APPENDIX 4

CRAIG BOROUGH'S MEMORANDUM SUBJECT: ESTIMATION OF DECEMBER 31, 2011, CONDITIONS TO USE AS INITIAL CONDITIONS FOR UPDATED URGWOM SIMULATIONS FOR RECLAMATION'S WATER OPERATIONS BIOLOGICAL ASSESSMENT DATED DECEMBER 15, 2011

Memorandum

To: Warren Sharp Reclamation –Albuquerque

CC: URGWOM Technical Team

From: Craig Boroughs

Date: December 15, 2011

Re: Estimation of December 31, 2011 Conditions to Use as Initial Conditions for Updated URGWOM Simulations for Reclamation's Water Operations Biological Assessment

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Introduction

Initial condition information is needed for modeling of river system operations for development of the Bureau of Reclamation's (Reclamation) Middle Rio Grande Water Operations Biological Assessment (BA) using an updated planning module of the Upper Rio Grande Water Operations Model (URGWOM). Initial conditions were developed to reflect expected conditions on December 31, 2011 to represent the latest and best information on starting conditions for the 10-year planning model runs. Estimated initial conditions are based on recent information regarding the current status of storage in the reservoirs in the basin and the account status as reflected in the Accounting Model maintained by Reclamation. The December 31, 2011 conditions were developed based on several basic assumptions for the movement of water and accounting adjustments expected before the end of the year as documented below. It is emphasized that the resulting estimated storage levels for December 31, 2011 will not match the actual storage levels on that date but represent reasonable and clean starting conditions that are adequate for planning model runs.

Approach for Estimating December 31, 2011 Conditions

Initial conditions needed to complete URGWOM runs include initial values for numerous series such as reservoir storage levels and the storage for all the individual storage accounts at each reservoir including the Compact credit at Elephant Butte Reservoir. Initial values are also needed for incidental content, carryover storage, and reservoir sedimentation at Abiquiu Reservoir, Cochiti Lake, and Jemez Reservoir. Values are needed for initial reach flows, total reservoir releases, and releases of native Rio Grande flow; although, it should be emphasized that initial river flows needed to start calculations in the model actually have little impact on the model results as long as the values are reasonable.

Storage conditions on December 31, 2011 were estimated starting with actual values for total reservoir storage and account storage on November 21, 2011. Refer to Table 1 for the actual November 21, 2011 values which include storage for the different accounts for San Juan-Chama Project water at Heron Reservoir along with the common pool for San Juan-Chama Project water

(Note that data errors for the gaged flows in the Low Flow Conveyance Channel at San Marcial and the pool elevation at Elephant Butte Reservoir on October 25th were corrected in the provided Accounting Model prior to evaluating conditions at Elephant Butte Reservoir). Storage of San Juan-Chama Project water in allocated space at El Vado and Abiquiu Reservoirs for Albuquerque, MRGCD, and the Combined account is also needed where the Combined account includes storage for all contractors other than Albuquerque, MRGCD, or the Cochiti Recreation Pool. Storage of Reclamation's leased San Juan-Chama Project water is included. Storage must also be input for the NMISC and Jemez Sediment Pool accounts which are not used. Storage of native Rio Grande water at each reservoir is included along with storage of Emergency Drought water from relinquished Compact credits as represented with the MRGCD Drought and Supplemental ESA accounts at El Vado Reservoir. Storage of Prior and Paramount (P&P) water at El Vado is represented by the Indian Storage account. Conservation storage at Abiquiu, Cochiti, or Jemez Reservoirs is set to zero. An initial estimate for the Compact credit at Elephant Butte Reservoir is also included. Storage of Albuquerque and Santa Fe San Juan-Chama Project water at Elephant Butte Reservoir along with Colorado credit water is input as an initial condition to assure initial account storage adds up correctly at Elephant Butte Reservoir.

Table 1. Actual November 21, 2011 Total and Account Storage Levels and Incidental, Carryover, and Sediment Contents

Account	Heron	El Vado	Abiquiu	Cochiti	Jemez	Elephant Butte
TOTAL	237,132	97,834	180,042	51,748	0	226,557
San Juan-Chama Project Water:						
Federal Pool	150,682	---	---	---	---	---
Albuquerque	48,200	0	166,735	---	---	30,787
MRGCD	13,966	65,360	1100	---	---	---
Combined	20,601	0	2386	---	---	19,103
Cochiti Rec Pool	2783	---	---	45,319	---	---
Reclamation	0	111	6198	---	---	---
NMISC	---	---	0	---	---	---
Jemez Sediment Pool	---	---	---	---	0	---
Native Rio Grande Water:						
Rio Grande	900	0	-125	540	-1114	52,356
Indian Storage	---	13,168	---	---	---	---
MRGCD Drought	---	0	---	---	---	---
Supplemental ESA	---	19,196	---	---	---	---
Rio Grande Conservation	---	---	0	0	0	---
NM Credit	---	---	---	---	---	123,151*
CO Credit	---	---	---	---	---	1160*
Incidental Content	---	---	-125	540	-1114	---
Carryover Content	---	---	0	0	0	---
Sed Deposition	---	---	3748	5889	1114	---
Total storage at Caballo Reservoir is 11,093 acre-ft.						

* Compact credits prior to the end of the year for New Mexico and Colorado are actually 164,700 and 1600 acre-ft, respectively, but the reported values in the Accounting Model for November 21, 2011 reflect daily evaporation losses for the year based on the accounting method in the model.

Adjustments were made to the November 21, 2011 storage levels to reflect expected movement of water and accounting adjustments to be completed by December 31, 2011. Adjustments were made for all the assumed remaining actions listed in Table 2 and discussed further in the separate sections below. All other potential reservoir inflows and outflows were neglected for the remainder of the year as these inflows and outflows are expected to be smaller and partially offsetting. Evaporation, precipitation, and sedimentation effects at the reservoirs for the remainder of the year were also neglected.

Table 2. Assumptions for Actions before December 31, 2011 Reflected by Adjustments to the November 21, 2011 Conditions to Estimate December 31, 2011 Conditions

#	Assumed Actions
1	Movement of MRGCD Water from Heron Reservoir to El Vado Reservoir
2	Movement of Cochiti Rec Pool Water at Heron Reservoir to Cochiti Lake
3	End-of-year Rio Grande Adjustment at Heron Reservoir for Evaporation and Recreation
4	P&P Storage Evacuated from El Vado Reservoir
5	Movement of Reclamation's Leased Water at El Vado Reservoir to Abiquiu Reservoir
6	Reclamation Lease of Albuquerque Water at Abiquiu Reservoir
7	Delivery of Albuquerque Water to Surface Water Diversion
8	Delivery of Combined Account Water to the Buckman Direct Diversion
9	Delivery of Albuquerque Account Letter Water
10	Rio Grande Storage at Abiquiu and Cochiti Returned to Zero
11	End-of-Year Compact Credit Adjustment at Elephant Butte Reservoir
12	Additional Storage of Rio Grande Inflows to Elephant Butte Reservoir

1. Movement of MRGCD Water from Heron Reservoir to El Vado Reservoir

It is assumed that MRGCD San Juan-Chama Project water at Heron Reservoir on November 21st would be moved to El Vado Reservoir prior to December 31st, so estimated storage of MRGCD San Juan-Chama Project water at Heron Reservoir on December 31st is set to zero (with the total reservoir storage adjusted accordingly) and storage in the MRGCD San Juan-Chama account at El Vado is set to 79,326 acre-ft to include the additional 13,966 acre-ft of water in Heron. Total storage at El Vado Reservoir is also adjusted accordingly. The San Juan-Chama loss rate between Heron Reservoir and El Vado Reservoir is zero, so no loss is applied for this transfer.

2. Movement of Cochiti Rec Pool Water at Heron Reservoir to Cochiti Lake

It is assumed the 2783 acre-ft of Cochiti Rec Pool water at Heron Reservoir on November 21st would be moved to Cochiti Lake by the end of the year, so the estimated storage of Cochiti Rec Pool water at Heron Reservoir on December 31, 2011 was set to zero (with the total storage at Heron Reservoir adjusted accordingly), and the amount of Cochiti Rec Pool water at Cochiti Lake was increased from 45,319 acre-ft to 48,037 for the additional water from Heron minus a loss based on the 2.33 percent San Juan-Chama loss rate between Heron Reservoir and Cochiti Lake.

3. End-of-year Rio Grande Adjustment at Heron Reservoir for Evaporation and Recreation

An end-of-year accounting adjustment is made to transfer Rio Grande water to the Federal pool to offset for the impacts of Rio Grande storage on evaporation losses of San Juan-Chama Project water along with recreation considerations. This adjustment entails a transfer of 350 acre-ft from the Rio Grande account to the Federal pool, so implementing this adjustment entails adjusting the November 21, 2011 Rio Grande storage to zero and increasing the Federal San Juan account storage by 350 acre-ft. Note that it is also assumed that additional Rio Grande water in storage on November 21 would be evacuated from Heron Reservoir and also bypassed at El Vado Dam due to Article VII being in effect.

4. P&P Storage Evacuated from El Vado Reservoir

It is assumed that water remaining in the Indian Storage account, representing remaining P&P storage, will be fully evacuated from El Vado Reservoir by December 31, 2011, so the storage in the Indian Storage account was set to zero. Since P&P water was stored when storage restrictions per Article VII of the Compact were in effect, the water is evacuated as opposed to being transferred to the Rio Grande account.

5. Movement of Reclamation's Leased Water at El Vado Reservoir to Abiquiu Reservoir

It is assumed that Reclamation's 111 acre-ft of leased San Juan-Chama Project water in storage at El Vado Reservoir would be moved to Abiquiu Reservoir by the end of the year as this water would be moved when convenient and as space at Abiquiu Reservoir becomes available, so the storage in the Reclamation account at El Vado Reservoir was decreased to zero (with the total El Vado Reservoir storage adjusted accordingly), and the storage in the Reclamation account at Abiquiu Reservoir was increased accordingly, considering San Juan-Chama losses between El Vado Reservoir and Abiquiu Reservoir.

6. Reclamation Lease of Albuquerque Water at Abiquiu Reservoir

It is assumed that a Reclamation lease of 10,000 acre-ft from Albuquerque will occur before the end of the year and is reflected as a transfer from the Albuquerque account to the Reclamation account at Abiquiu Reservoir (Donnelly, 2011). Albuquerque storage at Abiquiu on November 21st is decreased by 10,000 acre-ft for this transaction, and Reclamation's account storage is increased by 10,000 acre-ft. Note that the pending leases of approximately 12,000 acre-ft by Reclamation of contractor water in storage at Heron Reservoir, known as an initial condition, will actually be modeled during the first year of simulation.

7. Delivery of Albuquerque Water to Surface Water Diversion

It is assumed that water will continue to be delivered to the Albuquerque surface water diversion for the remainder of the calendar year. The daily release of Albuquerque San Juan-Chama Project water from Abiquiu on November 21, 2011 was 32 cfs, and this release rate is assumed for the remainder of the year (Kandl, 2011). The storage in the Albuquerque account at Abiquiu

Reservoir is thus reduced by the resulting release volume of 2539 acre-ft to estimate a December 31, 2011 storage level.

8. Delivery of Combined Account Water to the Buckman Direct Diversion

It is assumed that Santa Fe water will continue to be delivered to the Buckman Direct Diversion at a rate of 5.59 cfs for the remainder of the calendar year (Kandl, 2011). The storage in the Combined account at Abiquiu Reservoir is reduced by the resulting release volume of 444 acre-ft for estimating the December 31, 2011 storage level.

9. Delivery of Albuquerque Account Letter Water

It is estimated that a letter water delivery prior to the end of the year will occur at Elephant Butte Reservoir as a transfer of 1300 acre-ft of San Juan-Chama Project water from the Albuquerque account to the Rio Grande account. To reflect this pending transfer, the storage in the Albuquerque account was decreased by 1300 acre-ft. Note that a final estimated storage for the Rio Grande account at Elephant Butte Reservoir was set to an estimated value that also reflects an end-of-year Compact credit adjustment and estimated inflows for the remainder of 2011.

10. Rio Grande Storage at Abiquiu and Cochiti Returned to Zero

Storage levels of Rio Grande water at Abiquiu Reservoir and Cochiti Lake were reset from -125 and 540 acre-ft, respectively, to zero. It is assumed that operations would be conducted to correct for the incidental content apparent on November 21, 2011 to return to zero Rio Grande storage at both Abiquiu and Cochiti on December 31, 2011. Total storage at each reservoir was adjusted accordingly.

11. End-of-Year Compact Credit Adjustment at Elephant Butte Reservoir

The Compact credit as tracked with the NMCredit account at Elephant Butte Reservoir was adjusted for the end-of-year annual Compact calculations and the impacts of evaporation resulting in a new estimated total Compact credit of 65,000 acre-ft. The Colorado credit was also adjusted to 2000 acre-ft.

12. Additional Storage of Rio Grande Inflows to Elephant Butte Reservoir

It is assumed that additional storage of native Rio Grande inflows to Elephant Butte Reservoir plus the end-of-year Compact credit adjustment and the letter water transfer from the Albuquerque account will yield a storage of 164,410 acre-ft of native Rio Grande water at the end of the year resulting in a total Elephant Butte Reservoir storage of 280,000 acre-ft.

Resulting Estimated December 31, 2011 Conditions

Reservoir and Account Storage Levels

Resulting estimated conditions for December 31, 2011 are presented in Table 3. Areas with gray shading are unchanged from the referenced November 21, 2011 conditions. Values in blue bold font were increased as a result of the aforementioned adjustments, and values in the red italics font were reduced with the changes.

Note that initial allocations for storage of Emergency Drought water for MRGCD and ESA include water already in storage of 0 and 19,196 acre-ft, respectively, plus additional unused allocations from previous Relinquished Compact credits. The estimated unused allocations for December 31, 2011 are 50,500 acre-ft for MRGCD and 19,500 acre-ft for ESA. Additional Emergency Drought water will be stored during the Planning Model runs up to the unused allocation amount. The resulting total initial allocations will be set in the model to 50,500 acre-ft and 38,696 acre-ft to include both Emergency Drought water already in storage and the unused allocations.

Initial values for all Account Accruals and Gain Losses are all set to zero. The initial tallies for the cumulative Cochiti Rec Pool release from Heron Dam and account fill releases as needed to start calculations are set to zero. Heron waiver balances are set on January 1st during the simulation to the input storage values for the individual accounts at Heron Reservoir for December 31st.

Table 3. Estimated December 31, 2011 Total and Account Storage Levels and Incidental, Carryover, and Sediment Contents

Account	Heron	El Vado	Abiquiu	Cochiti	Jemez	Elephant Butte
TOTAL	*219,833*	**98,522**	*177,294*	**53,926**	0	**280,000**
San Juan-Chama Project Water:						
Federal Pool	**151,032**	---	---	---	---	---
Albuquerque	48,200	0	*154,196*	---	---	*29,487*
MRGCD	*0*	**79,326**	1100	---	---	---
Combined	20601	0	*1942*	---	---	19,103
Cochiti Rec Pool	*0*	---	---	**48,037**	---	---
Reclamation	0	*0*	**16308**	---	---	---
NMISC	---	---	0	---	---	---
Jemez Sediment Pool	---	---	---	---	0	---
Native Rio Grande Water:						
Rio Grande	*0*	0	**0**	*0*	-1114	**164,410**
Indian Storage	---	*0*	---	---	---	---
MRGCD Drought	---	0	---	---	---	---
Supplemental ESA	---	19,196	---	---	---	---
Rio Grande Conservation	---	---	0	0	0	---
NM Credit	---	---	---	---	---	**65,000**
CO Credit	---	---	---	---	---	**2000**
Incidental Content	---	---	**0**	*0*	-1114	---
Carryover Content	---	---	0	0	0	---
Sed Deposition	---	---	3748	5889	1114	---
Total storage at Caballo Reservoir is 11,093 acre-ft.						

Initial River Flows

Initial total reservoir outflows are required for each dam along with the outflow of native Rio Grande water at El Vado, Abiquiu, and Cochiti dams (Refer to Table 4 for the estimated initial reservoir outflows). Initial flows at gage sites and reach inflows are also required. Estimated values for December 31, 2011 are presented in Table 5. All assumed initial flows are typical values for December 31st and based on the historical average for December 31st for most locations. The initial flow values have little impact on the Planning Model results but are simply required to start a simulation.

Initial values for the accounting supplies for the release of water from the Indian Storage, MRGCD Drought, and Supplemental ESA accounts at El Vado Reservoir downstream are set to zero. Initial inflows needed for the following locations within MRGCD's system or on the Low Flow Conveyance Channel are all set to zero: Central East Side Lag, Isleta to Bernardo East Side Lag, Isleta to Bernardo West Side Lag, Drain Unit 7 Return, San Acacia to San Marcial Low Flow Time Lag, and San Acacia to San Marcial Canal Time Lag.

Table 4. Estimated Initial Reservoir Outflows

Reservoir	Rio Grande Outflow (cfs)	Total Outflow (cfs)
Heron	---	---
El Vado	100	100
Abiquiu	110	148
Cochiti	600	600
Jemez	---	27
Elephant Butte [1]	---	17
Caballo [2]	---	2

[1] Same total outflow from Elephant Butte Dam for December 30th and 31st.
[2] Same total outflow from Caballo Dam for December 24th through 31st.

Table 5. Estimated Initial Gage and Reach Inflows

Reach (or Gage)	Inflow (cfs)
Lobatos	200
Cerro to Taos[1]	297
Embudo to Confluence	512
Below Abiquiu to Chamita	210
Otowi to Cochiti	828
Cochiti to Central	821
Central to Bernardo	895
Bernardo to San Marcial	712
San Marcial to Elephant Butte	884
Leasburg to Mesilla	2
Mesilla to El Paso	2

[1] Value needed for 12/30 for the Cerro to Taos reach also set to 293 cfs

Initial Values for Shallow Aquifer Groundwater Levels

Initial groundwater storage levels for all the groundwater objects in the Middle Valley portion of the model were identified separately by the URGWOM Technical Team based on equilibrium conditions from completed calibration runs. The initial values are unchanged from the initial conditions used for other previous simulations completed with the planning module of URGWOM.

References

Donnelly, Carolyn. 2011. Personal Communication. Bureau of Reclamation. Albuquerque, New Mexico.

Kandl, Ed. 2011. Personal Communication. Bureau of Reclamation. Albuquerque, New Mexico.