Rebuttal Report to Myers (2017)

PRESENTATION TO THE OFFICE OF THE NEVADA STATE ENGINEER

Prepared by

SOUTHERN NEVADA WATER AUTHORITY

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Rebuttal Report to Myers (2017)

Submitted to:
Jason King, P.E., State Engineer
State of Nevada
Department of Conservation & Natural Resources
Division of Water Resources
901 S. Stewart Street, Suite 2002
Carson City, Nevada 89701

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Prepared by:
Southern Nevada Water Authority
Water Resources Division
P.O. Box 99956
Las Vegas, Nevada 89193-9956

Andrew G. Burns, Water Resources Division Manager	8.9.17 Date
Warda Drici, Hydrologist	8/9/2017 Date
James P. Prieur, Sr. Hydrologist	8/9/17 Date
James M. Watrus, Sr. Hydrologist	8-9-2017 Date

Myers' report (2017) is entitled *Hydrogeology of Spring, Cave, Dry Lake and Delamar Valleys Impacts of Developing Southern Nevada Water Authority's Clark, Lincoln, and White Pine Counties Groundwater Development Project* and was prepared on behalf of White Pine County and the Great Basin Water Network et al. (GBWN). This rebuttal of Myers' report summarizes some of the major areas of Myers' unfounded criticism, followed by specific issues and deficiencies, which are addressed in the order in which they occur in his report.

Major Areas of Criticism

Myers' report (2017) was reviewed to evaluate GBWN's response to four specific issues identified by Senior Judge Estes of the Seventh Judicial District Court of Nevada (the Court), which were remanded to the Nevada State Engineer (NSE) for resolution. These four issues are listed below and are the sole subjects of the administrative hearing scheduled for September 25 through October 6, 2017 (NDWR, 2016):

1. *The addition of Millard and Juab counties, Utah in the mitigation plan so far as water basins in Utah are affected by pumping of water from Spring Valley Basin, Nevada;*

2. *A recalculation of water available for appropriation from Spring Valley assuring that the basin will reach equilibrium between discharge and recharge in a reasonable time;*

3. *Define standards, thresholds or triggers so that mitigation of unreasonable effects from pumping of water are neither arbitrary nor capricious in Spring Valley, Cave Valley, Dry Lake Valley and Delamar Valley, and;*

4. *Recalculate the appropriations from Cave Valley, Dry Lake and Delamar Valley to avoid over appropriations or conflicts with down-gradient, existing water rights.*

Myers (2017) fails to address the remand issues before the NSE, and instead compiles previous investigations regarding matters already settled by the NSE and the Court. Some of the main areas of Myers' unfounded criticism are as follows:

- Myers (2017) claims that SNWA's proposed pumping would not bring the flow systems into equilibrium, but he bases this conclusion on an outdated model not designed to present projections of evapotranspiration (ET) capture.

- Myers (2017) claims that the SNWA Groundwater Development Project (GDP) will harm springs located downgradient of GDP basins by impermissibly using the results of a regional model to assess potential effects on local features.

- Myers (2017) misinterprets the simulated effects on the Muddy River springs due to existing pumping in the basins located downgradient of Pahranagat Valley, as being due to SNWA GDP pumping.

- Myers (2017) criticizes the previous 3M plans for not having enough monitor wells and specific triggers, based upon his review of outdated information.

Myers (2017) Summary (p. 1-2) and Introduction (p. 3)

Myers (2017) relies upon a version of the Central Carbonate Rock Province (CCRP) numerical groundwater flow model that does not represent the NSE-adopted water budget for Spring Valley. Further, Myers (2017) presents two production scenarios that were analyzed by the U.S. Bureau of Land Management (BLM) in its Environmental Impact Statement (EIS), neither of which represent the volumes permitted by the NSE, and neither of which are the preferred alternatives chosen by the BLM in its Record of Decision.

Myers (2017) relies upon the unmodified Alternative F scenario that assumes SNWA groundwater production rates in Spring Valley are 28 percent greater than those awarded by the NSE in Ruling 6164 (NDWR, 2012a), and 6,349 and 549.05 afy more in Cave and Delamar valleys than granted in Rulings 6165 and 6167 (NDWR, 2012b and d), respectively. He does not disclose the fact that BLM chose the modified Alternative F as the preferred alternative, and that the modified Alternative F uses pumping amounts as permitted by the NSE.

Myers (2017) uses these results to assert that pumping the permitted volume will lead to groundwater mining and irreversible environmental damage. A fundamental concept excluded from Myers' portrayal of the GDP is the staged-development and adaptive management mandated by the NSE, coupled with approved monitoring, management, and mitigation plans that will ensure protection of senior rights and environmentally-sensitive areas. In any event, Myers' discussion on this subject is not related to the four remand issues. Myers' introduction and summary present no new useful information, and instead are a distraction from the actual decisions already made by the NSE and BLM.

Myers (2017) Method of Analysis (p. 3-33)

This section does not support or offer any additional information to address the four specific issues identified by the Court that are the subject of this remand hearing.

There is a great deal of discussion within this section of Myers' report on the recharge and discharge for Spring, Cave, Dry Lake, and Delamar valleys. In this section, Myers ignores the NSE's determination of the proper values to be used regarding recharge and discharge within these valleys and instead presents incomplete and outdated data. However, the NSE evaluated Myers' previous estimates during the 2011 hearing, as well as those presented by SNWA, and found that the values shown in Table 1 to be the most appropriate for use. These values were not set aside by the Court and therefore should remain the same.

Specific rebuttal comments for this section within the Myers report include:

1. Myers inappropriately reiterates the position he took in 2011 that the precipitation values chosen for Dry Lake Valley caused SNWA's recharge value to be too high (Myers, 2017, p. 26). This conclusion once again demonstrates his lack of understanding of the basic approach used to calculate recharge within Dry Lake and Delamar valleys. In the rulings for these basins (Rulings 6165, 6166, and 6167), the NSE dismissed Myers' premise when the NSE stated:

Table 1
Recharge and Discharge Values Adopted by the Nevada State Engineer

Valley	Recharge (afy)	Discharge (afy)
Spring[1]	84,000 to 96,000 (NSE Ruling 6164, p. 90)	84,100 (NSE Ruling 6164, p. 90)
Cave[2]	12,900 (NSE Ruling 6165, p. 73)	1,300 (NSE Ruling 6165, p. 76)
Dry Lake[3]	15,000 (NSE Ruling 6166, p. 73)	0 (NSE Ruling 6166, p. 75)
Delamar[4]	6,100 (NSE Ruling 6167, p. 73)	0 (NSE Ruling 6167, p. 75)

[1]NSE Ruling 6164 (NDWR, 2012a).
[2]NSE Ruling 6165 (NDWR, 2012b).
[3]NSE Ruling 6166 (NDWR, 2012c).
[4]NSE Ruling 6167 (NDWR, 2012d).

> *However, using the Applicant's method, over-estimating precipitation does not yield more recharge. As the Applicant pointed out, the total recharge for the WRFS was determined using the groundwater balance equation and was constrained or limited by estimates of groundwater ET and interbasin flow. Therefore, any over-estimation of precipitation does not yield a greater value for recharge in the WRFS as a whole* (NDWR, 2012d, p. 74).

2. Myers attempts to use statements made in Eakin (1963) to claim that development of water in upgradient basins will have a negative impact on the water rights and national wildlife refuge in Pahranagat Valley (Myers, 2017, p. 31). Myers' statement is misleading as he clearly takes the conditional statements made by Eakin (1963) and turns them into absolutes. Myers chooses the words "any development", while Eakin used "substantial development." It is also important to recognize that Eakin used additional conditional statements such as "in time", "might intercept", and "some of the supply." Eakin's words should not have lead Myers to conclude that development in Cave, Dry Lake, or Delamar valleys (DDC) will come at the expense of water rights and the national wildlife refuge in Pahranagat Valley.

   What Eakin (1963) was really stating was that with substantial development in the basins upgradient of Pahranagat Valley, there is the possibility that some of the water along the flow path to Pahranagat Valley might be intercepted, and with enough time could cause a decrease in the discharge within Pahranagat Valley. The only SNWA applications that could arguably be along this flow path are those located in Cave Valley, and it is likely that these waters support discharge in White River Valley instead of flowing to Pahranagat Valley. Based on this, it is not likely that Eakin's conditional statements about impacts in Pahranagat Valley will come to pass due to SNWA GDP pumping.

3. Myers attempts to use the 1985 NSE Ruling 3225 along with his misinterpretation of Eakin (1963) to state that no water rights should be granted upgradient of Crystal Springs (Myers, 2017, p. 31). When the details of NSE Ruling 3225 are reviewed it can be seen that this ruling applied to Application numbers 42688 and 43598, which were applications for underground water rights for irrigation. Application number 42688 was for the development of a well

approximately 500 ft from Crystal Springs while Application number 43598 was for the development of a well approximately 2,400 ft from Crystal Springs. The NSE denied these applications because their close proximity made it evident that they were directly connected to the springs, and pumping from these locations would have an immediate and direct impact on the flow from Crystal Springs. Since 1985, when this ruling was issued, the NSE has permitted additional applications in Pahranagat Valley as well as in upgradient basins. Ruling 3225 is not relevant in these proceedings because the SNWA applications are not located within mere feet, but rather are located approximately 17 miles away from Crystal Springs and SNWA has prepared plans to monitor, manage, and mitigate for the propagation of any effects (SNWA, 2017a and b).

Myers (2017) Perennial Yield (p. 33-36)

This section does not support or offer any additional information to address the four specific issues identified by the Court that are the subject of this remand hearing. This section contains information regarding possible definitions of perennial yield and Myers' own assessment of how these numbers may be difficult to determine.

Specific comments for this section include:

1. Myers believes it may be more appropriate to consider the perennial yield for a larger system of interconnected basins rather than looking at it on a basin by basin case (Myers, 2017, p. 33).

It would be difficult to make accurate administrative decisions regarding larger systems of interconnected basins as opposed to focusing on a single basin at a time, while still taking interbasin flow into account. While scientists may study these larger systems, and group similar basins together, precisely defining a system flow is not without major complexities that would cause difficulties for the NSE. While we can certainly infer that the recharge in a basin such as Pahranagat Valley could not support the entirety of the spring flow within the basin, the precise nature and source of these necessary additional interbasin flows are unknown. The types of information that are needed for this analysis include accurate volumes of recharge and discharge within basins, the identification of permissible flow paths, and the aquifer properties from the area of recharge along the entirety of the flow path. These items are all uncertain and the uncertainty only gets larger the more basins that are included within the flow system.

The problems inherent in flow system accounting are well illustrated by the Welch et al. (2008) study. In this study, Welch et al. (2008) calculated recharge values for the study area that were unconstrained by discharge. This method resulted in a substantially higher than normal recharge value for Steptoe Valley. When this higher than normal value for recharge was compared with a reasonable discharge, the result was a significant imbalance in the water budget for the valley. To solve this imbalance, Welch et al. (2008) defined new and unexpected flow paths to distribute these excess waters through the flow system, thus changing the definition of some previously defined flow systems. This problem has been widely recognized and more recent studies, such as Heilweil and Brooks (2011), have not placed much value in the flows calculated by Welch et al. (2008).

Given all of the complexities of flow system determination, it is generally more appropriate to administratively manage groundwater basins individually, while taking into account applicable interbasin flows.

2. Myers completely misrepresents the study and conclusions within the Meixner et al. (2016) paper (Myers, 2017, p. 35).

The Meixner et al. (2016) paper was a discussion on the complexities related to groundwater recharge and climate change with a call toward developing integrated models that could explore these complexities. Meixner et al. (2016) concluded, based upon their evaluation of the western states, that:

- The available information indicates that average declines of 10 to 20 percent in total recharge may occur across the southern aquifers. However, a wide range of uncertainty that includes no change is associated with these estimates.

- The northern aquifers will likely experience changes in total recharge ranging from little to slight increases.

Myers (2017) utilized the results of Meixner et al. (2016) even though their study area did not include the SNWA GDP basins. Myers inappropriately compared the results of two areas within the study and concluded because the basins that are the subject of this hearing lie between these areas, then the results must be similar. This assumption overly simplifies the analysis performed in the study, where a detailed analysis was undertaken to determine what types of recharge take place within each area, and what the changes will be in each area according to the downscaled climate models' predictions.

Lastly, climate change is something that all water users must adapt to, based upon data and accurate scientific predictions. As Meixner et al. (2016) points out, total recharge as a result of climate change may increase or decrease given the currently available information. Current climate change models suggest that within the area of SNWA's permits, mean temperatures are expected to rise, and annual precipitation is likely to remain similar to present conditions as the century progresses (Redmond, 2009). However, there is insufficient information available to predict how changes in climate would affect the rate of groundwater recharge in the region.

The issuance of water rights should not be limited based upon speculation. Water rights should be granted or denied based on the best currently available scientific information. If climate change reduces the total recharge in the area of SNWA's permits, then SNWA will have to adapt to the change by taking the necessary management steps established in the 3M plans (SNWA, 2017a and b).

Myers (2017) Central Carbonate Flow System Numerical Modeling (p. 37-66)

In this section, Myers briefly describes the project basins of the CCRP region and provides estimates of the components of their groundwater budgets extracted from SNWA technical reports and the BLM Final EIS (FEIS). Myers ignores the fact that the groundwater budgets of the SNWA GDP basins have been updated by the NSE. He includes tables, graphs, and snapshots of maps from these reports.

Myers summarizes and criticizes results of simulations of baseline conditions and two EIS alternatives (E and F) for the whole model area first, then for the GDP basins. He presents simulated drawdown maps and hydrographs from the BLM FEIS. He also describes the simulated effects of SNWA's GDP pumping on storage, ET and interbasin flow.

The information presented by Myers is as described in source documents that preceded the NSE rulings published in 2012, which Myers completely ignored in this section. Major portions of this information are outdated and irrelevant to the four remand issues. This causes all of Myers' comments and conclusions to be inapplicable to the 2017 remand hearing. New simulations of Spring Valley conducted using a version of the CCRP model that is consistent with the 2012 NSE rulings are documented in Drici et al. (2017). The new version of the CCRP model, rather than previous versions or any of Myers’ models, should be used. Some specific statements made by Dr. Myers in this section are addressed below:

1. Myers (2017) erroneously describes Cave Valley as being at the headwaters of the White River Flow System (WRFS) to inflate its contribution of interbasin flow to the White River Valley (p. 37, 1st paragraph).

Cave Valley contributes some groundwater to the WRFS. Saying it is "at the headwaters" is misleading. The WRFS is not a river, and if it were, Cave Valley would be a relatively small tributary.

2. Myers (2017) misleadingly describes the simulated effects of SNWA GDP pumping at specific points in terms of drawdowns and spring discharges as though the CCRP model were designed to answer questions at the local scale (p. 45 to 48).

Myers’ discussion is irrelevant to the four remand issues. The CCRP model is a regional model: it is inappropriate to use it to simulate local effects. No matter what the simulated drawdowns and spring discharge changes may be, any effects of the SNWA GDP pumping will be monitored, managed and mitigated throughout the life of the project as described in the new 3M plans (SNWA, 2017a and b). These plans describe triggers and thresholds at the local scale that were based on observed data and not on model simulation results (Marshall et al., 2017, p. 3-1 to 3-5). Numerical modeling will be improved as stress-response data are collected during the GDP pumping to help with the implementation of the 3M plan (SNWA, 2017a, p. 4-1 and SNWA, 2017b, p. 4-1).

3. Myers utilizes outdated scenario simulations based on the outdated estimates of recharge and SNWA production volumes to draw misleading conclusions. For instance, the simulated recharge in Spring Valley was 82,600 afy and the total pumping including SNWA production was 69,000 and 93,400 afy for Alternatives E and F, respectively. He then concludes that the pumpage represents most of or more than the valley's total recharge (Myers 2017, p. 45).

The version of the CCRP model used to simulate Alternatives E and F has been updated by SNWA according to the NSE’s estimates of the water budget of Spring Valley (NDWR, 2012a). In Ruling 6164, the NSE adjusted the ET discharge estimate for Spring Valley to 84,100 afy (NDWR, 2012a, p. 214). In the updated CCRP model, this increase in ET discharge led to an increase in the recharge to about 90,000 afy (Drici et al., 2017, p. 3-3). This estimate of recharge is within the range of 84,000 to 96,000 afy estimated by the NSE (NDWR, 2012a, p. 90). In addition, the NSE also permitted a maximum rate of pumping of 61,127 afy in Spring Valley. Adding the existing pumping of about 9,000 afy, the total pumping in Spring Valley would total about 70,000 afy, which is much less than the recharge of 90,000 afy. The ET-capture scenario simulated using the updated model described in Drici et al. (2017) results in 96 to 98 percent of the GDP pumping from capture of the ET discharge in Spring Valley, 75 to 200 years after the start of full production (Drici et al., 2017, p. 6-2).

4. Myers misleadingly utilizes the results of alternatives E and F for Spring Valley to claim that SNWA GDP pumping still removes significant portions of the production from storage and interbasin flow, after 200 years from the start of full production (Myers, 2017, p. 45)

As described in Drici et al. (2017), the effects of pumping in a given aquifer system depend on many factors, including the water available for capture, the well locations, and the total GDP pumping and its distribution. Myers bases his conclusions on outdated values of ET discharge and permitted GDP pumping in Spring Valley. Using the updated information provided in Ruling 6164 (NDWR, 2012a), and a production well configuration designed to capture ET, Drici et al. (2017) show that ET discharge can effectively be captured after a reasonable time period of 75 to 200 years. Based on the same simulations, the cumulative volume of transitional storage captured after 200 years of GDP full production represents about 2.5 percent of the recoverable groundwater in storage in the top 100 feet of saturated basin fill in Spring Valley (Drici et al., 2017).

5. Again, Myers (2017) utilizes the results of Alternatives E and F to criticize their oudated simulated drawdowns and their extent over the boundaries of Spring Valley. Myers claims that such drawdowns lower and shift the groundwater divides away from Spring Valley (p. 45).

In general, a drawdown cone may cross a basin's boundary in areas where the hydrogeologic formations located along the boundary are permeable. Drawdown will not extend across mountain ranges because of the presence of mountain front faults. In the simulations cited by Myers, the conceptual model is simplified due to a lack of data. As a result, some faults may not be represented. In addition, pumping is simulated to be continuous with no management actions. In reality, the expansion of the drawdown caused by GDP pumping will be monitored and proper management and mitigation actions will be taken to comply with Nevada law and NSE rulings (SNWA, 2017a and b).

6. Myers falsely claims that the interbasin flow estimated by the USGS (Prudic et al., 2015; Welch et al., 2008) from Spring Valley to Hamlin is larger than that simulated in the CCRP model. He further claims that SNWA's pumping in Spring Valley would have more substantial effects than simulated in the FEIS, if the USGS estimates prove to be more accurate (Myers, 2017, p. 47).

This statement is not relevant to the four remand issues and is highly speculative. Myers attempts to interpret what the effects of higher interbasin flows from other sources might be on the FEIS simulated results. Yet, he does not attempt such interpretations if the recharge and GDP pumping were as described by the 2012 NSE rulings (NDWR, 2012a). In addition, the interbasin flow estimated by Prudic et al. (2015) ranges between 6,000 and 11,000 afy (p. 137). This range is within the range of 4,000 to 12,000 afy estimated by the NSE in Ruling 6164 (NDWR, 2012a, p. 85-86). The interbain flow simulated in the model is 7,600 afy (SNWA, 2009, Plate 3). Furthermore, the provisions described in the 3M plan will help monitor any potential effects on interbasin flow to Hamlin Valley (SNWA, 2017b).

7. After recognizing that Prudic et al. (2015) found that interbasin flow from Spring Valley is not the source of discharge from Big Springs, Myers speculates that pumping in Spring Valley would still affect the discharge of Big Springs. His faulty reasoning is based on the extent of simulated drawdown under the FEIS alternatives (Myers, 2017, p. 48).

Myers' statements are not relevant to the four remand issues. This interpretation oversimplifies a complex three-dimensional flow system as though it were a two-dimensional system. Just because drawdown ovelaps an area in a three-dimensional flow system does equate to impacts to every feature in that area. Uncertainties of connectivity of aquifers to surface water features still exist in that area. Furthermore, the provisions described in the 3M plan (SNWA, 2017b) will help monitor any potential effects on Big Springs.

8. Myers (2017) extracted the simulated effects of SNWA pumping in DDC on springs in neighboring valleys down to the acre foot, as though the CCRP model were that accurate (p. 53).

Given the regional nature of the CCRP model and the fact that little information is available about the hydrogeology of the springs, the simulated effects of pumping on springs such as those cited by Myers (2017) are not accurate. Potential impacts have been addressed by the NSE in Ruling 6165 (NDWR, 2012b) and by BLM in the FEIS (BLM, 2012a), and the U.S Fish and Wildlife Biological Opinion (USFWS, 2012). In addition, the effects of the SNWA GDP will be monitored, managed and mitigated, if necessary, as described in the updated 3M plans (SNWA, 2017a and b).

9. Myers (2017) inappropriately and repeatedly makes attempts to shift the Court's remand issue regarding a recalculation of water granted in DDC to avoid over appropriations or conflicts, to a discussion on equilibrium.

While the Court specifically asked the NSE to address equilibrium in Spring Valley, it did not for DDC. The decision not to focus on ET capture and equilibrium in these other valleys is appropriate as there are substantial differences in hydrologic conditions in Spring Valley versus those in DDC that would make such an analysis inappropriate.

Spring Valley is practically a closed basin with nearly all of its recharge being discharged as ET within its own basin boundaries. For a closed system such as Spring Valley, the distances between areas of recharge and discharge are relatively short and the flow paths are reasonably well known. In a closed basin, like Spring Valley, it is possible that the effects of groundwater production may be contained within the valley by capturing the discharge within the valley and approaching a new equilibrium. As documented in Drici et al. (2017), well placement has a significant impact on the capture of discharge within a closed basin. Drici et al. (2017) were able to demonstrate that nearly all of SNWA's proposed groundwater pumping could be derived from ET capture within Spring Valley in as little as 75 to 200 years. In this type of system, the quantities of water that are being removed by the capture of discharge, and how the drawdowns propagate through the system, can be directly observed.

The attributes of a closed system are not applicable to DDC or any other dry valley within Nevada. The recharged waters in these basins travel significant distances over unknown flow paths to discharge points in downgradient basins. These valleys are known as "dry basins" because they discharge little to no water as ET. Depending on the distances traveled and the presence of hydrogeologic features that may impede groundwater flow , the travel times to the discharge points may be on the order of millennia. In these systems, drawdowns would have to propagate over substantial distances and may require hundreds to thousands of years for changes to the discharge volumes to become measurable. As such, the time required to achieve a new equilibrium is sufficiently long as to become irrelevant to any reasonably accurate or helpful discussion on impacts from pumping.

In dry valleys such as DDC, it is more appropriate to base decisions regarding groundwater production on an examination of the pumping effects that can be observed within the basin and any measurable decrease in interbasin flow. For DDC, SNWA has established a monitoring, management, and mitigation plan to adaptively manage its groundwater production to prevent unreasonable effects, rather than focus on an irrelevant and highly speculative equilibrium analysis (SNWA, 2017a).

10. Myers criticizes the use of confined upper layers in the model, but then complains that they are also treated as unconfined. He claims that treating the upper layer in bedrock aquifers as unconfined causes the propagation of drawdown into Pahranagat Valley to be underestimated (Myers, 2017, p. 55, and p. 56).

Criticisms regarding modeling technicalities are not part of the four remand issues. Disputes over modeling approaches were resolved by the NSE in Ruling 6165 and were not overturned by the Court. The triggers and management actions contained in the 3M Plans (SNWA, 2017a and b) were not developed based on projected aquifer responses shown in model results, but were instead based on observations and analysis. Therefore, Myers' critique of the CCRP model is not applicable to the four remand issues. In any event, Myers (2017) criticism of the fact that the upper model cells of all hydrogeologic units were assigned appropriate specific yield values to represent their unconfined conditions is unfounded. This representation is adequate and was designed by USGS scientists to address numerical model convergence issues (Anderman and Hill, 2003). The model layers in the CCRP model are simulated as confined (constant transmissivity), but the top model cells are assigned values of specific yield to approximate unconfined conditions. This is a common practice used by modelers to address convergence issues in models such as the CCRP model.

11. Myers claims that pumping in DDC could impact springs in Pahranagat Valley, citing simulated results for specific locations based on the FEIS alternatives. He also claims that Delamar Valley would be the quickest to approach equilibrium by pulling water from the Muddy River springs and misinterprets Figure 35. He then notes that the WRFS will not approach equilibrium for a very long time (Myers, 2017, p. 56, and p. 58)

Again, discharge capture in the DDC basins is not one of the remand issues, The DDC basins do not have regional ET discharge areas and are considered “dry” valleys. As shown in the Stanka (2017) report prepared for the remand hearings, the groundwater rights allocated to SWNA in DDC will not cause over-appropriation in the WRFS. Myers (2017) uses the CCRP model, a regional model, to inappropriately assess local effects. Myers (2017) also ignores the fact that GDP pumping is assumed to be continuous in the FEIS Alternatives. Myers (2017) does not account for the hydrogeologic conditions in southern Delamar and northern Coyote Spring Valley which would limit changes in flux into Coyote Spring Valley. He does not consider the hydraulic gradient from southern Delamar to north central Coyote Spring Valley. The change in hydraulic gradient across this low hydraulic conductivity zone, even if there were drawdown present in southern Delamar Valley, would be limited. This would result in a minimal change in flux across the zone. So even if there is drawdown in southern Delamar Valley the response, if any, at Muddy River Springs would be immeasurable. Myers (2017) mistakenly attributes the ~2,000 afy of spring flow reduction to SNWA GDP pumping, when it is actually caused by existing production wells in basins located downgradient of Pahranagat Valley. It is easy to see Myers' mistake when looking at the labels of the alternatives in the legend of Figure 35. Myers fails to notice that the first alternative listed in the legend is the No Action alternative, which only includes existing pumping, does not include SNWA GDP pumping, and is responsible for the ~2,000 afy decline in spring flow.

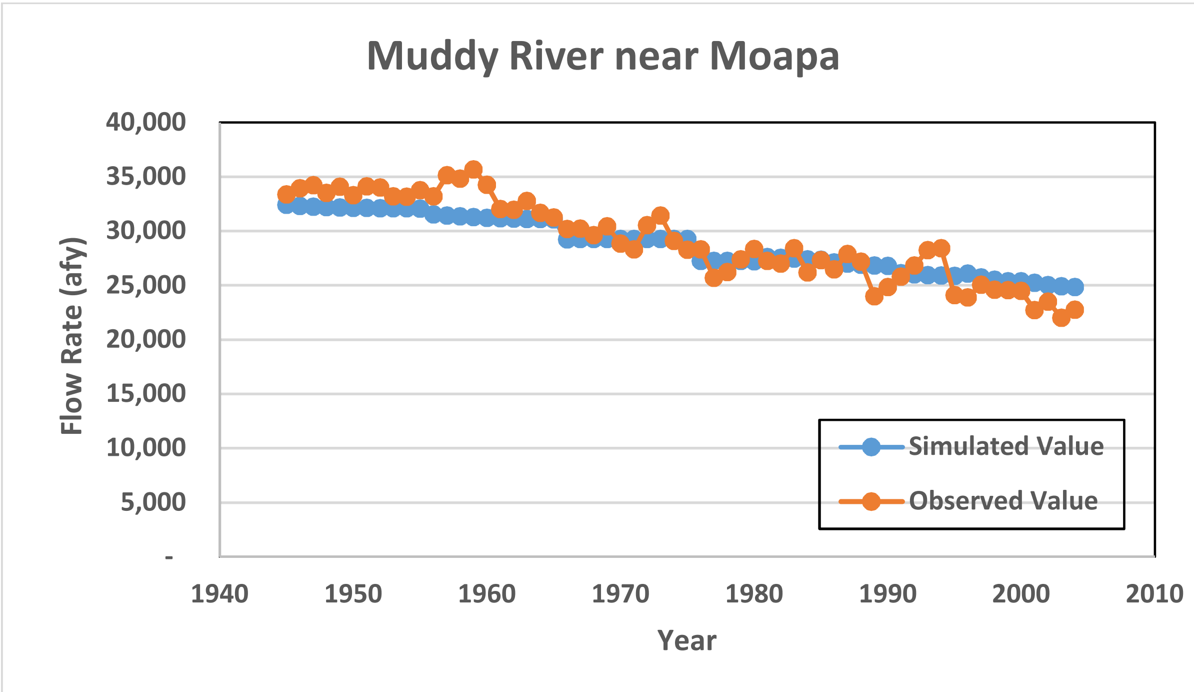
The NSE 2012 rulings addressed interbasin flow within the WRFS and the NSE's determinations on interbasin flows were not overturned by the Court (NDWR, 2012b, c and d). The effects of the SNWA GDP pumping will be monitored, managed and mitigated as described in the updated DDC 3M plan (SNWA, 2017a). The DDC 3M Plan and technical analysis report (Marshall et al., 2017, Section 9.0) specifically consider both northern and southern Pahranagat valleys. The monitoring network includes monitor wells, springs and selected senior water right POD locations to detect and measure propagation of drawdown. These locations will provide early warning and identify any propagation of significant drawdown which would need to be present in order to have a future influence on Muddy River Springs.

12. Myers reviews and criticizes how flow across the Pahranagat Shear Zone is simulated in the CCRP model and the simulated spring flows in the Muddy River springs under Alternatives E and F on pages 58 through 65.

This is not relevant to the four remand issues. The CCRP model is the best model available to date and was selected by both the NSE and the BLM to perform broad regional analyses. This model represents flow across the Pahranagat Shear Zone as accurately as possible based on the available information. The width of the faults follows the grid resolution, and the aquifer properties represent averages across the cells and were adjusted during calibration to match spring flows and water levels. The fact that the flows simulated in the Muddy River near Moapa and near Glendale reasonably match the observed flows at these locations (Figure 1) prove that Myers' assertions are unfounded. Contrary to Myers' insinuation that SNWA represented the faults to minimize effects of pumping, Figure 1 shows that SNWA's fault representation is adequate at the regional scale because it allows the model to simulate the historical flows in the Muddy River relatively well.

13. Equilibrium issues (Myers, 2017, p. 65-66).

For a given aquifer, time to equilibrium depends on many factors including location of discharge, recharge, the locations of the pumping wells, and pumping schedule. The examples provided by Myers are not designed to minimize time to equilibrium. After criticizing the CCRP model (the best model of the flow system available to date), Myers (2017) cites results from a Regional Aquifer System Analysis (RASA)-based model he developed for Spring Valley to claim that the system does



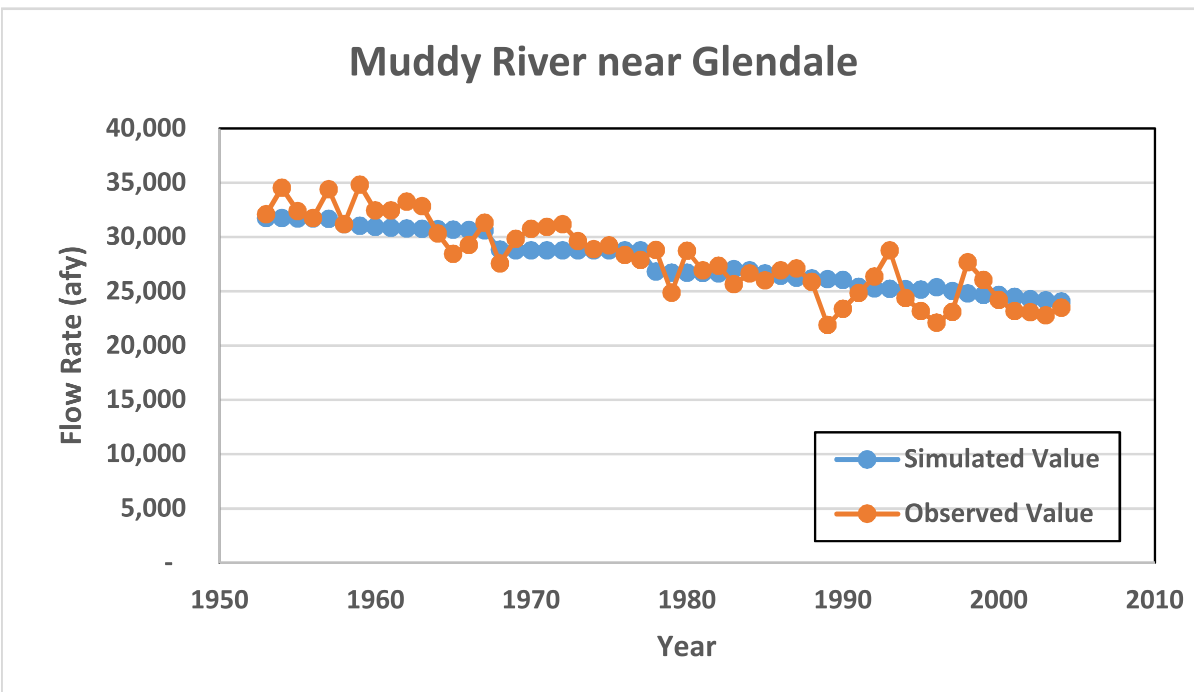


Figure 1
CCRP Model Simulated Versus Observed Flows at Muddy River Gages

not reach equilibrium. First, the production well configuration is not designed to capture ET discharge quickly. Second, the RASA model is older, coarser, has confined layers (layers assigned transmissivities), and was not calibrated for transient conditions. Furthermore, the NSE selected the CCRP model over the RASA model. In Ruling 6164, the NSE stated:

> *The State Engineer finds Dr. Myers' model is useful for analyzing effects of pumping, but that predictions of effects after hundreds of years will carry little weight. After considering both the Applicant's and Dr. Myers' models, the State Engineer finds that the Applicant's model is more comprehensive, better documented and peer reviewed, and will carry more weight in impacts analysis* (NDWR, 2012a, p. 151).

Myers (2017) Monitoring, Management, and Mitigation Plans (p. 66-80)

The Myers report presents comments associated with the 3M approach and elements of the Spring Valley and DDC 3M Plans. Myers did not review the 2017 3M Plans and many of his 3M related comments are addressed in the 2017 Spring Valley and DDC 3M Plans (SNWA, 2017a and b). Other comments by Myers are addressed in the 3M Plan Technical Analysis Report (Marshall et al., 2017). Myers' major comments are discussed below.

1. Myers (2017) stated that a 3M Plan must include monitoring of groundwater levels and flow rates that represent groundwater dependent ecosystems (GDE) and water rights (p. 67). Myers states that the 3M Plan must implement management actions if various triggers are reached and mitigation actions when management actions are not successful.

Marshall et.al. (2017) describes the 3M approach, monitoring program, quantitative investigation triggers, management actions, quantitative mitigation triggers, and mitigation actions (Section 3.0). Specific monitoring, triggers, and management and mitigation actions for senior water rights and environmental resources are included in the Spring Valley, and DDC 3M plans.

2. Myers stated that for the establishment of an adequate monitoring plan, the GDEs and water rights that should be protected are identified and what is necessary to protect them should be determined.

The environmental resources, senior water rights, and domestic wells in the 3M Plan area were identified, and thresholds and quantitative triggers established. This is described in Marshall et al. (2017, Sections 4.0 through 9.0) and are included in the 3M plans.

3. Myers states that the development of a localized conceptual flow model (CFM) that describes the hydrologic system that supports each GDE and water right is needed.

SNWA has committed to developing more detailed (local scale) groundwater flow models designed to simulate the effects of pumping within each specific basin, prior to BLM's NEPA review of specific groundwater development activities by SNWA. These basin-scale models will be coupled with the regional model by constructing separate models, whose boundary conditions are linked to the regional model. The basin-specific models will be used to evaluate the potential project-related pumping impacts once the rights-of-way for production wells have been requested. The models will be used to evaluate the effectiveness of management and mitigation measures including monitoring location selection (BLM, 2012b, Attachment C-2 Conditions for Approval, item GW-WR-3b).

It is important to recognize that initially these local-scale models will likely be no better at predicting project related impacts than the current regional scale model. The most important type of information that is necessary to improve the predictive capability of a model is aquifer-response data (i.e, data collected after the aquifer responds to pumping). The basins that are the subject of this hearing currently have very few production wells within them, which means there is very little aquifer-response data available. Aquifer-response data will be collected with the onset of groundwater production, and as such, the models' predictive capabilities will dramatically improve shortly after production begins.

The basin specific models are an integral part of the SNWA GDP 3M Plans. The Plans include investigation triggers at monitor wells and senior water right PODs, as described in Marshall et al. (2017, Section 3.2.2). If activated, the investigation triggers will result in management actions, including updating the model with specific aquifer-response data at that location to provide refinement of aquifer properties, and determine the significance of the change. The model is updated through an iterative process throughout the life of the GDP to improve the predicative ability of the model with aquifer-response data.

The basin-specific groundwater model runs will also be performed to optimize pumping rates and schedule to meet GDP goals, constraints, and objectives. The value of the basin-wide model to simulate the influence of the production wells increases with the use of aquifer response data to calibrate the model.

SNWA has already performed extensive studies, tests, and data collection activities to characterize the basin hydrogeologic framework and flow paths. Groundwater flow paths were considered when the 3M Plan monitoring network was developed, and are incorporated into the 3M process.

4. In his report Myers discusses the determination of the type and location of monitoring that would allow the prediction of changes at the GDE or water right (Myers, 2017, p. 69). He also discusses the implementation of the more refined CFM to determine the level of drawdown or other measurable effect that would signal impending impacts to a GDE or water right. These levels are the triggers that the monitoring would be designed to detect and prompt management changes. A regional model used for the overall GDP probably would not be sufficiently detailed to understand flow at individual sites.

The selection and design of the 3M Plan monitoring sites included consideration of hydrogeologic setting, groundwater flow paths, and proximity to production well, senior water right, and environmental resource sites. Investigation triggers, management actions, and mitigation triggers and actions for senior water rights and environmental resources are described in Marshall et al. (2017, Section 3.0), and in the Spring Valley and DDC 3M Plans (SNWA, 2017a and b). The plan includes the use of predictive tools in the establishment, verification, and revision of the 3M Plan monitoring network. Management actions, including evaluation of the significance of a change in water level at intermediate monitor wells and other monitoring sites, are included in the 3M Plan. The use and refinement of numerical groundwater flow models and other predictive tools to assist in avoiding or eliminating unreasonable effects are elements of the 3M Plans.

5. Myers (2017) claims that the identification of triggers must be based on what causes the effects on features. He further states that such triggers should not be based on monitored water level drawdowns exceeding those predicted in the FEIS (p. 70).

Mitigation triggers at senior water rights and environmental resources are established based on attributes and characteristics of the senior water right or environmental resource and not a departure from model projections.

6. Myers (2017) claims that management and mitigation strategies included in 3M plans must be supported by adequate proof that the resource will be effectively protected. He also states that the evaluation of a management plan requires the inclusion of modeling that demonstrates the effectiveness of the plan in preventing impacts to the GDE. He also states that the plan should also provide for data collection over a baseline period that is sufficiently long to allow for model verification, conceptualization updates, and management plan revisions (p. 71).

Implementation of the GDP hydrologic monitoring network and systematic baseline data collection began in 2006. Hydrologic monitoring data associated with the 3M Plans are provided to the NSE electronically on a quarterly basis. Annual data reports for the plans have been provided to the NSE since 2008.

Evaluation of management and mitigation action effectiveness and adaptive management are important elements of the 3M Plans to improve actions. Numerical groundwater flow models and other analytical tools are revised and calibrated based upon aquifer response data in an iterative manner to improve the predictive ability of the tools' response. This is addressed in Marshall, et al. (2017, Section 3.0).

7. Myers comments that mitigation plans should assess whether it is possible to replace water, including the source of the replacement water. The plan should consider the impacts of obtaining that replacement water.

Myers incorrectly states that a mitigation plan should recognize that environmental amenities cannot be mitigated with replacement water, because the ecosystem function that the plan is supposed to protect cannot be maintained in that way. Evaluation of the source of appropriate replacement water and effects of conveying the replacement water are considered in the 3M Plans (SNWA, 2017a and b). As shown in the 3M Plans, where replacement water would not be effective, SNWA did not propose using it as a mitigation measure. Where the use of a certain source of replacement water is not appropriate or would not be expected to be effective to mitigate a resource, it will not be proposed as part of the mitigation action.

8. Myers (2017) comments that vertical gradients in aquifer systems are created by hydraulic head differences within the system. Thus, the water level in a well with a single screen in an aquifer where vertical hydraulic gradients exist, represents an average water level of the aquifer. Myers further states that such an average level would represent the most transmissive

layer of the aquifer because the observed water level would be an average of the layers' hydraulic heads weighted by their transmissivity values (p. 72).

The location siting and screen interval and completion-depth design of monitor wells and shallow piezometers in the 3M Plan monitoring network considered the hydrogeologic setting, completion depth of the SNWA GDP production wells, intermediate monitoring location, and senior water right or environmental resource attributes.

For example, monitoring with different depth wells or piezometers is approrpriate within Spring Valley, in areas where there is shallow groundwater in the center axis of the valley underlain by lacustrine deposits, or low hydraulic conductivity material at the toe of the alluvial fans acting as an aquitard between aquifers. These areas are monitored with nested (paired) monitor wells or nearby wells with different completion depths.

For other locations, where multiple aquifer systems separated by an aquitard are not present, it is more important to detect a change in water level using a longer screen or gravel pack interval than using multiple completions, which may miss a transmissive zone. Drawdown will propagate through a continuous higher transmissive zone (e.g., fracture, or sand and gravel) prior to a low-transmissivity zone (e.g., silt and clay). As a result, the monitor well would represent the most transmissive layer which is the zone that will first show propagation of drawdown. Therefore, it is a priority that a monitor well intersect the highest transmissive zone, making long-screen intervals most appropriate for the kind of monitoring needed for the GDP.

Short screens are required in hydrogeologic studies associated with groundwater contamination studies, where three-dimensional definition of contaminant distribution is the objective of the monitoring network. For monitoring networks associated with detection of aquifer response, the screen length is dependent upon the hydrogeologic setting, with monitor wells completed in multiple aquifers, if present. Long screens are important to be used to intersect high-transmissivity zones in the aquifer where the production well is completed. The preferred use of a longer screen interval to detect aquifer response from pumping, is supported by Halford (2017) and discussed in Sterrett (2007, p. 190). The 3M Plan monitor network is effective at detecting propagation of drawdown in the GDP area.

9. Myers discusses the effect of groundwater flow paths on the effectiveness of 3M Plans (Myers, 2017, p. 73).

Groundwater flow paths are important in the design of a monitoring network and in the evaluation and prediction of aquifer response to pumping. SNWA has performed extensive studies, tests, and data-collection activities to characterize the basin hydrogeologic framework and flow paths. Groundwater flow paths were considered when the 3M Plan monitoring network was developed, and are incorporated into the 3M process.

10. Myers incorrectly comments that 13 springs were included in the Spring Valley monitoring program, that the springs are too few, and are not representative of the entire basin. He further incorrectly states that SNWA did not evaluate the springs properly, or provide a rationale for the selection into the network, and that SNWA did not justify any choice based on the value of

the spring. Myers also incorrectly states that the monitor well network is too sparse for Spring Valley. Myers provides further comments on the DDC monitoring network (Myers, 2017, p. 74 - 78).

SNWA monitors 19 spring locations in the Spring Valley 3M Plan monitoring area. Spring monitoring locations were selected in consensus with the NSE and technical representatives of the U.S. Department of Interior (DOI). Springs were selected based upon hydrologic setting, spatial distribution, biological significance, and spring characteristics. Springs are spatially distributed across the 3M GDP area and are located in the mountain block, range front, and valley floor hydrogeologic settings. Shallow piezometers were installed near spring locations with hydrologic characteristics indicating a likelihood of hydraulic interrelationship between spring pool level or discharge and groundwater water level. A Spring Valley field guide was prepared in 2012 to document data on selected springs available at that time (SNWA, 2012). The spring data collected at the spring locations from 2012 to 2017 is presented in the SNWA annual reports.

Continuous discharge gaging stations were installed at Swallow and Rock Springs, instead of utilizing piezometers. Big Spring in Snake Valley is monitored continuously by two gaging stations. Dearden Spring is monitored by the Utah Geological Survey (UGS), using three gaging stations located up and downstream of the spring on Lake Creek, Utah. UGS also maintains a gaging station at Clay Springs North, and a groundwater monitoring network in Snake Valley along the Nevada-Utah stateline.

The monitor well siting and selection process included input or consensus approval of the NSE, DOI, and USGS. The process to select existing wells included evaluation of well integrity, construction completion details, hydrogeologic setting, lithology, and spatial distribution to obtain representative data to meet program objectives.

Most monitoring is focused on the areas near production wells, senior water rights, environmental resources and intermediate areas. Additional less-dense monitoring is performed in outlying areas to observe general aquifer conditions. Myers over-exaggerates the sparse monitoring density and distribution, and fails to acknowledge the amount of monitoring in the vicinity of project activity. Myers states that Spring Valley is 1,700 mi^2, however, he fails to mention that close to 700 mi^2 is in the mountain block, and much of the northern portion of the valley is outside of the initial 3M Plan focus area. SNWA has over 80 stream, spring, piezometer, and monitor well sites in the Spring Valley 3M area, as listed in Section 10.0 in Marshall et al. (2017). This does not include additional monitoring performed directly at senior water right PODs, or temporary monitoring locations to supplement the 3M Plan for basin characterization and verification. The 3M Plan management plan also uses sentinel wells on the fringe of the production area and includes the evaluation of the need for construction of additional monitor wells after an investigation trigger is activated, as described in Section 3.0 in Marshall et al. (2017).

In DDC, monitor well and spring network locations were selected in consensus with the NSE and DOI technical representatives. The monitor well selection process included evaluation of well integrity, construction completion details, hydrogeologic setting, lithology, and spatial distribution to obtain representative data to meet program objectives. The DDC 3M Plan uses the appropriate level of monitoring, considering the hydrogeologic conditions, location of production wells, and location of senior water rights and environmental resources.

11. Myers commented on the DDC 3M Plan on pages 74-75.

The 2017 DDC 3M Plan addresses the comments presented by Myers (2017).

12. Myers (2017) comments that, by the time drawdown decreases flow at these springs in downgradient basins, it will have propagated a significant distance, and will therefore continue to propagate regardless of any changes in pumping (Bredehoeft and Durbin, 2009). Unless monitor wells detect the propagation for drawdown sufficiently in advance, the springs will not be protected (p. 78-79).

SNWA addressed Bredehoeft (2011), and Bredehoeft and Durbin (2009) in the rebuttal report submitted as Exhibit 428 for the 2011 hearings (Prieur, 2011, Sections 2.0 and 3.0). These commentators have suggested that monitoring would not be effective to prevent impacts unless it is placed in a manner to provide an "early warning" of impact. The NSE addressed Bredehoeft's concerns in Ruling 6164, (NDWR, 2012a, p. 109 - 111) and stated that Bredehoeft highlights some difficulties in monitoring, but these difficulties can be overcome.

The statements and conclusions of Bredehoeft (2011) are oversimplified and do not reflect the local hydrogeologic conditions, basic principles of managing water production well fields, and state of the industry practice in regard to groundwater monitoring and adaptive management. Bredehoeft's articles dismiss understanding of the specific local hydrogeologic conditions to locate and operate individual wells in an optimal manner to minimize and manage impacts. Bredehoeft's articles also dismiss the state of the industry project monitoring and adaptive management practices which would be actively utilized to refine predictive tools and system operation activities.

The degree of impacts presented by Bredehoeft (2011) are generalized and overexaggerated. Bredehoeft does not consider the degree of hydraulic connection between the specific pumping areas and areas of interest (i.e., streams, springs, wells, and phreatophytes). Bredehoeft's articles inadequately examine the site-specific conditions, and misapply generalized hypothetical examples to the GDP conditions and operations. Bredehoeft does not identify what constitutes significant harmful effects, and discounts or dismisses the effectiveness of state of the industry management and mitigation measures without proper scientific consideration and examination. Therefore, it would be inappropriate for a decision maker to apply the results and conclusions of Bredehoeft's articles, to SNWA's GDP pumping.

There are key differences between the example in Bredehoeft (2011) and locations in the GDP area. The first is the location of recharge areas in the GDP area. This is different than the example in the Bredehoeft article, where the recharge area is located tens of miles across the valley from the hypothetical spring. The second is the number of wells located between the pumping site and the senior water rights or environmental resource. In the Bredehoeft example, the only monitor well is 48 miles downgradient of the pumping well, and only two miles from the spring. In the real-life situation there are monitor wells providing much earlier detection and measurement of drawdown propagating toward the resource. The third is that the Bredehoeft example did not include specific investigation and mitigation triggers, or management and mitigation actions that will be implemented by SNWA pursuant to the 3M Plan.

In the 2011 hearing, Bredehoeft testified that adding monitor wells closer to the pumping center "*you'd see the pumping cone migrate toward the spring*" (NDWR, 2011, p. 5458, 1:7). These monitor wells would allow management actions to be taken earlier to prevent or eliminate an unreasonable effect at a resource.

Myers (2017) Numerical Model (p. 80-99)

This section does not support or offer any additional information to address the four specific issues identified by the Court that is the subject of this remand hearing. This section is only tangentially relevant to the remand as it discusses the model that was used for predictions. This section is simply an old review of the CCRP model that Myers prepared in 2010. However, even despite of his criticism of the CCRP model, Myers himself uses the modeling results from the CCRP model to make his conclusions throughout his report.

The CCRP model was prepared by SNWA to support the development of an EIS for the BLM. As part of this development, the BLM put together a Technical Review Panel comprised of senior groundwater modeling experts and hydrologists from academia, consulting companies, and the federal government to provide iterative reviews of the model as it was being developed. The conclusion regarding the quality of the model as stated in the FEIS was that,

> *Although there are inherent uncertainties and limitations associated with results of a regional groundwater flow model over a broad region with complex hydrogeologic conditions, the calibrated CCRP model is a reasonable tool for estimating probable regional-scale drawdown patterns and trends over time, resulting from the various pumping alternatives that were evaluated* (BLM, 2012a, p. 3.3-90).

Additionally, the CCRP model was used by SNWA during the 2011 hearing, while Myers used a variant of the RASA model. In the NSE rulings 6165, 6166 and 6167 (NDWR, 2012b, c and d), the NSE found that the CCRP model was the best scientific tool he had, to evaluate potential impacts and that "In the end, however, Dr. Myers stated that he did not disagree with the Applicant's model" (NDWR, 2012d, p. 106).

Myers (2017) Conclusions (p. 99-100)

Myers' (2017) report conclusions include the following:

1. Myers (2017) inappropriately concludes that groundwater mining will occur. This conclusion is based upon outdated modeling results performed by Myers with inaccurate details on how the GDP may be developed. Drici et al. (2017) demonstrated that a new equilibrium can be established after 75 to 200 years of full groundwater production. Additionally, SNWA has developed comprehensive 3M Plans to protect both water rights and groundwater dependent ecosystems (SNWA, 2017a and b).

2. Myers (2017) makes inappropriate conclusions based upon a regional model that is not designed to simulate local effects. These issues have been addressed by the NSE in Ruling 6165 (NDWR, 2012b) and by BLM in the FEIS (BLM, 2012a) and the U.S Fish and Wildlife Biological Opinion (USFWS, 2012). In addition, Myers' conclusions do not reflect that the SNWA GDP will be monitored, managed and mitigated to avoid impacts as described in the updated 3M plans (SNWA, 2017a and b).

3. Myers (2017) makes unsubstantiated claims about the construction of the CCRP Model and how the construction may manifest itself in different results, even though he has previously testified he did not disagree with the model, and uses it as the basis of his conclusions for his report. The CCRP model was prepared by SNWA to support the development of an EIS for the BLM. As part of this development, the BLM put together a Technical Review Panel comprised of senior groundwater modeling experts and hydrologists from academia, consulting companies, and the federal government to provide iterative reviews of the model as it was being developed. The conclusion regarding the quality of the model as stated in the FEIS was that "the calibrated CCRP model is a reasonable tool for estimating probable regional-scale drawdown patterns and trends over time" (BLM, 2012a, p. 3.3-90).

4. Myers' (2017) comments about monitoring, management, and mitigation are based upon his review of older 3M plans. The current 3M plans address Myers' concerns. The selection and design of the current 3M Plan monitoring sites included consideration of hydrogeologic setting; groundwater flow paths; and proximity to production well, senior water right, and environmental resource sites. The use of predictive tools in the establishment, verification, and revision of the 3M Plan monitoring network is incorporated into the plan. Specific quantitative triggers are set for investigation and mitigation actions to be performed. Management actions including evaluation of the significance of a change in water level at intermediate monitor wells and sites are also included in the 3M Plan. Specific mitigations actions are used to avoid or eliminate unreasonable effects. The 3M Plan approach and details are described in Section 3.0 in Marshall et al. (2017), and in the Spring Valley and DDC 3M Plans (SNWA, 2017a and b).

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