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June 16, 2008

Mr. Tracy Taylor, P.E.
Nevada State Engineer
Division of Water Resources
901 S. Stewart Street, Suite 2002
Carson City, NV 89701

State 'S EXHIBIT 23
DATE: 7-15-08

RE: Southern Nevada Water Authority's Request for Hearing on Application Nos. 54022 through 54030

Dear Mr. Taylor:

In a letter dated May 23, 2008, the Southern Nevada Water Authority (SNWA) requested a hearing "as soon as possible" on the above-referenced applications in Snake Valley, Nevada. The National Park Service (NPS) and U.S. Fish and Wildlife Service (FWS) (hereinafter "Federal Bureaus") request that the State Engineer schedule the evidentiary hearing regarding the subject applications no sooner than July 15, 2009, for the following reasons:

1. **Need for Additional Hydrogeologic Information:** Several hydrogeologic investigations, both site-specific and regional in scope, are ongoing or just beginning in Snake Valley, the results of which would be of benefit to the State Engineer.

    a. Spring Valley Stipulated Agreement: The monitoring network required by the USDOI/SNWA Stipulated Agreement regarding SNWA's applications in Spring Valley is not yet fully installed or operational. Several monitoring wells are planned to be installed in late 2008 within the "Interbasin Ground-Water Monitoring Zone" between Spring Valley and Snake Valley. Gain/loss runs are planned for early 2009 (before the beginning of springtime irrigation activities) along Big Springs Creek in southern Snake Valley, which will provide quantitative estimates of the interactions between ground-water and surface water along this stream.

b. SNPLMA Round 8 Study: An important site-specific hydrogeologic investigation ("Evaluation of Basin-Fill Aquifers in Southern Spring and Snake Valleys and Their Connection with Surface-Water Resources and with the Regional Carbonate-Rock Aquifer") by the U.S. Geological Survey and the University of Nevada at Reno is just getting underway in Snake Valley. This study will provide: (a) new site-specific data in the immediate vicinity of the subject SNWA applications; (b) an improved understanding of the hydrogeologic framework and interactions between ground water and surface water in southern Snake Valley, Nevada; and (c) better estimates of the magnitude and mechanisms of inter-basin ground-water flow from Spring Valley to Snake Valley. A copy of the study plan is attached.

The great value of the results of this study was acknowledged by the State Engineer in a letter of support for the project proposal dated April 27, 2007, wherein the State Engineer stated as follows:

The studies currently being proposed will provide much needed information on the aquifers in Spring and Snake Valleys, their hydraulic properties, flow paths, and the interaction between aquifers, and will effectively build on the soon to be completed BARCASS report. This information is critical to the responsible long-term management of the water resources of the area. Therefore, we offer our fullest support to the hydrologic studies currently proposed and other similar efforts that may be forthcoming.

Data collection on this project will begin in late 2008. Monitoring-well installation is scheduled for April through June 2009, followed by aquifer testing in summer 2009. A first draft of the final interpretive report is scheduled for completion in November 2010, and the final published report is scheduled for October 1, 2011.

c. Utah Geological Survey Project: The Utah Geological Survey (UGS) has initiated a project that includes the installation of several monitoring wells in Snake Valley, Utah, near the Nevada state line. Well installation is ongoing, and monitoring from these wells should yield useful data by summer 2009 regarding the hydrogeology of the basin-fill aquifer in Snake Valley, and the current distribution of ground-water elevations in the aquifer.

In summary, the Federal Bureaus believe that the above ongoing studies will provide substantial new data and an improved conceptual understanding of the aquifer system, which can serve as the scientific basis for the development of more reliable predictive tools (e.g. analytical and numerical ground-water flow models), at both site-specific and regional scales. The site-specific and regional-scale predictive tools, in turn, can be used to evaluate near-term localized effects on NPS resources and longer-term regional effects on FWS resources, as well as possible cumulative drawdown effects in southern Spring Valley (the area of Shoshone Ponds) due to the proposed ground-water withdrawals.

2. **Need for Models to Estimate Effects:** To date, neither a reliable regional-scale numerical model, nor a more site-specific model exists for Snake Valley. Such models can be used to provide predictive estimates of the potential for injury to existing water rights and water-related resources in Snake Valley, and can reduce the uncertainty associated with existing models. The Federal Bureaus believe that reliable predictive tools are needed at the hearing to inform the State Engineer of the potential effects of the proposed ground-water withdrawals on federal water rights and water-related resources, especially given: (a) the proximity of many of the proposed points of withdrawal to Nevada's only national park, Great Basin National Park (see Figure 1, enclosed); and (b) the outstanding natural resources of one of the principal ground-water discharge locations in the regional flow system at Fish Springs National Wildlife Refuge.

   Public interest considerations associated with the outstanding natural resources of Snake Valley counsel for the acquisition and use of the best scientific data and technical tools possible in the allocation and management of the ground-water resources of Snake Valley. If a hearing is scheduled after July 15, 2009, there will be time for the development of a more reliable site-specific predictive tool, which would benefit the State Engineer and better position him to make a decision on the merits of the above-referenced applications.

3. **Nevada/Utah Agreement:** The Federal Bureaus note that Nevada and Utah have yet to resolve the apportionment of water resources in Snake Valley as required by section 301(e)(3) of the Lincoln County Conservation, Recreation, and Development Act of 2004, Pub. L. 108-424. The act does not prohibit the State Engineer from ruling on the SNWA applications in Snake Valley before such an agreement is finalized; however, if an agreement between Nevada and Utah is not reached before the subject hearing, details regarding the allowable distribution of ground-water pumping throughout all of Snake Valley will not be available. Absent such information, the cumulative effects of all pending applications in Snake Valley, Utah, and adjacent valleys within the regional flow system should be considered and evaluated by the State Engineer in any decision regarding ground-water applications in Snake Valley, Nevada.

4. **Allow Time for Settlement Discussions and Coordination:** A hearing date of July 15, 2009, would allow time for discussions to occur between SNWA and the Federal Bureaus to determine if a stipulation can be reached to resolve some or all of the protest issues of the Federal Bureaus. Also, any discussions related to a potential stipulation in Snake Valley will require extensive coordination between FWS's Nevada Fish and Wildlife Office and the Utah Ecological Services Office due to the large number of resource concerns within the Utah portion of Snake Valley, as well as concerns for Fish Springs National Wildlife Refuge in Utah. Postponing the hearing until July 15, 2009, should allow sufficient time for such internal coordination and settlement discussions to occur.

Thus, for the foregoing reasons, the Federal Bureaus request that the State Engineer not schedule a hearing regarding the subject applications before July 15, 2009. We anticipate further discussion at the prehearing conference on July 15, 2008. Thank you for your consideration of our request, and please contact me or Steve Palmer if you have any questions or concerns.

Cordially yours,

Peter A. Fahmy
Water Rights Attorney
Branch of National Parks

Stephen R. Palmer
Assistant Regional Solicitor
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cc: John Entsminger, Esq. (Deputy General Counsel for Southern Nevada Water Authority)
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Molly Ross (Branch of National Parks, Office of the Solicitor, DOI)
Jerry Olds (Utah State Engineer)
Simeon Herskovits, Esq. (Advocates for Community and Environment)
George Benesch, Esq. (Nye County)
Eskdale Center

A. Title:

Evaluation of Basin-Fill Aquifers in Southern Spring and Snake Valleys and Their Connection with Surface-Water Resources and with the Regional Carbonate-Rock Aquifer

Nominating Organizations: National Park Service (lead agency)
Bureau of Land Management
U.S. Fish and Wildlife Service
USDA Forest Service

Approved [signature]
(Acting) Superintendent, Great Basin National Park

B. Contacts:

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C. Project Narrative:

1) EXECUTIVE SUMMARY:

Basin-fill and carbonate-rock aquifers in White Pine County, Nevada, provide water to springs, streams, pools, wetlands, limestone caves, and associated water-dependent ecosystems on Federal lands in the county. The pools of Shoshone Ponds offer a refuge for a species of federally listed endangered fish. These water-resources and water-dependent biological features also are enjoyed by fishermen, hunters, and other visitors to the county, including Great Basin National Park.

Due to a rapidly growing population in southern Nevada and a persistent drought in the Colorado River Basin, which is currently their principal source of water supply, southern Nevada is working to develop in-state water resources, including substantial ground-water withdrawals from Spring and Snake valleys in White Pine County. Prior to hearings by the Nevada State Engineer on water-rights applications by the Southern Nevada Water Authority for ground-water withdrawals in Spring Valley hydrographic area, the United States Department of the Interior National Park Service, Bureau of Land Management, Fish and Wildlife Service, and Bureau of Indian Affairs, hereafter referred to collectively as the USDOI bureaus, signed an agreement with the Southern Nevada Water Authority on their proposed ground-water development in Spring Valley, which stipulates monitoring, management, and mitigation plans and implementation. In April 2007, the Nevada State Engineer issued a ruling regarding Southern Nevada Water Authority's on ground-water applications in Spring Valley. Hearings on water-right applications for ground-water withdrawals from the Nevada portion of the Snake Valley hydrographic area, which is located in White Pine County, Nevada and parts of Utah, are planned but have not yet been scheduled. A Nevada-Utah agreement must be approved before any export of ground water occurs.

The agreement between the USDOI bureaus and the Southern Nevada Water Authority requires monitoring and elucidation of the ground-water connection between Spring and Snake valleys via Hamlin Valley. However, these organizations and the United States Department of Agriculture Forest Service need additional information on the connection of the basin-fill aquifers in Spring and Snake valleys with surface-water resources and water-dependent ecosystems and with the regional carbonate-rock aquifer, the known source of many high discharge springs.

Water-resources reconnaissance studies done in the mid 1960's identified an area where ground water in the basin fill flows southeast from southern Spring Valley across a low topographic divide through the carbonate-rock aquifer into southern Snake Valley. In 2002, a United States Geological Survey study commissioned by the National Park Service identified streams and springs in and adjacent to Great Basin National Park whose flows could be susceptible to ground-water withdrawals. This study did not evaluate physical properties that allow for flow between streams and ground water or the distribution and interconnection between the carbonate-rock aquifer in the mountains and aquifers in basin-fill deposits beneath the valleys.

The intent of this proposed new work is to determine the distribution and hydraulic properties of the basin-fill aquifers beneath the valleys and the carbonate-rock aquifer, and streambed properties that control the flow of water between streams and aquifers. Results from the study will aid in evaluating how pumping could affect surface-water resources important to ecosystems on Federal lands. The major elements of the study are: (1) determination of the geologic character of basin-fill aquifers in southern Spring and Snake valleys and their connection with each other and with the regional carbonate-rock aquifer; (2) characterization of streambed properties of creeks that flow across alluvial fans and valley floors and the source of water to high-discharge springs; and (3) determination of the ground-water divide between southern Spring and Snake valleys and estimation of subsurface flow between the valleys.

The expected products to be generated by the proposed work are interpretive peer-reviewed scientific reports that would provide the nominating organizations, as well as Nevada and Utah State agencies, the Southern Nevada Water Authority, and local governments and citizens, with information on how the proposed withdrawals could affect specific surface-water resource features.

The analyses also will complement the Southern Nevada Water Authority's long-term ground-water monitoring program by providing additional wells in areas distant from proposed pumping centers, information on the distribution of hydraulic properties in the unconsolidated deposits beneath the valleys and along streams, information on the source areas to high-discharge springs, and assessment of the ground-water divide and the hydraulic properties of aquifers that may connect southern Spring Valley with southern Snake Valley.

Study results can be used in any predictive numerical ground-water flow model for the area. This effort will improve the understanding of the hydrogeology of southern Spring and Snake valleys, so that predictive estimates from numerical flow models will better depict the hydrologic system.

2) GENERAL DESCRIPTION OF THE PROJECT:

Problem:

Basin-fill and carbonate-rock aquifers in White Pine County, Nevada, provide water to springs, streams, pools, wetlands, limestone caves, and associated water-dependent ecosystems on Federal lands in the county. The pools of Shoshone Ponds offer a refuge for a species of federally listed endangered fish. These water-resources and water-dependent biological features also are enjoyed by fishermen, hunters, and other visitors to the county, including Great Basin National Park.

Due to a rapidly growing population in southern Nevada and a persistent drought in the Colorado River Basin, which is currently their principal source of water supply, southern Nevada is working to develop in-state water resources, including substantial ground-water withdrawals from Spring and Snake valleys in White Pine County. An agreement between the United States Department of the Interior (USDOI) National Park Service (NPS), Bureau of Land Management (BLM), Fish and Wildlife Service (FWS), and Bureau of Indian Affairs (BIA), hereafter referred to collectively as the USDOI bureaus, and the Southern Nevada Water Authority (SNWA) on proposed ground-water development in the Spring Valley hydrographic basin of White Pine County requires monitoring and elucidation of the ground-water connection between Spring and Snake valleys via Hamlin Valley. However, these organizations and the United States Department of Agriculture Forest Service (USFS) need additional information on the connection of the basin-fill aquifers in Spring and Snake valleys with surface-water resources and water-dependent ecosystems and with the regional carbonate-rock aquifer, the known source of many high discharge springs.

Background:

An initial susceptibility study was commissioned by the NPS and done by the United States Geological Survey (USGS) from 2002 through 2005 that identified springs and streams in and adjacent to Great Basin National Park whose flows could be affected by ground-water pumping in Spring and Snake valleys (Elliott and others, 2006). Several streams and springs were identified in the study by measuring changes in streamflow and chemistry in relation to geology. The purpose of this initial study was to simply identify areas that warranted more detailed studies and was limited to streams and springs in and near Great Basin National Park.

Important analysis and data not included in this USGS study include a detailed analysis of the basin-fill deposits or how faulting and stratification of layers within the basin-fill deposits could act as conduits or barriers to ground-water flow. The study was not designed to determine the hydraulic properties of the alluvial basin-fill deposits beneath the streams nor evaluate how ground-water withdrawals may ultimately affect streamflow and associated riparian areas. Also not included was an evaluation of the vulnerability of surface-water resources in Snake Valley due to ground-water withdrawals in Spring Valley.

Objectives and Approach:

Funds are being requested from the Southern Nevada Public Lands Management Act (SNPLMA) under Round 8 of the Conservation Initiatives program to support an interagency effort to develop a better understanding of the nature of the water-bearing basin-fill deposits in southern Spring and Snake valleys in White Pine County, Nevada, and to evaluate the location and extent that these aquifers are connected to important surface-water resources of the area.

This effort will comprise three main tasks, as follows:

1. Determination of the geologic character of basin-fill aquifers in southern Spring and Snake valleys and their connection with each other and with the regional carbonate-rock aquifer;
2. Characterization of streambed properties of creeks that flow across alluvial fans and valley floors and the source of water to high-discharge springs; and
3. Determination of the ground-water divide between Spring and Snake Valleys and estimation of subsurface flow between the valleys.

The study area (southern Spring and Snake valleys) is within the much larger area studied as part of the USGS Basin and Range Carbonate Aquifer System Study (BARCASS), which focused on developing water budgets for all the hydrographic areas in White Pine County and included parts of western Utah where hydrographic areas crossed the Nevada-Utah State line. As a result, BARCASS was not designed to address heterogeneities in the unconsolidated basin-fill deposits and consolidated rocks that might act as barriers to or pathways from mountains to adjacent valleys, nor did it evaluate the interconnectedness of ground water in the basin fill with streams and other surface-water features.

A ground-water monitoring network is required pursuant to a stipulated agreement between the USDOI bureaus and the SNWA. The required monitoring plan includes the drilling of six new monitoring wells near the ground-water divide between southern Spring Valley and southern Snake Valley, a continual-recording streamgage on Big Springs, synoptic discharge measurements along Big Springs Creek/Lake Creek between Big Springs and Pruess Lake, extensive water-quality sampling and analyses, the installation of a shallow monitoring well near each of 12 selected springs in Spring Valley, and other monitoring. The plan for this proposed study is to collect selected hydrogeologic data, use the data collected from the stipulated agreement and other available sources, conduct hydrogeologic analyses to determine the distribution and connection of basin-fill aquifers with the regional carbonate-rock aquifer and with streams and springs, and to publish interpretive reports of the results.

3) PROJECT IMPLEMENTATION PROCESS:

Principal Tasks:

The project will be implemented by the three main tasks that would begin June 2008 and continue through December 2010. A description of the implementation of each task is as follows:

Task 1. *Geologic characterization of basin-fill aquifers:*

Sediments and sedimentary rocks that underlie Spring, Snake, and Hamlin valleys consist of deeply buried and deformed layers of Paleozoic carbonate and noncarbonate rocks overlain by deformed older Cenozoic sedimentary rocks that are themselves overlain by more recent less consolidated rocks to unconsolidated basin-fill deposits. The younger basin-fill deposits are critical to the understanding of the ground-water flow among the shallow ground-water in the younger unconsolidated basin fill, older consolidated rocks, and streams that flow across and springs that discharge from various types of sediments and rocks. The characteristics and distribution of the deeper, older Cenozoic sedimentary rocks are important to understanding the interaction of shallow ground water with deeper ground-water flow and with the carbonate-rock aquifer. The approach to characterization of the basin-fill aquifers will include a concerted effort to evaluate the distribution of fine- and coarse-grained deposits within the basin fill along the flanks of the southern Snake Range as well as in the adjacent valleys.

Young, unconsolidated basin fill will be evaluated through surface observation and targeted mapping, classification of grain size and depositional environment, and comparison with available sediment description from driller's logs, and from information obtained from test holes drilled by the Southern Nevada Water Authority and by the Utah Geological Survey. The compilation of existing drillers' logs will include the type of sediments and specific-capacity data, and the compilation of exploration and monitoring wells will include type of sediments, specific-capacity data, and analyses of aquifer tests done for selected wells by either the Southern Nevada Water Authority or the Utah Geological Survey.

The younger unconsolidated basin fill will be analyzed using sand/clay ratios of the basin fill (Bredehoeft and Farvolden, 1963). The sand/clay ratios will be used to identify the distribution of permeable sand and gravel and less permeable silt and clay. The specific-capacity data will be analyzed for estimates of transmissivities that can then be translated to estimates of hydraulic conductivity, which will then be associated with the sand/clay ratio of the well determined from sediment descriptions. A distribution of hydraulic conductivities for different ratios of sand/clay ratios will be estimated from all available data. These data will be used to develop a distribution of permeable and less permeable unconsolidated deposits and to identify areas for detailed mapping and the drilling of test wells at a few critical sites. These wells will be drilled for the purpose of collecting information on sand/clay ratios and hydraulic properties of both coarse-grained and fine-grained intervals encountered in the wells, and will ultimately provide wells for long-term monitoring in areas beyond those explored by either the Southern Nevada Water Authority or Utah Geological Survey.

Presently, most wells drilled into basin fill are on or near the base of alluvial fans where unconsolidated deposits are generally more permeable. Few wells have been drilled out in the center of each valley where finer-grained deposits likely exist or beneath the axial stream that flows from Big Springs to Pruess Lake (Big Springs Creek in Nevada and Lake Creek in Utah). Finer-grained deposits may act as barriers to flow and may be the reason for the discharge of springs along the toe of the alluvial fans on the west side of the southern Snake Range but we have no information on the depth and hydrologic properties of such deposits either in Snake or Spring valleys.

The older Cenozoic sedimentary rocks the underlie the younger unconsolidated basin fill beneath the valleys will be evaluated through a combination of observation of surface outcrops from around the margins of the basins, evaluation of stratigraphy from oil test wells, and incorporation of existing geophysical data such as gravity and seismic data. The geologic and geophysical data will be interpreted in terms of basin history in order to define basin depth, location of structural boundaries, and predict subsurface stratigraphy. A network of oil industry seismic data from the southern part of Snake Valley was presented in a student thesis (Alam, 1990; Alam and Pilger, 1991), but these data were not fully tied to currently available geophysical data, well control, and were not analyzed in three dimensions. The seismic data clearly show unconformity-bounded packages of rocks that record the history of basin opening and tilting; the data also record the presence of important subsurface faults. These seismic data will be used to identify subsurface faults, spatial extent of specific types of unconsolidated deposits, and sediment differences within the basin fill. Two oil test wells in southern Snake and Hamlin Valleys penetrated thick sequences of anhydrites within the older Cenozoic sedimentary rocks that could limit the interconnection between aquifers in the young unconsolidated basin fill with ground water in the underlying carbonate rock aquifer. Their presence at depth highlights the need to understand the variable types of sedimentary rocks and unconsolidated deposits present beneath the valleys

Ultimately, characterization of the Cenozoic sedimentary rocks and unconsolidated deposits is expected to result in maps, cross sections, and three-dimensional depictions of the distribution of coarse- and fine-grained deposits and sedimentary rocks beneath the valleys and their geometry as modified by numerous structures.

Task 2. *Hydrologic characterization of streambed properties of creeks and the source of water to high-discharge springs*:

The distribution of streambed properties and shallow unconsolidated deposits next to Lehman, Baker, Snake, and Big Springs creeks in southern Snake Valley and Cleve Creek in western

Spring Valley (fig. 1) will be determined by first measuring gains and losses using temperature and head measurements at several locations in each creek and in shallow wells drilled beneath or adjacent to the creek. A 1-kilometer long optic temperature cable will be placed on the streambed of each creek and used to determine areas of gains and losses in conjunction with the shallow wells (Selker and others, 2006). The cable is capable of measuring streambed temperatures every meter along its length. Subsurface temperature probes 0.5 and 1 m below the streambed will be installed every 100 m length of cable and used in the determination of streambed properties along each creek (Niswonger and Prudic, 2003).

Following the initial estimates of streambed properties, a group of five relatively shallow wells (less than 50 feet deep) will be drilled at a site beneath and next to each creek where the temperature data indicate a gaining stream. Each of the five wells will be pumped and heads and temperatures in the other wells and across the streambed will be collected and used to determine the hydraulic properties of the streambed and the shallow unconsolidated deposits associated with the stream. Such information is vital to understanding the distribution of ground-water recharge and discharge along streams in Spring and Snake valleys, and the extent to which pumping could affect streamflow. Hydraulic conductivity and types of unconsolidated deposits associated with streams will be integrated with available data from deeper and more distant drill holes and from the geologic analysis described in the first task. This will put the shallow unconsolidated deposits proximal to the streams into context of the entire basin and put the shallow ground-water associated with the streams into the context of basin-wide flow paths.

The Utah Geological Survey is planning to drill a large aquifer-test well near Snake Creek at the border between Utah and Nevada. The plan for this study is to coordinate with the Utah Geological Survey and place measuring equipment in Snake Creek and in shallow alluvial wells drilled as part of this study prior to the test so that we can better define the streambed properties of Snake Creek and streamflow depletion caused by pumping. Similarly, a well near Big Springs Creek is used for crop irrigation during the summer. The plan for this study is to coordinate with the rancher and instrument a section of Big Springs Creek prior to the well being pumped and maintaining data collection during the irrigation season. These data will provide important information on how pumping may or may not affect streamflow along these creeks. The study along Big Springs Creek/Lake Creek will be done in coordination with seepage measurements along the creeks that are part of the stipulated agreement between the USDOI bureaus and SNWA. Results provided by this study will provide hydraulic properties of the streambed as well as aquifer properties of the unconsolidated deposits through multiple aquifer tests of both shallow wells near the stream and deeper irrigation wells further from the stream. The hydraulic properties of the streambed and unconsolidated deposits are necessary for evaluating the potential effects caused by any additional pumping that may occur near and distant from the stream.

The source of water to high discharge springs will be evaluated for geologic, hydrologic, and geochemical analysis. These springs include: (1) Rowland Spring, which is located near Great Basin National Park headquarters; (2) Big Springs, which discharge on the southeast side of the southern Snake Range; (3) Spring Creek Spring, which is the source of water to the Nevada State Fish hatchery on Snake Creek; and (4) the collection of springs that discharge near the valley floor on the east side of southern Spring Valley near Shoshone Ponds. Rowland Spring adds considerable flow to Lehman Creek downstream of Lehman Caves. Considerable effort will be made to evaluate the source area of this spring, given its proximity to the cave system in the Lehman and Baker creek drainages. The analysis will include the drilling of two test wells between the spring and the cave system; sampling of water in Lehman Caves and in the caves near Baker Creek for chemistry and stable isotopes; and will include a dye tracer study once an initial estimate of flow paths are determined from chemistry and well drilling. The source of water to Spring Creek Spring, Big Springs, and the collection of springs that discharge near the valley floor on the east side of southern Spring Valley will be evaluated from available geologic information and test wells that are planned as part of this study and as part of the agreement between the USDOI bureaus and SNWA. Additional chemical analyses will be done at these springs to assess if the source of water is local, regional, or a combination of both.

Task 3. *Delineation of the ground-water divide between Spring and Snake valleys*:

Ground-water flow across the extreme southern edge of the southern Snake Range between Spring and Snake Valleys (via Hamlin Valley) was originally postulated by Rush and Kazmi (1965) because the water level in a well in southern Spring Valley was higher than that in a well in Hamlin Valley, which was higher than that in a well in southern Snake Valley. Rush and Kazmi estimated that the ground-water divide was west of the topographic divide used to delineate the Spring Valley and Hamlin Valley hydrographic areas and initially estimated annual flow of 4,000 acre-feet from southern Spring Valley into Hamlin Valley and thence to Snake Valley. More recently, higher estimates of ground-water flow across the topographic divide have been made but uncertainties in subsurface geology, hydraulic properties of the rocks, and even the hydraulic gradient result in a broad range in estimated flow (Knochenmus, L.A., USGS, written communication, 2007).

The ground-water divide may or may not be related to a geologic structure that restricts flow across it; rather the divide may simply be where ground water finds it easier to flow either westward to the wetlands in southern Spring Valley or to discharge areas (Big Springs or areas of natural evapotranspiration) in southern Snake Valley. Consequently, pumping of ground water in one valley or the other may result in unintended capture of water (even surface water) in another hydrographic area. Several test wells are planned for the southern end of Spring Valley and Snake Valley as part of the stipulated agreement between the DOI bureaus and SNWA. Additional test wells and analysis on the distribution of basin-fill aquifers and the carbonate aquifer requested in this study will reduce the uncertainty about the amount of ground water that might flow from southern Spring Valley into southern Snake Valley and how pumping could capture some of this flow.

This study is designed to coordinate with the DOI bureaus and SNWA in compiling, evaluating, and analyzing data collected from the planned test wells. This data will be augmented by seven additional test wells in areas not included in the agreement. Three wells will be drilled in the lowland area of southern Spring Valley to obtain information on the types of unconsolidated deposits and their water transmitting and storage properties. Two more wells will be drilled between the springs that discharge along the east side of southern Spring Valley and the western edge of the southern Snake Range. These two wells will be used in determining if the chemistry at the water table is similar to the springs, if the springs represent deeper ground-water discharge, or if the springs represent a mixture of both shallow and deeper flow. The last two wells will be in southern Snake Valley north of Big Springs and east of the Utah state line where the Utah Geological Survey is planning to drill several wells along the border. Wells in the lowland area of southern Spring Valley will be drilled to maximum depths of 400 feet to evaluate if coarse-grained deposits underlie the lowland areas. The existence of coarse-grained deposits would allow water-level declines to extend farther from pumping wells more quickly, whereas thick sequences of finer-grained deposits would limit water-level declines closer to the pumping wells. The two wells in Snake Valley would have to be drilled deeper than 400 feet in order to intersect the carbonate aquifer along the west side of Snake Valley. These wells could be greater than 1,000 feet deep. Only one well will be drilled if the depth of the well is greater than 1,200 feet. Single-well aquifer tests will be done to estimate the water transmitting and storage properties of the rocks and deposits encountered in each of the test wells. Multiple-well aquifer tests will be done whenever there are sufficient wells in the vicinity of the pumped well. The six new wells will provide locations for long-term monitoring that are outside of the main pumping centers.

The exploratory well data will be augmented by targeted surface geologic mapping and cross-section interpretation to evaluate stratigraphic and structural control of permeability within the exposed part of the carbonate-rock aquifer. The data will be used to determine the direction and quantity of ground-water flow across the topographic divides and to estimate the source areas of the flow between the topographic and ground-water divides. The data would be used to extrapolate estimates of flow over a larger region by correlating the regional geology to that encountered in the exploratory test holes.

References:

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Elliott, P.E., Beck, D.A., and Prudic, D.E., 2006, Characterization of surface-water resources in the Great Basin National Park area and their susceptibility to ground-water withdrawals in adjacent valleys, White Pine County, Nevada, 168 p.

Hood, J.W., and Rush, F.E., 1965, Water-resources appraisal of the Snake Valley area, Utah and Nevada, State of Nevada, Department of Conservation and Natural Resources Water Resources Reconnaissance Series Report 34, 43 p.

Niswonger, R.G., and Prudic, D.E., 2003, Appendix B—Modeling heat as a tracer to estimate streambed seepage and hydraulic conductivity, in Stonestrom, D.A., and Constantz, Jim, eds., Heat as a tool for studying the movement of ground water near streams: U.S. Geological Survey Circular 1260, p. 81-89.

Rush, F.E., and Kazmi, S.A.T., 1965, Water resources appraisal of Spring Valley in White Pine and Lincoln counties, State of Nevada, Department of Conservation and Natural Resources Water Resources Reconnaissance Series Report 33, 36 p.

Selker, John, van de Geisen, Nick, Westhoff, Martijn, Luxemburg, Wim, and Parlange, Marc, 2006, Fiber optics opens window on stream dynamics: Geophysical Research Letters, vol. 33, L24401, 4 p.

Schedule and Contractor Budget:

The project will take approximately three years, beginning in June 2008 and ending in December 2010. Costs are delineated by task for each year, as follows:

	Year 2008	**Year 2009**	**Year 2010**	**TOTALS**
Task 1	$167,000	$167,000	$166,000	$500,000
Task 2	300,000	500,000	200,000	1,000,000
Task 3	200,000	200,000	100,000	500,000
TOTALS	$667,000	$867,000	$466,000	**$2,000,000**

4) RESULTS AND PRODUCTS:

Objectives:

1. Determination of the geologic character of basin-fill aquifers in southern Spring and Snake valleys and their connection with each other and with the regional carbonate-rock aquifer;
2. Characterization of streambed properties of creeks that flow across alluvial fans and valley floors and the source of water to high-discharge springs; and
3. Determination of the ground-water divide between Spring and Snake Valleys and estimation of subsurface flow between the valleys.

Deliverables:

1. Report and Geographic Information System (GIS) coverages of the distribution of aquifers in southern Spring and Snake valleys and their connection to the regional carbonate-rock aquifer and to surface-water resources.
2. Report on the hydrogeology and source area of Rowland Spring and its connection to the Baker and Lehman Creek cave system, the carbonate-rock aquifer, and basin-fill aquifers.
3. Report on the ground-water divide between southern Spring and Snake valleys, estimation of ground-water flow between the two valleys, and the source area for Big Springs.

4. Report that summarizes the important connections among basin-fill aquifers, the regional carbonate-rock aquifer, and surface water resources in southern Spring and Snake valleys.
5. Six long-term monitoring wells in southern Spring and Snake valleys in areas distant from planned pumping centers.

5) METHODS AND TECHNIQUES TO DISSEMINATE RESULTS:

1. Quarterly progress reports that briefly summarize progress of study
2. NPS and USGS Web Pages that provides links to published USGS reports and GIS coverages
3. USGS reports
4. GIS coverages
5. All ground-water, surface-water, and water-quality data entered into USGS NWIS database

6) PHASED PROJECT:

Past Projects:

SNPLMA Round 5: "Developing capabilities to predict the effects of future regional ground-water withdrawals on riparian ecosystems at streams, springs, seeps, and areas of shallow ground water in undeveloped areas of northeastern Clark County"

This project comprised drilling new wells, quantifying ground-water discharge by evapotranspiration (ET), measuring ground-water levels and surface-water flows, and the construction and use of a predictive numerical ground-water flow model for an area of 13 hydrographic basins in northeastern Clark County. The project has run from Fiscal Year (FY) 2005 through FY2007, and the total cost was $1,897,500. The project currently is in its final year, and the predictive numerical model is in the final stages of construction and calibration.

SNPLMA Round 6: "Improving understanding of aquifer systems and access to hydrologic information in Clark County"

This project comprised the drilling of a series of 2,000-3,000 feet deep boreholes, a focused study of the source of hot and cold springs in the Black Canyon of the Colorado River below Hoover Dam, water-quality sampling, and hydrologic database management in selected locations throughout Clark County. The project runs from FY 2006 through FY2008, and the total cost is $5,940,000. The drilling and Black Canyon studies are ongoing.

USGS Study commissioned by the NPS on behalf of Great Basin National Park:
"Characterization of surface-water resources in the Great Basin National Park area and their susceptibility to ground-water withdrawals in adjacent valleys, White Pine County, Nevada"

This project had three objectives: (1) to quantify the current discharge of the major streams and springs within Great Basin National Park; (2) to assess the natural variability in the discharge, so that it can be distinguished from the effects, if any, from adjacent ground-water pumping at a later time; and (3) to evaluate areas where streams and springs would be susceptible to ground-water withdrawals in adjacent valleys. No attempt was made in this study to quantify the magnitude or timing of depletion from adjacent pumping that might occur. It was an initial study upon which more quantitative investigations, such as the current proposed project, can be built. The project ran from FY2001 through FY2005. It has been completed, and the final interpretive report has been published and is available online.

Future Projects:

Upper Great Salt Lake Desert Flow System Numerical Ground-Water Flow Modeling: The information gained from the results of the proposed project can be used to facilitate development of any predictive numerical ground-water flow model. Eventually, water-resource management throughout the regional carbonate-rock aquifer system will be best facilitated by assimilating all the models of smaller areas into one large predictive model of the entire carbonate-rock aquifer system. In this way, the cumulative effects of ground-water development throughout the regional aquifer system can be assessed, for the benefit of the management of all Federal lands, as well as the benefit of local water-development entities and State regulatory agencies.

D. Detailed Cost Analysis: (see attachment 1)

E. Letters of Support: (on following pages)

- United States Geological Survey, Nevada Water Science Center
- Nevada Department of Conservation and Natural Resources, Division of Water Resources
- United States Fish and Wildlife Service, Nevada Fish and Wildlife Office
- United States Bureau of Land Management, Ely Field Office
- White Pine County, Board of County Commissioners

United States Department of the Interior

U. S. GEOLOGICAL SURVEY
NEVADA WATER SCIENCE CENTER
2730 N. Deer Run Road
Carson City, Nevada 89701

April 27, 2007

Nancy Christ, Conservation Initiatives Project Specialist
Bureau of Land Management-Las Vegas Field Office (LVFO)
Division of SNPLMA Acquisition, Improvement and Conservation Programs
4701 N. Torrey Pines Drive
Las Vegas, NV 89130

Dear Ms. Christ:

The USGS fully supports the interagency proposal submitted by the National Park Service to evaluate the basin-fill aquifers in southern Spring and Snake Valleys in relation to their connection with surface-water resources and with the regional carbonate-rock aquifer. The effects of proposed ground-water withdrawals and exportation from Spring and Snake valleys on ecosystems that require surface water remain unknown. The proposal is the logical progression of two recent USGS studies, one commissioned by the National Park Service and the other by the U.S. Department of Interior. The study commissioned by the National Park Service was designed to simply identify susceptible surface-water resources in the vicinity of Great Basin National Park. The second USGS study evaluated regional ground-water budgets in terms of regional quantities of ground-water recharge and discharge but neither study evaluated the connection between ground water in basin-fill aquifers beneath the valleys with the regional carbonate-rock aquifer or between aquifers and surface water. The new proposal will determine the connection between ground water in both basin-fill and carbonate-rock aquifers in the southern Spring and Snake valleys with susceptible surface-water resources. The data collection and analyses described in the proposal is necessary in determining how ground-water withdrawals and exportation will affect sensitive ecosystems dependent on surface water.

Sincerely,

Kimball E. Goddard
State Director

JIM GIBBONS
Governor

STATE OF NEVADA

ALLEN BIAGGI
Director

TRACY TAYLOR, P.E.
State Engineer

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

DIVISION OF WATER RESOURCES

901 S. Stewart Street, Suite 2002
Carson City, Nevada 89701
(775) 684-2800 • Fax (775) 684-2811
http://water.nv.gov

April 27, 2007

Nancy Christ, Conservation Initiatives Project Specialist
Bureau of Land Management-Las Vegas Field Office (LVFO)
Division of SNPLMA Acquisition, Improvement and Conservation Programs
4701 N. Torrey Pines Drive
Las Vegas, NV 89130

Dear Ms. Christ:

The Nevada Division of Water Resources fully supports additional studies currently being proposed in the Spring and Snake Valley Hydrographic Basins of Nevada. As you may know, a number of water rights have recently been issued in Spring Valley, and there are numerous pending applications in adjacent basins, including Snake Valley. The Division of Water Resources is responsible for the conservation, protection, and management of the State's water resources for Nevada's citizens. To responsibly accomplish this duty, we are in need of accurate, specific and up-to-date hydrologic information. The studies currently being proposed will provide much-needed information on the aquifers in the Spring and Snake Valleys, their hydraulic properties, flow paths, and the interaction between aquifers, and will effectively build on the soon to be completed BARCASS report. This information is critical to the responsible long-term management of the water resources of the area. Therefore, we offer our fullest support to the hydrologic studies currently proposed and other similar efforts that may be forthcoming. In addition, we feel it is in the best interest of our office and all other interested parties that such studies are completed in conjunction and cooperation with other ongoing scientific programs.

Sincerely,

Tracy Taylor, P.E.
State Engineer

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Nevada Fish and Wildlife Office
1340 Financial Blvd., Suite 234
Reno, Nevada 89502
Ph: (775) 861-6300 ~ Fax: (775) 861-6301

April 27, 2007
File No. SNPLMA

Ms. Nancy Christ
Conservation Initiatives Project Specialist
Bureau of Land Management – Las Vegas Field Office
Division of SNPLMA Acquisition
4701 North Torrey Pines Drive
Las Vegas, Nevada 89130

Dear Ms. Christ:

Subject: Southern Nevada Public Lands Management Act Grant Proposal "Evaluation of Basin-fill Aquifers in Southern Spring and Snake Valleys and their Connection with Surface-Water Resources and with the Regional Carbonate Rock Aquifer"

The U.S. Fish and Wildlife Service (Service), Nevada Fish and Wildlife Office, fully supports the proposal submitted under Round 8 of the Southern Nevada Public Lands Management Act to conduct an intensive, site-specific water resources investigation in southern Spring and Snake valleys. This study will provide valuable information and increase our understanding of the basin-fill aquifers beneath these valleys, the relationship between the basin-fill and carbonate rock aquifers, and the relationship between the basin-fill aquifers and surface-water resources. These aquifers support a variety of water-dependent biotic communities, such as riparian vegetation, wetlands, wet meadow complexes, and springs, including a series of spring-fed and artesian well-fed ponds that are a refuge for the federally listed as endangered Pahrump poolfish (*Empetrichthys latos*). These water-dependent ecosystems are biologically important due to their rarity on the landscape and the high biodiversity found therein.

The proposed research will help both the DOI Bureaus and Southern Nevada Water Authority carry out the hydrologic and biologic monitoring components of the Spring Valley Stipulated Agreement, dated September 8, 2006. The information gathered will help us understand the source of specific springs in the area, including the Pahrump poolfish refuge location, and will give us site-specific information on how surface-water resources change as ground water levels change. The information gathered will also improve the predictive ability of ground-water flow and ecological models that are developed for this area, such as those that stem from the Spring Valley Stipulated Agreement.

TAKE PRIDE IN AMERICA

Ms. Nancy Christ File No. SNPLMA

If you have any questions or require any additional information, please contact me or Annalaura Averill-Murray at (775) 861-6300.

Sincerely,

For Robert D. Williams
Field Supervisor

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Ely Field Office
HC 33 Box 33500 (702 No. Industrial Way)
Ely, Nevada 89301-9408
http://www.nv.blm.gov/

In Reply Refer To:
(NV-040) 2710

Steve Tryon
Bureau of Land Management
Division of SNPLMA
4701 N. Torrey Pines Drive
Las Vegas, NV 89130

Dear Mr. Tryon:

The Ely Field Office of the BLM has reviewed the National Park Service's Round 8 proposal entitled "Evaluation of Basin-Fill Aquifers in Southern Spring and Snake Valleys and Their Connection with Surface-Water Resources and with the Regional Carbonate-Rock Aquifer." This submission for Round 8 funding under the Land Acquisition initiative is compatible and consistent with our land use management objectives. We are providing this letter in support of the proposed project.

Signed by:
Michael Herder
Acting Associate Field Manager

Authenticated by:
Patricia A. Heinbaugh
Management Assistant

Laurie L. Carson, Commissioner
Brent Eldridge, Commissioner
Gary Lane, Commissioner
RaLeene Makley, Commissioner
David Pound, Commissioner
Donna M. Bath, Ex-Officio Clerk of the Board

Courthouse Annex
801 Clark Street, Suite #4
Ely, Nevada 89301
(775) 289-2341
Fax (775) 289-2544

White Pine County
Board of County Commissioners

April 30, 2007

Nancy Christ, Conservation Initiatives Project Specialist
Bureau of Land Management-Las Vegas Field Office (LVFO)
Division of SNPLMA Acquisition, Improvement,
and Conservation Programs
4701 N. Torrey Pines Drive
Las Vegas NV 89130

Dear Ms. Christ:

The White Pine County Commission is pleased to support the interagency proposal for SNPLMA funding to evaluate the basin-fill aquifers in southern Spring and Snake Valleys in relation to their connection with surface water resources and with the regional carbonate-rock aquifer as submitted by the National Park Service.

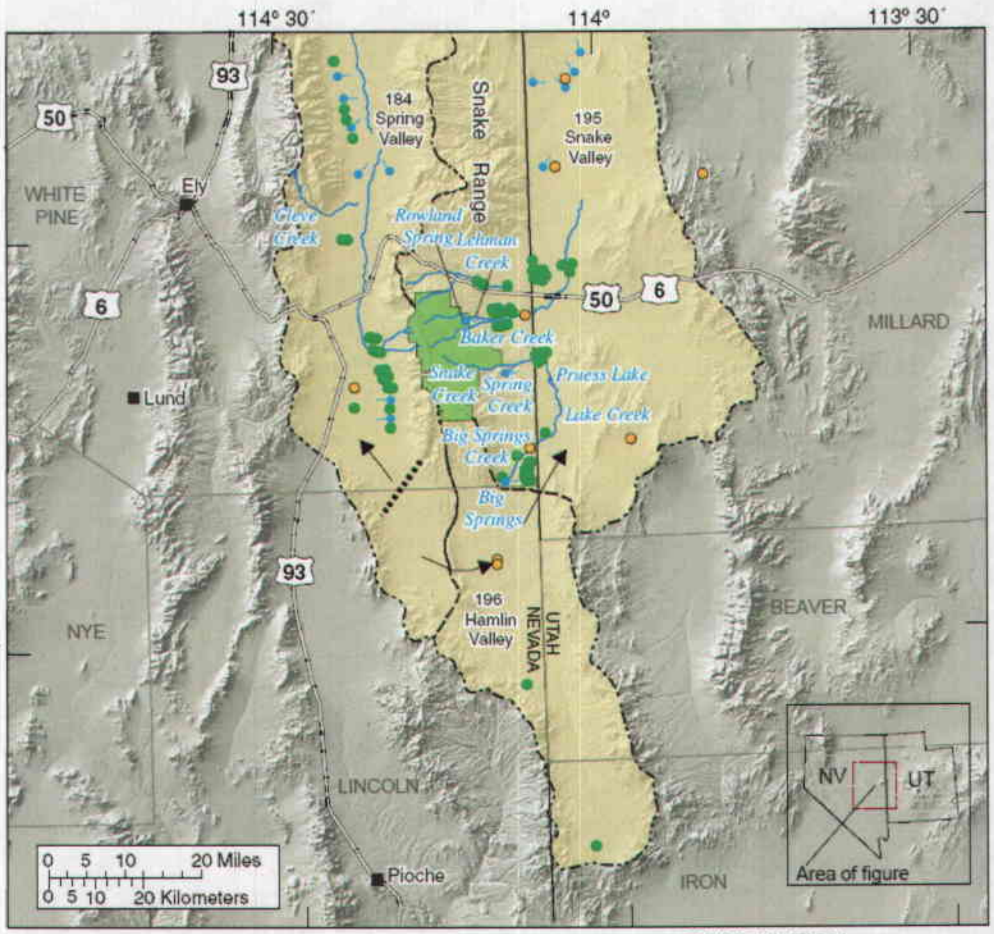
The Commission has gone on record several times supporting the need for additional studies of the water resources in Spring and Snake Valleys. The Commission supported the need for additional study of the water resources in White Pine County in its written comments to the State Engineer during the hearings on Southern Nevada Water Authority's applications in Spring Valley and it supported the need for a BARCASS II study during the deliberations on the White Pine Conservation, Recreation, and Development Act. The need for additional study is also a primary goal identified in the County's 2006 Water Resources Plan.

The County Commission urges you to fund the proposal submitted by the National Park Service. Thank you for your consideration.

Sincerely,

David Pound,
Vice Chairman

F. Location Map



Base from USGS 1:100,000-scale digital data, 1979-84.
Irrigation wells from Nevada Division of Water Resources State Well and Utah Division of Water Rights databases.
Hydrographic boundaries from USGS digital data.
Universal Transverse Mercator Projection, Zone 11, NAD83.

EXPLANATION

- Selected hydrographic areas
- Great Basin National Park
- Ground-water divide—Rush and Kazmi (1965)
- Ground-water flow direction
- Stream
- Spring
- Oil well
- Irrigation well

Figure 1. Location of Spring Valley, Hamlin Valley, and Snake Valley hydrographic areas, Great Basin National Park, oil and irrigation wells, selected springs, and streams.

I. Narrative Addressing Ranking Criteria:

1) RESULTS IN IMPROVED QUALITY OF FEDERAL LANDS

The U. S. Department of the Interior National Park Service, Bureau of Land Management, Fish and Wildlife Service, and U. S. Department of Agriculture Forest Service need additional information regarding the connection of the basin-fill aquifers in Spring and Snake valleys, White Pine County, Nevada, with surface-water resources and water-dependent ecosystems, and with the regional carbonate-rock aquifer, which is the known source of many high-discharge springs in the region. Ground-water withdrawals from these two valleys could deplete the flow of streams and springs and adversely affect associated ecosystems, but the specific effects are still largely unknown.

The expected products to be generated by the proposed work are interpretive peer-reviewed scientific reports that would provide the nominating organizations, as well as Nevada and Utah State agencies, with information on how the proposed withdrawals could affect specific surface-water resource features. The results of the analyses proposed as part of this study will improve the understanding of the hydrogeology of southern Spring and Snake valleys, so that predictive estimates made with numerical flow models will be more realistic and less generalized due to uncertainty. The added understanding of how surface-water features could be affected by ground-water withdrawals will help Federal land managers to better evaluate risks to natural resources, allow them to prioritize efforts to protect the sensitive natural resources at greatest risk, and thus will improve the quality of Federal lands.

2) RESULTS IN IMPROVED MANAGEMENT OF FEDERAL LANDS

The information obtained from the scientific analyses to be done as part of the proposed study will reduce the uncertainty pertaining to ground-water movement, ground-water – surface-water interactions, and the possibility of depletion of the flow of surface-water features due to ground-water withdrawals adjacent to Federal lands in White Pine County. Improved understanding of the mechanisms that control ground-water flow and ground-water – surface-water interactions will allow for prioritization of protection efforts and thus improved efficiency and less cost in the management of sensitive water-dependent natural resources on Federal lands.

Four peer-reviewed scientific reports will be produced as a result of the proposed project. he results of the analyses conducted in the project, which will be documented in the reports, will serve to advance the knowledge of the source areas of the largest springs in the study area, the mechanisms that control ground-water flow and ground-water – surface-water interactions, and thus will help the understanding of the characteristics of the water supply to water-dependent natural resources on Federal lands. This improved understanding will have an immediate practical application, because large-scale ground-water withdrawals from southern Spring and Snake valleys are already planned to be used for municipal supply purposes in southern Nevada. The added knowledge gained from the proposed study will facilitate more knowledgeable management of the resources, more focused negotiations with ground-water development entities, and ultimately, more responsible ground-water development in the area that would allow for maintaining healthy water-dependent natural-resource features.

The proposed products will be stand-alone reports that will have scientific value and practical application without further funding. The methods used and results obtained and documented in the reports will be able to be used throughout the regional carbonate-rock aquifer system for advancing the scientific understanding of ground-water – surface-water interactions.

3) PROVIDES OPPORTUNITIES TO INVOLVE, INFORM, AND/OR EDUCATE THE PUBLIC ABOUT THE ENVIRONMENT AND RESPONSIBLE USE OF FEDERAL LANDS

New information will be gained as a part of this project and the results will provide a tool to better describe the regional ground-water flow system. The results will promote the responsible use of Federal lands in that it will be used to determine where ground-water withdrawals from Federal lands may be done without greatly reducing the volume of water in storage and without affecting surface water resources important for sensitive water-dependent ecosystems.

Results from ground-water investigations coupled with geographic information systems (GIS) can be used to help the public understand how ground-water pumping can threaten sensitive riparian ecosystems and by demonstrating where and to what extent responsible development is achievable. Preliminary study results and additional insights about the ground-water flow system will be presented at technical conferences, workshops, or other appropriate meetings. Results of the study will be published in a series of reports and will be provided to the public through the internet. All Federal, State, and local government agencies and local residents will be kept apprised of the data collection and results. Local residents will be asked access to their lands and to assist in data collection. Volunteers will be used to assist in data collection and monitoring.

Meetings with Federal, State, and local government agencies and local residents will be done every six months at Ely, Nevada. Additional presentations will be made upon request. An internet website will be established to disseminate data and published reports that describe the connection between ground water and surface water. Particular emphasis will be placed on educating the public on conservation of surface water resources in Spring and Snake valleys.

4) SUSTAINS A SUCCESSFUL SNPLMA CONSERVATION INITIATIVE

Water resources throughout eastern Nevada are part of the Great Basin regional aquifer systems, including ground-water flow systems in basin-fill deposits and carbonate rocks. Discharge from these regional ground-water flow systems occurs as springs, streams, and wetlands, and sustains riparian habitats for diverse animal and plant species, many of which are endemic to Nevada and are protected under Federal, State, and local regulations. Improved knowledge and understanding of these ground-water flow systems will allow Federal managers to work to conserve these important natural resources.

Previous efforts to improve understanding of these aquifer systems in Clark County have begun as Conservation Initiatives as part of SNPLMA Rounds 5 and 6, and are ongoing (see Section C., 6, of this proposal, pg 11-12). Methodologies and results used in the Clark County studies and in this proposed White Pine County study are complementary, and improve overall knowledge of the regional aquifer systems. The knowledge gained from the studies in Clark County is currently being used to develop a predictive numerical ground-water flow model of 13 basins in northeastern Clark County (SNPLMA Round 5 project), which will be used to estimate the future cumulative effects of proposed ground-water developments within the model area.

The information gained from the results of this proposed study in White Pine County will serve to provide valuable input information to any predictive numerical ground-water flow model developed in White Pine County and the surrounding areas. Eventually, water-resource management throughout the regional carbonate-rock aquifer system will be best facilitated by assimilating all the models of smaller areas into one large predictive model of the entire regional aquifer system of eastern Nevada and parts of adjacent States. In this way, the cumulative effects of ground-water development throughout the regional aquifer system can be assessed, for the benefit of the conservation and management of all Federal lands.

5) PROMOTES COOPERATIVE CONSERVATION

This project represents a cooperative effort between the NPS, BLM, FWS, and USFS in Nevada. In addition, the results of this project will provide information to the Nevada State Engineer who has authority over the use of water in Nevada. Federal land-management agencies in Nevada have been collaborating for many years on efforts to evaluate and respond to proposed regional ground-water withdrawals in undeveloped areas of Clark, Lincoln, and White Pine counties. All of these Federal agencies are directly involved in this project and have made commitments to continue contributing to this project over the next few years. White Pine County Board of County Commissioners has also expressed support for this project, to help address local issues and concerns. Study results will provide opportunities for Federal land-management and local planning agencies to collaborate to protect water-dependent resources and at the same time allow the development of adequate water supplies needed for continued economic growth.

6) PROJECT DEMONSTRATES SOUND PROJECT MANAGEMENT AND QUALITY CONTROL MEASURES

This study will require collaboration between the USGS, University of Nevada, Reno (UNR), and land-management agencies in White Pine County, Nevada, and promote ongoing efforts to develop science-based solutions for challenges posed by rapid population growth. USGS and UNR management and technical specialists will internally review the progress and quality of project analytical efforts and data compilation. All project scientific efforts will comply with USGS standards and technical memoranda. The NPS, BLM, FWS, and USFS will periodically meet with USGS and UNR to discuss preliminary results and will review draft reports prior to publication.

Detailed Cost Analysis_Attachment 1.xls

Project Title: Evaluation of Basin-Fill Aquifers in Southern Spring and Snake Valleys and Their Connection with Surface-Water Resources and with the Regional Carbonate-Rock Aquifer

	---------------------- Expenses ----------------------			
1. Planning and Environmental Assessment Costs	**Year 1**	**Year 2**	**Year 3**	**Total**
Specialist Surveys/Reports				$0
NEPA	$10,000			$10,000
Permitting				$0
Consultant Fees				$0
Other				$0
Subtotal	$10,000	$0	$0	$10,000
2. FWS Consultation - Endangered Species Act	**Year 1**	**Year 2**	**Year 3**	**Total**
	10000			$10,000
Subtotal	$10,000	$0	$0	$10,000
3. Direct Labor/Payroll to Perform the Project (use fully loaded labor rate)	**Year 1**	**Year 2**	**Year 3**	**Total**
NPS Hydrologist	$6,000	$7,000	$7,000	$20,000
FWS Hydrologist	$6,000	$7,000	$7,000	$20,000
BLM Hydrologist	$6,000	$7,000	$7,000	$20,000
FS Hydrologist	$6,000	$7,000	$7,000	$20,000
COR/Contracting	$3,000	$3,000	$4,000	$10,000
Subtotal	$27,000	$31,000	$32,000	$90,000
4. Project Equipment (list equipment)	**Year 1**	**Year 2**	**Year 3**	**Total**
Item 1				$0
Item 2				$0
Item 3				$0
Item 4				$0
Item 5				$0
Subtotal	$0	$0	$0	$0
5. Project Materials and Supplies	**Year 1**	**Year 2**	**Year 3**	**Total**
				$0
Subtotal	$0	$0	$0	$0
6. Travel (airfare, car rental, per diem, etc)	**Year 1**	**Year 2**	**Year 3**	**Total**
NPS	$2,000	$2,000	$2,000	$6,000
FWS	$1,000	$1,000	$1,000	$3,000
BLM	$1,000	$1,000	$1,000	$3,000
FS	$1,000	$1,000	$1,000	$3,000
Travel 5				$0
Subtotal	$5,000	$5,000	$5,000	$15,000
7. Official Vehicle Use	**Year 1**	**Year 2**	**Year 3**	**Total**
NPS	$500	$500	$500	$1,500
BLM	$500	$500	$500	$1,500

Detailed Cost Analysis_Attachment 1.xls

FWS	$500	$500	$500	$1,500
FS	$500	$500	$500	$1,500
Vehicle Use 5				$0
Subtotal	$2,000	$2,000	$2,000	$6,000
8. Required Training (including tuition and required books)	**Year 1**	**Year 2**	**Year 3**	**Total**
Training 1				$0
Training 2				$0
Training 3				$0
Training 4				$0
Training 5				$0
Subtotal	$0	$0	$0	$0
9. Cost of Contracts and/or Agreements to Perform Project (list each contract)	**Year 1**	**Year 2**	**Year 3**	**Total**
Contract 1 Cost	$167,000	$167,000	$166,000	$500,000
Contract 2 Cost	$300,000	$500,000	$200,000	$1,000,000
Contract 3 Cost	$200,000	$200,000	$100,000	$500,000
CESU Cooperative Agreement:				$0
Subtotal	$667,000	$867,000	$466,000	$2,000,000
10. Other Necessary Expenses (see B-9)	**Year 1**	**Year 2**	**Year 3**	**Total**
Subtotal				$0
Expense Summary	**Year 1**	**Year 2**	**Year 3**	**Grand Total**
Total	$721,000	$905,000	$505,000	**$2,131,000**

APPENDIX B-9
Examples of Estimated Other Necessary Expenses
Category
ADMINISTRATION COSTS
Budget Tracking/Accounting and Execution
Allocation of Transferred Funds to the Region and to the Field*
Preparation of OMB Reports Required in Association with Transferred Funds*
Project Procurements and Contract Oversight (If any in addition to Direct Labor for the CO, COR, and PI
Preparing Transfer Requests*
Transfer of Station cost (PCS) for Hiring Project Personnel
Managing Allocation of Transferred Funds*
Financial Audit Support
Supervision and Oversight of SNPLMA-Funded Staff and/or Contractors
Travel Administration for Required Project Travel
Human Resource/Relations Tasks for SNPLMA-funded Personnel
Preparing Quarterly Status Reports
Tracking Project Activities, Expenses, IGOs, Task Orders (e.g., project database management)
IT Services to Install Hardware/Wiring, Project-Required Software, and Maintain/Trouble Shoot
A percent of Project-Related Indirect Costs for Support Based on Staff Time Spent on the Project(s),
PROJECT CONSTRUCTION, CONSULTATION AND MANAGEMENT
Duties of Project Manager/Supervisor (If not already included on the Estimated Expense Sheet)
Construction Trailers and Utilities
Required Project Consultations (e.g., safety and fire; cultural and historic, ADA, etc.)
Public Scoping and/or Meetings for Environmental Review, Project Design, etc. (Does not include ribbon
Review of Contracted Surveys, Assessments, Designs/Drawings, Reports (If not already included on the
Construction Site Security
Cell Phones, Cell Service, Radios for Project Personnel Primarily in the Field
Required Cultural, Wildlife, Biological, and other Similar Surveys (If not already included on the
Interest Required to be Paid on Construction Contract Retention Amounts
TEMPORARY OFFICE SPACE
Lease Costs for New Temporary Space
Design and Installation of Modifications to Meet Space Plan Needs
Set Up Fees for Utilities (Gas, Electricity, etc.)
Furniture and Fixtures
Required Modifications to Meet Codes
Computer Equipment (See section on equipment costs for limiting conditions)
Installation Costs for Computer Networks, Telephone Service

Revisions to:

SNPLMA ROUND 8
CONSERVATION INITIATIVE PROPOSAL
WHITE PINE COUNTY, NEVADA

November 29, 2007
(Proposal originally submitted May 1, 2007)

A. Title:

Evaluation of Basin-Fill Aquifers in Southern Spring and Snake Valleys and their Connection with Surface-Water Resources and with the Regional Carbonate-Rock Aquifer

Nominating Organizations: National Park Service (lead agency)
Bureau of Land Management
U.S. Fish and Wildlife Service
USDA Forest Service

B. Contacts:

William P. Van Liew, P.E. (primary)
Hydrologist
National Park Service
Water Resources Division
1201 Oakridge Drive, Suite 250
Fort Collins, CO 80525
Phone: (970) 225-3549
Email: william_p_van_liew@nps.gov

Timothy D. Mayer, Ph.D.
Hydrologist
U.S. Fish & Wildlife Service
Water Resources Branch
911 NE 11th Avenue
Portland, OR 97232-4181
Phone: (503) 231-2395
Email: tim_mayer@fws.gov

Robert Boyd
Nevada State Hydrologist
Bureau of Land Management
Nevada State Office
P.O. Box 12,000
Reno, NV 89520-0006
Phone: (775) 861-6516
Email: robert_boyd@nv.blm.gov

Joseph T. Gurrieri
Regional Geologist
USDA Forest Service
Intermountain Region
324 25th Street
Ogden, UT 84401
Phone: (801) 625-5668
Email: jgurrieri@fs.fed.gov

C. Project Narrative:

1) EXECUTIVE SUMMARY:

This executive summary addresses only the revisions to the proposal contained herein. The purpose of the revisions was to: (1) provide more detail and improve the clarity of purpose and approach; (2) remove duplicative efforts related to monitoring and analysis already included in the Stipulated Agreement between the USDOI bureaus and the Southern Nevada Water Authority in Spring Valley ("DOI/SNWA Stipulated Agreement"); and (3) accommodate a more collaborative approach with SNWA hydrologists to ensure that this proposed work will augment and build upon ongoing and planned investigations by SNWA in the study area.

The principal revisions contained herein are: (1) the study area and number of surface-water features to be investigated have been reduced; (2) the three main tasks that comprise the original proposed study have been retained, but have been modified and strengthened; and (3) a more detailed delineation of the project-implementation approach and associated costs has been included. The overall proposal cost remains unchanged at $2,131,000. The originally proposed study area was revised to focus on the eastern side of the southern Snake Range in Snake Valley, Nevada, and on the southern side of the southern Snake Range in parts of Snake Valley, Hamlin Valley, and a small part of Spring Valley that comprise the "interbasin ground-water monitoring zone" of the DOI/SNWA Stipulated Agreement. Investigations of springs in southern Spring Valley have been removed from this revised proposal, and will be considered in more detail in a future proposal (planned to be submitted in SNPLMA Round 10). This future proposed hydrogeologic investigation will focus on the area in southern Spring Valley near Shoshone Ponds and on one stream discharging from the west side of the southern Snake Range into Spring Valley.

The modified project-implementation approach of the three main tasks is as follows:

Task 1—The geologic characterization of the basin-fill deposits has been modified to focus on the drainages of Lehman, Baker, and Snake creeks between the southern Snake Range and the Nevada state line and in the vicinity of Big Springs (figure 1).

Task 2—The characterization of streambed properties of creeks and source of water to high-discharge springs has been modified to focus on Lehman, Baker, and Snake creeks, and the length of investigation will extend from where each creek crosses onto carbonate rocks or alluvial deposits to where they are diverted into concrete lined canals or at the Nevada state line. The type of data collection has been expanded to include synoptic stream discharge measurements, monitoring of head gradients between streams and shallow piezometers temporarily placed into the streambed, and aquifer tests from shallow wells drilled near each stream.

The determination of the source of water to high-discharge springs has been modified to focus on Rowland Spring near the headquarters of Great Basin National Park and on Big

Springs at the southeastern end of the southern Snake Range. These studies have been expanded to included the drilling and construction of a 200-foot deep monitoring well completed in the carbonate-rock aquifer between Rowland Spring and Baker Creek and two additional monitoring wells at the southeastern end of the southern Snake Range: a 500-foot deep well completed in the basin-fill aquifer northwest of Big Springs and a 700-foot deep well in the carbonate-rock aquifer southwest of Big Springs. Two sets of water samples will be collected from the springs and wells and used to assist in the evaluation of the source of water to the springs. Additionally, the study of Rowland Spring will include monthly samples of chemistry and isotopes of water discharging from the spring, from water in Lehman and Baker creeks, from precipitation, and from water in the newly drilled well nearby.

Task 3—The determination of the ground-water divide between Spring and Snake valleys has been modified to include an estimation of the subsurface flow across the hydrographic-area boundary between Spring Valley and Hamlin Valley through the Limestone Hills, in coordination with work being done as part of the DOI/SNWA Stipulated Agreement. A total of six monitoring wells within the area of the "interbasin ground-water monitoring zone" will be drilled as part of the DOI/SNWA Stipulated Agreement (one has already been completed), but an additional well is needed at the south end of the Limestone Hills. This 800-foot deep well is needed to provide a more complete estimate of the subsurface flow across the Limestone Hills. The drilling of this 8-inch diameter monitoring well and the two new monitoring wells near Big Springs described in Task 2, above, will provide important new information to help evaluate the contribution of water from southern Spring Valley into Hamlin Valley and then to Snake Valley.

A proposal for future work in southern Spring Valley will be submitted for consideration in SNPLMA Round 10. This proposal will focus on evaluation of the hydrogeology of southern Spring Valley in the Shoshone ponds area (also known as "The Cedars"). The proposed work will include: (1) a detailed study of the ponds area as well as the geology and hydraulic properties of basin-fill deposits beneath the floor of Spring Valley; and (2) a detailed study along Shingle Creek from where the creek crosses granitic rocks to where it is diverted into a pipeline. Shingle Creek is one of several creeks that discharge on the west side of the southern Snake Range that support Bonneville Cutthroat Trout.

3) PROJECT IMPLEMENTATION PROCESS:

Principal Tasks:

The project will be implemented by the three main tasks that would begin approximately June 2008 and continue through December 2010. A description of the implementation of each task is as follows:

Task 1. *Geologic characterization of basin-fill aquifers:*

The purpose of task 1 is to delineate the distribution of coarse-grained basin-fill deposits in areas where basin-fill sediments beneath the valleys abut against consolidated rocks in the mountains. The task remains the same as outlined in the original proposal except the area of focus during the first phase will be limited to two areas along the east and south ends of the southern Snake Range (figure 1). The first area extends from about Lehman Creek south to Big Wash and from the mountain front eastward to the Nevada state line. The second area is in the vicinity of Big Springs and also extends eastward to the Nevada state line. Both areas have sufficient outcrop of older basin-fill deposits and well logs such that a distribution of coarse- and fine-grained deposits can be estimated and used to evaluate the connection of ground-water flow in consolidated rocks with ground-water flow in the basin fill aquifer(s).

Geologic mapping of basin-fill deposits, available geophysical surveys, well logs drilled as part of this proposal and as part of the DOI/SNWA Stipulated Agreement, and drillers' logs of wells between the mountain front and the Nevada state line will be used to evaluate the connection of ground-water flow from recharge areas in consolidated rocks in the mountains to discharge areas in the basin fill aquifer(s). Estimates of percent gravel within the basin-fill deposits will be estimated on the basis of geologic sections measured from outcrops in the field as well as from drillers' logs of wells as described by Bredehoeft and Farvolden (1962) and Bredehoeft (1963). C.P. Zones (1961) was the first to use lithofacies mapping of basin-fill deposits in Crescent Valley to evaluate potential aquifers. He noted (figure 6) that good aquifers in Crescent Valley were near the toe of the alluvial-fan deposits because these deposits were better sorted than deposits higher on the alluvial fan.

Bredehoeft and Farvolden (1962) and Bredehoeft (1963) determined that well yields from specific capacity data reported in drillers' logs was correlated to the thickness of gravel encountered in the well. The geologic interpretation of drillers' logs for percent gravel was estimated by using the interpretation listed in Table 1 below (Bredehoeft and Farvolden, 1962, table 1; and Bredehoeft, 1963, table 3). A similar table will be developed and used to determine the extent of gravel associated with basin-fill deposits in the areas of Lehman, Baker, and Snake creeks and in the vicinity of Big Springs.

Table 1.—Geologic interpretation of drillers' description of sediments

Driller's description	Geologic interpretation	Percent gravel*
Gravel	Gravel	100
Cement gravel	Gravel, pebble sized grains predominate	100
Sand and gravel	Interbedded beds of medium to coarse grained sand with beds of gravel	50
Gravel and clay (gravelly clay)	Pebbles and larger clastic material in a matrix of fine sand and silt; interbedded with some beds of gravel. (Probably mudflow deposits with some interbedded stream sediments)	25
Sand	Sand, medium to coarse grains	0
Sandy clay	Interbedded clay, silt, and fine to medium grained sand	0
Silt clay	Silt with minor amounts of clay	0
Yellow clay	Interbedded clay, silt, and fine grained sand (possibly, at least in part, lacustrine)	0
Blue/gray clay	Clay, thinly bedded (probably lacustrine)	0
Lava rock	Either volcanic flows or volcanic detrital material	?

*Gravel is used to describe a clastic deposit in which the median grain size is 2 mm or larger with a matrix of predominantly medium to coarse grained sand.

Several elements comprise task 1, as follows:

1. Compile drill-hole data from wells drilled as part of this study and as part of the DOI/SNWA Stipulated Agreement, and from older drillers' logs, and assemble into digital form.
2. Field check locations of wells and verify correct well name.
3. Compile lithologic interval data into a database suitable for input into Rockworks.
4. Compile and digitize all borehole geophysical logs from test holes, water wells, and oil test wells that might be useful in the interpretation of the basin fill deposits.
5. Examine available surface outcrops on the eastern and southern ends of southern Snake Range
6. Assess relative age, amount of tilting in order to help provide an assessment of how much of the Quaternary and Tertiary basin fill is faulted and tilted, and how much is consolidated versus unconsolidated.
7. Assemble available surface geophysical data that includes Asch MT line, depth-to-basement, aeromagnetic data, Alam seismic data, McPhee AMT data, and locate all information on the surface as well as with depth.
8. Develop map-based, cross section-based, and 3D interpretations of unit thickness, lithology, grain-size distribution, location and importance of faulting based on outcrop, geophysical, and well data in Lehman, Baker, and Snake creeks drainages and in the vicinity of Big Springs.
9. Interpret the distribution of coarse-grained deposits similar to that described by Bredehoeft (1963) and well interpretation and cross section approaches similar to that described by Plume (1989).
10. Interpret the distribution of gravels within the basin-fill deposits in the area of Lehman, Baker, and Snake creeks and in the vicinity of Big Springs in relation to their degree of contact with the adjoining consolidated rocks.

The results of task 1 will be described in Chapter 2 of a U.S. Geological Survey report and will include maps and diagrams that delineate the distribution of gravel in basin-fill deposits within each of the two areas. Chapter 1 will be an executive summary that will provide the principal findings of the study in terms of the connectedness of Lehman, Baker, and Snake creeks to carbonate-rock and basin-fill aquifers, the source of water to Rowland Spring and Big Springs, which provide important surface-water resources to southern Snake Valley, and an estimation of the subsurface flow from southern Spring Valley into Hamlin Valley, and then into southern Snake Valley.

Task 2. *Hydrologic characterization of streambed properties of creeks and the source of water to high-discharge springs*:

The purpose of task 2 is to determine the streambed properties of streams that discharge onto alluvial fans and to determine the source of water to high-discharge springs. This task is largely unchanged from the original proposal except that the area of focus will be limited to the east side of the southern Snake Range. Characterization of streambed properties of creeks during the first phase will be limited to the drainages of Lehman, Baker, and Snake creeks.

Lehman, Baker, and Snake creeks are not typical of Basin and Range streams that discharge onto alluvial fans. Most creeks in the Basin and Range typically are intermittent, and those that are perennial are generally located in areas where the mountains have high precipitation (>20 inches per year) and the consolidated rocks are low permeability. Because of cold winters and hot summers, the combination of high precipitation and low permeability rocks in the mountains typically results in high flows during snowmelt and low flows during late summer and fall. Where such streams cross onto alluvial fans, the depth to ground water typically increases rapidly and streams lose at a maximum rate that is dependent only on gravity drainage through the streambed.

Lehman, Baker, and Snake creeks all begin in areas of low permeability, and thus the upper reaches of these streams are similar to many mountain streams in the Basin and Range province. However, these streams cross onto areas of carbonate rocks that are generally permeable. These streams exhibit gaining and losing reaches within the area of carbonate rocks that are dependent on the depth to ground water. Baker Creek loses flow where it crosses carbonate rocks, whereas Lehman Creek gains flow where it crosses over basin-fill deposits that cover carbonate rocks. Snake Creek alternately gains and loses flows across carbonate rocks but then gains considerably where basin-fill deposits overlap the carbonate rocks. Because of these rather unusual conditions and because these conditions occur largely within Great Basin National Park or near its boundary, additional detailed information on the relation between the three streams and ground water is needed.

Detailed studies using a combination of surface and subsurface temperatures, temporary stream-flow gages, synoptic stream-discharge measurements, and shallow piezometers will be used to estimate streambed properties. Detailed studies of the three streams will begin where streams cross over carbonate rocks and will continue to where the streams are diverted into lined canals or to the Nevada state line (study locations along each stream are shown on figures 2 and 3). Coordinated measurements will be taken at two different times along each stream, once during June when snowmelt runoff increases the flow and once during the fall when runoff is at a minimum. A 1,000-meter long optical temperature cable will be placed along the thalweg of the stream beginning at the top of the reach and will be used to measure water temperature each meter of the channel (Selker and others, 2006). Temperature will be recorded every 15 minutes for 48 hours. Shallow piezometers will be driven into the streambed every one hundred meters. Pressure transducers and temperature loggers will be placed in each piezometer along with a pressure transducer in the stream. Measurements also will be recorded every 15 minutes for 48 hours. The procedure will be repeated down each stream. Expected results from this phase of the study will be to map areas of gaining and losing flow at a finer scale then what can be determined from simply computing the difference between stream discharge measurements along the stream. The procedure will also provide estimates of the hydraulic conductivity of the streambed.

A set of five shallow monitoring wells will be drilled at a site along each stream where ground water in the basin-fill aquifer is in hydraulic connection with the stream (location of proposed sites also are shown on figure 2 and 3). A 6-inch diameter monitoring well will be drilled about 50 feet from the stream to a depth of about 50 feet. The well will be screened over the saturated interval. Two 2-inch diameter monitoring wells, one about 12 feet deep and the other 35 feet deep, will be drilled next to the stream and about 25 feet upstream. Both wells will have a 5-ft screened interval. A similar set of wells will be drilled 25 feet downstream. An aquifer test will be done during low flow by pumping the 6-inch well at a rate of about 200 to 400 gallons per minute for 2 days, provided the materials are sufficiently permeable to allow for such a rate. Water-level declines will be recorded in the pumping and observation wells and in shallow piezometers installed in the streambed at three locations. Temporary pressure transducers and/or flumes will be placed in the stream upstream and downstream of the test and stream discharge routinely measured if streamflow exceeds the capability of the flumes. Stream temperatures along both banks and the thalweg of the stream will be measured using an optical temperature cable. Ground-water temperatures will be measured in shallow piezometers temporarily driven beneath the streambed and in the wells next to the stream. The expected results will be an estimate of the vertical and horizontal hydraulic conductivities of the upper 50 feet of alluvium next to the stream and the hydraulic conductivity of the streambed that can be compared with those estimated from streambed temperatures described in the first part of the experiment. The expected results from the experiments will be the distribution of streambed hydraulic conductivity that can be related to the distribution of coarse-grained deposits delineated in task 1 and used in assessing the connectedness of the basin-fill aquifer(s) with streams as they flow across carbonate rocks and onto alluvial fans. The results will be presented as Chapter 3 in a U.S. Geological Survey report.

The study on the source of water to high-discharge springs will focus on Rowland Spring and Big Springs (figure 1). Rowland Spring is within the boundary of Great Basin National Park downstream of Lehman Caves (figure 2). The spring discharges from glacial deposits, which are draped on top of basin-fill deposits and carbonate rocks. The daily mean discharge of Rowland Spring during 2003 and 2004 ranged from 0.75 to 3.9 cubic feet per second (Elliot and others, 2006, p. 81-82). Peak discharges occurred in late June and early July and minimum discharges occurred in January and February. The peak discharges occurred later than those in either Baker or Lehman Creek, which occurred in late May and early June. Potential sources of water to Rowland Spring include water from Lehman Creek, local precipitation in the area of carbonate rocks between the outcrop of granitic rocks and the spring, and subsurface flow from the Baker Creek drainage northward to Rowland Spring.

The source of water to Rowland Spring will be evaluated with the help of water chemistry information. A 6-inch diameter monitoring well will be drilled to a depth of about 200 feet between Baker Creek and Rowland Spring to determine if ground water has the potential to flow from Baker Creek drainage northward to Rowland Spring. A complete suite of samples will be collected from Rowland Spring, Lehman and Baker creeks, and the well during low flow in the fall and again during peak discharge during June, and analyzed for the dissolved water-quality constituents listed in Table 2 below. Additionally, samples from the spring, the two creeks, and the monitoring well, and from precipitation will be collected monthly for one year and analyzed for major ions as well as the stable isotopes of oxygen and deuterium. The reason for monthly samples is to determine the variability in dissolved constituents that could be important to assessing time varying sources of water to Rowland Spring. The chemistry of Rowland Spring, Lehman Creek, Baker Creek, and the monitoring well will be used with geochemical mixing models using NETPATH (Plummer and others, 1994) to help evaluate the source of water to the spring. Results from the Rowland Spring study will be published as Chapter 4 in a U.S. Geological Survey Report.

Table 2.—Water chemistry field measurements and analysis of dissolved constituents

Field parameters	Major ions	Trace elements	Isotopes/dissolved gases
Water temperature	Total Dissolved Solids	Arsenic	Deuterium
Air temperature	Calcium	Barium	Oxygen-18
pH	Magnesium	Cadmium	Tritium
Electrical conductivity	Potassium	Chromium	Chlorine-36*
Dissolved Oxygen	Chloride	Lead	Carbon-14*
Alkalinity	Sodium	Mercury	Carbon 12/13
	Fluoride	Selenium	Strontium-86/87
	Bromide	Silver	Uranium-234, 235, 238*
	Sulfate	Manganese	Dissolved gases
	Nitrate	Aluminum	Helium-3/4
	Phosphate	Iron	Chlorofluorocarbons
	Silica		

*Optional – to be determined at a later date.

Big Springs is located near the southeast corner of the southern Snake Range (figure 1). The springs discharge from basin-fill deposits that presumably overlie carbonate rock. The combined daily mean discharge of the north and south channels of Big Springs during 2006 ranged from 8 to 12 cubic feet per second (USGS Annual Data Report, 2006, http://web10capp.er.usgs.gov/imf/sites/adr06/pdfs/10243224.2006.pdf and http://web10capp.er.usgs.gov/imf/sites/adr06/pdfs/102432241.2006.pdf). Potential sources of water to Big Springs include recharge to carbonate rocks in the southeast side of the southern Snake Range and subsurface flow from southern Spring Valley across the Limestone Hills south of the southern Snake Range.

The source of water to Big Springs also will be evaluated with the help of water chemistry information. Two new 8-inch diameter monitoring wells will be drilled near Big Springs as part of evaluating the source of water to the springs. One monitoring well is to be located about 1 mile northwest of the spring area. This well will be completed in basin-fill deposits to a total depth of about 500 feet and will have a 200-ft screened interval. The second monitoring well will be drilled about 2 miles southwest of the spring at the south end of the southern Snake Range (see figure 1). The target completion for this second well is in the carbonate-rock aquifer. The total depth of this well is expected to be about 700 feet, and it also will have a 200-ft screened interval. As part of the DOI/SNWA Stipulated Agreement, a basin-fill aquifer well will also be drilled near Big Springs, about 0.75 miles to the southwest. It will have a total depth between 400 and 500 feet and also will have a screened interval of 200 feet.

The Big Springs and the three aforementioned wells will each be sampled twice, once during high discharge of the springs and once during low discharge of the springs (October through November). Water from these wells and springs will be sampled for the same dissolved constituents as those for Rowland Spring (listed in table 2). The chemistry of the wells and springs will be used with geochemical mixing models using NETPATH (Plummer and others, 1994) to help evaluate the source of water to Big Springs. Results from the Big Springs study will be published as Chapter 5 in a U.S. Geological Survey Report.

The source of water to Spring Creek springs in the Snake Creek drainage will not be a focus of this study because it is being evaluated as part of a Desert Research Institute (DRI) study that has been commissioned by the Southern Nevada Water Authority.

Task 3. *Delineation of the ground-water divide between Spring Valley and Snake Valley, and estimation of subsurface flow between the valleys*:

The purpose of task 3 is to: (1) delineate the ground-water hydraulic gradient in the area of the south end of the southern Snake Range; and (2) provide the best estimate possible of the subsurface flow across the hydrographic-area boundary between Spring Valley and Hamlin Valley through the Limestone Hills, in coordination with work being done as part of the DOI/SNWA Stipulated Agreement.

One of the main elements of this task will be to drill an 8-inch diameter deep monitoring well (about 850 feet deep) into the carbonate-rock aquifer at the southern end of the Limestone Hills (figure 4). This well is needed to complete a north-south transect of wells along the Limestone Hills to further the understanding of subsurface flow from southern Spring Valley into Hamlin Valley. The well will be drilled on BLM land and will have a 200-ft screened interval.

In addition, an array of four carbonate-rock monitoring wells will be completed within the "interbasin ground-water monitoring zone" of the DOI/SNWA Stipulated Agreement to the north of this new well. One of these wells has already been completed by SNWA and three new monitoring wells are planned (figure 4). Data from this new well and the four wells drilled as part of the DOI/SNWA Stipulated Agreement will be used to estimate subsurface flow from southern Spring Valley into Hamlin Valley. Geophysical logs that include caliper, short- and long-normal resistivity, spontaneous potential, natural gamma, and a flow log will be completed in all the boreholes for these monitoring wells.

A water sample will be collected from the new southernmost monitoring well and analyzed for dissolved constituents listed in table 2. Additionally, samples will be collected from the six DOI/SNWA Stipulated Agreement wells drilled on the south end of the southern Snake Range and analyzed for chlorofluorocarbons, dissolved gases, and Helium 3-4. The sampling of these wells will be coordinated with Southern Nevada Water Authority at the time water samples are collected by them.

A main element of this task is to improve quantification of the subsurface flow from southern Spring Valley into Hamlin Valley. The estimate will require knowing the hydraulic gradient across the divide, an estimate of the effective thickness of the carbonate rocks that transmit most of the flow across the divide, and an estimate of the effective hydraulic conductivity. Subsurface flow across the divide may be divided into different zones depending on the results of the monitoring wells drilled along the divide.

Ground-water gradients across the divide will be determined using water levels in the new wells along with nearby existing wells in Spring Valley and Hamlin Valley. Flow-log data in the wells will identify the percent of transmissive zones in the intervals screened by the wells. These data will be used to approximate the effective thickness of the carbonate rocks through which ground water flows. Estimates of hydraulic conductivity of the effective zones will be estimated for each well by dividing the transmissivity estimated from a single-well aquifer test by the thickness of transmissive zones within the screened interval. The effective thickness of the overall screened interval will than be prorated to the entire thickness of carbonate rocks beneath the Limestone Hills on the basis of geologic interpretation. The quantity of subsurface flow from Spring Valley into Hamlin Valley will include an estimate of uncertainty caused by the uncertainty associated with the effective thickness of the carbonate rocks and its hydraulic conductivity.

Results from estimating subsurface flow across the divide between southern Spring Valley and Hamlin Valley will be published as Chapter 6 in a U.S. Geological Survey Report. The two reports written for this proposal will be reviewed by two independent external reviewers plus formal reviews by the Federal Nominating Organizations and the Southern Nevada Water Authority.

Table 3 summarizes the locations, elevations, depth, diameter, screened interval, geophysical logs, and expected lithology of the four deeper wells drilled for this proposal.

Table 3.—Location, elevation, total depth, hole diameter, well diameter, screened interval, lithology, and geophysical logs in the proposed four test holes

Township/ Range and section	Elevation (feet above mean sea level)	Total depth (feet)	Hole diameter (inches)	Well diameter (inches)	Screened interval (feet)	Lithology	Geophysical logs *
T13N R69E S15AD	6725	250	10	6	50	Pole Canyon Limestone	Yes
T10N R70E S29AA	6000	400	12	8	200	Basin fill	Yes
T9.5N R70E S31CC	6150	750	12	8	200	Carbonate	Yes
T7N R69E S27BB	6400	850	12	8	200	Carbonate	Yes

*Geophysical logs include caliper, short- and long-normal resistivity, spontaneous potential, natural gamma, and flow-meter logs

A single well aquifer test will be completed for each of the 4 new wells and used to estimate transmissivity of the carbonate-rock aquifer or basin-fill aquifer, depending on which unit across which the well is screened. Each well will be pumped for a minimum of 1 day and a maximum of 5 days. The pumping rate and water-level decline and temperature will be routinely collected in each well. Water level and temperature data will be collected for 2 weeks prior and for 1 month following each test. Data collected from drilling the wells, analyses of aquifer tests, and the chemistry of water sampled from the wells will be summarized in a separate U.S. Geological Survey Report published one year following completion of the data collection. The information from these wells will be used in the final analyses of the three main tasks.

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Schedule and Contractor Budget:

The project duration will be approximately three years, beginning in June 2008 and ending in December 2010. The total contractor budget is $2 million. A summary of the total contractor costs, specified by task for each year, are shown in Table 4, below.

Table 4.—Summary Total Contractor Budget

	Year 2008	**Year 2009**	**Year 2010**	**TOTALS**
Task 1	$38,500	$229,000	$146,000	**$413,500**
Task 2	156,000	311,000	162,000	**629,000**
Task 3	223,000	178,000	39,000	**440,000**
Drilling	388,000	60,000	0	**448,000**
Project Management	15,000	22,500	32,000	**69,500**
TOTALS	**$820,500**	**$800,500**	**$379,000**	**$2,000,000**

The costs for each individual task are delineated in tables 5-7. The drilling costs, which are a contributing component of all of the tasks, are shown separately in table 8. The report costs and management of the project are summarized in table 9.

Table 5.—Costs for completing Task 1

Fiscal Year	Category	Total cost
2008	Labor (Russell Plume, data compilation)	$ 33,500
	Travel	$ 2,000
	Operating	$ 3,000
Total		$ 38,500
2009	Labor (Donald Sweetkind, Alan Wallace, Russell Plume) field work	$215,000
	Travel	$ 10,000
	Operating	$ 4,000
Total		$229,000
2010	Labor (Donald Sweetkind, Alan Wallace, Russell Plume) report writing	$140,000
	Travel	$ 3,000
	Operating	$ 3,000
Total		$146,000
All years		$413,500

*Geophysical logs include caliper, short- and long-normal resistivity, spontaneous potential, natural gamma, and flow-meter logs

Table 6.—Costs for completing Task 2

Fiscal Year	Category	Total cost
2008	Labor (David Prudic, Scott Tyler, 1 Post Doctorate, 1 graduate student, James Wood, Victor Heilweil, Leigh Justet)	$110,000
	Travel	$ 11,000
	Equipment (temperature loggers, streamflow measurement equipment, precipitation collector, misc. supplies)	$ 30,000
	Laboratory costs for chemical analyses	$ 5,000
Total		$156,000
2009	Labor (David Prudic, Scott Tyler, 1 Post Doctorate, 1 graduate student, James Wood, Victor Heilweil, Larry Spangler, Brian Marshal, Richard Moscati, Leigh Justet)	$240,000
	Travel	$ 15,000
	Equipment and supplies	$ 11,000
	Laboratory costs for chemical analyses	$ 45,000
Total		$311,000
2010	Labor (David Prudic, Scott Tyler, 1 graduate student, Larry Spangler, Leigh Justet) report writing	$155,000
	Travel	$ 5,000
	Operating	$ 2,000
Total		$162,000
All years		$629,000

Table 7.—Costs for completing Task 3

Fiscal Year	Category	Total cost
2008	Labor (Alan Priessler, Russell Plume, Lari Knochenmus, Keith Halford, Victor Heilweil,)	$165,000
	Travel	$ 33,000
	Misc. supplies, pressure transducers	$ 10,000
	Laboratory costs for chemical analyses	$ 15,000
Total		$223,000
2009	Labor (James Wood, Keith Halford, Nyle Pennington, Lari Knochenmus, Brian Marshall, Richard Moscati)	$110,000
	Equipment (pump set and test, temperature loggers, misc. supplies)	$ 55,000
	Travel	$ 13,000
Total		$178,000
2010	Labor (Lari Knochenmus, Keith Halford) report writing	$ 35,000
	Travel	$ 2,000
	Operating expenses	$ 2,000
Total		$ 39,000
All years		$440,000

Table 8.—Costs for drilling wells

Fiscal Year	Category	Total cost
2008	Mobilization of drill rig for drilling needed for tasks 1, 2, and 3	$ 5,000
	Well 1 Northwest Big Springs	$ 75,000
	Well 2 Southwest Big Springs	$135,000
	Well 3 Southern Limestone Hills	$125,000
	Well 4 Rowland Spring area	$ 48,000
Total		$388,000
2009	Mobilization of drill rig for drilling needed for task 2	$ 5,000
	Six-inch test well next to Lehman, Baker, and Snake Creeks	$ 27,500
	2-inch, 35-ft deep wells near creeks	$ 17,500
	2-inch, 12-ft deep wells near creeks	$ 10,000
Total		$ 60,000
All years		$448,000

Table 9.—Report costs and project management

Fiscal Year	Category	Total cost
2008	Project management	$ 15,000
Total		$ 15,000
2009	Project management and oversight of drilling report	$ 15,000
	Publication costs for USGS report on results of drilling four test wells	$ 7,500
Total		$ 22,500
2010	Project management and oversight of final report	$ 15,000
	Publication cost for USGS report on summarizing work	$ 15,000
	Travel	$ 2,000
Total		$ 32,000
All years		$ 69,500

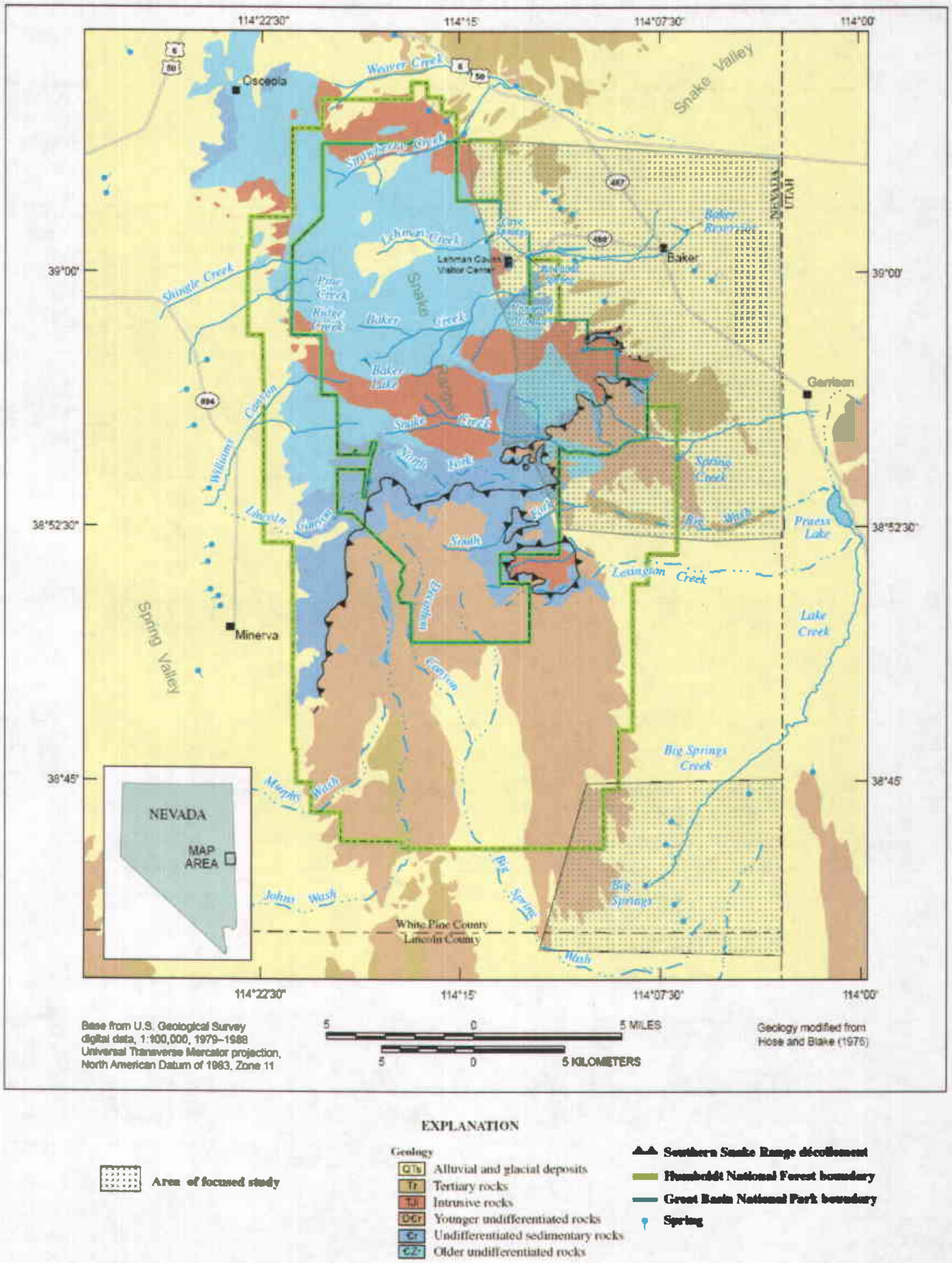


Figure 1.--Study area to evaluate connection of Lehman, Baker, and Snake Creeks with ground water in consolidated rocks and adjoining basin fill and source of water to Rowland and Big Springs.

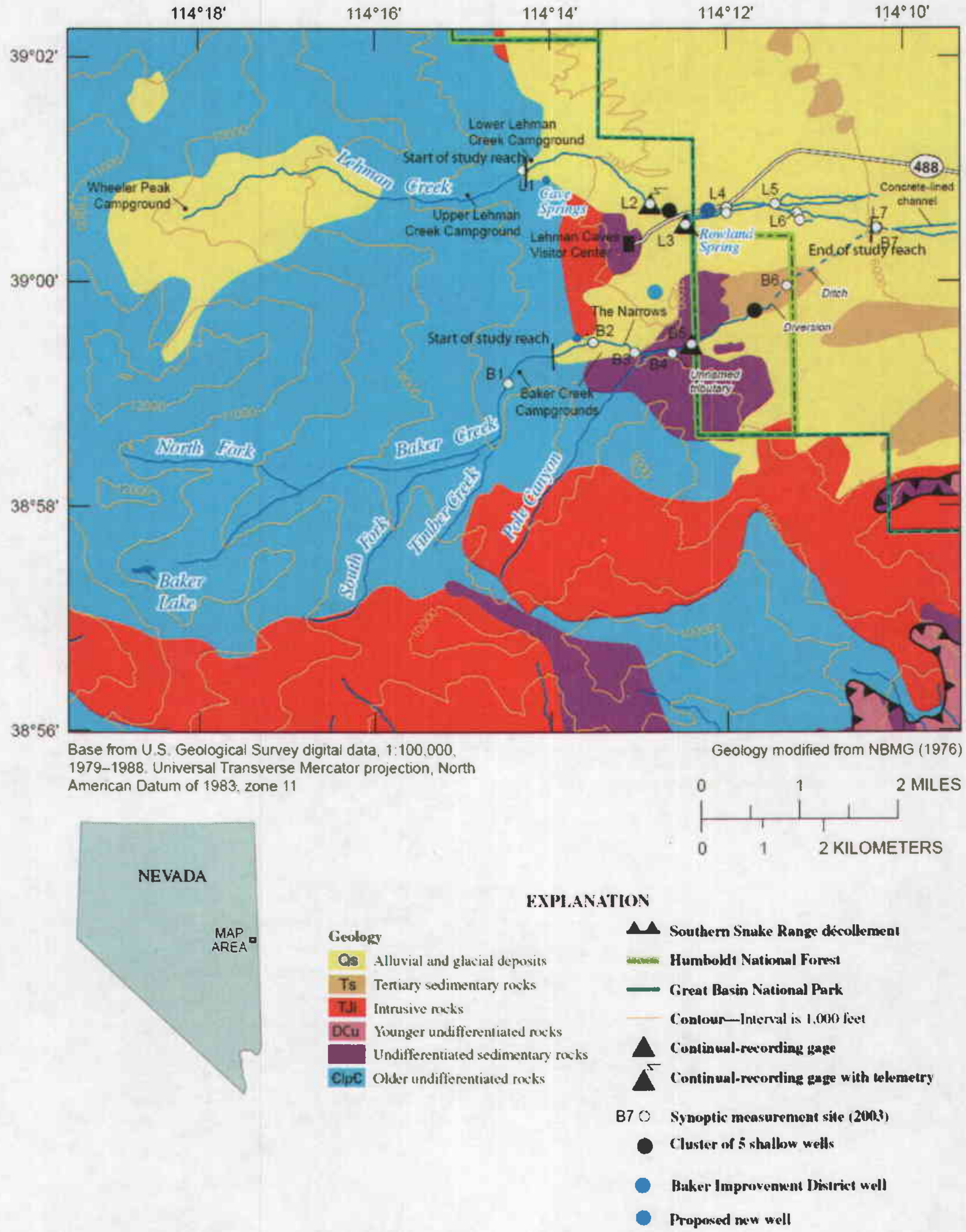


Figure 2—Location of wells and study reaches along Lehman and Baker Creeks.

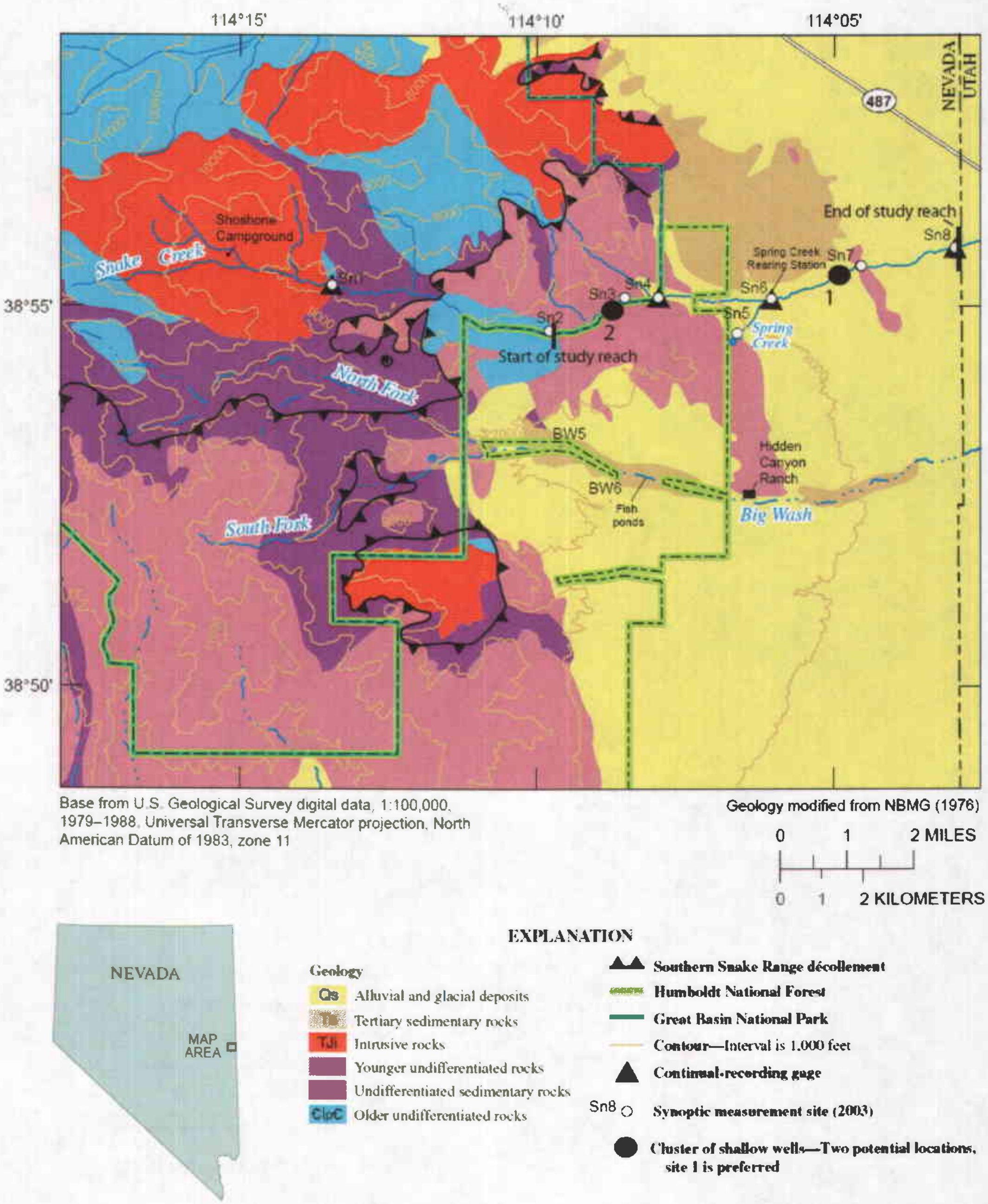


Figure 3—Location of wells and study reach along Snake Creek.

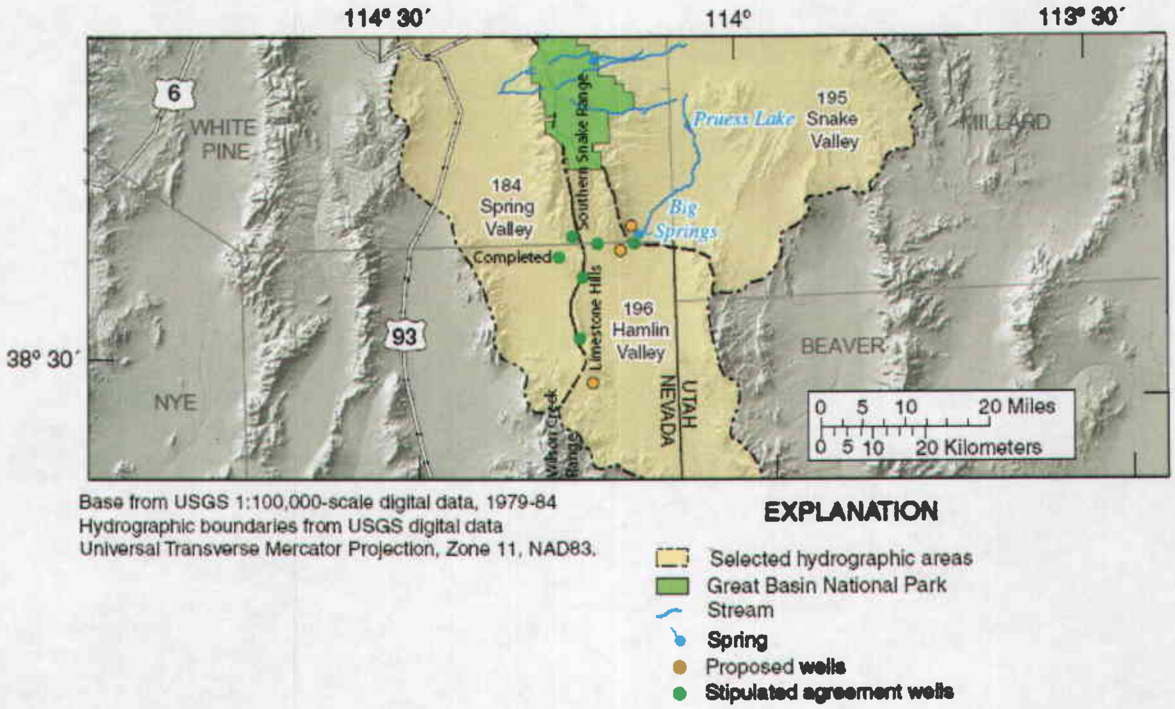


Figure 4—Location of proposed wells near Big Springs and along topographic divide between southern Spring Valley and Hamlin Valley (yellow dots) in relation to stipulated agreement wells (green dots—proposed and completed).

United States Department of the Interior

NATIONAL PARK SERVICE
Water Resources Division
1201 Oakridge Drive, Suite 250
Fort Collins, Colorado 80525-5596

IN REPLY REFER TO:

November 30, 2007

L54 (2380)
GRBA/Water Rights

Memorandum

To: Nancy Christ, Conservation Initiatives Project Specialist; Division of SNPLMA Acquisition, Improvement, and Conservation Programs; United States Bureau of Land Management

Through: Dan McGlothlin, Supervisory Hydrologist, Water Resources Division, National Park Service
and
Chuck Pettee, Chief, Water Rights Branch, Water Resources Division, National Park Service

From: William P. Van Liew, Hydrologist, Water Resources Division, National Park Service William P. Van Liew 11/30/07

Subject: Revisions to SNPLMA Round 8 Conservation Initiative Proposal Nominated by the NPS, Entitled: "*Evaluation of Basin-Fill Aquifers in Southern Spring and Snake Valleys and Their Connection with Surface-Water Resources and with the Regional Carbonate-Rock Aquifer*"

In response to critical input received by BLM from the Southern Nevada Water Authority (SNWA) during the public comment period in September 2007, regarding the above-referenced SNPLMA Round 8 Conservation Initiative proposal, the proposal has been revised and improved as the result of a substantial collaborative effort among the Nominating Organizations, SNWA, and the proposed scientific contractors (the U.S. Geological Survey and the University of Nevada at Reno).

A document containing revisions to the proposal, including the required "Detailed Cost Analysis" table, is enclosed herein. The purpose of the revisions was to: (1) provide more detail and improve the clarity of purpose and approach; (2) remove duplicative efforts related to monitoring and analysis already included in the Stipulated Agreement between the USDOI bureaus and the Southern Nevada Water Authority in Spring Valley ("DOI/SNWA Stipulated Agreement"); and (3) accommodate a more collaborative approach with SNWA hydrologists to ensure that this proposed work will augment and build upon ongoing and planned investigations by SNWA in the study area.

The principal revisions contained herein are: (1) the study area and number of surface-water features to be investigated have been reduced; (2) the three main tasks that comprise the original proposed study have been retained, but the methodology has been modified and strengthened; and (3) a more detailed delineation of the project-implementation approach and associated costs has been included. The total contractor budget remains unchanged at $2,000,000, and the overall proposal cost remains unchanged at $2,131,000.

The originally proposed study area was revised to focus on southern Snake Valley, Nevada, and on the area of the "interbasin ground-water monitoring zone" of the DOI/SNWA Stipulated Agreement between Spring Valley and Snake Valley on the southern side of the southern Snake Range. Investigations in southern Spring Valley have been removed from this revised proposal, and will be considered in more detail in a future proposal (planned to be submitted for consideration in SNPLMA Round 10). This future proposed hydrogeologic investigation will focus on the area in southern Spring Valley near Shoshone Ponds.

It is my understanding that these revisions address the concerns of the SNWA, and will allow them to support the above-referenced SNPLMA Round 8 Conservation Initiative proposal nominated by the NPS for work to be conducted in White Pine County, Nevada. If further clarification is needed, I would be happy to provide more detailed information. I can be reached by email at william_p_van_liew@nps.gov or by telephone at (970) 225-3549. Thank you for your consideration of this revised proposal.

Enclosure

cc: (via email)
National Park Service:
- Paul DePrey, Acting Superintendent, Great Basin National Park
- Tod Williams, Chief, Resource Management Div., Great Basin National Park
- Bill Dickinson, Superintendent, Lake Mead National Recreation Area
- Jon Jarvis, Director, Pacific West Region

U.S. Fish and Wildlife Service:
- Steve Thompson, Manager, California/Nevada Operation Office
- Bob Williams, Field Supervisor, Nevada Fish and Wildlife Office
- Tim Mayer, Hydrologist, Water Resources Branch

U.S. Bureau of Land Management:
- Ron Wenker, State Director, Nevada
- Bob Boyd, Nevada State Hydrologist, Nevada State Office
- Steve Tryon, Associate Field Manager, SNPLMA Division
- Jane Freeman, Special Legislation Program Manager, Nevada State Office

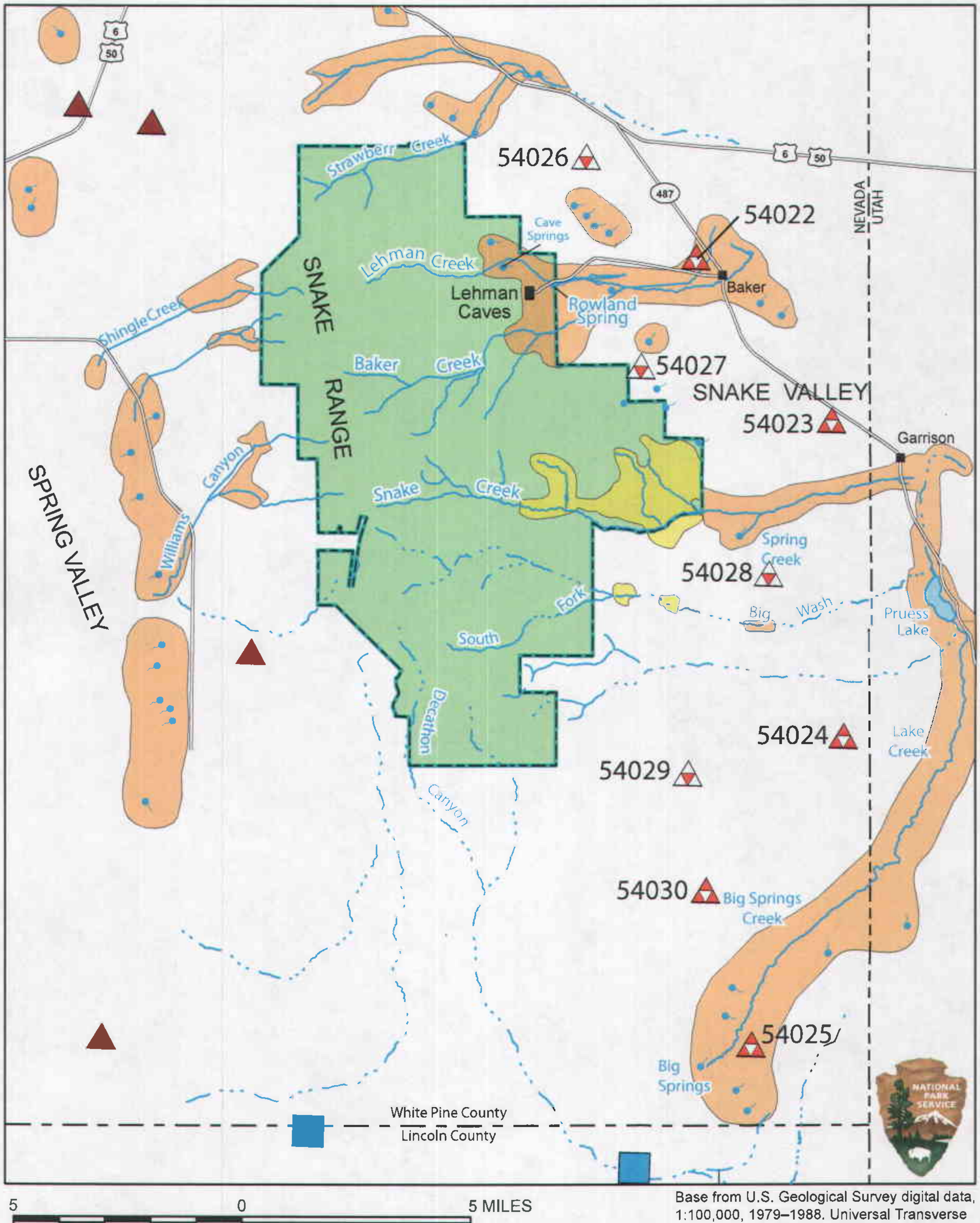
USDA Forest Service:
- Jack Troyer, Regional Forester, Intermountain Region
- Joe Gurrieri, Regional Geologist, Intermountain Region

USDOI Office of the Solicitor:
- Peter Fahmy, Water Rights Attorney for the National Park Service

USDOI Office of the Secretary:
- Diana Weigmann, Southern Nevada Project Manager

Southern Nevada Water Authority:
- Ken Albright, Director, Ground-Water Resources
- Kay Brothers, Deputy General Manager, Engineering and Operations

U.S. Geological Survey:
- Dave Prudic, Hydrologist, Nevada Water Science Center



Base from U.S. Geological Survey digital data, 1:100,000, 1979–1988. Universal Transverse Mercator projection, NAD 1983, Zone 11

EXPLANATION

- Area where surface-water resources likely are susceptible to ground-water withdrawals [From USGS (Elliott, Beck, and Prudic, 2006)]
- Area where surface-water resources potentially are susceptible to ground-water withdrawals [From USGS (Elliott, Beck, and Prudic, 2006)]
- Great Basin National Park
- Spring

Lincoln County WD & Vidler Water Company
- Pending applications

Southern Nevada Water Authority
- Existing permits
- Pending applications with numbers
  - Proposed diversion rate = 6 cfs
  - Proposed diversion rate = 10 cfs

Figure 1.--Ground-water-right applications near Great Basin National Park.