

ANALYSIS OF IMPACTS OF REQUESTED NAVAJO-GALLUP DEPLETION GUARANTEE REVISION IN THE SAN JUAN BASIN HYDROLOGY MODEL

BACKGROUND

The Depletion Guarantee is a commitment by the Navajo Nation that ensures that the depletions for its uses under the NGWSP will be offset by unused Navajo Nation depletions in the San Juan Basin, including forbearance of its uses on the Navajo Indian Irrigation Project as necessary, if and when required to keep the total of the depletions in the basin from exceeding the threshold described herein. –NGWSP BO, pg 12.

The **Depletion Guarantee** (DG) was defined in the *Final Biological Opinion for the Navajo-Gallup Water Supply Project* (NGWSP “BO”, February 2009) and was incorporated and accepted through the *Navajo-Gallup Water Supply Project Planning Report and Final Environmental Impact Statement* (“FEIS”, July 2009) and Reclamation’s associated *Record of Decision* (“ROD”, September 2009). Links to these documents are included at the end of this report.

In FY2019, the NMISC requested meetings with Reclamation to better understand the implementation of the DG in the SJRIP Riverware model. Based on their review, the NMISC believes the modeling method used in the current version (“Gen 4”) of the San Juan Basin Hydrology Model (SJBHM) is inconsistent with the Navajo Nation’s DG commitment. It is the NMISC’s position that in the manner currently implemented, “The Gen 4 model relies on the Depletion Guarantee against new depletions that were not accounted for in the Gen 2 model. This would mean additional development could occur at the expense of the Navajo Nation.” Thus, NMISC has requested that the consideration for the DG be removed from the SJBHM and the Baseline Demands scenario.

SUMMARY OF DEPLETION GUARANTEE CONDITIONS AND REQUIREMENTS

The DG is defined on page 12 of the NGWSP BO, and it is recommended that its definition, conditions, and requirements be reviewed thoroughly for proper context and due to its various intricacies and references, including to tables and numbers presented in the BO.

In summary, the DG can require reductions in the total Navajo Nation depletions in the basin of up to 20,782 acre-feet/year (afy) to accommodate the NGWSP if and when the sum of the basin’s depletions reach the “depletion threshold” as defined in the BO. Based on the SJBHM Baseline definition and modeling at the time of the BO (in 2009), the depletion threshold was determined to be an average annual depletion of 752,127 acre-feet.

However, it is important to note that definition of the sum of depletions used by the BO is quite convoluted and is not the basin’s total depletion but is the sum of the uses listed in Table 5 of the BO. Furthermore, it excludes the San-Juan Chama Project (SJC) depletions from this sum on an average annual basis (which is thus directly dependent on the period of record used) rather than each year’s actual SJC export. Also, importantly, the BO provides that the quantification of the depletion threshold

will be recomputed at the time that it is actually reached in the basin and when the DG would have to be implemented.

In addition to these convolutions there are various other open questions regarding the specific depletions included in the sum, the potential for a variable depletion threshold quantification, and the manner in which the DG would be actually implemented and administered (recognizing that the basin's annual depletions can vary significantly from year-to-year based on hydrologic and other conditions, once the threshold is reached for the first time, does it remain in effect into the future even if the annual depletions in some future years might be lower than the threshold? How well can a year's depletion actually be known or estimated ahead of time in order to implement the DG that year, or would adjustments have to be made to the next year's depletions?)

These various factors and questions could make the implementation of the DG quite difficult, both in the real world and in the model.

CURRENT IMPLEMENTATION OF DG IN THE SJBHM

For SJBHM baseline modeling purposes, under the SJBHM Baseline demands scenario, it is currently assumed that the depletion threshold has been reached and that the maximum Depletion Guarantee reduction in Navajo Nation water use is in effect during all model years. This assumption appears to have been in effect since at least the later Gen 3 version of the model.

For SJBHM modeling purposes, it is further assumed that the DG reduction requirement would be applied solely to NIIP, which gives to an average annual NIIP depletion demand of 249,218 afy (equals the full NIIP depletion demand of 270,000 afy minus the DG reduction requirement of 20,782 afy). Additionally, the NGWSP depletion demand is at its full level of 35,893 afy.

As applied, these assumptions make the quantification procedure and value of the DG depletion threshold irrelevant, as well as many of the other convolutions and questions associated with the DG.

This assumption has been made based on the fact that the annual average baseline depletions are greater than the depletion threshold. The current baseline scenario average annual depletion is ~778,788 afy (adjusted for the average annual SJC depletion) over the 84-year period, with 50 years having annual depletions greater than the BO's depletion threshold of 752,127 afy, and 34 years having lower annual depletions.

However, as the NMISC has pointed out, the model does in fact now contain some depletions from water uses that were not included in the hydrologic baseline at the time of the NGWSP BO/EIS and are not stated in Table 5 of the BO, and thus should not necessarily be included in the sum of the basin's annual depletions used to trigger the DG. Specifically, the "new" water uses present in the model are the future "tribal reserved" water rights associated with tribal settlements, and of which the majority are simulated within the San Juan StateMod part of the SJBHM. It should be noted that there is a StateMod scenario available that has these tribal reserved demands turned off (the "San Juan StateMod Baseline without Tribal Reserved" scenario).

REVISION REQUESTED AND MODEL ANALYSIS/COMPARISON OVERVIEW

Following review and discussion of potential ways to correct the identified inconsistencies associated with the implementation of the DG in the SJBHM, the NMISC has requested that the implementation of the DG simply be removed from the model. This request is in place of more complicated and unclear ways of addressing the issue that would inevitably necessitate revisiting the definition, conditions, and/or requirements associated with the DG as defined in the BO. The implementation of the requested revision in the model is described below.

In order to support and inform the SJRIP's decision-making on this matter, a simple comparison of model results was made between model runs simulating the following two scenarios:

- “Existing” SJBHM Baseline Depletions Scenario: **“NIIPwDG+NGWSP”**
 - “NIIP with DG reduction”, average annual depletion demand = 249,218 afy
 - NGWSP average annual depletion = 35,893 afy
- “Revised” SJBHM Baseline Depletions Scenario: **“FullNIIP+NGWSP”**
 - “Full NIIP”, average annual depletion demand = 270,000 afy
 - NGWSP average annual depletion = 35,893 afy

Note that the NGWSP demands are the same in each scenario but shown here for clarity. All other demands are also identical between scenarios, although the resulting depletions based on those demands may vary if the changes to the NIIP demands lead to differences in simulated shortages. Both runs also use the 2017 “Interim Flow Recommendations” (aka “Run C”) SJRIP Spring Peak Release Hydrograph procedures.

MODEL CHANGES NEEDED TO REMOVE DEPLETION GUARANTEE

The revision requested by NMISC would require the SJBHM Baseline Demand scenario to be adjusted such that the DG is never in effect. This model change is straightforward and efficient to make and run. This is largely due to recent enhancements and updates to the SJRIP RiverWare model's procedures and abilities that allow the model to be significantly more flexible regarding inputting and altering demand levels of various water users.

In order to remove the representation of the DG in the model and Baseline Demands Scenario, the NIIP annual depletion demand can be set at the full 270,000 afy and the NGWSP demands set to their full annual depletion demand of 35,893 af (i.e., the NGWSP demand remains the same). This change results in an overall increase in simulated demands of 20,782 afy, the amount of the DG reduction.

SUMMARY OF SIMULATED IMPACTS OF REQUESTED REVISION

Tables 1 through 4 below summarize the simulated impacts of the requested revision on the model results. The results are consistent with the magnitude and type of change made. Notable results include:

- The average annual total basin depletion increases by 19,400 afy due to the revision. This increase is slightly lower than DG amount of 20,782 AFY due to increased shortages. (Table 1)

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- The average annual total Navajo Reservoir outflow decreases by 23,400 afy due to the revision, while the average annual flow of the San Juan at Bluff decreases by 18,000 afy. (Table 1)
- The number of years with simulated shortages increases from 1 to 4 due to the revision. The 2003 shortage percentage increases from 45% to 60%. One of the added shortage years (2004) has a shortage percentage of 4%, while two of the years (1956 and 2002) have minor shortages of ~1%. (Table 1)
- The annual average SPR "Peak" length decreases from 62 to 59 days. (Table 2)
- The average Navajo Reservoir pool elevation decreases from 6054.2 to 6053.0 ft. (Table 2)
- With the revision, the maximum years between meeting the 10 day at 8,000 cfs flow target increases from 7 to 8. However, the maximum span recommendation is 6 which is already not met without the revision. There are no other impacts to the max years between targets performance. (Table 3)
- While there are impacts to the percentage of years meeting flow recommendation targets, there is not a change in pass/fail performance of any of the 4 primary targets (although 2 of the 4 primary targets are not met before the revision). There is one secondary flow recommendation target, 1 day at or above 8,000 cfs, that moves from pass to fail due to the revision. This changes from 41% of years met to 39% of years met where the target is 40%. (Table 4)

Table 1: Summary of Simulated Impacts to Select Depletion Categories, Flows, and Shortages.

Depletion Category	Simulated Average Annual Depletion ¹ , af		Change, af
	NIIP w/ DG ² and NGWSP	Full NIIP and NGWSP	
Total NM Depletions	448,240	467,640	19,400
Total NM Irrigation Depletions	352,000	371,700	19,700
<i>NIIP</i>	247,600	267,500	19,900
<i>Navajo Subtotal</i>	276,700	296,500	19,800
Total NM Non-Irrigation Depletion	96,240	95,940	-300
Total CO Depletions (without McElmo)	283,700	283,700	0
<i>Total CO Depletions Abv Navajo</i>	180,000	180,000	0
<i>Total CO Depletions from Tribs blw Navajo</i>	103,700	103,700	0
Total Other Project Depletions	203,000	202,800	-200
<i>Navajo Gallup WSP</i>	35,700	35,600	-100
Basin Total Depletion³	884,000	903,400	19,400
Flow Category	Simulated Average Annual Flow Volume, af		Change, af
Navajo Reservoir Outflow	529,900	506,500	-23,400
San Juan at Bluff Flow	1,118,300	1,100,300	-18,000
			Annualized Change ⁴ , af
<i>Model Run Ending Navajo Storage</i>	<i>920,500</i>	<i>810,100</i>	<i>-1,400</i>
Number of Shortage Years	1	4	
Shortage Years and %'s		1956 (1%)	
		2002 (1%)	
	2003 (45%)	2003 (60%)	
		2004 (4%)	
1: Including shortage years 2: Depletion Guarantee Volume = 20,782 af 3: Including offstream depletions 4: The annualized change in ending Navajo storage is shown to complete the overall mass-balance.			

Table 2: Summary of Impacts to General Flow Recommendation Performance Statistics

General Statistics			
Run Scenario	NIIP w/ DG and NGWSP	Full NIIP and NGWSP	Change
Average SPR Frequency (years)	2.5	2.6	0.1
Average SPR "Peak" Length (days)	62	59	-2.5
Average Days/Year > 2500 at Four Corners	43.5	41.9	-1.6
Average Days/Year > 5000 at Four Corners	29.6	27.8	-1.8
Average Days/Year > 8000 at Four Corners	14.9	14.3	-0.6
Average Days/Year > 10000 at Four Corners	4.4	4.4	0.0
Number of Shortage Sharing Years	1	4	3
Average Navajo Reservoir PE (ft)	6054.2	6053.0	-1.2

Table 3: Impacts to Maximum Years between Flow Recommendation Targets Made

Target Flow (cfs)	Max Years between Targets				
	Days at Flow Target	1999 Flow Rec Target Max	NIIP w/ DG and NGWSP	Full NIIP and NGWSP	Change
10000	5	10	14	14	0
8000	10	6	7	8	1
5000	20	4	7	7	0
2500	10	2	3	3	0

Table 4: Impacts to Percentage of Years Meeting or Exceeding Flow Duration Targets.

1999 Flow Recommendation Targets (Main Targets in Grey)					
Target Percentage of Years Meeting Flow Duration Target					
Duration (days)	Flow				
	>10,000 cfs	>8,000 cfs	>5,000 cfs	>2,500 cfs	
1	30%	40%	65%	90%	
5	20%	35%	60%	82%	
10	10%	33%	58%	80%	
15	5%	30%	55%	70%	
21		20%	50%	65%	
30		10%	40%	60%	
40			25%	50%	
50			20%	45%	
60			15%	40%	
80			5%	25%	
NIIP w/ DG and NGWSP					
1	27%	41%	45%	81%	Target exceeded (>+1%)
5	27%	40%	45%	78%	Target met (+-1 %)
10	20%	39%	44%	71%	Target not met (<-1%)
15	12%	34%	42%	67%	
21		32%	42%	59%	
30		26%	39%	49%	
40			38%	46%	
50			35%	41%	
60			29%	39%	
80			11%	22%	
Full NIIP and NGWSP					
1	26%	39%	44%	81%	Target exceeded (>+1%)
5	26%	38%	44%	78%	Target met (+-1 %)
10	21%	35%	42%	69%	Target not met (<-1%)
15	12%	32%	41%	67%	
21		31%	41%	56%	
30		26%	39%	49%	
40			34%	46%	
50			32%	40%	
60			26%	35%	
80			9%	22%	
Change, %					
1	-1%	-2%	-1%	0%	Change >+1%
5	-1%	-2%	-1%	0%	Minimal change (+-1 %)
10	1%	-4%	-1%	-1%	Change <-1%
15	0%	-2%	-1%	0%	
21		-1%	-1%	-2%	
30		0%	0%	0%	
40			-4%	0%	
50			-4%	-1%	
60			-4%	-4%	
80			-1%	0%	

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ADDITIONAL RESOURCES AND FULL MODEL RESULTS SUMMARY WORKBOOKS

The standard SJBHM Result workbooks (the “*Depletion Report*” and “*SJRIP Flow Recommendation Performance Report*” workbooks) for these model runs can be downloaded in a ZIP package by the following link. Please contact us if you have any issues accessing these files. The model files used for this analysis and saved with complete results are also available upon request.

<https://www.dropbox.com/s/yxuibvx14yj6hqk/NGDGRevisionRequestAnalysisResults.zip?dl=0>

The 2009 *Final Biological Opinion for the Navajo-Gallup Water Supply Project* is also included with the result workbooks above for convenience.

Additionally, the *Navajo-Gallup Water Supply Project Planning Report and Final Environmental Impact Statement* and supporting documents can be found through:

<https://www.usbr.gov/uc/envdocs/eis/navgallup/FEIS/index.html>