COMMENTS OF

WHITE PINE COUNTY, NEVADA

ON THE

DRAFT ENVIRONMENTAL IMPACT STATEMENT

FOR THE

CLARK, LINCOLN, AND WHITE PINE COUNTIES GROUNDWATER DEVELOPMENT PROJECT

Submitted: October 11, 2011

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I. INTRODUCTION

A. The Commenters

Advocates for Community and Environment submits these comments on behalf of White Pine County, Nevada, a political subdivision of the State of Nevada. White Pine County is a cooperating agency in the National Environmental Policy Act (NEPA) process on the Clark, Lincoln, and White Pine Counties Groundwater Development Project (Pipeline Project or Project). The proposed Project's footprint extends into White Pine County, and the water supply, economy, and environment of White Pine County stand to be adversely affected should the pipeline project move forward.

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White Pine County requests that these comments, and all attachments be included as part of the administrative record. White Pine County further requests that all documents, articles, and reports cited in these comments and attached expert testimony be included as part of the administrative record of this action. See County of Suffolk v. Secretary of Interior, 562 F.2d 1368, 1384, n.9 (2d Cir. 1977) (addressing scope of NEPA administrative record), cert. denied, 437 U.S. 1064 (1978); Silva v. Lynn, 482 F.2d 1282 (1st Cir. 1973) (same); see also Thompson v. United States Dep't of Labor, 885 F.2d 551, 555 (9th Cir. 1989) (administrative record consists of all documents and materials directly or indirectly considered by agency and includes evidence contrary to agency's position). White Pine County has closely reviewed the comments submitted by the Great Basin Water Network and by Dr. Jim Deacon and hereby incorporates those comments by reference.

B. Summary

The Southern Nevada Water Authority's (SNWA's) proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project would provide the infrastructure necessary to pump and convey up to 176,655 acre-feet per year of groundwater from Spring, Snake, Cave, Dry Lake, and Delamar Valleys in central-eastern rural Nevada 300 miles south to the Las Vegas Valley. The Project would entail the construction of the following facilities: main and lateral pipelines, power lines, and ancillary facilities.

The reviewing agency is the Bureau of Land Management (BLM). BLM's involvement in the Project results from the fact that SNWA has applied for a right of way through BLM land for the conveyance facilities and accompanying power lines. The BLM has chosen to address the project in a programmatic EIS followed by tiered site specific environmental analyses for individual well fields at later dates.

As explained in detail below, the Project is premised on unsustainable groundwater mining, and as such poses a serious threat to the groundwater system underlying a substantial portion of the carbonate aquifer province and the dependent environment. Among the harms likely to be caused by the Project is a long-term, catastrophic depletion of the aquifer that would take many millennia to remedy. By substantially drawing down the local and regional aquifer systems, the Project also threatens to dry out regional springs that support a host of endemic species, including species listed under the Endangered Species Act. The project also poses a significant risk of creating a substantial area of denuded, dried out sediment with considerable potential to generate harmful dust emissions comparable to those produced by the drying out of the Owens Valley, which ranks as one of the Nation's most conspicuous environmental disasters. These are only some of the disturbing potential environmental impacts from the Project, impacts that in practical terms will be permanent and very expensive to even attempt to mitigate.

The Draft Environmental Impact Statement (DEIS) does not adequately address these and other serious problems with the Project. Indeed the DEIS is woefully inadequate under NEPA. C2 Among its most glaring deficiencies, the DEIS is based on a patently deficient description of the C3 ~~Project and the physical conditions and environmental resources~~ in its vicinity, a grossly inadequate assessment of the purpose and need for the Project, C4 and a failure to examine the Project's feasibility and likely adverse environmental impacts. In all these regards, the DEIS fails to comply with NEPA.

The Draft Environmental Impact Statement (DEIS) does not adequately address these and other serious problems with the Clark, Lincoln, and White Pine Counties Groundwater Development Project. Indeed the DEIS is woefully inadequate under NEPA, and other state and federal laws. Among its most glaring deficiencies, the DEIS is based on a patently deficient description of the Project and the physical conditions and environmental resources in its vicinity, a grossly inadequate assessment of the purpose and need for the Project, and a failure to examine the Project's likely adverse environmental impacts. Rather than remedying any of these glaring deficiencies in the DEIS, the DEIS simply attempts to sidestep all substantive problems by proposing to defer the identification of problems and the decisions about how to deal with those problems to a future date and to unaccountable committees dominated by the Project's proponents under a vague and inadequate monitoring and management plan with no concrete triggers. C5 In all these regards, the DEIS fails to comply with NEPA, and we believe that the only appropriate action for the BLM to take is to correct its deficient analysis and issue a new DEIS for public comment. Additionally, for all these reasons the BLM should reject the proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project.

II. THE BUREAU OF LAND MANAGEMENT HAS FAILED TO COMPLY WITH THE NATIONAL ENVIRONMENTAL POLICY ACT

A. The Legal Requirements of the National Environmental Policy Act.

"Section 101 of NEPA declares a broad national commitment to protecting and promoting environmental quality." Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 348 (1989), citing 83 Stat. 852, 42 U.S.C. § 4331. "The sweeping policy goals announced in § 101 of NEPA are . . . realized through a set of 'action-forcing' procedures that require that agencies take a "hard look' at environmental consequences.'" Id. at 350, citing Kleppe v. Sierra Club, 427 U.S. 390, 410 n.21 (1976). NEPA's main "action-forcing" procedure comes in the form an environmental impact statement ("EIS"), a detailed statement on environmental impacts that must be prepared before an agency undertakes any "major Federal action[] significantly affecting the quality of the human environment." NEPA § 102(2)(C), 42 U.S.C. § 4332(2)(C).

Thus, NEPA "ensures that the agency, in reaching its decision, will have available, and will carefully consider, detailed information concerning significant environmental impacts." Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 349 (1989). See also Vermont Yankee Nuclear Power Corp. v. Natural Resources Defense Council, 435 U.S. 519, 553 (1978) ("NEPA places upon an agency the obligation to consider every significant aspect of the environmental impact of a proposed action"). "These procedural provisions of NEPA 'are designed to see that all federal agencies do in fact exercise the substantive discretion given them. These provisions are not highly flexible. Indeed, they establish a strict standard of compliance.'" Sierra Club v. Watkins, 808 F. Supp. 852, 859 (D.D.C. 1991), quoting Calvert Cliffs' Coordinating Comm., Inc. v. United States Atomic Energy Comm'n, 449 F.2d 1109, 1112 (D.C. Cir. 1971).

The Council on Environmental Quality ("CEQ") has promulgated regulations implementing NEPA that are binding on all federal agencies. 40 C.F.R. § 1500.3; Robertson v. Methow Valley Citizens Council, 490 U.S. at 354.

B. The BLM's Plan to Tier Site Specific Impacts Analyses Violates NEPA

NEPA's implementing regulations explain that agencies should consider connected, cumulative, and similar actions in the same impacts statement. "Connected actions" must "be considered together in a single EIS." *Thomas v. Peterson*, 753 F.2d 754, 758 (9th Cir. 1985); 40 C.F.R. § 1508.25(a)(1). Connected actions are those actions that:

i. Automatically trigger other actions which may require environmental impact statements.

ii. Cannot or will not proceed unless other actions are taken previously or simultaneously.

iii. Are interdependent parts of a larger action and depend on the larger action for their justification.

40 C.F.R. § 1508.25(a)(1).

Where two actions are "inextricably intertwined" they are connected actions that must be considered together. *Thomas*, 753 F.2d at 759; *Save the Yaak Committee v. Block*, 840 F.2d 714, 720 (9th Cir. 1988). Likewise, cumulative actions "which when viewed with other proposed actions have cumulatively significant impacts [] should [] be discussed in the same impact statement." 40 C.F.R. § 1508.25(a)(2). Similar, reasonably foreseeable actions also should be considered together in the same environmental review document when the actions "have similarities that provide a basis for evaluating their environmental consequences together, such as common timing or geography," and the "best way to assess adequately [their] combined impacts [...] or reasonable alternatives" is to consider them together. 40 C.F.R. § 1508.25(a)(3).

The requirements that connected actions, cumulative, and/or similar actions be evaluated together prevents an agency from dividing a single project into segments that individually seem to have limited environmental impact, but as a whole have considerable impact. *See Thomas v. Peterson*, 753 F.2d at 758. It is important for federal agencies to consider connected actions together in a single NEPA process as opposed to segmenting review. *Daly v. Volpe*, 514 F.2d 1106, 1110 (9th Cir. 1975) (where actions are interconnected in terms of fulfilling a joint purpose it may be necessary to conduct a single NEPA review); *Sierra Club v. U.S. Dept. of Energy*, 255 F. 2d 1177, 1184 (D. Colo. 2002).

Chapter 1.3.3 explains the tiering process to be used by the BLM for the proposed groundwater development project. According to this section, tiering includes an assessment of a combination of site specific actions and broader programs and issues in the initial (Tier 1) analysis, evaluating the effects of additional and site specific proposals more comprehensively in subsequent tiered NEPA analysis. It states that tiering is appropriate when it helps the lead agency focus on those issues ready for decision, deferring detailed consideration of those issues not yet ready for analysis due to uncertainty or lack of sufficiently detailed description of the proposed development. According to this section Tier 1 EIS will focus on the proposed alignment of the main pipeline and associated operational facilities (power transmission lines, pump stations, etc.) that are known. Details regarding future facilities for groundwater development including the number and locations of wells and the specific lengths and routes of collector pipeline and distribution power lines are unknown. The environmental effects of that future groundwater development including the long-term effects of groundwater production are the subject of programmatic analysis in Tier 1, but are based on a conceptual groundwater model that is incapable of predicting impacts at specific locations or to specific resources.

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At minimum, the BLM must consider all of the reasonably foreseeable impacts of the proposed project, including impacts of the proposed pumping at true production well sites as direct impacts of connected projects. This level of analysis would require the BLM to prepare a groundwater model based on sufficient data to enable it to predict impacts more precisely. Without such a model, a grant of a ROW would be premature because the analysis of impacts in the DEIS is inadequate.

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The BLM misuses tiering and wrongly segments the analysis and disclosure for the project, thus undermining full and fair public review of the impacts of the project in violation of NEPA. BLM must disclose and consider all of the connected, cumulative and similar projects' significant impacts together. Cumulative impacts analysis in multiple EISs is not sufficient where projects are so closely connected as they are here and will result in significant degradation of public lands that now serve multiple uses including providing high-quality occupied habitat for a threatened species.

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To correct these substantive deficiencies, the BLM must redo the DEIS and provide it for public review and comments.

C. <u>Chapter 1: The DEIS Fails to Adequately Evaluate the Purpose and Need for the Clark, Lincoln, and White Pine Counties Groundwater Development Project</u>

A DEIS must properly define the "purpose and need" of the action. <u>See</u> 40 C.F.R. § 1502.13 If the purpose and need of the action is too narrowly defined, then the range of alternatives considered will likewise be too narrow in scope. As described below, the Assessment of purpose and need that underlies the DEIS is woefully inadequate and is riddled with omissions and inconsistencies.

1. Las Vegas Valley Population Projections

C11 The DEIS cites and relies on SNWA's population projections to show the need for the Project. DEIS § 1.6.1. Without an analysis of the reliability of these projections, there is no way for the public to know whether or not they are reliable and provide a sound basis for decision. C12 It is apparent that the DEIS failed to consider alternative population projections because "[t]he BLM has no administrative or regulatory authority over the SNWA's demand projections, the timing or quantity of water required, potential alternative sources of water, or priorities established with respect to procuring additional sources." DEIS 1-12. However, this lack of regulatory authority does not relieve the BLM of the duty to evaluate SNWA's stated population projections for reliability.

C13 Further, throughout the brief assessment of future water demand, the BLM passively accepts projections of continued population growth without any examination of the sustainability of this trend or the obvious opportunities to moderate this trend through regular periodic planning summits to set population, and other, goals. DEIS 1-12, 13. See Sonoran Institute, Growth and Sustainability in the Las Vegas Valley (2010), attached hereto as Exhibit A. The recent economic downturn alone calls SNWA's projections into question.

C14 The DEIS also fails to acknowledge that population increases make it just as clear that there is an even greater need for aggressive implementation of conservation in the desert region that makes up SNWA's service area.

2. Conservation Measures and Future Demand Projections

To begin with, the DEIS does not provide sufficient specificity regarding what conservation measures have been, or reasonably can be expected to be, implemented in Lincoln and Clark Counties. Without this information it is not possible to assess the reasonableness of the assumed future demand on which the Groundwater Development Project is premised.

C15 Throughout the brief discussion of water demand and conservation in section 1.6.1, the DEIS betrays a bias in favor of obtaining additional water supply rather than aggressively pursuing additional available opportunities for increased conservation. See DEIS 1-12, 13. The assessment of future demand is limited to SNWA's per capita water use goal and contains no discussion of the conservation measures currently in place or those that are readily available to SNWA but have not been implemented.

The limited discussion reveals an inadequate consideration of this least environmentally harmful and most sustainable approach to avoiding future shortfalls. While SNWA makes much of its conservation programs in the media, the details reveal that there are many additional cost-effective steps that could be taken to reduce demand. In particular, SNWA and the Las Vegas area are not keeping up with the times or with many other cities in the West, and have failed to implement a number of readily available low-cost water conservation measures and policies that would achieve water savings substantial enough to satisfy most or all of the supposed future demand for additional water that SNWA seeks to use as justification for the Pipeline Project. Indoor water conservation, especially, has been largely ignored.

The Pacific Institute's review of single-family residential customers, hotels, and casinos indicates that installing water-efficient fixtures and appliances could reduce current indoor water demand by 40% in single-family homes and nearly 30% in hotels and casinos. Installing water efficient landscapes more widely and more aggressively could further reduce current outdoor water demand by up to 40% in single-family homes. Many of these efficiency improvements can be implemented at a lower cost and with fewer social and environmental impacts than developing new water supplies, including proposed efforts to tap groundwater systems in eastern Nevada via new pipeline infrastructure. See Pacific Institute & Western Resource Advocates, Hidden Oasis: Water Conservation and Efficiency in Las Vegas (2007), attached hereto as Exhibit B; see also Gleick and Cooley Rebuttal Report prepared for the Nevada State Engineer, attached hereto as Exhibit C; Sonoran Institute, Growth and Sustainability in the Las Vegas Valley (2010), attached hereto as Exhibit A.

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The failure of SNWA to implement these conservation measures is astounding given the fact that SNWA's service area lies in what naturally is a desert area, the economic and environmental costs of importing water are high, and significant additional cost-effective conservation measures are readily available.

Because the DEIS passively accepts SNWA's assertions concerning future water demand and fails to discuss current conservation measures or the potential to more aggressively pursue additional conservation measures, neither the BLM nor the public can have any confidence that the DEIS is based on an accurate or even reasonable assessment of projected future demand or reasonably achievable additional water conservation supplies.

3. Desalination Opportunities

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The purpose and need discussion also fails to adequately describe or address the opportunities to meet anticipated water demand through the construction of more cost effective desalination facilities. In particular, forward osmosis technology is likely to reduce energy costs associated with desalination by as much as 90% within the next 10 years, possibly before the pipeline will even begin to deliver water to the Las Vegas area. Such alternatives call the supposed need for the pipeline project into question. See Forward osmosis desalination articles attached hereto as Exhibits D through G.

4. Colorado River Supply[1]

When the growth boom ended in Southern Nevada, SNWA shifted its rationale for the Groundwater Development Project to a need to diversify its Colorado River-dependent portfolio because of the threat of drought drying up Lake Mead. However, the protocols developed by the

[1] See Pacific Institute, Municipal Deliveries of Colorado Basin River Water (2011), attached hereto as Exhibit H.

Colorado River Basin States and the federal government call for cuts of only 13,000 to 20,000 acre-feet annually (afa) in the SNWA allocation from the river in the event drought causes the water levels in Lake Mead to decline. Other basin states would face similar percentage reductions in their allocations. Those cuts, which would preserve access to the river for all users, would be, for Southern Nevada, far smaller than the conservation measures already achieved in metropolitan Las Vegas.[2] This means that even in the event of a deepening drought, Southern Nevada water users would not be seriously affected. Indeed, they have already conserved their way out of crisis and there is room for far greater conservation.

C18 The conservation achievements of Southern Nevada water users, along with responsible management of Colorado River resources, desalination opportunities, and the end of the rapid population and homebuilding booms of the early 2000s make the Groundwater Development Program unnecessary.

D. Chapter 2: The DEIS Fails to Adequately Describe the Clark, Lincoln, and White Pine Counties Groundwater Development Project

1. The DEIS Fails to Adequately Describe the Hydrogeologic Conditions in the Vicinity of the Project

C19 As detailed in the report of Dr. Tom Myers (attached hereto as Exhibit I), the DEIS is grossly deficient in many regards concerning the hydrogeology of Spring, Snake, Cave, Dry Lake, and Delamar Valleys and of the hydrologic impacts of the proposed project. That report and the criticisms contained therein are herby incorporated by reference in these comments.

C20 2. The DEIS Fails to Include an Adequate Description of the Proposed Project Facilities and Pumping Regimes

As a result of the BLM's decision to tier the analysis of site specific impacts, the DEIS's conceptual level description of the project lacks sufficient information for the public to gain an understanding of exactly what the project entails, how it will be managed, and what impacts would be likely to which resources. Without more detailed information and data gathering at this stage of the permitting process, neither the public nor the BLM has sufficient information to determine what level of impact the project will have on the resources described in the DEIS. For this reason, the DEIS is not only deficient, but is premature.

C21 3. The DEIS Fails to Include Cost Estimates

To allow the public to make a fair assessment of the feasibility of the project, the DEIS must include an independent accounting of the costs of the project to date, the costs of compliance with NEPA and other federal and state regulations to allow the project to go forward, the costs of construction and operation of the project, the financing costs associated with the project, future monitoring and mitigation costs, and the estimated cost per rate payer to support

[2] SNWA, "Water Resource Plan 09," December 2009, pp. 45-46.

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the project. It must also include documentation of SNWA's ability to finance the Project.

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SNWA's own most recent estimate put the cost at more than $15 billion exclusive of operating and monitoring and mitigation costs, which likely will be enormous. Southern Nevada Water Authority, Summary of Cost Estimate for Clark, Lincoln, and White Pine Counties Groundwater Development Project (June 2011) (attached hereto as Exhibit J); Hobbs, Ong & Associates, et. al., Ability to Finance Report to the Southern Nevada Water Authority (June 27, 2011) (Attached hereto as Exhibit K). Not only is the estimate incomplete given its failure to include operating and monitoring and mitigation costs, the estimate was prepared based on a conceptual plan of development, as opposed to a more concrete set of specifications, and thus, does not contain the specificity necessary to determine whether it is a reasonable estimate of the project's costs. White Pine County has attached a critique of SNWA's financing report by Sharlene Leurig of Ceres that was submitted by White Pine County to the Nevada State Engineer in the hearing on SNWA's water rights applications in Spring, Cave, Dry Lake, and Delamar Valleys. The report is attached hereto as Exhibit L; see also, Ceres, The Ripple Effect: Water Risk in the Municipal Bond Market (2010), attached hereto as Exhibit M.

E. Chapter 2: The DEIS Fails to Consider a Reasonable Range of Alternatives to the Clark, Lincoln, and White Pine Counties Groundwater Development Project

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The BLM's DEIS fails to consider a reasonable range of alternatives to the Project. Under NEPA, federal agencies must "study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources." 42 U.S.C. § 4332(2)(E); 40 C.F.R. § 1508.9(b). The discussion of reasonable alternatives section is the "heart" of any environmental analysis under NEPA. 40 C.F.R. § 1502.14. The DEIS limited its consideration of alternatives to alternate pumping scenarios and failed to explore different levels of pumping, alternative sources of water, piping from different sources, desalination, different combinations of pumping among valley fill and carbonate wells, various mitigation measures, and a water conservation alternative. See Section C, supra, discussions re Conservation and Desalination and accompanying Exhibits. This narrow focus does not constitute a reasonable range of alternatives. Thus, the DEIS is inadequate for the purpose of providing a basis for informed decision making.

F. Chapter 3: The DEIS Fails to Adequately Evaluate Effects of the Clark, Lincoln, and White Pine Counties Groundwater Development Project

1. The DEIS is not Based on Adequate Baseline Data

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The BLM's DEIS should have established the proper baseline upon which to base its impacts analyses and conduct the requisite "trends analysis," i.e., an assessment of the environmental impacts of all activities affecting the various resources over an extended period of time. Only by properly defining the baseline and engaging in a trends analysis can the BLM get a sense of the changes that have occurred and will occur over time. At a minimum, baseline data on water rights and claims (unrecorded vested, recorded vested, permitted, certificated, and applications), historic and current water uses, locations of all springs and seeps (on both private and public land), locations of all wet meadows and wetlands, locations of water-dependant flora

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and fauna, aquifer recharge rates, and information on the connectivity between the alluvial groundwater and carbonate system throughout the affected region is needed in order to properly analyze the impacts (direct, indirect, and cumulative) of the proposed action. Because the DEIS fails to adequately establish a baseline, it is inadequate under NEPA.

2. The DEIS is not Based on the Best Scientific Information Available

All agencies, including the BLM "shall insure the professional integrity, including scientific integrity, of the discussions and analyses in environmental impact statements." 40 C.F.R. §1502.24. Pursuant to NEPA, information included in a DEIS "must be of high quality." 40 C.F.R. § 1500.1(b). Accurate "scientific analysis [is] essential to implementing NEPA." Id. While a DEIS may not be expected to reference or rely on every study or opinion, the state of scientific knowledge on a particular subject must be fairly represented in a balanced manner. Moreover, a DEIS must contain a reasoned analysis in response to conflicting data or opinions on environmental issues.

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Under NEPA, an agency must honestly address the various uncertainties surrounding the scientific evidence upon which it relies in its environmental evaluations. The agency has a duty to respond to credible opposing points of view, and it may not ignore reputable scientific opinion. See, e.g., Seattle Audubon Soc'y v. Espy, 998 F.2d 699, 704 (9th Cir. 1993); Public Service Co. v. Andrus, 825 F. Supp. 1483, 1496-99 (D. Idaho 1993); see also Sierra Club v. Watkins, 808 F. Supp. 852, 864-69 (D.D.C. 1991). An agency's NEPA analysis must expose scientific uncertainty regarding the risk of a proposed action and inform decisionmakers of the full range of responsible scientific opinion on the environmental effects of the proposed action. Friends of the Earth v. Hall, 693 F.Supp. 904, 926, 934 (W.D. Wash 1988). Also, federal agencies are responsible for overseeing and ensuring the accuracy of environmental impact statements produced by contractors. 40 C.F.R. § 1506.5(c).

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The DEIS does not present and is not based upon the required high quality scientific data and analysis required by NEPA. In order to adequately analyze the direct, indirect, and cumulative impacts of the proposed action, the BLM will need to review and collect more scientific data. At a minimum, the BLM needs to complete sufficient pump tests (with monitoring) to detail the variability in hydraulic conductivity across the basins. In addition, the BLM needs to prepare a detailed groundwater model that includes all of the basins in the carbonate province and the overlying valley fill aquifers and contains sufficient precision to model effects to specific sites and resources within these basins. In order to properly account for the uncertainty in modeling, the BLM should also prepare a detailed and comprehensive monitoring and mitigation plan that includes triggers and action forcing mechanisms, and carefully review and consult all other available (or soon be available) studies on the aquifer system and the impacts of groundwater pumping on the area's natural resources.

3. Chapter 3.0.3 Incomplete and Unavailable Information

40 C.F.R. § 1502.22 provides that an EIS must disclose any incomplete and unavailable information. Under NEPA, an agency must honestly address the various uncertainties

surrounding the scientific evidence upon which it relies in its environmental evaluations.

C27 In light of the listed incomplete or unavailable information, especially that related to the conceptual model, this DEIS is premature and should be updated and resubmitted for full public review after the information described in this section is obtained.

C28 The DEIS is missing critical information on springs, streams, seeps, and wetlands in the "large" regional study area which may be directly affected by pumping drawdowns. The proposed project could have massive impacts over a huge area of eastern Nevada and western Utah. However, the size of the area does not provide an acceptable excuse for the paucity of information in the DEIS on the affected environment, especially the desert's scarce water resources, and the impacts of the GWD project.

C29 The DEIS provides no information on tracking of missing information would be collected, who would collect it, and how the public would have access to such information. The DEIS also fails to disclose the costs of collecting future information and the timeframe for collecting such information. In any event, without knowing the majority of water resources to be affected by the GWD project, it seems futile for anyone to collect information on dried up springs discovered in the future. How would collecting missing information affect BLM ROW decisions which have already been made or any future decisions?

C30 Other incomplete and unavailable information - visual resource information, soils, wildlife information, special status species, Great Basin National Park, caves, groundwater flow modeling/water resource information, and climate change - is critical for the public and the BLM to make informed comments and decisions on this DEIS . The EIS process should not proceed until this information is available to analysts and the public.

C31 In addition to inadequate information regarding affected resources, the DEIS is lacking critical information about the project and its impacts to these resources. In particular, project descriptions for well sites have not been provided to the BLM by the applicant. Using "groundwater development areas" in the DEIS for impacts analysis purposes leaves out of the NEPA analysis large areas with SNWA water rights applications. If approved, these additional water resources would be transported through the SNWA pipeline on the BLM ROW.

C32 The DEIS inappropriately limits the drawdown impact areas to those which appear between the estimated 1 and 10 foot drawdown contours, even though major impacts could occur in drawdown areas less than 10 feet. BLM justifies eliminating the areas affected by 1-10 foot drawdowns because that is what the agency has done in the past. However, such a limitation is inappropriate given that areas affected by less than a 10 foot drawdown may cover hundreds of square miles, including springs, wetlands, sub-irrigated meadows, wells, and vegetation. Unanalyzed climate change impacts to the study area could also affect water-dependent resources.

Likewise, limiting the timeframes of impacts analysis in the DEIS to only 200 years constitutes a failure to disclose all of the potential impacts of granting the ROW request for the proposed GWD project. It is an arbitrary decision, because BLM in Nevada commonly analyzes the effects of open-pit mines that will take more than 200 years to fill with groundwater.

C33 Finally, the DEIS does not disclose when equilibrium would be reached with various pumping amounts in the Proposed Action and alternatives or the relevance of this missing

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information. Does the BLM hydrological model show that significant pumping impacts continue to occur beyond 200 years until equilibrium is reached? If so, the DEIS fails to disclose the fact that pumping will cause a large amount additional damage to public lands and resources beyond the 200 year timeframe.

4. The DEIS Fails to Identify Acceptable Levels of Impacts

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On page 3-1, the DEIS states that Chapter 3 answers the question: "if impacts still occur at a higher than acceptable level of intensity after applying all avoidance and protection measures, what mitigation measures are recommended to approve additional resources?" However, the DEIS fails to disclose the "acceptable" levels of impacts. Deferring this critical determination to some future process not subject to NEPA prevents the public and the BLM from making informed comments and decisions on the DEIS. There may be substantial differences of opinion among decisionmakers, stakeholders, and the affected public about the definition of "acceptable" levels of impact. This critical missing information undermines the impacts analysis in the EIS.

5. Chapters 3.1 – 3.19 The Discussion of Affected Environment and Environmental Resources is Deficient

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The discussion of impacts to the environmental resources and values contained in Chapters 3.1 through 3.19 in the DEIS are deficient for multiple reasons thoroughly discussed in comments submitted by the Great Basin Water Network, and hereby incorporated by reference.

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Additionally, the deficiencies related to water resources and hydrology (Chapter 3.3) are described in detail in the Technical Memorandum by Tom Myers dated October 5, 2011 and attached hereto as Exhibit L.

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Deficiencies related to impacts to vegetation resources (Chapter 3.5) are described in detail in the report submitted to the Nevada State Engineer by the Great Basin Water Network, White Pine County, and others authored by Dr. Duncan Patten and attached hereto as Exhibit N; see also Patten et al., Isolated Springs and Wetlands (2008), attached hereto as Exhibit O; Elmore Regional Patterns of Plant Response to Changes in Water, attached hereto as Exhibit P.

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Deficiencies in the discussion of terrestrial wildlife (Chapter 3.6) and aquatic biological resources (Chapter 3.7) are also described in detail in the DEIS comments submitted by Dr. Jim Deacon and attached hereto as Exhibit Q, and the reports submitted to the Nevada State Engineer by the Great Basin Water Network, White Pine County, and others authored by Dr. Jim Deacon and attached hereto as Exhibits R and S. See also Deacon, J. et al., Fueling Population Growth in Las Vegas: How Large-scale Groundwater Withdrawal Could Burn Regional Biodiversity, Vol. 57, No. 8 BioScience 688 (September 2007), attached hereto as Exhibit T.

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Deficiencies in the discussion of socioeconomics (Chapter 3.18) are described in detail in the Memo by Karen Rajala, attached hereto as Exhibit U, and in the Snake Valley Socio-Economic Analysis, attached hereto as Exhibit V. Finally, additional information on the socioeconomics and socioeconomic potential of White Pine County is contained in Exhibits W through HH; see also Dr. Maureen Kilkenny reports to the State Engineer by the Great Basin Water Network, White Pine County, and others in the hearing on SNWA's water rights applications in Spring, Cave, Dry Lake, and Delamar Valleys, attached hereto as Exhibits II and JJ.

6. Chapter 3.20 The Monitoring and Mitigation Regime Described in the DEIS is Inadequate

The persistent dynamic response of the groundwater system to drawdown has profound implications for the monitoring and management scheme proposed in the DEIS. Indeed, it strongly indicates that the monitoring and management system will not work. As discussed previously, and in attached documents by Dr. Myers and Dr. Bredehoeft, the Project is estimated to result in severe overdraft.

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The likely long-term response of the groundwater system to the proposed extraction of native groundwater has been analyzed by Dr. John Bredehoeft. See John D. Bredehoeft, Report on the Hydrogeology of Proposed Southern Nevada Water Authority Groundwater Development (2011), attached hereto as Exhibit KK. Dr. Bredehoeft concludes that once the groundwater system is perturbed the effects of the perturbation from pumping will ripple outward though the system slowly with great persistence. The drawdown from pumping will migrate slowly outward from the area of the pumping wells and will continue to decline at some distance from the wells for many years, even after pumping has stopped. Consequently, even subtle indications of adverse impacts might not be observed for several decades. As a result, once an adverse impact to the system is observed by the proposed monitoring system, it will be too late to reverse the impact by stopping the pumping.

An analysis of the groundwater system's long term response to the proposed pumping, by Dr. Bredehoeft, reveals that the impacts from the drawdown will persist well beyond 200 years.

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Close monitoring of water levels and quality in the groundwater system may provide some early warning that the project is creating adverse environmental impacts even though these impacts may be impossible to stop. However, early warning signs of adverse impacts will be very subtle and small drawdowns due to the Project could easily be confused with impacts of nearby pumping or unusual climatic events. Because of the potential for long lasting effects, the Project would have to be halted very early on in order to prevent the significant adverse impacts discussed above. Given the enormous investment of funds necessary before project operations even begin, it is implausible to expect that the Project would be shut down early in its life where indications of impacts are subtle. See Bredehoeft Report, Exhibit KK; Bredehoeft, J. & Durbin, T., Ground Water Development—The Time to Full Capture Problem, Groundwater, v. 47, pp. 506-514 (2009), attached hereto as Exhibit LL; Bredehoeft, J.D., Monitoring regional groundwater extraction; the problem: Ground Water (2011), attached hereto as Exhibit MM; Bredehoeft, J.D., The water budget myth revisited: why hydrogeologists model, Ground Water, v. 40, pp. 340-345 (2002), attached hereto as Exhibit NN.

The DEIS sets up a system where mitigation decisions are made by two committees. Before any action could be taken to remedy or mitigate an unacceptable environmental impact, a decision to do so would have to be based on a consensus that such an impact had occurred or was beginning to occur. This procedure alone would guarantee delay and potential failure to recognize and respond to any environmental harm caused by the Project's depletion of the aquifer.

Even worse, the make-up of the committees virtually guarantees that no meaningful remedial action would ever be taken. Both committees are to have representatives from SNWA. Thus, given that the committees operate on a consensus framework, the committees that control the entire process of acknowledging environmental impacts and deciding how to respond to such impacts have been structured so as to favor continued extraction of groundwater. The limited provision for third party involvement in the case that consensus is not reached is vague enough that there is no guarantee that the determination of the third party will carry any weight or have any force.

G. The DEIS Fails to Adequately Consider Indirect Impacts.

C42

The DEIS fails to adequately analyze the indirect effects of the Project. Indirect effects are effects that are caused by the action but occur later in time or are further removed in distance. See 40 C.F.R. § 1508 (b). Indirect effects "may include growth inducing effects or other effects related to induced changes in pattern of land use; population density or growth rate; and related effects on air, water, and other natural resources." Id. Here, the indirect effects of the Project include, but are not limited to, the future growth and development of the Las Vegas Valley and the indirect effects on the region's human and wildlife communities that will result from the proposed pumping of the aquifer. Unfortunately, the DEIS fails to take a meaningful, let alone the required "hard," look at these impacts.

H. The DEIS Fails to Adequately Consider Cumulative Impacts

The DEIS does not contain the required hard look at the cumulative impacts of the proposed action. NEPA and the CEQ regulations require the discussion of cumulative impacts in EISs. 40 C.F.R. § 1508.7; Thompson v. Peterson, 753 F.2d 754-758 (9th Cir. 1985); LaFlamme v. Federal Energy Regulatory Comm'n, 852 F.2d 398, 402 (9th Cir. 1988) (individual project cannot be considered in isolation without considering the net impact that all projects in an area may have on the environment). The regulations define a "cumulative impact" as:

> The impact on the environment which results from the incremental impact of the action when added to past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

40 C.F.R. § 1508.7.

The Fifth Circuit, in a well-cited opinion, set a five-prong standard for what constitutes a "meaningful cumulative effects study." Fritiofson v. Alexander, 772 F.2d 1225, 1245 (5th Cir. 1985); see also City of Carmel-By-The-Sea v. U.S. Dept. of Transp., 95 F3d 892, 902 (9th Cir. 1996) (adopting the Fritiofson standard). The standard requires the EIS to identify:

1) the area in which effects of the proposed project will be felt;
2) the impacts that are expected in the area from the proposed project;

3) other actions — past, proposed, and reasonably foreseeable — that have had or are expected to have impacts in the same area;
4) the impacts or expected impacts from these other actions; and
5) the overall impact that can be expected if the individual impacts are allowed to accumulate.

City of Carmel-By-The-Sea, 95 F.3d at 902. The standard requires that "probable impacts be identified and considered." Fritiofson, 772 F.2d at 1245 n15.

C43 The DEIS does not properly analyze the cumulative effects of the Project because it does not: (1) identify the significant cumulative effects issues associated with the proposed action; (2) establish the proper geographic scope for the analysis; (3) establish an appropriate time frame for the analysis; or (4) identify other actions affecting the resources, ecosystems, and/or human communities of concern. Thus, the DEIS is deficient in all regards concerning cumulative effects.

C44 In this case, establishing the proper geographic scope or boundary for a cumulative impacts analysis is extremely important because the proposed action will have direct, indirect, and an "additive" affect on resources *beyond the immediate* area. To determine the appropriate geographic boundaries for a cumulative effects analysis, therefore, the BLM's DEIS should first have: (1) determined the area and resources (i.e., the aquifers) that will be affected by their proposed action (the "project impact zone"); (2) made a list of resources within that area or zone that could be affected by the proposed action; and (3) determined the geographic areas occupied by those resources outside the immediate area or project impact zone. The largest of these areas would be the appropriate area for the analysis of cumulative effects. By way of example, for resident or migratory wildlife, the appropriate geographic area for the cumulative impacts analysis will be the "species habitat" or "breeding grounds, migration route, wintering areas, or total range of affected population units." See e.g., NRDC. v. Hodel, 865 F.2d 288, 297 (D.C. Cir. 1988) (agency violated NEPA by failing to consider the synergistic effect of simultaneous development on migratory whales).

C45 Indeed, because the Project will directly impact a vast aquifer system (valley fill and carbonate), the scope of the cumulative impacts analysis in the DEIS must encompass the entire aquifer system. Some of Nevada's and Utah's aquifers are connected among basins. As such, the development of water resources in one basin may affect water levels in or discharges to other basins. It therefore is imperative that the scope of the BLM's cumulative impacts analysis extend far beyond Spring, Snake, Cave, Dry Lake, and Delamar Valleys, transcend State boundaries, and include the entire aquifer system (this includes the States of Idaho, California, and Utah). Unfortunately, however, the DEIS fails utterly to engage in this broad analysis.

According to the CEQ, the "most devastating environmental effects may result not from the direct effects of a particular action, but from the combination of individually minor effects of multiple actions over time." The requirement to consider cumulative impacts, therefore, is designed to avoid the "combination of individually minor" effects situation – to avoid the "tyranny of small decisions" or "death by a thousand cuts" scenario. See e.g., Grand Canyon Trust v. FAA, 290 F.3d 339, 346 (D.C. Cir. 2002).

C46

The DEIS therefore should have taken into account and analyzed a number of state, private, and other federal actions as well as natural occurrences or events that have taken place (historic and current pumping), are taking place, or are proposed to take place that will similarly impact the region's aquifers, wildlife populations and habitat, and human communities (i.e., existing rights, domestic wells). Individually, each groundwater pumping activity – though serious – may not rise to the level of posing a significant risk to the aquifer. Collectively, however, the impacts of all of these and other activities – whether conducted by private individuals, state agencies, or other federal agencies – may be significant and must be analyzed. See e.g., Grand Canyon Trust, 290 F.3d at 346 (discussing collective impacts to Zion National Park); NRDC v. Hodel, 865 F.2d 288 (D.C. Cir. 1988) (discussing collective impacts to migratory whales). As the D.C. Circuit Court noted, federal agencies must "give a realistic evaluation of the total impacts [of the action] and cannot isolate the proposed project, viewing it in a vacuum." Grand Canyon Trust, 290 F.3d at 342. Even "a slight increase in adverse conditions . . . may sometimes threaten harm that is significant. One more factory . . . may represent the straw that breaks the back of the environmental camel." 290 F.3d at 343 (quoting Hanly v. Kleindienst, 471 F.2d 823 (2nd Cir. 1972)).

In this regard, too, the DEIS is inadequate on its face and must be redone.

I. Chapter 5: The Public Participation Process for Comment on the DEIS Is Inadequate

C47

The public participation process for comment on the DEIS was inadequate to provide for meaningful public participation. The Project presents complex and highly controversial issues of great public import. The complexity of the issues that the public must consider and comment on within the time period provided is shown by the fact that it took SNWA, the BLM, and other cooperating agencies many years to produce the DEIS. To provide the public with a reasonable opportunity to address these issues, the BLM should have provided the public with enough time to carefully consider the DEIS and to consult with people possessing the necessary expertise to independently evaluate the issues, particularly considering the fact that the public must do this without access to the awesome resources of SNWA, the BLM, and the other state and federal agencies that contributed to the preparation of the DEIS. This is especially true given that the Nevada State Engineer's hearings on SNWA's water rights applications in the project basins coincide with the comment period, making it especially difficult for the public to participate fully in both processes. Given these factors, the public comment period for the DEIS should have been at least 180 days.

III. CONCLUSION

Thank you for providing this opportunity to submit comments on the Draft EIS for the Clark, Lincoln, and White Pine Counties Groundwater Development Project. White Pine County sincerely appreciates the opportunity to participate in this and other important decisions affecting public resources in Nevada. The significance of these interconnected water development projects in terms of the impacts to human communities in rural Nevada and Utah and the survival of unique ecosystems and endemic species in the Great Basin region cannot be overstated.

We hope you find these comments to be helpful, informative, and useful in your efforts to comply with NEPA. If you have any questions or comments, or wish to discuss the issues raised in these comments in greater detail, please do not hesitate to contact me.

Dated: October 11, 2011

Submitted by

for

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On Behalf of:

White Pine County, Nevada, Cooperating Agency

Technical Memorandum

October 5, 2011

To: White Pine County Commission

From: Tom Myers, Ph.D., Hydrologic Consultant

Subject: Review of the SNWA Pipeline Draft Environmental Impact Statement

The Bureau of Land Management (BLM) released the Clark, Lincoln, and White Pine Counties Groundwater Development Project Draft Environmental Impact Statement (DEIS)(BLM 2011) in early June 2011. This technical memorandum reviews that DEIS with a particular emphasis on impacts to White Pine County and Steptoe Valley. The memorandum has five primary sections reviewing the DEIS and supporting documents. First is a Summary and Conclusion of the overall memorandum. The next three sections review the actual DEIS (BLM 2009), the Conceptual Model Report (SNWA 2009a), and the SNWA Numerical Model (SNWA 2009b, 2010a, 2010b), respectively. Additionally, the fifth section is an analysis of the DEIS proposed action and a reduced pumping option for Spring and Snake Valleys using the Myers (2011a and 2011b) numerical groundwater model.

Summary and Conclusions

This DEIS has highlighted the potentially devastating impacts that will occur to the environment of eastern Nevada and far western Utah if the pipeline project is developed and SNWA pumps groundwater at up to the full application amount. These impacts are obvious even though the models used for the BLM's are fraught with errors and assumptions which bias the model to underpredict the impacts.

C48 A major deficiency with the DEIS is that it limits impacts to those which occur within the 10-foot drawdown cone, although major impacts can occur with less drawdown, including dried springs and wetlands and effective loss of water rights for wells that depend on a few productive zones. A second major deficiency is the DEIS considers impacts for only 200 years into the future. Groundwater model simulations do not reach equilibrium within that time frame, therefore the impacts will continue to increase after 200 years. Unless there are guarantees that the pumping will cease in 200 years, the DEIS must consider the impacts of pumping until equilibrium is reached. Based on the Myers model simulations, equilibrium requires at least 10,000 years.

C49 The groundwater model used to simulate the impacts of this project has many problems and is inappropriate for analyzing the impacts of this project. For one, it is too coarse to simulate such significant drawdown; the model cells are too large and the model layers too thick. Drawdown amounts at the wells are grossly underestimated as a result. The model is poorly conceptualized as evidenced by the fact that model simulations do not converge without

C49 cont'd the modelers having set all layers as confined. The model poorly simulates the area water balance and does not even attempt to simulate most springs. It has also placed fault barriers and conductive zones so as to minimize the predicted impacts to important spring.

The DEIS model shows that groundwater drawdown would exceed 1000 feet at the application points of diversion and the extent of drawdown would cover hundreds of square miles, drying springs and wetlands over most of that area. The distributed pumping option analyzed as the proposed action in the DEIS, would expand the extent of drawdown and dry even more springs and wetlands. The proposed action would impact 18 nearby basins, not just the five targeted for pumping. Steptoe Valley would experience drawdown up to 50 feet in its southern end and have significant amounts of water drawn toward Spring Valley.

Draft Environmental Impact Statement

The DEIS considers the impacts of the Southern Nevada Water Authority (SNWA) developing a right-of-way for its water rights applications in Snake, Spring, Cave, Dry Lake, and Delamar Valleys. This technical memorandum reviews exclusively the aspects of the DEIS that deal with pumping the groundwater. The DEIS review considers the alternatives, DEIS hydrogeology, and predicted impacts.

C50 **The DEIS fails to consider a range of pumping options that would involve pumping different amounts of water**. The DEIS considers pumping the full application amount for the five valleys, at the original application points of diversion (PODs) and at distributed pumping locations. Just one alternative (A) considers a reduced pumping amount, although another alternative considers intermittently pumping the full application amount. Considering the distributed pumping layout with a much reduced pumping rate would provide a comparison of the marginal impacts of increasing the pumping from low rates to much higher rates.

Inadequacy of Ten-Foot Drawdown Analysis

C51 The BLM presents impacts only to the ten-foot drawdown level, for reasons described in chapter 3 (p. 3.3-87). They do this even though they acknowledge that lesser drawdowns could cause additional impacts that they are ignoring. “Drawdowns of less than 10 feet could reduce flows in perennial springs or streams that are controlled by discharge from the regional groundwater flow system, which in turn could potentially cause declines in the diversity and abundance of associate riparian flora and fauna that may only be able to tolerate water declines on the order of a few feet” (*Id.*). BLM has acknowledged that the use of 10-foot drawdowns for their analysis is a failure to disclose all potential impacts from the pumping project.

C51 cont'd

BLM makes several excuses for limiting the analysis to the 10-foot drawdown. First, the "BLM does not believe that it is reasonable or appropriate to use the regional model to quantify changes in groundwater elevation" (*Id.*) because of the model's regional scale and "unavoidable uncertainty associated with the model predictions" (*Id.*). They could have developed a more detailed model for the targeted valleys, such as Myers (2011a and 2011b). Even so, understanding that predictions are uncertain is much better than just ignoring the impacts.

The point about uncertainty in the predictions is irrelevant. If the model has been objectively constructed, each contour line represents an expected value for that contour value. In the absence of obvious model bias, model error should be normally distributed (Hill et al 1998). There is just as much chance that the contour is underestimated as overestimated. All predictions should be treated as though there is a confidence band around them. If the BLM has concerns about the uncertainty, they should require the modeler to put confidence bands around the contour estimates.

C52

Second, the BLM is concerned that 10 feet is similar to the magnitude of natural variation. Seasonal variation in water levels at any point may exceed the predicted drawdown, but a constant drawdown would cause a new median level around which the natural changes would fluctuate. Where seasonal variability causes springs or wetlands to dry, the additional drawdown may cause them to be dry longer. The DEIS fails to disclose the impacts to those resources that have a significant natural variability.

C53

Third, the BLM justifies its use of 10-foot drawdown by mentioning other DEISs in which it used similar reasoning. The fact that the BLM did it wrong in the past is not a justification for doing it wrong in this project. This is particularly important because the area between the predicted 10-foot and 1-foot drawdown may be hundreds of square miles.

The following are reasons to include lesser drawdowns.

- Springs can be dried even if the water table is lowered less than 10 feet. Not identifying the springs between 10-ft and 1-ft of drawdown is a failure to present potential impacts of the proposed project.
- Lowered water tables can dry or significantly change the wetland ecosystem types. The same argument as for springs can be made for wetlands. A wetland that is naturally stressed could be killed with just a few feet of drawdown.
- Less than 10 feet of drawdown can affect wells with a productive zone near the top of the screens.

Halford and Plume (2011) presented drawdown contours as low as 0.3 ft, without making a detailed uncertainty analysis. They did mention the uncertainty in the placement of a contour as being equal in magnitude as the length of a side of a cell.

C54

Inadequacy of Limiting the Analysis to 200 Years

The DEIS considers the alternatives for only 200 years, which is a failure to disclose all the potential impacts of granting this right-of-way and allowing the concomitant pumping. This is an insufficient time period because the groundwater systems do not even approach equilibrium within 200 years. Equilibrium would occur at the time that the pumping essentially ceases to remove groundwater from storage. It is the time at which the pumping has captured an equivalent amount of natural discharge, meaning wetlands evapotranspiration (ET) and spring discharge. At this point the drawdown will have reached its maximum extent and the impacts caused by the project will be at a maximum. The DEIS does not identify these potential impacts.

Predicted water levels for various wells, for example, well 184 N11E6713B1 USBLM (DEIS, Figure 3.3.2-7), begin to decrease by the time of full build-out, but in the long-term trend almost linearly downward. Two hundred years after full build-out, the water levels are decreasing almost as rapidly as just a few years after full build-out. This demonstrates clearly that the impact will continue to worsen far beyond the time period as presented in the DEIS.

The 200-year time frame is arbitrary. The BLM in Nevada commonly analyzes the effects of open pit mines that will take more than 200 years to fill with groundwater, thereby forming a pit lake[1]. Longer analyses are necessary even though the predictions become more uncertain. The choice the BLM leaves the reader is between uncertain predictions and no predictions at all. The issues regarding uncertainty beyond 200 years are similar to those discussed and rejected above regarding the use of a 10-foot drawdown cone. The uncertainty could be considered with a stochastic analysis wherein they present the drawdown contours and hydrographs with a confidence band.

Unless there is a viable plan for ending the project after 200 years, the analysis should consider a much longer pumping period.

C55

Alternatives Analysis

The BLM presented impacts of its various alternatives and the No Action alternative as a series of drawdown maps and hydrographs of water levels and fluxes. The impacts of the project alternatives are the difference in the drawdown caused by the sum of the No Action and project alternatives and the No Action alternative. Although not stated in the DEIS, this assumes that drawdowns for No Action and the projects is additive.

The No Action alternative assumes that too many existing rights will be developed in the future. For example, No Action includes the future development of water for a power plant in Steptoe Valley, SNWA developing the 8000 af/y it has on the ranches it owns in Spring Valley, and the water rights to be transferred from Lake Valley to Coyote Springs (DEIS, chapter 2,

[1] Examples of such pit lakes are Betze/Post, Gold Quarry, and Twin Creeks.

C55 cont'd Figure 2.2-1). The impacts caused by these projects may not occur; if SNWA is not granted water rights in Spring Valley, it may not develop the other rights it has purchased. **The BLM should develop a No Action alternative that includes only existing pumping. The other options should be considered reasonably foreseeable future actions**.

The impacts of the action alternatives should be determined without pumping the No Action alternatives simultaneously. This would remove the potential nonlinearities which could skew the estimates of the with-project impacts. Predicted impact would be estimated with certainty that they are not potentially due to existing pumping.

C56 **The DEIS ignores too many applications that should be considered a reasonably forseeable future action**. Applications listed as APP, RFA, or RFP in 11 basins total almost 488,000 af/y (Table 5). BLM did not adequately justify its decision regarding which to consider as reasonably foreseeable. The BLM should include more of the potential future uses, especially since some are owned by credible entities including SNWA, Vidler, and Lincoln County.

Table 1: Total duty for pending applications in eleven basins within the study area.

Basin	Basin	Duty	Comment
210	Coyote	202268	The duty was determined by converting the proposed
205	L Meadow V	14632	
204	Clover	14479	
203	Panaca	3552	
202	Patterson	54364	Includes Vidler/Lincoln Cty from 1989 and various
195	Snake V	61598	Does not include NPS instream flow application or 1977
184	Spring V	100645	Includes many irrigation applications, including many by
183	Lake V	0	Valley has many change apps for moving water to Coyote
182	Cave V	0	The database includes SNWA's applications as RFP, not as
181	Dry Lake V	2388	The database includes SNWA's applications as RFP, not as
180	Delamar V	33018	The database includes SNWA's applications as RFP, not as
	TOTAL	486944	
The duty includes applications listed as APP, RFA, or RFP; application, ready for action, or ready for action protested.			

C56 cont'd The DEIS ignores the effects that developing existing surface water rights may have on groundwater. Surface water rights affect groundwater rights in two ways. First, groundwater pumping lowers the water table which may induce recharge from perennial streams; if those streams have been diverted there will be no induced recharge. Second, surface water rights to runoff may divert water that naturally would become recharge further downstream, at the intersection with alluvial fans for example, and reduce the perennial yield of a basin.

C57

Drawdown Effects

The DEIS presents many maps and figures showing drawdown for the various alternatives. **Even though SNWA's analysis underestimates the drawdown, the results**

C57 cont'd **presented in the DEIS show that any of the alternatives will cause massive drawdown and dry up much of the valleys within the 200-year analysis period.**

Alterative B, pumping the original application amounts at the original locations cause the deepest drawdowns within the targeted valleys. The drawdowns, which exceed 1000 feet at the wells, are excessive. The drawdown results from the aquifers not being able to provide 6 or 10 cfs at an original application point. The proposed action, a distributed pumping option, which would pump from 800 to 1000 gpm from as many as five times as many wells, cause a more widespread drawdown that is not as deep at specific well points.

DEIS Table 3.3.2-6 tabulates the devastation that would be caused by the proposed action. At full build-out, and 75- and 200-years after full build-out, drawdown will affect 7, 16, and 18 basins, respectively; the proposed action clearly affects much more than the target basins. It will also affect 6, 80, and 112 miles of perennial streams and 25, 145, and 212 surface water rights, respectively. Well over a hundred springs could be affected.

DEIS Table 3.3.2-6 also demonstrates how pumping the proposal will dry up Spring Valley. At full build-out, and 75- and 200-years after full build-out, the percent reduction in ET and spring discharge is 45, 77, and 84 percent, respectively. The similar values for Snake Valley are 0, 28, and 33 percent, respectively. The Snake Valley full build-out reduction is 0 because project pumping in Snake Valley only begins at full build-out. Big Springs would be dry within 75 years of full build-out. Numerous springs in Spring Valley will be substantially dried (DEIS, Table 3.3.2-7).

Predicted drawdown reaches the model boundary at Pine Valley (DEIS, p. 3.3-110). This demonstrates the BLM made an error in establishing the boundaries for the numerical groundwater model.

The maps and tables present the best estimates from the calibrated model (SNWA 2009b). Although the model has many errors and great uncertainty, if it has been calibrated objectively, the estimates may be considered an expected value (Hill et al 1998). This is similar to determining the mean where the observations around the mean are the variability but the mean may be an expected value. In general, the estimates should not be considered conservative. Drawdown and springflow reductions are as likely to have been underestimated as overestimated.

One model simplification likely causes an underestimate in the extent of drawdown. That is the assumption that groundwater flow is Darcian and that the aquifers are a homogeneous porous media. If the pumping affects a fracture or other preferential flow zone, it could draw water from much further away than the porous media simulation allows.

C58

Steptoe Valley

Steptoe Valley is of special interest because it is not directly targeted by SNWA's pumping and it is the center of White Pine County's population. However, the DEIS shows that

C58 cont'd the pumping will affect Steptoe Valley with drawdown and by drawing more flow into Spring Valley.

Drawdown in Steptoe Valley due to this project will be as high as 50 in the southeast corner of Steptoe Valley (BLM, 2011, Figure 3.3.2-5). This peak drawdown occurs under the Schell Creek Mountains and likely changes the location of any current groundwater divide between the valleys. The drawdown will divert some of the drawdown that occurs in the Schell Creek Mountains.

Based on steady state and project water budget estimates, 1500 af/y of water could be drawn from Steptoe Valley. The predictions report (SNWA 2010a) shows basin-by-basin water budgets for each pumping scenario at three times – full build-out, and 75- and 200-years post full build-out. Model file IBFUCTH814_1944SS shows that under steady state conditions in SNWA's groundwater model, Steptoe Valley provides 500, 2600, 3600, 4400, 8800, and 15,500 af/y to Tippet, Cave, Jakes, Lake, Spring, and White River Valley, respectively, and receives 12,800 af/y from Butte Valley. The sum of the interbasin flow originating in Steptoe Valley is 35,400 af/y and the net interbasin flow is 22,600 af/y from Steptoe Valley.

File No_Action_ucpd949_ZB_2250_200.pdf shows that the No Action alternative increases the interbasin flow from Steptoe Valley to 22,700 af/y 200 years after full build-out. File ZB_2250_200 for the proposed action shows the flow from Steptoe increases to 23,500 af/y 200 years after full build-out, an increase of 800 af/y from the No Action alternative. The DEIS model predicts the current PODs (alternative B) will increase the flow from Steptoe to 24,000 af/y, or 1300 af/y more than the No Action alternative. Distributed pumping draws less flow from Steptoe Valley because more of the pumping occurs further north in Spring Valley. Simulations below using the Myers (2011a and 2011b) show that more than 10,000 af/y could be drawn from Steptoe Valley by the time the system approaches equilibrium.

The interbasin flow estimates to and from Steptoe Valley are just that – estimates, although they are the expected value. There is as much chance the estimates are low as there is that they are high, if the model accurately describes the flow paths, due to the parameter estimates. If the model conceptualization does not account for preferential flow paths, such as through fracture zones, the effect on interbasin flow could be grossly underestimated.

C59

Monitoring and Mitigation

The primary interest of this review is the monitoring and mitigation as applied to the groundwater development activities (BLM, 2011, p. 3.3-97). The DEIS proposes most of the monitoring and mitigation as part of the stipulated agreement, for Spring Valley and Delamar, Dry Lake, and Cave Valleys (BLM, 2011, p. 3.3-113) (included in the DEIS Appendix C).

The stipulated agreements do not include Snake Valley. There is no interstate agreement regarding Snake Valley. **The DEIS provides no basis for monitoring or mitigation in Snake Valley**.

C59 cont'd

The stipulated agreements are intended to only protect "federal" resources, including water rights or the national park. **These stipulations are a poor basis for monitoring and mitigation for this entire project**. They do not contain mitigations for other water rights.

The DEIS presents a circular monitoring and mitigation discussion regarding the stipulate agreements and the BLM's authority. Basically, the M&M plan purportedly would allow "SNWA and the BLM to identify, avoid, minimize, and mitigate adverse effects associated with the proposed pumping in all five hydrographic basins" (DEIS, p. 3.3-116). It would "address uncertainties in predicting potential effects of SNWA's groundwater production on water dependent resources and water rights holders". The impacts could be far worse than predicted, but the DEIS does not present a plan for avoiding even the predicted impacts, such as drying up 84 percent of the discharges from Spring Valley or completely drying Big Springs, so it is unclear why the DEIS focuses on uncertainties. This could be due to the stipulated agreements occurring before the DEIS modeling predicted the valleys would be dried by the pumping.

The monitoring sites shown on Figures 3.3.2-9 and -10 may or may not be adequate – it is impossible to know until the actual location of the pumping wells is known. These monitoring wells were located based on the stipulated agreement, but until the actual well locations are known, the value of these monitoring wells is unknown. The monitoring wells specified in the stipulated agreements were based in part on the location of the original applications, which are the PODs for which the stipulated agreements were developed. However, the proposed action places pumping wells across the basins far from the current PODs, so the monitoring well sites may not be in the best locations. Adaptive management must assure that new monitoring sites be established prior to pumping by a sufficient time period to establish a baseline.

The DEIS fails by not describing the "groundwater-dependent, early warning thresholds" (DEIS, p. 3.3-116). In the appendix, they indicate that it is necessary to collect baseline data "before specific early warning thresholds can be identified" (DEIS, p. A-49). This is simply not correct because **they should use the DEIS model to establish thresholds**. In establishing thresholds and monitoring , **BLM must consider the "time to full capture" problem**. Once a monitoring well indicates that impacts are occurring, it may be too late to stop or mitigate them. Drawdown cones expand even after pumping ceases. The BLM admits as much on p. 3.3-120, where it claims that "specific adaptive management measures … may not successfully mitigate long-term impacts to surface water resources" and a "long-term reduction in surface discharge" is likely to occur. BLM considers this an unavoidable adverse impact.

Having established early warning thresholds based on the DEIS modeling, the monitoring sites would be established as long as possible before the pumping commences. Data collection at the sites would establish the range of natural variability before any pumping effects could occur. This is essential to understanding whether a change is project induced.

C60 The DEIS lists five adaptive management actions to reduce observed or predicted impacts, including geographic redistribution of the groundwater withdrawals, reduction or cessation, augmentation of water supplies using surface and groundwater sources, conducting recharge to offset local groundwater drawdown, and cloud seeding. These actions had been listed in the stipulated agreements. **Reducing or ceasing the pumping or significant changes in its location are the only potentially effective adaptive management actions.** Augmentation and recharge should not be relied upon because both require additional water – using them merely transfers the impact elsewhere in the valley. There is no unused water in any of the valleys, including surface water that may reach the playas in wet years because the moisture holds together the playa soils. Cloud seeding is unproven technology which, if it works, must actually reduce precipitation somewhere downgradient.

At various points, the DEIS notes that the BLM will require the implementation of mitigation measures, which could include the cessation of pumping. "**If the BLM determines those early warning thresholds have been reached** as a result of the SNWA's groundwater withdrawal; (sic) one or more adaptive management measures may be implemented" (DEIS, p. 3.3-116, emphasis added). "If the BLM determines that SNWA groundwater withdrawals have likely caused or contributed to the adverse effect, BLM will require that one or more adaptive management measures be taken" (DEIS, App E, p. A-54). The BLM should state its authority for requiring mitigation measures that will reduce the amount of water pumped from the project, because elsewhere the BLM maintains that the NSE establishes the amount of water that may be pumped from a water right, not the BLM. Also, these statements do not purport with the stipulated agreements which indicate a technical review team will consider whether the pumping has damaged resources.

The DEIS should specify a M&M plan that protects the resources in the project area. It should do so as best it can with current data and update the plan as new data and modeling becomes available. The following a basic steps that should be used:

- Identify resources to protect
- Define what it means to protect them
- Use existing modeling to establish monitoring sites
- Use existing modeling to establish triggers or early-warning thresholds.
- Use existing modeling to specify the mitigation that could be used – moving the pumping wells or reducing the amount being pumped. Predict if/when resources will be impacted.
- Every five years, use the monitoring data to verify and validate the model. if the data shows the model was poorly conceptualized, it should be reconstructed. If the data shows the basic model structure is adequate, the new data should be used to recalibrate the model.
- Use updated model and repeat # 3, 4, and 5.
- Continue through the life of the project

C60 cont'd

Several additional M&M factors should be considered in the DEIS. One, the DEIS states the groundwater model "identified areas of uncertainty with regard to geologic and hydraulic characteristics" (DEIS, p. 3.3-120). These areas should be specified in the DEIS. The additional studies suggested (*Id.*) should be completed prior to finalizing the EIS.

Second, the DEIS specifies that SNWA will develop a "groundwater flow system numerical model … specific to Snake Valley" (DEIS, p. 3.3-121). This indicates the BLM has no confidence in the results of the CCRP model used for this DEIS - an admission that the DEIS is insufficient at presenting the potential impacts of this project.

Third, as part of mitigation GW-WR-5, the DEIS notes that the pumping will likely affect Shoshone Ponds, and also specifies that deepened or new wells to replace the existing source shall draw water from the same aquifer. This may not be possible if the source is a layer of highly conductive gravel with artesian pressure related to recharge uphill on the fan above the ponds.

Miscellaneous DEIS Comments

C61 The maps throughout the DEIS should show Indian reservations along with the FWS, NPS, and state lands.

C62 The DEIS should not cite the Spring Valley or the Cave, Dry Lake, and Delamar state engineer rulings for the perennial yield in those valleys (DEIS, p. 3.3-66, Table 3.3.1-20). These rulings have been rescinded by court ruling and the perennial yield values will be reconsidered. It is more appropriate to use previous PY estimates for this purpose.

C63 The DEIS considers the risks to springs based on being within a ten-foot drawdown cone and on their susceptibility. The DEIS inappropriately downplays the risk to valley margin springs (DEIS, p. 3.3-89) by considering them to have just a moderate risk due to a lack of understanding of their hydrologic control. The BLM should complete more site-specific study of these springs. Springs that are controlled by normal faults are likely connected to the regional water table but a spring near recharge zone at the top of the fan may be perched. The simple classification used in the DEIS may downplay the importance of or risk to certain springs.

Similarly, the DEIS should not specify flow reductions that would be important in modeled springs (DEIS 3.3-92). It should simply provide hydrographs of spring/stream flow so that the reader can assess the potential impacts. The DEIS correctly claims these estimates are uncertain, but uncertainty cuts both ways. Spring flow is just as likely to be decreased more than simulated as it is to be affected less.

The problems highlighted in the DEIS with modeling Big Springs (DEIS, p. 3.3-93) are disturbing. The placement of a flow barrier east of the springs allowed the model to simulate the spring reasonably accurately, but the BLM requested the fault be moved west of the springs so that it would not limit the drawdown. Geologic mapping shows dual faults – a normal fault

C63 cont'd west of the springs and two of them just east of springs. The coarseness of the model discretization makes it difficult to simulate both faults because they are only one model cell apart. Another solution to the BLM's problem with the fault protecting the spring from Snake Valley pumping would be to have higher conductance on the fault to the north. A relatively impermeable HFB may be necessary at the spring, but faults are not homogeneous along their length.

Review of Conceptual Model

A conceptual model is a description of flow paths through an aquifer or flow system, from the point of recharge to the point of discharge. This section reviews the conceptual model used as a basis for the DEIS and the numerical model (SNWA 2009a).

Water Budget Comments

SNWA estimated recharge using a water budget method wherein they set basinwide recharge equal to the measured discharge and interbasin flow from the flow system. The method they used was similar to the original Maxey-Eakin method, but they estimated new coefficients to be used with new precipitation estimate. They effectively determined a proportion of the total annual average rainfall in the basin that would become recharge. The method balanced flows among basins within individual flow systems, so that recharge equaled discharge by flow system – Goshute Valley, Great Salt Lake, Meadow Valley Wash, or White River. The estimates led to basin recharge estimates that exceeded the original reconnaissance report recharge estimates, as shown in the following table.

Table 2: Comparison of annual recharge amounts (af/y) for flow systems considered in the CMR and various reconnaissance reports.

Flow System	Goshute Valley	Great Salt Lake	Meadow V Wash	White River
SNWA Study	116,373	237,911	54,227	159,579
Recon Reports	100,000	181,900	35,900	104,500

SNWA's estimates lie near the upper range of the other estimates, as may be seen in Tables 9-2, I-5, or I-6 (SNWA 2009a). The primary reason the recharge estimates are high compared with all estimates is that the groundwater discharge estimates have increased substantially because the groundwater evapotranspiration (GWET) rates have increased, from earlier studies. This is because the system recharge must equal system discharge, and system discharge depends on spring flow and GWET estimates. Basically, increasing the discharge estimates requires that more of the estimated precipitation becomes recharge; it also means that there is more discharge for their pumping to capture.

C64 SNWA's description of the method, however, indicated they really do not understand their own estimate. Their map of recharge does not account for geology:

> It must be noted that this spatial distribution only accounts for variation of recharge rates with altitude. It does not explicitly account for the geology of the units through which precipitation infiltrates to recharge the flow system, and it does not explicitly distribute the recharge from runoff to the actual locations where it occurs. The quantity of recharge from infiltration is, however, implicitly included in the recharge estimated using the groundwater-balance method. (CMR, page 9-10)

While SNWA acknowledges the map is inaccurate, their explanation is partly wrong. The map accounts for the variation of recharge with precipitation which, while correlating with altitude, is not the same as varying with altitude. It does not account for geology, as they correctly state. The method merely describes a means of determining recharge in each basin based on the precipitation bands (volume of precipitation between two depths, such as 12 and 16 inches). It is based on balancing overall flow system recharge with flow system discharge considering only the precipitation variation around the flow system. The recharge estimate includes both mountain block and mountain front recharge. These differ due to geology because high elevation precipitation may recharge where it falls on carbonate outcrops or run off from other bedrock outcrops and recharge at the mountain front.

The recharge estimates are incorrect because the groundwater discharge estimates are incorrect. SNWA used various methods to estimate the ET rates by phreatophyte type, and compiled a range of potential estimates from the literature – in fact, the CMR and appendices actually summarize almost every method and estimated rate available in the literature. Their final choice apparently is the BARCASS estimates for the basins within White Pine County.

ET rates (regardless of whether the source is ground or surface water) vary within a fairly narrow range, typically within 20%. SNWA's GWET estimates are wrong because of how they allocate the source water to accommodate that ET – groundwater, precipitation, surface runon, or unsaturated zone water.

> Groundwater ET emanating exclusively from the saturated zone is difficult, if not impossible, to measure separately. ET rates derived from field data (using ET towers) represent the total ET rates from the plants and the soils under and around the plants. The measured ET rates may include several sources of water: groundwater and soil moisture uptake by the plants, groundwater and soil moisture lost by evaporation, and water on the plant leaves lost by evaporation. The following simplifying assumption is usually made to derive mean annual groundwater ET rates: **all sources of water, other than groundwater, can be attributed to the mean annual precipitation**. Estimates of groundwater ET rates can then be obtained by **subtracting the local mean annual precipitation rate from the measured annual ET rate**. (CMR, page 7-6, emphases added)

C64 cont'd

SNWA acknowledges the various sources but makes the "simplifying assumption" that precipitation can represent all sources other than groundwater. Most precipitation at a site with GWET does satisfy the ET demands because wetland sites are usually flat and have little runoff – most precipitation infiltrates or ponds on the surface. SNWA's assumption ignores the following sources of water:

- Surface runon from offsite: Surrounding wetland areas are upland areas that usually have more topographic gradient than the much flatter wetland. Water runs off of that area and onto the wetland area thus satisfying more of the ET demands. If just 10% of the annual precipitation runs onto adjoining wetlands, because the surrounding upland may be larger, it could satisfy a much larger portion of the ET demand.
- Surface runoff from the mountains: Most wetland areas lie in the low portions of valleys, such as the playas and surrounding moist wetlands in Spring Valley. Most of the streams that discharge from the mountains infiltrate at the mountain front and contribute to basinwide recharge. During wet years, however, the streams flow to the valley bottoms and become another source of surface water to the wetlands, as evidenced by the playa lakes that form throughout the Great Basin.
- Mountain front springs contribute water to low-lying wetlands. An example is the regional springs in White River Valley which, predevelopment, satisfied ET demands in the wetlands below the springs.
- Lateral unsaturated zone flow: Water that infiltrates the ground surface adjacent to the wetlands will flow both vertically and laterally, and some will reach the unsaturated zone beneath the wetland areas.

Simply stated, SNWA modeled GWET as equal to the predicted ET minus predicted onsite precipitation (SNWA 2009a, pages 3-4 and 7-6) therefore estimated GWET depends on precipitation. SNWA used PRISM to estimate precipitation around the study area after rejecting other estimation methods. PRISM overestimates annual precipitation at most stations (Figure 6-4), as acknowledged and discussed by SNWA. "The comparison shows that the PRISM distribution slightly **overestimated** the period-of-record mean precipitation values for most stations" (CMR, page 6-5). Jeton et al (2005) substantially agree – **PRISM overestimates precipitation**. Yet, SNWA chose to use it for this study, claiming it would be a conservative estimate. "As precipitation is subtracted from ET to obtain groundwater ET, the larger estimates of precipitation derived from the PRISM grid will lead to smaller estimates of groundwater ET and, therefore, smaller recharge estimates. This demonstrates that the use of the PRISM precipitation distribution leads to **conservative estimates of recharge** and is appropriate in this study" (CMR, page 6-5, emphasis added).

The argument is conservative only if the other sources of water to satisfy ET listed above are ignored because they still overestimate GWET and recharge. This is understood by understanding the process through which precipitation becomes recharge (Wilson and Guan, 2004), as simulated with the BCM (Flint and Flint, 2007; Flint et al, 2004). The BCM estimates recharge using a water balance of the soil moisture zone in areas that are not wetlands; the method calculates infiltration and runoff. The infiltration either evapotranspires or becomes recharge; the runoff either recharges further downstream, at the mountain front, for example,

C64 cont'd

or discharges to the playa. Up to **85% of runoff that does not become recharge goes to satisfying the ET from the wetland areas (Flint et al 2004)**. Nothing in SNWA's basinwide recharge estimate accounts for the proportion of precipitation that runs off and satisfies the ET demand – in fact, the method as used by SNWA does not require that the precipitation pass through the groundwater at all before it satisfies ET.

A consideration of how much the CMR GWET estimates, by flow system, exceed the recon report estimates (Scott et al in CMR Table 6-1) demonstrates the potential for additional water in the basins to make up some of the ET demands. PRISM estimated precipitation as being substantially more than the recon reports in all of the flow systems with Meadow Valley Wash being by far the largest difference (Table 3).

Table 3: Percent additional precipitation estimated in the CMR as compared with Recon Reports.

Flow System	% Increase Over Recon Estimates
Goshute Valley	9.4
Great Salt Lake	17.0
Meadow Valley Wash	59.1
White River	41.7

C64 cont'd

Much of the overestimated precipitation occurs in Hamlin Valley; the overestimate was so great that SNWA had to manually lower the recharge estimate they made for the basin (see the NMR section review below). Halford and Plume (2011) also noted this problem).

C65

Miscellaneous Comments on the Conceptual Model

Spring Types: The difference between regional and intermediate springs appears to be arbitrary, with Gandy Warm and Big Springs considered intermediate. The basis is location in the basin, temperature, flow rate and its variability, hydrogeologic setting, and geochemistry. Regional springs are warm and constant, but the actual bounds were not specified. With respect to modeling, the difference is not important.

Interbasin Flows to Adjoining Flow Systems: SNWA estimated interbasin flows from the model domain to surrounding flow systems based on a probability distribution of material properties and gradient over the boundary. They assumed the gradient across the boundary equaled the gradient between mid-basin wells – "Because carbonate wells are scarce, water levels in the central parts of the basins were assumed to represent regional potentiometric levels, i.e., carbonate aquifer is connected to alluvial aquifers (CMR, 8-4)". This is an unfounded assumption. The gradient could be estimated using bedrock contours estimated in BARCASS or in chapter 5 of the CMR. The estimates are not well supported by the analysis, but are within the same orders of magnitude as should be expected (Welch et al, 2008).

C65 cont'd **Depth-decay relations**: SNWA estimated a conductivity/depth relationship to justify lowering the conductivity at depth, but the regression relationships barely justify it. CMR Figures C-9, C-10, and C-11 show the R^2 for Log K v depth regressions are 0.16, 0.27, and 0.43 for LC, LVF, and UVF, respectively; from the figures it is also apparent the relations would not be as good as they are, such as it is, except for a few very deep values. This spurious correlation may artificially increase the confidence in the relations.

Groundwater Contour Map: The SNWA GW contour map includes both basin fill and carbonate water levels (CMR, Figure 5-2). This may imply a substantial connection. Also they do not show any flow into Fish Springs Flat or Tule Valley, although their geologic analysis properly notes the presence of carbonate rock. BARCASS had treated the mountains on the east side of Snake Valley as a potential flow pathway.

Review of SNWA CCRP Model

C66 The DEIS used the Central Carbonate Rock Province (CCRP) model to simulate the proposed action and alternatives. This section reviews some of the details of that model, and shows that it is insufficient for NEPA analysis and may bias the simulations to minimize the predicted impacts.

The model calibration was not based on stresses similar to that expected in the future, which far exceed anything observed to date. T**he model will be used to predict drawdown that goes far beyond any drawdown observed to date so the model parameters are not representative of likely future conditions**.

The SNWA model is too coarse, both horizontally and vertically, to use for predicting the impacts due to this proposed groundwater development. SNWA's model cells are **all 3281 ft square. D'Agnese (2011, p. 2) pointed out that the simulation of drawdown at a pumping well improves with improved discretization but SNWA failed to implement it in their modeling effort.**

The model layers are too thick and simulate too much of the deeper aquifer layers. The CCRP model layer thickness varies from 328 to 984 feet over layers 2 through 5, from 328 to 6562 feet for layer 1, and 984 ft or thicker for layers 7 through 11; the total model thickness varies but the bottom is about 10,000 feet below sea level so at the center of Spring Valley, thickness would be about 16,000 ft. Halford and Plume (2011) generally did not simulate an overall model thickness more than 4000 ft because they expected little deep circulation. The lower half of the CCRP model is wasted.

SNWA's model is poorly conceptualized as demonstrated by the convergence problems they could only solve by simulating all layers as confined, including layer 1 (SNWA, 2009, p. 4-2, 4-4). SNWA set the top of layer 1 to coincide with the top of the water table so that the layer had a constant transmissivity and did not change the layer type during transient

C66 cont'd simulation. This means that layer-1 transmissivity remains constant through the simulation even though the thickness is significantly decreasing. There are areas where the simulated drawdown exceeds 328 feet, so the layer should go dry; SNWA's assumption would maintain the transmissivity and flow even when simulating heads below the bottom of the layer.

SNWA attempts to fix the problem by setting storage coefficients to represent specific yields. The valley fill storage is set at 0.015, which is higher than it should for specific storage but lower than a specific yield; this is the value for the upper six layers. The model will therefore release more water for a given drawdown than it would had a proper specific storage had been used. The combination of high specific storage and unchanging transmissivity would cause the model **to underestimate the drawdowns.** This will dampen the predicted effect of pumping and decrease the predicted drawdown.

Convergence problems during steady state simulations are typically caused by an inaccurate representation of the flow system. In this case, the model cell size may be too big to accurately simulate the details of flow in the upper layers. The model very precisely inputs the perceived geology (depths to formations and thicknesses) over a coarse grid. This requires detailed calculations in the HUF2 package and elsewhere to set the parameter values for each cell; this could cause rapid changes between cells, as formations pinch out, which also causes instability in the water balance calculations for these cells. Either the use of smaller grid cells or specifying the model layers with hydrogeologic units could obviate this problem.

C67 **SNWA's model calibration is biased to look better than it actually is.** SNWA presented unweighted residuals, in Figure 6-9 (SNWA, 2009), which shows extreme bias in the distribution of residuals. In the area of Dry Lake and Pahroc Valleys, six residuals are between -440 and -220; five more are between -200 and -50 (Figure 1). Just east of Dry Lake Valley, in a trend that looks very much like the PRISM precipitation overestimates in Patterson, Lake, and Cave Valleys, are at least ten residuals from 200 to 955 and another ten from 20 to 200 (Figure 1). The CCRP model ranges from gross overestimation of head in Dry Lake/Pahroc Valleys (simulated exceeds observed in a negative residual) to gross underestimation of heads 10 to 20 miles to the east.

SNWA's numerical model report addresses the residual problem between Patterson and Dry Lake Valley (SNWA, 2009, p 5-8). They used two low-K horizontal flow barriers (HFBs) to force the head to drop over 1000 feet between the valleys, but just were unable to do this which resulted in the high residuals. (The steady state model simulates 1600 af/y from Patterson to Dry Lake Valley). This should have caused SNWA to reconsider the overall conceptual model for the area. Their model simulates too much recharge in Dry Lake Valley, most specifically in the mountains on the east side of the valley between Dry Lake and Patterson Valleys; this extra recharge increases the head on each side of the fault and topographic divide so that the model cannot simulate sufficient head drop between valleys.

SNWA emphasizes the value of using "weighted" observations to calibrate the model. Weighting attempts to account for the accuracy of the observation measurement and may be

C67 cont'd based on many things, from the method of determining the ground surface elevation or the depths to water to the seasonal variability of a series of measurements (from which a variance for the observed values can be determined). Ultimately, setting a "weight" is as fraught with uncertainty as the observation itself. Halford and Plume (2011) set weights based on the source of the observations, but described weighting individual observations as a "fool's errand" because model-discretization error "typically dominates measurement error". In other words, **SNWA's use of weighted observations should not increase the perception of accuracy in the model**.

Two other obvious problems are the high positive residuals in north Spring Valley and along the mountain front in Snake Valley (Figure 1). The model does not accurately simulate the water table in the higher elevations along the boundary of the valleys. There should be little confidence in the simulated drawdown in these areas, potentially biasing the predicted results.

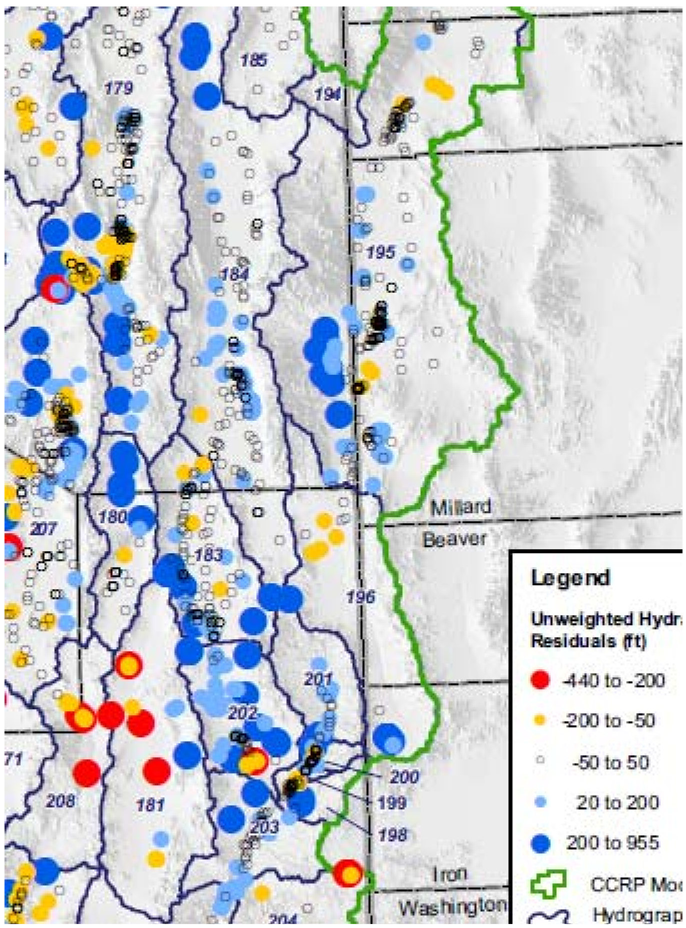

Figure 1: Snapshot from Figure 6-9 (SNWA, 2009) showing unweighted residuals.

C68 **The SNWA model handles faults in a way that may be biased because there is very little data to support their ultimate parameter choices**. The following sections describe some of the problems.

Pahranagat and Coyote Spring Valleys

C68 cont'd

The Pahranagat shear zone causes a head drop of about 700 feet across one model cell, as represented by the blue in the hydrogeology at column 62 (Figure 2); this is modeled with a series of HFBs. Further east (right) in column 72 is a conductive fault in LC3 (lower carbonate rock). The conductivity (K) in the fault ranges from 17 to 62 ft/d, over 3281 feet, while the surrounding LC3 cells have K about 0.5 ft/d. The high K fault runs north/south through Coyote Spring Valley to just south of the Pahranagat Shear zone (Figure 3); the fault is shown on Figure 3 just east of the highway; it ends approximately where it intersects the shear zone. Based on K, this fault zone would transport vastly more groundwater than the surrounding rock.

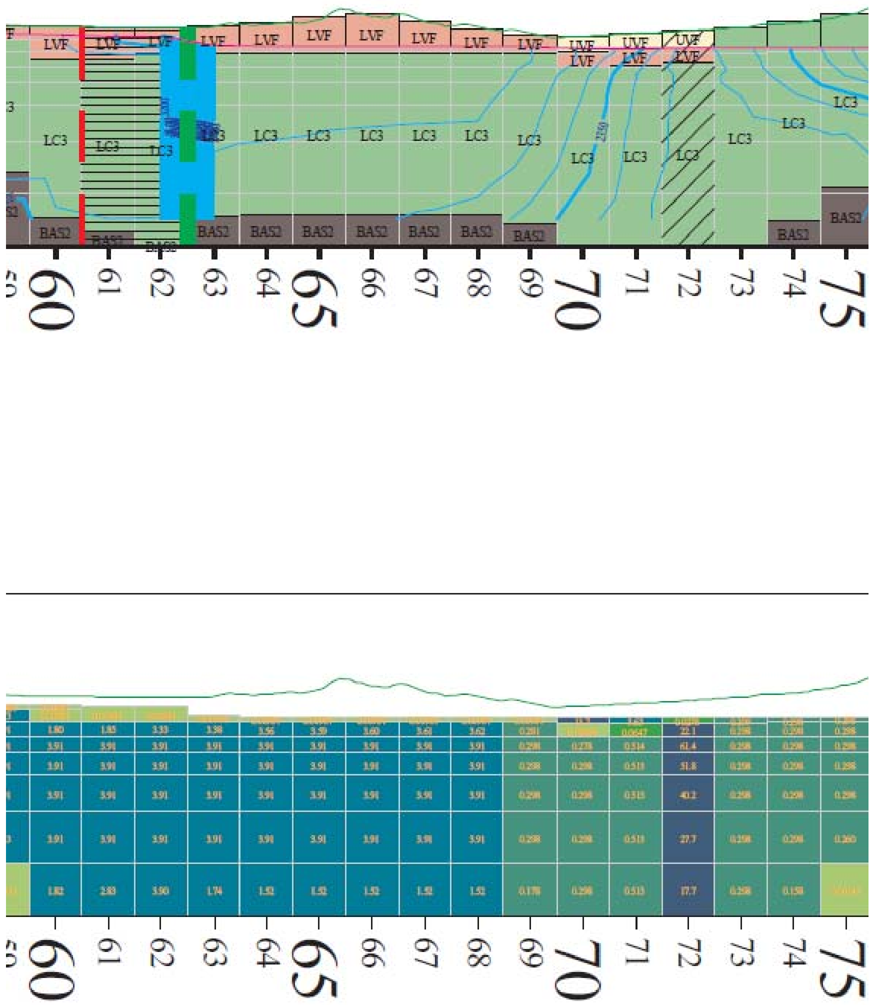

Figure 2: Snapshot of hydrogeology and calibrated K, model row 359. This section crosses Pahranagat and Coyote Spring Valley. (file xs_rum_rows-rev2-7o-map-hd-kh-s-1lay-ucth814-1-4748.pdf). The blue in the upper figure is a cluster of contours.

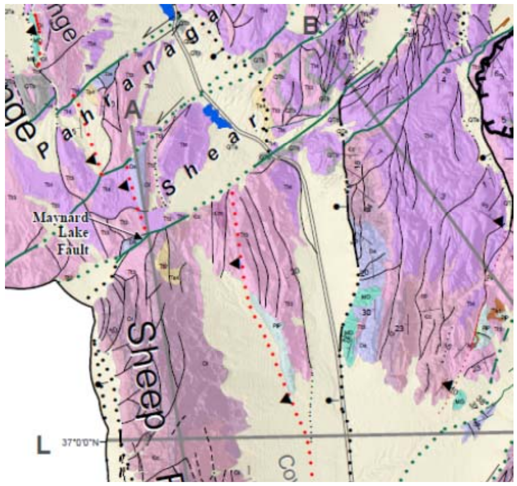

Figure 3: Snapshot from Plate 2, Rowley et al (2011).

C69 The source of the Pahranagat springs in SNWA's model is a highly conductive fault running down the middle of Pahranagat Valley. This fault gathers and transports groundwater from the north and west; K in the carbonate rock ranges to 30 ft/d for one or two column widths. The Pahranagat shear zone is simulated with a series of HFBs which prevent much of the flow from passing and also force groundwater to the surface to form the springs. Flow from the east to the central part of Pahranagat Valley is blocked by a normal fault that bounds the east side of the valley. The head drop across the HFB is about 300 feet (row 336); some flow occurs during steady state conditions but the HFB would be slow to respond to upgradient pumping. SNWA protects the Pahranagat Springs with an HFB that has not been proven on the ground.

Further south three faults converge in Coyote Spring Valley which allows groundwater to move to the Muddy River Springs area through a zone of very high K LC3 rock. Figure 4 shows two of the faults and high K zones right of the faults; Figure 5 shows the convergence of these faults and the fault on the east which impedes the flow causing it to surface at the springs. Figure 6 shows the three faults north of the springs near their convergence into the broad high K LC3 material. These figures demonstrate how a model simplifies complex geology but the problem with this is the broad zones with very high K cover as much as 20 model rows by 15 columns, or about 300 square kilometers. There is no geologic evidence for such a broad fractured zone in this area. Such a zone may bias the results for this area. The springs probably discharge from a narrow highly conductive fracture zone which could be drained sooner by pumping than would a 300 square km, 10,000 feet thick zone, with high K.

SNWA should use different storage coefficients for the high K zones. Clearly, highly fractured areas would have different storage properties than unfractured media.

SNWA added a constant head boundary between Pahranagat and Tickaboo Valleys to "allow some of the discharge to flow out of the model area" which was necessary because "discharge by groundwater ET from Pahranagat Valley tended to be larger than expected"

C69 cont'd

(SNWA, 2009, p. 5-13). In other words, they needed a release valve even though the Death Valley Flow System (DVFS) analyses had not included such an outflow. **The reason a "release valve" was needed was, once again, that SNWA estimated far too much recharge in the WRFS, mostly in Dry Lake and Delamar Valleys**.

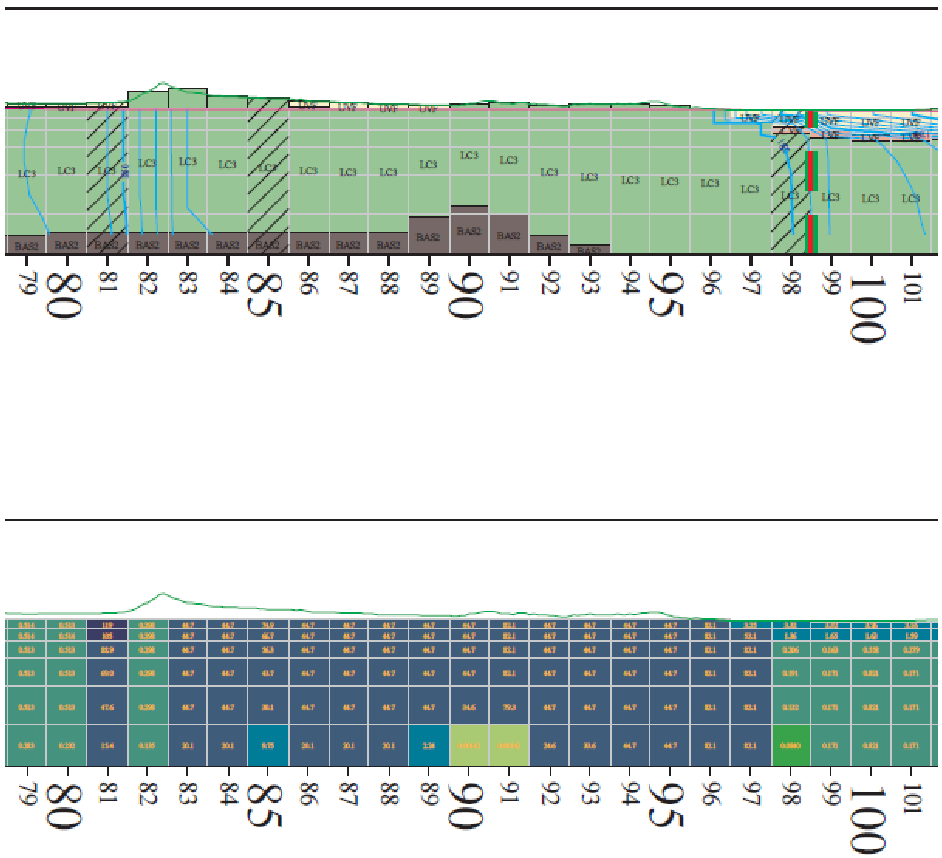

Figure 4: Hydrogeology and K values for row 407. (file xs_rum_rows-rev2-7o-map-hd-kh-s-1lay-ucth814-1-4748.pdf)

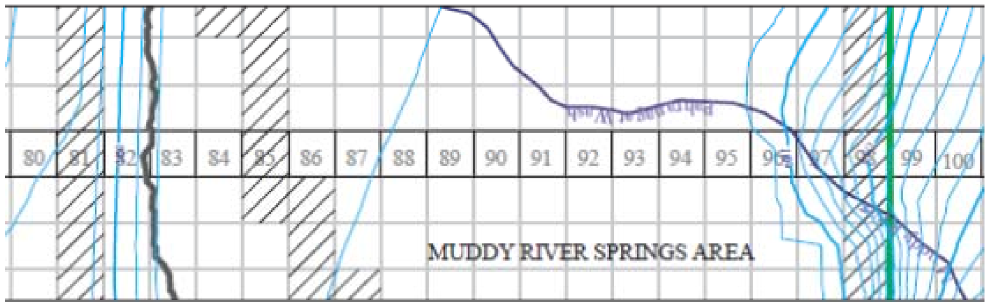

Figure 5: Model area near row 407 showing faults. (file xs_rum_rows-rev2-7o-map-hd-kh-s-1lay-ucth814-1-4748.pdf)

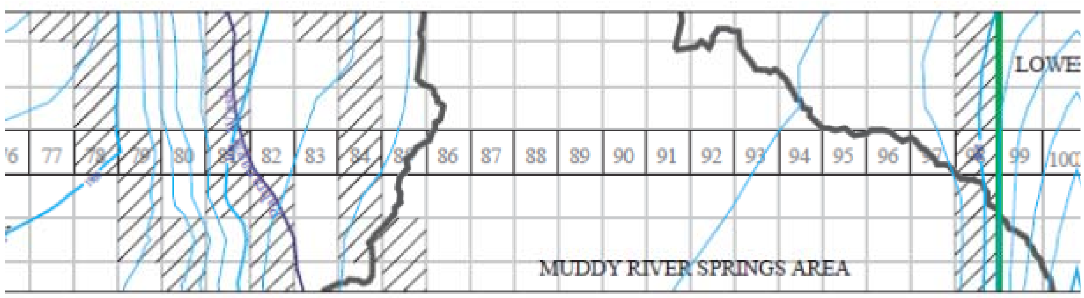

Figure 6: Model area near row 397 showing the collection of faults, all with high K but also the cells to the east have high K. (file xs_rum_rows-rev2-7o-map-hd-kh-s-1lay-ucth814-1-4748.pdf)

Spring Valley

C70

The CCRP model simulates Spring Valley with faults on each side, but only the normal fault on the west side affects the flow (Figure 7). An HFB runs between the bedrock and fill, causing a significant head drop. The bedrock is all low K, therefore the flow into the fill is probably low; the northern portion of Spring Valley has mostly mountainfront recharge. The east side fault shows as large displacement, but the K is not significantly different from the surrounding rock.

C70 cont'd

The carbonate rock that underlies northern Spring Valley extends into Tippett Valley, under the Antelope Range. The K under Tippet Valley is almost two orders of magnitude higher, and the normal faults along the boundaries of Tippet Valley have high K.

SNWA simulates the fill in Spring Valley as high to very high K. The primary feature is that the fill is modeled as a bowl, with high K fill surrounded by bedrock. SNWA models specific storage in lower layers of the fill, 5000 ft bgs, as 0.015. This imparts a huge bias on the predicted results because much more water is released for a unit drop in head than is realistic. Anderson and Woessner (1992, Table 3.4) specified a range of specific storage values ranging from 0.02 to 0.000049 m^{-1} for material ranging from clay through dense sandy gravel; the high range is for plastic clay, not the type of material found in Spring Valley. Halford and Plume (2011) used a specific storage of $2x10^{-6}$ ft^{-1} for their layers 2 through 4. These references support the use of a lower specific storage than was used by SNWA (2009). **SNWA's choice would improperly minimize the predicted drawdown by causing the model to release more water to pumping for a given drawdown than is realistic**. It biases the drawdown prediction to be much lower than would occur in reality.

SNWA (2009, p 3-2) notes that measured storage properties may not convert to model scale storage properties. This is similar to the scale issues for K as discussed by authors such as Schulz-Makoch et al (1999). It is reasonable that storage coefficients would increase with scale as the volume under consideration includes more connected fractures, but the issue with SNWA's choices in the previous paragraph refers to fill for which porous-media flow is more predominant and scale issues much less important.

SNWA uses high K cells on the boundary in the uppermost layers. These presumably were set to allow recharge into the zone near the mountain front. Underlying the high K cells, the K is an order of magnitude lower, which causes the groundwater to pond.

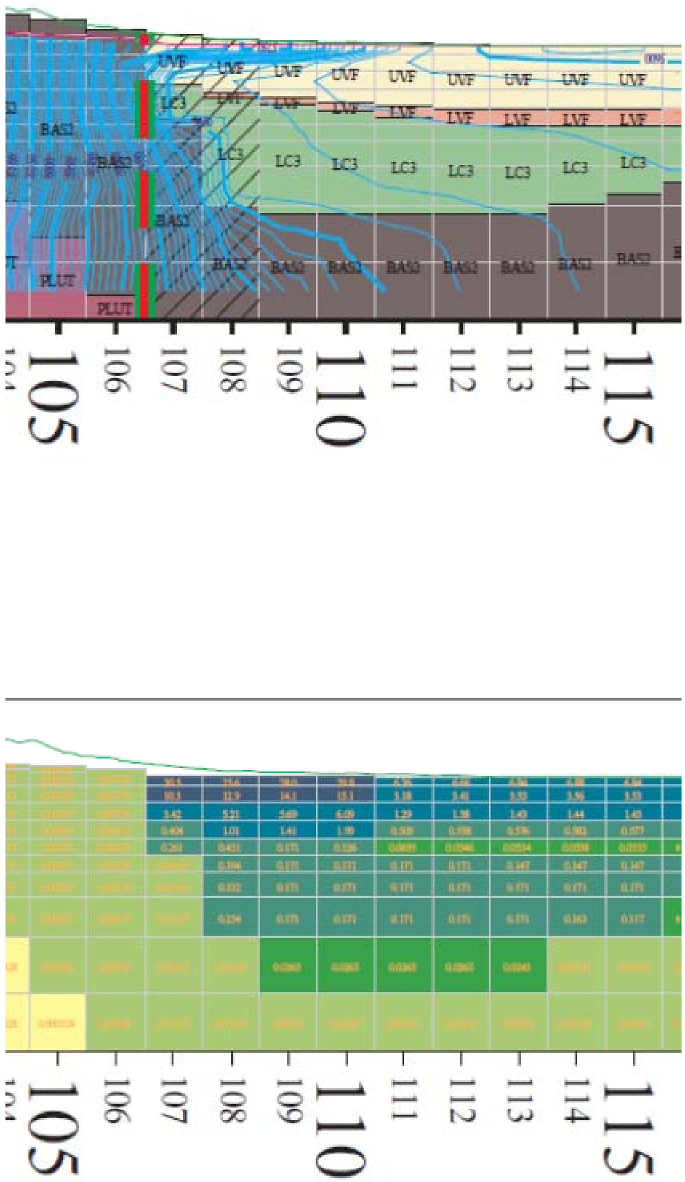

Figure 7: Snapshot of portion of row 128 in center of Spring Valley showing hydrogeology (upper) and K (lower). (file xs_rum_rows-rev2-7o-map-hd-kh-s-1lay-ucth814-1-4748.pdf)

Steptoe to Spring Valley

C71

Groundwater contours along row 160 show a gradient through carbonate rock from Steptoe to Spring Valley (Figure 8). The model includes an HFB, but no mounding of contours. This is an example of how the CCRP model allows flow from Steptoe to Spring Valley, in contradiction to their geology models. Figure 9 and 10 demonstrate how a groundwater level contour map can show a divide while there is clearly flow at depth.

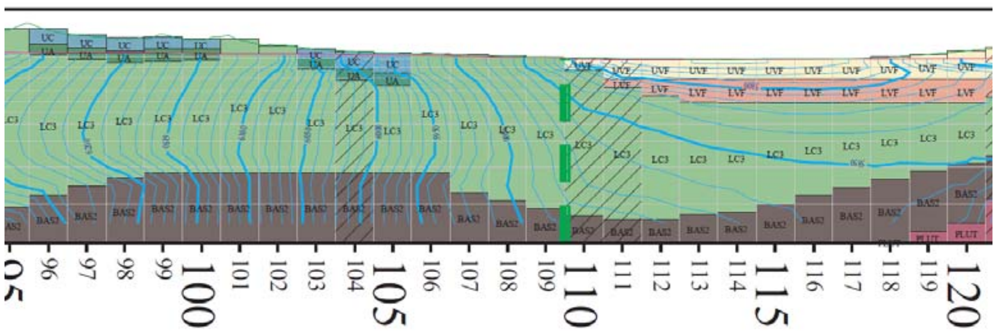

Figure 8: Snapshot of row 160 showing hydrogeology from Steptoe Valley (left) to Spring Valley. (file xs_rum_rows-rev2-7o-map-hd-kh-s-1lay-ucth814-1-4748.pdf)

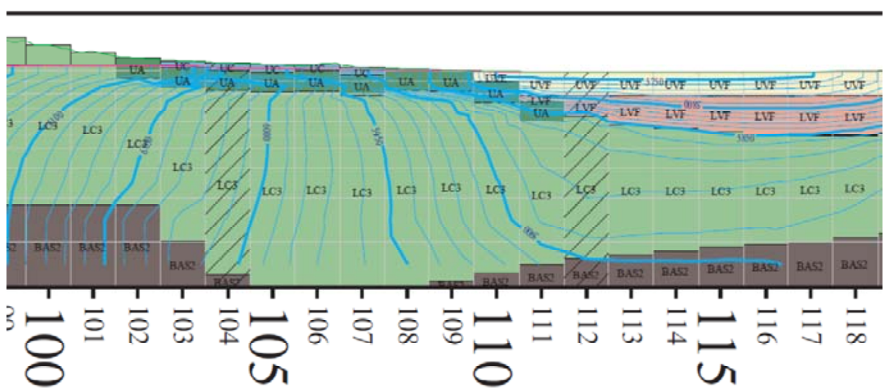

Figure 9: Snapshot of Row 166 showing hydrogeology from Steptoe Valley (left) to Spring Valley. (file xs_rum_rows-rev2-7o-map-hd-kh-s-1lay-ucth814-1-4748.pdf)

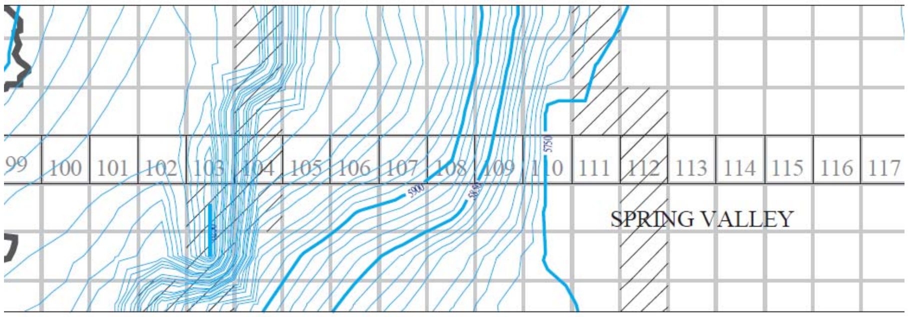

Figure 10: Snapshot of Row 166 showing groundwater contours from Steptoe Valley (left) to Spring Valley. (file xs_rum_rows-rev2-7o-map-hd-kh-s-1lay-ucth814-1-4748.pdf)

C71 cont'd

The source of Big Springs, in the model, appears to be a large expanse of carbonate rock that has K very near 0.413 ft/d. The carbonate rock extends through the thickness of the model meaning the upgradient transmissivity is very high. A fault forces groundwater to surface.

Gandy Warm Spring

C72

The simulated flow from Gandy Warm Spring is approximately one-third of the targeted flow (NMR, page 5-5), which is likely an error in the conceptual flow model. However, the simulated discharge overall from Snake Valley is within 4% of the targeted value. The valleywide discharge does not require the discharge from Gandy Warm Springs. The problem is that discharge which should be discharging from the springs is actually simulated as discharging from elsewhere in the valley, where it can be captured by the proposed pumping and *decrease the predicted impacts of pumping*. The error in simulating the spring is likely that SNWA treats the spring as intermediate rather than regional (CMR page 7-41), described as follows:

> Gandy Warm Springs is located on the western edge of Snake Valley in the northern portion of the study area (Plate 1). It discharges water from alluvial materials approximately 1.6 mi west of a normal fault. The spring was selected for inclusion in the conceptual model because of its large discharge. The average spring discharge is approximately 17 cfs. (CMR, page 7-41)

SNWA misses the two most likely sources of water to the spring: the substantial carbonate rock on the northeast side of the Snake Range southwest of the spring and interbasin flow from Spring Valley. A fault diverts flow from the Snake range. SNWA discounts the idea that interbasin flow from Spring Valley could support the spring (NMR, page 5-6). This is curious because the model simulates 11,800 af/y of interbasin flow to just north of Snake Valley which is

C72 cont'd of the same order of magnitude as the approximately 16,000 af/y estimated for this region in BARCASS (Welch et al, 2008, Figure 41). If even a third of that amount combined with carbonate recharge in the northeast portion of the Snake Range, the Gandy Warm Springs flow could be accurately reproduced.

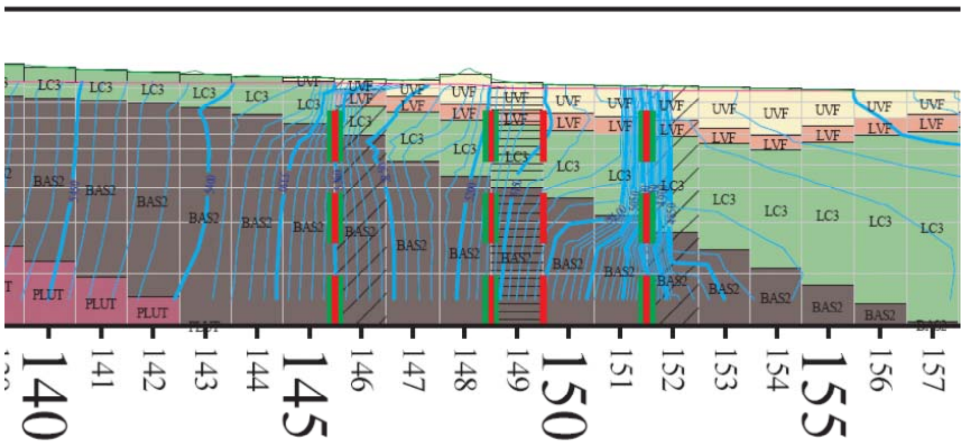

Figure 11: Snapshot for Row 100 showing groundwater contours and hydrogeologic formations near Gandy Warm Springs, near column 148.

C73

Recharge Redistribution

The recharge estimates used in SNWA's numerical model are not the same as in SNWA's conceptual model, which had estimated recharge by basin. SNWA somewhat reshuffled the recharge distribution during numerical model calibration so that the recharge can meet the discharges specified from the model (SNWA, 2009, p. 4-62 – 4-64). In other words, SNWA started the process over during their numerical model calibration but did not constrain the estimates by basin. This explains the differences in recharge by basin and difference in interbasin flow for the numerical model as compared to the conceptual model.

The PRISM precipitation estimates also caused too much interbasin flow from Hamlin to Snake Valley (SNWA, 2009, p. 3-3). This was due to the PRISM precipitation estimate for that area being much too high. Halford and Plume (2011) found similar problems.

C74

Shingle Pass

The model conceptualization of Shingle Pass is as complicated as any in the model, with several formations including carbonate rock and several faults (Figure 12). The faults within Cave Valley are simulated with HFBs which prevent flow from leaving Cave Valley. The mountain front faults on the east side of White River Valley have very high K, being high displacement faults. The high K zones extending north and south along the west side of the

C74 cont'd Egan Range capture and transmit substantial recharge from the mountains to the springs. However, SNWA does not include an HFB on these faults which would force water to surface in to the springs. Thus, the model is biased so that Cave Valley flow does not support the springs in two ways – HFBs within Cave Valley prevent flow from reaching White River Valley and high K faults along the east side of WRV bring water from the north to the springs rather than from the east.

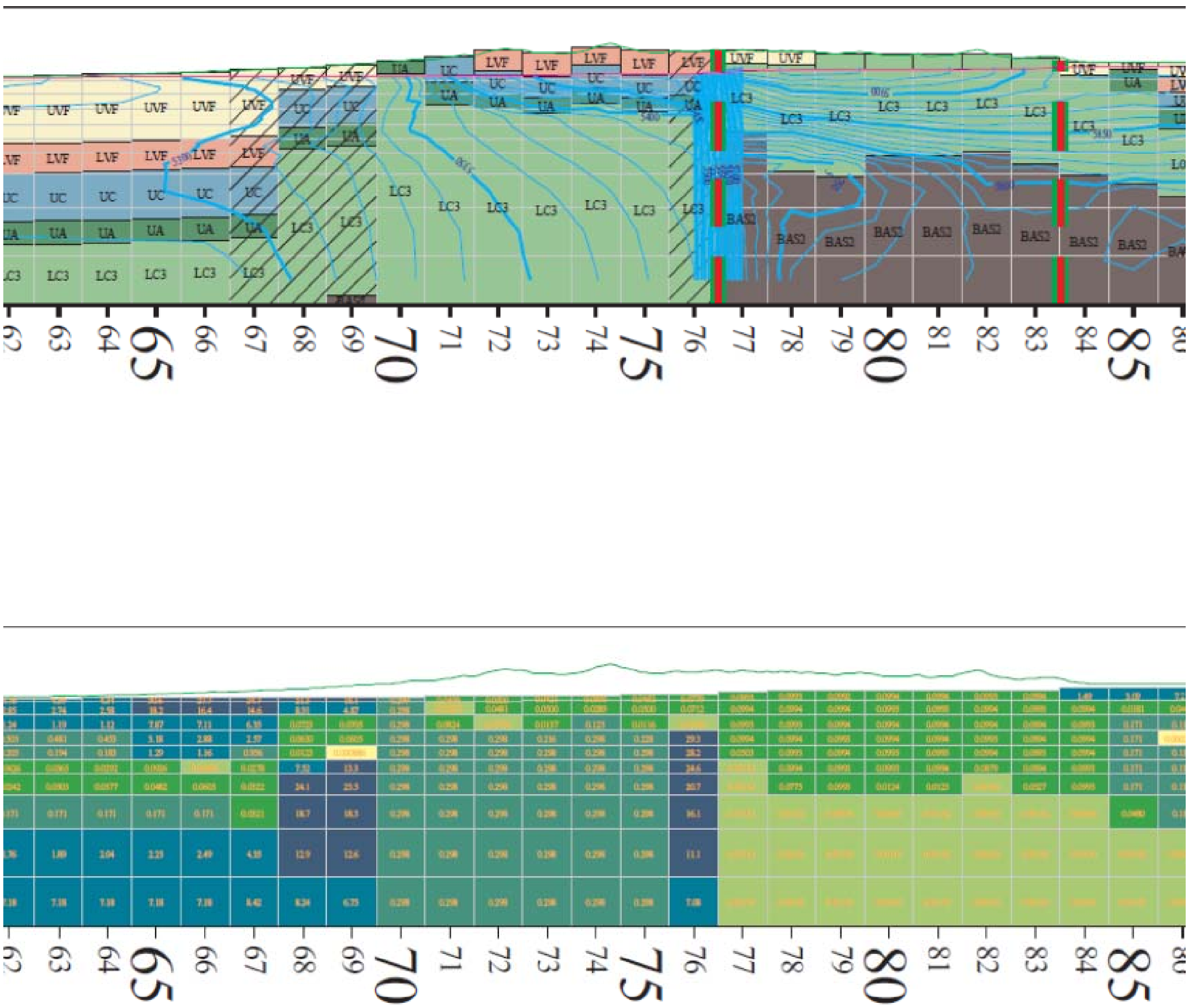

Figure 12: Snapshot of row 202 showing hydrogeology (top) and K values near Shingle Pass. (file xs_rum_rows-rev2-7o-map-hd-kh-s-1lay-ucth814-1-4748.pdf)

C75 Combining Inappropriate Formations in One Cell

The HUF2 routine (SNWA, 2009, p. 4-6) inappropriately combines grossly different media into one cell. “Although the HUF Package allows model layers to be defined independently of hydrogeologic units, **careful definition of the model layers** is important to represent properly the flow through the simulated area. Specifying model-layer boundaries that

C75 cont'd coincide with or are parallel to hydrogeologic-unit boundaries is helpful" (Anderman and Hill, 2000, emphasis added). If the HUF or HUF2 package combines significantly different hydrogeologic units, the cell properties may be an average of significantly different flow types. SNWA does not carefully define the model layers by combining formations in one cell, which results in an average K which is a meaningless number.

The east front of the Snake Range, near Baker, is a great example of inappropriately averaging formations in one cell. As may be seen (Figure 13), on column 149, the model averages UVF and LC3 properties. In column 150, the model averages LVF and LC3 properties. Considering the conductivity values by cell, the model combined values that differ by more than an order of magnitude (Figure 14). Also, the model would not allow continuous flow among columns within the LC3 unit under Snake Valley because the unit does not match in adjacent cells (Figure 13). This forces the groundwater to follow unrealistic pathways. It would essentially force water in the LC3 unit in column 149 to flow into the LVF unit in column 150.

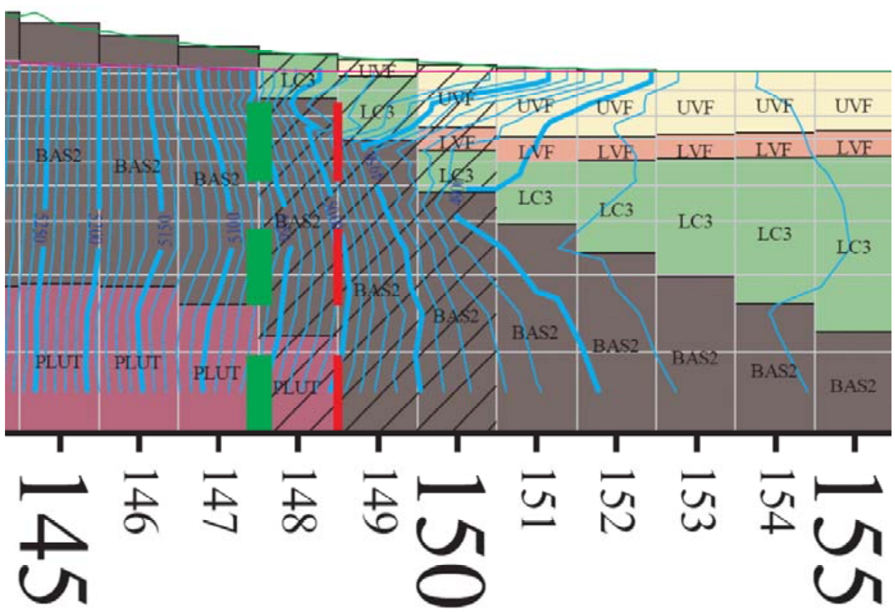

Figure 13: Portion of model row 126 near the east side of the Snake Range near Baker. White lines are cells, blue lines are groundwater head contours. Other colors represent hydrogeologic units as labeled.

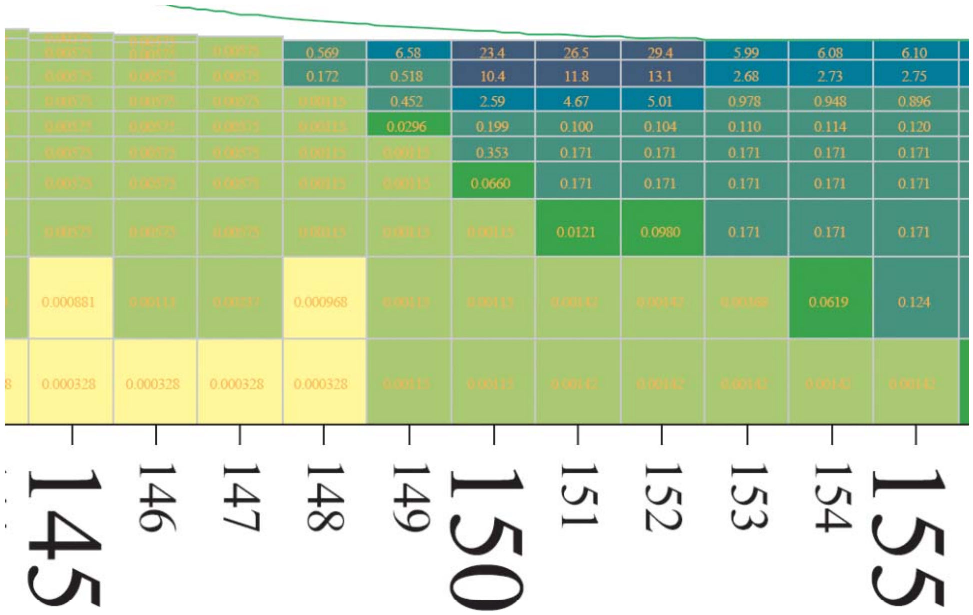

Figure 14: Portion of model row 126 near the east side of the Snake Range near Baker showing the average horizontal hydraulic conductivity values.

C75 cont'd

Forcing the flow into the valley fill, as just described, would **minimize predicted drawdowns from the model**. This is because the model pumps primarily from the valley fill units where the storage coefficient is much higher than in the carbonate units. The HUF2 package, as used by SNWA in this model, forces a connection so that water flow into the LVF where it supplies SNWA's wells, in the model, and may significantly bias the model to underestimate drawdown in these locations.

The numerical model simulated flow from Fish Springs Flat into Snake Valley (SNWA, 2009, p. 5-13). This goes against most other reports, which SNWA cites, showing that because of the high discharge from the springs there must be inflow from elsewhere.

SNWA did not do any verification modeling for this model, although they have data to do so with. They should use 2005-2010 data to verify for a model and DEIS being released now, in 2011.

Conclusion

C76

The DEIS used a regional groundwater flow model to make predictions of drawdown to be expected from pumping the No Action and action alternatives in Snake, Spring, Cave, Dry Lake, and Delamar Valley. It is inappropriate for use in predicting detailed drawdown impacts due to pumping the alternatives for many reasons documented in this report, including the following:

1. The model cells are too coarse for detailed drawdown predictions.

C76 cont'd

2. The model layers are too thick and the model domain extends much deeper than necessary for simulating the details of pumping their applications.
3. SNWA simulated all layers, including layer 1, as confined. This assumption biases the simulation to underpredict drawdown in Spring Valley because it does not adjust the transmissivity as the water table lowers.
4. The conceptual model used for the numerical model is substantially different from the conceptual model used to develop the numerical model.
5. The numerical model structure was far too complex for the quantity and quality of hydrologic data used to calibrate it.
6. The model relies on faults to control the flow even though there is little collaborating hydrologic data.
7. In many areas, the model is poorly conceptualized which allows the model to protect certain resources and to transmit too much water to certain areas.

C77

Simulation of Proposed Action with Myers Spring/Snake Valley Groundwater Model

The review of the SNWA CCRP model has shown that it is too coarse to make sufficiently accurate predictions for the study area. To provide an alternative tool for considering the impacts in Spring and Snake Valley, I ran the Myers (2011a) model to consider two alternatives. The first is the DEIS proposed action and the second is similar to the reduced pumping option, with the Snake Valley pumping reduced to 36,000 af/y for the entire valley and in Spring Valley reduced to one-third its proposed value. This is less pumping in Spring Valley than the reduced pumping option in the DEIS to better bracket the impacts and to determine whether the drawdown extent differs substantially even for much reduced pumping.

Simulations were run exactly as in Myers (2011b). Three stress periods, 75, 125, and 10,000 years long were used to simulate impacts up to 200 years and to allow the system to come to equilibrium at up to 10,200 years, if that is possible. Figure 15 shows the pumping locations, as for the DEIS, for each scenario; the difference between scenarios is the pumping rates. Pumping was drawn from model layers 4 and 5, 400 to 2000 ft bgs. Wells were not targeted to specific formations, however, as was done in the DEIS (BLM, 2011, p. 3.3-97) because water rights' applications do not limit the pumping to a given formation.

Starting the pumping in each valley at the same time allows better comparisons of predicted drawdown between valleys. The DEIS simulation included pumping in some valleys during the construction period; the DEIS drawdown maps show the results of much less pumping in Snake Valley than in Spring Valley. Nothing legally binds SNWA to pumping schedules as analyzed in the DEIS which means they could begin pumping the full amount from each valley as soon as any water rights are granted.

C77 cont'd

Also, the pumping includes only the project, so there is no confusion with ongoing pumping in the valleys – the drawdowns and changes in fluxes reported are due simply to pumping SNWA's proposals.

Results

Drawdown maps for the two scenarios are presented for two different model layers, 2 and 5, at two different times, 75 and 200 years after pumping begins (Figures 15 through 22). Flux values for the proposed action are shown in Figures 23 through 25 and for the reduced pumping option in Figures 24 to 26. Appendix A contains hydrographs for various monitoring points (Figure 15) for layers 2 and 5 for both pumping scenarios. Layer 2 is for 80 to 200 ft bgs and layer 5 is from 800 to 2000 ft bgs. Differences in water level at a point between the layers represent a vertical gradient.

Drawdown predicted with the Myers model for the proposed action is similar in extent to that predicted by the DEIS, with several exceptions (Figures 15 through 18). First, the drawdown of course clusters around the pumping wells. However, the Myers model simulates numerous areas near those wells with drawdown in excess of 200 feet whereas the DEIS simulation does not (BLM, 2011, Figure 3.3.2-5). Only for pumping the full amount from the original locations does the DEIS predict drawdown near the wells to exceed 200 feet (BLM, 2011, Figure 3.3.2-18). There are even some small areas with drawdown exceeding 500 feet in layer 5 after 200 years (Figure 18).

The SNWA model may underestimate drawdown at the wells because it simulates pumping to occur from 400 to 2000 ft bgs; a longer screen length may spread the impacts over a thicker aquifer section for modeling. This may bias the results because such long screens may not be feasible. Also, the SNWA model simulates all layers as confined, with specific storage too high. Such simulation maintains a constant transmissivity as the water level lowers which may minimize drawdown at the wells.

The Myers model also predicts more drawdown in the middle of the north half of Spring Valley (Figures 15 through 18); the DEIS modeled drawdown did not exceed 10 feet under a broad section of the playa even after 200 years. The DEIS probably underestimated discharge reductions in this area. The reasons for the difference are probably SNWA's specific storage values being too high (releasing more water for a unit head drop).

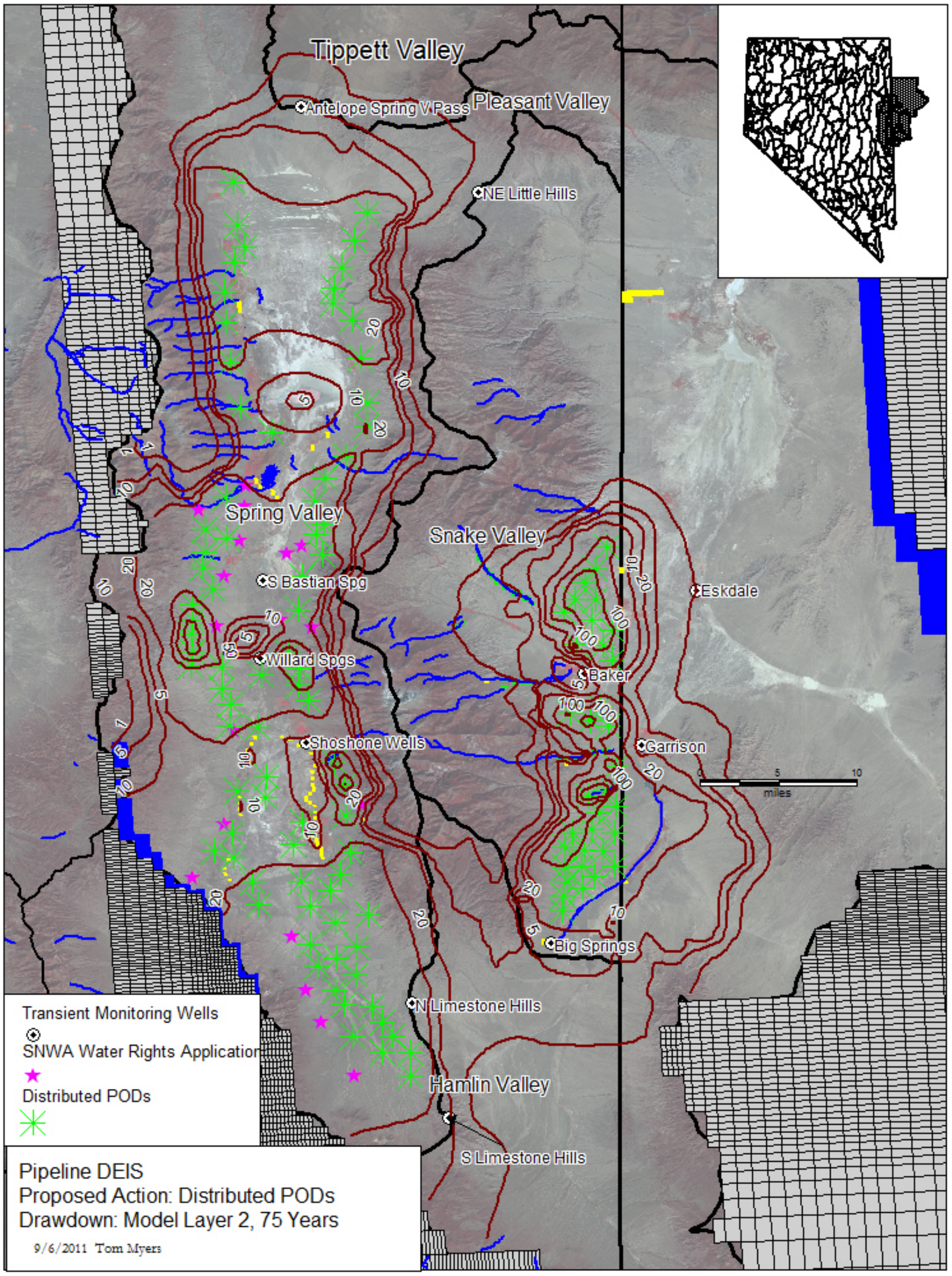

Figure 15: Drawdown for simulation of DEIS proposed action in model layer 2 after 75 years of pumping. The figure also shows pumping and monitoring well locations and the general outline of boundaries in the Myers (2011) model.

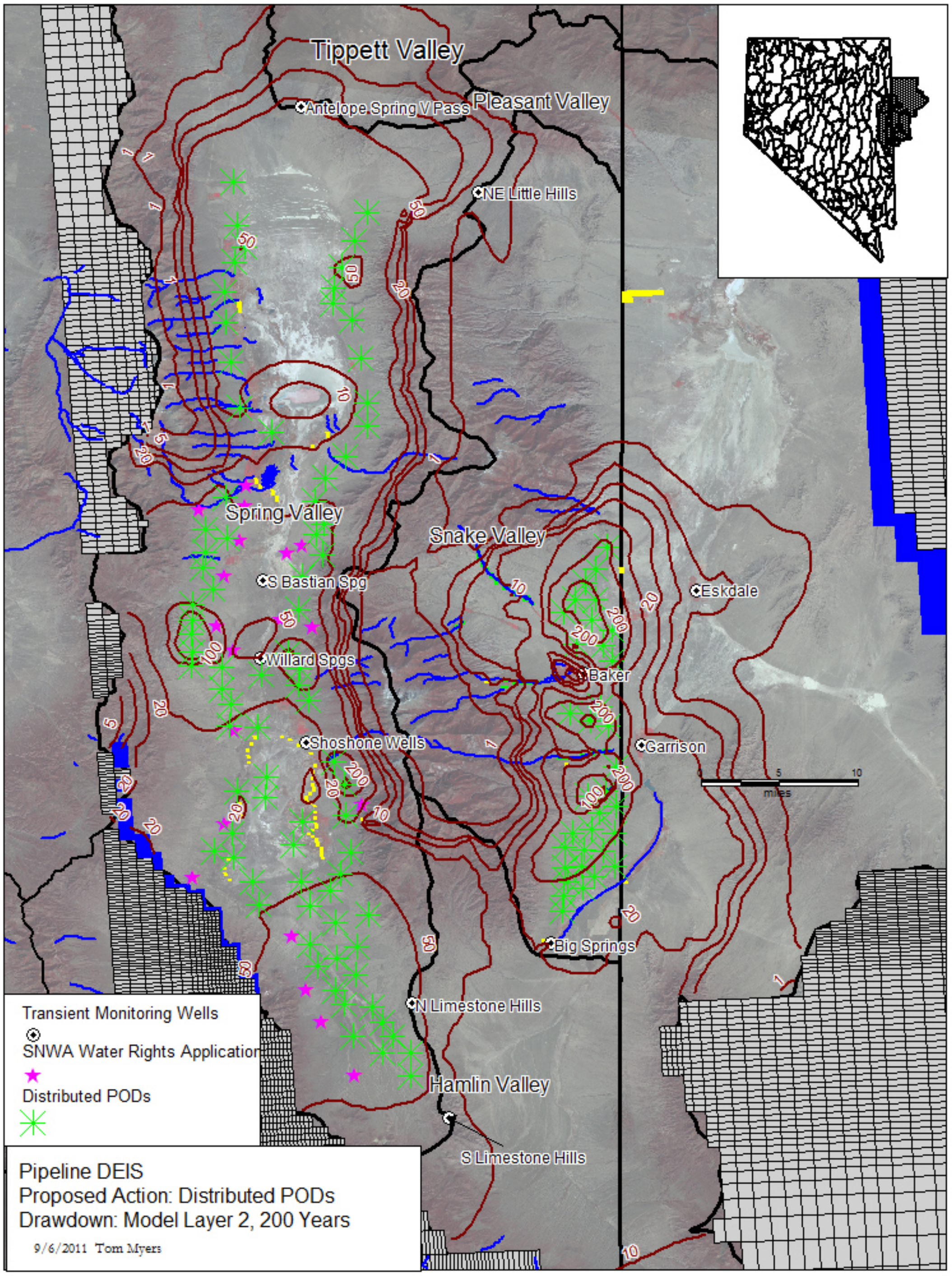

Figure 16: Drawdown for simulation of DEIS proposed action in model layer 2 after 200 years of pumping. The figure also shows pumping and monitoring well locations and the general outline of boundaries in the Myers (2011) model.

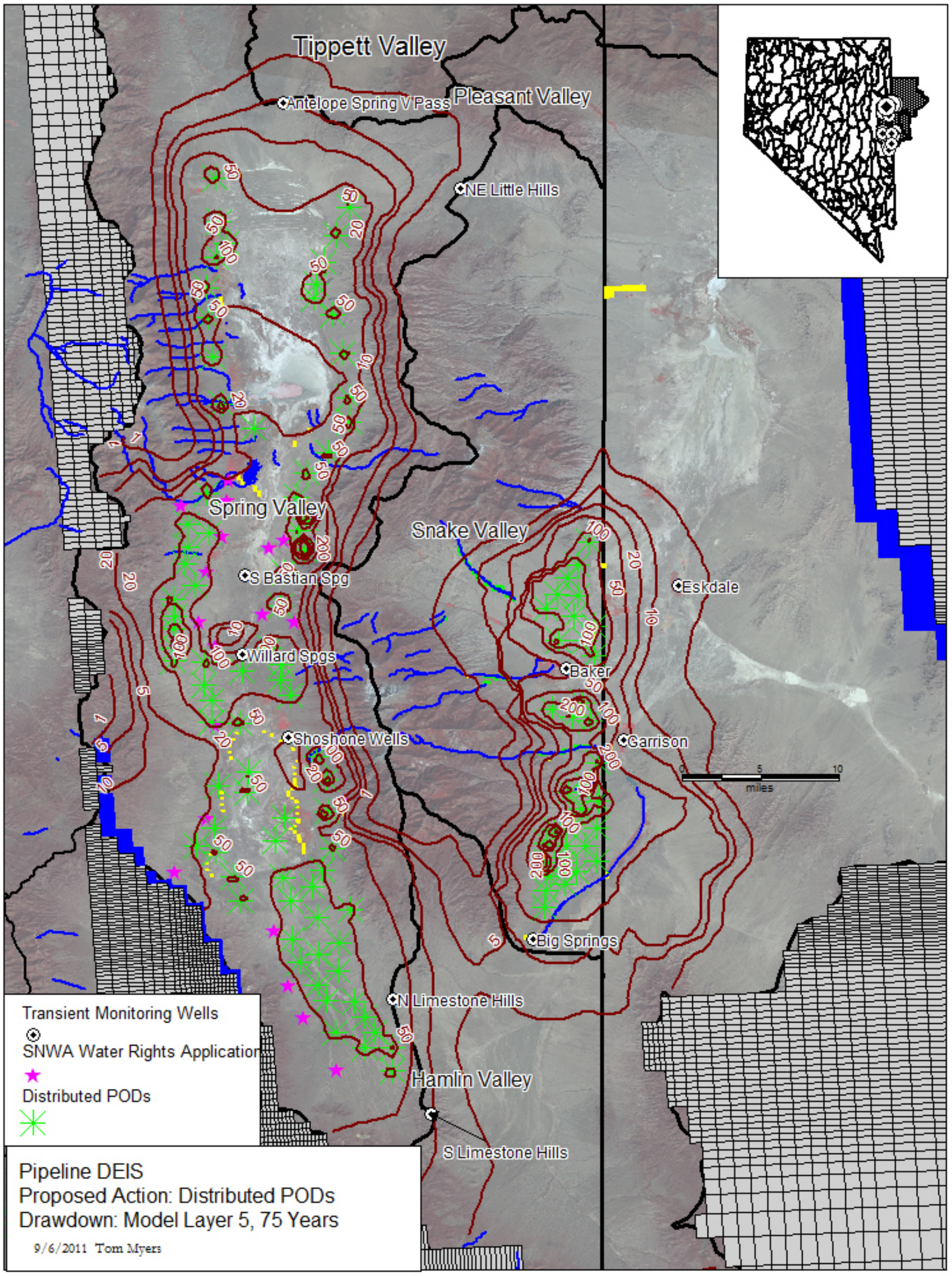

Figure 17: Drawdown for simulation of DEIS proposed action in model layer 5 after 75 years of pumping. The figure also shows pumping and monitoring well locations and the general outline of boundaries in the Myers (2011) model.

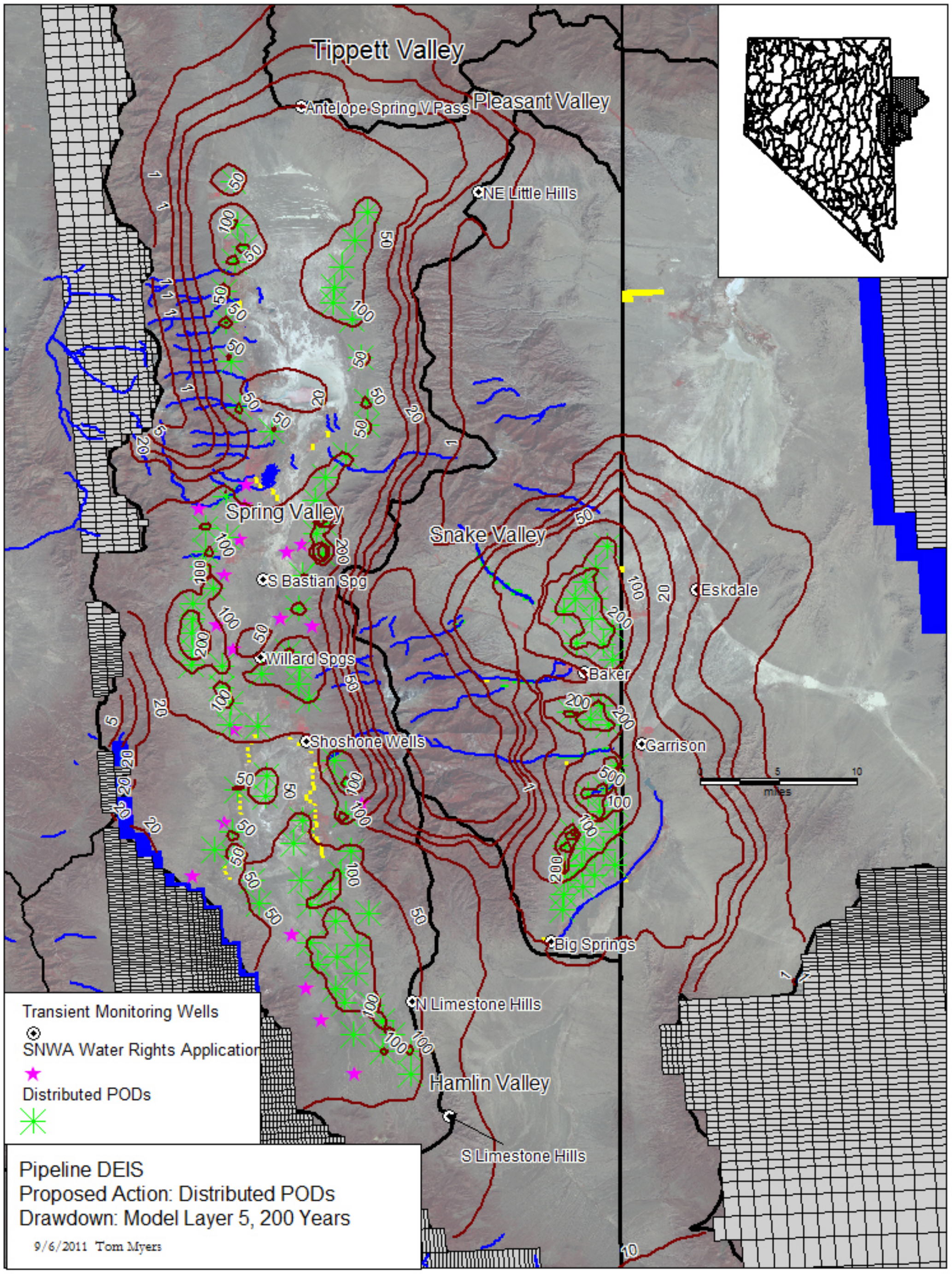

Figure 18: Drawdown for simulation of DEIS proposed action in model layer 5 after 200 years of pumping. The figure also shows pumping and monitoring well locations and the general outline of boundaries in the Myers (2011) model.

C77 cont'd

Pumping the DEIS proposed action causes most of the simulated spring flows to approach zero within 200 years (Figure 23). For example, Spring Creek and Millick Springs dry in 30 years, Big Springs in 80 years, Stateline Springs in 11 years, and discharge to Cleve Creek ceases in 120 years (Figure 24); Swallow Springs are relatively protected by the mountain-front normal fault. Flow from Steptoe Valley to Spring Valley increased by 3000 af/y within 200 years and by 10,000 af/y after 10,200 years.

The system does not come to equilibrium for over 10,000 years. Even at 10,000 years, approximately 1140 af/y continues to be removed from storage; the cumulative amount up to this time is about 100 million af. Over the 10,000 years, the total natural discharge, the sum of ET and springs, reduced from about 163,000 to 38,000 af/y, for a reduction of approximately 125,000 af/y. Total pumping is approximately 142,000 af/y, so the pumping has captured about 90 percent of its total from natural discharge. As noted, some groundwater continues to be removed from storage; the remainder is changes in flow across the model boundaries, so the pumping in Spring and Snake Valley will ultimately affect surrounding valleys with up to 17,000 af/y being drawn from or prevented from flow to those valleys.

The drawdown for reduced pumping option is nearly as extensive as the proposed action, but not as deep (Figures 19 through 22). This is due to the bounds in the model. The central and northern Schell Creek Range and the central two-thirds of the Snake Range are mostly impermeable – pumping quickly draws water from the available aquifer to those boundaries. The 1- through 10-foot drawdown contours near these boundaries are very similar between scenarios. The proposed action has deeper drawdown toward the middle of the valleys as compared to the reduced pumping scenario. Another difference is that the drawdown does not extend as far north into Tippet Valley as quickly.

Although the drawdown extents are similar, the reduced pumping option reduces the various fluxes proportional to the difference in pumping rates (Figures 26 through 28). The reduced option does not avoid impacts because even this option captures most of its pumping from discharge. Wetlands and springs will have reduced flow, but will continue to discharge groundwater. The lesser discharge is due to the decreased drawdown, but then the drawdown is less because less discharge must be captured to offset the pumping.

However, even after 10,200 years, the system has not reached equilibrium for reduced pumping, meaning that the pumping has not totally captured an equivalent amount of discharge. The change in storage flux is about 860 af/y, with a total of 39 million af being removed from storage in 10,200 years. The difference in cumulative storage between the options reflects the different drawdown depths.

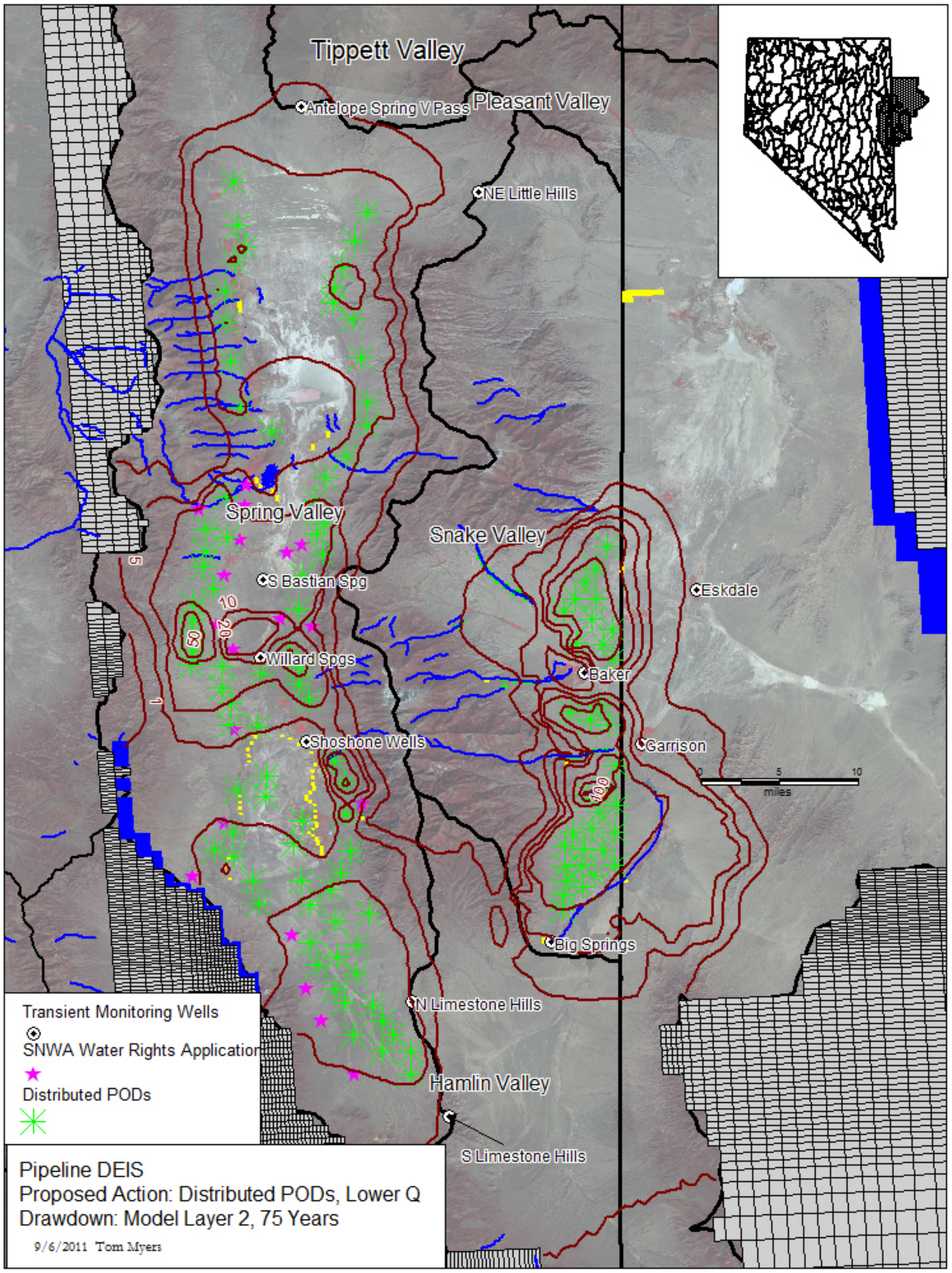

Figure 19: Drawdown for simulation of DEIS proposed action with reduced rates in model layer 2 after 75 years of pumping. The figure also shows pumping and monitoring well locations and the general outline of boundaries in the Myers (2011) model.

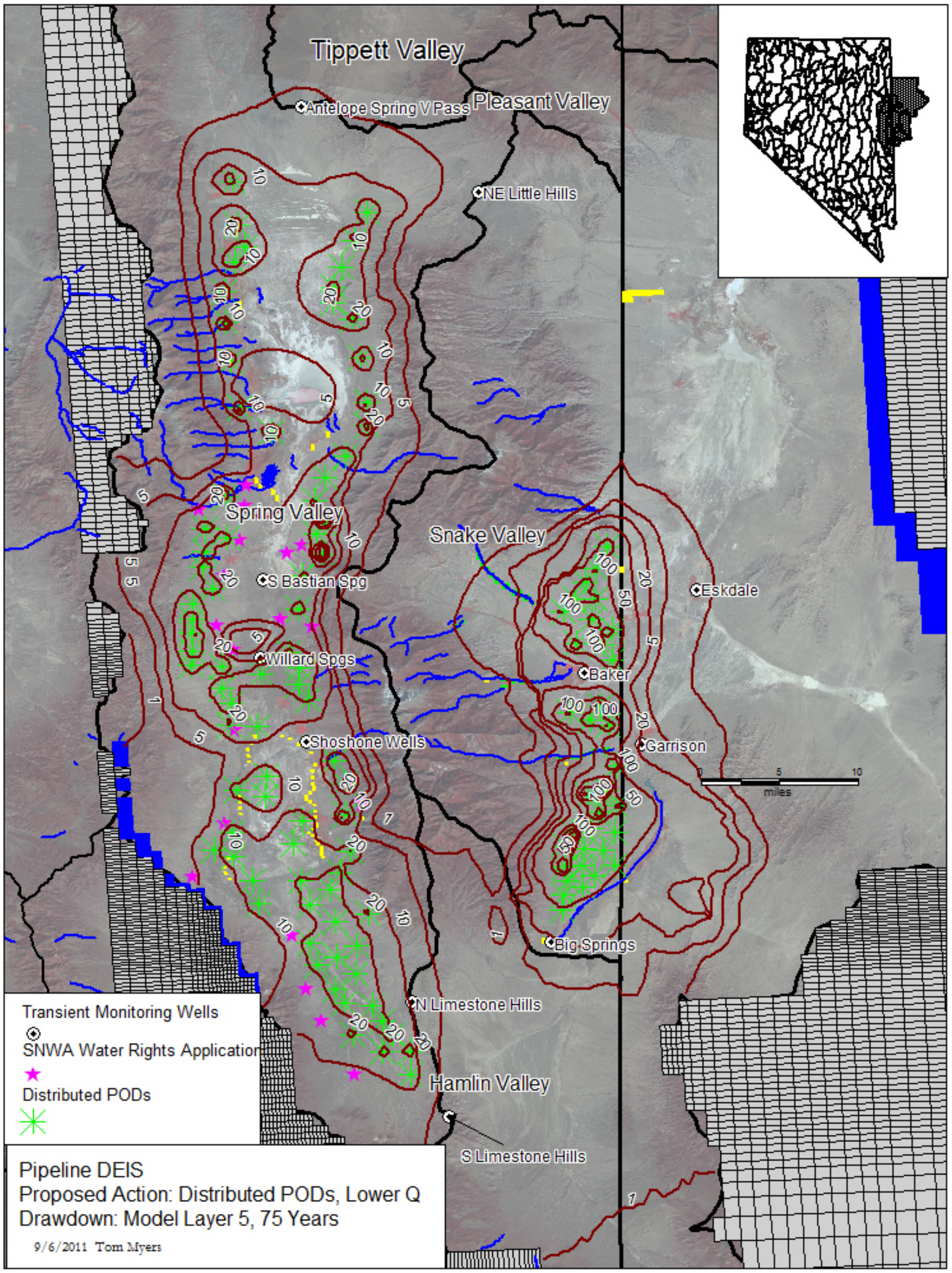

Figure 20: Drawdown for simulation of DEIS proposed action with reduced rates in model layer 5 after 75 years of pumping. The figure also shows pumping and monitoring well locations and the general outline of boundaries in the Myers (2011) model.

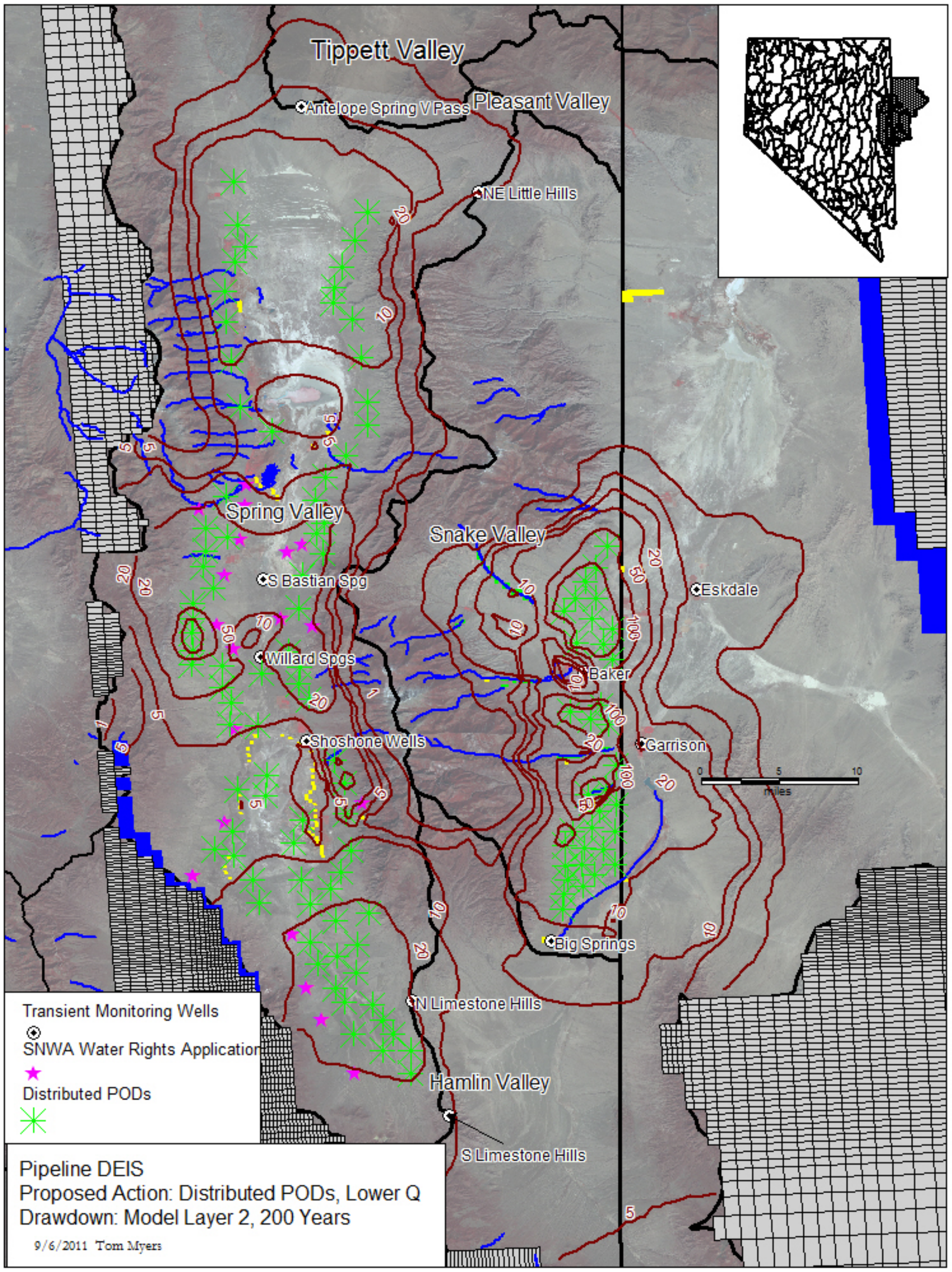

Figure 21: Drawdown for simulation of DEIS proposed action with reduced rates in model layer 2 after 200 years of pumping. The figure also shows pumping and monitoring well locations and the general outline of boundaries in the Myers (2011) model.

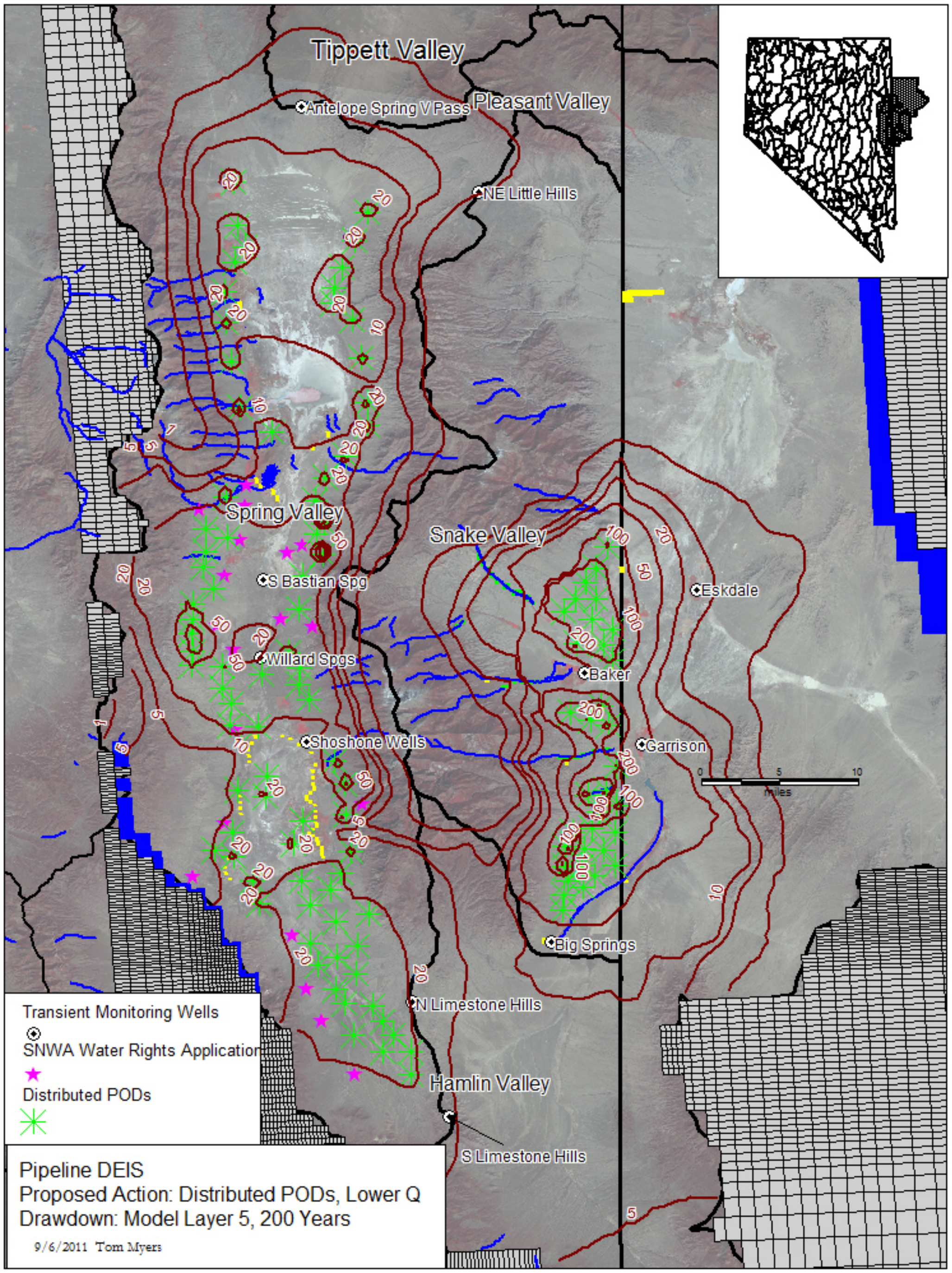

Figure 22: Drawdown for simulation of DEIS proposed action with reduced rates in model layer 5 after 200 years of pumping. The figure also shows pumping and monitoring well locations and the general outline of boundaries in the Myers (2011) model.

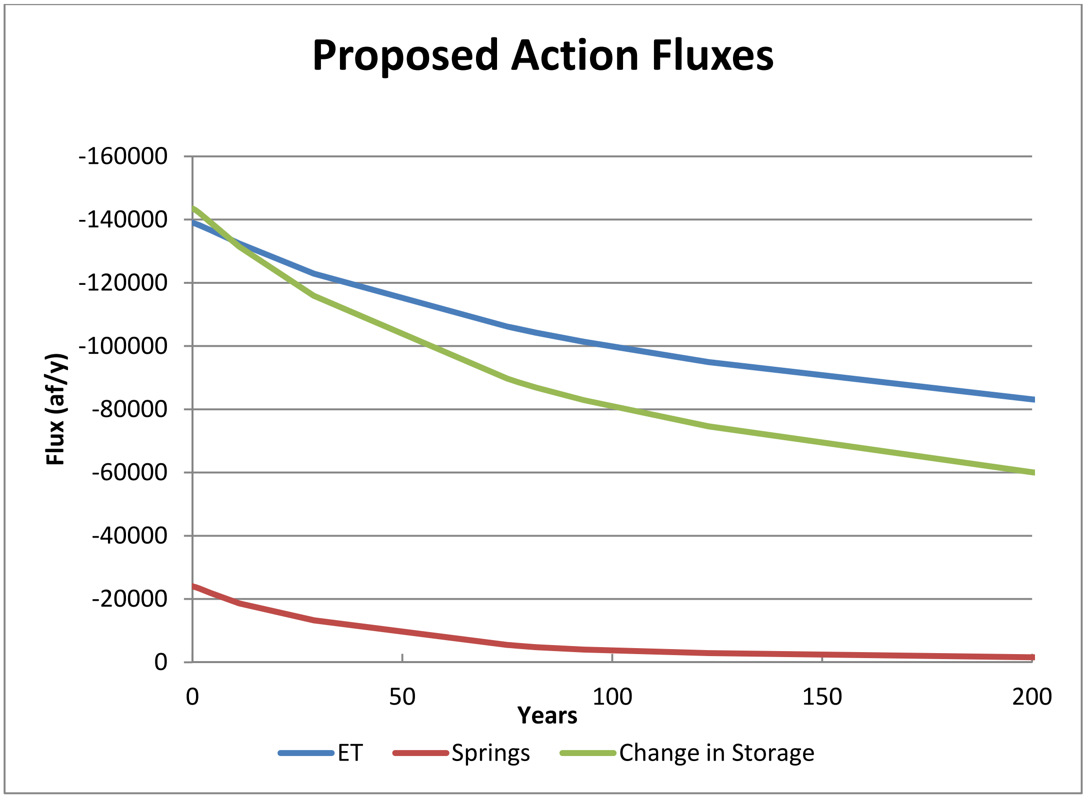

Figure 23: Simulated proposed action flux values.

C77 cont'd

The area most affected by pumping the reduced amount varies from the area most affected for pumping the full application amount. Some of the springs that dried quickly for the proposed action do not dry at all with reduced pumping – these include Millick Springs and the discharge to Cleve Creek. Pumping significantly affects the Snake Valley springs, with the time to complete drying just being increased due to reduced pumpage. The differences between the impacts to Spring and Snake Valleys reflects the fact that the pumping in Snake Valley was only reduced to 36,000 from 50,000 af/y but the pumping in Spring Valley was reduced to one-third of its original rate.

The monitoring well hydrographs (Appendix A) reveal much about the different responses to pumping around the model domain. Some areas initially have higher head in layer 5 than in layer 2; this represents an upward gradient. The Baker monitoring site demonstrates this clearly with about a 60-foot head drop between layers 5 and 2; this reflects the sub-irrigated pastures near Baker and the circulation of recharge in the carbonate in the Snake Range and at the head of the alluvial fans. Although the gradient varies, similar upward gradients occur at Garrison, both Swamp Cedar sites, Shoshone Wells, South Spring Valley Playa, Minerva, and barely at Big Springs. Pumping reduces or eliminates the vertical upward gradient, as is apparent at Baker and Shoshone Springs, which suggests the subirrigated meadows will eventually be dried and the well at Shoshone Wells will no longer be artesian.

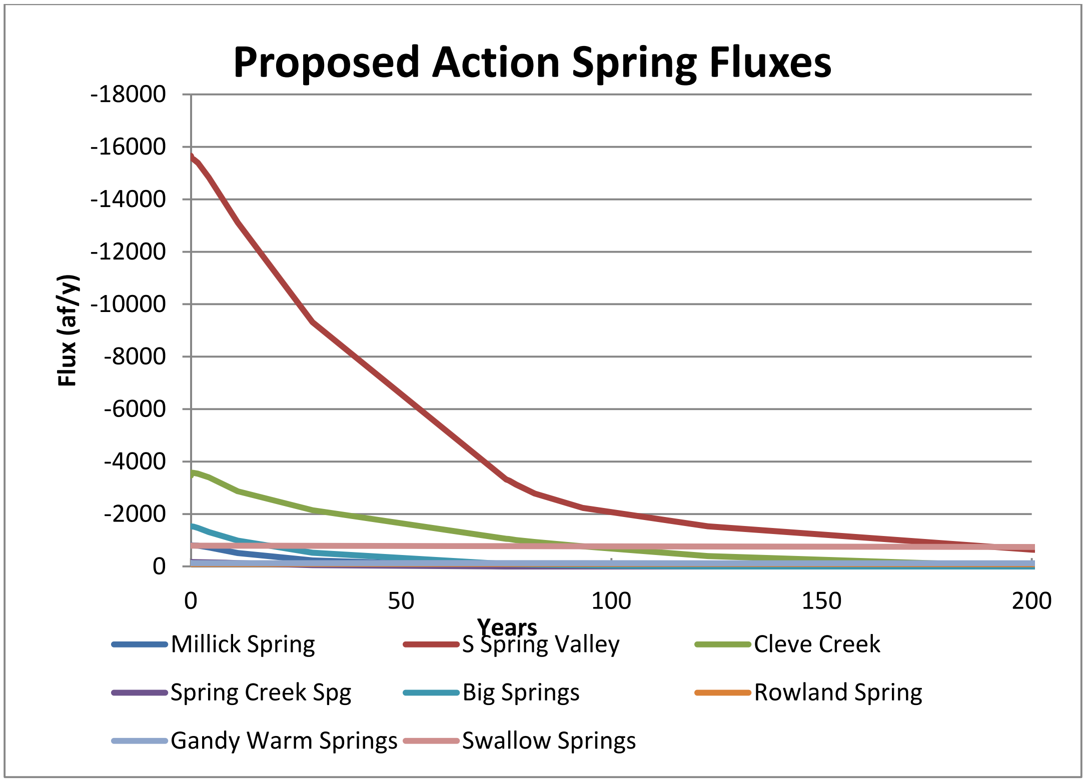

Figure 24: Simulated proposed action spring fluxes.

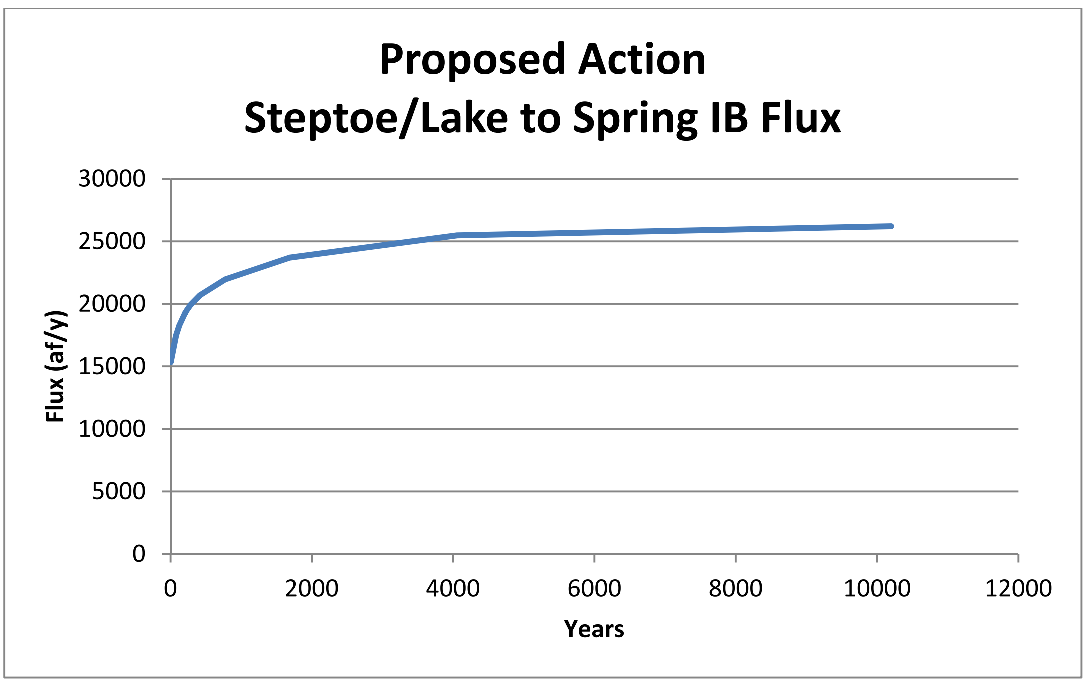

Figure 25: Simulated proposed action flux for interbasin flow from Steptoe to Spring Valley.

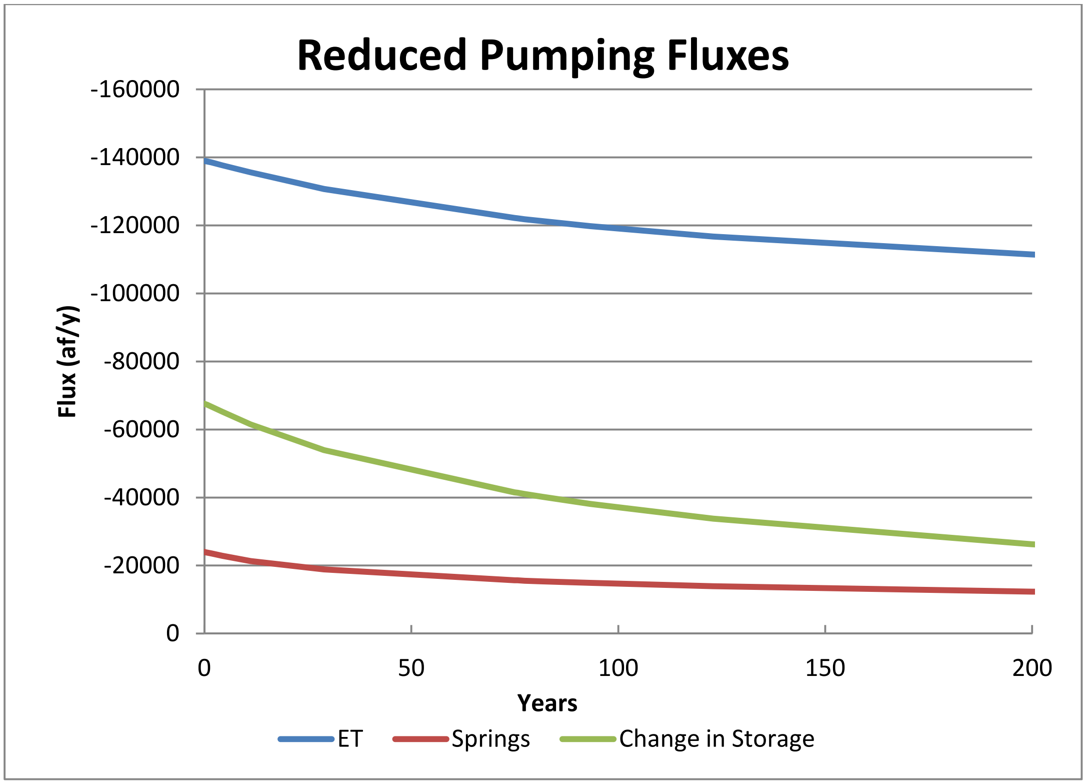

Figure 26: Simulated reduced pumping scenario fluxes.

C77 cont'd

Areas near the base of the mountains, such as Shingle Creek and Stonehouse Spring, naturally have a downward gradient. Pumping effects do not reach Stonehouse Spring for more than 200 years, but when they do, they lower the potentiometric surface in layer 5 more than in layer 2. This could increase the downward fluxes and induce recharge if any streams intersect the water table.

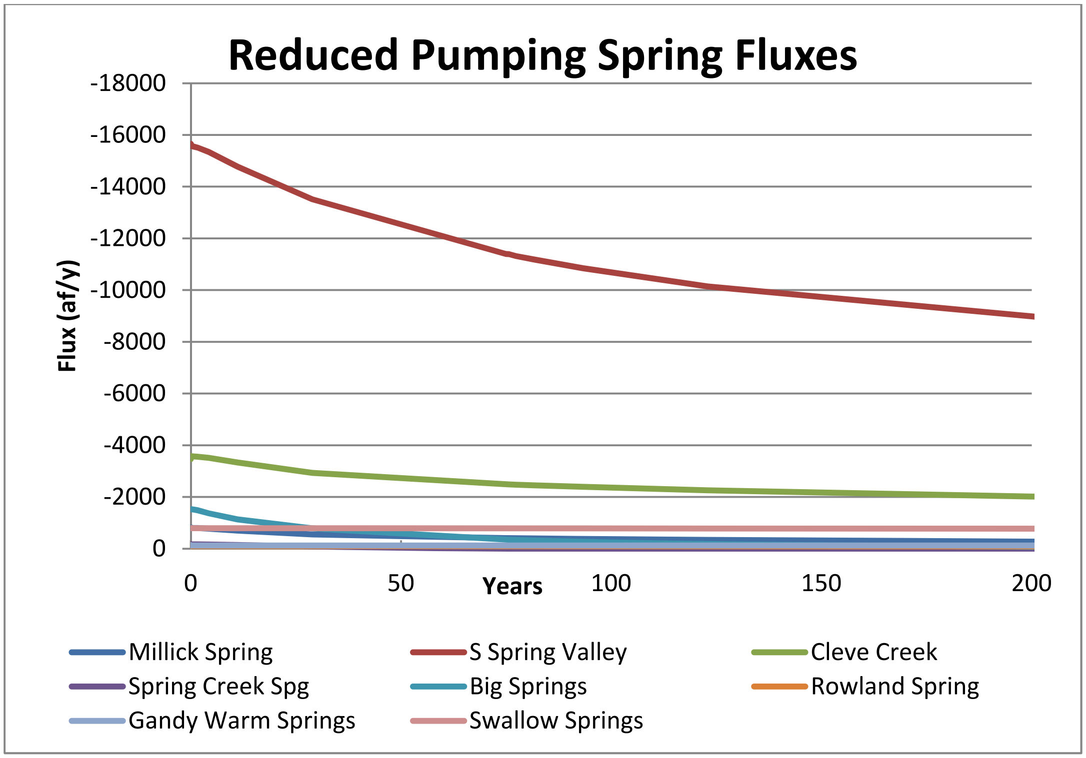

Figure 27: Simulated reduced pumping option spring fluxes.

C77 cont'd

Another obvious point from the monitoring well hydrographs is that the system is still undergoing significant change at 200 years. This may be seen by comparing the 10,200-year hydrographs with the 200 –year hydrographs. In the long-term, the drawdown will overwhelm the vertical gradient. After a few hundred years, the head level for both layers will be similar with the differences due to pumping scenario. Less drawdown at any point occurs with the reduced pumping option.

Drawdown at points near the center of the valley for the DEIS proposed action exceeds that caused by the reduced pumping option by much more than three times. At some of these points, the hydrographs suggest equilibrium has been established after several hundred years for the reduced pumping option while drawdown from the proposed action just continues to increase. The difference is that the proposed action draws the water table below the extinction depth for the ET zones; once that occurs, there is no more discharge to capture at the point. Continued water table lowering does not decrease the discharge, so at that point the system cannot come into equilibrium. The water table will continue to lower so that the drawdown extent can increase to capture more discharge. In Spring Valley, drawdown can only extend north or south to capture other discharges. This is why the water table continues to deepen after the ET discharge has ceased.

The Center South Spring playa site is a good example: the proposed action causes the water table to draw down indefinitely and completely eliminates the upward gradient; the reduced pumping option allows the upward gradient to continue.

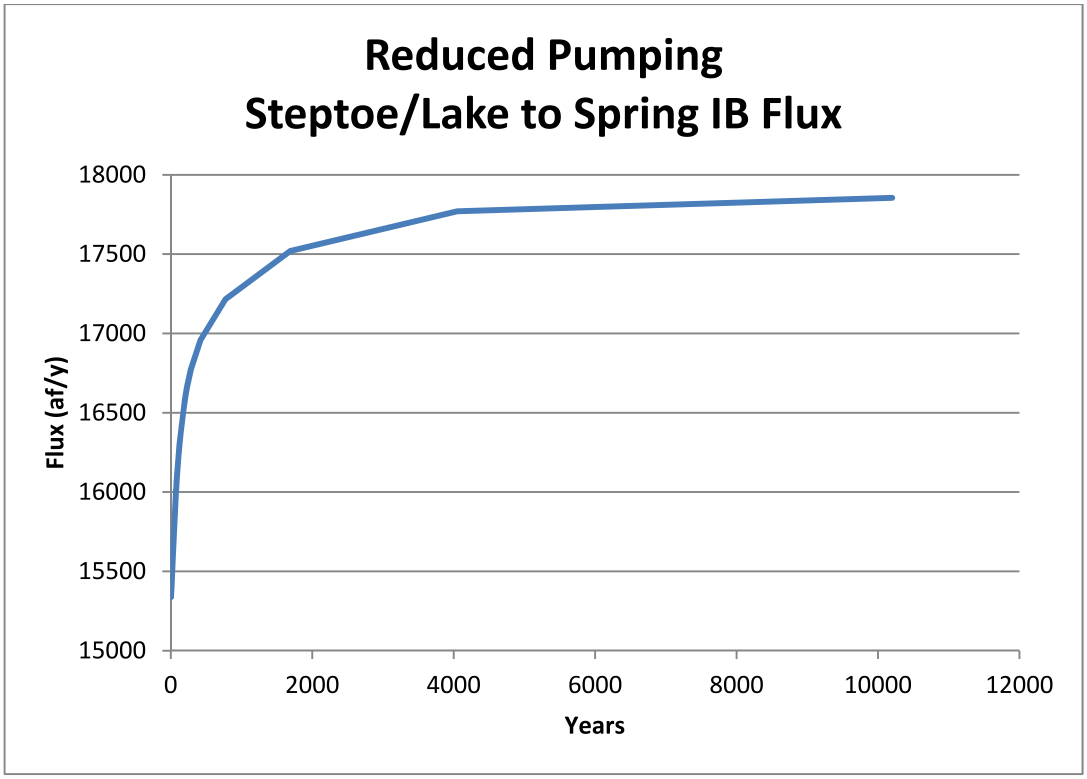

Figure 28: Simulated reduced pumping option interbasin flux from Steptoe/Lake Valleys to Spring Valley.

C78

Summary of Alternatives Simulations

Pumping either the DEIS proposed action or the reduced pumping scenario would cause widespread drawdown around both Spring and Snake Valleys. With time, either option draws groundwater from surrounding valleys, causing drawdown and intercepting discharge there. The DEIS proposed action will cause very substantial drawdown near the centers of pumping. The groundwater system does not come into equilibrium for more than 10,000 years.

Reducing the pumping rate to one-third of the full application amount, or about 30,000 af/y, allows the system to almost come to equilibrium with a some wetland ET discharge and spring flow continuing. Although the valley resources would be severely damaged, they would at least still remain while the proposed action would almost completely dry the valley.

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Myers, T., 2011b. Hydrogeology of Spring Valley and Surrounding Areas, PART C: IMPACTS OF PUMPING UNDERGROUND WATER RIGHT APPLICATIONS #54003 THROUGH 54021.

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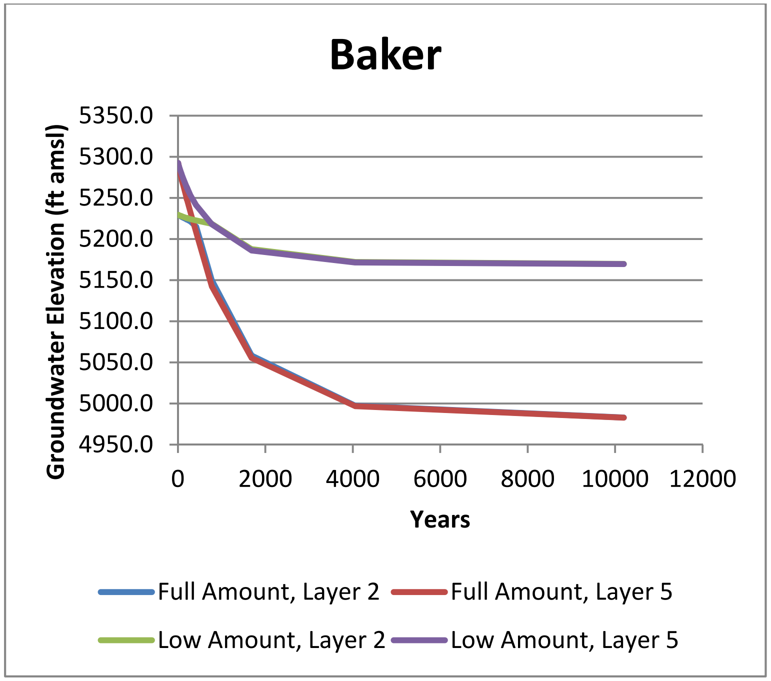
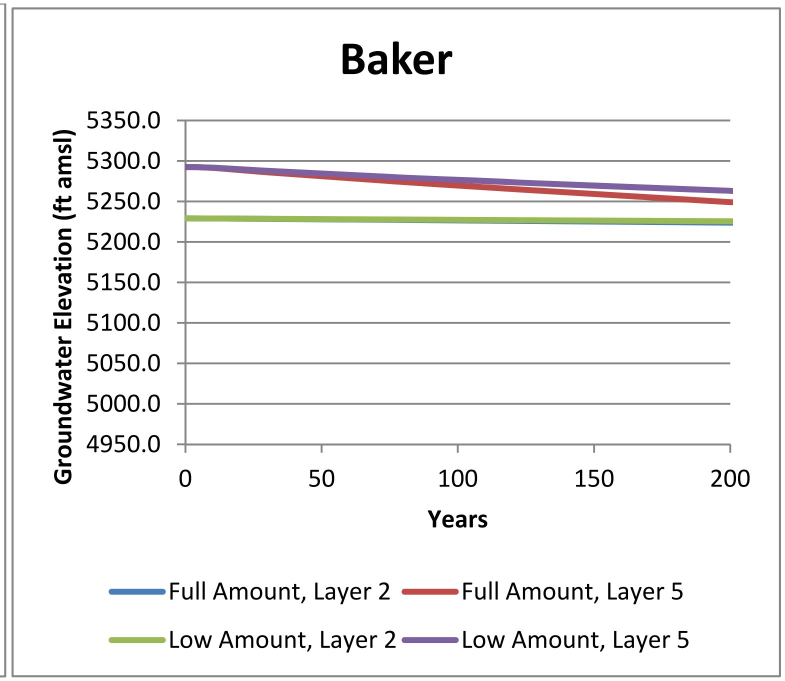
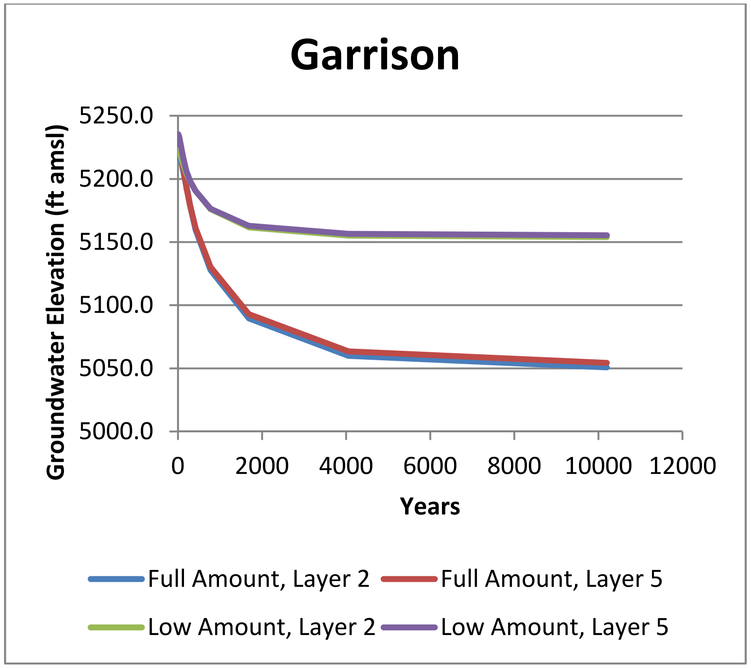
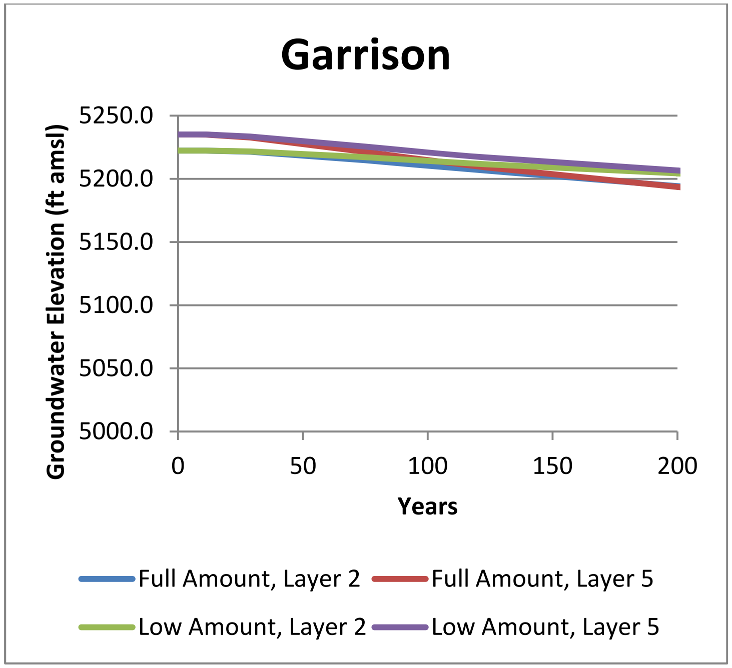
APPENDIX 1: GROUNDWATER LEVELS AT SELECT MONITORING POINTS.

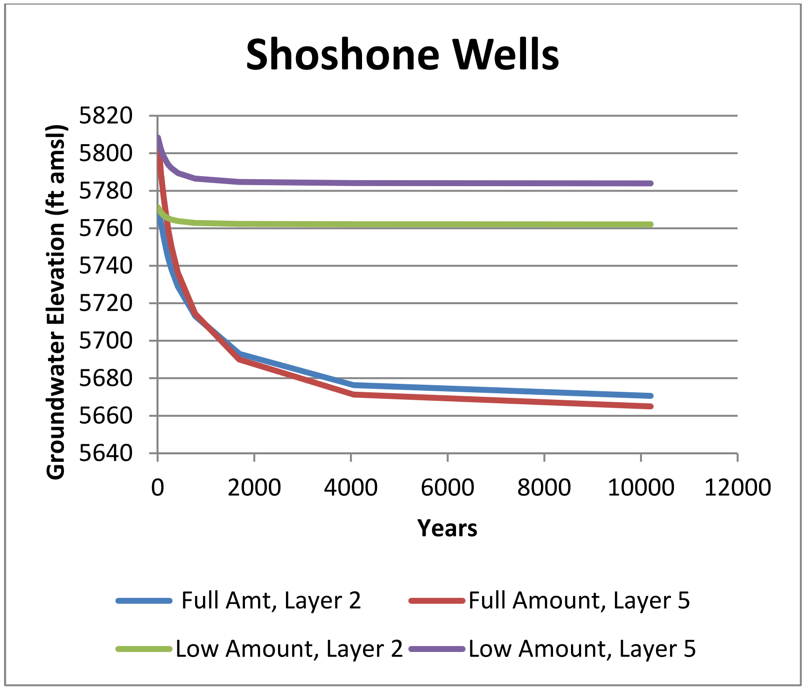
EACH PAGE PRESENTS HYDROGRAPHS FOR 10,200 YEARS AND FOR 200 YEARS.

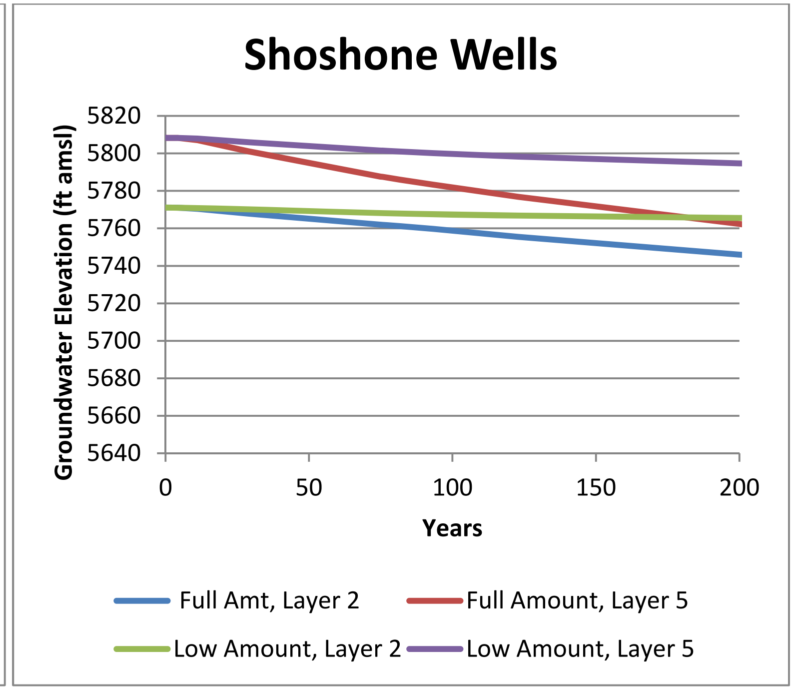


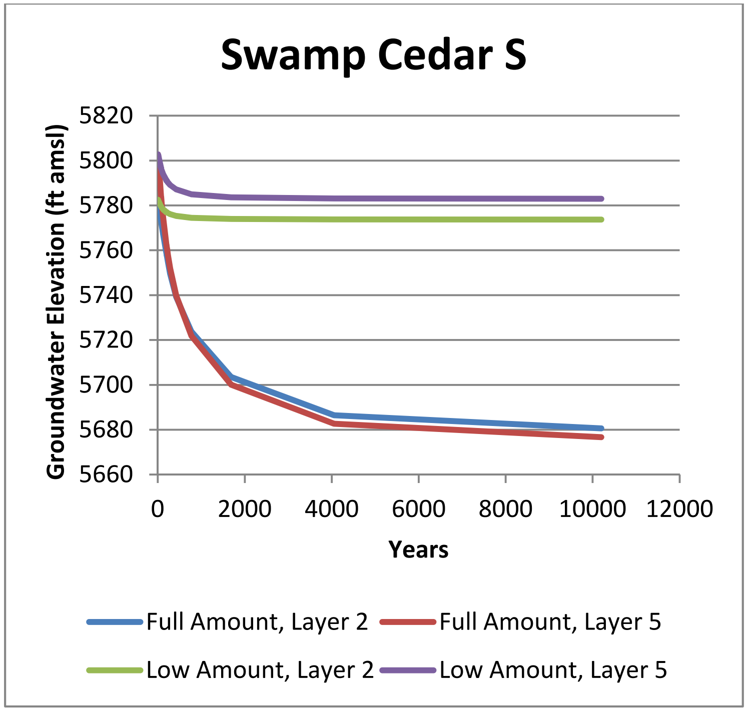


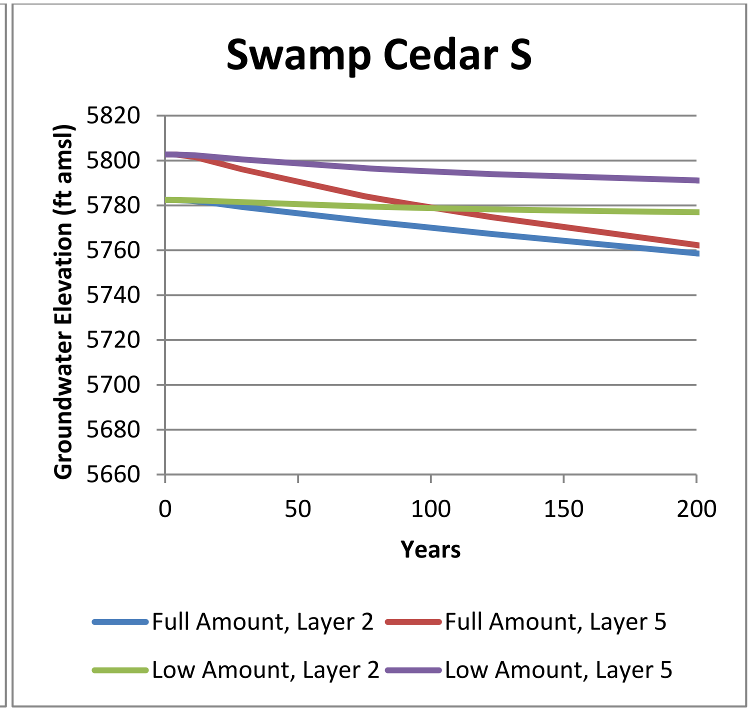

Garrison
Groundwater Elevation (ft amsl)
5250.0
5200.0
5150.0
5100.0
5050.0
5000.0
0
2000
4000
6000
8000
10000
12000
Years
Full Amount, Layer 2
Full Amount, Layer 5
Low Amount, Layer 2
Low Amount, Layer 5

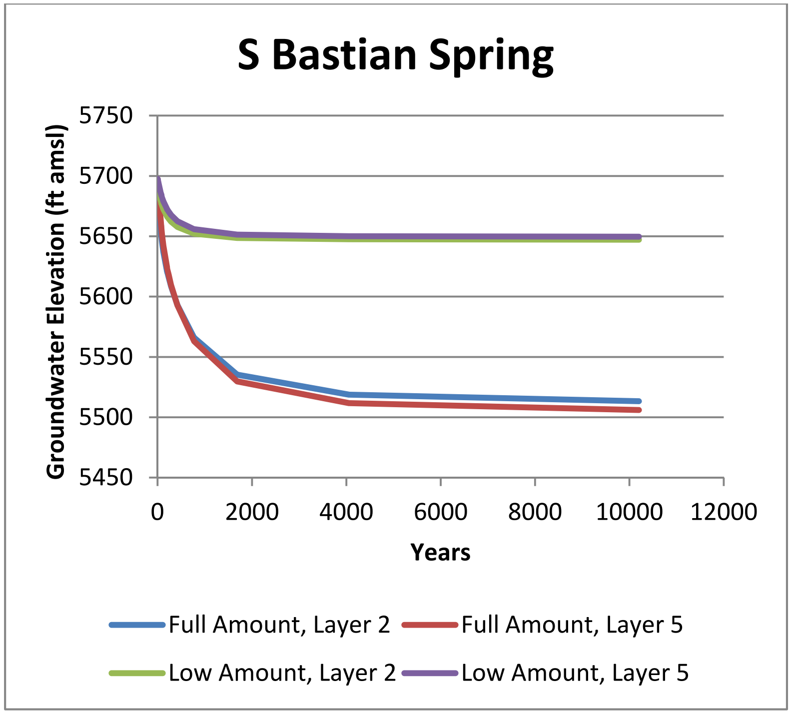

Garrison
Groundwater Elevation (ft amsl)
5250.0
5200.0
5150.0
5100.0
5050.0
5000.0
0
50
100
150
200
Years
Full Amount, Layer 2
Full Amount, Layer 5
Low Amount, Layer 2
Low Amount, Layer 5

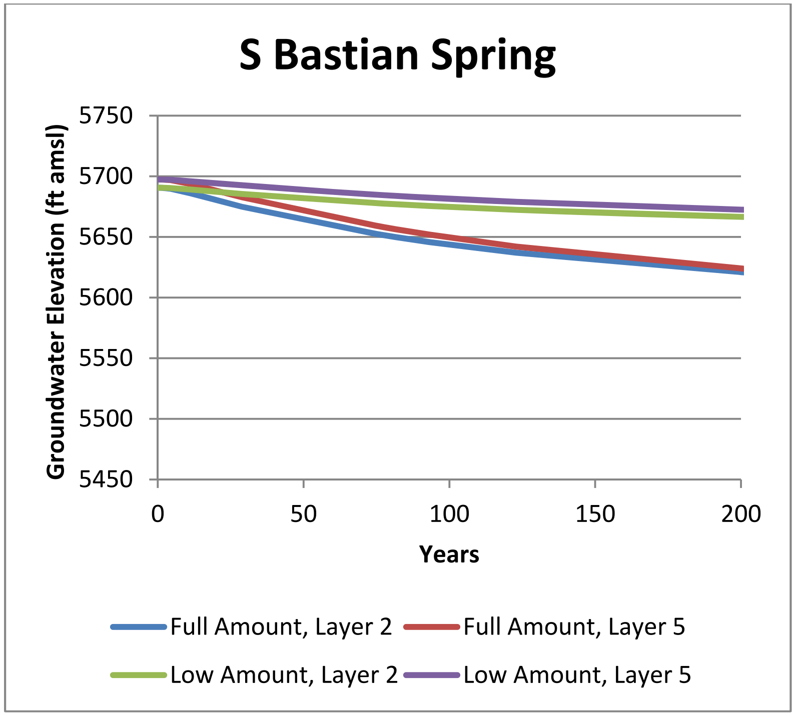

Shoshone Wells
Groundwater Elevation (ft amsl)
5820
5800
5780
5760
5740
5720
5700
5680
5660
5640
0
2000
4000
6000
8000
10000
12000
Years
Full Amt, Layer 2
Full Amount, Layer 5
Low Amount, Layer 2
Low Amount, Layer 5

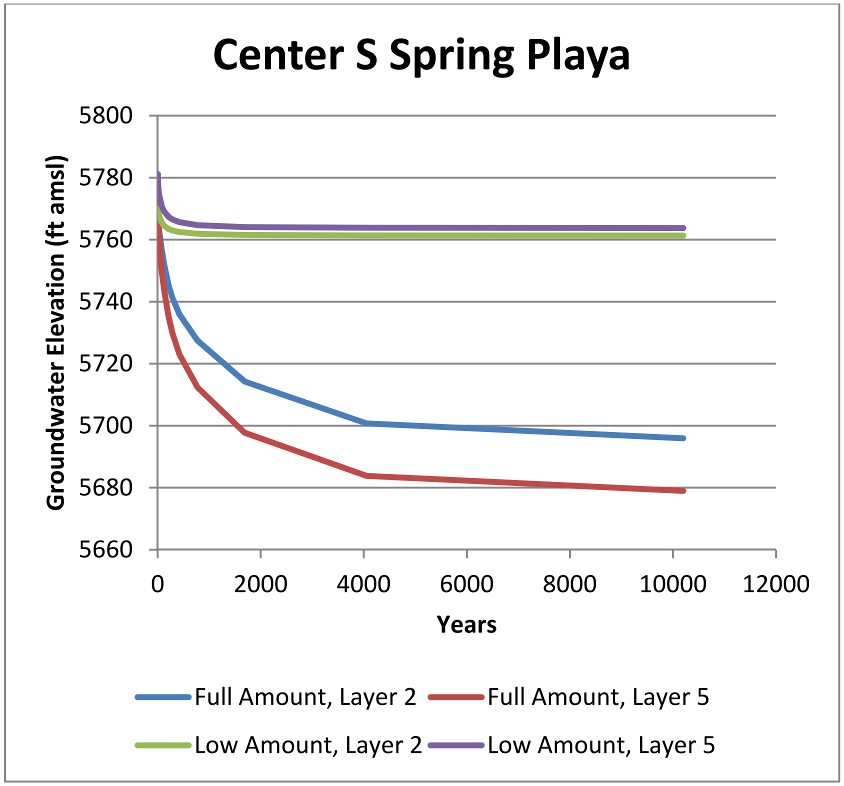

Shoshone Wells
Groundwater Elevation (ft amsl)
5820
5800
5780
5760
5740
5720
5700
5680
5660
5640
0
50
100
150
200
Years
Full Amt, Layer 2
Full Amount, Layer 5
Low Amount, Layer 2
Low Amount, Layer 5


Swamp Cedar S
Groundwater Elevation (ft amsl)
5820
5800
5780
5760
5740
5720
5700
5680
5660
0
2000
4000
6000
8000
10000
12000
Years
Full Amount, Layer 2
Full Amount, Layer 5
Low Amount, Layer 2
Low Amount, Layer 5

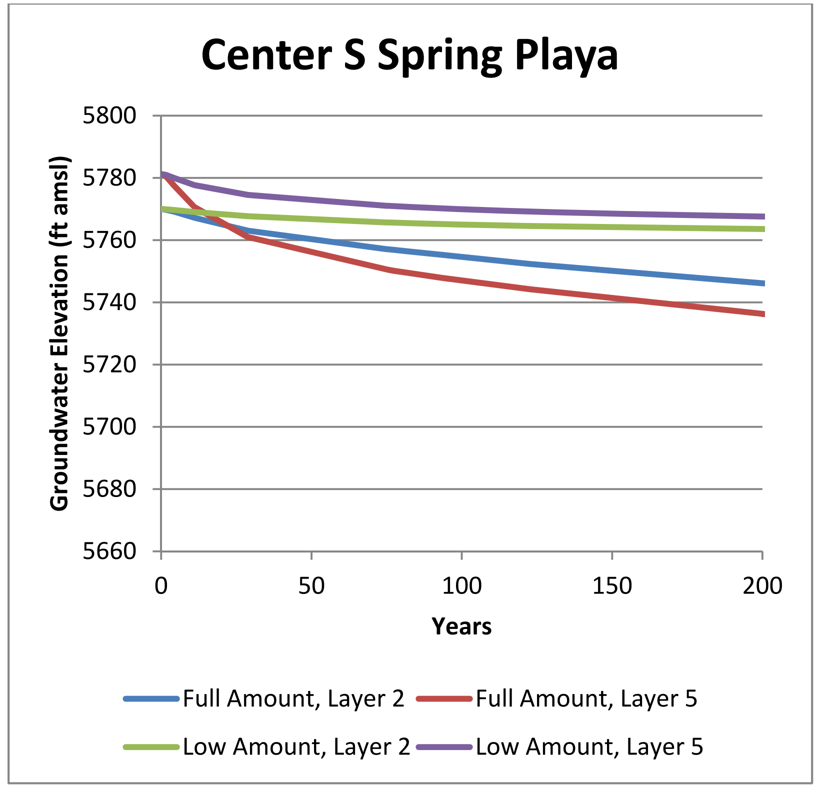

Swamp Cedar S
Groundwater Elevation (ft amsl)
5820
5800
5780
5760
5740
5720
5700
5680
5660
0
50
100
150
200
Years
Full Amount, Layer 2
Full Amount, Layer 5
Low Amount, Layer 2
Low Amount, Layer 5


S Bastian Spring
Groundwater Elevation (ft amsl)
5750
5700
5650
5600
5550
5500
5450
0
2000
4000
6000
8000
10000
12000
Years
Full Amount, Layer 2
Full Amount, Layer 5
Low Amount, Layer 2
Low Amount, Layer 5

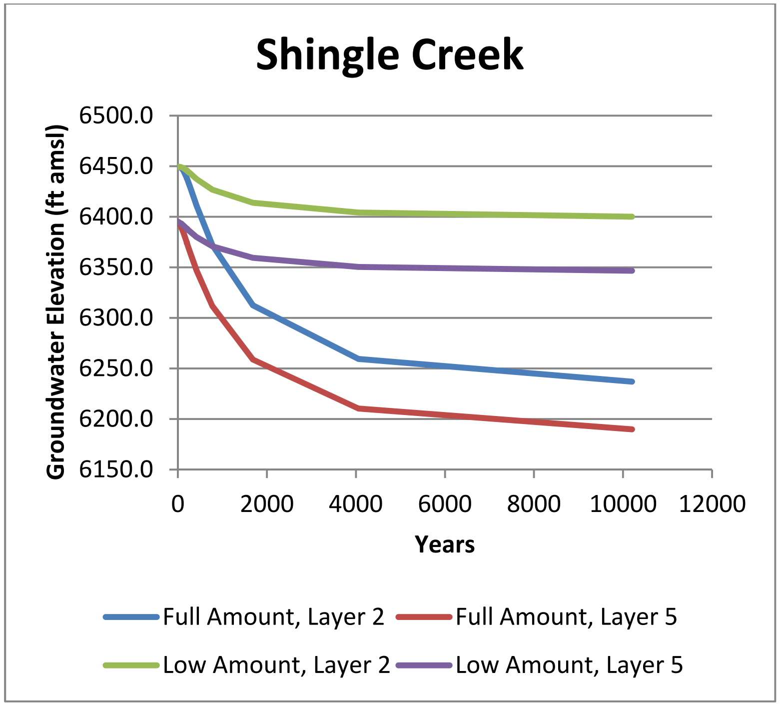

S Bastian Spring
Groundwater Elevation (ft amsl)
5750
5700
5650
5600
5550
5500
5450
0
50
100
150
200
Years
Full Amount, Layer 2
Full Amount, Layer 5
Low Amount, Layer 2
Low Amount, Layer 5

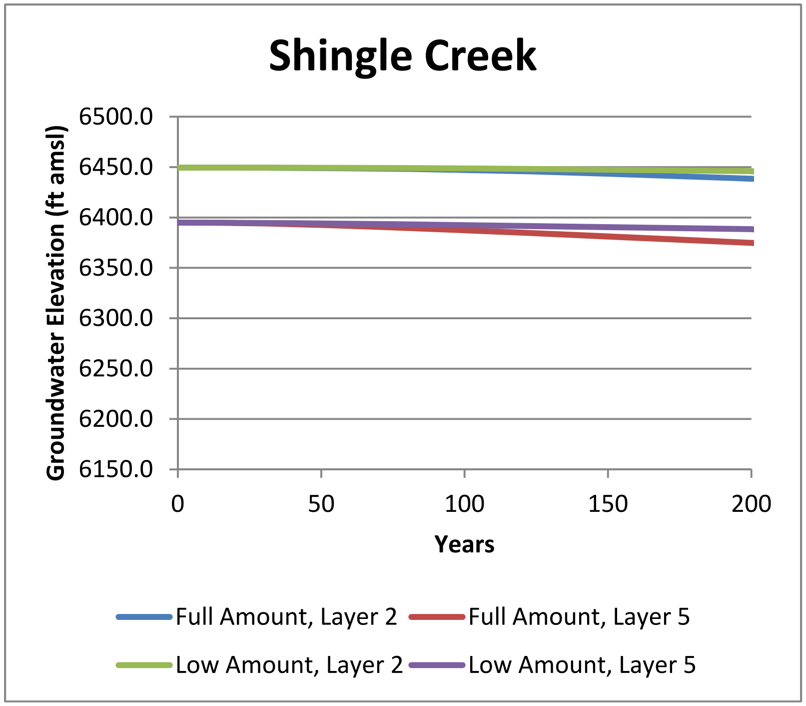


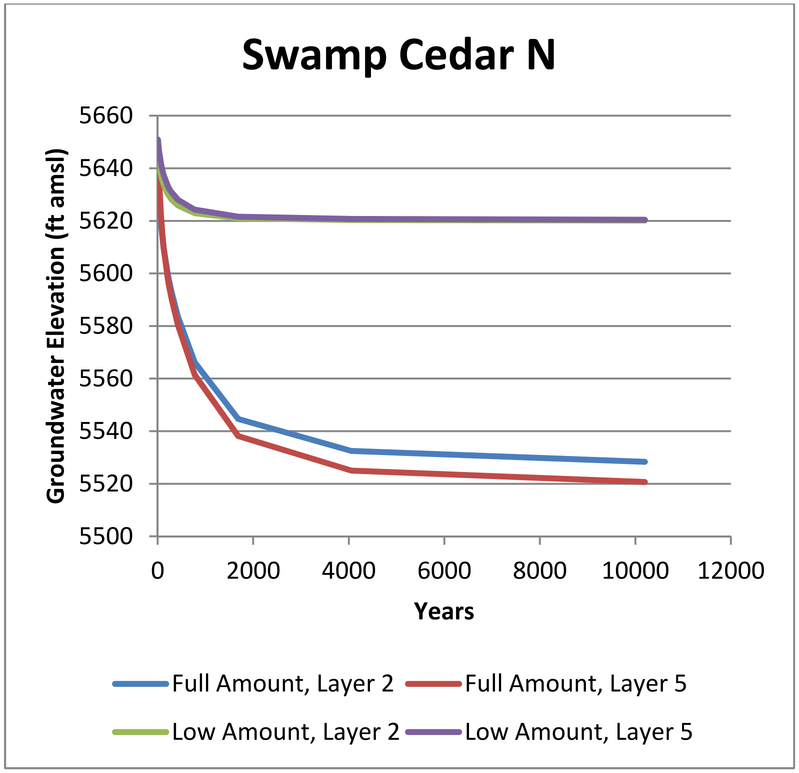
Center S Spring Playa
Groundwater Elevation (ft amsl)
5800
5780
5760
5740
5720
5700
5680
5660
0
2000
4000
6000
8000
10000
12000
Years
Full Amount, Layer 2
Full Amount, Layer 5
Low Amount, Layer 2
Low Amount, Layer 5

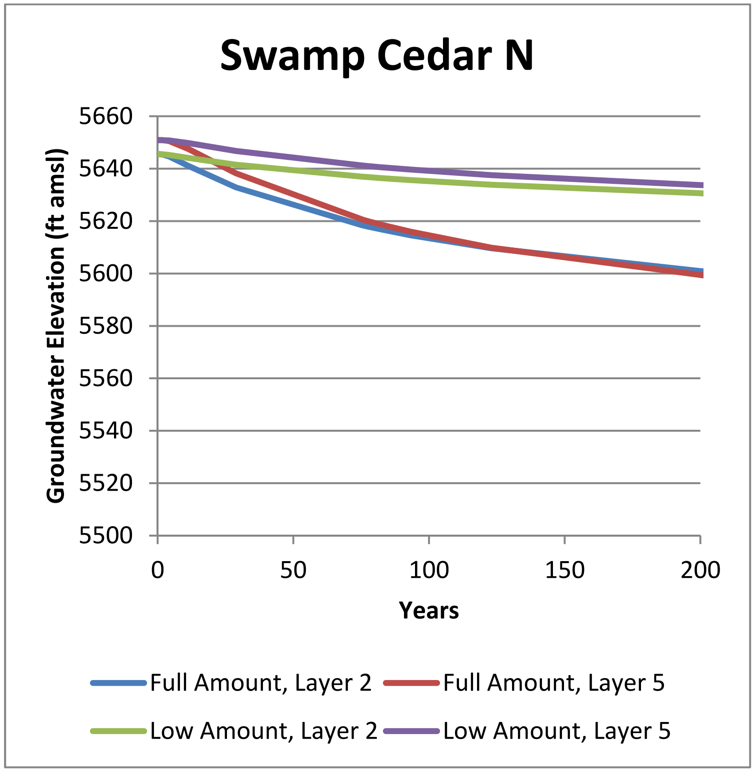


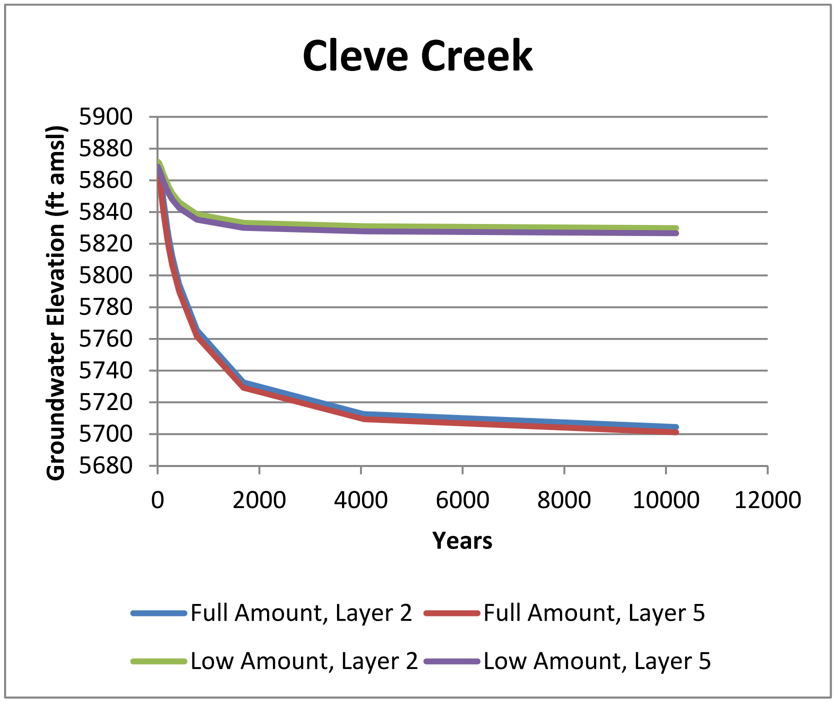
Center S Spring Playa
Groundwater Elevation (ft amsl)
5800
5780
5760
5740
5720
5700
5680
5660
0
50
100
150
200
Years
Full Amount, Layer 2
Full Amount, Layer 5
Low Amount, Layer 2
Low Amount, Layer 5

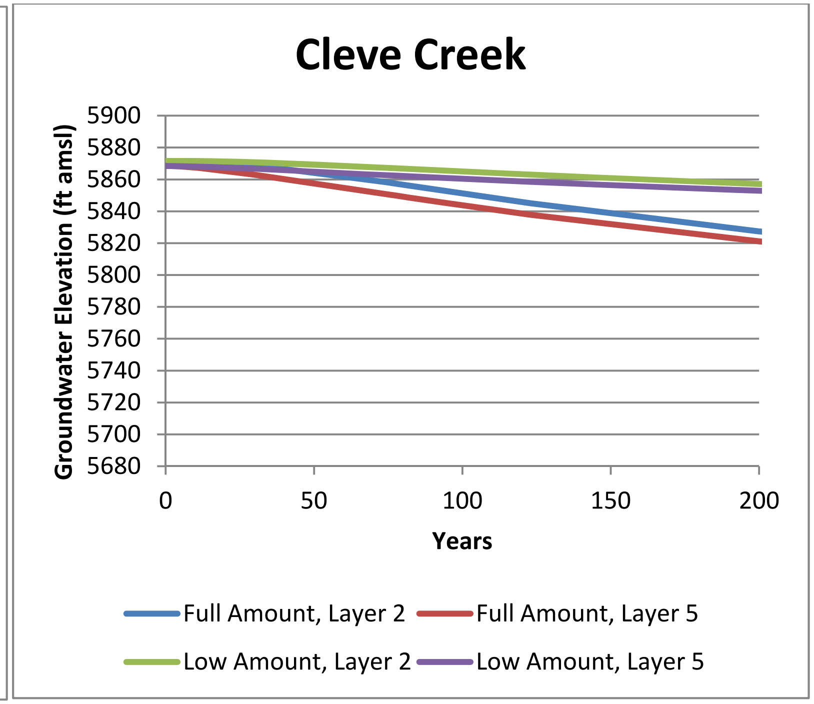

Shingle Creek
Groundwater Elevation (ft amsl)
6500.0
6450.0
6400.0
6350.0
6300.0
6250.0
6200.0
6150.0
0
2000
4000
6000
8000
10000
12000
Years
Full Amount, Layer 2
Full Amount, Layer 5
Low Amount, Layer 2
Low Amount, Layer 5

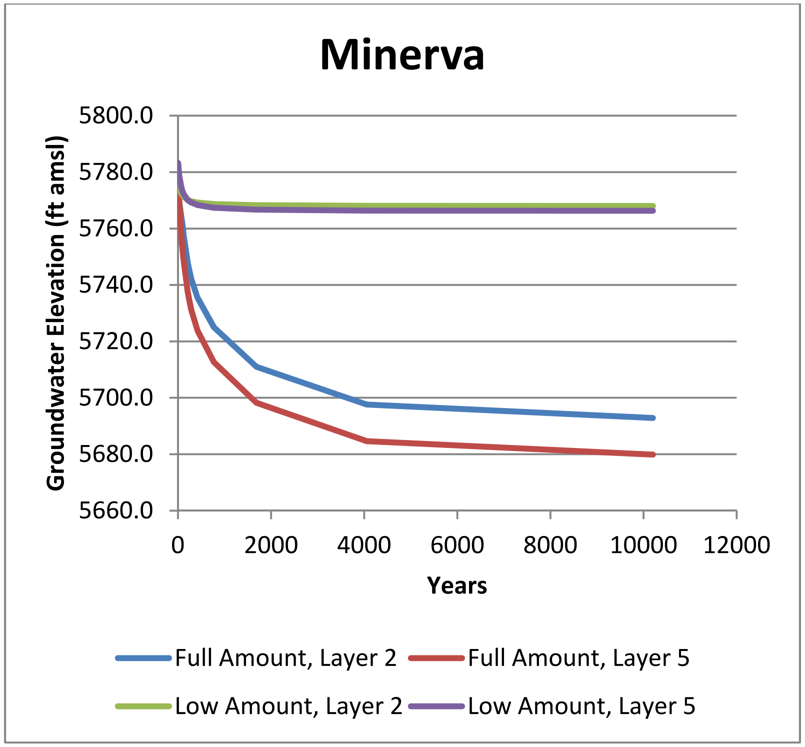

Shingle Creek
Groundwater Elevation (ft amsl)
6500.0
6450.0
6400.0
6350.0
6300.0
6250.0
6200.0
6150.0
0
50
100
150
200
Years
Full Amount, Layer 2
Full Amount, Layer 5
Low Amount, Layer 2
Low Amount, Layer 5

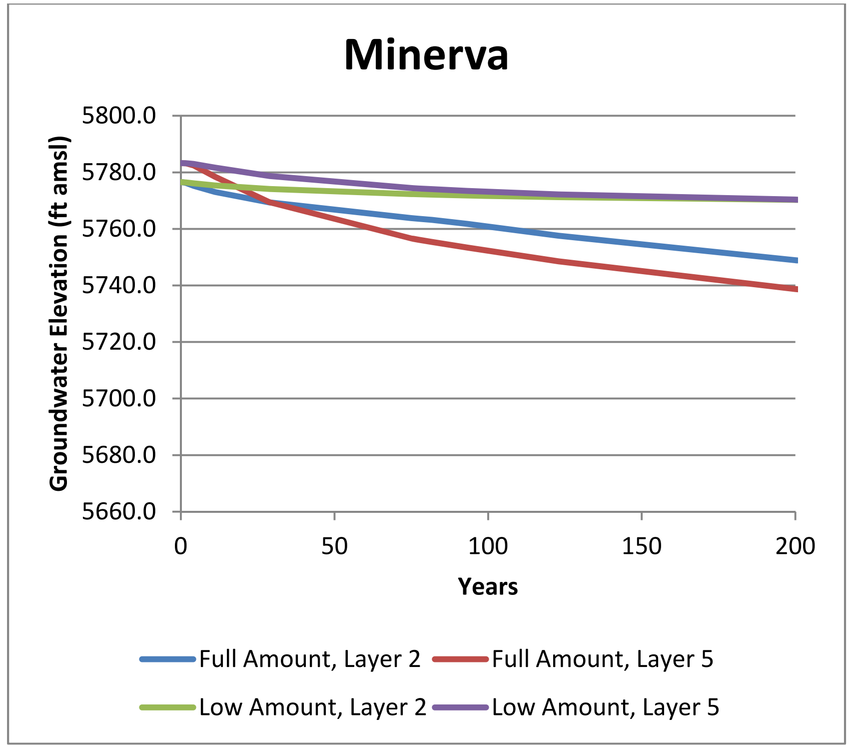

Swamp Cedar N
Groundwater Elevation (ft amsl)
5660
5640
5620
5600
5580
5560
5540
5520
5500
0
2000
4000
6000
8000
10000
12000
Years
Full Amount, Layer 2
Full Amount, Layer 5
Low Amount, Layer 2
Low Amount, Layer 5

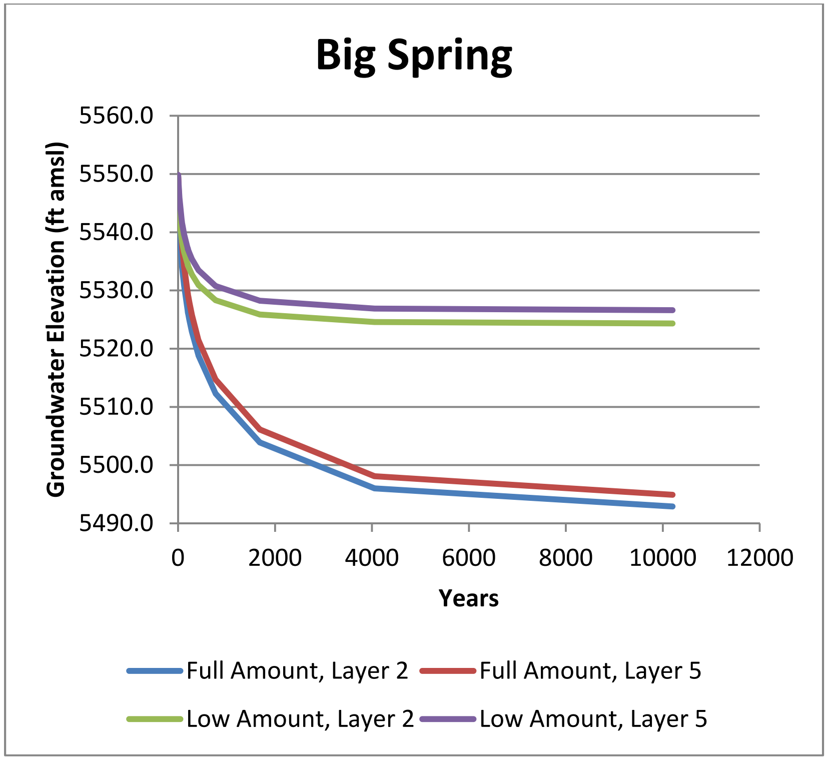

Swamp Cedar N
Groundwater Elevation (ft amsl)
5660
5640
5620
5600
5580
5560
5540
5520
5500
0
50
100
150
200
Years
Full Amount, Layer 2
Full Amount, Layer 5
Low Amount, Layer 2
Low Amount, Layer 5

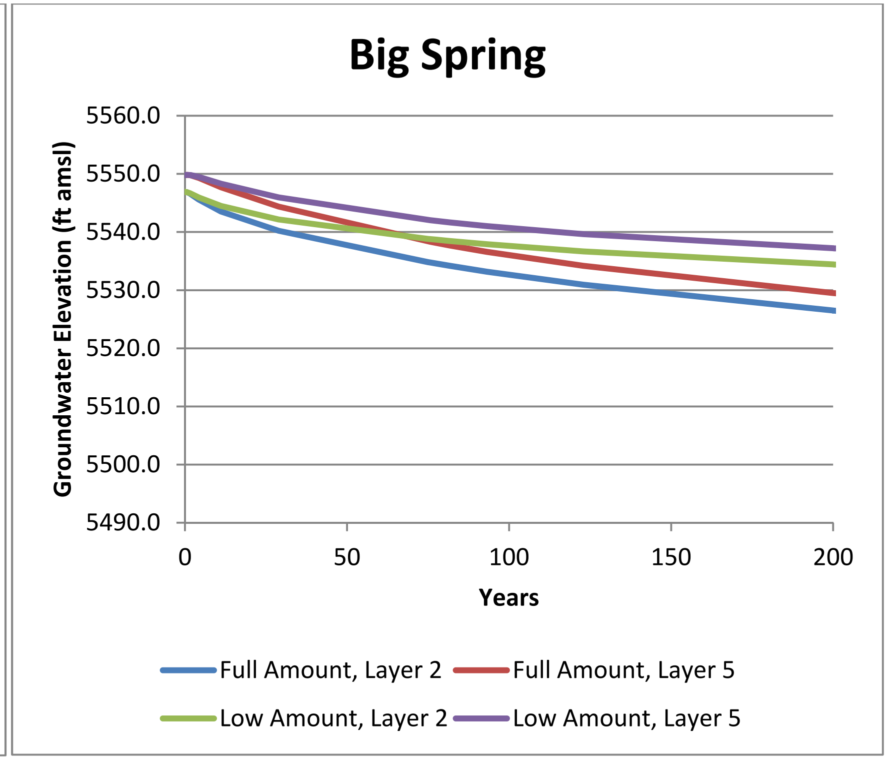

Cleve Creek
Groundwater Elevation (ft amsl)
5900
5880
5860
5840
5820
5800
5780
5760
5740
5720
5700
5680
0
2000
4000
6000
8000
10000
12000
Years
Full Amount, Layer 2
Full Amount, Layer 5
Low Amount, Layer 2
Low Amount, Layer 5

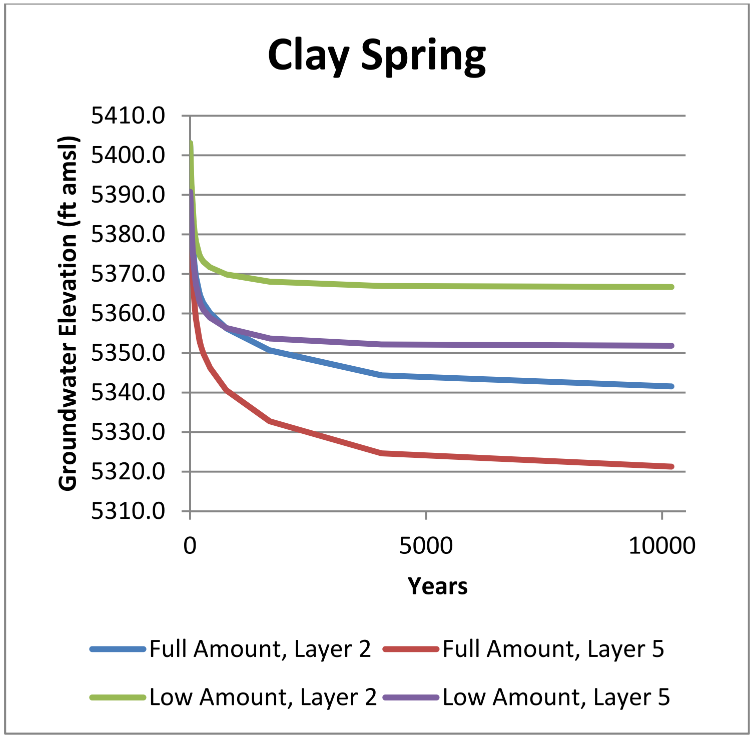

Cleve Creek
Groundwater Elevation (ft amsl)
5900
5880
5860
5840
5820
5800
5780
5760
5740
5720
5700
5680
0
50
100
150
200
Years
Full Amount, Layer 2
Full Amount, Layer 5
Low Amount, Layer 2
Low Amount, Layer 5

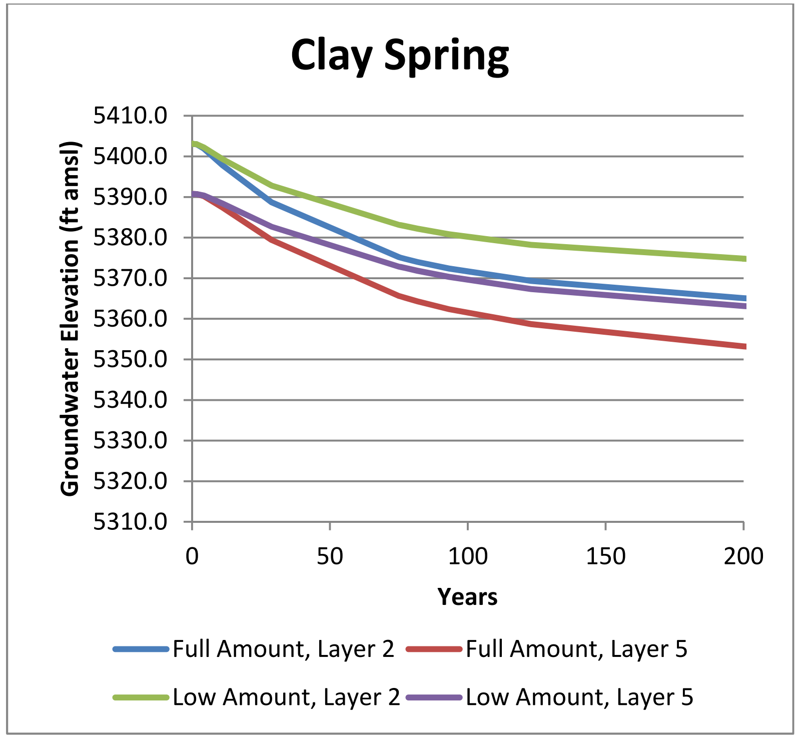

Minerva
Groundwater Elevation (ft amsl)
5800.0
5780.0
5760.0
5740.0
5720.0
5700.0
5680.0
5660.0
0
2000
4000
6000
8000
10000
12000
Years
Full Amount, Layer 2
Full Amount, Layer 5
Low Amount, Layer 2
Low Amount, Layer 5

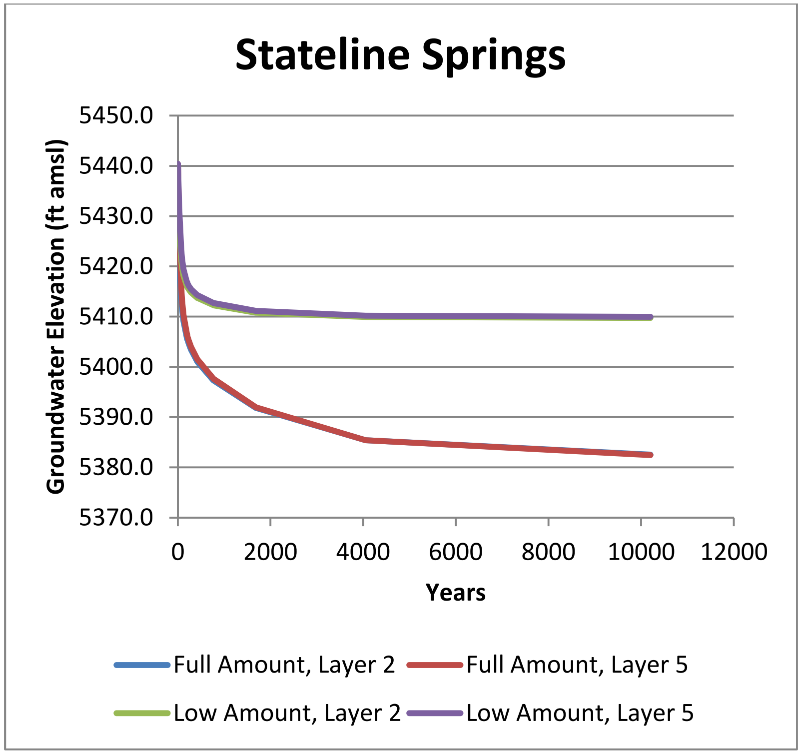

Minerva
Groundwater Elevation (ft amsl)
5800.0
5780.0
5760.0
5740.0
5720.0
5700.0
5680.0
5660.0
0
50
100
150
200
Years
Full Amount, Layer 2
Full Amount, Layer 5
Low Amount, Layer 2
Low Amount, Layer 5

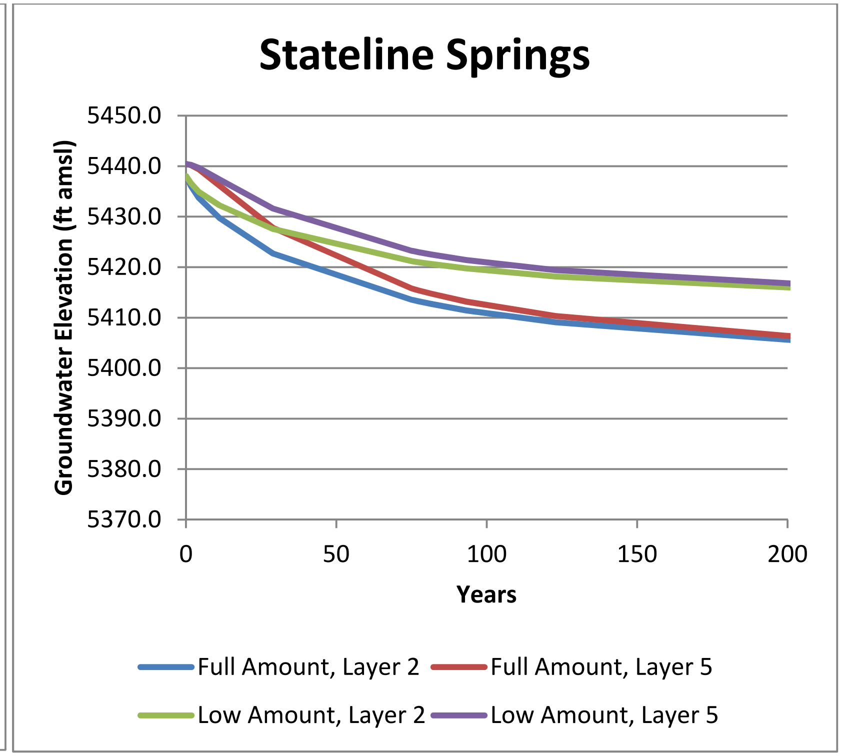

Big Spring
Groundwater Elevation (ft amsl)
5560.0
5550.0
5540.0
5530.0
5520.0
5510.0
5500.0
5490.0
0
2000
4000
6000
8000
10000
12000
Years
Full Amount, Layer 2
Full Amount, Layer 5
Low Amount, Layer 2
Low Amount, Layer 5

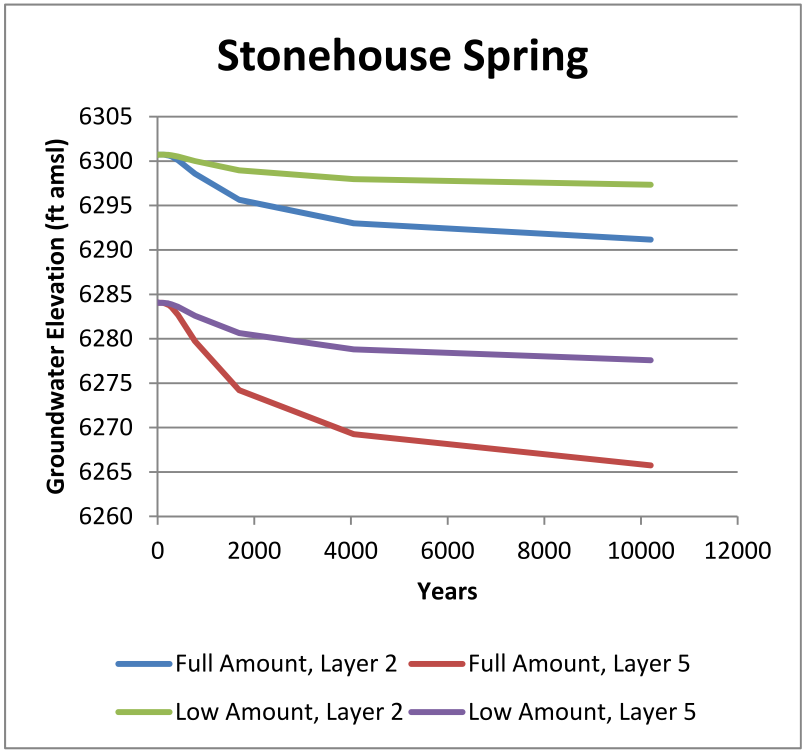

Big Spring
Groundwater Elevation (ft amsl)
5560.0
5550.0
5540.0
5530.0
5520.0
5510.0
5500.0
5490.0
0
50
100
150
200
Years
Full Amount, Layer 2
Full Amount, Layer 5
Low Amount, Layer 2
Low Amount, Layer 5

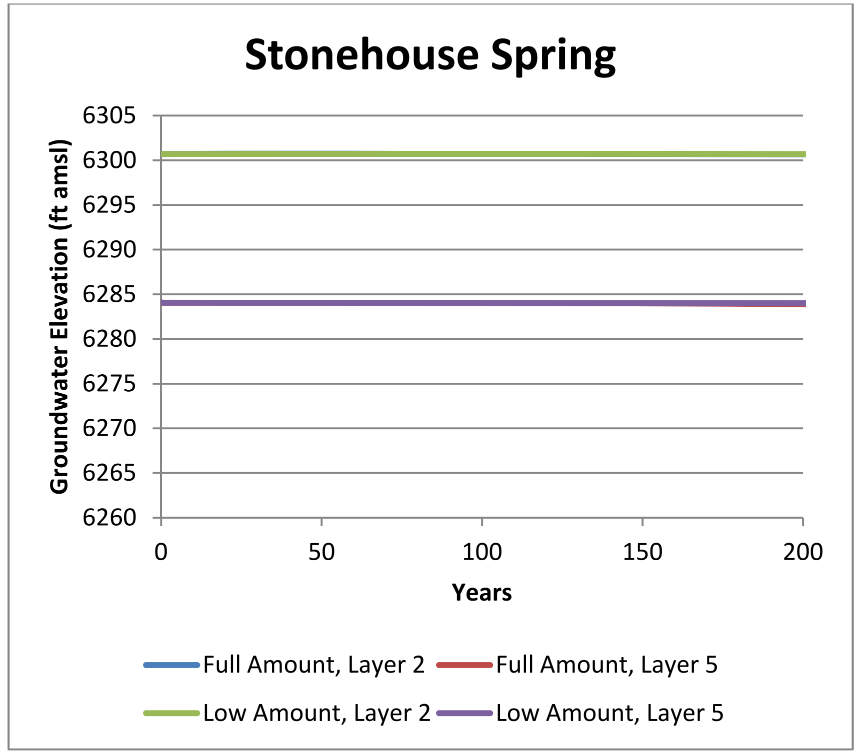

Clay Spring
Groundwater Elevation (ft amsl)
5410.0
5400.0
5390.0
5380.0
5370.0
5360.0
5350.0
5340.0
5330.0
5320.0
5310.0
0
5000
10000
Years
Full Amount, Layer 2
Full Amount, Layer 5
Low Amount, Layer 2
Low Amount, Layer 5


Clay Spring
Groundwater Elevation (ft amsl)
5410.0
5400.0
5390.0
5380.0
5370.0
5360.0
5350.0
5340.0
5330.0
5320.0
5310.0
0
50
100
150
200
Years
Full Amount, Layer 2
Full Amount, Layer 5
Low Amount, Layer 2
Low Amount, Layer 5


Stateline Springs
Groundwater Elevation (ft amsl)
5450.0
5440.0
5430.0
5420.0
5410.0
5400.0
5390.0
5380.0
5370.0
0
2000
4000
6000
8000
10000
12000
Years
Full Amount, Layer 2
Full Amount, Layer 5
Low Amount, Layer 2
Low Amount, Layer 5


Stateline Springs
Groundwater Elevation (ft amsl)
5450.0
5440.0
5430.0
5420.0
5410.0
5400.0
5390.0
5380.0
5370.0
0
50
100
150
200
Years
Full Amount, Layer 2
Full Amount, Layer 5
Low Amount, Layer 2
Low Amount, Layer 5


Stonehouse Spring
Groundwater Elevation (ft amsl)
6305
6300
6295
6290
6285
6280
6275
6270
6265
6260
0
2000
4000
6000
8000
10000
12000
Years
Full Amount, Layer 2
Full Amount, Layer 5
Low Amount, Layer 2
Low Amount, Layer 5


Stonehouse Spring
Groundwater Elevation (ft amsl)
6305
6300
6295
6290
6285
6280
6275
6270
6265
6260
0
50
100
150
200
Years
Full Amount, Layer 2
Full Amount, Layer 5
Low Amount, Layer 2
Low Amount, Layer 5