery and Associates, complete records of historical irrigation groundwater withdrawals in these basins are not available; therefore, the annual quantities of pumping used to construct the graph in Figure 4.3 were estimated by Montgomery and Associates through water budget analyses using known historical monthly quantities of water inflows to and outflows from the individual basins [5].

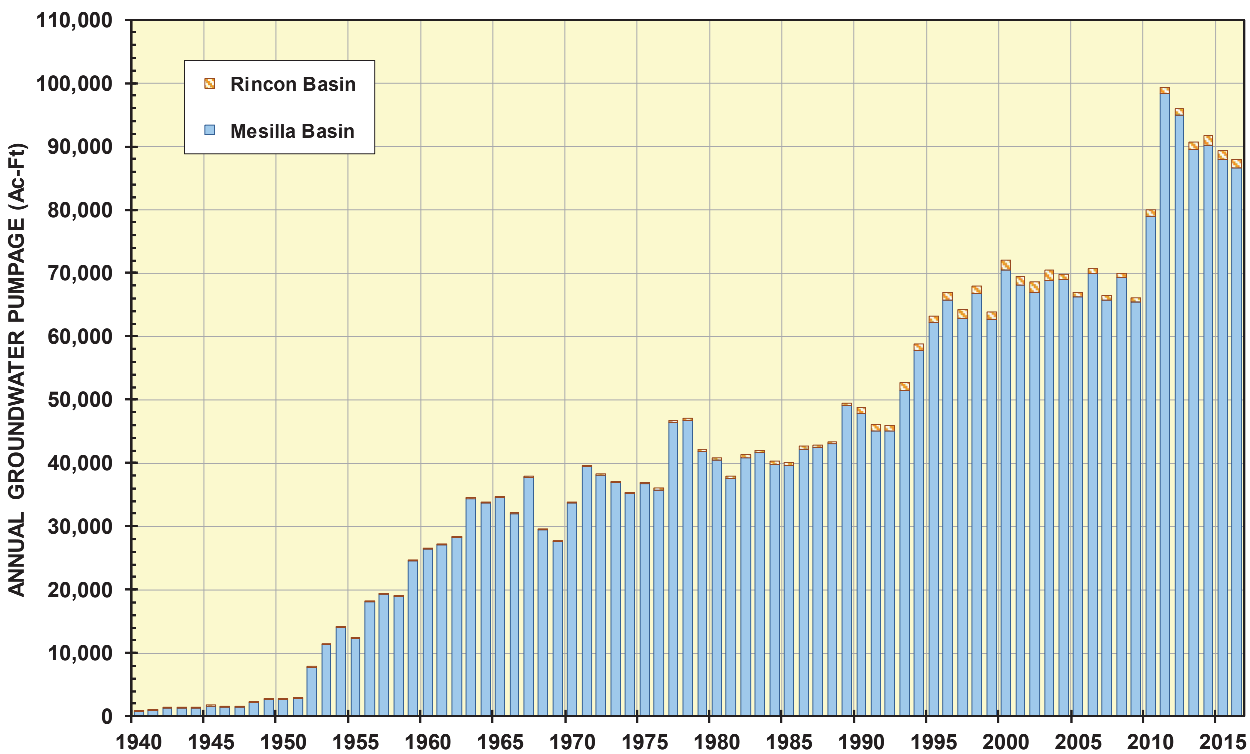
Figure 4.3 Annual Groundwater Pumpage for Irrigation Use in Rincon and Mesilla Basins



As shown by the bars on the chart in Figure 4.3, annual groundwater withdrawals for irrigation has varied considerably, likely in response to wet/dry conditions, and the annual volume of groundwater pumpage for irrigation was substantial even in the early 1950s, indicating that the groundwater well pumping capacity, and likely the total number of irrigation wells, at that time were significant. The demands for additional supplies of irrigation water during the severe drought of the 1950s and during other dry periods, particularly in the mid-2000s and after 2010, are illustrated by the higher levels of groundwater withdrawals on the chart.

A similar plot showing the reported annual groundwater withdrawals for urban uses in the Rincon and Mesilla basins is presented in Figure 4.4. As developed by Montgomery and Associates [5], these annual quantities include pumpage for municipal, industrial and domestic uses. As illustrated, groundwater withdrawals for these urban uses have grown significantly and steadily since the early 1950's in response to a growing population and the associated urbanized development [5]. It should be noted that these annual values for the Mesilla basin do include pumping by the City of El Paso from its Canutillo well field, which has varied from a few thousand acre-feet per year in the early 1950s up to the current range of 20,000 to 25,000 acre-feet per year and has averaged about 19,000 acre-feet per year [5]. They also include groundwater withdrawals in the Mexican portion of the Mesilla basin where groundwater pumpage was a few thousand acre-feet per year from around 1997 through 2009, but then increased substantially to over 25,000 acre-feet per year with the construction of a new well field by Cuidad Juarez for municipal use [5].

Figure 4.4 Annual Groundwater Pumpage for Urban Use in Rincon and Mesilla Basins

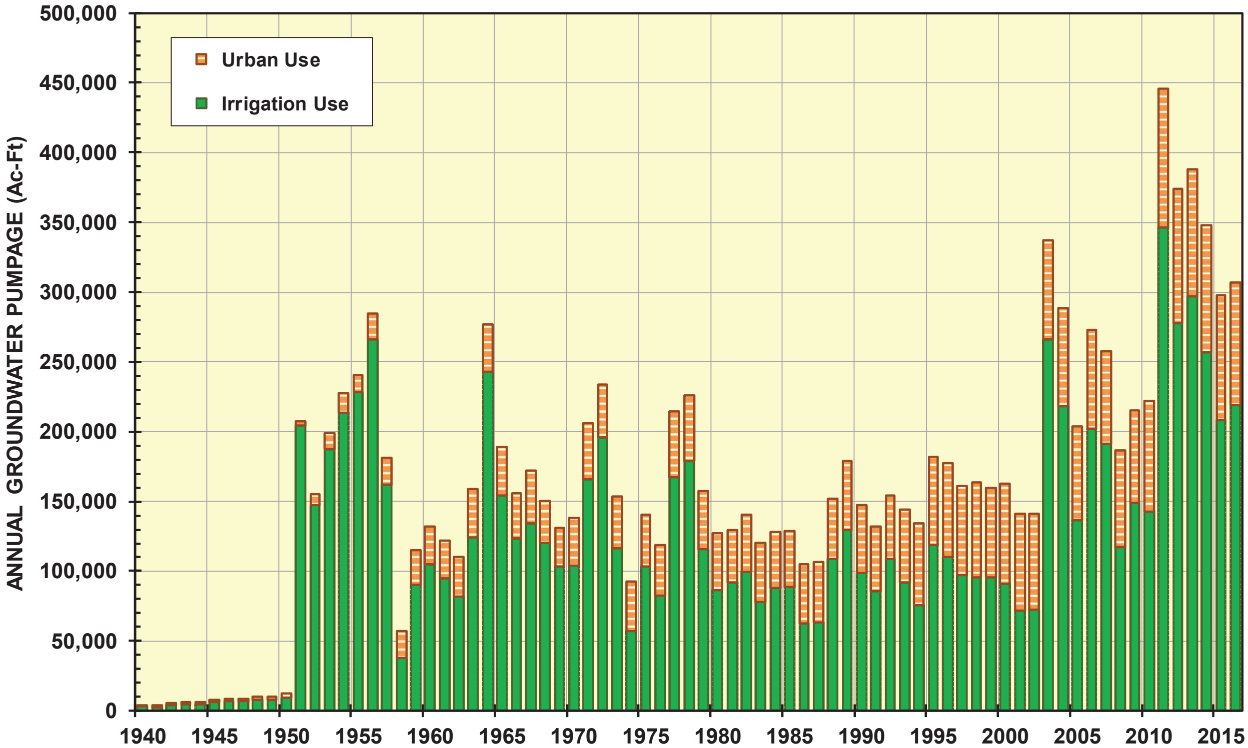


The plot in Figure 4.5 shows the total combined groundwater withdrawals for both irrigation and urban uses in the Rincon and Mesilla basins [5]. As indicated, since 1950, the total annual groundwater withdrawals consistently have been above 100,000 acre-feet per year, with peak pumpage in recent dry years in the range of 300,000 to over 400,000 acre-feet.

4.3 Previous Groundwater Concerns

The effects of groundwater pumping by New Mexico users in the Rincon and Mesilla basins on surface water flows in the Rio Grande have been recognized as a concern for many years. Numerous studies and investigations have identified groundwater pumping in New Mexico as a cause for reduced flows in the Rio Grande at El Paso. In the early 1950s when groundwater development in New Mexico along the Rio Grande below Elephant Butte Reservoir first started to accelerate, a study by C. S. Conover of the U. S. Geological Survey [4], a study that was requested by and conducted in cooperation with the EBID, noted that a significant portion of groundwater pumpage for supplemental irrigation water in the Rincon and Mesilla basins would originate as surface water through seepage from the Rio Grande and from drains.

Figure 4.5 Total Annual Groundwater Pumpage for Irrigation and Urban Uses in Rincon and Mesilla Basins



Following are excerpts from the abstract of the Conover report:

> *…… Ground water obtained by pumping in the Rincon and Mesilla Valleys does not represent an additional supply or new source of water to the project, but rather a change in method, time, and place of diversion of the supplies already available.*
>
> *…… The writer concludes that in a hypothetical year having only 50 percent of a normal supply of surface water available for diversions, the project lands would require an additional acre-foot per acre of water from wells to assure successful irrigation of the crops. However, because of the reduction in flow of the drains caused by pumping and because of losses in distribution, the use of water from wells to supply this deficit would require pumping 2.42 acre-feet per acre, or 213,000 acre-feet a year for the 88,000 acres of water-right land in New Mexico. Of the amount pumped, it is calculated that all but 63,000 acre-feet would be diverted from surface-water flow. If supplemental pumping were resorted to for 5 successive dry years, continued pumping would be necessary for 3 to 4 years after a return to normal surface supply so as to permit bypassing of the required share of water to the El Paso district, awaiting the restoration of ground-water storage by recharge from surface water.*

In a 1982 report by an unknown author [6] that was obtained from the papers of Joseph F. Friedkin, former United States Commissioner of the International Boundary and Water Commission ("IBWC"), housed at the Library and Archives of the University of Texas at El Paso, graphical analyses are presented that illustrate the changes in Rio Grande flows that occurred after substantial groundwater pumping began in New Mexico in the early 1950s. These graphs show historical cumulative flows in the Rio Grande below Elephant Butte Reservoir plotted against cumulative flows in the Rio Grande at El Paso beginning in 1915 and historical cumulative flows in the Rio Grande below Caballo Reservoir and below Leasburg Dam plotted against cumulative flows in the Rio Grande at El Paso beginning in 1938. Each of the curves on these graphs exhibits a noticeable change in slope beginning in the early 1950s when significant groundwater development began in the Rincon and Mesilla basins in response to the severe drought of the 1950s. As stated in the report:

> *This groundwater development has changed the flow regime established prior to 1951 such that a greater release is required from Elephant Butte Reservoir to achieve the same flow at El Paso. This new trend, which was established after the end of the drought of the 1950's, has continued to the present (1982).*

In this same report, comparisons of the graphs showing the 1938-1982 cumulative flows in the Rio Grande below Caballo Reservoir and below Leasburg Dam plotted against 1938-1982 cumulative flows in the Rio Grande at El Paso clearly indicate that most of the streamflow depletions along the Rio Grande occurred below the Leasburg Dam in the Mesilla Valley. From 1951-1982, a total of 3,600,000 acre-feet were shown to be lost from Caballo Dam to El Paso, but of this amount, 3,000,000 acre-feet were indicated to be lost from Leasburg to El Paso in the Mesilla Valley. This is consistent with the relatively small annual amounts of historical groundwater pumpage for irrigation in the Rincon basin compared to the Mesilla basin as shown on the bar chart in Figure 4.4. Numbers presented in the 1982 report [6] indicate that the decrease in the flow of the Rio Grande reaching El Paso from below Caballo Reservoir since 1951 compared to pre-1951 conditions was an average of 112,500 acre-feet per year, whereas the decrease in the flow of the Rio Grande reaching El Paso from below Leasburg Dam since 1951 compared to pre-1951 conditions was an average of 94,000 acre-feet per year. Thus, activities within the Rincon basin between Caballo Reservoir and the Leasburg Dam, namely groundwater pumping, accounted for the difference, only 18,500 acre-feet per year. This 1982 report concludes with the following statement:

> *In conclusion, all four figures used in this analysis show that the effects of the groundwater development below Elephant Butte Dam induced by the drought of the 1950's have significantly affected the amount of water reaching El Paso. The new relationship is well defined and has been continuous to the present (1982).*

In another investigation conducted in the mid-1980s, the IBWC sponsored a study undertaken by the consulting engineering firm of Tipton and Kalmbach, Inc. of Denver, Colorado [7] to analyze streamflow depletions caused by groundwater pumping for the segment of the Rio Grande from Leasburg Dam downstream to the El Paso Narrows, just upstream of the city of El Paso. Following are selected conclusions stated in the report regarding groundwater pumping and streamflow depletions:

1) *Depletions of the Rio Grande upstream of the El Paso Narrows have increased. The annual depletions from 1922 through 1950 averaged 237,000 acre-feet per year, from 1951 through 1984 averaged 260,000 acre-feet per year, and from 1980 through 1984 averaged 305,000 acre-feet per year.*

   ………..

5) *The use of wells in the Rincon Valley and Mesilla Basin for supplemental irrigation water and for municipal, industrial, and domestic uses since 1951 is the principal cause for the increased depletion upstream of the El Paso Narrows.*

   ………..

8) *The apportionment of deliveries to Mexico may be affected by the increased depletions in the Rincon Valley and Mesilla Basin due to ground water development as additional surface water releases must be made to recharge the depleted ground water reservoir. Since the decline in Rio Grande Project water supplies which started in 1951, the project apportionment including deliveries to Mexico has been made on the basis of a linear regression analysis of the 1951-1978 operational pattern. This regression analysis includes the effects of historic ground water depletions and recharge in the Rincon Valley and Mesilla Basin. By dividing the regression analysis into two periods; i.e., 1951-1964 and 1965-1978, it is seen that, during the second period, greater surface water releases were required to deliver a given quantity of water to U.S. farms and Mexico.*

In its Recommendations section, this same report notes that "An analysis of the effect of ground water pumping on surface water depletions will be necessary if there is increased ground water withdrawals or plans for increased ground water withdrawals." Furthermore, it states that "Should the depletion continue to increase, it will be necessary to make increased water supply releases to satisfy a given irrigation allotment", which is essentially the same conclusion drawn in the 1982 report [6].

In 1997, by Order of the Third Judicial District Court of New Mexico pursuant to Case No. CV 96-888, *Elephant Butte Irrigation District v. Thomas C. Turney, et al*, an appointed Hydrology Committee, comprised of hydrologists representing the New Mexico Office of State Engineer, the United States Bureau of Reclamation ("USBR"), New Mexico State University, EBID, and the cities of Las Cruces and El Paso, investigated general hydrologic relationships in the Lower Rio Grande Basin ("LRGB") [8]. For this purpose, the LRGB was defined generally as the majority of the Rio Grande drainage area extending from Elephant Butte Reservoir downstream to the New Mexico/Texas state line. Based on hydrologic analyses and computer modeling, this investigation concluded the following:

> *Well withdrawals in the LRGB have been derived partly from stored groundwater, partly from surface-water depletion and partly from capture of evapotranspiration. The fraction derived from the surface water grows through time. The historical portion of well withdrawal from surface-water depletion is estimated to be between 80 and 90 percent. Specific wells may derive water from appreciable different proportions of each source.*

Hence, results from this study support the contention that pumping of groundwater from wells located along the Rio Grande in the Rincon and Mesilla basins has directly reduced flows in the Rio Grande because the vast majority of the groundwater pumped has originated as surface water that was conveyed through channel losses and seepage from the river channel and drainage ways to the groundwater system.

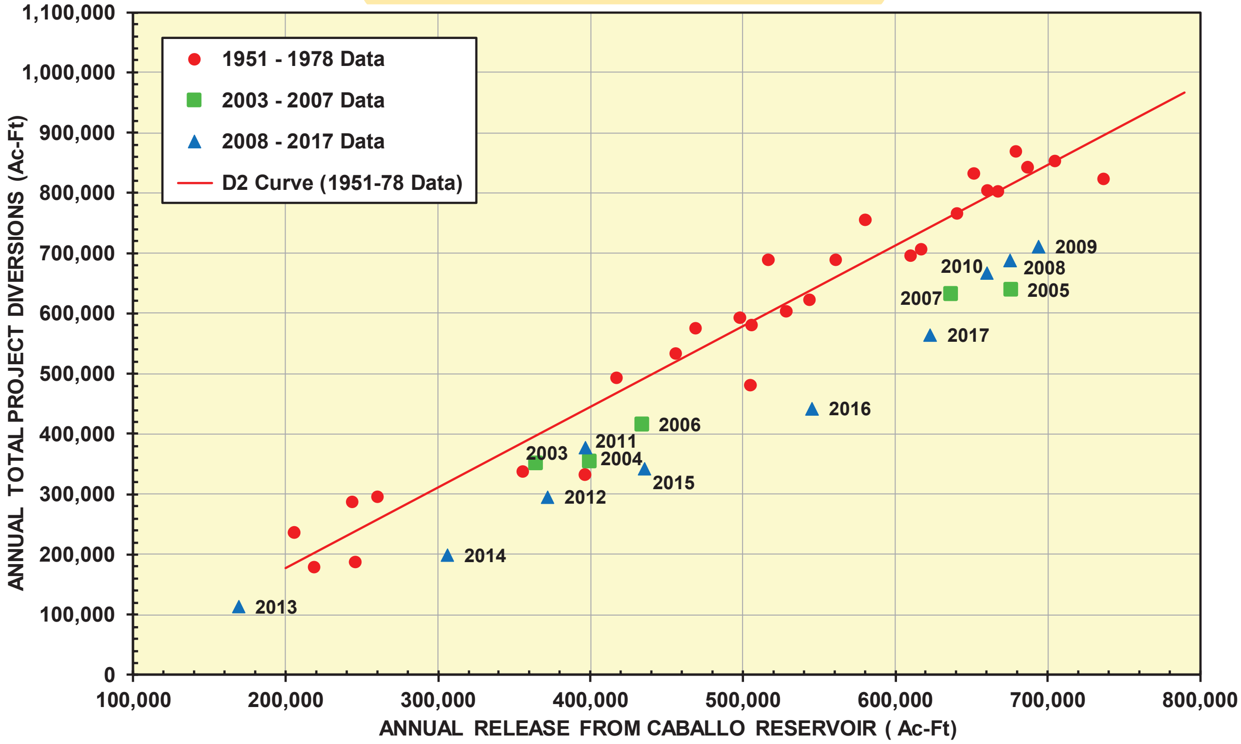
Finally, in a presentation in October 2008 at the 53rd Annual New Mexico Water Conference [9], Gary L. Esslinger, manager of the EBID, discussed the importance of the Operating Agreement for the Rio Grande Project ("Agreement") that had just been approved and adopted in August of 2008 by the USBR, the EBID and the EPCWID [3]. Preparation and adoption of a "detailed operational plan …….. setting forth procedures for water delivery and accounting ……" by USBR, the EBID and the EPCWID was a stipulation in earlier contracts [10, 11] between each of the Districts and the USBR under which each of the Districts assumed responsibility from the USBR for operation and maintenance of their respective canal and irrigation delivery systems. After many delays, the 2008 Agreement finally was intended to fulfill this requirement. As such, the 2008 Agreement prescribes procedures for determining annual allocations of Project water among EBID, EPCWID and Mexico, for releasing water from storage, for ordering and making deliveries of Project water, and for accounting and reporting. Maybe most importantly, the 2008 Agreement included provisions that were intended to address how groundwater pumping in New Mexico was to be recognized and accounted for, with certain concessions from EBID to the EPCWID regarding annual allocations of Project water.

Pursuant to this discussion, Esslinger explained how for specific annual releases of Project water from the reservoirs starting in 2003 when sustained dry conditions began and extending through the present (2007 at that time), the annual diversions of Project water from the Rio Grande at major canal headgates were considerably less than previous diversions corresponding to the same annual reservoir releases that were made during the 1951-1978 period. Esslinger illustrated this on a plot of annual diversions versus annual reservoir releases showing data for the 1951-1978 period and for the more recent years 2003 through 2007. A reconstruction of this plot is presented in Figure 4.6 below, except that the annual diversion and release data in this plot have been extended beyond Esslinger's 2007 data base and through the year 2017 [22,15].

As shown on the plot, practically all of the more recent data since 2003 (green squares and blue triangles) indicate reduced diversions relative to those for the 1951-1978 baseline data base for the same reservoir releases. The significance of the 1951-1978 period is that Project operations data from this period were used by the USBR around 1980 [12] to develop linear regression equations relating actual annual canal diversions to actual annual reservoir releases (referred to as the D2 Curve) and actual annual farm deliveries to actual annual reservoir releases (referred to as the D1 Curve). These relationships subsequently were used by the USBR for determining annual allocations of Rio Grande Project water for EBID, EPCWID and Mexico (see Subsection 6.3). Based on the fact that annual diversions have been reduced in recent years with respect to the D2 Curve for the same amount of annual releases from Caballo Reservoir as shown on the graph in Figure 4.6, Esslinger concluded that it was groundwater pumping and the lowering of groundwater levels in pumping areas and the associated depletions of surface water flows that caused the observed reductions in the annual volumes of Project water delivered and diverted during the 2003-2007 period (which now is further supported with the 2008-2017 data plotted on the graph).

With regard to the 2008 Agreement, Esslinger noted that a provision in the Agreement that required annual allocations of Project water to EPCWID and Mexico to be based on the 1951-1978 D1/D2 Curves tended to provide protection to these entities from subsequent impacts of groundwater pumping in New Mexico, and it allowed groundwater pumping in New Mexico to be grandfathered at the 1951-1978 levels that are embedded in the D1/D2 Curves. The fact that Project diversions since implementation of the 2008 Agreement still have remained well below the D2 Curve as shown on the graph in Figure 4.6 suggests that the effects of groundwater pumping in New Mexico on deliveries to Project users in the lower Mesilla basin and in the El Paso Valley of Texas still are not being adequately accounted for.

Figure 4.6 Annual Rio Grande Project Diversions versus Annual Releases from Caballo Reservoir

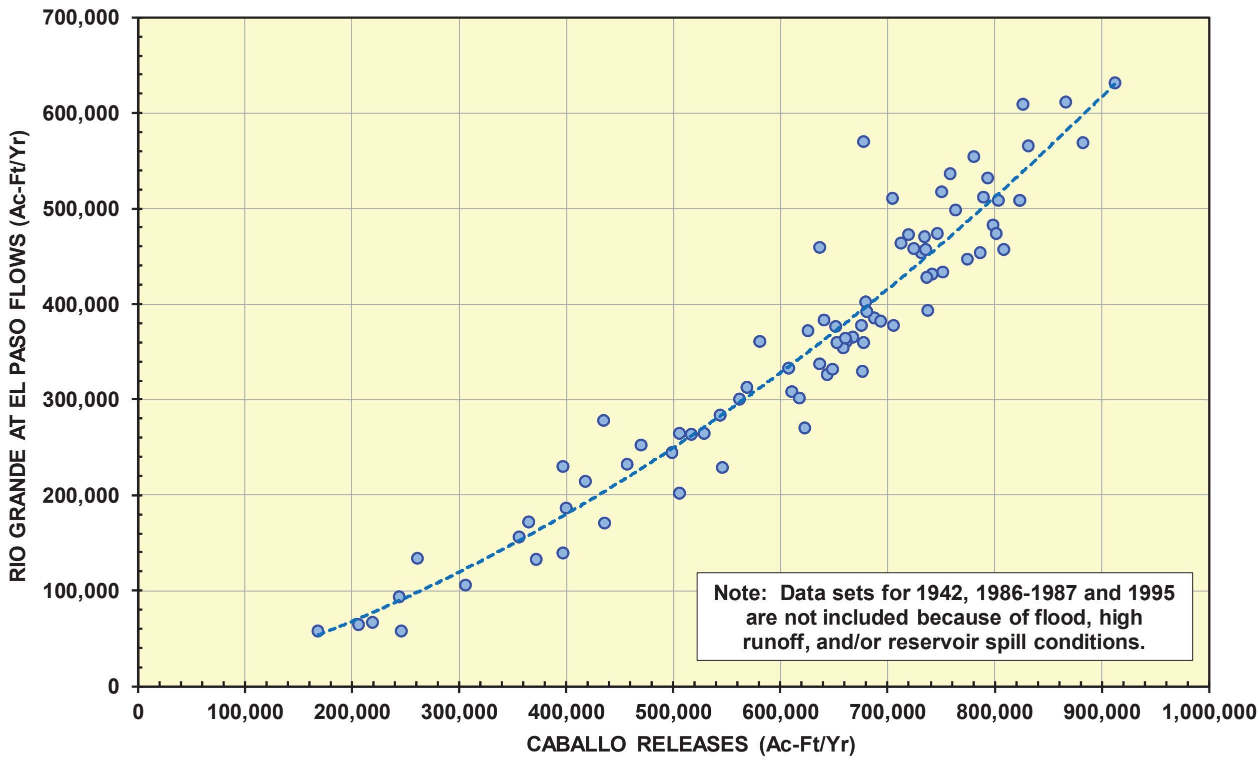


5.0 HISTORICAL TRENDS IN CHANGING FLOWS

As discussed above, examination of historical flows using various graphical and statistical methods applied to historical data can provide useful insight with regard to relationships, or changes in relationships, between different parameters of interest when trying to assess impacts of certain hydrologic phenomena. For example, if the historical groundwater pumping in the Rincon and Mesilla basins of New Mexico did, in fact, cause flows in the Rio Grande to be reduced and thereby be unavailable to Texas, these effects should be discernable in the historical data through the application of various graphical means.

Releases of Project water from Caballo Reservoir, and occasional spills of flood water, represent the principal source of water that influences the day-to-day magnitude of flows that occur downstream along the Rio Grande that ultimately reach Texas. While other factors such as canal diversions and arroyo inflows affect these river flows, it is the reservoir releases themselves that dominate the normal flow regime of the Rio Grande throughout the Project area. The historical relationship between flows in the Rio Grande at El Paso and releases from Caballo Reservoir is illustrated by the plot in Figure 5.1 [15,21,27].

Figure 5.1 1930-2017 Annual Rio Grande Flows at El Paso versus Releases from Elephant Butte and Caballo Reservoirs



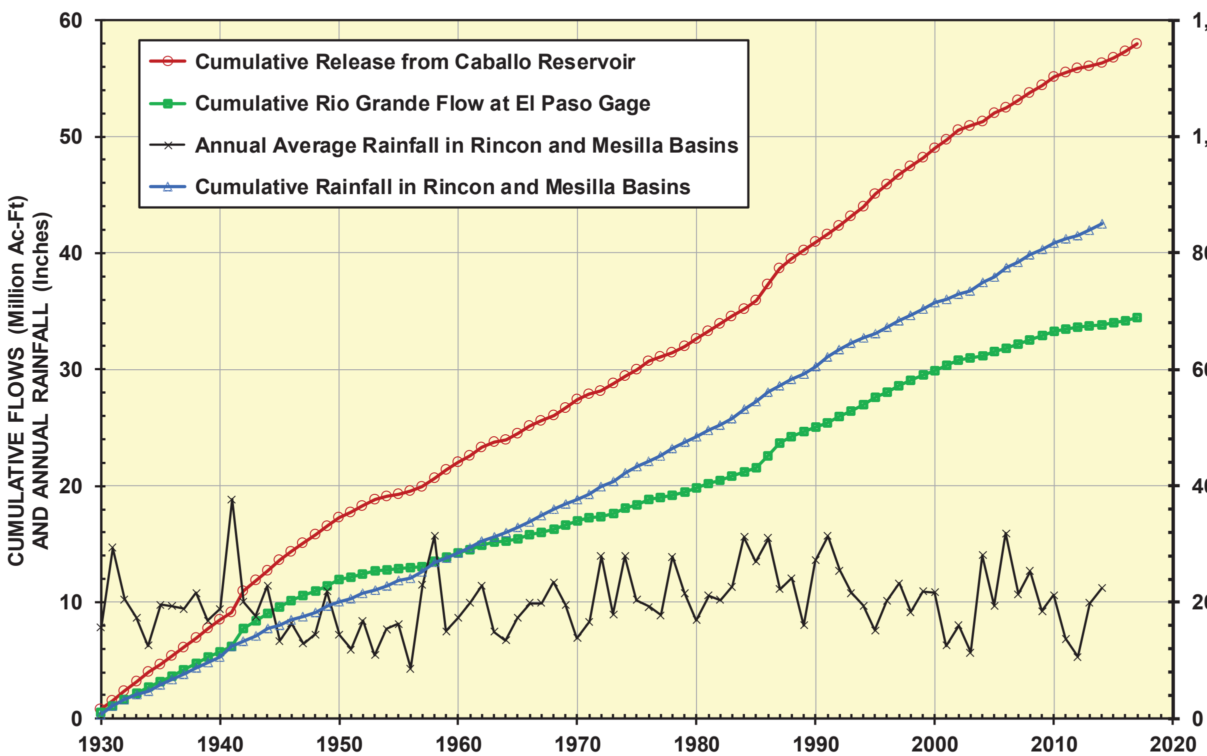
These data represent annual values for the period from 1930 through 2017, with Elephant Butte releases used for the 1930-1937 period prior to the time Caballo Dam was constructed, and, as expected, they demonstrate the general increase in the flows of the Rio Grande at El Paso as the annual reservoir releases increase. As shown, as the magnitude of the annual flows increases, the flows in the river at El Paso represent a greater fraction of the Caballo release, ranging from around a third on the lower end up to about two-thirds for the higher flows. This is due partly to the fact that losses from the Rio Grande and diversions in New Mexico represent a smaller proportion of the river flow under high-flow conditions.

5.1 Time Series Observations

Because of the dominance of the releases from Caballo Reservoir on the flows of the Rio Grande downstream, time series of annual reservoir releases provide a useful independent dataset against which corresponding river flows and other hydrologic parameters can be compared and examined for trends and changes in trends. Annual values of hydrologic variables often exhibit considerable variation in response to wet/dry conditions; therefore, sometimes it is more informative to examine cumulative summations of these quantities over time. Since groundwater pumping in the Rincon and Mesilla basins in New Mexico began to significantly develop in the early 1950s in response to drought conditions, cumulative plots beginning well before the 1950s are necessary in order to show any perturbations that may have been caused by the historical groundwater withdrawals.

Figure 5.2 is a plot of cumulative releases from Caballo Reservoir (or from Elephant Butte before 1938) and cumulative Rio Grande flows at El Paso beginning in 1930 and extending through 2015 [15,21,27]. Also displayed on the plot are cumulative values and average annual values of rainfall in the Rincon and Mesilla basins over this same period as compiled and area-averaged based on cell data from the PRISM rainfall data base [13]. As shown, the cumulative curves for both the Caballo releases (red circles) and the El Paso Rio Grande flows (green squares) exhibit steeper segments reflecting higher flow conditions and also flatter segments indicating lower flow conditions. The effects of the high flows during the early 1940s and mid-1980s and the low flows of the early to mid-1950s are readily apparent in the two curves. Lower flow conditions also are indicated beginning around 2010, which is consistent with observed climatic and hydrologic conditions. Overall, the cumulative curve for the Rio Grande flows at El Paso generally shows a somewhat flatter trend after the 1950s, indicating less river water reached El Paso relative to what was released from Caballo. The early 1950s, of course, is when significant groundwater pumping for irrigation began in New Mexico.

Figure 5.2 Time Series Plot of Cumulative Releases from Caballo Reservoir, Rio Grande Flows at El Paso, and Rainfall in Rincon and Mesilla Basins



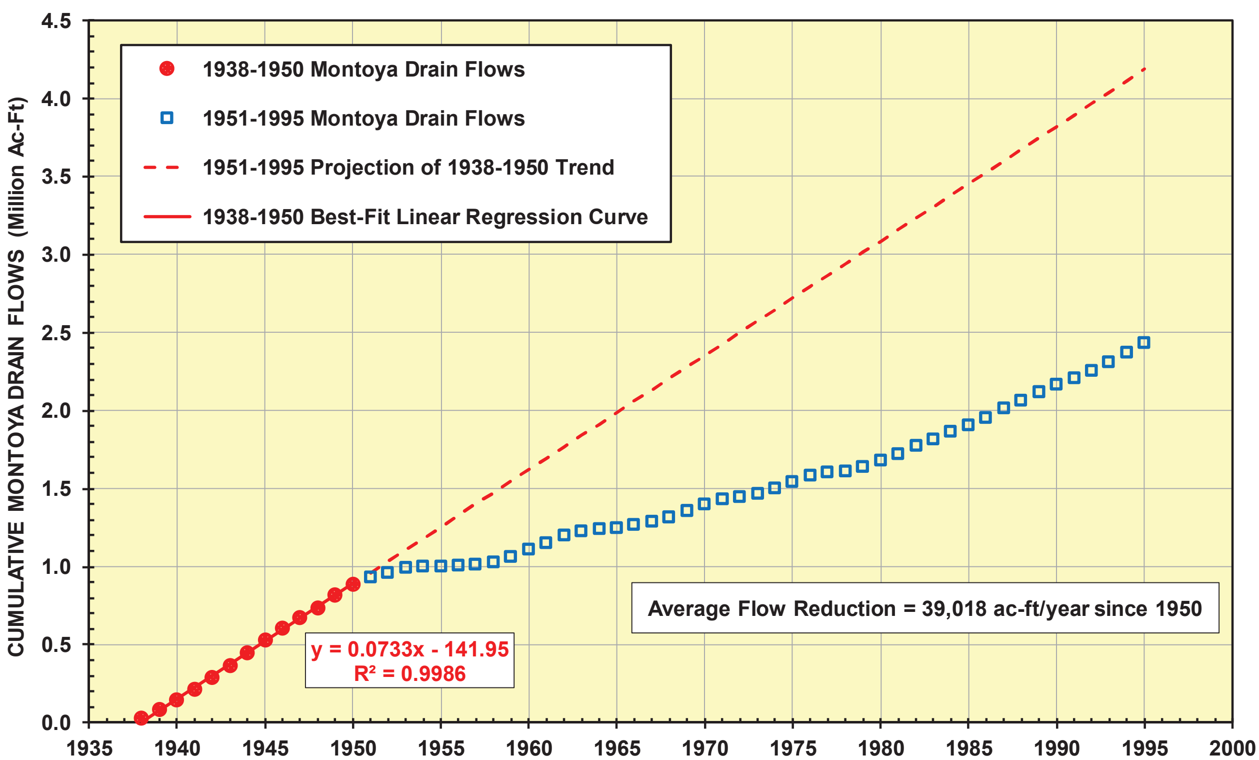
The fact that the cumulative rainfall curve (blue triangles) on the plot in Figure 5.2 generally does not exhibit these flatter and steeper variations, but rather follows a relatively uniform upward slope throughout the 1930-2015 period, indicates that the changes in the slope of the cumulative curve for the El Paso Rio Grande flows are not the result of local arroyo inflows to the Rio Grande generated by rainfall in the Rincon and Mesilla basins. Instead, flattening of the slope of the cumulative curve for the Rio Grande flows at El Paso beginning in the early 1950s is more likely than not indicative of the effects of lowered groundwater levels and increased losses from the Rio

Grande and drainage ways that resulted from the development of significant groundwater pumping in the Rincon and Mesilla basins.

It is important to emphasize here that the occurrence of wet and dry hydrologic conditions, particularly extended droughts, in the Project area are not rainfall driven. Overall, the region receives an average of only about 10 inches of rainfall per year, with annual amounts varying from about five inches up to about 20 inches as shown by the annual rainfall curve on the graph in Figure 5.2. Rainfall typically occurs during the monsoon season from mid-June through September, and while it contributes to river flows and soil moisture in the Project area, it is not enough to support a viable agricultural industry without supplemental irrigation. What produces the vast majority of the flows in the Rio Grande and the inflows to Elephant Butte Reservoir is snow melt that produces runoff primarily during the spring and summer months, with lessor amounts in other months. Consequently, the major droughts and periods of low river flows that have been experienced historically in the Project area, such as the severe drought of the 1950s and other droughts since 2000, are the result of low snowfalls and snow accumulations that occurred in the winter season of the year or years prior to the drought periods.

Another time series graph relevant to the groundwater issue in the Project area is presented in Figure 5.3. On this graph, measured discharges from Montoya Drain over the period from 1938 through 1995 are plotted as cumulative values [15].

Figure 5.3 Time Series Plot of Cumulative Discharges from Montoya Drain



The Montoya Drain collects and conveys return flows originating from tailwater discharges from irrigation fields and from subsurface inflows of excess irrigation water for much of the area east of the Rio Grande in the lower Mesilla basin. The Montoya Drain discharges into the Rio Grande just upstream of El Paso. The inflows to the Rio Grande from this drain, like that from many others upstream in the Rincon and Mesilla basins, are an important source of Project water for downstream users, in this case those in Texas. The use of these return flows to meet Project water demands has been an integral component of the Rio Grande Project since the early 1900s [19], and without these return flows, the water budget for the Project is significantly altered.

As shown on the graph, the historical data exhibit a drastic change of slope beginning during the early 1950s and then continuing with a flatter slope through 1995. This flattening of the slope of the historical data compared to the straight-line extension of the pre-1950 data trend (red dashed line) indicates that the flow discharging from the drain was significantly reduced – by an average of approximately 39,000 acre-feet per year from 1951 through 1995. While some of this flow reduction may be attributed to improved irrigation efficiency, it more likely than not was due to the loss of groundwater inflows to the drain that resulted from the lowering of groundwater levels caused by irrigation pumping that began in the early 1950s. With lower groundwater levels, any irrigation tailwater or excess irrigation water flowing in the drain seeped into the underlying soil thus reducing or eliminating flows in the drain and subsequent discharges of return flows into the Rio Grande. Hutchison illustrates this with his groundwater model [29,30].

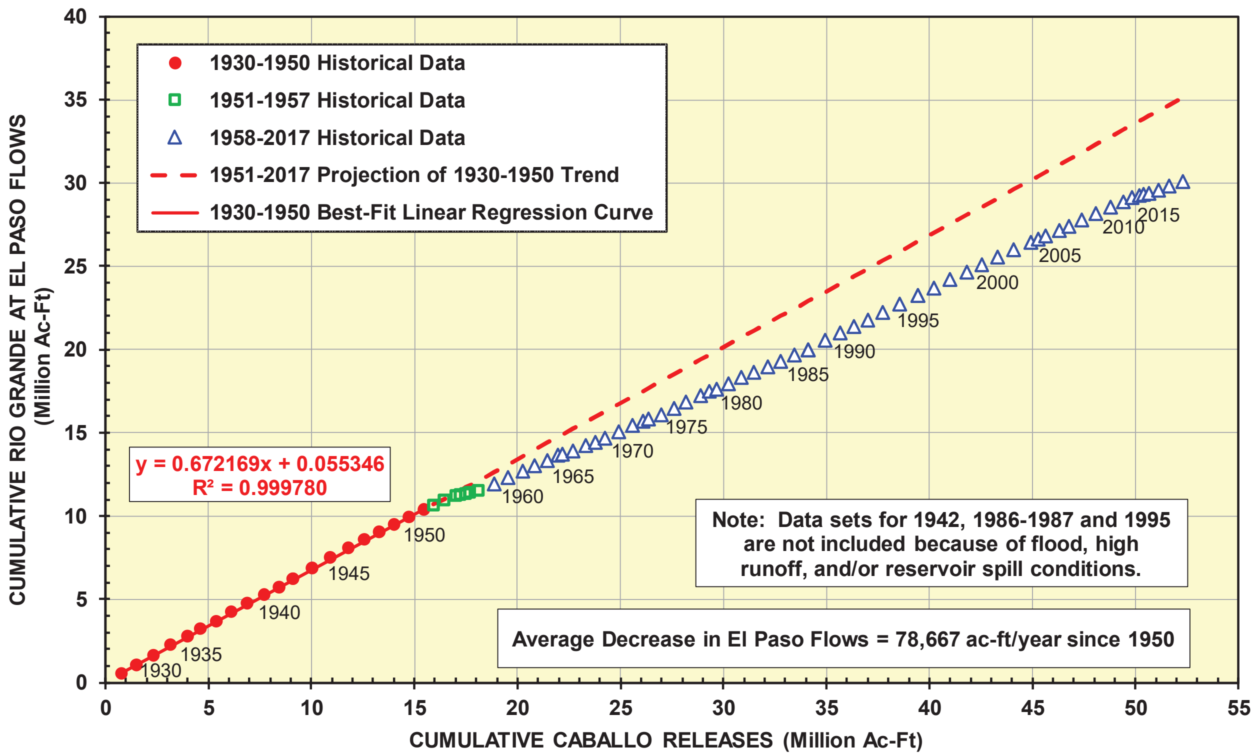
5.2 Rio Grande Flows at El Paso

As discussed in Subsection 4.3, reductions in the flow of the Rio Grande at El Paso coinciding with the development of groundwater pumping in the Rincon and Mesilla basins have been of concern for many years. While there is a multitude of approaches for examining these changes ranging from simple time-series graphs to complex modeling procedures, the double-mass graphical method provides one of the most useful means for analyzing historical data to gain insight into understanding the causes of changes in hydrologic phenomena. This technique involves graphical presentations of time series data expressed as cumulative values of a dependent variable plotted against the cumulative values of an independent variable, with the resulting curve beginning on a specified date and proceeding in time to an ending date.

This double-mass approach is applied to historical flow data for the Rio Grande at El Paso on the graph in Figure 5.4, where the historical cumulative flows in the Rio Grande at El Paso (dependent variable), beginning in 1930, are plotted against the corresponding cumulative releases from Caballo Reservoir (independent variable) [15,21,27]. This is the same form of graph that was previously discussed in Subsection 4.3 with regard to the 1982 report [6] for examining similar trends. As shown in Figure 5.4, the historical data are plotted in three groups corresponding to three different time periods; one for 1930 through 1950 before the 1950s severe drought, a second covering the 1950s drought from 1951 through 1957 when significant groundwater development began in the Rincon and Mesilla basins, and a third for 1958 through 2017 after the 1950s drought as groundwater pumping continued to develop.

The curve depicted by the combined data sets representing the entire 1930-2017 period exhibits a distinct change in slope beginning during the early 1950s (green squares), with the curve following a generally uniform but flatter slope after the 1950s (blue triangles). This change in the slope of the historical data curve during the 1950s could be partially a result of the drought of the 1950s when releases from Caballo Reservoir were reduced because of the limited supply of stored water in Elephant Butte Reservoir and when channel losses along the Rio Grande may have been more pronounced under low flow conditions. However, as discussed previously, the early 1950s also is the timeframe when significant groundwater development began in the Rincon and Mesilla basins to provide supplemental irrigation water in lieu of limited Project surface water for New Mexico farmers. The fact that the historical data curve continues after the drought of the 1950s (blue triangles) at a relatively uniform slope that is flatter than the curve prior to the 1950's (red dots) indicates that there was less river flow at El Paso for the same amount of water released from Caballo Reservoir. This illustration directly supports the conclusion that groundwater pumping along the Rio Grande in the Rincon and Mesilla basins was the principal cause of the reduced flows in the river at El Paso relative to releases from Caballo Reservoir. Hutchison [29,30] illustrates this same phenomenon with his groundwater model by reducing groundwater pumping in the Rincon and Mesilla basins from historical levels.

Figure 5.4 Double-Mass Plot of Cumulative Rio Grande Flows at El Paso versus Cumulative Releases from Caballo Reservoir Beginning in 1930

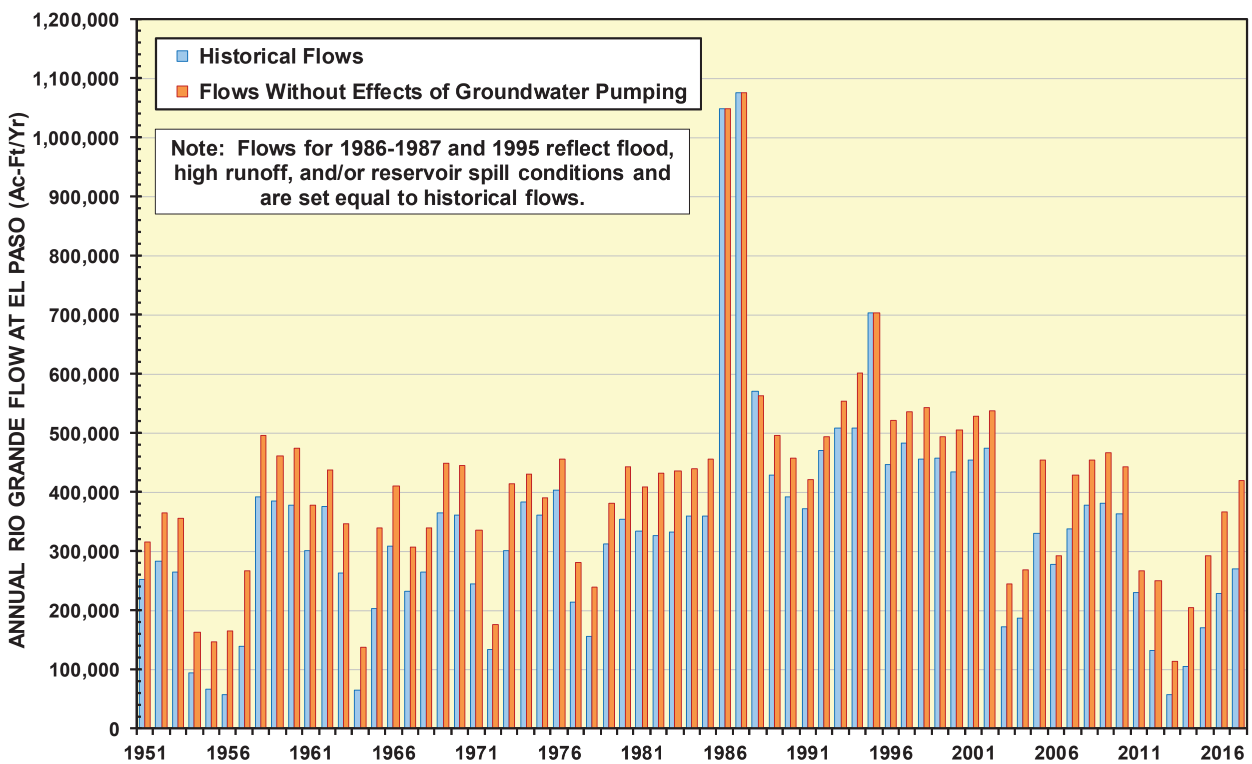


The deviation of the historical flows curve after 1950 (blue triangles) from the extension of the curve before the 1950s (dashed red line) averages 78,667 acre-feet per year, which is equivalent to a total reduction in the flow of the Rio Grande at El Paso of about 5,000,000 acre-feet for the period from 1951 through 2017, excluding the flood years of 1986-1987 and 1995. Based on this demonstration, it is more likely than not that groundwater pumping in New Mexico within the Rincon and Mesilla basins that began in the early 1950s and continues today played a major role in reducing flows in the Rio Grande at El Paso from what they were prior to the 1950s without groundwater pumping for the same annual quantities of water released from Caballo Reservoir. In essence, the extension of the 1930-1950 curve represents the "no compact violation" condition.

In essence, the extension of the 1930-1950 cumulative flow curve beyond 1950 to 2017 on the plot in Figure 5.4 (red dashed line) can be considered to represent the cumulative flows of the Rio Grande at El Paso that would have occurred if substantial groundwater pumping had not developed in the Rincon and Mesilla basins.

The corresponding annual river flows in the absence of groundwater pumping after 1950 (no compact violation condition) can be estimated by calculating the incremental annual increases in the extended cumulative flow curve (red dashed line). These estimated annual flows of the Rio Grande at El Paso without the effects of groundwater pumping for the 1951-2017 period are plotted on the bar chart in Figure 5.5 along with the corresponding historical annual flows. As expected, the annual flows without the effects of groundwater pumping are higher than the actual historical annual flows which were influenced by groundwater pumping. The average difference between the 1951-2017 annual flows without the effects of groundwater pumping and the actual historical annual flows with groundwater pumping is 78,667 acre-feet per year, the same value derived from the double-mass curves in Figure 5.4.

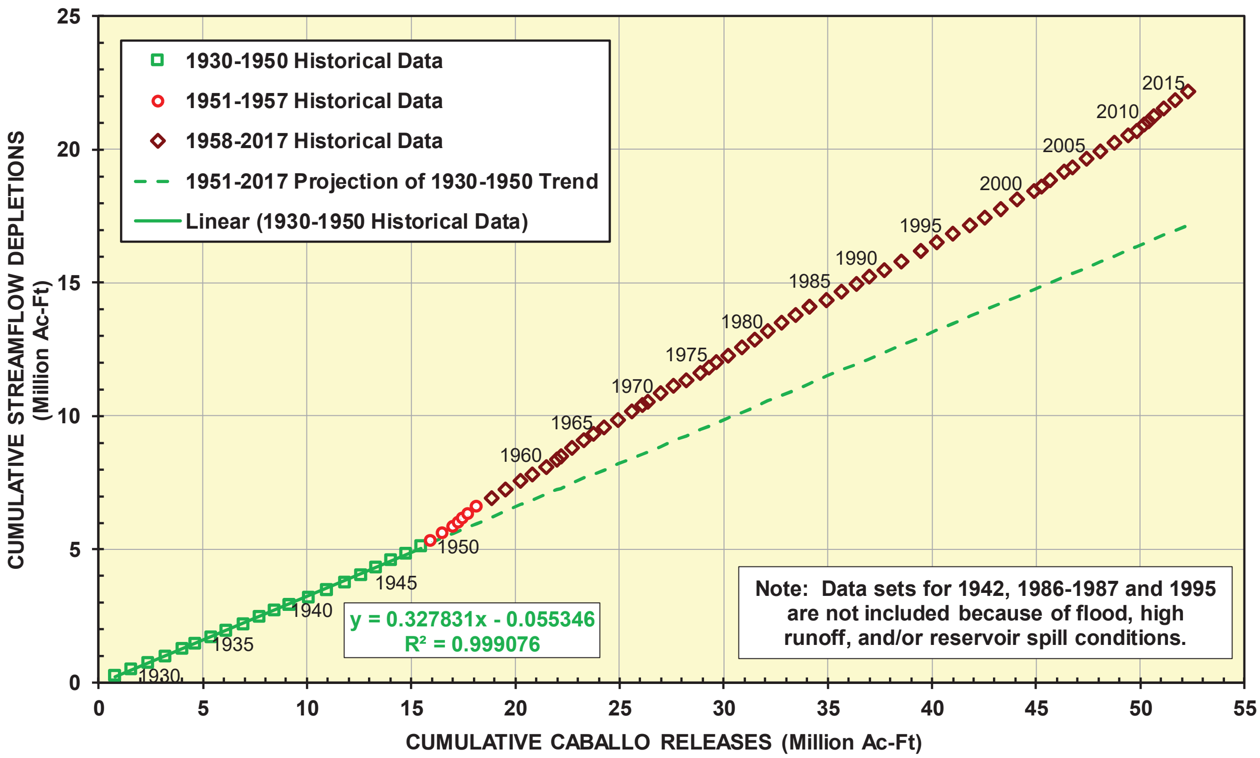
Figure 5.5 Bar Chart Comparing 1951-2017 Historical Annual Rio Grande Flows at El Paso With Corresponding Annual Flows Without the Effects of Groundwater Pumping



The counterpart to the analysis of the change in the Rio Grande flows at El Paso caused by the development of groundwater pumping in the Rincon and Mesilla basins is a similar analysis of streamflow depletions. For purposes of this analysis, streamflow depletions are defined as the difference between the annual releases from Caballo Reservoir and the corresponding annual flows in the Rio Grande at El Paso. Streamflow depletions in this case are the result of diversions from the river into the main canals for irrigation in the Rincon and Mesilla basins, river channel losses due to evaporation and seepage, and evapotranspiration by vegetation along the river, offset by arroyo inflows to the Rio Grande between Caballo Reservoir and El Paso and discharges into the Rio Grande from irrigation drains and canal wasteways. Figure 5.6 presents the double-mass graph of these cumulative streamflow depletions for the 1930 through 2017 period [15,21,27].

As shown on the graph in Figure 5.6, the historical depletions data are plotted for the same three periods as the El Paso river flow data in Figure 5.4, and the combined historical data curve also exhibits the same distinct change in slope beginning in the 1950s. However, in this case, it is in the opposite direction from the historical flow data curve in Figure 5.4 as the streamflow depletions along the Rio Grande increase after the 1950s rather than decrease as the Rio Grande El Paso flows did. Here again, the distinct change in slope after groundwater pumping began in the early 1950s and the increasing deviation of the historical data after the 1950s (brown diamonds) from the projection of the pre-1950 historical data (green dashed line) are indicative of the expected effects of groundwater pumping on streamflow depletions. In essence, the increase in streamflow depletions tracks the surface water losses associated with increased groundwater withdrawals [4,6,7,8,9,23,30].

Figure 5.6 Double-Mass Plot of Cumulative Rio Grande Streamflow Depletions versus Cumulative Releases from Caballo Reservoir Beginning in 1930



5.3 Summary

The various graphical illustrations presented in this section all exhibit the common theme that hydrologic conditions along the Rio Grande in the Rincon and Mesilla basins changed noticeably beginning after the 1950s. While this coincides with the onset of the severe drought of the 1950s that affected much of the southwestern United States, it also is when significant groundwater pumping began to develop and accelerate along the Rio Grande in the Rincon and Mesilla basins to provide a supplemental water supply for irrigation in New Mexico. Based on the significant changes that occurred in the observed Rio Grande flows, streamflow depletions, and drain discharges that began with the substantial increase in groundwater pumping, there is strong empirical evidence that groundwater pumping was a primary cause of these changes, which, in turn, lead to reductions in the availability of surface water supplies from the Rio Grande for Project users in Texas.

6.0 RIO GRANDE PROJECT OPERATIONS

6.1 1938 Pre-Compact Rio Grande Joint Investigation

The most comprehensive assessment of Rio Grande Project operations prior to the adoption of the 1938 Rio Grande Compact was a study conducted under authority of the National Resources Committee at the request of the Rio Grande Compact Commission, referred to as the "Joint Investigation" [19]. The compilation of reports and maps produced by this study often is referred to as the "Joint Investigation Report", or the "JIR".

Having worked for several years on attempting to resolve conflicts among Rio Grande water users in Colorado and New Mexico and in Texas above Fort Quitman, particularly with regard to the apportionment of these waters, the Rio Grande Compact Commissioners met in Santa Fe, New Mexico on December 2-3, 1935, and adopted a resolution requesting the National Resources Committee, through its Water Resources Committee and in consultation with the Compact Commission, to undertake an investigation [19]:

1) *of the water resources of the Rio Grande Basin above Fort Quitman,*
2) *of the past, present and prospective uses and consumption of water in such Basin in the United States, and*
3) *of the opportunities for conserving and augmenting such water resources by all feasible means,*

The primary purpose of this effort was to develop factual information *needed in arriving at an accord among the States of Colorado, New Mexico, and Texas on an equitable allocation and use of Rio Grande waters in the future development of the upper basin* [19], taking into consideration the commitment of the United States to deliver a prescribed amount of Rio Grande water to Mexico pursuant to the terms of the Convention of 1906 [2]. In general, the essential facts sought were *those relating to the available water supply, the water uses and requirements, and the possibilities of additional water supplies by storage, importation and salvage of present losses and wastes* [19]. Funding for this endeavor was provided by the federal government and by each of the three states. Field work for the collection of data was initiated in April of 1936, and the study concluded with a report published in February of 1938.

The Joint Investigation was undertaken under the direction of the Water Resources Committee and a Consulting Board. The JIR work was performed primarily through contractual agreements with the National Resources Committee by three federal agencies. The U. S. Geological Survey conducted field measurements and analyses of surface water flows, groundwater and water quality; the Bureau of Agricultural Engineering performed mapping of facilities and land use, classification of vegetative cover, compilation of irrigated and other water consuming acreages, and investigations of consumptive use of water by crops; and the Bureau of Reclamation investigated and reported on storage and trans-mountain diversion projects. Many other federal, state and local entities also made significant contributions in terms of services and/or funding.

While the Joint Investigation addressed the entire Rio Grande basin above Fort Quitman, its focus on the Rio Grande Project is of particular interest here because of the wealth of actual data and information that were compiled with regard to Project operations for the period of study, 1930-1936. This included measurements and records of Rio Grande flows, reservoir storage and releases, canal diversions, drainage and waste discharges, arroyo inflows, river and canal system losses, irrigated and non-irrigated land acreages, consumptive use of water by crops and native or nonbeneficial vegetation, domestic, municipal and industrial water use, precipitation and evaporation, groundwater observations, and water quality. Most of this information was organized and assembled according to geographic subdivisions, namely the Rincon, Mesilla, and El Paso Valleys in the United States, Hudspeth County in Texas[3], and the Juarez Valley in Mexico. The JIR discusses and analyzes these data and presents conclusions regarding the operation of the Rio Grande Project at that time, which, of course, represented conditions before adoption of the 1938 Rio Grande compact [19].

The Joint Investigation did not attempt to define explicitly the quantities of Rio Grande Project water that were to be delivered annually to New Mexico, Texas, and Mexico; however, it did provide useful data and information from which such distributions can be established. It is important to recognize that the 1930-1936 data base, upon which the Joint Investigation relied, did not reflect the operation of Caballo Dam and Reservoir for regulation of releases of Project water or the American Dam and Canal which regulate Rio Grande flows delivered to EPCWID users in the El Paso Valley and to the Acequia Madre for Mexico. Construction of these facilities was not completed until 1938. However, various adjustments were made as part of the Joint Investigation to reflect the anticipated operational effects of these facilities [19].

One important element of the JIR work involved quantification of the supply of water needed from Elephant Butte Reservoir under a normal annual supply condition to support existing and anticipated Project uses along the Rio Grande in New Mexico and in Texas above Fort Quitman, including agricultural uses in Mexico in the El Paso Valley. For this purpose, 145,000 acres of irrigated land in New Mexico and Texas, which was considered to represent the full development for purposes of the Project, was used as the basis for a normal supply [19]. For Mexico, a delivery of 60,000 acre-feet per year to the Acequia Madre near the city of Juarez was used as the normal supply, consistent with stipulations in the agreement between the United States and Mexico in the Convention of 1906 [2].

In addressing this task, the study compiled, or estimated, extensive information on river flows, arroyo inflows, river channel losses, diversions, wasteway flows, drainage return flows, streamflow depletions, agricultural consumptive use, and other hydrologic parameters based on the 1930-1936 dataset and related analyses. As part of this effort, the relative proportions of original reservoir water, arroyo inflows, and drain flows and seepage that comprised the historical

[3] The Hudspeth County Conservation and Reclamation District No. 1 provides irrigation water to lands along the Rio Grande, with part of this supply dependent on excess flows and drainage return flows from the Rio Grande Project.

diversions of Project water from the Rio Grande were determined for the Rincon and Mesilla basins in New Mexico and for the El Paso Valley in Texas, as well as for Mexico and downstream. These relative proportions are shown below in Table 6.1.

With these distribution values and the 1930-1936 diversion and other Project-related data, the Joint Investigation determined that 773,000 acre-feet of water would be required to be released from Elephant Butte Reservoir, and subsequently from Caballo Reservoir, to support a normal supply year. Of this amount, 600,000 acre-feet per year were for actual diversions into the main canals in New Mexico and Texas for irrigation of 145,000 acres under maximum development of the Project, 65,000 acre-feet per year were attributable to Project wastes and downstream flows, 64,000 acre-feet per year were for riverbed losses, 37,000 acre-feet per year were for deliveries to Mexico (supplemented with drain flows and arroyo inflows to achieve the required 60,000 acre-feet per year), and 7,000 acre-feet per year were for salinity control below El Paso [19].

Table 6.1 JIR Distribution of Sources of Project Water in Diversions for Individual Basins

Basin or Subdivision	Original Reservoir Release	Arroyo Inflow	Drain Flow and Seepage	Total
Rincon	97.5%	2.2%	0.3%	100.0%
Mesilla	89.8%	2.8%	7.4%	100.0%
El Paso	58.4%	- -	- -	- -
Upper El Paso	61.5%	3.4%	35.1%	100.0%
Lower El Paso	38.2%	4.1%	57.7%	100.0%
Hudspeth County	33.9%	6.1%	60.0%	100.0%
Juarez (Mexico)	49.5%	5.4%	45.1%	100.0%
Upper Juarez	58.3%	3.1%	38.6%	100.0%
Lower Juarez	24.4%	11.8%	63.8%	100.0%
Riverbed Losses	9.2%	- -	- -	- -
Passing Fort Quitman	17.2%	14.8%	68.0%	100.0%

It should be noted here that the 790,000 acre-feet per year of release from Elephant Butte and Caballo Reservoirs that is stipulated in the Rio Grande Compact as a normal supply for the Rio Grande Project was a negotiated amount that evolved through discussions in 1938 among the Rio Grande Compact Engineering Advisors representing Colorado, New Mexico and Texas. Values considered for this normal release ranged between the 773,000 acre-feet per year developed through the Joint Investigation and 800,000 acre-feet per year proposed by the Texas delegation, but in the end, "an average of 790,000 acre-feet per annum, adjusted for any gain or loss of usable water resulting from the operation of any reservoir below Elephant Butte" was agreed upon [20] and eventually adopted by the Rio Grande Compact Commissioners for the Rio Grande Compact.

With the information provided in the JIR, it is possible to develop a baseline for operation of the Rio Grande Project under a normal water supply scenario representing conditions before adoption of the Rio Grande Compact and, obviously, before significant groundwater development occurred along the Rio Grande in New Mexico. Table 6.2 presents this baseline case in Column 1 as derived solely from data and information in the JIR.

Table 6.2 Baseline Normal Supply Conditions for Rio Grande Project Based on 1938 JIR

	PARAMETER DESCRIPTION	(1) BASED ON 1938 JOINT INVESTIGATION	(2) EXTENDED TO RIO GRANDE COMPACT
	Normal-Supply Release from Reservoirs (ac-ft/year):	773,000	790,000
(1)	**Rincon Valley**		
(2)	Irrigated Lands (acres)	13,423	13,423
(3)	Net Diversions of Reservoir Releases, ac-ft	69,463	71,434
(4)	Net Diversions of Arroyo Inflow, ac-ft	1,496	1,496
(5)	Net Diversions of Drain Flow & Seepage, ac-ft	217	223
(6)	Total Net Diversions of Rio Grande Project Water, ac-ft	71,176	73,154
(7)	Drainage Return Flow, ac-ft	37,182	38,215
(8)	Calculated Streamflow Depletion, ac-ft	33,995	34,939
(9)	Unit Area Streamflow Depletion, ac-ft/acre	2.53	2.60
(10)	Total Riverbed Loss (Caballo to Leasburg)	30,974	30,974
(11)	Riverbed Loss of Reservoir Releases (Caballo to Leasburg)	30,200	30,200
(12)	**Mesilla Valley - EBID and EPCWID**		
(13)	Irrigated Lands (acres)	78,179	78,179
(14)	Net Diversions of Reservoir Releases, ac-ft	380,125	390,886
(15)	Net Diversions of Arroyo Inflow, ac-ft	11,090	11,090
(16)	Net Diversions of Drain Flow & Seepage, ac-ft	31,173	32,056
(17)	Total Net Diversions of Rio Grande Project Water, ac-ft	422,389	434,033
(18)	Drainage Return Flow, ac-ft	204,824	210,470
(19)	Calculated Streamflow Depletion, ac-ft	217,565	223,563
(20)	Unit Area Streamflow Depletion, ac-ft/acre	2.78	2.86
(21)	Total Riverbed Loss (Leasburg to Courchesne)	29,844	29,844
(22)	Riverbed Loss of Reseroir Releases (Leasburg to Courchesne)	26,800	26,800
(23)	**Mesilla Valley - EBID**		
(24)	Irrigated Lands (acres)	68,645	68,645
(25)	Net Diversions of Reservoir Releases, ac-ft	333,769	343,217
(26)	Net Diversions of Arroyo Inflow, ac-ft	9,738	9,738
(27)	Net Diversions of Drain Flow & Seepage, ac-ft	27,372	28,147
(28)	Total Net Diversions of Rio Grande Project Water, ac-ft	370,878	381,102
(29)	Drainage Return Flow, ac-ft	179,845	184,803
(30)	Calculated Streamflow Depletion, ac-ft	191,033	196,299
(31)	Unit Area Streamflow Depletion, ac-ft/acre	2.78	2.86
(32)	Total Riverbed Loss (Leasburg to Mesilla Dam)	10,927	10,927
(33)	Riverbed Loss of Reservoir Releases (Leasburg to Mesilla Dam)	9,812	9,812
(34)	**Mesilla Valley - EPCWID**		
(35)	Irrigated Lands (acres)	9,534	9,534
(36)	Net Diversions of Reservoir Releases, ac-ft	46,357	47,669
(37)	Net Diversions of Arroyo Inflow, ac-ft	1,352	1,352
(38)	Net Diversions of Drain Flow & Seepage, ac-ft	3,802	3,909
(39)	Total Net Diversions of Rio Grande Project Water, ac-ft	51,511	52,931
(40)	Drainage Return Flow, ac-ft	24,978	25,667
(41)	Calculated Streamflow Depletion, ac-ft	26,532	27,264
(42)	Unit Area Streamflow Depletion, ac-ft/acre	2.78	2.86
(43)	Total Riverbed Loss (Mesilla Dam to Courchesne)	18,917	18,917
(44)	Riverbed Loss of Reservoir Releases (Mesilla Dam to Courchesne)	16,988	16,988
(45)	**El Paso Valley**		
(46)	Irrigated Lands (acres)	53,398	53,398
(47)	Net Diversions of Reservoir Releases, ac-ft	157,412	161,679
(48)	Net Diversions of Arroyo Inflow, ac-ft	8,421	8,421
(49)	Net Diversions of Drain Flow & Seepage, ac-ft	110,376	113,395
(50)	Total Net Diversions of Rio Grande Project Water, ac-ft	276,209	283,496
(51)	Drainage Return Flow, ac-ft	145,692	149,535
(52)	Calculated Streamflow Depletion, ac-ft	130,518	133,961
(53)	Unit Area Streamflow Depletion, ac-ft/acre	2.44	2.51
(54)	Total Riverbed Loss (Courchesne to Tornillo Heading)	12,039	12,039
(55)	Riverbed Loss of Reservoir Releases (Courchesne to Tornillo H.)	7,000	7,000
(56)	Indivertible Reservoir Releases Bypassed below Project	65,000	65,000
(57)	Total Indivertible Water Bypassed below Project	202,900	202,900
(58)	**Mexico**		
(59)	Total Diversions of Rio Grande Project Water, ac-ft	60,000	60,000
(60)	Diversions of Reservoir Releases, ac-ft	37,000	37,000
(61)	Diversions of Drain Flow & Seepage (balance), ac-ft	21,000	21,000
(62)	Diversions of Arroyo Inflow (nearest 1,000), ac-ft	2,000	2,000

As noted for this baseline case, the annual value of the required reservoir release as determined by the Joint Investigation to support Project uses for New Mexico, Texas and Mexico under normal supply conditions is 773,000 acre-feet per year. In the table, this quantity is distributed among various categories by source and by Project area and Mexico based on the data and information presented in the JIR. To reflect the normal reservoir water supply stipulated in the Rio Grande Compact of 790,000 acre-feet per year, proportional extrapolations of the components of the JIR's 773,000 acre-feet per year reservoir release have been made and are presented in Column 2 of Table 6.2.

Table 6.3 presents a summary of net diversions[4] of reservoir releases, drain return flows, and arroyo inflows by basin or valley and by users in New Mexico, Texas and Mexico based on the information presented in Table 6.2.

Table 6.3 Summary of Net Diversions by Source for Rio Grande Project Based on 1938 JIR

		(1)	(2)	(3)
	PARAMETER DESCRIPTION	BASED ON 1938 JOINT INVESTIGATION	EXTENDED TO RIO GRANDE COMPACT	PERCENT OF TOTAL
	Normal-Allotment Release from Reservoirs (ac-ft/year):	773,000	790,000	790,000
(1)	**Summary:**			
(2)	EBID Irrigated Lands	82,068	82,068	56.6%
(3)	EPCWID Irrigated Lands	62,932	62,932	43.4%
(4)	Total Irrigated Lands	145,000	145,000	- -
(5)	Total New Mexico Net Diversions of Reservoir Releases	403,232	414,652	66.5%
(6)	Total Texas Net Diversions of Reservoir Releases	203,768	209,348	33.5%
(7)	Total U.S. Net Diversions of Reservoir Releases	607,000	624,000	79.0%
(8)	Total Mexico Net Diversions of Reservoir Releases	37,000	37,000	4.7%
(9)	Total Riverbed Losses of Reservoir Releases	64,000	64,000	8.1%
(10)	Indivertible Reservoir Releases Bypassed below Project	65,000	65,000	8.2%
(11)	Total Reservoir Releases	773,000	790,000	- -
(12)	Total New Mexico Net Diversions of Drain Return Flows	27,589	28,370	17.0%
(13)	Total Texas Net Diversions of Drain Return Flows	114,178	117,305	70.4%
(14)	Total Mexico Net Diversions of Drain Return Flows	21,000	21,000	12.6%
(15)	Total Net Diversions of Drain Return Flows	162,767	166,675	- -
(16)	Total New Mexico Net Diversions of Arroyo Inflows	11,234	11,234	48.8%
(17)	Total Texas Net Diversions of Arroyo Inflows	9,774	9,774	42.5%
(18)	Total Mexico Net Diversions of Arroyo Inflows	2,000	2,000	8.7%
(19)	Total Net Diversions of Arroyo Inflows	23,007	23,007	- -
(20)	Total New Mexico Net Diversions of Project Water	442,054	454,255	57.5%
(21)	Total Texas Net Diversions of Project Water	327,720	336,426	42.5%
(22)	Total U.S. Net Diversions of Project Water	769,774	790,682	92.9%
(23)	Total Mexico Net Diversions of Project Water	60,000	60,000	7.1%
(24)	Total Net Diversions of Project Water	829,774	850,682	- -
(25)	Reservoir Releases as Percent of New Mexico Total Net Diversions	91.2%	91.3%	- -
(26)	Drain Return Flows as Percent of New Mexico Total Net Diversions	6.2%	6.2%	- -
(27)	Arroyo Inflows as Percent of New Mexico Total Net Diversions	2.5%	2.5%	- -
(28)	Reservoir Releases as Percent of Texas Total Net Diversions	62.2%	62.2%	- -
(29)	Drain Return Flows as Percent of Texas Total Net Diversions	34.8%	34.9%	- -
(30)	Arroyo Inflows as Percent of Texas Total Net Diversions	3.0%	2.9%	- -
(31)	Reservoir Releases as Percent of Mexico Total Net Diversions	61.7%	61.7%	- -
(32)	Drain Return Flows as Percent of Mexico Total Net Diversions	35.0%	35.0%	- -
(33)	Arroyo Inflows as Percent of Mexico Total Net Diversions	3.3%	3.3%	- -

[4] Net diversions as used in the 1938 JIR represent actual diversions from the Rio Grande into the main canals adjusted for the amount of flows returned directly to the river through wasteways as part of canal operations.

The distributions of these net diversions between New Mexico and Texas users is not addressed in the JIR, but these quantities have been determined here by first distributing the total net diversions for the Mesilla basin between New Mexico and Texas based on irrigated acreage, and then adding these respective amounts to the Rincon basin net diversions for New Mexico and to the El Paso Valley net diversions for Texas. The total net diversions of Project water by users in New Mexico, Texas and Mexico are shown in Rows 20 through 24 of the table, and as indicated by the percentage values in Column 3, the percentage distribution of the United States net diversions between New Mexico and Texas conforms approximately to the 57/43 split as originally contemplated for the Rio Grande Project based on the States' relative acreages of irrigated land within the Project area (see acreage percentage values in Rows 2 and 3).

As indicated in Row 24 of Column 2 of Table 6.3, the release of 790,000 acre-feet per year from the reservoirs produces 850,682 acre-feet per year of total net diversions of Project water from the Rio Grande because of the increased availability of drain return flows and arroyo inflows that enter the river along its course to El Paso. The percentage compositions of reservoir releases, drain return flows, and arroyo inflows in the total net diversions of Project water for New Mexico and Texas users and for Mexico are shown in Rows 25 through 33 of the table, and as expected, the New Mexico net diversions contain a much higher percentage of reservoir releases (91.3%) than those of Texas (62.2%) or Mexico (61.7%).

Conversely, only 6.2% of New Mexico's net diversions are comprised of drain return flows, whereas those for Texas and Mexico contain 34.9% and 35.0%, respectively. It is significant to note that the Joint Investigation, based on the 1930-1936 historical data, determined that 65,000 acre-feet per year of Project water released from the reservoirs flowed past the lower end of the Project in the Rio Grande, and while this water was considered to be "indivertible"[5], it nonetheless was considered to be Project water and was included as part of the normal release from the reservoirs (see Row 10 in the table), as was 64,000 acre-feet per year of reservoir releases for riverbed losses (see Row 9).

The annual diversions for New Mexico, Texas and Mexico corresponding to the 790,000 acre-feet per year of normal release of Project water from Elephant Butte and Caballo Reservoirs (Rows 20, 21 and 23, respectively in Column 2 of Table 6.3) and the total of these diversions are plotted on the graph in Figure 6.1. Values of these quantities for the lower amounts of annual reservoir releases shown on the graph have been derived based on the same proportional distribution as the USBR's D2 Curve (see Subsection 6.3).

6.2 Overview of Historical Project Operations

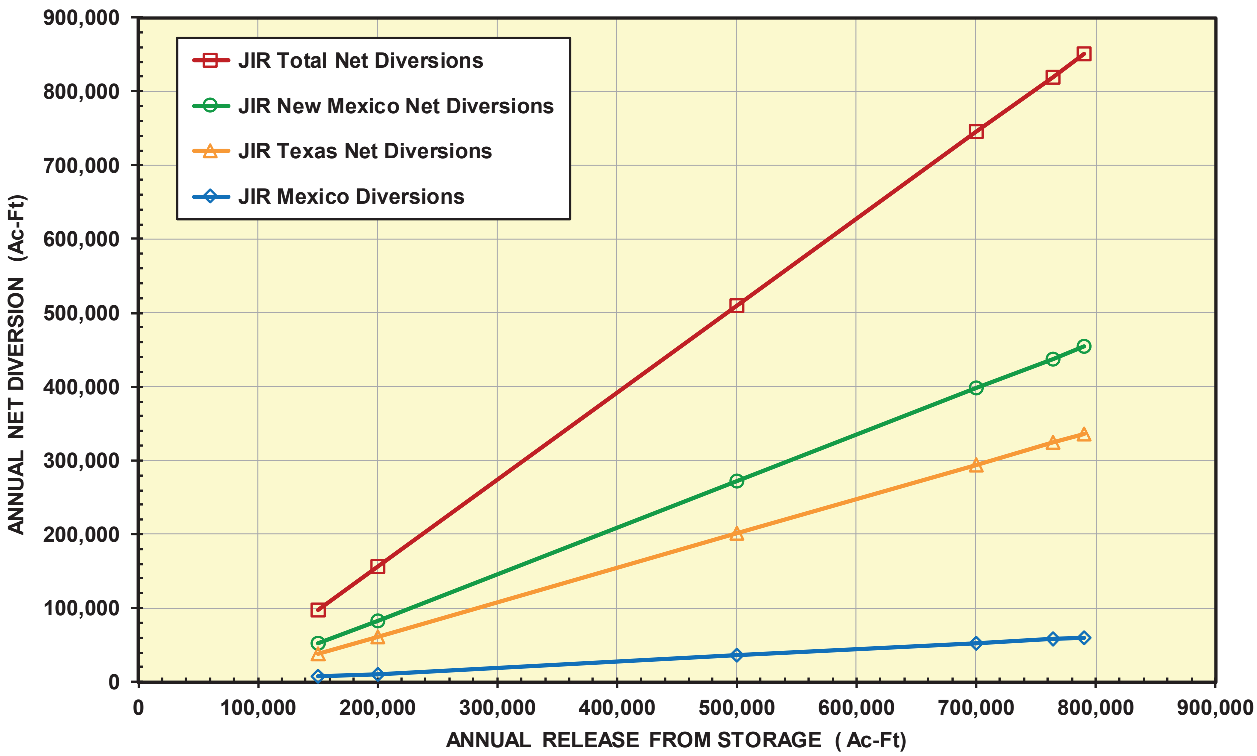
A fundamental premise of Rio Grande Project operations is that the annual supply of water available for Project users each year is determined by the volume of water either in storage or anticipated to be in storage in Elephant Butte and Caballo Reservoirs, and changes in downstream water demands or streamflow depletions do not affect the amount of the available supply. As noted in Subsection 5.1, the source of this water in storage is predominantly snow melt that sustains the flows in the Rio Grande and the inflows to Elephant Butte Reservoir. Hence, during periods when reservoir storage is limited, the snowfall and snow accumulations that occur during the

[5] Indivertible is not defined in the 1938 JIR, but it is assumed to mean unavailable for diversion.

winter or winters preceding an irrigation season are essentially what determine the available supply of Project water for the irrigation season.

Historically, allotments, or allocations, of Project water have been made by the USBR prior to each irrigation season in order to inform water users in the two Districts and Mexico of how much water they can expect to receive during the upcoming season. These initial values of annual allocations have been based on the volume of water in storage in Elephant Butte and Caballo Reservoirs at the time, taking into account provisions for a storage reserve, expected evaporation losses from the reservoirs during the upcoming irrigation season, and water demands. Depending on inflows to the reservoirs and changes in storage in the reservoirs during the course of an irrigation season, the USBR, in consultation with the Districts, has increased the initial allocation, sometimes multiple times, in response to changing conditions [28].

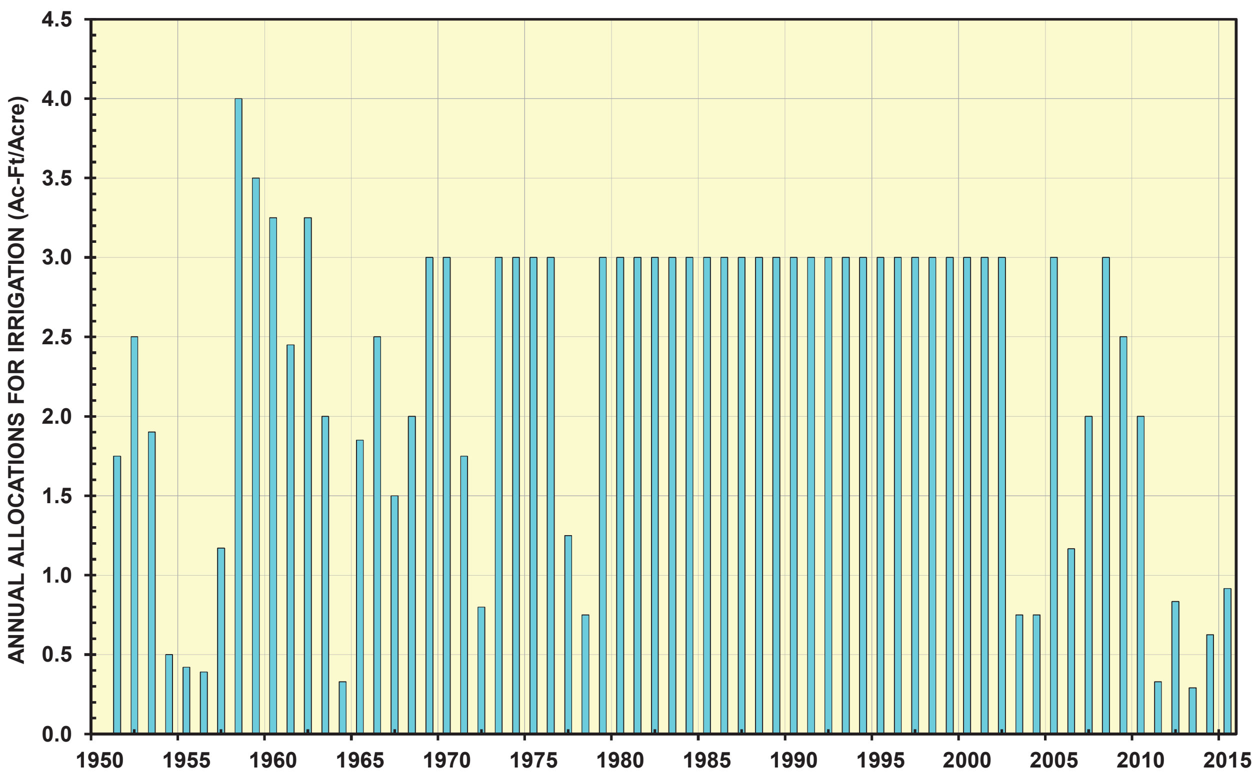
Figure 6.1 Distribution of Net Diversions Based on Information from 1938 JIR Analysis



Historical final annual allocations for deliveries of Project water to EBID and EPCWID users are plotted on the bar chart in Figure 6.2, with these allocations expressed in terms of acre-feet of water delivered per acre of irrigated land [15]. As shown, the first of these allocations of Project water was made in 1951, and maximum allocations generally have been limited to approximately 3.0 acre-feet of water per acre in accordance with procedures initially adopted by the USBR based on irrigation data for the 1946-1950 period [12]. Drought years with limited surface water supplies from the Project are readily apparent on the plot, as is the extended period of full allocations beginning in 1979 and extending through 2002. This period of full allocations coincided, of course, with wet conditions in terms of snowfall on the Rio Grande watershed and above average storage in Elephant Butte Reservoir.

Prior to the early 1980s, the USBR quantified annual allotments or allocations of Project water as an irrigation duty expressed in terms of acre-feet of water per acre of land irrigated, and deliveries of Project water were accounted for at the headgates of individual farm canals [12,18]. In 1979 and 1980, the Districts, having satisfied their debts to the United States for development of certain Rio Grande Project facilities, entered into contracts with the USBR that transferred ownership and responsibilities for the operation and maintenance of the Districts' respective irrigation and drainage systems from the USBR to the Districts [10,11]. The USBR retained ownership and administration of the lands and rights-of-way activities of the Project reservoirs and diversion dam areas and title and operation and maintenance responsibilities for Elephant Butte and Caballo Dams and Reservoirs [16]. After that time, the USBR no longer was responsible for the deliveries of Project water to individual farms, and it changed its procedures for making annual allotments and allocations of Project water from the farm canal headgates to the river diversion points for the main canals serving Project lands, i.e., Arrey, Leasburg, Mesilla Eastside and Westside, and American Canals [28]. Accounting for deliveries of Project water to the Districts also was changed to the main canal headings.

Figure 6.2 USBR Annual Allocations of Project Water for Irrigation



6.3 USBR D1/D2 Allocation Curves

With the Districts responsible for operation and maintenance of their respective canal and irrigation delivery systems following execution of the 1979 and 1980 contracts with the USBR [10,11] and with the USBR no longer responsible for deliveries of Project water to individual farms, the USBR undertook an effort around 1980 to formalize procedures for making annual allotments and allocations of Project water with deliveries at the main canal headings on the Rio Grande [12]. For this purpose, the USBR analyzed historical data for the period from the 1951 through 1978 and developed a set of relationships to facilitate this process. Use of data from this 1951-1978 period was considered appropriate because it included the extended drought conditions when less than normal Project water supplies were available, as well as some relatively wet years when stored water exceeded the normal annual supply. During this period, stored water in Elephant Butte Reservoir varied from near zero up to 1,200,000 acre-feet, and annual releases from Caballo Reservoir ranged from about 200,000 up to about 750,000 acre-feet per year [15].

With this dataset, the USBR developed two regression equations; one relating actual total irrigation season deliveries to farm canal head gates in the United States and to the Acequia Madre for Mexico to actual irrigation season releases of stored water from Elephant Butte and Caballo Reservoirs (referred to as the D1 Curve) and the other relating actual total irrigation season diversions of Project water from the Rio Grande into the main canals for New Mexico, Texas and Mexico to the actual irrigation season reservoir releases (referred to as the D2 Curve). The regression equations corresponding to the D1 Curve and the D2 Curve are presented below, and the concept of the D1 and D2 process is illustrated by the schematic in Figure 6.3 along with a graph of the D1 and D2 Curves.

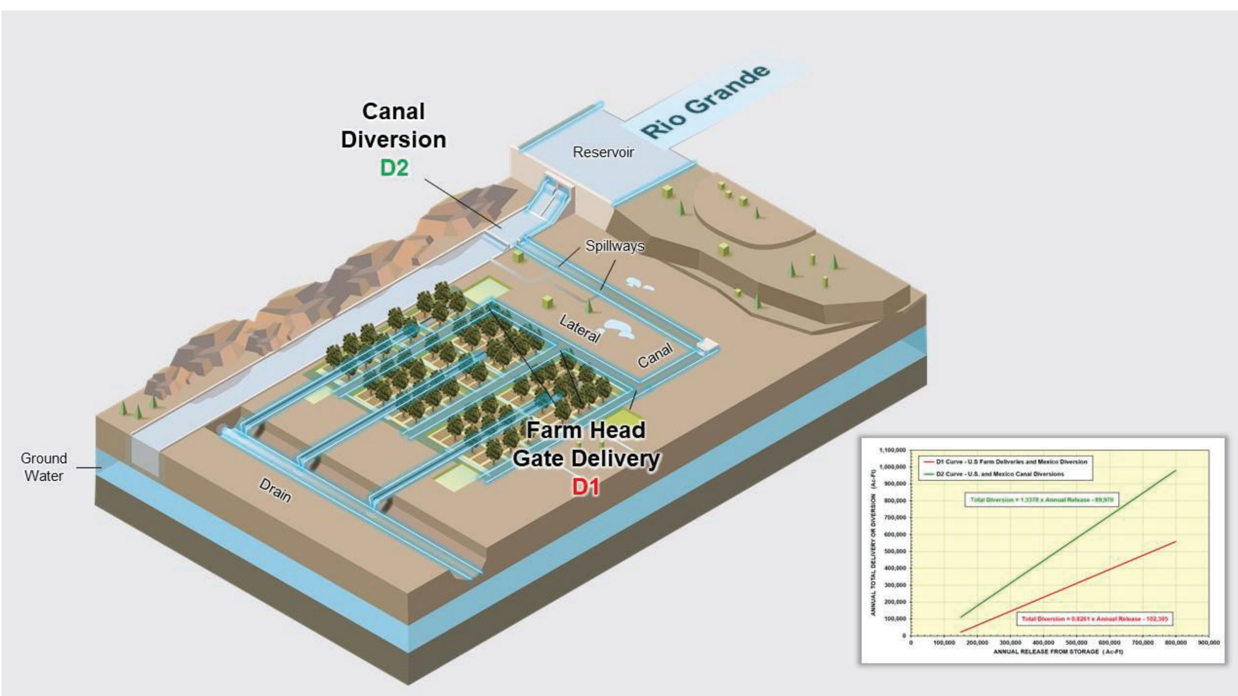
<u>D1 Curve</u>

Total Delivery to U.S. Farms & Mexico = (0.8261 x Release from Storage) - 102,305

<u>D2 Curve</u>

Total U.S. & Mexico Canal Diversions = (1.3378 x Release from Storage) - 89,970

Figure 6.3 Schematic of USBR D1 and D2 Curves Relating Deliveries and Diversions to Releases from Storage in Elephant Butte and Caballo Reservoirs



At the time the D1 and D2 Curves were developed, irrigated acreage in the Rio Grande Project included about 155,000 acres, and a full or normal supply of irrigation water was determined by the USBR based on 1946-1950 Project irrigation data to be 3.024 acre-feet of water per acre of irrigated land [12]. During the 1946-1950 period, hydrologic conditions were such that the annual releases from Caballo Reservoir ranged between 712,157 and 763,668 acre-feet per year, with the average equal to approximately 732,000 acre-feet per year [15]. Apparently, the USBR considered this series of annual reservoir releases to be generally consistent with the 790,000 acre-feet per year stipulated in the Compact as the normal annual supply of stored water from the reservoirs; thus, the associated average annual irrigation duty of 3.024 acre-feet of water per acre was adopted by the USBR as the normal supply of irrigation water. For 155,000 acres of irrigated land within the Project area, this irrigation duty equates to 468,720 acre-feet of water delivered to farms in Texas and New Mexico (3.024 x 155,000). Combined with the full supply authorized by the Convention of 1906 [2] for delivery to Mexico of 60,000 acre-feet per year, the total quantity of water to be delivered under normal supply conditions is equal to 528,720 acre-feet per year [12], of which 11.348 percent is Mexico's (60,000/528,720 = 11.348%).

To deliver 528,720 acre-feet per year of Project water during an irrigation season, the D1 Curve indicates that approximately 763,800 acre-feet of water must be released from the reservoirs as a normal supply. Again, this release amount is somewhat different from the 790,000 acre-feet per year stipulated in the Compact, but it was based on actual Project operations data for the 1951-1978 period and apparently was considered by the USBR to be generally consistent with the Compact. With this volume of reservoir release, the D2 Curve indicates that the amount of water apportioned for diversion from the Rio Grande into the main canals for irrigation in Texas and New Mexico and for delivery to Mexico is approximately 931,840 acre-feet. Of this amount, 60,000 acre-feet are allocated to Mexico and the balance of 871,840 acre-feet is distributed to EBID in New Mexico and to EPCWID in Texas based on the approximate 57/43 split of irrigated Project acreage (494,980 and 376,860 acre-feet per year, respectively). As noted previously, the increase in the amount of Project water diverted from the Rio Grande above the amount of stored water released from the reservoirs (931,840 - 763,800 = 168,040 acre-feet per year or 22 percent) is comprised of primarily return flows from drains that are discharged into the Rio Grande upstream of the main canals where diversions are made.

For conditions when the volume of water stored in Elephant Butte and Caballo Reservoirs does not support a normal Project water supply, the above D1 and D2 equations can be applied starting with the known value of Release from Storage (based on available usable water in storage at the beginning of an irrigation season) and then calculating the Total Delivery to U.S. Farms & Mexico and the Total U.S. & Mexico Canal Diversions. Mexico's allocation is calculated as 11.348 percent of the Total Delivery to U.S. Farms & Mexico. Allocations to EBID and EPCWID are based on their relative acreages of irrigated land within the Project area, approximately 57% and 43%, respectively.

The total diversion of 931,840 acre-feet per year as determined above based on the D2 Curve for the normal supply of Project water at the main canal headgates is somewhat greater than the comparable amount of 829,774 acre-feet per year determined by the 1938 Joint Investigation (see Row 24 of Column 1 in Table 6.3). One reason is that the JIR value was based on total Project acreage of 145,000 acres, whereas the D2 amount is based on 155,000 acres. Proportionally adjusting for this difference in acreage produces 887,000 acre-feet per year for the JIR value. The remaining difference between these total annual diversion amounts (approximately five percent) can be attributed partly to hydrologic and climatic differences in the 1930-1936 data upon which the JIR value is based and the 1951-1978 data used for the D2 value, but more likely, to changes in the manner in which the Project was operated during the two periods.

6.4 2008 Operating Agreement Allocation Procedures

The 2008 Operating Agreement for the Rio Grande Project [3] was approved and adopted in August of 2008 by the USBR, the EBID and the EPCWID. The preparation and adoption of this Agreement was in fulfillment, after many delays, of a stipulation in the earlier contracts [10, 11] between each of the Districts and the USBR that required that a "detailed operational plan …….. setting forth procedures for water delivery and accounting ……" be prepared by USBR. For a variety of reasons, some of them related to the hydrologic condition of the Rio Grande Project water supply and some concerning several instances of litigation among the parties, preparation of the "detailed operational plan" was never completed until 2008. As required by the Operating Agreement, an accompanying Project Operations Manual also was prepared, with the latest version of this Manual updated and revised in March of 2018 [17].

A concise yet comprehensive description of the Operating Agreement ("OA" or "Agreement") is presented in a Technical Memorandum prepared by the USBR in 2015 as part of a modeling effort pertaining to Project operations in the Rincon and Mesilla basins [18]. Rather than attempt to produce another similar description, the discussion presented on pages 8 through 11 of this USBR Technical Memorandum is reproduced here with full credit given to the USBR.

> *……… The OA is a written description of the procedures by which Reclamation operates the Rio Grande Project, including allocation of Project water to EBID, EPCWID, and Mexico; release of Project water from storage; delivery of Project water to authorized points of diversion; and accounting of allocation charges and credits. The Operations Manual further defines the procedures outlined within the OA for day-to-day operation of the Project. The OA and Operations Manual are reviewed annually and updated as needed to optimize Project operations consistent with applicable water rights, state and federal laws, and international treaties. Revision of the OA or Operations Manual requires unanimous consent of the Rio Grande Project Allocation Committee, which consists of one representative each from Reclamation, EBID, and EPCWID.*
>
> *Operating procedures defined in the OA are largely consistent with prior operating practices during the period 1980-2007. The procedure used to determine the annual diversion allocation to Mexico is identical under the OA and prior operating practices. Similarly, the quantity of water available for diversion at Project diversion points each year is calculated from the estimated annual release of Project water according to the D-2 Curve, and the annual diversion allocations to EBID and EPCWID are calculated from the estimated water available for diversion after delivery obligations to Mexico are fully satisfied.*
>
> *Two key provisions of the OA, however, deviate from prior operating practices. First, the OA provides carryover accounting for the unused balance of annual diversion allocations to EBID and EPCWID. Under prior operating practices, annual diversion allocations were*

calculated based only on the estimated release of Project water for the current year; the unused balance of each district's annual diversion allocation, if any, was implicitly relinquished at the end of each calendar year. Under the OA, the unused balance of each district's annual diversion allocation, if any, is carried over and becomes part of the district's total diversion allocation the following year. The OA specifies that carryover balance may be accumulated by either district up to 60% of each district's respective full annual allocation, or up to 305,918 AF for EBID and 232,915 AF for EPCWID; carryover balance in excess of this limit is transferred to the other district. The carryover provision is intended to encourage water conservation within the Project by allowing each district to maintain its unused allocation balance up to a specified limit.

Second, the OA provides for adjustment of annual diversion allocations to EBID and EPCWID to account for changes in annual Project performance — i.e., changes in the amount of water actually available for diversion compared to the estimated available diversion based on the D-2 Curve. The OA represents Project performance using the diversion ratio, which is calculated as the ratio of total annual Project allocation charges to total annual Project release. The diversion ratio adjustment provision of the OA allows for adjustment of the annual Project allocations to EBID and EPCWID so as to maintain district diversion allocations to EPCWID at a level consistent with historical Project performance as represented by the D-2 Curve. When the actual diversion ratio is greater than the D-2 Curve, EBID receives an increase in annual allocation compared to prior operating practices; when the diversion ratio is less than the D-2 Curve, EBID receives a decrease in allocation. The diversion ratio adjustment provision of the OA therefore mitigates potential negative effects of changes in Project performance, which result predominately from the actions of individual landowners within EBID, by ensuring that Project allocations and deliveries to EPCWID remain consistent with historical Project performance.

Project water accounting under the OA is consistent with water accounting under prior operating practices. Project water accounting involves the calculation of charges against the Project allocation balances of EBID, EPCWID, and Mexico, as well as credits to the allocations balances of EBID and EPCWID, consistent with each entity's use of Rio Grande surface water. Allocation charges reflect the amount of surface water diverted from the Rio Grande, and allocation credits reflect the amount of water bypassed or returned to the Rio Grande and available for diversion at a downstream diversion point. In general, allocation charges are computed as the greater of the amount of water ordered for diversion at a specified diversion point and the amount of water actually diverted, whereas allocation credits are computed as the lesser of the amount of water ordered or bypassed at specified bypass points and the actual amount of water bypassed or returned to the Rio Grande. Dependence of allocation charges and credits on corresponding Project water orders promotes efficient operation of the Project by creating an incentive to divert all water ordered.

Specific exceptions to these general accounting procedures are summarized below.

First, charges to EBID and EPCWID for water diverted to Eastside and Westside Canals depend on whether one or both districts have ordered water. EPCWID receives water in

Mesilla Valley as bypass from EBID via the Eastside and Westside Canal systems. If only EBID has ordered water, EBID is charged as described above. If both districts have ordered water, EBID is charged for water diverted at the canal heading as described above and is credited for water bypassed to EPCWID in addition to water bypassed to the Rio Grande. EPCWID is then charged for water received as bypass from EBID; EPCWID is credited for water bypassed to the Rio Grande from the Westside Canal system at a designated location on the La Union East Canal (Reclamation et al. 2008), which contributes to the water available for diversion downstream at American and International Dams. Lastly, if only EPCWID has ordered water, EPCWID is charged at the canal heading, rather than at the district boundary, and is credited for water bypassed to the Rio Grande.

Second, charges to EPCWID for water diverted at American Dam for use in El Paso Valley are not determined at the heading of American Canal. For consistency with historical water distribution and accounting practices, charges are determined at four locations that receive water from American Canal: the intakes to the Umbenhaurer-Robertson and Jonathon W. Rogers water treatment facilities and the headings of Riverside and Franklin Canals. In order to promote maximal use of Project water available to the United States, EPCWID is encouraged to divert all flow reaching American Dam that is not allocated for delivery to Mexico. EPCWID is then charged for all water reaching the four accounting locations listed above, regardless of corresponding diversion orders. In the event that diversions to American Canal exceed the district's diversion order, EPCWID is credited for the unused portion of water diverted in excess of its order. Unused water in excess of EPCWID's order is computed by analysis of hydrographs of flow exiting the downstream end of the district.

Third, in addition to credit for water bypassed to the Rio Grande from the Eastside and Westside systems and for unused diversion in excess of its order at American Dam, EPCWID receives a credit towards their Project allocation balance for water savings associated with construction of the American Canal Extension. The original American Canal, completed in 1938, conveys water from American Dam approximately two miles south to Franklin Canal; the American Canal Extension, completed in 1998, carries water from the original terminus of the American Canal approximately 12 miles further south to Riverside Canal. Historically, water was diverted from the Rio Grande to Riverside Canal at Riverside Dam. The American Canal Extension is concrete lined and provides for surface-water savings through reduced seepage losses compared to historical conveyance in the Rio Grande and diversion of water at Riverside Dam. The annual credit towards EPCWID's allocation balance for water savings from the American Canal Extension is calculated based on annual flow in the American Canal.

Lastly, in the event that only one district or Mexico has ordered water, the charge against that entity's Project allocation balance is equal to the greater of the amount of water released from Caballo Dam or the amount of water diverted at the specified diversion point(s)……..

After many years, the 2008 Operating Agreement finally set out procedures for how the Rio Grande Project was to be operated as agreed to by the USBR and the two Districts, including procedures for determining annual allocations of Project water among EBID, EPCWID and Mexico, for releasing water from storage, for ordering and making deliveries of Project water, and for accounting and reporting. However, it is significant to note that the Agreement also attempted to address, at least partially, the issue of New Mexico's groundwater pumping impacts by including provisions intended to limit these effects on flows in the Rio Grande and deliveries to Texas users. As with prior operating practices, the D2 Curve is stipulated in the Agreement as the basis for determining the total amount of Project water available for diversion from the Rio Grande, with Mexico's share determined in the same manner as before the Agreement and with the balance divided among the two Districts based on irrigated acreage [18]. However, the Agreement deviates from prior operating practices with stipulated adjustments to diversions for EBID and EPCWID to account for changes in annual Project performance, defined as "changes in the actual amount of water available for diversion compared to the estimated available diversion based on the D2 Curve" [18]. As stated in the USBR report [18]:

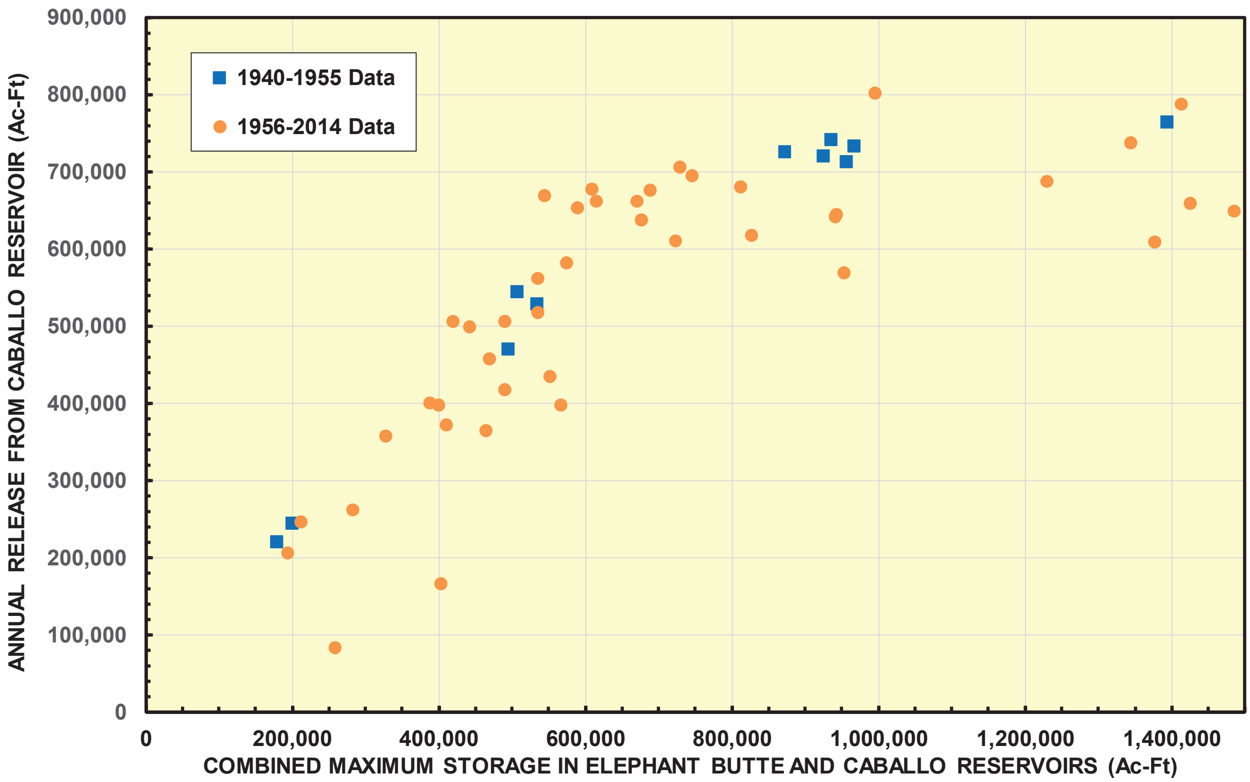
> *The OA represents Project performance using the diversion ratio, which is calculated as the ratio of total annual Project allocation charges to total annual Project release. The diversion ratio adjustment provision of the OA allows for adjustment of the annual Project allocations to EBID and EPCWID so as to maintain district diversion allocations to EPCWID at a level consistent with historical Project performance as represented by the D-2 Curve. ……The diversion ratio adjustment provision of the OA therefore mitigates potential negative effects of changes in Project performance, which result predominately from the actions of individual landowners within EBID, by ensuring that Project allocations and deliveries to EPCWID remain consistent with historical Project performance*.

Notwithstanding the process embedded in the Operating Agreement for attempting to mitigate for the effects of groundwater pumping in New Mexico on deliveries to Texas, the fact remains that groundwater pumping along the Rio Grande in the Rincon and Mesilla basins of New Mexico is not limited and continues at significant levels, adversely affecting flows in the river and diversions for Project water users in Texas. This is evident by the data presented on the graphs in Figures 4.7, 5.4 and 5.6 where the post-2007 data exhibit little change from conditions prior to adoption of the Agreement.

6.5 Effect of Groundwater Pumping on Reservoir Releases

As discussed in Subsection 4.2, the development and use of groundwater in the Rincon and Mesilla basins began in the early 1950s and has continued to increase, accompanied by reductions in the flows of the Rio Grande at El Paso and in the drain discharges to the Rio Grande as discussed and illustrated in Section 5.0. It is significant to note, however, that the operation of Elephant Butte and Caballo Reservoirs and the annual allocation of Project water and the associated releases from Caballo do not appear to have noticeably changed as a result of the groundwater pumping. The graph in Figure 6.4 presents a plot of annual reservoir releases from Caballo Reservoir versus the corresponding maximum combined storage in Caballo and Elephant Butte Reservoirs prior to and during the irrigation season. The storage data on this plot are limited to years when the total storage was less than 1,500,000 acre-feet because with storage amounts greater than this, annual releases have been somewhat erratic due to high river flows and releases of flood water. Data plotted on the graph are segregated into two time periods; one for 1940-1955 before the effects of groundwater pumping had fully evolved and the other for 1956-2014 after significant groundwater development had occurred.

Figure 6.4 Variation of Annual Releases from Caballo Reservoir with Corresponding Maximum Combined Storage in Elephant Butte and Caballo Reservoirs



On the graph, there is little discernable difference between the pattern of annual releases from Caballo Reservoir relative to total combined storage after significant groundwater pumping began in the early 1950s compared to the pattern of releases before pumping began. While there is considerable scatter in the data, no trends are apparent that would suggest releases from Caballo changed as a result of groundwater pumping in the Rincon and Mesilla basins. This is consistent with the USBR's operation of the Rio Grande Project whereby annual allocations and releases of Project water have been based on the volume of usable water in storage prior to and during each irrigation season, with some consideration of yearly demands [18]. This also demonstrates that changes in operating procedures for making reservoir releases has not been the cause of the reduced flows in the Rio Grande that have occurred coincident with the onset of groundwater pumping in the Rincon and Mesilla basins in the early 1950s.

7.0 PROJECT WATER DELIVERIES

The historical deliveries of Project water to EBID and EPCWID and to Mexico are an important part of understanding the historical operation of the Rio Grande Project and how deliveries have changed. For purposes of this study, the assessment of Project deliveries has focused on the period from 1938, when the Rio Grande Compact was adopted and implemented, through the present to the extent that data are available. The year 1938 is an appropriate starting point because that was the first year Caballo Dam was in operation regulating releases of stored Project water. Furthermore, the American Dam on the Rio Grande at El Paso also was completed in 1938 to facilitate diversions from the Rio Grande for EPCWID in the El Paso Valley and to provide better regulation of deliveries of water into the Acequia Madre for Mexico.

Complete uniform sets of historical delivery or diversion data for EBID and for EPCWID are not readily available; however, there are various forms of information available from USBR records and the Districts and other sources that, taken together, do provide a useful basis for compiling, and in many cases estimating, monthly and annual values of historical deliveries. A complete set of historical data for diversions by Mexico from the Rio Grande near El Paso into the Acequia Madre is available from various sources, including gage measurements reported by the IBWC [21] and information contained in USBR monthly and annual Project allocation and accounting reports since 2008 [22].

Part of the complication with developing reliable information regarding the historical deliveries of Project water relates to the manner in which deliveries have been accounted for and reported by the USBR. For some period of time up until the Districts assumed responsibility for the operation and maintenance of their respective canal and irrigation systems around 1980, and even beyond for several years, irrigation farm deliveries to EBID and EPCWID were reported by the USBR in the annual Project History documents at the individual farm canal headgates [14]. Allocations of Project water were made on the basis of a duty in terms of acre-feet of water per acre of irrigated land, and then deliveries were quantified, and often estimated, at the canal headgates for individual farms [12]. During the early 1980s, allocations began to be made by the USBR in terms of diversions from the Rio Grande at the major canal headings[6], i.e., Arrey, Leasburg, Mesilla Eastside and Westside, Franklin, and Riverside Canals, and deliveries to the Districts then were accounted for and charged at these diversion point locations [28] (except for isolated cases such as the deliveries to Texas users in the lower Mesilla Valley that were quantified based on measured flows in certain laterals and in the El Paso Valley where some deliveries were accounted for based on measured diversions by certain individual users such as the City of El Paso). Certainly, after adoption of the 2008 Operating Agreement, the total deliveries and charges to the Districts have been determined based on: (1) diversions from the Rio Grande into the main canals, (2) measured flows within certain main canals and laterals, and (3) diversions from the main canals for specific users [3].

Thus, deliveries of Project water to EBID and EPCWID historically have been expressed in two different ways, basically either as deliveries to farms or as canal diversions. The magnitudes of these different forms of deliveries are considerably different because of the losses incurred within the canal systems of the Districts from the main canal headgates on or near the Rio Grande where diversions have been quantified and reported to the headgates of the smaller canals and laterals that serve individual farms where the deliveries to farms have been quantified and reported. It should be noted that since construction of the American Dam in 1938, deliveries of Project water to Mexico have always been based on measured flows diverted directly from the Rio Grande into the Acequia Madre near El Paso.

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[6] This change in how allocations of Project water were made and charged by the USBR was the result of the Districts assuming responsibility for the operation and maintenance of their respective canal and irrigation systems pursuant to contracts with the USBR that were executed during 1979 and 1980, after which time the USBR was no longer responsible for accounting for the deliveries of Project water to individual farms [10,11].

It is important to note that except for Mexico's deliveries, which are readily available except for a few years, the resulting deliveries of Project water to New Mexico and Texas presented here often are based on estimates and are being used primarily to demonstrate historical variations and changes in delivery patterns. These estimated deliveries are considered to be reasonable representations of the historical deliveries that exhibit generally similar orders of magnitude and trends over time.

7.1 Historical Deliveries to Farms in New Mexico

For purposes of this report, historical annual values of Project water deliveries to farms in New Mexico have been obtained from Montgomery and Associates [5]. This farm delivery information was compiled by Montgomery from USBR annual Project history reports when available, and then supplemented with a variety of estimated values based on regression analyses and data correlations. Historical deliveries-to-farms data for the Rincon and Mesilla basins were analyzed by Montgomery, resulting in specific equations relating monthly values of these deliveries to main canal diversions, annual allotments of Project water, and other Project-related parameters. The resulting regression equations then were used by Montgomery to estimate missing records of the monthly deliveries to farms to produce complete sets of these quantities for each basin for the 1938-2016 period.

A portion of the deliveries to farms for the Mesilla basin are for EPCWID users in Texas in the lower part of the basin. Only very limited data are available for quantifying these historical Texas deliveries; therefore, Montgomery estimated these Texas deliveries based on the irrigated acreage in Texas relative to the total irrigated acreage in the Mesilla basin, and then subtracted these Texas deliveries from the total Mesilla basin deliveries to arrive at only the New Mexico deliveries. The resulting annual historical deliveries to farms in the Rincon and Mesilla basins for New Mexico are plotted on the bar chart in Figure 7.1 for the 1938-2016 period. As shown, the Rincon basin portion of the total deliveries is fairly small (only about 19 percent), and the maximum annual historical deliveries to farms in New Mexico generally have been on the order of 250,000 to 300,000 acre-feet per year.

7.2 Deliveries to Farms in New Mexico Without Groundwater Pumping

The double-mass analysis approach discussed in Subsection 5.2 pertaining to the analysis of Rio Grande flows at El Paso also provides a useful means for assessing the extent to which deliveries of Project water to farms in New Mexico may have changed relative to releases from Caballo Reservoir, particularly since the early 1950s when significant groundwater pumping began in the Rincon and Mesilla basins. The graph in Figure 7.2 presents an application of this methodology to the New Mexico deliveries to farms data for the 1938-2016 period. As shown, the curve represented by the historical data on this graph exhibits the same break in slope around the early 1950s as the curve for the Rio Grande flows at El Paso shown in Figure 5.4. Again, this supports the conclusion that groundwater pumping in the Rincon and Mesilla basins for irrigation of farms in New Mexico, which began to develop during the early 1950s, more likely than not impacted the deliveries of Project water to farms in New Mexico.

Figure 7.1 Historical Water Deliveries to Farms in Rincon and Mesilla Basins in New Mexico

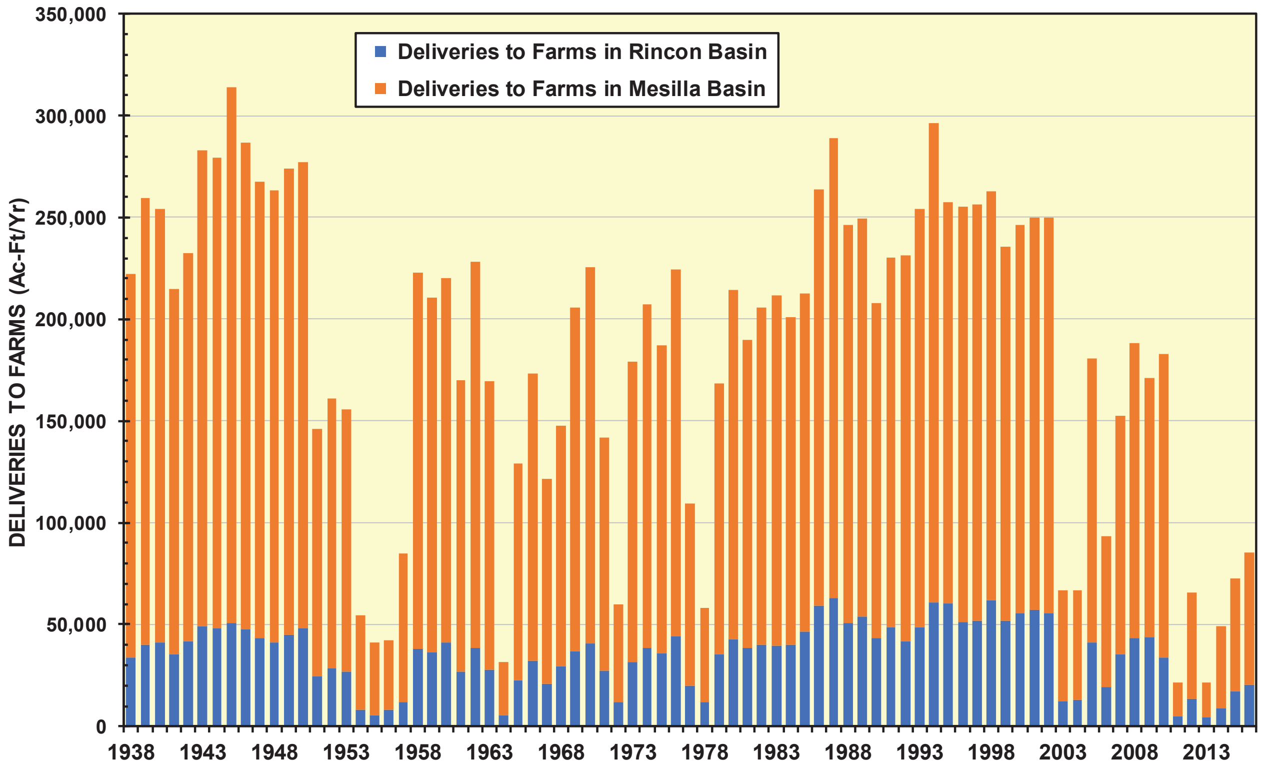
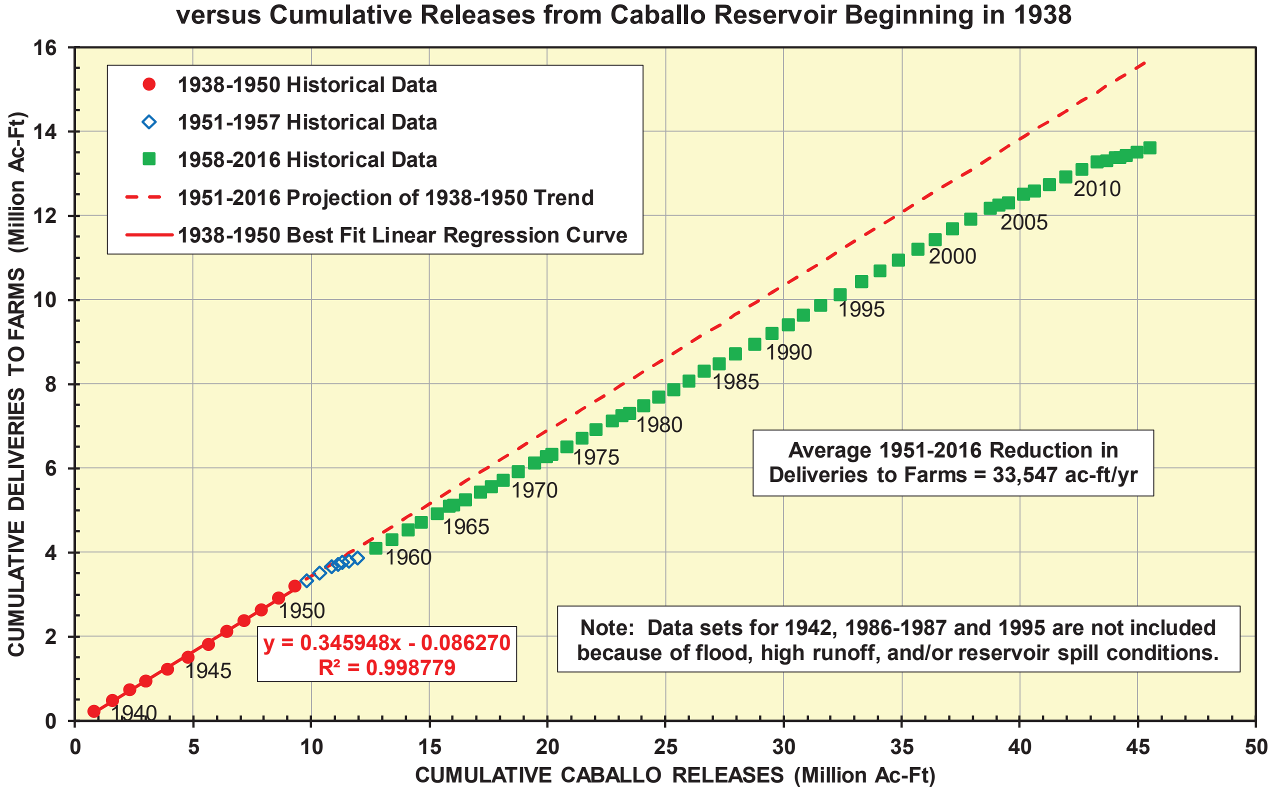
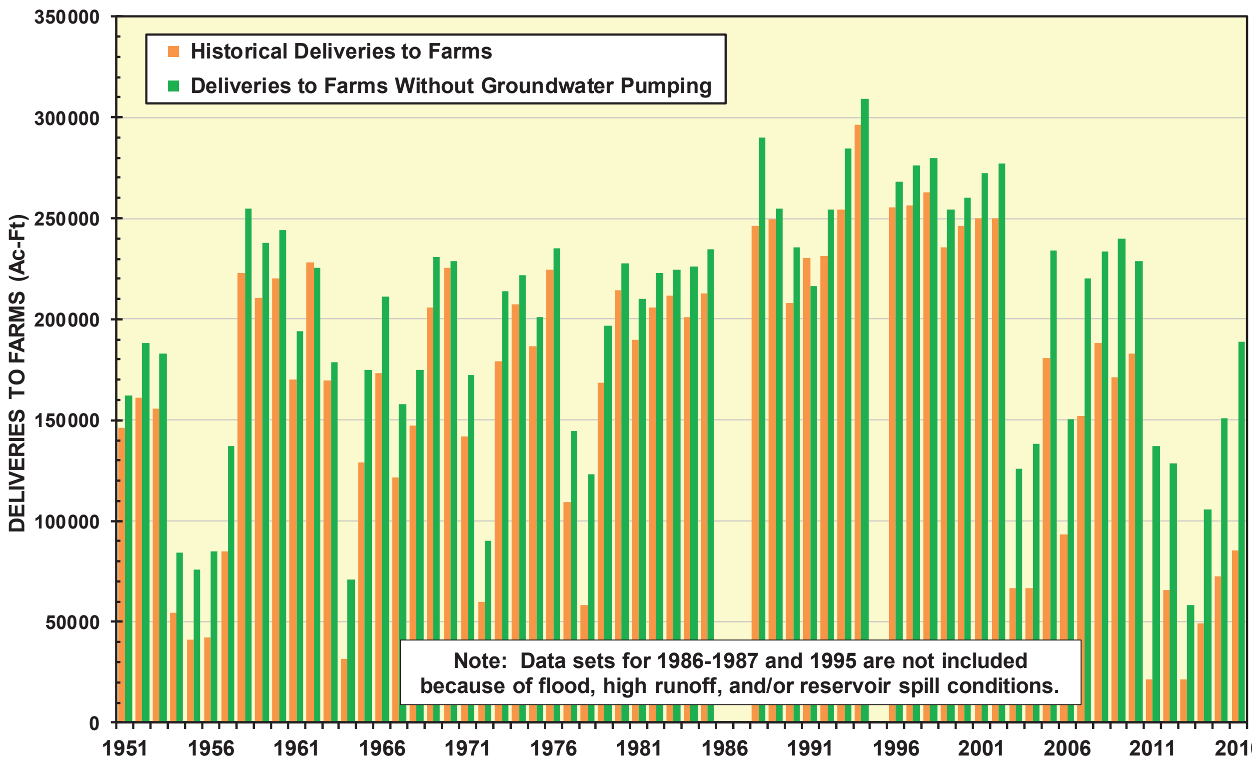


Figure 7.2 Double-Mass Plot of Cumulative Deliveries to Farms in New Mexico versus Cumulative Releases from Caballo Reservoir Beginning in 1938



On the graph in Figure 7.2, the deviation of the historical data after 1950 (green squares) from the extension of the 1938-1950 data curve out to 2016 (red dashed line) demonstrates the potential magnitude of the groundwater pumping impacts. The total reduction in farm deliveries for the 1951-2016 period is about 2,100,000 acre-feet, which translates to an average annual reduction of 33,547 acre-feet. The estimated annual values of the New Mexico farm deliveries without the reductions caused by groundwater pumping can be determined by calculating the annual incremental increases in the 1951-2016 extension of the 1938-1950 data curve (red dashed line). These values are plotted on the bar chart in Figure 7.3 along with the corresponding historical deliveries to farms in New Mexico for the 1951-2016 period.

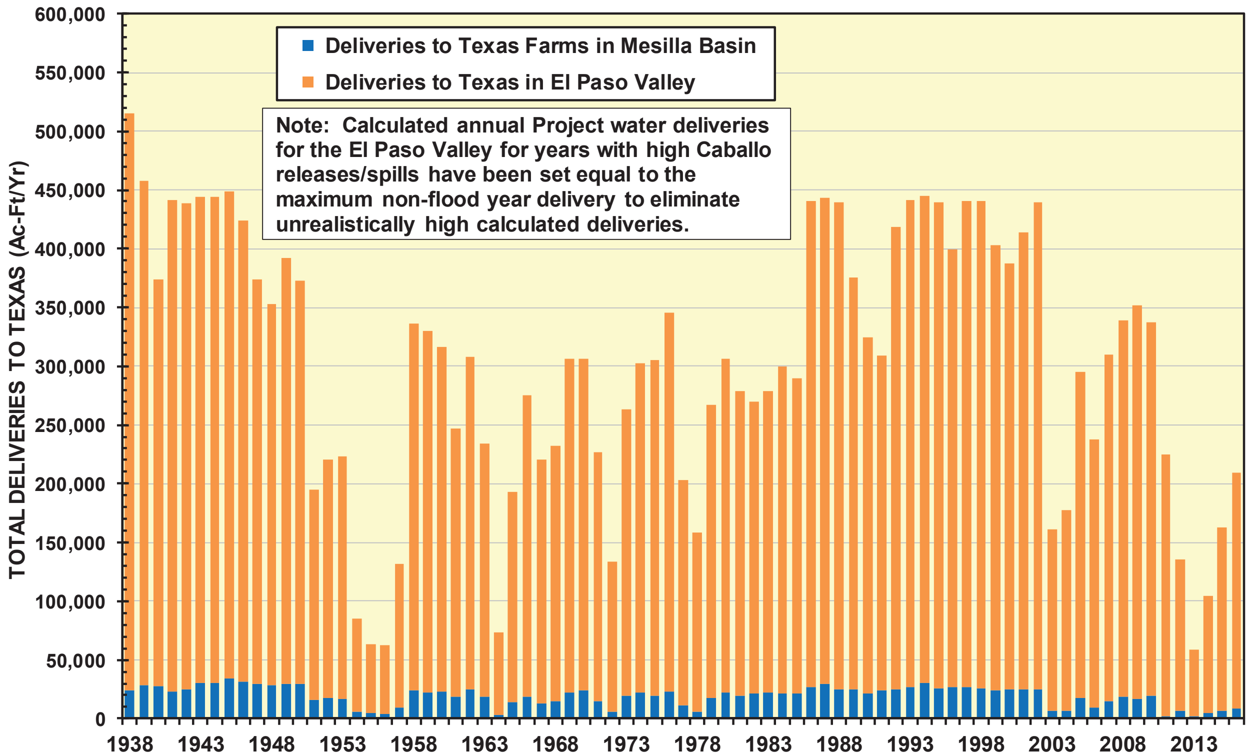
Figure 7.3 Bar Chart Comparing 1951-2016 Historical Annual Deliveries to Farms in New Mexico With Corresponding Annual Deliveries Without the Effects of Groundwater Pumping



7.3 Historical Deliveries to Texas

Historical deliveries of Project water to Texas have been calculated using available data and the information from Montgomery and Associates for Texas deliveries to farms in the Mesilla basin [5]. Since water flowing in the Rio Grande at El Paso immediately upstream of the American Dam under normal, non-flood conditions during the irrigation season is almost entirely comprised of Project water, estimates of the total annual deliveries to Texas in the El Paso Valley have been derived by subtracting from the irrigation-season Rio Grande flow at El Paso the amount of water diverted into the Acequia Madre for Mexico. Then, assuming that the City of El Paso's Canutillo well field pumpage also is composed of Project water depleted from the Rio Grande, the annual quantities of the Canutillo well field pumpage have been added to the previous net sum of the Rio Grande flows at El Paso minus the Acequia Madre diversions. The resulting annual quantities then have been used as a representation of the actual annual deliveries of Project water to Texas in the El Paso Valley. These annual values are plotted on the bar chart in Figure 7.4 along with the corresponding annual deliveries to Texas farms in the Mesilla basin as developed by Montgomery.

Figure 7.4 Total Historical Deliveries of Project Water to Texas in Mesilla Basin and El Paso Valley



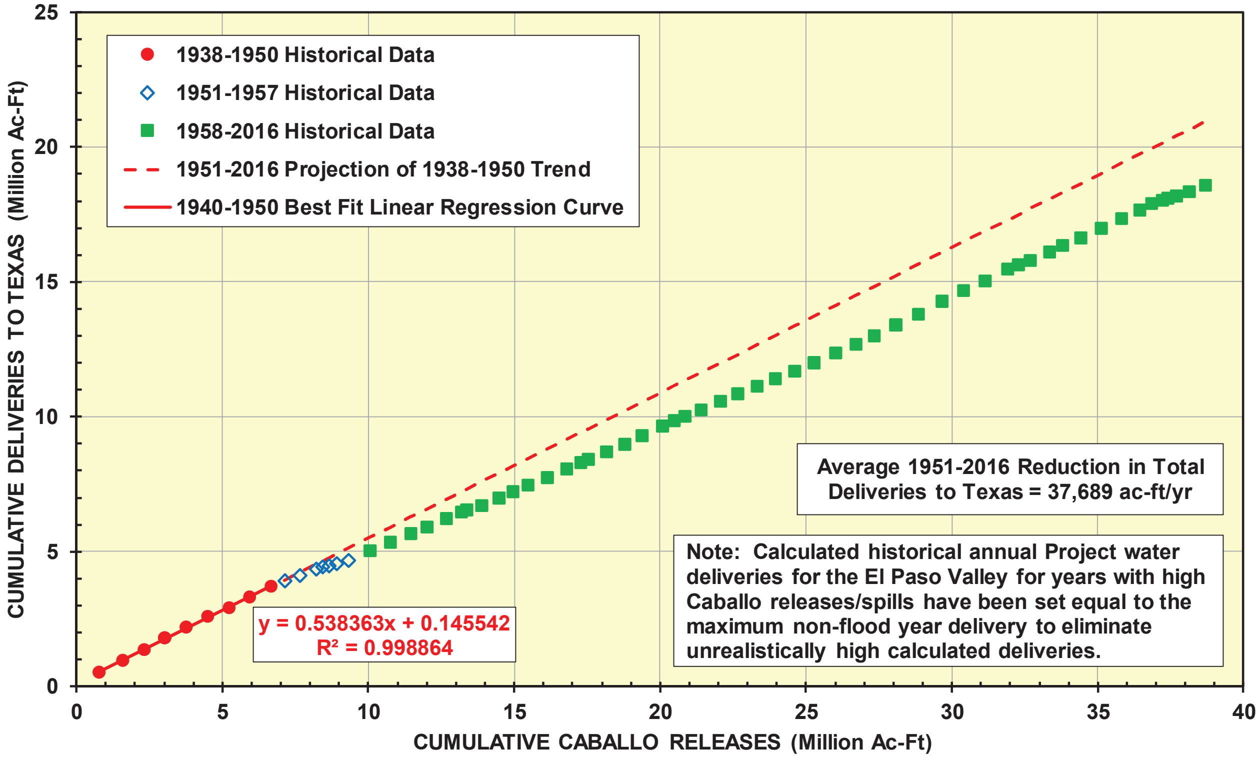
As noted, the calculated values for the El Paso Valley deliveries for years with abnormally high releases from Caballo Reservoir have been adjusted by setting them equal to the highest annual delivery value for non-flood years, which turns out to be in 1997. A value of 800,000 acre-feet per year has been used as the threshold reservoir release value since this is slightly greater than the normal supply release of 790,000 acre-feet per year stipulated in the Compact. This adjustment eliminates unrealistically high values of the calculated El Paso Valley deliveries due solely to high river flows at El Paso that result from high reservoir releases or spills. Even with these adjustments, some above-normal flow conditions still are likely reflected in the annual delivery values as a result of arroyo inflows that entered the river below Caballo Dam during local rainfall events. As plotted in Figure 7.4, the average of the 1938-2016 total historical deliveries to Texas is 302,165 acre-feet/year, with an average of 19,479 acre-feet/year for the deliveries to farms in the Mesilla basin and an average of 282,687 acre-feet/year for the El Paso Valley deliveries.

7.4 Deliveries of Project Water to Texas Without Groundwater Pumping

The double-mass analysis approach has been applied to the historical total Project water deliveries to Texas to assess apparent changes in historical delivery patterns relative to releases from Caballo Reservoir, particularly changes that may have occurred after significant groundwater pumping began in the Rincon and Mesilla Valleys in the early 1950s. The graph in Figure 7.5 presents the double-mass curves based on the 1938-2016 total historical delivery data for Texas plotted on the graph in Figure 7.4. As noted on the graph, the historical data for the total annual deliveries to

Texas reflect the same adjustment described above for the calculated values for the El Paso Valley deliveries for years with abnormally high releases or spills from Caballo Reservoir.

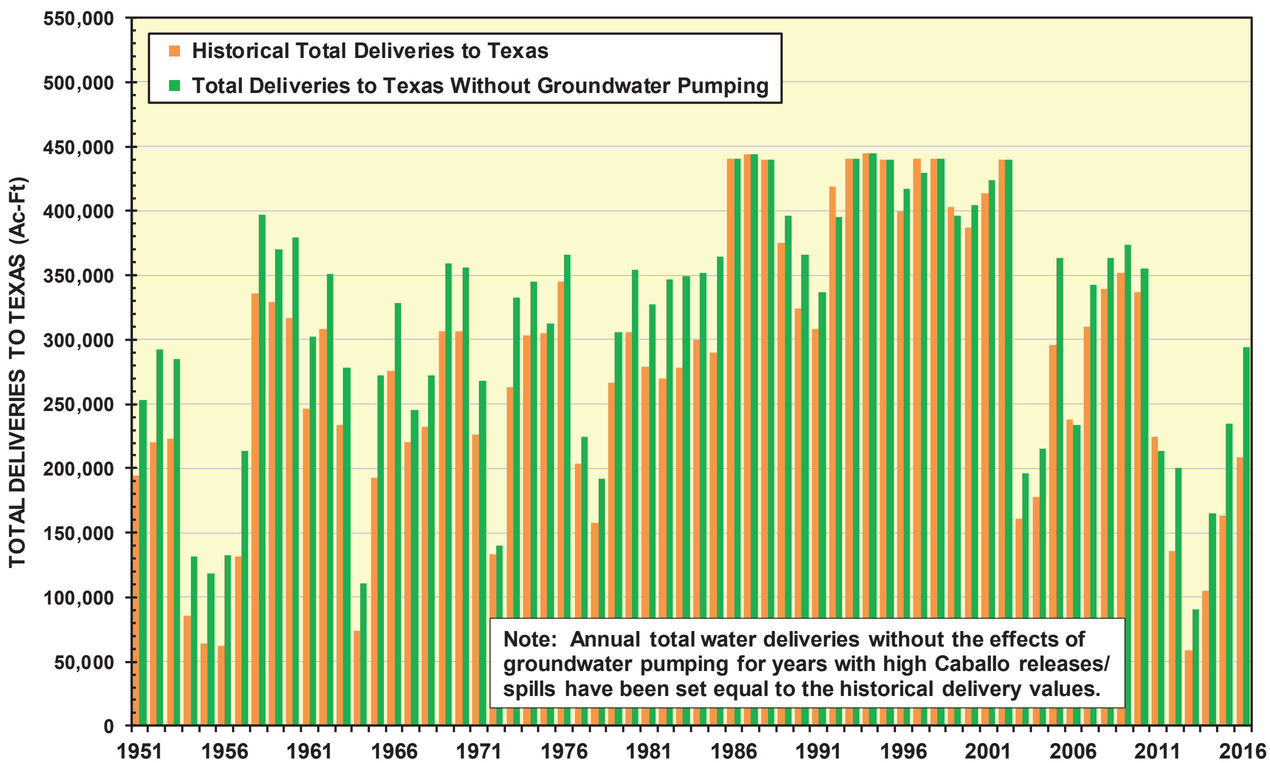
Figure 7.5 Double-Mass Plot of Cumulative Deliveries to Texas versus Cumulative Releases from Caballo Reservoir Beginning in 1938



As shown, the curve represented by the historical data on the graph exhibits the same downward change in slope during the early 1950s as depicted on the double-mass graph for deliveries to farms in New Mexico in Figure 7.2. Again, more likely than not this is indicative of the effects of groundwater pumping that began about this same time in the Rincon and Mesilla basins for irrigation of farms in New Mexico. The deviation of the curve represented by the Texas total historical deliveries data (green squares) after 1950 from the extension of the 1938-1950 data curve out to 2016 (red dashed line) demonstrates that there was less water delivered to Texas relative to the releases from Caballo Reservoir. The total reduction in the total deliveries for the 1951-2016 period is about 2,400,000 acre-feet, which translates to an average annual reduction in deliveries of 39,689 acre-feet per year. Whether these reductions in deliveries to Texas are directly attributable to the effects of groundwater pumping in the Rincon and Mesilla basins of New Mexico may not be clearly established with this demonstration; however, the trend of reduced deliveries after groundwater pumping began in the late 1950s certainly is consistent with the reductions in the Rio Grande flows at El Paso [29,30]. Based on these trends, one would conclude more likely than not that groundwater pumping in the Rincon and Mesilla basins played a major role in adversely affecting deliveries of Project water to Texas.

The deliveries of Project water to Texas that would have occurred in the absence of these apparent effects of groundwater pumping can be derived from the incremental annual increases in the projected extension of the 1938-1950 data curve from 1950 out to 2016 (red dashed line) in Figure 7.5. The resulting annual Texas deliveries without the effects of groundwater pumping are plotted on the bar chart in Figure 7.6 along with the corresponding historical Texas deliveries. As shown, the total deliveries to Texas without the effects of groundwater pumping generally are greater than the historical deliveries, thus demonstrating the adverse impacts of groundwater pumping. As discussed above, the average reduction in Texas deliveries from the projected deliveries without the effects of groundwater pumping in the Rincon and Mesilla basins is about 40,000 acre-feet per year. Since both the historical delivery values and the projected delivery values without groundwater pumping reflect the underlying calculation approach for estimating the historical deliveries of Project water in the El Paso Valley, any inherent uncertainties in this approach are embedded in both sets of total deliveries, which suggests that the calculated annual differences between the two sets of total delivery values are likely unaffected by these uncertainties.

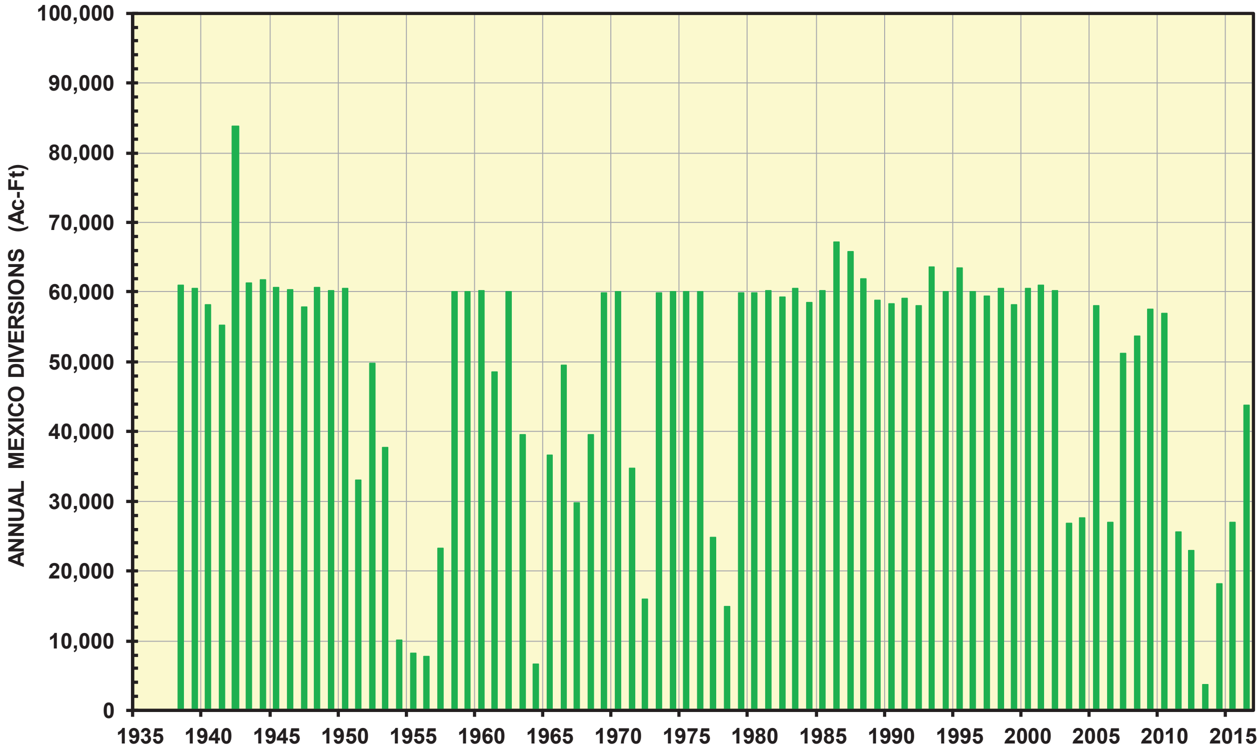
Figure 7.6 Bar Chart Comparing 1951-2016 Historical Total Annual Deliveries to Texas With Corresponding Annual Deliveries Without the Effects of Groundwater Pumping



7.5 Deliveries to Mexico

As noted previously, historical deliveries to Mexico have been measured almost continuously since the early 1900s at the headgate of the Acequia Madre just upstream of the International Dam on the Rio Grande near El Paso. Since construction of the American Dam was completed in 1938, flows in the Rio Grande to which Mexico is entitled have been controlled and bypassed down the river to the International Dam for diversion into the Acequia Madre. Annual diversions into the Acequia Madre for the 1940-2014 period are plotted on the bar chart in Figure 7.7. As shown, these diversions, for the most part, have been limited to the maximum commitment of 60,000 acre-feet per year as agreed to by the United States and Mexico under the Convention of 1906 [2].

Figure 7.7 Annual Mexico Diversions from Rio Grande into Acequia Madre



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APPENDIX

PROFESSIONAL RESUME OF ROBERT J. BRANDES

AND SUMMARY OF PRIOR TESTIMONY DURING PRECEDING FOUR YEARS

PROFESSIONAL RESUME

ROBERT J. BRANDES

PERSONAL DATA

Birthplace: East Bernard, Texas
Home Address: 6000 Maurys Trail
Austin, Texas 78730

EDUCATION

Pre-Engineering Curriculum, Southwestern University, 1962-1964
B. S., Civil Engineering, The University of Texas at Austin, 1967
M. S., Civil Engineering, The University of Texas at Austin, 1968
Ph.D., Water Resources, The University of Texas at Austin, 1972

HONORS

Tau Beta Pi, Chi Epsilon, Sigma Xi

REGISTRATION

Professional Engineer, State of Texas, No. 39120

EXPERIENCE

Dr. Brandes has been engaged in consulting engineering practice in Texas since the late 1960s, specializing in water resources and related engineering and environmental disciplines. He has represented numerous private, commercial, and governmental entities, providing various planning, analysis, permitting, design, and operational services for a wide range of water projects. He has directed and conducted numerous studies and investigations dealing with surface and ground water hydrology and hydraulics; water resources planning and development; water availability modeling (WAMs), water rights permitting and related issues; municipal, industrial and agricultural water supply; reservoir system operations; rural and urban flooding and stormwater management; water quality; irrigation system analyses; project site development engineering; and environmental impact assessments. His experience encompasses a wide variety of problems involving rivers and streams, lakes and reservoirs, ground water aquifers, wetlands, and bays and estuaries, and he is especially familiar with the development and application of computerized simulation techniques for analyzing water-related phenomena in these systems. Dr. Brandes has prepared and presented testimony and served as an expert witness in various judicial proceedings in state and federal courts and in administrative and regulatory hearings conducted by the State Office of Administrative Hearings and natural resources agencies in Texas, as well as the Texas Legislature.

PUBLICATIONS

Dr. Brandes has authored or co-authored numerous technical documents and project reports, and he has presented many technical papers and lectures pertaining to water resources and water rights at professional society meetings, water conferences and short courses.

COMMITTEES

Dr. Brandes has served on several committees appointed by Texas state agencies and professional associations dealing with water rights, wastewater reuse, water supply planning, and environmental flow issues. He was chairman of the Science Advisory Committee for the Legislative-appointed Study Commission on Water for Environmental Flows and the Science Advisory Committee for the Governor-appointed Environmental Flows Advisory Committee, and he was vice-chair for the Senate Bill 3 Texas Environmental Flows Science Advisory Committee. He currently is a director, flood response committee chairman, surface water committee co-chair, and past president of the Texas Water Conservation Association.

PROFESSIONAL AFFILIATIONS

American Society of Civil Engineers
American Water Resources Association
Texas Water Conservation Association
Texas Society of Professional Engineers
American Academy Water Resources Engineers

PROFESSIONAL
HISTORY

2008 to Present	Principal and Owner; Robert J. Brandes Consulting; Austin, Texas.
2008 to 2015	Senior Consultant; Atkins (formerly PBS&J); Austin, Texas.
2005 to 2008	Principal; TRC/R. J. Brandes Company, Consulting in Water Resources; Austin, Texas.
1994 to 2018	Principal and Director; Crespo Consulting Services, Inc.; Austin, Texas.
1992 to 2005	Principal and Director; Terra Dynamics, Inc.; Austin, Texas.
1984 to 2005	Principal and Owner; R. J. Brandes Company, Consulting in Water Resources; Austin, Texas.
1975 to 1984	Associate and Vice President; Camp Dresser & McKee Inc.; Austin, Texas.
1971 to 1980	Associate, Senior and Principal Engineers and VP; Water Resources Engineers; Austin, Texas.
1970 to 1971	Special Consultant; F. Barry Haskett Investments/Aquarius, Inc.; New York, NY and Zurich, SUI
1968 to 1971	Associate; Frank D. Masch & Associates; Austin, Texas.
1967 to 1970	Research Engineer/Scientist; The Univ. of Texas at Austin, Depart. of Civil Engr.; Austin, Texas.

REPRESENTATIVE PROJECT
ASSIGNMENTS

- Currently developing naturalized flows for extension of the hydrologic data base for the water availability model for the Sulphur River Basin and modifying existing water availability model to represent current conditions.

- Currently represent the State of Texas in a lawsuit filed with the U.S. Supreme Court against New Mexico and Colorado regarding violations of the Rio Grande Compact and deliveries of Rio Grande Project water to Texas users.

- Directed and performed water availability and project operation studies for the Unappropriated Flows Permit sponsored by the Lower Colorado River Authority, including development and evaluation of alternative project configurations and components, applying water availability models, investigating numerous environmental flow scenarios, working with state regulatory and resource agencies as part of water rights permitting, and coordinating work with client, other project team members, and various environmental groups.

- Directed and performed reservoir water availability and firm yield studies, conceptual dam and spillway design, and project mitigation planning and analyses for the proposed Lake Ralph Hall on the North Sulphur River in Fannin County, Texas, for the Upper Trinity Regional Water District, including preparation of supporting documents for the water rights permit application, coordination of permitting activities with the TCEQ, and presentation of expert testimony in the SOAH permit hearing.

- Served as a special consultant to the State of Texas and the International Boundary and Water Commission through the Texas Water Development Board and the Texas Natural Resource Conservation Commission regarding water deficits incurred by Mexico under the 1944 Treaty between the United States and Mexico and participated in negotiations between the two countries.

- Directed and performed long-range water supply planning for the Lower Colorado River Authority, including analysis of future municipal, industrial and power water demands, identification and evaluation of numerous supply alternatives, and consideration of alternative means for satisfying environmental flow requirements.

- Performed water supply studies for Dow Chemical Company in Brazoria County, Texas, including analysis of DOW's historical and projected water demands and supplies, modification and application of the TCEQ's Brazos Basin water availability model for evaluations of DOW's existing and proposed water supply system, investigated reservoir storage and river pumping requirements to meet specific levels of water demands considering river salinity effects, and provided expert testimony in SOAH permit hearings.

- Developed naturalized streamflows for the Sulphur, Sabine, Colorado, San Bernard, and Rio Grande River Basins and for the Brazos-Colorado and Nueces-Rio Grande Coastal Basins for the Texas Commission on Environmental Quality as part of the Senate Bill 1 water availability modeling program and direction application of the Texas A&M Water Rights Analysis Package to develop water availability models (WAMs) and simulate water availability for existing water rights under different flow conditions, assumed water rights cancellation, and various levels of wastewater reuse.

- For Lake Chapman water users, performed firm yield analyses of the reservoir and developed an accounting plan to provide an equitable distribution and use of inflows to and storage in the reservoir and to allow equal access to the available water supply from the reservoir among water rights holders and users.

- Directed and performed surface water availability studies for the Lower Colorado River Authority/San Antonio Water System joint Water Supply Project, including development and evaluation of alternative project configurations and components, developing and applying various water availability models to test alternatives, and coordinating work with LCRA/SAWS and project team members and making public presentations.

- Directed and performed water availability and project operation studies for the Excess Flow Optimization Project sponsored by the Tarrant Regional Water District, including development and evaluation of alternative project configurations and components, applying water availability models, investigating numerous environmental flow scenarios, preparation of water rights permit application, working with TCEQ as part of water rights permitting, and coordinating work with client and other project team members.

- For the City of Irving, performed assessment of existing water rights and applications for water supplies from Lake Hugo and Kiamichi Creek in Oklahoma, developed and applied water availability model for Kiamichi Basin to assess Lake Hugo firm yield and reliability of water supplies from reservoir under different operating plans, and prepared documentation of findings and study results.

- Performed hydrology, water quality and water supply system operations studies for the Texas Attorney General's Office to support potential Federal litigation regarding the use and ownership of water from the Rio Grande Project in Texas and New Mexico, including the development of a quantity and quality routing models of Project operations.

- For a public power company, evaluated availability and reliability of cooling water supplies for potential power plant projects in the Colorado and Guadalupe River Basins, including application of basin water availability models and simulation of off-channel reservoir operations under different water demand conditions.

- For the Lavaca-Navidad River Authority, examined increased water supplies for industrial users through joint operation of Lake Texana in the Lavaca River Basin with other surface water rights in adjacent basins, including conceptual design and analysis of an off-channel reservoir and development of operating procedures.

- Served as special consultant to the Lower Colorado River Authority with negotiations with the City of Austin to develop a joint settlement agreement regarding future use of water rights and available water supplies, including return flows, from the Colorado River for the next 100 years.

- Served as special consultant to the Lower Colorado River Authority with negotiations with the South Texas Nuclear Project to develop a joint settlement agreement regarding future use of water rights and a dependable supply of water from the Colorado River for the life of the project.

- Served as a special consultant to the International Boundary and Water Commission to provide assistance with review of water conservation plans and other strategies proposed by Mexico to alleviate its water deficit under the 1944 Treaty between the United States and Mexico.

- For the Lower Colorado River Authority, performed water availability analyses and modeling to assess water supplies and strategies in support of regional water supply planning undertaken pursuant to Senate Bill 1 of the 75th Texas Legislature for the Lower Colorado Regional Planning Study (Region K).

- Performed water supply systems operations analyses and water rights/environmental permitting for the proposed Brownsville Weir and Reservoir Project on the Lower Rio Grande, including computer simulations of the hydrologic behavior and performance of the proposed project considering daily historical sequences of streamflows; preparation of an environmental assessment; state water rights and federal 404 permitting support; and meetings and negotiations with regulatory agencies, protestants, and Mexican representatives.

- Directed and performed water availability studies as part of a multidisciplinary team of consultants for the Lower Guadalupe Water Supply Study that was jointly sponsored by the San Antonio River Authority, San Antonio Water System and Guadalupe-Blanco River Authority, including evaluation of alternative project scenarios, applying water availability models, coordinating work project team, and making public presentations.

- Investigated existing and projected surface water supplies and demands for municipal, industrial and irrigation users in the lower and middle Rio Grande Basin, including reservoir simulations and yield analyses under alternative reservoir operating plans and storage allocations, and evaluated Mexican Rio Grande water deficits under the 1944 Treaty, as part of the eight-county Rio Grande Regional Water Planning Study (Region M).

- Represented the State of Texas as a consultant and expert for the State Attorney General's Office regarding State ownership of land in the Texas Panhandle along the Canadian River in a dispute over oil and gas royalties.

- For the City of San Antonio, evaluated alternative scenarios for maintaining springflow conditions required for preservation of endangered species at Comal and San Marcos Springs, analyzed stream channel and springrun hydraulics at Comal Springs, and presented expert witness testimony in Federal District Court.

- Provided consulting assistance to a private water right holder with determining losses and operating procedures associated with adding new diversion points on the Rio Grande in Maverick and Webb Counties for diverting approximately 8,000 acre-feet/year of water for municipal use that was previously authorized for irrigation use near Presidio, Texas upstream of Lake Amistad and assisted with TCEQ permitting activities.

- Inventoried surface and ground water supply sources and facilities on the 21,000-acre Indio-Faith Ranch on the Rio Grande in Maverick and Dimmitt counties in South Texas and developed recommendations and a plan for joint use of the available water supplies and water facilities by two entities owning different parts of the ranch.

- Investigated flooding in Big Fossil Creek watershed caused by upstream development in city of Saganaw and provided expert witness support and testimony for plaintiffs in Tarrant County, Texas law suit.

- Analyzed domestic and agricultural water demands for 112,000-acre Comanche Ranch in Maverick County, Texas, developed water supply plans and facility designs for providing Rio Grande water to meet ranch water demands, and assisted with implementation of various water supply strategies and facilities.

- Analyzed potential downstream flooding caused by warehouse and drainage projects implemented by City of Fredericksburg, represented City in law suits, and developed mitigation measures used in settlement proceeding.

- Evaluated the impacts of upstream artificial recharge projects in the Edwards Aquifer recharge zone on the yield and operations of City of Corpus Christi's reservoirs in the Nueces River Basin, including examination of bay and estuary inflows and system operation with other sources of water supply.

- Provided hydrologic and water rights permitting support for amendment of Tarrant Regional Water District's permits for diversion of upper Trinity Basin return flows from the Trinity River into Richland-Chambers Reservoir and Cedar Creek Reservoir in order to develop additional firm supply for TRWD customers.

- Analyzed future water supply availability for the Lower Neches Valley Authority considering existing municipal, industrial and irrigation water rights in the Neches River Basin and Federal hydropower water requirements at Sam Rayburn Reservoir, including application of the Neches water availability model.

- Served as special consultant to the Texas Natural Resource Conservation Commission for the evaluation and analyses of various water rights and water resources management models as part of technical advisory team to select a general modeling approach pursuant to the requirements of Senate Bill 1 of the 75th Texas Legislature.

- Analyzed the feasibility (yield and cost) of constructing and operating off-channel reservoir projects for developing new municipal water supplies at various locations throughout the San Antonio and Guadalupe River Basins as part of the South Central Texas Regional Water Planning Study (Region L).

- Investigated causes of flooding of Republic Bank Towers in Dallas, Texas during severe rainfall event for plaintiffs in law suit in Dallas County District Court, including definition of contributing drainage areas, analysis of street inflows to lower level parking areas, and presentation of expert deposition testimony.

- Performed hydrology, hydraulics, drainage and flood control studies and investigations for the City of Fredericksburg as part of a TWDB-sponsored regional flood prevention plan for the City and surrounding area, including drafting of stormwater ordinances, preparation of a drainage criteria manual, and facilities design.

- Performed hydrologic and water rights investigations for the Dallas County Park Cities Municipal Utility District to evaluate the ability of Lake Grapevine in the upper Trinity River Basin to provide a firm water supply under various operating rules and demand scenarios involving other existing water right holders.

- Analyzed surface water issues related to a Medina Lake water rights amendment for the Bexar-Medina-Atascosa Counties Water Control and Improvement District, including analysis of release requirements for instream uses below the lake, evaluation of reservoir yield and operations, and examination of reservoir water quality impacts.

- Analyzed stream flooding and erosion using HEC-2 backwater program and sediment transport methods for the City of Austin on lower Walnut Creek to evaluate the potential erosion impacts of the City's treated wastewater effluent on an adjacent property owner and presentation of expert witness testimony for defendant in Travis County District Court.

- Performed hydrologic and hydraulic investigations involving floodplain reclamation, hydraulic design of flood control facilities, and runoff and flooding simulations for a 2,000-acre residential and commercial development on the West Fork of the Trinity River in Tarrant County, Texas, including Section 404 permitting support.

- Performed hydrology and hydraulic studies of the potential impacts of sand and gravel dredging operations proposed by Sand Supply, Inc. on or near the Brazos River in Fort Bend County, Texas, and the Colorado River in Fayette County, Texas, including assistance with acquisition of permits from the Texas Parks and Wildlife Department, the Texas Natural Resource Conservation Commission and the U. S. Army Corps of Engineers.

- Performed hydrologic and hydraulic studies of runoff control and wastewater retention facilities for confined animal feeding operations (feedlots and dairies) and simulation of combined runoff storage and irrigation operations for effective disposal of contaminated waters under state and federal laws and rules, including analyses for facilities in Erath and Maverick Counties, Texas.

- Performed water quality impact analyses and nonpoint source pollution studies for the Brownsville Public Utilities Board pertaining to a proposed raw water pipeline diversion from a series of existing storage lakes and resacas, including field data collection and water quality sampling, runoff and pollutant transport modeling for a 50-year historical period, and projections of water quality conditions with and without the project.

- Served as officer-in-charge for an investigation of a groundwater mound beneath Texas Tech University and the City of Lubbock, Texas, including computer modeling of the mound's hydraulic behavior, the development of remedial measures to reduce the mound, water quality analyses, and the formulation of a comprehensive water management program for the University.

- Worked as a consultant investigating the theory and application of the <u>Fiscalin</u> hydraulic mixing process, including reviewing previous applications of the process in Switzerland and designing/testing several units for application to municipal wastewater treatment and various industrial problems in the United States.

SUMMARY OF PRIOR TESTIMONY BY ROBERT J. BRANDES
DURING PRECEDING FOUR YEARS

1) Prefiled Testimony and Testimony; *Application by the Lower Colorado River Authority for the Amendment of Certificate of Adjudication No. 14-5434*; Texas State Office of Administrative Hearings; Docket No. 582-17-0553; Austin, Texas; June - September, 2017.

2) Expert Report and Oral Deposition; *The Randolph Company and/or Prototype Machine Company v. HSC Pipeline Partnership*; Eminent Domain Proceedings; Cause Nos. C154899 and C154903, County Court at Law No. 4; Brazoria County, Texas; April 2018 – January 2019.

IN THE SUPREME COURT OF THE UNITED STATES
BEFORE THE OFFICE OF THE SPECIAL MASTER
HON. MICHAEL J. MELLOY

STATE OF TEXAS	)	
	)	
Plaintiff,	)	
	)	Original Action Case
VS.	)	No. 220141
	)	(Original 141)
STATE OF NEW MEXICO,	)	
and STATE OF COLORADO,	)	
	)	
Defendants.	)	

****

ORAL DEPOSITION OF
ROBERT BRANDES, Ph.D., P.E.
SEPTEMBER 24, 2019
VOLUME 1

****

ORAL DEPOSITION of ROBERT BRANDES, Ph.D., P.E., produced as a witness at the instance of the Defendant State of New Mexico, and duly sworn, was taken in the above-styled and numbered cause on September 24, 2019, from 9:07 a.m. to 4:13 p.m., before Heather L. Garza, CSR, RPR, in and for the State of Texas, recorded by machine shorthand, at the offices of SOMACH SIMMONS & DUNN, 500 Capitol Mall, Suite 1000, Sacramento, California, pursuant to the Federal Rules of Civil Procedure and the provisions stated on the record or attached hereto; that the deposition shall be read and signed.

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ALSO PRESENT:

Mr. Greg Sullivan
Ms. Michelle Estrada-Lopez

EXAMINATION INDEX

WITNESS: ROBERT BRANDES, Ph.D., P.E.

EXHIBIT INDEX

ROBERT BRANDES, Ph.D., P.E.,

having been first duly sworn, testified as follows:

E X A M I N A T I O N

BY MR. ROMAN:

Q. Good morning, Dr. Brandes.

A. Good morning.

Q. We met a minute ago, but my name is David Roman, and I'm one of the attorneys for the State of New Mexico in this case. Clearly, you've been deposed before and so I'm sure that your counsel has prepared you, as well, so I assume I don't need to go over any of the typical deposition rules except maybe for I'll have to get a yes or no answer to questions rather than a head nod.

A. Right.

Q. One thing I will ask of you, I tend to ask questions that aren't always completely clear, especially when we're dealing with very technical issues, and so if there's anything that I ask of you that you don't understand, I would just ask that you seek some clarification on that because if you do answer the question, I'll assume that you did understand it. Is that okay?

A. I will. Yes.

Q. And one other thing I'd like to ask is how

would you like to be referred to in questions, Dr. Brandes or what's your preference?
A. That's fine.
Q. Okay. So I've seen your resume where you listed the times that you've either given deposition or trial testimony over the last four years. Beyond that, how often approximately would you say you've testified either by deposition or at trial over the course of your long career?
A. Many times, 20 to 30 maybe, maybe more.
Q. And do you have an approximate breakdown as to what that testimony was by deposition versus at trial?
A. No. It may be about equal. I don't know.
Q. Okay. And you've testified in federal court, state court, and specialized adjudication courts?
A. I have.
Q. What did you do to prepare for your testimony today?
A. I met with the attorneys yesterday and kind of reviewed my report. I spent some time over the last couple of weeks reviewing my report.
Q. Did you work with anyone other than your attorneys to prepare for your testimony today?
A. No.

understanding that the water that is received by the City of El Paso is still released in accordance with irrigation demands to the extent it is part of the water that is called for by EP1?

A. I'm not certain of that. I -- I know how the City of El Paso is -- is allocated a portion of project water, because it's related to the irrigated acreage that they have control over, but whether their actual order for water is an irrigation request, I don't know.

Q. Okay. In the next paragraph, in the second sentence, you state that, "The Rio Grande project is the means by which Compact water from Elephant Butte Reservoir is apportioned between and delivered to New Mexico, Texas, and Mexico." Am I correct to take from this that it's your understanding that New Mexico has a Compact apportionment of water below Elephant Butte Reservoir?

A. Well, the project allocates water on a basis of irrigated acreage in New Mexico and in Texas, and that's the basis for -- for how that's delivered.

Q. I understand that the project allocates water on the basis of irrigated acreage. I'm trying to understand the import of your statement that the project is the means by which Compact water from

Elephant Butte Reservoir is apportioned between New Mexico, Texas, and Mexico, and what I'm getting at there is, am I correct to take from your statement that it's your understanding that New Mexico is entitled by Compact to a specified portion of water delivered by the project below Elephant Butte.

A. I don't think the Compact makes that distinction, but the project does, project -- Rio Grande project. The Compact delivers water to Elephant Butte for both New Mexico and Texas.

Q. If the project is the means by which the Compact water is apportioned between the states then doesn't it follow that there is a Compact apportionment to each state below Elephant Butte that is fulfilled through the project, as you just said?

A. Well, there's no apportionment to each state in the Compact.

Q. And, again, I'm just trying to understand the import of your statement that the project is the means by which Compact water is apportioned, and I think I understand now your point. It's your point that the water in Elephant Butte Reservoir is Compact water, and it is delivered by the project?

A. That's correct.

Q. Okay. Again, just wanted to see the -- the import of where you're going with that.

You finish up that paragraph on the next page by saying, "It's significant to note that both the Rio Grande project and the Rio Grande Compact were conceived and implemented prior to the significant development of groundwater in the Rincon and Mesilla Basins of New Mexico, which began in the early 1950s, correct?

A. Correct.

Q. Why do you say that that's significant?

A. Well, at the time the Compact and the Rio Grande project were implemented or developed, there was very little groundwater pumping in the Rincon and Mesilla Valley and so there was no acknowledgment at that time that there would be significant groundwater pumping.

Q. As part of the project you undertook here, did you do any exploration of what the parties' understanding or expectations might have been with respect to potential groundwater development at the time of either the Project's or the Compact's concession or implementation?

A. No. I mean, I have read -- I've read documents or reports or studies that were done at that time that referenced groundwater use, but nothing that he made the statement, and it's his opinion as to how the operating agreement is structured. I guess that was its intent.

Q. And I understand that that's his statement and his opinion as to how it's structured. I'm asking you if -- first, I'll ask: You reviewed and read the 2008 operating agreement, correct?

A. I have.

Q. Did you form an opinion in reviewing that as to whether New Mexico pumping was grandfathered in the 1951 to 1978 levels through the 2008 operating agreement?

A. No. I didn't form an opinion based on reading that operating agreement.

Q. Did you form an opinion based on anything else?

A. This chart. It's apparent that the operating agreement, since it's been in effect, has not delivered the same quantity of water as D2 curve.

Q. And I'll ask you about that in a minute, but first I'd like to turn to in the same presentation on Page 16, in the second full paragraph you indicate that, "Esslinger explained how for specific annual releases of project water from the reservoirs starting in 2003, when sustained dry conditions began, and

S I G N A T U R E   O F   W I T N E S S

I, ROBERT BRANDES, Ph.D., P.E., solemnly swear or affirm under the pains and penalties of perjury that the foregoing pages contain a true and correct transcript of the testimony given by me at the time and place stated with the corrections, if any, and the reasons therefor noted on the foregoing correction page(s).

____

ROBERT BRANDES, Ph.D., P.E., VOLUME I

Job No. 3524372

IN THE SUPREME COURT OF THE UNITED STATES
BEFORE THE OFFICE OF THE SPECIAL MASTER
HON. MICHAEL J. MELLOY

STATE OF TEXAS	)	
	)	
Plaintiff,	)	
	)	Original Action Case
VS.	)	No. 220141
	)	(Original 141)
STATE OF NEW MEXICO,	)	
and STATE OF COLORADO,	)	
	)	
Defendants.	)	

THE STATE OF TEXAS :
COUNTY OF HARRIS :

I, HEATHER L. GARZA, a Certified Shorthand Reporter in and for the State of Texas, do hereby certify that the facts as stated by me in the caption hereto are true; that the above and foregoing answers of the witness, ROBERT BRANDES, Ph.D., P.E., to the interrogatories as indicated were made before me by the said witness after being first duly sworn to testify the truth, and same were reduced to typewriting under my direction; that the above and foregoing deposition as set forth in typewriting is a full, true, and correct transcript of the proceedings had at the time of taking of said deposition.

I further certify that I am not, in any capacity, a regular employee of the party in whose

behalf this deposition is taken, nor in the regular employ of this attorney; and I certify that I am not interested in the cause, nor of kin or counsel to either of the parties.

That the amount of time used by each party at the deposition is as follows:

MR. ROMAN - 04:28:43
MR. SOMACH - 00:00:00
MR. WALLACE - 00:00:00
MR. MACFARLANE - 00:00:00
MS. BARNCASTLE - 00:00:00
MS. STEVENSON - 00:00:00

GIVEN UNDER MY HAND AND SEAL OF OFFICE, on this, the 10th day of October, 2019.

HEATHER L. GARZA, CSR, RPR, CRR
Certification No.: 8262
Expiration Date: 12-31-19
VERITEXT LEGAL SOLUTIONS
Firm Registration No. 571
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Fort Worth, TX 76102
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IN THE SUPREME COURT OF THE UNITED STATES
BEFORE THE OFFICE OF THE SPECIAL MASTER
HON. MICHAEL J. MELLOY

STATE OF TEXAS)
)
Plaintiff,)
) Original Action Case
VS.) No. 220141
) (Original 141)
STATE OF NEW MEXICO,)
and STATE OF COLORADO,)
)
Defendants.)

****
REMOTE ORAL AND VIDEOTAPED DEPOSITION OF
ESTEVAN LOPEZ
SEPTEMBER 18, 2020
****

REMOTE ORAL AND VIDEOTAPED DEPOSITION of ESTEVAN LOPEZ, produced as a witness at the instance of the United States, and duly sworn, was taken in the above-styled and numbered cause on September 18, 2020, from 9:02 a.m. to 12:38 p.m., before Heather L. Garza, CSR, RPR, in and for the State of Texas, recorded by machine shorthand, remotely at the offices of HEATHER L. GARZA, CSR, RPR, The Woodlands, Texas, pursuant to the Federal Rules of Civil Procedure and the provisions stated on the record or attached hereto; that the deposition shall be read and signed.

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VIDEOGRAPHER:
Ms. Kayla Brown

ALSO PRESENT:

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Kari Olson
Al Blair
Greg Ridgley
John D'Antonio
Robin Cypher
Gary Esslinger
Erek Fuchs
Phil King
Cheryl Thacker
Daniel Ortiz

EXAMINATION INDEX

WITNESS: ESTEVAN LOPEZ

EXHIBIT INDEX

THE VIDEOGRAPHER: The time is 9:02 a.m. We're on the record.

MR. DUBOIS: First, let's do appearances. Mr. Lopez, my name is Jim Dubois. We've met once before, pre COVID, I think your first deposition when you were not an expert witness, and I am representing the United States. Also on the line, I believe, is Lee Leininger, who appears that -- oh, and Judy Coleman, and that appears to be it for the United States this morning. Jeff?

MR. WECHSLER: Jeff Wechsler for New Mexico, and it looks like we have the state engineer, John D'Antonio, Gregg Ridgley, Cheryl Thacker, Shelly Dalrymple, Kari Olson, and Susan Barela, and Arianne Singer.

MR. DUBOIS: And for the State of Texas?

MR. SOMACH: Yes, this is Stuart Somach. I'll be asking Mr. Lopez questions to the extent Mr. Dubois doesn't cover the universe. Sarah Klahn is also on, and she'll be covering the other depositions today. Theresa Barfield is on, Mac Goldsberry is on for Texas, and I believe there are a couple of other people, but to be honest with you, I'm not certain who they are. But if anybody else, either at my firm or representing Texas wants to make an appearance, that

Brockmann on behalf of both amici.

MR. DUBOIS: Mr. Utton, I'm blanking on who you're representing. Is it NMSU?

MR. UTTON: Yes. Good morning. This is John Utton representing New Mexico State University.

MR. DUBOIS: And for the water users group?

MS. DAVIDSON: This is Tessa Davidson, good morning, for New Mexico pecan growers.

MR. DUBOIS: And are there any other amici who are on that I have missed?

(No response.)

MR. DUBOIS: Okay. Hearing none, apparently that's everybody.

ESTEVAN LOPEZ,

having been first duly sworn, testified as follows:

E X A M I N A T I O N

BY MR. DUBOIS:

Q. All right. Mr. Lopez, you've been deposed before in this proceeding several times. You've -- you've done video depositions in this case. I'm just going to cover the very basic ground rules. You're under oath this -- as if you're testifying in a court of law. We need to try not to talk over each other. Let me finish my questions, and I will try not to

interrupt your answers, and we'll have a cleaner record. If you don't understand a question, please ask me to clarify it, and I will try and rephrase it; otherwise, I'll assume you're -- if you're answering, you're understanding the question. And because this is a remote deposition, your other communication devices, e-mails, texts, things like that need to be turned off. Is that all clear

A. It is.

Q. Let's pull up the -- the notice as a starting point.

MR. DUBOIS: Kayla, if you can load up the 30(b)(6) U.S. notice.

THE VIDEOGRAPHER: And how did you want to mark this one?

MR. DUBOIS: That's a good question because Mr. Lopez was up to 9 or 10, but this is -- this is a 30(b)(6) deposition, so it is slightly different.

MR. SOMACH: Yes. Mark it 1, Jim, because it is a 30(b)(6).

MR. DUBOIS: Yeah. Let's go with -- let's mark it Lopez 30(b)(6) No. 1.

(Exhibit No. 1 was marked.)

Q. (BY MR. DUBOIS) All right. Mr. Lopez, you

was in April of 1938. Is that -- is that sufficient specificity?

Q. Yes. As I said, I can provide them. I just wanted to make sure that we're talking about the same things. So do the -- do the -- do the downstream contracts between the United States and EBID and between EBID and EPCWID define the apportionment to New Mexico?

A. I think they inform the -- the apportionment to New Mexico. They don't define it as explicitly as -- as -- as I've defined here in my responses to you. They inform it by -- in several ways. First of all, the -- the contract between EBID and -- and EP No. 1 that is EPCWID has a shortage provision that is specific and explicit about in times of shortage, water is to be shared 57/43. In essence, in proportion to the acreage in each of the districts as a total of -- a total project authorized acreages. And then the -- the two contracts between Reclamation and the districts specify the acreages of each of the districts, the authorized acreages of each of the districts. That's consistent with that. Those two contracts also have essentially identical terms except for the -- the proportion of payment that is also proportionate to the acreage and so those things inform that apportionment, and in my report and in responses to my prior depositions, I've explained how the 57/43 that I assert is the apportionment below Elephant Butte we get from a reading of the Compact together with those downstream contracts and the historical practice of how the project has been operated up until essentially 2006.

Q. So is the contract with EBID the sole means for New Mexico obtaining its apportionment under the Compact?

MR. WECHSLER: Object to form.

A. Are you referring only to that -- the apportionment below Elephant Butte?

Q. (BY MR. DUBOIS) Yes. I'm sorry. I should have been clear on that. I apologize.

A. I believe that it is, yes.

Q. Okay. Is it New Mexico's position that the contracts between the United States and the two districts and the contract between the two districts are integrated into the Compact?

A. I think what I testified is that they -- that the Compact and the project are inextricably linked, and the -- and the contracts are also kind of inextricably linked to -- or inextricably intertwined, I think is what I -- what I said in my report. I was

that allow four-and-a-half to five-and-a-half acre-feet per acre of farm delivery requirement; is that a fair statement?

A. Not exactly. And I guess what I mean by not exactly is that, yeah, for certain acreage, could be that it's up to five-and-a-half acre -- acre-feet per acre, but on an overall weighted average for the entire author -- authorized project acreage, it's considerably less than that.

Q. But the permits --

A. So --

Q. The permits -- go ahead. I'm sorry.

A. So for a -- a certain specific acreage to which there is a permit for five-and-a-half acre -- five-and-a-half acre-feet per acre, yes, that's correct.

Q. Okay. So the limitation on pumping is whatever is in the state-defined permits; is that accurate?

A. I think it's whatever is -- that's the ultimate limitation, I guess, and if the actual crop requirement is less than that, that's the limitation.

Q. Okay. But under New Mexico law, the limitation on pumping would be whatever it's the maximum in the permits; is that right?

WITNESS CORRECTIONS AND SIGNATURE

Please indicate changes on this sheet of paper, giving the change, page number, line number and reason for the change. Please sign each page of changes.

PAGE/LINE CORRECTION REASON FOR CHANGE

14/5 Delete "states" and replace with "repesentatives of the state"; clarity

15/15 Delete "done" and replace with "nuanced"; wrong word

15/17 Insert "nuanced" between "more" and "way"; clarity

17/8 Insert "less Mexico's share under the Treaty" after "Quitman"; incomplete answer.

19/25 After "Butte" insert "that remains after providing Mexico's portion"; incomplete

20/19 Before "it" insert "after supplying Mexico"; incomplete answer.

20/19 After "the" insert "remaining"; incomplete, clarity.

22/25 Delete "proportionate" and replace with "proportional"; wrong word.

24/21 Delete "is" and replace with "are"; wrong word

29/25 Before "43 percent" insert "After providing Mexico's supply, it is"; incomplete

30/1 After "the" insert "remaining"; incomplete, clarity.

33/1 After "that" insert "if"; clarity.

33/19 After "If" insert "after supplying Mexico"; incomplete

33/20 Delete "its" and replace with "the remaining"; incomplete.

44/24 Delete "respected" and replace with "respective"; wrong word.

49/12 Delete "appropriation" and replace with "apportionment"; wrong word.

49/18 Delete "and doing" and replace with "in lieu of"; wrong words.

60/18 Delete "private positions" and replace with "prior depositions"; wrong words

[signature]

ESTEVAN LOPEZ

WITNESS CORRECTIONS AND SIGNATURE

Please indicate changes on this sheet of paper, giving the change, page number, line number and reason for the change. Please sign each page of changes.

PAGE/LINE CORRECTION REASON FOR CHANGE

62/24 Delete "that" and replace with "Reclamation used the"; clarity.
62/25 Delete "tried" and replace with "to try"; clarity.
63/10 Delete "thing for release" and replace with "claim for relief"; wrong words.
64/18 Delete "conflict" and replace with "Compact"; wrong word.
64/20 Delete "on"; clarity.
66/5 After apportionment insert "is"; clarity
67/2 Delete "for" and replace with "with"; wrong word, clarity.
71/9 Delete "precedes" and replace with "preceded"; wrong tense.
75/3 Delete "you" and replace with "they"; wrong pronoun.
79/2 Delete "I" and replace with "me"; wrong pronoun.
84/19 After "Butte" insert "Irrigation District"; incomplete reference.
84/20 Delete "portion" and replace with "apportionment"; wrong word.
86/19 Delete "per-project" and replace with "per-acre"; wrong word.
86/20 Delete second occurrence of "the" and replace with "in"; clarity.
89/15 Delete "referring" and replace with "referred"; wrong word
90/19 Delete "reduced in" and replace with "reduced. In"; sentence break.
96/5 After "'40s" insert a comma (","); clarity.
100/11 Delete "Humberto" and replace with "Filiberto"; wrong name
101/12 Delete "is" and replace with "are"; wrong word

ESTEVAN LOPEZ

S I G N A T U R E   O F   W I T N E S S

I, ESTEVAN LOPEZ, solemnly swear or affirm under the pains and penalties of perjury that the foregoing pages contain a true and correct transcript of the testimony given by me at the time and place stated with the corrections, if any, and the reasons therefor noted on the foregoing correction page(s).

ESTEVAN LOPEZ

Job No. 65405

IN THE SUPREME COURT OF THE UNITED STATES
BEFORE THE OFFICE OF THE SPECIAL MASTER
HON. MICHAEL J. MELLOY

STATE OF TEXAS	)	
	)	
Plaintiff,	)	
	)	Original Action Case
VS.	)	No. 220141
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STATE OF NEW MEXICO,	)	
and STATE OF COLORADO,	)	
	)	
Defendants.	)	

THE STATE OF TEXAS :
COUNTY OF HARRIS :

I, HEATHER L. GARZA, a Certified Shorthand Reporter in and for the State of Texas, do hereby certify that the facts as stated by me in the caption hereto are true; that the above and foregoing answers of the witness, ESTEVAN LOPEZ, to the interrogatories as indicated were made before me by the said witness after being first remotely duly sworn to testify the truth, and same were reduced to typewriting under my direction; that the above and foregoing deposition as set forth in typewriting is a full, true, and correct transcript of the proceedings had at the time of taking of said deposition.

I further certify that I am not, in any capacity, a regular employee of the party in whose

behalf this deposition is taken, nor in the regular employ of this attorney; and I certify that I am not interested in the cause, nor of kin or counsel to either of the parties.

That the amount of time used by each party at the deposition is as follows:

MR. SOMACH - 00:48:35
MR. WECHSLER - 00:00:00
MR. DUBOIS - 02:02:47
MR. WALLACE - 00:00:00
MS. O'BRIEN - 00:13:01
MS. BARNCASTLE - 00:00:00

GIVEN UNDER MY HAND AND SEAL OF OFFICE, on this, the 7th day of October, 2020.

Heather L. Garza

HEATHER L. GARZA, CSR, RPR, CRR
Certification No.: 8262
Expiration Date: 04-30-22

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No. 141, Original

In the

SUPREME COURT OF THE UNITED STATES

STATE OF TEXAS,

Plaintiff,

v.

STATE OF NEW MEXICO and
STATE OF COLORADO,

Defendants.

OFFICE OF THE SPECIAL MASTER

STATE OF TEXAS'S SUPPLEMENTAL RESPONSES TO STATE OF NEW MEXICO'S FIRST SET OF INTERROGATORIES TO THE STATE OF TEXAS

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Robert B. Hoffman, Esq.
Francis M. Goldsberry II, Esq.
Theresa C. Barfield, Esq.
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**Counsel of Record*

October 26, 2020

DEITCHMAN DECL. EXH 12

Pursuant to the Case Management Plan adopted September 6, 2018, as amended (CMP), and Rule 33 of the Federal Rules of Civil Procedure, the State of Texas (Texas) hereby submits the following SUPPLEMENTAL responses to the State of New Mexico's (New Mexico) First Set of Interrogatories ("Interrogatory" or "Interrogatories") to Texas.

SUPPLEMENTAL RESPONSES TO INTERROGATORIES

INTERROGATORY NO. 1:

State with specificity the authority for your contention that only water that enters the "bed" of the Rio Grande River is Project water, including but not limited to any administrative or court decisions upon which you rely.

RESPONSE TO INTERROGATORY NO. 1:

Without waiving the objections raised in its separate pleading, State of Texas's Objections to State of New Mexico's First Set of Interrogatories to the State of Texas (Texas's Objections to NM's Interrogatories, Set 1), filed July 29, 2020, Texas responds as follows:

This was a determination made by the United Stated Bureau of Reclamation (USBR) with regard to the Rio Grande Project (Project) as a whole, and consistent with the historic operations of the Project.

INTERROGATORY NO. 2:

State with specificity the circumstances surrounding the decision to change the characterization of El Paso Valley municipal effluent from Project water to non-Project water based on its discharge to the American Canal Extension.

RESPONSE TO INTERROGATORY NO. 2:

Without waiving the objections raised in its separate pleading, Texas's Objections to NM's Interrogatories, Set 1, filed July 29, 2020, Texas responds as follows:

For purposes of all responses herein, references to "the City" means the City of El Paso, and generally also encompass the City acting by and through the El Paso Water Utilities Public Service Board (EPWU).

INTERROGATORY NO. 13:

Identify with specificity all Documents supporting Your contention that the Compact apportions no water to New Mexico south of Elephant Butte Reservoir.

RESPONSE TO INTERROGATORY NO. 13:

Without waiving the objections raised in its separate pleading, Texas's Objections to NM's Interrogatories, Set 1, filed July 29, 2020, Texas responds as follows:

The 1938 Rio Grande Compact; Opinion IV of the Expert Report of Scott A. Miltenberger, Ph.D., dated May 31, 2019, and documents referenced therein; the JIR; the 1938 contracts between and among EBID, EPCWID, and the USBR. The December and March 1938 Engineer Advisors Reports to the Rio Grande Compact Commission.

SUPPLEMENTAL RESPONSE TO INTERROGATORY NO. 13:

Without waiving the objections raised in its separate pleading, Texas's Objections to NM's Interrogatories, Set 1, served July 29, 2020, and supplemental to the response set forth in Texas's Responses to NM's Interrogatories, Set 1, Texas supplements its response as follows:

Compact accounting information and data as reflected in Engineer Advisors reports to the Rio Grande Compact Commission; Memorandum of Understanding attached to the 2001 Rio Grande Compact Commission Report; pleadings filed in the United States Supreme Court, No. 9 Original, by New Mexico.

INTERROGATORY NO. 14:

Identify with specificity all Documents pertaining to communications from You to officials in the State of New Mexico demanding or requesting that New Mexico curtail groundwater pumping in the Project area to protect delivery of Project water supplies to Texas.

RESPONSE TO INTERROGATORY NO. 14:

Without waiving the objections raised in its separate pleading, Texas's Objections to NM's Interrogatories, Set 1, filed July 29, 2020, Texas responds as follows:

- Draft allocation of the Rio Grande Project water (November 18, 1992);

OBJECTIONS TO INTERROGATORY NO. 35:

Without waiving the objections raised in its separate pleading, Texas's Objections to NM's Interrogatories, Set 1, filed July 29, 2020, Texas responds as follows: Yes.

INTERROGATORY NO. 36:

If the answer to Interrogatory No. 35 is yes, please state in detail the basis for Texas's position.

OBJECTIONS TO INTERROGATORY NO. 36:

Without waiving the objections raised in its separate pleading, Texas's Objections to NM's Interrogatories, Set 1, filed July 29, 2020, Texas responds as follows:

The allocation of Project water is only one element of what Texas was apportioned under the Compact. The Texas complaint does not address shortages in "Project allocation," but rather shortages in Compact water apportioned to Texas.

Respectfully submitted,

SOMACH SIMMONS & DUNN

Dated: October 26, 2020

____

STUART L. SOMACH, ESQ.*
ANDREW M. HITCHINGS, ESQ.
ROBERT B. HOFFMAN, ESQ.
FRANCIS M. GOLDSBERRY, ESQ.
THERESA C. BARFIELD, ESQ.
SARAH A. KLAHN, ESQ.
BRITTANY K. JOHNSON, ESQ.
RICHARD S. DEITCHMAN, ESQ.

VERIFICATION

I, Patrick Gordon, am the Commissioner for the Rio Grande Compact on behalf of the State of Texas, and I believe, based on reasonable inquiry, that the foregoing **State of Texas's Supplemental Responses to State of New Mexico's First Set on Interrogatories to the State of Texas** are true and correct to the best of my knowledge, information and belief.

I declare under penalty of perjury under the laws of the State of Texas that the foregoing is true and correct.

Executed on Oct 23, El Paso, Texas.

Pat Gordon

Patrick Gordon
Rio Grande Compact Commissioner

No. 141, Original

In the

SUPREME COURT OF THE UNITED STATES

STATE OF TEXAS,

Plaintiff,

v.

STATE OF NEW MEXICO and
STATE OF COLORADO,

Defendants.

OFFICE OF THE SPECIAL MASTER

CERTIFICATE OF SERVICE

This is to certify that on this 26th day of October 2020, I caused a true and correct copy of **STATE OF TEXAS'S SUPPLEMENTAL RESPONSES TO STATE OF NEW MEXICO'S FIRST SET OF INTERROGATORIES TO THE STATE OF TEXAS AND VERIFICATION** to be served upon all parties and *amici curiae*, by and through the attorneys of record and/or designated representatives for each party and *amicus curiae* in this original action. As permitted by order of the Special Master, and agreement among the parties, service was effected by electronic mail to those individuals listed on the attached service list, which reflects all updates and revisions through the current date.

Respectfully submitted,

Dated: October 26, 2020

Corene E. Rodder

SERVICE LIST FOR ALL PARTIES AND AMICI CURIAE

PARTIES
(Service via Electronic Mail)

PARTIES[1]

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No. 141, Original

In the

SUPREME COURT OF THE UNITED STATES

STATE OF TEXAS,

Plaintiff,

v.

STATE OF NEW MEXICO and
STATE OF COLORADO,

Defendants.

OFFICE OF THE SPECIAL MASTER

DECLARATION OF SCOTT A. MILTENBERGER, Ph.D. IN SUPPORT OF THE STATE OF TEXAS'S MOTION FOR PARTIAL SUMMARY JUDGMENT; MEMORANDUM OF POINTS AND AUTHORITIES IN SUPPORT THEREOF FEDERAL RULE OF CIVIL PROCEDURE 56

Stuart L. Somach, Esq.*
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**Counsel of Record*

November 2, 2020

I, Scott A. Miltenberger, declare as follows:

1. I am a professional consulting historian, specializing in water and natural resources issues. I am a partner at JRP Historical Consulting, LLC (JRP), located at 2850 Spafford Street, Davis, CA 95618. My qualifications to render the opinions contained in this Declaration are set forth in my professional resume, attached hereto as Attachment 1 and incorporated herein by this reference.

2. I have been retained as an expert by Somach Simmons & Dunn to provide expert opinions and testimony on behalf of the State of Texas as to the history and historical issues concerning the Rio Grande Compact of 1938 ("Compact" or "Compact of 1938").

3. To develop my expert opinions, I researched, collected, and analyzed thousands of archival documents, published primary and secondary sources, and academic monographs over the course of eight years. This material was obtained by myself, my former business partner (now retired) Mr. Stephen Wee, and JRP staff under my direction (all of whom possess graduate degrees in history) from several federal, state, and local records repositories. These include:

- The National Archives in Washington, DC;
- The National Archives at College Park, Maryland;
- The National Archives at Denver, Colorado;
- The National Archives at Fort Worth, Texas;
- The Dolph Briscoe Center for American History at The University of Texas at Austin;
- The Texas State Archives in Austin;
- The C.L. Sonnichsen Special Collections Department of the University of Texas at El Paso;
- The El Paso Historical Society;
- The New Mexico State Records Center and Archives in Santa Fe;
- The University of New Mexico Center for Southwest Research and Special Collections in Albuquerque;
- The New Mexico State University Archives and Special Collections in Las Cruces;

- History Colorado (formerly the Colorado Historical Society) in Denver;
- The Water Resource Archives at Colorado State University, Fort Collins;
- The American Heritage Center at the University of Wyoming in Laramie;
- The Water Resources Collections and Archives at the University of California, Riverside; and
- The Harvard Law School Library, Historical and Special Collections, in Cambridge, Massachusetts.

4. I have also examined documents produced in this litigation by the states of Texas, Colorado, and New Mexico, and the United States. I have reviewed expert reports submitted in this action by New Mexico and the United States. I further reviewed the *First Interim Report of the Special Master* and the historical documents appended to that Report.

5. Based on my review of the historical record of the Rio Grande Compact of 1938, the following sub-paragraphs are a summary of my opinions regarding the states' agreed-to apportionment of the Rio Grande. I have, in brackets, indicated the specific locations within this declaration that provide support in the historical record for these opinions. True and correct copies of all the references contained in the footnotes of this declaration are attached as Attachment 2. The references may also be viewed in the electronic version of this declaration by selecting the links embedded in the footnote citations.

a. The Rio Grande Compact of 1938 was rooted in the conflicts over upstream depletions in the Upper Rio Grande Basin that began in the late-nineteenth century and persisted into the twentieth century. The issue of depletions and responses to that issue – the 1896 federal embargo, the federal Rio Grande Reclamation Project ("Rio Grande Project," or "Project"); the 1906 Mexican treaty, the Compact negotiations of the 1920s and 1930s, Texas's suit against New Mexico, and the Rio Grande Joint Investigation – shaped the Compact's "equitable apportionment" [paragraphs 6-19];

b. That "equitable apportionment" did not assign a specific quantity of water to each state. Rather, because the water resources of the basin were considered to be fully appropriated, the Compact was designed effectively to freeze depletions at the Colorado-New Mexico state line and at San Marcial to "present conditions" to ensure "present uses" of water downstream of these points as of 1938. All three states nonetheless had "freedom of development" of their waters, provided depletions did not exceed those permitted by the Compact [paragraphs 20-28];

c. For Texas specifically in 1938, "present uses" required flows to be delivered by New Mexico at San Marcial to produce a 790,000 acre-feet (af) average annual release from Elephant Butte Dam. Only by diversion and re-diversion through the Rio Grande Project could this water serve lands in Texas down to Ft. Quitman pursuant to the Compact. Development of the Project rendered a state line delivery to Texas by New Mexico impossible, and thus San Marcial, at the head of the reservoir created by the federal dam, became the *de facto* state-line delivery to Texas [paragraphs 29-46]; and

d. The historical record indicates that groundwater was not considered a source of water augmentation to the existing surface water supply at the time of the Compact. Hydrological investigations prior to and following the Compact highlighted an interdependence between basin groundwater and surface flows in the Rio Grande. Later studies suggested groundwater could be used as a supply in times of drought or even a sustainable source of water within certain limits but recognized that groundwater extraction would ultimately deplete surface flows below Elephant Butte. By at least the 1950s, the New Mexico State Engineer was aware of this as well, and by the 1980s acknowledged that groundwater pumping since the 1950s imperiled the Compact [47-62].

CONFLICTS OVER UPSTREAM DEPLETIONS IN THE UPPER RIO GRANDE BASIN FORM THE ESSENTIAL HISTORICAL CONTEXT OF THE RIO GRANDE COMPACT OF 1938

6. Conflicts over upstream depletions in the Upper Rio Grande Basin form the essential historical context for the Rio Grande Compact of 1938. Water users in Mexico near Juarez, in New Mexico's Mesilla Valley, and in Texas's El Paso Valley began complaining in the 1890s that diversions within Colorado's San Luis Valley, near the Rio Grande headwaters, diminished river flows reaching their lands. In response to Mexican protests, the federal government imposed an "embargo," or moratorium, on the use of federal land for reservoirs and other water facilities in 1896.[1] This action largely forestalled further private irrigation efforts in San Luis Valley, and facilitated both development of the federal Rio Grande Reclamation Project in New Mexico and Texas (authorized by Congress in 1905, extending the provisions of 1902 Reclamation Act) and an international treaty with Mexico in 1906.[2] Water from the Project's Elephant Butte Dam was to serve Mexico under the treaty and lands in southern New Mexico and western Texas by contract. Despite agitation by Colorado, federal authorities retained the embargo with little modification into the 1920s to protect the waters intended for Elephant Butte from upstream depletions.[3]

[1] D.B. Francis, Secretary, to The Commissioner of the General Land Office, December 5, 1896. ff. RG48 E-631 Rio Grande Project, Contract, Suspension of Applications for use of water of the Rio Grande, Box No. 41 Rio Grande, Rouge Canyon, Sacramento Valley, Saint Mary's River, Salt River, Entry 631 Records Relating to Specific Reclamation Projects 1889-1907, Records of the Department of the Interior, Office of the Secretary, Record Group 48 [hereafter RG 48], National Archives at College Park, Maryland [hereafter NARA II]; and National Resources Committee, *Regional Planning Part VI – The Rio Grande Joint Investigation in the Upper Rio Grande Basin in Colorado, New Mexico, and Texas 1936-1937*, vol. 1 (GPO, 1938) [hereafter *JIR*], 8.

[2] *An Act Relating to the construction of a dam and reservoir on the Rio Grande, in New Mexico, for the impounding of the flood waters of said river for purposes of irrigation*, February 26, 1905, chap. 798, Public No. 104, 33 Stat. 814; *Proclamation of the Convention Between the United States and Mexico, signed at Washington on May 21, 1906, Providing for the equitable distribution of the waters of the Rio Grande for Irrigation Purposes*, January 16, 1907. Folder 690, Rio Grande Project. Corres. With Secy of State and Others as to Claims of Mexico. June 1, 1905 to Dec. 31, 1909, Box 823 Rio Grande, 874A- -690, Entry 3 General Administrative and Project Records, 1902-1919 [hereafter Entry 3], Record Group 115, Records of the Bureau of Reclamation [hereafter RG 115], National Archives at Denver [hereafter NARA-Denver]; and *JIR*, 8.

[3] Ottamar Hamele, "The Embargo on the Upper Rio Grande," November 11, 1924, 13-15, and 20-30. 8-3 Rio Grande Distribution of Waters (Loose File), Box 1638 8-3, Rio Grande C-D, Central Classified File 1907-1936 [hereafter CCF 1907-36], RG 48, NARA II; and *JIR*, 8.

7. In the early 1920s, Colorado sought to conclude an interstate compact solely with New Mexico to obtain relief from the embargo. Concern about renewed upstream depletions in the wake of a Colorado-New Mexico compact led Texas to push for its inclusion in the negotiations, and the upstream states acquiesced.[4] Revocation of the embargo in 1925 and federal approval of new right-of-way applications in Colorado prompted New Mexico to withdraw from the negotiations.[5]

8. The three states did not meet again until December 1928. At that conference, Colorado argued that construction of a Colorado state line reservoir would not impair flows to New Mexico and Texas, that it would only make use of waters otherwise wasted in the basin or lost to Mexico, and in fact, the downstream states stood to benefit from augmented flows into Elephant Butte created by upstream storage. New Mexico and Texas, however, feared that Colorado's plans would imperil water projects in their respective states. New Mexico expressed concern for the fledgling Middle Rio Grande Conservancy District ("MRGCD") project above San Marcial and insisted that a quantity of water for delivery at the Colorado-New Mexico state line be fixed. Texas was protective of the Project's water supply which it maintained served lands down to Ft. Quitman.[6]

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[4] First Meeting, Rio Grande River Compact Commission, Breadmoor Hotel, Colorado Springs, Colo., Sunday, October 26, 1924, 1-37. Folder 1. First Meeting Rio Grande Compact Commission. Oct. 26, 1924, Box 02-D.002, MS 0235 Elephant Butte Irrigation District Records, 1883-1981, Rio Grande Historical Collections, New Mexico State University Archives and Special Collections, Las Cruces

[5] Hubert Work to The Commissioner of the General Land Office, Rio Grande Embargo, May 20, 1925. ff. 032.02 Rio Grande Basin Water Rights; Rio Grande River Basin Embargo. THRU 1925 Transfer Case, Box No. 924 Rio Grande Basin 023.- -032.02, Entry 7, Project Files, 1919-1929, General Administrative and Project Records, 1919-1945 [hereafter Entry 7], RG 115, NARA Denver; J.O. Seth, Rio Grande Commissioner for New Mexico, to Hon. A.T. Hannett, Governor of New Mexico, June 1, 1925. ff. Gov. Arthur T. Hannett Rio Grande Compact Commission, 1925, 209, Box 5, Serial No. 14153, Governor Arthur T. Hannett report, penal papers, New Mexico State Records Center and Archives, Santa Fe [hereafter NMSA].

[6] Proceedings of the Rio Grande Compact Conference, Held December 19-20-21, 1928, At Santa Fe, New Mexico, 3, 10-11, and 13-19. ff. Rio Grande Compact Commission Records, 1924-1941, 1970, Richard F. Burges Papers, Proceedings of the Rio Grande Compact Conference Held Dec. 19-20-21 at Santa Fe, N.M. (Title page, 78 pp.), Box 2F471, Rio Grande Compact Commission Records, 1924-1941, 1970 [hereafter RGCCR, 1924-1941, 1970], Dolph Briscoe Center for American History, The University of Texas at Austin [hereafter UTA].

9. The resulting temporary compact of February 1929 reflected the impasse among the states over the question of whether proposed upstream developments would deplete flows to the detriment of existing uses downstream. The compact provided for construction of a Closed Basin drain and a "State line reservoir" by the federal government (Article II) and the establishment of several stream-gaging stations to gather flow data (Article III). The compact also restricted any further upstream depletions until consummation of a permanent compact. Neither Colorado at the state line (Article V) nor New Mexico at Elephant Butte (Article XII) was to "cause or suffer the water supply" of the river "to be impaired by new or increased diversions or storage" during the duration of this compact, which was set to expire in June 1935. New Mexico further recognized that "prior vested rights above and below Elephant Butte Reservoir shall never be impaired hereby" (Article XII). Whether a "closed basin drain and the State line reservoir be built" in Colorado prior to the compact's expiration, the commissioners for each state were to meet in June 1935 for "the purpose of concluding a Compact . . . providing for the equitable apportionment of the use of the waters of the Rio Grande among said States" (Article VII).[7]

10. When negotiations for a permanent compact resumed in December 1934, little progress was made.[8] The following month, Colorado made a detailed presentation, arguing once more that reservoir construction in the San Luis Valley would not deplete downstream

[7] Francis C. Wilson, Rio Grande Compact Commissioner, *Rio Grande Compact: Report of Commissioner for New Mexico and Memorandum of Law on Interstate Compacts on Interstate Streams* 2/19/29, 4 (Article II), 5-6 (Article III), 6 (Article V), 7 (Article VII), and 9 (Article XII), and 11-21. ff. 032.1, Rio Grande Basin. Water Rights: Rio Grande Compact. THRU 1929., Box 924 Rio Grande Basin 023.- -032.02, Entry 7, RG 115, NARA Denver.

[8] Proceedings of the Rio Grande Compact Conference held at Santa Fe, New Mexico, December 10-11, 1934, 1-38. ff. Proceedings of the Rio Grande Compact Commission, Santa Fe, New Mexico. 1934-1935, Box 62, Series 7: Publications and reports, 1856-1992 and undated [hereafter Series 7], Subseries 7.1: Compacts and rivers, 1893-1986 and undated [hereafter Series 7.1], Papers of Delph E. Carpenter and Family [hereafter PDECF], Water Resources Archives [hereafter WRA], Colorado State University, Fort Collins [hereafter CSU-FC]; and S. O. Harper to Secretary of the Interior, December 14, 1934. File No. 8-3 (Part 2), Rio Grande-Distribution of Waters-Compact, C-D, August 18, 1930-February 25, 1936, Box 1638, CCF 1907-1936, RG 48, NARA II.

flows. New Mexico and Texas, although not convinced, agreed to a two-year extension of the temporary compact, until June 1937, to consider Colorado's proposal in detail.[9]

11. During this period, concern in Texas that MRGCD's operations within the Middle Rio Grande Valley were impairing the Elephant Butte water supply in violation of the 1929 compact led the state to file a complaint against New Mexico and the district in the United States Supreme Court in October 1935.[10] After extensive hearings, citing the current investigation by the National Resources Committee ("NRC") and at the request by counsel representing Texas, New Mexico, and MRGCD, Special Master Charles Warren recommended postponement of the case until January 1938, to give the states an opportunity to conclude a compact. The Supreme Court subsequently approved his recommendation, and adoption of the 1938 Compact brought an end to the suit.[11]

12. The investigation referenced by Warren was a direct outgrowth of the stalemate in the Upper Rio Grande Basin over the question of permissible upstream depletions. The NRC – a special working group within the Roosevelt administration that

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[9] Proceedings of the Rio Grande Compact Commission, Santa Fe, January 28-30, 1935, 1-45. ff. Proceedings of the Rio Grande Compact Commission, Santa Fe, New Mexico. 1934-1935, Box 62, Subseries 7.1, Series 7, PDECF, WRA, CSU-FC.

[10] The State of Texas, By Wm. McCraw, Its Attorney General, H. Grady Chandler, Assistant Attorney General, Richard F. Burges, Walter S. Howe, Edwin Mechem, Of Counsel, Supreme Court of the United States, October Term, 1935, No. – Original, *State of Texas, Complainant, vs. State of New Mexico, et al.*, Motion for Leave to File Bill of Complaint and Bill of Complaint [October 29, 1935]. w. Texas' Briefs, A.G. 51-238, *State of Texas v. State of New Mexico, et al.*, Box 1993/127-1, Litigation Files, Texas Attorney General [hereafter LF-TAG], Texas State Archives, Austin [hereafter TSA].

[11] Special Master to Richard F. Burges, Esquire, March 26, 1937. ff. 4-1 Warren Charles, Correspondence re Texas v. New Mexico June 1936; *State of Texas v. State of New Mexico, No. 12 Original, 1936 Term, Statement by Special Master*, March 5, 1937, 4-7. ff. Warren Charles, Correspondence re Texas vs. New Mexico / March, 1937, Box 4 Correspondence, Notes, Reports re: Texas vs. New Mexico, Series 1: Materials re: cases, Charles Warren Papers 1885-1954, Manuscripts Unit, Harvard Law School Library, Historical and Special Collections, Cambridge, Massachusetts; *Supreme Court of the United States, October Term 1936, No. 12 Original, State of Texas vs. State of New Mexico, et al., Ad Interim Report of the Special Master*, received Mar. 26, 1937, 9-10 and 12-13; and *Supreme Court of the United States, October Term 1936, No. 10 Original, State of Texas vs. State of New Mexico, et al., Final Report of the Special Master*, filed Sep. 25, 1939, 4-6. ff. RG 267, Entry 26, TX v NM #10, Box 401 1939 to 1939 PI 139, Entry 26, Original Jurisdiction Case Files, 1792-2005 [hereafter Entry 26], Record Group 267, Records of the Supreme Court of the United States [hereafter RG 267], National Archives Building, Washington, DC [hereafter NAB].

aimed to foster planned development of the nation's natural resources – appointed a "Board of Review" ("Board") in September 1935, a month prior to Texas's filing in the Supreme Court, "to consider various projects and problems related to the use and control of waters" in the Upper Rio Grande Basin.[12]

13. Surveying the problems posed by increased water consumption above existing projects, the Board concluded in September 1935 that "the water resources of the Rio Grande were fully appropriated." The most established uses of the Rio Grande flow, reflecting the basin's history, emanated from the waters stored in Elephant Butte for the Rio Grande Project. The Board expressed concern that proposed and existing upstream projects in New Mexico above San Marcial (notably, MRGCD's) and in Colorado's San Luis Valley imperiled this supply.[13]

14. By the 1930s, the Project had been fully developed. Waters entering the federal dam not only fulfilled the 1906 Mexican treaty obligation of 60,000 af annually, but also served lands downstream to Ft. Quitman.[14] Under notices of appropriation filed with the New Mexico territorial engineer, the United States Reclamation Service (predecessor to the Bureau of Reclamation, or BOR) claimed 730,000 af annually in 1906, and "[a]ll of the unappropriated water of the Rio Grande and its tributaries" at Elephant Butte in 1908.[15]

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[12] *JIR*, 10.

[13] "Report of the Rio Grande Board of Review," September 13, 1935, 1, and 3-8. Folder 390-Rio Grande Joint Investigation Purpose and Organization, 1935-1937 [hereafter Folder 390], Box 26, Frank Adams Collection [hereafter FAC], Water Resources Collections and Archives, University of California, Riverside [hereafter WRCA].

[14] *JIR*, 83-84.

[15] B.M. Hall, Supervising Engineer to Mr. David L. White, Territorial Irrigation Engineer, Jan. 23, 1906. ff. 41 New Mexico, Water Appropriations- -General, Thru 1910, Box 6 38C- -41; and Supervising Engineer [Louis C. Hill] to Mr. Vernon L. Sullivan, Territorial Engineer, Subject: Supplemental notice of the intention of the United States to use the waters of the Rio Grande for irrigation purposes on the Rio Grande Project, April 14, 1908. ff. 41-D New Mexico. Water Appropriations. RIO GRANDE PROJECT THRU 1910, Box 9 41B- -41D, Entry 3, RG 115, NARA Denver.

15. Absent importation of water from outside the basin, the Board believed "adjustments in use rather than new uses" was required.[16] It therefore recommended certain projects already approved by certain agencies be disapproved and that no future projects for the Upper Rio Grande Basin's waters proceed without the NRC's prior approval. A September 1935 executive order adopted this recommendation, and effectively reinstated the embargo.[17]

16. The Board also proposed a joint federal-state investigation to develop the information that would assist the states in formulating a permanent compact.[18] The Rio Grande Compact Commission embraced this idea when it was presented by NRC representatives in December 1935, provided that the investigation would be limited to the "collection, correlation and presentation of factual data."[19]

17. Available in the late summer of 1937 and published in February 1938, the *Rio Grande Joint Investigation* report, or *JIR*, compiled a considerable amount of information. It described the Upper Rio Grande Basin's geography and known hydrology and surveyed all the important events leading to the investigation, beginning with the nineteenth-century protests over upstream depletion. Laying out the water resources problem of the basins, the monumental report offered data and detailed analyses of hydrology, hydrogeology, irrigation development and irrigated acreage, and water uses and requirements for the basin's three major sections defined by geography and history – Colorado's San Luis Valley, New

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[16] "Report of the Rio Grande Board of Review," September 13, 1935, 1. Folder 390, Box 26, FAC, WRCA.

[17] "Report of the Rio Grande Board of Review," September 13, 1935, 8. Folder 390, Box 26, FAC, WRCA; and Franklin D. Roosevelt, To Federal agencies concerned with projects or allotments for water use in the Upper Rio Grande Valley above El Paso, September 23, 1935. File No. 8-3 (Pt. 7). Reclamation Bureau - Rio Grande Project - Rio Grande River - Distribution of Waters – General, February 6, 1933 to December 12, 1956, Box 1642, 8-3, Rio Grande, R, Riverton, CCF 1907-1936, RG 48, NARA II.

[18] "Report of the Rio Grande Board of Review," September 13, 1935, 10. Folder 390, Box 26, FAC, WRCA.

[19] "Resolution Passed by Rio Grande Compact Commission at Santa Fe, New Mexico," December 3, 1935, 1-2. Folder 401-Rio Grande Compact Commission Resolutions, 1935-1937, Box 26, FAC, WRCA.

Mexico's Middle Rio Grande Valley above San Marcial, and the lands between Elephant Butte and Ft. Quitman – all to assist in apportioning the Rio Grande waters to meet present and future needs in these sections.[20]

18. With information from the *JIR*, the Rio Grande Compact engineering advisors, Royce Tipton for Colorado, John Bliss for New Mexico, Raymond Hill for Texas, and E.B. Debler for the United States, developed the "technical basis" for a Compact that was adopted in March 1938 and apportioned the waters of the Rio Grande.[21] Central to that apportionment were two delivery schedules for the basin's three sections: one for Colorado to New Mexico near the state line (Article III), and another for New Mexico to Texas at the head of Elephant Butte Reservoir (Article IV).[22] These delivery points were effectively the same points that the 1929 compact had used to restrict depletions. These schedules, in Tipton's words, "would insure each section of the basin against injury by acts of water uses in another section and yet would permit of the construction and operation of additional reservoirs above Elephant Butte Reservoir."[23]

19. Upstream depletions have continued to be a source of conflict despite the Compact. On two prior occasions, Texas has defended its downstream supply against the upstream states. In 1951, the state revived its suit against New Mexico and MRGCD, alleging once again that district operations were diminishing flows that should reach Elephant Butte

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[20] Proceedings of the Meeting of the Rio Grande Compact Commission Held in Santa Fe, New Mexico, September 27, to October 1, 1937, 1 and 6-8. Unnamed folder 5, Box 2F463, Rio Grande Compact Comm'n. Frank B. Clayton Papers [hereafter RGCC-FBCP], UTA; and *JIR*, 7-18 and passim.

[21] R.J. Tipton, *Analysis of Report of Committee of Engineers to Rio Grande Compact Commissioner, Dated December 27, 1937* (February, 1938), 1. ff. 70, Box 44-70, MSS 312 Michael Creed Hinderlider Collection, 1897-1987 [hereafter MCHC 1897-1987], History Colorado, Denver [hereafter HC]; and "Rio Grande Compact," in Proceedings of the Meeting of the Rio Grande Compact Commission Held at Santa Fe, March 3rd to March 18th, inc., 1938, Appendix No. 11, 72-82. ff. 032.1 Rio Grande Basin, Corres. re Compact between States of Colorado; New Mexico & Texas re Rio Grande Basin Water Rights Jan. 1938 thru May 1939, Box No. 936 Rio Grande Basin 023._246., Entry 7, RG 115, NARA Denver.

[22] "Rio Grande Compact," Article III and Article IV, in Proceedings of the Meeting of the Rio Grande Compact Commission . . . March 3rd to March 18th, inc., 1938, Appendix No. 11, 74-78. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

[23] Tipton, *Analysis*, 6. ff. 70, Box 44-70, MCHC 1897-1987, HC.

pursuant to the Compact.[24] In 1966, Texas and New Mexico together filed suit in the Supreme Court against Colorado, alleging that the upstream state was failing to adhere to its Compact delivery obligations and was depleting the waters available downstream.[25]

"PRESENT CONDITIONS" AND "PRESENT USES" IN 1938 STRUCTURED THE "EQUITABLE APPORTIONMENT" OF THE WATERS OF THE RIO GRANDE IN THE UPPER RIO GRANDE BASIN AMONG THE STATES OF COLORADO, NEW MEXICO, AND TEXAS

20. "Present conditions" and "present uses" in 1938 structured the "equitable apportionment" of the waters of the Rio Grande in the Upper Rio Grande Basin among the states of Colorado, New Mexico, and Texas. In developing the basis for an apportionment in the fall of 1937, the Rio Grande Compact engineering advisors "avoided discussion of the relative rights of waters users in the three States," and did not assign each state a fixed quantity of water.[26] They concurred with the Board and the *JIR* that only water from outside the basin could address all on-going and then-planned water uses in the basin fully, and did not consider the development of groundwater as an additional source of supply.[27]

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[24] In the Supreme Court of the United States, October Term, 1951, No. . . . , Original, *State of Texas, Plaintiff, v. State of New Mexico, et al. Defendants, Motion for Leave to File Complaint and Complaint*, 2-3, and 10-14. The complaint was eventually "dismissed because of the absence of the United States as indispensable party. No. 9. *Orig – State of Texas v. State of New Mexico, et al.*, Filed April 28, 1952, 6-24-58. ff. RG 267 Entry 26 TX v. NM #9, Box 459 1957 (Begin TX v. MN #9) to 1957, Entry 26, RG 267, NAB.

[25] In the Supreme Court of the United States, October Term, 1966, No. . . . , Original, *State of Texas and State of New Mexico, Plaintiffs, v. The State of Colorado, Defendant, Motion for Leave to File Complaint and Complaint*, 2-3, and 5-7. This suit was ultimately settled by the states out of court. Vince Taylor, "Colorado's Snow Melt Reaching El Paso: A Status Report on No. 29 Original, U.S. Supreme Court," *Texas Bar Journal* (October 1968): 831-832, 871-872, and 874. ff. B-12.2.6.3 Tri-State Rio Grande Compact Commission 4 of, Oct 1966 thru Mar 1977, Box 6-25, Acc #076-89-0004 6-25, Records of Boundary and Claims Commissions and Arbitrations, Record Group 76, National Archives at Ft. Worth, Texas.

[26] "Report of Committee of Engineers to Rio Grande Compact Commissioners," December 27, 1937, in Proceedings of the Meeting of the Rio Grande Compact Commission . . . New Mexico, March 3rd to March 18th, inc., 1938, Appendix No. 1, 47. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

[27] Raymond A. Hill, Memo to Mr. Clayton: In re Meeting of Committee of Engineers, at Santa Fe, November 22 to 24, 1937, November 26, 1937, 3. [1937], Box 2F467, RGCC-FBCP, UTA; and "Report of Committee of Engineers to Rio Grande Compact Commissioners," December 27, 1937, in Proceedings of the Meeting of the Rio Grande Compact Commission . . . March 3rd to March 18th,

21. The engineers instead focused on distributing the known available water supply to meet existing demands for that water – as Tipton put it, "to permit not only present uses of water, but also to allow increased diversion and consumption of water above Elephant Butte Reservoir by utilizing water which otherwise would spill from that reservoir." The only way Tipton and his fellow advisors found "[t]o accomplish this end" was by developing delivery schedules based on "present conditions" of flow manifesting at the Lobatos gaging station near the Colorado-New Mexico state line, and at Elephant Butte Reservoir, later the San Marcial gaging station.[28]

22. What constituted "present conditions" varied for each upstream section, but each was predicated on data and analyses from the *JIR*. For Colorado's delivery to New Mexico (Article III), those "present conditions" were reflected in the waters reaching the Lobatos "the period 1928 to 1937."[29] Stream flow data and analyses in the *JIR* had suggested a stability in consumptive water use in the San Luis Valley for much of this period, and Tipton was convinced that a state line delivery schedule on this basis would not hamper Colorado proposed developments in the valley.[30]

23. For New Mexico's delivery schedule to Texas (Article IV), those "present conditions" were reflected in the waters reaching San Marcial for "the period prior to 1930."[31] The engineering advisors initially considered a schedule based on Otowi Bridge-San Marcial

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inc., 1938, Appendix No. 1, 47. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

[28] Tipton, *Analysis*, 5-6. ff. 70, Box 44-70, MCHC 1897-1987, HC. In February 1948, the Rio Grande Compact Commission adopted a resolution that, in pertinent part, changed the delivery point from the San Marcial gaging station to the Elephant Butte gaging station. "Minutes of the Ninth Annual (Nineteenth) Meeting of the Rio Grande Commission Held in El Paso, Texas," February 22, 23, 24, 1948, 5-8. ff. Opinions of Attorney Generals concerning switch of Gaging Stations, w. Factual Research, *State of Texas vs. State of New Mexico*, et al, AG No. 51-238, Box 1991/17-188, LF-TAG, TSA.

[29] Tipton, *Analysis*, 6. ff. 70, Box 44-70, MCHC 1897-1987, HC.

[30] *JIR*, 29-30; and Tipton, *Analysis*, 5. ff. 70, Box 44-70, MCHC 1897-1987, HC.

[31] "Letter from Committee of Engineering Advisers," March 9, 1938, in Proceedings of the Meeting of the Rio Grande Compact Commission . . . March 3rd to March 18th, inc., 1938, Appendix No. 7, 61-62; and "Rio Grande Compact," Article IV, in Proceedings of the Meeting of the Rio Grande Compact Commission . . . March 3rd to March 18th, inc., 1938, Appendix No. 11, 76-78. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

relationship for the period roughly between 1912 and 1935, a schedule developed by Hill.[32] According to the *JIR*, the relationship between flows at Otowi Bridge at the head of the Middle Rio Grande Valley and at San Marcial suggested a stability in consumptive use above San Marcial for the period between 1890 and 1935 similar to that found in the San Luis Valley for the period 1927 to 1935. The report, however, acknowledged that the data of tributary inflow between Otowi and San Marcial was poor, and that the impact of MRGCD's operations on downstream flows was difficult to assess.[33] The engineers subsequently decided that a relationship between Otowi Bridge discharge and Elephant Butte inflow (excluding the months of July, August, and September) for a 1915-1937 time frame was a more accurate measure of "present conditions."[34]

24. Objections to this Otowi Bridge-Elephant Butte schedule made by the New Mexico compact commissioner Thomas McClure, prompted by criticisms raised by MRGCD's consulting engineer H.C. Neuffer, led the engineering advisors in March 1938 to return to an Otowi Bridge-San Marcial relation (excluding the months of July, August, and September) "for the period prior to 1930."[35] As later explained by Bliss and McClure, this

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[32] Proceedings of the Meeting of the Rio Grande Compact Commission . . . September 27, to October 1, 1937, 20. Untitled folder 5, Box 2F463, RGCC-FBCP, UTA.

[33] *JIR*, 42-43.

[34] Preliminary Draft of Report of Committee to Rio Grande Compact Commissioners, December 22, 1937, 5. CB-F-137-34, Box 4X215, RAHP, UTA; Tipton, *Analysis*, 6. ff. 70, Box 44-70, MCHC 1897-1987, HC; and "Report of Committee of Engineers to Rio Grande Compact Commissioners," December 27, 1937, in Proceedings of the Meeting of the Rio Grande Compact Commission . . . March 3rd to March 18th, inc., 1938, Appendix No. 1, 42-43. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

[35] H.C. Neuffer, Memorandum, Subject: Report of Committee of Engineers to Rio Grande Compact Commissioners, December 27, 1937, January 6, 1938, np [1-2]. NM_00156900 – NM_00156901 and NM_00156905; H.C. Neuffer, Consulting Engineer, to Mr. John H. Bliss, State Engineer's Office, Re: Report of Committee of Engineers to Rio Grande Compact Commissioners, December 27, 1937, January 7th, 1938. NM_00054005; [H.C. Neuffer] to Mr. Thomas M. McClure, State Engineer, January 13, 1938; Thomas M. McClure, State Engineer, to Mr. S.O. Harper, Chairman, Rio Grande Compact Commission, January 25th, 1938; and "Letter from Committee of Engineering Advisers," March 9, 1938, in Proceedings of the Meeting of the Rio Grande Compact Commission . . . March 3rd to March 18th, inc., 1938, Appendix No. 7, 61. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

different time scale avoided the effects of development in the MRGCD since 1929.[36] Nevertheless, according to Bliss, "[t]he Compact recognize[d] by implications, in several of its provisions storage in Elephant Butte reservoir" – and waters for the Rio Grande Project which served lands in Texas – were "prior in right to storage in reservoirs constructed in the Rio Grande basin after 1929."[37]

25. These schedules effectively froze upstream depletions to "present conditions" that would not compromise "present uses" downstream, circa 1938. The potential for increased upstream depletions were strictly addressed through a system of credits and debits, adopted as Article VI, and were ultimately contingent on downstream uses being met.[38] Colorado, pursuant to this credits-and-debits system, was permitted to pursue post-1937 reservoir construction.[39] Similarly, New Mexico, like Colorado, could depart from its delivery schedule; it could hold water in "reservoirs constructed after 1929" pursuant to the Article VI credits-and-debits system.[40] Yet, in accordance with Article VIII, New Mexico could call upon Colorado to release the water in its reservoirs to satisfy the upstream state's accrued debits, and Texas could call upon both upstream states to release water from

[36] J.H. Bliss, Engineer, "Provisions of the Rio Grande Compact," Santa Fe, N.M., April 2, 1938, 1. ff. Rio Grande Compact Engineer-Adviser Data, 1937-1938, Box No. 27, Accession Number 7978, John H. Bliss Collection [JHBC], American Heritage Center, University of Wyoming, Laramie [hereafter AHC]; and Thomas B. McClure, State Engineer, "Analysis of the Compact," undated, 21. NM_00164500.

[37] Bliss, "Provisions of the Rio Grande Compact," 4. ff. Rio Grande Compact Engineer-Adviser Data, 1937-1938, Box No. 27, Accession Number 7978, JHBC, AHC.

[38] "Rio Grande Compact," Article VI, in Proceedings of the Meeting of the Rio Grande Compact Commission . . . March 3rd to March 18th, inc., 1938, Appendix No. 11, 78-79. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

[39] "Rio Grande Compact," Article III, in Proceedings of the Meeting of the Rio Grande Compact Commission . . . March 3rd to March 18th, inc., 1938, Appendix No. 11, 74-76 and 78-79. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

[40] "Rio Grande Compact," Article VI, in Proceedings of the Meeting of the Rio Grande Compact Commission . . . March 3rd to March 18th, inc., 1938, Appendix No. 11, 74-76. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

"reservoirs constructed after 1929" to satisfy accrued debits.[41] Correspondingly those debits were forgiven when "actual spill" from Elephant Butte occurred.[42]

26. The "present uses" for the apportioned Rio Grande water were left unstated in the Compact, but the positions articulated by the states throughout the Compact negotiations leave little doubt that these uses encompassed the plans Colorado had for its San Luis Valley, New Mexico's Middle Rio Grande development, and the Rio Grande Project through which Texas obtained its apportioned water. For the Project in particular, as Bliss suggested, various Compact provisions recognized its essential importance and protected it. Article IV required "appropriate adjustments" to be made to New Mexico's delivery schedule at San Marcial for "depletion after 1929 . . . at any time of the year of the natural runoff at Otowi Bridge" and "depletion of the runoff during July, August, and September of tributaries between Otowi Bridge and San Marcial by works constructed after 1937." Article VII limited the amount of water the two upstream states could store in post-1929 reservoirs to ensure a minimum amount of water in Rio Grande "project storage." Article VIII further provided for an average or "normal release of 790,000 acre-feet" from Rio Grande Project storage.[43]

27. United States compact commissioner S.O. Harper also believed the Compact was inclusive of the Project's water supply. Days following the conclusion of the Compact negotiations, he informed the Secretary of the Interior that not only was the Compact "an eminently fair and equitable solution" but also that U.S. "interests" were "fully safeguarded" in the Compact, in part as a result of the "inclusion, in the State allocations, of all water to which Federal irrigation projects are entitled."[44]

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[41] "Rio Grande Compact," Article VIII, in Proceedings of the Meeting of the Rio Grande Compact Commission . . . March 3rd to March 18th, inc., 1938, Appendix No. 11, 80. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

[42] "Rio Grande Compact," Article I and Article VI, in Proceedings of the Meeting of the Rio Grande Compact Commission . . . March 3rd to March 18th, inc., 1938, Appendix No. 11, 73 and 78-79. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

[43] "Rio Grande Compact," Article IV, Article VII, Article VIII, in Proceedings of the Meeting of the Rio Grande Compact Commission . . . March 3rd to March 18th, inc., 1938, Appendix No. 11, 77-78 and 79-80. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

[44] S.O. Harper, Chairman, Rio Grande Compact Commission, to The Honorable, The Secretary of the

28. Although the Compact permitted Colorado and New Mexico to pursue other irrigation developments while protecting the Project, it did not explicitly limit water use to irrigation. Any use of the apportioned waters was permissible, as Hill testified when deposed in the original action against Colorado in the 1960s: "subject only to the maintenance of depletions that had occurred, subject only to not increasing those overall depletions, there is a freedom in each State to store, develop, improve or do anything else within that State."[45]

THE WATER APPORTIONED TO TEXAS BY THE 1938 COMPACT WAS THE WATER TO BE DELIVERED BY NEW MEXICO TO SAN MARCIAL, SUFFICIENT TO ENABLE "A NORMAL RELEASE OF 790,000 ACRE-FEET" OF WATER FROM RIO GRANDE PROJECT STORAGE

29. The water apportioned to Texas by the 1938 Compact was the water to be delivered by New Mexico to San Marcial, sufficient to enable "a normal release of 790,000 acre-feet" of water from Rio Grande Project storage.[46] BOR pursued the Project in the early 1900s to mollify water users in Mexico, New Mexico, and Texas. Those users all protested upstream diversions in Colorado, contending that those diversions had deprived them of the flows that until the late-nineteenth century had reached their lands. Initially, an "international dam" at El Paso was contemplated to supply both the United States and Mexican irrigators. Subsequent assessment by federal engineers, however, identified a dam site at the geological formation in New Mexico known as Elephant Butte – more than 100 miles from the present New Mexico-Texas state line – as providing the opportunity to water the most land within the United States while also serving Mexico. Presented to the 1904 National Irrigation Congress

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Interior, Washington, D.C., Re: Rio Grande Compact, March 26, 1938, 2. ff. 032.1 Box No. 936, Entry 7, RG 115, NARA Denver.

[45] In the Supreme Court of the United States, October Term 1967, No. 29, Original, *State of Texas and New Mexico, Plaintiffs, vs. State of Colorado, Defendant,* Deposition of: Raymond A. Hill, Taken December 4, 1968, Denver, Colorado, 36. ff. *Texas & New Mexico v. Colorado*, w. *Texas vs. Colorado* 66-1061, Box 1989 41-240, LF-TAG, TSA.

[46] "Rio Grande Compact," Article VIII, in Proceedings of the Meeting of the Rio Grande Compact Commission . . . March 3rd to March 18th, inc., 1938, Appendix No. 11, 80. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

in El Paso, the proposed Elephant Butte Dam received the endorsement of delegates from Mexico, New Mexico, and Texas.[47]

30. Although there were two separate irrigation districts that contracted for the water appropriated for the Project, Elephant Butte Irrigation District ("EBID") in New Mexico and El Paso County Water Improvement District No. 1 ("EP #1") in Texas, BOR treated the Project "as an administrative unit" in Clayton's words.[48] Project infrastructure was built largely without regard to state boundaries, and diversions to serve lands in Texas were made within New Mexico.[49]

31. These circumstances shaped the Compact. Both McClure and Bliss acknowledged, as Clayton had, that the "Project must be operated as a unit."[50] Consequently, as Bliss noted in recommending the Compact's adoption, "no schedule of releases from Elephant Butte Project storage" was provided aside from the 790,000-af "normal release" provision (Article VIII).[51]

32. Texas contemplated asking for a state-line delivery in the 1930s, but decided against it because of the Project.[52] As far back as the 1929 temporary compact, New Mexico

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[47] *International Dam in Rio Grande River, Near El Paso, Tex.*, 54th Cong., 1st sess., 1896, H. Doc. 125, 1-6; Guy Elliott Mitchell, ed., *The Official Proceedings of the Twelfth National Irrigation Congress, Held at El Paso, Texas, Nov. 15-16-17-18, 1904* (Galveston, TX: Clarke & Courts, 1905), 107-109 and 214-216; and B.M. Hall, Supervising Engineer, U.S. Reclamation Service, "A Discussion of Past and Present Plans for Irrigation of the Rio Grande Valley," November 1904, 3-8, and 56-57. ff. 46 Rio Grande Project. Penasco Rock Resv. Site-Elephant Butte Resv. Site, 1904-1905, Box No. 792 Rio Grande 17-46, Entry 3, RG 115, NARA Denver.

[48] Frank B. Clayton, Rio Grande Compact Commissioner for Texas, to Mr. Sawnie B. Smith, October 4, 1938, 1. Box 2F466, RGCC-FBCP, UTA.

[49] Clayton to Smith, October 4, 1938, 1. Box 2F466; and *Proceedings of Meeting Held on Friday, May 27, 1938 at El Paso, Texas, between Representative of Lower Rio Grande Water Users and Representatives of Irrigation Districts Under the Rio Grande Project of the Bureau of Reclamation*, 15. ff. Proceedings and Minutes 1935-1938, Box 2F463, RGCC-FBCP, UTA.

[50] Thomas B. McClure, State Engineer, "Analysis of the Compact," undated, 21-22. NM_00164500; and Bliss, "Provisions of the Rio Grande Compact," 1. ff. Rio Grande Compact Engineer-Adviser Data, 1937-1938, Box No. 27, Accession Number 7978, JHBC, AHC.

[51] Bliss, "Provisions of the Rio Grande Compact," 1 and 3. ff. Rio Grande Compact Engineer-Adviser Data, 1937-1938, Box No. 27, Accession Number 7978, JHBC, AHC.

[52] Raymond A. Hill to Mr. Frank B. Clayton, February 8, 1938. Box 2F466; and *Proceedings of Meeting Held on Friday, May 27, 1938*, 10 and 11. ff. Proceedings and Minutes 1935-1938, Box 2F463, RGCC-FBCP, UTA.

and Texas acknowledged that "New Mexico's obligations . . . must be in reference to deliveries at Elephant Butte reservoir [i.e., San Marcial]," as Clayton explained to attorney Sawnie Smith in October 1938. Federal control of the dam and Project works, spanning across New Mexico and Texas, anticipated to continue, defeated any effort to establish obligations for the upstream states for a specific quantity of water to Texas in 1938. "[N]either Colorado nor New Mexico," the Texas commissioner stressed, "could be expected to guarantee any fixed deliveries at the Texas line" owing to those circumstances.[53] Clayton made this same point to state representative Homer L. Leonard in August 1938, observing that the upper states' "only responsibility was to see that Texas' equitable share was delivered at the state line, or, rather, delivered into Elephant Butte reservoir, which is the point of control."[54] San Marcial was thus the *de facto* state line delivery to Texas.[55]

33. Texas concentrated on safeguarding the Rio Grande Project water supply throughout the Compact negotiations for only through the Project did Rio Grande waters reach lands in Texas. It was joined in this effort by EBID in New Mexico. The shared interest of EBID and Texas in limiting depletions above Elephant Butte reflected their mutual dependence on the waters captured and released from the dam. Clayton pointed this out to water users in Texas below Ft. Quitman in May 1938, telling them, "[a]s far as they [EBID] and we are concerned, our source is the same. If the supply is impaired above Elephant Butte, we all suffer alike."[56]

34. Water released from the federal dam to serve lands in EBID under federal contract formed a portion of the water supply to Texas, manifesting as return flows to the channel or in Project drains once those waters had been used within New Mexico. In the

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[53] Clayton to Smith, October 4, 1938, 1. Box 2F466, RGCC-FBCP, UTA.

[54] Frank B. Clayton, Rio Grande Compact Commissioner for Texas, to Hon. Homer L. Leonard, August 3, 1938, 2. Box 2F466, RGCC-FBCP, UTA.

[55] *Proceedings of Meeting Held on Friday, May 27, 1938*, 10, 11, and 15. ff. Proceedings and Minutes 1935-1938, Box 2F463, RGCC-FBCP, UTA.

[56] *Proceedings of Meeting Held on Friday, May 27, 1938*, 11. ff. Proceedings and Minutes 1935-1938, Box 2F463, RGCC-FBCP, UTA.

1910s, federal engineers and BOR officials recognized that return flows could help meet downstream demands.[57] Although such flows became of poorer quality (higher in salts) down through the Project, both Project lands in the El Paso Valley of Texas in EP #1 and lands in Hudspeth County outside the Project were dependent upon return flows by the 1920s.[58] Water users within Hudspeth County Conservation and Reclamation District No. 1 ("Hudspeth") were permitted by a federal Warren Act contract to divert water passed beyond the Project only when those waters were "available."[59] However, Project releases from Elephant Butte to EP #1 intended to improve the quality of water reaching EP #1 lands indirectly benefitted Hudspeth.[60]

35. Reliance on return flows within and from the Project explains why Texas in October 1937 asked that Colorado and New Mexico "release and deliver at San Marcial a supply of water sufficient to assure the release annually from Elephant Butte Reservoir of

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[57] United States Congress, House of Representatives, *Fund for Reclamation of Arid Lands: Message from the President of the United States, Transmitting a Report of the Board of Army Engineers in Relation to the Reclamation Fund*, H. Doc. No. 1262, 61st Cong. 3d sess. (1911-12), 106; "Water Supply of Rio Grande, from Official Records, 1912," 4-5, enclosed with A.P. Davis, Chief Engineer, Memorandum for Secretary Lane, April 17, 1913. File 8-3 (Part 4) Reclamation Service, Rio Grande Project, New Mexico, Rio Grande River, Distribution of Waters, Nov. 21, 1912 – Apr. 17, 1914, Box No. 1639 8-3, Rio Grande D-E, CCF 1907-1936, RG 48, NARA II; and Harold Conkling, Engineer, and Erdman Debler, Asst. Engr., Water Supply for and Possible Developments on Irrigation and Drainage Projects on the Rio Grande River Above El Paso, Texas, June-1919, 110-112. ff. 302.31, New Mexico. Report dated June 1919 by Conkling and Debler on Water Supply for and Possible Developments on Irrigation and Drainage Projects on the Rio Grande River Above El Paso, Texas, transmitted by letter July 15, 1919, Box 262 302.28--302.31 A. NV-NM, Entry 7, RG 115, NARA Denver.

[58] E.B. Debler, Engineer, Bureau of Reclamation, "Return Flow and Its Problems on Reclamation Projects," *New Reclamation Era* (August, 1927), 125. ff. 030.1, Box 33, General Files, 1919-1929, Entry 7, RG 115, NARA Denver, and *JIR*, 85-86, 99-104, and 403.

[59] Contract, Ilr-493, Hudspeth County Conservation & Reclamation District, December 1, 1924, Department of the Interior, Bureau of Reclamation, Contract Between the United States and Hudspeth County Conservation and Reclamation District No. 1, Providing for the Rental of Water to the District, December 1, 1924, 2. ff. 223.02 Rio Grande Water, Hudspeth County Conservation & Reclamation District, Transfer Case, Thru 1929, Box 907 Rio Grande 223.02, Entry 7, RG 115, NARA Denver.

[60] *Proceedings of Meeting, held on Friday, May 27, 1938*, 16, 17, and 25. ff. Proceedings and Minutes 1935-1938, Box 2F463, RGCC-FBCP, UTA; and L.R. Fiock, Superintendent to Commissioner, Subject: Protest of Hudspeth County Conservation and Reclamation District No. 1 – Rio Grande Project, May 22, 1939, 4. ff. 301 Rio Grande Project - Board and Engineering Report on Construction Features, Jan 1, 1937, Box 927 Rio Grande Pro. 246. - 301., Entry 7, RG 115, NARA Denver.

800,000 acre-feet of the same average quality as during the past ten years . . . ."[61] This was a figure that Hill had calculated would provide lands in Texas with a sufficient quantity and quality of water while also meeting the Mexican treaty obligation.[62] The *JIR* and Bliss assessed lower quantities for Texas but both appreciated the importance of return flows for lands in the downstream state. The *JIR* offered 773,000 af as a "conservative estimate," with "necessary allowances for drain flow, wastes, arroyo inflow, and "salinity control."[63] During the engineering advisors' meetings in late 1937, Bliss estimated 750,000 af as sufficient for the Elephant Butte-Ft. Quitman section, and made provision for water to Hudspeth (water that would have included return flows from upstream diversions) and the achievement of a "salt balance" down to Ft. Quitman (recognition that lands downstream relied on poor-quality return flows).[64]

36. The engineering advisors initially agreed to an 800,000-af release, linking this release to a delivery schedule based on an Otowi Bridge-Elephant Butte relationship, before revising this figure downward along with changing the schedule in March 1938.[65] As with the change to the delivery schedule, criticism by Neuffer led to this revision. The MRGCD consulting engineer believed that a 700,000-af release from Elephant Butte was "liberal," but was willing to accept as much as a 750,000 af release. Despite not making specific provision for lands outside the Project, Neuffer's own allowances for "[u]navoidable project wastes

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[61] Proceedings of the Meeting of the Rio Grande Compact Commission . . . September 27, to October 1, 1937, 13. Untitled folder 5, Box 2F463, RGCC-FBCP, UTA.

[62] *State of Texas vs. State of New Mexico, et al*, *Plaintiff's Case in Chief*, Volumes V, VI & VII, 1202-1206, 1220-1221, and 1235-1236. CB-F-171A thru CB-F-1716: Transcripts of TX v. NM, Vol. 1-16, Box 4X219, RAHP; and Hill to Clayton, November 26, 1937, 2. [1937], Box 2F467, RGCC-FBCP, UTA.

[63] *JIR*, 103-104.

[64] [Raymond Hill], "TEXAS COMPACT: John Bliss Estimate of Project Requirements at Elephant Butte," 12/17/37, and "John Bliss Estimate of Project Requirements at Elephant Butte," typescript, n.d. CB-F-137-34, Box 4X215, RAHP, UTA.

[65] "Report of Committee of Engineers to Rio Grande Compact Commissioners," December 27, 1937, in Proceedings of the Meeting of the Rio Grande Compact Commission, Held at Santa Fe, New Mexico, March 3rd to March 18th, inc., 1938, Appendix No. 1, 45. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver. Both the 800,000-af release and the later 790,000-af release (as discussed below) were subject to the 60,000-af Mexican treaty obligation.

below Riverside heading" and "[w]inter discharge of Project drains in New Mexico not redivertable" in that release figure would have entailed return flows for lands in Hudspeth.[66]

37. New Mexico's actions in the Compact negotiations demonstrated little concern about lands below Elephant Butte; it instead focused on the lands above San Marcial. With Texas advocating for the Rio Grande Project water supply, New Mexico appeared willing to cede EBID's interests to Texas in order to secure water for the Middle Rio Grande.[67] McClure's responsiveness to Neuffer's opposition to the higher release figure and the original schedule – both of which would have benefitted EBID – is indicative of this. Hinderlider and Clayton were critical of their New Mexico counterpart for listening to the MRGCD engineer, with the latter insisting to Harper in January 1938 that McClure "seems to lose sight of the fact that there is a very extensive section of his own State lying below the Elephant Butte dam . . . ."[68]

38. In March 1938, Texas agreed to a smaller figure of 790,000 af for a "normal release," or average release, and this was adopted as Article VIII in the Compact along with the new delivery schedule (Article IV).[69] Thirty years after the Compact had been signed, Hill explained that the 790,000 af figure recommended by him and his fellow engineers and adopted in the Compact was 730,000 af "for uses in the United States and sixty [thousand] for uses in Mexico . . . ."[70] Those "uses in the United States" were the "present uses" at the time of the Compact.

[66] Neuffer to Bliss, January 7th, 1938. NM_00054005; and Neuffer, Memorandum, January 6, 1938, np [2-3, and 6]. NM_00156901 – NM_00156902 and NM_00156905.

[67] Hill to Clayton, February 8, 1938. Box 2F466, Box 2F463, RGCC-FBCP, UTA.

[68] Frank B. Clayton, Rio Grande Compact Commissioner for Texas, to Mr. S.O. Harper, Chairman, Rio Grande Compact Commission, January 27, 1938; and M.C. Hinderlider, Commissioner for Colorado, to S.O. Harper, Chairman, Rio Grande Compact Commission, February 4, 1938. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

[69] "Letter from Committee of Engineering Advisers," March 9, 1938, in Proceedings of the Meeting of the Rio Grande Compact Commission . . . March 3rd to March 18th, inc., 1938, Appendix No. 7, 65; and "Rio Grande Compact," Article VIII, in Proceedings of the Meeting of the Rio Grande Compact Commission . . . March 3rd to March 18th, inc., 1938, Appendix No. 11, 80. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

[70] Deposition of Raymond A. Hill, Taken December 4, 1968, Denver, Colorado, 18. ff. Texas & New Mex. v. Colo., w. 66-1061 Texas vs. Colorado, Box 1989 41-240, LF-TAG, TSA.

39. This release figure consequently constrained the Rio Grande waters apportioned to Texas. The water supply the City of El Paso obtained from Elephant Butte in the early 1940s illustrates this. Because the apportionment was defined consistent with the Project, El Paso was only able to secure this water through the acquisition of Project lands within EP #1.[71] Releases from the federal dam in accordance with Project operations would have served those EP #1 lands with water, by direct diversion and return flows, as of 1938.

40. The same Compact provisions that protected the Project against upstream depletions ensured that Texas would receive its apportionment. A 790,000-af average release from Elephant Butte; adjustments to be made in New Mexico's delivery to San Marcial for increased depletions after 1929 at Otowi Bridge and "for works constructed after 1937" above San Marcial (Article IV); and limitations on the water that Colorado and New Mexico could store above San Marcial "in reservoirs constructed after 1929" to provide a minimum amount of "project storage" (Article VII) all assured Texas some water via the Project. Article VIII, moreover, gave the Texas Rio Grande Compact Commissioner the sole authority to call for releases from post-1929 reservoirs in Colorado and New Mexico that would result in a 790,000-af release – underscoring Texas's dependence on the waters to be delivered to Elephant Butte and delivered by the Project.[72]

41. The absence of a state-line delivery requirement confounded some in Texas below Ft. Quitman who expected the Compact to apportion the Rio Grande down to the Gulf

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[71] H.W. Bashore, Acting Commissioner, to Mr. W.E. Robertson, Chairman, Water Development Commission of the City of El Paso, Jul 25, 1940; Memorandum for Mr. Stinson (Harrell), Subject: Rio Grande Project – Sale of water to City of El Paso for supplemental supply for Municipal purposes, January 17, 1941, 2-4. ff. 223.02 Rio Grande – Leases, Sales & Rentals of Water, El Paso, City of, thru Dec 1941, Box 920 Rio Grande Pro. 223.02, Entry 7, RG 115, NARA Denver; John C. Page, Commissioner, to The Secretary of the Interior, Feb 17, 1941; and J. Kennard Cheadle, Acting Commissioner, to The Secretary of the Interior, Nov 22, 1944. File No. 8-3 (Part 8), Reclamation Bureau, Rio Grande Project, Distribution of Waters, General, January 27, 1937 thru February 10, 1950, 8-3 Rio Grande-Distribution-Waters-General, Box 3623 8-3 Rio Grande-Contracts-Nelson, J.P. 8-3 Rio Grande Flood Control, Central Classified Files, 1937-1953, RG 48, NARA II.

[72] Proceedings of the Meeting of the Rio Grande Compact Commission . . . March 3rd to March 18th, inc., 1938, 31-33; and "Rio Grande Compact," Articles IV, VII, and VIII, in Proceedings of the Meeting of the Rio Grande Compact Commission . . . March 3rd to March 18th, inc., 1938, Appendix No. 11, 77-78, 79, and 80. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

of Mexico. Yet, for Clayton the matter was clear. His "duty," as he informed lower Rio Grande water users in May 1938, "[was] to see Texas got every drop of water originating in Colorado and New Mexico that she was entitled to and to see that that water was delivered into the Elephant Butte Reservoir," and "[b]y that compact [i.e., the Compact of 1938] Texas got all she was entitled to. . . ."[73]

42. That entitlement, Clayton emphasized to lower Rio Grande water users and their representatives, was for water for lands above Ft. Quitman. In explaining to Smith in particular in October 1938 why there was no state line delivery for Texas, the compact commissioner also pointed to existing federal contracts for water from the Project – the contracts between the United States and EBID and EP #1 as well as the contract between EBID and EP #1 and Hudspeth's Warren Act contract – as providing further assurance that those lands would receive their due.[74]

43. The contracts involving the United States, EBID, and EP #1, referenced by Clayton and identified by the Supreme Court in this original action as the "Downstream Contracts," however, did not prescribe specific quantities of water to either Project district. The Downstream Contracts, executed contemporaneous with the Compact, were: (1) the November 9, 1937 United States-EBID contract, (2) the November 10, 1937 United States-EP #1 contract, and (3) the February 16, 1938 EBID-EP #1 contract. All these agreements primarily concerned the obligations of EBID and EP #1 to repay the federal investment in the Project, pursuant to the 1902 Reclamation Act, its subsequent amendments, and the 1905 act authorizing the Project.[75]

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[73] *Proceedings of Meeting, held on Friday, May 27, 1938*, 10. ff. Proceedings and Minutes 1935-1938, Box 2F463, RGCC-FBCP, UTA.

[74] Clayton to Smith, October 4, 1938, 1. Box 2F466, RGCC-FBCP, UTA.

[75] Contract Dated Nov. 9, 1937, Ilr-982, Elephant Butte Irrigation District (Adjustment of project construction charges and other purposes), United States, Department of the Interior, Bureau of Reclamation, Rio Grande Project, New Mexico-Texas, Contract between the United States and the Elephant Butte Irrigation District adjusting construction charges and for other purposes. ff. 222.- Rio Grande Project. Contracts with Elephant Butte Irrigation District, Separate Folder, Box No. 917, Rio Grande Pro. 222._222.-; Contract Dated Nov. 10, 1937, Ilr-981, El Paso County Water Improvement District No. 1 (Adjustment of project construction charges and other purposes), United States,

44. The 1902 Reclamation Act, or Newlands Act, created a federal program to irrigate the arid West through the construction of large-scale irrigation projects. Water users within these projects were required to repay the United States for the costs of construction over a period of years.[76] On the Rio Grande Project, the repayment obligation was dealt with first in a 1906 agreement between the United States and the Elephant Butte Water Users Association and the El Paso Valley Water Users Association, and then later in individual contracts to both districts in 1918 and 1920 following the dissolution of these associations.[77]

45. Agricultural surpluses in the 1920s and the Great Depression of the 1930s undercut farming prices and undermined the ability of users to meet their repayment obligations.[78] Congress thus amended reclamation law to provide relief to Project water users.[79] These amendments paved the way for the Downstream Contracts. In their 1937

Department of the Interior, Bureau of Reclamation, Rio Grande Project, New Mexico-Texas, Contract between the United States and the El Paso County Water Improvement District No. 1, adjusting construction charges and for other purposes. ff. 222.- Rio Grande Project. Irrigation Districts, El Paso County Water Improvement District No. 1, Separate Folder, Box No. 918 Rio Grande Pro. 222._222.-; and Contract between Elephant Butte Irrigation District of New Mexico and El Paso County Water Improvement District No. 1 of Texas, signed February 16, 1938, and approved by Assistant Secretary of the Interior Oscar L. Chapman, April 11, 1938. ff. 400. Rio Grande, Lands-General, 1930 thru, Box 932 Rio Grande Pro. 400.__400.08, Entry 7, RG 115, NARA-Denver.

[76] *An Act Appropriating the receipts from the sale and disposal of public lands in certain States and Territories to the construction of irrigation works for the reclamation of arid lands*, June 17, 1902, chap. 1093, Public, No. 161, 32 Stat. 388.

[77] Articles of Agreement by and between the U.S., acting in this behalf by Jesse E. Wilson, Acting Secretary of the Interior, and the Elephant Butte Water Users' Association of New Mexico and the El Paso Valley Water Users' Association, June 27, 1906. ff. 330-B Rio Grande. Contracts with Elephant Butte Irri. Dist., Transfer Case, Box 817 Rio Grande 330B- -348C, Entry 3; Department of the Interior, Bureau of Reclamation, Rio Grande Project-New Mexico-Texas, Contract Dated June 15, 1918 – between The United States of America and The Elephant Butte Irrigation For Repayment of Construction and Operation and Maintenance Charges; and Department of the Interior, Bureau of Reclamation, Rio Grande Project-New Mexico-Texas, Contract Dated January 17, 1920 between The United States of America and The El Paso County Water Improvement District No. 1, For Repayment of Construction and Operation and Maintenance Charges, in Department of the Interior, Bureau of Reclamation, Rio Grande Irrigation Project, New Mexico-Texas, Contracts with Water User's Organizations (Copies), Compiled November 1, 1929. 232-29 RG Separate Folder, 249-H, Contracts with Water Users, Box 716 Old Box 509-510, Code 104.RG 37 through Code 402.RG 28, Engineering and Research Center, Project Reports, 1910-55 [hereafter PR 1910-55], RG 115, NARA Denver.

[78] Donald J. Pisani, *Water and American Government: The Reclamation Bureau, National Water Policy, and the West, 1902-1935* (Albuquerque: University of New Mexico Press, 1992), 149-150.

[79] *An Act For the temporary relief of water users on irrigation projects constructed and operated under the reclamation law*, April 1, 1932, 47 Stat. 75, chapter 94; *An Act To extend the operation of*

contracts with the United States, the districts relinquished their rights to hydroelectric power revenue from Elephant Butte in order to reduce their repayment obligations.[80] The 1938 contract executed between the two districts, and approved by the United States, memorialized the historical distribution of repayment costs for storage and general project features between EBID and EP#1 on the basis of the respective irrigated acreages, permitting a three-percent expansion in that acreage in any one year "to be subject to construction charges."[81]

46. For its part, New Mexico later directly acknowledged that the waters delivered to San Marcial, pursuant to the Compact, were for the benefit of lands in Texas above Ft. Quitman. In the state's reply to Texas's 1951 complaint in the Supreme Court, approved by former New Mexico engineering advisor and now New Mexico State Engineer John Bliss, it argued that the Compact "does not attempt to make an apportionment between the New Mexico area and the Texas area below Elephant Butte." This statement was evocative of Clayton, McClure, and Bliss's observations at the time of the Compact that the Project functioned as "an administrative unit" or "operated as a unit." New Mexico with Bliss's assent, however, went further in 1951. The state asserted that "the natural dependable flow of the river below San Marcial was over-appropriated in 1906," and in the absence of Project storage "no substantial quantity of water would be available for use in Texas."[82]

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the Act entitled, "An Act For the temporary relief of water users on irrigation projects constructed and operated under the reclamation law," approved April 1, 1932, March 3, 1933, 47 Stat. 1427, chapter 200.

[80] Contract Dated Nov. 9, 1937, Ilr-982, Elephant Butte Irrigation District (Adjustment of project construction charges and other purposes), Articles 3-5, 2-4. ff. 222.-, Box No. 917; Contract Dated Nov. 10, 1937, Ilr-981, El Paso County Water Improvement District No. 1 (Adjustment of project construction charges and other purposes), Article 3-5, 2-4. ff. 222.-, Box No. 918, RG 115, NARA Denver.

[81] Contract between Elephant Butte Irrigation District of New Mexico and El Paso County Water Improvement District No. 1 of Texas, signed February 16, 1938, 1. ff. 400. Box 932, Entry 7, RG 115, NARA-Denver.

[82] In the Supreme Court of the United States, October Term, 1951, No . . . ., Original, *State of Texas, Plaintiff, v. State of New Mexico, et al., Defendants, Return of Defendants to Rule to Show Cause* [December 15, 1951], 3 and 8. ff. RG 267 Entry 26 TX v. NM #9, Box 459 1957 (Begin TX v. MN #9) to 1957, Entry 26, RG 267, NAB.

THE HISTORICAL RECORD INDICATES THAT GROUNDWATER WAS NOT CONSIDERED A SOURCE OF WATER AUGMENTATION TO THE EXISTING SURFACE WATER SUPPLY AT THE TIME OF THE COMPACT – AND SINCE AT LEAST THE 1950S THE NEW MEXICO STATE ENGINEER HAS BEEN AWARE THAT GROUNDWATER PUMPING COULD DEPLETE SURFACE WATERS BELOW ELEPHANT BUTTE RESERVOIR

47. The historical record indicates that groundwater was not considered a source of water augmentation to the existing surface water supply at the time of the Compact – and since at least the 1950s, the New Mexico State Engineer has been aware that groundwater pumping could deplete surface waters below Elephant Butte Reservoir. Investigations prior to and following construction of Elephant Butte found that the surface flow of the Rio Grande and the surrounding groundwater were hydrologically connected. United States Geological Survey ("USGS") hydrologist Charles Slichter in 1904 was the first to identify this relationship in lower New Mexico's Mesilla Valley as part of the investigation leading to the Rio Grande Project. He informed the delegates to the 1904 National Irrigation Congress that the valley's groundwater derived from the Rio Grande itself.[83] An overlapping investigation by fellow USGS hydrologist Willis Lee released in 1907 concurred in Slichter's assessment.[84]

48. An independent study by New Mexico engineering advisor John Bliss, made at the suggestion of Rio Grande Project superintendent L.R. Fiock and provided to New Mexico State Engineer and Rio Grande Compact commissioner Thomas McClure in February 1936, uncovered a "direct relation" between surface flow and the surrounding groundwater downstream of the federal dam. At certain critical points between Elephant Butte and El Paso, Bliss found that Rio Grande underflow fed the groundwater table, providing basin lands

[83] Mitchell, ed., *The Official Proceedings,* 218. Slichter subsequently reiterated this finding in his published study in 1905. Charles S. Slichter, *Observations on the Ground Water of Rio Grande Valley*, Department of the Interior, United States Geological Survey Water-Supply and Irrigation Paper No. 141 (GPO, 1905), 27.

[84] Willis T. Lee, *Water Resources of the Rio Grande Valley in New Mexico and their Development*, Department of the Interior, United States Geological Survey Water-Supply and Irrigation Paper No. 188 (GPO, 1907), 41 and 49-50.

with additional water that was recovered by project drains and returned to the river channel for use on lands downstream.[85]

49. The interconnection between the surface flow of the Rio Grande and the groundwater was apparent in the "water logging" of Project lands, which made construction of drainage works necessary in Mesilla Valley the 1910s.[86] By returning excess ground water to the stream or otherwise making it available for lands downstream, drains ensured that the water table remained in balance, that the root zones of crops were not flooded.[87]

50. Groundwater pumping had occurred in the Mesilla Valley prior to the Project but declined as users opted for surface water deliveries from Elephant Butte.[88] The Project, in turn, came to rely upon the use of return flows from upstream diversions to meet irrigation demands to those lands furthest from Elephant Butte. In the early 1910s, as completion of the dam neared, federal authorities in recognition of the importance of these return flows asserted claims "to all waste, seepage, spring, and percolating water arising within the project" with the intent "to use such water in connection therewith."[89]

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[85] John H. Bliss, "Report on Investigation of Invisible Gains and Losses in the Channel of the Rio Grande from Elephant Butte to El Paso." Feb. 1936, 1-2 and 9-12. Folder 1435, Bliss, Report on Investigation of Invisible Gains and Losses in the Channel of the Rio Grande from Elephant Butte to El Paso, February 1936, Box 55, State Engineer Reports: Rio Grande, Exps. 161-163, Nos. 1417-1437, NMSRCA.

[86] Memorandum, From: Board of Engineers: E.H. Baldwin, Rio Grande Project Supervising Engineer; L.C. Hill, Consulting Engineer; D.W. Murphy, Engineer in charge of Drainage and L.M. Lawson, Project Manager, To: Reclamation Commission, Subject: Report on Drainage – Rio Grande Project, April 7, 1915, 2. Vol. 495, New Mex.-Texas, Rio Grande, Board of Engineers Report, ff. Rio Grande, 1904, Box 474 Rio Grande (NM-TX), Entry 10 Project Histories, Feature Histories, and Reports 1902-32 [hereafter Entry 10], RG 115, NARA Denver.

[87] Memorandum, From: Board of Engineers, To: Reclamation Commission, Subject: Report on Drainage – Rio Grande Project, April 7, 1915, 2-8. Vol. 495, Box 474, Entry 10; "Report on Mesilla & El Paso Valley Drainage, Rio Grande Project, February, 1917, 2-25. ff. Report on Mesilla & Rio Paso Valley Drainage Feb 1917; L.R. Fiock, Ass't Engineer, History of Drainage on the Rio Grande Project, To December 31st, 1918, Investigations, Plans and Estimates, Surveys and Construction, Chapter VI, Department of the Interior, United States Reclamation Service, Rio Grande Project – New Mexico, Texas, Annual History – 1918, in Department of the Interior, US Reclamation Service, Rio Grande Project, Texas New Mexico, Drainage. 530-18 RG, Box 723 [Old Box 512] Code 520 RG 14 through Code 550 RG 42, PR 1910-55, RG 115, NARA Denver.

[88] C. S. Conover, *Ground-Water Conditions in the Rincon and Mesilla Valleys and Adjacent Areas in New Mexico*, Geological Survey Water-Supply Paper 1230, Prepared in cooperation with the Elephant Butte Irrigation District, Department of the Interior (GPO, 1954), 9.

[89] *Twelfth Annual Report of the Reclamation Service, 1912-1913* (GPO, 1914), 176. U.S. Department

51. There is little evidence that federal or state engineers in the years leading up to the Compact conceptualized underlying groundwater as a separate, independent supply for the Mesilla Valley or the basin. Those that contemplated the possibility of groundwater extraction to expand Project lands in the 1910 and 1920s noted that pumping would deplete the available surface supply.[90] Neither the Board, the *JIR*, nor the Rio Grande Compact engineering advisors considered groundwater as a solution to the basin's strained supply.

52. The *JIR* did make some broad observations about the interdependence of groundwater and surface flows in the basin, indicative of Slichter, Lee, and Bliss's findings. "[E]xtensive development of ground water," it noted, "would add no new water to the Upper Rio Grande Basin," and "recharge of ground-water basin would necessarily involve a draft on surface supplies which are now utilized otherwise." The *JIR* further cautioned that "redistribution of the availability and use of present supplies and the resulting effect upon the water supply of lower major units [i.e., the Rio Grande Project and beyond to Ft. Quitman]" would have to be taken into account if groundwater was developed.[91]

53. The *JIR* also discussed groundwater pumping by "cities, towns, and villages" in the basin. Although municipal water use was modest when compared to irrigation diversions for agriculture in the 1930s, it was considered "a stream flow depletion" and factored into assessments of water use for the three sections of the basin. In evaluating the Middle Rio Grande's water uses, for instance, the investigation included the City of Albuquerque because its wells were "undoubtedly a draft, direct or indirect, on the Rio

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of the Interior, *14th Annual Report of the Reclamation Service, 1914-1915* (Washington: Government Printing Office, 1915), 215; and U.S. Department of the Interior, *17th Annual Report of the Reclamation Service, 1917-1918* (Washington: Government Printing Office, 1918), 251.

[90] Memorandum, From: Engineer Harold Conkling, To: Chief of Construction, Subject: Water Supply – Rio Grande River, June 18, 1919, 17-19. ff. 302.31 New Mexico. Surveys and Investigations. THRU 1929, Box 262 NV-NM 302.28- -302.31 A, Entry 7, RG 115, NARA Denver; and D.C. Henny to Mr. J.W. Taylor, President, Elephant Butte Irrigation District, January 9, 1926, 1-2 and 10. 19260109_NMSU-EBID_02-G_001_07.

[91] *JIR*, 56.

Grande." Communities in lower New Mexico were similarly figured into the water use for the basin's Elephant-Butte-Ft. Quitman section.[92]

54. Knowledge of the interrelationship between groundwater and stream flow grew in the years following the Compact and before significant groundwater development occurred. Detailed investigation by USGS hydrologist C.S. Conover in the late 1940s and early 1950s came to the same specific conclusions for the Rincon and Mesilla valleys of lower New Mexico that the *JIR* had generally arrived at for the basin. Conover's study, made at the request of EBID to assess the use of groundwater as the surface supply dwindled in the face of drought, was provided in preliminary form to the New Mexico State Engineer in 1947, with the final report published in 1954.[93] Conover, like Slichter, Lee, and Bliss before him, noted that the Rio Grande surface flow and surrounding groundwater were hydrologically connected. The hydrologist found that the two were in a state of balance in lower New Mexico, owing to the Project's drainage system. He did not believe that extracting groundwater could then permanently augment the existing surface supply, but rather would diminish it over time – particularly for those lands further downstream that were reliant upon return flow from drains.[94] "Pumping of ground water," as Conover put it in his final report, was "essentially a change in point of diversion of an existing supply."[95]

55. There is evidence that during the 1950s drought, both BOR and EBID appreciated the connection between surface flow and groundwater that Conover had

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[92] *JIR*, 104-105. The investigation did not include the City of El Paso in this assessment because its wells, unlike Albuquerque's and others in the basin, drew upon groundwater fed by precipitation east of the city. *JIR*, 105.

[93] Chas. V. Theis, District Geologist, to Mr. John L. Gregg, Manager, Elephant Butte Irrigation District, October 23, 1947, attached to Clyde S. Conover, U.S. Geological Survey, Preliminary memorandum on ground-water supplies for Elephant Butte Irrigation District, New Mexico, September 1947, NM_00124166; and C. S. Conover, *Ground-Water Conditions in the Rincon and Mesilla Valleys and Adjacent Areas in New Mexico*, Geological Survey Water-Supply Paper 1230, Prepared in cooperation with the Elephant Butte Irrigation District, Department of the Interior (GPO, 1954), 4-5.

[94] Conover, Preliminary memorandum, 1, 8, 12-15, 20-21, and 24-27. NM_00124167, NM_00124174, NM_00124178-NM_00124180, NM_00124167, NM_00124186-NM00124187, and NM_00124190-NM_00124193; and Conover, *Ground-Water Conditions*, 2, and 132-135.

[95] Conover, *Ground-Water Conditions*, 132.

documented in lower New Mexico. A 1952 BOR study of "river loss" above El Paso, for instance, found that groundwater pumping which had expanded to compensate for shortages in the surface supply was reducing both Rio Grande flows and return flows from drains.[96] Notably, in endorsing pumping during the drought, Project officials and EBID urged those Project water users with wells to "transfer" the water they otherwise would have received from Elephant Butte releases to those users without wells rather than continue to use both surface and ground waters.[97] When the drought broke and surface flows improved in the late 1950s, Project water users shifted away from groundwater pumping once more.[98]

56. Subsequent investigations took some exceptions to Conover's findings, but did not deny the interconnection between groundwater and surface flow in lower New Mexico and were attentive to the implications of groundwater development for lands below Elephant Butte. A 1961 New Mexico State University study by Narendra Gunaji, for instance, found that drain flows recovered more quickly with the reduction of pumping following the drought than Conover had predicted. This suggested use of groundwater "as a supplemental water supply" in drought years, yet Gunaji did not recommend "continued use and re-use of ground

[96] United States, Department of the Interior, Bureau of Reclamation, Rio Grande Project – New Mexico-Texas, River Loss, Caballo Dam to El Paso and Irrigation Wells, El Paso, Texas, July 1, 1952, Summary, Part I, A. NM_00138516.

[97] L.R. Fiock, "Rio Grande Project -- New Mexico-Texas, Water Announcement" (Department of the Interior, Bureau of Reclamation, August 1, 1951). JS000278; "Statement Issued by the Board of Directors of the Elephant Butte Irrigation District in Regard to the 1952 Water Situation" (Las Cruces, New Mexico: Elephant Butte Irrigation District, January 11, 1952). JS000280; L.R. Fiock, "Rio Grande Project -- New Mexico-Texas, Water Announcement" (Department of the Interior, Bureau of Reclamation, March 7, 1952). JS000281; L.R. Fiock, "Rio Grande Project -- New Mexico-Texas, Water Announcement" (Department of the Interior, Bureau of Reclamation, April 7, 1952). JS000282; "Statement from Elephant Butte Irrigation District Regarding the Water Situation" (Elephant Butte Irrigation District, June 3, 1953). JS000292; "Statement Regarding the Current Water Situation" (Las Cruces, New Mexico: Elephant Butte Irrigation District, March 4, 1954). JS000293; W.F. Resch, "Rio Grande Project -- New Mexico-Texas, Water Announcement" (Department of the Interior, Bureau of Reclamation, March 1, 1954). JS000283; and "Board of Directors, Elephant Butte Irrigation District, to All Irrigation Well Owners," March 11, 1955. JS000285.

[98] Narendra Gunaji, "Ground Water Conditions in Elephant Butte Irrigation District" (University Park, New Mexico: Engineering Experiment Station, New Mexico State University, November 1961), 5. JS000286; and E.R. Leggat, M.E. Lowry, and J.W. Hood, *Ground-Water Resources of the Lower Mesilla Valley, Texas and New Mexico*, U.S. Geological Survey Water Supply Paper 1669-AA (GPO, 1963), AA18-AA19 and AA24. JS000287.

water." The hydrologist instead urged EBID to "maintain, and use, all of its surface water rights to the fullest extent possible" because repeated use of groundwater would yield a supply of deficient quality for irrigation.[99]

57. A 1963 USGS report of an investigation by E.R. Leggat, M.E. Lowry, and J.W. Hood of the lower Mesilla Valley (which included a portion of the valley lands in Texas) between 1952 and 1958 indicated that "sustainable supplies" could be obtained from wells in the lower valley, but recognized that surface water applied to the land recharged groundwater, and that "the surface-water supply will be reduced if ground-water withdrawals in the valley are increased" beyond the levels of the 1950s.[100] Leggat, Lowry, and Hood warned that if surface supplies diminished and groundwater extraction expanded "drain flow will cease" and groundwater quality would degrade.[101]

58. For its part, the New Mexico State Engineer's Office ("OSE") evidenced heightened awareness of the interrelationship between Rio Grande stream flow and subsurface water beginning in the 1950s. Two years after the official release of Conover's findings, citing a "scientific investigation" of this connection in the Middle Rio Grande, New Mexico State Engineer S.E. Reynolds declared an "underground water basin" above Elephant Butte to provide for state management and control. Reynolds noted that "the waters of said basin are interrelated with the flow of the Rio Grande Stream System, so that such underground waters are a substantial source of the flow of said stream system," and that "the waters of the Rio Grande Stream System are fully appropriated."[102]

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[99] Gunaji, "Ground Water Conditions in Elephant Butte Irrigation District," 15, 27, and 36-37. JS000286.

[100] Leggat, et al., *Ground-Water Resources of the Lower Mesilla Valley*, AA25, AA45, and AA48. JS000287.

[101] Leggat, et al., *Ground-Water Resources of the Lower Mesilla Valley*, AA45. JS000287.

[102] S.E. Reynolds, State Engineer, Order Declaring the Rio Grande Underground Water Basin, November 29, 1956. ff. 245 Public Works Committee, Middle Rio Grande River - Elephant Butte Dam. 1957-58, 85th Cong, Box 6, Serial No. 6401. File 235-245, 246-254, 255-257, John Dempsey Papers, NMSA.

59. In remarks for an April 1968 symposium on "International Water Law Along the Mexican-American Border," given as New Mexico and Texas were joined in challenging Colorado's performance under the Compact in the Supreme Court, the state engineer linked his earlier action to the Compact. Reynolds acknowledged that the Compact "makes no specific reference to ground water." "However," he went on, "the inflow-outflow mechanism for determining delivery obligations makes the control of ground water appropriations in the upstream states essential for the protection of existing surface water rights in those states and the preservation of their ability to meet the compact commitments."[103]

60. In the 1980s, on this basis, Reynolds opposed El Paso's efforts to mine Mesilla Valley groundwater to enhance its municipal water supply. He declared a "Lower Rio Grande Underground Water Basin in Dona Ana County" in October 1980, and denied El Paso's applications.[104] In the ensuing litigation, *City of El Paso v. Reynolds*, the state engineer defended his decision in part on the hydrological connections between surface flow and groundwater and on the Compact. Although the federal district court in New Mexico ultimately ruled against Reynolds and expressed skepticism about the sincerity of his position, the historical record indicates that he and those in his office were aware of the problem groundwater extraction in lower New Mexico posed to the Project and thus the Compact.[105]

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[103] S.E. Reynolds, State Engineer, The Rio Grande Compact (April 29, 1968), 20-21. Folder 2062, Reynolds, The Rio Grande Compact, April 29, 1968, Box 78, Exps. 231-233, Nos. 2016-2085, State Engineer Reports: Basic/Rio Grande, NMSA; and S.E. Reynolds, State Engineer, State of New Mexico, "The Rio Grande Compact," in Clark S. Knowlton, ed., *International Water Law Along the Mexican-American Border*, Contribution No. 11 of The Committee on Desert and Arid Zones Research, Southwestern and Rocky Mountain Division, A.A.A.S. (El Paso: University of Texas, 1968): 58-59.

[104] Memorandum, To: S.E. Reynolds, From: D.E. Gray, Subject: Lower Rio Grande, September 10, 1980; State Engineer of the State of New Mexico, Special Order No. 126, In the Matter of State Engineer Order No. 126 Declaring the Lower Rio Grande Underground Water Basin in Dona Ana County, September 11, 1980, signed S.E. Reynolds, State Engineer, Received and Approved: Richard A. Simms, Special Assistant Attorney General; and State Engineer of the State of New Mexico, Special Order No. 126-A, In the Matter of State Engineer Order No. 126 Declaring the Lower Rio Grande Underground Water Basin in Dona Ana County, October 22, 1980, signed S.E. Reynolds, State Engineer, Received and Approved: Richard A. Simms, Special Assistant Attorney General. Provided by the City of El Paso; and Ira G. Clark, *Water in New Mexico: A History of Its Management and Use* (Albuquerque: University of New Mexico Press, 1987), 675.

[105] United States District Court for the District of New Mexico, *The City of El Paso*, By and Through

61. In 1982, OSE circulated a paper to the International Boundary and Water Commission (the federal agency charged with ensuring delivery of water to Mexico pursuant to the 1906 treaty) that highlighted the issue. Entitled "Rio Grande, Elephant Butte Dam to El Paso, Texas," the paper summarized the result of "[a] study of streamflow depletion in the Rio Grande Valley between Elephant Butte Dam and El Paso, Texas," plotted on four figures. A double mass diagram (Figure 1), charted "the relationship between the flow of the Rio Grande below Elephant Butte Dam and the flow of the Rio Grande at El Paso, Texas, since storage began in Elephant Butte in 1915," across three periods of time. It took special note of the third period which began in 1951, "the start of the period of lowest water supply available from Elephant Butte Reservoir" that coincided with "extensive groundwater development . . . undertaken to offset shortages to Rio Grande Project lands." "This groundwater development," according to the paper, "has changed the flow regime established

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Its Public Service Board, *Ray Pearson, Carlton C. Homan, Jr., Louie Giallanza, Clinton E. Wolf,* and *Thomas D. Westfall*, Plaintiffs, v. *S. E. Reynolds*, individually and as State Engineer of New Mexico, *Jeff Bingaman*, individually and as Attorney General of New Mexico, *Lalo Garza*, individually and as New Mexico District Attorney for Dona Ana County, Defendants, *Elephant Butte Irrigation District, The City of Las Cruces, New Mexico, and Stahmann Farms, Inc.*, Defendant-Intervenors, Civ. No. 80-730 HB, January 17, 1983. 563 F. Supp. 379; 1983 U.S. Dist. LEXIS 19988; 13 ELR 20755. Provided by Somach Simmons & Dunn. The dispute persisted until 1989 when the U.S. Court of Appeals for the District of Columbia Circuit ruled that no live controversy remained. United States District Court for the District of New Mexico, *Ray Pearson, Carlton C. Homan, Jr., Louie Giallanza, Clinton E. Wolf,* and *Thomas D. Westfall*, Plaintiffs, v. *S. E. Reynolds*, individually and as State Engineer of New Mexico, *Paul Bardacke*, individually and as Attorney General of New Mexico, *Lalo Garza*, individually and as New Mexico District Attorney for Dona Ana County, Defendants, *Elephant Butte Irrigation District, The City of Las Cruces, New Mexico, and Stahmann Farms, Inc.*, Defendant-Intervenors, Civ. No. 80-730 HB, August 3, 1984. 597 F. Supp. 694; 1894 U.S. Dist. LEXIS 24568; 15 ELR 20259; United States District Court for the District of New Mexico, *Ray Pearson, Carlton C. Homan, Jr., Louie Giallanza, Clinton E. Wolf,* and *Thomas D. Westfall*, Plaintiffs, v. *S. E. Reynolds*, individually and as State Engineer of New Mexico, *Paul Bardacke*, individually and as Attorney General of New Mexico, *Lalo Garza*, individually and as New Mexico District Attorney for Dona Ana County, Defendants, *Elephant Butte Irrigation District, The City of Las Cruces, New Mexico, and Stahmann Farms, Inc.*, Defendant-Intervenors, Civ. No. 80-730 HB, August 17, 1984. 1984 U.S. Dist .LEXIS 24276; and United States Court of Appeals for the District of Columbia Circuit, *In re Applications of El Paso*, No. 88-5357, September 22, 1989, Argued; October 20, 1989, Decided. 887 F. 2d 1103; 1989 U.S. App. LEXIS 15897; 281 U.S. App. D.C. 112; 15 Fed. R. Serv. 3d (Callaghan) 22. Provided by Somach Simmons & Dunn.

prior to 1951 such that a greater release is required from Elephant Butte Reservoir to achieve the same flow at El Paso."[106]

62. More recently OSE has recognized groundwater pumping in lower New Mexico directly threatens the Compact. An internal memorandum from 2003 warned that extensive groundwater development below Elephant Butte jeopardized the Project water supply and raised the possibility of a dispute with Texas.[107] The following year, New Mexico State Engineer John R. D'Antonio, Jr. declared a "Lower Rio Grande Water Master District" to provide for the administration of groundwater rights and safeguard "prior surface water…rights."[108]

THE BODY OF RELEVANT HISTORICAL DOCUMENTS FOR UNDERSTANDING THE INTENT AND PURPOSES OF THE 1938 COMPACT IS DISCRETE

63. The body of relevant historical documents for understanding the intent and purposes of the 1938 Compact is discrete. The water resources history of the Upper Rio Grande Basin is broad and encompasses an array of subjects of scholarly interest. However, in my expert opinion, the Rio Grande Compact proceedings and correspondence among the commissioners from the 1920s through the 1930s; records concerning the Rio Grande Joint Investigation and the resulting report; meeting notes and correspondence related to the development of the "technical basis" for the Compact; and subsequent retrospective

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[106] [Office of the New Mexico State Engineer,] Rio Grande, Elephant Butte Dam to El Paso, Texas [1982], 1. Folder 11 Correspondence and data concerning Mesilla Valley pumping. 1982., Box 1, MS 555 Joseph F. Friedkin Papers, C.L. Sonnichsen Special Collections Department, University of Texas at El Paso.

[107] Memorandum, Office of the State Engineer, District 4, May 15, 2003, File: LRG-1776, To: John R. D' Antonio Jr., State Engineer, Paul Saavedra, Water Rights Division Chief, John Romero, WRAP Director, Through: Calvin Chavez, District Supervisor, From: Erek H. Fuchs, Lower Rio Grande Basin Supervisor, Re: Emergency Application for Permit for Supplemental Wells, Local impairment analysis and issues for consideration, Applicant: Elephant Butte Irrigation District, 2-3, and 11-12. Provided by Somach Simmons & Dunn.

[108] State of New Mexico, Office of the State Engineer, In the Matter of the Creation of the Lower Rio Grande Water Master District for the Administration of Rights to and the Use of Ground Water from the Lower Rio Grande Groundwater Basin of New Mexico, Dated this 3rd day of December, 2004, signed John R. D'Antonio, Jr., P.E., State Engineer. NM_00018294 - NM_00018297.

assessments of the Compact deliberations by the commissioners and their engineering advisors offer the most crucial evidence for appreciating how and why the Rio Grande Compact of 1938 was drafted as it was.

64. These historical documents – most produced at or near the time of the Compact by those with direct involvement in the Compact negotiations – reveal the geographic, hydrological, political, and historical circumstances that made an apportionment of the waters of the Rio Grande challenging; the information available to the Rio Grande Compact commissioners and their engineering advisors in the mid-to-late 1930s; and the debates over how best to effectuate an "equitable apportionment" that began in the 1920s and continued into the 1930s. These are many of the same documents relied upon by the first Special Master.

65. Other materials I have reviewed, documents and expert reports produced in these proceedings as well as academic monographs and secondary works, provide further details as to the events leading to and the issues informing the Rio Grande Compact of 1938, but do not fundamentally change my primary conclusions about the Compact and which I believe are clearly drawn from an examination of its history. These conclusions are set forth in Paragraphs 5. a-d above.

I declare under penalty of perjury that the foregoing is true and correct. Executed this 2nd day of November 2020 at Davis, California.

Scott A Miltenberger

Scott A. Miltenberger, Ph.D.

No. 141, Original

In the

SUPREME COURT OF THE UNITED STATES

STATE OF TEXAS,

Plaintiff,

v.

STATE OF NEW MEXICO and
STATE OF COLORADO,

Defendants.

OFFICE OF THE SPECIAL MASTER

DECLARATION OF SCOTT A. MILTENBERGER, Ph.D. IN SUPPORT OF THE STATE OF TEXAS'S OPPOSITIONS TO THE STATE OF NEW MEXICO'S MOTIONS FOR PARTIAL SUMMARY JUDGMENT AND BRIEFS IN SUPPORT

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December 22, 2020

I, Scott A. Miltenberger, declare as follows:

1. I am a professional consulting historian, specializing in water and natural resources issues. I am a partner at JRP Historical Consulting, LLC (JRP), located at 2850 Spafford Street, Davis, CA 95618.

2. I have been retained as an expert by Somach Simmons & Dunn to provide expert opinions and testimony on behalf of the State of Texas (Texas) as to the history and historical issues concerning the Rio Grande Compact of 1938 ("Compact" or "Compact of 1938").

3. I produced the Declaration of Scott Miltenberger, Ph.D.in support of the Texas Motion for Partial Summary Judgment filed on November 5, 2020 (Miltenberger Declaration). TX_MSJ_001585. My professional resume was also provided at that time and is found along with the Miltenberger Declaration in the Texas Appendix of Evidence in Support of Texas's Motion for Summary Judgment. TX_MSJ_001585.

4. I have also examined documents produced in this litigation by Texas, the State of Colorado (Colorado), the State of New Mexico (New Mexico), and the United States. I have reviewed expert reports submitted in this action by New Mexico and the United States. I further reviewed the *First Interim Report of the Special Master* and the historical documents appended to that Report.

5. I additionally examined and evaluated New Mexico's Motion for Partial Summary Judgment on Compact Apportionment, Motion for Partial Summary Judgment to Exclude Claims for Damages in Years that Texas Failed to Provide Notice to New Mexico of its Alleged Shortages, and supporting information filed therewith. The following are my opinions and responses to certain purported undisputed material facts and undisputed facts presented in the two motions.

6. To the extent documents I have relied on in reaching my opinions in this declaration have not been previously produced, true and correct copies of those documents are appended to this declaration as Attachment 1 and produced as part of the Texas Appendix of documents filed contemporaneously. These documents may also be viewed in the electronic version of this declaration by selecting the relevant bookmark. Documents I have relied on that were previously produced in the litigation but not included in the Miltenberger Declaration are appended to this declaration as Attachment 2.

7. I have also authenticated several relevant documents. True and correct copies of those documents are appended as TX_MSJ_006492 - TX_MSJ_006829 and produced as part of the Texas Appendix of documents filed contemporaneously.

A. UNDISPUTED MATERIAL FACT #1, FROM NEW MEXICO'S MOTION FOR PARTIAL SUMMARY JUDGMENT ON COMPACT APPORTIONMENT

8. This paragraph is misleading in that the source documents provide additional factual context that New Mexico excluded. The United States Reclamation Service (Reclamation) did recommend construction of a storage reservoir near Elephant Butte over another site at El Paso, Texas, and that the reservoir was to capture and store flood waters. However, review of the provided primary-source documents – F.H. Newell's *Second Annual Report of the Reclamation Service* (1904), NM-EX 300, and B.M. Hall's *A Discussion of Past and Present Plans for Irrigation of the Rio Grande Valley* (Nov. 1904), NM-EX 301 – indicates that these were not the only waters contemplated to be captured and stored for later use. Newell's report observed that the "proposed [Elephant Butte] reservoir" was "the only . . . with a capacity large enough to utilize the entire flow of the drainage basin. It is situated sufficiently low in the basin to intercept, practically, all of the waters . . . ." – an

inclusive statement of the waters to be stored.[1] Similarly, Hall's report – which considered dams at both the Elephant Butte and El Paso sites before endorsing the former over the latter – noted that with regard to "these projects, or any other plan of water storage on the Rio Grande, it is well to keep in mind the following facts," of which the second was: "All of the water that comes down the river is needed for irrigation. We cannot afford to waste any of it."[2]

B. UNDISPUTED MATERIAL FACT #5, FROM NEW MEXICO'S MOTION FOR PARTIAL SUMMARY JUDGMENT ON COMPACT APPORTIONMENT

9. This paragraph is factually incorrect. Neither cited source (NM-EX 305 and NM-EX 112) indicates that Newell made the quoted remarks in relation to congressional authorization for work on the reservoir. Congress authorized the Rio Grande Project, with Elephant Butte Dam as its centerpiece, the previous year, in 1905.[3] Additionally, the provided quote is incomplete and misleading. According to both cited sources, Newell identified the "balance" of the acreage distribution as "the balance below El Paso on the Texan side of the river."

C. UNDISPUTED MATERIAL FACT #7, FROM NEW MEXICO'S MOTION FOR PARTIAL SUMMARY JUDGMENT ON COMPACT APPORTIONMENT

10. This paragraph is factually incorrect. The 1907 Appropriations Act authorized, for the Department of State, $1 million "Toward the construction of a dam for storing and delivering sixty thousand acre-feet of water annually . . . as provided by a convention between

[1] NM-EX 300, F.H. Newell, *Second Annual Report of the Reclamation Service*, H.R. Doc. No. 58-44, 379 (1904).

[2] NM-EX 301, B.M. Hall, *A Discussion of Past and Present Plans for Irrigation of the Rio Grande Valley*, 8 (Nov. 1904).

[3] TX_MSJ_002189 – 002192, *An Act Relating to the construction of a dam and reservoir on the Rio Grande, in New Mexico, for the impounding of the flood waters of said river for purposes of irrigation*, February 26, 1905, chap. 798, Pub. L. No. 58-104, 33 Stat. 814.

the United States and Mexico . . . ."; it did not authorize construction of the dam itself.[4] As noted in paragraph 9 above, Congress authorized construction of Elephant Butte Dam along with the Rio Grande Project in 1905.

D. UNDISPUTED MATERIAL FACT #8, FROM NEW MEXICO'S MOTION FOR PARTIAL SUMMARY JUDGMENT ON COMPACT APPORTIONMENT

11. This paragraph is factually incomplete and mischaracterizes the cited primary-source document, Fund for Reclamation of Arid Lands, H.R. Doc 61-1262 (1911). NM-EX 310. References to 750,000 acre-feet and 800,000 acre-feet in the document are projections and estimates of "annual supply" from the reservoir – not as expected release figures. These estimates were based not only on reservoir capacity, but also flow, evaporation, and (as acknowledged by the paragraph), a three acre-feet per acre water duty and losses. Forty percent and not "20 per cent" was the total allowance to be made for those losses: 1) "loss in the distribution system" ("20 per cent"), and 2) "losses in transit" ("20 per cent").[5]

E. UNDISPUTED MATERIAL FACT #9, FROM NEW MEXICO'S MOTION FOR PARTIAL SUMMARY JUDGMENT ON COMPACT APPORTIONMENT

12. This paragraph is misleading. Reclamation made these filings – Letter from B.M. Hall, Supervising Engineer, United States Reclamation Service, to David L. White, Territorial Irrigation Engineer, Territory of New Mexico (Jan. 23, 1906) (NM-EX 306), and NM-EX 309, a Letter from Louis C. Hill, Supervising Engineer, United States Reclamation Service, to Vernon L. Sullivan, Territorial Irrigation Engineer, Territory of New Mexico (Apr. 1908). However, neither filing cited Section 8 of the 1902 National Reclamation Act.

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[4] TX_MSJ_007470 – 007546, *An Act Making Appropriations for Sundry Civil Expenses of the Government for the Fiscal Year Ending June Thirtieth, Nineteen Hundred and Eight, and for Other Purposes*, March 4, 1907, chap. 2918, Pub. L. No. 59-253, 34 Stat. 1295, 1357.

[5] NM-EX 310, Fund for Reclamation of Arid Lands, H.R. Doc 61-1262, 105-106 (1911).

Both filings instead referenced the United States "authority" under the 1902 Reclamation Act to pursue construction of "certain irrigation works in connection with the so-called Rio Grande Project," and observed that "operation of the works in question contemplates the diversion of water from the Rio Grande River." Both filings also cited New Mexico territorial law – Sec. 22, Chap. 102 of the 1905 laws, in the case of the 1906 filing, NM-EX 306; and Sec. 40, Chap. 49 of the 1907 laws, in the case of the 1908 filing, NM-EX 309.[6]

F. UNDISPUTED MATERIAL FACT #15, FROM NEW MEXICO'S MOTION FOR PARTIAL SUMMARY JUDGMENT ON COMPACT APPORTIONMENT

13. This paragraph is factually incorrect. The assumption expressed was not Texas's. In his February 20, 1925 letter to Governor A.T. Hannett in February 1925, New Mexico Compact Commissioner J.O. Seth noted that "Chapter 112 of the Session Laws of 1923 makes no provision whatever for according Texas the right of representation on the Commission."[7] This law was New Mexico's own, authorizing compact negotiations with Colorado.[8] The New Mexico Commissioner wrote:

> The omission of the State of Texas from Chapter 112 of the Session laws of 1923 can be accounted for only on the theory that the Legislature assumed that the only lands in Texas that would be affected by any Compact or Agreement are those lying above Fort Quitman and within the Rio Grande Project of the United States Reclamation Service and that all rights to the waters of the Rio Grande held by these lands would be protected by the Reclamation Service.[9]

[6] NM-EX 306, Letter from B.M. Hall, Supervising Engineer, United States Reclamation Service, to David L. White, Territorial Irrigation Engineer, Territory of New Mexico (Jan. 23, 1906), and NM-EX 309, Letter from Louis C. Hill, Supervising Engineer, United States Reclamation Service, to Vernon L. Sullivan, Territorial Irrigation Engineer, Territory of New Mexico (Apr. 1908).

[7] NM-EX 315, Letter from J.O. Seth, Commissioner, State of New Mexico, to A.T. Hannett, Governor, State of New Mexico, 2 (Feb. 20, 1925).

[8] TX_MSJ_003356 – 003393, First Meeting, Rio Grande River Compact Commission, Broadmoor Hotel, Colorado Springs, Colo., Sunday, October 26, 1924, 10. Folder 1. First Meeting Rio Grande Compact Commission. Oct. 26, 1924, Box 02-D.002, MS 0235 Elephant Butte Irrigation District Records, 1883-1981, Rio Grande Historical Collections, New Mexico State University Archives and Special Collections, Las Cruces.

[9] NM-EX 315, Letter from J.O. Seth, Commissioner, State of New Mexico, to A.T. Hannett, Governor, State of New Mexico, 3 (Feb. 20, 1925).

The full quotation, read in context, indicates that Commissioner Seth presumed the New Mexico State Legislature believed that Reclamation would safeguard Texas's Project water supply.

G. UNDISPUTED MATERIAL FACT #17, FROM NEW MEXICO'S MOTION FOR PARTIAL SUMMARY JUDGMENT ON COMPACT APPORTIONMENT

14. This paragraph excludes context essential to understanding how the resulting "comprehensive study" – the Rio Grande Joint Investigation (as referenced in paragraph 18 of New Mexico's Motion for Partial Summary Judgment on Compact Apportionment) – was framed. The proposal by the National Resources Committee (NRC) resulted from an NRC Board of Review's assessment that the "water resources of the Rio Grande were fully appropriated," and that New Mexico's Middle Rio Grande Conservancy District's project and other proposed projects in New Mexico and Colorado above Elephant Butte threatened the Rio Grande Project. Miltenberger Declaration paragraphs 12-16, addresses this context. TX_MSJ_001585.

H. UNDISPUTED MATERIAL FACT #19, FROM STATE OF NEW MEXICO'S MOTION FOR PARTIAL SUMMARY JUDGMENT ON COMPACT APPORTIONMENT

15. This paragraph is misleading. Diversions were a category of information in the Joint Investigation Report (or "*JIR*," NM-EX 318), but those diversions were not limited to the waters that might be considered as derived solely from reservoir releases. The *JIR* noted that "return flow" from drains constituted 50 percent of the diversions within the Rio Grande Project, which New Mexico's citation omits.[10] Miltenberger Declaration paragraph 35 likewise notes the importance the *JIR* placed on return flows. TX_MSJ_001585.

[10] NM-EX 318, Harlow M. Stafford et al., Rio Grande Joint Investigation Part I: General Report of the Rio Grande Joint Investigation, 13 (1937).

I. UNDISPUTED MATERIAL FACT #20, FROM STATE OF NEW MEXICO'S MOTION FOR PARTIAL SUMMARY JUDGMENT ON COMPACT APPORTIONMENT

16. This paragraph is misleading. According to the cited pages of the primary-source document – the September 27 to October 1, 1937 Rio Grande Compact Commission proceedings, NM-EX 319 – New Mexico expressed it "was willing to negotiate" for a compact on the basis of several "minimum requirements" (the fourth of which is the quoted statement), and not that the final compact had to possess all these elements for the state to consummate a Compact with Colorado and Texas, as this paragraph implies.[11] The historical record further indicates that the Compact ultimately privileged uses over rights in the Upper Rio Grande Basin, and that New Mexico bargained for water uses above San Marcial and below the Colorado-New Mexico state line, while Texas bargained for water use below San Marcial. Miltenberger Declaration paragraphs 20-26 discuss the privileging of uses over rights, TX_MSJ_001585; and Miltenberger Declaration paragraphs 8, 24, 26, and 37 specifically address what New Mexico and Texas bargained for, as does paragraph 49 below, TX_MSJ_001585.

J. UNDISPUTED MATERIAL FACT #21, FROM NEW MEXICO'S MOTION FOR PARTIAL SUMMARY JUDGMENT ON COMPACT APPORTIONMENT

17. The facts presented in this paragraph are incomplete and assert an incomplete understanding of the Committee of Engineers' December 27, 1937 Report. NM-EX 322. As stated on the first page of the report (after the title page), the "general policy" was expressed by the Compact Commissioners themselves, and the engineers "avoided discussion of the

[11] NM-EX 319, Rio Grande Compact Commission, Proceedings of the Meeting of the Rio Grande Compact Commission Held in Santa Fe, New Mexico, September 27, to October 1, 1937, 12-13 (1937).

relative rights of the water users in the three states."[12] Miltenberger Declaration paragraphs 20-26 discuss the privileging of uses over rights in the development of the Compact and the Committee of Engineers' December 27, 1937 Report. TX_MSJ_001585.

K. UNDISPUTED MATERIAL FACT #23, FROM NEW MEXICO'S MOTION FOR PARTIAL SUMMARY JUDGMENT ON COMPACT APPORTIONMENT

18. The facts presented in this paragraph are incomplete and assert an incomplete understanding of the reasons for the revision. The Committee of Engineers (or Engineering Advisors) revised the normal release figure downward from 800,000 acre-feet to 790,000 acre-feet only after protests made by the Middle Rio Grande Conservancy District's consulting engineer H.C. Neuffer. New Mexico State Engineer and Compact Commissioner Thomas McClure supported Neuffer, even though McClure's engineering advisor John Bliss had accepted the 800,000 acre-feet figure for which Texas had advocated and which the Committee of Engineers had recommended in December 1937. Miltenberger Declaration paragraphs 35-38 discuss this change. TX_MSJ__001585.

L. UNDISPUTED MATERIAL FACT #27, FROM NEW MEXICO'S MOTION FOR PARTIAL SUMMARY JUDGMENT ON COMPACT APPORTIONMENT

19. The *Expert Report of Estevan R. Lopez, P.E.*, at the page cited in this paragraph, page 15, provides no evidence that the figure given for "Project Storage within the Compact" was considered the "maximum capacity of Elephant Butte Reservoir."[13] NM-EX 107.

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[12] NM-EX 322, Letter from E.B. Debler, et al., Committee of Engineer Advisors, Rio Grande Compact Commission, to Rio Grande Compact Commission, 40 (Dec. 27, 1937).

[13] NM-EX 107, Estevan R. Lopez, *Expert Report of Estevan R. Lopez, P.E.*, 15 (Oct. 31, 2019).

M. UNDISPUTED MATERIAL FACT #33, FROM NEW MEXICO'S MOTION FOR PARTIAL SUMMARY JUDGMENT ON COMPACT APPORTIONMENT

20. Although the content of Article IV of the Compact and the relationship between the Otowi and San Marcial gages is correctly stated in this paragraph, the paragraph's presented facts are incomplete. NM-EX 330. The paragraph does not recognize the temporal basis for the delivery schedule, which is important context for understanding what those flows truly are and how the Compact works. Miltenberger Declaration paragraphs 22-24 discuss the temporal basis for the delivery schedule. TX_MSJ_001585.

N. UNDISPUTED MATERIAL FACT #36, FROM NEW MEXICO'S MOTION FOR PARTIAL SUMMARY JUDGMENT ON COMPACT APPORTIONMENT

21. The content of Article VII of the Compact as presented in this paragraph is correct. NM-EX 330. However, neither the Compact nor the Lopez expert report state at their respective cited pages that the "relinquished Credit Water becomes Useable Water and is available for use on lands in both New Mexico and Texas."[14] NM-EX 107.

O. UNDISPUTED MATERIAL FACT #37, FROM NEW MEXICO'S MOTION FOR PARTIAL SUMMARY JUDGMENT ON COMPACT APPORTIONMENT

22. Although the content of Article VIII as presented is correct, this paragraph does not acknowledge the second-order purpose of Article VIII: to protect the Project, and thus the water supply to Texas. Miltenberger Declaration paragraph 24 and paragraph 40 address this. TX_MSJ_001585.

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[14] NM-EX 330, Rio Grande Compact of 1938, 53 Stat. 785, 788 (1939); and NM-EX 107, Estevan R. Lopez, *Expert Report of Estevan R. Lopez, P.E.*, 23 (Oct. 31, 2019).

P. UNDISPUTED MATERIAL FACT #39, FROM NEW MEXICO'S MOTION FOR PARTIAL SUMMARY JUDGMENT ON COMPACT APPORTIONMENT

23. This paragraph mischaracterizes the historical record. The historical record makes clear that existing uses, circa 1938, not rights were to be protected by the Compact. Miltenberger Declaration paragraphs 20-27 address the privileging of uses over rights in the Compact. TX_MSJ_001585.

Q. UNDISPUTED MATERIAL FACT #42, FROM NEW MEXICO'S MOTION FOR PARTIAL SUMMARY JUDGMENT ON COMPACT APPORTIONMENT

24. This paragraph is misleading. In the cited Letter from Frank B. Clayton, Rio Grande Compact Commissioner, State of Texas, to Sawnie B. Smith (Oct. 4, 1938), Clayton was referencing contract rights – not appropriative rights.[15] NM-EX 328. Miltenberger Declaration paragraphs 30 and 42-45 discuss the contracts for water delivery for the two Rio Grande Project districts – Elephant Butte Irrigation District (EBID) in New Mexico, and El Paso County Water Improvement District No. 1 (EP #1) in Texas. TX_MSJ_001585. The meaning and intent of the Clayton-Smith letter is addressed more fully in paragraphs 28-37 below.

R. UNDISPUTED MATERIAL FACT #43, FROM NEW MEXICO'S MOTION FOR PARTIAL SUMMARY JUDGMENT ON COMPACT APPORTIONMENT

25. This paragraph is misleading. The 790,000 acre-feet release was to serve Project lands in New Mexico and Texas, the 1906 Mexican treaty obligation, and non-Project lands in Texas down to Ft. Quitman, ca. 1938. Miltenberger Declaration paragraphs 29-38 discuss this, and it is addressed in paragraphs 49-51 below. TX_MSJ_001585.

[15] NM-EX 328, Letter from Frank B. Clayton, Rio Grande Compact Commissioner, State of Texas, to Sawnie B. Smith, 1-2 (Oct. 4, 1938).

S. UNDISPUTED MATERIAL FACT #44, FROM NEW MEXICO'S MOTION FOR PARTIAL SUMMARY JUDGMENT ON COMPACT APPORTIONMENT

26. This paragraph is misleading because the Compact does not rely upon the Project to effectuate any apportionment between New Mexico and Texas below Elephant Butte, as the paragraph implies. Instead, it depends on the Project to see that Project beneficiaries in New Mexico receive water – in other words, protecting the Project as an existing use. Miltenberger Declaration paragraphs 26-46 discuss this, and it is addressed in paragraphs 49-51 below. TX_MSJ_1585.

T. UNDISPUTED MATERIAL FACT #45, FROM NEW MEXICO'S MOTION FOR PARTIAL SUMMARY JUDGMENT ON COMPACT APPORTIONMENT

27. This paragraph mischaracterizes the historical record and my deposition testimony. The historical record indicates that Project deliveries were generally based on irrigable acreage in the two states in a ratio of 57 percent for Project lands in New Mexico and 43 percent for Project lands in Texas. However, this paragraph does not offer any supporting evidence that deliveries were made in this fashion in every year and that deliveries were always made in accordance with the 57-43 percent ratio. I did not testify that either was the case. I merely replied in the affirmative when asked if I agreed with that portion of Texas's Complaint that noted this general, historical distribution of Project water deliveries.[16] At least one primary-source document produced by New Mexico in support of its motions in fact suggests that allotments of Project water were not always equal (see paragraph 53 below). NM-EX 323. Moreover, there is no language in the Compact requiring deliveries of Project water in this manner, and I did not testify that the Compact directed Project deliveries in any way, which the phrase "under the Compact" in this paragraph implies.[17] NM-EX 330.

[16] NM-EX 220, Miltenberger Dep. (June 8, 2020), 39:2-40:6.
[17] *Id* at 47:17-48:18.

U. UNDISPUTED MATERIAL FACT #46, FROM NEW MEXICO'S MOTION FOR PARTIAL SUMMARY JUDGMENT ON COMPACT APPORTIONMENT

28. This paragraph mischaracterizes Frank B. Clayton's October 4, 1938 letter to Sawnie Smith. NM-EX 328. Although the paragraph accurately quotes Clayton, it pays insufficient attention to the details of the letter and fails to acknowledge the context in which the letter was drafted – both of which are essential to understanding the ideas Clayton was expressing to Smith. Miltenberger Declaration paragraphs 31 and 42 discuss the Clayton-Smith letter and additional discussion is provided here to clarify further the letter's meaning. TX_MSJ_001585.

29. Following the negotiation of the Compact, interests in Texas below Ft. Quitman questioned the absence of a state line delivery for Texas (as noted in Miltenberger Declaration paragraph 41, TX_MSJ__001585) as well as the lack of a specific quantity of water for Texas in the Compact (as Smith did, as noted below). Clayton sought to assure water users in Texas's lower Rio Grande and others that Texas's delivery was at Elephant Butte, that the waters above Ft. Quitman were fully dedicated, and that the Compact secured the waters to which the downstream state was entitled above Ft. Quitman.

30. Clayton's letter to Smith was written within this context. Smith, an attorney from the McAllen area of Texas, below Ft. Quitman, was specifically concerned, as he articulated in a September 29, 1938 letter to the Texas commissioner that "the Rio Grande Compact makes no provision for the division of waters below Elephant Butte between the States of New Mexico and Texas, and makes no provision concerning the amount of water to which Texas is entitled." Smith's "understanding" was that "the total amount of water in the project storage provided for in the compact is used or needed by the Rio Grande project except the portion thereof required to be delivered to Mexico" and that there was a "60%-40%" division of the Project "area" between New Mexico and Texas. By Smith's reasoning,

"if . . . the present usage and physical conditions remain the same, the division of the waters as between Texas and New Mexico would be in the proportions of the Rio Grande project area in said two States." However, Smith saw nothing to this effect in the Compact itself, and "nothing that would prevent controversy between the two States in the future regarding the division of the water between the two States." "This omission is too obvious to have been inadvertent," so Smith asked for an explanation.[18]

31. In answering Smith, Clayton drew an important distinction between the "question of where the point of division of the waters of the Rio Grande as between Texas and New Mexico should be fixed," and the "the question of the division of the water released from Elephant Butte reservoir." Regarding this first question, Clayton emphasized to Smith that federal control of Elephant Butte and the historical development of the Rio Grande Project rendered a state line delivery to Texas impossible; he also cited the "irregular contour" of the state line as presenting difficulties in assessing "the water passing the Texas state line." As far back as the temporary compact, the states had therefore agreed that "New Mexico obligations as expressed in the compact must be with reference to deliveries at Elephant Butte." Elephant Butte, in short, was the delivery point for Texas's apportionment.[19]

32. As to the separate "question of the division of the water released from Elephant Butte reservoir," Clayton pointed to federal contracts for Project water as well as the 1906 Mexican treaty. Those contracts included not only the so-called "Downstream Contracts" – the 1937 contracts between the United States and EBID and the United States and EP #1, and the 1938 contract between EBID and EP #1 concerning Project repayments and water delivery

[18] TX_MSJ_007565 – 007566, Sawnie B. Smith to Frank B. Clayton, Rio Grande Compact Commissioner for Texas, September 29, 1938. Box 2F466, Rio Grande Compact Commission – Frank B. Clayton Papers, Dolph C. Briscoe Center for American History, University of Texas at Austin.
[19] NM-EX 328, Frank B. Clayton, Rio Grande Compact Commissioner, State of Texas, to Sawnie B. Smith, 1 (Oct. 4, 1938).

– but also a Warren Act contract with Hudspeth County Conservation and Reclamation District No. 1 (Hudspeth), below the Project and above Ft. Quitman, for water wasted beyond the Project (referenced in Miltenberger Declaration paragraphs 34 and 42 TX_MSJ_001585. The districts' 1937 contracts, Clayton explained, provided for water on an equal basis between the two Project districts based "on the areas involved in the two States," and the 1938 contract identified more precisely "the acreage now actually in cultivation" between the two districts: 88,000 in EBID and 67,000 in EP #1.[20]

33. The contracts assured Clayton that Texas would receive its due from Elephant Butte. The EBID and EP #1 contracts delineated the basis upon each would receive water from the Project, which was under federal control. The Texas commissioner thus expressed confidence to Smith that there would be no "difficulty about the allocation of this water" in the future – a statement clearly intended to assuage Smith's concern about a possible "controversy."[21]

34. Releases from Elephant Butte, however, served more than Project lands as Clayton pointed out to Smith. In addition to the 1906 Mexican treaty obligation, the Texas commissioner noted that non-Project lands above Ft. Quitman received water. As noted in Miltenberger Declaration paragraph 34, lands in Texas downstream to Ft. Quitman were the beneficiaries of return flows from drainage works upstream. Clayton acknowledged this phenomenon, observing to Smith that Hudspeth obtained "'tail-end' or waste water" from the Project, water the non-Project district could divert under its Warren Act contract. "[L]ands privately owned below [Hudspeth]" also acquired water "by taking by gravity or pumps what happens to be in the river channel," the Texas commissioner told Smith – a further indication

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[20] *Id.* at 2.
[21] *Id.*

of return flows from upstream and water service beyond the limits of the Project. Importantly, in calling attention to the attenuated nature of this water below the Project and above Ft. Quitman, Clayton underscored the fact that little water would pass Ft. Quitman and be available to downstream water users outside the Compact.[22]

35. None of the contracts referenced or discussed by Clayton are recognized in the language of the Compact and none bear on Compact administration. The 1938 contract, in fact, was purposefully excluded. The Texas commissioner informed Smith that because this contract was "a private one between the districts involved . . . it was felt neither necessary nor desirable that it be incorporated in the terms of the Compact."[23] This statement implies that the Compact negotiators intended for the Compact to stand alone.

36. Furthermore, I am unaware of any historical documents that would support a claim that the commissioners intended the contracts to supplement the Compact, as New Mexico's Motion for Partial Summary Judgment on Compact Apportionment suggests. Most notably, summaries and assessments of the Compact by New Mexico State Engineer and Rio Grande Compact Commissioner Thomas McClure and his engineering advisor John Bliss following the Compact do not mention these contracts as a component or an element of Compact administration. Neither, moreover, recognized that New Mexico obtained an apportionment below Elephant Butte by these contracts.[24]

37. In my expert opinion, Clayton's letter to Smith is not an explanation of how the Compact was to function as asserted in New Mexico's Motion for Partial Summary Judgment on Compact Apportionment. Rather, to address Smith's specific concerns, Clayton

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[22] *Id.*
[23] *Id.*
[24] NM-EX 327, J.H. Bliss, Provisions of the Rio Grande Compact, (Apr. 2, 1938); and Thomas B. McClure, State Engineer, "Analysis of the Compact," undated. NM_00164500.

offered a description of the prevailing physical circumstances that structured the Compact and the "present uses" which the Compact was intended to respect and preserve. As I discussed above, and in Miltenberger Declaration paragraphs 29-46, development of the Rio Grande Project meant that New Mexico's deliveries to San Marcial pursuant to the Compact were the state-line delivery to Texas. TX_MSJ_001585. A primary intent of the Compact, moreover, was to protect "present uses" of water in the Upper Rio Grande Basin, circa 1938; the Rio Grande Project was an existing "use" to be safeguarded. Throughout the Compact negotiations, Texas advocated for the Project for only through the Project could it obtain Rio Grande water. The downstream state accepted that releases from Elephant Butte under federal control served Project lands in New Mexico by contract in accordance with Project operations – just as those releases also satisfied the 1906 Mexican treaty obligation. The water delivered by New Mexico pursuant to the Compact, as Clayton's letter to Smith makes clear, was nonetheless ultimately water for Texas.

V. UNDISPUTED MATERIAL FACT #47, FROM NEW MEXICO'S MOTION FOR PARTIAL SUMMARY JUDGMENT ON COMPACT APPORTIONMENT

38. The paragraph mischaracterizes the document, Letter from Frank B. Clayton, Rio Grande Compact Commissioner, State of Texas to C.S. Clark, Chairman, Board of Water Engineers, State of Texas (October 16, 1938). NM-EX 329. As with the Clayton-Smith letter, the quotation offered from the Clayton-Clark letter is correct. NM-EX 328. However, attention to the details of the letter and the essential context for the letter reveals a different purpose and meaning for the communication and the provided quotation.

39. Clayton wrote to Clark, the chairman of the Texas Board of Water Engineers ("Board"), immediately following meetings the Texas commissioner had with water users below Ft. Quitman, meetings in which "misunderstandings" about the Compact were voiced

that he was compelled to correct. Clayton traced the source of these misunderstandings, which "reflect[ed]" on him "both personally and officially, and on the officials of the irrigation districts above Fort Quitman," to Clark and the Board.[25] Clayton's detailed ten-page letter responded to claims that he had failed to keep the Board informed as to the Compact negotiations and addressed several of the misunderstandings about the Compact that the Texas commissioner had confronted.

40. One "statement" in particular, "attributed" to Clark, prompted a reply by Clayton that is important to consider when assessing the meaning of the quotation offered in New Mexico's motion. This statement was "to the effect that in negotiating the permanent compact [Clayton] disregarded the rights and interests of the lower Rio Grande Valley." The Texas commissioner reminded the chair that "the commissioners found it utterly impossible to agree on the relative priorities of the rights of the three States." Instead, they drafted a Compact which had "the whole effect . . . to 'freeze' the supply of water to Elephant Butte reservoir at its present status; that is, to guarantee to Texas that no further encroachments will be made up-stream, in New Mexico or Colorado." According to Clayton, "it was the sense of all concerned, including [Clark] . . . that this was the very best Texas could hope to get."[26] Such a statement is consistent with my expert opinions expressed in Miltenberger Declaration paragraphs 20-26, that the Compact privileged existing uses of water over rights and sought to protect the hydrological status quo in the basin. TX_MSJ_001585.

41. Clayton went on observe that "no allocation of waters as between different sections of the same State was possible in an interstate compact, and none was attempted."[27]

[25] NM-EX 329, Letter from Frank B. Clayton, Rio Grande Compact Commissioner, State of Texas to C.S. Clark, Chairman, Board of Water Engineers, State of Texas, 1 (October 16, 1938).
[26] *Id.* at 7.
[27] *Id.*

Made in reference to lands in Texas above and below Ft. Quitman, the statement was in keeping with the understood purpose of the Compact, as reflected in the history of its negotiation: to effectuate an equitable apportionment among the states involved – not within the states.

42. Turning his attention then to "some misunderstanding regarding the fact that it is the supply to the reservoir that is provided for in the Compact, and not what passes the New Mexico-Texas state line," Clayton explained the reasons for the absence of a state-line delivery for Texas in a nearly identical way as he had in his letter to Smith. The Texas commissioner cited "the irregular contour of the boundary between the two States and other physical facts" that made "it . . . practically impossible to measure the water passing the state line at the various places in the river channel and in the canal, lateral and drains."[28]

43. Clayton also pointed to federal control of Elephant Butte Reservoir as a reason – and here is where the quotation offered by New Mexico begins. The Texas commissioner noted to Clark that "since the source of supply for all the lands above Fort Quitman and below Elephant Butte reservoir, whether in Texas or New Mexico, is the reservoir itself," neither Colorado nor New Mexico "could hardly be expected . . . [to] guarantee a certain amount of water to pass the Texas line . . . ." That amount was "wholly dependent upon the releases from the reservoir, and the reservoir is under the control of an entirely independent agency: the Bureau of Reclamation."

44. Clayton then raised the 1938 "contract between the New Mexico interests and the Texas interest in the Rio Grande Project." As he did in his letter to Smith, the Texas commissioner observed that "all the lands in the Project have equal water rights, and the acreage to be irrigated is practically 'frozen' at its present figure, with a three percent.

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[28] *Id.*

'cushion.'" "It is therefore not necessary," he expressed Clark, "even if it were practicable, to make definite provision in the Compact for the amount of water to pass the Texas-New Mexico state line."[29]

45. In my expert opinion, the provided quotation is not a description of Compact operation and fails to consider the context of Clayton's efforts to dispel opposition in Texas, the earlier Smith letter, and relevant details of Clark's letter. The quotation is instead an explanation as to the absence of a state line delivery and an attempt to allay concerns that the lack of such a delivery provision in the Compact would preclude Texas from obtaining its equitable apportionment under the Compact. Clayton viewed federal control of Elephant Butte Reservoir and the contracts that directed water delivery to Project lands in New Mexico and Texas as providing assurance to Texas, independent of the Compact but consistent with the Compact's aim of safeguarding existing uses.

W. UNDISPUTED MATERIAL FACT #48, FROM NEW MEXICO'S MOTION FOR PARTIAL SUMMARY JUDGMENT ON COMPACT APPORTIONMENT

46. This paragraph does not provide sufficient context to understand fully the meaning of the quotation provided from Raymond Hill's *Development of the Rio Grande Compact of 1938*. NM-EX 401. The paragraph correctly quotes from Hill's narrative, but in the absence of context – much of which is also discussed in Miltenberger Declaration paragraphs 29-46 – the quotation is misleading. TX_MSJ_001585.

47. Hill, Texas's engineering advisor during the Compact negotiations and for several years after, drafted *Development of the Rio Grande Compact of 1938* for a Supreme Court original action involving the three Rio Grande states in the 1960s. Hill's narrative relies upon his memory and the available engineers' reports and commission proceedings to

[29] *Id.* at 8.

provide an account of the specific events, issues, and considerations that led to the Compact and an explanation of the Compact provisions.

48. According to Hill, he and his fellow advisors were directed to preserve the hydrological "status quo" of the Upper Rio Grande Basin in formulating the basis for the Compact:

> The Committee of Engineering Advisers was instructed to prepare schedules of deliveries by Colorado and by New Mexico that would insure [*sic*] maintenance of the relationships of stream inflow to stream outflow that had prevailed under the conditions existent when the Compact of 1929 was executed. The Committee of Engineering Advisers was also instructed to provide for freedom of development of all water resources in the drainage basin of Rio Grande above Elephant Butte subject only to compliance with these schedules.[30]

Additionally, in his opinion,

> The Rio Grande Compact should thus be looked upon as an expansion of the Compact of 1929, designed to provide for the maximum beneficial use of water in the basin of Rio Grande above Fort Quitman without impairment of any supplies beneficially used under the conditions prevailing in 1929.[31]

Hill makes plain that fundamentally the Compact was intended to protect existing water uses through preservation of prevailing conditions, as noted in paragraph 37 in particular above and in Miltenberger Declaration paragraphs 20-28. TX_MSJ_001585.

49. As these statements show, the quotation provided by New Mexico is taken out of context because it disregards how Hill understood the structure and purpose of the Compact. Of equal importance in assessing the meaning of the quotation was New Mexico and Texas's respective positions throughout the negotiations of the 1930s. According to Hill, "it was the position of the Commissioner for New Mexico that, for the purposes of the Compact, Elephant Butte Dam should be deemed to be the dividing line between New Mexico

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[30] NM-EX 401, Raymond A. Hill, *Development of the Rio Grande Compact of 1938*, 5 and 62 (Oct. 8, 1968).
[31] *Id.* at 63.

and Texas."[32] Additionally, "The Rio Grande Compact Commissioner for Texas, who had been of counsel in the action Texas vs New Mexico in the Supreme Court of the United States, likewise considered that it was impracticable to separate the requirements of Texas from those of the lands in New Mexico supplied by water from Elephant Butte Reservoir." The commissioner, Frank Clayton, thus requested 800,000 acre-feet per year from Elephant Butte.[33]

50. The quotation provided by New Mexico itself appears at the end of a section in Hill's narrative, entitled "Allotment for Texas" – and that leaves little doubt that the content of the section concerns Texas's apportionment under the Compact, precisely along the lines Hill indicates above and which have been discussed earlier in this declaration and in the previous Miltenberger Declaration. Texas's engineering advisor begins this section by once again observing that Clayton asked first for 800,000 acre-feet as the annual release from Elephant Butte. Hill explains that this figure was revised downward to 790,000 acre-feet annually following the objection of New Mexico's Rio Grande Compact Commissioner, before identifying where in the Compact this figure appears (specifically in Article I, paragraph (q), Article VII, and Article VIII).[34]

51. After this discussion comes the paragraph from which New Mexico quotes. In the absence of the additional detail and context provided above, New Mexico's reliance on the quotation is misleading. Hill clearly understood the 790,000 acre-feet release from Elephant Butte to be for the benefit of Texas – but given the aim of the Compact to protect existing water uses, of which the Rio Grande Compact was one, some of the water apportioned to Texas served Project lands in New Mexico as well as the 1906 Mexican treaty.

[32] *Id.* at 18.
[33] *Id.* at 19.
[34] *Id.* at 34-37.

X. UNDISPUTED MATERIAL FACT #54, FROM NEW MEXICO'S MOTION FOR PARTIAL SUMMARY JUDGMENT ON COMPACT APPORTIONMENT

52. While this paragraph is correct that "[a]t the time the Compact was signed" the Project had been in operation for "over twenty years," the cited sources in this paragraph do not provide support for the claim that the Project had been operated "as a single unit" nor do they explain what is meant by "under Reclamation law." NM-EX 318 and NM-EX 005. NM-EX 005 paragraph 9 states that the Project was operated "as a single unit and pursuant to Reclamation law" but does not cite to documentary evidence.

Y. UNDISPUTED MATERIAL FACT #56, FROM NEW MEXICO'S MOTION FOR PARTIAL SUMMARY JUDGMENT ON COMPACT APPORTIONMENT

53. This paragraph is misleading. The cited primary document, United States Reclamation Service, *Project History Rio Grande Project Year 1937* (1938) suggests that an equal allocation was set in 1937. NM-EX 323. However, it is unclear from that document if this was the practice in all years prior to the Compact. Even for 1937, the allotment basis was abandoned because individual water users had exceeded that amount in July.[35]

Z. UNDISPUTED MATERIAL FACT #57, FROM NEW MEXICO'S MOTION FOR PARTIAL SUMMARY JUDGMENT ON COMPACT APPORTIONMENT

54. This paragraph is factually misleading. Congress authorized the execution of amended repayment contracts with EBID and EPCWID (or EP #1) in 1937,[36] but it did not authorize the 1938 contract as such.[37] The 1938 Downstream Contract was instead part of an

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[35] NM-EX 323 at PDF p. 22, NM_00024871 (original document unpaginated).

[36] NM-EX 320, Contract between the United States and the Elephant Butte Irrigation District adjusting construction charges and for other purposes (Nov. 9, 1937) and NM-EX 321, Contract between the United States and the El Paso County Water Improvement District No. 1 adjusting construction charges and for other purposes (Nov. 10, 1937).

[37] NM-EX 324, Contract Between Elephant Butte Irrigation District and El Paso County Water Improvement District No. 1 (Feb. 16, 1938) ("1938 Downstream Contract").

effort by Reclamation, extending back to 1929, to fix the basis for repayments between the two districts. The districts themselves ultimately instigated this particular agreement to settle the issue. Miltenberger Declaration paragraphs 43-45 discuss the 1937 and 1938 Downstream Contracts; the context and purpose of the 1938 Downstream Contract is addressed in more detail below. TX_MSJ_001585.

55. As discussed in Miltenberger Declaration paragraph 44, federal law obligated reclamation project water users to repay the costs incurred by the United States in building, operating, and maintaining a reclamation project. TX_MSJ_001585. The original 1906 joint construction contract between Elephant Butte Water Users Association (predecessor to EBID) and El Paso Valley Water Users Association (predecessor to EP #1), and the United States had specified "ten equal annual payments," "apportioned equally per acre among those acquiring such rights [i.e., the water users]."[38] In 1918 and 1920, following the dissolution of the water users' associations and their reconstitution as quasi-municipal entities with the power to tax individual members, new contracts were drafted that made irrigated acreage the basis for allocating shared projects costs between EBID and EP#1, respectively.[39] Eight years

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[38] NM-EX 308, Articles of Agreement between the United States of America, Elephant Butte Water Users Association, and El Paso Valley Water Users' Association, section 4, page 3-4 (June 27, 1906).

[39] TX_MSJ_006343 – TX_MSJ_006484, Department of the Interior, Bureau of Reclamation, Rio Grande Project-New Mexico-Texas, Contract Dated June 15, 1918 – between The United States of America and The Elephant Butte Irrigation For Repayment of Construction and Operation and Maintenance Charges, Article 6, Article 8, and Article 10; Department of the Interior, Bureau of Reclamation, Rio Grande Project-New Mexico-Texas, Contract Dated January 17, 1920 between The United States of America and The El Paso County Water Improvement District No. 1, For Repayment of Construction and Operation and Maintenance Charges, Article 7, Article 8, and Article 9, in Department of the Interior, Bureau of Reclamation, Rio Grande Irrigation Project, New Mexico-Texas, Contracts with Water User's Organizations (Copies), Compiled November 1, 1929. 232-29 RG Separate Folder, 249-H, Contracts with Water Users, Box 716 Old Box 509-510, Code 104.RG 37 through Code 402.RG 28, Engineering and Research Center, Project Reports, 1910-55, Records of the United States Bureau of Reclamation, Record Group 115 [RG 115), National Archives at Denver [NARA Denver]. These documents were previously provided with my Expert Report and with Miltenberger Declaration.

later, in the summer of 1928, Congress authorized the Interior Department to extended the districts' repayment schedule with irrigation acreage remaining as the basis for repayments.[40]

56. Neither the 1918 and 1920 contracts nor the extended repayment schedule, however, identified what each district's irrigated acreage should be for the purposes of repayment. In early February 1929, facing the prospect of constructing additional drainage works for EP #1, Reclamation Chief Engineer R.F. Walter sought to determine this with EBID and EP #1. At a meeting with Walter and acting Rio Grande Project superintendent L.R. Fiock, EP #1 manager Roland Harwell expressed his district's desire for its obligation to be predicated on 67,000 acres. EBID representatives did not attend this meeting, but informed Walter by telegram that their district requested 88,000 acres as its basis.[41] Reclamation officials were agreeable, but before a formal agreement could be made the global financial collapse precipitated by the United States stock market crash of October 1929 cast into doubt the ability of any federal reclamation project's water users to meet their repayment obligations.[42]

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[40] TX_MSJ_007547 – 007548, *An Act Extending the time of construction payments on the Rio Grande Federal irrigation project, New Mexico-Texas*, May 28, 1928, chap. 815, Pub. L. No. 70-556, 45 Stat. 785.

[41] TX_MSJ_007552 – 007556, Memorandum, From: Chief Engineer, To: Commissioner, Subject: Determination of irrigable acreage and total construction liability of the irrigation districts – Rio Grande Project, February 18, 1929; and TXC_MSJ_007452 – 007456, Memorandum Relating to Additional Work for El Paso County Water Improvement District Number One [February 16, 1929], enclosed with Memorandum, February 18, 1929. ff. 301. Rio Grande, Board & Engineering Reports on Construction Features, Oct. 1926 thru July 1929, Transfer Case, Box 913 Rio Grande 241.27—301; Entry 7, RG 115, NARA Denver. Memorandum, From Chief Engineer, To: Commissioner, February 18, 1929 was previously produced with my Expert Report.

[42] TX_MSJ_007552 – 007556, Memorandum, From: Chief Engineer, To: Commissioner, Subject: Determination of irrigable acreage and total construction liability of the irrigation districts – Rio Grande Project, February 18, 1929. ff. 301. Rio Grande, Board & Engineering Reports on Construction Features, Oct. 1926 thru July 1929, Transfer Case, Box 913 Rio Grande 241.27—301; Entry 7, RG 115, NARA Denver; and TX_MSJ_005847 – 005852, Donald J. Pisani, *Water and American Government: The Reclamation Bureau, National Water Policy, and the West, 1902-1935* (Berkeley: University of California Press, 2002), 149. Both documents were previously produced with my Expert Report.

57. As discussed in Miltenberger Declaration paragraph 45, Congress amended reclamation law to provide relief to Project water users and those amendments led to the 1937 "Downstream Contracts" TX_MSJ_001585; NM-EX 320; NM-EX 321. The basis for the allocation of repayments between EBID and EP #1, however, remained unsettled with no formal agreement as to each district's irrigated acreage. In the fall of 1937, the districts themselves prepared an agreement to this effect, which included a three percent "cushion" to permit some fluctuation in the irrigated areas of the two districts.[43] This draft contract became the basis for a negotiation between the districts and Reclamation that lasted into early 1938. Reclamation officials ultimately agreed that the Secretary of the Interior should approve of the contract and that the contract should be made effective for the duration of the amended repayment contracts then being worked out with each district – the 1937 Downstream Contracts.[44] EBID and EP #1 readily accepted these changes, executing the revised contract collectively and submitting it for Interior Department approval within a day of receiving Reclamation comments in early November.[45] Concerns that language regarding

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[43] TXC_MSJ_007457 – 7459, Roland Harwell, Manager, to L.R. Fiock, Superintendent, Bureau of Reclamation, October 22nd, 1937. ff. 400. Rio Grande, Lands-General, 1930 thru, Box 932, Rio Grande Pro. 400.__400.08, Project Correspondence File, 1930-1945, RG 115, NARA Denver; and Contract, undated, with comments. Folder 2, El Paso Water Improvement District #1. (500.2), Box 02-B.036, Office Files, 1937-1948, MS 0235 Elephant Butte Irrigation District Records, 1883-1981, Rio Grande Historical Collections, New Mexico State University Archives and Special Collections, Las Cruces.

[44] TXC_MSJ_007460 – 007463, Memorandum, From: Superintendent [L.R. Fiock], To: The Commissioner, Washington, D.C. [John C. Page], Subject: Interdistrict Agreement regarding Irrigable Area – Rio Grande Project, October 23, 1937; TXC_MSJ_007468 – TXC_MSJ_007469_1, Memorandum, From: Commissioner [John C. Page], To: Superintendent, El Paso Texas, Subject: Interdistrict Agreement regarding Irrigable Area – Rio Grande Project., Nov. 2, 1937; TXC_MSJ_007464 – 007467, Memorandum, From: Chief Engineer [R.F. Walter], To: The Commissioner, Washington, DC [John C. Page], Subject: Interdistrict Agreement regarding Irrigable Area – Rio Grande Project, November 2, 1937. ff. 400. Rio Grande, Lands-General, 1930 thru, Box 932, Rio Grande Pro. 400.__400.08, Project Correspondence File, 1930-1945, RG 115, NARA Denver.

[45] TXC_MSJ_007469_2 – 007469_5, L.R. Fiock, Superintendent, to Roland Harwell, Manager, November 9, 1937. ff. 222. Rio Grande, Irrigation District, Sept. 1937 thru Dec. 1937, Box 916, Rio

"the distribution of accounting" in the proposed contract could be interpreted as altering the individual contracts between the US and the districts (the 1937 Downstream Contracts), however, delayed approval.[46] An additional revision was made to clarify this language before the was executed by the districts in mid-February 1938.[47] Assistant Secretary of the Interior, Oscar L. Chapman subsequently provided departmental approval to the agreement in April 1938.[48]

58. As noted in Miltenberger Declaration paragraph 45, the 1938 Downstream Contract between the two districts memorialized the historical distribution of repayment costs for storage and general project features between EBID and EP #1. TX_MSJ_001585. Those costs were based their respective irrigated acreages – acreages to which the districts had

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Grande Pro. 222.; TXC_MSJ_007469_6 – 007469_8, , Roland Harwell, Manager, to L.R. Fiock, Project Superintendent, November 10th, 1937; TXC_MSJ_007469_9 – 007469_11, Memorandum, From: Superintendent [L.R. Fiock], To: The Commissioner, Washington, DC (Through Chief Engineer), Subject: Interdistrict Agreement regarding Irrigable Area – Rio Grande Project, November 12, 1937; and TX_MSJ_007557 – 007559, John C. Page, Commissioner to The Secretary of the Interior, November 29, 1937. ff. 400. Rio Grande, Lands-General, 1930 thru, Box 932, Rio Grande Pro. 400.__400.08, Project Correspondence File, 1930-1945, RG 115, NARA Denver.

[46] TXC_MSJ_007469_12 – 007469_16, Memorandum, From: Acting Commissioner [R. Williams], To: Superintendent, El Paso, Texas, Dec. 1, 1937; TXC_MSJ_007469_16 – 007469_18, L.R. Fiock, Superintendent, to Roland Harwell, Manager, December 9, 1937. ff. 400. Rio Grande, Lands-General, 1930 thru, Box 932, Rio Grande Pro. 400.__400.08, Project Correspondence File, 1930-1945, RG 115, NARA Denver.

[47] TXC_MSJ_007469_19 – 007469_21, Memorandum, From: Superintendent [L.R. Fiock], To: The Commissioner, Washington, D.C., Subject: Interdistrict agreement regarding irrigable area – Rio Grande Project, January 20, 1938; TXC_MSJ_007469_22 – 007469_24, Memorandum, From: Commissioner [John C. Page], To: Superintendent, El Paso, Texas, Subject: Interdistrict agreement regarding irrigable area, Rio Grande Project, January 31, 1938; TXC_MSJ_007469_25 – 007469_27, L.R. Fiock, Superintendent, to N.B. Philips, Manager, Elephant Butte Irrigation District, and Roland Harwell, Manager, El Paso County Water Improvement District No. 1, February 11, 1938; TXC_MSJ_007469_28 – 007469_30, Roland Harwell, Manager, to L.R. Fiock, Project Superintendent, March 5th, 1938; and TXC_MSJ_007469_31 – 007469_33, Memorandum, From: Superintendent [L.R. Fiock], To: The Commissioner (Through Chief Engineer, Denver, Colorado), Subject: Interdistrict Agreement regarding Irrigable Area – Rio Grande Project, March 7, 1938. ff. 400. Rio Grande, Lands-General, 1930 thru, Box 932, Rio Grande Pro. 400.__400.08, Project Correspondence File, 1930-1945, RG 115, NARA Denver.

[48] NM-EX 324, Contract Between Elephant Butte Irrigation District and El Paso County Water Improvement District No. 1 (Feb. 16, 1938).

committed themselves in 1929: 88,000 acres in EBID and 67,000 acres in EP #1 – permitting a three-percent expansion in that acreage in any one year "to be subject to construction charges."[49]

59. In my expert opinion, the 1937 and 1938 Downstream Contacts are less about water deliveries than they are about the repayment obligations of the districts to the federal government for the Project. Where it comes to references to water delivery in these contracts, it is clear those deliveries concern the Project and not the Compact. Moreover, while Clayton presented these contracts to Smith and Clark as providing assurance that Texas would receive Rio Grande water in the absence of a state-line delivery requirement and prescribed quantity of water (as pointed out in paragraphs 31-34 above), none of these contracts were incorporated by reference or in the language of the Compact; in fact, the 1938 Downstream Contract was specifically excluded. Additionally, as the Texas commissioner noted to Smith, Texas also received water from Elephant Butte outside the limits of the Project and these Downstream Contracts. There is no historical evidence, in short, that the 1937 and 1938 Downstream Contracts define the Compact apportionment to Texas.

AA. UNDISPUTED MATERIAL FACT #58, FROM NEW MEXICO'S MOTION FOR PARTIAL SUMMARY JUDGMENT ON COMPACT APPORTIONMENT

60. This paragraph correctly quotes from the cited document but mischaracterizes the context and purpose of the 1938 Downstream Contract as discussed in paragraphs 54-59 above. NM-EX 324.

[49] *Id.*

BB. UNDISPUTED FACT #5, FROM NEW MEXICO'S MOTION FOR PARTIAL SUMMARY JUDGMENT TO EXCLUDE CLAIMS FOR DAMAGES IN YEARS THAT TEXAS FAILED TO PROVIDE NOTICE TO NEW MEXICO OF ITS ALLEGED SHORTAGES

61. This paragraph correctly quotes from the 1938 Downstream Contract but in the absence of an understanding of the context and purpose of the contract (as explained in paragraphs 54-59, above), the paragraph is misleading. NM-EX 324.

CC. UNDISPUTED FACT #7, FROM NEW MEXICO'S MOTION FOR PARTIAL SUMMARY JUDGMENT TO EXCLUDE CLAIMS FOR DAMAGES IN YEARS THAT TEXAS FAILED TO PROVIDE NOTICE TO NEW MEXICO OF ITS ALLEGED SHORTAGES

62. This paragraph is factually incomplete. The 1908 filing was for "all the unappropriated waters of the Rio Grande and its tributaries."[50] NM-EX 309.

DD. AUTHENTICATION OF DOCUMENTS RELIED ON IN TEXAS'S OPPOSITION TO THE NEW MEXICO MOTION FOR PARTIAL SUMMARY JUDGMENT TO EXCLUDE CLAIMS FOR DAMAGES IN YEARS THAT TEXAS FAILED TO PROVIDE NOTICE TO NEW MEXICO OF ITS ALLEGED SHORTAGES

63. Each document described below was produced during the course of discovery in this litigation and is in a condition that creates no suspicion about its authenticity.

64. Attached hereto at TX_MSJ_006492 – TX_MSJ_006519, is a true and correct copy of the U.S. Geological Survey study entitled "Preliminary memorandum on ground-water supplies for Elephant Butte Irrigation District, New Mexico," dated September 1947. This document was produced by New Mexico during discovery. I used it in my expert rebuttal / supplemental report dated December 30, 2019, and in my previous declaration (Miltenberger Declaration paragraph 61. TX_MSJ_001585. I have examined it and the

[50] NM-EX 309, Letter from Louis C. Hill, Supervising Engineer, United States Reclamation Service, to Vernon L. Sullivan, Territorial Irrigation Engineer, Territory of New Mexico (Apr. 1908).

document is in a condition that creates no suspicion about its authenticity, was located in a place where, if authentic, it would likely be, and would be at least 20 years old when offered at trial.

65. Attached hereto at TX_MSJ_006520 – TX_MSJ_006727, is a true and correct copy of U.S. Geological Survey Water-Supply Paper 1230, Ground-Water Conditions in the Rincon and Mesilla Valleys and Adjacent Areas in New Mexico, dated 1954. This document was produced by New Mexico during discovery. I have examined it and it appears identical to a report that I collected from the US Geological Survey Publication Warehouse (online) in my research. The document is in a condition that creates no suspicion about its authenticity, was located in a place where, if authentic, it would likely be, and would be at least 20 years old when offered at trial.

66. Attached hereto as TX_MSJ_006728 – TX_MSJ_006737, is a true and correct copy of the document entitled "Memorandum, Subject: Declaration of the Rio Grande Underground Water Basin," dated November 29, 1956. The document was produced by New Mexico during discovery. I have examined it and the document is in a condition that creates no suspicion about its authenticity, was located in a place where, if authentic, it would likely be, and would be at least 20 years old when offered at trial.

67. Attached hereto as TX_MSJ_006738 – TX_MSJ_006745, is a true and correct copy of the study entitled "Rio Grande, Elephant Butte Dam to El Paso, Texas," introduced as Exhibit 5 at the February 5, 2020 deposition of Peggy Barroll. I have examined this document and aside from the handwritten annotations on the first page, it appears identical to the copy I collected in the course of my research from the Joseph Friedkin Papers, C. L. Sonnichsen Special Collections Department, University of Texas at El Paso. The document is

in a condition that creates no suspicion about its authenticity, was located in a place where, if authentic, it would likely be, and would be at least 20 years old when offered at trial.

68. Attached hereto as TX_MSJ_006746 – TX_MSJ_006758, is a true and correct copy of the Minutes for the 1992 Rio Grande Compact Commission Meeting held March 26, 1992, at Alamosa, Colorado. The document was produced by Colorado during discovery. I have examined it and the document is in a condition that creates no suspicion about its authenticity, was located in a place where, if authentic, it would likely be, and would be at least 20 years old when offered at trial.

69. Attached hereto as TX_MSJ_006759 – TX_MSJ_006760, is a true and correct web printout copy of the Albuquerque Journal newspaper article entitled "Texas Itching for a Fight Over Rio Grande Water," published April 11, 2001. The document was produced by New Mexico during discovery. I have examined it and the document is in a condition that creates no suspicion about its authenticity, was located in a place where, if authentic, it would likely be, and would be at least 20 years old when offered at trial.

70. Attached hereto as TX_MSJ_006761 – TX_MSJ_006762, is a true and correct copy of a letter authored by John M. Baker, Commissioner for the Texas Natural Resource Conservation Commission, sent to Thomas C. Turney, New Mexico State Engineer and Secretary of the Interstate Stream Commission on April 27, 2001. The document was produced by Texas during discovery and was collected from the Texas Commission on Environmental Quality's "Rio Grande Compact General Cabinet." I have examined it and the document is in a condition that creates no suspicion about its authenticity, was located in a place where, if authentic, it would likely be, and would be at least 20 years old when offered at trial.

71. Attached hereto as TX_MSJ_006763 – TX_MSJ_006767, is a true and correct copy of the "Comments of Thomas C. Turney before United States Senate Committee of Energy and Natural Resources Field Hearing on Water Issues," held August 14, 2001 at New Mexico State University in Las Cruces, New Mexico. The document is a printout from the New Mexico Office of the State Engineer's website and was produced by New Mexico during discovery. I have examined it and the document is in a condition that creates no suspicion about its authenticity, was located in a place where, if authentic, it would likely be, and would be at least 20 years old when offered at trial.

72. Attached hereto as TX_MSJ_006768 – TX_MSJ_006770, is a true and correct web printout copy of the Santa Fe New Mexican article entitled "State is Bracing for a Water Dispute," published January 23, 2002. The document was produced by Texas during discovery. I am a person with knowledge of the matters in this litigation, and I have examined the document, have no reason to doubt its authenticity, and believe it is what it claims to be.

73. Attached hereto as TX_MSJ_006771 – TX_MSJ_006801, is a true and correct copy of the deposition of Thomas C. Turney, taken January 14, 2003. The document was produced by the EBID during discovery. I am a person with knowledge of the matters in this litigation, and I have examined the document, have no reason to doubt its authenticity, and believe it is what it is claimed to be.

74. Attached hereto as TX_MSJ_006802 – TX_MSJ_006817, is a true and correct copy of the March 15, 2003 Memo authored by Erek Fuchs to State Engineer John D'Antonio - EBID_160073. This document was produced by EBID during discovery. A non-Bates stamped copy was provided to me by Somach Simmons & Dunn. I am a person with knowledge of the matters in this litigation, and I have examined the document, have no reason

to doubt its authenticity, and believe it is what it is claimed to be; I relied on it in my expert rebuttal / supplemental report dated December 30, 2019.

75. Attached hereto as TX_MSJ_006818 – TX_MSJ_006822, is a true and correct copy of a facsimile sent to the New Mexico Office of the State Engineer and others on January 12, 2004, enclosing a letter (subject line: "Groundwater Pumping within EBID") authored by attorneys for the EP#1 and the El Paso Water Utilities Public Service Board, sent to Filiberto Cortez, El Paso Field Division Manager for the U.S. Bureau of Reclamation on January 5, 2004. The document was produced by EBID during discovery. I am a person with knowledge of the matters in this litigation, and I have examined the document, have no reason to doubt its authenticity, and believe it is what it is claimed to be.

76. Attached hereto as TX_MSJ_006823 – TX_MSJ_006825, is a true and correct copy of an email (subject line: "RE: Request for Meeting") authored by Susanne Hoffman-Dooley, AWRM Project Attorney for the New Mexico Office of the State Engineer, sent to Lee Leininger at the United States Department of Justice on March 23, 2006. The document was produced by the United States during discovery. I am a person with knowledge of the matters in this litigation, and I have examined the document, have no reason to doubt its authenticity, and believe it is what it is claimed to be.

77. Attached hereto as TX_MSJ_006826 – TX_MSJ_006829, is a true and correct copy of a letter (subject line: "Comments on the Second Draft of Rules and Regulations for Active Water Resources Administration of the Waters of the Lower Rio Grande Water Master District") authored by Rebecca Dempsey on behalf of the City of El Paso, sent to John D'Antonio, Office of the State Engineer on August 30, 2007. The document was produced by New Mexico during discovery. I am a person with knowledge of the matters in this litigation,

and I have examined the document, have no reason to doubt its authenticity, and believe it is what it is claimed to be.

I declare under penalty of perjury that the foregoing is true and correct. Executed this 21st day of December 2020 at Davis, California.

Scott A. Miltenberger, Ph.D.

May 31, 2019

EXPERT REPORT OF:
Scott A. Miltenberger, Ph.D.

In the matter of:

No. 141, Original
In the Supreme Court of the United States
State of Texas v. State of New Mexico and State of Colorado

Prepared for:

Somach Simmons & Dunn
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Introduction

I, Scott A. Miltenberger, Ph.D., am a partner at JRP Historical Consulting, LLC (JRP), located at 2850 Spafford Street, Davis, California. This expert report was prepared by me for Somach Simmons & Dunn, attorneys representing the State of Texas before the Supreme Court of the United States in *State of Texas v. State of New Mexico and State of Colorado*, No. 141, Original. I have been asked to provide opinions on the following questions regarding the Rio Grande Compact of 1938 and its historical interpretation:

1. What was the purpose of the 1938 Rio Grande Compact?
2. Did the amount of water apportioned to Texas by the 1938 Rio Grande Compact include water to address water quality concerns on Rio Grande Project lands in Texas?
3. What comprised the water supply for the Rio Grande Project, circa 1938?
4. What did delivery of water by the State of New Mexico to San Marcial, under the terms of the 1938 Rio Grande Compact, constitute?
5. Did the 1938 Rio Grande Compact limit the uses to which water in the Upper Rio Grande Basin could be put?
6. Did the Special Master fairly describe the background history leading to the 1938 Rio Grande Compact on pages 31 through 187 and 203 through 209 of the *First Interim Report of the Special Master*, dated February 9, 2017?

In addressing these questions, I have relied upon my education and nearly 13 years of experience as a professional historian, primarily of western water and land use, as well as my review and analysis of archival documents, published sources, and academic monographs. Together with my former business partner (now retired) Mr. Stephen Wee and JRP staff under my direction (all of whom possess graduate degrees in history), I undertook research and collected historical material from a number of federal, state, and local repositories. These include: the National Archives in Washington, DC, at College Park, Maryland, at Denver, Colorado, and at Fort Worth, Texas; the Dolph Briscoe Center for American History at The University of Texas at Austin; the Texas State Archives in Austin; the C.L. Sonnichsen Special Collections Department of the University of Texas at El Paso; the El Paso Historical Society; the New Mexico State Archives in Santa Fe; the University of New Mexico Special Collections in Albuquerque; the New Mexico State University Archives and Special Collections in Las Cruces; History Colorado (formerly the Colorado Historical Society) in Denver; the Water Resource Archives at Colorado State University, Fort Collins; the American Heritage Center at the University of Wyoming in Laramie; the Water Resources Collections and Archives at the University of California, Riverside; and the Harvard Law School Library, Historical and Special Collections, in Cambridge, Massachusetts. I also examined documents produced by the states of Texas, Colorado, and New Mexico, and the United States in this action as well as the materials appended to the *First Interim Report of the Special Master*.

Initial review of these documents was a collaborative effort between Mr. Wee and myself, but I am the sole author of this expert report. My current (as of May 31, 2019) resume is included in the **Appendix** to this report.

My compensation for this matter is $154 per hour for time spent in research, analysis, and preparation of this expert report. My compensation for deposition and trial testimony is $308. A list of cases for which I have provided expert testimony at deposition or trial over the past four years is included in my resume, along with a list of my publications in the previous 10 years.

As indicated above, I have based my opinions on primary and secondary sources known to me, gathered by me or those under my direction, or produced in this action. Those sources are cited in the history profession's preferred footnote citation format as detailed in the *Chicago Manual of Style*. There are other documents that support my opinions which are not cited herein. In the interests of brevity and to avoid repetition, I have chosen to discuss the historical evidence that most directly informs my responses to the questions posed to me. If any other historical material is presented or made known to me, or if I review any additional documents, it may have some effect on the specific opinions offered herein.

Opinion I: The purpose of the 1938 Rio Grande Compact was to protect the water supply of the federal Rio Grande Project while making possible new water developments in Colorado and New Mexico above the project's Elephant Butte Reservoir by equitably apportioning the waters of the Upper Rio Grande Basin among the states of Colorado, New Mexico, and Texas.

Since the 1880s, the Rio Grande had been a source of international and interstate conflict with the US and Mexico, and Colorado, New Mexico, and Texas each making claims to the river's waters. The Rio Grande Project, authorized in 1905, offered a partial solution by delivering water via its Elephant Butte Reservoir to Mexico under the terms of a 1906 treaty, and to lands in southern New Mexico and western Texas that had been deprived by upstream diversions near the river's headwaters. The so-called Rio Grande "embargo," enacted to prevent further upstream diversions from inflaming international tensions until a settlement with Mexico could be negotiated, supported the project's development into the 1920s yet restricted further utilization of the Rio Grande above Elephant Butte. Revocation of the embargo in 1925 created momentum for the negotiation of a tristate compact, with Colorado seeking the opportunity to develop its own water resources projects comparable to the Rio Grande Project. Texas and New Mexico, while not entirely opposed to Colorado, nonetheless sought to safeguard not only the water necessary for the federal reclamation project but also for Texas, the water necessary for lands down to Fort Quitman. Texas and New Mexico's subsequent dispute over the Middle Rio Grande Conservancy District's proposed development above Elephant Butte created further urgency for a compact in the mid-1930s and precipitated the federal Rio Grande Joint Investigation. With data gathered by federal engineers, the engineering advisors for three states recognized that in the absence of additional water being imported into the Upper Rio Grande Basin the usable water supply was limited. They therefore devised two water delivery schedules that became the foundation for the compact – one for Lobatos, near the Colorado-New Mexico state line, and another for San Marcial, above Elephant Butte Reservoir. These schedules were intended to enable water resource development in Colorado and New Mexico above Elephant Butte Reservoir without compromising the Rio Grande Project and the supply of water to lands in Texas above Ft. Quitman.

The limited availability of usable water in the Upper Rio Grande Basin spawned the international and interstate problem of equitable distribution of the Rio Grande waters. The basin is an area of approximately 34,000 square miles that stretches from the headwaters of the Rio Grande in the San Juan Mountains in Colorado southward through the narrow Rio Grande Valley in New Mexico and then southeast to Fort Quitman, Texas. Historically, it has been divided into three smaller sections: the San Luis Valley in Colorado; the Middle Rio Grande Valley between the Colorado-New Mexico state line and San Marcial, New Mexico; and the Elephant Butte-Ft. Quitman section that encompasses the area between Elephant Butte Reservoir and Ft. Quitman (roughly 80 miles downstream from El Paso).

At nearly 2,000 miles long, draining approximately 175,000 square miles before debouching into the Gulf of Mexico, the Rio Grande is the principal river within the basin. Ft. Quitman has long been recognized as a natural dividing point on the river's course. Above Ft. Quitman, nearly all of the water supply for the Rio Grande originates in Colorado and New Mexico, and by the early 1930s the river in this stretch was devoted almost entirely to irrigated agriculture. Below Ft. Quitman, numerous arroyos and tributary streams originating in Mexico feed the river for the remainder of its course.[1]

Like most western rivers under natural conditions, the Rio Grande was irregular; sustained periods of minimal or no flow were punctuated by shorter periods of high flows and even flood. Lack of precipitation in the Upper Rio Grande Basin floor historically demanded the use of the river's waters for irrigation. Native Americans in the basin had irrigated from the Rio Grande, its lesser tributaries, and intermittent basin streams long before the Spanish encountered them in the mid-sixteenth century. They cultivated wheat, corn, fruit, and flowers, principally through the use of what the Spanish identified as "acequias," or community ditches. The most historically significant of these was the so-called "Acequia Madre" located in present-day Ciudad Juarez opposite El Paso, Texas. This large diversion, which could be more than four centuries old in origin, became the centerpiece of Spanish colonization in the area in the seventeenth century.[2]

Following the signing of the Treaty of Guadalupe Hidalgo in 1848 at the end of the Mexican-American War, American settlers in Colorado's San Luis Valley began irrigating from the river. It was not until the 1880s, however, that considerable development occurred on both sides of the international border established at the Rio Grande. Many of the canal systems that predated the federal Rio Grande Project were constructed during this decade. In the immediate vicinity of Juarez and El Paso, an estimated 550 cubic feet per second (cfs, or second feet) of water was diverted to support irrigated agriculture and burgeoning populations – some 15,000 acres and nearly 10,000 people on the American side, and 25,000 acres and 20,000 people on the Mexican

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[1] National Resources Committee, *Regional Planning Part VI – The Rio Grande Joint Investigation in the Upper Rio Grande Basin in Colorado, New Mexico, and Texas 1936-1937*, vol. 1 (GPO, 1938) [hereafter *JIR*], 7; and Douglas R. Littlefield, *Conflict on the Rio Grande: Water and the Law, 1879-1939* (Norman: University of Oklahoma Press, 200), 18-19, and 33-36.

[2] *International Dam in Rio Grande River, Near El Paso, Tex.*, 54th Cong., 1st sess., 1896, H. Doc. 125, 1; and Ottamar Hamele, Special Attorney Representing the Bureau of Reclamation before the Rio Grande Commission, "The Embargo on the Upper Rio Grande," November 11, 1924, 1. 8-3 Rio Grande Distribution of Waters (Loose File), Box 1638, 8-3, Rio Grande C-D, Central Classified File 1907-1936 [hereafter CCF 1907-36], Records of the Department of the Interior, Office of the Secretary, Record Group 48 [hereafter RG 48], National Archives at College Park, Maryland [hereafter NARA II]; and *JIR*, 7.

side. Demands on the river were reportedly still greater upstream. In the Territory of New Mexico nearly 183,000 acres used 5,600 cfs, and in Colorado, roughly 122,000 acres used 3,700 cfs.[3]

As upstream diversions increased, downstream American irrigators in the Mesilla and El Paso valleys and Mexican irrigators in the vicinity of Juarez began to complain of diminished river flows. They focused their ire on Colorado's San Luis Valley, near the Rio Grande's headwaters. The Mexican government took up their citizens' complaints, arguing to the US State Department that the diversions were an abrogation of the 1848 treaty. The dispute lingered over the next decade, and while Congress authorized the president in 1890 to negotiate a resolution with Mexico, the only achievement was the creation of the joint US and Mexican International Boundary Commission (predecessor to the present International Boundary and Water Commission) to address questions of the international boundaries formed by the Rio Grande and Colorado rivers.[4]

The Rio Grande Dam and Irrigation Company's proposed dam in New Mexico ultimately brought decisive action from the US. In early 1895, under the March 3, 1891 federal right-of-way act that granted ditch and canal companies and drainage and irrigation districts a right of way through federal (public domain) lands, the secretary of the interior authorized the company to develop a reservoir site near the mountain peak of Elephant Butte, more than 100 miles upstream from El Paso and Juarez. The company, financed largely by British capital, was led by Dr. Nathan Boyd. Boyd envisioned developing much of the narrow Rio Grande Valley running through New Mexico into small, irrigated farms. When the Mexican government learned of the proposed dam, it renewed its protest. The State Department was unwilling to embrace the view articulated by the attorney general that denied any US "duty or obligation" under the 1848 treaty or international law to see that Rio Grande water reached Mexican ditches. Together with the Mexican foreign minister, Secretary of State Richard Olney directed the boundary commission to investigate the problem further. The boundary commissioners endorsed construction of an "international dam" at El Paso to resolve the international dispute, and warned that Boyd's development imperiled this dam. US commissioner Anson Mills went further, recommending that further applications for rights-of-way to appropriate water on the public domain in the Upper Rio Grande Basin be denied. Olney relayed Mills' recommendation to the Interior Department, and on December 5, 1896, Secretary of the Interior D.R. Francis directed the commissioner of the General Land Office by letter "to suspend action on any and all applications for right of way through public lands for

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[3] Hamele, "The Embargo on the Upper Rio Grande," November 11, 1924, 3. 8-3 Rio Grande Distribution of Waters (Loose File), Box 1638, CCF 1907-36, RG 48, NARA II; and *JIR*, 8.

[4] Hamele, "The Embargo on the Upper Rio Grande," November 11, 1924, 3-5. 8-3 Rio Grande Distribution of Waters (Loose File), Box 1638, CCF 1907-36, RG 48, NARA II; and Littlefield, *Conflict on the Rio Grande*, 18-32.

the purpose of irrigation by using the waters of the Rio Grande River or any of its tributaries in the State of Colorado or in the Territory of New Mexico until further instructed…."[5]

This "embargo," as it came to be known, brought private irrigation development above Elephant Butte, particularly in Colorado, almost to a halt for three decades. The embargo was modified several times, prior to its revocation in 1925. These modifications permitted some rights of way that made possible the appropriation of nearly 115,000 af in Colorado by 1923. Nearly every modification, however, safeguarded the delivery of water to Mexico under the 1906 treaty and the Rio Grande reclamation project, authorized in 1905.[6]

Coloradoans chafed at the embargo's restrictions. San Luis Valley landowners were the most vocal in their condemnation. They insisted that their irrigation works did not impair downstream developments. Valley landowners and their state representatives argued that the embargo violated both the enabling act by which Colorado was admitted to the Union, and the 1891 right-of-way act.

Federal authorities into the 1920s rejected these arguments. They maintained that the enabling act reserved unto the federal government control of public lands within Colorado, and that the secretary of the interior enjoyed "discretion" under the 1891 act to approve or disapprove of right-of-way applications in the "public interest." Congressional authorization of the Rio Grande Project, they further argued, provided "that as a condition precedent to the approval of any application, it must appear clear that the Government project will not be injured thereby."[7]

As controversial as the embargo was within the Upper Rio Grande Basin, it nevertheless fostered settlement of the international dispute between the US and Mexico and development of the Rio Grande Project. In 1897, the federal government moved against Boyd and his company, seeking

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[5] Edw. A. Bowers, Assistant Commissioner, Department of the Interior, General Land Office, to Register and Receiver, Las Cruces, N. Mex., February 11, 1895, "Correspondence Touching the Protest of Mexican Citizens Against the Construction of Dams by the Rio Grande Dam and Irrigation Company," in *Equitable Distribution of the Waters of the Rio Grande. Message from the President of the United States, transmitting, in response to resolution of the Senate of February 26, 1898, reports from the Secretary of State, the Secretary of War, the Secretary of the Interior, and the Attorney-General, with accompanying papers, relative to the equitable distribution of the waters of the Rio Grande River*, 55th Cong., 2d sess, 1898, S. Doc. 229, 2-3; Hamele, "The Embargo on the Upper Rio Grande," November 11, 1924, 6, 14-15, and Exhibit E, 49. 8-3 Rio Grande Distribution of Waters (Loose File), Box 1638, CCF 1907-36, RG 48, NARA II; and Littlefield, *Conflict on the Rio Grande*, 39-40, and 46-52.

[6] Hamele, "The Embargo on the Upper Rio Grande," November 11, 1924, 15-16, and 25-28. 8-3 Rio Grande Distribution of Waters (Loose File), Box 1638, CCF 1907-36, RG 48, NARA II.

[7] Hamele, "The Embargo on the Upper Rio Grande," November 11, 1924, 29-30. 8-3 Rio Grande Distribution of Waters (Loose File), Box 1638, CCF 1907-36, RG 48, NARA II; and Littlefield, *Conflict on the Rio Grande*, 170-171.

to nullify the right-of-way for the private Elephant Butte Dam. Over the next 12 years, federal attorneys and company lawyers argued over whether the river was a navigable waterway; if the Rio Grande was navigable, as US lawyers argued, then the secretary of the interior could not issue a right-of-way under the 1891 act. Twice the US Supreme Court reversed findings made in trial court and affirmed by the New Mexico Territorial Supreme Court that favored the Rio Grande Dam and Irrigation Company, remanding the case back to the lower court. The US changed tactics for the third and final trial. Federal attorneys argued that as five years' time had elapsed for the company to begin construction with no work being done, the right-of-way had expired. Persuaded, the trial court found for the US in May 1903. Both the Territorial Supreme Court and the US Supreme Court subsequently affirmed the decision, effectively bringing the private effort to develop an Elephant Butte reservoir to end in 1909.[8]

The federal government's victory over the Rio Grande Dam and Irrigation Company coincided with a policy shift that finally brought forth a settlement with Mexico. The embargo had eased Mexican concerns, leading the US's southern neighbor to propose a treaty, but the US's own efforts to provide a physical solution to the international problem had lagged. Ongoing litigation with the private company contributed to delays, as did opposition in New Mexico. Several bills were introduced in Congress in the late 1890s and early 1900s that provided for the construction of an international dam at El Paso, and a system of distribution between the US and Mexico. Interests in New Mexico, however, reportedly opposed the idea of this dam, fearing that it would flood much of the Mesilla Valley and impede agricultural development.[9]

This was a view that the principal federal engineer responsible for the Rio Grande Project, Benjamin M. Hall, shared.[10] Passage of the National Reclamation Act of 1902 – also known as the Newlands Reclamation Act, or the Newlands Act for its sponsor Representative Francis Newlands of Nevada – established a new federal program to furnish water to arid regions of the American West. The act created the United States Reclamation Service (Reclamation), forerunner to the present Bureau of Reclamation. Reclamation initially focused on developing those Western

[8] Hamele, "The Embargo on the Upper Rio Grande," November 11, 1924, 18-19, 11, and Exhibit G, 55-56. 8-3 Rio Grande Distribution of Waters (Loose File), Box 1638, CCF 1907-36, RG 48, NARA II. The complicated legal fight between the United States and Boyd's Rio Grande Dam and Irrigation Company is discussed at length in Littlefield, *Conflict on the Rio Grande*, 56-78.

[9] Hamele, "The Embargo on the Upper Rio Grande," November 11, 1924, 19-20. 8-3 Rio Grande Distribution of Waters (Loose File), Box 1638, CCF 1907-36, RG 48, NARA II.

[10] Benjamin M. Hall, or B.M. Hall, earned a degree in engineering from the University of Georgia in 1876. He was a mathematics instructor at what is now North George College and State University, before finding work as an engineer on water and mining projects. Hall consulted with the USGS in 1896, and joined Reclamation soon after it was established. Hall was the supervising engineer on a number of federal reclamation projects in New Mexico, and after leaving Reclamation worked in Puerto Rico. Littlefield, *Conflict on the Rio Grande*, 97.

reservoir sites that had been identified by the "Irrigation Survey" of the United States Geological Survey (USGS) between 1889 and 1890. The Elephant Butte site that Boyd had intended to develop was among these. A more detailed federal investigation began in March 1903, as the final trial with Rio Grande Dam and Irrigation Company neared its conclusion, and involved assessing the possible irrigable acreage that could be served by a reservoir at Elephant Butte. By February 1904, borings for a federal dam at the location were complete. In June, after Mexico once again entreated the US for a settlement, Secretary of State John Hay suggested to Secretary of the Interior Ethan Hitchcock that the National Reclamation Act might offer a path to a settlement with Mexico. Planning for a federal reclamation project centered at Elephant Butte embraced the idea.[11]

Before the assembled delegates to the National Irrigation Congress in November 1904, Hall declared that 180,000 acres of land in the United States could be served by a dam opposite Engle, New Mexico, a third of a mile below Elephant Butte, while delivering water to Mexico. Hall's presentation was based upon a much larger study that he had made prior to the congress, "A Discussion of Past and Present Plans for Irrigation of the Rio Grande Valley." Both in his presentation to the congress and in that study, Hall asserted that a Reclamation dam near Elephant Butte could offer more than the "International Dam" proposed for the El Paso area; it would furnish valuable flood control benefits and supply more US lands with water. Hall's proposed reservoir would have a storage capacity of 2 million af and would yield 600,000 acre-feet (af) to serve "110,000 acres in New Mexico," "20,000…[in] Texas above El Paso," and "50,000…[in] El Paso Valley below El Paso." In order to serve the valley lands sufficiently, given the area's aridity, seasonal flooding, and the high silt content of the Rio Grande, Hall insisted upon building a reservoir

> as large as possible, and as deep as possible; having capacity for carrying a supply of water over from year to year to equalize the yearly inequalities, a surplus capacity for mud accumulations, and a surface for evaporation that is as small as possible in comparison with the quantity of water in storage.

As he emphasized in his presentation and study, "[a]ll of the water that comes down the river is needed for irrigation. We can not [*sic*] afford to waste any of it."[12]

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[11] Hamele, "The Embargo on the Upper Rio Grande," November 11, 1924, 20-211. 8-3 Rio Grande Distribution of Waters (Loose File), Box 1638, CCF 1907-36, RG 48, NARA II; and Littlefield, *Conflict on the Rio Grande*, 94-97.

[12] Guy Elliott Mitchell, ed., *The Official Proceedings of the Twelfth National Irrigation Congress, Held at El Paso, Texas, Nov. 15-16-17-18, 1904* (Galveston, TX: Clarke & Courts, 1905), 215-216; B.M. Hall, Supervising Engineer, U.S. Reclamation Service, "A Discussion of Past and Present Plans for Irrigation of the Rio Grande Valley," November 1904, 7-8, and 57-58. ff. 46 Rio Grande Project. Penasco Rock Resv.

The delegates were pleased with Hall's proposal, calling it "an equitable distribution of the waters of the Rio Grande with due regard to the rights of New Mexico, Texas and Mexico," and Congress acted swiftly to make the project a reality. In 1905, it authorized the Rio Grande Project for New Mexico and Texas. Specifically, it extended the 1902 Newlands Act

> to the portion of the State of Texas bordering upon the Rio Grande which can be irrigated from a dam to be constructed near Engle, in the Territory of New Mexico, on the Rio Grande, to store the flood waters of that river, and if there shall be ascertained to be sufficient land in New Mexico and in Texas which can be supplied with the stored water at a cost which shall render the project feasible and return to the reclamation fund the cost of the enterprise, then the Secretary of the Interior may proceed with the work of constructing a dam on the Rio Grande as part of the general system of irrigation, should all other conditions as regards feasibility be found satisfactory.[13]

The following year, with the conclusion of successful negotiations with Mexico, the Senate ratified a treaty promising the US's southern neighbor 60,000 af of water a year from the Rio Grande.[14]

Federal reclamation authorities worked to develop the Rio Grande Project over the next several years. In 1906, Hall filed a notice of appropriation with the New Mexico territorial engineer for 730,000 af of water for the project. That same year, Reclamation entered into the first of several agreements with two water users associations, the Elephant Butte Water Users Association in New Mexico and the El Paso Valley Water Users Association in Texas, and their successors Elephant Butte Irrigation District (EBID) and El Paso County Water Improvement District No. 1 (EP #1), to furnish water from the project. Two years later, new project supervising engineer Louis C.

Site-Elephant Butte Resv. Site, 1904-1905, Box No. 792, Rio Grande 17-46, Entry 3, General Administrative and Project Records, 1902-1919 [hereafter Entry 3], Records of the Bureau of Reclamation, Record Group 115 [hereafter RG 115], National Archives at Denver [hereafter NARA Denver]; and Littlefield, *Conflict on the Rio Grande*, 100-102 and 108-109.

[13] Historian Douglas Littlefield argues that by extending the provisions of Newlands Act to the El Paso Valley in Texas – a non-"Reclamation" state – Congress "authorized the Reclamation Service to carry out the first true apportionment of any interstate stream." He goes on to connect this act to the later 1938 "interdistrict agreement" between Elephant Butte Irrigation District and El Paso County Water Improvement District No. 1, approved by the Interior Department to explain why no state-line delivery to Texas was established. See Littlefield, *Conflict on the Rio Grande*, 114-115, 203 and 207, and Opinion IV below.

[14] Mitchell, ed., *Official Proceedings*, 107; Hamele, "The Embargo on the Upper Rio Grande," November 11, 1924, 23-25. 8-3 Rio Grande Distribution of Waters (Loose File), Box 1638, CCF 1907-36, RG 48, NARA II; *An Act Relating to the construction of a dam and reservoir on the Rio Grande, in New Mexico, for the impounding of the flood waters of said river for purposes of irrigation*, February 25, 1905, chap. 798, 33 Stat. 814; and Littlefield, *Conflict on the Rio Grande*, 105-145.

Hill filed a supplemental notice for "[a]ll of the unappropriated water of the Rio Grande and its tributaries."[15]

Construction proceeded apace. Leasburg Diversion Dam and its canal, the first elements of the project system, were completed in 1908. Eight years later, Elephant Butte Dam was completed, and the remaining major irrigation works were constructed between 1914 and 1919. In the late 1910s, work began on a vast drainage system to manage rising groundwater levels and fulfill Hall's plan to utilize all of the waters of the Rio Grande, including return flow (see Opinion III). By the mid-1920s, while planning and construction of various elements would continue into the 1930s, the project was substantially completed.[16]

Although the embargo was intended to last until a resolution could be found to the diplomatic dispute with Mexico, federal officials eager to protect the water supply of the Rio Grande Project continued to supported it into the early 1920s. Successful conclusion of the Colorado River Compact, however, prompted Reclamation Director A.P. Davis to solicit the opinions of the Colorado attorney general and the general managers of EBID and EP #1 as to a modification of the embargo and possible negotiation of a compact in December 1922.[17]

In March 1923, citing recent criticism of the embargo by Coloradoans, Davis recommended to Secretary of the Interior Albert B. Fall that the embargo be modified such that Reclamation could "negotiate for the release of specific areas of public land for purposes of water storage under conditions that will best conserve and protect vested rights in all parts of the Rio Grande Basin."

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[15] B.M. Hall, Supervising Engineer to Mr. David L. White, Territorial Irrigation Engineer, Jan. 23, 1906. ff. 41 New Mexico, Water Appropriations- -General, Thru 1910, Box 6 38C- -41; Supervising Engineer [Louis C. Hill] to Mr. Vernon L. Sullivan, Territorial Engineer, Subject: Supplemental notice of the intention of the United States to use the waters of the Rio Grande for irrigation purposes on the Rio Grande Project, April 14, 1908. ff. 41-D New Mexico. Water Appropriations. RIO GRANDE PROJECT THRU 1910, Box 9 41B- -41D; Articles of Agreement between the United States of America, the Elephant Butte Water Users' Association, and the El Paso Valley Water Users' Association, June 27, 1906. ff. 330-B Rio Grande. Contracts with Elephant Butte Irri. Dist., Box 817 Rio Grande 330B- -348C, Entry 3, RG 115, NARA Denver.

[16] F.H. Newell, Director, *Seventh Annual Report of the Reclamation Service 1907-1908* (GPO, 1908), 150; Arthur P. Davis, Director and Chief Engineer, and Will R. King, Chief Counsel, *Seventeenth Annual Report of the Reclamation Service 1917-1918* (GPO, 1918), 250-251; and *Twenty-Fourth Annual Report of the Bureau of Reclamation, Transmitted to Congress in pursuance of the Act of June 17, 1902 (32 Stat. 388) for the Fiscal Year Ended June 30, 1925* (GPO, 1925), 25.

[17] A.P. Davis, Director, to Hon. V.E. Keynes, Attorney General of Colorado, Dec. 12, 1922; A.P. Davis, Director, to Mr. H.H. Brook, President, Elephant Butte Irrigation District, Dec. 12, 1922.; and A.P. Davis, Director, to Mr. Roland Harwell, President, El Paso County Water Improvement Dist. #1, Dec. 12, 1922. ff. 032.02, Rio Grande Basin Water Rights: Rio Grande River Basin Embargo, Thru 1925, Box No. 925 Rio Grande Basin 032.02-- Lower Rio Grande 090., Project Files, 1919-1929, General Administrative and Project Records, 1919-1945, Entry 7 [hereafter Entry 7], RG 115, NARA Denver; and Littlefield, *Conflict on the Rio Grande*, 170-171.

The director predicated this recommendation on an analysis proffered by federal reclamation engineer Harold Conkling nearly four years earlier. In a June 1919 memorandum, Conkling argued that water developments in the San Luis and the Middle Rio Grande valleys would have a negligible impact on the Rio Grande Project downstream. In fact, he believed that with the construction of drainage works these developments could augment the water supply below Elephant Butte. Davis echoed this belief, expressing confidence that with Reclamation granted new authority, upstream projects could move forward without compromising the Rio Grande Project's water supply. Fall concurred, authorizing the modification in March 1923.[18]

The embargo came to an end entirely two years later. In September 1924, Davis's successor Elwood Mead expressed his support for the long-contemplated Vega-Sylvestre Reservoir in San Luis Valley. In April 1925, the Interior Department approved the reservoir. A little over a month later, Secretary of the Interior Hubert Work rescinded the embargo, reasoning that it was no longer necessary.[19]

Colorado and New Mexico had already moved forward with negotiating a compact, prior to Work's decision. In 1923, both states appointed commissioners to meet with a federal representative, and they initially sought to negotiate an agreement solely between themselves with the secretary of the interior's support and encouragement.[20] Concern for the possible

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[18] Memorandum, From: Engineer Harold Conkling, To: Chief of Construction, Subject: Water Supply-Rio Grande River, June 18, 1919. ff. 302.31 New Mexico, Surveys & Investigations, Thru 1929, 2 of 2, Transfer Case, Box 262 302.28- -302.31 A NV-NM, Entry 7 General Files, 1919-1929; A.P. Davis, Director, to The Secretary of the Interior, March 2, 1923, Approved: Albert B. Fall, Secretary, 9-11. ff. 032.02 Rio Grande Basin Water Rights: Rio Grande Basin Embargo Thru 1929, Box No. 925 Rio Grande Basin 032.02--Lower Rio Grande 090., Entry 7, RG 115, NARA Denver; and Littlefield, *Conflict on the Rio Grande*, 183.

[19] Elwood Mead, Commissioner, Memorandum to the Secretary, September 6, 1924. ff. 032.02 Rio Grande Basin Water Rights: Rio Grande Basin Embargo Thru 1929, Box No. 925, Entry 7, RG 115, NARA Denver; and Hubert Work, Secretary, to The President, May 23, 1925. ff. Rio Grande Compact Commission Records, 1924-1941, Richard Burges Papers: Correspondence, 1924-1935, May-December 1925, Box 2F468, Rio Grande Compact Commission Records, 1924-1941, 1970 [hereafter RGCCR, 1924-1941, 1970], Briscoe Center for American History, University of Texas at Austin [hereafter UTA]; and Littlefield, *Conflict on the Rio Grande*, 184-187.

[20] According to Colorado Lieutenant Governor George Corlett's recollection, that encouragement came circa 1925, when at a conference with Work in Washington, D.C. The Secretary of the Interior urged Corlett to meet with New Mexico's commissioner Francis Wilson, who was also in D.C., and find "just one thing" upon which they agreed. Arrangements were made for the two men to meet at the Senate office building, and they ultimately sat down with Work and Reclamation representatives to discuss the possibility of an "outlet drain" for Colorado. Proceedings of the Rio Grande Compact Conference held at Santa Fe, New Mexico, December 10-11, 1934, 5-6. ff. Proceedings of the Rio Grande Compact Commission, Santa Fe, New Mexico. 1934-1935, Box 62, Series 7: Publications and reports, 1856-1992 and undated [hereafter Series 7], Subseries 7.1: Compacts and rivers, 1893-1986 and undated [hereafter Series 7.1], Papers of Delph E. Carpenter and Family [hereafter PDECF], Water Resources Archives

impact of water projects upstream from the Rio Grande Project, however, led Texas to push for inclusion. Following a preliminary "first" meeting of the Rio Grande Compact Commission in October 1924, in which El Paso attorney Major Richard F. Burges argued on Texas's behalf as an unofficial representative, the federal representative, Secretary of Commerce Herbert Hoover and the Colorado and New Mexico commissioners agreed to include Texas.[21] The parties further agreed that their negotiations should focus on the allocation of the waters of the Rio Grande above Fort Quitman, Texas as this was a natural dividing point in the river.[22]

Appointment of an official commissioner for Texas, New Mexico's withdrawal from compact negotiations following Work's rescission of the embargo, and the resignation of Hoover upon his election to the presidency delayed further talks among the three states until December 1928.

[hereafter WRA], Colorado State University, Fort Collins [hereafter CSU-FC], available online at http://hdl.handle.net/10217/41293, last accessed April 8, 2019.

[21] Richard Fenner Burges came from a prominent family of El Paso attorneys. After graduating from Texas Agricultural and Mechanical College (today Texas A&M University), he read law in Seguin, Texas. He joined the El Paso law practice of his oldest brother, William Henry Burges, Jr., in 1892. Burges was admitted to the bar two years later, and along with William and his middle brother Alfred Rust Burges (who joined Richard in his separate law practice in 1912) established the El Paso Bar Association in the early 1910s. Burges was the city attorney for El Paso between 1905 and 1907, where he drafted the City Charter and continued an anti-vice campaign began by William when he was city attorney. As a member of the Texas State Legislature between 1913 and 1915, Burges authored the Texas Forestry Act and the Texas Irrigation Code. He earned the military title of major for his service in France during World War I; Burges also earned a Croix de Guerre for his bravery on the battlefield. Returning to El Paso after the war, he was considered as a potential gubernatorial candidate but Burges declined. Instead he dedicated much of the rest of his life to representing El Paso, El Paso County, and adjacent Hudspeth County, particularly on matters related to the Rio Grande – as noted in the opinions offered here. From 1935 to 1940, Burges served as a special counsel to the Department of Justice on the Rio Grande Rectification Project (see footnote 169). See Laura Hollingsed, Biography, "Guide to MS 262 Burges-Perrenot Family Papers," C.L. Sonnichsen Special Collections Department, University of Texas at El Paso, available online at digitalcommons.utep.edu/cgi/viewcontent.cgi?article=1073&context=finding_aid, last accessed April 15, 2019.

[22] Pat M. Neff, Governor of Texas, to Honorable Herbert Hoover, Secretary of Commerce, Re: Commission to Divide Waters of the Rio Grande, September 20, 1924. Folder 3, Herbert Hoover, Sec. of Commerce (11.); First Meeting, Rio Grande River Compact Commission, Breadmoor Hotel, Colorado Springs, Colo., Sunday, October 26, 1924, 1-37. Folder 1. First Meeting Rio Grande Compact Commission. Oct. 26, 1924, Box 02-D.002, MS 0235 Elephant Butte Irrigation District Records, 1883-1981 [hereafter MS 0235], Rio Grande Historical Collections [hereafter RGHC], New Mexico State University Archives and Special Collections, Las Cruces [hereafter NMSU Spec. Coll]; and Littlefield, *Conflict on the Rio Grande*, 177-183.

As Burges put it, "It is a matter of fact, and it can be established to the satisfaction of any fair minded person, that the use of water of the Rio Grande above Fort Quitman does not at least materially affect the interests of the people below Del Rio, Texas, as there is no irrigation that is of any consequence, and I think no possible irrigation of any importance between Fort Quitman and Del Rio, Texas." First Meeting, Rio Grande River Compact Commission…October 26, 1924, 4.

Over the course of three meetings, from December 19 through December 21, New Mexico and Texas aligned in defending the Rio Grande Project against Colorado. New Mexico's commissioner Francis Wilson was adamant that a specific quantity of water for New Mexico be determined and delivered at the Colorado-New Mexico state line. Wilson also argued that the best development Colorado could make, and which would have little effect on projects downstream, would be to drain the so-called "Closed Basin" – lands in the San Luis Valley waterlogged by the river. Any dam or reservoir that would impound the existing surface flow of the stream, in his view, threatened the Rio Grande Project and its 1906 and 1908 water filings in New Mexico.[23]

Burges, speaking for Texas, argued that his state's claims to the waters of the Rio Grande derived largely from the Rio Grande Project filings and the allocation of water to lands in New Mexico and Texas within the project. He further pointed out that approximately 20,000 acres below the end of the project (roughly Fabens, Texas) down to Ft. Quitman was irrigated. These lands in Hudspeth County relied almost entirely upon return flow from the project, obtained under the provisions of a federal Warren Act contract (see Opinion III).[24]

Colorado sought the freedom to develop its San Luis Valley. Lieutenant Governor George M. Corlett was the principal voice for the state. He insisted downstream water users would not be harmed by the construction of upstream reservoirs and in fact, stood to benefit from return flows and reduced evaporation caused by the long transit time in stream flow to Elephant Butte. Corlett acknowledged the benefits of the drain suggested by Wilson, and although he did not abandon the idea of a San Luis reservoir he ultimately agreed to join with New Mexico and Texas to request federal support for a Closed Basin drainage project.[25]

Although Colorado marshaled data to convince New Mexico and Texas of its position, there was little else upon which the states agreed aside from the Closed Basin project. In February 1929, limited again by their states' respective schedules and needing more time to study the problem, Colorado, New Mexico, and Texas concluded a temporary compact. This agreement, in effect, was to maintain the status quo in the basin for a period of six years until June 1935. Neither Colorado (Article V) nor New Mexico (Article XII) was to "cause or suffer the water supply" of the

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[23] Proceedings of the Rio Grande Compact Conference, Held December 19-20-21, 1928, At Santa Fe, New Mexico, 3, and 10-11. ff. Rio Grande Compact Commission Records, 1924-1941, 1970, Richard F. Burges Papers, Proceedings of the Rio Grande Compact Conference Held Dec. 19-20-21 at Santa Fe, N.M. (Title page, 78 pp.) [hereafter ff. Proceedings of the Rio Grande Compact Conference Held Dec. 19-20-21], Box 2F471, RGCCR, 1924-1941, 1970, UTA; and Littlefield, *Conflict on the Rio Grande*, 187-189.

[24] Proceedings of the Rio Grande Compact Conference...1928, 13. ff. Proceedings of the Rio Grande Compact Conference Held Dec. 19-20-21, Box 2F471, RGCCR, 1924-1941, 1970, UTA.

[25] Proceedings of the Rio Grande Compact Conference...1928, 14-19. ff. ff. Proceedings of the Rio Grande Compact Conference Held Dec. 19-20-21, Box 2F471, RGCCR, 1924-1941, 1970, UTA; and Littlefield, *Conflict on the Rio Grande*, 190.

river "to be impaired by new or increased diversions or storage" – affording protection for the Rio Grande Project water supply – during this time. However, should the Closed Basin drain and State Line Reservoir be constructed prior to June 1935, "depletions" were permissible if "offset by increase of drainage return." The temporary compact further provided for the establishment of several stream-gaging stations to gather flow data (Article III), necessary to formulating a permanent compact and endorsed construction of the Closed Basin Drain and State Line Reservoir by the federal government (Article II).[26]

With the expiration of the temporary compact a mere six months away, Colorado commissioner M.C. Hinderlider, New Mexico commissioner Thomas McClure, Texas commissioner T.H. McGregor, and the new federal representative (and Reclamation assistant chief engineer) S.O. Harper re-opened talks on a permanent compact in December 1934. Little had changed for the three states; all remained committed to the positions they articulated back in 1928. Corlett once again insisted that Colorado have "parity" with New Mexico and Texas in the use of Rio Grande waters – which Harper understood to mean "equality as regards dependability of water supply with the lands under the Elephant Butte Reservoir in New Mexico and Texas." New Mexico and Texas representatives, however, demanded to know whether Colorado intended to accept federal monies then being offered by the President Franklin Roosevelt's New Deal administration for a Closed Basin drain study. Ralph Carr, legal advisor to Colorado, responded that certain obligations attached to this funding were objectionable, and he asked for New Mexico and Texas's support in addressing those objections. He also maintained that the commission's "problem" and "task" was "to make an equitable division of the waters of the Rio Grande." Colorado sought to "arrive at a permanent compact," and notwithstanding the issues surrounding the drain, Carr argued for the opportunity to "present the data which is needed to arrive at a solution…."[27]

Burges countered that until the drain was constructed it was impossible to estimate the quantity of additional water to be developed by storage for use in Colorado, and thus an equitable apportionment remained elusive. Texas, according to Burges, preferred to continue the present compact until the effective yield of the Closed Basin drain could be determined. Carr, however, believed that this was unnecessary, as the 1929 compact, in Harper's words, "concedes to

[26] Proceedings of the Rio Grande Compact Conference...1928, 22-78. ff. Proceedings of the Rio Grande Compact Conference Held Dec. 19-20-21, Box 2F471, RGCCR, 1924-1941, 1970, UTA; *JIR*, 8; and Littlefield, *Conflict on the Rio Grande*, 191-193.
[27] Proceedings of the Rio Grande Compact Conference…1934, 10-11, 19-23, and 27-29. ff. Proceedings of the Rio Grande Compact Commission, Santa Fe, New Mexico. 1934-1935, Box 62, Series 7, Subseries 7.1, PDECF, WRA, CSU-FC; S. O. Harper to Secretary of the Interior, December 14, 1934, 4-5. File No. 8-3 (Part 2), Rio Grande-Distribution of Waters-Compact, C-D, August 18, 1930-February 25, 1936, Box No. 1638, CCF 1907-36, RG 48, NARA II; and Littlefield, *Conflict on the Rio Grande*, 196-197.

Colorado an additional amount of water equivalent to that developed by the drain…." At an impasse, but with each of the states informed as to the others positions, the commissioners decided to adjourn, study the questions in more detail, and reconvene in January 1935.[28]

The January meeting picked up where the December meeting had left off, with Colorado continuing to insist on parity with Texas and New Mexico. Corlett argued that construction of "the Outlet Drain" (i.e., the Closed Basin Drain) together "with the savings of avoidable waste from the Elephant Butte Project" would ensure sufficient water for Colorado's intended developments. By "avoidable waste," he meant the water released below Rio Grande Project lands in Texas. Corlett insisted that this waste had been controlled following the adoption of the temporary compact but since that time it had "crept into the operations of these projects, so that the releases at the Elephant Butte have now come back to approximately what they were before." Construction of the Closed Basin drain, together with control of "avoidable waste" on the Rio Grande Project would enable, he argued, "an annual uniform supply of water to the lands of Colorado on a parity with the supply now furnished to lands in New Mexico and Texas."[29]

As before, negotiation of the compact for Colorado was not contingent upon construction of the drain. Corlett believed that "with all of the excellent accumulated engineering data and advice" available to the commissioners that a compact could be devised, and to that end, Colorado's engineering advisor Royce J. Tipton took the floor.[30] Tipton elaborated on the argument first

[28] Proceedings of the Rio Grande Compact Conference…1934, 23-24, 29-30, and 34-38. ff. Proceedings of the Rio Grande Compact Commission, Santa Fe, New Mexico. 1934-1935, Box 62, Series 7, Subseries 7.1, PDECF, WRA, CSU-FC; Harper to Secretary of the Interior, December 14, 1934, 5-6. File No. 8-3 (Part 2), Box No. 1638, CCF 1907-36, RG 48, NARA II; and Littlefield, *Conflict on the Rio Grande*, 197-198.

[29] Proceedings of the Rio Grande Compact Commission, Santa Fe, January 28-30, 1935, 3-4. ff. Proceedings of the Rio Grande Compact Commission, Santa Fe, New Mexico. 1934-1935, Box 62, Series 7, Subseries 7.1, PDECF, WRA, CSU-FC.

[30] Born in Illinois in 1893, Royce Jay Tipton grew up in Colorado. After he graduated high school, he worked as an elementary school teacher before receiving practical training as an engineer with a mining company. Tipton entered the University of Colorado in 1915 to study civil engineering but before completing his degree he went overseas during World War I. Tipton never finished his academic studies, although in 1940 he was awarded "an Honorary Degree in Civil Engineering" by the university. Following his military service, Tipton worked as chief engineer for the San Luis Valley Land and Cattle Company, and in the early 1920s formed the first of several business partnerships and engineering consulting companies. In 1929, he became Colorado's engineering advisor in the Rio Grande Compact negotiations, and briefly assisted with Reclamation water supply studies for what became the Hoover Dam. His association with the Colorado State Engineer's office continued into the 1930s. Tipton's professional life took him abroad, and he partnered with Hill on a water supply projects in Pakistan and Egypt. Texas's engineering advisor recalled Tipton fondly in a 1968 deposition that Hill gave in an original action filed against Colorado by Texas and New Mexico, alleging violations of the 1938 Compact: "Mr. Royce Tipton was one of the outstanding engineer in this field… and I considered him of the of the ablest engineers in the field….I liked the man personally, I admired his ability…." "Memoir, Royce Jay Tipton, F. ASCE, Died December 23, 1967,"

advanced back in 1928 that the entire Rio Grande Basin stood to gain from the construction of reservoirs to serve the San Luis Valley. He presented technical data that he maintained demonstrated such works would assist in regulating the water supply and providing sufficient carryover storage from high to low water years in the valley, and by doing so return as much as 100,000 af to the stream to the benefit of downstream users in New Mexico and Texas.[31]

The rest of the commission, while intrigued by Tipton's presentation, felt that they had little time to consider it in detail. Extensive questioning by Burges (serving as Texas's acting commissioner at the request of the Governor James V. Allred), led to Colorado agreeing to make Tipton's work available to Texas and New Mexico for further review. In the meantime, the commissioners decided to recommend to their respective governors and legislatures a two-year extension of the temporary compact until June 1937.[32]

Before negotiations resumed, Texas filed suit against New Mexico and the Middle Rio Grande Conservancy District (MRGCD) in the US Supreme Court in October 1935. Texas alleged that by permitting diversions above Elephant Butte by MRGCD, diversions that diminished both the quantity and quality of water reaching Texas lands, New Mexico had abrogated the terms of the 1929 compact. Organized in August 1925 under the laws of New Mexico, the Middle Rio Grande Conservancy District aimed to reclaim and develop that portion of the basin above San Marcial, providing not only water but also flood protection to lands in the vicinity of Albuquerque. As the negotiations leading to the 1929 temporary compact were underway, MRGCD had formulated its plans and had contracted with Reclamation for additional technical support and study, leading to an assessment of "the water conditions of the Rio Grande." By the early 1930s, primarily with financial support from the federal Reconstruction Finance Corporation, the district had embarked on constructing El Vado, a proposed 190,000-af storage reservoir on the Rio Chama near the

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enclosed with Olin Kalmbach to Mr. William H. Wisely, Executive Secretary, ASCE, January 28, 1969. Folder 1 Biographical notes – Royce J. Tipton, 1967-1969, Box 1, Series 1: Tipton's biography and writings, 1915-1969 and undated, Papers of Royce J. Tipton, 1915-1969, WRA, CSU-FC, available online at https://mountainscholar.org/handle/10217/181886, last accessed May 20, 2019; and Deposition of Raymond A. Hill. Taken December 4, 1968. Denver, Colorado, *State of Texas and State of New Mexico, Plaintiffs, vs. State of Colorado, Defendant,* No. 29, Original, in the Supreme Court of the United States, October Term 1967, 9-11. ff. Texas & New Mex. v. Colo., w. 66-1061 Texas vs. Colorado, Box 1989 41-240, LF-TAG, TSA.

[31] Proceedings of the Rio Grande Compact Commission...January 28-30, 1935, 6, 7, and 8-17. ff. ff. Proceedings of the Rio Grande Compact Commission, Santa Fe, New Mexico. 1934-1935, Box 62, Series 7, Subseries 7.1, PDECF, WRA, CSU-FC.

[32] Proceedings of the Rio Grande Compact Commission...January 28-30, 1935, 43-45. ff. Proceedings, Box 62, Series 7, Subseries 7.1, PDECF, WRA, CSU-FC; and Littlefield, *Conflict on the Rio Grande*, 198.

Colorado-New Mexico state line, as well as half a dozen diversion dams on the Rio Grande, and several hundred miles of irrigation and drainage canals and levees.[33]

MRGCD's plans notwithstanding, New Mexico rejected Texas's allegations. The state asserted that diversions by Mexico in excess of that permitted under the 1906 treaty and inefficient operation of Elephant Butte Dam were to blame for the diminished water supply to lands in Texas. New Mexico further argued that the US's 1906 appropriation of water for the federal reservoir was not made in accordance with New Mexico law, in violation of the 1902 Newlands Act.[34]

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[33] State of New Mexico, County of Bernalillo, In the District Court, In the Matter of the Middle Rio Grande Conservancy District, No. 14157, First Report of the Board of Directors, G.E. Cook, President, Ramon Baca y Chavez, Director, Robert E. Dietz, Director, E.G. Watson, Secretary. Dated at Albuquerque, New Mexico, August 27th, 1926, 2-5, and 13. ff. 222. Rio Grande Basin Irrigation Districts Middle Rio Grande Transfer Case Thru 1929, Box 928 Rio Grande Basin-Lower Rio Grande 301.- -545., Middle Rio Grande 222.- -223., Entry 7, RG 115, NARA Denver; *Supreme Court of the United States, October Term 1936, No. 12 Original, State of Texas vs. State of New Mexico, et al., Ad Interim Report of the Special Master*, received Mar. 26, 1937, 4-5. ff. RG 267, Entry 26, TX v NM #10, Box 401 1939 to 1939 PI 139, Entry 26, Original Jurisdiction Case Files, 1792-2005 [hereafter Entry 26], Records of the Supreme Court of the United States, Record Group 267 [hereafter RG 267], National Archives Building, Washington, DC [hereafter NAB]; and Littlefield, *Conflict on the Rio Grande*, 198-199.

Discussions with Reclamation regarding development of the Middle Rio Grande extended back to late 1919, and resulted in the drafting of an initial study in December 1922 by Homer Gault. Ottamar Hamele, Acting Director, to The Secretary of the Interior, Dec.-1 1919. ff. 301. Rio Grande Basin-Middle Rio Grande Engineering Reports & Estimate Thru 1929, Box 929 Rio Grande Basin, Middle Rio Grande 301.- -400.05, Entry 7, RG 115, NARA Denver; and Homer J. Gault, Engineer, US Reclamation Service, Denver, Colorado, Department of the Interior, United States Reclamation Service, in cooperation with The State of New Mexico, Report on the Middle Rio Grande Reclamation Project, New Mexico (December 1922). ff. 21, Rio Grande Commission, 1921-1930, Box 15, MSS 90 BC Richard Charles Dillon Papers, 1918-1944, University of New Mexico Special Collections, Albuquerque.

[34] The State of Texas, By Wm. McCraw, Its Attorney General, H. Grady Chandler, Assistant Attorney General, Richard F. Burges, Walter S. Howe, Edwin Mechem, Of Counsel, Supreme Court of the United States, October Term, 1935, No. – Original, *State of Texas, Complainant, vs. State of New Mexico, et al.*, Motion for Leave to File Bill of Complaint and Bill of Complaint [October 29, 1935]; Supreme Court of the United States, October Term, 1935, No. 15, Original, *State of Texas, Complainant vs. State of New Mexico, et al.*, Answer of the Defendant State of New Mexico, and Answer of Defendants, Middle Rio Grande Conservancy District, Robert Dietz, M.R. Buchanan, T.J. Seneker, George Cook, and Constancio Hendren, Directors of Said District - Supreme Court of the United States [March 26, 1936]. w. Texas' Briefs, A.G. 51-238, State of Texas v. State of New Mexico, et al., Box 1993/127-1, Litigation Files, Texas Attorney General [hereafter LF-TAG], Texas State Archives, Austin [hereafter TSA]; Supreme Court of the United States, No. 15, Original, October Term, 1935, *The State of Texas, Complainant, v. The State of New Mexico, et al.*, Docket Entries, nd. ff. 4-1 Warren Charles, Correspondence re Texas v. New Mexico June 1936; and *State of Texas v. State of New Mexico*, No. 12 Original, 1936 Term. *Statement by Special Master*, March 5, 1937. ff. Warren Charles, Correspondence re Texas vs. New Mexico / March, 1937, Box 4 Correspondence,

The Supreme Court granted leave to Texas to proceed with its suit in November, and appointed a special master, attorney Charles Warren, to take testimony in May 1936. Between November 1936 when Warren opened hearings and March 1937 when hearings concluded, nearly 40 hearings were held in Albuquerque, New Mexico, and El Paso, Texas, and in excess of 3,000 pages of evidence – including more than 260 exhibits, maps, charts, graphs, and witness testimony – were produced. Warren further personally inspected several hundred miles of the Rio Grande and the various irrigation and drainage system that served lands in New Mexico and Texas.[35]

Despite all of this, when the hearings ended the special master could not see a clear resolution. In his *Ad Interim Report* to the Supreme Court in March 1937, Warren indicated that he was "of opinion that findings of fact by me based on the evidence in its present shape would be unsatisfactory and might not result in an equitable adjustment of the situation." Essential legal issues (such as the absence of the US and Colorado as parties to the litigation) aside, the special master cited incomplete records and partial analyses of flow depletion and salinity levels as constituting an insufficient basis for findings of fact. Aware that the federal government through the National Resources Committee (NRC) was "investigating the whole problem of water supply and distribution in the Upper Rio Grande region," and at the request by counsel representing Texas, New Mexico, and MRGCD, to hold "further proceedings…in abeyance until the first day of October 1937," Warren recommended postponement of the case until January 1938. The high court approved the recommendation in April.[36]

The National Resources Committee referenced by Warren was a special working group of government officials and consultants within the Roosevelt Administration that aimed to foster development of the nation's natural resources through planned regional public works programs. In September 1935, a month prior to Texas filing suit against New Mexico and MRGCD, "spurred by the need for prompt action to avoid uncoordinated development of water utilization projects" in the Upper Rio Grande Basin, the group appointed a Board of Review to study the various water use problems and proposed projects in the basin. The board readily identified the potential for

Notes, Reports re: Texas vs. New Mexico [hereafter Box 4], Series 1: Materials re: cases, Charles Warren Papers 1885-1954 [hereafter CWP], Manuscripts Unit, Harvard Law School Library, Historical and Special Collections, Cambridge, Massachusetts [hereafter HLS HSC]; and *Ad Interim Report of the Special Master*, received Mar. 26, 1937, 4-6. ff. RG 267, Entry 26, TX v NM #10, Box 401, Entry 26, RG 267, NAB.

[35] *Ad Interim Report of the Special Master*, received Mar. 26, 1937, 1. ff. RG 267, Entry 26, TX v NM #10, Box 401, Entry 26, RG 267, NAB.

[36] Special Master to Richard F. Burges, Esquire, March 26, 1937. ff. Correspondence re: Texas vs. New Mexico/March, 1937, Box 4, CWP, HLS HSC; *Ad Interim Report of the Special Master*, received Mar. 26, 1937, 5-13; and *Supreme Court of the United States, October Term 1936, No. 10 Original, State of Texas vs. State of New Mexico, et al., Final Report of the Special Master*, filed Sep. 25, 1939, 4. ff. RG 267, Entry 26, TX v NM #10, Box 401, Entry 26, RG 267, NAB.

the MRGCD to jeopardize the 1906 treaty with Mexico and prior federal investment in the Rio Grande Project. Other proposed federal water projects, such as the Conejos and Vega-Sylvestre dams and the so-called "State Line Reservoir" in Colorado, also presented potential conflicts with not only the Rio Grande Project and the MRGCD but also with the tristate compact under negotiation. Furthermore, the river basin was considered to be fully appropriated. New drafts on existing water resources without enhancing supply, the board ultimately concluded, would damage vested rights in the basin.[37]

In the interests of efficient, full, and equitable utilization of the basin's waters, the board recommended that no action be taken "to approve any application for a project involving the use of Rio Grande waters without securing from the National Resources Committee a prompt opinion on it from all relevant points of view." President Franklin D. Roosevelt, at the urging of Secretary of the Interior Harold Ickes, issued an executive order in September 1935 prohibiting federal officials from authorizing any water projects for the Rio Grande Basin without obtaining the approval of the NRC – in effect, restoring the embargo.[38]

In early October 1935, the NRC contacted Harper about the possibility of having representatives from the group meet with the Rio Grande Compact Commission to discuss how they might facilitate conclusion of a permanent compact by providing "needed basic data" that would foster "agreement on facts by the three states…." With the approval of Harper and the other compact commissioners, the NRC sent Harlan H. Barrows, a University of Chicago historical geographer and a member of the Board of Review, and Frank Adams, an agricultural economist with the NRC's Water Resources Committee, to meet with the commission in December.[39] At that

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[37] "Report of the Rio Grande Board of Review," September 13, 1935, 1-4. Folder 390-Rio Grande Joint Investigation Purpose and Organization, 1935-1937, Box 26, Frank Adams Collection [hereafter FAC], Water Resources Collections and Archives, University of California, Riverside [hereafter WRCA]; *JIR*, 10; and Littlefield, *Conflict on the Rio Grande*, 200-201. For more on the NRC, see Richard Lowitt, *The New Deal and the West* (Norman: University of Oklahoma Press, 1993).

[38] "Report of the Rio Grande Board of Review," September 13, 1935, 6-11. Folder 390, Box 26, FAC, WRCA; and Franklin D. Roosevelt, To Federal agencies concerned with projects or allotments for water use in the Upper Rio Grande Valley above El Paso, September 23, 1935. File No. 8-3 (Pt. 7). Reclamation Bureau - Rio Grande Project - Rio Grande River - Distribution of Waters – General, February 6, 1933 to December 12, 1956, Box 1642, 8-3, Rio Grande, R, CCF 1907-1936, RG 48, NARA II.

[39] Harlan H. Barrows came to the University of Chicago as an undergraduate in 1903, earned a BA in geology, and later joined the university's Department of Geography – the first such academic department for the discipline in the United States. He went on to become a foundational figure in the study of historical geography, and garnered recognition and acclaim for his lectures. Barrows entered public service during World War I, as a member of the United States War Trade Board. In the early 1930s, he consulted on a number of US Department of the Interior-led, or -based initiatives, such as the Water Resources Committee of the National Resources Committee. See Biographical Note, "Guide to the Harlan H. Barrows Papers, circa 1880-1939,", University of Chicago Library, available online at

meeting, Barrows and Adams proposed a joint federal-state investigation of the water resources, uses, and needs throughout the Upper Rio Grande Basin, and the commissioners agreed. The investigation, it was determined, would include: 1) the water resources of the Rio Grande Basin "above Fort Quitman;" 2) the "past, present and prospective uses and consumption of water" in the basin within the United States; and 3) opportunities for conserving and enlarging the water supply to assist the commission "in reaching a satisfactory basis for the equitable apportionment of the waters of the Rio Grande Basin in the United States above Fort Quitman, as contemplated by such Rio Grande Compact."[40]

The commissioners embraced the offer of assistance, but were wary of the investigation coming to conclusions or making recommendations. Texas's new commissioner, attorney Frank B. Clayton (who also represented Texas in its suit against New Mexico and MGRCD) explicitly raised this concern, and the other state commissioners concurred.[41] In the final resolution authorizing the NRC to move forward, the Rio Grande Compact Commission pledged to assist in the joint

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https://www.lib.uchicago.edu/e/scrc/findingaids/view.php?eadid=ICU.SPCL.BARROWSH, last accessed April 8, 2019.

Much like Barrows, Frank Adams was a pioneer in his field. He earned degrees in economics from Stanford and the University of Nebraska in the early 1900s, and worked for the US Office of Experiment Stations, based in the Department of Agriculture, between his degrees. After a brief interlude working with his brother on a commercial venture, Adams re-joined with the Office of Experiment Stations in 1910 and was later appointed to lead the Division of Irrigation Investigations and Practices at the University of California's College of Agriculture. In the 1920s and through the 1940s, he consulted with Reclamation and was a key member of the National Resources Committee. See Biography, "Inventory of the Frank Adams papers, 1889-1962," Water Resources Collections and Archives, University of California, Riverside, available online at https://oac.cdlib.org/findaid/ark:/13030/tf9489p11x/entire_text/, last accessed April 8, 2019.

[40] Proceedings of the Rio Grande Compact, held in Santa Fe, New Mexico, December 2-3, 1935, 2-3 and 5-7. ff. 032.1 (2/3), Box 1326 Owyhee Proj. 222., Rio Grande Basin 032.1, Entry 7, RG 115, NARA Denver; and "Resolution Passed by Rio Grande Compact Commission at Santa Fe, New Mexico," December 3, 1935, 1-2. Folder 401-Rio Grande Compact Commission Resolutions, 1935-1937, Box 26, FAC, WRCA.

[41] A native of El Paso, born in 1902, Frank Britton Clayton attended Texas Western College (now the University of Texas at El Paso) and later enrolled at the University of Texas (at Austin) where he earned his law degree in 1925. He held fellowships at Yale and Harvard in 1927 and 1928, and taught at the University of Texas law school until 1930 when he entered private practice. Between 1933 and 1935, Clayton served as special counsel to the City of El Paso before becoming Texas's Rio Grande Compact Commissioner. As noted above, he represented the State of Texas in the original action against the State of New Mexico and the Middle Rio Grande Conservancy District; and as noted in Opinion IV, Clayton was counsel to Hudspeth County Conservation and Reclamation District No. 1. Following the ratification of the 1938 compact, he resigned his position as compact commission to become the city attorney for El Paso. In 1941, Clayton became counsel to the International Boundary and Water Commission. See Frank B. Clayton to Governor W. Lee O'Daniel, April 18, 1939. ff. Rio Grande Compact, Commissioner Appointments, 1938-9, 2001/138-143, W. Lee O'Daniel Governor's Papers, TSA; and "F.B. Clayton, Prominent Lawyer, Dies," *The El Paso Times*, December 2, 1951.

investigation, to secure matching state funds and services, and to share costs of the studies with the federal government. They also expressed their understanding that the cooperative investigation "shall be limited to the collection, correlation and presentation of factual data."[42]

After nearly two years of work, with the USGS, Reclamation, and the US Department of Agriculture's Bureau of Agricultural Engineering and Bureau of Plant Industry all contributing, an initial draft of the Rio Grande Joint Investigation report, or *JIR*, was available in August 1937.[43] Barrows, in presenting that draft to the commissioners when negotiations resumed in late September, expressed his belief that the report provided "a factual basis for an allocation of the waters of the river above Ft. Quitman that would be fair and just to each of the three states and to its citizens dependent upon the river."[44]

Although Texas's engineering advisors expressed reservations over the *JIR* (discussed in Opinion II), later accounts of the meetings between the engineering advisors for all three states and the US indicate that the report was an essential compilation of information for them. As Tipton reported to Hinderlider, "all the basic data pertaining to the problem were assembled and analyzed" in *JIR*. This data included "detailed studies" by the individual states as well as the federal investigation itself. From this, Tipton and his fellow engineers were able to ascertain "the discharge of the river at various points under present development in the basin," and "schedules of water delivery which would insure each section of the basin against injury by acts of water

[42] Richard F. Burges to Governor James V. Allred, telegram, March 9, 1935. [2nd unlabeled file folder], Box 2F470, RGCCR, 1924-1941, 1970, UTA; Richard F. Burges, to Hon. S.O. Harper, Chairman, Rio Grande Compact Commission, Hon. M.C. Hinderlider, State Engineer, Hon. Thomas M. McClure, March 9, 1935. NM_00120235; James V. Allred, Governor of Texas, to His Excellency, the Governor of New Mexico, telegram, April 27, 1935. ff. 301 Gov. Clyde K. Tingley, Rio Grande Compact, 1935-1938, Box 9, Serial No. 13103, 09-19 special reports, conservation, new deal. Dates: 1935-1938, Governor Clyde Tingley Papers, New Mexico State Records Center & Archives, Santa Fe [hereafter NMSA]; Proceedings of the Rio Grande Compact...December 2-3, 1935, 19, and 42-43. ff. 032.1 (2/3), Box 1326, Entry 7, RG 115, NARA Denver; and "Resolution Passed by Rio Grande Compact Commission at Santa Fe, New Mexico," December 3, 1935, 1-2. Folder 401, Box 26, FAC, WRCA.

[43] The final draft was released in February 1938 as National Resources Committee, *Regional Planning Part VI – The Rio Grande Joint Investigation in the Upper Rio Grande Basin in Colorado, New Mexico, and Texas 1936-1937* (GPO, 1938).

[44] Frank Adams and Harlan H. Barrows, consulting board Rio Grande Joint Investigation, to Abel Wolman, chairman Water Resources Committee, Letter of Transmittal, August 10, 1937. Folder 397-Rio Grande Joint Investigation Outlines and Drafts, 1936-1937, Box 26, FAC, WRCA; and Proceedings of the Meeting of the Rio Grande Compact Commission Held in Santa Fe, New Mexico, September 27, to October 1, 1937, 1, 3 and 5. Unnamed folder 5, Box 2F463, Rio Grande Compact Comm'n. Frank B. Clayton Papers [hereafter RGCC-FBCP], UTA; and Littlefield, *Conflict on the Rio Grande*, 201.

uses in another section and yet would permit of the construction and operation of additional reservoirs above Elephant Butte Reservoir."[45]

Three decades after the permanent compact was signed, the recollections of Texas's engineering advisor Raymond A. Hill were similar.[46] Hill acknowledged that in the course of the federal investigation requests for "clarification" were made, "questions were raised as to the accuracy of some of the data," and "exceptions were taken to some of the findings." The *JIR* nevertheless assembled "all essential data as to the sources and quantities of water available for use in the several States, the needs for water in these States, and means for development and use of those supplies." Where it specifically came to development of delivery schedules that were at the heart of the compact, Hill stressed that the report brought together "all pertinent data." With this data provided to the commission, the engineering advisors crafted the technical basis for the compact.[47]

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[45] R.J. Tipton, *Analysis of Report of Committee of Engineers to Rio Grande Compact Commissioner, Dated December 27, 1937* (February, 1938), 1-4. ff. 70, Box 44-70, MSS 312 Michael Creed Hinderlider Collection, 1897-1987 [hereafter MCHC 1897-1987], History Colorado, Denver [hereafter HC].

[46] Raymond A. Hill was a consulting engineer and partner with the Los Angeles-based engineering firm of Quinton, Code and Hill-Leeds and Bernard (after 1940, Leeds, Hill, Bernard and Jewett). The son of Louis C. Hill, the second supervising engineer for the Rio Grande Project, Raymond Hill graduated from the University of Michigan in 1914 with a Bachelor of Civil Engineering. He worked for Reclamation while in college on Strawberry Valley Project in Utah, the Green River Project in Colorado, and the Yuma Project in Arizona. Hill first became familiar with the Upper Rio Grande Basin when assisted in the investigation of the proposed high-line canal between Elephant Butte Reservoir and El Paso led by his father in the late 1910s. After a stint in the US Army Corps of Engineers during World War I, he returned to the University of Michigan and obtained, in his words, "the degree of Civil Engineer" in 1922. Hill and his firm were hired by EBID and EP#1 to investigate possible hydroelectric power development at the federal reservoir. In 1934, he studied possible canalization of the Rio Grande from Elephant Butte through El Paso, a study that became the basis for the Rio Grande Rectification Project (see discussion in footnote 169). In addition to serving as Texas's engineering advisor (which he did for nearly 40 years), Hill advised the International Boundary and Water Commission and served as consulting water engineer to the cities of Santa Barbara and San Diego. He also worked internationally on projects in Mexico and the Middle East. *State of Texas vs. State of New Mexico, et al*, *Plaintiff's Case in Chief*, Volumes III & IV [hereafter *Plaintiff's Case in Chief*, Vols.], 599a-603. CB-F-171A thru CB-F-1716: Transcripts of TX v. NM, Vol. 1-16, Box 4X219, Raymond A. Hill Papers [hereafter RAHP], UTA. See also Littlefield, *Conflict on the Rio Grande*, 161.

Hill's recollections were prompted by a suit filed in US Supreme Court by Texas and New Mexico against Colorado for breach of the compact in the mid-1960s. For more, see Opinion V below.

[47] Raymond A. Hill, Consulting Civil Engineer, "Development of the Rio Grande Compact of 1938," 14 and 21. In re: Rio Grande Project AG No. 011504362, Copies from the Center for American History, Raymond A. Hill Papers & The Rio Grande Compact Commission Collection. See also same cited pages in Raymond Hill, Consulting Engineer, "Development of the Rio Grande Compact of 1938." ff. 49 Development of Rio Grande Compact of 1938, good history on water conflict, Texas, New Mexico, Colorado, prepared in context of 1966 Supreme Court Case, Box 4, MS 555 Joseph F. Friedkin Papers, C.L. Sonnichsen Special

When the Rio Grande Compact Commission re-opened negotiations in September 1937 few of the attendees had had an opportunity to examine the report in advance, so the engineer-in-charge of the investigation, Harlowe M. Stafford, presented the *JIR*'s findings.[48] Calling attention to the report's immense size (1,700 mimeographed pages), he conceded that it was not easily summarized. At Harper's prodding, Stafford focused on those issues most critical to the commissioners. He emphasized that the investigation aimed to offer "factual data on the water supply, water utilization and water requirements, with the possibilities of augmenting supplies to the basin by transmountain diversion or conservation by storage." The quantity and quality of water, the federal engineer assured the commissioners, were central concerns. He described the efforts made by the various federal agencies involved to measure the water supply and assess water quality, and identified in which volumes specific information developed by these agencies could be found. Findings as to runoff, return flow, groundwater, irrigation development and irrigated acreage, and water uses and requirements within the Upper Rio Grande Basin were summarized in Volume I and, according to Stafford, assisted in the determination of the "diversion requirements of major units of the basin" – namely the San Luis Valley in Colorado, the Middle Rio Grande in New Mexico, and the lands between Elephant Butte Reservoir in New Mexico and Fort Quitman, Texas.[49]

Asked by Harper to identify the amount of irrigable acreage and current water uses in these areas for the benefit of those who had not yet seen the report, Stafford went to the tables in Volume I. The study had determined that 3 million af of water was produced in the basin – almost all of which came from sources in Colorado and New Mexico. Irrigated and "water consuming" acreage in the basin amounted to nearly 2 million acres, but less than 1 million was "actually irrigated with the balance taken up by areas temporarily out of crop and areas occupied by cities and towns and bare lands." The engineer noted that the "Total for the basin [was] 924,000" – "600,000 in the San Luis section; 153,000 in the Middle Rio Grande section, which includes acreage in tributary areas; and 171,000 in the Elephant Butte-Fort Quitman sections." Basin-wide stream flow depletion was 2.7 million af, which according to Stafford suggested there was "about 200,000" acre-feet of surplus flow on average during the 46-year study period (1890-1935)

Collections Department, University of Texas at El Paso [hereafter UTEP Spec Coll]. Additionally, this narrative was published posthumously in the *Natural Resources Journal* in 1974. See Raymond A. Hill, "Development of the Rio Grande Compact of 1938," *Natural Resources Journal* 14:2 (April 1974): 64-200.

[48] The NRC selected Stafford, then serving as Water Commissioner for the Sacramento and San Joaquin Valleys of California to lead the federal effort in January 1936. Barrows and Adams were to serve as "a Consulting Board," "an advisory group," to work with Stafford and liaise with the Rio Grande Compact Commission. Rio Grande Joint Investigation, January 10, 1936, Approved: January 11, 1936, by Frederic A. Delano, Vice Chairman, National Resources Committee, 4-5. Folder 390, Box 26, FAC, WRCA.

[49] Proceedings of the Meeting of the Rio Grande Compact Commission...September 27, to October 1, 1937, 6-8. Untitled folder 5, Box 2F463, RGCC-FBCP, UTA.

chosen by the investigation. This same 200,000 af was, he also noted, "about what now flows at Fort Quitman." Of this 2.7 million af, the San Luis Valley, "exclusive of the consumption in the closed basin," took 1,047,000 af; the Middle Rio Grande, 768,000 af; and the Elephant Butte-Ft. Quitman lands, 885,000 af. As to the diversion requirements for the various areas within the basin, Stafford presented the investigation's findings concisely:

> 650,000 acre-feet would be the diversion demand at Del Norte; in the Conejos area 230,000; Middle Rio Grande area 580,000 at Otowi Bridge; between Middle Rio Grande and San Marcial about 80,000, and Elephant Butte-Fort Quitman section 953,000 at San Marcial; or taking out the estimate of seepage and evaporation, 773,000 acre-feet demand on the reservoir. Those figures are set up on the basis of the irrigated acreage as follows: In the San Luis section 353,000 acres; Conejos, 80,000; Middle Rio Grande, 100,000; Elephant Butte-Fort Quitman section, 145,000 acres. That would not be total irrigated acreage, but the maximum for any one year.

Almost immediately following presentation of these figures, the commission adjourned at Clayton's suggestion. Texas's commissioner, citing an earlier proposal by former Colorado Governor A.T. Hannett, recommended that the individual commissioners withdraw to meet with their advisors and draft "written statements" outlining "the minimum conditions under which we would be willing to negotiate."[50]

When the commission reconvened the afternoon of September 28, Colorado commissioner M.C. Hinderlider explicitly used information contained in tables and charts presented in Volume I to support his state's longstanding view that there was sufficient water in the basin for the development of lands in Colorado "comparable to that which now exists in the Middle and Elephant Butte-Fort Quitman sections" without harming established developments in New Mexico and Texas. "As a matter of fact," he asserted, "the usable water supply for the Middle section would be improved by the construction and operation of the reservoirs required in the San Luis section."[51]

For their part, both New Mexico and Texas signaled their willingness to negotiate with each other and with Colorado. New Mexico was open to discussing "increased storage" in the basin for Colorado provided that "proper safeguards" for New Mexico's water users were instituted and a transmountain diversion to bring additional water into the basin was "made an accomplished fact coincident with the construction of such storage in Colorado." With regard to Texas, New Mexico indicated it was receptive to talks focusing on "the right to the use of water claimed by

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[50] Proceedings of the Meeting of the Rio Grande Compact Commission...September 27, to October 1, 1937, 9. Untitled folder 5, Box 2F463, RGCC-FBCP, UTA.

[51] Proceedings of the Meeting of the Rio Grande Compact Commission...September 27, to October 1, 1937, 2-3 and 11. Untitled folder 5, Box 2F463, RGCC-FBCP, UTA.

citizens of Texas under the Elephant Butte Project on the basis of fixing a definite amount of water to which said project is entitled." It insisted that Mexican diversions had to "be strictly limited to treaty provision of 60,000 acre-feet per annum." Development of the Middle Rio Grande Conservancy District to its approximately 123,000 acres, moreover, had to be respected as did "[a]ll existing rights to the use of water in the Rio Grande Basin in New Mexico."[52]

Texas's negotiation position was the most succinct and direct of the three:

> Although the State of Texas feels that it should share in the benefits from new works for the augmentation of the water supply of the Rio Grande, it will not insist thereon, provided that the States of Colorado and New Mexico will release and deliver at San Marcial a supply of water sufficient to assure the release annually from Elephant Butte Reservoir of 800,000 acre-feet of the same average quality as during the past ten years, or the equivalent of this quantity if the quality of the supply is altered by any developments upstream.

The proceedings then adjourned for an "informal discussion" between the commissioners and their advisors regarding how the meeting might move forward. The commissioners decided to meet in executive session the following day with each commissioner limited to two advisors who could participate in discussions. Additional representatives from each state and the NRC attended, but only as observers. No record was made of this executive session.[53]

Substantive talks resumed on the third day, and quickly became technical in nature with the engineering advisors debating the relative merits of flow schedules and the quantity as well as the quality of water the downstream states (Texas, in particular) could expect should Colorado develop its own reservoirs upstream. For its part, Colorado offered a schedule of deliveries that would provide 750,000 af per year for the "mean required releases from Rio Grande Project storage." After considerable discussion, principally among the engineering advisors, the commissioners elected to adjourn to provide their advisors an opportunity to meet as a group, sift through the data, develop the "technical basis" for a compact, and report back to the full commission.[54]

The engineering advisors met twice following the October adjournment – the first time in Santa Fe from November 22 to 24, and the second in Los Angeles from December 15 to 27. On both

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[52] Proceedings of the Meeting of the Rio Grande Compact Commission...September 27, to October 1, 1937, 12-13. Untitled folder 5, Box 2F463, RGCC-FBCP, UTA.
[53] Proceedings of the Meeting of the Rio Grande Compact Commission...September 27, to October 1, 1937, 13. Untitled folder 5, Box 2F463, RGCC-FBCP, UTA.
[54] Proceedings of the Meeting of the Rio Grande Compact Commission...September 27, to October 1, 1937, 16-42, 53, and Exhibit No. 4, 61 (the schedule is also given on p. 32 of the proceedings themselves). Untitled folder 5, Box 2F463, RGCC-FBCP, UTA; and Littlefield, *Conflict on the Rio Grande*, 201.

occasions the attendees were the same: Reclamation engineer E.B. Debler for the US, Tipton for Colorado, John Bliss for New Mexico, and Hill for Texas.[55] The Santa Fe meeting was dedicated to discussions about the factors influencing discharge of Rio Grande water at the Colorado-New Mexico state line and delivery of water to Elephant Butte Reservoir. The Los Angeles meetings dealt with these same issues in greater detail, developing explicit delivery schedules at certain control stations on the Rio Grande and its tributaries.

In Santa Fe in November, the engineers clung to their state's positions and were quite apart from each other. Tipton, as he had with the full commission meetings, opened the discussion. According to a memorandum prepared for Clayton by Hill following the meeting, in addition to insisting that Colorado receive credits for water prevented from being illegally diverted by Mexican interests, Colorado's engineering advisor stressed:

> a. Colorado can not [*sic*] consider anything less than present requirements, which means that depletion in the future will be at least as great as during the past few years.[56]
>
> b. The people in the San Luis valley are strongly opposed to any state line schedule that will restrict their use of water prior to the time that storage is provided.
>
> c. Even after storage is provided, they do not want any schedule that will give more water in dry years than actually did pass the state line.

Hill took all of this to mean that Colorado would not accept any restrictions on its use of water. He nevertheless believed that Colorado desired a compact and was willing to work toward "some reasonable schedule." Tipton, in fact, had developed such a schedule for a state-line delivery, "which could have been satisfied under natural conditions during the past eight or nine years." Colorado's engineering advisor was going to try to persuade San Luis Valley interests to accept

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[55] A graduate of the Colorado Agricultural College (today Colorado State University) in 1925, John Bliss first worked to the Colorado State Engineer's office in land surveying. In 1926, he joined the New Mexico State Engineer's office and eventually rose to become the state engineer in 1946. He worked on several hydrographic investigations on streams in New Mexico, which included work in the Upper Rio Grande Basin, in Colorado's San Luis Valley, the Middle Rio Grande (above Elephant Butte), and as discussed in greater detail in Opinion III below, between Elephant Butte and El Paso. In addition to serving as engineering advisor to McClure, the New Mexico State Engineer, Bliss had substantial involvement in New Mexico's contributions to the federal Rio Grande Joint Investigation. *Defendant's Case in Chief*, Vols. X & XI, 2011. CB-F-171A thru CB-F-1716: Transcripts of TX V. NM, Box 4X219, RAHP, UTA; and "Past New Mexico State Engineers," New Mexico Office of the State Engineer / Interstate Stream Commission, available online at http://www.ose.state.nm.us/ProgramSupport/sepastEngineers.php, last accessed May 11, 2019.

[56] In his notes, Hill did not elaborate on what Tipton meant by "depletion."

this schedule. The other advisors, for their part, did not accept it outright but rather indicated that it "might be acceptable."[57]

Bliss, according to Hill, was apparently willing to accept deliveries to Elephant Butte based upon water actually stored in the reservoir in prior years. Yet, New Mexico's engineering advisor was apparently "very fearful of any fixed schedule, on account of uncertainty of physical conditions, particularly as to the amount of tributary inflow between Ottiwi [*sic*] and San Marcial." Hill thought that an agreeable schedule on the basis of prior years' inflow could be found "[i]f some formula can be developed that will protect them against under-deliveries through causes beyond their control."

As discussed in Opinion II, Hill addressed the issue of water quality with Bliss independently of the discussions with Debler and Tipton. Texas's engineering advisor believed that Bliss was sympathetic but unsure of how to proceed. Hill remained hopeful that he could convince Bliss "that some allowance be made for change in quality of water."[58]

For his part, Hill continued to advocate for 800,000 af for Texas via Elephant Butte. In the fact of skepticism from Tipton, Bliss, and Debler, Texas's engineering advisor argued that this quantity of water was necessary to assure downstream lands in Texas with a sufficient quality of water – what he called "equivalent service." Hill privately acknowledged to Clayton that the 800,000 af was open to dispute given recent releases from Elephant Butte and careful operation of the project:

> Unfortunately the project, with 1,500,000 acre feet in storage and more acres in crop than in any other year, or in several years, the release from Elephant Butte has been only about 730,000 acre feet, and will be less than 730,000 acre for the entire year 1937. This desire to save water in one year, when there was every reason for using larger amounts, has made and will make it very difficult to substantiate the 800,000 acre feet requirement, especially as we can look to some reduction in diversion, particularly on that to Mexico.
>
> The economy in use this year may cost the project 50,000 acre feet annually hereafter.[59]

Transmountain diversions were also discussed at the engineers' meeting. Debler was of the mind that new water from outside the basin was needed to provide a "permanent solution." Hill grudgingly accepted that if new water was brought into the basin for the benefit of existing lands, "the situation will be corrected automatically." In Hill's view, if a state paid for a water-

[57] Raymond A. Hill, Memo to Mr. Clayton: In re Meeting of Committee of Engineers, at Santa Fe, November 22 to 24, 1937, November 26, 1937, 1-2. [1937], Box 2F467, RGCC-FBCP, UTA.
[58] Hill, Memo to Mr. Clayton, November 26, 1937, 2. [1937], Box 2F467, RGCC-FBCP, UTA.
[59] Hill, Memo to Mr. Clayton, November 26, 1937, 2-3. [1937], Box 2F467, RGCC-FBCP, UTA. Notably, 730,000 af was the quantity of water first appropriated by Reclamation for the Rio Grande Project in 1906.

importation project, it should receive sole benefit of the water. If the federal government brought new water to the Rio Grande, however, each of the three states should receive equal amounts of that water. Tipton was strongly opposed to Texas receiving any new water, but he conceded "the equity of the provision" suggested by Hill.[60]

Despite the limited progress Hill described in his account of the November meetings, the engineering advisors arrived at what they believed was the technical basis for a compact by the end of the December meetings. Critically for Texas, Hill secured the concession of 800,000 af from the engineering advisors from Colorado and New Mexico. At that meeting, Bliss offered his own calculations of the project requirements for Elephant Butte. Allowing for delivery of water not only within the project and to Mexico but also to downstream lands in Hudspeth County, "unavoidable" project wastes and losses, "undivertable winter flow," and water necessary to achieve a "salt balance" down to Ft. Quitman, the engineer projected 750,000 af from Elephant Butte. This was the same figure developed by Tipton and offered by Colorado at the September-October compact proceedings.[61]

Yet, both Tipton and Bliss ultimately accepted 800,000 af. Tipton was persuaded, as he later explained to Hinderlider, that this "amount [was] not far different from the proposal made by Colorado [at the compact proceedings], and not far different from the conclusions of the engineers for the N.R.C. [i.e., the Rio Grande Joint Investigation]." "These engineers," he pointed out,

> arrived at two demands on Elephant Butte by two methods of analysis, one demand being 773,000 acre-feet and one being 736,000 acre-feet. The 773,000 acre-foot demand was recommended. Both were based on a delivery of 60,000 acre-feet to Mexico. It was estimated by N.R.C. engineers that the diversions to Mexico in 1930-1936 inclusive above the Tornillo Canal heading averaged 130,000 acre-feet per year. Therefore, if these diversions were reduced to 60,000 acre-feet there would result a saving of 70,000 acre-feet, and the normal release from Elephant Butte Reservoir would become 800,000 acre-feet, minus two-thirds of 70,000, or about 753,000 acre-feet. This is almost exactly the average between the two demands worked out by the engineers of the N.R.C. and practically the same as the 750,000 acre-feet suggested by Colorado in October, 1937, which was based upon a diversion to Mexico of 60,000.

This reasoning appears to have held true for Bliss as well. On December 22, as the engineering advisors prepared to draft their recommendations, he informed McClure by letter that all had

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[60] Hill, Memo to Mr. Clayton, November 26, 1937, 3. [1937], Box 2F467, RGCC-FBCP, UTA.
[61] [Raymond Hill], "TEXAS COMPACT: John Bliss Estimate of Project Requirements at Elephant Butte," 12/17/37. CB-F-137-34, Box 4X215, RAHP, UTA; and "John Bliss Estimate of Project Requirements at Elephant Butte," typescript, n.d. CB-F-137-34, Box 4X215, RAHP, UTA.

agreed that "the Elephant Butte Project [would]…be limited to annual releases of 800,000 acre feet reduced by two-thirds of the savings to be made by limiting Mexico."[62]

In the resulting "Report of Committee of Engineers to the Rio Grande Compact Commissioners," dated December 27, 1937, the engineering advisors noted that they had "avoided discussion of the relative rights of water users in the three States." Instead, they "were guided…by the general policy – expressed at the meeting of the Compact Commission in October – that present uses of water in each of the three States must be protected in the formulation the Compact," as "the usable water supply is no more than sufficient to satisfy such needs." The engineers further recognized that "precise determination of past conditions and close estimates of future changes" were "not possible," so they recommended "review of these matters" by the commission "after five years and for adjustments within the intent of the Compact."[63]

For the purposes of their discussion on how to distribute equitably the existing water among the three states, the engineers recognized the three natural divisions of the Upper Rio Grande Basin:

1. San Luis Valley – "the drainage area above the Lobatos gaging station on the Rio Grande near the Colorado-New Mexico State Line;"
2. "The Middle Rio Grande from Lobatos to Elephant Butte Reservoir…;"
3. "The balance of the Rio Grande Basin from Elephant Butte and Fort Quitman, including the Juarez Valley in Mexico."

The main issue with respect to Colorado was to adopt a state-line delivery schedule to New Mexico. The engineers noted that there was a "consistent relationship…between the combined inflow of the major streams flowing into San Luis Valley and the outflow of the Rio Grande at Lobatos." Construction of upstream storage reservoirs would disrupt this relationship so the engineers offered "separate schedules [of water delivery] for the Conejos and Rio Grande stream systems." These schedules would "automatically" compensate for "variations in discharge of contributing streams…particularly, if storage reservoirs are constructed." "The obligation of Colorado to deliver water in the Rio Grande at the Colorado-New Mexico State Line" the engineers observed, "would be the sum of the quantities set forth" in the schedules provided, subject to certain permissible departures. Use of these schedules would permit "appropriate

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[62] Tipton, *Analysis*, 11. ff. 70, Box 44-70, MCHC 1897-1987, HC; and John H. Bliss to Tom [Thomas M. McClure, State Engineer], December 22, 1937.Rio Grande Compact – July 7, 1937 to June 30, 1938, 26th Fiscal Year, NM_0015692 – NM_00156929.

[63] Hill, Memo to Mr. Clayton, November 26, 1937, 3. [1937], Box 2F467, RGCC-FBCP, UTA; "Report of Committee of Engineers to Rio Grande Compact Commissioners," December 27, 1937, in Proceedings of the Meeting of the Rio Grande Compact Commission, Held at Santa Fe, New Mexico, March 3rd to March 18th, inc., 1938, Appendix No. 1, 40. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

adjustments…[to] made for any trans-mountain diversions, for any change in location in gaging stations, and for any new or increased depletion of natural run-off at gaging stations above Lobatos."[64]

With regard to New Mexico's obligation to Texas, the engineers observed that "wide variations in the discharge of tributary streams" rendered the "amount of water in the Rio Grande above the principal agricultural areas of New Mexico and inflow into Elephant Butte Reservoir" inconsistent and unpredictable. After careful study, they agreed that a "reasonable relationship" existed "between the discharge of Rio Grande at Otowi Bridge and the inflow to Elephant Butte Reservoir," excluding the months of July, August, and September. Removing these three months from the calculations, the remaining data could be used to adopt a proper schedule of deliveries at Otowi Bridge to obtain the appropriate supply of water at Elephant Butte. The curve then required some adjustment "to compensate for increased salinity of the Elephant Butte supply." The New Mexico's obligation to deliver water into Elephant Butte Reservoir was subject to several factors: a system of accrued credits and debits on annual scheduled deliveries; "appropriate adjustments…for any change in points of measurement"; "any new and increased depletion in New Mexico of the natural runoff measured at Otowi Bridge"; and "any trans-mountain diversions between Lobatos and Elephant Butte."[65]

The engineers set an average of 800,000 af per year as the "normal release" from Elephant Butte Reservoir – the quantity for which Hill and Clayton had argued. This release was subject to "any gain and loss in usable water resulting from the operation of any reservoir below Elephant Butte." As both Tipton and Bliss indicated to their commissioners, it would also be "reduced or increased by two-thirds of any change in aggregate diversions and loss to Mexico between Courchesne gaging station and the lowest point of diversion to lands of the Rio Grande Project." The suggested index used to determine the amount of change was "the average annual diversion and loss to Mexico from 1928 to 1937." Should "normal release…[be] modified by any change in the amount of diversions and loss to Mexico," Colorado and New Mexico had to "share equally" with

64 "Report of Committee of Engineers to Rio Grande Compact Commissioners," December 27, 1937, in Proceedings of the Meeting of the Rio Grande Compact Commission…March 3rd to March 18th, inc., 1938, Appendix No. 1, 40-42. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

65 "Report of Committee of Engineers to Rio Grande Compact Commissioners," December 27, 1937, in Proceedings of the Meeting of the Rio Grande Compact Commission…March 3rd to March 18th, inc., 1938, Appendix No. 1, 42-44. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

their "accrued credits or debits…adjusted annually by an amount equal to one-third of such change in diversions and loss to Mexico."[66]

Although the engineers recognized that natural variations in discharge at their selected control stations and additional storage of flood waters in upstream reservoirs would require appropriate adjustments to delivery schedules, they established definite limitations on accrued debits and credits. Colorado's annual or accrued debit was capped at 100,000 acre-feet, except as caused by storage in reservoirs constructed above Lobatos after 1937. New Mexico's allowable accrued debit was capped at 200,000 acre-feet, except as caused by storage in reservoirs in New Mexico. However, in both states accrued debit caused by such storage could not exceed the amount of water held in storage in such reservoirs. If in any year the total accrued debits of Colorado and New Mexico exceeded "the difference between the total capacity of [Rio Grande] Project storage and the amount of usable water then in storage, such debit shall be reduced proportionally to an aggregate amount equal to the minimum unfilled capacity in that year." If there was unusable spill from Elephant Butte, all accrued debits of Colorado and New Mexico for that year would be cancelled, "excepting debits caused by storage in reservoirs prior to the time of spill."[67]

Accruals in excess of the limits established for Colorado and New Mexico, respectively, could be applied to offset debits caused by storage in reservoirs. In computing accrued credits or debits, annual credits in excess of 150,000 acre-feet were to be taken as equal to that amount. If unusable spill occurred at Elephant Butte Reservoir, the aggregate credits of Colorado and New Mexico would be reduced by the amount of such spill in proportion to each state's respective credits at the time of the spill. "[N]o credits…[would] be considered in a year of spill."[68]

The report also proposed specific protections for the Rio Grande Project water supply. "[W]henever there [was] less than 400,000 acre-feet of water in storage available for use in the Rio Grande Project," neither Colorado nor New Mexico would be allowed to increase storage in any reservoir built after 1929 in the Upper Rio Grande Basin. Furthermore, if the same minimum stage was reached on January 1 of any year, Colorado and New Mexico had to "release on

[66] "Report of Committee of Engineers to Rio Grande Compact Commissioners," December 27, 1937, in Proceedings of the Meeting of the Rio Grande Compact Commission…March 3rd to March 18th, inc., 1938, Appendix No. 1, 45 and 47. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

[67] "Report of Committee of Engineers to Rio Grande Compact Commissioners," December 27, 1937, in Proceedings of the Meeting of the Rio Grande Compact Commission…March 3rd to March 18th, inc., 1938, Appendix No. 1, 45-46. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

[68] "Report of Committee of Engineers to Rio Grande Compact Commissioners," December 27, 1937, in Proceedings of the Meeting of the Rio Grande Compact Commission…March 3rd to March 18th, inc., 1938, Appendix No. 1, 46. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

demand, at the greatest rate practicable, water from reservoirs in the amount equal to the total debit of each which was caused by storage of water in reservoirs."[69]

In addition to adjusting the curve for New Mexico's deliveries into Elephant Butte to compensate for increased salinity in the reservoir, the engineers also recommended a limitation on the salinity at the Colorado-New Mexico state line. It was still unclear whether or not Colorado's "Closed Basin Drain" would be constructed and what effect the drain would have on the salt content of the Rio Grande downstream. Therefore, the engineers suggested that if any works were constructed after 1937 to deliver water from the Closed Basin Drain into the Rio Grande, Colorado would only be credited for the water so delivered if "the proportion of sodium ions is less than 45% of the total positive ions in that water."[70]

Concluding their report, the engineers offered their recommendation for the basis of a compact. They noted that "no material expansion of the irrigated area in the Rio Grande Basin above Fort Quitman" was feasible without transfers of water from outside the basin. Acknowledging that "[g]ood use could be made of this [imported] water," they nevertheless determined that the "allocation of any supply so obtained constituted a matter of policy beyond our province." Therefore, "no recommendation [was] made" on this issue. Three other recommendations were:

1. "…that the normal release from Elephant Butte Reservoir be deemed to be 800,000 acre-feet per annum, adjusted for gains or loss of usable water resulting from the operation of any reservoir below Elephant Butte," and "that this normal release be reduced or increased by two-thirds of any change in aggregate diversions and loss to Mexico."
2. "…that deliveries by New Mexico into Elephant Butte Reservoir be made in accordance with the schedule based on the flow at Otowi Bridge and the usable supply at Elephant Butte, subject to proper limitations on departures" (as outlined in the table in the report, "Deliveries Into Elephant Butte Reservoir Exclusive of July, August, and September").
3. "…that deliveries by Colorado be the sum of the amounts set forth in the schedules for the Conejos stream system and for the Rio Grande system, exclusive of Conejos River, both subject to proper limitations on departures."

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[69] "Report of Committee of Engineers to Rio Grande Compact Commissioners," December 27, 1937, in Proceedings of the Meeting of the Rio Grande Compact Commission…March 3rd to March 18th, inc., 1938, Appendix No. 1, 46-47. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.
[70] For more on the water quality requirements at the Colorado-New Mexico state line, see footnote 120 below.

Inclusion of the delivery schedules and other provisions of the report, in the opinion of the engineering advisers, would result in both "the maximum practicable use of the waters of the Rio Grande, and would minimize unusable spill at Elephant Butte."[71]

Confident that progress was being made toward an interstate compact, Texas filed a motion in December for a continuance of the *Texas v. New Mexico* hearings, which Warren subsequently granted. A month later, Clayton forwarded a copy of the report of the committee of engineers to the special master. Texas's commissioner confessed that the report "means more to an engineer than to a lawyer," but after having Hill explain the approach and conclusions, he and the other attorneys for Texas had been convinced that it represented "a reasonably fair compromise of the views of the three States and provides a fairly workable basis for a permanent compact."[72]

Although all of the engineering advisors signed off on the December 1937 report and recommended its adoption by the compact commission, McClure objected to the report in late January 1938. Even before the report was completed, he had reservations. When the New Mexico state engineer and compact commissioner learned the general outlines of the report on December 22 from Bliss, McClure confidentially told his advisor that the 800,000 af release "will not be agreeable."[73]

The New Mexico commissioner's opposition hardened in the wake of a detailed analysis of the December 1937 report prepared by MRGCD consulting engineer H.C. Neuffer. After reviewing the engineering advisors' report in January, Neuffer forwarded a six-page memorandum to Bliss critical of the work. In his transmittal letter he suggested re-consideration "of the schedules of delivery at San Marcial or Elephant Butte," and recommended that "the figures upon which the curves" of the "usable supply at Elephant Butte" be obtained as he was having difficulty deriving those curves based upon the data he had on hand.[74]

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[71] "Report of Committee of Engineers to Rio Grande Compact Commissioners," December 27, 1937, in Proceedings of the Meeting of the Rio Grande Compact Commission…March 3rd to March 18th, inc., 1938, Appendix No. 1, 47. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver. Water quality is also discussed in Opinion II below.

[72] Charles Warren to Frank Clayton, December 21, 1937; and Frank B. Clayton to Charles Warren, January 27, 1938. [1938], Box 2F467, RGCC-FBCP, UTA.

[73] Bliss to [McClure], December 22, 1937; and T.M. McClure to John H. Bliss, telegram, 1937 Dec 24 AM 10 27. Rio Grande Compact – July 7, 1937 to June 30, 1938, 26th Fiscal Year, NM_0015692 – NM_00156929 and NM_00156927.

[74] Two weeks after this letter, and after receiving his own from Neuffer, McClure contacted Hill to obtain "the data used in corrected the Elephant Butte storage figures and thereby arriving at your [Hill's] Usable Supply table." Thomas M. McClure, Engineer, to Mr. Raymond A. Hill, January 14, 1938. Rio Grande Compact – July 7, 1937 to June 30, 1938, 26th Fiscal Year, NM_00156897.

Neuffer and the district's "chief objection," as Bliss privately informed Tipton, was the report's recommended "normal release" of 800,000 af from Elephant Butte. According to New Mexico's engineering advisor, "The Middle Valley people have set their mind upon a much smaller figure as ample Project release annually." Indeed, Neuffer argued that figure "need not be in excess of 700,000 acre feet per annum." The MRGCD consulting engineer pointed in his memorandum that over the past decade, 1927 to 1936, 781,000 af on average had been released from the reservoir – a figure inclusive "of excessive quantities of water delivered to Mexico, avoidable project wastes, and savings which can be made after the channel rectification is completed."[75] He calculated that as little as 686,000 af could satisfy "Project use above El Paso," "Mexican Treaty Requirements plus river loss to riverside drain in Mexico," "Unavoidable project wastes below Riverside heading," "Winter discharge of Project drains in New Mexico not redivertable," and "Net project diversions below El Paso." In Neuffer's mind, 700,000 af "would be liberal allowance" for Elephant Butte Reservoir. The engineer nonetheless conceded the necessity for negotiation, and expressed his openness to 750,000 af "as the very maximum figure without injury to New Mexico or the Middle Valley" – the same figure suggested by Tipton and Bliss prior to the December 1937 report.[76]

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[75] For more on this channel rectification program, see footnote 169 below.

[76] H.C. Neuffer, Consulting Engineer, to Mr. John H. Bliss, State Engineer's Office, Re: Report of Committee of Engineers to Rio Grande Compact Commissioners, December 27, 1937, January 7th, 1938. NM_00054005; H.C. Neuffer, Memorandum, Subject: Report of Committee of Engineers to Rio Grande Compact Commissioners, December 27, 1937, np [1-3, and 6]; JHB, Engineer, to Mr. R.J. Tipton, Consulting Engineer, January 14th, 1938. Rio Grande Compact – July 7, 1937 to June 30, 1938, 26th Fiscal Year, NM_00156900 – NM_00156902, NM_00156905, and NM_00156892 – NM_00156894.

The other objections included adjustments to be made for Caballo; accounting for losses to Mexico; the tally of 2,638,860 af for the "maximum storage for the Rio Grande Project"; language in the December 27, 1937 report concerning "unusable spill"; "the arbitrary figure of 400,000 acre feet storage in Project reservoirs, below which all storage debits of the upper basin states could be called for by the Project"; and the relation between Colorado-New Mexico state line deliveries and Otowi. Independently, Bliss expressed second thoughts as to the exclusion of the months of July, August, and September, in the Otowi-Elephant Butte index – although Neuffer had "no serious objection" to this. See Neuffer, Memorandum, December 27, 1937, np [1-6]; and JHB to Tipton, January 14th, 1938. Rio Grande Compact – July 7, 1937 to June 30, 1938, 26th Fiscal Year, NM_00156900 – NM_00156905, and NM_00156892 – NM_00156894.

On the issue of Elephant Butte releases, Tipton wrote back a few days later that he was "inclined to agree with" Bliss, and that it was "a matter which will have to be thoroughly discussed by the Compact Commissioner." Tipton himself was "going to give more thought to" the issue. Tipton also clarified some matters relating to the 400,000 af figure, and expressed interest in developing "a State Line-Otowi relationship." As to the exclusion of the three months from the Otowi-Elephant Butte index, the Colorado engineer admitted that he "did not follow in sufficient detail your [Bliss], and Mr. Hill's work in connection with setting up the Otowi-Elephant Butte relationship to express an opinion…." R.J. Tipton, to Mr. John H.

Two weeks after writing Bliss, Neufer urged McClure to reject the engineering advisors' report. The MRGCD consulting engineer had thus far been unable to verify portions of the report because "of the availability of the data used by the Committee in working out the relationship of the flow of the Rio Grande at various stations." Moreover, he argued that "[t]here are…certain other items which we feel, if agreed upon, would result in permanent damage to the Middle Rio Grande Conservancy District and other water users in New Mexico above the Elephant Butte Dam." Neuffer did not specify what those are items were in his letter, but they were likely the same as he raised in the memorandum forwarded to Bliss. The MRGCD consulting engineer further offered the services of the district to the engineering advisors.[77]

McClure formally objected to the "Report of the Committee of Engineers" in a January 25, 1938 letter to Harper. The New Mexico state engineer indicated that he had given the report "additional consideration," and was now "in thorough accord with the position taken by Mr. Neuffer." McClure had also discussed the work "with others in authority representing the State of New Mexico," and all were of the same mind to reject it. He dismissed the report as "too vague and indefinite in some respects," lacking a sufficiency of data to support "the relationship of flow at various stations." The "basis for the water supply to the State of Texas," furthermore, was in McClure's "judgment and in the judgment of others in authority in New Mexico…so far out of reason that it could not be considered as a basis for negotiations." Most damningly, the New Mexico state engineer asserted that "the engineers in their recommendation plainly exceeded their authority." Rather than "reporting accurate basic data," which McClure understood to be their charge, they offered "a compromise of basic data." Echoing Neuffer, he called "for the engineers to reassemble at the earliest possible moment and give this matter further study."[78]

New Mexico's view of the December 1937 report was in stark contrast to Texas's and Colorado's. Two days after McClure's letter to Harper, which was circulated to the other commissioners, Clayton praised the work of the engineers to the Rio Grande Compact Commission chair. He thought their report offered "a fairly workable basis for the equitable apportionment of the waters of the Rio Grande, without permitting further encroachments upon Texas' already inadequate supply." Texas's commissioner neither accepted McClure's characterization of the

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Bliss, January 18, 1938. Rio Grande Compact – July 7, 1937 to June 30, 1938, 26th Fiscal Year, NM_00156881 – NM_00156882.

[77] [H.C. Neuffer] to Mr. Thomas M. McClure, State Engineer, January 13, 1938; and Thomas M. McClure, State Engineer, to Mr. S.O. Harper, Chairman, Rio Grande Compact Commission, January 25th, 1938. ff. 032.1 Rio Grande Basin Corres. re Compact between States of Colorado; New Mexico & Texas re Rio Grande Basin Water Rights, Jan. 1938 thru May 1939, Box No. 936 Rio Grande Basin 023._246., Entry 7, RG 115, NARA Denver.

[78] McClure to Harper, January 25th, 1938. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

work nor believed that the engineers had exceeded their authority. As to the assertion that "the basis for water supply to the State of Texas" was unreasonable, Clayton countered

> It seems to me and to those interested with me in the protection of Texas' water supply that the report contains no recommendations for the benefit of Texas than what she is plainly entitled to. In fact, it makes concessions to the upper States about which we are somewhat dubious. But in the interests of an amicable settlement of our common problems, we are willing to accept the report as a basis for further negotiation…. [T]he engineering representatives of all three States and of the United States, as well, apparently reached the conclusion, after considerable research and negotiation, that the basis suggested in the report will do no more than preserve the status quo as far as the water supply is concerned, while, at the same time, permitting New Mexico and Colorado to proceed with certain desired developments.

He further pointed out

> in passing that the commissioner for New Mexico seems to lose sight of the fact that there is a very extensive section of his own State lying below the Elephant Butte dam, and that its large vested interests are likewise entitled to representation and protection, along with the Middle Rio Grande Conservancy District.

Texas was "unwilling to recede from…the minimum requirements for the protection of Texas' water supply in the report," but was ready "to proceed with negotiations towards a permanent compact, based upon the report of the committee of engineers."[79]

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[79] Frank B. Clayton, Rio Grande Compact Commissioner for Texas, to Mr. S.O. Harper, Chairman, Rio Grande Compact Commission, January 27, 1938. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

Hill also took exception to McClure's objections in two separate letters to Clayton in early February. In the first, he admitted he was "somewhat amused by McClure's position," in that the New Mexico's compact commissioner "relies more upon the judgment of Neuffer than that of his own deputy." He supported Clayton's position that another meeting of the engineers was unnecessary and the compact commission was the best venue for further deliberation. Raymond A. Hill to Mr. Frank B. Clayton, February 3, 1938. Box 2F466, RGCC-FBCP, UTA.

The tone of Hill's second letter, sent less than a week after the first, was angrier. Noting that Clayton had admonished McClure for failing to recognize the interests of New Mexican lands within the Rio Grande Project (Elephant Butte Irrigation District), Texas's engineering advisor insisted "that the time has come when the State of Texas should cease being the direct representative of an irrigation district situated in New Mexico." He argued that as long as Texas advocated for the water rights of all lands under the Rio Grande Project, New Mexico officials would identify more strongly with the interests of the Middle Rio Grande Conservancy District. Hill suggested that "pressure" be brought to bear on McClure to defend all of New Mexico's interests, and that Texas demand a schedule of deliveries measured at Courchesne for its lands only. Such a schedule would provide roughly 500,000 af for Texas:

(a) for all water diverted or lost to Mexico;

(b) for all consumptive requirements below El Paso;

Hinderlider was similarly critical of McClure. Writing to Harper in early February, he insisted that "Mr. McClure should not unqualifiedly accept the views of Mr. Neuffer," and he strongly opposed including the MRGCD engineers in the discussions. The Colorado commissioner objected further to what he saw as local interests influencing state authorities, insisting "that it will be impossible to reach an interstate agreement so long as every individual group of water users is permitted to inject and insist upon individual points of view." Colorado sought "parity with the two lower states, in the development of her water resources in the San Luis Valley," and Hinderlider believed that the engineers' report "could be accepted in principle as a basis of further discussions and negotiations by the Compact Commission." He suggested that McClure "specifically and definitely point out the items in said report to which he takes exception, and indicate the particular points upon which he desires further information." On this basis, the commission as a whole could determine if the engineers needed to meet again prior to the commissioners.[80]

Because of McClure's letter and the subsequent correspondence from Clayton and Hinderlider, Harper suggested the commission meet on March 3 in Santa Fe. When proceedings re-opened both Clayton and Hinderlider expressed their support of the engineering advisors' report even as McClure rose to repudiate it. Altogether New Mexico's commissioner proposed nine separate specific changes to the report. Before the commission, however, McClure stressed that the two most important issues were: 1) the indexing between Otowi and Elephant Butte "usable [supply]," and 2) use of 800,000 af as the "basis of releases from the Elephant Butte Reservoir." He argued that the engineers offered no "actual factual data" to support the Otowi-Elephant Butte indexing relationship and the release schedules for the reservoir. The 800,000 af was, moreover, "far in excess of past and present average releases and [was] far in excess of their project needs." As evidence of the report's deficiencies, McClure asserted that his office had

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(c) for drainage outflow in sufficient amount to give a salt balance and provide equivalent service;

(d) for operating waste; and

(e) for water undivertible in the winter and in excess of irrigation demands during the irrigation season.

Hill recognized that this idea had been discussed and rejected previously, but he was of the opinion "that the situation is sufficiently changed to warrant such a demand from Texas." Raymond A. Hill to Mr. Frank B. Clayton, February 8, 1938. Box 2F466, RGCC-FBCP, UTA. As discussed in Opinion IV, such an arrangement was untenable owing to the nature of the Rio Grande Project. No historical evidence, moreover, has come to light that Hill's suggestion was seriously entertained by Clayton or discussed at the subsequent (and last) compact commission meetings in March 1938. See also Littlefield, *Conflict on the Rio Grande*, 202-203.

[80] M.C. Hinderlider, Commissioner for Colorado, to S.O. Harper, Chairman, Rio Grande Compact Commission, February 4, 1938. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

analyzed the indexing stations used in the report and found the Otowi-Elephant Butte indexing in the report inaccurate.[81]

Clayton preferred the commissioners to work out these issues, calling upon the engineering advisors or NRC representatives for clarification as necessary. Harper, Hinderlider, and the engineers themselves, however, were persuaded that the engineers should formally assess the merits of New Mexico's objections. In a presentation the following day (March 4), the engineers indicated their willingness to re-consider their report on the basis of nearly all the issues raised by McClure.[82] With regard to the two key objections – use of an Otowi-Elephant Butte index and the 800,000 af to be released from the reservoir – they agreed "to give further consideration" to New Mexico's proposal for an Otowi-San Marcial index, and to examine "any data in support" of New Mexico's claim that "800,000 acre-feet of water exceeds both past uses and requirements below Elephant Butte," data hitherto unavailable to them. The commissioners concluded that the engineering advisors should meet again to revise their report, with Clayton insisting that New Mexico "furnish the data and other figures on which they predicate their demands" and the commission proceed with negotiations while awaiting a revised report.[83]

That revision took a week to complete. The engineers worked in isolation, joined only by Neuffer who acted as a "witness."[84] A "Memo of Suggested Changes to be Made in the Engineering

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[81] S. O. Harper, Chairman, Rio Grande Compact Commission, to Mr. M.C. Hinderlider, Rio Grande Compact Commissioner for Colorado, Mr. Thomas M. McClure, Rio Grande Compact Commissioner for New Mexico, and Mr. Frank B. Clayton, Rio Grande Compact Commissioner for Texas, February 12, 1938. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver; and Proceedings of the Meeting of the Rio Grande Compact Commission…March 3rd to March 18th, inc., 1938, 1, 3, 5 and 9. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

[82] On two issues the engineering advisors were unwilling to concede to further review. Collectively, they concluded that New Mexico's request "to be relieved of responsibility for Indian or other operations beyond its control" was "a matter…of policy for determination by the Compact Commission." The group further dismissed New Mexico's assertion that their December 1937 report had engaged in a "judicial interpretation" of the Mexican treaty. They were nevertheless open to examining data that New Mexico might have with regard to fixing the figure of present-day use by New Mexico. Proceedings of the Meeting of the Rio Grande Compact Commission...March 3rd to March 18th, inc., 1938, 11-15. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

[83] Proceedings of the Meeting of the Rio Grande Compact Commission...March 3rd to March 18th, inc., 1938, 7-15, and Appendix No. 6, 56-57. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

[84] Neuffer's attendance was prompted by a suggestion by one of McClure's legal advisors, former New Mexico governor Arthur T. Hannett in a stated bid to "save a lot of time." Edwin Mechem, EBID's counsel and a legal advisor to Clayton, immediately objected to what he saw as MRGCD engineering consultant being "substituted for the State's [New Mexico's] expert." Mechem asserted that EBID's interests were greater and that "Mr. Neuffer doesn't represent us." Hannett countered that his suggestion was not to replace Bliss, but simply to include Neuffer. It was a "practical matter," because MRGCD's support for the compact was essential to the compact's ratification by New Mexico's legislature. "For that reason the

Advisors' Report," prepared by Bliss coming out of the March 3 meeting, indicates that altogether 11 revisions were to be made or considered. The most notable of these were the substitution of "an "Otowi-San Marcial relation" for the engineers' recommended "Otowi-Elephant Butte Supply relation," and the reduction in the proposed 800,000 af average "Normal Release from Elephant Butte" per year to 775,000 af. This was close to the figure that the federal Rio Grande Joint Investigation had determined as the demand on the reservoir for the Elephant Butte-Ft. Quitman section of the basin, and 25,000 af more than Tipton and Bliss had calculated ahead and during the engineering advisors' meetings.[85]

Dated March 9 but presented the following day, the revised engineers' report reflected the two key changes sought by New Mexico. An Otowi-San Marcial index (excluding the months of July, August, and September) replaced the original Otowi-Elephant Butte index, and the recommended figure for "normal release from Elephant Butte" was reduced. However, that reduction was not from 800,000 af annually to 775,000 af as suggested by Bliss's "Memo." Instead the normal release was proposed to be "an average of 790,000 acre-feet per annum, adjusted for any gain or loss of usable water resulting from the operation of any reservoir below Elephant Butte."[86]

As discussed above, Hill had been adamant that 800,000 af was critical to serving lands in Texas with a sufficient quantity and quality of water, and it was a position that Clayton strongly supported before the rest of the commission. Nonetheless, the revised report recommended a lesser figure under pressure from interest in New Mexico. The reason for Texas's concession may very well lie in the problem Hill had identified back in November 1937: the fact that in recent years the Rio Grande Project had utilized closer to 730,000 af. Thirty years after the compact had been signed, Hill gave sworn testimony in a deposition for the *Texas and New Mexico v. Colorado*

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engineering expert of that district," he asserted, "has got at least to have the opportunity to check our figures before we bind ourselves, and that's all we ask." At Hinderlider's suggestion, Neuffer was therefore designated a "witness" rather than a direct participant in the engineering discussions with the commissioners agreeing that his contributions would be at the discretion of the engineers. Proceedings of the Meeting of the Rio Grande Compact Commission...March 3rd to March 18th, inc., 1938, 18-20. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

[85] J.H. Bliss, Memo of Suggested Changes to be Made in Engineering Advisors' Report, March 3, 1937. . Rio Grande Compact – July 7, 1937 to June 30, 1938, 26th Fiscal Year, NM_00156842-NM_00156843. The date, "March 3, 1937," on the face of this document is likely a typographic error. The memo's content makes clear that it was drafted either just before or just after the March 3, 1938 compact meeting, in light of McClure's objections to the December 27, 1937 engineering advisors' report. Additionally, this particular copy of the memo (NM_00156842) appears in sequence of chronologically organized documents between other documents from 1938.

[86] Proceedings of the Meeting of the Rio Grande Compact Commission...March 3rd to March 18th, inc., 1938, 61, 62, and 65. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

suit before the US Supreme Court in 1968 that succinctly explained the 790,000 af figure adopted by the commission and later ratified in the 1938 Compact:

> The 790,000 acre-feet that was arrived at as the normal release, so defined in the Compact, included the water which was obligated to be delivered to Mexico under the Treaty of 1906, the 60,000 acre-feet in the Acequia Madre. So that the allotment on the downstream side of Elephant Butte was really seven hundred thirty for uses in the United States and sixty for uses in Mexico, and the provision that was incorporated that if they used more than sixty in Mexico, it came out of the seven hundred thirty….[87]

Following Debler's presentation and submittal of the written report, the commission recessed until March 11 to give the compact commissioners an opportunity to review the proposed changes to the December 1937 engineering advisors' report. When the commission reconvened, it almost immediately went into a closed session to permit an "informal discussion, off the record" so the commissioners could "speak freely" on points in the report that required "further clarification or change." The precise substance of this discussion is unknown; it went unrecorded by the commission secretary. The recorded proceedings merely indicate that the commission as whole sought "additional information" about the report.

A formal written clarification report was submitted by the engineers on March 11, and before the commission Debler and Hill addressed two specific issues: "the stage of project storage when the upstream reservoirs ceased storing," and the meaning of "average" with regard to the proposed 790,000 af releases from Elephant Butte annually. For the first, Debler explained that the group had settled on 400,000 af as the minimum level of project storage to serve lands below Elephant Butte. As the clarification report went on to detail, if there was less than 400,000 af of usable storage in the reservoir then neither of the upper states could continue storing water in any reservoirs built after 1929. The "intent" (in Debler's words) or "principle" (in Hill's), was that the states would share proportionately in diminished stored water.[88]

As for the second issue, according to Debler, use of the term "average" reflected the engineers' understanding that releases could be greater or lesser from year to year. McClure was concerned about the potential impact of years of releases greater than 790,000 af. Debler assured McClure that the system of debits and credits would protect the upper states from significant depletion. He also made plain that so long as the United States operated the reservoir, it would "bear down

[87] Deposition of Raymond A. Hill. Taken December 4, 1968, 18. ff. Texas & New Mex. v. Colo., w. 66-1061 Texas vs. Colorado, Box 1989 41-240, LF-TAG, TSA.

[88] Proceedings of the Meeting of the Rio Grande Compact Commission...March 3rd to March 18th, inc., 1938, 25-27, and Appendix No. 8, 66. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

awfully hard so those boys down there [i.e., the waterusers] don't short themselves in low periods as they have in the past."[89]

Following this presentation, the commissioners' focus shifted to the drafting of the compact. They accepted these revisions and appointed a "Drafting Committee" to put the final document together. The legal advisors to the commissioners comprised this committee: Corlett and Carr for Colorado; former New Mexico governor Arthur Hannett and Fred E. Wilson for New Mexico; and Burges and EBID attorney Edwin Mechem for Texas. No federal representative was available to attend, so the attorneys for the state commissioners worked out a draft. The full commission recessed for nearly a week, from March 11 to March 17, as the legal committee deliberated. "Several closed and informal meetings of the Commission," according to the recorded commission proceedings, "were held." At these meetings "controversial questions were discussed with the Drafting Committee and the engineering advisors and differences were resolved" confidentially with "[n]o record of these meetings…kept."[90]

The engineers reviewed at least one draft of the compact dated March 16. A memorandum signed by all of the engineering advisors and Neuffer and dated that same day suggested some changes. They recommended, for instance, the inclusion of a paragraph compelling the Commission to undertake "special studies" of the flow at San Acacia, San Marcial, and below Elephant Butte should "the necessity arise" for "an equivalent schedule." The engineers also suggested "[a]mplifying" paragraph 15 of the draft compact like so:

> During the month of January of any year the Commissioner for Texas may demand of Colorado and New Mexico, and the Commissioner for New Mexico may demand of Colorado, the release of water from storage reservoirs constructed after 1929 to the amount of the accrued debits of Colorado and New Mexico, respectively, and such release . . .

"In the next to the last line" of this paragraph, they further called for the addition of the phrase "of 790,000 acre-feet" to modify the term "release."[91]

On March 17, 1938, the Drafting Committee submitted their final compact draft to the commissioners who accepted it unanimously the following day. Although no provision was made in the final document for the "special studies" suggested by the engineers, Article IV required that "[c]oncurrent records…be kept of the flow of the Rio Grande at San Marcial, near San Acacia,

[89] Proceedings of the Meeting of the Rio Grande Compact Commission...March 3rd to March 18th, inc., 1938, 29. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.
[90] Proceedings of the Meeting of the Rio Grande Compact Commission...March 3rd to March 18th, inc., 1938, 31-33. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.
[91] Proceedings of the Meeting of the Rio Grande Compact Commission...March 3rd to March 18th, inc., 1938, Appendix No. 9, 68-70. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

and of the release from Elephant Butte Reservoir, to the end that the records at these stations may be correlated." The final draft also incorporated the language suggested by the engineers for paragraph 15 as Article VIII.[92]

The state compact commissioners, Clayton, Hinderlider, and McClure, soon after forwarded the document to their respective governors, and in the case of Harper, to the secretary of the interior. In his November 1938 transmittal letter to Governor W. Lee O'Daniel, Clayton expressed his opinion that the "compact represents a fair and equitable settlement of the controversies that have raged almost continuously for over forty years between the three States." "As far as Texas is concerned," the commissioner wrote, "it in effect prevents further encroachments on the waters of the Rio Grande by the upper basin States.""[93]

Letters by Hinderlider, McClure, and Harper all evoked the same optimism, even as each touted the individual benefits of the compact of their respective states or for the United States. Hinderlider "believed" that the "interstate River Compact or Agreement…equitably allocates the waters of the Rio Grande Basin originating above Fort Quitman, Texas, between the States of Colorado, New Mexico, and Texas." For Colorado specifically, he informed Governor Teller Ammons a few days after Clayton wrote O'Daniel, the "permanent compact…fully protects present and future uses of waters in the San Luis Valley, and the San Juan Basin in Colorado against exportations of water out of that basin for use in the Rio Grande Basin in New Mexico, except upon the conditions stated in the Compact." That protection further extended, according to Hinderlider, to "the rights of the water users under federal reclamation projects in New Mexico and Texas," as well as to "Indian tribes, and to the Republic of Mexico under existing treaty obligations."[94]

McClure used almost identical language to Hinderlider in his letter to New Mexico Governor John E. Miles in January 1939. "The Compact," he wrote, "fully protects present and future uses of the waters of the Rio Grande stream system in New Mexico." He envisioned an end to the controversies over the use of the Rio Grande waters with the compact, "particularly the suit

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[92] Proceedings of the Meeting of the Rio Grande Compact Commission...March 3rd to March 18th, inc., 1938, 33-37, and Appendix No. 11, 78 and 80. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.
[93] Frank B. Clayton to Hon. W. Lee O'Daniel, November 16, 1938, 1-4. [1938], Box 2F467, RGCC-FBCP, UTA.
[94] M.C. Hinderlider, Commissioner for Colorado, to His Excellency, Governor Teller Ammons, State Capitol, Denver, Colorado, November 15, 1938, in *Rio Grande Basin Compact* [and Analysis Thereof by M.C. Hinderlider in Address to Colorado Legislature and to Gov. Teller Ammons on Nov. 15-1938], 5-9. ff. 58 Rio Grande Basin Compact, Box 44-70, MSS 312, MCHC 1897-1987, HC.

between the States of New Mexico and Texas now pending in the Supreme Court of the United States."[95]

Likewise, writing to Secretary of the Interior Harold Ickes, days following the conclusion of the compact negotiations in March 1938, Harper was unequivocal: "The Compact, if ratified, will end over forty years of controversy and dispute among the States, and it is the unanimous opinion of the Commissioners and their advisors that it provides an eminently fair and equitable solution of this troublesome problem." Harper believed that U.S. "interests" were "fully safeguarded" in the compact, in part as a result of the "inclusion, in the State allocations, of all water to which Federal irrigation projects are entitled."[96]

Although some Texans below Ft. Quitman expressed concerns for the compact (discussed in Opinion IV), all three states and the United States ratified the agreement in 1939.[97] As the statements of the compact commissioners indicate, all those representatives believed that the compact equitably apportioned the waters of the Rio Grande above Ft. Quitman after several decades of controversy. That apportionment protected the Rio Grande Project in New Mexico and Texas, which also served lands down to Ft. Quitman, and gave Colorado and New Mexico above Elephant Butte the freedom to pursue new water projects. The water delivery schedules devised by the engineering advisors for the three states were the basis for that apportionment, and reflected the understanding among the engineers that in the absence of a transfer of additional water into the Upper Rio Grande Basin the Rio Grande was fully appropriated.

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[95] Thomas M. McClure, Commissioner for New Mexico, to His Excellency, Governor John E. Miles, Santa Fe, New Mexico, January 9, 1939. ff. RG 267, Entry 26, TX v NM #9, Box 460 1957 (TX v. MN #9) to 1957, Entry 26, RG 267, NAB

[96] S.O. Harper, Chairman, Rio Grande Compact Commission, to The Honorable, The Secretary of the Interior, Washington, D.C., Re: Rio Grande Compact, March 26, 1938, 2. ff. 032.1 Box No. 936, Entry 7, RG 115, NARA Denver.

[97] M.C. Hinderlider, Rio Grande Compact Commissioner for Colorado to Mr. Frank B. Clayton, Rio Grande Compact Commission for Texas and Mr. Thos. M. McClure, Rio Grande Compact Commissioner for New Mexico, February 21, 1939. [1939], RGCC-FBCP, UTA; Governor of New Mexico [John E. Miles] to Hon. W. Lee O'Daniel, Governor of Texas, March 2, 1939; and W. Lee O'Daniel, Governor of Texas to Honorable John E. Miles, March 9, 1939. ff. 277 Gov. John E. Miles, Conservation – Ratification of the Rio Grande Compact, 1939, Box 9, Serial No. 13225, Governor John E. Miles, special issues, Dates: 1939-1942, Governor John E. Miles Papers, NMSA; and United States of America, *Congressional Record: Proceedings and Debates of the 76th Congress, First Session*, Volume 84-Part 6, May 19, 1939, to June 9, 1939 (pages 5771 to 6948) (GPO, 1939), 6589.

Opinion II: The quantity of water apportioned to Texas by the 1938 Rio Grande Compact included flows to address water quality concerns for Rio Grande project lands in Texas.

As noted in Opinion I, the quantity of water to be apportioned to Texas by the 1938 Rio Grande Compact was inextricably linked to the quality of water. The loudest voice for water quality belonged to Texas's engineering advisor Raymond A. Hill. Hill was vociferous in his advocacy of flows to mitigate the salinity of irrigation water reaching downstream lands in Texas. In the *Texas v. New Mexico* original action, in the compact proceedings, and before his fellow engineering advisors, he was adamant that an 800,000 af release from Elephant Butte was essential to achieving a "salt balance." Broadly speaking, Hill argued that Texas required more water than it could use consumptively to ensure that little or no additional alkali salts were deposited as a result of irrigation on downstream lands to the detriment of those lands. The 800,000 af figure reflected his calculations of what was necessary to achieve what he called, "equivalent service." Neither of Hill's counterparts in Colorado and New Mexico, Royce Tipton and John Bliss, readily agreed that such a large release from Elephant Butte was justified. The federal Rio Grande Joint Investigation, which aimed to provide the requisite technical data to craft a compact, similarly did not assess a sufficient quantity of water to achieve Hill's equivalent service. With the completion of the federal investigation and the resumption of negotiations in late 1937, Texas's engineering advisor redoubled his efforts to convince his fellow advisors that 800,000 af was the appropriate amount – and he succeeded. The December 1937 engineering advisors' report recommended 800,000 af as the "normal release" from Elephant Butte. Although this figure was reduced to 790,000 af after New Mexico's compact commissioner Thomas McClure objected (reflecting the concerns of upstream interests in New Mexico), Texas's acceptance of this reduction and the compact indicates that 790,000 af was inclusive of the flows necessary to achieve Hill's "equivalent service."

Salinity was a known issue within the stretch of the Rio Grande between Elephant Butte Reservoir and Ft. Quitman. Beginning in the 1920s, the Bureau of Reclamation (Reclamation), the US Department of Agriculture (USDA), and the International Boundary Commission (predecessor to today's International Boundary and Water Commission), responsible for overseeing the provisions of the 1906 treaty with Mexico, had made various measurements and analyses of water quality and salt concentration in the river and at riverside drains. In 1929-1930 and in 1933-1934, Rio Grande Project drainage waters were the subject of close study. According to project superintendent L.R. Fiock, in 1933 alone water from the reservoir carried 600,000 tons of dissolved salts. As noted below and discussed in Opinion IV, Reclamation purposefully released additional water from Elephant Butte to compensate for increased salinity at the lowest end of the project, which further benefitted lands downstream to Ft. Quitman.[98]

The issue of water quality with regard to the quantity of Rio Grande water to be apportioned to Texas by a compact, however, was not clearly articulated until Texas filed suit against New Mexico and the Middle Rio Grande Conservancy District (MRGCD) in the US Supreme Court in October 1935. Texas alleged that New Mexico "violated the [1929] Compact by impairing the water supply in the Elephant Butte Reservoir through excessive diversions and through injurious increase of the salt contents of the water," and "that such excessive diversions and increase of salt contents were in violation of the rights of Texas waters users." As discussed in Opinion I, New Mexico denied this claim and instead asserted that illegal Mexican diversions and inefficient operation of Elephant Butte were to blame.[99]

Quantity and quality of water reaching lands in Texas went hand-in-hand, as Frank Clayton, attorney for Texas and the state's Rio Grande Compact commissioner, explained to Special Master Charles Warren near the outset of the hearings in November 1936. Clayton, citing Article XII of the 1929 compact that the water supply for Elephant Butte "shall not…be impaired by new or increased diversions or storage on the upper Rio Grande," argued that "the increased diversion in the Middle Rio Grande District has impaired both as to quality and quantity." Compensation for the diminished quality, the attorney insisted, "required an increased quantity in order to give equivalent service."[100]

Although Fiock testified that Reclamation released water "for the purpose of washing out salts," characterizing this practice as "both beneficial and necessary," much of the testimony and evidence for Texas's argument was offered by Hill and his associate (later partner) J.Q. Jewett.[101]

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[98] *Plaintiff's Case in Chief*, Vols. III, IV, 805-836; *Defendant's Case in Chief*, Vols. X, XI, 1862-1864, 1871, and 1874. CB-F-171A thru CB-F-1716: Transcripts of TX V. NM, Box 4X219; C.S. Scofield, Principal Agriculturalist in Charge, Messrs. Quinton, Code and Hill-Leeds and Barnard, Attention Mr. J.Q. Jewett, August 9, 1935. ff. Elephant Butte-El Paso Dists. General Correspondence G352 1935, Box 4X190, RAHP, UTA; Charles Warren, Attorney, Mills Building, Wash. DC, large leather black binder, unpaginated [65-66]. ff. Large black binder, Box 4, CWP, HLS HSC; and "Water From Dam Enriches Lands," *El Paso Herald-Post*, June 30, 1933. ff. 023. Rio Grande – Clippings 1930 thru 1937, Box 908 Rio Grande Pro. 010.-023, Entry 7, RG 115, NARA Denver.

[99] *Ad Interim Report of the Special Master*, received Mar. 26, 1937, 4-6. ff. RG 267, Entry 26, TX v NM #10, Box 401, Entry 26, RG 267, NAB.

[100] *Plaintiff's Case in Chief*, Vol. III, IV, 498-499. CB-F-171A thru CB-F-1716: Transcripts of TX v. NM, Vol. 1-16, 4X219, RAHP, UTA.

[101] John Q. Jewett earned his Bachelor of Science in Civil Engineering from the University of Colorado in 1920, and like Hill, later received "the degree of Civil Engineer." He was an instructor at the university during the 1922 and 1923 academic years. After the University of Colorado, Jewett joined the Yaqui Valley Irrigation Project in Mexico as an "office engineer," rising the position of "assistant to the Chief Engineer."

Using a demonstrative exhibit, Hill endeavored to explain to Warren the dynamic between irrigation, drainage, and increased salt concentration in the waters of the Rio Grande as it moved downstream. The illustration from which the engineer spoke compared a typical cross-section of the Rio Grande Valley as it would appear in "a state of nature" to that same cross-section "after irrigation and drainage." Hill noted that part of the water from the irrigation canal passed out to the land, carrying with it salts in solution. Some of that water was lost into the atmosphere as vapor, and carried no salts. Part of the water consumed by crops, the excess over the consumptive use, passed into the ground and found its way to the drainage system. Only part of this water reached the drain, but in a well-designed irrigation system, no salts can be allowed to accumulate, Hill pointed out. If it did, the land would become unfit for cultivation over time. In a successful drainage system, the engineer emphasized, there had to be a continuous movement of salt from the canal to the drain – i.e., as much salt must reach the drain as left the canal. Therefore, water in the drain would necessarily have a higher salt concentration than the water in the delivery canal. These drains necessarily connected and discharged back into the river, with the result of increased salinity as in the Rio Grande as the river flowed downstream.[102]

Jewett pointed out in his testimony that this was in fact the case for land in Texas. Water quality analyses, he argued, indicated that there had been an accumulation of salts between Courchesne, Texas (immediately upstream from El Paso) and Ft. Quitman in every year from 1930-1935, inclusive, a period of consistent record. The accumulation varied from 141,000 tons in 1931-1932 to 345,000 tons in 1934. The total salt accumulation during the entire six-year period, 1930-1935, was nearly 1.3 million tons. The purpose of Jewett's testimony, Clayton told the special master, was "to show whether we are increasing the concentration of [salt in] the soil through too sparing use of the water." Or, put in another way, "how much water is necessary to be used to maintain a balance." Jewett indicated that the evidence pointed to a substantial salt balance between Elephant Butte and Courchesne, lands largely in New Mexico, but a salt balance between Courchesne and Ft. Quitman, lands in Texas, was "not being maintained by a very wide margin." If the same area was to be irrigated under the same conditions and the same amount

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In 1926, Jewett joined Quinton, Code & Hill, Leeds & Barnard. He assisted in the water supply-hydroelectric power study the firm made of Elephant Butte Dam in the 1920s, and in the 1930s, oversaw the company's work on water supply studies of the federal Salt River Project in Arizona. *Plaintiff's Case in Chief*, Vols. I, II, 215-216. CB-F-171A thru CB-F-1716: Transcripts of TX v. NM, Vol. 1-16, Box 4X219, RAHP, UTA

[102] *Plaintiff's Case in Chief*, Vo. I, II, 409-416; and Vol. III, IV, 603-615. CB-F-171A thru CB-F-1716: Transcripts of TX v. NM, Vol. 1-16, 4X219, RAHP, UTA.

of water consumed, the only way to produce a more favorable salt balance, the engineer testified, would be to "increase the supply at the head of the valley."[103]

To accomplish this, Hill testified that 800,000 af was the necessary release of water for lands below Elephant Butte. This was the "maximum amount which can be properly withdrawn" from the reservoir, according to the engineer, based upon recorded releases from the reservoir over the past decade. Hill calculated that gross consumptive use between the reservoir and Ft. Quitman over the previous decade (1925-1935) had amounted to 675,000 af: 300,000 af from Elephant Butte to Courchesne, and 375,000 af from Courchesne to Ft. Quitman (including land in Mexico). The engineer further estimated that the "average total consumption" between Elephant Butte and Ft. Quitman "under present conditions of distribution of crops" at 3 af per acre (af/a), and in his judgment, 50,000 af of unavoidable operating waste was a "reasonable allowance" for the Rio Grande Project. Beyond these figures, Hill argued that an additional 145,000 af was necessary to maintain a "salt balance" for the lands between Courchesne and Ft. Quitman. Cumulatively, these figures were in excess of 800,000 af by 70,000 af. This led to additional testimony by Hill ascribing the additional water use to Mexican diversions above the 60,000 af prescribed by the 1906 treaty.[104]

An undated memorandum, "Equivalent Service Under Present Conditions (Hill)," located in Clayton's papers at the Dolph Briscoe Center University for American History at The University of Texas at Austin sheds additional light on the salt balance Hill believed necessary. According to this memorandum – which may be Clayton's summary of a larger analysis prepared by Hill or which may have been prepared for Clayton by Hill – "[t]he "average concentration of water available for diversion to the El Paso Valley [as] 50% greater than the concentration of water available for diversion to the valleys above El Paso at the present time." To achieve equivalent service in the valley, therefore, "the farm duty should be about 1.5 greater than for the other valleys [above El Paso, i.e., Palomas, Rincon, and Mesilla]." "However," the memorandum acknowledged, "this excess is evidently not available even under present conditions."[105]

New Mexico challenged this analysis. John Bliss, New Mexico's engineering advisor and an expert witness called by the state, in particular offered an alternative view. He acknowledged that the further downstream water travelled from Elephant Butte, the higher the concentration of salts. However, Bliss argued that project "officials dilute the entire flow of the river to produce a

[103] *Plaintiff's Case in Chief,* Vols. III, IV, 838-851. CB-F-171A thru CB-F-1716: Transcripts of TX v. NM, Vol. 1-16, Box 4X219, RAHP, UTA.
[104] *Plaintiff's Case in Chief*, Vols. V, VI & VII, 1202-1206, 1210, 1220-1221, and 1235-1238. CB-F-171A thru CB-F-1716: Transcripts of TX v. NM, Vol. 1-16, Box 4X219, RAHP, UTA.
[105] "Equivalent Service Under Present Conditions (Hill)," undated. ff. Rio Grande Commission (Memorandum), Box 2F465, RGCC-FBCP, UTA.

satisfactory quality" at the lowest end of the project – the "Tornillo unit." As much as 50,000 af, New Mexico's engineer calculated, was passed out of the project to achieve this balance at Tornillo. In fact, passing this much water, Bliss further observed, resulted in lands outside the project, in Hudspeth County above Ft. Quitman receiving as much 38,000 af of reservoir water.[106]

As discussed in Opinion I, after nearly five months of testimony and argument, Warren was unable to arrive at suitable findings of fact for the Supreme Court. The amount of data presented and analyzed in testimony was considerable. The special master nevertheless found the evidence regarding the salt content of Rio Grande water "limited" and "unsatisfactory." At the urging of counsel for Texas, New Mexico, and MRGCD, he recommended in March 1937 that the case be stayed, in part until the federal Rio Grande Joint Investigation completed its studies of the water resources of the Upper Rio Grande Basin.[107]

Water quality was a critical concern for Texas in the federal investigation, but Colorado and New Mexico were initially hesitant to examine the issue of salinity. The Middle Rio Grande Conservancy District was especially opposed. Federal engineers, however, concurred with Texas as to the necessity of the work, as did representatives from Colorado following an organizational meeting of the Rio Grande Joint Investigation held in Santa Fe in late April and early May 1936. The USDA Bureau of Plant Industry and its principal agriculturalist, C.S. Scofield, were charged with the study of water quality in the basin as part of the federal investigation. Although Texas did not contribute to that investigation as Colorado and New Mexico did, Hill endeavored to relay what he believed was the appropriate consideration of "equivalent service" to the federal investigators.[108] In particular, he provided Scofield with the mathematical formula for "service

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[106] *Defendant's Case in Chief*, Vols. X & XI, 2011. CB-F-171A thru CB-F-1716: Transcripts of TX V. NM, Box 4X219, RAHP, UTA.

[107] *Ad Interim Report of the Special Master*, received Mar. 26, 1937, 7-13. ff. RG 267, Entry 26, TX v NM #10, Box 401, Entry 26, RG 267, NAB.

[108] At a series of meetings in Santa Fe in early February 1936, Barrows, Adams, the state engineering advisors, and compact commissioners worked out the plans for the joint investigation – including the work to be done and the various costs of work. Meeting with C. C. Hezmalhalch, deputy state engineer for Colorado, McClure, Clayton, and W.A. Laflin (an engineer working with Clayton's engineering advisor Raymond Hill), Barrows and Adams asked the states to collectively contribute upwards of $55,000 either "in cash or acceptable services." Hezmalhalch indicated that Colorado was willing to provide a third of this amount, "how much, if any…in services to be worked out later." McClure likewise pledged a third for New Mexico "in money or services," but indicated that it "would take a good deal of scratching about to do this." Clayton agreed that an equal division of the cost among the three states was "entirely fair and equitable," but he was unable even after speaking with Gov. Allred to commit Texas to any amount of money. He pledged to "'do his damnedest'" to convince the Texas legislature to "make an emergency appropriation for the purposes of the Rio Grande Compact Commission for the balance of the fiscal year ending Aug. 31, 1937," but subsequent events suggest that he was unable to secure a financial contribution from Texas. Only the Colorado State Engineering Department and the Office of the New

equivalence" that was used in the Bureau of Plant Industry's study for which the federal engineer expressed his indebtedness.[109]

Hill's contribution notwithstanding, the draft *JIR* distributed in mid-August 1937 failed, in his mind and Jewett's, to recommend the necessary for equivalent service. Writing to Texas's compact commissioner Frank Clayton not long after securing a copy of the report, Hill remarked that he was "becoming discouraged at the progress possible." He observed that much of the "discussion of water supply [was] limited to records taken prior to the instigation of the Rio Grande Joint Investigation," and reflected "the opinions" of federal engineers.[110]

In September, in advance of the next round of compact proceedings, Jewett elaborated on the concerns Hill alluded to in his letter to Clayton. The engineer prepared a thorough critique of the draft summary report of *JIR* (which he called Volume I, and which is identified in the final released copy as Part I). Jewett, in particular, took the study to task for failing to appreciate the scope of

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Mexico State Engineer are credited in the final report as "Cooperating Agencies" from the three states. Acknowledgments are also given to "the contributions and assistance" of the MRGCD, the San Luis Valley-based Rio Grande Water Users Association, the "Rio Grande Reclamation Project," but to no Texas state agency or local organization. Hill, in his 1968 report on the development of the compact did note that "the engineering advisor to each of the Rio Grande Compact commissioners worked closely with those carrying out the Joint Investigation" – and that certainly seems to be the case where it came to the salinity issue, as discussed below. See Typed notes, Conference in U.S.G.S. office, Santa Fe, 2-4-36, 2-5-36, and 2-6-36. Folder 393-Rio Grande Joint Investigation Financial Statements, 1935-1937; Handwritten notes, Conference with members Rio Grande Compact Com., 2-3-36, Santa Fe. Folder 394-Rio Grande Joint Investigation Minutes and Memoranda of Meetings, 1936-1937; National Resources Committee, Rio Grande Joint Investigation, Progress Report – September 1, 1936, 5. Folder 391-Rio Grande Joint Investigation Progress Reports, 1936-1937; and Rio Grande Joint Investigation, Progress Reports – February 1, 1937. Folder 390, Box 26, FAC, WRCA; *JIR*, 6 and 10; and Hill, "Development of the Rio Grande Compact of 1938," 14.

[109] Even before the federal investigation, on the eve of the hearings before Special Master Warren, Hill was in communication with Scofield. During the spring and summer of 1936, he solicited the federal investigator for information and shared his views on the problem. See, for example, Raymond A. Hill to Mr. C.S. Scofield, Division of Western Irrigation, Bureau of Plant Industry, U.S. Department of Agriculture, April 16, 1936; Raymond A. Hill to Mr. C.S. Scofield, Bureau of Plant Industry, U.S. Department of Agriculture, May 12, 1936; C.S. Scofield, Principal Agriculturalist in Charge to Mr. Raymond A. Hill, June 3, 1936. ff. Elephant Butte-El Paso Dists. General Correspondence G352 1935, Box 4X190, RAHP, UTA; and *JIR*, 464.

Hill also explained how he developed this equation for equivalent service in a letter to the investigation's engineer-in-charge, Harlowe M. Stafford, in May 1937. Raymond A. Hill to Mr. Harlowe Stafford, Engineer in Charge, Rio Grande Joint Investigation, May 18, 1937. [1937], Box 2F467, RGCC-FBCP, UTA.

[110] Proceedings of the Meeting of the Rio Grande Compact Commission…September 27, to October 1, 1937, 1. Unnamed folder 5, Box 2F463; and Raymond A. Hill to Mr. Frank B. Clayton, August 20, 1937. ff. Correspondence Business and Legal, 1935-1938, Pamphlets, 1935-1938, Box 2F464, RGCC-FBCP, UTA.

water quality issues confronting downstream lands in Texas. These lands included not only those project lands at the furthest end of the Rio Grande Project, "the Tornillo unit," but also beyond, down to Ft. Quitman, "in the Hudspeth District." Jewett acknowledged that the report observed that "more abundant applications [of irrigation water] are needed to prevent the accumulation of salt in the soil and resultant deleterious effect upon plant growth" in these areas of the basin. Yet, the engineer pointed out, the report failed to recognize "that the concentration of salts in irrigation water may affect the production of crops regardless of whether or not there be an accumulation of salts in the soil." No "consideration," moreover, "[is] given to the possibility that any other portions of the Rio Grande Valley below Elephant Butte [i.e., other than Tornillo or Hudspeth] may be affected either by concentrations of the irrigation water or by accumulation of salts within the area."[111]

Jewett maintained that the draft summary report gave short shrift to "equivalent service" despite Scofield's own use of Hill's formula. In his assessment of the work of the federal investigators, he stressed that "nowhere in Volume I or studies of water supply by R.G.J.I. is any consideration given to the outflow of Rio Grande which should be maintained either from Rio Grande Project or from the basin at Fort Quitman to preserve the irrigated areas in a productive condition by removal of salts." The engineer further remarked, "[n]o consideration is given to the question as to whether there has been a sufficient outflow from the El Paso District above Fabens to preserve a salt balance in that district in the past three years." "[L]iberal allowance for water to the Tornillo District" – on the order of 19,000 af – appeared to the engineer as "an excuse for not giving further consideration to salinity control."[112]

Bringing his appraisal to a conclusion, Jewett expressed the view that Texas and its needs hardly seem to matter to the federal investigators. The "general implication," he wrote,

> is that proposed storage development on Rio Grande in Colorado and New Mexico will benefit developed lands, and probably new lands in Colorado, and will improve the water supply to lands in New Mexico above Elephant Butte. The further general implication is that the lands below Elephant Butte would suffer shortages during drouth [sic] period anyway, and that probably the shortages would not be much worse if conditions in Colorado and New Mexico were to be improved.
>
> It seems to the writer that the answer to the voluminous report of R.G.J.I. can be stated very simply. The purpose of the proposed development on the Upper Rio Grande, principally construction of storage reservoirs, is to regulate the water supply in Colorado and New Mexico to meet as closely as possible the irrigation demands in those areas, and secondarily to conserve the water supply for the purpose of avoiding shortages in

[111] J.Q. Jewett, "Notes and Comments on Volume I of Report of Rio Grande Joint Investigation," September 1937, 41. CB-F-137-11, Box 4X215, RAHP, UTA.
[112] Jewett, "Notes and Comments," 42, 44-45, 55, and 56. CB-F-137-11, Box 4X215, RAHP, UTA.

> developed areas, or for the purpose of irrigating new lands. Such being the purpose of the proposed development, it follows directly that the effect upon the lands below Elephant Butte will be an impairment of their water supply in either quantity or quality, or both. This inevitable action of cause and effect cannot be stopped by estimates and opinions, by fortuitous 46-year averages [the years 1890-1935 were used as the basis for calculating water supply], or by an unsound grouping of statistics.[113]

It was within this context, this critical assessment by Texas's engineers that the water quality needs of lands in Texas above Ft. Quitman were not adequately addressed by the federal investigation, that Clayton offered Texas's sole demand when the Rio Grande Compact Commission reconvened in September 1937:

> …that the State of Colorado and New Mexico will release and deliver at San Marcial a supply of water sufficient to assure the release annually from Elephant Butte Reservoir of 800,000 acre-feet of the same average quality as during the past ten years, or the equivalent of this quantity if the quality of the supply is altered by any developments upstream.[114]

Texas's concerns for water quality were thus not limited to developments immediately above Elephant Butte in New Mexico; those concerns extended to the water supply that Colorado proposed to develop from draining the so-called "Closed Basin" in San Luis Valley. When the subject was raised during the September-October 1937 meeting, "[s]peaking for the people at the lower end of the [El Paso] valley," Hill observed that this water was "of a highly undesirable quality [87 percent sodium content]…." Consequently, if it were "added to the Rio Grande it would be necessary for dilution at the lower end to offset it, and we much prefer that it not be dumped into the river."[115]

Federal investigators, Jewett's criticism of the *JIR* notwithstanding, were sympathetic to Texas's desire for an improved quality of water. NRC representative Harlan Barrows echoed Hill's position when called upon by commission chair S.O. Harper to offer his views at that same meeting. After praising the group for tackling the problem of the equitable distribution of the waters of the Rio Grande, Barrows surveyed various possibilities for development of each of the sections of the Upper Rio Grande Basin. The lower end, he believed, unquestionably required a higher-quality water:

> Going to the lower valley, - shall I say for the sake of brevity the El Paso District, meaning the whole lower end, - what does it need if it is to realize, so far as conditions of water

[113] Jewett, "Notes and Comments," 63-64. CB-F-137-11, Box 4X215, RAHP, UTA.
[114] Proceedings of the Meeting of the Rio Grande Compact Commission...September 27, to October 1, 1937, 13. Untitled folder 5, Box 2F463, RGCC-FBCP, UTA.
[115] Proceedings of the Rio Grande Compact…September 27 to October 1, 1937, 24. Unnamed folder 5, Box 2F463, RGCC-FBCP, UTA. See also footnote 120.

> and land are concerned, its potentialities? Of course, it needs an adequate supply of water, a reliable supply and a supply of good quality…. Hudspeth has poor water and it ought to have good water.[116]

When the development of the technical basis for the compact moved to the respective states' engineering advisors, as discussed in Opinion I above, Hill continued to insist that 800,000 af was the necessary release from Elephant Butte to meet the needs of the project in New Mexico and Texas down to Ft. Quitman. He expressly urged his fellow engineering advisors, Royce Tipton of Colorado, Bliss and E.B. Debler for the United States, to adopt "the 800,000-acre-feet requirements" for the benefit of Texas during their November 1937 meetings. Tipton and Bliss, Hill noted in a memorandum to Clayton, expressly opposed this quantity. "I showed them," the engineer explained

> …by different methods of calculation that this amount [800,000 af] would be needed for equivalent service to lands below El Paso, in the Rio Grande project, or to maintain a salt balance in the El Paso area. In fact, it worked out about the same either way. If the salt balance is maintained, then equivalent service is given, and vice versa.[117]

According to Hill, New Mexico in particular did "not want to accept responsibility of furnishing Texas any additional water for salinity control in case the quality of water should change adversely." A letter to Texas's engineering advisor prepared by Bliss for McClure less than a week before the November meetings summed up the upstream state's position:

> New Mexico believes that the quality of water available to Texas under present conditions is influenced by so many factors in Colorado, New Mexico and Texas, many of which are uncontrollable and for many of which New Mexico can in no way be responsible, that she is not justified in assuming the responsibility of furnishing Texas additional water for salinity control in case that quality should change adversely.[118]

Hill was not dissuaded. Away from Debler and Tipton at the November meeting, he discussed with Bliss increased water deliveries to address rising salinity levels in the Rio Grande below Elephant Butte. As noted in Opinion I above, Hill believed that New Mexico engineer sympathized with Texas's position on this issue "but does not know how to measure the effect upon the water supply produced by an irrigation development above Elephant Butte." Texas's engineering

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[116] Proceedings of the Rio Grande Compact…September 27 to October 1, 1937, 46. Unnamed folder 5, Box 2F463, RGCC-FBCP, UTA.

[117] Raymond A. Hill, Memo to Mr. Clayton: In re Meeting of Committee of Engineers, at Santa Fe, November 22 to 24, 1937:-, November 26, 1937, 3. [1937], Box 2F467, RGCC-FBC, UTA.

[118] Raymond A. Hill to Mr. Frank B. Clayton, November 17, 1937. [1937], Box 2F467, RGCC-FBC, UTA; and Thomas M. McClure, State Engineer, By _____ Engineer to Mr. Raymond A. Hill, JAH:EM, cc: Mr. Royce J. Tipton, November 16, 1937, 3. Rio Grande Compact – July 7, 1937 to June 30, 1938, 26th Fiscal Year, NM_00156944.

advisor remained hopeful that he could convince Bliss "that some allowance be made for change in quality of water."[119]

As discussed in Opinion I, Hill succeeded by the end of the December meetings. When the group reconvened in Los Angeles, Bliss had prepared his own estimate of the demand on Elephant Butte Reservoir. Out of a total of 750,000 af, the New Mexico engineering advisor had made an allowance of 19,000 af for "Salt Balance & Service Equivalents" – the same amount that the *JIR* made, as Jewett had noted. At the end of the meetings, Bliss and Tipton had both conceded the 800,000 af figure to Hill.[120] The December 1937 "Report of the Committee of Engineers" subsequently adopted the figure as an average for the "Normal Release from Elephant Butte."[121]

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[119] Hill, Memo to Mr. Clayton, November 26, 1937, 2. [1937], Box 2F467, RGCC-FBCP, UTA.

[120] Hill also sought a water-quality guarantee from Colorado for deliveries made at the Colorado-New Mexico state line, and here he was less successful. Hill's own notes of the engineering advisors' meetings do not disclose much information on this issue, but Tipton discussed the matter in his February 1938 *Analysis of Report of Committee of Engineers to Rio Grande Compact Commissioner, Dated December 27, 1937*. According to the Colorado engineer,

> Due to the fears of Texas with respect to the quality of water below Courchesne, this item was a very controversial one during the meetings of the engineering committee. The Texas representative [Hill] insisted that so far as Colorado was concerned, credits at the stateline should be reduced by one acre-foot for each three ton increase in salt at the stateline over 80,000 tons per annum. Such a provision would have prevented further development in the [San Luis] Valley since Colorado cannot put into effect the proposed plan of reservoir operation without increasing the salt content at the stateline. The proposed provision by the Texas member of the Committee, therefore, was not made a part of the agreement. It was provided, however, that no credit should be claimed by Colorado for water imported from the "Dead Area" which had sodium ions in excess of 45% of the total positive ions. This would prevent the receiving by Colorado of credit for water brought to the river from the sump area proper, but would not prevent its receiving credit for water developed west of the sump, or from water developed from such creeks as Saguache, San Luis, Sand, and east side creeks.

This provision, as noted in Opinion I above, was recommended in the report, and it was ultimately incorporated into the 1938 Compact as part of Article III. Tipton, *Analysis*, 10-1. ff. 70, Box 44-70, MCHC 1897-1987, HC; and "Rio Grande Compact," in Proceedings of the Meeting of the Rio Grande Compact Commission…March 3rd to March 18th, inc., 1938, Appendix No. 11, 77. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

[121] [Raymond Hill], "TEXAS COMPACT: John Bliss Estimate of Project Requirements at Elephant Butte," 12/17/37. CB-F-137-34, Box 4X215, RAHP, UTA; "John Bliss Estimate of Project Requirements at Elephant Butte," typescript, n.d. CB-F-137-34, Box 4X215, RAHP, UTA; Tipton, *Analysis*, 11. ff. 70, Box 44-70, MCHC 1897-1987, HC; Bliss to Tom, December 22, 1937. Rio Grande Compact – July 7, 1937 to June 30, 1938, 26th Fiscal Year, NM_0015692 – NM_00156929; and "Report of Committee of Engineers to Rio Grande Compact Commissioners," December 27, 1937, in Proceedings of the Meeting of the Rio Grande Compact Commission…March 3rd to March 18th, inc., 1938, Appendix No. 1, 45 and 47. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

Although the 800,000 af figure was later reduced to 790,000 af following objections raised by New Mexico (as discussed in Opinion I above), historical evidence exists that this slightly smaller figure nevertheless encompassed the flows that Hill argued was necessary for "equivalent service." Article XI of the 1938 Compact, for example, states in pertinent part, "New Mexico and Texas agree that upon the effective date of this Compact all controversies between said States relative to the quantity or quality of the water of the Rio Grande are composed and settled…."[122] Such a statement, given Texas's position on the quality of Rio Grande water during the compact negotiations of the late 1930s, is indicative that the 790,000 af figure was sufficient.

Clayton joining with McClure and Hinderlider in signing the compact in March 1938, and later advocating for ratification is further evidence. In a pamphlet "To Water Users Under The Rio Grande Compact" that included a copy of the compact, released soon after the negotiations, Texas's commissioner stressed that the compact "seeks primarily to protect vested uses of water above Fort Quitman, and guard them against future impairment, both as to quantity and quality." Clayton delivered a similar message to water users outside the geographical confines of the compact in May 1938 (addressed in Opinion IV). At a meeting of the Lower Rio Grande Water Users Association, he expressed his conviction that Texas had obtained "every drop of water originating in Colorado and New Mexico that she was entitled to" above Ft. Quitman – a declaration that given his earlier statement would appear to be inclusive of the flows to ensure a sufficient quality of water. To Texas Governor W. Lee O'Daniel in November 1938, Clayton indicated the "engineers, attorneys, and other technical experts" for Texas were similarly convinced. In their collective "judgment," the commissioner confidently predicted to the governor, the compact would "restore a feeling of security to the water users in Texas above Fort Quitman…."[123] Indeed, as noted above (and discussed in Opinion IV below), water users between the end of the Rio Grande Project and Ft. Quitman relied upon unused waters released through the project. These waters possessed a higher quality owing to Rio Grande Project operations intended to ensure a sufficient quality of water throughout the project.

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[122] "Rio Grande Compact," in Proceedings of the Meeting of the Rio Grande Compact Commission, Held at Santa Fe, New Mexico, March 3rd to March 18th, inc., 1938, Appendix No. 11, 80. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

[123] Frank B. Clayton, "To Water Users Under The Rio Grande Project," El Paso, Texas, March 25, 1938. Folder 1, Memos of Interior Department, 1913-1915, Box 14, Arthur Powell Davis Papers, 1896-1952, Accession Number 1366 [hereafter APDP 1896-1952, American Heritage Center, University of Wyoming, Laramie [hereafter AHC]; *Proceedings of Meeting Held on Friday, May 27, 1938 at El Paso, Texas, between Representative of Lower Rio Grande Water Users and Representatives of Irrigation Districts Under the Rio Grande Project of the Bureau of Reclamation*, 10. ff. Proceedings and Minutes 1935-1938, Box 2F463; Clayton to O'Daniel, November 16, 1938, 4. Box 2F467, RGCC-FBCP, UTA; and Littlefield, *Conflict on the Rio Grande*, 209-210.

That the quality of the water of the Rio Grande reaching its lands was a central concern for the State of Texas in the negotiations leading to the 1938 compact is clear. The state had singular demand by 1937: the annual release of 800,000 af from Elephant Butte Reservoir "of the same average quality as during the past ten years, or the equivalent of this quantity if the quality of the supply is altered by any developments upstream." Texas's engineering advisor Raymond Hill advocated for this figure, and sought to convince federal engineers and the engineering advisors for Colorado and New Mexico of the necessity of additional flows to Texas above what the state's present consumptive use suggested. The other engineers agreed that lands downstream required an improved quality, but until late 1937 were unconvinced of Hill's projection. Hill managed to persuade them, and while Texas ultimately agreed to a slightly lesser figure of 790,000 af, the state's commitment to the final compact strongly indicates that this quantity of water was inclusive of the flows to ensure water of sufficient quality for downstream lands.

Opinion III: The Rio Grande Project water supply, circa 1938, included not only the surface flow of the Rio Grande captured in Elephant Butte Reservoir, but also all water tributary to the project including groundwater as well as return flows.

At the outset of the federal reclamation program established by the 1902 Newlands Act, federal lawyers and engineers embraced a broad conception of what constituted the water supply for federal projects primarily out of concerns for adequacy. The United States Reclamation Service's principal legal officer Morris Bien argued that while the Newlands Act obligated the United States to recognize state and territorial water laws concerning the appropriation of water, the federal government held dominion over public lands and unappropriated waters. The scale of proposed reclamation projects, moreover, demanded that the US have unique freedom as an appropriator, that the water supply for projects be protected from adverse claims. This latter idea found expression in New Mexico territorial water laws in 1905 and 1907 that drew upon a draft water code prepared by Bien. Legal arguments aside, Rio Grande Project supervising engineer Benjamin M. Hall envisioned the project in 1904 as utilizing all of the waters of the Rio Grande – the surface flow within the river's channel, tributary flows to the river, and groundwater – so as to serve lands in New Mexico and Texas adequately. At the recommendation of Reclamation attorneys, Hall's 1906 filing for 730,000 af was supplemented in 1908 with a filling for "[a]ll the unappropriated water of the Rio Grande and its tributaries." By the early 1910s, federal reclamation authorities were claiming "waste, seepage, spring, and percolating water arising within the project" as well as "return flows," water released from the Elephant Butte Reservoir that was diverted, used on project lands, and returned to the river channel for further use downstream. As Rio Grande Compact negotiations moved forward in the 1920s and 1930s, federal and state engineers alike recognized that surface flows, water tributary to the project including groundwater, and return flows constituted the water supply for the Rio Grande Project.

The 1902 Newlands Act, or National Reclamation Act, that created the Reclamation Service (or Reclamation, predecessor to the present Bureau of Reclamation) was not the first attempt by the US to provide for the irrigation of arid western lands. The act replaced the 1894 Federal Desert Lands Act, better known as the Carey Act after its sponsor Senator Joseph M. Carey of Wyoming. The Carey Act sought to foster private-state irrigation projects. It authorized the General Land Office, working in concert with individual western state governments, to award upwards of 1 million acres of the public domain to each semi-arid western state. The states were to administer the sale of this land, see that it was irrigated and developed into no larger than 160-acre farms sold to actual settlers only, with irrigation systems being built and operated either by individual states or by private enterprises that sold water to irrigators owning farms within the project. Project plans were to be submitted to the secretary of the interior. Although the Interior Department set aside nearly 4 million acres of the public domain for use by the states, outside of Idaho and Wyoming, the program had few demonstrably successful projects. Most western states did not possess the necessary administrative and financial resources to fulfill the Carey Act's promise and speculative investors often had insufficient capital to carry their irrigation projects to completion. By 1902 nearly 90% of the private irrigation companies developing Carey Act projects were nearing bankruptcy, and arid land development continued to lag further behind the number of acres set aside under the Carey Act. With the failure of the Carey Act, western proponents of irrigation, led by Senator Francis Warren of Wyoming, turned to the federal government, recommending federal construction of dams and reservoirs, leaving to the states the building of water distribution systems with allocation of water in accordance with state water right laws. When Congress failed to approve Warren's bill, Representative Francis Newlands of Nevada introduced a bill in 1901 providing for the federal government itself to construct irrigation projects in western states and territories.[124]

Some western representatives were hesitant of Newland's proposed legislation, fearing centralized authority and concerned that railroad and other more highly capitalized interests would benefit. Following extensive legislative negotiations involving President Theodore Roosevelt and debates over competing bills that proposed more modest programs and measures, Congress enacted the National Reclamation Act, or Newlands Act in June 1902. The act provided for the federal government, through the secretary of the interior, to withdraw un-entered and unoccupied public lands in 16 western states and territories: Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Utah, Washington, and Wyoming. Upon these lands, Reclamation was to build dams, canals, and other irrigation works for the benefit of small family farmers settling on irrigable land within the designated reclamation project area.[125]

Appropriation of water was central to the newly-created federal reclamation program. To varying degrees, state and territorial law by the early 1900s required that claims to the use of water were to be recorded by filing notices of appropriation that would be perfected by applying the water

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[124] *An Act Making appropriations for sundry civil expenses of the Government for the fiscal year ending June thirtieth, eighteen hundred and ninety-five, and for other purposes*, August 18, 1894, ch. 301, section 4, 28 Stat. 422; Paul W. Gates, *History of Public Land Law Development* (Washington D.C.: U. S. Government Printing Office, 1968), 647-652; and Robert G. Dunbar, *Forging New Rights in Western Waters* (Lincoln: University of Nebraska Press, 1983), 36-45; and Donald J. Pisani, *To Reclaim a Divided West: Water, Law, and Public Policy, 1848-1902* (Albuquerque: University of New Mexico Press, 1992), 252-303.

[125] *An Act Appropriating the receipts from the sale and disposal of public lands in certain States and Territories to the construction of irrigation works for the reclamation of arid lands*, June 17, 1902, chap. 1093, Public, No. 161, 32 Stat. 388; Gates, *Public Land Law Development*, 652-659; Dunbar, *Forging New Rights*, 51; Pisani, *To Reclaim a Divided West*, 298-325; and William D. Rowley, *The Bureau of Reclamation: Origins and Growth to 1945*, Bureau of Reclamation, United States Department of the Interior, vol. 1 (GPO, 2006), 100-101.

so claimed to beneficial use. Such law also provided for adjudication of existing rights and prescribed methods for the determination, regulation, and control of the rights to water in the future. Some states, such as California, looked to the judiciary to settle claims of appropriators, while others like Wyoming relied upon a state board or a state engineer to adjudicate claims before the courts became involved.[126]

Reclamation supervising engineer and principal legal officer Morris Bien saw the US as having a unique status relative to all other appropriators, especially with regard to its reclamation projects.[127] At the first conference of Reclamation engineers and officials in Ogden, Utah, in September 1903, he articulated a position that shaped not only Reclamation's early approach to its projects, but also state and territorial water law in the early 20th century. Bien asserted that "[t]he control of the Federal Government over the public lands and the nonnavigable waters is that of a proprietor…." Put another way, as he did in a February 1904 memorandum prepared "in connection with the motion of U.S. to intervene in the case of Kansas v. Colorado" – an interstate dispute over the waters of the Arkansas River – the federal government was the "sole proprietor" of the public domain and was consequently "in sole control of the waters on such lands." Prior acts of Congress, specifically the 1891 right-of-way act and the 1897 organic act (which provided for the establishment of federal forest reserves), as well as the Newlands Act, "merely…recognize the system of state control, regulation, and recording" of water appropriation.

Bien found support in recent case law, most notably the US Supreme Court's ruling in favor of the federal government against the Rio Grande Dam and Irrigation Company. In the Rio Grande

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[126] Morris Bien, "Relation of Federal and State Laws to Irrigation," in *Proceedings of First Conference of Engineers of the Reclamation Service with Accompanying Papers*, F.H. Newell, Chief Engineer, comp., Department of the Interior, United States Geological Survey, Water Supply and Irrigation Paper No. 93 (Washington: GPO, 1904), 233; Morris Bien, "Proposed State Code of Water Laws," in *Proceedings of Second Conference of Engineers of the Reclamation Service with Accompanying Papers*, F.H. Newell, Chief Engineer, comp., Department of the Interior, United States Geological Survey Water Supply and Irrigation Paper No. 146. (Washington: GPO, 1905), 29-30, and Morris Bien, Supervising Engineer, U.S. Reclamation Service, to Mr. Samuel C. Wiel, November 1, 1905, in Samuel C. Wiel, *Water Rights in the Western States* (San Francisco: Bancroft-Whitney Company, 1905), vi-ix. This development is also traced in Dunbar, *Forging New Rights*, 73-132.

[127] Morris Bien was a University of California, Berkeley-trained engineer who later earned a law degree from Columbian University (predecessor to George Washington University in Washington, DC). In 1903, at the request of Reclamation Chief Engineer F.H. Newell, he came to the Reclamation Service from the General Land Office in 1903. Over the next 20 years, he led Reclamation's Land and Legal Division. His "expansive view of the authority and prerogatives of the Reclamation Service," laid out here with specific reference to the Rio Grande Project, is discussed more broadly in William Rowley's official history of the Bureau of Reclamation. See Rowley, *Bureau of Reclamation*, 147-151.

Dam and Irrigation Company case, the high court identified "'two limitations'" to state control of waters "'within its dominion.'" The Reclamation official highlighted the first:

> in the absence of specific authority from Congress a state cannot by its legislation destroy the right of the United States, as the owner of lands bordering on a stream, to the continued flow of its waters; so far at least as may be necessary for the beneficial uses of the government property.

This sentence, Bien maintained,

> indicates clearly that the United States has the right to the continued flow of the waters that have not already been appropriated, for there has been no specific authority granted to the States to infringe upon this right, Congress having merely authorized the acquirement of rights by prior appropriation, and the States having undertaken to regulate this right of appropriation.

A "similar view was expressed" in *Gutierrez v. the Albuquerque Land and Irrigation Company* (188 U.S. 545) concerning "the utilization of water for irrigation purposes in the Territory of New Mexico." Whether a state or territory was concerned, Bien saw "no reason why the same view should not be held…." He also pointed out that in *Howell v. Johnson* (89 Fed. Rep. 556), a dispute over the waters of Sage Creek, an interstate stream flowing from Montana to Wyoming, the US Circuit Court of Appeals "held in a similar way as to the rights of the Federal government over the unappropriated waters on the public domain."[128]

In 1904, following meetings with commissioners from Oregon and Washington seeking a "code of irrigation law," Bien was asked to "prepare a draft" of his own. Bien's draft reflected his views of federal dominion over public lands and waters, and made special provision for developing federal reclamation projects. As he explained to the second Reclamation conference in November 1904,

> In order that the State may obtain the full benefit of this work and prevent serious interference with and perhaps the entire abandonment of the projects to be investigated, it is provided that the water supply for such projects shall be reserved from general appropriation until the investigations of the Reclamation Service shall determine the precise amount required for the project, the remainder being then released from such reservation.

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[128] Bien, "Relation of Federal and State Laws to Irrigation," 233-234; and Morris Bien, "Memorandum Concerning the Origin of the Right of Appropriation of the Public Domain," February 6, 1904, 1-5. ff. 762. Legal Discussions -General. Thru December 31, 1907., Box 223 760F- -762, Entry 3, RG 115, NARA Denver. Bien also discussed the Rio Grande Dam and Irrigation Company case and *Howell v. Johnson* in "Relation of Federal and State Laws to Irrigation," 234-236.

The "theory" behind this was

> that the State regulates the appropriation of water, exercising this power and holding the land in trust for the public, and that when the interest of the public are so directly involved as in these large irrigation projects, and when further, there is no element of individual speculation and profit in the construction the works, which are for the purpose of establishing the maximum number of homes on the land, it is the duty of every State to which the reclamation act is applicable to assist with every resource under its control.[129]

Bien insisted that the water supply for federal projects be protected against adverse claims by other appropriators. When Idaho Commissioner of Reclamation D.W. Ross "object[ed] to the proposition providing for the withholding of water for appropriation after the filing of the claim for it by the Reclamation Service," the supervising engineer argued in January 1904 letter to F.H. Newell, Reclamation's chief engineer, that Ross "fails to perceive…that a project might be completed and fail because of interference with water rights." Reclamation, Bien believed, would in "nearly every project…develop the whole water resources of the stream." It would "build better and must do more preliminary work on that account," and thus could not "compete with private parties as to time of completion…." Instead, with this "safety against speculative water filings," the federal government would "act in good faith and promptly release any claim to water which it does not propose to use."[130]

Elements of Bien's draft water code were ultimately reflected in the New Mexico territorial water laws under which Reclamation made its filings for the Rio Grande Project in 1906 and 1908. In 1905, the states of Colorado, Idaho, Montana, Nebraska, Nevada, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming and the territories of Oklahoma and New Mexico all adopted new water codes. Each state and territory, as Bien noted to his colleagues at the second Reclamation conference in El Paso, made provision "for cooperation with the work of the United States in the construction of reclamation projects." In some instances, this cooperation extended to the "Necessary water supply" along the lines that he had proposed in his draft code.[131]

This was certainly true for New Mexico. Section 22 of its new water code stated:

> Whenever the proper officers of the United States authorized by law to construct irrigation works, shall notify the territorial irrigation engineer that the United States intends to utilize certain specified waters, the waters so described, and unappropriated at the date of such notice, shall not be subject to further appropriations under the laws of New Mexico, and no adverse claims to the use of such waters, initiated subsequent to the date of such notice, shall be recognized under the laws of the territory, except as to

[129] Bien, "Proposed State Code of Water Laws," 32-33.
[130] Morris Bien, engineer, to Mr. F.H. Newell, Chief Engineer, January 5, 1904. ff. 110-E Legislation. Corres. Re Irrigation Laws; Water Codes; Etc., Box 91 110E- -110E-6, Entry 3, RG 115, NARA Denver.
[131] Bien, "Proposed State Code of Water Laws," 34; and Rowley, *Bureau of Reclamation*, 149.

> such amount of the water described in such notice as may be formally released in writing by an officer of the United States thereunto duly authorized.

Section 22, as Reclamation "assistant examiner," or attorney B.E. Stoutemyer later observed, did "not affirmatively provide that the U.S. shall acquire any rights by filing the notice described [in this section] but provides that after this notice is given, no other person shall acquire any right," which presumably may have been adverse to the federal government's.[132]

As noted in Opinion I, on January 23, 1906, pursuant to the 1905 code, B.M. Hall, the engineer supervising Reclamation's proposed reclamation projects in New Mexico, formally notified New Mexico Territorial Engineer David L. White through Reclamation's chief engineer of Reclamation's intent to construct the Rio Grande Project. The proposed project would "utilize…a volume of water equivalent to 730,000 acre feet per year requiring a maximum diversion or storage of 2,000,000 miner's inches. This water would "be diverted or stored from the Rio Grande River," in a 2 million acre-foot storage reservoir at Elephant Butte, "and diversion dams below at Palomas, Rincon, Mesilla and El Paso Valleys in New Mexico and Texas." Hall "requested" that these "waters…be withheld from further appropriation and that rights and interests of the United States" as contemplated in the 1905 territorial statute "be otherwise protected."[133]

Hall found this filing "unsatisfactory.". It was prepared on the basis of a form provided by the chief engineer, and was used not only for the Rio Grande Project but also for filings for four other proposed storage projects in New Mexico. In forwarding these for approval, Hall lamented that he "would have greatly preferred filing on the entire unappropriated flow [original emphasis] in each case."[134]

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[132] Chapter 102, "An Act Creating the Office of Territorial Irrigation Engineer, to Promote Irrigation Development and Conserve the Waters of New Mexico for the Irrigation of Lands and for Other Purposes," A.H.B. No. 98; Approved March 16, 1905, Section 22, *1905 Acts of the Legislative Assembly of the Territory of New Mexico, Thirty-Sixth Session* (Santa Fe: The New Mexican Printing Company, 1905), 277; and B.E. Stoutemyer, Assistant Examiner, to Mr. W. M. Reed, District Engineer, U.S.R.S., re Appropriation Notices in New Mexico, Nov. 8, 1907. ff. 41, Box 6, Entry 3, RG 115, NARA Denver. For more on the 1905 law, see Ira G. Clark, *Water in New Mexico: A History of Its Management and Use* (Albuquerque: University of New Mexico Press, 1987), 117-118.

[133] Hall to White, Jan. 23, 1906; B.M. Hall, Supervising Engineer, to Chief Engineer, U.S. Reclamation Service, re Appropriations, Jan. 23, 1906; and David M. White, New Mexico Territorial Engineer, to B. M. Hall, Supervising Engineer, U.S. Reclamation Service, February 16, 1906. ff. 41, Box 6, Entry 3, RG 115, NARA Denver.

[134] B.M. Hall to Chief Engineer, Jan. 23, 1906; and Acting Chief Engineer to B. M. Hall, January 29, 1906. ff. 41, Box 6, Entry 3, RG 115, NARA Denver. The other projects were Hondo, Urton Lake, Carlsbad, and Las Vegas

Hall's preference was in keeping with the conception of the project's water supply that he articulated at the same Reclamation conference at which Bien discussed his water code. "The 180,000 acres of land to be irrigated" by the project, Hall informed his colleagues, "are in a long, narrow valley, and the return water from the irrigation of the upper valley can be rediverted on lands lower down the valley." The "Engle Dam," as the engineer called it,

> will hold back all of the floods and distribute them over the irrigation period of ten months. The water will be let out as needed and there will be no more disastrous floods below the dam. The river bed will never be dry at any time of year, as the return water from such a large irrigated area will form constant springs along the whole course of the river. Lastly, the supply of ground water for pumping will be greater and more constant than it now is, as the water entering the ground from the irrigated lands will form a constant supply.[135]

As noted above, Hall emphasized in both his study and in his presentation to the National Irrigation Congress that "[a]ll of the water that comes down the river is needed for irrigation. We can not [*sic*] afford to waste any of it."[136]

Responding to a question from a delegate regarding his proposal at the congress, Hall suggested that the water coming down the Rio Grande channel was a mix of surface and subsurface flows, and that Elephant Butte Dam would aggregate and control these waters for the beneficial use of downstream lands:

> Question – As I understand it, you propose to bring that water [from the dam] down the river channel, is that true, Mr. Hall?
>
> Mr. Hall – The water that you get now in the river, that is underneath the river bed and in the valley lands comes from the rains on the high lands and from floods down the river, and from the water that is flowing in the river at certain periods. The under gravel gets saturated. We estimate that when we get in that storage dam, that instead of injuring that condition we will better it. You will still get all of the rainfall that comes down below the dam; of course you will have the floods originated below the dam – they will not be disastrous floods – but you will at all times have a wet river bed, and considerable water flowing in it, while at present you have a river bed that is dry for five months – and longer this year – and I suppose the conditions ought to be better because of the percolation from the river bed more or less and there is always a flow from the rain-fall on the mesa.[137]

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[135] B.M. Hall, "Rio Grande Project," in *Proceedings of Second Conference of Engineers of the Reclamation Service*, 77.

[136] Mitchell, ed., *Official Proceedings*, 215-216; and Hall, "A Discussion of Past and Present Plans for Irrigation of the Rio Grande Valley," November 1904, 7-8. ff. 46, Box No. 792, Entry 3, RG 115, NARA Denver.

[137] Mitchell, ed., *Official Proceedings*, 219.

The work of Charles Slichter, a hydrologist consulting with USGS, informed Hall's response. Interested in learning more about the potential water supply to be derived from groundwater sources, particularly in the Mesilla Valley, the Reclamation engineer had contacted Slichter in July 1904, before the National Irrigation Congress meeting. Hall observed in a letter to the hydrologist that valley irrigators who pumped groundwater had found a "plentiful quantity of water at a short distance from the surface." Pumps with a capacity of 1,000 gallons per minute could operate "continuously for weeks without lowering the water plane." The water table might be drawn down as much as seven feet, observed Hall, but returned to its former level "within a few minutes after the pump stops." He therefore sought to know:

> 1st:- How much water per square mile can be pumped continuously from the ground at lowest season, without lowering the water table?
>
> 2nd:- What were the sources of supply of this underground water? Does the water all come down the river bed, or is there a large quantity coming from beneath the mesa country on each side?
>
> 3rd:- If there is a continuous under-flow along the river bed, what is its volume in cubic feet per second, during the time that the river is dry, so far as surface flow is concerned?
>
> 4th:- The river bed of the Rio Grande consists of coarse sand to a depth of 70 to 100 feet and more. Just above El Paso the bed rock is limestone and there is a narrow pass where the bluffs are only 400 feet apart at the river level, and the bed rock is at a depth of about 100 feet. If a submerged concrete dam or weir were constructed here with its crest at the level of the river bed surface, how much underflow would be brought to the surface by such a structure?

These were not idle questions for Hall. As he stressed to Slichter,

> In order to irrigate the rich lands of the Rio Grande Valley in the Territory of New Mexico alone it will probably be necessary to use all of the floods and all of the underground water than can possibly be made available, and no time is to be lost in determining this vital question of underflow.[138]

The hydrologist began his work the following month, and by October, a month before the National Irrigation Congress, he had completed his pumping plant tests. Slichter found a direct connection between the river and the ground water in the Mesilla Valley, as he told the assembled delegates following Hall's presentation:

> I will not take up your time with any further matters except one point I observed in the Mesilla Valley, near Mesilla Park and Las Cruces, where we succeeded in measuring the amount of water lost by the river and contributed to the gravels. I think we have

[138] B. M. Hall, supervising engineer, to Charles E. Slichter, July 9, 1904. Folder 432 Rio Grande – Power Development – Slichters Reports as to Water Supply, Box 819 Rio Grande 430A – 458A, Entry 3, RG 115, NARA Denver.

> established that the source of the water that is used by the pumping plants is the river itself; that the origin of the ground waters or the supply of ground waters which are used by the pumping plant, is the water contributed to the river itself or lost by the river.[139]

Slichter made this same point when he published his work as USGS Water-Supply and Irrigation Paper No. 141, *Observations on the Ground Water of Rio Grande Valley* in 1905. According to his "observations of the test wells" in the Mesilla Valley,

> the ground waters in the Mesilla Valley originate in the flood waters of the river. During times of low water the river bed is so thoroughly covered with mud that probably only a small amount of water escapes in the sand and gravels of the valley. During the period of flood, when the scour is deep, the contributions of the river to the underflow reach a maximum, as at that time the greatest amount of water is available for this purpose.[140]

Federal reclamation plans for the Rio Grande Project thus from the outset anticipated utilizing all of the waters hydrologically connected to the river for the benefit of lands in New Mexico and Texas.

New Mexico's adoption of a more comprehensive irrigation code in 1907 opened an opportunity to expand federal claims to Rio Grande waters as Hall had wished. Stoutemyer had a direct role in shaping this new water code, especially with respect to "the work of the Reclamation Service," as he later informed Hall.[141] The new code further drew upon aspects of Bien's draft code. Section 40 of the 1907 act was virtually identical to Section 22 of the prior 1905 act, and the new law greatly expanded the authority of the territorial engineer. That office was soon filled by the appointment of Vernon L. Sullivan, who Stoutemyer noted to Bien in April was "well known to the Reclamation Service." Under Sullivan, the office placed greater emphasis on the public interest, ascertaining the validity of old claims to water rights, determining the quantity of

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[139] Charles S. Slichter to F. H. Newell, USGS Chief Engineer, October 25, 1904. Folder 432, Box 819, Entry 3, RG 115, NARA Denver; Mitchell, *Official Proceedings*, 218; and Charles S. Slichter, *Observations on the Ground Water of Rio Grande Valley*, Department of the Interior, United States Geological Survey Water-Supply and Irrigation Paper No. 141 (GPO, 1905), 1.

[140] Slichter, *Observations*, 27. Slichter further noted "that a small portion of the underflow reaches the river valley from the mesa and foothills to the north and east of Las Cruces."

[141] Stoutemyer had met with the New Mexico territorial governor and attorney general to "outline a plan" for the "proposed Irrigation Code" in 1907. He later met with various members of the territorial assembly and local attorneys to discuss "some features of the bill, particularly as to the territorial engineer and his work…." Stoutemyer believed that the new law would "be satisfactory to the Reclamation Service," and that it was "a great improvement over the present [1905] law." See B.E. Stoutemyer, Assistant Examiner, to Mr. B.M. Hall, Supervising Engineer, El Paso, Texas, Proposed Irrigation Code in New Mexico, March 4, 1907. ff. 110-E9, Legislation, Irrigation Laws; Water Codes; Etc., New Mexico, Transfer Case, Box 92 110E-7- -110E-12, Entry 3, RG 115, NARA Denver. See also Clark, *Water in New Mexico*, 118-122.

unappropriated water in the public streams of the territory, setting reasonable timetables for completion of large projects initiated prior to the adoption of the new water code.[142]

In early November 1907, Stoutemyer wrote to Reclamation district engineer W.M. Reed, recommending a "supplemental" filing for the Rio Grande Project under the revised territorial water code. After reviewing copies of the various notices of water appropriations made for projects in the Office of the Territorial Engineer, the assistant examiner believed re-filing Reclamation's notice of water right appropriation for Elephant Butte Reservoir and the Rio Grande Project was prudent. Stoutemyer was concerned about the highly variable flow of the Rio Grande from year to year, a flow that could be as small as 200,000 af to upwards of 2 million af per year. Hall's 1906 filing for 730,000 af could thus become a significant limitation on project operations. If Reclamation desired "all the flow of the river," then Stoutemyer favored amending the notice of appropriation to read "all the unappropriated water of the Rio Grande and its tributaries," or if a definite number of acre-feet was required to "make it large enough to cover the entire flow of the largest year." He cautioned that the filing must be made in a manner that did not forfeit any of the government's existing rights under the 1906 notice, and recommended the inclusion of language that "clearly expressed" Reclamation's "intention to preserve our rights under the former notice…." Stoutemyer noted there were a number of water right applications in the Rio Grande drainage pending in the territorial engineer's office and undoubtedly more would be filed before the federal dam was completed.[143] Filing for all the unappropriated waters

[142] Chapter 49, "An Act to Conserve and Regulate the Use and Distribution of the Waters of New Mexico; to Create the Office of Territorial Engineer; to Create a Board of Water Commissioners, and for Other Purposes," H.B. No. 120; Approved March 19, 1907, *1907 Acts of the Legislative Assembly of the Territory of New Mexico, Thirty-Seventh Session* (Santa Fe: New Mexican Printing Company, 1907), 71-95; B. F. Stoutemeyer to Morris Bien, April 2, 1907. ff. 110-E9, Box 92, Entry 3, RG 115, NARA Denver; and Clark, *Water in New Mexico*, 118-123.

[143] B.E. Stoutemyer, Assistant Examiner, to Mr. W. M. Reed, District Engineer, U.S.R.S., re Appropriation Notices in New Mexico, Nov. 8, 1907. ff. 41, Box 6, Entry 3, RG 115, NARA Denver.

Several applications for water rights on the Rio Grande and its tributaries that had the potential to adversely affect the Rio Grande Project were filed in late 1907. Stoutemyer responded with formal protests against each application. One application was for a partially constructed irrigation project with two failed dams on the Rio Puerco that flowed into the Rio Grande near Albuquerque. Some $80,000 had been invested in the project, but no water had been applied to irrigate the land within the project. A second project was designed to divert water from the Rio Grande into the old La Union Community Acequia. This was a small project but its location was bothersome as it was located between Elephant Butte Reservoir and the Texas state line. The third, and largest, project was an application by the Red River Land & Water Company in Taos, New Mexico for development of a large irrigation project involving the La Plata River. Reclamation filed formal protests with the territorial engineer against the three applications, but later withdrew its protest against the Red River Land & Water Company as Reclamation's La Plata River project had been abandoned. B.E. Stoutemyer, assistant examiner, to W. M. Reed, district engineer, U.S. Reclamation Service, December 20, 1907; Morris Bien, Acting Director, to B. E. Stoutemyer, of the Rio Grande could check adverse competition by taking advantage of Section 28 of the 1907 law which declared that "If in the opinion of the territorial engineer there is no unappropriated water available, he shall reject the application."[144]

Reed forwarded Stoutemyer's recommendation to the Reclamation director and Bien, serving as acting director, responded in late November. He agreed that the 1906 filing for "a volume of water equivalent to 730,000 acre feet per year" under the 1905 act was an insufficient quantity of water and should be expanded to include a supplemental filing for "all unappropriated water of the Rio Grande and its tributaries" under the 1907 act while "reserving all rights under notice of January 23, 1906." The director's office was nonetheless of the opinion that Reclamation's 1906 filing was legally sufficient without further action. Bien specifically cited Section 22 of the 1905 act as constituting

> a waiver by the Territory or a release to the Federal Government of all territorial rights over unappropriated waters upon the completion of certain acts by agents of the United States. By Section 22 of Chapter 102 of 1905, and the notice filed in pursuance thereof, the Territorial Legislature has relinquished claim to the waters of the Rio Grande in favor of the Federal Government, and there remains to be done only the filing of amendment of the notice as suggested.[145]

As noted in Opinion I above, on April 14, 1908, Louis C. Hill, Hall's successor as supervising engineer of the Rio Grande Project, filed a "supplemental notice" with Sullivan, pursuant to Section 40 of Chapter 49 of the laws of the 37th New Mexico territorial assembly enacted in 1907. The filing declared that the United States intended to utilize "[a]ll the unappropriated water of the Rio Grande and its tributaries" to be diverted or stored at a storage dam located 9 miles west of Engle, New Mexico, with a capacity of 2 million af and at diversion dams below in Palomas, Mesilla and El Paso valleys in New Mexico and Texas. Hill requested that these waters be withheld from further appropriation and that the rights of the United States be protected.[146]

By the 1910s, however, Sullivan had embraced the idea that a large proportion of water diverted upstream would return to the Rio Grande – the "'return water theory,'" in the words of one Reclamation official – and thereby cause no material damage to the federal project. It was a stance that inclined the territorial engineer toward approval of most other filings for water on

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February 18, 1908. ff. 41-D New Mexico. Water Appropriations. Rio Grande Project. THRU 1910, Box 9 41B-41D, Entry 3, RG 115, NARA Denver.

[144] Expressly reserving all of the unappropriated water in excess of 730,000 af per year would also tie the hands of an unfriendly territorial engineer who might favor private enterprises, Stoutemyer noted. Stoutemyer to Reed, Nov. 8, 1907. ff. 41, Box 6, Entry 3, RG 115, NARA Denver.

[145] W.M. Reed, District Engineer, to The Director, U.S. Reclamation Service, November 15, 1907; Acting Director [Morris Bien] to Reed, November 29, 1907. ff. 41, Box 6, Entry 3, RG 115, NARA Denver.

[146] Supervising Engineer to Sullivan, April 14, 1908. ff. 41-D, Box 9, Entry 3, RG 115, NARA Denver.

the Rio Grande and its tributaries. After carefully examining the issue, Reclamation and the Interior Department came out against such applications. Federal authorities believed that these filings would have an adverse effect on the water supply for Elephant Butte Reservoir. They asserted that approval would set a "precedent for the general allowance of such claims and the ultimate destruction of the Rio Grande Project," abrogating treaty obligations to Mexico and contracts with water users dependent on the project water supply. These arguments, coupled with the Rio Grande "embargo" and the temporary 1929 compact, were sufficient to preclude significant developments upstream from Elephant Butte until the advent of the Middle Rio Grande Conservancy District's proposed project.[147]

Around this same time, Reclamation began asserting the right to "waste, seepage, spring, percolating water," as well as "return flows" from project operations. As noted above, in proposing the Rio Grande Project in 1904, Hall had suggested that the project would make use of "return water." Bien's 1905 draft water code had also provided for the appropriation "of seepage water…in the same manner as other waters…provided that the seepage can be traced to such works beyond reasonable doubt." The 1905 New Mexico territorial water law did not adopt such a provision, but Section 53 of the 1907 law did. There is no indication from the historical record reviewed that a formal filing for "seepage water" from the Rio Grande Project was made by either Reclamation or another party, pursuant to Section 53.[148]

Federal authorities nevertheless saw such waters as an essential element of the overall supply for the Rio Grande Project as it developed into the 1930s. In 1912, four years prior to the completion of Elephant Butte Reservoir, a board of US Army engineers reporting on the progress of the project to Congress recognized that "losses in the distribution system," estimated at 20

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[147] P.W. Dent, Assistant Examiner, to Director, U.S. Reclamation Service, April 26, 1910. ff. 41, Box 6; William Reed, district engineer, to Director, U.S. Reclamation Service, April 28, 1910; F. H. Newell, Director, to Secretary of the Interior, May 11, 1910; and Secretary of the Interior to Vernon L. Sullivan, Territorial Engineer, May 12, 1910. ff. 41-D, Box 9, Entry 3, RG 115, NARA Denver. For more on the Rio Grande "embargo" and the 1929 temporary compact, see Opinion I.

[148] Bien, "Proposed State Code of Water Laws," 33; and Chapter 49, Section 53, *1907 Acts of the Legislative Assembly of the Territory of New Mexico*, 89. Section 53 stated:

> In the case of the seepage of water from any constructed works, the owner of such works shall have the first right to use thereof upon filing an application with the territorial engineer as in the case of an original appropriation, but if such owner shall not file said application within one year after the completion of such works, or the appearance upon the surface of such seepage water, any party desiring to use the same shall make application to the territorial engineer, as in the case of unappropriated water, and such party shall pay to the owner of such works reasonable charge for the storage or carriage of such water in such works; Provided, That the appearance of such seepage water can be traced beyond reasonable doubt to the storage or carriage of water in such works.

percent, would occur as a result of "transit between the reservoir and the diversion dams." However, such "losses in transit," these engineers maintained would "be partly offset by the return seepage in upper parts of the valley, which will be available for diversion lower down."[149]

The following year, in April 1913, Reclamation chief engineer A.P. Davis prepared for the new secretary of the interior a report on the Rio Grande Project and its water supply, "Water Supply of Rio Grande, from Official Records, 1912," that again emphasized the importance of return flows:

> In the irrigation development of a large river system, such as the Rio Grande, it is undoubtedly wise to use a considerable proportion of the water in the upper valleys soon after it leaves the mountains and before it has had much opportunity to evaporate. As more tributaries reach the river, the additional water supply justifies other diversions lower down, which can also utilize return seepage from the upper valleys.[150]

The *Twelfth Annual Report of the Reclamation Service for 1912-1913*, released in 1914, offered this explicit statement with regard to the Rio Grande Project: "The United States claims all waste, seepage, spring, and percolating water arising within the project, and proposes to use such water in connection therewith." Such claims for other Reclamation projects were asserted in the *Twelfth Annual Report* as well.[151]

Subsequent Reclamation annual reports repeated this claim within the context of the project's "Irrigation Plan." The 1914-1915 report, for instance, described the Rio Grande Project as 19.7 percent complete exclusive of storage and 50 per cent complete including the storage works at Elephant Butte Dam. The project at that time served 47,160 acres. No stored water was yet available to project lands in 1914, only direct diversions, but the following year stored water was. The report indicated that the project would increasingly rely on water now being stored at Elephant Butte Reservoir. Its "Irrigation Plan" nonetheless included a claim to "all waste, seepage, spring, and percolating water arising within the project and proposes to use such water

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[149] United States Congress, House of Representatives, *Fund for Reclamation of Arid Lands: Message from the President of the United States, Transmitting a Report of the Board of Army Engineers in Relation to the Reclamation Fund*, H. Doc. No. 1262, 61st Cong. 3d sess. (1911-12), 106.

[150] A.P. Davis, Chief Engineer, Memorandum for Secretary Lane, April 17, 1913, and "Water Supply of Rio Grande, from Official Records, 1912," 4-5. File 8-3 (Part 4) Reclamation Service, Rio Grande Project, New Mexico, Rio Grande River, Distribution of Waters, Nov. 21, 1912 – Apr. 17, 1914, Box No. 1639 8-3, Rio Grande D-E, CCF 1907-1936, RG 48, NARA II.

[151] *Twelfth Annual Report of the Reclamation Service, 1912-1913* (GPO, 1914), 176. The plan for Colorado's "Uncompahgre Valley project," for instance, included "utilization of all the waste, seepage, spring, percolating, and return water arising within the project in the irrigation of lands in the Uncompahgre Valley." The irrigation plan for the Minidoka Project in Idaho used the exact same language as used for the Rio Grande Project. Newell, *Twelfth Annual Report*, 78 and 95.

in connection therewith." Three years later, in its 1917-1918 annual report, Reclamation again described its "Irrigation Plan," which was estimated as 40 per cent complete excluding Elephant Butte Dam and 66.4 per cent including the dam. The project at that time was serving about 90,000 acres. As in the 1914-1915 report, Reclamation asserted "claims [to] all waste, seepage, spring, and percolating water arising within the project…."[152]

In June 1919, Reclamation engineers Harold Conkling and Erdman Debler produced the first comprehensive assessment of the operations of the Rio Grande Project since the completion of Elephant Butte Dam, an assessment that emphasized the importance of "return flows." Conkling and Debler noted that given the long irrigation season in the basin (from February to November) "conditions are favorable for a reuse of almost the entire return flow." This return flow, according to the engineers, "consist[ed] of the transportation loss from canals and deep percolation from irrigated areas." Such waters were often captured in project drains, and brought back to the river channel. The engineers maintained that unlike with most projects, such return flow did not pose much of a problem "because of immediate rediversion by canal headings below," and in fact the lowest units of the project – San Elizario Island and the Tornillo District – could "probably use the entire return from the El Paso Valley." Although the amount of return flow from drains was then "uncertain," Conkling and Debler estimated 1.5 af/a per year. They further anticipated that other than the return flow from the Tornillo unit (which would be lost to the project because Tornillo was the lowest unit) and return flow during the winter (which would be lost because of lack of use) return flow would be fully utilized on project lands.[153]

Conkling prepared a separate memorandum report on the water supply for the San Luis Valley in Colorado, the Middle Rio Grande Valley in New Mexico, and the Rio Grande Project in New Mexico and Texas later that same month. He once again stressed that "on each…project conditions are favorable for re-use of return flow by the acreage on the lower end." With specific reference to the Rio Grande Project, the engineer reiterated the analysis he and Debler offered in their larger report. Conkling assumed 4.32 af/a for the diversion duty for the project, and

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[152] U.S. Department of the Interior, *14th Annual Report of the Reclamation Service, 1914-1915* (Washington: Government Printing Office, 1915), 214-217; and U.S. Department of the Interior, *17th Annual Report of the Reclamation Service, 1917-1918* (Washington: Government Printing Office, 1918), 250-251, and 254-256.

[153] Harold Conkling, Engineer, and Erdman Debler, Asst. Engr., Water Supply for and Possible Developments on Irrigation and Drainage Projects on the Rio Grande River Above El Paso, Texas, June-1919, 105, 111-112. ff. 302.31, New Mexico. Report dated June 1919 by Conkling and Debler on Water Supply for and Possible Developments on Irrigation and Drainage Projects on the Rio Grande River Above El Paso, Texas, transmitted by letter July 15, 1919, Box 262 302.28--302.31 A. NV-NM, Entry 7, RG 115, NARA Denver.

believed that given the basin's 10-month irrigation season, "almost all of the return flow may be utilized on the project if this duty can be obtained."[154]

The engineer took further note of the potential impact of non-federal groundwater development on project lands. He observed that the project was then assumed to serve 155,000 acres ("as estimated by the project office") but could be extended "privately [i.e., not by federal authorities] by pumping from ground water under assumed unirrigable acreage of 29,000 acres." "An additional draft of 70,000 acre feet annually," Conkling pointed out, would significantly worsen two prior years of shortages "without adverse effect in other years." Whether such expansion was advisable, he left to the "attitude of the government toward the question of allowing such possible shortages."[155]

Conkling's observations highlight the interrelationship of surface, subsurface, and return flows upon which the Rio Grande Project and many other federal projects had come to rely. The claim to waters other than surface flow was, as Assistant Attorney General William D. Riter wrote to John F. Truesdell, Special Assistant to the Attorney General, in July 1921, a "matter of policy…for the Secretary of the Interior to decide." In Riter's view, as evidenced by the assertions made over the years in "annual reports and otherwise," the Interior Department had "announced the intention of reclaiming seepage and waste waters of government projects for further use thereon." At the time of Riter's writing, Truesdell was apparently uncertain of the efficacy of this position. While acknowledging that the question was not entirely settled from a legal perspective, Riter noted that both the Justice Department's Public Land Division and US Solicitor General Alexander Campbell King gave "careful consideration" to the issue. Both believed that the federal government was on firm ground, provided that it took the position

> that when the Government makes an appropriation of water for a reclamation project, it is for the project as a whole, and not for particular farms comprising parts of the project; and the fact that a portion of the water, after serving to irrigate one farm escapes by seepage and finds its way to a piece of private land which happens to be inclosed [*sic*] by the project lands, is no evidence of an intent on the part of the Government to abandon that water, and does not in law amount to an abandonment; but the Government may recapture it and apply it to other parts of the same project.

[154] Memorandum, From: Engineer Harold Conkling, To: Chief of Construction, Subject: Water Supply – Rio Grande River, June 18, 1919 [hereafter Conkling Memorandum…June 18, 1919, 2 and 17. ff. 302.31, New Mexico. Surveys and Investigations. THRU 1929, Box 262, Entry 7 RG 115, NARA Denver. This report led to the modification of the Rio Grande "embargo" in 1923, as discussed in Opinion I.

[155] Conkling Memorandum, June 18, 1919, 17-19. ff. 302.31, New Mexico. Surveys and Investigations. THRU 1929, Box 262, Entry 7, RG 115, NARA Denver.

Riter later informed Reclamation chief counsel Ottamar Hamele, who steadfastly insisted upon the federal government's claim to these waters, "that the two Departments [Justice and Interior] are in accord."[156]

The federal government's assertions of ownership over waters returning to or arising on project lands further won judicial approval in federal and state courts in the early 1920s. In the case of *United States v. Ramshorn Ditch Co.*, which concerned waters initially diverted for the North Platte River Project in Nebraska, the federal Circuit Court of Appeals in November 1920 reportedly "sustained the right of the Government to reclaim seepage waters from a part of the reclamation project and use them again upon other lands of the same project." The federal district court in Idaho likewise sustained "the right of the Government to recapture and again use seepage waters" for lands in the Boise Project in Idaho in *New York Canal Co. (Ltd.) v. Bond and Weinkauf*. US attorneys made similar arguments in 1921 for the recapture and reuse of water previously diverted to serve lands in the Shoshone Project in Wyoming in *United States v. Ide et al.*, and *The Lincoln Land Co. et al. v. Weymouth et al.*[157]

Within the Rio Grande Project itself, Elephant Butte Irrigation District recognized the importance of what its president H.H. Brook termed "Drainage return flow." Brook, writing project superintendent L.R. Fiock to express concerns about the proposed inclusion of downstream lands in Hudspeth County into the project (discussed in Opinion IV below), observed that the "water supply of these arises from two sources":

> (1) The formally acquired unappropriated natural flow, flood and torrential waters of the Rio Grande including the ancient natural flow rights of the landowners of the present project and stored in the Elephant Butte Dam…
>
> (2) Drainage return flow artificially created by the expenditure of large sums by the United States under contract with the landowners giving a first lien on their land to secure repayment and which artificially created water supply, according to the law of the West, belongs to the landowners creating it to be used or disposed of by the United States as trustee for the benefit of the said land and water right owners.

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[156] Assistant Attorney General [William D. Riter], For the Attorney General, to John F. Truesdell, Esq., Special Assistant to the Attorney General, July 21, 1921; Ottamar Hamele, Chief Counsel, to Hon. William D. Ritter, Assistant Attorney General, July 26, 1921; and W.D. Riter, Assistant Attorney General, For the Attorney General, to Ottamar Hamele, Esq., Chief Counsel, US Reclamation Service, July 27, 1921. ff. 030.1 General Correspondence re Return flow, Waste & Seepage Water Thru 1929, Box 33 023.6- -032, Entry 7, RG 115, NARA Denver.

[157] *Annual Report of the Attorney General for the United States, For the Fiscal Year 1921* (GPO, 1921), 86.

Brook further asserted in his letter that "the right to drainage and seep water was reserved in the water right filings" for the project.[158]

Persistent interest in the issue of return flow into the late 1920s prompted Reclamation Commissioner Elwood Mead to suggest that an article be drafted for the agency's *New Reclamation Era* publication, whose readership included farmers and water users on federal reclamation projects. This article would discuss "the utilization of the return flow of water in connection with various irrigation projects." E.B. Debler, who had co-authored with Harold Conkling the 1919 study that identified the central importance of return flows to the Rio Grande Project, drafted the piece for the August 1927 issue.[159]

In "Return Flow and Its Problems on Reclamation Projects," Debler emphasized both the necessity of return flow while acknowledging the somewhat legally ambiguous status of such water. By way of introduction, he offered a detailed and inclusive definition of "return flow," that seemed to embrace not only previously diverted surface flow that made its way back to the stream within the project but also water underlying project lands:

> When water is applied to the earth's surface naturally through rains and snow or artificially by irrigation it is disposed of in a number of ways. A part passes away immediately or very soon as surface run-off or evaporation from the surface of the snow, ground, or from the exposed surfaces of plants which catch the moisture. Another part enters the ground is in part returned to the surface by capillary action to replace water evaporated from the surface. Some is taken up through the roots of plants and evaporated in the growth processes of the plant or stored in the plant structure and hauled away as a plant product. The remainder passes beyond the limit of capillary action and joins the mass of water existing under the ground surface, there generally to form part of a moving stream seeking a lower level, and reappearing in the form of seepage, springs, or artesian flow, the particular name popularly applied being dependent on the concentration of flow and the pressure with which it reaches the surface. The reappearance of these waters may be but a few hundred feet from the source thereof, or it may be several hundred miles, depending entirely on the ground structure and topography.

Return flow in "arid regions" was thus

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[158] Elephant Butte Irrigation District, (Signed) H.H. Brook, President & Manager to Mr. L.R. Fiock, Acting Project Manager, US Bureau of Reclamation, August 8, 1923, 1 and 3. Folder 222. Rio Grande Project. Corres. re Organization of Irrigation Districts and Execution of Contracts Guaranteeing Repayment of Construction Costs, Thru 1929.Transfer Case, Box 902, Rio Grande 212.—222, Entry 7, RG 115, NARA Denver.

[159] Memorandum, From: Commissioner [Elwood Mead], To: Chief Engineer, Denver, Colorado, Subject: Article for the New Reclamation Era on Return Flow, February 4, 1927. ff. 030.1, Box 33, Entry 7, RG 115, NARA Denver.

> the increase therein due to the application of irrigation water. This includes waters lost by seepage from canals and reservoirs, as well as waters applied by the irrigator to his land. Such return flow is in these places particularly prominent, as the return flow from precipitation prior to irrigation development is usually so small that the stream in its passage through the region actually loses a part of the water it brings from its mountain sources, at times drying up completely. With irrigation development such conditions are materially changed and living stream often result therefrom.[160]

Return flow was "heavily concentrated in the irrigation season," with "large irrigation areas underlain to great depths with permeable deposits" experiencing nearly continuous return flow. Debler estimated that 60 percent of the water diverted for irrigating crops became return flow "and reenters streams for further use unless intercepted." In some areas with diversions of up to 15 af /a return flow could be as much as 90 percent, and in other areas, concrete-lined canals and "favorable soils" could reduce return flow to 25 percent of the water diverted.[161]

Regardless of the amount, the engineer stressed the importance of return flow to federal reclamation projects. He argued that

> return flow augments the irrigation water available in the late summer after the stream flow, due to melting snows, has declined to less than the irrigation requirements of lands dependent thereon, and in that way serves a similar purpose as do storage reservoirs, but with the advantage that there is no loss from evaporation. In practice the effect has been to materially improve water rights on the lower portions of stream systems due to irrigation development on the upper reaches. In some cases the irrigation systems that have produced such return flow have been able to benefit in that less water is thereafter necessary to be passed down the stream to care for prior rights.

Debler pointed out that return flow was vital to the water supply for both federal projects and beyond.[162] For Texas specifically, he noted Hudspeth County water users (discussed in Opinion IV) who were not part of the Rio Grande Project were nonetheless "entirely dependent on return flow and waste water from project lands" upstream in the El Paso Valley. The El Paso Valley,

[160] E.B. Debler, Engineer, Bureau of Reclamation, "Return Flow and Its Problems on Reclamation Projects," *New Reclamation Era* (August, 1927), 124. ff. 030.1, Box 33, Entry 7, RG 115, NARA Denver.
[161] Debler, "Return Flow and Its Problems on Reclamation Projects," *New Reclamation Era* (August, 1927), 124. ff. 030.1, Box 33, General Files, 1919-1929, Entry 7, RG 115, NARA Denver.
[162] According to Debler, both the Notus Division of the Boise Project in Idaho and the "west extension division" of the Umatilla Project relied upon return flows from upstream project diversions. On the North Platte Project in Wyoming and Nebraska, utilization of return flow likewise enabled more efficient use of stored water.

which was within the project, "in turn uses return flow from Mesilla Valley in New Mexico and Texas."[163]

The importance of return flows to established reclamation projects aside, Debler observed that state law was neither entirely decided nor altogether antagonistic to the issue. Early water codes in western states were "generally…framed before return flow became a recognized factor in irrigation supply" and consequently were "in a rather unsatisfactory shape" with "decisions…in conflict." "The general tendency, however," according to the engineer, "is to regard return flow in all of its forms recoverable by the agent producing it until it enters a stream which in its natural condition supplied irrigation diversions, when it becomes a part of such stream and subject to appropriation therefrom as are other waters of the same stream."[164]

As the states of Colorado, New Mexico, and Texas moved forward with negotiations for a compact, federal and state engineers alike recognized that the Rio Grande project water supply encompassed a range of surface and return flows, both of which influenced and were influenced by waters lying beneath the surface of project lands. As early as 1924, Reclamation measured the groundwater in the Mesilla Valley, in the later words of the Rio Grande Joint Investigation report, or *JIR*, "chiefly to derive the annual increment or decrement of ground water as a necessary factor in computing the annual consumptive use of water in the valley by the inflow-outflow method."[165]

In an internal Reclamation report on silt issues prepared by Rio Grande Project Superintendent L. R. Fiock for Reclamation's Chief Engineer in July 1931 (at the latter's request), the superintendent yet again emphasized the importance of return flows in his discussion of project operations. Fiock observed that the reservoir retained the "entire flow or discharge of the Rio Grande reaching [it]," and fully controlled and regulated releases "to meet irrigation demand requirements." According to the project superintendent,

> The water as released is drawn from the river at the various diversion throughout the project. Part of the amount diverted at each respective diversion point is compensated for by waste return and drainage recovered flow which mingling with the remaining released reservoir water as it passes through each succeeding project division is available for rediversion at the diversion points on farther down.[166]

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[163] Debler, "Return Flow and Its Problems on Reclamation Projects," *New Reclamation Era* (August, 1927), 124-125. ff. 030.1, Box 33, General Files, 1919-1929, Entry 7, RG 115, NARA Denver.
[164] Debler, "Return Flow and Its Problems on Reclamation Projects," *New Reclamation Era* (August, 1927), 125. ff. 030.1, Box 33, General Files, 1919-1929, Entry 7, RG 115, NARA Denver.
[165] *JIR*, 62.
[166] L.R. Fiock, "Effect of the Operation of Elephant Butte Reservoir on the River through Rio Grande," 1-2, enclosed with Memorandum, From Superintendent [signed L.R. Fiock], To Chief Engineer, Denver,

This was especially true for lands below El Paso in Texas (as Debler had previously suggested):

> The flow required at El Paso to meet the normal irrigation requirements from April 1st to September 1st is from 800 to 1,000 second feet, this has required from 300 to 500 second feet in the river below Mesilla Dam, the difference being made up of waste return and drain recovery in the valley above between Mesilla Dam and El Paso….[167]

The surface flow of the Rio Grande captured by Elephant Butte and the return flow from diversions – i.e., "waste return and drain recovery" – also fed and relied upon the groundwater underlying the project, as New Mexico engineer John Bliss found in the mid-1930s. Conkling's observations about the potential impact of private groundwater pumping within the project notwithstanding, there were few investigations of groundwater below Elephant Butte prior to Bliss's study in 1935-1936. Slichter's study of the Mesilla Valley in 1904 had indicated a hydrological connection between the river and the valley's groundwater, but it was made prior to the construction of the Rio Grande Project. Reclamation had made "[m]easurements" in 1917 and 1918, however, as Bliss pointed out, "the data were obtained prior to drainage construction and are not applicable to present day conditions." In 1928, E.L. Barrows, working for the New Mexico State Engineer's Office, made "a preliminary seepage determination" for the stretch between Elephant Butte Reservoir and the Leasburg Diversion Dam, yet a planned follow-up study ultimately was not undertaken. Later that same year, a study of river hydrographs by Middle Rio Grande Conservancy District Designing Engineer R.G. Hosea found no "evidence of an invisible underground flow tributary to the river." He instead noted instead that "it is apparent that when the reservoir is not releasing water during the winter months, the Ft. Quitman flow is just about equal to the total drainage water from the project."[168]

Bliss's investigation, by contrast, identified "a direct relation of seepage to ground water and irrigation": at certain critical points between Elephant Butte and El Paso, underflow fed the groundwater table, providing basin lands with additional water that was recovered by project

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Colorado, Subject: Effect of clear water on bed of Rio Grande below Elephant Butte Reservoir – Rio Grande Project, July 25, 1931. ff. 301.1 Rio Grande Project-Dams-Elephant Butte Dam 1930 thru, Box 928 Rio Grande Pro. 301.-301.12, Entry 7, RG 115, NARA Denver.

[167] Fiock, "Effect of the Operation of Elephant Butte Reservoir on the River through Rio Grande," 2-3. ff. 301.1, Box 928, Entry 7, RG 115, NARA Denver.

[168] R.G. Hosea, Report on Irrigation in the Rio Grande Valley, State of New Mexico, The Rio Grande Valley Survey Commission, Albuquerque, New Mexico, December, 1928, 169. Folder 3 Report on Irrigation in the Rio Grande Valley-R.G. Hosea-December 1928 [EBID Item #20], December 1928, Box 02-D.003, MS 0235, RGHC, NMSU; and John H. Bliss, "Report on Investigation of Invisible Gains and Losses in the Channel of the Rio Grande from Elephant Butte to El Paso." Feb. 1936, 1. Folder 1435, Bliss, Report on Investigation of Invisible Gains and Losses in the Channel of the Rio Grande from Elephant Butte to El Paso, February 1936, Box 55, State Engineer Reports: Rio Grande, Exps. 161-163, Nos. 1417-1437 [hereafter Box 55], NMSA.

drains and returned to the river channel for use on lands downstream. Bliss's study, presented to New Mexico State Engineer and Rio Grande Compact Commissioner Thomas McClure in February 1936 as "Report on Investigation of Invisible Gains and Losses in the Channel of the Rio Grande from Elephant Butte to El Paso" grew out of a suggestion for such an investigation made by Fiock in fall 1935. "[D]etermination of invisible gains and losses in the bed of the Rio Grande," as Bliss noted in his report, were "an important item in the study of the use and distribution of the waters of the river" yet "few such data are available below Elephant Butte Reservoir." Fiock had proposed that such an investigation be made prior to the construction of Caballo Dam; Caballo was a critical feature of international efforts to rectify the river's channel downstream from Elephant Butte, and pursuing a study before the dam was built would permit "work in the canyon above Percha Dam."[169] With the cooperation and assistance of USGS, Reclamation, and

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[169] Caballo Dam, which today regulates the flow of the Rio Grande for flood control purposes, compensates for the loss of storage space in Elephant Butte due to silting, and generates hydroelectric power, came about as a result of international efforts to rectify the channel of the Rio Grande. The treaty of Guadalupe Hidalgo had established the river as the boundary between the two nations. Periodic high flow events since the treaty's ratification, however, altered the river's course, damaging land and property on both sides of the river and confusing the precise location of the border. Completion of Elephant Butte Dam in May 1916 brought greater control over the river, but the Rio Grande continued to meander into the 1920s. See Department of the Interior, *Fifteenth Annual Report of the Reclamation Service 1915-1916* (GPO, 1916), 324; and History and Development of the International Boundary and Water Commission, United States and Mexico, El Paso, Texas, April 1952, Revised April 1954, 45-49. Item 41, Box 1, MS042 International Boundary & Water Commission Records [MS042], UTEP Spec Coll.

A major flood in 1925 prompted the US and Mexico to enact a treaty eight years later that committed to the nations to stabilizing the river channel through the Rio Grande Rectification Project. A chief feature of this project was "the construction of [a] flood retention dam at Caballo, New Mexico" to enhance river regulation and prevent further meanders. Between 1934 and 1936, under pressure from local interests that had long sought a hydroelectric power facility at Elephant Butte as well as additional water for Rio Grande Project lands, the USBR in conjunction with the International Boundary Commission committed to building an 85-foot high and 4,250-foot long dam at Caballo. The proposed dam, according to the Interior Department:

> will, through flood control, become a highly important feature of the International Boundary Commission's plan for rectification of the Rio Grande in El Paso and Hudspeth counties, Texas, and it will provide an afterbay for the Elephant Butte Dam of the Bureau of Reclamation. Elephant Butte Dam stores water for the Rio Grande Federal Reclamation project in New Mexico and Texas. Provision of an afterbay will provide additional storage for project lands and will make it possible to install hydroelectric generation equipment at Elephant Butt Dam in the future.

Caballo was substantially completed in September 1938. History and Development of the International Boundary and Water Commission, United States and Mexico, El Paso, Texas, April 1952, Revised April 1954, 45-49. Item 41, Box 1, MS042, UTEP Spec Coll; Chronology – Caballo Dam Construction, February 1, 1933-November 30, 1935, December 16, 1935. ff. B-8.2.4.2, Conservation, Power, Diversion & Drainage Projects, Caballo Dam, 5 of 6. August 1935 thru March 1937, Box 5, Accession Number 076-69A-0928, Records of the International Boundary and Water Commission, Record Group 76 [hereafter RG 76], National Archives and Records Administration at Fort Worth, Texas [hereafter NARA Ft. Worth]; and the International Boundary Commission, Bliss embarked on the study in early January 1936 so as "to allow ground water and bank storage to reach a minimum" before water was released for the 1936 irrigation season."[170]

Bliss initially intended to examine that stretch of the Upper Rio Grande Basin between Elephant Butte and Ft. Quitman. Field work was to consist of two parties each making "complete series of measurements," guided by Reclamation engineers. Reclamation also installed temporary recording gages at Percha and Leasburg diversion dams, and brought into service the "operation station at Mesilla Dam…during the investigation." The methodology was like so:

> River stations were selected at frequent intervals to localize channel gains and losses in order to determine their probable sources or causes. No diversions were being made in any of the canals during the period of the investigation. To speed the work, all drain flows were measured but once, which was felt to be sufficient as these discharges vary but slightly.

Conditions during the investigation, however, forced alterations. The ongoing channelization program limited Bliss's work to the area between Elephant Butte and Courchesne, and unexpected rains soon after surveys began forced a "remeasurement of the entire river" – a "third series" of measurements starting February 1. High winds further affected this third series, "caus[ing] considerable variation in the discharge" as well as "preclude[ing] any reliable additional measurements." Despite these issues, survey work was completed by February 7, and the three sets of measurements were tabulated and averaged. Discharges were ascertained "by comparison of the three series, those apparently in error being discarded," and a "few measurements were corrected for change in river stage due to rain." Other corrections were made for the rising river stage below Elephant Butte and evaporation.[171]

Whatever the limitations of the study, Bliss felt confident enough in the work to make several significant observations about the complicated dynamics of underflow, groundwater, irrigation, and gains and losses in the Rio Grande that affected the project. He noted, for instance, that there was a "consistent increase in the canyon from the [Elephant Butte] Dam to the Dona Ana-

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Department of the Interior, Memorandum for the Press, Immediate Release, May 2, 1936. ff. 023.6 Rio Grande-Caballo Dam-Press Releases, Box 939, Rio Grande-Caballo Dam 011.-301.1, Entry 7, RG 115, NARA Denver; *Project History, Rio Grande Project, Calendar Year 1938*, 42-43. United States Bureau of Reclamation, Washington, DC, Project Histories of the Rio Grande Project, 1912-1988. Microfilmed by the Government Publications Department, General Library, University of New Mexico, Eulalie W. Brown, In cooperation with the United States Bureau of Reclamation, Rio Grande Project, El Paso, Texas, Dan N. Page, Project Superintendent, December, 1992, Southwest Micropublishing, Inc. [hereafter USBR PHRGP 1912-1988 (mf)]; and Robert Autobee, "Rio Grande Project," (Bureau of Reclamation, 1994), 17.

[170] Bliss, "Report on Investigation of Invisible Gains and Losses," 1-2 and 12. Folder 1435, Box 55, NMSA.

[171] Bliss, "Report on Investigation of Invisible Gains and Losses," 3-4, 7, and 14. Folder 1435 Box 55, NMSA.

Sierra Country line," which Bliss ascribed "chiefly to underflow from the large intermittent streams entering [the Rio Grande channel] from the west."[172]

In the Rincon and Mesilla valleys, there were further fluctuations. "[W]ater lost in the Rincon Valley," the engineer asserted, "feeds the ground water of the surrounding lands and is recovered largely by the [project] drains." In the valley's Selden Canyon, Bliss identified a "small increase" attributable to "several short arroyos and from seeps in the vicinity of Radium Springs." In the Mesilla Valley, losses were greater "particularly in the section between Picacaho Flume and Mesquite, through which the large Del Rio Drain parallels the river at a short distance." Yet, "above Vinton bridge where the rivers enters a canalized section," he found an "increase." Bliss hypothesized that this was caused either by "underflow in the old river channels on the west side of the valley entering the present channel above the bridge," or "that the cut, which traverses an apparently undisturbed deposit of caliche and heavy clay, is effective in bringing a considerable underflow to the surface in this section."[173]

For the Mesilla Valley losses, Bliss made a further analysis of the data gathered. Taking a closer look at the drain measurements, the engineer noted that "much" of the Del Rio Drain flow was "drawn directly from the river channel through underflow." This was less true of the Montoya Drain and the "the Chamberine which drains the old river channels on the west side of the valley below Las Cruces."[174]

Attempting to develop curves for his study in comparison to others previously made, Bliss acknowledged that the data sets all differed from each other and those differences were not fully explainable. "It is impossible to account for the eccentricities of the curves prior to the present one, as little is known of the conditions of flow, irrigation, etc., at the time the measurements were made," he wrote. Bliss nevertheless argued that the curves demonstrated "a direct relation of seepage to ground water and irrigation." He proposed further study of "seepage during the non-irrigation period" so as to compare "against gains and losses found during the summer at a period when river and canal flows can be kept in a stable condition."[175]

This "direct relation of seepage to ground water and irrigation" was not addressed in the testimony given in the original action between Texas and New Mexico in the mid-1930s. However, Bliss, Fiock, and Texas engineers Raymond Hill and J.Q. Jewett all gave testimony acknowledging that the Rio Grande Project relied upon return flows. These were the flows that Bliss's study suggested intercepted groundwater, found their way to drains that fed the river

[172] Bliss, "Report on Investigation of Invisible Gains and Losses," 9. Folder 1435, Box 55, NMSA.
[173] Bliss, "Report on Investigation of Invisible Gains and Losses," 9-10. Folder 1435, Box 55, NMSA.
[174] Bliss, "Report on Investigation of Invisible Gains and Losses," 10. Folder 1435, Box 55, NMSA.
[175] Bliss, "Report on Investigation of Invisible Gains and Losses,"12. Folder 1435, Box 55, NMSA.

channel below Elephant Butte, and would have served, either wholly or in part, downstream lands in Texas.

Fiock was among the first to affirm the importance of all the waters arising on the Rio Grande Project before Special Master Charles Warren. Confirming Warren's understanding that "nearly double" the amount of water released from Elephant Butte Dam was needed to satisfy irrigation demands on the project, for instance, the project superintendent stated, "That is nearly, approximately the proportion, although we [federal Rio Grande Project officials and staff] do recover and redistribute water over and over down through the project."[176]

Fiock reiterated this point later when asked by Texas's attorney Frank Clayton, "Now, in the upper reaches of the river, the sand traps, or sluice ways, go back into the river and the water is rediverted below, is that correct?":

> With successive operating diversion points, and operating divisions down the river, as the Rio Grande Project has, that water is available and is counted on as part of the supply for the succeeding diversion below.[177]

The project superintendent not only testified that water released from Elephant Butte was used multiple times – such water variously identified by Fiock as "return flow from drainage," "drain water," "drain flow," or "drain runoff" – but also reported the same officially, outside of the courtroom. From one project operations report, dated November 7, 1934, New Mexico's attorney George Hannett read:

> …the demand for water was high due to continued dry warm weather. There was eight thousand five hundred twenty-eight acre feet delivered with a release of nineteen hundred acre feet from storage. In 1933 all water used for satisfying irrigation demands was return flow from drainage, which was rediverted into various canals as demands required.

When asked if he could recall making this report, the federal Reclamation official replied: "I don't recall the exact words, but that is the nature of our reports." [178]

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[176] *Plaintiff's Case in Chief*, Vols I & II, 312. CB-F-171A thru CB-F-1716: Transcripts of TX v. NM, Vol. 1-16, Box 4X219, RAHP, UTA.
[177] *Plaintiff's Case in Chief*, Vols I &II, 327. CB-F-171A thru CB-F-1716: Transcripts of TX V. NM, Box 4X219, RAHP, UTA.
[178] *Plaintiff's Case in Chief*, Vols. I & II, 343. CB-F-171A thru CB-F-1716: Transcripts of TX V. NM, Box 4X219, RAHP, UTA.

Later still, under cross examination, when asked "How do you deliver water down from the dam, the Elephant Butte Dam, to serve the Tornillo canal for mixing for this Tornillo area?" Fiock responded:

> After being released from Elephant Butte reservoir, which is a hundred fifty miles above the heading of the Tornillo canal, it passes down the Rio Grande, which is utilized as a main carrier canal. In passing through the main Rio Grande Project, water is diverted at the successive diversion dams, and the drain discharge from the successive operating divisions of the Project discharges at the other end, lower end respectively of each division; and, each time one of the operating divisions is passed, then there is that much higher percent of drain water, so that when the water has arrived at Fabens, it has, some of it, been diverted and used, and is returned through the drains, as much as four times. A certain percent of it, of course, flows right on through, directly through the channel of the river.[179]

Under further questioning from Warren about the measurement of drain flow within the project, Fiock explained

> The drain flow over the Rio Grande Project constitutes a very important element in the irrigation supply, and must be taken account of in computing the release of water for irrigation from the reservoir, so we [Rio Grande Project staff] measure those drains frequently, that is once a week we meter the drains.[180]

The project superintendent stressed again the importance of such water to the overall project water supply when the special master asked him about the reported 1934 reservoir release, which was substantially larger than in prior years. Fiock noted that project staff had estimated the delivery at farms in the project to be 1.5 af/a and thus twice that amount had been released to ensure this delivery. "There are other things," he cautioned "to take into consideration" in making releases. One of these was the "drain runoff," which was "to make up part of the irrigation supply."[181]

Fiock was not alone in his conception of what constituted the water supply for the Rio Grande Project. Two other expert witnesses for the State of Texas similarly asserted the critical value of re-diverted water (to paraphrase Fiock). J.Q. Jewett testified that in his calculations "reservoir water" was "all the water reaching Courchesne station except the estimated tributary flow" – in other words, "a mixture of drain water and water released from Elephant Butte reservoir." When

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[179] *Plaintiff's Case in Chief*, Vols. I & II, 399-400. CB-F-171A thru CB-F-1716: Transcripts of TX V. NM, Box 4X219, RAHP, UTA.

[180] *Plaintiff's Case in Chief*, Vols. V, VI, VII, 1029. CB-F-171A thru CB-F-1716: Transcripts of TX V. NM, Box 4X219, RAHP, UTA.

[181] *Plaintiff's Case in Chief*, Vols. V, VI, VII, 1034. CB-F-171A thru CB-F-1716: Transcripts of TX V. NM, Box 4X219, RAHP, UTA.

asked a clarifying question as to whether this "reservoir water" was in fact the "reservoir release no matter how many times it has been used in the meanwhile," Jewett replied in the affirmative.[182]

Texas's engineering advisor Raymond Hill likewise acknowledged the project's reliance upon what Clayton called "drain waters," and expressed concerns for the practice owing the diminishing quality of the water as it moved downstream (see Opinion II above):

> [Clayton]: "The testimony adduced in the trial of this case has shown that drain waters in the valleys below Elephant Butte dam to Fort Quitman has been used and re-used progressively as you proceed down the stream. What is your conclusion, Mr. Hill, as to whether that is a proper use of those waters?"
>
> [Hill]: "As a general principal [*sic*], the use of drainage waters at the successive points of diversion from Elephant Butte down through the valleys is proper; however it is my judgment that the process has been carried to an extreme in the case of the Rio Grande Project, or in other words there has been too great a use of the drainage waters and that additional dilution of these waters would have been better, and taken over a longer period of time some greater dilution of those waters will be necessary in order to insure continued production of a profitable nature."[183]

New Mexico's own experts did not offer direct testimony on the issue of return flow. Bliss nevertheless acknowledged under cross-examination from Clayton that "drain water" was utilized on the lands below Elephant Butte:

> [Clayton]: "You mean to say that drain water that enters the river in the Rincon and Mesilla Valleys is not used?"
>
> [Bliss]: "It is altered – Yes."
>
> [Clayton]: "It is rediverted down below?"
>
> [Bliss]: "Yes"
>
> [Clayton]: "And used for irrigation?"
>
> [Bliss]: "Yes"[184]

The subsequent federal Rio Grande Joint Investigation likewise took note of the importance of return flows to the Rio Grande Project and lands beyond, as discussed in Opinion IV. With regard to groundwater, the *JIR* focused largely on the San Luis and Middle Rio Grande valleys.

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[182] *Plaintiff's Case in Chief*, Vols. III & IV, 781. CB-F-171A thru CB-F-1716: Transcripts of TX V. NM, Box 4X219, RAHP, UTA.

[183] *Plaintiff's Case in Chief*, Vols. V, VI, VII, 1307-1308. CB-F-171A thru CB-F-1716: Transcripts of TX V. NM, Box 4X219, RAHP, UTA.

[184] *Defendant's Case in Chief*, Vols. X, XI, 2058. CB-F-171A thru CB-F-1716: Transcripts of TX V. NM, Box 4X219, RAHP, UTA.

Nonetheless, observations made in the report suggest federal engineers were aware of the relationship between surface and subsurface flows and groundwater in the basin. For the Middle Rio Grande, for instance, "Ground water in the Middle Valley" was identified as having several sources," including "seepage from canals" and "seepage from irrigated lands." For the basin overall, the *JIR* made three critical observations that underscore the complicated relationship between surface water and groundwater:

1) "extensive development of ground water for irrigation would add no new water to the Upper Rio Grande Basin…",
2) "recharge of the ground-water basins would necessarily involve a draft on surface supplies which are now utilized otherwise"; and
3) "The chief element to be considered in such a development [of groundwater] would be the redistribution of the availability and use of present supplies and the resulting effect upon the water supply of lower major units [i.e., the Rio Grande Project and beyond to Ft. Quitman]"[185]

The compact negotiations of the 1930s neither engaged with the issue of groundwater on Rio Grande Project lands nor the specific nature of the project water supply. However, as discussed above, both engineering advisors for New Mexico and Texas, Bliss and Hill, and the federal engineering advisor, Debler, were familiar with the project, its diverse water supply, and the hydrology of the Elephant Butte-Ft. Quitman section. The commissioners themselves believed the compact protected the project with the federal representative S.O. Harper insisting that the compact garnered "all water to which Federal irrigation projects are entitled." This was water that as a matter of longstanding Reclamation policy and practice included surface, subsurface, tributary, and return flows – waters arising on project lands.[186]

Reclamation's broad conception of the Rio Grande Project water supply arose from the impulse to assure sufficient water for the project. Reclamation authorities leveraged New Mexico territorial law, which recognized a unique standing for the United States with regard to reclamation projects, to protect and support the project's development. The project's aim from the outset was to utilize as much of the Rio Grande's flow, surface and subsurface, for the benefit of lands in New Mexico and Texas. In due course, Reclamation recognized that water released from Elephant Butte and diverted to project lands could be and necessarily must be reused. Such waters – characterized as "return flow," "seepage," "waste water," and "drain water" – were

[185] *JIR*, 56, 59, and 62.

[186] S.O. Harper, Chairman, Rio Grande Compact Commission, to The Honorable, The Secretary of the Interior, Washington, D.C., Re: Rio Grande Compact, March 26, 1938, 2. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

captured in project drains. These waters, as New Mexico's engineering advisor John Bliss later found and explained to New Mexico State Engineer and Rio Grande Compact Commissioner Thomas McClure, intercepted basin groundwaters, joined with tributary flows before re-entering the river's channel, and ultimately supplied lands downstream within the project and (as discussed in Opinion IV) below the project. The engineers most involved in developing the compact thus knew and understood that the Rio Grande Project's water supply included more than the surface flow stored in Elephant Butte. Waters arising on project lands, including groundwater, tributary flows, and return flows, however defined, were as essential as storage waters to the project.

Opinion IV: Delivery of water by New Mexico to San Marcial, under the terms of the 1938 Rio Grande Compact, constituted the delivery of water to serve lands in Texas within the Rio Grande Project as well as downstream to Fort Quitman.

As discussed in Opinion III above, water released from Elephant Butte Reservoir and water arising on the Rio Grande Project was used and re-used throughout the project. Reclamation and other federal, state, and local authorities considered such waters part and parcel of the project's water supply. By the 1920s, these waters had also become important to several thousand acres of Rio Grande bottomlands that stretched downstream from the end of the project through Hudspeth County to Fort Quitman, an area historically known as the "Fort Hancock district." Under a Warren Act contract, in exchange for relinquishing claims to Rio Grande flow, Hudspeth county landowners – organized as Hudspeth County Conservation and Reclamation District No. 1 in 1923 – obtained the use of waters captured by Elephant Butte, used on project lands, and ultimately passed out of the project. This extra-project water supply figured into the technical studies leading to the 1938 compact, and thus formed part of the 790,000 af "normal release" from the federally-controlled Elephant Butte Reservoir that was apportioned to Texas for lands above Ft. Quitman by the compact. In an acknowledgement of federal control over the Rio Grande between Elephant Butte and Ft. Quitman, encompassing lands both within and without the Rio Grande Project, the compact commissioners eschewed a state-line delivery by New Mexico for Texas and instead made the delivery point for the Rio Grande water apportioned to Texas at San Marcial, above the federal reservoir.

Reclamation plans for the Rio Grande Project initially did not consider land beyond the El Paso Valley. As discussed in Opinion I above, the project's first supervising engineer, B.M. Hall, conceived of a project to water arid lands in southern New Mexico and the El Paso Valley in Texas. Reclamation subsequently executed contracts for the delivery of water to two local water users' associations, and later their successors, Elephant Butte Irrigation District (EBID) in New Mexico and El Paso County Water Improvement District No. 1 (EP #1). Reclamation's *Twelfth Annual Report* for 1912-1913 also plainly described that the project was to serve lands in the Palomas, Rincon, and Mesilla valleys in New Mexico, and the El Paso Valley in Texas.[187]

Nevertheless, as construction of the federal project advanced in the late 1910s, individual Hudspeth County landowners began diverting water that flowed down the Rio Grande from the project. Reclamation, in response, executed annual rental contracts with these water users to deliver water into the Rio Grande "at the end of the project limits where four private and community ditches have their heads." This was done, as project superintendent L.R. Fiock later

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[187] *Twelfth Annual Report*, 176.

explained, “under the theory that it was project developed water” – that is, having originated out of the project’s water supply, as surface flow, drainage water, or return flow.[188]

By the early 1920s, according to one Reclamation estimate, this surplus water irrigated more than 10,000 acres downstream of the project, and area landowners sought to obtain a still greater supply. In April 1923, they met with Reclamation director A.P. Davis during his visit to the El Paso Valley to discuss extension of the project’s Tornillo Canal to serve their lands. The current Hudspeth-area diversion works were insufficient for taking water from the Rio Grande unless there was “a very large excess flow.” Davis, although concerned that additional project releases would encourage Mexican diversions on the opposite side of the river that would diminish the project water supply, was sympathetic to the Hudspeth landowners. Observing that their irrigated lands were “mainly in large holdings” and there was “no organization…thru which to act,” the director suggested the formation of a separate “irrigation district” and subdivision of agricultural holdings so as to conform with federal reclamation law. Davis also charged project officials to investigate the cost of extending Tornillo Canal, but he made no commitment to encumber government funds to do so. He further cautioned Acting Director F. E. Weymouth that any renewal of the surplus water contracts must contain “proper provision protecting the Government against adverse diversion, and against initiating a right to permanent water supply. However, as Rio Grande project manager L.M. Lawson recalled afterwards, Davis was of the opinion that “surplus waters recovered at the end of the project” would probably “take care of lands now under cultivation.”[189]

Hudspeth-area landowners acted quickly following their meeting with Davis. In August, they organized their own water district, Hudspeth County Conservation and Reclamation District No. 1 (HCCRD #1). That same month, the district’s new president W.T. Young addressed petitions to both the secretary of the interior and EP #1 seeking to join the project through consolidation with the El Paso district.[190]

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[188] Memorandum, From: Project Manager [L.M. Lawson], To: Chief Engineer, Denver, Colorado, Subject: Disposition of Surplus Water – Rio Grande Project, April 28, 1923. Folder 303. Rio Grande Project. Petitions for Construction, Fort Hancock. THRU 1929, Box 919, Rio Grande 301.4—303; L.R. Fiock, Superintendent to Commissioner, Subject: Protest of Hudspeth County Conservation and Reclamation District No. 1 – Rio Grande Project, May 22, 1939, 1-2. ff. 301 Rio Grande Project - Board and Engineering Report on Construction Features, Jan 1, 1937, Box 927 Rio Grande Pro. 246. - 301., Entry 7, RG 115, NARA Denver.
[189] A.P. Davis, Director, to F.E. Weymouth, Acting Director, Reclamation Service, April 21, 1923; and Memorandum, From: Project Manager, To: Chief Engineer, April 28, 1923. Folder 303, Box 919, Entry 7, RG 115, NARA Denver.
[190] W.T. Young, President, Hudspeth County Conservation and Reclamation District No. 1, To the Honorable, The Secretary of the Interior, August 16, 1923; and W.T. Young, President, Hudspeth County

EBID and EP #1 were wary about the addition of these downstream lands to the project. Their concerns were similar to those articulated by Davis, that the project water supply would prove insufficient to irrigate land down to Ft. Quitman. EP #1 manager Roland Harwell, although like Davis sympathetic to Hudspeth landowners, consequently declined to accept the district's petition citing the need for "the consent of the Secretary of the Interior."[191]

Lawson, however, believed that efforts could be made to improve the water available to lands downstream without incorporating those lands into the project. Having received a forwarded copy of Harwell's reply to Young, the Rio Grande project manager observed in his own letter to the EP #1 manager that "recovered water from the Juarez and El Paso valleys below the International Dam [which turned water released from Elephant Butte into Mexico] if properly collected, would probably supply irrigation demands for the area now in cultivation in the Fort Hancock district." Additionally, given that current "methods employed by the Fort Hancock area in obtaining their water supply are entirely inadequate and wasteful," Lawson favored those area landowners undertaking "such construction work as will place them in a position to receive the beneficial use of such water as is available in the Rio Grande at the upper end of the area." Such an effort would leverage "the recently constructed intake works near Fabens for the [Rio Grande Project's] Tornillo Main Canal, which intake has the advantage of full river control," and would provide "for the collection of the lower project's recovered water and the delivery of this supply undiminished by river losses and unauthorized diversion to the Fort Hancock area." The Rio Grande Project manager also favored continuation of the delivery of such water to Hudspeth-area landowners on an annual contract basis "with the particular understanding that the quantity furnished is on a surplus basis and subject to prior project demands."[192]

Lawson had made substantially the same suggestions in a memorandum to Reclamation Chief Engineer F.E. Weymouth back in August 1923, and in October, Weymouth furnished his endorsement. At the same time, the chief engineer noted the need for the approval of EBID and EP #1, and advised against a proposed plan for downstream landowners to pay for the canal

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Conservation and Reclamation District No. 1, To the President and Board of Directors of El Paso County Water Improvement District No. 1, August 18, 1923. Folder 303, Box 919, Entry 7, RG 115, NARA Denver.

[191] H.H. Brook, President & Manager, to Hon. D.W. Davis, US Bureau of Reclamation, August 23, 1923. Folder 303, Box 919; Brook to Fiock, Acting Project Manager, US Bureau of Reclamation, August 8, 1923; Roland Harwell, El Paso Co. Water Imp. Dist. No. 1, to Mr. L.M. Lawson, Project Manager, September 19, 1923. Folder 222, Box 902; El Paso Co. Water Imp. Dist. No. 1, By (SGD) Harwell, Manager to Mr. W.T. Young, President, Hudspeth Co. Conservation & Reclamation Dist No. 1, September 19, 1923. Folder 303, Box 919, Entry 7, RG 115, NARA Denver.

[192] L.M. Lawson, Project Manager to Mr. Roland Harwell, Manager, El Paso County Water Improvement District No. 1, Subject: Water Supply for Fort Hancock Lands – Rio Grande Project, September 21, 1923. Folder 303., Rio Grande Project. Petitions for Construction, Fort Hancock. THRU 1929, Box 919 Rio Grande 301.4--303, Entry 7, RG 115, NARA Denver.

extension itself and thereby obtain an ownership interest and a legal claim to its use. Weymouth expressly cautioned that "no water can be turn out of the Elephant Butte Storage for its [Hudspeth's] benefit."[193]

Reclamation Commissioner D.W. Davis approved of the plan in November, and after obtaining an assurance that it could enter into a temporary contract for "such waste water as would be available at the end of the Tornillo Canal," HCCRD #1 agreed to the proposal. Financed through a bond issue of $750,000, the district subsequently built a main canal with distribution laterals as well as a deep-well pump drainage system that was later replaced by an open drain system. In August 1924, Hudspeth executed a temporary contract which provided for the diversion of water from the river below the Rio Grande Project, as Fiock later reported, "through several private or community ditch headings which existed before the organization and development as a District."[194]

With the completion of the extension of Tornillo Canal, HCCRD #1 entered into a Warren Act contract with Reclamation in December 1924. Passed by Congress in 1911, the Warren Act authorized Reclamation to contract for impoundment, storage, or conveyance of non-project irrigation water in federal facilities, when excess waste was available. The Hudspeth district's Warren Act contract permitted the district to purchase waste or other excess water available at the end of the Tornillo Canal, the last major project irrigation structure, but it did not expressly guarantee any quantity of water to the district. According to Fiock, the canal was to supply those lands between Fabens and Ft. Quitman with "such waste, return flow and developed water as was considered might be available at the lower end of the project." It further defined the water delivered as "secondary and inferior to the right to use water for any purposed on the lands of the Rio Grande Federal Irrigation Project." In executing the contract, HCCRD #1 "relinquish[ed] any and all right, title, interest, and claim to any and all waters of the Rio Grande, except…as provided" by the contract. Both EBID and EP #1 acquiesced to the canal's construction, and paid for its construction. The two project districts viewed the arrangement with downstream

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193 Memorandum, From: Project Manager [L.M. Lawson], To: Chief Engineer, Denver, Colorado, Subject: Disposition of Surplus Water – Rio Grande Project, August 23, 1923; and Memorandum, From: Chief Engineer [F.E. Weymouth], To: Commissioner, Subject: Petition of the Hudspeth County Conservation and Reclamation District No. 1 – Rio Grande Project, October 29, 1923. Folder 303., Rio Grande Project. Petitions for Construction, Fort Hancock. THRU 1929, Box 919, Rio Grande 301.4--303, Entry 7, RG 115, NARA Denver.

194 Memorandum, From: Commissioner [D.W. Davis], To: Chief Engineer, Subject: Petition of the Hudspeth County Conservation and Reclamation District No. 1 – Rio Grande Project, November 6, 1923. Folder 303., Rio Grande Project. Petitions for Construction, Fort Hancock. THRU 1929, Box 919 Rio Grande 301.4—303; and Fiock to Commissioner, May 22, 1939, 1. ff. 301, Box 927, Entry 7, RG 115, NARA Denver.

landowners as not only defraying their own project expenses, but also ensuring "beneficial use of such water [i.e., available waste, return flow, and developed water] at the end of the project.[195]

Starting with the 1925 irrigation season, water was delivered to land in Hudspeth County through the Tornillo Canal. The water supplied, however, remained inadequate. Both the Tornillo Canal and the Hudspeth district's own main canal lacked the capacity to deliver all the water required for irrigable lands downstream of the project. Moreover, the amount of water within the Tornillo Canal available for diversion was limited to that which passed through unused by the Rio Grande Project above. HCCRD #1 had to supplement its supply by diverting directly from the Rio Grande below the end of the Tornillo Canal. This water, although not part of the supply to be delivered when available pursuant to the Warren Act contract, nonetheless consisted of project drainage water (from drains emptying below Tornillo Canal) and surplus water in the river that had not been diverted into the Tornillo Canal yet had passed through the project. The latter occurred typically when the water in the river exceeded the capacity of the Tornillo Canal at its heading.[196]

That any water was available to Hudspeth County lands through Tornillo Canal was the result of project operations intended to supply the Tornillo district of the Rio Grande Project with water of sufficient quality (as noted in Opinion II above). This district was the last unit of the project, the furthest downstream. According to Fiock, a "50-50 mixture of upper valley irrigation water and the drain water discharging immediately above Fabens" was necessary to dilute the alkali in the water reaching this area, so Reclamation endeavored "to carry enough of the reservoir released water on through to Fabens" so that it could be "mixed with the drain water discharging immediately above Fabens." This, consequently,

> produced a total discharge at Fabens about equal to the capacity of the Tornillo Canal, or more than twice the amount necessary for the irrigation requirements of the Tornillo area alone, thus making available water for delivery to the heading of the Hudspeth District Canal at the terminus of the Tornillo Canal.

Moreover, when the amount of water – "a mixture of drain and upper valley irrigation water" – reaching Fabens exceeded "the capacity or requirements of the Tornillo Canal…[it] has been allowed to go on down the river." This was particularly true during the fall, winter, and early spring irrigations, which required "as much of the upper valley irrigation water supply reaching Fabens in order to accomplish the dilution of drain water." "[A] large part of the mixed water"

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195 C.M. Newman to Dr. Elwood Mead, April 19, 1924. Folder 303., Rio Grande Project. Petitions for Construction, Fort Hancock. THRU 1929, Box 919, Rio Grande 301.4—303, Project Files, 1919-1929, General Administrative and Project Records, 1919-1945; and Fiock to Commissioner, May 22, 1939, 2-3. ff. 301, Box 927, Entry 7, RG 115, NARA Denver.
196 Fiock to Commissioner, May 22, 1939, 3. ff. 301, Box 927, Entry 7, RG 115, NARA Denver.

thus went "to waste" below the project and became available to lands downstream, between Fabens and Ft. Quitman.[197]

In the negotiations leading to the 1929 temporary compact, the water received by Hudspeth County lands was a focus of discussion. Various parties maintained that this water had to be considered in drafting a compact that would equitably apportion the waters of the Rio Grande above Ft Quitman. Major Richard Burges, an El Paso attorney who represented EP #1, HCCRD #1, and the City of El Paso, established the geographic boundaries for the commission's consideration at the first compact commission meeting in October 1924. Burges was deeply interested in a compact as lands in both El Paso and Hudspeth counties depended upon Rio Grande water. As no representative for Texas had yet been selected, he attended the meeting with Texas Governor Pat Neff's blessing. Burges stressed to the Colorado and New Mexico commissioners, Delph Carpenter and Julian O. Seth, respectively, that "the problem of the Rio Grande, as it affects the state of Texas," principally concerned "the El Paso Valley, which includes the irrigable lands in El Paso County and Hudspeth County." This was a point of view that Carpenter heartily accepted and Seth was willing to entertain once a Texas commissioner was formally appointed.[198]

Burges reiterated this stance in December 1928 after T.H. McGregor had been appointed the commissioner for Texas. Serving as special counsel, he delivered at McGregor's request Texas's opening statement, and in that statement, he made clear that Texas claimed not only "its rights under the federal Rio Grande Project" but also waters for some 20,000 acres between the project and Fort Quitman that was "under successful cultivation today by irrigation" – land in Hudspeth County.[199]

For Colorado, excess water beyond the project, the water for Hudspeth that Burges identified, was objectionable. Provided the state secured its own water project for San Luis Valley, however, that water could be tolerated. Corlett, for instance, complained that the "return water" received by Hudspeth lands "would some three or four times supply all of the water that was conceded to Mexico" yet was denied Colorado. Colorado's engineering advisor R.I. Meeker, supported Corlett's contention in his presentation to the commission, noting "that there are large wastes passing the lower end of the Rio Grande Project at Fort Quitman," and among the beneficiaries

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[197] Fiock to Commissioner, May 22, 1939, 4. ff. 301, Box 927, Entry 7, RG 115, NARA Denver.
[198] First Meeting, Rio Grande River Compact Commission, Breadmoor Hotel, Colorado Springs, Colo., Sunday, October 26, 1924, 3-4, 9-12, and 24-25. Folder 1, Box 02-D.003:1, MS 0235, RGHC, NMSU Spec. Coll.
[199] Proceedings of Rio Grande Compact Commission, Held December 19-20-21, 1928, At Santa Fe, New Mexico, 13. Folder Rio Grande Compact Commission Records, 1924-1941, 1970, Richard F. Burges Papers, Proceedings of Rio Grande Compact Conference Held Dec. 19-20-21, 1928 at Santa Fe, N.M., Box 2F471, RGCCR, 1924-1941, 1970, UTA.

of this water was land in Hudspeth County. Nevertheless, in calculating an equitable quantity for Texas that made possible development of Colorado's San Luis Valley, Meeker included the water received by land downstream of the project along with the water demands of lands within the Rio Grande Project and the obligations to Mexico under the 1906 treaty, even though the water diverted by Hudspeth landowners was "junior in every respect."[200]

Harwell likewise sought to condition the rights of landowners downstream of the project before the commission, although he did not dismiss the fact that those in Hudspeth obtained water via the project and would in the future. He explained that "the Hudspeth District is entitled to no more water than the surplus waters which may exist at the Tornillo canal." Put another way, "Hudspeth District was entitled to receive no more water from the project than this unavoidable waste which is bound to occur through this 150 miles of operation between the dam [Elephant Butte] and the point of lowest delivery." Any additional water that Hudspeth landowners could obtain, according to Harwell, would be "by their own pumping operations for drainage…putting to use water which would otherwise be put to use in the stream bed by them or anyone else interested." He believed that with increased efficiencies in water use by the project and its completion to serve the full irrigable acres within the project, future water use downstream of the project would be "limited to… [that] which can be called legitimately unavoidable waste."[201]

The temporary compact of 1929 did not specifically address the relative water needs of the three states, save to endorse federal construction of a "closed basin drain" and "State line reservoir" in Colorado. Nevertheless, as noted above, Article XII acknowledged the importance of Elephant Butte Reservoir to lands below, lands that as the federal project was operated included lands in Hudspeth, and attempted to safeguard the reservoir's water supply:

> New Mexico agrees with Texas with the understanding that prior vested rights above and below Elephant Butte Reservoir shall never be impaired hereby, that she will not cause or suffer the water supply of the Elephant Butte Reservoir to be impaired by new or increased diversions or storage within the limits of New Mexico unless and until such

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[200] Proceedings of Rio Grande Compact Commission…December 19-20-21, 17, 37-38, 40-41, and 43. Folder Rio Grande Compact Commission Records, 1924-1941, 1970, Richard F. Burges Papers, Proceedings of Rio Grande Compact Conference Held Dec. 19-20-21, 1928 at Santa Fe, N.M., Box 2F471, RGCCR, 1924-1941, 1970, UTA.

[201] Proceedings of Rio Grande Compact Commission…December 19-20-21, 1928, 52-58. Folder Rio Grande Compact Commission Records, 1924-1941, 1970, Richard F. Burges Papers, Proceedings of Rio Grande Compact Conference Held Dec. 19-20-21, 1928 at Santa Fe, N.M., Box 2F471, RGCCR, 1924-1941, 1970, UTA.

> depletion is offset by increase of drainage waters [i.e., through development of Colorado's Closed Basin].[202]

The water supply and needs of the lands between Fabens and Ft. Quitman were more specifically analyzed and considered in 1930s as Colorado, New Mexico, and Texas sought to arrive at a permanent compact.[203] As first discussed in Opinion I, critical to the development of the compact was the federal Rio Grande Joint Investigation of the National Resources Committee. This investigation provided much of the technical data for the drafting of the compact. Endeavoring to scope that work for the Rio Grande Compact Commission in December 1935, University of Chicago historical geographer Harlan H. Barrows and agricultural economist Frank Adams, both with NRC, suggested confining the study to "the water resources and irrigable and irrigated lands of the Rio Grande Basin above El Paso." Colorado, however, insisted that any investigation "should include the area between El Paso and Ft. Quitman" – an area inclusive of Hudspeth County – as the "duties of the Rio Grande Compact Commission relate to that area of the Rio

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[202] Francis C. Wilson, Rio Grande Compact Commissioner, *Rio Grande Compact: Report of Commissioner for New Mexico and Memorandum of Law on Interstate Compacts on Interstate Streams* 2/19/29, 9. ff. 032.1, Rio Grande Basin. Water Rights: Rio Grande Compact. THRU 1929., Box 924 Rio Grande Basin 023.--032.02, Entry 7, RG 115, NARA Denver.

[203] There is some historical evidence that water users downstream of the Rio Grande Project did not figure into the compact negotiations of the 1930s. In the early 1950s, EP#1 retained Raymond Hill as a technical expert in a lawsuit filed in US District Court for the Western District of Texas, El Paso Division, by HCCRD #1. HCCRD #1 sued several parties, including EP#1, over the availability of water in the Rio Grande for appropriation. The district insisted that the construction of Caballo Reservoir had increased the water supply in the basin. EP #1, however, argued that despite Caballo's construction there was no water to be appropriated from the river; the federal Rio Grande Project had already fully appropriated the stream. Hill, Texas's engineering advisor, was called upon to submit an affidavit supporting this position. According that document, signed and dated by Hill on January 20, 1953 (but stamped as received on January 19), he

> participated in the negotiation of the Rio Grande Compact and particularly in the negotiations conducted by the engineers representing the Federal Government and the several States. At no time in such negotiations were the needs of the Hudspeth County Conservation and Reclamation District No. 1 in Texas considered. On the contrary, the representatives of Colorado and New Mexico consistently and emphatically refused to consider any rights or uses of water in the Hudspeth District.

In the United States District Court, for the Western District of Texas, El Paso Division, *Hudspeth County Conservation and Reclamation District No. 1, et al., Plaintiffs v. Howard E. Robbins, et al, Defendants*, Civil Action No. 1342, Affidavit of Raymond A. Hill in Support of Defendants' Cross-motion for Summary Judgment, January 20, 1953. ff. El Paso County Water Impr. Dist. No. 1 a/c Hudspeth CCRD No. 1 G3330, Box 4X189, RAHP, UTA. This single statement stands in stark contrast to a larger body of evidence discussed in this opinion that indicates that downstream water users were a consideration in the negotiations.

Grande Valley above Ft. Quitman." After some deliberation, the commission adopted a resolution that identified the study area as "the Rio Grande Basin above Ft. Quitman."[204]

The reliance of downstream water users on Rio Grande project water was also noted and intended to be a focal point in Texas's suit against New Mexico and the Middle Rio Grande Conservancy District before the US Supreme Court. In testimony before Special Master Charles Warren in November 1936, Fiock explained that under current operations Hudspeth received the waste water from the project, below the Tornillo district. By December 1936, with the hearings continuing, Frank Clayton, who was not only Texas's attorney in its original action and the state's Rio Grande Compact Commissioner but also the attorney for HCCRD #1, sought to demonstrate "that millions of dollars were added to tax valuations in Hudspeth County as a result of irrigation development under this project, commencing about 1918 and reaching its culmination about 1928."[205]

This information was apparently not introduced before Warren (as noted in Opinion I above) placed the proceedings on hold to enable the Rio Grande Joint Investigation to complete its work. Delayed by several months, a copy of the investigation's report, the *JIR*, was distributed to the compact commission in September 1937. In presenting the *JIR*, Barrows expressed his belief "that the report provides a basis, a factual basis, for an allocation of the waters of the river above Ft. Quitman that would be fair and just to each of the three states and to its citizens [*sic*] dependent upon the river."[206]

The *JIR* recognized the dependence of lands downstream of the project on the water captured, stored, and released from the Rio Grande Project's Elephant Butte Reservoir. It specifically included HCCRD #1's current water needs in its assessment of the available diversions necessary from the reservoir to supply the stretch of the Rio Grande between the reservoir and Ft Quitman. The investigation was truly a series of studies of the Upper Rio Grande Basin, undertaken by federal agencies that included Reclamation as well as the USGS and the US Department of Agriculture's Bureau of Agricultural Engineering. The summary report produced by the investigation noted that the Hudspeth district was located within the Elephant Butte-Fort Quitman section of the basin, and "maintenance of an adequate water supply for irrigation" of its lands and "maintaining satisfactory control of salinity" were both major problems. The latter

[204] Proceedings of the Rio Grande Compact…December 2-3, 1935, 24-43. ff. 032.1 (2/3), Box 1326, Entry 7, RG 115, NARA Denver.
[205] *Plaintiff's Case in Chief*, Vol. I, II, 399-406. CB-F-171A thru CB-F-1716: Transcripts of TX v. NM, Vol. 1-16, 4X219, RAHP; and Frank B. Clayton, Rio Grande Compact Commissioner for Texas, to Milam H. Wright, Tax Assessor and Collector, December 1, 1936. [1936], Box 2F467, RGCC-FBCP, UTA.
[206] Proceedings of the Rio Grande Compact, Held in Santa Fe, New Mexico, September 27 to October 1, 1937, 5. Unnamed folder 5, Box 2F463, RGCC-FBCP, UTA.

issue of salinity, in particular, was "an important consideration" in assessing the section's needs. The summary acknowledged that the district received "return water" below the Tornillo Canal heading. This water was "a direct diversion of drainage and waste waters of the Rio Grande Project" under a Warren Act contract. The contract applied "only to the return water as it occurs in the normal operation of the Rio Grande Project and puts no obligation upon the latter for delivery of any specific amounts of water."[207]

The report of the USDA Bureau of Agricultural Engineering specifically recognized the vital importance of this water for Hudspeth. It noted the "drain and tail water from the El Paso Valley system [of the project] becomes the irrigation supply for most of the remaining valley lands above Fort Quitman." Diversions to Hudspeth County lands were thus factored into the investigation's calculation of net diversion and stream-flow depletion between 1930 and 1936 for the Elephant Butte-Fort Quitman section. These diversions formed an essential part of the "necessary allowances for drain flow, wastes, arroyo inflow, and salinity control to derive the required diversion demand on Elephant Butte Reservoir." That diversion demand amounted to 736,000 af, but given the acres "actually irrigated" in the late 1920s into the early 1930s, 773,000 af was recommended to "be used as conservative estimate."[208]

As discussed in Opinion II above, the need to ensure a water supply of sufficient quality through the project lands and downstream to Ft. Quitman was precisely the reason Texas insisted upon 800,000 af from Elephant Butte. For the remainder of the compact negotiations, although no designated representatives from Hudspeth addressed the proceedings, Clayton and Hill advocated for both for the Rio Grande Project and the entire Elephant Butte-to-Ft. Quitman stretch. Barrows also included Hudspeth in his call for a dependable supply of low-alkali water for lands above Ft. Quitman.

Drafting of the compact itself focused on the "present uses of water" in the Rio Grande Basin above Ft. Quitman, a geographical area that included lands in Hudspeth County. New Mexico's own engineering advisor, John Bliss, recognized that Hudspeth was a part of the demand on Elephant Butte. In his own calculations of that demand, presented during the December 1937 meetings, he estimated the need for these lands between the project and Ft. Quitman as 70,000 af. As discussed in Opinion I above, at the commission's direction, the engineering advisors collectively prepared a report suggesting the schedule of deliveries to be specified in the compact, and in doing so "avoided discussion of the relative rights of water users in the three

[207] *JIR*, 7, 12, 23, 49, 62, 74, and 85-86.
[208] *JIR*, 99, 103-104, and 403.

States," and instead sought to protect the "present uses of water in each of the three States…because the usable water supply is no more than sufficient to satisfy such needs."[209]

When New Mexico State Engineer and Rio Grande Compact Commissioner Thomas McClure challenged some of the engineers' recommendations, Clayton defended their work as safeguarding Texas's entitlements to the waters of the Rio Grande. He argued in a January 1938 letter to Harper that "in the protection of Texas' water supply that the report contains no recommendations for the benefit of Texas than what she is plainly entitled to." Texas's commissioner insisted that the engineers had developed "a fairly workable basis for the equitable apportionment of the waters of the Rio Grande, without permitting further encroachments upon Texas' already inadequate supply." Indeed, Texas was "unwilling to recede from what we conceive to be the minimum requirements for the protection of Texas' water supply as embodied in the report."[210]

Texas eventually conceded to a lesser figure of 790,000 af, yet Clayton believed that he had secured the water to which all of the lands in Texas down to Ft. Quitman were entitled. As noted in Opinion II, after the conclusion of the compact negotiations, in a pamphlet "To Water Users Under The Rio Grande Compact," Clayton sought to reassure Texans anxious over the compact's provisions. The compact commissioner, the "engineering consultants who represented Texas in its lawsuit with New Mexico over the waters of the Rio Grande," and "the managers and attorneys of the Elephant Butte Irrigation District and the El Paso County Water Improvement District No. 1" were convinced "the Compact protects the water supply of users in New Mexico and Texas between Elephant Butte and Fort Quitman, and that it [the Compact] represents a fair and equitable solution of the controversy which has long existed between various interests in the three states." Clayton maintained that the compact "seeks primarily to protect vested uses of water above Fort Quitman, and guard them against future impairment, both as to quantity and quality." The commissioner explained further,

> Since the Rio Grande is essentially a torrential stream and its discharge varies widely from year to year, it is physically impossible to establish fixed and determinate deliveries into Elephant Butte Reservoir in terms of acre-feet per year. However, engineering

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[209] [Raymond Hill], "TEXAS COMPACT: John Bliss Estimate of Project Requirements at Elephant Butte," 12/17/37. CB-F-137-34, Box 4X215, RAHP, UTA; and "Report of Committee of Engineers to Rio Grande Compact Commissioners," December 27, 1937, in Proceedings of the Meeting of the Rio Grande Compact Commission…March 3rd to March 18th, inc., 1938, Appendix No. 1, 40. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

[210] Frank B. Clayton, Rio Grande Compact Commissioner for Texas, to Mr. S.O. Harper, Chairman, Rio Grande Compact Commission, January 27, 1938, in Proceedings of the Meeting of the Rio Grande Compact Commission…March 3rd to March 18th, inc., 1938, Appendix No. 3, 50-51. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

> investigation has shown that there have been in the past reasonably reliable relationships between the flow of the river and its tributaries above all principal points of diversion in Colorado and New Mexico, and at other points below all principal diversions in Colorado and New Mexico above Elephant Butte Reservoir. These relationships have been expressed in the Compact in tabular form, and this instrument imposes an obligation upon Colorado and New Mexico to maintain these schedules of relationship, regardless of any future development above the Rio Grande Project.

Colorado's obligation was to the Colorado-New Mexico state line (reflected in Article III), and New Mexico's was to San Marcial (reflected in Article IV). Clayton noted that the Compact established a debit-and-credit system, in recognition "that there will probably be departures from time to time from the schedules of relationship." A "definite limitation," however, existed on debits and credits "to insure a normal average release from the [Elephant Butte] Reservoir of 790,000 acre-feet of water per year, including the deliveries to Mexico."[211]

Clayton reiterated many of these same points at a May 1938 meeting of the Lower Rio Grande Water Users Association. Members of the association came from Cameron and Hidalgo counties, below Hudspeth County and Ft. Quitman. They were concerned that their water supply was not adequately protected by the compact. "From the legal standpoint," however, as Clayton explained, "our negotiations related to the division of the waters above Fort Quitman." Identifying the need to satisfy Mexican claims to water from the Rio Grande through the 1906 treaty as the essential background to the 1906 and 1908 filings made by Reclamation, he asserted that those filings were "for the purpose of impounding them in a storage dam [Elephant Butte] in the vicinity of Engle, New Mexico for the benefit of lands between that point and Fort Quitman" – not just for the lands within the project. He believed his "duty, as commissioner for Texas, [was] to see that Texas got every drop of water originating in Colorado and New Mexico that she was entitled to and to see that that water was delivered into the Elephant Butte Reservoir," and that he was successful: "By that compact Texas got all she is entitled to."[212]

Moreover, that water Texas received for its lands above Ft. Quitman was the same water that irrigated lands in New Mexico. "[A]s far as the Rio Grande project is concerned," Clayton told the attendees

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[211] Proceedings of the Meeting of the Rio Grande Compact Commission…March 3rd to March 18th, inc., 1938, 24. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver; and Frank B. Clayton, "To Water Users Under The Rio Grande Project," El Paso, Texas, March 25, 1938. Folder 1, Memos of Interior Department, 1913-1915, Box 14, APDP 1896-1952, AHC.

[212] *Proceedings of Meeting Held on Friday, May 27, 1938 at El Paso, Texas, between Representative of Lower Rio Grande Water Users and Representatives of Irrigation Districts Under the Rio Grande Project of the Bureau of Reclamation*, 10. ff. Proceedings and Minutes 1935-1938, Box 2F463, RGCC-FBCP, UTA; and Littlefield*, Conflict on the Rio Grande*, 209-210.

> the interests of the Elephant Butte District, in New Mexico, and the districts in Texas above Fort Quitman are common interests ... and because our interests are common we determined long ago that no satisfactory, practical, legal, or engineering way could be devised by which the waters could be allocated between these districts at the Texas line. As far as they and we are concerned, our source is the same. If the supply is impaired above Elephant Butte, we all suffer alike.[213]

Harwell also tried to clarify matters for the association. In the process, he emphasized both Reclamation's control over the waters that entered Elephant Butte Reservoir, and the dependence of lands downstream of the project on releases from the federal reservoir. The EP #1 manager stressed that while the water supply below Ft. Quitman was "wholly without our control," the "supply of water at the end of this project [i.e., the Rio Grande Project]...will be substantially as it has been in the past." He acknowledged that there would be "a certain amount of operating water and a certain amount of summer runoff" entering the river "entirely beyond our control." Roughly 16,000 acres of land in Hudspeth County benefitted from the water passed beyond the project; these lands were irrigated "in part by surplus waters which we [EP #1] deliver into their canal for a consideration, and in part by diversion from the river." Harwell went on to invoke the argument that Hill had made for water quality: "it is necessary to pass excess amounts of water in order to maintain the salt balance." Lands below the project and above Ft. Quitman were the beneficiaries of this operational necessity.[214]

Following the meeting with the Lower Rio Grande Water Users Association, Clayton yet again emphasized that Texas obtained all that it was entitled from the compact negotiations in an August 1938 letter to Homer L. Leonard, a state representative from McAllen on the lower Rio Grande. The compact commissioner sought to secure Leonard's support for ratification of the compact in the face of opposition from his constituents. "It was the opinion," Clayton explained, "of every one of the Texas representatives attending the meeting that by the Compact Texas secured all that she was entitled to, and, indeed, all that could physically be delivered to her." He acknowledged that the "upper and lower water users in Texas" differed "as to whether the districts under the Rio Grande Project were obligated to deliver any water past Fort Quitman and if so, the amount." Clayton and the rest of the Texas delegation to the compact proceedings nonetheless believed this "was a matter of internal negotiation" and raising before the Colorado and New Mexico commissioners and their advisors "would gravely prejudice our case and

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[213] *Proceedings of Meeting, held on Friday, May 27, 1938*, 11. ff. Proceedings and Minutes 1935-1938, Box 2F463, RGCC-FBCP, UTA.

[214] *Proceedings of Meeting, held on Friday, May 27, 1938*, 16, 17, and 25. ff. Proceedings and Minutes 1935-1938, Box 2F463, RGCC-FBCP, UTA.

perhaps result in the collapse of the negotiations." "Obviously," he attempted to reassure Leonard,

> Colorado and New Mexico could not be asked to guarantee that any certain quantity of water would be delivered to any particular locality in Texas. Their only responsibility was to see that Texas' equitable share was delivered at the state line, or, rather, delivered into Elephant Butte reservoir, which is the point of control.[215]

Federal control of Elephant Butte Reservoir as well as the water needs served by releases from the reservoir were two essential points that Clayton also stressed to attorney Sawnie B. Smith in October 1938. Smith had been hired by lower Rio Grande water users to file suit to stop ratification of the compact. In a letter to Clayton in late September 1938, he questioned the absence of provisions in the signed-yet-unratified compact concerning the "division of waters below Elephant Butte between the States of New Mexico and Texas" and "the amount of water to which Texas is entitled." Smith could "not find anything in the compact…which ties down and limits the use or division of the waters according to present usage and physical conditions, and nothing that would prevent controversy between the two States in the future regarding the division of the waters between the two States." "This omission," the attorney bluntly wrote, "is too obvious to have been inadvertent, and therefore unquestionably, the Commissioners had what they considered valid reason for it." On behalf of his clients, Smith asked for that reason.[216]

Writing back to Smith, Clayton insisted that New Mexico's delivery of water above Elephant Butte constituted the delivery of water to Texas and that all of the releases from Elephant Butte made in the course of federal project operations served requirements below the dam down to Ft. Quitman. As far back as the negotiations for the temporary compact, the commissioner noted, Elephant Butte had been the focus for deliveries to Texas. The parties had, in Clayton's words, "decided…that New Mexico's obligations as expressed in the compact must be with reference to deliveries at Elephant Butte reservoir, and this provision was inserted in the temporary compact [i.e., Article XII of the temporary compact]." He insisted that that the "reasons" for this were "numerous," and "the obstacles in the way of providing for any fixed flow at the Texas were considered insuperable." Clayton drew specific attention to federal operational control of Elephant Butte and the flow of the water through the project's canals and down the river itself:

> The Rio Grande Project, as you know, is operated as an administrative unit by the Bureau of Reclamation, and the dam and releases from the reservoir are controlled by the Bureau and will continue to be at least until the federal government is repaid its investment, and

[215] Frank B. Clayton, Rio Grande Compact Commissioner for Texas, to Hon. Homer L. Leonard, August 3, 1938, 2. Box 2F466, RGCC-FBCP, UTA.
[216] Sawnie B. Smith to Mr. Frank B. Clayton, Rio Grande Compact Commissioner for Texas, September 29, 1938. Box 2F466, RGCC-FBCP, UTA.

> very probably even beyond that time. Obviously, neither Colorado nor New Mexico could be expected to guarantee any fixed deliveries at the Texas line when the operation of the dam is not within their control but is in control of an independent government agency.
>
> Moreover, measurements of the water passing the Texas state line would be very difficult and expensive, if not impossible. This, for the reason that irrigation canals, ditches and laterals cross the line, which is of a very irregular contour, at many different points, carrying water in addition to what is carries in the river itself, and it would require continual measurements in these various channels to make any reasonably accurate computations of the total flow.

Texas's commissioner nevertheless indicated that federal management of Elephant Butte facilitated ultimate delivery of the Rio Grande water allocated to Texas above Ft. Quitman. Clayton observed that lands below Elephant Butte Reservoir received water through project operations by either contract or treaty – lands in New Mexico in EBID; lands in El Paso County, in EP #1; lands in Hudspeth County in HCCRD #1; and lands in Mexico. Contractual arrangements between the two project districts, EBID and EP #1, established the irrigable acreages in each, and Clayton expressed his conviction "that there will never by any difficulty about the allocation of this water" as a result.[217] As for the "lands above Fort Quitman and below the Rio Grande Project," the commissioner observed, they

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[217] According to Clayton, under "contracts between the districts under the Rio Grande Project [i.e., EBID and EP#1] and the Bureau of Reclamation…the lands within the Project have equal water rights, and the water is allocated according to the areas involved in the two States." "By virtue of the contract recently executed" – the so-called interdistrict agreement of February 16, 1938 – he explained to Smith,

> the total area is "frozen" at the figure representing the acreage now actually in cultivation: approximately 88,000 acres for the Elephant Butte Irrigation District, and 67,000 for the El Paso County Water Improvement District No. 1, with a "cushion" of three per cent. [*sic*] for each figure.

This "arrangement," Clayton acknowledged, was "of course a private one between the districts involved, and for that reason it was felt neither necessary nor desirable that it be incorporated in the terms of the Compact."

Historian Douglas Littlefield argues that the interdistrict agreement "rendered irrelevant" a New Mexico-Texas state line delivery. Characterizing the congressional authorization of the Rio Grande Project in 1905 as providing for a de facto "allocation" of water between New Mexico and Texas, he contends that the agreement "verified the Bureau of Reclamation's determination that the maximum irrigable acreage of the Elephant Butte Irrigation District was 88,000 acres and that of El Paso County Water Improvement District No. 1 was 67,000 acres." Littlefield, *Conflict on the Rio Grande*, 203 and 207.

The agreement was nonetheless "private" as Clayton recognized. While it was given Interior Department approval, the agreement was executed solely by the two districts, and it was concerned with the allocation of costs for the Rio Grande Project. Federal law obligated project water users to repay the costs incurred by the United States in building, operating, and maintaining a reclamation project. The original 1906 joint construction contract between EBWUA and EPVWUA, and the United States had specified "ten equal annual payments," "apportioned equally per acre among those acquiring such rights [i.e., the water users]." In 1918 and 1920, following the dissolution of the water users' associations and their reconstitution as quasi-municipal entities with the power to tax individual members, new contracts were drafted that made irrigated acreage the basis for allocating shared projects costs between EBID and EP#1, respectively. Eight years later, in the summer of 1928, at the insistence of the water users and at the direction of Congress, the Interior Department extended the repayment schedule for the districts but retained acreage as the basis for repayments. See Construction Contract of Rio Grande Project, 6/27/06, section 4, page 4. ff. 430-A, Rio Grande Project. Joint Contract with Two Water Users Ass'ns, Box 818 Rio Grande 430- -430A, Entry 7; Department of the Interior, Bureau of Reclamation, Rio Grande Project-New Mexico-Texas, Contract Dated June 15, 1918 – between The United States of America and The Elephant Butte Irrigation For Repayment of Construction and Operation and Maintenance Charges, Article 6, Article 8, and Article 10; Department of the Interior, Bureau of Reclamation, Rio Grande Project-New Mexico-Texas, Contract Dated January 17, 1920 between The United States of America and The El Paso County Water Improvement District No. 1, For Repayment of Construction and Operation and Maintenance Charges, Article 7, Article 8, and Article 9, in Department of the Interior, Bureau of Reclamation, Rio Grande Irrigation Project, New Mexico-Texas, Contracts with Water User's Organizations (Copies), Compiled November 1, 1929. 232-29 RG Separate Folder, 249-H, Contracts with Water Users, Box 716 Old Box 509-510, Code 104.RG 37 through Code 402.RG 28, Engineering and Research Center, Project Reports, 1910-55, RG 115, NARA Denver; and *An Act Extending the time of construction payments on the Rio Grande Federal irrigation project, New Mexico-Texas*, May 28, 1928, chap. 815, 45 Stat. 785.

In early February 1929, facing the prospect of constructing additional drainage works for EP #1, Reclamation Chief Engineer R.F. Walter sought to determine more precisely the districts' respective obligations. He met with acting Rio Grande Project superintendent L.R. Fiock and EP #1 manager Roland Harwell; neither EBID's president nor its manager was able to appear but they made their opinions known. Harwell insisted that his district "wished to pay on 67,000 acres," with the caveat that nearly 2,000 acres currently in need of "river rectification or other work not provided by the district contract be delayed a reasonable length of time to permit such work being done by the land owners." As for EBID, its president "informally advised that 88,000 acres was desired by the district," and its manager telegrammed the same to Walter. Satisfied, federal reclamation officials agreed to a distribution of costs on the basis of these acreages: 88,000 acres for EBID and 67,000 acres for EP #1. Before a formal arrangement could be made, however, the global financial collapse precipitated by the US stock market crash of October 1929 cast into doubt the ability of any federal reclamation project's water users to meet their repayment obligations. See Elephant Butte Irrigation District, B.P. Fleming, Manager, telegram to R. F. Walter, Chief Engineer, Bureau of Reclamation, Feb. 16, 1929; Memorandum, From: Chief Engineer, To: Commissioner, Subject: Determination of irrigable acreage and total construction liability of the irrigation districts – Rio Grande Project, February 18, 1929. ff. 301. Rio Grande, Board & Engineering Reports on Construction Features, Oct. 1926 thru July 1929, Transfer Case, Box 913 Rio Grande 241.27—301; and Memorandum, From: Commissioner, To: Chief Engineer, Denver, Colo., Subject: Determination of irrigable acreage and total construction liability of the irrigation districts – Rio Grande Project, March 16, 1929. ff. 330. Rio Grande Project, Corres re Drainage of Seeped Lands. Thru December 31, 1928, Transfer Case, Box No. 921 Rio Grande 322.--430., Entry 7, RG 115, NARA Denver; and Donald J. Pisani, *Water and American Government: The Reclamation Bureau, National Water Policy, and the West, 1902-1935* (Berkeley: University of California Press, 2002), 149.

Congress twice extended the schedule for EBID and EP#1's repayments in the early 1930s, permitting continued deferment, and through 1936 both districts availed themselves of this opportunity. Execution of "adjustment contracts" in 1937, in which the districts relinquished their rights to hydroelectric power revenue at the newly-constructed Caballo Dam below Elephant Butte, reduced their obligations – but the allocation of repayment costs between the two districts remained outstanding. *An*

> receive only 'tail-end' or waste water, the land in the Hudspeth County district taking it water by virtue of a contract and the lands privately owned below the district lower boundary only by taking by gravity or pumps what happens to be in the river channel.

This was the "unavoidable waste" from the project-irrigated valleys above.[218]

Additional evidence that New Mexico's delivery of water at San Marcial was the delivery of water to Texas may be found in an undated "Analysis of the Terms of the Compact," authored by New Mexico State Engineer and Rio Grande Compact Commissioner Thomas B. McClure. In the piece, which summarizes the compact, McClure agrees with the explanation offered by Clayton to Smith regarding the absence of a state-line delivery to Texas, analogous to the state-line delivery to New Mexico from Colorado. "The subdivision of the basin at San Marcial," he stated

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Act For the temporary relief of water users on irrigation projects constructed and operated under the reclamation law, April 1, 1932, 47 Stat. 75, chapter 94; *An Act To extend the operation of the Act entitled, "An Act For the temporary relief of water users on irrigation projects constructed and operated under the reclamation law," approved April 1, 1932*, March 3, 1933, 47 Stat. 1427, chapter 200; *Project History, Rio Grande Project, Calendar Year 1932*, 20; and *Project History, Rio Grande Project, Calendar Year 1933*, 16; *Project History, Rio Grande Project, Calendar Year 1934*, 16; *Project History, Rio Grande Project, Calendar Year 1935*, 16; *Project History, Rio Grande Project, Calendar Year 1936*, 15. USBR PHRGP 1912-1988 (mf); Department of the Interior, Bureau of Reclamation, Contract Dated Nov. 9, 1937, Ilr-982, Elephant Butte Irrigation District (Adjustment of project construction charges and other purposes). ff. 222.- Rio Grande Project. Contracts with Elephant Butte Irrigation District, Separate Folder, Box No. 917, Rio Grande Pro. 222._222.-; Department of the Interior, Bureau of Reclamation, Contract Dated Nov. 10, 1937, Ilr-981, El Paso County Water Improvement District No. 1 (Adjustment of project construction charges and other purposes). ff. 222.- Rio Grande Project. Irrigation Districts, El Paso County Water Improvement District No. 1, Separate Folder, Box No. 918 Rio Grande Pro. 222._222.-, Entry 7, RG 115, NARA-Denver.

Resolution of the cost apportionment question finally came with signing of the interdistrict agreement, six months of negotiations between the districts and Reclamation and Interior Department officials. The agreement memorialized the historical distribution of repayment costs for storage and general project features between EBID and EP#1 on the basis of the respective irrigated acreages that the districts themselves had committed to back in 1929 and which Reclamation agreed to serve in proportion to the available water supply: 88,000 acres in New Mexico, in EBID, and 67,000 acres in Texas, in EP #1. Contract between Elephant Butte Irrigation District of New Mexico and El Paso County Water Improvement District No. 1 of Texas, signed February 16, 1938, and approved by Assistant Secretary of the Interior Oscar L. Chapman, April 11, 1938. ff. 400. Rio Grande, Lands-General, 1930 thru, Box 932 Rio Grande Pro. 400.__400.08, Entry 7, RG 115, NARA Denver.

Whether the interdistrict agreement accomplished a de facto allocation of water between New Mexico and Texas as Littlefield maintains or was focused solely on the allocation of the cost of the federal project between the districts, this agreement, prior contracts between the federal government and EBID and EP #1, the Hudspeth Warren Act contract, and the 1906 Mexican treaty all underscore federal management and control over the waters delivered by New Mexico at San Marcial.

[218] Frank B. Clayton, Rio Grande Compact Commissioner for Texas, to Mr. Sawnie B. Smith, October 4, 1938. Box 2F466, RGCC-FBCP, UTA; and Littlefield, *Conflict on the Rio Grande*, 213-214.

unequivocally, "is necessary because the Rio Grande Project of the Bureau of Reclamation must be operated as a unit."[219]

As these statements by Clayton and McClure, and the service to lands beyond the Rio Grande Project down to Ft. Quitman make plain, New Mexico's San Marcial delivery per the compact was the state-line delivery to Texas. Water captured and stored in Elephant Butte Reservoir on release and re-use served lands not only within the Rio Grande Project but also downstream to Ft. Quitman. Calculations of the demands on the federal reservoir by federal engineers and the engineering advisors to the Rio Grande Compact commissioners recognized the dependence of these lands on the reservoir's water supply. The commissioners themselves understood that that water delivered to the reservoir would be under federal control, and thus a state-line delivery by New Mexico to Texas, similar to the state-line delivery by Colorado to New Mexico, was impractical.

[219] Thomas B. McClure, State Engineer, "Analysis of the Compact," undated, 21-22. NM_00164500 – NM_00164501.

Opinion V: Although irrigation water was the prime concern of compact commissioners and their engineering advisors in the 1920s and 1930s, the 1938 Rio Grande Compact ultimately did not limit the uses to which water in the Upper Rio Grande Basin could be put in the future.

As noted at various points in the opinions above, irrigation for agricultural development was a central theme of the negotiations leading to both the temporary 1929 and permanent 1938 compacts. The recorded compact proceedings are filled with discussions of how much land could be irrigated in the San Luis Valley in Colorado with the construction of a drain or other works, for instance, and the impact that the Middle Rio Grande Conservancy District could have on the Rio Grande Project and the need to prevent a decline in the quantity and quality of water reaching already irrigated lands within the federal Rio Grande Project and beyond were of equal concern. However, other uses – domestic, industrial, and municipal – were addressed in those proceedings and the federal Rio Grande Joint Investigation. Actions and statements by federal and state negotiators and engineers following the compact, moreover, indicate that the drafters both recognized the potential for non-agricultural uses of the Rio Grande's waters and intended for the three states, pursuant to the schedules of delivery established by the compact, to have autonomy in the development of the waters within their borders, post-1938.

At the first meeting of the Rio Grande Compact Commission in October 1924, the possibility of El Paso seeking a water supply from the Rio Grande as part of a compact was raised. Joseph Taylor, an attorney with EBID, in fact argued for the inclusion of Texas in the compact negotiations initiated between Colorado and New Mexico precisely for this reason. He insisted,

> In my District, the one warning I get from the water users, in going ahead with this procedure, is the possibility that our interests at sometime may be different from the interest of the El Paso Valley, and that unless we are very careful, that we proceed with the full acquiescence of the people of the lower valley, there may be question of water supply which may at some time limit the project, and which might be interpreted by our friends below as being a limitation which would effect [*sic*] New Mexico's interests only. We have the City water supply of El Paso that may come up, and our people are a little doubtful of the propriety of going ahead unless Texas is fully and legally represented in every respect.[220]

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[220] First Meeting, Rio Grande River Compact Commission…October 26, 1924, 18-19. Folder 1. First Meeting Rio Grande Compact Commission. Oct. 26, 1924, Box 02-D.003, MS 0235, RGHC, NMSU Spec. Coll. As early as 1921, at the suggestion of consulting engineer John Lippincott, the City of El Paso was looking to the Rio Grande, and specifically the water stored in Elephant Butte Dam, to supplement its reliance on groundwater. For a brief overview of the early history of El Paso's municipal water development see A.N. Sayre and Penn Livingston, *Ground-water Resources of the El Paso Area, Texas*, prepared in cooperation with the El Paso Water Board and the Texas State Board of Water Engineers, United States Department of the Interior, Geological Survey, Water-Supply Paper 919 (GPO, 1945), 3 and 5-7.

Taylor was correct in his belief. When the Rio Grande Compact Commission met again in December 1928 with Texas "fully and legally represented," Major Richard F. Burges, legal advisor to Texas's compact commissioner T.H. McGregor and attorney for the City of El Paso, indicated that at the behest of "the municipal authorities at El Paso" he was there to present "before the commission the claims of the City of El Paso to a municipal water supply from the waters of the Rio Grande."[221]

Those claims were made in full at the next commission meeting in January 1929. El Paso mayor R.E. Thomason, appearing in person, read a statement asking for "consideration, recognition and establishment of [El Paso's] legal right to the municipal water supply from and out of the waters of the Rio Grande River…."[222] Noting that El Paso fronted on the river, the statement emphasized that the Rio Grande was "for many years…the source of the water supply of El Paso." It explained that "in recent years the City has obtained its water from wells, because the same could be more economically obtained than from the flow of the river." The supply from the wells was "limited

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EBID was aware of the city's interest, with president and manager H.H. Brook noting in March 1923 letter to the US Reclamation Service (more than a year before Taylor made his remarks) that it was (in the later words of Reclamation Chief Engineer F.E. Weymouth) "probable the City of El Paso, Texas will request water from the Rio Grande project for domestic purposes." In his letter, Brook had sought additional information on "contracts in existence between the United States and municipalities within and without Reclamation Service projects where water is furnished for similar purposes."

Weymouth obliged. In his reply, he enclosed a copy of a "standard form of contract for water service to incorporated towns," and pointed out that Section 4 of the 1906 Town Sites and Power Act (34 Stat. 116) "provides for water rights for towns and contracts therefor…." Reclamation was therefore authorized to supply water "for municipal purposes which would include the watering of lawns and such general irrigation as may be practiced within the town limits." Towns, the chief engineer emphasized, had to pay for such water as agricultural areas and could not secure "more favorable" terms. A handwritten note on the letter, most likely made by Brook, indicates that this letter was read to the EBID board, who expressed their desire to oppose such "schemes…as unsatisfactory." F.E. Weymouth, Chief Engineer, to Mr. H.H. Brook, President & General Manager, Elephant Butte Irrigation District, March 31, 1923. Folder 3, Box 023.016, Subject File, 1906-1925. Unclassified. H.H. Brook [9.21], MS 0235, RGHC, NMSU Spec. Coll. Federal reclamation authorities later determined that the 1920 Miscellaneous Purposes Act was the pertinent federal legislation, and as briefly discussed in footnote 234, the United States, EP #1, and one instance, EBID, entered into water service contracts with the City of El Paso in the 1940s, pursuant to that act.

[221] Proceedings of the Rio Grande Compact Conference...1928, 11-13. ff. ff. Proceedings of the Rio Grande Compact Conference Held Dec. 19-20-21, Box 2F471, RGCCR, 1924-1941, 1970, UTA.

[222] Thomason had telegrammed Burges on December 20, 1928, during the first meeting, asking him that "If water rights of City of El Paso are to be in any affected by proposed treaty or if any definite action is to be taken at present session please advise me so I can send McBroom or Woods to represent city." R.E. Thomason, Mayor, to Major Richard F. Burges, telegram, Dec. 20, 1928. ff. Rio Grande Compact Commission Records, 1927-1941, 1970, Richard Burges Papers: Correspondence, 1924-1935, 1927, Box 2F468, RGCCR, UTA.

and uncertain," which was why the City of El Paso believed "it will become necessary again to obtain its water supply from the waters of the Rio Grande River." El Paso had grown steadily since the turn of the nineteenth century, and within a generation was projected to "attain a population of at least 250,000," which would "require an annual municipal water supply of twelve billion gallons." Citing Texas's "riparian rights doctrine," the city asserted its rights to the waters of the Rio Grande as "necessity" to which it may have "to resort…in the future from failure or inadequacy of such other present available source of supply or from deleterious changes that may occur in such present source of supply."[223]

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[223] Proceedings of Rio Grande Compact Conference, Held January 21 to , 1929, At Santa Fe, New Mexico, 64-65. ff. Rio Grande Compact Commission Records, 1924-1941, 1970, Richard F. Burges Papers, Proceedings of Rio Grande Compact Conference, Held Jan. 21-, 1929 at Santa Fe, N.M. (84 pp.), Box 2F471, RGCC Records, UTA.

Thomason's efforts on behalf of his city were not limited to the submission of this statement. In December 1927, more than a year before he addressed the Rio Grande Compact Commission, Thomason and city water works superintendent A.H. Woods met with Interior Secretary Hubert Work to discuss the matter. Work advised him and Woods to meet with former Rio Grande Project superintendent and US International Boundary Commissioner L.M. Lawson. Lawson, in turn, recommended that the city wait until elections in EBID and EP#1 had been held. He also suggested that the city seek water within the project's operational 155,000-acre irrigable-acreage framework.

This suggestion, as Woods later explained to Work, was embodied in a letter that Thomason wrote to Work in February 1928. In that letter, Thomason noted that as much as 4,000 acres of the 67,000 acres allotted to Texas had not been brought under irrigation. He proposed for the City of El Paso to acquire those lands and thus obtain a right to water through the federal reclamation project. Woods for his part believed that this "should raise no objection on the part of the irrigation district, because of the fact that the City of El Paso would be expected to relieve the district of the construction repayments for such an area." Although the acting Rio Grande Project superintendent L.R. Fiock and EP#1 manager Roland Harwell were generally supportive of the city's proposal, before any further arrangements could be made, the temporary 1929 compact was adopted and progress towards the city obtaining Rio Grande water came to a halt. Footnote 234 below briefly discusses how the idea of securing Rio Grande project water was revived in 1940. See R.E. Thomason to Honorable Hubert Work, Secretary of the Interior, February 16, 1928; A.H. Woods to Hon. Hubert Work, Secretary of the Interior, February 17, 1928; Hubert Work, Secretary, to Hon. R.E. Thomason, Mayor of El Paso, Texas, Feb. 25, 1928; P.W. Dent, Acting Commissioner to Mr. A.H. Woods, Superintendent, City Water Works, March 2, 1928; Memorandum, From: Acting Superintendent [L.R. Fiock], To: The Secretary (Thru The Commissioner, Washington, D.C.), Subject: Water Supply for City of El Paso – Allotment of Irrigable Area to The Texas District – Rio Grande Project, El Paso, Texas, March 27th, 1928; A.H. Woods to Honorable Hubert Work, Secretary of the Interior, Department of the Interior, El Paso, Texas, April 13, 1928; Hubert Work, Secretary, to Mr. A.H. Woods, Superintendent, City Water Works, Apr. 20, 1928; Memorandum, From Commissioner [Elwood Mead], To Superintendent, El Paso, Tex., Subject: Proposed purchase of water by City of El Paso, April 21, 1928; and Memorandum, From: Acting Superintendent [L.R. Fiock], To: The Secretary (Thru The Commissioner, Washington, D.C.), Subject: Proposed purchase of water by City of El Paso – Rio Grande Project., El Paso, Texas, June 26th, 1928. ff. 223.02 Rio Grande, Corres re Lease or Sale of Water thru 1929, 1 of 2, Transfer Case, Box 907 Rio Grande 223.02, Entry 7, RG 115, NARA Denver.

Although there is no record of the commissioners discussing or deliberating El Paso's claim prior to congressional ratification of the 1929 temporary compact, the compact was intended to preserve existing water uses within the basin. It therefore recognized "domestic" and "municipal" purposes of water along with the "agricultural." Article XI, in particular, offered a strong statement of the relative importance of "domestic" and "municipal" uses:

> Subject to the provisions of this Compact, water of the Rio Grande or any of its tributaries, may be impounded and used for the generation of power, but such impounding and use shall always be subservient to the use and consumption of such waters for domestic, municipal and agricultural purposes. Water shall not be stored, detained nor discharged so as to prevent or impair use for dominant purposes.

For Colorado's compact commissioner and the father of the Colorado River Compact Delph Carpenter, the provision's meaning was clear. Article XI "provides for the development of power by use of waters of the Rio Grande but makes such use subservient to uses for domestic, municipal and agricultural purposes which are made dominant."[224]

When discussions towards a permanent compact resumed in December 1934, existing or present uses and needs of water for agriculture remained centerstage. Former Colorado governor George Corlett, for instance, under questioning from Texas commissioner T.H. McGregor argued for "parity" among the three states on the basis of "the present acreage now under cultivation." Pushed further by McGregor about what "parity" meant, Corlett clarified: "Present requirements, then."[225]

The federal Rio Grande Joint Investigation pushed the commissioners to think more expansively about the basin's water needs. In his first appearance before the commission in December 1935 to offer the assistance of the National Resources Committee, University of Chicago historical geographer and consultant Harlan H. Barrows posed pertinent questions as to future uses of the water to be equitably apportioned among the three states:

> What, in the long run, will be your needs for water, not for irrigation supply, but for all other purposes, for city and town water supply, for industry, and the like? What are the prospects with respect to growth in population, and the prospects for now and greater needs for water associated with that growth? What are the possibilities for decentralized

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[224] *An Act Giving the consent and approval of Congress to the Rio Grande compact signed at Santa Fe, New Mexico, on February 12, 1929*, June 17, 1930, Public, No. 370, chap. 506, 46 Stat. 767; and Report of Delph E. Carpenter, Commissioner for the State of Colorado in re Rio Grande River Compact, March 1, 1929, 5. ff. WDEC 16-12, Rio Grande 1934, WDEC Box 16, Series 1: DEC Correspondence, 1895-1949 and undated, Subseries 1.2 Loose Correspondence, 1895-1949 and undated, PDECF, WRA, CSU-FC.

[225] Proceedings of the Rio Grande Compact Conference held at Santa Fe, New Mexico, December 10 & 11, 1934, 12-13. ff. 1 Proceedings of the Rio Grande Compact Conference held at Santa Fe, New Mexico, 1934-1935, Box 62, Series 7, Subseries 7.1, PDECF, WRA, CSU-FC.

> industry, involving the use of more or less water? What are your prospective, no less than your existing, aggregated needs? To what extent can these prospective needs be met effectively?[226]

The commissioners were not dismissive of learning more about their respective states' future needs, but did not immediately embrace a study as wide ranging as Barrows sought. Colorado State Engineer and compact commissioner M.C. Hinderlider, for one, expressed his desire to obtain

> all factual data…of an engineering character, as Mr. Barrows has intimated, having to do with availability of water supply, the demands upon those supplies, the deficiencies, the surpluses, when they occur, and, in fact, all matters pertaining to the efficient, and I believe, ultimate utilization of this entire natural resource provided by the Rio Grande.[227]

Texas's commissioner Frank Clayton, McGregor's successor, while concerned mostly with safeguarding the water supply to Texas via the Rio Grande Project, supported the idea of a federal study of the Rio Grande. The resolution he introduced to provide for that study emphasized "a determination of all salient facts bearing on the present and potential water resources of the Rio Grande Basin above Ft. Quitman, and bearing on past and present uses therein."[228]

Barrows and fellow NRC consultant and agricultural economist Frank Adams pressed the issue, seeking a more open investigative mandate. Their suggested resolution called for an "investigation of the water resources and of the irrigable and irrigated lands of the Rio Grande Basin above El Paso, and of the present and prospective uses of water for agricultural and other purposes in such basin." Hinderlider largely accepted this, but Clayton remained more interested in focusing the federal efforts. In a second draft resolution, the Texas commissioner acknowledged that the compact commission sought "a thorough finding of all facts," including those "relevant to the use of water for irrigation and other beneficial purposes," but he proposed

> that such investigation be restricted to the findings of facts relevant to the water supply available in said [Rio Grande] Basin, and which could be made available from outside thereof, and relative to the use and consumption of water within said basin….

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226 Proceedings of Rio Grande Compact Commission…December 2-3, 1935, 6. ff. 032.1 (2/3), Box 1326, Entry 7, RG 115, NARA Denver.
227 Proceedings of Rio Grande Compact Commission…December 2-3, 1935, 9. ff. 032.1 (2/3), Box 1326, Entry 7, RG 115, NARA Denver.
228 Proceedings of Rio Grande Compact Commission…December 2-3, 1935, 20. ff. 032.1 (2/3), Box 1326, Entry 7, RG 115, NARA Denver.

Adams was concerned that this resolution, if adopted, would severely circumscribe the investigation and he instead urged "a broader study of this whole basin problem…."[229]

New Mexico State Engineer and compact commissioner Thomas McClure was more inclined to Clayton's position, that the federal investigation be directed to a "factual survey" that would address more directly the issue of equitable apportionment of the Rio Grande among the three states. Yet, he too recognized "other purposes" for the river's waters. McClure's proffered resolution read, in part,

> that the National Resources Committee, through the Water Resources Committee, be hereby requested to arrange immediately for some investigation of the water resources and of the irrigable and irrigated lands in the Rio Grande Basin, and of the respective uses for agricultural and other purposes in such Basin….[230]

The compromise resolution adopted by the commission expressly "limited" the "cooperative investigation…to the collection, correlation and presentation of factual data," unless the commissioners unanimously requested "recommendations." An early version defined that investigation to be "of the past, present and prospective uses of water for agricultural and other beneficial purposes in such basin." When Texas's engineer advisor Raymond Hill expressed concern that such language may "be construed as omitting consideration of natural losses," a consideration that he believed was "a major factor in any investigation," Barrows suggested that the phrase be revised to "read 'of the past, present and prospective uses of water and other consumption of water in such basin." Hill explained to the commissioners that this language was inclusive of "Domestic uses, and then consumption, which takes place naturally, striking out 'for agricultural and other beneficial uses.'"[231]

The resulting report of the federal investigation, the *JIR*, consequently considered "Uses and requirements other than for irrigation." These uses included municipal purposes, for "cities, towns, and villages" as well as "power purposes." The "General Report," which summarized the individual reports by various federal agencies, observed that these uses were "but a small fraction of the irrigation use" that was common from the Rio Grande's headwaters in Colorado to Fort Quitman, Texas. "As general average," the report noted, "the water requirement of cities and towns corresponds closely to the irrigation requirement of agricultural lands of an equivalent area." Nearly all the area cities, towns and villages derived their water supply from "pumping

[229] Proceedings of Rio Grande Compact Commission…December 2-3, 1935, 25-28 and 30. ff. 032.1 (2/3), Box 1326, Entry 7, RG 115, NARA Denver.
[230] Proceedings of Rio Grande Compact Commission…December 2-3, 1935, 31-32. ff. 032.1 (2/3), Box 1326, Entry 7, RG 115, NARA Denver.
[231] Proceedings of Rio Grande Compact Commission…December 2-3, 1935, 37-38 and 42-43. ff. 032.1 (2/3), Box 1326, Entry 7, RG 115, NARA Denver.

ground water which, in turn, has its source in stream flow and in precipitation on the floor of the valleys," and the report determined that "[f]rom a basin-wide standpoint…this use constitutes a stream-flow depletion." To the USDA Bureau of Agricultural Engineering fell the task of assessing these depletions within the various sections of the basin. The agency included these urban and semi-urbanized areas within the "total area for which consumptive requirement [were] estimated," and thus "no special consideration of this use or allowance for it" was made. The City of Albuquerque, for example, was "included in the figures [of stream flow depletion]" for the so-called "Middle section" of the basin that extended "from the Colorado-New Mexico state line to San Marcial at the head of Elephant Butte Reservoir."[232]

The City of El Paso was excluded from this calculation of urban water consumption in the basin (which totaled 21,000 af) because of its dependence on wells located east of the city. These were, wells that drew upon groundwater fed by precipitation. Albuquerque likewise relied upon groundwater. Yet, the calculation of water consumption for the Middle section included the city because engineers involved with Albuquerque's proposed Jemez Creek development (which aimed to replace municipal wells with a direct diversion from one of the Rio Grande's tributaries) believed that the city's groundwater use was "undoubtedly a draft, direct or indirect, on Rio Grande; that therefore construction of the Jemez project amounts only to a change in point of diversion…."[233]

The *JIR* nevertheless made note that "the future of the water supply for El Paso" could include a direct diversion from the Rio Grande. It quoted at length from a letter that Harlowe Stafford, the federal engineer in charge of the investigation, received from the superintendent of El Paso's municipal waterworks:

> We are contemplating the drilling and construction of three additional wells within the very near future, said construction to be contingent upon the recommendations and advice which will be contained in a report of a survey of the underground water resources of El Paso and vicinity which was made during 1935 and 1936 by the United States Geological Survey.
>
> The records which this department has maintained over a period of years indicate that the static level of our ground-water supply is slowly receding. This, of course, can mean but one thing; that is, that the pumping in this area exceeds recharge.
>
> Should the static level continue to drop during the next 10 or 20 years as it has during the last 15 years, we believe that we shall find it necessary to seek another source of supply. Of course, there is but one other source of supply available and that is the Rio Grande.

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[232] *JIR*, 1, 20, and 104-105. The Bureau of Agricultural Engineering's data is offered in Part 3: Water Utilization: Report of the United States Bureau of Agricultural Engineering, Section 7 – Consumptive Use of Water Requirements, in *JIR*, 368, 370-371, and 422-423.
[233] *JIR*, 105-106.

> However, we do not think that it will be necessary for us to use water from that source for several years, it at all.[234]

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[234] *JIR*, 106.

The superintendent may have been optimistic in his assessment. In the summer of 1940, El Paso city officials, having had to cut back on water use on city-owned properties and confronting the possibility of having to supply the nearby US Army post, Fort Bliss, with additional water, approached federal reclamation authorities again. El Paso's new proposal was much like its previous proposal from the 1920s: to purchase land within EP#1 and thereby obtained water from the project. Working with the EP #1 manager Roland Harwell and El Paso City Attorney and former Texas compact commissioner Frank Clayton, Rio Grande Project Superintendent L.R. Fiock and Reclamation District Counsel H.J.S. Devries drafted a contract, pursuant to the 1920 Miscellaneous Purposes Act in November 1940. That contract, which EBID approved but did not join as a party, was finalized in February 1914 by the United States, EP #1, and the City of El Paso. A supplemental contract, with EBID as a party, was approved in 1944, and a third supplemental contract between EP #1 and the city (without either EBID or the US as a party, although the US approved the agreement) was prepared in 1949. See Ashley G. Classen and J.N. Hinyard, *Report on the Use of Rio Grande River Water as a Supplemental or Total Supply for the City of El Paso*, Lance Engineers, Inc., May, 1940), 1-8 and 13-124. 090-2000-028-W054, Box 090 028 W044-W054, El Paso Historical Society, El Paso, Texas; W.E. Robertson, Chairman, Water Development Commission of the City of El Paso, To the Honorable John C. Page, Commissioner, Bureau of Reclamation, June 8, 1940; Memorandum, From: Superintendent [L.R. Fiock], To: The Commissioner (Through Chief Engineer, Denver, Colorado), Subject: Negotiations by City of El Paso for municipal water supply from project sources – Rio Grande Project., El Paso, Texas, June 20, 1940; H.W. Bashore, Acting Commissioner, to Mr. W.E. Robertson, Chairman, Water Development Commission of the City of El Paso, Jul 25, 1940; City of El Paso, Texas, to The Honorable, The Secretary of the Interior, Statement as to the Water Supply of the City of El Paso in connection with its application for permission to supplement its supply from the Rio Grande, August 31, 1940; Memorandum, From: Acting Commissioner [H.W. Bashore], To: District Counsel, El Paso, Texas, Subject: Desire of city of El Paso to secure a municipal water supply from Rio Grande Project, September 30, 1940; H.J.S. Devries, District Counsel, to Hon. Edw. Mechem, October 5, 1940; Memorandum, From Superintendent [L.R. Fiock], To Commissioner (Through Chief Engineer, Denver, Colorado), Subject: Water supply for City of El Paso from project sources – Rio Grande Project, November 26, 1940; and United States Department of the Interior, Bureau of Reclamation, Rio Grande Project, New Mexico-Texas, Contract for Supplemental Water Supply for the City of El Paso, El Paso draft 11/18/40, Dec-9'40. ff. 223.02 - Rio Grande - Leases, Sales & Rentals of Water, El Paso, City of, thru Dec 1941. Box 920, Rio Grande Pro. 223.02, Entry 7, RG 115, NARA Denver; Memorandum, To: Secretary J.A. Krug, From: Commissioner [Michael W. Strass], Subject: Proposed supplemental contract with City of El Paso for municipal water supply – Rio Grande Project, May 13, 1949, Approved: May 19, 1949, (sgd) William E. Warne, Assistant Secretary of the Interior; Memorandum, To: The Solicitor, From: Acting Commissioner [Wesley R. Nelson], Subject: Proposed contract arrangements to supplement City of El Paso water supply--Rio Grande project, Sep 2 1949; and Memorandum, To: The Solicitor, From: Bruce Wright, Subject: Arrangements to supplement City of El Paso water supply--Rio Grande Project, Sep 14 1949. File No. 8-3 (Part 8), Reclamation Bureau - Rio Grande – Distribution of Waters, General. January 27, 1937 thru February 10, 1950, 8-3 Rio Grande – Distribution of Waters - General, Box 3623, 8-3 Rio Grande—Contracts-Nelson, J.P. 8-3 Rio Grande Flood Control, CCF 1937-1953, RG 48, NARA II; and Contract between the City of El Paso and El Paso County Water Improvement District Number One, dated August 10, 1949, approved J.A. Krug, Sec'y of the Interior, Sept. 23, 1949. ff. B-12.2.12.1 Water Control &

Neither in the December 1937 "Report of Committee of Engineers" nor in the recorded proceedings leading up to the formal drafting and signing of the permanent compact in March 1938 is there explicit discussion of other possible or future uses of compact water. As addressed in Opinion I, "present uses of water" was the focus of the engineering advisors' report and the predominant use of water in the basin circa 1938 was irrigation. The compact itself references "irrigation demands" and "irrigation."[235]

There is no language in the compact, however, explicitly precluding the use waters of the Rio Grande for domestic, municipal, and industrial uses. Historical evidence exists, moreover, that those most involved with the negotiations did not see the compact as foreclosing opportunities to use water for purposes other than irrigation within the basin. Bliss, for one, in reviewing the general outlines of the technical basis of the compact to McClure in December 1937, noted "Developments in the three valleys [i.e., the San Luis Valley, the Middle Rio Grande, and the Elephant Butte-Ft. Quitman section of the upper basin] will be limited only by certain restrictions in reservoir storage during period of extremely low run off and by limitation of debits which may be incurred at any time."[236]

Clayton, for another, construed his responsibility as Texas's commissioner to secure all the waters to which Texas was entitled – not just water for irrigation. A little over two months after signing the compact, at a May 1938 conference of water users below Ft. Quitman, he unequivocally stated that it was his duty "to try and get every drop of water Texas had a right to claim, irrespective of how or where it was to be used in Texas." Such a statement indicates that Clayton saw the uses to which the waters Texas obtained under the compact were put were immaterial.[237]

New Mexico's pursuit of the Jemez Creek project in the wake of the compact's signing similarly suggests that interests in that state did not see the waters of the Rio Grande as dedicated exclusively to agriculture. Clayton's response to that project also bolsters the notion that he and others saw other possible uses for the water within the confines of the compact. After the compact's signing but before its ratification by the states and Congress, the City of Albuquerque sought funds from the Public Works Administration to initiate the Jemez Creek Project. Federal

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Accounting 1 of 4, City & County of El Paso; El Paso, Hudspeth County Conservation District; Hudspeth County Conservation & Reclamation District No. 1; Elephant Butte Irrigation District, January 1906 thru September 1960, Box 22, Accession Number 076-69A-0928, RG 76, NARA Ft. Worth.

[235] "Rio Grande Compact," in Proceedings of the Meeting of the Rio Grande Compact Commission…March 3rd to March 18th, inc., 1938, Appendix No. 11, 73, 80. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

[236] Bliss to [McClure], December 22, 1937. Rio Grande Compact – July 7, 1937 to June 30, 1938, 26th Fiscal Year, NM_0015692 – NM_00156929.

[237] *Proceedings of Meeting, held on Friday, May 27, 1938*, 10. ff. Proceedings and Minutes 1935-1938, Box 2F463, RGCC-FBCP, UTA.

funds for water development within the Rio Grande Basin had been frozen by executive order pending the Rio Grande Joint Investigation, but now with the compact nearly in place long-contemplated projects were pushed forward in New Mexico and Colorado. Albuquerque consulting engineer H.C. Neuffer (who also played a pivotal role in the development of the compact as consultant to the Middle Rio Grande Conservancy District, as discussed in Opinion I) urged Clayton – as the Texas commissioner later related to engineering advisor Raymond Hill – "to clear the Jemez Creek water supply project for the City of Albuquerque."

Clayton demurred on giving Neuffer assent, not so much on the basis of the project itself but because the compact had not yet been adopted. This was a position that the Texas commissioner reportedly shared with EBID and EP #1 representatives, all of whom likewise opposed Colorado's Wagon Wheel Gap project for the same reason. For Wagon Wheel Gap, Clayton wrote Hill, "Our attitude was that until the compact had been ratified, we could not give clearance to any project involving the use of water of the Rio Grande," and he gave Neuffer "the same answer" as to Jemez Creek. Although the engineer and Colorado's representative Ralph Carr both "threaten[ed] to defeat ratification if our refusal to clear these projects result in the loss of federal funds," the Texas commissioner informed his engineering advisor that he could "not see my way to give them clearance, and this was the unanimous attitude of the officials of the Elephant Butte and El Paso County district." Should federal monies be "earmarked pending ratification of the compact," however, "we shall probably have no objection." For Clayton, EBID, and EP #1, it would appear that so long as the compact was in place, the nature of water use within the states was irrelevant.[238]

More compelling evidence of water use agnosticism in the compact comes from statements and analyses prepared by the compact drafters themselves following the compact's singing. As noted in Opinion I above, both Colorado commissioner M.C. Hinderlider and New Mexico commissioner Thomas McClure in letters to their respective governors urging adoption of the compact stated that the agreement safeguarded "present and future uses" of the Rio Grande waters in their states.

An undated "Analysis of the Terms of the Compact," authored by McClure, twice made the point that future, unspecified water uses were protected by the compact. Citing the "schedules of delivery of water at the Colorado-New Mexico State Line and at San Marcial at the head of Elephant Butte Reservoir," the New Mexico state engineer wrote,

> they provide that the three major basins [i.e., Colorado's San Luis Valley, New Mexico's Middle Rio Grande, and the Elephant Butte-Fort Quitman stretch] may make the best use

[238] Frank B. Clayton, Rio Grande Compact Commissioner for Texas, to Mr. Raymond Hill, August 24, 1938. Box 2F466, RGCC-FBCP, UTA.

> of their available supplies by the conservation and use of waters now being beneficially consumed and particularly by the construction of additional reservoirs to make use of waters which would otherwise spill from Rio Grande Project storage and be lost to the entire area [i.e., the Upper Rio Grande Basin, above Ft. Quitman].

Further in the "Summary" to the piece, McClure noted that among the compact's accomplishments,

> It permits each State to make the best possible use of her available supply and by means of storage, to conserve considerable flood waters which must otherwise spill from Project storage and be lost to the basin.[239]

Raymond Hill, recalling the compact negotiations three decades later, agreed. For a Supreme Court original action involving the three Rio Grande states in the late 1960s, Hill prepared a narrative account, "Development of the Rio Grande Compact of 1938," and sat for a deposition. His narrative largely summarizes the available engineers' reports and commission proceedings, yet much like the compact itself does not expressly deny water uses other than irrigation. In fact, in reviewing the events leading to the compact, Hill's narrative suggests that future water developments were not tied exclusively to irrigation:

> The Committee of Engineering Advisers was instructed to prepare schedules of deliveries by Colorado and by New Mexico that would insure [*sic*] maintenance of the relationships of stream inflow to stream outflow that had prevailed under the conditions existent when the Compact of 1929 was executed. The Committee of Engineering Advisers was also instructed to provide for freedom of development of all water resources in the drainage basin of Rio Grande above Elephant Butte subject only to compliance with these schedules.[240]

An exchange that Hill had with United States attorney Donald Redd at a December 1968 deposition further clarified the engineer's meaning as to "freedom of development":

> By Mr. Redd:
>
> Q. Mr. Hill, I call your attention to your statement on page 20 and on page 62 of your report [i.e., "Development of the Rio Grande Compact of 1938"] and on page 62 where you stated that the objective in the negotiations was to base the use on the 1929 conditions [i.e., the passage quoted above], is that correct?
>
> A. Yes, the primary instructions to the Committee of Engineers, of which I was a member, were to develop a relationship between the supply entering the valleys, each valley, and the outflows from the valley, and to development schedules which would reflect that relationship as near as possible. That was the first instruction.

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[239] McClure, "Analysis of the Compact," undated, 21 and 29. NM_00164500, NM_00164509.
[240] Hill, "Development of the Rio Grande Compact of 1938," 62.

> Q. But in doing so, you contemplated improvements that would make more water available or could make more water available?
>
> A. Yes, that's exactly what I referred to in the second instruction, and it was the clear intent, I am positive, that we were instructed in the development of the schedules and in the provision for operation. Article VI [of the compact, which addressed debits and credits for the states of Colorado and New Mexico], for example, as drafted by the engineers, almost no change in the final text, was to provide for freedom of development between these points of upper index and lower index in each case, so that each State would be free to change its use and the manner of use, each State would be free to provide storage, but subject always to the delivery in accordance with the schedules.
>
> Colorado, for example, had been promoting the Wagon Wheel Gap Reservoir for many, many years, and all of the provisions in the Compact that referred to storage of water in the Reservoirs and how they would be operated were all to make it possible – for example, Wagon Wheel Gap – so the 200,000 acre-feet could be stored in Wagon Wheel Gap that otherwise would have passed over Elephant Butte and down the river and have been of no value to anybody. Obviously, you could not store that flood water in Elephant Butt, then pump it back to San Luis, it had to be stored in Wagon Wheel Gap.
>
> So the whole theory of the thing, the premise under which the Compact was negotiated, that subject only to the maintenance of depletions that had occurred, subject only to not increasing those overall depletions, there is a freedom in each State to store, develop, improve or do anything else within that State. That was the whole intent.[241]

Hill's understanding of the intent of the compact aligned with McClure's: each state was free to utilize the waters of the Rio Grande within their borders as they saw fit, pursuant to the schedules of delivery adopted in the compact that allocated the available water supply of the Upper Rio Grande Basin.

The December 1937 report of the compact engineering advisors and the compact proceedings themselves indicate that "only present needs" within the basin could be considered in the formulation of a compact given the "usable water supply." Irrigation was the predominant use of water in the basin at time. The compact references "irrigation demands" and "irrigation," yet it does not specifically prohibit other uses of the Rio Grande water it apportioned. There is evidence, moreover, from direct participants in the negotiations that, pursuant to the schedules of delivery established by the 1938 compact, Colorado, New Mexico, and Texas were to have autonomy in the development of the waters within their borders – both at the time of the compact and in the future.

---

[241] In the Supreme Court of the United States, October Term 1967, No. 29, Original, *State of Texas and New Mexico, Plaintiffs, vs. State of Colorado, Defendant,* Deposition of: Raymond A. Hill, Taken December 4, 1968, Denver, Colorado, 35-36. ff. Texas & New Mexico v. Colorado, w. Texas vs. Colorado 66-1061, Box 1989 41-240, LF-TAG, TSA.

Opinion VI: The Special Master fairly described the background history leading to the 1938 Rio Grande Compact on pages 31 through 187 and 203 through 209 of the *First Interim Report of the Special Master*, dated February 9, 2017.

Having reviewed the background history leading to the 1938 Rio Grande Compact presented on pages 31 through 187 and 203 through 209 of the *First Interim Report of the Special Master*, dated February 9, 2017 as well as the materials appended to it, it is my expert opinion that the Special Master fairly described that history. I base my opinion not only on my professional knowledge and expertise, but also on the historical records that I examined in the course of researching and analyzing the history of the 1938 Rio Grande Compact, many of which are cited in the opinions above.

Appendix

Resume of Scott A. Miltenberger, Ph.D. – May 31, 2019

Scott A. Miltenberger, Ph.D.

Partner / Consulting Historian

Summary

Dr. Miltenberger is a professional consulting historian, specializing in environmental and natural resources issues. Since joining JRP in 2006, he has researched alleged riparian and appropriative water rights, historical ground water rights, and Native American and federal reserved water rights in California and throughout the American West. Dr. Miltenberger has also led historical investigations of flood events, land ownership, survey / boundary disputes, and potentially-responsible parties for toxic clean-up under the provisions of CERCLA. His clients have included local, state, and federal agencies, as well as private parties. Dr. Miltenberger has qualified as an expert historian and given expert witness testimony in Sacramento County Superior Court, Santa Clara County Superior Court, and in Arizona's San Pedro-Gila River Adjudication.

Selected Professional Experience

Expert Witness Work, Deposition, and Trial Testimony over the Past 4 Years

State of Texas v. State of New Mexico and State of Colorado, No. 141, Original, Supreme Court of the United States. Preparation of expert historian report and anticipated expert witness deposition and trial testimony concerning the development of the Rio Grande Compact of 1938. Sacramento, CA: Somach Simmons & Dunn, 2012-Present.

Matt Pear and Mark Pear, Plaintiffs, vs. City and County of San Francisco, a municipal corporation, Does, 1-50, inclusive, Case No. 112CV227801, Superior Court of the State of California, County of Santa Clara. Provided expert witness testimony concerning historical land use and urban/suburban/industrial development of Santa Clara County in the 1950s as related to the Hetch Hetchy Aqueduct Right of Way. San Francisco, CA: City and County of San Francisco, City Attorney's Office, San Francisco Public Utilities Commission, 2017.

In Re the General Adjudication of All Rights to Use Water in the Gila River System and Source. Civil Nos. W-1, W-2, W-3, and W-

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Education

Ph.D., United States History, University of California, Davis, 2006.
M.A. United States History, University of California, Davis, 2001
A.B. History, *summa cum laude* Colgate University, New York, 1999

Academic Honors, Fellowships, and Grants

Agricultural History Center Dissertation Grant, University of California-Davis, 2005-2006
Reed-Smith Dissertation-Year Fellowship, University of California-Davis, 2004-2005
Jacob K. Javits Graduate Fellowship, United States Department of Education, 2000-2004
Legacy Fellowship, American Antiquarian Society, 2004
Distinction, Ph. D. Comprehensive Examinations, University of California-Davis, December 2001
Reed-Smith Graduate Fellowship, University of California-Davis, 1999.
Alumni Memorial Scholarship, Colgate University, 1995-1999
Charles A. Dana Fellowship, Colgate University, 1997-1999
Phi Beta Kappa, Colgate University, September 1998 (inducted)
Phi Alpha Theta, Colgate University, September 1997 (inducted)

Professional Affiliations

American Historical Association (Pacific Coast Branch)
American Society for Environmental History
National Council on Public History (Consultants' Committee)
National Trust for Historic Preservation

4, Contested Case No. W-1-11-605, Maricopa County Superior Court, State of Arizona. Preparation of expert historian report, and expert witness deposition and trial testimony concerning the history of Fort Huachuca, Arizona, its changing missions, population, and water use, for the purposes of a federal reserved water right claim. Washington, DC and Denver, CO: United States Department of Justice, 2012-2016.

Modesto Irrigation District vs. Heather Robinson Tanaka, et al. Case No. 34-2011-00112886, Superior Court of the State of California, County of Sacramento. Expert witness deposition and trial testimony concerning the riparian status of a parcel in San Joaquin County and the historical land and water uses on that parcel. Sacramento, CA: O'Laughlin & Paris LLP for Modesto Irrigation District, 2014-2015.

Consulting Historican Services Since 2006

Clear Lake Littoral Rights Analysis, Lake County, CA. Woodland: Yolo County Flood Control and Water Conservation District, 2019-Present.

Riparian and Pre-1914 Appropriative Water Rights Investigation of Parcels along Merced River, Merced County, CA, 2018-Present.

Investigation of Historical Water Right Entitlements within the Kern River Basin, Kern County, CA, 2018-Present.

Riparian Water Rights Investigation of Parcels in San Joaquin County, 2018-Present.

Investigation of Historical Water Right Entitlements within the Stanislaus River Basin, 2018-Present.

Riparian and Pre-1914 Appropriative Water Rights Investigation of an Agricultural Parcel in Merced County, CA, 2017-Present.

Riparian and Pre-1914 Appropriative Water Rights Investigation of Agricultural Lands in the Kings River Basin, Fresno County, CA, 2017-Present.

Historical Research of Water Rights for a Parcel in Stanislaus County. Sacramento, CA: O'Laughlin & Paris, LLP, 2017-Present.

Riparian and Pre-1914 Appropriative Water Rights Investigation of Sacramento-San Joaquin Delta Islands, 2016-Present.

In Re the General Adjudication of Rights to the Use of Water from the Coeur d'Alene-Spokane River Basin Water System. District Court of the Fifth Judicial District of the State of Idaho, Twin Falls, ID. Assisted in the research, data management, and preparation of an expert report regarding water rights claims made in the general adjudication of water rights in the Coeur d'Alene-Spokane River Basin, Idaho. Boise, ID: Natural Resources Division, Office of the Attorney General, State of Idaho, 2010-Present.

Historical Research of California Public Utilities Records, 2018.

Historical Research of Military Operations at McClellan United States Air Force Base, Sacramento, CA, concerning use of chromium and chromium products, 2018.

Historical Research of Native American / Federal Reserved Water Rights Claims. Humboldt County, CA, 2017-2018.

Potentially Responsible Parties (CERCLA) Title Research for a Parcel in Tulare County. Rancho Cordova, CA: Geocon Consultants, Inc., 2017.

Historical Research of Water Rights acquired by the City of Santa Cruz. Santa Cruz, CA: Atchison, Barisone, Condotti & Kovacevich, 2016-2017.

Historical Research on Dams and Flood Control Operations on the Boise River. Boise, ID: Natural Resources Division, Office of the Attorney General, State of Idaho, 2015-2017.

Historical Research Concerning Reclamation District Assessments in Colusa County. Sacramento, CA: Somach Simmons & Dunn, 2016.

In Re the General Adjudication of Rights to the Use of Water from the Snake River Drainage Basin Water System, State of Idaho v. United States; State of Idaho; and all unknown claimants to the use of water from the Snake River Drainage Basin Water System, District Court of the Fifth Judicial District of the State of Idaho, Twin Falls, ID. Assisted in the research, data management, and preparation of several expert and consultant reports related to Idaho state water rights from statehood to the present of the more than 158,000 water claimants in the Snake River Drainage Basin, Idaho. These studies involved reservoir storage rights, appropriative water claims, groundwater use, submerged lands, hydro-electric power generation, municipal water uses, federal reserved water rights for military, forest, and Indian reservations, tribal water claims, and legislative histories. Boise, ID: Natural Resources Division, Office of the Attorney General, State of Idaho, 2006-2016.

Research regarding Pre-1914 Water Rights of Woods Irrigation Company, San Joaquin County, CA. Sacramento, CA: State Water Contractors and San Luis and Delta-Mendota Water Authority, 2015-2016.

Riparian Water Rights Investigation for Agricultural and Wetlands in the Cosumnes River watershed, Sacramento County, CA. Sacramento, CA: Sacramento County Counsel, 2015-2016.

Riparian and Pre-1914 Appropriative Water Rights Investigation of Agricultural Lands in the Salinas River Basin, Monterey County, CA, 2015-2016.

Riparian and Pre-1914 Appropriative Water Rights Investigation of Agricultural Lands adjacent to the Sacramento River, Yolo County, CA, 2015-2016.

Historical Research and Analysis of the Construction of Cline Falls Dam and Power Plant on Deschutes River, Oregon. Bend, OR: Holland & Knight, LLP, 2015.

Historical Research of Shipbuilding Operations at Swan Island Shipyards, Port of Portland, Oregon. San Francisco: Bassi, Edlin, Huie and Blum, 2015.

Historical Research of Land Uses and Development West of Hunters Point, San Francisco. San Francisco, CA: Bassi, Edlin, Huie and Blum, 2015.

Research Regarding Historical Background of Groundwater Pumping and Litigation in the 1950s among Orange County, Riverside, and San Bernardino Area Water interests in the Upper Santa Ana River Basin in Southern California. Redlands, CA: Thomas McPeters, Esq., McPeters McAlearney Shimoff & Hatt, 2013-2015.

Historical Investigation of Riparian and Pre-1914 Appropriative Water Right Claims for Three Parcels in eastern Contra County, CA, 2014.

Gallo Cattle Company v. Lincoln White Crane Hunter Farms; Merced Irrigation District, et. al. Case No. CV00105, Superior Court, State of California, County of Merced. Assisted in the collection of historical documentation in support of an expert witness deposition and planned testimony regarding Crocker Huffman Land and Water Company history, development of its irrigation and drainage system (later acquired by MID), and the background of a 1918 agreement to flow water from Merced County Drainage District (later acquired by MID) to a private landowner. Walnut Creek, CA: Miller Starr Regalia; and San Francisco, CA: Duane Morris, LLP, 2013-2014.

Land Use History, Union Lumber Company and adjacent properties, Fort Bragg, CA. San Francisco, CA: Bassi, Edlin, Huie and Blum, 2013-2014.

Reclamation and Land Use History Investigation: Roberts Island, San Joaquin Delta, CA. Sacramento, CA: O'Laughlin & Paris LLP for Modesto Irrigation District; Kronick, Moskovitz, Tiedemann & Girard for State Water Contractors; and Diepenbrock Harrison for San Luis and Delta-Mendota Water Authority, 2010-2014.

History of Groundwater Development and Use in Antelope Valley to Fulfill the Changing Military Missions of Edwards Air Force Base, Kern, San Bernardino and Los Angeles Counties, CA. Denver, CO: US Department of Justice, 2009, 2012-2014.

Research on a Pre-1914 Appropriative Water Rights Claim for a Ranch in Merced County, 2013.

Cortopassi Partners v. California Department of Water Resources, et al. Case No. CV034843, Superior Court, State of California, County of San Joaquin. Assisted in the collection of historical documentation in support of an expert witness deposition and planned testimony concerning public and private dredging on the Mokelumne River. Sacramento, CA: California Department of Justice, 2012-2013.

Investigation of Historical Reclamation and Land Use of Union Island, San Joaquin Delta, CA. Sacramento, CA: O'Laughlin & Paris LLP for Modesto Irrigation District; Kronick, Moskovitz, Tiedemann & Girard for State Water Contractors; and Diepenbrock Harrison for San Luis and Delta-Mendota Water Authority, 2011-2013.

Investigation of Historical Delineations of the Rialto Groundwater Basin, San Bernardino, CA. Redlands, CA: Thomas McPeters, Esq., McPeters McAlearney Shimoff & Hatt, 2010-2013.

Investigation of Historic Water Development at Two Well Sites: Chino Groundwater Basin. Rancho Cucamonga, CA: Cucamonga Valley Water District, 2010-2012.

Historical Research of Water Development on the Merced River for Irrigation, Mining, and Power Purposes Prior to the Organization of the Merced Irrigation District, 1860-1926. Merced, CA, 2008-2012.

Historical Research of US Army Corps of Engineers' dredging and flood control activities on the Yuba River. Sacramento: MBK Engineers, 2012.

Sacramento River and San Joaquin River Levees: Research on history of construction, maintenance, repair, and performance, California. Sacramento: Kleinfelder, 2008-2012.

Research related to Water Storage, Diversion and Use by American Falls Reclamation District No. 2, *In Re the General Adjudication of Rights to the Use of Water from the Snake River Drainage Basin Water System, State of Idaho v. United States; State of Idaho; and all unknown claimants to the use of water from the Snake River Drainage Basin Water System*, Subcase No. 39576, District Court of the Fifth Judicial District of the State of Idaho, Twin Falls, ID. Boise, ID: Natural Resources Division, Office of the Attorney General, State of Idaho, 2011.

Historical Research regarding Operation of and Water Use at a Power Plant on Lytle Creek, San Bernardino County, CA for California Public Utilities Commission Hearings. Fontana, CA: Fontana Water District, and Rosemead: San Gabriel Water District, 2011.

Historical Water Rights Investigation – San Joaquin, Amador, and Calaveras counties, CA, 2011.

Susan River Pre-1914 Water Rights Investigation, Lassen County, CA. Chico, CA: O'Laughlin & Paris LLP, 2010.

Lower Lytle Creek Power Plant and Appurtenant Facilities: Construction and Water Use History. Redlands, CA: Thomas McPeters, Esq., McPeters McAlearney Shimoff & Hatt, 2010.

Due Diligence Research of Historical Land Uses, and Pre-1914 Appropriative and Riparian Water Rights associated with an 8,000-acre Historic Ranch in Madera County, CA, 2009-2010.

Legislative history of California's "Area of Origins" laws (County of Origin, Water Code Sections 10500-10506, and the Watershed Protection Statute, Water Code Sections 11460-11465). Stockton, CA: Herum/Crabtree Attorneys, 2009-2010.

History of Fontana Union Water Company's Lytle Creek Diversion on the San Bernardino National Forest. Fontana, CA: Fontana Union Water Company; Rancho Cucamonga: Cucamonga Valley Water District; and Rosemead, CA: San Gabriel Water District for submission to the Chief Counsel for Natural Resources, US Department of Agriculture, 2009.

Oakdale Irrigation District Water Rights Investigation. Chico, CA: O'Laughlin & Paris, 2008–2009.

Riparian Lands and Agricultural Land Uses Investigation for Major Reclaimed Islands in the southern San Joaquin Delta, San Joaquin County, CA. Chico, CA: O'Laughlin & Paris LLP, 2007-2009.

Historic Meandering of the River Bend Section of the Russian River, Sonoma County, CA. Sacramento, CA: Lennihan Law, APC, 2008.

Delta Risk Management Strategy, Franks Tract Levee Research: Historical research into the original condition of levees around Franks Tract, and collection of aerial photographs showing how the levees deteriorated over time after the island flooded, Contra Costa County, California. Benjamin & Associates, 2007–2008.

Pre-1914 Water Rights Investigation for Idyllwild Water District regarding Strawberry Creek, a tributary to the San Jacinto River. California State Water Resources Control Board, Complaint No. 33-05-01 In Re Strawberry Creek, Riverside County, CA. Sacramento, CA: Ellison, Schneider & Harris, Attorneys at Law, LLP, 2007 – 2008.

Fort Boise Military Reservation Federal Reserved Water Rights Investigation. Boise, ID: Natural Resources Division, Office of the Attorney General, State of Idaho, 2007.

Historical Property Ownership Research for a Mine in Lake County, CA. Houston, TX: El Paso Corporation, 2006.

Publications Authored in the Previous 10 Years

"Viewing the Anthrozootic City: Humans, Domesticated Animals, and the Making of Early Nineteenth-Century New York," in *The Historical Animal*, ed. Susan Nance (Syracuse, NY: Syracuse University Press, 2015), pp. 261-271.

IN THE SUPREME COURT OF THE UNITED STATES
BEFORE THE OFFICE OF THE SPECIAL MASTER
HON. MICHAEL J. MELLOY

STATE OF TEXAS Plaintiff, VS. STATE OF NEW MEXICO, and STATE OF COLORADO, Defendants.	Original Action Case No. 220141 (Original 141)

****
REMOTE ORAL AND VIDEOTAPED DEPOSITION OF
SCOTT MILTENBERGER
JUNE 8, 2020
****

REMOTE ORAL AND VIDEOTAPED DEPOSITION of SCOTT MILTENBERGER, produced as a witness at the instance of the Defendant State of New Mexico, and duly sworn, was taken in the above-styled and numbered cause on June 8, 2020, from 9:03 a.m. to 3:30 p.m., before Heather L. Garza, CSR, RPR, in and for the State of Texas, recorded by machine shorthand, at the offices of HEATHER L. GARZA, CSR, RPR, The Woodlands, Texas, pursuant to the Federal Rules of Civil Procedure and the provisions stated on the record or attached hereto; that the deposition shall be read and signed.

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ALSO PRESENT:

Ms. Susan Barela
Mr. Al Blair
Ms. Jennifer Stevens
Mr. Drew Miller
Mr. Nicolai Kryloff

EXAMINATION INDEX

WITNESS: SCOTT MILTENBERGER

EXHIBIT INDEX

SAM EXHIBIT NO.9 95
Letter dated January 27, 1936

THE VIDEOGRAPHER: The time is 9:03 a.m. We're on the record.

SCOTT MILTENBERGER,

having been first duly sworn, testified as follows:

E X A M I N A T I O N

BY MR. WECHSLER:

Q. Good morning, Dr. Miltenberger. How are you?

A. Good morning. I'm well. Thank you.

Q. My name is Jeff Wechsler. I'm from a law firm called Montgomery & Andrews, and I represent the State of New Mexico in this matter.

MR. WECHSLER: Why don't we go ahead and do appearances of -- of all counsel and people attending the deposition. On behalf of New Mexico, in addition to myself, we have Lisa Thompson and Susan Barela. We also have Dr. Jennifer Stevens, who's an expert in this case. How about for the State of Texas?

MR. HOFFMAN: Robert Hoffman for the State of Texas, and also attending is Stuart Somach.

MR. WECHSLER: For the United States? Lee, are you on mute?

MS. RANDEL: Jeff, the lead for the United States is going to be Judy Coleman, and she's got some stuff going on at home. This is Shelly pose as open-ended a question as possible and then to try to fully understand what may be required to answer that.

Q. Is it common for two historians to review the same set of events and reach different interpretive conclusions?

A. Yes. It is possible.

Q. One of the issues in your deposition that you indicated you did not agree with Dr. Littlefield was on the apportionment itself. Do you recall that?

A. My recollection is that I disagreed with Dr. Littlefield's claim that the apportionment was accomplished, I -- I believe, if memory serves, and I didn't review his book again in preparation for this deposition, that the 1905 legislative act is what accomplished the apportionment, that is to say the division between New Mexico and Texas, and my view is that the apportionment of the Rio Grande, at least relative to New Mexico and Texas, was accomplished by the Compact.

Q. Let's see if I can find -- I -- I'm curious, giving that answer, to understand your view on something. I -- I've just marked Exhibit SAM, which is a copy of Texas' complaint.

(Exhibit No. 5 was marked.)

Q. (BY MR. WECHSLER) Please let me know when that comes up for you.
A. It has come up.
Q. So the -- the first paragraph I'd like to get you to look at is Paragraph 4. Do you have that before you?
A. Yes.
Q. The first sentence reads, "As detailed below, the Rio Grande Compact, among other purposes, was entered into to protect the operation of the Rio Grande Reclamation project." Do you see that?
A. I do.
Q. Based on your review of the historical record, do you agree with that statement?
A. Yes. And as a matter of fact, I think that is a component of one of my opinions in my original expert report.
Q. Do you have any input into drafting this complaint?
A. No, not to my knowledge. I wasn't asked to review it or respond to it.
Q. Further down in Paragraph 4, I'm skipping one sentence about New Mexico. It then says, "Once delivered to Elephant Butte Reservoir, that water is allocated and belongs to Rio Grande project

beneficiaries in southern New Mexico and in Texas based upon allocations derived from the Rio Grande project authorization and relevant contractual arrangements." Again, based on your review of the historical record, do you agree with that statement?

A. Yes.

Q. A couple others here that I'm curious on your impression about. I'm moving now to Paragraph 6, Dr. Miltenberger. I'm looking at the last sentence in that paragraph, which reads, "The 1904 irrigation Congress also recommended delivery of water from the proposed project as between the lands in southern New Mexico and in Texas based on the ratio of project lands within each state. The recommendations of the 1904 irrigation Congress were adopted by the secretary of the interior and the Rio Grande Reclamation project was authorized pursuant to the Rio Grande Reclamation Act." Based on your review of the historical record, do you agree with that statement?

A. Yes.

Q. All right. Paragraph 8. And here, I'm looking at the first sentence, which reads, "As noted, Rio Grande project water deliveries are made based upon the ratio between the irrigable acreage of the Rio Grande project situated in New Mexico and the

irrigable acreage of the Rio Grande project situated in Texas. Historically, this ratio has been 57 percent New Mexico and 43 percent in Texas." Based on your review of the historic record, do you agree with that statement?

A. Yes.

Q. All right. Paragraph 10. Again, I'm looking at the first part of this paragraph. It says, "The Rio Grande Compact did not specifically identify quantitative allocations of water below Elephant Butte Dam as between southern New Mexico and Texas, nor did it articulate a specific state line delivery allocation. Instead, it relied upon the Rio Grande project and its allocation and delivery of water in relation to the proportion of Rio Grande project irrigable lands in southern New Mexico and in Texas to provide the basis of the allocation of Rio Grande waters between Rio Grande project beneficiaries in southern New Mexico and the State of Texas." Based on your historic review, do you agree with that statement?

A. Yes.

Q. All right. There's another document I want to get you to look at, and I'm marking this as Exhibit SAM 6. Again, please let me know when that comes up.

(Exhibit No. 6 was marked.)

A. It's up.

Q. (BY MR. WECHSLER) Do you recognize this document, Dr. Miltenberger?

A. Yes.

Q. In fact, this is a document that you describe in your original report; is that correct?

A. Yes.

Q. And what is this document?

A. This is a letter from Frank Clayton, the Rio Grande Compact commissioner for Texas, to an attorney, Sawnie B. Smith.

Q. What's the date of the letter?

A. October 4th, 1938.

Q. When was the agreement to enter into the Compact, when was that agreement reached?

A. The specific date actually -- I don't recall the exact date, but I believe it was before this letter.

Q. Same year?

A. Yes.

Q. If you look at the second paragraph here, Mr. Clayton says that the Rio Grande project, as you know, is operated as an administrative unit by the Bureau of Reclamation, and the dam and releases from

the reservoir are controlled by the Bureau and will continue to be at least until the federal government has repaid its investment and very probably even beyond that time. Now, my first question about that language is: In your report, you used the language that the Rio Grande project is operated as an administrative unit. What do you understand that term to mean?

A. That the -- that Reclamation administers the Rio Grande project as a whole.

Q. What the do you mean "as a whole"?

A. As a single piece.

Q. And here, Mr. Clayton is talking about that the Bureau will continue to operate the project. Based on your review of the historical record, was that an expectation that the states held as they were negotiating the Compact?

A. I don't recall it being a subject of discussion as to whether it would not be.

Q. Does that mean that there seems to be an assumption reviewing -- amongst the parties that that would continue?

A. Yes.

Q. This statement here indicates that, at least until the federal government has repaid its

investment, what do you understand that to mean?

A. Well, the basis of federal reclamation projects was that the beneficiaries would have to reimburse the federal government for the construction of the project itself, of the project works itself, at which point it would then be turned over to the project beneficiaries, at least that was the idea. The Reclamation Act was amended several times to reflect difficulties in repayments.

Q. And how did the beneficiaries repay the investment?

A. I believe through various assessments made.

Q. They would -- they had to pay -- they were given certain services and -- and water, and ultimately, they had to pay the government back?

A. Yes.

Q. If you -- if you go down a little bit further, Dr. Miltenberger, you skip over the paragraph "moreover," and you go to the paragraph that reads -- it starts with the word, "However." I'll just read that into the transcript. "However, the question of the division of the water released from Elephant Butte Reservoir is taken care of by contracts between the districts under the Rio Grande project and the Bureau of Reclamation." And that's similar to the

language we saw in the Texas complaint; would you agree, the concept?

A. It's similar language.

Q. It goes on, "These contracts provide that the lands within the project have equal water rights, and the water is allocated according to the areas involved in the two states." Do you see that?

A. Yes. I see that.

Q. What was meant by that language, "Lands within the project have equal water rights"?

A. I read that as Clayton asserting that the lands within the project -- there was no priorities among the lands within the project.

Q. What do you mean by that?

A. That one acre of land in the Mesilla Valley versus another acre of lands further down -- let's say one acre of land in the Rincon Valley versus one acre of land in the Mesilla Valley, that one or the other didn't have greater priority than the other, had a greater entitlement, shall we say, to the water. Although to be fair that the concept of water rights here, that this statement about water rights, is -- is a little ambiguous to me.

Q. Why is it ambiguous?

A. Water rights can mean a number of different things. I -- I think that Clayton here is evoking the fact that there's a contract, contracts between EBID, Elephant Butte Irrigation District, and El Paso Water -- Water District -- Water Conservation District No. 1. They're a contract as opposed to saying that there is a -- a appropriative right, a prior right, prior appropriative right. But the concept of water rights could be contractual or legal.

Q. Let me ask you first about the answer you gave about priority. Are you saying that there was no separate priority amongst any of the lands within the project?

A. That is my understanding of the Reclamation policy.

Q. And then you also said that each acre had an equal entitlement. Does that mean that each acre was entitled to the same amount of water?

A. I'm not entirely certain as I sit here, because I think that water deliveries were complicated -- more complicated and specific than simply to say that every acre gets precisely this amount, if I'm remembering some of the project histories that I looked at.

Q. So when you say you are remembering some of the project histories, are there particular documents

you're thinking of that you could point me to?

A. I'm thinking what I generally understand to be how Reclamation delivered water from Elephant Butte.

Q. And what's your general understanding?

A. My general understanding is that there would be various calls that would then be rising out of the districts that would then be relayed to the operator at the dam. And with that, actually, may we take a -- may we take a break?

Q. Of course, yeah. It's 10:10 now. Why don't we come back at 10:25.

THE VIDEOGRAPHER: The time is 10:09 a.m. We're off the record.

(Break.)

THE VIDEOGRAPHER: The time is 10:26 a.m. We're on the record.

Q. (BY MR. WECHSLER) All right. Dr. Miltenberger, back from our short break, and we were discussing deposition Exhibit SAM 6. I just have a couple more questions about that document and then we'll move back to the principles of Compact interpretation and then we'll talk again about your rebuttal report. My -- my first question back on deposition Exhibit SAM 6, you see at the beginning of

the paragraph we were discussing, it starts on Page 1 and carries over to 2, we can see there that Mr. Clayton is talking about, as he puts it, the question of the division of the water released from Elephant Butte Reservoir, right?

A. Yes.

Q. If you look at the last sentence of that paragraph, he says, "By virtue of the contract recently executed, the total area is, quote, frozen at the figure representing the acreage now actually in cultivation, approximately 88,000 acres for the Elephant Butte Irrigation District, and 67,000 for the El Paso County Water Improvement District No. 1 with a, quote, cushion of 3 percent for each figure." Do you see that?

A. Yes.

Q. My question is: Based on your review of the historical record, how did knowing the acreage in each of the districts allow for the division of water?

A. The original conception of the Rio Grande project was that water would be -- the water delivery was tied to the amount of irrigable acres.

Q. I'm sorry. You cut out at that last statement.

A. The water -- I believe I was saying that the water delivery through the project, to project lands, would be on the basis of irrigable acres.

Q. How so?

A. From the beginning.

Q. How were the -- was the water delivery on the basis of irrigable acres?

A. I'm not quite sure if I understand the question.

Q. How much water would each of the districts be entitled to?

A. Not certain if I could answer that specifically without taking a closer look at the -- perhaps the project histories. What -- my point was that the basis of the project, and this is one of the first Reclamation projects in the American west, was that rather than there be a certain amount of water, that the amount of water be determined by the amount of acres that could be irrigated through the project.

Q. And you have reviewed those project histories?

A. I have.

Q. So how -- what do the project histories tell you about how the water was divided between the districts?

A. I believe that there is some data in there regarding the amount of -- of water delivered to the various branches or divisions of the project.

Q. At the beginning of each year, was an allotment made for each project acre? Do you recall that?

A. I don't -- I don't recall offhand.

Q. All right. Let's turn back to -- well, let me ask you one last question about -- on the topic of this letter, are there any letters, other than this one we've been discussing, that you would point to that highlight a description of the way that water was divided between either the districts or the states?

A. I think there are -- there are a number of documents that describe both of those.

Q. And that -- my -- my question is: If -- if I wanted to go and review those documents that you considered to be important on that subject, what documents would you point me to? And I'm looking for a specific document so that I can go read those.

A. As I say, there -- there's a number. The -- much of the notes and correspondence of the engineers speak to how water should be apportioned among the states. If you're talking about between the districts, there's, again, number of correspondence, project histories. I think this is an issue that's turned over in several places. As I sit here, I don't think of any one that particularly stands out among all -- among all the others. I mean, I think there's -- many of those documents speak to these -- or many documents that speak to these things.

Q. And are you talking about documents immediately before and immediately after the Compact was agreed upon?

A. Yes.

Q. Will you agree with me that a Compact is an agreement between states?

A. Yes. I would say a Compact is an agreement between states.

Q. As you're reviewing these records, the correspondence, the historical record, were there issues that, say, one state would advocate for that ultimately states did not agree to?

A. There were specific positions, specific, might say demands, that weren't necessarily the ones that were incorporated into the Compact by the various -- by the various states.

Q. And so is part of the task of a historian to review those documents and try and understand what actually was agreed upon?

A. If that's -- if that's the research question,

A. I think as I stated earlier, it's the obligation of historian to acknowledge the entire historical record to the best they can and so to the extent that that would provide additional context or additional information through this and to address this answer, I would have.

Q. I asked you about New Mexico. Did Reclamation complain to the State of Texas about the groundwater pumping that was going on in that state in the 1940s and '50s?

A. I don't know.

Q. Do you know if, in the 1940s or 1950s, the State of Texas complained to the State of New Mexico about groundwater pumping?

A. I do not know.

Q. I have the same questions really on Page 21. We -- we looked at that paragraph on Page 21 that identifies the wells and the well numbers that starts with the words, "As for the irrigation wells themselves." Are you aware of any complaints from Reclamation, the State of Texas, or EP No. 1 about irrigation wells in the State of New Mexico?

A. As I sit here today, I'm not aware.

Q. Turn, please, to Page 23. And here, you're talking about -- you can look at Page 22 for context

if you want. I think you're -- you're talking -- on Page 22, you talk about -- you're talking about a Reynolds discussion of the Compact, and ultimately of declaring the groundwater basin in the Middle Rio Grande; is that right?

A. Yes.

Q. And -- and I'm looking at that -- on Page 23 now, you're looking at -- or I'm looking at the indentation here followed by the -- the next sentence and so I'll give you a moment just to review that.

A. Sorry. Where exactly are you seeking to draw my attention?

Q. Yeah. I wasn't clear. I'm looking at the block quote that you have in the middle of the page and then the sentence immediately afterwards. And I just have a couple general questions about that.

A. The block quote beginning with, "Heavy, sustained pumping"?

Q. Correct. My question is: So do you know what year this tool became available to the New Mexico state engineer to declare an underground water basin?

A. I believe Ira Clark discusses it in his book, "Water in New Mexico." I think it was in the early 1950s. In fact, it may have even been the year before maybe 1955, 1954.

Q. And then what year did the state engineer declare the underground water basin in the Middle Rio Grande?

A. In 1956.

Q. So since that time, this was a tool that was available to the state of New Mexico. Do you, in the historical record, is there any discussion that the State of Texas or Reclamation was aware of this tool of the State of New Mexico?

A. There may be documents in the historical record that would indicate that awareness. I can't recall having seen any in our research. Again, the focus of our research was really more prior to the Compact rather than post Compact.

Q. Are you aware of any documents, keeping in mind that same limitation, that suggests that the State of Texas or Reclamation requested that New Mexico declare the lower Rio Grande underground water basin?

A. I am not aware. I don't know.

Q. Do you know if the State of Texas has the same tool to declare an underground water basin in that state?

A. I do not know.

Q. Have you studied the groundwater regulation

that has occurred in the State of Texas?

A. I have not.

Q. Have you studied the groundwater regulation that has occurred in the State of New Mexico?

A. To some extent, yes.

Q. What have you studied? What did you look at?

A. Well, principally, reviewing Ira Clark's study of water in New Mexico where he discusses this -- this shift in -- in both law and policy.

Q. Why did you look at groundwater administration in New Mexico, but not Texas?

A. Well, the research of groundwater wasn't a central theme of our research. I looked at Ira Clark, for instance, largely to understand the -- the broader context for Steve Reynolds' actions and to try to understand New Mexico's orientation to the waters that were passing through their state -- through the state and would ultimately reach Texas. Once it reached Texas, at least for the -- for my purposes, the issues seemed to be less -- less salient.

Q. Why?

A. Because the controversy present here is a dispute between New Mexico and Texas.

Q. And Texas is one-half of that equation, is it not?

A. Yes.
Q. But you didn't think that understanding the actions or contexts in the State of Texas had any value for your reports?
A. I didn't say that.
Q. You said that once the water reached Texas, for your purposes, the issues seemed to be less salient, right?
A. Yes.
Q. Why?
A. Because an issue is to the extent that New Mexico's activities may have harmed Texas, and, again, it was more how we constructed, how we attempted to answer the questions that we had in front of us. I wasn't given a specific question to examine -- I wasn't asked specifically to research groundwater management practices in any of the three states.
Q. Fair to say you did not review actions or groundwater administration in Texas?
A. I recall examining some reports relating to El Paso's groundwater development efforts.
Q. Was that relevant to your analysis?
A. It emerged as a -- it emerged as a question.
Q. What do you mean by that?
A. Well, in the course of -- of research,

oftentimes, there will be other issues that emerge, things this you didn't expect as you were beginning your work, and certainly in the mid to late 1940s, the question of El Paso obtaining water from the Rio Grande project was one thing that emerged.

Q. Do you understand the actions of Texas to be relevant in any way in this case?

A. It could be.

Q. How so?

A. There's a whole host of -- of issues here so understanding, say, Texas' position or -- or orientation towards the Compact, helping to get the Compact circa 1938, seems important from a historical perspective.

Q. Given that potential, why did you look at New Mexico groundwater administration, but not Texas'?

A. Well, I think I've answered that before so I -- I would just repeat the answer I gave previously, which is that groundwater -- the study of groundwater administration historically wasn't a central theme of our research, that it emerged more in the course of our research, and that to -- the focus of our research was what was -- what did the parties understand that they obtained, in this case the states, each of the states obtained.

Q. Turn to Page 24, please, and here is the description of the City of El Paso case. We talked about this a little bit this morning. Here, El Paso sought to appropriate groundwater in New Mexico, right?

A. Yes.

Q. How did this case come to your attention?

A. I think it emerged from a discussion in Ira Clark's book.

Q. Do you know if there -- or can you tell from the historic record if there were any discussions between the City of El Paso and the State of Texas prior to or in connection with this application for groundwater in New Mexico?

A. I don't recall us ever researching that issue.

Q. Are there any documents which reflect the City of El Paso considering the Compact implications of its application?

A. I never researched that question. With that, may we take another break?

Q. Of course, yeah. It's -- well, it's 1:00 your time, so how about we come back at 1:15, or 2:15 New Mexico time.

THE VIDEOGRAPHER: The time is 2:00 p.m.

We're off the record.

(Break.)

THE VIDEOGRAPHER: The time is 2:15 p.m. We're on the record.

Q. (BY MR. WECHSLER) All right. Dr. Miltenberger, back after the break, I just have a couple more questions about the El Paso applications that you discuss on Page 24 of your rebuttal report. Now, you talk about the relative physicians of the parties a little bit, particularly New Mexico there. Are you aware that El Paso argued that the Compact did not prohibit the application, right?

A. I believe that may be reflected in the materials that I examined.

Q. And the Compact did not prohibit El Paso from appropriating groundwater in New Mexico; is that right?

A. I am not as familiar with the specific arguments of -- of El Paso on that, given what I reviewed.

Q. What did you review?

A. What I -- what I cited -- what I cited there. I -- I believe that may be covered -- I didn't review the -- the entire case record for these decisions, rather, I reviewed the decisions themselves and Ira

Clark's discussion of their -- of their import.

Q. Why did you include this discussion of that case in your rebuttal report?

A. Well, I think for a couple of reasons. One, Ira Clark, probably one of the foremost water historians in New Mexico, discusses it so it seemed important, it seemed a relevant part of the overall history. The other matter was as I tried to understand what the Office of the State Engineer might have understood -- excuse me, New Mexico's Office of the State Engineer might have understood about the relationship between groundwater and surface flow. The fact that this case happened so closely to the 1982 paper prepared by the office raised questions about the potential connections among them.

Q. Do you know the outcome of the case?

A. I believe I discuss it briefly in the footnote that follows. Yes, I believe -- I mean, what's -- what's contained in the discussion in Footnote -- Footnote 61 constitutes sort of my understanding of -- of the -- of the course of the case. Ultimately just skipping down here just to refresh my memory, ultimately the U.S. -- 1989 the U.S. Court of Appeals District of Columbia Circuit ruled that no live controversy remained. So as I understand, there was a dispute going back and forth up through various courts, and that at the end of the day, it just -- it stopped and litigants didn't continue to pursue the litigation.

Q. Based on the materials that you reviewed, do you know if the Bratten decision and decisions impacted the actions of the State of New Mexico?

A. I believe Clark discusses that there were some changes in New Mexico state law that happened in or around this -- this dispute. I don't recall the specifics.

Q. All right. Let's turn to your supplemental opinion, which starts on Page 31. My -- my first and general question is: Why are you offering a supplemental opinion?

A. I was asked to provide one.

Q. By whom?

A. Counsel.

Q. What were you asked to do? Is that reflected on Page 1?

A. Yes.

Q. Do you know why you were asked to give a supplemental opinion?

A. I think I might have addressed this earlier in the deposition this morning. My recollection is

WITNESS CORRECTIONS AND SIGNATURE

Please indicate changes on this sheet of paper, giving the change, page number, line number and reason for the change. Please sign each page of changes.

PAGE/LINE	CORRECTION	REASON FOR CHANGE
81/17	Add "Not" before "limited"	Intended meaning
85/14	"Constitute" for "institute"	Intended Meaning / clarity
103/6	"salient" for "salme"	Intended meaning / mistranscribed

Scott M Miltenberger 7/13/2020

SCOTT MILTENBERGER

S I G N A T U R E   O F   W I T N E S S

I, SCOTT MILTENBERGER, solemnly swear or affirm under the pains and penalties of perjury that the foregoing pages contain a true and correct transcript of the testimony given by me at the time and place stated with the corrections, if any, and the reasons therefor noted on the foregoing correction page(s).

Scott M Miltenberger 7/13/2020
____
SCOTT MILTENBERGER

Job No. 63391

IN THE SUPREME COURT OF THE UNITED STATES
BEFORE THE OFFICE OF THE SPECIAL MASTER
HON. MICHAEL J. MELLOY

STATE OF TEXAS	)	
	)	
Plaintiff,	)	
	)	Original Action Case
VS.	)	No. 220141
	)	(Original 141)
STATE OF NEW MEXICO,	)	
and STATE OF COLORADO,	)	
	)	
Defendants.	)	

THE STATE OF TEXAS :
COUNTY OF HARRIS :

I, HEATHER L. GARZA, a Certified Shorthand Reporter in and for the State of Texas, do hereby certify that the facts as stated by me in the caption hereto are true; that the above and foregoing answers of the witness, SCOTT MILTENBERGER, to the interrogatories as indicated were made before me by the said witness after being first remotely duly sworn to testify the truth, and same were reduced to typewriting under my direction; that the above and foregoing deposition as set forth in typewriting is a full, true, and correct transcript of the proceedings had at the time of taking of said deposition.

I further certify that I am not, in any capacity, a regular employee of the party in whose

behalf this deposition is taken, nor in the regular employ of this attorney; and I certify that I am not interested in the cause, nor of kin or counsel to either of the parties.

That the amount of time used by each party at the deposition is as follows:

MR. WECHSLER - 04:26:04
MR. HOFFMAN - 00:00:00
MR. DUBOIS - 00:00:00
MR. WALLACE - 00:01:59
MS. O'BRIEN - 00:00:00
MS. BARNCASTLE - 00:00:00

GIVEN UNDER MY HAND AND SEAL OF OFFICE, on this, the 22nd day of June, 2020.

HEATHER L. GARZA, CSR, RPR, CRR
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IN THE SUPREME COURT OF THE UNITED STATES

STATE OF TEXAS,

Plaintiff(s),

vs.

STATE OF NEW MEXICO and
STATE OF COLORADO,

Defendant(s).

____

DEPOSITION OF SCOTT A. MILTENBERGER, PH.D.
Sacramento, California
Wednesday, October 2, 2019
Volume I

Reported by:
Carrie Pederson
CSR No. 4373, RMR, CRR
Job No. 3524789
Pages 1 - 138

IN THE SUPREME COURT OF THE UNITED STATES

STATE OF TEXAS,

Plaintiff(s),

vs.

STATE OF NEW MEXICO and
STATE OF COLORADO,

Defendant(s).

____

Videotaped Deposition of SCOTT A. MILTENBERGER, PH.D., Volume I, taken on behalf of the defendants, at 500 Capitol Mall, Suite 1000, Sacramento, California, beginning at 9:11 a.m. and ending at 4:31 p.m. on Wednesday, October 2, 2019, before Carrie Pederson, Certified Shorthand Reporter No. 4373.

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Also Present:

Jennifer Stevens, Ph.D.

Shelly Randel

Videographer: John Macdonell

INDEX

WITNESS:

SCOTT A. MILTENBERGER, Ph.D.

Volume I

EXHIBITS

DEFENDANT'S

Exhibit	DESCRIPTION	PAGE
Exhibit 1	Expert Report of Scott A. Miltenberger, Ph.D., May 31, 2019	14

Sacramento, California, Wednesday, October 2, 2019

9:11 a.m. - 4:31 p.m.

SCOTT A. MILTENBERGER, PH.D.,

having been administered an oath, was examined and testified as follows:

EXAMINATION

MR. ROMAN: Before we get started, can everyone on the phone identify themselves for the record, please?

MR. WALLACE: This is Chad Wallace for the --

MR. HOFFMAN: Okay. One at a time. Chad first.

MR. WALLACE: Yeah. This is Chad Wallace for the State of Colorado, and at this time, I'd just like to get in the record an objection for Colorado on the adequacy of the deposition because we are not able to remote in and get realtime, so we're objecting to our ability to fully participate in this deposition at this time.

MR. ROMAN: And this is David Roman.

MS. BARNCASTLE: This is Samantha Barncastle for EBID, and, again, I would just say on the record that because we don't have realtime, it's going to be

imperative that everybody speak loud and clear.
MR. ROMAN: And just to respond --
MS. STEVENSON: This is Sarah Stevenson for El Paso County Water Improvement District Number 1.
MR. HOFFMAN: Is there anybody else on the phone?
MS. ESTRADA-LOPEZ: Michelle Estrada-Lopez, the Bureau of Reclamation.
MR. HOFFMAN: Say it again.
MS. ESTRADA-LOPEZ: Michelle Estrada-Lopez, Bureau of Reclamation.
MR. MACFARLANE: It's Estrada dash Lopez.
MR. ROMAN: Is that everyone on the phone?
MR. HOFFMAN: I guess so.
MR. ROMAN: All right.
MR. HOFFMAN: How about the room?
MR. ROMAN: Yes. Why don't we go around the room starting with Dr. Miltenberger. Identify yourself.
THE WITNESS: I'm Dr. Scott Miltenberger.
MR. HOFFMAN: I'm Robert Hoffman from Somach Simmons & Dunn representing the State of Texas.
MR. MACFARLANE: Stephen MacFarlane, Department of Justice, representing the United States.

MR. SOMACH: Stuart Somach, State of Texas.

MS. RANDEL: Shelly Randel, Solicitor's Office, Department of Interior.

MR. STEIN: Jay Stein of Stein & Brockmann representing the Amicus, City of Las Cruces, New Mexico.

DR. STEVENS: Jennifer Stevens.

MR. ROMAN: And I'm David Roman representing the State of New Mexico in this case.

BY MR. ROMAN:

Q. Dr. Miltenberger, clearly you've been deposed before, and I'm sure your counsel has prepared you on the rules of the deposition, so I won't go over the normal rules unless you want me to.

Are you comfortable with the normal rules in terms of not speaking over each other and giving audible answers, for instance, as opposed to nodding your head or saying "nuh-uh," "uh-huh" sort of thing?

A. Yes.

Q. Okay. One thing I will ask of you, though, is if I'm asking a question that is not clear, which is entirely possible, especially in kind of a realm such as history, I would ask that if you need clarification, that you ask for clarification. If you answer my question, I will assume that you that was provided to us as well.

Q. Okay. Now I believe you characterized what you were asked to look at as essentially the history of the 1938 Rio Grande Compact; correct?

A. Yes.

Q. Do you recall with any more specificity whether there were specific questions related to the history of the 1938 Rio Grande Compact that you were asked to investigate by counsel?

A. I recall that one question at the very beginning was how the figure of 790,000 acre feet was reached.

Q. Uh-huh.

A. That is one question I recall.

Q. Obviously, the history of the Rio Grande Compact is a very broad issue to look at, so do you remember -- other than the question of how the figure of 790,000 acre feet was reached, do you recall any other specific questions that you were asked to look at at the beginning of your assignment?

A. Another question that I can recall, as I sit here, was learning more about the context for the 1938 interdistrict agreement.

Q. Do you recall being provided information as to why that question was of interest to counsel?

A. My recollection is that on that -- on that particular question was that it emerged from, I believe, the analysis that Dr. Douglas Littlefield had provided in his book, "Conflict in the Rio Grande."
Q. I'm not sure I understand your answer as far as that it emerged from the analysis that Dr. Littlefield provided in "Conflict on the Rio Grande." In other words, were you asked to evaluate Dr. Littlefield's opinion and either agree with it or distinguish it?
A. My recollection is that we were asked to just learn more about it, how he might have arrived at it, what source material that was used, taking a look at his footnotes, for instance, and just trying to learn because Dr. Littlefield places an importance on that agreement, and so we were asked to learn more about that and how he might have arrived at that conclusion if I -- that's my recollection as I sit here today.
Q. I understand that it's been a long time.
A. Yeah.
Q. In general, in reviewing the analysis that Dr. Littlefield conducted in his book, did you form an impression as to the reliability of his

conclusions?
A. I don't know -- I don't understand what you mean by "reliability."
Q. Were there conclusions that Dr. Littlefield reached in his book that you believed, after the research you conducted, were not supported?
A. After conducting the research that I did, I arrived in certain places with an interpretation slightly different from Dr. Littlefield's. Nevertheless, I think that -- I wouldn't characterize my differences as being that his weren't supported. I think they're interpreted differences.
Q. In other words, if I understand you correctly, professional historians can look at the same source material and reach different but still supported conclusions?
A. Yes.
Q. Do you recall which of Dr. Littlefield's conclusions you didn't completely agree with?
A. Yes.
Q. And which were those?
A. I think the one was his analysis about how a de facto allocation of water was made between New Mexico and Texas, and he -- if memory serves from his book, he bases that conclusion on the 1905

authorization for the Rio Grande Project and the interdistrict agreement. They kind of worked in concert. I don't quite view it that way. I think that allocation was more complex, I think it involved a other set of events, and ultimately the compact accomplished that apportionment, so that's one point where I think I depart from Dr. Littlefield. Again, if I recall his work correctly.

Q. I understand. It's not meant to be a history test. We'll certainly touch on this later, but when you say ultimately the compact accomplished the apportionment, are you saying that as opposed to the Rio Grande Project accomplishing apportionment?

A. Yeah, I believe that the compact accomplished the apportionment. I wouldn't then go on to draw the conclusion or make the case that the Rio Grande Project was not important or integral to the compact but rather that it was the three states meeting in interest of comity to resolve this dispute over the Upper Rio Grande Basin. That's what accomplished the apportionment.

Q. Okay. Looking back at page one in your list of questions, I note that you have, as question number two, "Did the amount of water apportioned to Texas by the 1938 Rio Grande Compact include water to if I may get some more water.

Q. Of course.

A. Thank you.

(Pause)

BY MR. ROMAN:

Q. In reviewing the United States's Expert Historian Report, were there any of its conclusions that you questioned or disagreed with?

A. None that I can recall as I sit here.

Q. Would you characterize your review of that report as in-depth or cursory or somewhere in between?

A. Well, I guess I would want to know what you mean by "in-depth."

Q. Very reasonable question. First question is did you review it more than once?

A. Yes.

Q. Did you review any of the source materials cited therein that were different from your own source materials?

A. I believe so.

Q. Did your review of the United States's Expert Historian Report cause you to consider adding or revising any of the opinions in your disclosed report?

I, SCOTT A. MILTENBERGER, PH.D., do hereby declare under penalty of perjury that I have read the foregoing transcript; that I have made any corrections as appear noted, in ink, initialed by me, or attached hereto; that my testimony as contained herein, as corrected, is true and correct.

EXECUTED this 5th day of November, 2019, at Davis ______, California.

(City) (State)

SCOTT A. MILTENBERGER, PH.D.

WITNESS CORRECTIONS
AND SIGNATURE

Page	Line	Change	Reason for Change
21	12	"interpreted" to "interpretative"	Correcting transcription
25	7	"dialect" to "dialectic"	Correcting transcription
41	14	"H-i-n-d-e-r-l-i-d-r" to "H-i-n-d-e-r-l-i-d-e-r"	Correcting spelling
112	11	"JAR" to "JIR"	Correcting spelling/transcription
112	12	"JAR" to "JIR"	Correcting spelling/transcription
112	22	"JAR" to "JIR"	Correcting spelling/transcription
112	23	"JAR" to "JIR"	Correcting spelling/transcription
117	2	"reclamation" to "Reclamation"	Reflecting intended meaning
128	6:7	"I'm not at" to "I do not know"	Reflecting intended meaning; correcting transcription

Scott A. Miltenberger, Ph.D.
Deposition of Scott Miltenberger, Vol 1 taken October 2, 2019

I, the undersigned, a Certified Shorthand Reporter of the State of California, do hereby certify:

That the foregoing proceedings were taken before me at the time and place herein set forth; that any witnesses in the foregoing proceedings, prior to testifying, were duly sworn; that a record of the proceedings was made by me using machine shorthand which was thereafter transcribed under my direction; that the foregoing transcript is a true record of the testimony given.

Further, that if the foregoing pertains to the original transcript of a deposition in a Federal Case, before completion of the proceedings, review of the transcript [ ] was [ ] was not requested.

I further certify I am neither financially interested in the action nor a relative or employee of any attorney or party to this action.

IN WITNESS WHEREOF, I have this date subscribed my name.

Dated: October 15, 201

Carrie Pederson

CARRIE PEDERSON

CSR No. 4373

Context of the 1938 Rio Grande Compact

Submitted to:

U.S. Department of Justice

Submitted by:
Nicolai Kryloff

Historical Research Associates, Inc.
Washington, D.C.

May 31, 2019

HISTORICAL
RESEARCH
ASSOCIATES, INC.

EXHIBIT
NK-02

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Summary

Scope of Engagement

Attorneys representing the U.S. Department of Justice have retained me as an expert witness to provide professional historical expertise in the original action *Texas v. New Mexico*. The scope of my assignment was to conduct historical research and analysis on the intent of the parties to the Rio Grande Compact of 1938, particularly in relation to allocation of water between Texas and New Mexico, groundwater, return flows, or other subjects that may have bearing on issues raised in the original action. In this capacity, I was asked to assess the 2017 First Interim Report of the Special Master as a possible basis for further historical inquiry, and to offer opinions and supplemental historical information where appropriate.

I began my work on this matter in late March 2018. I conducted original research at two archival repositories: the Water Resources Archive (in Fort Collins, Colorado) and the Archives and Special Collections at New Mexico State University (in Las Cruces, New Mexico), which hold the Papers of Delph E. Carpenter and the Elephant Butte Irrigation District records, respectively. Both collections contain varied reports and correspondence among the compact parties and other organizations having an interest in the compact. I have not been able to fully evaluate the discovery documents produced in this original action, consisting of more than 70,000 documents in digital format, some of which include relevant historical material. I am continuing to review those documents, however, and may supplement my report if I develop further opinions or modify the opinions expressed herein.

Other important historical documents may not have been produced to date, but instead may reside in archival repositories. I have not had the opportunity to conduct research at the National Archives Rocky Mountain Region (in Denver, Colorado) or the Dolph Briscoe Center for American History (in Austin, Texas). These repositories hold the records of the Bureau of Reclamation, the records of the Rio Grande Compact Commission, and various personal papers of some of the principal individuals involved in negotiating the Rio Grande Compact. Some records from these repositories have been produced in discovery, but it is not possible to determine the extent of the records reviewed or collected at these archives. I have nevertheless conducted as thorough a review as possible of the information currently available, and I have formed opinions on that basis. The documents I considered are listed in Appendix A to this report.[1]

[1] I may supplement the source citation information in this report with production Bates numbers where appropriate.

Basis for Historical Inquiry

In 2014, the United States brought claims against New Mexico in the original action *Texas v. New Mexico*.[2] These claims, which paralleled similar claims made by Texas, alleged that New Mexico violated the 1938 Rio Grande Compact by intercepting surface water and groundwater belonging to other parties below Elephant Butte Reservoir. The United States claimed that these activities interfered with water releases from the federal Rio Grande Project that were intended for Texas (pursuant to contracts under federal reclamation law) and for Mexico (under a 1906 treaty with the United States) because they affected Rio Grande surface flows, including "return flow" to the Rio Grande, thus potentially jeopardizing the federal government's delivery obligations from the Rio Grande Project.[3]

In 2017, Special Master A. Gregory Grimsal issued the First Interim Report of the Special Master, which reviewed the history of the Rio Grande Compact. The Special Master concluded that the structure of the 1938 Compact fully incorporated the Rio Grande Project, which functioned as the vehicle by which Texas and part of New Mexico would receive their equitable apportionments of the Rio Grande above Fort Quitman, Texas. The Special Master found that project deliveries to El Paso County Water Conservation District No. 1 (EP No. 1) constituted the Compact's apportionment to Texas.[4]

Although the Special Master held that the United States could not bring a claim against New Mexico for violating the Compact, the U.S. Supreme Court sustained the United States' exception to that ruling, holding that the United States could bring a Compact claim based on federal interests in the Rio Grande Project and the treaty with Mexico. Like the Special Master, the Supreme Court found the project to be fully integrated into the 1938 Rio Grande Compact. It noted that the United States had assumed "a legal responsibility to deliver a certain amount of water to Texas," and served as an "agent" of the compact responsible for fulfilling Texas' apportionment under contracts between EP No. 1 and the federal government.[5]

The Special Master's report presented the conditions and problems that led to the 1938 Rio Grande Compact. Although I found the report to be thorough and accurate, it did not examine in detail certain concepts that may have been understood by the compact parties about the Rio Grande Project and water resources below Elephant Butte Reservoir. Such details may be relevant to

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[2] *Texas v. New Mexico et al.*, 134 S. Ct. 1050 (2014).

[3] *Texas v. New Mexico et al.*, No. 141, Original, Complaint in Intervention, February 2014.

[4] *Texas v. New Mexico et al.*, No. 141, Original, A. Gregory Grimsal, First Interim Report of the Special Master, February 9, 2017.

[5] *Texas v. New Mexico et al.*, 583 U.S. ___ (2018), 6.

evaluating claims in this case, to the extent they show or suggest the expectations of the compact parties at the time they signed the 1938 Compact.

In my own report below, I have built on the historical elements of the Special Master's 2017 report as a foundation for additional analysis. This report explains my opinions, based on the historical evidence I have reviewed to date, regarding the understandings or assumptions the parties may have held in reaching the 1938 Rio Grande Compact.

Opinions

I have formed the following opinions as an expert historian, based on the research I have been able to conduct to date:

1) The parties to the 1938 Rio Grande Compact presumed that water for Texas would be apportioned through the Rio Grande Project.

2) The compact parties understood the importance of return flow to irrigation in the Upper Rio Grande Basin and within the Rio Grande Project.

3) The compact parties understood the surface water supply requirements and limitations in the area below Elephant Butte Reservoir.

4) Some information about groundwater and its connection to surface flow was available to the compact parties.

I reserve the right to supplement this report based on additional information or documents produced in the original action.

Rio Grande Background

The 2017 First Interim Report of the Special Master serves as a foundation for understanding the historical events leading to the 1938 Rio Grande Compact. I offer the following summary of the Special Master's historical account to provide a basic explanation of the water disputes on the Rio Grande, the establishment of the Rio Grande Project, and the events leading to the 1938 Rio Grande Compact.

The Rio Grande, in its entirety, is approximately 1,800 miles long, originating in southern Colorado and meandering some 400 miles through New Mexico before crossing into Texas, where it forms the international boundary between Texas and Mexico, and then flows approximately 1,250 miles to the Gulf of Mexico.[6]

The Upper Rio Grande Basin—with which this report is concerned—is the section of the river from the headwaters in Colorado to Fort Quitman, Texas (about 60 miles below El Paso). Below Fort Quitman, the river is supplied mainly by tributaries in Mexico, and was considered by the negotiators of the Rio Grande Compact to be hydrologically and administratively separate from the river above Fort Quitman.[7] The Upper Rio Grande Basin includes parts of Colorado, New Mexico, and a small part of Texas. The Rio Grande in this section is known as a "torrential" river, frequently carrying low or insignificant flows, but at times subject to extreme flood stages.[8]

International and Interstate Water Disputes

The Rio Grande above Fort Quitman was historically subject to international and interstate disputes. In the 1880s, irrigation development in Colorado's San Luis Valley (near the headwaters) and natural droughts led to chronic water shortages in established agricultural areas in southern New Mexico, Texas, and Mexico.[9] In 1894, Mexico lodged a formal claim for damages.[10] Investigations by the International Boundary Commission resulted in a report dated November 25, 1896, which confirmed that increased irrigation in Colorado was the primary cause of water shortages downstream.[11]

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[6] *Texas v. New Mexico et al.*, No. 141, Original, A. Gregory Grimsal, First Interim Report of the Special Master, February 9, 2017, [hereafter First Interim Report], 32.

[7] First Interim Report, 176.

[8] First Interim Report, 33.

[9] First Interim Report, 34–38.

[10] First Interim Report, 43–50.

[11] First Interim Report, 52.

In December 1896, the Secretary of the Interior ordered the General Land Office to suspend action on all rights-of-way applications through public lands in Colorado and New Mexico involving irrigation on the Rio Grande and its tributaries. This action—known as the "embargo"—effectively froze new irrigation development in the Upper Rio Grande Basin.[12]

In its 1896 report, the International Boundary Commission proposed an international reservoir and dam near El Paso to resolve the water dispute with Mexico.[13] This plan was at odds with a competing, private plan for a reservoir in New Mexico, an effort led by Nathan E. Boyd, whose company had formed in 1893. Protracted litigation ensued between the Rio Grande Dam and Irrigation Company and the United States, which was not resolved until 1909, when the Supreme Court affirmed that the company's right to construct the dam had expired.[14]

The Rio Grande Project

Around the same time, Congressional attempts to solve the problem of reclamation in the arid Western states culminated in the passage of the 1902 Reclamation Act. This act also created the U.S. Reclamation Service (later the Bureau of Reclamation) and signaled greater federal involvement in water resources management.[15] Soon after, the Reclamation Service examined the situation on the Rio Grande. Whereas the International Boundary Commission had proposed a dam near El Paso, the Reclamation Service suggested an alternative dam site, in New Mexico, which would serve not only Mexico, but also productive agricultural areas in New Mexico and Texas.[16] At the Twelfth National Irrigation Congress of 1904, representatives from Mexico, New Mexico, and Texas endorsed this general plan of action.[17]

Congress authorized the Secretary of the Interior to proceed with constructing the proposed dam and reservoir by the Act of February 25, 1905, which also extended the 1902 Reclamation Act to portions of Texas susceptible to irrigation from the project.[18] In 1906, pursuant to the 1902 Reclamation Act and in accordance with the territorial laws of New Mexico, the United States filed with the Territorial Irrigation Engineer of New Mexico a notice of intent to utilize 730,000 acre-feet

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[12] First Interim Report, 51–52.

[13] First Interim Report, 55–56.

[14] First Interim Report, 57–66.

[15] First Interim Report, 67–92.

[16] First Interim Report, 92–95.

[17] First Interim Report, 96–99.

[18] The 1902 Reclamation Act provided that the sale of public lands in certain Western states would underwrite reclamation activities, but since Texas had entered the Union as a sovereign republic, it had no public lands and thus was not included among the sixteen states and territories identified in the Reclamation Act. See First Interim Report, 99–101.

yearly from the Rio Grande, for the Rio Grande Project.[19] The United States supplemented this filing in 1908 with a notice of its intent to utilize "[a]ll the unappropriated water of the Rio Grande and its tributaries" for the Rio Grande Project.[20]

To guarantee the feasibility of the Rio Grande Project, the Reclamation Service, by 1906, had entered into agreements with two irrigation associations: the Elephant Butte Water Users' Association (in New Mexico) and the El Paso Valley Water Users' Association (in Texas). To assure greater security of repayment to the federal government for the cost of the project, including drainage, these associations later underwent corporate transitions to quasi-municipal irrigation districts—Elephant Butte Irrigation District (EBID) and El Paso County Water Conservation District No. 1 (EP No. 1)—having the power to tax all land within their boundaries.[21]

With establishment of the Rio Grande Project, the United States and Mexico entered into a 1906 treaty whereby Mexico agreed to waive its claims for damages on the Rio Grande, in exchange for delivery of 60,000 acre-feet annually from the Rio Grande Project's storage reservoir, sited near a rock formation called Elephant Butte.[22] Construction of Elephant Butte Dam and Reservoir was completed in 1916, while construction of the distribution and drainage systems continued for years afterward.[23]

1929 Rio Grande Compact

After completion of the Rio Grande Project, the 1896 federal rights-of-way "embargo" remained in place. Upstream water users and developers protested this restriction, especially in Colorado's San Luis Valley. The Secretary of the Interior modified the embargo several times between 1896 and 1923 but maintained it overall.[24] By the 1920s, complaints about the embargo prompted suggestions for an interstate compact to apportion the waters of the Rio Grande. New Mexico and Colorado sanctioned this approach in 1923 by authorizing representatives to serve on an interstate negotiating body, the Rio Grande Compact Commission. They were joined by a federal representative, and in 1925, an official commissioner from Texas joined the Rio Grande Compact Commission.[25] Also in

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[19] First Interim Report, 102. The Rio Grande Project is taken to mean, generally. the storage works that would become Elephant Butte Dam and Reservoir, and the diversion and drainage works downstream.

[20] First Interim Report, 104.

[21] First Interim Report, 107–10.

[22] First Interim Report, 110–12.

[23] First Interim Report, 112–14.

[24] First Interim Report, 116–17.

[25] First Interim Report, 121–23.

1925, the Secretary of the Interior lifted the embargo. New Mexico withdrew from the compact commission in protest, but later rejoined.[26]

On February 12, 1929, the commissioners signed a temporary Rio Grande Compact designed to preserve the "status quo" on the river while the states sought federal funding for certain drainage and storage works in Colorado, designed to augment the overall water supply by reclaiming waterlogged lands. Under the compact, Colorado agreed not to impair the water supply at the New Mexico state line unless depletions were offset by increased drainage returns; New Mexico agreed not to impair the water supply into Elephant Butte Reservoir without similar offsets. The temporary compact also provided for gauging stations on the river and for information sharing. It set a deadline of June 1, 1935, for arriving at a permanent compact, under which the waters of the Rio Grande would be allocated among the states.[27]

1938 Rio Grande Compact

When the Rio Grande Compact Commission reconvened in 1934, the federal drainage and storage works contemplated by the 1929 Compact were still unrealized. New Mexico and Texas objected to proceeding further without more data, as the drainage and storage works were expected to affect the overall water supply. The commissioners agreed to extend the temporary compact as they sought a way forward.[28]

In 1935, Texas filed suit against New Mexico for allegedly violating the 1929 Compact through developments in the Middle Rio Grande Valley, above Elephant Butte Reservoir. This interstate litigation, in part, prompted President Franklin Roosevelt to assign the National Resources Committee to assist the compact parties in gathering facts and providing a basis for agreement. The compact commission accepted the assistance, and compact talks proceeded as the National Resources Committee set about collecting, correlating, and presenting comprehensive data on the Upper Rio Grande Basin.[29]

The Rio Grande Joint Investigation, completed in August 1937, was the result of the National Resources Committee's efforts. The investigation presented a large amount of data and other information, but still the compact commissioners could not reach an accord. However, New Mexico and Texas agreed that the Rio Grande Project would serve as the basis for Texas' apportionment, with deliveries made by New Mexico into Elephant Butte Reservoir. The compact parties

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[26] First Interim Report, 124–25.

[27] First Interim Report, 126–32.

[28] First Interim Report, 133–35.

[29] First Interim Report, 136–37.

determined that further technical analysis was necessary to help them arrive at actual delivery schedules.[30]

To establish these delivery schedules, the Rio Grande Compact Commission formed a committee of engineers, with one engineer adviser appointed by each state, and one by the federal government. This four-person engineering committee submitted a report to the compact commission in December 1937 and a slightly revised report in March 1938 to address various concerns of the parties.[31] The compact commissioners adopted the recommendations of the engineers' second report, including the proposed schedules of deliveries by Colorado and New Mexico, and the "allowable departures" from those schedules, designed to account for natural variation in water supply by allowing water debits or credits among the states from year to year.[32]

On March 18, 1938, the compact commissioners signed the final Rio Grande Compact to equitably apportion the Rio Grande above Fort Quitman among Colorado, New Mexico, and Texas.[33] However, ratification by the states proved difficult, as interests in Colorado and New Mexico jockeyed for federal funding and favored projects.[34] In Texas, irrigators below Fort Quitman (the "Lower Valley") also demanded consideration.[35] Responding to these concerns, Texas commissioner Frank Clayton wrote that the Rio Grande above and below Fort Quitman were supplied from separate water sources.[36]

Commissioner Clayton also explained why the compact commission had chosen Elephant Butte as the point at which Texas received its apportionment, instead of the Texas state line: "Obviously," he wrote, "neither Colorado nor New Mexico could be expected to guarantee any fixed deliveries at the Texas line when the operation of the dam is not within their control but is in the control of an independent government agency." He added that stream gauging at the state line would be costly and difficult. "However, the question of the division of the water released from Elephant Butte reservoir is taken care of by contracts between the districts under the Rio Grande Project and the Bureau of Reclamation."[37]

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[30] First Interim Report, 142–43.

[31] First Interim Report, 144–52.

[32] First Interim Report, 152–54.

[33] The First Interim Report provided a summary of each article of the 1938 Compact, 156–70.

[34] First Interim Report, 170–72.

[35] First Interim Report, 173–78.

[36] First Interim Report, 176.

[37] First Interim Report, 180–82; Frank B. Clayton, Rio Grande Compact Commissioner for Texas, to Sawnie B. Smith, October 4, 1938, 1.

These contracts provided that water from the Rio Grande Project would be allocated to the districts according to the acreage under cultivation in the two states—roughly 88,000 acres in New Mexico and 67,000 acres in Texas. By virtue of these contracts, Clayton explained, the total project area was "frozen" based on these figures, with a "cushion" of three percent for each figure, to allow for annual variations in the area of land irrigated.[38] The inter-district contracts, he added, were a private arrangement "between the districts involved, and for that reason it was felt neither necessary nor desirable that it be incorporated in the terms of the compact."[39]

Ultimately, the state legislatures of Colorado, New Mexico, and Texas ratified the compact in February and March 1939. Texas and New Mexico agreed upon the dismissal of their 1935 litigation upon federal ratification of the compact. Congress ratified the compact in May 1939, making the 1938 Rio Grande Compact federal law.[40]

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[38] Frank B. Clayton, Rio Grande Compact Commissioner for Texas, to Sawnie B. Smith, October 4, 1938, 2; Contract, Elephant Butte Irrigation District and El Paso County Water Improvement District No. 1, February 16, 1938.

[39] First Interim Report, 180–82; Frank B. Clayton, Rio Grande Compact Commissioner for Texas, to Sawnie B. Smith, October 4, 1938, 2. On February 16, 1938, EBID and EP No. 1 entered into an inter-district agreement which, in Special Master Grimsal's words, "affirmed Reclamation's prerogative under the Reclamation Act of 1902 to apportion waters of the Rio Grande Project and recognized Reclamation's determinations of maximum irrigable acreage between the two districts as a[n] 88:67 ratio, respectively." First Interim Report, 149.

[40] First Interim Report, 184; U.S. Bureau of Reclamation, Project History, Rio Grande Project, Calendar Year 1939, 31.

Historical Findings

Opinion 1: Rio Grande Project Apportionment

The parties to the 1938 Rio Grande Compact presumed that water for Texas would be apportioned through the Rio Grande Project.

The Special Master's report and the U.S. Supreme Court both reached the conclusion that the Rio Grande Project was fully integrated into the 1938 Rio Grande Compact, thereby serving as the vehicle by which Texas receives its apportionment of water. In light of the Supreme Court opinion, this conclusion does not appear to be in dispute in the original action. As an independent reader of the Special Master's report and the Supreme Court's opinion, I find their analysis to be consistent with the documents they cited and the documents I have reviewed to date. Because the 1938 Compact did not explicitly address water allocation below Elephant Butte Reservoir, I agree with the conclusion that the compact parties relied upon the Rio Grande Project to ensure Texas' apportionment under the compact.

Special Master's Conclusions

In his 2017 First Interim Report, Special Master Grimsal concluded that the structure of the 1938 Rio Grande Compact integrated the Rio Grande Project "wholly and completely," thereby incorporating the project as the vehicle by which Texas would receive its compact apportionment.[41] Although integration of the project was not explicit in any single article of the 1938 Compact, the Special Master pointed to the "structure and interplay of the articles" as evidence that the compact "presumes and fully relies upon the Rio Grande Project" to ensure that water reached its intended destinations under the compact's provisions.[42]

Although the compact required New Mexico to make its water deliveries into Elephant Butte—not to the Texas state line—the Special Master found that the 1938 Compact was a "comprehensive agreement" to equitably apportion water among all three signatory states, Texas as well as New Mexico and Colorado. New Mexico's compact obligations, he wrote, were "woven throughout" the compact to achieve equitable apportionment. The Special Master reasoned that if New Mexico intercepted water belonging to Texas below Elephant Butte Reservoir, the compact would be rendered "senseless and purposeless" in numerous articles and its basic accounting structure.[43]

[41] First Interim Report, 198.

[42] First Interim Report, 200.

[43] First Interim Report, 201.

Special Master Grimsal pointed out that as early as 1924, New Mexico acknowledged in Rio Grande Compact discussions that Texas received its water through the Bureau of Reclamation's administration of the Rio Grande Project. At the first meeting of the Rio Grande Compact Commission, New Mexico compact commissioner J. O. Seth remarked that the Rio Grande Project was divided between Texas and New Mexico, and acknowledged that lands in both states were "both served by the Elephant Butte Reservoir."[44] In 1937, Grimsal noted, New Mexico equated Texas' apportionment with the water it received through Rio Grande Project and was willing to negotiate with Texas "on the basis of fixing a definite amount of water to which said project is entitled."[45]

The Special Master also marshalled historical evidence illustrating Texas' understanding of the 1938 Compact provisions. He quoted extensively from a letter dated October 4, 1938, from Texas commissioner Frank B. Clayton, including the following:

> [T]he question of the division of the water released from Elephant Butte reservoir is taken care of by contracts between the district under the Rio Grande Project and the Bureau of Reclamation. These contracts provide that the lands within the Project have equal water rights, and the water is allocated according to the areas involved in the two States.[46]

Among the historical documents I have reviewed to date, Clayton's 1938 letter provides the most thorough explanation of how he understood Texas' allocation to operate under the compact. Equally enlightening, from the same letter, was Clayton's explanation of why Texas' compact apportionment was measured at Elephant Butte Reservoir, rather than the Texas state line. In addition to gauging difficulties, Clayton observed that "neither Colorado nor New Mexico could be expected to guarantee any fixed deliveries at the Texas line when the operation of the dam is not within their control but is in the control of an independent government agency."[47]

This question of "control" over the water released from Elephant Butte Reservoir also surfaced in 1938 discussions among Rio Grande Project water users and irrigators below Fort Quitman. EBID attorney Edwin Mechem (who also served on the Rio Grande Compact Commission as an adviser to both New Mexico and Texas, at different times) explained that the irrigation districts under the Rio Grande Project were in no position to guarantee water to the irrigators below Fort Quitman, as they did not control releases from the reservoir: "Elephant Butte Irrigation District doesn't own any water or control any water except to take what is delivered to it and collect from

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[44] Rio Grande River Compact Commission, First Meeting, October 26, 1924, 12.

[45] Proceedings of the Meeting of the Rio Grande Compact Commission, September 27–October 1, 1937, quoted in First Interim Report, 206.

[46] Frank B. Clayton, Rio Grande Compact Commissioner for Texas, to Sawnie B. Smith, October 4, 1938, 1–2, quoted in First Interim Report, 208.

[47] Frank B. Clayton, Rio Grande Compact Commissioner for Texas, to Sawnie B. Smith, October 4, 1938, 1.

the water users within its boundaries the charges assessed against them and pay it over to the United States Government."[48]

In all, Special Master Grimsal found that the Rio Grande Compact Commission, in negotiating the 1938 Rio Grande Compact, "fully relied upon the existing Rio Grande Project to impart Texas' and lower New Mexico's respective equitable apportionments of Rio Grande waters." He observed that New Mexico did not dispute this conclusion. It was "unfathomable," he wrote, that Texas would have agreed to the 1938 Compact if New Mexico had been allowed to "simply recapture the water it delivered to the Project, destined for Texas, upon its immediate release from the Reservoir."[49] To Special Master Grimsal, the Rio Grande Compact parties understood that water for Texas would be apportioned through the Rio Grande Project.

Supreme Court Opinion

On March 5, 2018, the U.S. Supreme Court issued an opinion that agreed with Special Master Grimsal's general proposition: The 1938 Rio Grande Compact incorporated the Rio Grande Project as the vehicle for delivering Texas' apportionment. In the opinion, Justice Neil Gorsuch noted that "downstream contracts," between the federal government and the irrigation districts under the Rio Grande Project, resolved apportionment issues between New Mexico and Texas below Elephant Butte Reservoir, based on irrigable acres in each state under the project—roughly 57 percent for New Mexico and 43 percent for Texas.[50]

The Supreme Court viewed the 1938 Compact as being "inextricably intertwined with the Rio Grande Project and the Downstream Contracts." Gorsuch wrote that the compact could only achieve its purpose of "equitable apportionment" of the Rio Grande, because at the time of the compact's signing, the federal government had assumed a legal responsibility to deliver a certain amount of water to Texas through the downstream contracts.[51] Additionally, the Court pointed out that New Mexico conceded that the United States had an integral role in compact operations, by virtue of its responsibility for water delivery under the downstream contracts.

In the Supreme Court's opinion, the United States served as a sort of "agent" of the Rio Grande Compact, with the downstream contracts implicitly incorporated into the compact's terms. These contracts were, in the opinion of the Court, "themselves essential to the fulfillment of the compact's

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[48] Proceedings of Meeting between Representatives of Lower Rio Grande Water Users and Representatives of Irrigation Districts Under the Rio Grande Project of the Bureau of Reclamation, May 27, 1938, 14.

[49] First Interim Report, 209.

[50] *Texas v. New Mexico et al.*, 583 U.S. ___ (2018), 2.

[51] *Texas v. New Mexico et al.*, 583 U.S. ___ (2018), 5–6.

expressly stated purpose."[52] In addition, the court noted that the 1938 Compact stated plainly that treaty obligations of the United States to Mexico were unaffected.[53] In all, the Supreme Court accepted the proposition that the 1938 Compact incorporated the Rio Grande Project as the vehicle for apportionment of water to Texas.

[52] *Texas v. New Mexico et al.*, 583 U.S. ___ (2018), 6.

[53] *Texas v. New Mexico et al.*, 583 U.S. ___ (2018), 7.

Opinion 2: Return Flow

The compact parties understood the importance of return flow to irrigation in the Upper Rio Grande Basin and within the Rio Grande Project.

The concept of return flow—here taken broadly to include seepage, drainage, and return flow back to the river—was important in Rio Grande Compact discussions from the outset. The compact parties understood that not all water delivered for irrigation could be used consumptively, and that some portion returned to the river as surface drainage or underground seepage. In this way, return flow became available for repeated uses and contributed to the overall water supply.

The compact parties understood the concept of return flow generally, and its occurrence on the Rio Grande Project specifically. Project deliveries were based, in part, on the availability of return flow. These findings are consistent with the United States' claim that return flow "historically comprised a significant part of the Project's deliveries."[54]

Return Flow Understood by Compact Parties

Ideas about return flow provided the initial impetus for negotiating a Rio Grande Compact. Development plans in Colorado's San Luis Valley led to compact discussions, initially between Colorado and New Mexico.[55] As early as 1915, engineer Ralph Meeker (who served on the Rio Grande Compact Commission as an adviser to Colorado from 1924 to 1929), argued that with proper drainage of seeped lands, the Rio Grande carried enough water for both the federal Rio Grande Project and new developments upstream.[56] In 1924, Meeker prepared a report stating that water diverted from a stream was not wholly "consumed," but rather returned to the river in some portion, "for repeated re-use as irrigation progresses." In his view, maximum efficiency could be achieved by irrigating first near the headwaters and continuing downstream to establish a cycle of repeated use.[57]

The parties involved in Rio Grande Compact negotiations understood that irrigation increased return flow, and that return flow could be reused for more irrigation. In 1924, at the first meeting of

[54] *Texas v. New Mexico et al.*, No. 141, Original, Complaint in Intervention, February 2014, 4.

[55] For a summary, see Ottamar Hamele, Special Attorney Representing the Bureau of Reclamation before the Rio Grande Commission, "The Embargo on the Upper Rio Grande," no date [circa August 1924], 29–30, Elephant Butte Irrigation District, Ms 0235, Archives and Special Collections Department, New Mexico State University Library [NMSU-EBID], Series 02-J, Box 3, Folder 1.

[56] R. I. Meeker, "Interstate Water Problems, Rio Grande Controversy," April 29, 1915, Papers of Delph E. Carpenter and Family, Water Resources Archive, Colorado State University [CSU-WDEC], Series 2.2, Box 133, Folder 31.

[57] R. I. Meeker, "Consumptive Use of Water, Rio Grande Basin," May 1924, 3, CSU-WDEC, Series 7.1, Box 61, Folder 24.

the Rio Grande Compact Commission, the participants agreed that on the Rio Grande, as on other rivers under other reclamation projects, irrigation made perennial surface flows more consistent over time, due to drainage and return flow. According to Richard Burges, who was representing Texas informally in compact talks at the time, the Rio Grande had not been dry at El Paso since completion of the Rio Grande Project: "The perennial flow is improved by the construction of reservoirs and the irrigation of lands."[58]

In the view of Reclamation officials, according to EBID's president, "increased irrigation on the upper reaches of the stream detracts but little from the water supply and that the compensation found in the return flow equals in a practical way the amount diverted for irrigation." Consequently, in this view, upstream irrigation was seen to benefit lower irrigators as well.[59] Colorado representatives argued that irrigation development upstream did not cause river depletion, but instead resulted in "an enrichment of outflow" due to drainage recovery and return flow.[60]

Return Flow Below Elephant Butte Reservoir

Reclamation Service officials and EBID managers had developed an understanding of return flow before the Rio Grande Compact was negotiated. In a 1919 report, Harold Conkling and Erdman Debler for the U.S. Reclamation Service addressed return flow in the Rio Grande Project area.[61] They acknowledged the practical necessity of diverting more water than could be consumptively used by crops. Over time, they wrote, transportation losses from canals and deep percolation from irrigated areas resulted in "return flow to the river from the irrigated areas" after consumptive uses. On many reclamation projects, they wrote, this water was lost entirely, but on the Rio Grande Project, the issue was "comparatively unimportant if diversion is approximately as assumed, because of immediate rediversion by canal headings below."[62]

The Reclamation Service understood that seepage and percolation losses did "not represent final loss to the water supply of the project, as practically all of this flow will be recovered" and made

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[58] Rio Grande River Compact Commission, First Meeting, October 26, 1924, 28.

[59] President and Manager, EBID, to George M. Neel, New Mexico State Engineer, August 17, 1925, NMSU-EBID, Series 02-D, Box 1, Folder 8.

[60] Ralph I. Meeker to Delph E. Carpenter, Interstate Rivers Commissioner, December 6, 1927, CSU-WDEC, Series 1.1, Box 7, Folder 1.

[61] Erdman Debler went on to become deeply involved in the Rio Grande Compact Commission. His studies (subsequent to the 1919 study referenced here) played an important part in compact negotiations before the temporary 1929 Compact. See U.S. Bureau of Reclamation, Project History, Rio Grande Project, Calendar Year 1928, 16. He later served as the United States representative on the Committee of Engineers appointed by the Rio Grande Compact Commissioners.

[62] Harold Conkling and Erdman Debler, "Water Supply for and Possible Development of Irrigation and Drainage Projects on the Rio Grande River above El Paso, Texas," no date [circa 1919], 110–11, NMSU-EBID, Series 06-C, Box 3, Folder 9.

available for redistribution to project lands.[63] In 1920, EBID President H. H. Brook noted that drainage water on the project could be "picked up by lower diversions and used over and over again," contributing to the overall supply.[64] EBID officials in 1924 claimed that drainage water belonged to the district, as its members had to repay the federal government for construction of drainage works. "This water developed by drainage, we maintain, belongs to the two Districts by right of development . . . ."[65] Drainage works within the project were substantially complete by 1924.[66]

Participants in the Rio Grande Compact negotiations understood that return flow was utilized within the Rio Grande Project. D. C. Henny, who served on the Rio Grande Compact Commission in 1928 and 1929 as a consulting engineer for both New Mexico and Texas, explained this process in a 1925 report for EBID and EP No. 1. He wrote that each unit of the project was supplied by its own irrigation canal. The river served as a carrier throughout the project, with "return flow from upper units as well as side inflow from the drainage shed and seepage return from the reservoir becom[ing] successively available along the course of the river." In short, "return water" from upper units was utilized as part of the supply for lower units.[67]

In discussions leading to the temporary 1929 Rio Grande Compact, Colorado representatives characterized flows passing the lower end of the Rio Grande Project as "waste," which justified their own development plans upstream. Colorado commissioner Delph Carpenter argued that return flow within the Rio Grande Project had reduced the overall demand on Elephant Butte Reservoir. Water users in the El Paso Valley, he wrote, "admitted that their project has always had plenty of water and with considerable going to waste and that the seepage returns from the upper lands of the project are to a large degree releasing the demand of the reservoir."[68]

In 1929, return flow featured in some Rio Grande Compact proposals. In one plan, Mexico (under the 1906 treaty) and Texas would receive "return and seepage water" which, according to Colorado commissioner Delph Carpenter, had created "constant flow with supplies always

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[63] L. M. Lawson, Project Manager, to H. H. Brook, June 24, 1919, NMSU-EBID, Series 02-D, Box 3, Folder 5.

[64] President and Manager, EBID, to A. P. Davis, U.S. Reclamation Service, January 3, 1923, 3, NMSU-EBID, Series 02-B, Box 1, Folder 17.

[65] EBID to L. M. Lawson, U.S. Bureau of Reclamation, May 28, 1924, 1, NMSU-EBID, Series 02-B, Box 17, Folder 2.

[66] "Rio Grande Project, Data from 1924 History of Project, U.S.R.S. Office, Denver," copied by R. I. Meeker, July 30, 1925, CSU-WDEC, Series 1.1, Box 6, Folder 7.

[67] D. C. Henny, Exhibit VIII, Part of Statement of Elephant Butte Irrigation District, El Paso County Water Improvement District No. 1, June 1925, 37, NMSU-EBID, Series 02-G, Box 1, Folder 7.

[68] Delph E. Carpenter to Herbert Hoover, Secretary of Commerce, June 4, 1925, 2, CSU-WDEC, Series 1.2, Box 131, Folder 1.

available."[69] He explained: "By reason of the return and seepage water from the Rio Grande Project, Colorado and New Mexico may proceed almost unhampered without injury to each other or to Texas, providing adequate storage and drainage are provided."[70] He advocated storage reservoirs in Colorado, "with systematic return of waters by drainage from irrigated lands back to the stream for reuse below," which would allow for "complete control of the waters of the river and assure their repeated use and reuse."[71]

However, the 1929 Rio Grande Compact did not apportion any water. Instead, it served as a "temporary expedient" for preserving conditions on the river while the states pursued drainage projects intended to increase the overall supply.[72] Under the temporary 1929 Compact, Colorado agreed not to impair the water supply at the New Mexico state line by new development, unless the depletions were offset by increased drainage returns.[73] Similarly, New Mexico agreed with Texas not to "cause or suffer the water supply of the Elephant Butte Reservoir to be impaired by new or increased diversion or storage within the limits of New Mexico unless and until such depletion is offset by increase of drainage return."[74]

Other Sources of Information on Return Flow

As compact talks continued in the 1930s, additional information on return flow emerged through interstate litigation in *Texas v. New Mexico*, which for a time proceeded alongside compact negotiations. In 1935, Texas brought claims against New Mexico for allegedly violating the 1929 Compact, contending that excessive diversions in the Middle Rio Grande Valley had impaired the water supply and decreased water quality in Elephant Butte Reservoir.[75] In 1936, L. R. Fiock of the Bureau of Reclamation answered questions from Frank B. Clayton, compact commissioner for Texas since 1935. Also present were A. T. Hannett, an adviser for New Mexico on the Rio Grande

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[69] [Delph E. Carpenter, statement, circa January 22, 1929], 12, CSU-WDEC, Series 2.2, Box 24, Folder 23. See also "Colorado Accepts Fourth of River Proposals on Monday," *Santa Fe New Mexican,* January 22, 1929, CSU-WDEC, Series 8.1, Box 77, Folder 15.

[70] [Delph E. Carpenter, statement, circa January 22, 1929], 13, CSU-WDEC, Series 2.2, Box 24, Folder 23.

[71] [Delph E. Carpenter, statement, circa January 22, 1929], 16–17, CSU-WDEC, Series 2.2, Box 24, Folder 23.

[72] Rio Grande Compact, February 12, 1929, Article XVI, 13, CSU-WDEC, Series 2.2, Box 24, Folder 24.

[73] Rio Grande Compact, February 12, 1929, Article V, 7, CSU-WDEC, Series 2.2, Box 24, Folder 24.

[74] Rio Grande Compact, February 12, 1929, Article XII, 11, CSU-WDEC, Series 2.2, Box 24, Folder 24.

[75] Myra Ellen Jenkins, "The Rio Grande Compact of 1938" (Ph.D. diss., March 1982), 27, John L. Gregg Papers, Ms 0395, New Mexico State University Library, Archives and Special Collections Department, [NMSU, John L. Gregg Papers], Box 11, Folder 14.

Compact Commission since 1935, and Richard Burges, who served on the Compact Commission in various capacities from 1924 to 1938.[76]

Fiock explained Rio Grande Project operations, system losses, drainage, and salinity. He said the Rio Grande Project first curtailed reservoir releases in 1935, due to a possible water shortage. That year, each acre of irrigable land under the project was entitled to a reduced "allotment" of 1.5 acre-feet—half the normal project water right of 3 acre-feet per acre—at the farm.[77] He explained that water deliveries to farms in 1935 required more than twice the amount to be released from Elephant Butte Reservoir, due to losses in the system.[78] In other words, to supply 1.5 acre-feet at the farm, approximately 3 acre-feet had to be released at the dam. "That is approximately the proportion," he said, "although we do recover and redivert water over and over down through the project."[79]

Fiock's testimony also covered the water delivery process: water users placed orders with local ditch-riders, who transmitted them to a Bureau of Reclamation project hydrographer, who consolidated the orders. The hydrographer calculated necessary releases based on drainage flows, river losses and leakage, and return flows from upper divisions available for use by lower divisions. The Bureau of Reclamation endeavored to make irrigation releases twice a week.[80] Releases from Elephant Butte took about five days to travel through the entire Rio Grande Project—twelve hours to reach the Rincon Valley, twenty-four hours to reach the Mesilla Valley, three days to reach the El Paso Valley, and five days to finally exit the project.[81] The upper end of the project's irrigated area was about 24 miles below Elephant Butte Dam; the lower end about 160 miles distant.[82]

Fiock explained that return flow increased progressively downstream, with about one-third of the irrigation supply at El Paso being drain water from the Mesilla Valley.[83] However, water became saltier as it drained through the soil, with salinity increasing at the lower end of the project, where dilution with river water was necessary to avoid crop damage.[84] "We get in extreme difficulty every time we allow the flow to get down to the point of where it is practically all drain water," he said. "Even more than fifty percent drain water." He noted that project farmers had threatened recourse

[76] L. R. Fiock, Direct Examination by Frank B. Clayton, November 11, 1936, [hereafter Fiock, Direct Examination], NMSU-EBID, Series 02-G, Box 6, Folder 1.

[77] Fiock, Direct Examination, 14.

[78] Fiock, Direct Examination, 13.

[79] Fiock, Direct Examination, 14.

[80] Fiock, Direct Examination, 15–16.

[81] Fiock, Direct Examination, 17.

[82] Fiock, Direct Examination, 20.

[83] Fiock, Direct Examination, 20–21.

[84] Fiock, Direct Examination, 24.

for crop damage in such situations.[85] It was necessary, therefore, to pass water through the lower end of the project to keep water quality satisfactory for the lower diversions.[86] Overall, Fiock testified that, in his experience, the Rio Grande Project had been economic in its use and conservation of water.[87]

Rio Grande Project records were another source of information about return flows.[88] As early as 1918, when a drainage system was being built to relieve waterlogged project lands, work was underway to secure "regular discharge measurements on the constructed drains."[89] By 1919, project administrators were measuring drainage flows twice monthly.[90] Drainage discharges that year measured 109,459 acre-feet.[91] Project officials expected return flow to increase as more land came under cultivation.[92] In 1921, total drainage from project was measured at 191,145 acre-feet.[93] By 1923, the project drainage system was about 90 percent complete, and Bureau of Reclamation personnel continued to monitor drainage discharge.[94] Drainage works were substantially complete by 1924.[95]

Rio Grande Project information regarding drainage and return flow was available to the compact parties. Since the first meeting of the Rio Grande Compact Commission in 1924, members of EBID and EP No. 1 regularly participated in the proceedings. EP No. 1 attorney Richard F. Burges attended nearly every compact commission meeting on behalf of Texas from 1924 to 1938. Other compact commission participants since 1924 included EBID presidents Joseph Taylor, A. Robertson and N. B. Phillips, EBID attorney Edwin Mechem, and EP No. 1 Manager Roland Harwell.[96] In addition, since at least 1928, Rio Grande Project administrators shared hydrological

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[85] Fiock, Direct Examination, 22.

[86] Fiock, Direct Examination, 31.

[87] Fiock, Direct Examination, 34.

[88] At least some compact parties accessed information from Rio Grande Project histories around the time the histories were produced. For example, see "Rio Grande Project, Data from 1924 History of Project, U.S.R.S. Office, Denver," copied by R. I. Meeker, July 30, 1925, CSU-WDEC, Series 1.1, Box 6, Folder 7.

[89] L. M. Lawson, Project Manager, Annual Project History and Operation and Maintenance Report, Rio Grande Project, New Mexico–Texas, Year 1918," 186.

[90] U.S. Reclamation Service, Project History, Rio Grande Project, 1919, 302.

[91] U.S. Reclamation Service, Project History, Rio Grande Project, 1919, 284.

[92] U.S. Reclamation Service, Project History, Rio Grande Project, 1919, 303.

[93] U.S. Reclamation Service, Annual Project History, Rio Grande Project New Mexico–Texas, 1921, 160.

[94] U.S. Bureau of Reclamation, Project History, Rio Grande Project, 1923, 100–101.

[95] U.S. Bureau of Reclamation, Project History, Rio Grande Project, 1924, 23.

[96] Rio Grande River Compact Commission, First Meeting, October 26, 1924; Proceedings of Rio Grande Compact Conference, December 19–21, 1928, TX_00137579; Proceedings of Rio Grande Compact Conference, January 21, 1929, TX_00137660; Proceedings of the Rio Grande Compact Conference, December 10–11, 1934; Proceedings of the Rio Grande Compact Commission, January 28–30, 1935; Proceedings of the Rio Grande Compact Commission, December

data with Texas and New Mexico in preparation for compact talks.[97] Such information sharing was regularly mentioned in Rio Grande Project histories throughout the 1930s.[98] On this basis, it seems reasonable to conclude that the compact parties had knowledge of conditions on the Rio Grande Project.

In 1937, the Rio Grande Joint Investigation provided additional information to compact negotiators on return flow below Elephant Butte Reservoir. The investigation noted that there was "a supply of considerable magnitude" from irrigation water returning to the Rio Grande as surface or groundwater inflow. This "return water" came from canal losses, surface drainage after irrigation, and underground seepage. In estimating overall water supplies for the entire Upper Rio Grande Basin above Fort Quitman under various conditions, the Joint Investigation acknowledged return flow as "an important consideration."[99]

For lands below Elephant Butte, the Joint Investigation found that return flow was high. While data was incomplete for areas within this section outside the Rio Grande Project, drain discharges on project lands had been measured for many years. The Joint Investigation analyzed return flow data from a seven-year period, 1930 to 1936. The investigation found that the mean volume of return flow in the Rio Grande Project for these years was 50.3 percent of net diversions, due in part to high seepage from the many miles of main canals and laterals that were "required to irrigate the long narrow valleys."[100]

2–3, 1935; Proceedings of Rio Grande Compact Commission, March 3–4, 1937; Proceedings of the Meeting of the Rio Grande Compact Commission, September 27–October 1, 1937; Proceedings of Rio Grande Compact Commission, March 3–18, 1938.

[97] U.S. Bureau of Reclamation, Project History, Rio Grande Project, Calendar Year 1928, 45.

[98] U.S. Bureau of Reclamation, Project History, Rio Grande Project, 1930, 16; 1931, 14; 1932, 12; 1933, 9; 1934, 10; 1935, 10; 1936, 9; 1937, 12; 1938, 12; 1939, 14.

[99] U.S. National Resources Committee, *Regional Planning, Part VI: The Rio Grande Joint Investigation in the Upper Rio Grande Basin in Colorado, New Mexico, and Texas, 1936–1937* (Washington, DC: GPO, 1938), [hereafter Rio Grande Joint Investigation], 48–49.

[100] Rio Grande Joint Investigation, 55.

Table 45.—*Net diversions and drainage return, Rio Grande Project, 1930–36*

[Unit 1,000 acre-feet except as otherwise noted]

Year	Rincon: Net diversion	Rincon: Drainage return Amount	Rincon: Drainage return Percent of diversions	Mesilla: Net diversion	Mesilla: Drainage return Amount	Mesilla: Drainage return Percent of diversions	El Paso: Net diversion	El Paso: Drainage return Amount	El Paso: Drainage return Percent of diversions	Project total: Net diversion	Project total: Drainage return Amount	Project total: Drainage return Percent of diversions
1930	64.4	31.9	49.5	424.1	183.8	43.4	268.1	132.5	49.4	756.6	348.2	46.0
1931	64.0	36.7	57.3	410.7	196.5	47.9	237.0	131.2	55.4	711.7	364.4	51.2
1932	73.9	39.2	53.0	439.5	194.4	44.2	244.6	138.0	56.4	758.0	371.6	49.0
1933	69.4	41.0	59.1	416.3	205.4	49.4	243.4	137.2	56.4	729.1	383.6	52.6
1934	82.7	40.9	49.5	426.3	217.8	51.1	265.3	132.8	50.1	774.3	391.5	50.5
1935	51.3	26.8	52.3	298.7	167.1	56.0	198.8	109.5	55.1	548.8	303.4	55.3
1936	63.0	28.5	45.3	368.8	185.2	50.2	237.4	112.9	47.6	669.2	326.6	48.8
Mean	67.0	35.0	52.2	397.8	192.9	48.5	242.1	127.7	52.7	706.9	355.6	50.3

Figure 1. Source: Rio Grande Joint Investigation, 55.

In negotiations leading to the 1938 Compact, return flow was sometimes discussed among the engineer advisers, although calculations and comparisons of inflow and outflow models predominated in compact discussions.[101] The 1938 Compact was a data-driven exercise, drawn in largely technical terms.[102] While return flow seems to have factored into the data underlying the compact's delivery schedules, as its prominence in the Joint Investigation would suggest, it was not directly addressed in the definitions or terms of the 1938 Rio Grande Compact.[103] However, its significance from the outset of compact discussions and its quantification in the Joint Investigation indicates that its importance was well understood by the compact parties when they signed the 1938 Rio Grande Compact.

[101] For example, Proceedings of the Meeting of the Rio Grande Compact Commission, September 27–October 1, 1937, 22–23.

[102] As an illustration, Colorado engineer Royce Tipton claimed to be the author of Article III of the 1938 Compact. Statement by Mr. Royce J. Tipton, December 8–9, 1966, 2, NMSU, John L. Gregg Papers, Box 10, Folder 9. Raymond Hill, who served as the engineer adviser for Texas, wrote retrospectively that the 1938 compact "adopted almost verbatim the wording of the reports of the Engineering Advisers to avoid renewal of controversies that had been resolved." Raymond A. Hill, "Development of the Rio Grande Compact of 1938," *Natural Resources Journal* 14, no. 2 (April 1974): 163–200, at 198. In contrast to a data-driven approach, Colorado's Delph Carpenter (who was central to the 1929 Compact) advocated simplicity in compact writing, "such that the lay mind may easily grasp its terms and discern the fairness of its provisions." [Delph E. Carpenter, statement, circa January 22, 1929], 12, CSU-WDEC, Series 2.2, Box 24, Folder 23. Carpenter also wrote: "The best compact is that written by three or four men, off by themselves and away from all the disturbing influences." Delph E. Carpenter to William J. Donovan, January 15, 1929, "Santa Fe Conference," CSU-WDEC, Series 1.1, Box 6, Folder 18.

[103] Rio Grande Basin Compact, March 18, 1938, CSU-WDEC, Series 7.1, Box 62, Folder 5.

Opinion 3: Surface Water Supply below Elephant Butte

The compact parties understood the surface water supply requirements and limitations in the area below Elephant Butte Reservoir.

The compact parties had access to information regarding the surface water supply requirements for the Rio Grande Project and the area below Elephant Butte Reservoir. Project hydrological information first was accessible to the parties through Bureau of Reclamation data, and later through the Rio Grande Joint Investigation, which was analyzed Rio Grande Compact Commission's Committee of Engineers. The New Mexico state engineer demonstrated an awareness of surface water supply limitations below Elephant Butte Reservoir in his denial or non-approval of several water-rights filings below the reservoir from 1925 to 1935.

Rio Grande Project Data

Complete hydrological data for the Rio Grande Project first became available to the Reclamation Service (later the Bureau of Reclamation) in 1919, after the federal government took over the old, irregular community ditch systems that distributed water to most farms under the project. With the Reclamation Service in control of both reservoir releases and distribution infrastructure, it became possible, for the first time, for project administrators to make a comprehensive study of water distribution, losses, and recovery.[104]

In 1921, Rio Grande Project officials acknowledged the total limits of the two irrigation districts under the project (EBID and EP No. 1) to be 155,000 acres.[105] In 1922, the Reclamation Service considered expanding the project area with land in the Palomas Valley, just below Elephant Butte Reservoir, as well as bench land in both the Mesilla and El Paso Valleys, "which it is quite probable will eventually be reached by pumping, if sufficient water supply is available after the project now under contract has been fully developed."[106] However, by 1923, these proposed expansions had lost traction, and apparently they were not considered again by project officials.[107] In 1926, D. C. Henny (who served on the Rio Grande Compact Commission in 1928 and 1929 as a consulting engineer for New Mexico and Texas) counseled EBID against increasing the project's limits beyond 155,000

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[104] U.S. Reclamation Service, Project History, Rio Grande Project, 1919, 15.

[105] U.S. Reclamation Service, Annual Project History, Rio Grande Project New Mexico–Texas, 1921, 6.

[106] U.S. Reclamation Service, Project History, Rio Grande Project, 1919, 245–46.

[107] U.S. Bureau of Reclamation, Project History, Rio Grande Project, 1923, 218. After 1923, the Bureau did not mention these prospective expansions again in the project's future plans or needs in its annual project histories through 1939.

acres, as any expansion might be viewed by Colorado as evidence that excess project water was available for upstream uses.[108]

In 1928, in preparation for Rio Grande Compact negotiations, project officials supplied Texas and New Mexico with information on Rio Grande Project water supply and irrigation development. Project offices provided maps, agricultural statistics, and hydrological data to engineer D. C. Henny, who was then an adviser on the Rio Grande Compact Commission for New Mexico and Texas.[109] Through 1939, project officials continued to share annual gauging information and hydrological data with the compact parties.[110] In 1931, for example, surface flow data was made available to New Mexico, Texas, and Colorado state engineers, and was furnished specifically to the Rio Grande Compact Commissioners. Other hydrographic data on canal and drain flows compiled by the Bureau of Reclamation was made available to the compact parties and other agencies.[111]

In 1936, project engineers increased their hydrographic monitoring to assist the Rio Grande Joint Investigation with new gauging points, additional water quality sampling, and more detailed information in general. According to project officials, "All of the data compiled was forwarded to the Rio Grande Joint Investigation engineer and has been incorporated in the report published by the National Resources Committee."[112] The results of this hydrographic work, they noted, "were quite detailed and formed a very complete basis for water supply studies on the Rio Grande Project."[113] Through 1938, Rio Grande Project officials continued to make project hydrological information available to the compact parties, including gauging data, canal flows, and drainage returns.[114]

Rio Grande Joint Investigation

The compact parties also had access to comprehensive surface water requirements below Elephant Butte Reservoir through the Rio Grande Joint Investigation. First made available to the compact commission in 1937, the Joint Investigation was a compilation of hydrological information

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[108] D. C. Henny to J. W. Taylor, President, EBID, January 9, 1926, 10, NMSU-EBID, Series 02-G, Box 1, Folder 7.

[109] U.S. Bureau of Reclamation, Project History, Rio Grande Project, Calendar Year 1928, 45.

[110] For example, see U.S. Bureau of Reclamation, Project History, Rio Grande Project, Calendar Year 1929, 18. Thereafter, Bureau of Reclamation Rio Grande Project annual histories noted that hydrological data was made available to the compact parties.

[111] U.S. Bureau of Reclamation, Project History, Rio Grande Project, Calendar Year 1931, 14.

[112] U.S. Bureau of Reclamation, Project History, Rio Grande Project, Calendar Year 1936, 21.

[113] U.S. Bureau of Reclamation, Project History, Rio Grande Project, Calendar Year 1936, 22.

[114] U.S. Bureau of Reclamation, Project History, Rio Grande Project, Calendar Year 1938, 12.

for the entire Upper Rio Grande Basin.[115] Colorado commissioner M. C. Hinderlider described it as quite probably "the most comprehensive, and in many respects detailed study ever made of the water and land resources of a river basin in the arid West."[116] The joint investigation provided the compact parties with surface flow information and other data to use in reaching the 1938 Rio Grande Compact.

The Joint Investigation divided the Upper Rio Grande Basin (above Fort Quitman) into three sections, with the area below Elephant Butte Reservoir comprising a single section. For this area and the other sections, the investigation analyzed topography, climate, runoff, return flow, irrigation development, and other factors.[117] It also detailed the water uses and requirements for each section. For the "Elephant Butte-Fort Quitman section," the investigation considered actual diversions and uses of water from 1930 to 1936, including detailed studies of river flow, net diversions, drainage, river-bed losses, and arroyo inflows. In addition, the investigation incorporated certain modifications to account for salinity control, and it made allowances for future distribution improvements associated with the American diversion dam in the El Paso Valley, which was not yet complete.[118] Based on the actual acres irrigated by the Rio Grande Project from 1930 to 1936, the investigation assumed a maximum irrigated area of 145,000 acres under the project, and it arrived at a probable demand on Elephant Butte Reservoir, including Mexico's treaty allotment, of 773,000 acre-feet annually.[119]

The Rio Grande Compact Commission analyzed the Joint Investigation's findings through a Committee of Engineers, or "engineering advisers"—one each for Colorado, New Mexico, Texas, and the United States. The engineers assessed the general and specific factors affecting the discharge of the Rio Grande at the Colorado/New Mexico state line and into Elephant Butte Reservoir.[120] What they produced was very much like a compact draft, complete with definitions, delivery schedules into Elephant Butte Reservoir, and allowable water credits and debits among the states. Based on technical analysis, the committee estimated average normal releases from Elephant Butte Reservoir to be 800,000 acre-feet annually.[121] The engineers were "satisfied that no material

115 Proceedings of the Meeting of the Rio Grande Compact Commission, September 27–October 1, 1937.

116 M. C. Hinderlider, Commissioner for Colorado, to Governor Teller Ammons, November 15, 1938, in Rio Grande Basin Compact, March 18, 1938, 7, CSU-WDEC, Series 7.1, Box 62, Folder 5., 7.

117 Rio Grande Joint Investigation, 19–65.

118 Rio Grande Joint Investigation, 99.

119 Rio Grande Joint Investigation, 101–04.

120 Report of Committee of Engineers to Rio Grande Compact Commissioners, December 27, 1937, [hereafter Report of Committee of Engineers], 1, NMSU-EBID, Series 02-D, Box 3, Folder 5.

121 Report of Committee of Engineers, 9.

expansion of the irrigated area in the Rio Grande Basin above Fort Quitman will be practicable without importations from other watersheds."[122]

New Mexico commissioner Thomas McClure acknowledged that the Committee of Engineers' report "fixes a basis for water supply to the State of Texas," but he objected that the estimated "normal release" from Elephant Butte Reservoir was far too large.[123] In compact proceedings from March 1938, the commissioners for New Mexico and Texas debated the proper figure, with New Mexico arguing that the engineering committee's estimate of 800,000 acre-feet per year was too high.[124] The commission agreed that the engineering advisers should consider New Mexico's concerns.[125] On March 9, 1938, the Committee of Engineers submitted a revised report that reduced the average annual release at Elephant Butte to 790,000 acre-feet.[126] Thus, the surface water requirements for the area below Elephant Butte Dam were thoroughly studied and considered by the compact commissioners and their engineer advisers prior to the signing of the 1938 Rio Grande Compact.

New Mexico Denial of Water-Rights Filings

During compact negotiations, the New Mexico state engineer's office recognized United States water rights on the Rio Grande, and demonstrated an awareness of the water requirements in the area below Elephant Butte Reservoir by declining to approve several water-rights filings in the area from 1925 to 1935.[127] In 1927, New Mexico State Engineer Herbert W. Yeo rejected a 1926 application by Wm. C. Roche, No. 1689 to appropriate approximately 17,340 acre-feet from the Rio Grande to irrigate more than 6,300 acres in the Palomas Valley, just below Elephant Butte Dam.[128]

In considering Roche's application, State Engineer Yeo found in 1927 that the United States had a "valid and existing right" to appropriate 730,000 acre-feet from the Rio Grande. This filing, which the federal government made in 1906 in connection with the Rio Grande Project, was supplemented by an additional filing in 1908 claiming "all the unappropriated waters of the Rio Grande" in New Mexico. Based on these federal filings, Yeo concluded that "there are no unappropriated waters

[122] Report of Committee of Engineers, 13.

[123] Thomas M. McClure, State Engineer, to S. O. Harper, Chairman, Rio Grande Compact Commission, January 25, 1938.

[124] Proceedings of Rio Grande Compact Commission, March 3–18, 1938, 4–5, 11.

[125] Proceedings of Rio Grande Compact Commission, March 3–18, 1938, 8.

[126] Committee of Engineering Advisers to Rio Grande Compact Commission, March 9, 1938.

[127] U.S. Bureau of Reclamation, "Legal and Institutional Framework for Rio Grande Project Water Supply and Use, a Legal Hydrograph," Final Draft, October 1995, CO-007325 at CO-007395.

[128] State of New Mexico, Office of the State Engineer, Application No. 1689, Findings and Order of State Engineer, April 16, 1927, 1–2, TX_00092478 at TX_00092480–81.

available in the Rio Grande," and that approval of Roche's application would be "contrary to the public interest of the people of the State of New Mexico." Accordingly, he rejected Roche's application.[129]

Subsequently, Roche appealed the state engineer's decision, but on motion of the appellant, the appeal was eventually dismissed.[130] Similarly, New Mexico state and territorial engineers did not approve several other water-right filings in the area below Elephant Butte Reservoir, including an application by Eugene Van Patten, cancelled in 1909, and two applications by the El Paso Electric Company, cancelled in 1929.[131] In regard to Roche's application, the New Mexico state engineer recognized that in view of valid federal water-right filings, there were no additional surface flows left to appropriate below Elephant Butte Reservoir.

[129] State of New Mexico, Office of the State Engineer, Application No. 1689, Findings and Order of State Engineer, 3–4, TX_00092478 at TX_00092482–83.

[130] L. R. Fiock and H. J. S. Devries to Commissioner of Reclamation, August 18, 1938, 2–4, HRA0011158.

[131] U.S. Bureau of Reclamation, "Legal and Institutional Framework for Rio Grande Project Water Supply and Use, a Legal Hydrograph," Final Draft, October 1995, CO-007325 at CO-007395.

Opinion 4: Groundwater

Some information about groundwater and its connection to surface flow was available to the compact parties.

Although groundwater did not feature prominently in Rio Grande Compact talks—it was not widely used as a primary source of irrigation water in the Upper Rio Grande Basin leading to the compact—it is reasonable to conclude that the compact parties had at least some awareness of groundwater dynamics below Elephant Butte Reservoir. Groundwater information was available to the compact parties, and some participants in Rio Grande Compact Committee meetings demonstrated an understanding of groundwater's connection to surface flows within the Rio Grande Project.[132]

In 1905, the U.S. Geological Survey published Water Supply Paper No. 141, "Observations of the Ground Water of the Rio Grande Valley," by C. S. Slichter. He reported that groundwater was present in both the El Paso and Mesilla Valleys, held within loosely composed sands and gravels. The origin of this water, he wrote, was probably the Rio Grande itself, which soaked into water-bearing subsurface formations during flood stages.[133] Generally, he observed low groundwater levels in dry periods and higher levels after floods.[134]

Slichter noted in 1905 the presence of active irrigation pumping in the Mesilla and El Paso Valleys, with wells drilled 48 to 63 feet deep, utilized to supplement river supplies during frequent shortages.[135] He posited that certain volumes of water that could be pumped to maintain equilibrium with recharge—that is, if groundwater were pumped in volumes matching the contributions from the river over a certain time, the water table would remain unchanged. However, he noted that a "greater rate of pumping would have a tendency to lower the water plane below its initial value and make a draft upon the permanent supply stored in the gravels."[136]

Rio Grande Project Information

Groundwater levels rose quickly within the Rio Grande Project after 1916, with completion of Elephant Butte Dam providing more water for irrigation. By 1917, large areas of farmland were

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132 Groundwater is here taken broadly to include all subsurface waters of the Rincon, Mesilla, and El Paso valleys, regardless of their source, whether from natural flooding prior to the Rio Grande Project, pre-project irrigation, or irrigation and seepage under the project, which may constitute or contribute to return flow.

133 Charles S. Slichter, U.S. Geological Survey, Observations on the Ground Waters of the Rio Grande Valley, Water-Supply and Irrigation Paper No. 141 (Washington, D.C.: GPO, 1905), 18, 27.

134 Slichter, Observations on the Ground Waters of the Rio Grande Valley, 19.

135 Slichter, Observations on the Ground Waters of the Rio Grande Valley, 22, 29.

136 Slichter, Observations on the Ground Waters of the Rio Grande Valley, 28.

waterlogged.[137] In the Mesilla Valley, for example, an estimated two-thirds of the total acreage had groundwater levels 4 feet or less from the surface. Reclamation Service Engineer J. L. Burkholder pointed out that the rising water table was "an unnatural condition" resulting from irrigation water accumulating in the soil faster than natural drainage could carry it back to the river.[138] The Rio Grande Project area had slow natural drainage, and Burkholder recommended a reduction in water use by irrigators, as well as an engineered drainage system.[139]

Construction for open drains began in 1916 and was in full progress by 1917. For the next several years, work on the project's drainage system was "prosecuted vigorously," according to one Reclamation official.[140] Test wells were active on the project by 1916, with more being added to measure "the stage of underground water" on project lands.[141] In 1918, EBID and the Reclamation Service notified water users to "make only the most beneficial use of irrigation water," both to conserve reservoir water and to reduce seepage. Water users were further advised that constructed drainage ditches were designed to "relieve the underground water and not to carry off waste surface water from irrigated lands."[142]

By 1919, there were more than 1,700 test wells operating on the project.[143] Reclamation officials noted that by that time, the water supply of the Rio Grande Project included not only surface water stored in Elephant Butte Reservoir, but also the "seepage recoveries collected by the river bed and drains from about three-quarters of the irrigated area."[144] Project administrators reported that drainage was generally effective in lowering the water table and protecting farmland from waterlogging.[145]

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137 U.S. Reclamation Service, Rio Grande Project, New Mexico–Texas, History of the Project, 1917, 1.

138 J. L. Burkholder, U.S. Reclamation Service, "Seepage–Its Cause and Remedy," no date [circa June 30, 1917], 6, NMSU-EBID, Series 02-B, Box 6, Folder 5. Burkholder appears to have attended Rio Grande Compact Commission meetings in 1928 and 1929 [documents partly illegible]. Proceedings of Rio Grande Compact Conference, December 19–21, 1928, TX_00137579; Proceedings of Rio Grande Compact Conference, January 21, 1929, TX_00137660.

139 J. L. Burkholder, U.S. Reclamation Service, "Seepage–Its Cause and Remedy," no date [circa June 30, 1917], 13, NMSU-EBID, Series 02-B, Box 6, Folder 5.

140 U.S. Bureau of Reclamation, Project History, Rio Grande Project, 1924, 23.

141 U.S. Reclamation Service, Rio Grande Project, New Mexico–Texas, History of the Project, 1917, 1, 58–59 [quotation at 1]. See also U.S. Reclamation Service, Rio Grande Project, New Mexico–Texas, History of the Project, 1916, 112.

142 L. M. Lawson, U.S. Reclamation Service, to Albert S. Eylar, July 10, 1918, NMSU-EBID, Series 02-B, Box 2, Folder 11.

143 U.S. Reclamation Service, Project History, Rio Grande Project, 1919, 298.

144 U.S. Reclamation Service, Project History, Rio Grande Project, 1919, 225.

145 U.S. Reclamation Service, Project History, Rio Grande Project, 1919, 298.

Some observers recognized the possibility of future groundwater development below Elephant Butte Reservoir. For example, in 1919, a team of engineers led by D. C. Henny (later an engineering adviser for New Mexico and Texas on the Rio Grande Compact Commission) reported on the Rio Grande Project's water supply for the High Line Canal Board.[146] During periods of water shortage, the team noted, there was "a possibility that the quality of the ground water may in time improve so that it may be used to reduce the shortages as they occur provided cheap power is available."[147]

By 1923, the Rio Grande Project had "an elaborate and effective system of drainage canals," which both protected project lands from waterlogging and "provided an additional water supply at the lower end of the project."[148] Drainage construction was about 90 percent complete by 1923, with no additional test wells planned. By that time, not all test wells were still being monitored, but project administrators continued to take readings from selected wells "to determine the ground water movement throughout various points on the project."[149] The drainage system was substantially complete by 1924, when Rio Grande Compact discussions began.[150]

There was at least some awareness that groundwater pumping could affect Rio Grande surface flow and, by extension, project deliveries. In 1926, consulting engineer D. C. Henny reported to EBID President J. W. Taylor that groundwater pumping on Rio Grande Project lands above El Paso could affect surface flows to the El Paso Valley.[151] Henny observed that any groundwater extraction above El Paso would "diminish practically to the same extent the flow reaching the International dam as would pumping from project channels." He recommended pumping from areas below El Paso instead, which would be "equivalent to diversion from drains and will ultimately affect Hudspeth County lands only."[152] In Henny's understanding, surface water and groundwater under

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[146] D. C. Henny served on the Rio Grande Compact Commission as a consulting engineer on behalf of Texas and New Mexico in 1928 and 1929. Proceedings of Rio Grande Compact Conference, December 19–21, 1928, TX_00137579; Proceedings of Rio Grande Compact Conference, January 21, 1929, TX_00137660.

[147] Quoted in President and Manager, EBID, to A. P. Davis, U.S. Reclamation Service, January 3, 1923, 3, NMSU-EBID, Series 02-B, Box 1, Folder 17.

[148] U.S. Bureau of Reclamation, Project History, Rio Grande Project, 1923, 4.

[149] U.S. Bureau of Reclamation, Project History, Rio Grande Project, 1923, 100.

[150] U.S. Bureau of Reclamation, Project History, Rio Grande Project, 1924, 23.

[151] Both Henny and Taylor were involved in the Rio Grande Compact Commission at different times. Taylor participated in the Rio Grande Compact Commission's first meeting in 1924. Rio Grande River Compact Commission, First Meeting, October 26, 1924. Henny was present at compact commission meetings as a consulting engineer for New Mexico and Texas in 1928 and 1929. Proceedings of Rio Grande Compact Conference, December 19–21, 1928, TX_00137579; Proceedings of Rio Grande Compact Conference, January 21, 1929, TX_00137660.

[152] D. C. Henny to J. W. Taylor, President, EBID, January 9, 1926, 1, NMSU-EBID, Series 02-G, Box 1, Folder 7.

the project were hydrologically connected, and pumping could diminish the flow of the Rio Grande.[153]

From 1935 to 1937, Rio Grande Project administrators assisted with groundwater investigations in connection with *Texas v. New Mexico* at the request of the consulting engineer for Texas (who was also employed by EBID and EP No. 1). Activities included increased water sampling in drains and groundwater test wells, with about 100 new test wells installed by 1937.[154] This work occurred mainly in the El Paso Valley and Hudspeth District areas, where studies indicated that groundwater in the Tornillo District (in Texas, at the project's lower end) contained higher salt concentrations than elsewhere within the project.[155] However, hearings in *Texas v. New Mexico* were suspended in May 1937, pending compact negotiations and completion of the Rio Grande Joint Investigation.[156]

Rio Grande Joint Investigation

In 1938, the Rio Grande Joint Investigation addressed groundwater supplies for the entire Upper Rio Grande Basin. The investigation dealt separately with groundwater and return flows, but the main source for both was the same: "percolation from rainfall and from water applied in irrigation, and by seepage from canals and natural stream channels."[157] The investigation indicated minimal development activity: "There has been little utilization of ground water as a basic source of supply for irrigation in the Upper Rio Grande Basin."[158]

The Joint Investigation also recognized that groundwater and surface supplies in the Upper Rio Grande Basin were connected, and it cautioned that groundwater pumping would not increase the overall water supply:

> It is to be observed, in general, that extensive development of ground water for irrigation would add no new water to the Upper Rio Grande Basin and that recharge of the ground-water basins would necessarily involve a draft on surface supplies which are now utilized otherwise. The chief element to be considered in such a development would be the redistribution of the availability and use of present supplies and the resulting effect upon the water supply of lower major units.[159]

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[153] Such an increase, he explained, would be seen by Colorado as evidence that Elephant Butte Reservoir was too large for the project's needs, and that the excess water was available for Colorado's use. D. C. Henny to J. W. Taylor, President, EBID, January 9, 1926, 10, NMSU-EBID, Series 02-G, Box 1, Folder 7.

[154] U.S. Bureau of Reclamation, Project History, Rio Grande Project, Calendar Year 1937, 25.

[155] U.S. Bureau of Reclamation, Project History, Rio Grande Project, Calendar Year 1938, 25, 40.

[156] Frank B. Clayton, Rio Grande Compact Commissioner for Texas, to Lee O'Daniel, November 16, 1938, 3.

[157] Rio Grande Joint Investigation, 55.

[158] Rio Grande Joint Investigation, 13.

[159] Rio Grande Joint Investigation, 56.

For the area below Elephant Butte Reservoir, the Joint Investigation noted the "meager" data on groundwater for the Rincon, Mesilla, and El Paso Valleys. The investigation did not make its own studies of groundwater in these areas. However, it reported that the Rio Grande Project was "well provided with open drains that satisfactorily maintain ground-water levels at the depths below ground surface required to prevent waterlogging and seeping of the lands." Additionally, it found that the Bureau of Reclamation monitored groundwater depths "to derive the annual increment or decrement of ground water as a necessary factor in computing the annual consumptive use of water in the valley by the inflow-outflow method."[160] In other words, the Joint Investigation acknowledged that the Bureau factored groundwater into Rio Grande Project operations.

However, with no significant groundwater usage existing or expected, the subject of groundwater was not a significant focus of compact negotiations. Leading up to the 1938 Compact, discussions were largely by engineers who offered computations of surface inflow and outflow to arrive at prospective delivery schedules among the parties. Although groundwater conditions may have factored into the data underlying these schedules, there was rarely any direct mention of groundwater.[161] Neither the temporary 1929 Rio Grande Compact nor the 1938 Rio Grande Compact addressed groundwater or pumping, and neither compact defined groundwater or used the term.[162]

In summary, although the 1938 Rio Grande Compact did not address groundwater directly, some information was available to the compact parties regarding groundwater below Elephant Butte Reservoir. The Rio Grande Project drainage crisis in the years after 1916 demonstrated that project operations affected groundwater levels. There was also some awareness, at least within EBID, that groundwater pumping could diminish water availability downstream. Moreover, the Joint Investigation noted that the Bureau of Reclamation factored groundwater levels into project operations. Overall, while it was not a major factor in Rio Grande Compact discussions, it is reasonable to conclude that the compact parties were aware of groundwater's connection to surface supplies in the area below Elephant Butte Reservoir.

Recommendations for Further Research

Further historical analysis would be useful in understanding the implementation of the 1938 Rio Grande Compact, particularly as it related to groundwater use. Pumping in the Rio Grande Project area increased significantly in the 1950s. How was this development understood by the compact

[160] Rio Grande Joint Investigation, 62.

[161] For example, Proceedings of the Meeting of the Rio Grande Compact Commission, September 27–October 1, 1937, 8.

[162] Rio Grande Compact, February 12, 1929, CSU-WDEC, Series 2.2, Box 24, Folder 24; Rio Grande Basin Compact, March 18, 1938, CSU-WDEC, Series 7.1, Box 62, Folder 5.

parties? How was it regulated, if at all? How did this activity fit within Rio Grande Compact administration? These questions present avenues for further historical research, to determine whether developments after 1938 confirm, supplement, or otherwise affect my opinions about information available to the compact parties regarding project operations and conditions below Elephant Butte Reservoir.

Nicolai Kryloff

Project Historian, HRA

Appendix A: Sources Consulted

Throughout the report, I have cited in footnotes the specific documents upon which I am relying for my opinions. I considered the documents listed below in forming my opinions.[163]

Document or Publication:	Bates Number or Source Information:[164]
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EBID to L. M. Lawson, U.S. Bureau of Reclamation. May 28, 1924.	NMSU-EBID, Series 02-B, Box 17, Folder 2

[163] I may supplement this report with other production Bates numbers for the documents listed.

[164] Abbreviations for archival collections are as follows: Papers of Delph E. Carpenter and Family, Water Resources Archive, Colorado State University [CSU-WDEC]; Elephant Butte Irrigation District, Ms 0235, Archives and Special Collections Department, New Mexico State University Library [NMSU-EBID], and the John L. Gregg Papers, Ms 0395, New Mexico State University Library, Archives and Special Collections Department, [NMSU John L. Gregg Papers].

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Henny, D. C. to J. W. Taylor, President, EBID. January 9, 1926.	NMSU-EBID, Series 02-G, Box 1, Folder 7
Hill, Raymond A. “Development of the Rio Grande Compact of 1938.” *Natural Resources Journal* 14, no. 2 (April 1974).	Published Source
Jenkins, Myra Ellen. “The Rio Grande Compact of 1938.” Ph.D. diss. March 1982.	NMSU, John L. Gregg Papers, Box 11, Folder 14
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Lawson, L. M., U.S. Reclamation Service, to Albert S. Eylar. July 10, 1918.	NMSU-EBID, Series 02-B, Box 2, Folder 11
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President and Manager, EBID, to George M. Neel, New Mexico State Engineer. August 17, 1925.	NMSU-EBID, Series 02-D, Box 1, Folder 8
Proceedings of Meeting between Representatives of Lower Rio Grande Water Users and Representatives of Irrigation Districts Under the Rio Grande Project of the Bureau of Reclamation. May 27, 1938.	First Interim Report of the Special Master
[Rio Grande Compact Commission]. Rio Grande River Compact Commission, First Meeting. October 26, 1924.	CSU-WDEC, Series 2.2, Box 24, Folder 13
[Rio Grande Compact Commission]. Proceedings of Rio Grande Compact Conference. December 19–21, 1928.	TX_00137579
[Rio Grande Compact Commission]. Proceedings of Rio Grande Compact Conference. January 21, 1929.	TX_00137660
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[Rio Grande Compact Commission]. Proceedings of the Rio Grande Compact Commission. January 28–30, 1935.	CSU-WDEC, Series 7.1, Box 62, Folder 1
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Appendix B: Statement of Qualifications

HISTORICAL RESEARCH ASSOCIATES, INC.

Nicolai Kryloff

Project Historian

SUMMARY OF EXPERIENCE

Mr. Kryloff joined HRA in 2008 with a background in U.S. environmental history. His postgraduate studies at Colorado State University focused on water-resources history in the American West, with emphasis on groundwater development in the South Platte valley and early water diversions in northern New Mexico. Since joining HRA, he has done extensive research and writing on natural resource management, land use issues, water rights, Native American history, environmental contamination, military activities, administrative histories, and corporate history. As a researcher, his experience includes the National Archives, U.S. Library of Congress, U.S. Department of the Interior, National Museum of American History, and many other public and private repositories. Mr. Kryloff was also the lead author of *Building Strong in Korea: A History of the U.S. Army Corps of Engineers, Far East District*. He also co-authored a history of the U.S. Army Corps of Engineers, Baltimore District, and was project manager for an award-winning history of water use in South Florida and the Everglades. His independent studies have involved oil and gas regulatory history. Prior to joining HRA, Mr. Kryloff worked as a journalist, editor, independent researcher, and was an assistant at the Colorado Water Resources Archive.

EDUCATION

MA, History, 2008, Colorado State University
BA, History, 1998, University of New Mexico
BA, Journalism, 1998, University of New Mexico

WATER RIGHTS/NATURAL RESOURCES/LAND USE

Tribal Trust Litigation, United States ***9/2007 - present***

Lead historian and researcher. Contributed to resource management histories for various reservations involved in tribal trust lawsuits. Conducted research at National Archives repositories in Washington, D.C. and regional branches, the American Indian Records Repository in Kansas City, Missouri, and Bureau of Indian Affairs offices throughout the United States. Produced numerous expert reports on the historical management and development of natural resources on Indian reservations

Wilderness Roads, Kane County, Utah ***9/2018 - present***

Research historian. Investigated construction and historical uses of roads in a remote area of Utah to help determine their jurisdictional status. Reviewed records in a closed-access database and contributed written material for historical report.

Confidential Projects ***7/2008 - present***

This list excludes a number of projects performed on a confidential basis over the past 10 years.

ADMINISTRATIVE HISTORY

Far East District History, USACE, Seoul, Republic of Korea ***4/2016 - present***

Lead author and project manager. Produced book on the Far East District of the U.S. Army Corps of Engineers, the Army Corp's only "maneuver" district, trained to mobilize in wartime contingency action. Traced the district's history from the Korean War to the present, including military construction, North Korean tunnel detection, and Cold War events. Involved research in the Republic of Korea. Publication pending.

Everglades History Update, USACE, Jacksonville, Florida ***9/2010 - 9/2011***

Project manager and editor. Oversaw the addition of an epilogue for the U.S. Army Corps of Engineer's history of water management in South Florida and the Everglades. Project activities included conducting oral history interviews, on-site research at the South Florida Water Management District, editorial work, and project administration. The book, *River of Interests,* received an award of notable publication from the American Library Association.

Baltimore District History Update, USACE, Baltimore, Maryland ***12/2008 - 4/2011***

Co-author and research historian. Conducted research and writing for a history of the U.S. Army Corps of Engineers, Baltimore District. This book-length publication chronicled the changing missions of the district from 1975 to 2008, from an original focus on dam-building and civil works to a broader charge involving environmental remediation, military works, and service to the nation's capital. Project work included oral history interviews and research in the administrative records of the Baltimore District.

Residential Communities Initiative History, U.S. Army ***10/2008 - 2/2012***

Contributing author. Contributed written elements for a history of the U.S. Army's Residential Communities Initiative, which chronicled the privatization of military family housing for service members and their families. Conducted background research concerning corporate project partners and wrote special segments for inclusion in book publication.

OTHER STUDIES

Property Ownership, Washington D.C. ***2/2018 - 9/2018***

Principal investigator and author. Examined origins of development and ownership of a historic building in downtown Washington D.C., now valued at more than $30 million. Conducted research in a private archival collection and in U.S. Congressional records to produce a report on the building's history, changes in ownership interests over time, and current ownership status.

Archival Collections Assessment, Washington D.C. ***4/2017 - 12/2017***

Consulting historian. Assisted with assessment of unorganized historical materials held by the Independent Order of Odd Fellows in Washington D.C. Investigated records locations and helped to produce a high-level inventory of historical documents, including basic organization and preservation of certain records. Conducted oral-history interviews with selected members of the order, for use in the production of a short historical documentary presented at a 190th Anniversary Gala.

PUBLICATIONS

Building Strong in Korea: A History of the U.S. Army Corps of Engineers, Far East District. With Joshua Pollarine and Lindsey Weaver. [Publication pending]

A History of the U.S. Army's Residential Communities Initiative, 1995-2010: Privatizing Military Family Housing. In collaboration with Matthew Godfrey, Paul Sadin, Dawn D. Vogel, and Joshua R. Pollarine. Washington, D.C.: Government Printing Office, 2012.

An Era of Change: A History *of the Baltimore District, U.S. Army Corps of Engineers, 1974-2008.* In collaboration with Keith Zahniser and Matthew Godfrey. Baltimore: U.S. Army Corps of Engineers, 2010.

Colorado Water History: A Bibliography. Compiled with Patricia J. Rettig. Fort Collins: Colorado Water Resources Research Institute, 2008.

"Groundwater in the South Platte Valley." *Colorado Water* (October 2007).

"From Irrigation to Recreation." *Colorado Water* (October 2006).

"The Frontier Legend." *Mirage,* vol. 14 (Spring 1997).

"The 25 Richest People in New Mexico." *Crosswinds* (October 1996).

Appendix C: Compensation

HRA is being paid its standard rates for consulting engagements. My rate as a testifying expert for this engagement is $115 per hour. I have been assisted by HRA historians whose rates range from $77 to $138 per hour. As of May 31, 2019, HRA has invoiced a total of $27,107.56 for this engagement, and expects to invoice for an additional $19,676.76 for work completed but not yet invoiced through May 31, 2019, for a total to date of $46,784.32. Our expenses are reimbursed at cost. HRA's payment is not contingent on my opinion or on the outcome of this litigation.

JRP Historical Consulting LLC

December 30, 2019

EXPERT REBUTTAL / SUPPLEMENTAL REPORT OF:

Scott A. Miltenberger, Ph.D.

In the matter of:

No. 141, Original
In the Supreme Court of the United States
State of Texas v. State of New Mexico and State of Colorado

Prepared for:

Somach Simmons & Dunn
500 Capitol Mall, Suite 1000
Sacramento, CA 95814

Prepared by:

Scott A. Miltenberger, Ph.D.
JRP HISTORICAL CONSULTING, LLC
2850 Spafford Street
Davis, CA 95618

Table of Contents

Introduction

I, Scott A. Miltenberger, Ph.D., am a partner at JRP Historical Consulting, LLC (JRP), located at 2850 Spafford Street, Davis, California. This expert rebuttal / supplemental report was prepared by me for Somach Simmons & Dunn, attorneys representing the State of Texas before the Supreme Court of the United States in *State of Texas v. State of New Mexico and State of Colorado*, No. 141, Original. I have been asked to address the following questions:

1. In her expert report, Dr. Jennifer Stevens opines, in part, that "The scientific understanding of connections between groundwater and surface water was too nascent in the first decades of the 20th century for Reclamation to have intended" appropriation of "the Upper Rio Grande Basin's groundwater" (Opinion 5, p. 11), and that "Scientific understanding of the relationship between surface and groundwater supplies in the Upper Rio Grande Basin was still in its infancy at the time of the 1938 Rio Grande Compact negotiations…." (Opinion 6, p. 11). Based on your research, what is your opinion as to the "scientific understanding" of the relationship between surface flow and groundwater in the Upper Rio Grande Basin and why?
2. Can you determine from your research what period of record formed the bases for the delivery schedules set forth in Articles III and IV of the 1938 Rio Grande Compact, and if so, what is the relevant period of record relied on by the Compact negotiators?

In formulating my responses, as with my expert report, I have relied upon my education and nearly 13 years of experience as a professional historian, primarily of western water and land use, as well as my review and analysis of historical documents, published sources, and academic monographs collected by me or those at my firm in connection with this action. I have further examined Dr. Jennifer Stevens' report, Mr. Nicolai Kryloff's expert report for the United States, and documents produced by the states of Texas, Colorado, and New Mexico, and the United States in this action.

Sources upon which I relied are cited in the history profession's preferred footnote citation format as detailed in the *Chicago Manual of Style*. If any other historical material is presented or made known to me, or if I review any additional documents, it may have some effect on the specific opinions offered herein.

Rebuttal Opinion I: The historical record discloses several studies that explored the relationship between surface flow and groundwater in the Upper Rio Grande Basin prior to and following ratification of the 1938 Rio Grande Compact, and those studies provide an essential context for understanding what waters were apportioned by the Compact.

This rebuttal opinion does not offer an assessment of the quality of the "scientific understanding" of the relationship between surface flow and groundwater in the Upper Rio Grande Basin in the early twentieth century. Rather it reviews the historical record regarding studies made of that relationship, and finds that several investigations and analyses of Rio Grande surface flow and subsurface waters – variously identified in the collected record as "underflow," "underground waters," and "ground water" or "groundwater" – were made by the US Geological Survey (USGS), the US Reclamation Service (later the Bureau of Reclamation, or Reclamation), and the State of New Mexico over the course of the twentieth century. My expert opinion as a historian, having examined these studies, is that an inter-relationship between surface flow and groundwater was observed for lands below Elephant Butte prior to ratification of the Rio Grande Compact. Furthermore, with the advent of groundwater pumping in the Upper Rio Grande Basin in the mid-to-late 1940s, concerns emerged first among federal engineers and later within New Mexico's Office of the State Engineer (OSE) that development of groundwater for irrigation put the Rio Grande Project and the terms of the 1938 Rio Grande Compact at risk.

USGS hydrologist Charles Slichter in 1904 was the first to study and document a relationship between surface flow and subsurface waters within the Mesilla Valley – the largest valley in New Mexico downstream from Elephant Butte Reservoir site. As discussed in my expert report (p. 63), B.M. Hall, the supervising engineer for the Rio Grande Project, requested that Slichter investigate "the underground water" in the valley as part of Hall's efforts to develop a plan for the federal reclamation project.[1] The hydrologist began his work in August 1904, and by October (a month before the National Irrigation Congress in El Paso at which Hall unveiled that plan) Slichter had completed his assessment.[2] He found a direct connection between the river and the "ground waters" of the Mesilla Valley, telling the assembled delegates following Hall's presentation that

[1] Hall was aware of a "plentiful quantity of water at a short distance from the surface," and believing that to realize the Rio Grande Project "it will probably be necessary to use all of the floods [of the Rio Grande] and all of the underground water," he sought to learn more about the underlying hydrological conditions. B. M. Hall, supervising engineer, to Charles E. Slichter, July 9, 1904. ff. 432 Rio Grande – Power Development – Slichters Reports as to Water Supply, Box 819 Rio Grande 430A – 458A, Entry 3 General Administrative and Project Records, 1902-1919 [hereafter Entry 3], Record Group 115 Records of the Bureau of Reclamation [hereafter RG 115], National Archives at Denver [hereafter NARA Denver].

[2] See Charles S. Slichter to F. H. Newell, USGS Chief Engineer, October 25, 1904. Folder 432, Box 819, Entry 3, RG 115, NARA Denver.

> I think we have established that the source of the water that is used by the pumping plants is the river itself; that the origin of the ground waters or the supply of ground waters which are used by the pumping plant, is the water contributed to the river itself or lost by the river.[3]

Slichter made this same point when the USGS released his work as Water-Supply and Irrigation Paper No. 141, *Observations on the Ground Water of Rio Grande Valley* in 1905. According to his "observations of the test wells" in the Mesilla Valley,

> the ground waters in the Mesilla Valley originate in the flood waters of the river. During times of low water the river bed is so thoroughly covered with mud that probably only a small amount of water escapes in the sand and gravels of the valley. During the period of flood, when the scour is deep, the contributions of the river to the underflow reach a maximum, as at that time the greatest amount of water is available for this purpose.[4]

Two years after the release of Slichter's findings (and a year before the second of the two water filings made for the Rio Grande Project), the USGS published Willis Lee's investigation, *Water Resources of the Rio Grande Valley in New Mexico and Their Development* as Water-Supply and Irrigation Paper No. 188. Lee's study was, as he explained himself, "undertaken for the purpose of gathering information which might aid in the development of the water resources of the Rio Grande Valley in New Mexico." He explicitly pursued two lines of inquiry: "one pertaining to underground waters and their utilization, the other to the storage and conservation of the surface waters." Field work was pursued during roughly the same time period as Slichter in 1904 and 1905. With specific regard to "[u]nderground water" within the "Mesilla District," an area Lee defined for his study as "Mesilla Valley," the hydrologist observed that such waters were "found throughout Mesilla Valley at practically the river level," and that "[t]he water table changes position to some extent, according to changes in the volume of the water in the river." Lee gave credit to Slichter's already released work, writing "Professor Slichter has shown that the ground water of the valley is derived largely from the river…." The hydrologist further noted, drawing on Slichter's work, that there was "underflow in Mesilla Valley" above El Paso, and that "[t]he waters of the underflow are derived mainly from the Rio Grande." Neither rainfall nor tributary streams contributed much to this underflow, "leaving," in Lee's words, "the Rio Grande as the main source of supply." "Measurements of the flow of the Rio Grande," he went on, "demonstrate the fact that the river is continually losing water, the greater volume of flow being measured at the upstream rather than the downstream gaging stations." Lee stated succinctly:

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[3] Guy Elliott Mitchell, ed., *The Official Proceedings of the Twelfth National Irrigation Congress, Held at El Paso, Texas, Nov. 15-16-17-18, 1904* (Galveston, TX: Clarke & Courts, 1905), 218. See also Charles S. Slichter, *Observations on the Ground Water of Rio Grande Valley*, Department of the Interior, United States Geological Survey Water-Supply and Irrigation Paper No. 141 (GPO, 1905), 1.
[4] Slichter, *Observations*, 27. Slichter further noted "that a small portion of the underflow reaches the river valley from the mesa and foothills to the north and east of Las Cruces."

"All known facts point to the conclusion that a large amount of water is continually passing from the river into the underflow, and must either return to the surface and evaporate or find some underground passage by which to escape." Precisely how and where the water escaped Lee could not determine with certainty, although he opined that the "more probable means…[was] by evaporation."[5]

Slichter and Lee were not the only ones to identify and study this hydrological phenomenon in the early 1900s. According to Lee, the International (Water) Boundary Commission was making "[a]n effort…to determine what percentage of the known loss [in the Rio Grande]" was attributable "to irrigation and what to seepage and evaporation" at around the same time as his study. Lee reported the Commission found "a notable loss of water over and above that diverted for irrigation" – as much as "13 per cent of the San Marcial flow was lost by seepage and evaporation above El Paso."[6]

Recognition of the connection between surface flow and groundwater in the Upper Rio Grande Basin was likewise reflected in Reclamation's opposition toward other water projects as the Rio Grande Project itself was in development in the 1910s. My expert report discusses the broad claims federal reclamation authorities made as to the water supply for the project as well as for other projects throughout the west (pp. 67-71), but with specific reference to groundwater development on the Rio Grande Project, Reclamation Chief Engineer A.P. Davis' response to F.L. Bixby, a New Mexico irrigation engineer working out of New Mexico Agricultural College (today New Mexico State University) in September 1912 is notable.[7] Bixby had requested annual reports from the US Reclamation Service, and had questioned whether pumping either "from the Rio Grande in the neighborhood of the Government dams" or "on the bank of the river" was permissible. As to the first question, Davis replied was that "[t]here would be no difference in law or morals between taking the water by means of a canal and by means of a pump." The second question was more complicated in Davis' view. He was less sure about the law, but his comments suggest that the chief engineer understood the filings made for the Rio Grande Project

[5] Willis T. Lee, *Water Resources of the Rio Grande Valley in New Mexico and their Development*, Department of the Interior, United States Geological Survey Water-Supply and Irrigation Paper No. 188 (GPO, 1907), 7, 41, and 49-50.
[6] Lee, *Water Resources in the Rio Grande Valley*, 50. He noted on this same page that "The discussion [on this issue] may be found in the Proceedings of the International (Water) Boundary Commission, United States and Mexico, vol. 2, pp. 405-424." These published International (Water) Boundary Commission proceedings were not collected in the course of JRP's research.
[7] At this time of his letter to Davis, Bixby was involved with the cooperative irrigation investigation sponsored by the US Department of Agriculture's Office of Experiment Stations. His area of responsibility was New Mexico. See "Office of Experiment Stations," in F.W. Roeding, *Irrigation in California*, Prepared under the Direction of Samuel Fortier, Chief of Irrigation Investigation, US Department of Agriculture, Office of Experiment Stations – Bulletin 237 (GPO, 1911), (2).

were sufficiently broad as to provide legal protections against groundwater development that could impair the appropriated supply. "This [the second question] is a matter which would be less easily proved," Davis wrote:

> Of course, the appropriation of the United States is for the entire flow of the river and the storage reservoir now under construction is, beyond question, of a magnitude to justify this blanket appropriation, as there would be wastewater in very few years. If wells were so located as to infringe on the supply of the river they would be an infringement of a Government right, but I suppose, as a matter of law, the burden of proof would be upon the United States and would be very difficult.[8]

The then-hypothetical situation notwithstanding, of greater concern to Reclamation authorities was a rising water table on the project as a result of irrigation and analyses of this problem pointed to the relationship between surface flow and subsurface waters identified by Slichter and Lee. An April 1915 "Board of Engineers" memorandum report offered the following observation: "Generally the water in the Rio Grande is but little below the adjacent lands on either side. This condition permits waters from the river being carried under the irrigable lands through more or less porous sand strata." Application of irrigation water project lands, in the Mesilla Valley in particular, thus had the effect of bringing subsurface flow to the surface, so the engineers recommended construction of drainage works to manage the level of the water table.[9]

A February 1917 "Report on Mesilla & El Paso Valley Drainage, Rio Grande Project," focused on "expediting the drainage work" endorsed by the April 1915 Board of Engineers, explicitly took note of Slichter and Lee's findings:

> These studies [i.e., by Slichter and Lee] indicated that little water comes into the valley from the side hills, that a movement of underground waters exists down the valley, that the river along certain stretches loses water, that only a small portion of the water proceeds under ground through the narrow valley west of El Paso, that the underground flow may continue from the lower end of the valley in a southwesterly direction away from the river under high mesa lands towards Mexico and that more probably the outflow

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[8] A. P. Davis, Chief Engineer, to Mr. F.L. Bixby, Irrigation Engineer, September 11, 1912. ff. 41-D, New Mexico, Water Appropriations, Rio Grande Project. 1911-1912, Box 9 41B- -41D, Entry 3, RG 115, NARA Denver.

[9] Memorandum, From: Board of Engineers: E.H. Baldwin, Rio Grande Project Supervising Engineer; L.C. Hill, Consulting Engineer; D.W. Murphy, Engineer in charge of Drainage and L.M. Lawson, Project Manager, To: Reclamation Commission, Subject: Report on Drainage – Rio Grande Project, April 7, 1915. 2. Vol. 495, New Mex.-Texas, Rio Grande, Board of Engineers Report, ff. Rio Grande, 1904, Box 474, Box 474 Rio Grande (NM-TX), Entry 10 Project Histories, Feature Histories, and Reports 1902-32, RG 115, NARA Denver.

> is largely disposed of through evaporation from ponds and wet soil surfaces within the valley itself.[10]

In connection with this drainage work, Reclamation engineers in 1917 and 1918 scrutinized ground-water levels, prepared water-table maps, and studied fluctuations in surface flow relative to drainage.[11]

As discussed in my expert report (p. 70), at least one Reclamation engineer took note of the possible use of groundwater. In a June 1919 memorandum report on the water supply for the San Luis Valley in Colorado, the Middle Rio Grande Valley in New Mexico, and the Rio Grande Project in New Mexico and Texas, Harold Conkling specifically "consulted" the reports by Slichter and Lee, as well the various Reclamation drainage studies of the mid-to-late 1910s. He described a hydrologic dynamic involving irrigation water, return flows, and groundwater that other engineers would likewise observe in subsequent years. Return flow, according to the engineer,

> consists of the transportation loss from canals and deep percolation from irrigated areas. In most projects these items are of considerable importance because they are lost to the project, but on the Rio Grande are comparatively unimportant if diversion is approximately as assumed, because of immediate rediversion by canal headings below. Deep percolation on the Rio Grande Project will maintain the ground water at such depth that the plant roos can take advantage of it and relieve, to some extent, the necessity of surface irrigation. On the other hand, if irrigation is lavish, it may raise the ground water so much that an unduly large amount will be wasted by surface evaporation from untilled areas.[12]

While stressing the "re-use of return flow by the acreage on the lower end" of the Rio Grande Project, Conkling suggested that the irrigable acreage within the basin could be expanded

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[10] "Report on Mesilla & El Paso Valley Drainage, Rio Grande Project, February, 1917, 2-3. ff. Report on Mesilla & Rio Paso Valley Drainage Feb 1917, Box 723 [Old box 512] Code 520 RG 14 through Code 550 RG 42, Project Reports, 1910-55, Engineering and Research Center, RG 115, NARA Denver.

[11] See L.R. Fiock, Ass't Engineer, History of Drainage on the Rio Grande Project, To December 31st, 1918, Investigations, Plans and Estimates, Surveys and Construction, Chapter VI, Department of the Interior, United States Reclamation Service, Rio Grande Project – New Mexico, Texas, Annual History – 1918, in Department of the Interior, US Reclamation Service, Rio Grande Project, Texas New Mexico, Drainage. 530-18 RG, Box 723 [Old Box 512] Code 520 RG 14 through Code 550 RG 42, PR 1910-55, RG 115, NARA Denver; and L.R. Fiock, Assistant Engineer, Drainage Results on the Rio Grande Project to Oct. 1, 1919 (Oct. 1919). United States Bureau of Reclamation Library, Denver. See also C.S. Conover, *Ground-Water Conditions in the Rincon and Mesilla Valleys and Adjacent Areas in New Mexico*, Geological Survey Water-Supply Paper 1230, Prepared in cooperation with the Elephant Butte Irrigation District, United States Department of the Interior, Douglas McKay, Secretary, Geological Survey, W.E. Wrather, Director (United States Government Printing Office, 1954), 6, 53-54, and 69.

[12] Memorandum, From: Engineer Harold Conkling, To: Chief of Construction, Subject: Water Supply – Rio Grande River, June 18, 1919 [hereafter Conkling Memorandum, June 18, 1919], 99a and 111. ff. 302.31, New Mexico. Surveys and Investigations. THRU 1929, Box 262, Entry 7 RG 115, NARA Denver.

through groundwater pumping. He estimated that some 29,000 acres could be served with such waters – at a cost. "An additional draft of 70,000 acre feet annually," the engineer pointed out, could be pumped but would significantly worsen two prior years of shortages "without adverse effect in other years." Whether such expansion was advisable, Conkling left to the "attitude of the government toward the question of allowing such possible shortages."[13]

As noted by Mr. Nicholai Kryloff in his expert report for the United States (pp. 30-31), D.C. Henny, a Reclamation engineer turned consulting engineer, in correspondence with Elephant Butte Irrigation District (EBID) president J.W. Taylor in January 1926 considered this very issue – and pointed out that groundwater development within Rio Grande Project lands above El Paso would materially affect surface flow. In December 1925, Taylor had contacted Henny to solicit his opinion "as to the inclusion of pumped mesa lands" to expand the project's irrigated acreage. The consulting engineer believed that "pumped lands" could be added to the project without "affect[ing] the project water supply" either "by transfer of reservoir rights from less valuable valley lands to pumped lands" or "by pumping from underground water sources below [emphasis in original] El Paso." "Pumping from underground source [*sic*] above El Paso," Henny believed would

> diminish practically to the same extent the flow reaching the International dam as would pumping from project canals. Pumping from such source below [emphasis in original] El Paso is equivalent to diversion from drains and will ultimately affect Hudspeth County lands only.

Henny ultimately dismissed the idea of adding "pumped lands" at all, including those "which will not affect the project water supply," in his analysis of whether EBID and the other project irrigation district, El Paso County Water Improvement District #1, ought to consider expanding their collective irrigated acreage.[14]

New Mexico engineers undertook their own hydrological studies of surface flow and subsurface waters in lands below Elephant Butte in the 1910s, 1920s, and 1930s. In late October 1913, New Mexico State Engineer James French launched a "seepage investigation of the Rio Grande." In this study four hydrographers measured "seepage gains and loss from the State Bridge, near Lobatos, Colorado, to El Paso, Texas." The study ultimately "found [it] extremely difficult to draw conclusions below Elephant Butte and in view of the fact that the Elephant Butte dam will soon

[13] Conkling Memorandum, June 18, 1919, 17-19. ff. 302.31, New Mexico. Surveys and Investigations. THRU 1929, Box 262, Entry 7 RG 115, NARA Denver

[14] D.C. Henny to Mr. J.W. Taylor, President, Elephant Butte Irrigation District, January 9, 1926, 1-2. 19260109_NMSU-EBID_02-G_001_07.

control the flow to the New Mexico-Texas state line more attention was given to that part of the stream above this point."[15]

New Mexico's chief hydrographer E.L. Barrows and Middle Rio Grande Conservancy District (MRGCD) Designing Engineer R.G. Hosea in 1928, as noted in my expert report (p. 75), both considered this reach of the Rio Grande. Barrows' investigation was made in late November 1928, and specifically concentrated on the river basin between Elephant Butte and Leasburg dams. Part of series of hydrographic studies of the Rio Grande under the supervision of then-New Mexico State Engineer Herbert Yeo, the resulting "Report of Seepage Study on Rio Grande Between Elephant Butte Dam and Leasburg Dam" was, in Barrows' words, "the first…since completion of the drainage works [of the Rio Grande Project] and the stabilization of the river."[16] He aimed to learn more about "the actual gains or losses of the river below Elephant Butte Dam," an outgrowth of "[a]n analysis of data available relative to the water supply and the use of water for irrigation purposes of the Rio Grande in New Mexico." Barrows sought to test the notion "that there were large losses by seepage from the reservoir into the river and also that there was a large invisible inflow to the river from the tributaries having their source in the Black Range to the west of the valley." To facilitate his study, irrigation releases from Elephant Butte were terminated for five days in November "in order to allow the flow [of irrigation water] to become stabilized and for the bank storage along the river to be depleted…." Barrows then made a series of measurements of flow in the river's channel at seven points between Elephant Butte and Leasburg as well as "of all visible contributing flows between those points." The hydrographer further computed areas of water surface, making several assumptions regarding area, and used "the average daily evaporation [rate] for November" to determine "the loss in stream flow by

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[15] Rio Grande Basin, Seepage Investigation of the Rio Grande, October 20 to 30, 1913, New Mexico, 1913, 81, excerpt included with E.L. Barrows, Chief Hydrographer, "Report of Seepage Study of Rio Grande Between Elephant Butte Dam and Leasburg Dam," November 26-28, 1828. Folder 1405, Barrows, Report on Seepage Study of Rio Grande Between Elephant Butte Dam and Leasburg Dam, 1928, Box 54, State Engineer Reports: Rio Grande, Exps. 158-160, Nos. 1393-1416 [hereafter Box 54], New Mexico State Archives, Santa Fe [hereafter NMSA]. An online search of library collections indicated that this excerpt comes from James A. French, State Engineer, *Report on the Surface Water Supply of New Mexico, 1913* (Albuquerque: Albright & Anderson, Printers-Binders, 1913), available at https://catalog.hathitrust.org/Record/012370302, last accessed November 12, 2019. This official New Mexico State Engineer's report was not collected in JRP's research.

[16] The "Graph Showing Invisible Gains and Losses of the Rio Grande, from Elephant Butte Dam to Leasburg Dam," included with Barrows' study identifies the hydrographer's work as part of Yeo's "Hydrographic Studies of the Rio Grande." Barrows' report was reproduced, uncredited to the chief hydrographer, as "Seepage Study on Rio Grande between Elephant Butte Dam and Leasburg Dam, November, 1928," in Herbert W. Yeo, State Engineer, *Ninth Biennial Report of the State Engineer of New Mexico for the 17th and 18th Fiscal Years or From July 1st, 1928 to June 30th, 1930* (Santa Fe, New Mexico, 1930), 22-26. New Mexico Office of the State Engineer Library.

evaporation from the water surface…." Barrows prepared three tables which reflected his calculations and findings of "invisible" gains and losses in the Rio Grande channel, and "[a] graphical representation of the facts and resulting computations…." The hydrographer offered no clear conclusions in the text of his report, although both his tables and his graph appear to show that there were gains and losses in the stream at various points between Elephant Butte and Leasburg dams.[17]

Hosea's December 1928 "Report on Irrigation in the Rio Grande Valley," by contrast, offered a definitive statement as to the existence and influence of subsurface waters. Working not for the state but instead for MRGCD, his report was intended to provide New Mexico's Rio Grande Valley Survey Commission "certain data…upon the status of the water rights and claims to water existing in the Rio Grande Basin." "It was deemed essential," Hosea wrote to the Commission in forwarding his report, that the "Commission be fully informed of the conflicting rights and claims to water, of the interstate phases of the situation, and of the menace to water supply for project constructed and proposed on the lower river by reason of progressively increasing depletion of the river by the State of Colorado."[18]

As such, Hosea's work had a broader focus than Barrows. Nonetheless, in a section of his report devoted to the "Water Requirement for Project Lands" – i.e., Rio Grande Project lands – Hosea examined river hydrographs and concluded that these did not "show evidence of an invisible underground flow tributary to the river." This conclusion appears to have been based solely on his analysis of these hydrographs; there is no indication from his report that he embarked on any field investigation. According to Hosea,

> it is apparent that when the reservoir is not releasing water during the winter months, the Ft. Quitman flow is just about equal to the total drainage water from the project. This drainage the farmers refuse to use in an undiluted condition, and consequently any underground flow that could come in would be shown by an excess in the Ft. Quitman record, over the total drainage return after takin account of river channel losses. Such an excess is not apparent.[19]

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[17] Barrows, "Report of Seepage Study on Rio Grande Between Elephant Butte Dam and Leasburg Dam," np [1-5] and "Graph." Folder 1405, Box 54, NMSA.

[18] R.G. Hosea to The Rio Grande Valley Survey Commission, Albuquerque, New Mexico, December 1, 1928, in R.G. Hosea, "Report on Irrigation in the Rio Grande Valley," State of New Mexico, The Rio Grande Valley Survey Commission, Albuquerque, New Mexico, December, 1928. Folder 3 Report on Irrigation in the Rio Grande Valley-R.G. Hosea-December 1928 [EBID Item #20], December 1928, Box 02-D.003, MS 0235 Elephant Butte Irrigation District Records, 1883-198 [hereafter MS 0235], Rio Grande Historical Collections [hereafter RGHC], New Mexico State University Archives and Special Collections [hereafter NMSU].

[19] R.G. Hosea, "Report on Irrigation in the Rio Grande Valley," 169. Folder 3 Report on Irrigation in the Rio Grande Valley-R.G. Hosea-December 1928 [EBID Item #20], December 1928, Box 02-D.003, MS 0235, RGHC, NMSU.

John Bliss's 1936 investigation, however, came to a different conclusion based on his own field work, as discussed in my expert report (pp. 75-78). Bliss, the technical advisor to New Mexico State Engineer Thomas McClure during the Rio Grande Compact negotiations of the 1930s, embarked on the study at the apparent suggestion of Rio Grande Project Superintendent L.R. Fiock. In his "Report on Investigation of Invisible Gains and Losses in the Channel of the Rio Grande from Elephant Butte to El Paso," presented to McClure in February 1936, Bliss acknowledged the previous work of Barrows and Hosea, but noted a paucity of "data" for the reach of the Rio Grande "below Elephant Butte Reservoir." The engineer identified from his study "a direct relation of seepage to ground water and irrigation": at certain critical points between Elephant Butte and El Paso, underflow fed the groundwater table, providing basin lands with additional water that was recovered by project drains and returned to the river channel for use on lands downstream. He proposed an additional investigation of "seepage during the non-irrigation period" so as to compare "against gains and losses found during the summer at a period when river and canal flows can be kept in a stable condition."[20]

The historical record reviewed does not disclose evidence that either Bliss or another engineer with New Mexico undertook this proposed supplemental study in the 1930s. As noted in my expert report (p. 81), the federal Rio Grande Joint Investigation, which overlapped Bliss's investigation, focused largely on groundwater conditions in the San Luis Valley in Colorado and the "Middle Valley" of the Upper Rio Grande Basin in New Mexico. The investigation's resulting report, or *JIR*, was – as also noted in my expert report (pp. 21-22) – a critical source of information for the engineering advisors who crafted the technical basis for the Compact.[21] According to the *JIR*'s "General Report" (Part I) a summary of the entire investigation, "no study of ground-water conditions in them [i.e., the Rincon, Mesilla, and El Paso valleys] was included in the Rio Grande Joint Investigation."[22]

That same "General Report," however, noted the interconnection of irrigation water from the project, return water, and ground waters. It pointed out that lands in the Rincon, Mesilla, and El Paso valleys "comprise the Rio Grande Project, which is well provided with open drains that satisfactorily maintain ground-water levels at the depths below ground surface required to prevent waterlogging and seeping of the lands." Reclamation engineers since 1921, moreover, made "[p]eriodic measurements of the depth to ground water in 55 to 88 wells in Mesilla Valley" annually. "The observations were made and the results were used chiefly," according to the

[20] Bliss, "Report on Investigation of Invisible Gains and Losses," 1-2 and 12. Folder 1435, Box 55, NMSA.

[21] Part I of the *JIR*, the "General Report," notably identified the "Ground water in the Middle Valley" as having several sources," including "seepage from canals" and "seepage from irrigated lands." National Resources Committee, *Regional Planning Part VI – The Rio Grande Joint Investigation in the Upper Rio Grande Basin in Colorado, New Mexico, and Texas 1936-1937* (GPO, 1938) [hereafter *JIR*], 59.

[22] *JIR*, 62.

"General Report, "to derive the annual increment or decrement of ground water as a necessary factor in computing the annual consumptive use of water in the [Mesilla] valley by the inflow-outflow method." The US Bureau of Agricultural Engineering (BAE) further used this "data…in its study of the consumptive use of water in Mesilla Valley."[23]

An early version of that data was in fact made available to Raymond Hill, the engineering advisor to Texas Rio Grande Compact commissioner Frank Clayton, in late 1936 prior to the release of the *JIR*. Hill, focusing on Table 21, which "was a calculation of consumptive use by means of the difference between the flow at Leasburg [Dam] and Courchesne [above El Paso] adjusted for changes in groundwater levels," and an accompanying "graph showing depth to groundwater," identified a "series of errors." He proceeded to correct those errors and forwarded a new graph showing "the fluctuations in the groundwater level" to Harry Blaney, the engineer responsible for the BAE report.[24]

Hill, moreover, was apparently aware of Conkling's 1919 analysis that touched on groundwater within the Rio Grande Project. In his papers, deposited at the Briscoe Center for American History of the University of Texas at Austin, is an undated bound volume, "Extracts from Report of Harold Conkling to Chief of Construction, U.S. Reclamation Service on Water Supply of the Rio Grande River, Report dated June 18-1919." On page 9 of this volume, Conkling's observations about possible extension of irrigated lands within the project through groundwater development are reproduced. The Reclamation engineer's analysis that "[d]eep percolation on the Rio Grande Project," attributable to return flows, "will maintain the ground water at such depth that the plants roots can take advantage of it and relieve, to some extent, the necessity of surface irrigation" appears on page 34 of the volume.[25]

The USGS senior geologist Kirby Bryan, in charge of the federal investigation's study of groundwater conditions in the Upper Rio Grande Basin was similarly familiar with Slichter's investigation. Although Bryan did not study the Mesilla Valley as part of the investigation, in Part II of the *JIR*, "Ground Water Resources: Report of the United States Geological Survey," he nonetheless commented on groundwater conditions there, referencing Slichter's work:

> Mesilla Valley is almost closed at both ends, but is open to the sides. It seems from the somewhat meager information available that ground-water levels in Las Mesa are higher than the floor of the valley and that there must be a ground-water gain. Loss of ground

[23] *JIR*, 62.

[24] Raymond A. Hill to Mr. Harry Blaney, U.S. Department of Agriculture, November 5, 1936. ff. Elephant Butte-El Paso Dists. Other Official Agencies-Correspondence. G-352., Box 4X190, Raymond A. Hill Papers [hereafter RAHP], Briscoe Center for American History, University of Texas at Austin [hereafter UTA].

[25] "Extracts from Report of Harold Conkling to Chief of Construction, U.S. Reclamation Service on Water Supply of the Rio Grande River, Report dated June 18-1919," 9 and 34. Box 4X213 & 4X231 & 4X231a, RAHP, UTA.

> water in Mexico west of El Paso seems unlikely as the enclosed basins to the south appear, according to a reconnaissance by A.N. Sayre, of the United States Geological Survey, to have altitudes higher than the valley floor above El Paso. The gorge at El Paso has at least 86 feet of alluvium above bedrock and Slichter's measurements show that underflow is small.[26]

Bryant also acknowledged Lee's 1907 study. He counted it among other several others "of the geology and geomorphology of New Mexico" made "over a long period by many observers."[27]

Overall, as pointed out in my expert report (p. 82), the "General Report" made three critical observations for the entire Upper Rio Grande Basin that underscore the relationship between surface and subsurface waters as suggested by the work of Slichter, Lee, and Bliss:

1) "extensive development of ground water for irrigation would add no new water to the Upper Rio Grande Basin…";
2) "recharge of the ground-water basins would necessarily involve a draft on surface supplies which are now utilized otherwise"; and
3) "The chief element to be considered in such a development [of groundwater] would be the redistribution of the availability and use of present supplies and the resulting effect upon the water supply of lower major units [i.e., the Rio Grande Project and beyond to Ft. Quitman]"[28]

The pioneering work of Bryan's supervisor C.V. Theis informed these observations.[29] In the early 1930s, after fieldwork in New Mexico and on the High Plains, Charles Vernon Theis – who earned a doctorate in Geology from the University of Cincinnati in 1929 – developed a formula, later known as the "Theis equation," that described groundwater flow and impact of groundwater

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[26] *JIR*, 225.
[27] *JIR*, 197.
[28] *JIR*, 56. Prior to the meetings of the Committee of Engineering Advisors, the group that developed the technical basis for the Compact, in late 1937 Reclamation engineer E.B. Debler reportedly expressed concern for the impact of groundwater development on Colorado's deliveries to New Mexico to Hill. Debler, according to a November 11, 1937 letter from Hill to Texas compact commissioner Frank B. Clayton,

> was…worried by the development of the sentiment in Colorado from pumping from the groundwater basin in lieu of storage reservoirs. If Colorado should elect to put in a number of wells and supplement their gravity supply with pumped water, the effect upon the flow of Rio Grande at Lobatos would be very adverse, especially in dry years.

Raymond A. Hill to Mr. Frank B. Clayton, November 16, 1937. [1937], Box 2F46, Rio Grande Compact Commission – Frank B. Clayton Papers [hereafter RGCC-FBCP], UTA.
[29] Bryan, a USGS senior geologist and associate professor of geology at Harvard University, carried out his study "under the direction of C.V. Theis…." *JIR*, 197.

pumping on aquifers. First published in 1935, and then again in 1938 and 1940, Theis' work, according to USGS hydrologists and Theis' biographers Robert R. White and Alfred Clebsch, "revolutionized the science of ground-water hydrology" and "provided a foundation for the application of well hydraulics to aquifer evaluation that would be used by hydrogeologists to come." By the 1940s, in White and Clebsch's estimation, his ideas had been "given wide distribution."[30]

Those ideas can be seen in the observations of the "General Report." In the May 1940 version of his paper, published by the American Society of Civil Engineers, "The Source of Water Derived from Wells: Essential Factors Controlling the Response of an Aquifer to Development," Theis pointed out, in part, that "[a]ll water discharged by wells is balanced by a loss of water somewhere," and that "prior rights to the surface water may be injured" if wells drew on "natural discharge [that] fed surface streams."[31]

This was subsequently brought out for the Rincon and Mesilla valleys in New Mexico by USGS hydrologist Clyde S. Conover's investigation of potential groundwater development in the late 1940s. Struggling through a sustained period of drought, EBID approached the federal agency for such a study. Conover, whose supervisor was Theis, understood the district's need for this information as arising "from indications that the Rio Grande Project of the Bureau of Reclamation…would be seriously short of surface water supplies." The situation had become particularly dire as the 1947 irrigation season drew to a close, and the outlook for 1948 was "poor."[32]

Conover's investigation was initiated in 1946, and in September 1947 he produced a "preliminary memorandum" as there was "imminence of some action regarding pumping," presumably on the district's part. The memorandum was forwarded to EBID manager John L. Gregg by Theis, in October 1947, and "officially approved for release…to the [New Mexico] State Engineer." A copy was also circulated to the USGS Chief Hydraulic Engineer. Whether the state engineer received

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[30] Robert R. White and Alfred Clebsch, "C.V. Theis, The Man and His Contributions to Hydrogeology," in *Selected Contributions to Ground-Water Hydrology by C.V. Theis, and a Review of His Life and Work*, ed. Alfred Clebsch, United States Geological Survey Water-Supply Paper 2415 (GPO, 1994), 51 and 52. Bryan, in fact, used Theis' equation in his study. *JIR*, 237 and 254.

[31] C.V. Theis, "The Source of Water Derived from Wells: Essential Factors Controlling the Response of an Aquifer to Development," United States Department of the Interior, Geological Survey, Water Resources Division, Ground Water Branch, Ground Water Notes, Hydraulics, No. 34 (December 1957), 10. This document is a reprint of the May 1940 paper.

[32] Clyde S. Conover, U.S. Geological Survey, Preliminary memorandum on ground-water supplies for Elephant Butte Irrigation District, New Mexico, September 1947, 1. NM_00124167.

and reviewed Conover's work is unknown, although as the memorandum was produced in this litigation by New Mexico, it was likely found in OSE records.[33]

The focus of the hydrologist's work was on "the possibilities of pumping ground water for irrigation, mainly from the standpoint of productiveness of wells and the effect of pumping upon the surface-water supply in the rivers and drains" within EBID. In his memorandum, Conover surveyed project operations, noting the reliance on return flows from the Rincon Valley ("discharged into the river above the Leasbury [*sic*] Dam") and from the Mesilla Valley ("discharged into the river below Mesilla Dam to be diverted for re-use in the El Paso Valley portion of the project and Mexico"). He also provided approximations of the "quantities involved in the present irrigation with surface water," before considering the "Ground-water conditions."[34]

Regarding "present conditions in the Rincon and Mesilla Valleys," Conover observed – as had Slichter in 1904, Lee in 1907, and Bliss in 1936 – an inter-relationship between "surface" and "ground waters." The two types of waters were in "an approximate state of balance" in the two valleys, as he explained:

> Surface water released from Caballo Dam [as part of Rio Grande Project operations] is diverted to the canals and irrigated land mainly from April through August of each year. The part that is not lost by transportation and evaporation seeps underground from the canals and irrigated lands to return to the river as drain flow which is re-used in lower divisions of the Project. A large part of the drain water is return seepage from the surface-water supply, mainly from the canals and irrigation lands but in part directly from the river. A small part of the drain flow is ground water from the higher mesa lands that border the valleys. Because of the drains, the amount of ground water in storage each year at the beginning of the irrigation season is approximately constant, small variations from year to year occurring as a result of the varying amounts and time of application of irrigation water to the lands in the preceding year and to the condition of the drains. The low flow of the drains occurs approximately a month later than the minimum diversion, and the maximum flow of the drains usually occurs in the same month as the maximum diversions.[35]

Groundwater development within the two valleys since completion of Elephant Butte Dam in 1916 was modest. Conover observed that as of 1946 there were only 10 irrigation wells in the Rincon Valley, "about 13 wells…on the alluvial fans of the arroyos west of the valley," and "[v]ery few…in operation at present in the Mesilla Valley." The Rio Grande Project itself had seemingly

[33] Conover, Preliminary memorandum, 1. NM_00124167; and Chas. V. Theis, District Geologist, to Mr. John L. Gregg, Manager, Elephant Butte Irrigation District, October 23, 1947, attached to Conover, Preliminary memorandum. NM_00124166.

[34] Conover, Preliminary memorandum, 1-3, and 7. NM_00124167-NM_00124169, and NM_00124173.

[35] Conover, Preliminary memorandum, 8. NM_00124174.

forestalled ground water extraction, according to the hydrologist: “A number of irrigation wells were in operation in the early 1900’s but were abandoned after a water supply was assured by Elephant Butte Dam.” The anticipated shortfall in project water deliveries in 1948 had prompted some drilling of wells in the Mesilla Valley, but as of Conover’s preliminary memorandum, no pumps had been connected to these wells.[36]

Assessing “the coefficient of transmissibility and the storage coefficient” permitted Conover to draw several conclusions regarding “the amount of flow of underground water and the long-term effects of pumping.”[37] The most notable of these was the anticipated impact on the Rio Grande Project water supply, given the nature of project water delivery operations and the then-static relationship between surface flows and groundwater in EBID. The hydrologist, acknowledging that groundwater pumping resulted “in lowering of the water table, at first in the vicinity of the well but as times goes on at greater and greater distances from the well,” pointed out

> All water pumped from wells is balanced by a loss of water from somewhere else in the ground-water system, either from the amount stored underground, from the amount seeping out of the aquifer, or, less commonly in arid countries, from the amount of surface water that the system is unable to absorb (rejects) because the aquifer is overfull under non-pumping conditions. Places of ground-water discharge in the Rincon and Mesilla Valleys are the drainage ditches, where lowering of the water table would result in a decrease in the pickup of the drains, and the relatively small areas of waterlogged land where a lowering of the water table would decrease the evaporation and transpiration now taking place. Areas of rejected recharge are sections of the river where the water level in the river is above and in direct contact with the ground water. A lowering of the water table in such areas induces a larger amount of water to seep away from the river.
>
> The increased seepage from the river to the aquifer and the decreased drain-flow resulting from the effects of pumping would not make more water available to the Project as a whole but instead would divert to the pumps water that would otherwise be available as surface supply lower down the valley.[38]

Put another way, as Conover did after making several calculations,

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[36] Conover, Preliminary memorandum, 9. NM_00124174.

[37] Conover determined the “coefficient of transmissibility…from pumping tests on wells, and from the correlation of slopes of the water table to various drains with the flow of the drains.” The “storage coefficient” was “approximately equal to the specific yield under water-table conditions,” but the “specific yield of an aquifer…[was] difficult to determine accurately, either in the field or the laboratory.” Using “[d]eterminations of the specific yield in other localities of unconsolidated alluvial fill” – much like was found in the Rincon and Mesilla valleys – Conover estimated the specific yield at “probably about 25 percent.” See Conover, Preliminary memorandum, 11-12. NM_00124177- NM_00124178.

[38] Conover, Preliminary memorandum, 12-13. NM_00124178-NM00124179.

> Little net water can be gained to the Rio Grande Project as a whole by pumping ground water in the Elephant Butte District and the total amount of water received by the Elephant Butte District under a pumping system is practically no more than would have been obtained from surface supplies, if the customary interest of the El Paso District [i.e., El Paso County Water Improvement District No. 1, or EP #1] is preserved. The reason for this is, of course, that the drain water is used again in the Project and the District would be physically responsible for any decrease of the flow of the drains resulting from pumping.[39]

This issue extended beyond the legal boundaries of EBID, as the hydrologist further argued:

> Pumping of ground water in the [Mesilla] valley by individual farmers would of course have the same effect upon the flow of the drains as would pumping by Elephant Butte Irrigation District. Any water pumped on the land that does not return to the ground-water body would be water lost to the Project, even though a gain of water might accrue to an individual farm.[40]

Conover thus foresaw the Project water supply for lands downstream from EBID as being compromised by pumping, even as EBID or other lands in New Mexico benefitted. Although he conceded that pumping could retain water otherwise "now lost by evapo-transpiration in the waterlogged areas" with "an actual increase in water supply for beneficial use in the project," Conover was skeptical of the utility of this as "the amount of water saved would be very small."[41]

The hydrologist similarly acknowledged new land could be brought into production by groundwater pumping, but not without diminishing return flow captured by drains. Conover estimated that "about 15,000 acres" within the district and not currently served and outside the district "might eventually be irrigated from ground water…." Much of this acreage was "on the high ground along the edges of the valley" where the impact to drain and river flows would be minimal. "However," he cautioned,

> as all the ground water in the valleys and mesas is connected and contributes to the drains, any pumping must eventually mean a decrease in the drain-flow, in the long run equal to the amount that had been pumped, less any small amount saved by reduction of evapo-transpiration losses.[42]

At the end of his memorandum, Conover distilled his then-findings into 14 conclusions. Conclusions 3, 4, 5, 6, 7, 13, and 14 all underscored the inter-related nature of surface flow and subsurface waters within the Mesilla Valley:

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[39] Conover, Preliminary memorandum, 20-21. NM_00124186-NM00124187.
[40] Conover, Preliminary memorandum, 24. NM_00124190.
[41] Conover, Preliminary memorandum, 13. NM_00124179.
[42] Conover, Preliminary memorandum, 25. NM_00124191.

3. Pumping of ground water would divert water from the drains and the river. The drains would be dried the first summer if enough pumps were installed to furnish an adequate water supply for all lands in a dry year.

4. On a long-term basis all water removed from storage must be replaced before the drain system returns to normal.

5. If water diverted from the drains were made up to the lower district [i.e., EP #1] by additional releases from the dams [i.e. Elephant Butte and Caballo], a corresponding reduction in the diversions to the Elephant Butte Irrigation District would be necessary.

6. As there is no unused ground-water recharge, and very little unused ground-water discharge, only a small amount of water can be salvaged to the Rio Grande Project as a whole over a period of years by pumping in the Elephant Butte District [.]

7. Assuming that the El Paso Division [i.e., EP #1] continues to get diversion in the same proportion to reservoir releases as in the past, pumping of ground water will not result in any additional water for the District [i.e., EBID] on a year-to-year basis unless the amount of pumping exceeds the amount of the diverted drain flow, thus pumping from storage.

13. Pumping of ground water on individual farms would ultimately reduce the water supply of the Rio Grande Project. If such a reduction were borne by the Elephant Butte Irrigation District, deliveries of surface water to farms with pumps might be reduced in order to maintain the expected deliveries to farms without pumps.

14. About 15,000 acres of presently undeveloped land and suspended land could be irrigated by ground water. Water pumped to these lands will, in a few years, reduce the water available to the existing irrigated lands by a nearly like amount.[43]

Seven years later, the USGS released the final report of Conover's investigation in 1954 as USGS Water-Supply Paper 1230, *Ground-Water Conditions in the Rincon and Mesilla Valleys and Adjacent Areas in New Mexico* (WSP 1230).[44] Whereas the 1947 preliminary memorandum was an interim set of findings, WSP 1230 presented the full results of the hydrologist's work into 1948, and included numerous illustrations and tables. Conover also noted in WSP 1230 the prior work that informed his conclusions. He specifically cited Slichter and Lee's reports, and noted the drainage work undertaken by federal reclamation authorities in the mid-to-late 1910s. Conover characterized the work of the *JIR* with regard to "groundwater conditions in the Mesilla Valley" as "casual," but took note of Bryant's comments on "ground-water levels" and the "flow of ground water" in Mesilla Valley. He further used federal reclamation studies of drainage from

[43] Conover, Preliminary memorandum, 26-27. NM_00124192-NM_00124193.

[44] Prior to the publication of WSP 1230, an "open-file report" was produced in 1950: Open-File Report 50-66 (OFR 50-66). Open-file reports are internal agency drafts, subject to revision. It is possible that Conover's 1947 preliminary memorandum became OFR 50-66, or that it served as the basis for a slightly different document. Searches of the online USGS Publications Warehouse (https://pubs.er.usgs.gov/), a digital library of most USGS publications identified the existence of OFR 50-66 – but JRP was unable to obtain a copy. The link to the report instead directs to WSP 1230, which superseded OFR 50-66.

1917 and 1918 along with Bliss's unpublished 1936 work to analyze surface flow and assess the contributions of "Seepage from the Rio Grande."[45]

WSP 1230 was thus a more thoroughly researched and considered work than the 1947 preliminary memorandum, but the conclusions were substantially the same. Conover provided a greater historical perspective on "previous" and "present development" of ground water in the Rincon and Mesilla valleys. Drawing Slichter's work, he pointed out

> [t]he variable nature of the flow of the Rio Grande in the years prior to construction of Elephant Butte Dam caused much crop loss and inducted a number of farmers to install irrigation wells in order to have a dependable water supply.[46]

These "older wells were of small capacity," and were limited in their ability to extract subsurface waters by "well construction and equipment." By the time the hydrologist embarked on his investigation in the late 1940s, "[t]he principal use of ground water in the Rincon and Mesilla Valleys…[was] for domestic purposes."[47]

Drilling of irrigation wells, however, increased in 1947 and 1948. According to Conover, "at the end of 1946 about 11 irrigation wells were in operation in the Rincon and Mesilla Valley, 5 of which had been in operation for a number of years." Within a year, approximately 45 more wells had been drilled, and by February 1948, nearly 70 wells.[48]

Much as the earlier studies by Slichter, Lee, and Bliss had indicated, Conover's first conclusion offered in his "Summary" was

> The ground water in the valley fill originates mainly from surface water, that is, from seepage of the canals and the river, and from excess water applied to irrigated lands, but partly from ground water from the adjoining high lands, and, occasionally, from precipitation upon the valley floor.[49]

Conclusions 5, 6, 7, 8, 9, 15, and 17, moreover, were nearly identical to conclusions 3, 4, 5, 6, 7, 13, and 14 presented in 1947:

> 5. Pumping of ground water will divert water from the drains and the river. The drains may practically stop flowing by the end of the first summer in a dry year if enough pumps are installed to furnish an adequate water supply for all lands.

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[45] Conover, *Ground-Water Conditions*, 5-6, 39, 69, and 71. See also footnote 8 regarding the federal drainage studies and footnote 14 regarding Bryant's contribution to the *JIR*. Conover acknowledged that, "[v]ery few seepages runs have been made on the Rio Grande below Elephant Butte" prior to his work (p. 69); the federal studies and Bliss's were the only ones he noted.
[46] Conover, *Ground-Water Conditions*, 103.
[47] Conover, *Ground-Water Conditions*, 105.
[48] Conover, *Ground-Water Conditions*, 107.
[49] Conover, *Ground-Water Conditions*, 133.

> 6. If an increase portion of releases from the reservoir were made up to the lower district as compensation for the reduction in flow of the drains, caused by pumping in the Rincon and Mesilla Valleys, a corresponding reduction in the diversions to the Elephant Butte Irrigation District would be necessary.
>
> 7. As no unused ground-water recharge escapes from the project, and there is very little unused ground-water discharge, only a small amount of water can be salvaged to the Rio Grande project as a whole over a period of years by pumping in the Elephant Butte district.
>
> 8. Assuming that the El Paso division [i.e., EP #1] continues to get diversions in the same proportion of reservoir releases as in the past, pumping of ground water will not result in any additional water for the Elephant Butte Irrigation District on a year-to-year basis unless the amount of pumping exceeds the amount of the diverted drain flow, when this excess will come from storage.
>
> 9. On a long-term basis nearly all water removed from storage must be replaced before the flow of the drains returns to normal….
>
> 15. Pumping of ground water on individual farms in years of deficient gravity water supply would ultimately reduce the water supply of the Rio Grande project. If such a reduction were born by the Elephant Butte Irrigation District, it would be necessary to reduce deliveries of surface water to farms with pumps in order to maintain the expected deliveries to farms without pumps….
>
> 17. About 15,000 acres of now undeveloped land and suspended land could be irrigated by ground water. Water pumped on these lands will, in a few years, reduce the water available to the existing lands by an amount equal to the consumptive use by the lands and crops irrigated.[50]

Most importantly, Conover retained his negative assessment of groundwater pumping in EBID on the Rio Grande Project water supply, particularly to lands in Texas. As he stated succinctly in the opening abstract to his 200-page report, “Ground water obtained by pumping in the Rincon and Mesilla Valleys does not represent an additional supply or new source of water to the project, but rather a change of method, time, and place of diversion of the supplies already available.” Expressed more fully towards the end of the report,

> …water pumped by wells in the Rincon and Mesilla Valleys is not an additional or new supply but, instead, is water that would normally flow to the drains and be diverted for use in a lower part of the project. Pumping of ground water, therefore, is essentially a change in point of diversion of an existing supply. In times of normal or adequate supply of surface water to the project, pumping obtains water that would otherwise be available by gravity. In a year of surface-water shortage, pumping results in an adequate supply of water to those farmers having pumps but may reduce the amount of surface water available for diversion in the lower part of the district or project. Pumping water from

[50] Conover, *Ground-Water Conditions*, 133-135.

> wells upon new lands, either in or bordering the valleys, will result in reducing to some extent the supply of water to the project.[51]

Groundwater development in the Rincon and Mesilla valleys thus came at a cost to the project's water supply, in Conover's analysis.

Conover's concerns, first expressed in 1947, were borne out even before the results of his investigation were finalized in 1954. A July 1952 Reclamation study of "river loss" on the project between Caballo Dam and El Paso, noted groundwater pumping was already having a negative impact the river's flow, imperiling the project water supply. Examining "available records and data for the six year period 1946-51," this study found "an increase in loss from the river between Caballo Dam and El Paso for 1951 compared to the previous five years." In fact, the "loss during 1951…[was] about twice the average for the period 1946-50." Groundwater pumping, coupled with unseasonably high temperatures, was to blame, in the Reclamation analysis:

> The indicated increase in river loss during 1951 over the period 1946-50 probably reflects the effects of (a) increased irrigation pumping; (b) increase in evaporation in river channel, due to unusually high summer temperatures and below average precipitation during 1951; (c) reduced accretion to river in those segments where in the past the river may have been effluent or gaining; (d) decreasing ground-water elevation during 1951, which was 1.2 feet lower than the previous five years' average. The rate of decline of the ground-water per year for 1950-51 was over seven times that for any two years during 1946-50, as evidence by reading from 38 test wells in the Mesilla Valley. The major factor is undoubtedly the increased irrigation pumping resulting from the shortage in the water supply of the Project.

Drain flows, upon which lands lower on the project relied, were similarly diminished but were perhaps

> prevented from showing a larger decrease by appreciable interception of seepage from the river. This, coupled with the fact seepage loss from the distribution system continued high and to possibility that pumping may have temporarily created a suspended water table, may account for drain return maintaining a ratio to releases and diversion nearly the same in 1951 as the previous five years.

This was not expected to continue, with both losses to the river and the drains anticipated to worsen in the upcoming irrigation season and beyond:

> A further increase in loss may occur from the river in 1951, since 53 new irrigation wells were installed up to May 1, 1952. Pumping from all wells will commence at an earlier date, since all wells installed during 1951 were put down throughout the year, and not available at start of irrigation season. Also a decrease in drain discharge would be expected under the foregoing conditions.

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[51] Conover, *Ground-Water Conditions*, 2 and 132.

Furthermore,

> under the conditions of a continually dropping water table with resulting decrease in drain flows, the losses from the river instead of being recovered in part by the drains will be principally recharge to the subsurface water table.
>
> At such time as drain flows would cease, with no consequent recovery of river seepage for return to the river, a major problem of water distribution on the Project will exist. The present trend of increasing loss from the river, if continued, will require a change in water distribution policy in order that all divisions of the Project receive their proportionate share of storage water.[52]

The Reclamation study acknowledged that these "conclusions" were made in part from "many estimated wasteway records, the accuracy of which is questionable." However, it pointed to "the actual river operation" as "[f]urther proof": "more storage release was required in1951 to obtain required flows at diversion points than was necessary during the normal period 1946-50."[53]

As for the irrigation wells themselves, the Reclamation study tallied a greater number within the Rincon and Mesilla valleys than in the El Paso Valley. Of the nearly 900 wells within the Rio Grande Project as of December 31, 1951, 170 were in the Rincon Valley, 535 were in the Mesilla Valley, and 188 in the El Paso Valley. Collectively, the Rincon and Mesilla wells had extracted an estimated 95,390 acre-feet (af) of water as opposed to 33,275 af by the El Paso wells in 1951 – a little less than three times as much water. Reclamation concluded that because of pumping nearly 30,000 af "was diverted directly from the river between April 1, 1951 and December 31, 1951, between Caballo Dam and El Paso" – approximately "31 percent of the estimated total water pumped from wells." "This pumping," moreover, "further diverted water from the drains; and assuming none of these dried up, the river and drains were effected by at least 76,630 acre-feet diverted from them during the same period and for the same river reach," and consequently diminishing the overall supply to project lands.[54]

Circulation of this study, WSP 1230, or any of the other studies discussed above, cannot be known for certain. While federal reclamation engineers would have had access to internal drainage investigations, river loss studies, and published USGS work, including Theis' pioneering hydrogeological study, New Mexico materials – Bliss's unpublished investigation, in particular – may not have been as available prior to Conover's investigation. Similarly, New Mexico engineers could more readily obtain published USGS studies and previous work out of the State Engineer's

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[52] United States, Department of the Interior, Bureau of Reclamation, Rio Grande Project – New Mexico-Texas, River Loss, Caballo Dam to El Paso and Irrigation Wells, El Paso, Texas, July 1, 1952, Summary, Part I, A. NM_00138516.
[53] Rio Grande Project – New Mexico-Texas, River Loss, Summary, Part I, B. NM_00138517.
[54] Rio Grande Project – New Mexico-Texas, River Loss, Summary, Part II, B and C. NM_00138517-NM_00138518.

office than they could internal federal reclamation reports from the early 1910s. Yet, setting aside the New Mexico 1913 seepage study, which predated completion of Elephant Butte Reservoir did not scrutinize lands below the dam; Barrows' November 1928 investigation, which only studied the reach of the Rio Grande between Elephant Butte and Leasburg dams; and Hosea's 1928 examination of available river hydrographs, with no apparent fieldwork, federal and state investigations appear to point to an inter-relationship between surface flow and groundwater in the Rincon and Mesilla valleys in New Mexico, prior to the project and Compact and following the Compact. The published USGS reports in 1905, 1907, and 1954 examined this hydrological phenomenon, and WSP 1230 elaborated on and confirmed the findings of Conover's 1947 "preliminary memorandum" that was provided to EBID and likely OSE.

Later actions by New Mexico State Engineer S.E. Reynolds suggest that he came to accept these findings over time, whether he examined Conover's work or any other study. In the mid-1950s, Reynolds recognized a connection between surface flow and subsurface waters in the lands above Elephant Butte in the "Middle Valley" between the Colorado-New Mexico state line and the federal reservoir. Two years after publication of WSP 1230, in 1956, citing a "scientific investigation" of the issue, the state engineer declared an "underground water basin," the "Rio Grande Underground Water Basin" for the Middle Valley. In making this declaration, he noted that "the waters of said basin are interrelated with the flow of the Rio Grande Stream System, so that such underground waters are a substantial source of the flow of said stream system," and that "the waters of the Rio Grande Stream System are fully appropriated."[55]

Twelve years later, Reynolds reiterated his understanding of the relationship between surface flow and "ground water" in the Upper Rio Grande Basin. In "The Rio Grande Compact," a paper prepared in April 1968 for a symposium on "International Water Law Along the Mexican-American Border," held at the University of Texas at El Paso.[56] Reynolds' remarks, made in the context of a dispute over the waters of the Rio Grande between Colorado on the one hand and

[55] S.E. Reynolds, State Engineer, Order Declaring the Rio Grande Underground Water Basin, November 29, 1956. ff. 245 Public Works Committee, Middle Rio Grande River - Elephant Butte Dam. 1957-58, 85th Cong, Box 6, Serial No. 6401. File 235-245, 246-254, 255-257, John Dempsey Papers, NMSA.

[56] The copy of Reynolds' paper collected by JRP came from the State Engineer's records deposited at the New Mexico State Archives and Records Center, as cited below. Subsequent research revealed that the paper had been given at this symposium and published by the University of Texas at El Paso as well as the Southwestern and Rocky Mountain Division of the American Association for The Advancement of Science. See S.E. Reynolds, State Engineer, State of New Mexico, "The Rio Grande Compact," in Clark S. Knowlton, ed., *International Water Law Along the Mexican-American Border*, Contribution No. 11 of The Committee on Desert and Arid Zones Research, Southwestern and Rocky Mountain Division, A.A.A.S. (El Paso: University of Texas, 1968): 48-62.

New Mexico and Texas on the other, acknowledged that the Compact "makes no specific reference to ground water." "However," the state engineer went on,

> the inflow-outflow mechanism for determining delivery obligations makes the control of ground water appropriations in the upstream states essential for the protection of existing surface water rights in these states and the preservation of their ability to meet the compact commitments.
>
> Surface waters and ground water in the Rio Grande Valley are intimately related. At some points, the surface flow feeds the ground water reservoirs and, at other points, the ground water reservoirs discharge into the stream. Along the mainstem of the river, the situation is one in which groundwater discharge contributes to surface flow.[57]

Pointing out that "[a]nnual ground water accretions to the river's mainstem in the reach between the Colorado line and Elephant Butte Reservoir amounts to 200,000 to 300,000 acre-feet," Reynolds justified his decision to establish an underground water basin above the reservoir to safeguard the supply of water to the reservoir:

> Heavy, sustained pumping from the groundwater reservoir would cut off this accretion and ultimately would reverse the water table gradient so that the water now flowing into the stream and constructed drains would disappear into the groundwater reservoir. These hydrologic facts of life, couple with imminent large-scale developments of groundwater for agricultural and municipal and industrial uses in New Mexico above Elephant Butte led the State Engineer in 1956 to assume jurisdiction over appropriations of ground water in the Rio Grande Valley along the river's mainstem and lower reaches of its tributaries by proclaiming the boundaries of an underground water basin which extends from the Colorado line to Elephant Butte Dam. The action was taken, both to protect the existing water rights in New Mexico and to preserve the state's ability to meet its compact obligations.[58]

The state engineer did not declare a similar underground basin for lands below Elephant Butte until 1980. After the City of El Paso sought to appropriate groundwater from the Mesilla and Hueco bolsons in New Mexico, he established the Lower Rio Grande Underground Water Basin for the former and the Hueco Underground Water Basin for the latter. El Paso made filings for more than 350 wells in the two basins, and Reynolds denied the applications based on New Mexico's prohibition of the export of groundwater out of the state.[59]

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[57] S.E. Reynolds, State Engineer, The Rio Grande Compact (April 29, 1968), 20-21. Folder 2062, Reynolds, The Rio Grande Compact, April 29, 1968, Box 78, Exps. 231-233, Nos. 2016-2085, State Engineer Reports: Basic/Rio Grande, NMSA.

[58] Reynolds, The Rio Grande Compact, 21. Folder 2062, Box 78, State Engineer, NMSA.

[59] Ira G. Clark, *Water in New Mexico: A History of Its Management and Use* (Albuquerque: University of New Mexico Press, 1987), 675.

This denial brought to a boil a simmering legal dispute in US District Court, *City of El Paso v. Reynolds*, in which Reynolds as New Mexico State Engineer defended in his action in part on the Compact and on the hydrological connections between surface flow and groundwater.[60] Presiding judge Howard C. Bratton ultimately ruled in favor of El Paso. According to Bratton's decision in January 1983, the state engineer's arguments were predicted upon

> three factual assertions: (1) all of the waters in which El Paso has asserted an interest [i.e., the water within the two bolsons] are Rio Grande waters; (2) the Rio Grande Compact apportions the surface waters of the Rio Grande between the states of New Mexico and Texas and controls the use of hydrologically related ground water; and (3) any taking of ground water is ultimately fully reflected in the flow of the river.

Bratton dismissed these contentions as "labyrinthin," citing in part the history of the Compact prepared by New Mexico historian Myra Ellen Jenkins for the case, Raymond Hill's *Development of the Rio Grande Compact of 1938*, and statements made at Rio Grande Compact Commission proceedings. He was further critical of the fact that both Reynolds and New Mexico had previously denied the Compact apportioned water to Texas, and that the former only changed his position, articulated in 1956, with El Paso's lawsuit.[61]

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[60] As Clark notes, El Paso had filed suit prior to Reynolds' declaration of the two basins and ahead of its filings for groundwater in September 1980. Clark, *Water in New Mexico*, 675 and 676.

[61] United States District Court for the District of New Mexico, *The City of El Paso*, By and Through Its Public Service Board, *Ray Pearson, Carlton C. Homan, Jr., Louie Giallanza, Clinton E. Wolf,* and *Thomas D. Westfall*, Plaintiffs, v. *S. E. Reynolds*, individually and as State Engineer of New Mexico, *Jeff Bingaman*, individually and as Attorney General of New Mexico, *Lalo Garza*, individually and as New Mexico District Attorney for Dona Ana County, Defendants, *Elephant Butte Irrigation District, The City of Las Cruces, New Mexico, and Stahmann Farms, Inc.*, Defendant-Intervenors, Civ. No. 80-730 HB, January 17, 1983. 563 F. Supp. 379, 383 and 385-387; 1983 U.S. Dist. LEXIS 19988, 9 and 19-24; 13 ELR 20755. Provided by Somach Simmons & Dunn.

Notably for the original action at hand, Bratton also opined,

> Contrary to defendants' contention, a decision that the Compact does not apportion the river below Elephant Butte does not mean that New Mexico, having made its delivery, could undermine it by pumping down the surface flow of the river below the point of delivery. This opinion does not address that issue at all.

City of El Paso v. Reynolds, Civ No. 80-730 HB, 563 F. Supp. 387; 1983 U.S. Dist. LEXIS 19988, 26; 13 ELR 20755.

Following Bratton's decision, the New Mexico legislature repealed the export ban and introduced a new statute that made out-of-state water transfers possible. Such applications required a permit from the state engineer who was required to consider several factors including present water right holders and New Mexico's commitment to water conservation. The State of New Mexico subsequently filed an appeal to the United States Tenth Circuit Court of Appeals, arguing that the new law rendered the issue moot. Clark, *Water in New Mexico*, 678-680.

Reynolds' shifting views, however, may be less indicative of a legal strategy and more indicative that by the 1980s the state engineer had come (or was coming) to recognize what Slichter, Lee, Bliss, and Conover had found for the Rincon and Mesilla valleys earlier in the century and which he himself had acknowledged to be the "hydrologic facts of life" for the Upper Rio Grande Basin above Elephant Butte in 1956: that surface flow and groundwater were hydrologically connected. In 1982, OSE produced a brief paper, entitled "Rio Grande, Elephant Butte Dam to El Paso, Texas," that summarized the result of "[a] study of streamflow depletion in the Rio Grande Valley between Elephant Butte Dam and El Paso, Texas," plotted on four figures.[62] Figure 1, a double

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In late 1983, the appeals court vacated Bratton's ruling and remanded the case back to the lower court for reconsideration. New Mexico in February 1984, in Bratton's later words, "enacted a two year moratorium on new appropriations of groundwater hydrologically connected to the Rio Grande below Elephant Butte." The US district judge once again found for El Paso in August 1984, deciding that the moratorium violated the Interstate Commerce Clause and reaffirming his prior ruling. The legal battle dragged until 1989 when the US Court of Appeals for the District of Columbia Circuit ruled that no live controversy remained. United States District Court for the District of New Mexico, *Ray Pearson, Carlton C. Homan, Jr., Louie Giallanza, Clinton E. Wolf,* and *Thomas D. Westfall*, Plaintiffs, v. *S. E. Reynolds*, individually and as State Engineer of New Mexico, *Paul Bardacke*, individually and as Attorney General of New Mexico, *Lalo Garza*, individually and as New Mexico District Attorney for Dona Ana County, Defendants, *Elephant Butte Irrigation District, The City of Las Cruces, New Mexico, and Stahmann Farms, Inc.*, Defendant-Intervenors, Civ. No. 80-730 HB, August 3, 1984. 597 F. Supp. 694; 1894 U.S. Dist. LEXIS 24568; 15 ELR 20259; United States District Court for the District of New Mexico, *Ray Pearson, Carlton C. Homan, Jr., Louie Giallanza, Clinton E. Wolf,* and *Thomas D. Westfall*, Plaintiffs, v. *S. E. Reynolds*, individually and as State Engineer of New Mexico, *Paul Bardacke*, individually and as Attorney General of New Mexico, *Lalo Garza*, individually and as New Mexico District Attorney for Dona Ana County, Defendants, *Elephant Butte Irrigation District, The City of Las Cruces, New Mexico, and Stahmann Farms, Inc.*, Defendant-Intervenors, Civ. No. 80-730 HB, August 17, 1984. 1984 U.S. Dist .LEXIS 24276; and United States Court of Appeals for the District of Columbia Circuit, *In re Applications of El Paso*, No. 88-5357, September 22, 1989, Argued; October 20, 1989, Decided. 887 F. 2d 1103; 1989 U.S. App. LEXIS 15897; 281 U.S. App. D.C. 112; 15 Fed. R. Serv. 3d (Callaghan) 22. Provided by Somach Simmons & Dunn.

[62] The paper discussed below, for which an author is unidentified, was collected from the Joseph F. Friedkin Papers (MSS 555), deposited at the C. L. Sonnichsen Special Collections Department, University of Texas, El Paso (UTEP), University Library. The Friedkin Papers consist of correspondence, memoranda, studies and reports, and other historical materials previously maintained and in the possession of Joseph F. Friedkin, head of the US Section of the IBWC from 1962 to 1986. The commission is an international bilateral organization with representatives and technical staff from the US and Mexico, charged with overseeing the various boundary and water treaties between the two countries, particularly with regard to the Rio Grande. Assuring the delivery of 60,000 acre-feet of water from the Rio Grande annually to Mexico in accordance with the Convention of 1906 is a central responsibility of the IBWC.

At the time of JRP's research, the Friedkin Papers were only partially described and organized to archival standards. From an "initial inventory" of the collection (developed by special collections staff), I identified relevant boxes and folders. The document in question was located in box 1, folder 11 – a folder described in the "initial inventory" as "Correspondence and data concerning Mesilla Valley pumping, 1982." Rio Grande, Elephant Butte Dam to El Paso, Texas" was included with a group of three other documents in the folder dating to July 1985. Of these other documents, a July 15, 1985 memorandum to mass diagram, charted "the relationship between the flow of the Rio Grande below Elephant Butte Dam and the flow of the Rio Grande at El Paso, Texas, since storage began in Elephant Butte in 1915," across three periods of time. The paper took special note of the third period, which began in 1951, "the start of the period of lowest water supply available from Elephant Butte Reservoir" and coincided with "extensive groundwater development…undertaken to offset shortages to Rio Grande Project lands." Echoing the findings of the July 1952 Reclamation study of "river loss" between Caballo Dam and El Paso, the paper stated, "This groundwater development has changed the flow regime established prior to 1951 such that a greater release is required from Elephant Butte Reservoir to achieve the same flow at El Paso."[63]

The three other figures demonstrated much the same. "The effects of the drought of the 1950's and increased groundwater development…[was] clearly evident" in Figure 2, a double mass diagram focused on the reach of the Rio Grande between Caballo Dam and El Paso:

Friedkin from Thomas P. Wootton, Chief, Special Studies Branch of the IBWC, routed through George R. Baumli, PE, Inv. & Planning Division, with the subject "Effects of Pumping on Rio Grande Flows," clearly identifies the document in question:

> The Commissioner and staff met with Technical Advisor Harshbarger on June 25, 1985, to discuss the U.S. Section's position on the paper from the New Mexico State Engineer's Office, "Rio Grande, Elephant Butte Dam to El Paso, Texas" (copy attached).
>
> The author of the paper concludes "…that the effects of the groundwater development below Elephant Butte Dam induced by the drought of the 1950's have <u>significantly</u> affected the amount of water reaching El Paso (emphasis added [in original])."

The title of "the paper from the New Mexico State Engineer's Office" is identical to the document in question, and the quoted passage matches a sentence in the "Rio Grande" document found on page 3. The other two documents included in the "Rio Grande" document further support the contention that OSE authored the piece. In both a July 10, 1985 letter from John W. Harshbarger – the Technical Advisor mentioned in the July 15 memorandum – to Wootton, and a July 16, 1985 letter from Wootton to Baumli, forwarding the July 10 Harshbarger-Wootton letter, the "Rio Grande" document is identified as the "New Mexico State Engineer's office paper, 'Rio Grande, Elephant Butt Dam to El Paso, Texas." See John W. Harshbarger to Mr. Thomas P. Wootton, Chief, Special Studies Branch, International Boundary and Water Commission, July 10, 1985; and International Boundary and Water Commission, United States and Mexico, Memorandum, For Information, To: George R. Baumli, PE, Inv. & Planning Division, From: Thomas P. Wootton, Chief, Special Studies Branch, Subject: Effects of Pumping on Rio Grande Flows, July 16, 1985. Folder 11 Correspondence and data concerning Mesilla Valley pumping. 1982., Box 1, MS 555 Joseph F. Friedkin Papers, C.L. Sonnichsen Special Collections Department, University of Texas at El Paso [hereafter UTEP].

As for dating the document to 1982, all of the diagrams end with 1982 and the final sentence on page 3 of the document states: "The new relationship [between "groundwater development below Elephant Butte Dam" and "the amount of water reaching El Paso"] is well defined and has been continuous to the present (1982)." This strongly indicates that the document was authored in 1982.

[63] [Office of the New Mexico State Engineer,] Rio Grande, Elephant Butte Dam to El Paso, Texas [1982], 1. Folder 11, Box 1, MS 555, UTEP.

> Since 1951 there had been a cumulative decrease in the streamflow reaching El Paso totaling 3.7 million acre-feet when compared to the pre-1951 relationship, an average of 112,500 acre-feet per year. Since 1951, the cumulative decrease in streamflow reaching El Paso has averaged 106,000 acre-feet.

Figure 3, a double mass diagram concentrating on the reach between Leasburg Dam and El Paso, "show[ed] that the greatest portion of the decrease in streamflow at El Paso since 1951 is the result of activities occurring below Leasburg Diversion dam, which is located 45 miles below Caballo Dam."

> During the period 1951-1982, there has been a cumulative decrease in the streamflow reaching El Paso of 3.9 million acre-feet when compared to the pre-1951 relationship, an average of 94,000 acre-feet per year. Since 1957, the cumulative decrease in streamflow reaching El Paso has averaged 88,000 acre-feet per year.[64]

Figure 4, a streamflow correlation, further depicted "the effects of the drought of the 1950's on the river." Of particular note," according to the paper, was

> the year 1958, the first year of normal water supply after the drought of the 1950's. The discharge at Leasburg in 1958 was comparable to flows during the 1938-1950 period, yet the amount of water reaching El Paso was about 120,000 acre-feet less than would have been delivered in the period prior to 1951.

From this, the paper concluded,

> all four figures used in this analysis show that the effects of the groundwater development below Elephant Butte Dam induced by the drought of 1950's have significantly affected the amount of water reaching El Paso. The new relationship is well defined and has been continuous to the present (1982).[65]

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[64] Rio Grande, Elephant Butte Dam to El Paso, Texas [1982], 2-3. Folder 11, Box 1, MS 555, UTEP.

[65] Rio Grande, Elephant Butte Dam to El Paso, Texas [1982], 3. Folder 11, Box 1, MS 555, UTEP. Both Harshbarger and Wootton were skeptical of this analysis when they reviewed it in July 1985. Harshbarger, a hydrogeologist, found "the statements given in the New Mexico State Engineer's office paper, 'Rio Grande, Elephant Butte Dam to El Paso, Texas' very confusing and difficult to understand." Writing to Wootton on July 10, 1985, he explained "[t]he basic data do not support the conclusion given in the paper." The IBWC's technical advisor did agree with Wootton's own analysis of the "basic data; annual Rio Grande flows and estimated groundwater pumpage." This analysis, as Wootton explained in a separate memorandum to the IBWC Commissioner Joseph Freidkin five days later, was "that there is no data presently available that indicates that groundwater development (pumping) has significantly affected the quantity of water reaching El Paso." The Special Studies Branch chief presented that data in a series of tables and a graph. Wootton further elaborated on Harshbarger's assessment, stating that the technical advisor found "that since there has been no apparent effect of pumping on the shallow aquifer and the Rio Grande, is an indication that recharge is equal or greater than the average annual pumping." He did conclude his memorandum with a portend: "At some point in time the pumping will exceed the recharge and the effects should be noticeable in the shallow aquifer and the Rio Grande flows." See

The relationship between this study and Reynold's arguments in the El Paso lawsuit cannot be determined from the available documentation reviewed. The preponderance of historical evidence considered here nonetheless suggests that by the 1980s Reynolds had come to such a recognition. Within the past 15 years, OSE staff appear to have further acknowledged what early-twentieth century USGS studies had observed, and which mid-twentieth century hydrological investigations had warned: that surface and subsurface waters were intimately related in the Upper Rio Grande Basin, and that extensive groundwater development threatened the water supply for Rio Grande Project lands and raise the possibility of a Compact dispute with Texas.[66]

For its part, the USGS continues to recognize that groundwater pumping has the potential to affect surface flow significantly. In the forward to Circular 1376, entitled *Streamflow Depletion by Wells – Understanding and Managing the Effects of Groundwater Pumping on Streamflow* and

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Harshbarger to Wootton, July 10, 1985; and International Boundary and Water Commission, United States and Mexico, Memorandum, For Information, To: Commissioner, Thru: George R. Baumli, PE, Inv. & Planning Division, From: Thomas P. Wootton, Chief, Special Studies Branch, Subject: Effects of Pumping on Rio Grande Flows, July 15, 1985. Folder 11, Box 1, MS 555, UTEP.

[66] In a May 15, 2003 memorandum to then-New Mexico State Engineer John R. D'Antonio, Jr., regarding EBID's Emergency Application for Permit for Supplemental Wells, OSE Lower Rio Grande Basin Supervisor Erek H. Fuchs pointed out:

> Given the interrelated nature of the surface and groundwater system in question, groundwater diversions of the magnitude potentially necessary to serve the application or that may occur for years to come despite the application as discussed herein are such that much of the available or remaining mainstem flows of the Rio Grande below Caballo Reservoir, beginning with drain flows within the EBID, could be negatively and substantially affected almost immediately, although it is uncertain how severe these effects might be.

Fuchs expressed concern that

> the EBID pumping program as it is proposed may strain already tenuous relations with Texas and others and could result in many problems, including the increased potential for a challenge under the Rio Grande Compact due to the uncertain extent of effects of this large scale pumping on the quantity and quality of the mainstem flows of the Rio Grande below Caballo Reservoir…. Similar to and in some respects worse than the effect documented during the drought of the 1950's, groundwater diversions of the magnitude suggested above would rapidly create a large, negative hydraulic gradient throughout the Rincon and Mesilla Valley's [sic] such that virtually all surface water drains within the EBID would soon go dry. In turn, much of the available or remaining mainstem flows of the Rio Grande below Caballo Reservoir, if there are any for all practical purposes, would be negatively and substantially affected almost immediately, however it is uncertain how severe these effects might be and for how long even after drought conditions eventually subside.

Memorandum, Office of the State Engineer, District 4, May 15, 2003, File: LRG-1776, To: John R. D' Antonio Jr., State Engineer, Paul Saavedra, Water Rights Division Chief, John Romero, WRAP Director, Through: Calvin Chavez, District Supervisor, From: Erek H. Fuchs, Lower Rio Grande Basin Supervisor, Re: Emergency Application for Permit for Supplemental Wells, Local impairment analysis and issues for consideration, Applicant: Elephant Butte Irrigation District, 2-3, and 11-12. Provided by Somach Simmons & Dunn.

released in 2012, USGS Associate Director for Water (Acting) Jerad D. Bales, acknowledged the benefits of groundwater while taking stock of the impact of its use by recalling Theis' work:

> Groundwater withdrawals also can lead to a reduction in streamflow, affecting both human uses and ecosystems. The first clear articulation of the effects of groundwater pumping on surface water was by the well-known USGS hydrologist C.V. Theis. In a paper published in 1940 entitled "The Source of Water Derived from Wells," Theis pointed out that pumped groundwater initially comes from reductions in aquifer storage. As pumping continues, the effects of groundwater pumping can spread to distant connected streams, lakes, and wetlands through decreased rates of discharge from the aquifer to those surface-water systems. In some settings, increased rates of aquifer recharge occur in response to pumping, including recharge from the connected surface-water features. Associated with this decrease in groundwater discharge to surface waters is an increased rate of aquifer recharge. Pumping-induced increased inflow to and decreased outflow from an aquifer is now called "streamflow depletion" or "capture."[67]

In conclusion, as a historian without academic or professional credentials as a hydrologist, hydrogeologist, or water engineer, I cannot assess the *quality* of the "scientific understanding" of the relationship between surface flow and groundwater. Nor can I opine, as Dr. Stevens has done, that the "scientific understanding" of the relationship between surface flow and groundwater "was too nascent" at the time of the 1906 and 1908 filings for the Rio Grande Project (Opinion 5, p. 11) and "still in its infancy at the time of the 1938 Rio Grande Compact negotiations" (Opinion 6, p. 11). Nonetheless, the available historical record that I have examined indicates that federal and New Mexico engineers documented a hydrological connection between Rio Grande surface flows and groundwater in the Rincon and Mesilla valleys in New Mexico from the early 1900s through the 1930s, and this is essential context for understanding what waters were ultimately apportioned by the Compact.

As pointed out in my expert report (p. 64), Reclamation plans for the Rio Grande Project from the outset envisioned utilizing all the available water within the basin below Elephant Butte Dam. This was predicated, in part, on Charles Slichter's 1904 investigation that found a relationship between water in the river's channel and groundwater within the Mesilla Valley itself. Leveraging New Mexico territorial law and as a matter of practice and policy not only on the Rio Grande Project but also on other federal projects throughout the arid west, Reclamation authorities further asserted control over waters arising on project lands. There were waters that originated from the Rio Grande, were applied to those lands, interacted with subsurface waters, and returned by project drains to the channel for additional use downstream.

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[67] Jerad D. Bales, forward to *Streamflow Depletion by Wells – Understanding and Managing the Effects of Groundwater Pumping on Streamflow*, by Paul M. Barlow and Stanley A. Leake, Groundwater Resources Program, Circular 1376, US Department of the Interior, US Geological Survey (Reston, VA: US Geological Survey, 2012), iii.

This dynamic, as noted in my expert report (p. 82), was understood and recognized by those engineers involved in crafting the technical basis for the Compact. Federal engineers engaged with the Rio Grande Joint Investigation did not made a dedicated study of groundwater in the Rincon and Mesilla valleys in the mid-to-late 1930s. Yet they were aware of the pioneering hydrogeological work of C.V. Theis, which exposed the potential of groundwater development to affect surface flow. The resulting *JIR* reiterated some of Slichter's findings regarding Mesilla Valley hydrology; acknowledged the necessity of return flows to downstream land; took note of Reclamation's groundwater monitoring activities in the Rincon and Mesilla valleys and its drainage operations; and made pointed observations about the state of the Upper Rio Grande Basin water supply that recognized groundwater development would not add water to the basin. Data regarding groundwater conditions within the Mesilla Valley, gathered by Reclamation, was scrutinized by Texas's engineering advisor Raymond Hill, and Hill himself appears to have had on hand at least one federal analysis of return flow and groundwater. Perhaps more importantly, more than 30 years after Slichter's investigation and following nearly two decades of project operations, New Mexico's engineering advisor John Bliss appears to have arrived at similar conclusions as Slichter, finding a "direct relationship" between surface and subsurface waters below Elephant Butte.

Whatever the quality of this work or the limitations that these early investigations may possess – especially when evaluated with contemporary measuring systems and analytical methods by technical experts – a throughline is apparent in them and in subsequent studies and assessments to the end of the twentieth century. When water users in the Rincon and Mesilla valleys in New Mexico looked to augment a diminished supply of Rio Grande surface flow with groundwater and sought the expertise of the USGS in the late 1940s, they were cautioned as to the impact of groundwater development on the available surface flow. This analysis was based in part on prior investigations that identified a direct relationship between the two sources of water in the basin. In a detailed study, initiated at the request of EBID in 1946, carried through 1948, and published in 1954, USGS hydrologist Clyde S. Conover confirmed findings made Slichter and Bliss. He observed that groundwater extraction would deplete surface supplies available to lands within the Rio Grande Project. As early as 1952 Reclamation began observing this impact, and by the mid-1950s, New Mexico State Engineer S.E. Reynolds accepted the existence of a hydrological connection between surface flow and subsurface waters for lands above Elephant Butte. By the early 1980s, there is evidence that he and his office came to a similar recognition for lands below Elephant Butte and attributed a diminished surface supply from the Rio Grande for lands below El Paso to the expansion of pumping in New Mexico.

Supplemental Opinion I: Available historical evidence indicates that two periods of streamflow record, reflecting then-present conditions of water use in the Upper Rio Grande Basin, were used to formulate the delivery schedules set forth in Articles III and IV of the 1938 Rio Grande Compact: the period 1928 to 1937 for Colorado's delivery to New Mexico (Article III), and "the period prior to 1930," approximately 1890 to 1929, for New Mexico's delivery to Texas (Article IV).

This supplemental opinion offers a historical not technical analysis. Focused on documents that contributed to and captured the substance of the discussions among the engineering advisors as they worked toward a technical basis for the Compact in late 1937 and early 1938 – most notably, the *Rio Grande Joint Investigation* report, the proceedings of the Rio Grande Compact Commission following the report, and the notes, reports, and other materials produced by the engineering advisors during and after the Compact negotiations – it traces how the delivery schedules of the 1938 Rio Grande Compact were developed. As addressed in my expert report (pp. 29-30, 32, and 38-39), the Committee of Engineering Advisors who formulated the technical basis for the Compact recognized that without the introduction of water from outside the Upper Rio Grande Basin, no additional water existed within the basin to be apportioned. The engineers thus sought to protect existing developments, such as the Rio Grande Project, while providing for new projects in Colorado and New Mexico through the establishment of delivery schedules tied to measurements of inflow and outflow at various points in the basin. Armed with data from the Rio Grande Joint Investigation, they based Colorado's deliveries to New Mexico (Article III of the Compact) on tabulations of inflow and outflow of the Conejos River and the inflow and outflow of the main stem of the Rio Grande above Lobatos near the Colorado-New Mexico state line, and New Mexico's deliveries to Texas (Article IV of the Compact) on tabulations of Rio Grande inflow at Otowi Bridge and Rio Grande outflow at San Marcial above Elephant Butte Reservoir. Unstated in the Compact, however, was the period of record used to derive these inflow and outflow figures. My expert opinion as a historian is that the engineering advisors ultimately relied upon two different time periods, reflecting then-present conditions of water use in the Upper Rio Grande Basin: the period 1928 to 1937 for Colorado's delivery to New Mexico (Article III), and "the period prior to 1930," approximately 1890 to 1929, for New Mexico's delivery to Texas (Article IV).

The *Rio Grande Joint Investigation* report, or *JIR*, as discussed in my expert report (pp. 21-22), provided an essential compilation of information for the engineering advisors. Colorado's engineering advisor Royce Tipton reported that from the data in the *JIR* he and his fellow engineers were able to ascertain "the discharge of the river at various points under present development in the basin," and "schedules of water delivery which would insure each section of the basin against injury by acts of water uses in another section and yet would permit of the construction and operation of additional reservoirs above Elephant Butte Reservoir."[68]

Similarly, Texas' engineer Raymond Hill recalled the importance of the federal investigation to the development of the Compact some three decades following the Compact's ratification. The *JIR*, in his words, assembled "all essential data as to the sources and quantities of water available for use in the several States, the needs for water in these States, and means for development and use of those supplies." Where it specifically came to development of delivery schedules that were at the heart of the compact, Hill stressed that the report brought together "all pertinent data." With this data provided to the commission, the engineering advisors crafted the technical basis for the Compact.[69]

The "pertinent data" from the *JIR* regarding stream flow or run off in the Upper Rio Grande Basin covered the period from approximately 1890 to January 1936, and that data was analyzed in the report with reference to the prevailing water use conditions. Most of the stream-flow measurements presented in the report were obtained from the United States Geological Survey (USGS), which had established several stations in the basin in the late-nineteenth century. Other measurements for the investigation were made by "the State Engineering Departments of Colorado and New Mexico, the Bureau of Reclamation (Reclamation), the International Boundary Commission, and other public and private agencies."[70] The gaging station "near Del Norte [Colorado], where Rio Grande enters San Luis Valley, was established in July 1889." Ten years later, measurements of the Rio Grande began at El Paso, Texas, and "near Lobatos, Colo., [a station] which records the Rio Grande flow below the San Luis Valley and near the Colorado-New Mexico State line." "The station at Otowi Bridge, formerly referred to as 'near Buckman,' located at the head of White Rock Canyon and below the confluence of the Rio Chama," began recording flow in February 1895. The San Marcial station, "at the lower end of the Middle Valley and upper

[68] R.J. Tipton, *Analysis of Report of Committee of Engineers to Rio Grande Compact Commissioner, Dated December 27, 1937* (February, 1938), 1-4. ff. 70, Box 44-70, MSS 312 Michael Creed Hinderlider Collection, 1897-1987 [hereafter MCHC 1897-1987], History Colorado, Denver [hereafter HC].

[69] Raymond A. Hill, Consulting Civil Engineer, "Development of the Rio Grande Compact of 1938," 14 and 21. In re: Rio Grande Project AG No. 011504362, Copies from the Center for American History, Raymond A. Hill Papers & The Rio Grande Compact Commission Collection. See also same cited pages in Raymond Hill, Consulting Engineer, "Development of the Rio Grande Compact of 1938." ff. 49 Development of Rio Grande Compact of 1938, good history on water conflict, Texas, New Mexico, Colorado, prepared in context of 1966 Supreme Court Case, Box 4, MS 555 Joseph F. Friedkin Papers, C.L. Sonnichsen Special Collections Department, University of Texas at El Paso [hereafter UTEP Spec Coll]. Additionally, this narrative was published posthumously in the *Natural Resources Journal* in 1974. See Raymond A. Hill, "Development of the Rio Grande Compact of 1938," *Natural Resources Journal* 14:2 (April 1974): 64-200.

[70] Plate 4 of "General Report" "lists the upper basin gaging stations for which records are available, indicates the source or agency which has published the records, gives the drainage areas in square miles above the stations, and shows the period for which the records are available." *JIR*, Plate 4, 27.

end of the present Elephant Butte Reservoir" was established in January 1895. The tributary with the "longest record" was "the Conejos River near Mogote in Colorado," which began in May 1903.[71]

The *JIR* acknowledged that records for these stations and many others in the basin were incomplete, "but the gaps do not seriously impair the utility of the record." The largest gap existed "in the Embudo record, a period of 8 ½ years from 1904 to 1912." Both the Otowi Bridge and El Paso stations had "maximum gaps of 3 ½ years each" while Del Norte had a 1 ½ year gap, "and the other stations of a few months only." For some tributaries, the period of record was short. For Pinos Creek, near Del Norte, Colorado (Table 134), for instance, only a portion of the years 1919 through 1924 were available, and for some months, the flow was estimated. This was similarly true for the Rio Chama, at Chama, New Mexico (Table 172), which only had the years 1912 and 1916, and some monthly figures for those years were estimated. Where it came to the Rio Grande, however, the tables ran through December 1935.[72]

The federal report further identified "main-river stations which record the inflow to and outflow from the San Luis, Middle, and Elephant Butte-Fort Quitman sections" – the three major geographical areas of the Upper Rio Grande Basin – "and those near the sites of major reservoir developments, present and proposed" as "key stations." These were: Rio Grande at Wason, Del Norte, Alamosa, and Lobatos in Colorado; at Embudo, Otowi Bridge, and San Marcial in New Mexico; at El Paso, Texas; and at the Conejos River near Mogate and the Rio Chama above El Vado Reservoir in New Mexico. The *JIR* developed tables (Tables 14 and 15) that depicted "the mean annual and mean monthly run-off for the 46-year period 1890-1935, the monthly mean in percent of the mean annual, and the annual run-off in percent of the mean annual" for the Del Norte, Lobatos, Embudo, Otowi Bridge, and San Marcial stations. Stream-flow data from each, the report pointed out, "[did] not wholly represent direct mountain run-off but record the flow which has passed or is returned from upper irrigated areas plus intermediate tributary flow." The report also offered a figure (Figure 5) that presented the "characteristics of run-off for a maximum, mean, and minimum year for Del Norte, Otowi Bridge, and San Marcial stations, as representative of the run-off at the head, respectively, of the main irrigated areas of the San Luis, Middle, and Elephant Butte-Fort Quitman sections."[73]

This data was vital to the determination of water production from run off in the basin – in the words of the *JIR*, "[t]o arrive at a comprehensive and adequate knowledge of the available water supply…." Federal engineers, utilizing "all available stream-flow records" calculated that "mean

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[71] *JIR*, 26.
[72] *JIR*, 26 and Appendix A – Precipitation, Evaporation, and Stream Flow Records, 139-171 (Table 134 on p. 151 and Table 172 on p. 165).
[73] *JIR*, 28.

annual water production was slightly more than 3 million acre-feet (af), and originated principally and nearly equally in Colorado and New Mexico.[74]

Having made that calculation, however, adjustments in run-off had to be made "for Present Development" at the head of the San Luis and Middle valley sections in the basin. The *JIR* explained,

> the run-off of Rio Grande near Lobatos represents the residual flow below the San Luis Valley irrigation development. The run-off at Embudo and Otowi Bridge represents this same residual flow plus or minus intermediate tributary inflow or losses, respectively. The run-off at San Marcial represents the residual flow below the Middle Valley irrigation development. In estimates of the water supply for given future conditions it become important to determine what the flow, 1890 to 1935, would have been at these gaging stations under present conditions of development. Put in another way, this means a determination of what the consumption of inflow was in the San Luis and Middle Valleys in this period [i.e., 1890-1935].[75]

For the San Luis Valley, this determination was based on a slightly narrower time period – between 1927 and 1935. The *JIR* noted that irrigation development in the valley had occurred before 1890, but the temporary Rio Grande Compact of 1929 had limited "increased use of Rio Grande water in Colorado to an amount offset by drainage return." Surveys of irrigated acreage by Colorado and New Mexico engineers indicated that acreage had remained "substantially constant" between 1927 and 1935, "except for variations due to the availability of water." "[T]his period" was therefore "taken as representative of present irrigation development. and of the use of water in San Luis Valley and that use in the past may be referred to use in this period to derive corrections to past stream flow for present conditions." Moreover,

> the run-off to the southeast area of San Luis Valley is practically all consumed in irrigation and does not reach the river, the difference between the total outflow to the southwest area and the flow of Rio Grande near Lobatos may be taken to represent the total consumption of southwest area inflow which includes that of Rio Grande near Del Norte. Although this difference does not represent the total depletion of water in San Luis Valley, it does represent a very substantial part of it, and with respect to correction to the Lobatos flow for past use, may be taken as a complete index of the use factors governing the river flow at that station. In any one year the water consumption and hence outflow at Lobatos is influenced to a substantial degree by the extent of available inflow. It was necessary, therefore, to establish the present consumption, or that in the period 1927-35, as related to the inflow.[76]

[74] *JIR*, 28-29.
[75] *JIR*, 29.
[76] *JIR*, 30.

The *JIR* went on to present a series of curves that plotted inflow and outflow using the 1927-1935 time period (Figures 8 through 11), acknowledging flood peaks that were undivertible and unusable as compared with discharge records for the Rio Grande Del Norte and Conejos River stations. It produced two tables from this effort that offered "Corrections to recorded of Rio Grande near Lobatos, Colo., to give flow under present irrigation developing in San Luis Valley" (Table 17) and "Estimated run-off of Rio Grande near Lobatos, Colo., under present irrigation development in San Luis Valley" (Table 18), both for the period 1890-1935.[77]

Adjustment for present development in the Middle Valley was more challenging. This was because of "the meagerness and uncertainty of records of tributary inflow between Otowi Bridge and San Marcial, the controlling upper and lower river stations, respectively, for the principal unit of water consumption in the Middle section." Without better data, the difference of inflow between the two stations could not be simply taken; "some estimate of this total consumption of inflow" had to be made. To assess tributary inflow, federal engineers first derived "gains in the river flow between intermediate stations," using the recorded Rio Grande flow at the San Felipe station for the ten-year period between 1926 and 1936, expanded to encompass the 1890-1935 period. The gains shown on the resulting tables (Tables 20 and 21) "represent[ed] the excess tributary inflow, surface and seepage, over consumption of inflow…."[78]

Federal engineers next assessed the "the relation between Otowi Bridge-San Marcial losses and the Otowi Bridge flow," concentrating on those days in the Otowi Bridge-San Marcial record where tributary inflow was minimal. Through a variety of calculations, analysis of four different period of record – 1890-1905, 1906-19, 1920-29, and 1930-35 (which encompassed "construction of the irrigation and drainage works of the Middle Rio Grande Conservancy District") – plotting of curves (Figures 16 and 17) and adjustments for side inflow, estimates of "monthly consumption of inflow" (Table 22) and "monthly tributary inflow" (Table 23) were obtained for the period 1890 to 1935.[79]

The engineers further used "progressive 5-year weighed means" (Figure 18) to "smooth the effect of annual irregularities and to bring out more clearly the relation." The results, however, did not expose any "marked long-time trend in consumption." Rather, much like for the San Luis section, the analysis "indicated that little change in this consumption, except that due to variation in water supply, has occurred since 1890."[80]

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[77] *JIR*, 31-35.
[78] *JIR*, 37, 38 (Tables 20 and 21), and 39 (Table 21 continued).
[79] *JIR*, 37-39, 40 (Figure 16), 41 (Tables 22 and 23), and 42 (Table 23 continued and Figure 17).
[80] *JIR*, 42 and 43 (Figure 18). Separate from this analysis, federal engineers explored the utility of using a "deduced flow" for San Marcial rather than the available record as a means of correcting for possible

The analysis performed for the Middle Valley, however, was ultimately not as determinative as for the San Luis Valley. According to the *JIR*, the work did not permit an assessment of "the effect on the regimen of the river of the works and operations of the Middle Rio Grande Conservancy District" – which, as noted above, spanned the period from 1930 to 1935 – nor "the effect of certain conditions obtaining in particular years."[81]

The inability of federal engineers to assess the impact of the Middle Rio Grande Conservancy District (MRGCD) on the Rio Grande was significant. Development of the district, as noted in my expert report (pp. 16-17), had precipitated the original action that Texas filed against New Mexico and MRGCD in the US Supreme Court in late 1935; this litigation was subsequently stayed, pending the results of the Rio Grande Joint Investigation. New Mexico's experts in hearings before Special Master Charles Warren had argued, in part, that the district would not impinge upon the Rio Grande Project water supply. For instance, studying Otowi and San Marcial flows for 1929 and 1936, former Reclamation engineer Harold Conkling testified that there would in fact be a net gain in water above San Marcial as a consequence of MRGCD's works – as much as 118,000 af "more water reaching San Marcial each year than would have reached that point if such works had not been constructed and operated…."[82]

Texas disputed this point. In his testimony on behalf of the downstream state, Hill offered "three general conclusions" arising from his analysis of the district's effect on Elephant Butte Reservoir:

1. "the water supply which was available prior to the construction of the works of the Middle Rio Grande Conservancy District are no greater in amount than that needed to satisfy the proper beneficial uses in the water served with water from Elephant Butte reservoir."
2. "…by the construction and operation of the works of the Middle Rio Grande Conservancy District, there has been caused some impairment of the water supply of the Elephant butte reservoir by reduction in quantity, and a very substantial impairment of quality has taken place…."
3. "…if the Middle Rio Grande Conservancy District is developed to the extent of the total area which can be served from existing canal systems, and which is served by existing drain systems, and if fifty thousand acres of new lands are thereby placed in cultivation, the water supply in Elephant Butte reservoir will further be impaired as to quantity and quality, and in order to offset these conditions there will be required a total of at least

inaccuracies in that record. The resulting study, however, found a minimal difference between recorded and deduced flow when assessing the Otowi Bridge-San Marcial relation. *JIR*, 43-46.

[81] *JIR*, 43.

[82] *State of Texas vs. State of New Mexico, et al, Defendants' Case in Chief*, Volumes XII, XIII & XIV, 2443-2448. CB-F-171A thru CB-F-1716: Transcripts of TX v. NM, Vol. 1-16, Box 4X219, RAHP, UTA. The quoted text are the words of a New Mexico attorney who questioned Conkling; Conkling replied in the affirmative.

> one hundred fifty thousand acre feet per annum of water in addition to that which has been accustomed to enter Elephant Butte Reservoir."[83]

Despite leaving this issue unresolved and for all the limitations of the available streamflow data, the *JIR* expressed a guarded confidence in the federal investigation's analysis of the Otowi Bridge-San Marcial relation:

> Although subject to relatively wide variation in derivation because of the indeterminate character of available data, this estimate [i.e., of Otowi Bridge-San Marcial flow] is believed to approach within reasonable limits the actual consumption of inflow which occurred, and to be adequate for purposes of analysis if, based thereon, a reasonably wide latitude is maintained in determining the sufficiency of water supplies or additional requirements for water.[84]

In determining "the available water supply in the Upper Rio Grande Basin," the stream flow analyses for the San Luis and Middle Valley sections were a critical component of the *JIR*'s ultimate assessment of the "Availability and Use of Water Under Given Conditions."[85] Eleven different "conditions" were considered, involving various scenarios of water storage development (principally in the San Luis Valley and involving MRGCD in the Middle Valley), estimates of diversion demand in the three sections of the basin (including for the Rio Grande Project, Mexican deliveries under the 1906 Convention, and MRGCD), and return flows in the three sections. For each condition, the "period of analysis" was slightly different but all included the years from 1911 to 1935.[86]

In assessing the various conditions through 1935, presented largely through a series of tables (Tables 109 to 116) and figures (Figures 40 to 43), the *JIR* focused on three items. These were:

> (1) annual run-off of Rio Grande at Lobatos and San Marcial and of Conejos River at mouth; (2) monthly run-off at Lobatos for maximum, minimum, and mean years; and (3) amount and year of occurrence of shortages in San Luis, Middle, and Elephant Butte-Fort Quitman sections.[87]

With the data and analysis from the Rio Grande Joint Investigation available in late summer 1937, the engineering advisors for the three states proceeded to develop delivery schedules to

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[83] *State of Texas vs. State of New Mexico, et al*, *Plaintiff's Case in Chief*, Volumes V, VI & VII, 1349-1350. 599a-603. CB-F-171A thru CB-F-1716: Transcripts of TX v. NM, Vol. 1-16, Box 4X219, RAHP, UTA.
[84] *JIR*, 43.
[85] Others included "estimates of the required diversion demand of the major units of the basin; the opportunities for water storage; and the possibilities of additional water supplies by transmountain diversion and by salvage of present losses." *JIR*, 127.
[86] *JIR*, 127-130.
[87] *JIR*, 130, 131 (Tables 109 to 111), 132 (Figure 40), 133 (Figure 41), 134 (Tables 112 and 113), 135 (Tables 114 and 115), 136 (Figures 42 and 43), and 137 (Table 116)

apportion the Rio Grande water supply. Those schedules depended upon streamflow relationships at key gaging stations on the main stem of the Rio Grande and in Colorado on Conejos River, a Rio Grande tributary, described in the *JIR*, and these relationships, in turn, were viewed as describing or reflecting then-current water supply conditions.[88]

As discussed in my expert report (p. 24), at the first meeting of the compact commission on September 28 following a presentation on the investigation, Colorado compact commissioner and state engineer M.C. Hinderlider explicitly used data from the *JIR* to support his state's longstanding view that there was sufficient water in the basin for the development of lands in Colorado. The state's "position" was that

> an adequate supply of water exists in the Upper Rio Grande Basin above Fort Quitman which, if properly regulated and used, will meet the requirements of present irrigation development in the Basin at the date of the signing of the Compact, and under present conditions to the extent indicate by the report of the Rio Grande Joint Investigation.[89]

Hinderlider preceded to offer a series of "graphs prepared from certain tables appearing in Part I, Vol. I, of the report of the Rio Grande Joint Investigation" that focused on "shortages in irrigation requirements which exist under present conditions of development" for the three sections of the basin. These tables from the *JIR*, as noted above, covered the available period of record to 1935. Colorado nevertheless extended the data set to 1937 to make its case that the San Luis Valley did not have "parity" with the Middle Valley or the Elephant Butte-Fort Quitman sections at present and should.[90]

Neither New Mexico nor Texas at that meeting used the *JIR* to support their positions, but on September 30 the engineering advisors began to discuss bases for possible delivery schedules that used relationships studied in the Rio Grande Joint Investigation. Hill presented "an analysis of the relation between the historical flow at San Marcial and the historical flow at Otowi less the historical flow at Lobatos." This relationship, expressed as both a table and curve, the engineer offered as defining a quantity of flow to reach San Marcial for the benefit of Texas.[91]

When questioned by Tipton as to the "period…covered in setting up the relationship," Hill explained, "We took all the historical years first and applied them." "[T]he earlier years,"

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[88] As noted in my expert report (p. 21), although the *JIR* was not officially released until 1938, the compact commissioners and their engineering advisors were given a final draft in August 1937.

[89] Proceedings of the Meeting of the Rio Grande Compact Commission Held in Santa Fe, New Mexico, September 27, to October 1, 1937, 11. Unnamed folder 5, Box 2F463, RGCC-FBCP, UTA

[90] Proceedings of the Meeting of the Rio Grande Compact Commission...September 27, to October 1, 1937, 12. Untitled folder 5, Box 2F463, RGCC-FBCP, UTA.

[91] Proceedings of the Meeting of the Rio Grande Compact Commission...September 27, to October 1, 1937, 16. Untitled folder 5, Box 2F463, RGCC-FBCP, UTA.

however, proved to be "more erratic…because of the inaccuracy of the records" – a circumstance that the *JIR* had likewise observed. He therefore focused on "the last 20 years…from 1912 when Elephant Butte was started, up to the last five years, inclusive; and the relationship is particularly accurate as to the last 10 or 12 years" – i.e., 1925 or 1927 to 1937.[92]

Tipton thought that this "relationship might reflect more water at San Marcial than actually would occur under present conditions," but Hill insisted it did capture those present conditions. He echoed the *JIR*'s observation that the flow at Lobatos had remained substantially unchanged for several years:

> The practical angle is this – that over the past ten years the points [on the curve] representing progressive five-year averages are almost squarely on the curve with the maximum departure, being 200,000 out of four million. During that ten years the conditions at Lobatos have been substantially frozen. For the larger years where points become erratic, if we were to get seven million acre-feet at San Marcial in five years, there would be a period of spill that would interrupt it anyway. If you go beyond the conditions prevailing from 1920 t0 1935, you run into conditions from 1920 to 1935, during which time the flow at Lobatos has not been materially affected.[93]

John Bliss, the engineering advisor for New Mexico, did not participate in this discussion of deliveries to Texas but did offer a schedule of delivery for Colorado to New Mexico. His schedule was predicated on a comparison of "the natural flow of the Rio Grande at Del Norte" with the flow passing the Colorado-New Mexico state line. This relationship was expressed in a table similar to Hill's.[94]

Bliss's schedule, also like Hill's, was "merely an interpolation between the control points set forth in this [Bliss's] table" – yet, he was more vague as to the period of record he used. New Mexico's engineer advisor explained that the intention of the schedule was to reflect the operation of Wagon Wheel Gap Reservoir in the San Luis Valley, "an operation which would return to the state line the same amount of water which presumably would be returned under present day conditions."[95]

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[92] Proceedings of the Meeting of the Rio Grande Compact Commission...September 27, to October 1, 1937, 20. Untitled folder 5, Box 2F463, RGCC-FBCP, UTA.
[93] Proceedings of the Meeting of the Rio Grande Compact Commission...September 27, to October 1, 1937, 20-21. Untitled folder 5, Box 2F463, RGCC-FBCP, UTA.
[94] Proceedings of the Meeting of the Rio Grande Compact Commission...September 27, to October 1, 1937, 22. Untitled folder 5, Box 2F463, RGCC-FBCP, UTA.
[95] Proceedings of the Meeting of the Rio Grande Compact Commission...September 27, to October 1, 1937, 23. Untitled folder 5, Box 2F463, RGCC-FBCP, UTA.

Tipton separately suggested that Bliss "bring Conejos [River] in as part of the yardstick as a method of determining water supply," pointing the "long-time station on the Conejos" and the contribution to the river made to the Rio Grande flow above Lobatos. This latter point, as noted above, was also made in the *JIR*. New Mexico's engineering advisor expressed "No objection" to this.[96]

When the commission convened the following day, October 1, Hinderlider offered a revised schedule for Colorado's deliveries to New Mexico that reflected the discussion from the previous day and expressly defined a roughly 10-year period of record to be used. Broadly, the commissioner offered:

> Deliveries of water shall be made by Colorado at Lobatos gaging station near the Colorado-New Mexico state line in accordance with the following schedule, which indicates the relation under present conditions (1928-1937) of development, between the recorded flow of the Rio Grande at the gaging station near Del Norte, plus the recorded flow of the Conejos at the Mogote gaging station, and the recorded flow of the Rio Grande at the Lobatos gaging station.[97]

Tipton subsequently elaborated on this outline. Colorado's engineering advisor insisted that the schedule "was designed with the idea of protecting both lower basin states [i.e., New Mexico and Texas] absolutely against any depletion at the state line by reservoir construction which would adversely affect present uses in those area." The schedule, moreover, was "built on the relationship between recorded flows for the years 1928 to 1935." Tipton explained, "The last two years [i.e., 1936 and 1937] is not in that [the schedule] as that data was not available."[98]

Following Colorado's presentation, as addressed in my expert report (p. 25), considerable discussion was had largely among the engineers regarding various aspects of the proposed schedule of delivery. No one clearly challenged or debated the period of record Colorado was relying upon for the deliveries at the Colorado-New Mexico state line, and no one addressed the period of record for deliveries from New Mexico to Texas. The commissioners instead elected to

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[96] Proceedings of the Meeting of the Rio Grande Compact Commission...September 27, to October 1, 1937, 26. Untitled folder 5, Box 2F463, RGCC-FBCP, UTA.
[97] Proceedings of the Meeting of the Rio Grande Compact Commission...September 27, to October 1, 1937, 31. Untitled folder 5, Box 2F463, RGCC-FBCP, UTA. This schedule was presented in full on p. 32 and appears as Exhibit No. 4, on p. 61 of the Proceedings.
[98] Proceedings of the Meeting of the Rio Grande Compact Commission...September 27, to October 1, 1937, 33. Untitled folder 5, Box 2F463, RGCC-FBCP, UTA.

adjourn to provide their advisors an opportunity to develop the "technical basis" for a compact as a group, and report back to the full commission.[99]

As discussed in my expert report (pp. 25-32), over the course of two meetings – in Santa Fe between November 22 and 24, and in Los Angeles between December 15 and 27 – the engineers developed that technical basis by crafting delivery schedules for Colorado and New Mexico. At the November meeting, Tipton reportedly offered a "tentative schedule of deliveries at the state line which could have been satisfied under natural conditions during the past eight or nine years," or approximately 1928 or 1929 to 1937. This range was consistent with the Colorado schedule considered at the October 1 commission meeting.[100]

There is no clear indication if a period of record for New Mexico's deliveries was discussed in Santa Fe. According to Hill, Bliss was "very fearful of any fixed schedule, on account of uncertainty of physical conditions, particularly as to the amount of tributary inflow between Ottiwi [*sic*] and San Marcial." This was, yet again, the same issue that had been brought out in the *JIR*. Provided that "some formula can be developed that will protect them against under-deliveries through causes beyond their control," Hill nonetheless thought that New Mexico "will accept a schedule of deliveries corresponding to actual inflow in past years."[101]

A December 2, 1937 letter from Hill's associate Alan Laflin to Texas' engineering advisor suggests Bliss had "New Mexico schedules" – presumably for Colorado's delivery to New Mexico, and New Mexico's to Texas – at or around the time of the November meeting. According to Laflin, those schedules had been influenced by MRGCD consulting engineer H.C. Neuffer, who Laflin had encountered in the office of USGS chief hydrologist C.V. Theis on December 1:

> Your [Hill's] guess that Neuffer had a hand in drawing up the New Mexico schedules as presented by Bliss are evidently well founded as he and Bliss have spent four days in discussing the last engineers conference, and at present are giving their whole attention towards the coming meeting.[102]

The December meeting, as noted in a "Preliminary Draft of Report of Committee to Rio Grande Compact Commissioners," dated December 22, 1937 was focused on the development of

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[99] Proceedings of the Meeting of the Rio Grande Compact Commission...September 27, to October 1, 1937, 31-42, 53. See also Douglas Littlefield, *Conflict on the Rio Grande: Water and the Law, 1879-1939* (Norman: University of Oklahoma Press, 2000), 201.

[100] Raymond A. Hill, Memo to Mr. Clayton: In re Meeting of Committee of Engineers, at Santa Fe, November 22 to 24, 1937, November 26, 1937, 1-2. [1937], Box 2F467, RGCC-FBCP, UTA.

[101] Raymond A. Hill, Memo to Mr. Clayton: In re Meeting of Committee of Engineers, at Santa Fe, November 22 to 24, 1937, November 26, 1937, 2. [1937], Box 2F467, RGCC-FBCP, UTA.

[102] Alan Laflin to Mr. Raymond A. Hill, December 2, 1937. ff. Elephant Butte - El Paso Co. Dist. Laflin Correspondence, July-Dec. 1937. G 351, Box 4X19, RAHP, UTA.

"definite schedules of deliveries."[103] This draft report – prepared a week after the Los Angeles meetings opened – and other documents leading to the formal December 27 report were obtained from the Raymond Hill Papers at the Briscoe Center for American History at the University of Texas at Austin, and offer a window into the December deliberations. Several documents were either hand-annotated by Hill or were handwritten by Hill; they appear to reflect decisions the engineers made as they were working out those schedules.

According to this preliminary draft report, the engineers were "guided…by the general policy – expressed at the meeting of the Compact Commission in October – of maintenance in the future of the same conditions of flow at the State Line and into Elephant Butte Reservoir as those which prevailed in recent years." In acknowledgement of the limitations of their work, the preliminary draft report included the following statement before delving into the delivery schedules that had been formulated:

> It must be recognized that precise determination of past conditions and close estimates of future changes are not possible. Accordingly, in submitting the following for your favorable consideration and inclusion in a permanent Compact to govern the future administration of the Rio Grande above Fort Quitman, we suggest that provision be made for review of these matters [added "after five years"] and for adjustments within the intent of the Compact.[104]

With reference to "the same conditions of flow…which prevailed in recent years," "recent years" appears to have been the past decade. The "Scheduled Deliveries at Lobatos," the Colorado-New Mexico state-line delivery outlined in the preliminary draft report, reflected Colorado's proposed schedule from the October commission meeting. It used measurements of flow of the Conejos River at Mogote and of the Rio Grande at Del Norte to derive the delivery requirement at Lobatos. Two tables, one for the Conejos and another for the Rio Grande above Del Norte, were offered. The Conejos table had a column for "Conejos Index Supply" and "Conejos River at Mouths." The index supply was the sum of "the natural flow of Conejos River at the gaging station near Mogote"

[103] Three different versions of the December 22 preliminary draft report were found in folder CB-F-137-34, Box 4X215 of the Raymond Hill Papers at the Briscoe Center for American History, University of Texas, Austin. One of these appears to be earlier than the other two; it is shorter (at eight pages long, it stops with the schedule of deliveries to Elephant Butte Reservoir), and handwritten corrections and changes noted on it are reflected in the other two versions. Those other two have the same additional corrections, changes, and marginalia but those annotations appear to be in two different hands – one of which is likely Hill's. The copy believed to be annotated by Hill is the copy cited in this discussion, and where appropriate those annotations are reproduced in brackets within quoted statements. All three preliminary drafts contain the same information regarding the period of record used to derive the delivery schedules. The December 27 report incorporates the changes in the latter two.

[104] Preliminary Draft of Report of Committee to Rio Grande Compact Commissioners, December 22, 1937, 1 and 2. CB-F-137-34, Box 4X215, RAHP, UTA.

and the Los Pinos and San Antonio rivers for the months April to October. "Conejos River at Mouths" was "the combined discharge of branches of this river…." The Rio Grande above Del Norte had columns for "Rio Grande at Del Norte" and "Rio Grande at Lobatos less Conejos at Mouths." The "values" given in the columns for both tables were taken "from a smooth curve expressing the relationship for the past ten years" – presumably from 1928 to 1937.[105]

Further support for this conclusion may be found in another document entirely in Hill's hand, entitled "Tiptons Relation Curves for Natural Flow at Lobatos." Initialed "R.A.H.," and dated "12/18/37," this document was a series of three tables on three pages. The first table listed a set of figures under two broad columns. "Curve 4A" had figures for both "Del Norte" and "Lobatos minus Conejos," and "Curve 4B" had figures for "Conejos Index" and "Conejos at Mouth." The following two tables were devoted to the Conejos and the Rio Grande at Del Norte. The Conejos table had columns for Conejos at Mogote, San Antonio and Los Pinos for the months of April to October, inclusive, the "Total Index Supply" and "Conejos at Mouth"; the Rio Grande at Del Norte table, in turn, had columns for "Del Norte," "Lobatos," "Conejos at Mouth," and "Lobatos minus Conejos at Mouth." There are 12 figures in each of the columns for these two tables; each column ends with a figure, and this final row is identified as "1937." It is unclear if figures appearing in the columns above the final "1937" row are in fact a sequence of years from 1926 to 1936 but the arrangement of this data strongly suggests it may be. The document itself is most likely either Hill's analysis of Tipton's work, or Hill's reproduction of Tipton's work – although the figures given do not match the figures in the typescript December 22 preliminary report.[106]

A similar 10-year period appears to have been used to derive the New Mexico delivery schedule for water for Elephant Butte Reservoir. The preliminary draft report acknowledged that "[t]he relation between the amount of water in the Rio Grande above the principal agricultural areas in New Mexico and inflow to Elephant Butte Reservoir is quite erratic," and attributed this "to wide variations in the discharge of tributary streams." Although the engineers endeavored "to eliminate the influence of such tributary flow through "many devices," as a group they settled on a partial record of "discharge of Rio Grande at Otowi Bridge and the inflow to Elephant Butte Reservoir," one that did not include the months of July, August, and September, as the basis for a New Mexico delivery schedule. In their "opinion…no more precise relationship can be developed from present information, and that is use as a schedule will be practicable."[107]

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[105] Preliminary Draft of Report of Committee to Rio Grande Compact Commissioners, December 22, 1937, 3-4. CB-F-137-34, Box 4X215, RAHP, UTA.
[106] R.A.H., "Tiptons Relation Curves for Natural Flow at Lobatos," 12/18/37. CB-F-137-34, Box 4X215, RAHP, UTA.
[107] Preliminary Draft of Report of Committee to Rio Grande Compact Commissioners, December 22, 1937, 5. CB-F-137-34, Box 4X215, RAHP, UTA.

The engineers initially developed a curve based on an Otowi Bridge-San Marcial relation. However, owing to both the operational cost of the San Marcial station and the "physical condition" of the station that made "it difficult to obtain accurate records," they looked to releases from Elephant Butte Reservoir which could "be measured with considerable precision." Comparing the "normal net loss from the river below San Marcial and from the reservoir," the engineers "found that for more than ten years" – presumably from 1937 back – such "losses have borne a very close and consistent relation to the discharge of the river at San Marcial." According to the preliminary draft report,

> The third step was then the subtraction of the normal losses so found from the curve of relationship between the flow at Otowi and that at San Marcial. The net result was to give a curve which expresses the relation between the flow of the Rio Grande at Otowi and the usable supply of water at Elephant Butte, both exclusive of July, August, and September.

"The final relationship" that the engineers "recommend[ed] be used as the schedule of deliveries" was expressed in a single table entitled "Deliveries into Elephant Butte Reservoir Exclusive of July, August, and September" with a column for "Otowi Index Supply" and "Elephant Butte Index Supply."[108]

Aside from the individual discussions of delivery schedules, additional evidence appears in the preliminary draft report that indicates the engineers had a 10-year period of record, roughly 1928 to 1937, in mind as they formulated the technical basis for a compact. The "Normal Release from Elephant Butte" was defined

> as an average of 800,000 acre feet per annum drawn out of Elephant Butte Reservoir, adjusted for any gain or loss in usable water resulting from the operation of any reservoir below Elephant Butte; provide that this amount shall be adjusted by two-thirds of any change in aggregate diversions and loss to Mexico between Courchesne gaging station and the lowest point of diversion to lands of Rio Grande Project.

"[T] average annual diversion and loss to Mexico," for the period "from 1928 to 1937, inclusive" was to be used as the "basis" for assessing "the amount of such change."[109]

Development of the delivery schedules does not seem to have posed the same challenges for the engineers that other aspects of the Compact – such as the quantity of water to be released from Elephant Butte and safeguards against diminished water quality, both discussed in my expert

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[108] Preliminary Draft of Report of Committee to Rio Grande Compact Commissioners, December 22, 1937, 6. CB-F-137-34, Box 4X215, RAHP, UTA.
[109] Preliminary Draft of Report of Committee to Rio Grande Compact Commissioners, December 22, 1937, 8-9. CB-F-137-34, Box 4X215, RAHP, UTA.

report (pp. 28-29, and 52-53) – did. In fact, two days after the date of the preliminary draft report, Hill telegrammed Clayton to inform him that

> except for Debler [the engineering advisor for the compact commissioner chair and Reclamation assistant chief engineer S.O. Harper] reasonable schedules for deliveries at Lobatos agreed upon and schedules of deliveries into Elephant Butte. Allowable departures likewise agreed upon but we are hung up on allowance to be made for bad quality of Middle Rio Grande water.[110]

There were some differences in language between the December 22 preliminary draft report and the final "Report of Committee of Engineers to the Rio Grande Compact Commissioners," dated December 27, 1937. At the outset of the final report, for instance, the engineering advisors characterized their meetings slightly differently. As stated in my expert report (p. 29), the engineering advisors noted that they had "avoided discussion of the relative rights of water users in the three States." Instead, they "were guided…by the general policy – expressed at the meeting of the Compact Commission in October – that present uses of water in each of the three States must be protected in the formulation the Compact," as "the usable water supply is no more than sufficient to satisfy such needs." The engineers further recognized that "precise determination of past conditions and close estimates of future changes" were "not possible," so they recommended "review of these matters" by the commission "after five years and for adjustments within the intent of the Compact." Where it came to the chronological basis for the delivery schedules, however, the same references to a roughly 10-year period of record, approximately 1928 to 1937, appear in the final report.[111]

Tipton's February 1938 *Analysis of Report of Committee of Engineers to Rio Grande Compact Commissioners, Dated 27, 1937* provides some further clarity as to the period of record used by the engineering advisors. This report was prepared for Hinderlider and was an assessment of "the effect of a compact," predicated upon the recommendations made in the December 27 report, "on present and prospect water uses in the San Luis Valley."[112]

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[110] Raymond [Hill] to Frank B. Clayton, Telegram, 1937 Dec 24. [1938-1940], Box 2F466, RGCC-FBCP, UTA.
[111] "Report of Committee of Engineers to Rio Grande Compact Commissioners," December 27, 1937, in Proceedings of the Meeting of the Rio Grande Compact Commission, Held at Santa Fe, New Mexico, March 3rd to March 18th, inc., 1938, Appendix No. 1, 40, 41 (reference to "past ten years" in "Schedule Deliveries at Lobatos" section), 43 (reference to "more than ten years" in "Scheduled Deliveries into Elephant Butte Reservoir"), and 45 (reference to "average annual diversion and loss to Mexico from 1928-1937" under "Definitions," paragraph (e) "Normal Release from Elephant Butte"). ff. 032.1 Rio Grande Basin. Corres. re Compact Between States of Colorado; New Mexico & Texas re Rio Grande Basin Water Rights, Jan. 1938 THRU May 1939, Box No. 936 Rio Grande Basin 023._246, Project Correspondence file 1930-1945, RG 115, NARA Denver.
[112] Royce J. Tipton to Mr. M.C. Hinderlider, February 19, 1938, in Tipton, *Analysis*, i. ff. 70, Box 44-70, MCHC 1897-1987, HC.

While the focus of Tipton's *Analysis* was on Colorado, he nevertheless addressed the chronological bases for both delivery schedules. The engineering advisor noted that "the agreement of the engineering committee" reflected in its report

> recognized the impracticability of encroaching upon the present legitimate use of water in any section of the basin. The proposal was designed to permit not only present uses of water, but also to allow increased diversion and consumption of water above Elephant Butte Reservoir by utilizing water which otherwise would spill from that reservoir.
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> …To accomplish this end, the agreement recommends the setting up schedules of delivery of water at the Colorado-New Mexico stateline and into the Elephant Butte Reservoir, the first to represent present conditions based on the period 1928 to 1937, and the second based essentially on the period 1915 to 1937.[113]

Tipton's comments indicate that instead of using the same 10-year period of record, the engineers used two slightly different periods for the schedules – each "represent[ing] present conditions" in the two sections of the Upper Rio Grande Basin above Elephant Butte. The 1915-1937 timeframe is notably similar to the period of record that Hill used in making his initial September 30 proposal for deliveries to Texas, discussed above.

Although all the engineering advisors signed off on the December 27 report and recommended its adoption by the compact commission, as addressed in my expert report (pp. 33-35, and 37-38), Neuffer (in spite of whatever influence he may have exercised over Bliss, as noted above) and New Mexico compact commissioner and state engineer Thomas McClure objected to the report's recommendations and ultimately forced a revision. Neuffer and McClure's objections centered mostly on the recommended 800,000 af release for Elephant Butte, which Neuffer notably questioned based on his calculation of the average release from the reservoir over the past decade, 1927 to 1936.[114] MRGCD's consulting engineer also could not replicate the curves used to develop the Otowi Bridge-Elephant Butte Reservoir relation and urged it be reconsidered.[115]

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113 Tipton, *Analysis*, 5-6. ff. 70, Box 44-70, MCHC 1897-1987, HC.

114 As noted in my expert report (p. 33), when the New Mexico state engineer and compact commissioner learned the general outlines of the report on December 22 from Bliss, McClure confidentially told his advisor that the 800,000 af release "will not be agreeable." Bliss to [McClure], December 22, 1937; and T.M. McClure to John H. Bliss, telegram, 1937 Dec 24 AM 10 27. Rio Grande Compact – July 7, 1937 to June 30, 1938, 26th Fiscal Year, NM_0015692 – NM_00156929 and NM_00156927.

115 H.C. Neuffer, Consulting Engineer, to Mr. John H. Bliss, State Engineer's Office, Re: Report of Committee of Engineers to Rio Grande Compact Commissioners, December 27, 1937, January 7th, 1938. NM_00054005; H.C. Neuffer, Memorandum, Subject: Report of Committee of Engineers to Rio Grande Compact Commissioners, December 27, 1937, np [1-3, and 6]; JHB, Engineer, to Mr. R.J. Tipton, Consulting Engineer, January 14th, 1938. Rio Grande Compact – July 7, 1937 to June 30, 1938, 26th Fiscal Year, NM_00156900 – NM_00156902, NM_00156905, and NM_00156892 – NM_00156894.

McClure likewise stressed this point to his fellow compact commissioners, when the group assembled again in March 1938. He informed the commission that an analysis by his office found the Otowi-Elephant Butte indexing to be inaccurate and characterized the recommended relation to define New Mexico's delivery obligations as a "compromise" among the engineers.[116]

New Mexico's compact commissioner therefore asserted that an Otowi-San Marcial index (the months of July, August, and September excluded) be used instead. In his formal objections, McClure argued

> The best relationship which existed in the past is expressed by a curve showing the relationship of Otowi to San Marcial. The numerous indeterminate factors that enter into the picture of usable supply in the reservoir will reflect greater inaccuracies than will the San Marcial method in using this as a basis for deliveries. These factors are bank storage, the determination of silt content on an annual basis, and losses occurring from the San Marical gaging station to the reservoir.

And further,

> New Mexico objects to natural flow at the Otowi station and insists upon recorded flow. Natural flow debits us with El Vado storage during the spring months, with no credit when this stored water is released during the months of July, August, and September.[117]

The engineering advisors, following a discussion among the commissioners and separately among the advisors themselves, agreed to re-visit both the Otowi Bridge-San Marcial relation and the 800,000 af release for Elephant Butte and revise their report accordingly. For his part, Texas compact commissioner Frank Clayton insisted that New Mexico "furnish the data and other figures on which they predicate their demands," which McClure was willing to oblige.[118]

The engineers worked in isolation, joined only by Neuffer. As addressed in footnote 84 of my expert report (p. 38), Neuffer's attendance was prompted by a suggestion by one of McClure's legal advisors, former New Mexico governor Arthur T. Hannett in a stated bid to "save a lot of time." Edwin Mechem, counsel to Elephant Butte Irrigation District (EBID) and a legal advisor to Clayton, immediately objected to what he saw as MRGCD engineering consultant being "substituted for the State's [New Mexico's] expert." Mechem asserted that EBID's interests were greater and that "Mr. Neuffer doesn't represent us." Hannett countered that his suggestion was not to replace Bliss but simply to include Neuffer. It was a "practical matter," because MRGCD's

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[116] Proceedings of the Meeting of the Rio Grande Compact Commission…March 3rd to March 18th, inc., 1938, 1, 4-5, 7, 9, and 13. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.
[117] Proceedings of the Meeting of the Rio Grande Compact Commission…March 3rd to March 18th, inc., 1938, 13. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.
[118] Proceedings of the Meeting of the Rio Grande Compact Commission...March 3rd to March 18th, inc., 1938, 11-12 and 15, and Appendix No. 6, 56-57. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

support for the compact was essential to compact ratification by New Mexico's legislature. "For that reason the engineering expert of that district," he asserted, "has got at least to have the opportunity to check our figures before we bind ourselves, and that's all we ask." At Hinderlider's suggestion, Neuffer was therefore designated a "witness" rather than a direct participant in the engineering discussions with the commissioners agreeing that his contributions would be at the discretion of the engineers.[119]

The revised report took a week to complete. Dated March 9, 1938 and signed by all the engineering advisors with Neuffer "concur[ring]," it was presented to the compact commissioners the following day. The report reflected the two key changes sought by New Mexico: an Otowi Bridge-San Marcial index (excluding the months of July, August, and September), and a lesser figure of 790,000 af for the "normal release from Elephant Butte."[120]

In returning to the Otowi Bridge-San Marcial relation that the engineering advisors had previously rejected, they also made a notable change to the period of record. The March 9, 1938 report, as the December 22, 1937 preliminary draft and the December 27, 1937 report, acknowledged the difficulties in assessing streamflow above Elephant Butte Reservoir in nearly the same language:

> The relation between the amount of water in the Rio Grande above the principal agricultural areas in New Mexico and inflow to Elephant Butte Reservoir is quite erratic, due primarily to wide variations in the discharge of tributary streams.

Yet, whereas previously the engineers "had tried many devices to minimize the influence of such tributary inflow," only to be unable to do so and embraced an Otowi-Elephant Butte relation, with this revised report, they

> found that there was a reasonable relationship between the discharges of Rio Grande at the Otowi Bridge and San Marcial gaging stations when the months of July, August, and September were excluded.

The revised report presented a new table, "Discharge of Rio Grande Exclusive of July, August, and September at Otowi Bridge and San Marcial," with a column for "Otowi Index Supply" and "San

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119 Proceedings of the Meeting of the Rio Grande Compact Commission...March 3rd to March 18th, inc., 1938, 15, and 18-22. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.

120 Proceedings of the Meeting of the Rio Grande Compact Commission...March 3rd to March 18th, inc., 1938, 24, and Appendix No. 7, 61-62, and 65. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver. Ironically, in 1947, following recommendations by the Rio Grande Compact Commission engineering advisors, the commission elected to adopt a new Otowi-Elephant Butte relation as the basis for the New Mexico delivery schedule and to base that relation on a full year, rather than nine months. See Hill, "Development of the Rio Grande Compact of 1938," 33.

Marcial Index Supply." The report also identified that the "values" in the column "express that relationship [between Otowi Bridge and San Marcial] for the period prior to 1930."[121]

Precisely what was meant by "the period prior to 1930" and why such a change was made is not apparent from the immediate historical record produced at the time of the Compact negotiations. Although as discussed in my report (pp 39-40) the commissioners had additional questions for the engineers (which prompted a March 11 clarification report) none of those concerned the Otowi Bridge-San Marcial index or the period of record for the relation. This change, moreover, is in stark contrast to the period of record used for the "Scheduled Deliveries at Lobatos." For both the "Discharge of Conejos River" and the "Discharge of Rio Grande Exclusive of Conejos," reference continued to be made to "the past ten years," which as discussed above was likely 1928 to 1937.[122] Finally, without further clarification and without reference to periods of record, the Rio Grande Compact of March 18, 1938 incorporated the relationships worked out for both Lobatos and San Marcial as Article III and Article IV, as defining Colorado and New Mexico's delivery obligations respectively.[123]

Statements by Tipton, Bliss, McClure, and Hill following the signing of the Compact and decades later, however, shed further light on the periods of record used for both schedules. With regard to Article III, in early December 1966, in a signed statement to Texas Assistant Attorney General Vince Taylor, Tipton unequivocally declared that the period of record used to define Colorado's delivery schedule was the period 1927 to 1938. This statement was given "in connection with the States of Texas and New Mexico versus Colorado, No. 29 Original in the Supreme Court of the United States."[124] Colorado's former compact engineering advisor admitted to Taylor that he "was actually the author of the formula found in Article III." Tipton explained that the "reason" for the two indices, one for the Conejos and another for the Rio Grande, "were [*sic*] primarily for the purpose of Colorado and its internal measurement." "The formula," in his words, "was based

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[121] Proceedings of the Meeting of the Rio Grande Compact Commission...March 3rd to March 18th, inc., 1938, Appendix No. 7, 61. ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver.
[122] Even when in the course of the Compact drafting the engineers noted an error in the curve for the "Discharge of Conejos River" and recommended different "values," there is no indication that they abandoned "the past ten years" timeframe. See Committee of Engineering Advisors to The Rio Grande Compact Commission, March 17, 1938, 2. CB-F-169 E, Box 4X218, RAHP, UTA.
[123] Proceedings of the Meeting of the Rio Grande Compact Commission...March 3rd to March 18th, inc., 1938, 25-27, Appendix No. 7, 59, Appendix No. 8, 66, and Appendix No. 11, 74-76 (Article III of the Rio Grande Compact and 76-77 (Article IV). ff. 032.1, Box No. 936, Entry 7, RG 115, NARA Denver
[124] This statement, while signed, was undated. According to the document it was made at conference with Taylor "in the office of Tipton and Kalmbach, Inc." in Denver, Colorado, December 8 and 9. Statement by Mr. Royce J. Tipton, 1. ff. Rio Grande Compact Commission Re suit against Colorado, w. 66-1061 Texas vs. Colorado, Box 1989 41-240 Litigation Files, Texas Attorney General [hereafter LF-TAG], Texas State Archives, Austin [hereafter TSA].

on 1927 to 1938 experience." Other than to assert that "a terrific amount of work [was] done" for "the tables contained in Article III and Article IV," Tipton offered nothing more in his statement on the derivation of the schedules in the March 9 report.[125]

A discussion of the Compact provisions by Bliss nearly 30 years prior to Tipton's statement supports the Colorado engineer's assertation about the time period used for Article III and further explains the time period "prior to 1930" used for New Mexico's delivery schedule. In an April 2, 1938 report, entitled "Provisions of the Rio Grande Compact," New Mexico's engineering advisor pointed out that the "two schedules" – "(1) at the Colorado-New Mexico State Line, and (2) at San Marcial at the head of Elephant Butte Reservoir" – provided for "[t]he division of the waters of the Rio Grande between the three states." "The Colorado obligation," according to Bliss, was "based upon two schedules of discharge, the sum of which equals the conditions of flow of the Rio Grande at the State Line during the past 10 years," that is, 1927 to 1938.[126] New Mexico's "obligation," in turn,

> to deliver water at San Marcial is based upon the index inflow of the Rio Grande at Otowi at the head of the Middle Valley and the index outflow at San Marcial at the lower end thereof, the relationship between the two representing conditions prior to 1930 when reclamation and drainage in the Middle Rio Grande Conservancy District was started.[127]

Bliss's observation that the Otowi-San Marcial index captured "conditions prior to 1930 when reclamation and drainage in the Middle Rio Grande Conservancy District was started" would seem to imply that the New Mexico delivery schedule was predicated upon basin conditions as those existed at the time of the 1929 temporary compact.

McClure's undated "Analysis of the Terms of the Compact" confirms Tipton and Bliss's observations about the differing chronological bases for the two delivery schedules. According

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[125] Statement by Mr. Royce J. Tipton, 1-2. ff. Rio Grande Compact Commission Re suit against Colorado, w. 66-1061 Texas vs. Colorado, Box 1989 41-240, LF-TAG, TSA. Referenced by Tipton and more clearly explained by Hill, "the overall obligation of Colorado to deliver water at Lobatos" was later "reduced by 10,000 acre feet per annum…to avoid an impasse arising out of a conflict between water users along Conejos River and users of water from the Rio Grande." Hill, "Development of the Rio Grande Compact of 1938," 25.

[126] Likewise, Hinderlider in his "Analysis of Compact" from late 1938,makes the point with regard to Article III that the Colorado-New Mexico delivery schedule was "as determined by conditions of inflow and outflow since 1928 (the former temporary compact provided that the conditions on the river should remain as of 1929)." M.C. Hinderlider, "Analysis of Compact," in *Rio Grande Compact* [*and Analysis Thereof by M.C Hinderlider in Address to Colorado Legislature and to Gov. Teller Ammons on Nov. 15-1938*], 23. ff. 58, Box 44-70, MCHC 1897-1987, HC.

[127] J.H. Bliss, Engineer, "Provisions of the Rio Grande Compact," Santa Fe, N.M., April 2, 1938, 1. ff. Rio Grande Compact Engineer-Adviser Data, 1937-1938, Box No. 27, Accession Number 7978, John H. Bliss Collection, American Heritage Center, University of Wyoming, Laramie.

to the New Mexico state engineer and compact commissioner, "The Colorado schedule of water deliveries is based upon the relation found to exist between the annual inflow into, and the outflow from, the San Luis Valley for the years 1928 to 1937, both inclusive." As for "The New Mexico schedule of water deliveries," it was predicated "upon the relationship between the inflow to the Middle Valley at Otowi gaging station for the years of record prior to 1930." "The period 1930 to 1937," McClure elaborated, "could not be included because of the changed conditions of discharge at San Marcial due to the works of the Middle Rio Grande Conservancy District."[128]

Hill had a slightly different but not contradictory view on the timeframes upon which the two schedules were based. As discussed in my expert report (p. 112), in a 1968 narrative account of the Compact negotiations prepared for the same original action Texas and New Mexico filed against Colorado in which Tipton offered his views on Article III, Texas' engineering advisor opined:

> The Committee of Engineering Advisers was instructed to prepare schedules of deliveries by Colorado and by New Mexico that would insure [*sic*] maintenance of the relationships of stream inflow to stream outflow that had prevailed under the conditions existent when the Compact of 1929 was executed.

This was done because

> [t]he Rio Grande Compact Commissioners, during their meetings in 1937 and 1938…had to divide an insufficient supply among three groups of water users, each of which was antagonistic to the other two. Their solution was to hold to the principles of the 1929 Compact and to depart as practicable from its provisions.

In the engineer's opinion,

> The Rio Grande Compact should thus be looked upon as an expansion of the Compact of 1929, designed to provide for the maximum beneficial use of water in the basin of Rio Grande above Fort Quitman without impairment of any supplies beneficially used under the conditions prevailing in 1929.[129]

Given the streamflow data compiled by the Rio Grande Joint Investigation and the engineering advisor's positive assessment of the work for their negotiations, it seems likely that the data used by the engineers to capture "the conditions prevailing in 1929" for the New Mexico delivery schedule would have been for the period 1890 to 1929.

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[128] Thomas B. McClure, State Engineer, "Analysis of the Compact," undated, 21. NM_00164500.
[129] Hill, "Development of the Rio Grande Compact of 1938," 62 and 63.

Yet, where it came to Colorado, judging from Tipton's 1966 statement, Bliss's 1938 report, and McClure's undated analysis, a different time period was used. Hill himself acknowledged in his 1968 narrative that the schedule initially developed by Tipton and presented at the September 1937 meetings of the compact commission was based on

> the relationship, under 1928-1937 conditions of development, between the recorded flow of the Rio Grande at the gaging station near Del Norte plus the recorded flow of the Conejos at the Mogote gaging station and the recorded flow of the Rio Grande at the Lobatos gaging station.[130]

This apparent departure from "the conditions prevailing in 1929" for the Colorado delivery schedule could very well have been a "practicable" decision, reflecting the exigencies of the Compact negotiation. As discussed above and in Opinion I of my expert report (pp. 3-43), in apportioning the waters of the Rio Grande equitably, the purpose of the 1938 Rio Grande Compact was to enable new water projects above Elephant Butte while protecting the water supply of the federal Rio Grande Project below the reservoir. The *JIR*'s 1937 analysis of stream flow above Lobatos under then-present conditions focused on the period 1927 to 1935 and provided Tipton with the data necessary to make the case for Colorado. As negotiations continued among the engineers, he shifted that period of record to 1928 to 1937 and there is little in the historical record to counter the conclusion that Tipton's fellow engineers rejected his use of this timeframe for establishing Colorado's delivery schedule. For them, as suggested by Hill's December 24, 1937 telegram to Clayton, it was "acceptable," and as indicated in Tipton's February 1938 *Analysis*, it "represented present conditions" for Colorado.

Use of a period of record "prior to 1930" for the New Mexico delivery schedule was line with Hill's stated understanding of the commissioners' direction to their engineering advisors and may have been a "practicable" decision of its own that "represented present conditions." This schedule seemingly balanced the two competing water projects within New Mexico: the Middle Rio Grande Conservancy District and the federal Rio Grande Project. MRGCD, as discussed in my expert report (pp. 16), was organized in 1925 and by the mid-1930s, was seen by Texas as a threat to the Rio Grande water supply below Elephant Butte.[131] As also noted in my expert report (pp.

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[130] Hill, "Development of the Rio Grande Compact of 1938," 23.

[131] See State of New Mexico, County of Bernalillo, In the District Court, In the Matter of the Middle Rio Grande Conservancy District, No. 14157, First Report of the Board of Directors, G.E. Cook, President, Ramon Baca y Chavez, Director, Robert E. Dietz, Director, E.G. Watson, Secretary. Dated at Albuquerque, New Mexico, August 27th, 1926, 2-5, and 13. ff. 222. Rio Grande Basin Irrigation Districts Middle Rio Grande Transfer Case Thru 1929, Box 928 Rio Grande Basin-Lower Rio Grande 301.- -545., Middle Rio Grande 222.- -223., Entry 7, RG 115, NARA Denver; *Supreme Court of the United States, October Term 1936, No. 12 Original, State of Texas vs. State of New Mexico, et al., Ad Interim Report of the Special Master*, received Mar. 26, 1937, 4-5. ff. RG 267, Entry 26, TX v NM #10, Box 401 1939 to 1939 PI 139, Entry

24-25), prior to the engineering advisors' meetings, McClure insisted that the district's development be protected in a compact, and Neuffer's subsequent objections to the Otowi-Elephant Butte relation (reiterated by McClure) and his later inclusion in the engineering advisors' meetings is further evidence of New Mexico's interest in supporting its Middle Valley.[132]

Texas negotiators nevertheless insisted that the Rio Grande Project water supply, which served lands in New Mexico and Texas, be safeguarded and the resulting schedule aimed to do that without preventing development of lands above Elephant Butte. The *JIR*'s streamflow analysis of the Otowi Bridge-San Marcial relation, as discussed above, had focused on the period from 1890 to 1935. Although available records for both stations only went back to 1895, federal investigators had extrapolated a relationship back to 1890 and had concluded that that little had changed in water consumption within this part of the Upper Rio Grande Basin since then (except for "variations in the water supply"). Yet, those engineers had also been unable to determine the impact of MRGCD's works on the Rio Grande between 1930 and 1935. Adopting a timeframe prior to the advent of the district's operations would appear to side-step the issue, preserving a water supply condition as of 1929 when the temporary compact took effect. While this might have left to New Mexico and Middle Rio Grande Conservancy District the challenge of demonstrating that the district would not diminish the river's flow and harm the Rio Grande Project, it may also have insured that the federal project would not obtain any more water that a longer period of record, or a more recent one, based on a different relationship (Otowi-Elephant Butte) might provide. This historical interpretation would further tend to support the finding in the Special Master's *First Interim Report* (pp. 197-198) that

> New Mexico's duties to relinquish control of the water at Elephant Butte and *to refrain from post-Compact depletions of water below Elephant Butte* [emphasis added] do not arise from any implied covenant or implied term, but from the very meaning of the text of the Compact.

In conclusion, in my expert opinion as a historian, available historical evidence indicates that the engineering advisors responsible for developing the technical basis for the 1938 Rio Grande Compact used two different periods of record for the Compact's delivery schedules: the period 1928 to 1937 for Colorado's delivery to New Mexico, and the period "prior to 1930," or approximately 1890 to 1929, for New Mexico's delivery to Texas. This evidence further suggests that these schedules were based on streamflow analyses of Rio Grande and tributary flow at key

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26, Original Jurisdiction Case Files, 1792-2005, Records of the Supreme Court of the United States, Record Group 267, National Archives Building, Washington, DC; and Littlefield, *Conflict on the Rio Grande*, 198-199.

[132] For McClure's statement in support of MRGCD, see Proceedings of the Meeting of the Rio Grande Compact Commission...September 27, to October 1, 1937, 12. Untitled folder 5, Box 2F463, RGCC-FBCP, UTA.

stations within the Upper Rio Grande Basin made by the federal Rio Grande Joint Investigation. These schedules were intended to reflect then-present conditions of water use within the San Luis Valley in Colorado and the Middle Valley in New Mexico for their respective time periods – thus providing an equitable apportionment of the waters of the Rio Grande that would permit new water developments within the basin without compromising the water supply of the existing Rio Grande Project.